WORK PLAN
LANDFARMING PILOT TREATMENT SYSTEM
WATERVLIET ARSENAL
Siberia Area, NE Quadrant
Watervliet, New York

Baltimore Corps of Engineers
Baltimore, Maryland

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US Army Corps
of Engineers
Baltimore District
DRIVEN BY A VISION...to be the BEST

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1.0 BACKGROUND AND PURPOSE OF DOCUMENT

1.1 INTRODUCTION

This Work Plan has been developed to outline field and laboratory activities involved in the implementation of soil pilot-scale landfarming in the Siberia Area of the Watervliet Arsenal (WVA). The pilot test will encompass two adjacent test plots, one treating approximately 3,200 cubic yards of soil, and the other approximately 200 cubic yards of soil. Each test plot will undergo periods of active treatment (landfarming) alternated with periods of monitored natural attenuation (MNA). This Work Plan outlines the construction of the test plots and describes operation and maintenance procedures to be followed during the active landfarming treatment phases and the monitored natural attenuation phases. This Work Plan includes a Field Sampling Plan (FSP) detailing the procedures to be followed for treatment verification sampling and a Quality Assurance Project Plan (QAPP) to ensure that data obtained during the Pilot Study is of acceptable quality for use in future design of corrective measures. In addition, a Site Specific Health and Safety Plan (HASP) is included as Appendix A to the Work Plan.

1.2 SITE DESCRIPTION

The WVA is a 140-acre government-owned installation under the command of the U.S. Army Industrial Operations Command (USAIOC). The WVA is located in the City of Watervliet, New York, west of the Hudson River and five miles north of the City of Albany (see Figure 1-1). The WVA consists of two contiguous areas: the Main Manufacturing Area (MMA) is a 125-acre tract used for manufacturing and administrative operations; the second area, a 15-acre tract known as the Siberia Area, is located to the west of the MMA (see Figure 1-2). Immediately after its purchase in the early 1940s, the swampy Siberia Area was filled in with debris consisting of slag, cinders, wood, brick and other debris of unknown origin. Once filled in, two areas were used for burning combustible material (i.e., scrap lumber and other sanitary waste) until

1967. Currently, the Siberia Area is used as a shipping yard and for the interim storage of raw materials, hazardous materials, finished goods, and supplies brought in from the MMA.

To assist in the descriptions of locations within the Siberia Area, the Area has been divided into four quadrants: southwest (SW), southeast (SE), northeast (NE) and northwest (NW) (see Figure 1-3). The Main Substation and Building 145 are located in the SW Quadrant; a lumber yard is located in the SE Quadrant; former burn pit and Buildings 148 and 151 are located in the NE Quadrant; and the Chip Handling Facility is located in the NW Quadrant. The pilot study test plots will be located in the NE Quadrant.

1.3 PREVIOUS SITE INVESTIGATIONS

Malcolm Pirnie, Inc. (Malcolm Pirnie) conducted a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at the Siberia Area of the WVA. The RFI was performed during the period of December 1994 to November 1995 under contract to the U.S. Army Corps of Engineers (USACE), Baltimore District. The RFI was performed in accordance with an Administrative Order of Consent between WVA, the New York State Department of Environmental Conservation (NYSDEC), and the United States Environmental Protection Agency (USEPA). The results of the RFI have been presented in the Final RCRA Facility Investigation Report, Siberia Area, Watervliet Arsenal, Watervliet, New York dated December 1997 (Final RFI Report).

Chlorinated organic compounds, petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs) and metals were detected in groundwater and/or in soil at the Siberia Area. A Corrective Measures Study has been initiated by Malcolm Pirnie on behalf of the USACE, Baltimore District to evaluate, develop, and recommend Corrective Measures Alternatives for the impacted areas of the Siberia Area. Additional investigations have been completed to define the limits of soil/sediment contamination and the extent of groundwater contamination as part of the CMS. These data are included in the CMS Field Data Report, Siberia Area, Watervliet Arsenal, Watervliet, New York dated October 1998.

1.4 BIOLOGICAL TREATABILITY STUDIES

The site investigations described above revealed that total petroleum hydrocarbon (TPH) and PAH contamination of surface and sub-surface soils at the Siberia Area is widespread. Bioremediation is a preferred remediation alternative for soils contaminated with TPH/PAH because the associated costs are generally much lower than for other alternatives, particularly when excavation may be required for these alternatives. A series of biological treatability studies were conducted to evaluate specified parameters and demonstrate the viability of bioremediation for treatment of contaminated soils at the Siberia Area. These studies included radiotracer phenanthrene tests, microbial isolation experiments, bioslurry evaluations, column evaluations, and pan evaluations. The results of these studies are summarized in the Draft Biological Treatability Studies of Siberia Area, Watervliet Arsenal, Watervliet, New York, dated April 2000. The treatability studies confirmed the existence of indigenous microorganisms capable of degrading TPH and PAH under aerobic conditions.

1.5 PILOT STUDY GOALS

The pilot-scale test will be implemented utilizing information garnered from the execution of the bench-scale laboratory bioremediation tests. The goals of the pilot study are as follows:

- # Reduce initial concentration of total PAHs by 75 percent.
- # Reduce initial concentration of TPH by 75 percent.
- # Demonstrate the full-scale viability of landfarming of PAHs and TPHs and refine full-scale operating parameters and costs associated with this technology.
- # Define environmentally acceptable endpoints for the Siberia Area.

2.0 PILOT STUDY DESIGN

2.1 LANDFARMING

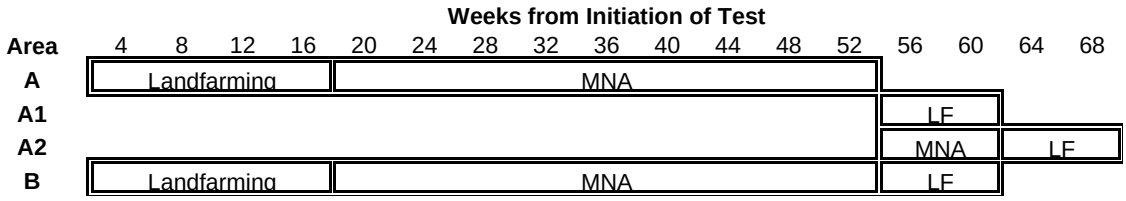
Landfarming as a remediation technology is the controlled application and cultivation of contaminant-impacted soil at a properly engineered site in order to use microorganisms naturally present in the soil to decompose the organic fraction of waste. This process may consist of the disposal and incorporation of other impacted materials or soils from hot spots on the site. The objective of the landfarm system is to enhance the biological, physical, and chemical interactions occurring to allow for maximum degradation, transformation, and/or immobilization of contaminants. Successful treatment can be achieved only if the micro-environmental conditions are optimized. Overall, when properly designed and operated, landfarms have proven to be highly successful. The characteristics of being environmentally sound, simple and low cost ($12 to $15/ton) make landfarming a viable consideration for the remediation of soils impacted by organic contaminants.

