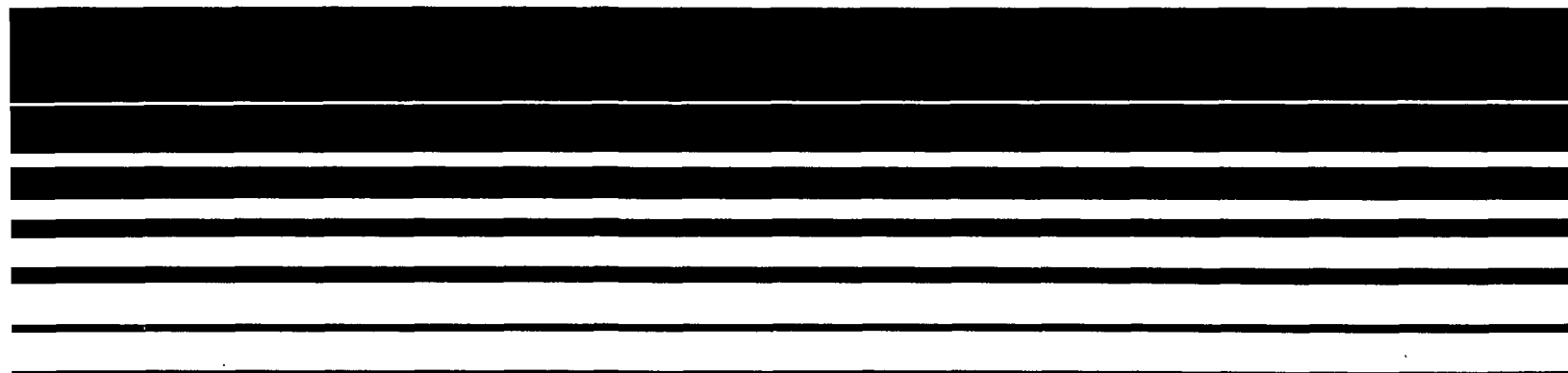


Air



Hazardous Waste Treatment, Storage, and Disposal Facilities

Site-Specific Test Report Test Site 01



SITE-SPECIFIC TEST REPORT

SITE 01

ESED 85/12
EMB 85 FPE 01

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1.0 INTRODUCTION

On September 23 and 24, 1985, Entropy Environmentalists, Inc. collected soil samples from three treatment, storage, and disposal related processes at Site 01. The purpose of this sampling program was to provide preliminary data on the magnitude of fugitive particulate emissions from various processes at treatment, storage, and disposal facilities (TSDF's) and the degree to which these emissions are contaminated. The U. S. Environmental Protection Agency (EPA) anticipates utilizing the analytical data from this program with emission models to estimate contaminated fugitive particulate emissions from TSDF's. The information generated by this study may ultimately be used by the Office of Air Quality Planning and Standards (OAQPS) of EPA to assess the adequacy of regulations governing contaminated fugitive particulate emissions from TSDF's.

To accomplish the overall goals of this study, soil samples were collected from representative processes at this facility and were submitted for the appropriate analyses in order to determine the following:

- o The percent by weight of silt in the soil (i.e., material that passes through a 200 mesh screen and has a nominal diameter less than 75 μ m) and the percent by weight of moisture in the soil.
- o The degree of contamination of the soil silt fraction with metals, cyanide, and semivolatile organics.
- o The percent by weight of soil silt that is less than 20 μ m in diameter based on a sonic sieving technique.

- o The particle size dependency of the degree of contamination (i.e., greater or lesser degree of contamination in particles with diameters not in excess of 20 μ m) by conducting separate analyses of different soil particle size fractions.
- o The repeatability and reproducibility of the sampling and analytical procedures for the entire sampling program (not included in this report since no samples were collected for this purpose at Site 01).

At Site 01, the three processes sampled were (1) an active lift; (2) a dry surface impoundment; and (3) unpaved road segments at the entrance to the impoundments, in the lift access area, and adjacent to the impoundments. A pair of background samples were also taken.

Samples taken were analyzed for silt content, PM_{10} content, metals, cyanide, and semivolatile organics as described in Chapter 4. Research Triangle Institute (RTI) conducted the analyses for metals and cyanide and PEI and Associates performed the analyses for the semivolatile organics. Additional cleanup of semivolatile organic extracts was performed by Triangle Laboratories, Inc.

Field sampling was performed by Mr. Steve Plaisance and Mr. Bernie von Lehmden of Entropy Environmentalists. Dr. Chatten Cowherd and Mr. Phillip Englehart of Midwest Research Institute (MRI) directed Entropy personnel regarding specific processes to be sampled and the boundaries of the processes and recorded the pertinent process and operating characteristics. Mr. Gene Riley (EPA Task Manager) of the Emission Measurement Branch (EMB) and Mr. Lee Beck (EPA Task Manager) of the Industrial Studies Branch (ISB) observed the sampling program.

This report is organized into several chapters addressing various aspects of the sampling and analysis program. Immediately following this chapter is the "Summary and Discussion of Results" chapter which presents table summaries of data on silt and PM_{10} content and degree of contamination for each sample fraction analyzed. Two analyses for semivolatile organics were performed for

comparison of two different cleanup procedures for the organic extracts.

Following the "Summary and Discussion of Results" chapter is the "Process Description" chapter (supplied by MRI) which includes descriptions of each process sampled. The next chapter, "Sampling and Analysis," presents the plot plan and sampling grid for each process. The method of selecting the sampling grid and the sample collection procedures are outlined, including deviations and problems encountered. This chapter also describes the sample preparation and analytical procedures used for each sample; any deviations from the normal procedures are addressed. The appendices present the Raw Field Data and Sampling Logs (Appendix A); Analytical Data (Appendix B); detailed Sampling and Analytical Procedures (Appendix C); Sampling Program Participants and Observers (Appendix D); and Process Operations Data (Appendix E).

2.0 SUMMARY AND DISCUSSION OF RESULTS

This chapter presents a summary of the sampling and analysis results and a brief discussion of significant deviations from the proposed sampling and analysis protocol for this program. Since the standard sampling and analytical procedures are not addressed in this chapter, it is recommended that those individuals who are not familiar with the sampling and analytical procedures used in this study review Chapter 4, "Sampling and Analysis," prior to reading this chapter.

Soil samples were collected from three processes at Site 01. The processes included: (1) an active lift; (2) a dry surface impoundment; and (3) unpaved road segments at the entrance to the impoundments, in the lift access area, and adjacent to the impoundments. Sampling and analysis were conducted using the procedures described in the Sampling and Analysis Protocol which was written specifically for this sampling program. The proposal was provided to the facility prior to the sample collection. The procedures described in this protocol are described again in detail in Chapter 4 and Appendix C of this report.

As described in the Sampling and Analysis Protocol, this site-specific report is intended to present the data related to the samples obtained at one site in this study and the procedures used to obtain those samples. Some statistical analyses will be performed on the data concerning this site; however, the majority of statistical analyses will involve the data collected over the entire study and will be included in the summary report to be completed at the conclusion of the program. With the exception of the data from the screening conducted to determine silt contents, there is not sufficient data to conduct meaningful statistical analyses on a site- or process-specific basis.

The sampling plan for Site 01 is shown in Table 2.1. The sampling procedures were designed to obtain a representative sample of that portion of the soil with the potential to become airborne. The analyses of the collected samples were conducted to measure the concentration of the most likely compounds or elements that could be soil contaminants (metals, cyanide, semivolatile organics, and pesticides). The sample collection techniques were generally as follows: (1) for undisturbed hard surfaces a sweeping technique was used to obtain surface samples only; (2) for moderately disturbed surfaces a scooping technique was used to obtain near surface samples; and (3) for surfaces that were mechanically disturbed to a specific depth, coring was used to sample to the depth of the disturbance. The number of samples collected within each process was a function of the variability expected in the degree of contamination and/or the amount of sample that was needed for the analyses.

According to the Sampling and Analysis Protocol, the collected samples were to be analyzed for metals, cyanide, semivolatile organics, and pesticides. If significant quantities of cyanide, semivolatile organics, or pesticides were not expected to be present in a particular sample from a process, the analysis of those corresponding compounds was not performed. MRI decided that at this particular site, pesticides would not be present in significant quantities and therefore, pesticides analyses were deleted. All samples were analyzed for metals, cyanide and semivolatile organics. Complete lists of compounds or elements for which analyses were conducted and their detection limits are presented in Chapter 4 (see Tables 4.2 and 4.3). Organic compounds in some samples caused the detection limits to be higher than desired for the semivolatile organic analyses. An alternative cleanup method was developed to minimize this problem, and the samples were reanalyzed at a lower detection limit.

TABLE 2.1. SAMPLING PLAN FOR SITE 01

Process Sampled	Process Designation	Number of Samples	Collection Method	Analyses
Active Lift	A	8	Scooping	Loss on drying Silt and PM ₁₀ content Metals and cyanide Semivolatile organics
Dry Surface Impoundment	B	6*	Modified coring** (stainless tube)	Loss on drying Silt and PM ₁₀ content Semivolatile organics
		6*	Modified coring** (plastic tube)	Metals and cyanide
Dirt Roadway	C	1	Sweeping	Loss on drying Silt and PM ₁₀ content Metals and cyanide Semivolatile organics
Lift Access Area	D	1	Sweeping	Loss on drying Silt and PM ₁₀ content Metals and cyanide Semivolatile organics
Impoundment Access Road	E	1	Sweeping	Loss on Drying Silt and PM ₁₀ content Metals and cyanide Semivolatile organics
Background Samples	BGD	2	Scooping	Loss on drying Silt and PM ₁₀ content Metals and cyanide Semivolatile organics

* Two cores for metals analysis (plastic core tube) and two cores for organic analysis (stainless core tube) were taken from each of 6 single grid cells.

**For each organics sample and each metal sample, 2 cores approximately two inches deep were taken, followed by using the core tube to scoop up loose soil within the aliquot area.

The analytical results are discussed in the following subsections.

Complete sampling data sheets are presented in Appendix A and analytical data sheets are presented in Appendix B.

2.1 BACKGROUND SAMPLES

Because many compounds and elements are either naturally occurring in the soil or may be present as a result of factors other than those which may be attributed to Site 01's activities, background samples were taken at a point off-site and analyzed. The percent weight loss on drying (LOD) determined on a ten gram aliquot of the background sample was 9.8 percent. The background sample was dried by desiccation for 24 hours prior to being screened for silt. The silt content of the two jars constituting the background sample (sample identification number BGD-109) averaged 34.7 percent by weight (see Table 2.2). The silt material (sample identification number BGD-192) separated from the sample (BGD-109) was further processed using a sonic sieve to determine the PM_{10} content of the silt. Material passing through a 20 μm sieve constituted the PM_{10} content. The PM_{10} content averaged 24.32 percent by weight of the silt material.

Results of the analyses for metals and cyanide are shown in Table 2.3. The analytical results for the metals and cyanide in the background silt sample (Sample ID BGD-191) are in terms of micrograms of the metal or cyanide per gram of silt sample (dry basis). These results reflect the nominal concentrations of these materials present in the soil which are not a result of Site 01's activities. The results for the background samples have not been subtracted from the results for the other samples since risk assessments utilize the inclusive value of the degree of contamination. It should be understood, however, that the actual outside contribution to the degree of contamination of the soil is that portion of the contaminate concentration which exceeds the nominal background level.

TABLE 2.2.
ANALYTICAL RESULTS OF SILT SCREENING, WEIGHT LOSS ON DRYING, AND PM₁₀ SIEVING
FUGITIVE PARTICULATE FROM TSDF (85/12)

Site and Process	Sample ID	Percent Silt	Percent Loss on Drying	Sample ID	Percent PM ₁₀
Active Lift, Landfill (Process A)	A-101	8.3			
	A-102	11.0			
	A-103	5.9			
	A-104	11.0			
	A-105	10.0			
	A-106	14.4			
	A-107	13.1		A-158	21.48
	A-108	13.7	1.0	A-158	20.77
	Average	10.9			21.13
	Std. Dev.	2.9			0.50
Dry Surface Impoundment (Process B)	B-111-M	15.1			
	B-112-M	16.1			
	B-113-M	18.7			
	B-114-M	23.0			
	B-115-M	14.8			
	B-116-M	15.5			
	B-111-O	19.1			
	B-112-O	19.1			
	B-113-O	18.5			
	B-114-O	22.7			
	B-115-O	20.7		B-168	22.17
	B-116-O	14.6	13.3	B-168	26.36
	Average	18.2			24.27
	Std. Dev.	3.0			2.96
Dirt Roadway (Process C)	C-117	29.4		C-173	30.43
	C-117	23.0	3.1	C-173	30.08
	Average	26.2			30.25
	Std. Dev.	4.5			0.25
Lift Access Area (Process D)	D-118	20.7		D-176	26.64
	D-118	24.4	1.4	D-176	22.80
	Average	22.6			24.72
	Std. Dev.	2.6			2.72
Impoundment Access Road (Process E)	E-119	11.3		E-179	12.20
	E-119	10.2	3.7	E-179	18.37
	Average	10.8			15.29
	Std. Dev.	0.8			4.37
Background Samples	BGD-109	32.8		BGD-192	24.49
	BGD-109	36.6	9.8	BGD-192	24.14
	Average	34.7			24.32
	Std. Dev.	2.7			0.25

TABLE 2.3 ANALYTICAL RESULTS FOR METALS ANALYSIS
FUGITIVE PARTICULATE FROM TSDF (85/12)

Metals Analysis		Lift			Impound.			Dirt	Background		
		Active Lift		Access Rd.	Dry Surface Impoundment			Access Rd.	Roadway	Sample	
Sample Identity		Silt	>PM-10	PM-10	Silt	Silt	>PM10	PM-10	Silt	Silt	Silt
		A-153	A-157	A-155	D-175	B-160	B-162	B-161	E-178	C-172	B6D-191

Elements (ug/g)											
Aluminum (Al)	21,800	18,500	21,300	26,400	29,200	26,600	25,900	20,750	25,600	22,900	
Antimony (Sb)	<1	<1	<1	<1	<1	6.8	5.1	<1	3.2	<1	
Arsenic (As)	8.3	8.3	9.2	13.5	15.3	10.5	20.4	3.7	10.8	21.9	
Barium (Ba)	957	846	215	958	955	950	950	389	955	130	
Beryllium (Be)	4.4	3.1	0.9	3.4	2.4	1.6	1.9	2.6	2.5	1.9	
Bismuth (Bi)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	
Cadmium (Cd)	5.5	4.2	8.0	16.0	33.2	31.5	36.5	3.6	5.1	1.5	
Chromium (Cr)	223	219	154	94	245	224	344	68.2	118	54.2	
Cobalt (Co)	21.2	18.3	20.7	26.3	12.2	11.5	11.7	10.1	12.0	11.9	
Copper (Cu)	3,570	2,380	10,400	295	1,090	1,010	1,360	129	304	43.8	
Iron (Fe)	27,000	25,300	23,300	24,600	20,800	19,600	21,100	19,100	19,700	22,200	
Lead (Pb)	1,030	780	1,780	2,960	3,380	3,270	3,930	175	864	15.0	
Manganese (Mn)	533	474	482	474	392	368	411	361	358	375	
Mercury (Hg)	0.2	0.4	0.4	0.6	0.4	0.4	0.5	0.2	0.5	0.2	
Molybdenum (Mo)	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	
Nickel (Ni)	173	159	190	145	340	148	190	58	313	44.8	
Osmium (Os)	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	
Selenium (Se)	2.3	<1	1.8	1.6	2.4	1.4	2.2	0.7	<1	<1	
Silver (Ag)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	
Thallium (Tl)	<1	<1	<1	<1	<1	<1	<1	<1	1.6	<1	
Vanadium (V)	105	867	106	131	106	98.2	106	75.8	95.9	65.2	
Zinc (Zn)	1,030	966	1,250	856	3,270	3,110	3,850	856	983	83.5	
cyanide	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	

The background silt sample (Sample ID BGD-190) was analyzed for semivolatile organic compounds at two different detection limits. The first analysis was on the background sample extract prepared by following the low level procedure in the U S. EPA Contract Laboratory Program, Statement of Work for Organic Analysis, 7/85 Revision (referred to as the CLP in this report). The extract was cleaned using a gel permeation chromatography (GPC) procedure recommended in the CLP for soil samples. The cleaned background sample extract was diluted similar to the rest of the samples from this site. At the detection limit of 19.8 µg/g, none of the semivolatile compounds on the CLP hazardous substance list (HSL) were detected.

The second semivolatile organic analysis of the background sample was conducted on a portion of the original sample extract after being cleaned by adsorption chromatography on Sephadex LH-20. The cleaned extract was analyzed without further dilution (other than the dilution resulting from the cleanup procedure). At a detection limit of 0.431 µg/g, three phthalate esters, bis(2-ethylhexyl)phthalate, butylbenzylphthalate, and di-n-butylphthalate, were detected in the background sample. Di-n-butylphthalate was the only compound found in the background sample at a concentration above the quantifiable detection limit (see Table 2.4).

With the exception of diluting the semivolatile organic sample extract prior to the first analysis and the use of the LH-20 cleanup method for the second analysis, all procedures for the background sample followed the sampling and analysis protocol.

TABLE 2.4. ANALYTICAL RESULTS FOR SEMIVOLATILE ORGANIC HSL COMPOUNDS
FUGITIVE PARTICULATE FROM TSDF (85/12)

Gel Permeation Cleanup				Lift				Impound.		Dirt	Background		
Sample Identity				Active Lift		Access Rd.		Dry Surface Impoundment		Access Rd.	Roadway	Sample	
				Silt	>PM-10	PM-10	Silt	Silt	>PM10	PM-10	Silt	Silt	Silt
				A-150	A-156	A-154	D-174	B-164	B-167	B-166	E-177	C-171	BGD-190
Compounds				(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)
benzo(a)pyrene				N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	2.3 J	N.D.	N.D.	N.D.
bis(2-ethylhexyl)phthalate				N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	32.0	N.D.	N.D.
2-Chlorophenol				N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	16.0	N.D.	N.D.
chrysene				N.D.	N.D.	N.D.	N.D.	5.0 J	6.5 J	7.6 J	N.D.	N.D.	N.D.
fluoranthene				N.D.	N.D.	N.D.	N.D.	N.D.	1.9 J	N.D.	N.D.	N.D.	N.D.
fluorene				2.5 J	N.D.	2.3 J	N.D.	2.2 J	2.5 J	N.D.	N.D.	N.D.	N.D.
1-Methylnaphthalene				8.1 J	3.2 J	N.D.	1.2 J	2.0 J	3.3 J	2.7 J	N.D.	N.D.	N.D.
phenanthrene				8.1 J	6.3 J	9.7 J	6.6 J	13.0 J	12.0 J	14.0 J	7.6 J	2.1 J	N.D.
pyrene				N.D.	N.D.	N.D.	N.D.	4.3 J	4.8 J	N.D.	N.D.	N.D.	N.D.

N.D. = less than quantifiable detection limit of 19.8 ug/g

J = Estimated value where the compound meets the mass spectral criteria but the result is less than the quantifiable detection limit.

LH-20 Cleanup				Lift				Impound.		Dirt	Background
Sample Identity	Active Lift			Access Rd.	Dry Surface Impoundment			Access Rd.	Roadway	Sample	
	Silt	>PM-10	PM-10	Silt	Silt	>PM10	PM-10	Silt	Silt	Silt	
	A-150	A-156	A-154	D-174	B-164	B-167	B-166	E-177	C-171	BGD-190	
Compounds	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	
anthracene	N.D.	N.D.	N.D.	N.D.	N.D.	1.200 J	N.D.	N.D.	N.D.	N.D.	
benzo(a)anthracene	0.340 J	0.340 J	0.320 J	0.660 J	2.200 J	2.400 J	1.800 J	1.000 J	N.D.	N.D.	
benzo(b)fluoranthene	N.D.	0.580 J	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	
benzo(a)pyrene	N.D.	0.350 J	N.D.	N.D.	1.500 J	N.D.	N.D.	N.D.	N.D.	N.D.	
bis(2-ethylhexyl)phthalate	N.D.	N.D.	0.770	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.110 J	
butylbenzylphthalate	N.D.	0.140 J	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.069 J	
chrysene	0.610	0.640 J	0.650	2.300	6.500	7.600	N.D.	4.600	1.500	N.D.	
di-n-butylphthalate	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	3.700 J	N.D.	0.520	
1-Methylnaphthalene	1.400	4.100	1.800	0.780 J	3.400 J	3.400 J	N.D.	N.D.	0.170 J	N.D.	
2-Methylphenol	0.310 J	N.D.	0.320 J	N.D.	N.D.	N.D.	N.D.	N.D.	0.070 J	N.D.	
naphthalene	0.570	0.210 J	0.150 J	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	
phenanthrene	7.800	8.200	7.500	4.500	12.000	13.500	10.000	6.000	2.500	N.D.	
phenol	0.097 J	N.D.	0.280 J	N.D.	N.D.	N.D.	N.D.	N.D.	0.110 J	N.D.	
pyrene	N.D.	0.890 J	0.600	1.500 J	3.500 J	4.600 J	3.000 J	2.900 J	N.D.	N.D.	
	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	
Sample Detection Limit	0.412	0.937	0.472	4.023	5.143	6.650	6.065	4.023	0.455	0.431	

N.D. = less than quantifiable detection limit for the sample

J = Estimated value where the compound meets the mass spectral criteria but the result is less than the quantifiable detection limit.

2.2 ACTIVE LIFT (PROCESS A)

The active lift (Process A) was sampled using a grid layout. Eight samples were collected within this grid in a random manner as described in Chapter 4. The scoop sampling technique was employed to obtain near-surface samples. The LOD for sample A-108 was 1.0 percent by weight. The samples were dried by desiccation for 24 hours prior to silt screening. Each of the eight samples (sample identification numbers A-101 through A-108) were screened for silt content which averaged 10.9 percent silt by weight (see Table 2.2). The silt composite (sample identification number A-158), resulting from screening samples A-101 through A-108, was then sonic sieved for PM_{10} content which averaged 21.13 percent by weight in the silt sample. Portions of three fractions (silt, $>PM_{10}$, and PM_{10}) produced from the active lift composite silt sample were analyzed for metals and cyanide as shown in Table 2.3. The portion of the silt sample that did not pass through the 20 μ m sieve was referred to as the "greater than PM_{10} " ($>PM_{10}$) fraction. All three fractions were analyzed to determine if the degree of contamination was less or greater in the PM_{10} fraction (particle size dependent). The results for the metals and cyanide are expressed in micrograms (μ g) of the metal per gram of sample on a dry basis. The concentrations measured for the background sample were not subtracted from the active lift sample results.