2.2 TEST PLOT DESCRIPTION

The pilot study will consist of two adjacent test plots: Plot A and Plot B (see Figure 2-1). Plot A, approximately 72 feet by 220 feet in area, will encompass approximately 3,200 cubic yards of soil, including 1,600 cubic yards excavated from a former burn-pit adjacent to the pilot study plot area. The excavated burn-pit soil will be spread in a layer approximately 3 feet deep, and will then be combined with an additional 1,600 cubic yards of soil by mixing it with the 3 feet of soil directly below-grade of the excavated soil layer. This will result in a combination in-situ and ex-situ land-treatment cell. Fifty-two weeks from the initiation of the test, Area A will be divided into two sub-cells of equal area, A1 and A2, which will be further evaluated under difference conditions (see below). Plot B will consist of a 30 feet by 60 feet area with an in-situ depth of 3 feet.

The pilot study will include two active treatment periods. The first treatment period will involve 16 weeks of active treatment and the second treatment period will involve 8 weeks of active treatment. The two landfarming periods will be separated by 36 weeks of monitored natural attenuation (MNA) for A1 and Area B. For Area A2, the two landfarming periods will be separated by 44 weeks of MNA. This timeline is illustrated below.

Landfarming Time Line



MNA = monitored natural attenuation
LF = landfarming

2.3 BURN-PIT EXCAVATION AND TEST PLOT CONSTRUCTION

As discussed above, Test Plot A will be partially composed of soil excavated from a former burn-pit. This serves the dual purpose of executing an Interim Corrective Measure (ICM) for the burn-pit soils, which have been identified as a source of groundwater contamination, and providing soil for the pilot study. A separate Work Plan has been developed for the excavation of the former burn-pit and the subsequent placement of the excavated soils onto Test Plot A. This Work Plan is entitled 'Watervliet Arsenal Former Burn Pit Interim Corrective Measures Investigation Summary Report/Removal Work Plan', and was prepared in April 2000 as a preliminary draft. The following sequence of construction events will be followed to excavate the former burn-pit and construct the pilot test plots:

- # Prepare Test Plots A and B by removing the existing gravel base materials and stabilization fabric to a depth of approximately 1.0 foot over an area of 75 feet wide by 240 feet long.
- # Excavate a rectangular dewatering infiltration trench to the dimensions of 15 feet wide by 70 feet long.

- # Construct a perimeter drainage swale/berm around the entire staging area (Plots A and B) for controlling 'run-on and 'run-off' during pilot study treatment. All liquid collected in the swale will flow by gravity to the dewatering infiltration trench.
- # Install an eight-feet high chain link fence around the dewatering trench.
- # Excavate the contaminated former burn-pit soils and stage them at Plot A to a total depth of three feet, screening for removal of large debris, and dewatering if necessary.

The first active landfarming phase of the pilot study will commence after preparation of the pilot study plots and emplacement of the excavated soils from the former burn-pit. This phase is scheduled to take place over a period of 16 weeks. The following sub-sections provide a description of the tasks that will be followed to operate and maintain the pilot plots during active landfarming.

2.3.1 Mixing Procedures

It is important to achieve good mixing of the landfarming plots to ensure successful treatment. Mixing of the soils breaks up clods and soil aggregates that have formed. This improves the accessibility of the microbes to interact with the waste while also increasing aeration. The soils at Test Plots A and B will be mixed using a proprietary soils blending unit called the Enviro-Mix 2000. The unit is track-mounted and is designed to aerate and homogenize soil to unsaturated depths of eight feet. Test plot soils will be completely mixed every two weeks during the active land-farming phases of the study. It is anticipated that it will take three days to fully mix the soils during the first active treatment phase, and two days for the subsequent active treatment phase.

2.3.2 Application of Bulking Materials

Bulking materials help maintain the aerobic conditions of the landfarm by increasing the porosity of the test plot soils which in turn allows increased air flow throughout the test plots. They also improve the drainage characteristics and workability of the soils. Bulking agents typically include materials such as wood chips, rice hulls, straw, and corn stalks. Wood chips will be used for the pilot study, as they are readily

available from a source nearby the WVA. Since the soils at Watervliet contain some gravel and slate, it was estimated that approximately 500 cubic yards of wood chips (or 15 percent of the pilot test soil volume) will be added to the test plots during the initial mixing event. If it is determined that this is not sufficient, additional wood chips will be added during later mixing events. The wood chips will be mixed into the test plot soils using the Enviro-Mix 2000 unit described above. The addition of 500 cubic yards of the bulking material will increase the effective depth of the test plots by approximately 3/4 foot.

2.3.3 Soil Moisture/Nutrient/pH Control

The landfarm operation goal is to manage the parameters that optimize conditions for microbial activity. Typically, these include controlling soil moisture content, nutrient levels, and pH levels. Optimal soil moisture content for landfarming is between 50 and 75 percent of field moisture capacity. Field moisture capacity will be determined by the analytical laboratory at the start of the pilot test. The nutrients of most importance to sustain the microorganisms are carbon (C), nitrogen (N), and phosphorus (P). The recommended C:N:P ratio is 100:10:1. The desired pH range is from 6.5 to 8.0.

Four days prior to each mixing event, soil samples will be collected and analyzed for soil moisture content, nutrient concentrations, and pH. If it is determined that moisture content is too low, a pipe attachment will be fitted to the Enviro-Mix 2000 unit to deliver water during mixing. Based upon pan study results, it is anticipated that nutrients will be added during no more than two of the mixing events to maintain healthy nitrogen and phosphorus levels in the soil. Nutrients, if needed, will be provided through the addition of a commercial-grade fertilizer. Based upon pan study results, it is anticipated that pH will remain in the desired range.

2.3.4 Dust Suppression/Odor Control

There are several options for dust suppression. A sprinkler system may be installed and operated either manually or through an automated timer. The sprinklers would be mounted on poles and installed along the sides of the plot to avoid interference with the mixing rig. Another option would be to use a black tarpaulin cover which would

be rolled back during mixing and sampling events. Potential benefits of using a black tarpaulin cover include an added measure of moisture and heat retention, which would further stimulate biodegradation. However, this option would be difficult to implement at full-scale.