The silt fractions (silt, $>PM_{10}$, and PM_{10}) from the active lift process were also analyzed for semivolatile organic HSL compounds at two different detection limits. The first set of analyses were on the sample extracts prepared by the low level procedure. The sample extracts were screened by gas chromatography as specified by the CLP and found to be at the medium concentration level. The extracts were cleaned using the GPC procedure and diluted to achieve a concentration similar to a sample prepared by the medium level procedure. The diluted extracts were then analyzed.

In the silt sample (Sample ID A-150), only three semivolatile HSL compounds were detected (see Table 2.4); two compounds in each of the silt fractions ($>PM_{10}$ and PM_{10} , sample ID A-156 and sample ID A-154) were detected. The compounds detected were at concentration levels below the quantifiable detection limit (i.e., the mass spectral criteria for these compounds were met for identifying the compounds, but the actual concentration reported is only an estimated value).

The second set of semivolatile organic analyses of the active lift samples were conducted on portions of the original sample extracts after the extracts were cleaned by adsorption chromatography on Sephadex LH-20. The cleaned extracts were analyzed without further dilutions (other than the dilutions resulting from the cleanup procedure). In the silt sample (A-150), seven semivolatile HSL compounds were detected. Four compounds, chrysene, 2-methylnaphthalene, naphthalene, and phenanthrene, were found at concentrations above the sample's quantifiable detection limit of $0.412 \mu\text{g/g}$ (see Table 2.4). In the $>PM_{10}$ fraction (A-156), nine semivolatile HSL compounds were detected. Two compounds, 2-methylnaphthalene and phenanthrene, were found at concentrations above the sample's quantifiable detection limit of $0.937 \mu\text{g/g}$. In the PM_{10} fraction (A-154), nine HSL compounds were detected. Five compounds, bis(2-ethylhexyl)phthalate, chrysene, 2-methylnaphthalene, phenanthrene, and pyrene, were found at concentrations above the sample's quantifiable detection limit of $0.472 \mu\text{g/g}$.

With the exception of diluting the semivolatile organic sample extracts prior to the first analysis and the use of the LH-20 cleanup method prior to the second analysis, all procedures used for the active lift samples followed the sampling and analysis protocol.

2.3 DRY SURFACE IMPOUNDMENT (PROCESS B)

The dry surface impoundment (Process B) was sampled using a coring technique to obtain samples to a depth of approximately two inches. A sampling grid was laid out and six randomly selected cells were sampled. Because of the materials used in construction of the core sampling equipment, the samples taken for metals analysis (sample identification numbers B-111-M through B-116-M) were sampled with a PVC coring tube, and the samples taken for organic analysis (sample identification numbers B-111-0 through B-116-0) were sampled with a stainless steel coring tube. The LOD was 13.3 percent by weight for sample B-116-0 (see Table 2.2). The samples were oven dried at 105°C for 1 hour prior to silt screening. The resulting twelve samples were screened for silt content which averaged 18.2 percent by weight.

The silt fractions separated from the samples taken for organic analysis and those taken for metals analysis were each sonic sieved for PM₁₀ content which averaged 24.27 percent by weight of the silt. The two sets of fractions (silt, >PM₁₀, and PM₁₀) separated for semivolatile organics, cyanide, and metals analysis were analyzed separately to determine both (1) the degree of contamination and (2) the possible particle size dependency of the degree of contamination. The analytical results for metals are shown in Table 2.3.

The silt fractions from the dry surface impoundment process samples were also analyzed for semivolatile organic HSL compounds at two different detection limits. The first analyses were on the sample extracts prepared by the low level procedure. The sample extracts were screened as specified by the CLP and found to be at the medium concentration level. The extracts were cleaned using the GPC procedure and diluted to achieve a concentration similar to a sample prepared by the medium level procedure. The diluted extracts were then analyzed.

In the silt sample (Sample ID B-164), five semivolatile HSL compounds were detected (see Table 2.4). In the >PM₁₀ fraction (Sample ID B-167), six HSL compounds were detected. In the PM₁₀ fractions (Sample ID B-166), four HSL compounds were detected. All of the compounds detected were at concentration levels below the quantifiable detection limit of 19.8 µg/g (i.e., the mass spectral criteria for these compounds were met for identifying the compounds, but the actual concentration reported is only an estimated value).

The second semivolatile organic analyses of the dry surface impoundment samples, like the active lift samples, were also conducted on portions of the original sample extracts after the extracts were cleaned by adsorption chromatography on Sephadex LH-20. The cleaned extracts were analyzed without further dilutions (other than the dilutions resulting from the cleanup procedure). In the silt sample (B-164), six semivolatile HSL compounds were detected. Two compounds, chrysene and phenanthrene, were found at concentrations above the sample's quantifiable detection limit of 5.143 µg/g (see Table 2.4). In the >PM₁₀ fraction (B-167), six semivolatile HSL compounds were detected. Two compounds, chrysene and phenanthrene, were found at concentrations above the sample's quantifiable detection limit of 6.650 µg/g. In the PM₁₀ fraction (B-166), three HSL compounds were detected. Only one compound, phenanthrene, was found at a concentration above the sample's quantifiable detection limit of 6.065 µg/g.

With the exception of diluting the semivolatile organic sample extract prior to the first analysis and the use of the LH-20 cleanup method for the second analysis, all procedures used on the surface impoundment samples followed the sampling and analysis protocol.

2.4 DIRT ROADWAY (PROCESS C)

The main roadway entrance (Process C) to a number of impoundments was sampled using a modified sweeping technique. A scoop was used to scrape loose particulate from a 2-foot wide strip across the entire width of the road (16 feet). Two sample jars were filled with the sample. The LOD was 3.1 percent by weight. The sample was desiccated for 24 hours prior to silt screening. The sample was screened for silt content which averaged 26.2 percent by weight (see Table 2.2). The silt obtained was sonic sieved for PM_{10} content which was 30.25 percent by weight. Because an insufficient amount of silt was available, PM_{10} and $>PM_{10}$ fractions were not separated from the silt for analysis of metals, cyanide, and semivolatile organic compounds.

The results of the metals and cyanide analyses of the silt sample are presented in Table 2.3. The concentrations measured for the background sample were not subtracted from the results for the silt sample.

The dirt roadway sample (Sample ID C-171) was also analyzed for semi-volatile organic HSL compounds at two different detection limits. The first analysis was on the dirt roadway sample extracts prepared by the low level procedure. The sample extract was screened as specified by the CLP and found to be at the medium concentration level. The extract was cleaned using the GPC procedure and diluted to achieve a concentration similar to a sample prepared by the medium level procedure. The diluted extract was then analyzed. Only one semivolatile HSL compound was detected and was found at a concentration below the quantifiable detection limit of 19.8 g/g (see Table 2.4).

The second semivolatile organic analysis of the dirt roadway sample was conducted on a portion of the original sample extract after the extract was cleaned by adsorption chromatography on Sephadex LH-20. The cleaned extract

was analyzed without further dilution (other than the dilution resulting from the cleanup procedure). Five HSL compounds were detected in the dirt roadway sample extract. Two compounds, chrysene and phenanthrene, were found in concentrations above the quantifiable detection limit of 0.455 μ g/g.

With the exception of diluting the semivolatile organic sample extract prior to the first analysis and the use of the LH-20 cleanup method for the sample analysis, all procedures for the dirt roadway sample followed the sampling and analysis protocol.

2.5 LIFT ACCESS ROAD (PROCESS D)

The lift access area (Process D) that provided truck access to the active lift was sampled using a modified sweeping technique. A 16-inch wide strip was sampled using a scoop to scrape up loose particulate along the 68-foot width of the access area. Two jars were filled with the sample. The LOD was 1.4 percent by weight. The sample was desiccated for 24 hours prior to silt screening. The sample was screened for silt content which averaged 22.6 percent by weight (see Table 2.2). The silt sample was sonic sieved to determine the PM_{10} content which averaged 24.72 percent by weight. Because an insufficient amount of silt was available, PM_{10} and $>PM_{10}$ were not separated from the silt for analysis of metals, cyanide, and semivolatile organic compounds.

The lift access road sample (Sample ID D-174) was also analyzed for semivolatile organic HSL compounds at two different detection limits. The first analysis was on the lift access road sample extracts prepared by the low level procedure. The sample extract was screened as specified by the CLP and

found to be at the medium concentration level. The extract was cleaned using the GPC procedure and diluted to achieve a concentration similar to a sample prepared by the medium level procedure. The diluted extract was then analyzed. Two semivolatile HSL compounds were detected and both were found at concentrations below the quantifiable detection limit of 19.8 $\mu\text{g/g}$ (see Table 2.4).

The second semivolatile organic analysis of the lift access road sample was conducted on a portion of the original sample extract after the extract was cleaned by adsorption chromatography on Sephadex LH-20. The cleaned extract was analyzed without further dilution (other than the dilution resulting from the cleanup procedure). Five HSL compounds were detected in the lift access road sample extract. One compound, phenanthrene, was found at a concentration above the quantifiable detection limit of 4.023 $\mu\text{g/g}$.

With the exception of diluting the semivolatile organic sample extract prior to the first analysis and the use of the LH-20 cleanup method for the second analysis, all procedures for the lift access road samples followed the sampling and analysis protocol.

2.6 IMPOUNDMENT ACCESS ROAD (PROCESS E)

The impoundment access road (Process E) was located in the impoundment area and was sampled using a modified sweeping technique. A 15-inch wide strip was sampled using a scoop to scrape up loose particulate along the 34-foot width of the road. Two sample jars were filled with the sample. The LOD averaged 3.7 percent by weight. The sample was oven dried at 105°C for 1 hour prior to silt screening. For this sample, silt content averaged 10.8 percent by weight, and the PM_{10} content of the silt averaged 15.29 percent by weight. Because an insufficient amount of silt was available, PM_{10} and $>\text{PM}_{10}$ were not separated

from the silt for analysis of metals, cyanide, and semivolatile organic compounds. The analytical results for metals and cyanide in the silt sample are shown in Table 2.3.

The impoundment access road sample (Sample ID E-177) was also analyzed for semivolatile organic HSL compounds at two different detection limits. The first analysis was on the impoundment access road sample extracts prepared by the low level procedure. The sample extract was screened as specified by the CLP and found to be at the medium concentration level. The extract was cleaned using the GPC procedure and diluted to achieve a concentration similar to a sample prepared by the medium level procedure. The diluted extract was then analyzed. Three semivolatile HSL compounds were detected. One compound, bis(2-ethylhexyl)phthalate, was found at a concentration above the quantifiable detection limit of 19.8 $\mu\text{g/g}$ (see Table 2.4).

The second semivolatile organic analysis of the impoundment access road sample was conducted on a portion of the original sample extract after the extract was cleaned by adsorption chromatography on Sephadex LH-20. The cleaned extract was analyzed without further dilution (other than the dilution resulting from the cleanup procedure). Five HSL compounds were detected in the impoundment access road sample extract. Two compounds, chrysene and phenanthrene, were found at concentrations above the quantifiable detection limit of 4.023 $\mu\text{g/g}$.

With the exception of diluting the semivolatile organic sample extract prior to the first analysis and the use of the LH-20 cleanup method for the second analysis, all procedures for the impoundment access road sample followed the sampling and analysis protocol.

2.7 CONCLUSIONS

No major problems were encountered during sample collection. However, the amount of time required to lay out a complete sampling grid proved to be too great and a modified procedure for establishing the sampling grid and cells was developed to reduce the sampling time. Also, it proved difficult to remove the soil plugs from the coring tubes. Better core removal techniques were also developed. The sampling program was considered successful in obtaining representative samples.

Some difficulty was encountered in breaking up the core samples after oven drying. The problem was rectified by breaking up the lumps before oven drying. In the analyses of the samples, no problems were encountered in obtaining silt content or determining PM_{10} content. The results of the metals analyses are also believed to be accurate.

The LOD measurement was intended to measure the moisture content of the soil samples. However, the LOD procedure is an indirect measure of moisture, and a high bias can occur when volatile compounds are lost from the sample during the procedure. The LOD values were used to select the drying procedures for the samples (e.g., desiccation or oven drying).

The only significant problem encountered during the organic analyses was the fact that the samples contained a significant amount of non-HSL organic compound. This prevented the semivolatile organics analyses from being conducted at the level described in the analytical protocol. Because of the high concentrations of organics, the samples had to be diluted to protect the analytical equipment. An alternative sample clean-up procedure was used on the sample extracts in an attempt to remove these organics. The clean-up procedure used on the semivolatile organic sample extracts allowed the samples to be reanalyzed at lower quantifiable detection limits.

The results of the two semivolatile analyses at the two detection limits reveal some qualitative differences. For all the samples at this site, more compounds were detected at the lower detection limit (fourteen compounds) than at the medium detection limit (nine compounds). Four compounds, bis (2-ethylhexyl) phthalate, 2-chlorophenol, fluoranthene, and fluorene, detected at the medium level in certain samples (see Table 2.4) were not detected in the same samples at the lower detection limit after the samples had been subjected to cleanup by the LH-20 procedure. At least two hypotheses for the qualitative differences can be considered.

The first hypothesis involves the LH-20 cleanup procedure developed to reduce the interference from non-HSL aliphatic compounds during the semivolatile organics analysis. The four compounds mentioned above may not have been quantitatively recovered during the LH-20 cleanup procedure. The soil surrogate recoveries for halogenated phenolic compounds and polynuclear aromatic hydrocarbons (PAH's) do not support this hypothesis. The recoveries of the halogenated phenolic surrogates and the PAH surrogates for the samples in question (A-150, A-154, B-164, B-167, and E-177) were essentially the same for both analyses (see Tables 5.2 and 5.3) and in some cases the recoveries were better for the second analysis.

The second hypothesis involves the difficulty of interpreting GC/MS analyses. For samples from complex matrices that require dilutions prior to analysis, the results are less accurate. For example, in the matrix spike/matrix spike duplicate set of samples (B-164), fluorene (one of the compounds in question) and chrysene were detected in the unspiked sample (see Table 2.4) but not in the matrix spike (MS) sample or the matrix spike duplicated (MSD) sample (see pages B-88 and B-89). All three samples were derived from the same silt aliquot and diluted 50-fold prior to analysis and thus these compounds should have been detected at approximately the same level in all three samples.

3.0 PROCESS DESCRIPTION

As indicated in the previous section, at this facility sampling was undertaken for three processes. The term "process" refers to a likely source of potentially contaminated fugitive particulate emissions within a facility. The processes sampled included:

- (a) The active lift for landfill (94);
- (b) Surface impoundment (11); and
- (c) Unpaved roadway segments at three locations in the facility.

The following process descriptions are based largely upon (1) the information provided by the facility, and (2) observations made during the course of the survey/sampling effort. Occasional reference is also made to the trip report from a prior EPA-sponsored visit concerned with air emissions of volatile organic compounds.¹

3.1 ACTIVE LIFT FOR LANDFILL (94)

According to facility supplied information, the landfill operation may be characterized as consisting of a master cell with division into smaller cells (see Figures 4.1a and b). The landfill has been in operation for 14 years, with total design capacity given in the earlier EPA-sponsored survey as 692,000 yd³.

During the survey, landfill activity was concentrated in the area designated as cell 94. Observations indicate that material was used to construct a "lift" of nominal 4 ft depth. Approximate surface area of the lift was 14,000 sq. ft.

Facility supplied figures indicate that approximately 47,500 yd³ of solid material that may be considered hazardous, were landfilled during the previous year. Materials landfilled in greatest quantity in the past year are shown below.

<u>Waste</u>	<u>Quantity (yd³)</u>
Scrubber Salts (Cake)	4934
Oil Production Solids	13171
Gasoline Contaminated Soil	29436

¹ Case Study prepared by Engineering Science (Contract No. 68-03-3040), July 1984.

The corresponding EPA hazardous waste numbers for these wastestreams were not readily available.

The principal equipment types, functions, and approximate level of activity for the landfill operations are given below.

Equipment (commerical designated if available)	Function	Activity units
Bulldozer (Komatsu D85P) with 14 ft 4 in. blade.	Waste spreading; lift construction and maintenance.	4 hr/day
Sheepsfoot	Compaction of waste materials.	6 hr/wk
Hauler traffic--5 axle, 18 wheel trucks.	Delivery of waste materials for landfill disposal.	Variable demand, avg. for most recent 30 day period prior to survey indicates ~ 10-12 haulers/day.

None of this equipment is designated for exclusive use in the landfill area.

According to plant personnel, all material is landfilled in the same way. During the site survey, observed operating procedures included initial load-out of solids by haulers (tractor/trailer, dump trucks) into piles on the active lift surface. The bulldozer then spreads material across the surface attempting to maintain uniform conditions. Presumably, the sheepsfoot is then used to further compact the material.

It is likely that each of these operations generates some level of particulate emissions. However the actual waste spreading and lift construction probably constitutes the greatest source of potentially contaminated particulate emissions. It should be noted that during the survey, hauler traffic was routed directly over the active lift such that the trucks were making at least two passes over uncovered waste material. In addition to any direct resuspension of particulate material, this procedure also increases the possibility that contaminated material will be spread onto other roads within the facility. In turn, the material would be available for resuspension by equipment not directly associated with the landfill operations.

Note that plant personnel indicate that the practices described above are not "typical" of site landfill practices. Instead, typical operating procedure was to dump the contaminated soils on the "working bench" adjacent to the working face where it was mixed and stirred regularly to enhance loss

of volatiles and biodegradation. Dust Control Moisture was mixed to enhance the various biological processes. When the material had changed to a light brown color, when wet, it was moved over the working face and incorporated into the landfill. Conditions were usually less than ideal so some heavy hydrocarbon might be expected to remain in the fill materials.

Flue gas emission scrubber salts were placed directly onto the working face and covered with the treated soils.

It should be noted that vehicle traffic was never passed over untreated contaminated soil and that the spread of waste would be minimal.

3.2 SURFACE IMPOUNDMENT (11)

At present, the facility operates 15 surface impoundments (SIs)/spreading fields with a total area of approximately 20 acres. Summary dimensions for all SIs are given in Table 3.1. As noted in the prior EPA sponsored survey,¹ each SI serves to both treat and dispose of relatively high liquid content waste streams through evaporation, settling, and biodegradation.

TABLE 3.1. SUMMARY OF SURFACE IMPOUNDMENTS/SPREADING FIELDS

Field no.	Area (acres)	Capacity (gal.)	Use designation ^a
1	0.89	17,276	Drilling muds/tank bottoms/oil field brine
2	1.65	32,029	Drilling muds/tank bottoms/oil field brine
3	1.89	36,688	Drilling muds/tank bottoms/oil field brine
6	1.66	32,224	Drilling muds/tank bottoms/oil field brine
7	1.51	29,312	Drilling muds/tank bottoms/oil field brine
8	1.15	22,324	Drilling muds/tank bottoms/oil field brine
11	1.08	20,965	Drilling muds
12	.97	18,829	Drilling muds
14	1.74	33,776	Drilling muds/tank bottoms
17	.41	7,959	Wet solids ^b
21	.94	18,247	Liquid scrubber
23	1.05	20,382	Drilling muds
18	1.07	20,770	Liquid scrubber
24	2.14	41,541	Liquid scrubber
25	1.05	20,382	Liquid scrubber

a General categories based on conversation with site manager.

b This designation based on free-fluid test at facility gate.

Each of the SIs is managed with reference to a "process cycle." Information provided by the facility personnel suggests that the duration of a process cycle probably depends upon factors including demand, climate, and day-to-day management practices. As a typical value, the SIs undergo three cycles/year where a cycle consists of:

- (a) Waste application to a maximum depth of 2.5 ft;
- (b) Evaporation and if necessary, on-site transfer of liquid to a down-gradient SI;
- (c) Mixing/biodegradation; and
- (d) Clean-up of residual solids material in SI.

During the site-survey, the SIs were in various stages of the process cycle. SI-11 was selected for sampling to represent an area that had recently undergone clean-up of residual solids (d, above); this is the portion of the process cycle in which the surface material is driest and thus most susceptible to entrainment and dispersion of fine particulate.

The following information shows various equipment available for use in this part of the process cycle. As indicated, this is an intermittent activity that occurs at the end of each process cycle.

Equipment (commerical designated if available)	Function	Activity units
Bulldozer (Komatsu D85P) with 14 ft 4 in. cutting blade.	Used for SI clean-up after completion of process cycle. Material added to existing berms.	Intermittent, ~ 3 process cycles/yr.
Front-end loader (Michigan 175-B).	Used for SI clean-up with material transferred to dump truck if SI freeboard problem is anticipated.	Bucket capacity-- 5 yd ³ ; highly intermittent activity.
Dump truck (Kenworth)-- 3 axles, 10 wheels.	Used to move residual SI material to landfill if freeboard problem anticipated.	10 yd ³ capacity; highly intermittent activity.
Scraper (John Deere 860A).	Used for clean-up and transfer of SI residual material.	16 yd ³ capacity; intermittent activity.

Note that there were no actual clean-up activities observed during the site survey.

The SIs are used almost exclusively to treat and dispose of wastes generated by oil production. Categories of waste include: oil sump sludge, oil field brine, drilling (rotary) muds, tank bottom sediments, and liquid scrubber wastes. According to facility personnel SI-11 is designated to receive drilling muds. In the aggregate, the SIs receive about 2000 bbl/day. More detailed figures on waste allocation were not obtained during the site survey, however data for 1982 are available from the previous site visit report.¹

3.3 UNPAVED ROADS--THREE SEGMENTS

Samples were collected from roads at three different points in the facility. Estimated traffic volumes range from 10 passes/day to approximately 50 passes/day. Vehicle mix information was not obtained during the survey. Fugitive emissions from the unpaved roads at the facility are controlled through the use of water. Principal equipment for this program is a vacuum truck (Kenworth, 3,500 gal. capacity) which is used on an "as needed" basis. During the survey, the water truck appeared to be quite active with repeat applications at approximately 1.5-2 hr intervals on the major unpaved roads within the facility.

4.0 SAMPLING AND ANALYSIS

This section outlines the procedures used for (1) the sampling conducted at Site 01 and (2) the analysis of the samples collected. Included are descriptions of the location of each process sampled and the sampling grid used for sample collection. Sample handling, preparation, and/or analysis specific to this facility or any process therein are described in detail. Any deviations from the standard sampling and analysis procedures (see Appendix C) are discussed.