There is a potential for odors from volatile organic carbons in the burn-pit soils on Test Plot A. If the dust suppression measures are not sufficient to control odors, a proprietary odor mitigation agent called BioSolve will be applied to the test plot. BioSolve is a water-based biodegradable surfactant that solubilizes and emulsifies hydrocarbons. It will be stored at the site in a viscous form, and will be diluted with water prior to application either via sprinklers or via a garden hose.

2.3.5 Treatment Verification Sampling

Soils samples will be collected from Plots A and B every four weeks following a mixing event to evaluate the progress of the pilot study treatment process. Concentrations of TPH, total PAH, and individual PAH compounds will be evaluated for treatment verification. The schedule and procedures for sample collection and analysis are detailed in the FSP and QAPP portions of this Work Plan.

2.4 MONITORED NATURAL ATTENUATION

The term 'monitored natural attenuation' (MNA) refers to the reliance on natural attenuation processes to achieve site-specific remediation objectives within a time frame that is reasonable compared to that offered by other more active methods. The 'natural attenuation processes' that are at work typically include biodegradation, dispersion, sorption, volatilization, and chemical or biological stabilization, transformation, or destruction of contaminants.

Following 16 weeks of active landfarming, MNA will be implemented at Plots A and B for a period of 36 weeks. The test plots will be monitored for PAH, TPH, toxicity, and bioavailability reduction under passive conditions. The schedule and procedures for sample collection and analysis are in the FSP and QAPP portions of this Work Plan.

3.0 FIELD SAMPLING PLAN

3.1 INTRODUCTION AND SAMPLING RATIONALE

Soil samples will be collected from the pilot-study landfarming plots in order to ensure that optimal moisture content, and nutrient levels are maintained. Soil samples will also be collected to verify that soil treatment objectives are being met. This FSP has been prepared to describe the specific Laboratory Standard Operating Procedures (SOPs) that will be followed during these field activities (see Appendix B).

The purposes of specific analyses are identified in Table 3-1.

Table 3-1: Purpose/Rationale for Analytical Data Collection

Analytical Parameters	**Purpose for Collecting Data**
Total Petroleum Hydrocarbons (TPH) Polycyclic Aromatic Hydrocarbons (PAHs)	Treatment Performance Monitoring
Toxicity Characteristic Leaching Procedure (TCLP) TPH TCLP PAH	Treatment Performance Monitoring of Leachable Component
Volatile Organic Compounds	Incidental/Non-targeted Degradation
Moisture Content pH Total Organic Carbon	Microorganism growth conditions monitoring
Ammonia Nitrate Nitrite Ortho Phosphate	Essential nutrient monitoring
Biomass	Microorganism growth

3.2 SOIL SAMPLING LOCATIONS

3.2.1 Test Plot A Sample Locations

Due to the historically high heterogeneity of hydrophobic organic compounds such as PAHs, seven composite samples from Test Plot A will be collected for use in all analyses except VOCs. Seven discrete grab samples of soil will also be collected for VOC analysis. This should allow characterization of the test plot as a whole with sufficiently low standard deviation to make a statistically significant comparison between time intervals. The seven sample locations will be selected randomly from a sample grid of the site. This grid will be established by dividing Test Plot A into 20 to 30 sections of equal area. The grid shall be labeled alphabetically along one axis and numerically along the other. Each area of the grid will be assigned an alphanumeric designation based on the column and row designations. Seven grid squares from Test Plot A will be selected randomly for sampling during each sample period. Figure 3-1 illustrates a simulated sampling matrix for one sample interval.

Figure 3-1: Simulated Sample Matrix

A	B	C	D	E	
			X X X X X		1
	X X X X X		X X X X X	X X X X X	2
X X X X X					3
X X X X X			X X X X X		4

X indicates grab sample location.

A single composite sample will be collected from each of the seven grid squares selected for analysis for all analyses except VOCs. Each composite sample will be made up of a minimum of five (5) soil cores, which span the depth of the test soil (approximately 6-7 feet in depth). The number of cores collected must be sufficient to fill the appropriate sample container defined in Table 4-2. Sample locations shall be recorded in the field logbook.

3.2.2 Test Plot B Sample Locations

In a similar fashion describe in Section 3.2.2, three composite samples will be collected from Test Plot B for all analyses except VOCs, and three discrete grab samples will be collected for VOC analysis. Sample locations shall be recorded in the field logbook.

3.3 SAMPLING FREQUENCY

Sampling will be performed at approximately 4-week intervals during the active treatment phases. Certain analyses will be performed prior to the scheduled mixing event and other analyses will be performed following the mixing event. Nutrients and growth conditions parameters will be monitored before and after the mixing event to insure the appropriate conditions are present in the cell.

The sampling frequency of each analytical parameter and the complete sampling and analysis program is summarized on Table 3-2 on the following page.