Three processes were sampled: an active lift, a dry surface impoundment, and three unpaved road segments. The samples from each of these processes were analyzed for silt and PM_{10} content, metals, cyanide, and semivolatile organics. A tabular presentation of the sampling plan for Site 01 which specifies the number and types of samples and the locations at which they were collected can be found in Chapter 2 (see Table 2.1). The subsections that follow further describe the sampling locations, sampling grid schemes, and applicable sampling and analytical procedures.

4.1 SITE PLOT PLAN

Figures 4.1a and b show the site plot plan for Site 01 and an enlargement of one area of the plan, respectively. The scale of Figure 4.1a is approximately 1 inch equals 290 feet. The scale of Figure 4.1b is approximately 1 inch equals 200 feet. The location of each process sampled is indicated on these site plot plans using the designated process letter. Pertinent topographical features, both natural and man-made, are also shown.

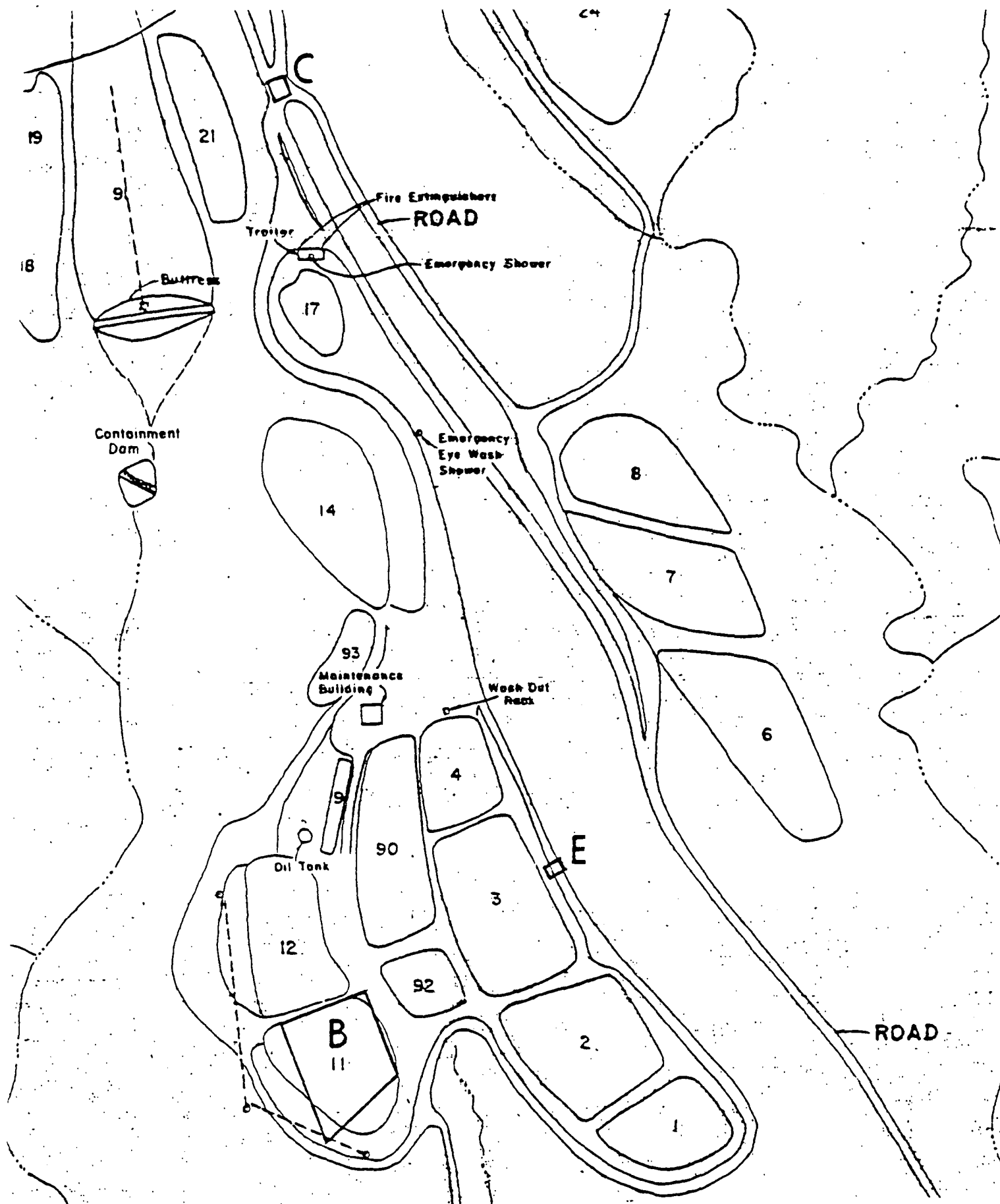


Figure 4.1a. Site plot plan for Site 01 showing locations of Processes B, C, and E sampled.

4.2 ACTIVE LIFT (PROCESS A)

The active lift, designated process A, is located at the north end of Site 01 (see Figures 4.1a and b). The process boundaries were determined to approximate a trapezoid with sides of 108', 86', 113', and 113'. Based on these dimensions, the sampling grid was designed and laid out using 15 foot square grid cells (see Figure 4.2). The grid cells were numbered from left to right starting in the northwest corner of the sampling grid.

Based on an expected high level of variability in the soil at this process site, MRI determined that eight grid cells would be sampled. A random number table was used to select the grid cells for sampling (Appendix C) and no selected cells were eliminated.

Because this process involved a temporary soil cover which is a moderately disturbed surface, MRI decided that it would be sampled using the scooping technique (see Appendix C). Within each cell a sampling template was randomly tossed four times. The sample from each cell consisted of the four soil aliquots (two scoops each) taken from inside the areas defined by the template. The eight samples were numbered A-101 through A-108. Figure 4.2 shows each sample and the corresponding grid cell from which it was taken.

A ten gram aliquot of a sample (A-108) from this process was first analyzed for weight loss on drying (LOD) by drying for 12 to 16 hours in a 105°C oven. All samples were dried in a desiccator for 24 hours (see Table 4.1). Following drying, the samples were screened to determine percent silt content and were sonic sieved to determine percent PM₁₀ content (see Appendix C for specifics of sample handling during each of these analyses).

Using the screening and sieving techniques described in Appendix C, all the samples from this process were utilized to make composite samples of the silt, PM₁₀, and >PM₁₀ fractions. The part of the silt sample that did not pass

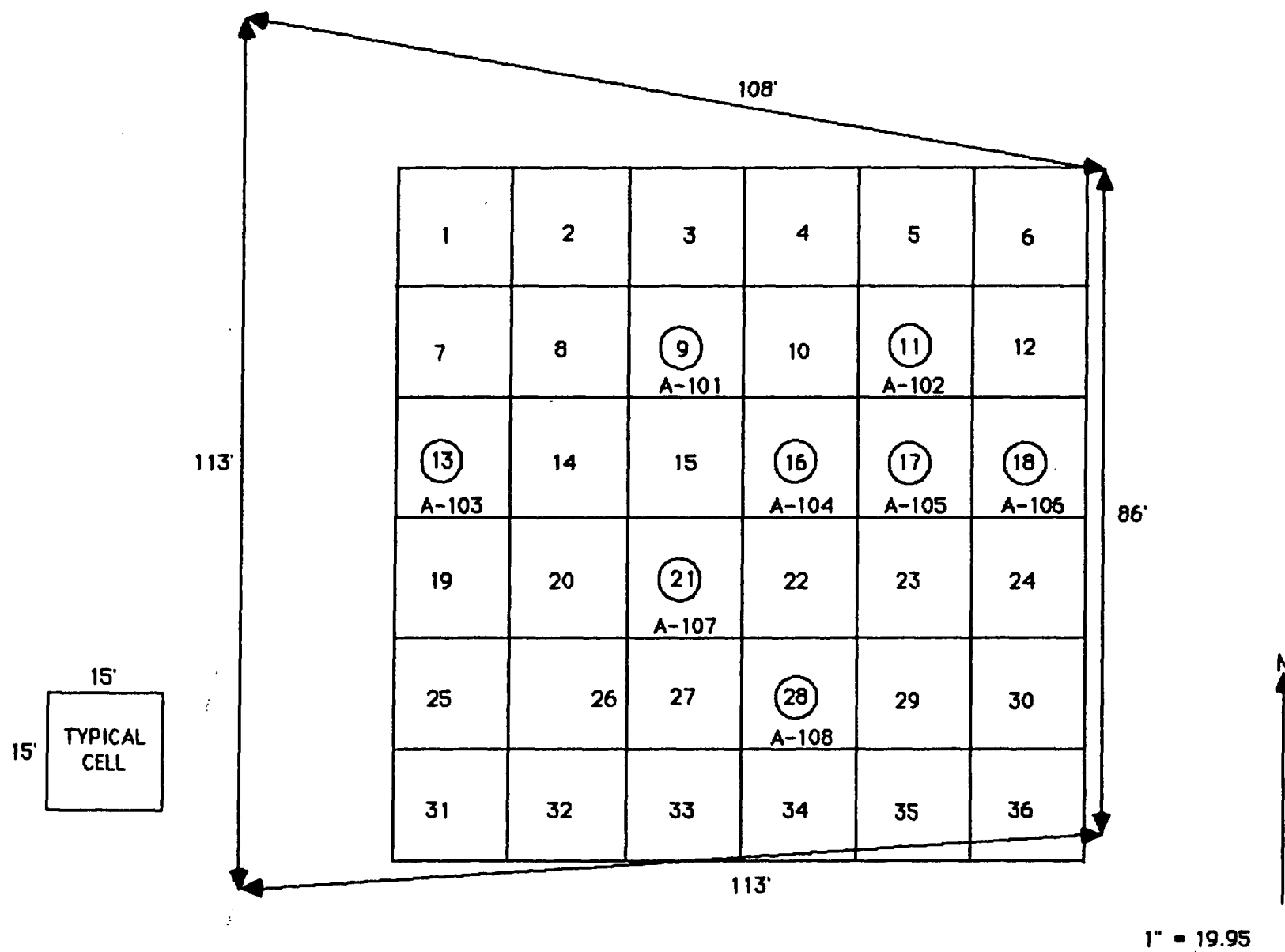


FIGURE 4.2. SAMPLING GRID AND PROCESS DIMENSIONS FOR ACTIVE LIFT AT SITE 1 (PROCESS A).

TABLE 4.1. SAMPLE DRYING PROCEDURE SUMMARY

Sample ID	Process Description	Drying Procedure
A	Active Lift, Landfill	Desiccated for 24 hours
B	Dry Surface, Impoundment	Oven dried at 105°C for 1 hour
C	Dirt Roadway	Desiccated for 24 hours
D	Lift Access Area	Desiccated for 24 hours
E	Impoundment Access Road	Oven dried at 105°C for 1 hour
BGD	Background Sample	Desiccated for 24 hours

through the 20 μm sonic sieve was referred to as the "greater than PM_{10} " ($>\text{PM}_{10}$) fraction. Portions of these fractions were then sent to RTI for metals and cyanide analysis.

The procedures used for analysis of the metals followed the methods outlined in the EPA publication "Testing Methods for Evaluating Solid Waste," SW-846. The metals measured and the detection limit of the analytical methods used are shown in Table 4.2. Samples for analysis of all metals except mercury (Hg) were prepared by acid digestion using EPA Method 3050 (SW-846). Mercury (Hg) samples were prepared and analyzed by the cold-vapor atomic absorption procedure following EPA Method 7471. Two modifications were used in the final dilutions of the digestates. The samples for inductively-coupled argon plasmography (ICAP) determination by EPA Method 6010 and furnace atomic absorption determination of antimony (Sb) by EPA Method 7041 were diluted to achieve a final concentration of 5% HCl. The sample digestates for arsenic (As) determination by EPA Method 7060, for selenium (Se) determination by EPA Method 7740, and for thallium (Tl) determination by EPA Method 7841 were diluted to achieve a final concentration of 0.5% nitric acid.

Cyanide determinations were done by colorimetric measurement following EPA Method 335.3 found in "Methods for the Evaluation of Water and Wastewater," EPA-600/4-79-020. The analyses for metals and cyanide were performed without any problems.

TABLE 4.2. METALS, MEASUREMENT METHODS, AND DETECTION LIMITS*

Element	ICAP***	Detection Limits ($\mu\text{g/g}$)*	
		GFAA***	Cold Vapor AA***
Aluminum (Al)	40	-----	
Antimony (Sb)	-----	1.0	
Arsenic** (As)	-----	1.0	
Barium** (Ba)	0.7	-----	
Beryllium (Be)	0.1	-----	
Bismuth (Bi)	10.0	-----	
Cadmium** (Cd)	0.4	-----	
Chromium** (Cr)	0.7	-----	
Cobalt (Co)	0.7	-----	
Copper (Cu)	7.3	-----	
Iron (Fe)	100	-----	
Lead** (Pb)	10.0	-----	
Manganese (Mn)	5.9	-----	
Mercury** (Hg)	-----	-----	0.25
Molybdenum (Mo)	9.0	-----	
Nickel (Ni)	2.2	-----	
Osmium (Os)	4.0	-----	
Selenium** (Se)	-----	1.0	
Silver** (Ag)	10	-----	
Thallium (Tl)	-----	1.0	
Vanadium (V)	3.9	-----	
Zinc (Zn)	0.2	-----	

* Detection limits were calculated as three times the standard deviation of the values measured for compounds at or near the suspected detection limit in the background sample. For compounds not detected in the background sample, the detection limits were calculated as three times the standard deviation of the background noise. Fe, Mg, and Al detection limits were determined using low level standards as three times the standard deviation of the values measured.

** Eight RCRA metals

*** ICAP = Inductively-Coupled Argon Plasmography
 GFAA = Graphite Furnace Atomic Absorption
 AA = Atomic Absorption

Portions of the composite samples of the silt, PM_{10} , and $>PM_{10}$ fractions were also sent to PEI; these were analyzed for the semivolatile organic compounds listed in Table 4.3. The three silt fractions from the active lift process were prepared for analysis of semivolatile organics following the low concentration level extraction method detailed in the U. S. EPA Contract Laboratory Program, Statement of Work for Organic Analysis, 7/85 revision (referred to as the CLP in this report). The sample extracts were screened by gas chromatography/flame ionization detection (GC/FID) to determine the concentration level of the organic compounds in the sample extract. The extracts were found to be at the medium level (i.e., any organic compound over 20 $\mu\text{g/g}$). The extracts were cleaned by the CLP gel permeation chromatography (GPC) cleanup procedure recommended for soil samples. The sample extracts were diluted 50-fold to reach a concentration level similar to a medium level sample. The diluted extracts were then analyzed using a capillary-column gas chromatograph/mass spectrometer (GC/MS) with a detection limit of 19.8 $\mu\text{g/g}$ for the semivolatile organic HSL compounds. The dilutions resulted in a higher detection limit than the originally intended level of 0.330 $\mu\text{g/g}$, but the dilutions were necessary to protect the GC/MS.

An alternative cleanup procedure for the sample extracts using adsorption chromatography was developed to reduce the amount of sample dilution necessary to protect the GC/MS. This allowed the GC/MS analyses to be conducted at a lower detection limit. The remaining portions of the extracts from the active lift samples were concentrated and subjected to an adsorption chromatography cleanup procedure using Sephadex LH-20 (described in Appendix C). The cleaned extracts were analyzed by GC/MS without further dilution other than the dilution resulting from the LH-20 cleanup procedure. The detection limit for the silt fraction (A-150) was 0.412 $\mu\text{g/g}$ (see Table 2.4) after a 1.25-fold

TABLE 4.3. SEMIVOLATILE ORGANIC COMPOUNDS FOR ANALYSIS

ACENAPHTHENE
ACENAPHTHYLENE
ANTHRACENE
BENZO (a) ANTHRACENE
BENZOIC ACID
BENZO (a) PYRENE
BENZO (ghi) PERYLENE
BENZO (b) FLUORANTHENE
BENZO (k) FLUORANTHENE
BENZYL ALCOHOL
BIS (2-CHLOROETHOXY) METHANE
BIS (2-CHLOROETHYL) ETHER
BIS (2-CHLOROISOPROPYL) ETHER
BIS (2-ETHYHEXYL) PHTHALATE
4-BROMOPHENYL PHENYL ETHER
BUTYL BENZYL PHTHALATE
4-CHLOROANILINE
4-CHLORO-3-METHYLPHENOL
2-CHLORONAPHTHALENE
2-CHLOROPHENOL
4-CHLOROPHENYL PHENYL ETHER
CHRYSENE
DIBENZO (a,h) ANTHRACENE
DIBENZOFURAN
1,2 DICHLOROBENZENE
1,3 DICHLOROBENZENE
1,4 DICHLOROBENZENE
3,3'-DICHLOROBENZIDINE
2,4-DICHLOROPHENOL
DIETHYLPHTHALATE
2,4-DIMETHYLPHENOL
DIMETHYL PHTHALATE
DI-N-BUTYLPHTHALATE
2,4-DINITROPHENOL
2,4-DINITROTOLUENE
2,6-DINITROTOLUENE
DI-N-OCTYL PHTHALATE
FLUORANTHENE
FLUORENE
HEXACHLOROBENZENE
HEXACHLOROBUTADIENE
HEXACHLOROCYCLOPENTADIENE
HEXACHLOROETHANE
INDENO(1,2,3-cd) PYRENE
ISOPHORONE
2-METHYL-4,6-DINITROPHENOL
2-METHYLNAPHTHALENE
2-METHYLPHENOL
4-METHYLPHENOL
NAPHTHALENE
2-NITROANILINE
3-NITROANILINE
4-NITROANILINE
NITROBENZENE

(Continued)

TABLE 4.3. (continued)

2-NITROPHENOL
4-NITROPHENOL
N-NITROSO-DI-N-PROPYLAMINE
N-NITROSODIPHENYLAMINE
PENTACHLOROPHENOL
PHENANTHRENE
PHENOL
PYRENE
1,2,4-TRICHLOROBENZENE
2,4,5-TRICHLOROPHENOL
2,4,6-TRICHLOROPHENOL

dilution from the cleanup procedure. For the >PM₁₀ fraction (A-156) with a 2.84-fold cleanup dilution factor, the sample detection limit was 0.937 µg/g and for the PM₁₀ fraction (A-154) with a 1.43-fold cleanup dilution factor, the sample detection limit was 0.472 µg/g.

4.3 DRY SURFACE IMPOUNDMENT (PROCESS B)

Process B, a dry surface impoundment, is located in the southwest corner of Site 01 (see Figure 4.1). The process boundaries approximated an irregular trapezium with side dimensions of 255', 186', 186', and 220'. MRI determined that the grid cells would be 30 feet square, and the sampling grid was laid out using surveyors stakes and tape. The grid cells were numbered as shown in Figure 4.3.

Based on an expected moderate level of variability in the soil at this process site, MRI directed that six grid cells be sampled; a random number table was used to select the specific grid cells for sampling (see Appendix C). No selected sample cells were rejected.

MRI determined that for the sample collection, the coring technique should be used at this process. As previously described for Process A, a sampling template was randomly tossed four times within each cell sampled. The cored sample aliquots were taken from inside the areas defined by the template. The

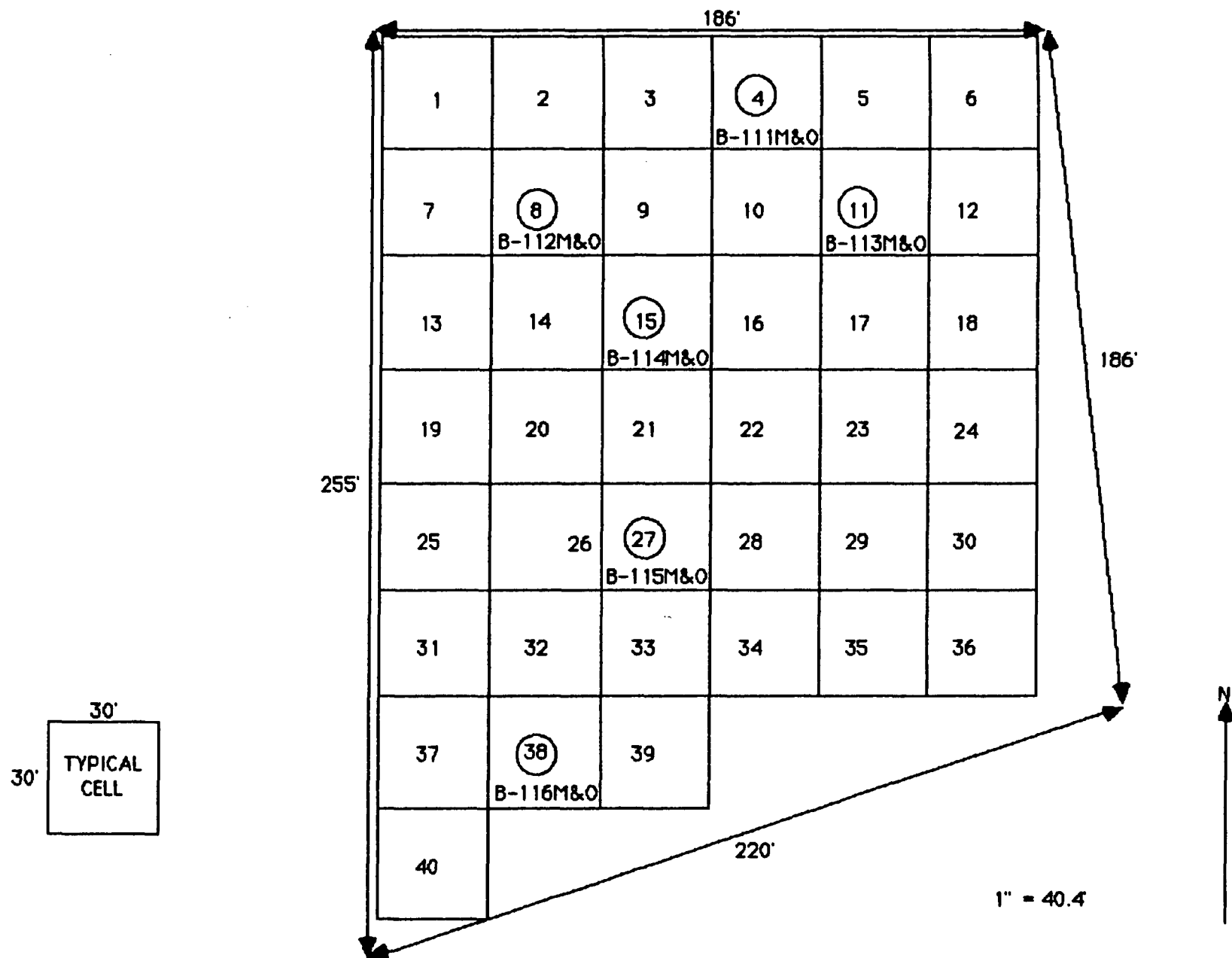


FIGURE 4.3. SAMPLING GRID AND PROCESS DIMENSIONS FOR DRY SURFACE IMPOUNDMENT AT SITE 1 (PROCESS B).

application of the basic coring technique (see Appendix C), however, proved to be difficult and a modified coring technique was devised based on discussions between MRI and Entropy personnel. The modified technique involved taking two 2-inch cored aliquots from each of the four template areas using each type of core tube (stainless steel or plastic) and then using the appropriate core tube to scoop up additional loose soil from the aliquot area. Because of the coring tube materials of construction, two samples were taken from each grid cell, one for metals analysis (using the plastic coring tube) and one for organics analysis (using the metal coring tube). The twelve samples taken from the six grids were numbered using the following scheme: B-111-O, B-111-M, B-112-O, B-112-M B-116-O, B-116-M.