Table 3-2: Sampling Program

						Analyses														
Test Plot	Sample Type [1]	Work Phase	Approx.# of Weeks from Start of Sampling Events	# of Events	Samples/ Event	VOCs	SVOCs	TPH	SPLP SVOCs	SPLP TPH	TOC	Biomass (PLFA)	Ammonia	Nitrate	Nitrite	Ortho-P	% Moisture	pH	Before or After Mixing	Total # of Samples
A	environmental	Active	0, 16	2	7	X	X	X	X	X	X	X	X	X	X	X	X	X	after	14
B	environmental	Active	0, 16, 52, 60	4	3		X	X	X	X	X	X	X	X	X	X	X	X	after	12
A1	environmental	Active	52, 60	2	3	X	X	X	X	X	X	X	X	X	X	X	X	X	after	6
A2	environmental	Passive	52	1	3		X	X	X	X	X	X	X	X	X	X	X	X	N/A	3
A2	environmental	Active	60, 68	2	3	X	X	X	X	X	X	X	X	X	X	X	X	X	after	6
	rinse blank		0, 16, 52, 60, 68	5	1	X	X	X											after	5
	blind dupl.		0, 16, 52, 60, 68	5	1	X	X	X	X	X									after	5
	matrix spike		0, 16, 52, 60, 68	5	1	X	X	X	X	X									after	5
	matrix spike dupl.		0, 16, 52, 60, 68	5	1	X	X	X	X	X									after	5
A	environmental	Active	4, 12	2	7		X	X					X	X	X	X	X	X	after	14
B	environmental	Active	4, 12, 56	3	3		X	X					X	X	X	X	X	X	after	9
A1	environmental	Active	56	1	3		X	X					X	X	X	X	X	X	after	3
A2	environmental	Active	64	1	3		X	X					X	X	X	X	X	X	after	3
	rinse blank		4, 12, 56, 64	4	1		X	X											after	4
	blind dupl.		4, 12, 56, 64	4	1		X	X											after	4
	matrix spike		4, 12, 56, 64	4	1		X	X											after	4
	matrix spike dupl.		4, 12, 56, 64	4	1		X	X											after	4
A	environmental	Active	8	1	7		X	X			X		X	X	X	X	X	X	after	7
B	environmental	Active	8	1	3		X	X			X		X	X	X	X	X	X	after	3
	rinse blank		8	1	1		X	X											after	1
	blind dupl.		8	1	1		X	X											after	1
	matrix spike		8	1	1		X	X											after	1
	matrix spike dupl.		8	1	1		X	X											after	1
A	environmental	Active	3, 7, 11, 15	4	7								X	X	X	X	X		before	28
A	environmental	Passive	51	1	7								X	X	X	X	X		N/A	7
B	environmental	Active	3, 7, 11, 15, 55, 59	6	3								X	X	X	X	X		before	18
B	environmental	Passive	51	1	3								X	X	X	X	X		N/A	3
A1	environmental	Active	55, 59	2	3								X	X	X	X	X		before	6
A2	environmental	Passive	59	1	3								X	X	X	X	X		N/A	3
A2	environmental	Active	63, 67	2	3								X	X	X	X	X		before	6
A	environmental	Passive	22, 48	2	7		X	X											N/A	14
B	environmental	Passive	22, 48	2	3		X	X											N/A	6
	rinse blank		22, 48	2	1		X	X											N/A	2
	blind dupl.		22, 48	2	1		X	X											N/A	2
	matrix spike		22, 48	2	1		X	X											N/A	2
	matrix spike dupl.		22, 48	2	1		X	X											N/A	2
A	environmental	Passive	40	1	7		X	X	X	X	X	X	X	X	X	X	X	X	N/A	7
B	environmental	Passive	40	1	3		X	X	X	X	X	X	X	X	X	X	X	X	N/A	3
	rinse blank		40	1	1		X	X											N/A	1
	blind dupl.		40	1	1		X	X	X	X									N/A	1
	matrix spike		40	1	1		X	X	X	X									N/A	1
	matrix spike dupl.		40	1	1		X	X	X	X									N/A	1

Notes:
(1) All samples (except rinse blanks and VOC samples) are composite samples made up of grab samples from 5 locations.

3.4 SAMPLING METHODOLOGY

3.4.1 Sampling Equipment

The following equipment will be used to collect soil samples:

- 10.2 eV Photoionization Detector (PID)
- JMC Environmentalist Sub-soil Probe (JMC)
- Stainless steel spatula or spoon
- Stainless steel bowl
- Polyethylene sheeting
- Ziplock™ bags
- Latex gloves (disposable)
- Neoprene gloves
- Certified, precleaned sample containers
- Aluminum foil
- Field logbook and pen
- Decontamination equipment.

3.4.2 Soil Sampling Procedures

Composite samples from the pilot soil areas will be collected using the following procedure. Composite samples will be made up of at least five grab samples. Composite samples will be collected using the JMC, a hand-operated soil-coring device. The JMC consists of two main parts, the drive assembly, which houses the sampling tube, and the retrieval device. Subsurface soil samples are collected by driving the sampling tube into the ground with a slam-bar. Upon reaching the target depth, the sampling tube is removed from the ground using the retrieval device. The soil core is then removed from the sampling tube and placed on a clean piece of polyethylene sheeting for soil characterization and sampling. The JMC will be decontaminated between composite sampling locations following procedures described in Section 4.0.

The JMC core(s) from each grab sampling location will be placed in a decontaminated stainless steel bowl. Once the soils from all cores for a composite sample are in the bowl, the soil will be homogenized and then transferred to a laboratory supplied, precleaned sample container for off-site analysis by the analytical laboratory.

3.4.2.1 Sample Homogenization

Core samples collected for off-site laboratory analysis for all parameters except VOCs will be homogenized prior to being placed in the sample containers in order to ensure representative samples. Samples will be homogenized by first removing rocks, twigs, leaves, and other debris (if they are not considered part of the sample), then removing soil from the sampling device, placing it in a decontaminated stainless steel bowl and thoroughly mixing it with a stainless steel spoon. After mixing, a portion of the sample will be placed in appropriate sample containers and the containers will be closed securely. The sample containers will then be labeled, a chain-of-custody form will be completed, and the samples will be stored at $4^{\circ}C$ for transport to the laboratory.

Any soil remaining in the homogenization bowl after collecting the sample for analytical purposes will be spread on the surface of the sampled grid square.

3.4.2.2 Photoionization Detector (PID) Field Screening and VOCs Sampling

Grab soil samples will be removed from the center of each JMC core using a stainless steel spatula or spoon and placed in the appropriate VOC sample containers. A portion of the soil samples obtained from each core will be placed in Ziplock™ bags and screened with a Photoionization Detector (PID) for volatile organic headspace. One sample from each boring will be selected for off-site laboratory analysis based on results from the volatile organic headspace screening. Samples submitted for laboratory analysis will be selected from the sample interval indicating the highest PID reading. If no elevated PID readings are detected, samples for laboratory analysis will be submitted from the locations with the highest petroleum odor or visible staining.

3.4.2.3 Sampling Equipment Decontamination

Sampling equipment shall be decontaminated in accordance with the procedures specified in Section 4.2.1.

4.0 QUALITY ASSURANCE PROJECT PLAN (QAPP)

4.1 DATA QUALITY OBJECTIVES (DQOs)

Data produced from this study should be of sufficient quality and quantity to estimate the rate and extent of contaminants of concern (COCs) removal from the soil through landfarming. COCs for this test are total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAHs). Specifically the data should adequately describe 16 weeks of landfarming followed by 36 weeks of monitored natural attenuation (MNA) and an additional 8 weeks of landfarming. The data should definitively measure the capability of this treatment protocol to achieve soil concentrations of COCs less than or equal to the proposed action levels (NYSDEC TAGM 4046 values) listed in Table 4-1 with 95 percent confidence except for the following compounds: benzo(a)anthracene, benzo(a)pyrene, and dibenz(a,h)anthracene. The mean soil concentration of these three compounds will be compared with the proposed action levels. Estimated values will be used to determine the mean for these compounds if necessary; however, estimated values below the MDLs may not be used. Further, if these treatment goals are not achieved, this test should measure the level of treatment landfarming technology can be expected to achieve at the Site and may result in the establishment of site-specific treatment goals.

Although the intention of this treatment is not to remove chlorinated solvents, the change in chlorinated solvent concentrations will be monitored in Plot A due to the addition of soil with these compounds (from the former burn-pit) to Plot A. Definitive results measuring the levels of VOCs listed in Table 4-1 are necessary to determine of further treatment or action is necessary for this soil after completion of the test.

In addition, as a qualitative measure of treatment effectiveness, the leachability of COCs from the test soil will also be measured to determine if contamination of the groundwater remains a potential pathway of exposure to the COCs. These tests will evaluate the leachability of COCs prior to treatment (after initial mixing of the soils), after the first phase of landfarming, at the midpoint and completion of the MNA phase, and after the second landfarming phase. While there are not standards specifically

targeted at leachability of these COCs from the soil, a comparison will be made to the groundwater standards listed in Table 4-2. No groundwater standards have been set for the TPH in the groundwater; however, the leachability of this COC will be measured to determine the potential of TPH to impact groundwater quality.

Data collected during the course of this study will also provide sufficient information for the operation of the landfarming test. While this information needs to be quantitative in nature, the precision, accuracy, and sensitivity required for these measurements are low, and field tests can be used if convenient. This information will include analysis of soil moisture content and nutrient levels to estimate necessary additions of water and nutrients during mixing of the soil.

Biomass in the soil samples will also be assessed to determine the general health, concentration, and type of the microbial populations. Data obtained during this study will provide the basis for estimating full-scale landfarming operating parameters.

Table 4-1: Method Detection and Quantitation Limits and Proposed Action Levels for Soils

	Method Detection Limit (ug/kg-wet weight)	Method Quantitation Limit (ug/kg-wet weight)	NYSDEC TAGM 4046[a] (ug/kg)
VOCs via 8260B			
Benzene	5	50	480
2-Butanone	5	50	2,400
Carbon disulfide	5	50	10,000[b]
Chlorobenzene	5	50	10,000[b]
Chloroform	5	50	2,400
1,2-Dichlorobenzene	5	50	10,000[b]
1,1-Dichloroethene	5	50	3,200
cis-1,2-Dichloroethene	5	50	10,000[b]
trans-1,2-Dichloroethene	5	50	2,400
Trichloroethene	5	50	5,600
Tetrachloroethene	5	50	10,000[b]
Methylene chloride	5	50	800
Ethylbenzene	5	50	10,000[b]
Toluene	5	50	10,000[b]
Vinyl chloride	5	50	1,600
Xylene (total)	5	50	9,600
Total VOCs			10,000[b]
SVOCs via 8270C (PAHs)			
Acenaphthene	10	100	50,000[c]
Acenaphthylene	10	100	50,000[c]
Anthracene	10	100	50,000[c]
Benzo[a]anthracene	10	100	224[e]
Benzo[b]flouranthene	10	100	8,800
Benzo[k]flouranthene	10	100	8,800
Benzo[a]pyrene	10	100	61[e]
Benzo[g,h,i]perylene	10	100	50,000[c]
Chrysene	10	100	3,200
Dibenzo[a,h]anthracene	10	100	14[e]
Fluoranthene	10	100	50,000[c]
Fluorene	10	100	50,000[c]
Indeno[1,2,3-c,d]pyrene	10	100	25,600
Naphthalene	10	100	50,000[c]
Phenanthrene	10	100	50,000[c]
Pyrene	10	100	50,000[c]
Total SVOCs			500,0000[d]
NJDEP QAM-025			
TPH	50,000	500,000	*

[a] TAGM 4046 values based on 8% TOC in backfill material.

[b] As per TAGM 4046 total VOCs $\leq$ 10 mg/kg.

[c] As per TAGM 4046 individual SVOCs $\leq$ 50 mg/kg.

[d] As per TAGM 4046 total SVOCs $\leq$ 500 mg/kg.

[e] USEPA Health Based concentration. There is no correction for TOC.

* No applicable TAGM 4046 value available.

Table 4-2: Method Detection and Quantitation Limits for Leachate

	Method Detection Limit (ug/kg-wet weight)	Method Quantitation Limit (ug/kg-wet weight)	** NYSDEC TAGM 4046[a] (ug/L)
VOCs via 8260B			
Benzene	0.5	5	0.7
2-Butanone	0.5	5	50
Carbon disulfide	0.5	5	50
Chlorobenzene	0.5	5	5
Chloroform	0.5	5	7
1,2-Dichlorobenzene	0.5	5	4.7
1,1-Dichloroethene	0.5	5	5
cis-1,2-Dichloroethene	0.5	5	*
trans-1,2-Dichloroethene	0.5	5	5
Trichloroethene	0.5	5	5
Tetrachloroethene	0.5	5	5
Methylene chloride	0.5	5	5
Ethylbenzene	0.5	5	5
Toluene	0.5	5	5
Vinyl chloride	0.5	5	2
Xylene (total)	0.5	5	5
SVOCs via 8270C (PAHs)			
Acenaphthene	2	20	20
Acenaphthylene	2	20	20
Anthracene	2	20	50
Benzo[a]anthracene	2	20	2
Benzo[b]flouranthene	2	20	2
Benzo[k]flouranthene	2	20	2
Benzo[a]pyrene	2	20	2
Benzo[g,h,i]perylene	2	20	5
Chrysene	2	20	2
Dibenzo[a,h]anthracene	2	20	50
Fluoranthene	2	20	50
Fluorene	2	20	50
Indeno[1,2,3-c,d]pyrene	2	20	2
Naphthalene	2	20	10
Phenanthrene	2	20	50
Pyrene	2	20	50
NJDEP QAM-025			
TPH	1,000	10,000	*

* No applicable TAGM 4046 value available.

** Groundwater standards/criteria taken from NYSDEC TAGM 4046.

4.2 QUALITY ASSURANCE OBJECTIVES FOR CHEMICAL DATA MEASUREMENT

Several measures will be taken to ensure the precision and accuracy of chemical data generated for COCs (i.e., SVOCs and TPH) and VOCs. At a minimum, the laboratory analysis of chemical parameters will meet the standards for precision and accuracy set forth in the corresponding methods of analysis listed in Table 4-6. In addition, initial calibrations, CCVs, MSs, and LCSs will contain the analytes listed in Table 4-1 for Methods 8270C and 8260B and will be monitored according to the criteria set forth in Tables 4-3 through 4-5.

- The MQL will be set at the lowest standard used for the initial calibration curve or higher for each target analyte.
- All target analyte values detected and reported below the MCL must be flagged as an estimated quantity.
- If CCVs for the compounds listed in Table 4-1 exceed 20 percent then the results for these analytes shall be reported as estimated values.