Because the LOD determination on a 10 gram portion of sample yielded a value greater than 10 percent, the samples from this process were oven-dried at 105°C for 1 hour (see Table 4.1). They were then screened to determine percent silt content and sonic sieved to determine PM₁₀ content (see Appendix C for a complete explanation of sample handling during these analyses).

The same screening and sieving techniques were used to make composite samples of the silt, PM₁₀, and >PM₁₀ fractions from this process. Portions of these were sent to RTI for metals and cyanide analyses and to PEI for semivolatile organic analysis. All samples were analyzed for metals, cyanide, and semivolatile organic compounds as described previously for the composite samples from Process A. Like the Process A sample extracts, 50 to 70 fold dilutions were required to achieve a suitable concentration for the GC/MS semivolatile compounds analysis. This resulted in the higher detection limit of 19.8 g/g for the compounds shown in Table 4.3.

Like the Process A sample, the remaining portions of the extracts from dry surface impoundment process samples were concentrated and subjected to the LH-20 cleanup procedure. The cleaned extracts were analyzed by GC/MS without further dilution, other than the dilutions resulting from the LH-20 cleanup procedure. The detection limit for the silt fraction (B-164) was $5.143 \mu\text{g/g}$ (see Table 2.4) after a 15.6-fold dilution from the cleanup procedure. For the $>\text{PM}_{10}$ fraction (B-167) with a 14.3-fold cleanup dilution factor, the sample detection limit was $6.650 \mu\text{g/g}$ and for the PM_{10} fraction (B-166) with a 20.8-fold cleanup dilution factor, the sample detection limit was $6.065 \mu\text{g/g}$.

4.4 DIRT ROADWAY (PROCESS C)

The dirt roadway sampled was the main roadway entrance to a number of impoundments; the sampling location was approximately 130 yards southeast of the active lift sampling site (see Figure 4.1). Sampling of this dirt roadway included the entire width of the road (16 feet) and covered a distance of a 2-foot band across the road (see Figure 4.4).

Because unpaved roads consist of hard-crusts, undisturbed surfaces, MRI recommended sampling this process using a modified sweeping technique. This technique involved using a disposable scoop to scrape the loose particulate from the surface of the road and to deposit it into the sample jars. The single sample taken was numbered C-117.

A 10 gram aliquot of the sample from this process was first analyzed for LOD by drying a portion for 12 to 16 hours in a 105°C oven. Later, the entire sample was dried in a desiccator for 4 hours. The dried sample was screened for percent silt content and sonic sieved for percent PM_{10} content (see Appendix C). Since a sufficient quantity of silt was not obtained during the silt screening, PM_{10} and $>\text{PM}_{10}$ fractions were not produced for chemical analysis.

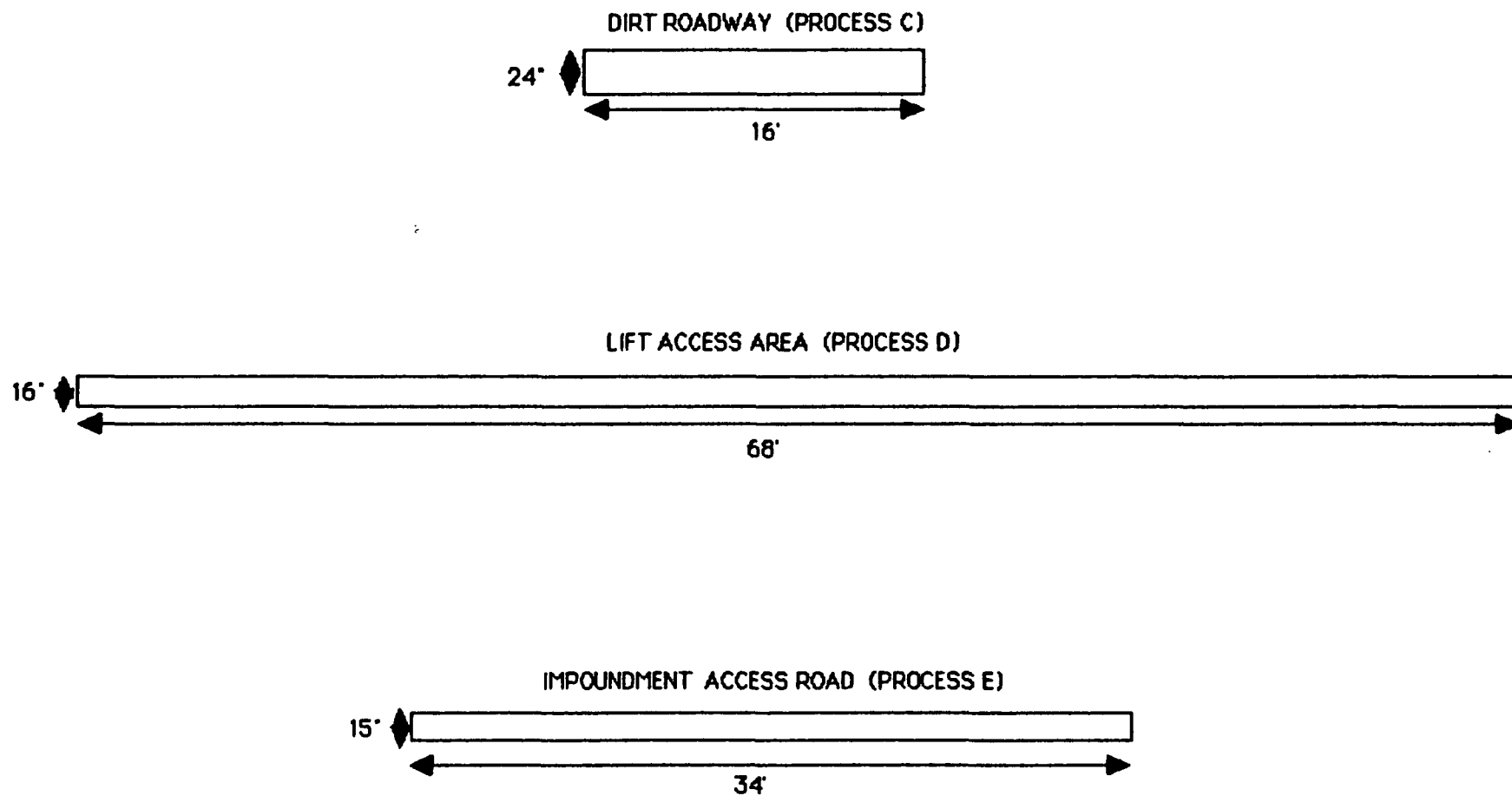


FIGURE 4.4. PROCESS DIMENSIONS FOR DIRT ROADWAY, LIFT ACCESS AREA,
AND IMPOUNDMENT ACCESS ROAD AT SITE 1 (PROCESSES C, D, AND E).

The entire sample was screened to yield only the silt fraction. Portions of this fraction were submitted to RTI and PEI for metals and cyanide analyses and semivolatile organics analysis, respectively. They were analyzed for metals, cyanide and semivolatile organic compounds as described previously for the composite samples from Process A. Like the Process A sample extracts, 50 to 70 fold dilutions were required to achieve a suitable concentration for the GC/MS semivolatile compounds analysis. This resulted in the higher detection limit of 19.8 $\mu\text{g/g}$ for the compounds shown in Table 4.3.

Like Process A samples, the remaining portion of the dirt roadway sample extract was concentrated and subjected to the LH-20 cleanup procedure. The cleaned extract was analyzed by GC/MS without further dilution, other than the dilutions resulting from the LH-20 cleanup procedure. The detection limit for the dirt roadway sample was 0.455 $\mu\text{g/g}$ with a 1.25-fold dilution resulting from the cleanup procedure.

4.5 LIFT ACCESS AREA (PROCESS D)

The active lift access area (Process D) was located due north of the active lift (Process A) (see Figure 4.1). This area provides truck access and turn-around space for the active lift. The area sampled was a long strip, 16 inches by 68 feet with the long axis parallel to the adjacent side of the lift site (see Figure 4.4).

Because this process area consisted of a hard-crusted undisturbed surface, MRI determined that it should be sampled using a modified sweeping technique. A disposable scoop was used to scrape all loose particulate from the strip sampled into a sample jar. The single sample taken was numbered D-118.

The sample from this process was first analyzed for LOD by drying a 10 gram portion for 12 to 16 hours in a 105°C oven. Later, the entire sample was dried in a desiccator for 4 hours (see Table 4.1). The dried sample was screened for percent silt content and sonic sieved for percent PM₁₀ content (see Appendix C). Since a sufficient quantity of silt was not obtained during the silt screening, PM₁₀ and >PM₁₀ fractions were not produced for chemical analysis.

Portions of the silt fraction were submitted to RTI and PEI for metals and cyanide analyses and semivolatile organics analysis, respectively. They were analyzed for metals, and cyanide, and semivolatile organic compounds as described previously for the composite samples from Process A. Like the Process A sample extracts, 50 to 70 fold dilutions were required to achieve a suitable concentration for the GC/MS semivolatile compounds analysis. This resulted in the higher detection limit of 19.8 µg/g for the compounds shown in Table 4.3.

Like Process A samples, the remaining portion of the dirt roadway sample extract was concentrated and subjected to the LH-20 cleanup procedure. The cleaned extract was analyzed by GC/MS without further dilution, other than the dilutions resulting from the LH-20 cleanup procedure. The detection limit for the dirt roadway sample was 0.455 µg/g with a 1.25-fold dilution resulting from the cleanup procedure.

4.6 IMPOUNDMENT ACCESS ROAD (PROCESS E)

The impoundment access road sampled was located in the impoundment area in the southern section of Site 01 (see Figure 4.1). Sampling covered the width of the road (34 feet) in a 15-inch wide strip (see Figure 4.4).

Since unpaved roads are hard-crusted, undisturbed surfaces, MRI recommended sampling this process using a modified sweeping technique. As for Process C, a disposable scoop was used to scrape the loose particulate from the road and deposit it into a sample jar. The single sample taken was numbered E-119.

The sample from this process was first analyzed for LOD by drying a 10 gram portion for 12 to 16 hours in a 105°C oven. Later, the entire sample was dried in a desiccator for 4 hours. It was analyzed for percent silt content and percent PM₁₀ content (see Appendix C). Since a sufficient quantity of silt was not obtained during the silt screening, PM₁₀ and >PM₁₀ fractions were not produced for chemical analysis.