Table 4-3: Method Quality Objectives for Method 8260

QC Element	Target Analyte / Surrogate	Poor Purgers / Gases / Sporadic Marginal Failures[1]
Initial Calibration	Instrument Evaluation: SPCC: minimum RF values per method requirements CCCs: verify %RSD ≤ 30% Primary Evaluation: r ≥ 0.995, %RSD ≤ 15%, r^2 ≥ 0.990 Alternative Evaluation: Mean %RSD for all target analytes ≤ 15%	No allowance Alternative Evaluation: Maximum allowable %RSD for each target analyte ≤ 30%
ICV	% Rec = 80% - 120%	Sporadic Marginal Failures[1]: % Rec = 60% - 140%
CCV	Instrument Evaluation: SPCC: minimum RF values per method requirements CCCs: verify %D ≤ 30% Primary Evaluation (CCCs): %Drift ≤ 20%, %D ≤ 20%	Primary Evaluation (remaining target analytes): Qualitative
MB	Target Analytes: Analytes < MDL Check Sample (~2X MDL)	Common Lab Contaminants: Analytes < MQLs
LCS	Water: %Rec = 80% - 120% Solids: %Rec = 75% - 125%	Sporadic Marginal Failures[1]: % Rec = 60% - 140%
MS	%Rec = 70% - 130%	Sporadic Marginal Failures[1]: % Rec = 60% - 140%
MSD/MD	Water: RPD ≤ 30% Solids: No RPD Limits	Water: RPD ≤ 40% Solids: No RPD Limits
Surrogates	%Interference-Free Matrix: Water: %Rec = 80% - 120% Solids: %Rec = 75% - 125% Sample Matrix: %Rec = 70% - 130%	Not applicable

[1]Two (2) Sporadic Marginal Failure (SMF) allowed.

Table 4-4: Method Quality Objectives for Method 8270

QC Element	Target Analyte / Surrogate	Poor Purgers / Gases / Sporadic Marginal Failures[1]
Initial Calibration	Instrument Evaluation: SPCC: minimum RF values per method requirements CCCs: verify %RSD ≤ 30% Primary Evaluation: r ≥ 0.995, %RSD ≤ 15%, r^2 ≥ 0.990 Alternative Evaluation: Mean %RSD for all target analytes ≤ 15%	No allowance Alternative Evaluation: Maximum allowable %RSD for each target analyte ≤ 40%
ICV	% Rec = 70% - 130%	Sporadic Marginal Failures[1]: % Rec = 50% - 150%
CCV	Instrument Evaluation: SPCC: minimum RF values per method requirements CCCs: verify %D ≤ 30% Primary Evaluation (CCCs): %Drift ≤ 20%, %D ≤ 20%	Primary Evaluation (remaining target analytes): Qualitative
MB	Target Analytes: Analytes < MDL Check Sample (~2X MDL)	Common Lab Contaminants: Analytes < MQLs
LCS	Water: %Rec = 45% - 135% Solids: %Rec = 45% - 135%	Sporadic Marginal Failures[1]: Water: %Rec = 15% - 150% Solids: %Rec = 25% - 150%
MS	Water: %Rec = 45% - 135% Solids: %Rec = 45% - 135%	Sporadic Marginal Failures[1]: Water: %Rec = 15% - 150% Solids: %Rec = 20% - 150%
MSD/MD	Water: RPD ≤ 50% Solids: RPD ≤ 60%	Sporadic Marginal Failures[1]: Water: RPD ≤ 60% Solids: RPD ≤ 60%
Surrogates	%Interference-Free Matrix: Water: %Rec = 80% - 120% B/N cmpds %Rec = 45% - 135 A cmpds Solids: %Rec = 60% - 120% B/N cmpds %Rec = 45% - 135% A cmpds Sample Matrix: Water: %Rec = 45% - 135% B/N cmpds %Rec = 35% - 140 A cmpds Solids: %Rec = 45% - 135% B/N cmpds %Rec = 35% - 140% A cmpds	Sporadic Marginal Failures[1]: Water: %Rec = 15% - 150% Solids: %Rec = 20% - 150%

[1]Two (2) Sporadic Marginal Failure (SMF) allowed.

The analytes listed in Table 4-1 shall be reported for VOCs and SVOCs. Blind duplicates will be submitted to the analytical laboratory to measure and ensure the precision of chemical data. Matrix spikes and matrix spike duplicates will be submitted to the analytical laboratory for to ensure and measure the accuracy of laboratory analytical methods. Rinsate blanks from field equipment will be submitted to the analytical laboratory to ensure sampling accuracy. These additional sample analyses will be performed according to the schedule in Table 3-2.

Multiple replicate and composited samples will be taken from each test plot to improve the representativeness of chemical analysis results used for data analysis. The numbers of replicate samples collected and analyzed from each Test Plot is listed in Section 3.2 of this work plan. In order to ensure comparability of the samples and chemical analysis results, sampling and chemical analysis procedures specified in this work plan will be followed explicitly. Any deviations from this work plan shall be approved in advance.

In order to produce a satisfactory data point for a particular analyte, greater than 66 percent of the replicate samples analyzed for each Test Plot at any given sampling period must meet the precision and accuracy standards set forth in the analytical method used for the analysis. In order to produce a sufficient quantity of useable data to achieve the goals of this project, at least 80 percent of the sample periods must produce a satisfactory data point for a particular analyte. In addition, the final sample period for each Test Plot shall produce 100 percent satisfactory data for SVOCs, TPH, and VOCs.

Sensitivity of the analytical data shall be of a level to make a comparison with the treatment goals for COCs and for VOCs. For this reason, MDLs for each analyte of interest will be at or below the stated NYSDEC TAGM levels. MDLs shall be at or below values listed in Table 4-1 for all non-detect values. To achieve the MDLs specified for PAH compounds by SW-846 8270C, it is anticipated that the analytical laboratory will need to use selective ion monitoring (SIM) mode and concentration of sample extracts to less than 1 mL. If MDLs listed in Table 4-1 cannot be met for non-detect values due to matrix interference, the USACE project manager shall be notified as soon as practicable.

4.3 SAMPLING LOCATIONS AND PROCEDURES

Sampling locations and procedures are described in Sections 3.2 and 3.4, respectively. The appropriate sample container for each sample period is listed in Table 4-5.

Table 4-5: Sample Containers

Analysis	Sample Container
Semivolatiles (TPH) Semivolatiles (PAHs) pH Moisture Content Ammonia Nitrate Nitrite Ortho Phosphate SPLP Semivolatiles (TPH) SPLP Semivolatiles (PAHs) Total Organic Carbon	1 sample collected per replicate for these analyses 1-liter wide-mouth amber glass jars with Teflon lined cap
Volatiles (CHCs)	Approximately 5-g soil in prepreserved and weighed 40-mL VOA vial
Biomass (PLFA)	1-ounce wide-mouth glass jar with Teflon lined cap

Daily weather data will be collected from the Albany Airport weather station. This data will include high and low temperatures and precipitation.

4.4 EQUIPMENT DECONTAMINATION PROCEDURES

To avoid cross-contamination of samples, equipment used in sampling must be clean and free from the residue of previous samples. Non-dedicated sampling equipment must be cleaned initially and prior to being reused. Decontamination will be performed between composite samples, not between grab samples (i.e., no decontamination necessary for grab samples taken from the same grid square). The following procedure for field decontamination does not apply to heavy equipment. Heavy equipment will be

steam cleaned on a decontamination pad prior to use at and removal from the site.

- # Wash and scrub with low phosphate, laboratory grade detergent,
- # Tap water rinse,
- # Isopropanol rinse,
- # Thorough rinse with deionized demonstrated analyte-free water,
- # Air dry, and
- # Wrap in aluminum foil for transport.

4.5 ANALYTICAL METHODS AND SAMPLE HOLDING TIMES

The extraction and analytical procedure method numbers, holding time requirements, and preservation methods are indicated on Table 4-6.

Table 4-6: Analytical Procedure Holding Times and Preservatives

Parameter	Analytical Procedure	Holding Time Sample/Extract	Preservative
Volatiles (CHCs)	SW-846 5035 & 8260B	14 days	sodium bisulfate solution Ice to 4°C
Semivolatiles (TPH)	NJDEP QAM-025	14 days/40 days	Ice to 4°C
Semivolatiles (PAHs)	SW-846 3540C & 8270C	14 days/40 days	Ice to 4°C
SPLP Semivolatiles (TPH)	SW-846 1312 & NJDEP QAM-025	14 days/14 days/40 days	Ice to 4°C
SPLP Semivolatiles (PAHs)	SW-846 1312, 3540C, & 8270C	14 days/14 days/40 days	Ice to 4°C
Total Organic Carbon	EPA 415.1	28 days	Ice to 4°C
Biomass (PLFA)	Microbial Insights	7 days	Ice to 4°C
Ammonia	EPA 350.2	14 days	Ice to 4°C
Nitrate	EPA 352.1	14 days	Ice to 4°C
Nitrite	EPA 354.1	14 days	Ice to 4°C
Ortho Phosphate	EPA 365.2	14 days	Ice to 4°C
Moisture Content	ASTM D2216-98	7 days	Ice to 4°C
pH	SW-846 9045C	48 hours	Ice to 4°C
Temperature	**		
Precipitation	**		

** Daily high and low air temperature and precipitation will be collected from the Albany Airport weather station.

4.5.1 Analytical Procedures

Samples will be analyzed for the parameters listed in Table 4-6 above. Table 4-6 also provides the extraction and analytical method numbers, holding times and preservation methods that will be used. TA Environmental, Inc. will perform the laboratory analyses of soil samples for the following parameters: VOCs, PAHs, TPH, biomass, pH, and soil moisture content. TA Environmental will subcontract the analysis of total organic carbon (TOC), nitrate, nitrite, ammonia, and orthophosphates to Argus

Analytical, Inc. (Argus) in Ridgeland, MS. Microbial Insights will perform the analysis of biomass. The required method MDLs and MQLs for analysis of COCs are included in Table 4-1. Laboratory MDLs are below NYSDEC TAGM 4046 levels for all compounds. For those compounds that do not have MQLs below the PAL, the reporting limit will be 1/2 the listed MQL to allow comparison with the proposed action levels. Reported values below the MQL will be identified as estimated values in all reports. The laboratory will report the list of constituents identified in Table 4-1 and will use the MQLs listed in the table with the exception of the three compounds listed above. Based on these criteria the laboratory will provide data of sufficient quality to meet the project objectives. The following should be noted regarding Table 4-1:

- The values are quantitation limits, not absolute detection limits. The amount of material necessary to produce a detector response that can be identified and reliably quantified is greater than that needed to simply be detected above background noise.
- The quantitation limits in Table 4-1 are set at the concentrations in the sample equivalent to the concentration of the lowest calibration standard analyzed for each analyte.
- The specified quantitation limits are highly matrix dependent. The quantitation limits are provided for guidance and may not always be achievable.
- Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, as required by the protocol, will be higher.

The laboratory addresses are as follows:

TA Environmental, Inc.
3510 Manor Dr.
Vicksburg, MS 39180-5693
(601) 636-4445 (phone)
(601) 636-4495 (fax)

Argus Analytical, Inc.
235 Highpoint Drive
Ridgeland, MS 39157
(601) 957-2676 (phone)
(601) 957-1887 (fax)

Microbial Insights, Inc.
2340 Stock Creek Blvd.
Rockford, TN 37853-3044
423 573-8188 (phone)
423 573-8133 (fax)

At a minimum, the laboratories will follow internal Quality Control procedures presented in the appropriate EPA and NJDEP methods listed in Table 4-6.

4.5.2 QA/QC Samples

Field duplicate, rinse blank, and MS/MSD samples will be collected for analysis at a frequency of approximately 10 percent in the manner discussed in Section 3. QA/QC samples to be collected are indicated in Table 3-2. Soils used for QA/QC of VOCs analysis will be collected from a section of soil core immediately adjacent to that sent for analysis to TA Environmental. All other QA/QC (i.e., MS/MSDs) samples will come from the aliquot of homogenized soil discussed in Section 3.

4.6 SAMPLE MANAGEMENT AND CUSTODY PROCEDURES

Sample custody during the field investigations will be performed in three phases. The first phase encompasses sample collection, pre-laboratory treatment procedures (preservation), packaging, and shipping field custody procedures. The second custody phase involves sample shipment, where mode of shipment, airbill numbers, dates and times are documented. The third phase involves the custody procedures employed by the laboratory.

All three phases of sample custody will be performed to provide that:

- All samples are uniquely identified;
- The correct samples are tested and are traceable to their source;
- Important sample characteristics are preserved;
- Samples are protected from loss or damage; and
- A record of sample integrity is established and maintained through the entire custody process.

4.6.1 Field Documentation

A bound field logbook will be maintained in which to record daily activities. All entries will be made in indelible ink. The field notebook pages shall be prenumbered. Incorrect entries will be corrected by a single stroke through the error and will be verified with the recorder's initials. Entries to the logbook, in addition to the required sampling entries, will include:

- Date;
- Start and finish times;
- Summary of work performed (including samples collected);
- Names of personnel present;
- Names of visitors;
- Weather;
- Level of personal protection used during various activities;
- Calibration of equipment; and
- Observations and remarks.