Portions of the silt fraction only were submitted to RTI and PEI for metals and cyanide analyses and semivolatile organics, respectively. They were analyzed for metals, cyanide, and semivolatile organic compounds as described previously for the composite samples from Process A. Like the Process A sample extracts, 50 to 70 fold dilutions were required to achieve a suitable concentration for the GC/MS semivolatile compounds analysis. This resulted in the higher detection limit of 19.8 µg/g for the compounds shown in Table 4.3.

Like Process A samples, the impoundment access road sample extract was concentrated and subjected to the LH-20 cleanup procedure. The cleaned extract was analyzed by GC/MS at a detection limit of 4.023 µg/g without further dilution, other than the 11.4-fold dilution resulting from the cleanup procedure.

4.7 BACKGROUND SAMPLES

Two background samples were taken at Site 01 in area T-24. The scooping technique was used for sample collection. These samples were numbered BGD-109 and BGD-110. At the direction of MRI, BGD-110 was discarded because it was considered nonrepresentative.

The remaining background sample was analyzed for LOD and dried in a desiccator for 24 hours. It was then analyzed for percent silt and percent PM₁₀ content (see Appendix C). Since a sufficient quantity of silt was not obtained during the silt screening, PM₁₀ and >PM₁₀ fractions were not produced for chemical analysis.

Portions of the silt fraction generated by screening were sent to RTI and PEI for metals and cyanide analyses and semivolatile organics analysis, respectively. They were analyzed for metals, cyanide, and semivolatile organic compounds as described previously for the composite samples from Process A. The extract from the background sample was diluted 50-fold to have a detection limit similar to the other samples. This resulted in the higher detection limit of 19.8 µg/g shown in Table 4.3.

Like all the process samples, the background sample extract was concentrated and subjected to the LH-20 cleanup procedure. The clean extract was analyzed by GC/MS at a detection limit of 0.431 µg/g with a 1.25-fold dilution factor resulting from the cleanup procedure.

5.0 QUALITY ASSURANCE

The quality assurance (QA) measures for the chemical analyses were conducted internally by each laboratory. For the metals analysis, RTI used National Bureau of Standards (NBS) water (1643 B) as check samples for the accuracy of the instrumentation. An NBS fly ash sample (1633 A) was used as a QA sample to check the overall accuracy of the digestion and analysis procedures. One sample (A-155) was spiked with eight elements and their percent recoveries calculated to assess matrix effects. A sample (E-178) was analyzed in duplicate to demonstrate analytical precision. Quality assurance results for the metals analysis are presented in Table 5.1.

For the QA on the analysis of the semivolatile organics and pesticides (Table 5.2), PEI used a sample (B-164) for a matrix spike (MS) and a matrix spike duplicate (MSD). The percent recoveries were determined and the relative percent difference (RPD) for the duplicates calculated. The MS and MSD were within the acceptable percent recovery range and below the RPD specified by the Contract Laboratory Program (CLP). All samples received were spiked with surrogate compounds and the percent recoveries of these compounds were determined.

Recovery of 2,4,6-tribromophenol on the first analysis was below 10% on all samples, but because the sample extracts were diluted, the surrogate compounds were present only in trace quantities. Surrogate compound recovery data are less accurate when the surrogates are at trace levels.

TABLE 5.1. QUALITY ASSURANCE RESULTS FOR METALS ANALYSIS

Sample Identity	NBS Water 1643 B		NBS Fly Ash 1633 A		A-155 Spiked	Duplicates		Duplicates		Duplicates	
	Expected	Found	Expected	Found		E-178	E-178	A-153	A-153	A-157	A-157
Elements (ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)		(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)
Aluminum (Al)	-	-	140,000	18,600	-	20,200	21,300	-	-	-	-
Antimony (Sb)	8.2	8.8	7.0	7.4	-	<1	<1	-	-	-	-
Arsenic (As)	76.0	74.0	145	129	95%	-	-	8.3	7.5	-	-
Barium (Ba)	4.4	4.3	1500	700	26%	546	232	-	-	-	-
Beryllium (Be)	1.9	1.9	12.0	4.3	98%	2.6	2.6	-	-	-	-
Bismuth (Bi)	-	-	-	-	-	<10	<10	-	-	-	-
Cadmium (Cd)	2.0	2.2	1.0	5.3	105%	3.5	3.6	-	-	-	-
Chromium (Cr)	1.9	1.7	196	34.6	-	67.7	68.7	-	-	-	-
Cobalt (Co)	2.6	2.6	46.0	15.0	-	10.0	10.1	-	-	-	-
Copper (Cu)	2.2	2.3	118	41.7	-	131	126	-	-	-	-
Iron (Fe)	<100	<100	94,000	23,700	-	18,900	19,300	-	-	-	-
Lead (Pb)	-	-	72.4	81.0	73%	-	-	-	-	780	850
Manganese (Mn)	2.8	3.2	190	25.0	93%	360	361	-	-	-	-
Mercury (Hg)	1.5	1.5	0.16	0.15	-	0.25	0.15	-	-	-	-
Molybdenum (Mo)	8.5	9.8	29	24.8	-	<9	<9	-	-	-	-
Nickel (Ni)	4.9	5.2	127	36.2	-	57.1	59.8	-	-	-	-
Osmium (Os)	-	-	-	-	-	<4	<4	-	-	-	-
Selenium (Se)	10.0	12.0	10.3	9.3	95%	-	-	2.3	2.1	-	-
Silver (Ag)	-	-	-	-	-	<10	<10	-	-	-	-
Thallium (Tl)	7.0	5.7	4.0	5.7	-	<1	<1	-	-	-	-
Vanadium (V)	4.5	5.0	300	111	-	76.0	75.6	-	-	-	-
Zinc (Zn)	6.6	6.6	200	75.3	200%	842	870	-	-	-	-
cyanide	-	-	-	-	-	<0.5	<0.5	-	-	-	-

TABLE 5.2. QUALITY ASSURANCE RESULTS FOR FIRST SEMIVOLATILE ORGANICS ANALYSIS

SOIL SURROGATE PERCENT RECOVERY SUMMARY

Sample Identity	Silt >PM-10 A-150	PM-10 A-156	PM-10 A-154	Silt D-174	Silt B-164	>PM10 B-167	PM-10 B-166	Silt E-177	Silt C-171	Silt B6D-190	Sample Blank	MS/MSD Blank	Matrix Spike	Matrix Duplicate
Surrogate Compounds														
Nitrobenzene-d5	66%	44%	47%	45%	56%	59%	61%	58%	57%	33%	43%	68%	63%	74%
2-Fluorobiphenyl	47%	68%	67%	59%	53%	54%	62%	66%	65%	55%	43%	79%	64%	72%
Terphenyl-d14	55%	75%	61%	62%	74%	77%	109%	73%	72%	48%	34%	89%	85%	102%
Phenol-d5	94%	66%	52%	56%	49%	49%	45%	69%	98%	64%	61%	113%	113%	124%
2-Fluorophenol	78%	64%	23%	30%	27%	27%	10%	55%	16%	50%	54%	99%	99%	105%
2,4,6-Tribromophenol	0%	0%	0%	0%	0%	0%	0%	9%	0%	0%	0%	50%	43%	42%

SOIL MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY SUMMARY

Sample Identity B-164	Spike Conc.	Unspiked Sample	Matrix Percent Spike Recovery	Matrix Spike Duplicate	Percent Recovery	RPD
Compound	(ug/g)	(ug/g)	(ug/g)	(ug/g)		
1,2,4-Trichlorobenzene	100.0	0.0	68.0	68%	67.6	68%
Acenaphthene	100.0	0.0	63.8	64%	69.2	69%
2,4-Dinitrotoluene	100.0	0.0	76.4	76%	88.5	89%
Pyrene	100.0	0.0	78.2	78%	95.4	95%
N-Nitrosodi-n-Propylamine	100.0	0.0	51.9	52%	56.5	57%
1,4-Dichlorobenzene	100.0	0.0	58.9	59%	65.2	65%
Pentachlorophenol	200.0	0.0	119.0	60%	100.0	50%
Phenol	200.0	0.0	127.0	64%	128.0	64%
2-Chlorophenol	200.0	0.0	124.0	62%	136.0	68%
4-Chloro-3-methylphenol	200.0	0.0	141.0	71%	135.0	68%
4-Nitrophenol	200.0	0.0	141.0	71%	127.0	64%

METHOD BLANK SUMMARY

Blank ID	Compound Identity	Concentration
		(ug/g)
Sample Blank	Aldol Condensation Product	5.0
	Unknown	100.0
MS/MSD Blank	Aldol Condensation Product	1000.0
	Unknown	20.0
	Ketone	8.0
	Dimethylbenzene	20.0
	Trimethylbenzene	10.0

Analyses were conducted on two blank samples consisting of a purified solid matrix spiked with surrogate compounds and carried through extraction and concentration. One blank was for the samples and the other blank was for the MS and MSD. The CLP specifies surrogate recovery limits for the blanks as well as limits on the levels of common phthalate esters and Hazardous Substances List (HSL) compounds. The blank for the samples also had less than 10% recovery of 2,4,6-tribromophenol. The blank for the MS and MSD was within the CLP surrogate recovery limits. Neither blank contained phthalate esters or HSL compounds above the specified limits.

The surrogate compound recovery summary for the second semivolatile organics analysis is shown in Table 5.3. Recovery of nitrobenzene-d5 was low with the recoveries for samples A-154, A-156, B-164, D-174, E-177, and the background sample being below the recovery limit. For 2-fluorobiphenyl, the recovery for sample A-150 was above the limit and the background sample was below the limit. For terphenyl-d14, the recovery for sample A-150 was below the limit, and for sample A-156, the recovery was above the limit. For phenol-d5, only the background sample was below the recovery limit. For 2-fluorophenol, the surrogate recovery was below the limit for all the samples except C-171. For 2,4,6-tribromophenol, all the samples were within the surrogate recovery limits, except C-171 which was above the limit. The MS, MSD, and blanks were not reanalyzed.

TABLE 5.3 QUALITY ASSURANCE RESULTS FOR SECOND SEMIVOLATILE ORGANICS ANALYSIS

SOIL SURROGATE PERCENT RECOVERY SUMMARY

Sample Identity	Silt	>PM-10	PM-10	Silt	Silt	>PM10	PM-10	Silt	Silt	Silt	Sample	MS/MSD	Matrix	Matrix	Spike
	A-150	A-156	A-154	D-174	B-164	B-167	B-166	E-177	C-171	B6D-190	Blank	Blank	Spike	Duplicate	
Surrogate Compounds															
Nitrobenzene-d5	23%	10%	17%	19%	24%	28%	0%	17%	37%	0%	N.A.	N.A.	N.A.	N.A.	
2-Fluorobiphenyl	125%	78%	81%	46%	94%	78%	64%	56%	73%	0%	N.A.	N.A.	N.A.	N.A.	
Terphenyl-d14	0%	204%	52%	64%	72%	75%	59%	81%	72%	66%	N.A.	N.A.	N.A.	N.A.	
Phenol-d5	35%	23%	32%	33%	35%	54%	34%	40%	63%	1%	N.A.	N.A.	N.A.	N.A.	
2-Fluorophenol	7%	3%	8%	16%	0%	24%	0%	19%	32%	0%	N.A.	N.A.	N.A.	N.A.	
2,4,6-Tribromophenol	77%	95%	101%	54%	63%	93%	47%	68%	163%	61%	N.A.	N.A.	N.A.	N.A.	

N.A. = not analyzed