The following information will be recorded in a field notebook at the time of sampling:

- Sample designation;
- Name of sampler;
- Method of collection;
- Time and date of sampling;
- Type of sample;
- Depth of sample;
- Analyses required and sample container types;
- Field measurements and calibration (if applicable);
- Stratigraphy and/or observed conditions which may impact the chemistry of the sample; and

Observations and remarks.

4.6.2 Sample Identification

All samples collected from the site must be identified with a sample label in addition to an entry on a chain-of-custody record. Indelible ink will be used to complete sample labels, then labels will be covered with clear plastic waterproof tape.

4.6.2.1 Sample Labels

Sample labels will require the field team to complete the following information for each sample bottle:

1. Site Name
2. Sample Number
3. Sample Matrix
4. Parameters to be Analyzed
5. Date of Collection
6. Time of Collection
7. Preservation Technique Employed
8. Sampler's Name

Sample labels will be attached to the sample bottles.

4.6.2.2 Sample Numbering

Each sample shall be identified by a unique sample number. The sample number scheme to be used will identify which plot the sample is collected from, the grid location, and the date. The sample ID will be assembled as follows:

Plot # - Grid Location – mmddyy

For example, sample ID A-D2-072000 would indicate a sample collected on July 20, 2000 from Plot A, grid location D2. Corresponding QA/QC samples would be labeled as follows:

A-D2-072000-MS (Matrix Spike)

A-D2-072000-MSD (Matrix Spike Duplicate)

RB-072000 (Rinse Blank)

Duplicate samples will be "blind" to the laboratory and will be indicated with a Grid Location that was not sampled.

4.6.2.3 Chain-of-Custody Record

The chain-of-custody creates an accurate written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis. Chain-of-custody forms will be completed for each sample at the time of collection and will be maintained while shipping the sample to the laboratory. A person is in custody of a sample if the sample is:

- in that person's physical possession;
- in view after being in that person's physical possession;
- placed in a locked repository by that person; or
- placed in a secure, restricted area by that person.

As soon as practical after sample collection, the following information must be entered on the chain-of-custody form. All information is to be recorded in ink.

1. Project number. Enter the alphanumeric designation that uniquely identifies the project site.
2. Project name. Enter the site name.
3. Samplers. Sign the name(s) of the sampler(s).
4. Sample number. Enter the sample number for each sample in the shipment. This number appears on the sample identification label.
5. Date. Enter a six-digit number indicating the month, day and year of sample collection (MMDDYY).
6. Time. Enter a four-digit number indicating the time of collection based on the 24-hour clock; for example, 1354.
7. Sample matrix. Enter the matrix (e.g., soil, aqueous, etc.) of the sample.
8. Parameters for analysis. Enter the analyses to be performed for each sample.

9. Number of containers. For each sample number, enter the number of sample bottles that are contained in the shipment by parameter for analysis.

10. Remarks. Enter any appropriate remarks.

4.6.3 Sample Shipment

Custody of samples must be maintained through the shipment of samples to the selected laboratory. Samples will be delivered directly to the laboratory by sampling personnel or shipped via the following procedures:

- # Use waterproof high-strength plastic ice chests or coolers only.
- # After filling out the pertinent information on the sample label and tag, put the sample in the bottle or vial and screw on the lid. For all samples except VOA vials, secure the bottle lid with strapping tape.
- # Tape cooler drain shut.
- # Place about 3 inches of inert cushioning material such as vermiculite or styrofoam "popcorn" in the bottom of the cooler. Styrofoam packing shall not be used when sampling for volatile organics.
- # Enclose the bottles in clear plastic bags through which sample labels are visible, and seal the bag. Place bottles upright in the cooler in such a way that they do not touch and will not touch during shipment.
- # Put in additional inert packing material to partially cover sample bottles (more than half-way). Place bags of ice or ice-gel packs around, among, and on top of the sample bottles.
- # Fill the remaining space in the cooler with cushioning material.
- # If sending the samples by common carrier, sign the chain-of-custody under "Relinquished by," enter the carrier name and airbill number, retain a copy for field records and put the chain-of-custody record in a waterproof plastic "ziplock" bag and tape it with masking tape to the inside lid of the cooler. If sending the samples by courier or field team shipper, follow the above procedures, but also have the receiving carrier sign under "Received by."
- # Apply custody seals to the front and back of the cooler, across the lid.
- # Secure lid by taping. Wrap the cooler completely with strapping tape at a minimum of two locations. Do not cover any labels.
- # Attach completed shipping label to top of the cooler. The shipping label shall have a return address.

Ship the cooler by overnight express or courier to the respective laboratory.

4.6.4 Laboratory Custody Procedures

When the sample arrives at the laboratory, the sample custodian receives the sample. The label will be identified upon receipt by the laboratory and cross-referenced to the chain-of-custody record. Any inconsistencies will be noted on the custody record. Laboratory personnel will notify the Project QA/QC Coordinator, Site Field Manager, or the Project Manager immediately if any inconsistencies exist in the paper work associated with the samples.

4.7 LABORATORY REPORTING

The results of the analytical report will include the following information:

Analytical summary tables

Chain-of-custody records

Full data laboratory package (including forms, raw data, and associated QA/QC).

5.0 REPORTING

5.1 PILOT TEST REPORT

Upon completion of the second landfarming phase of the pilot study, a Landfarming Pilot Test Report will be prepared. The report shall address the following:

- Site History;
- Site Conditions;
- Pilot-Test Results and Conclusions; and
- Recommendations for Full-scale Implementation.

A Pre-Draft Landfarming Pilot-Test Report will be submitted to the USACE and WVA for review and comment prior to submittal to the regulators. One set of revisions will be made to the report based on the USACE and WVA comments. The Draft CM Landfarming Pilot-Test Report will then be submitted to the regulators. The Final CM Landfarming Pilot-Test Report shall include one set of revisions based on comments from the regulatory agencies.

5.2 DATA ANALYSIS

Composite samples collected for chemical analysis of PAHs and TPH and discrete sample collected for chemical analysis of VOCs will be treated as random samples from a single population. Estimated values will be used for results falling between the MQL and MDL. The MDL will be used for non-detected values. These results will be used to develop a mean and standard deviation of the population at each time interval sampled. A one sample t-Test comparison will be made between the proposed action level listed in Table 4-1 and population mean for each compound except for the following compounds: benzo(a)anthracene, benzo(a)pyrene, and dibenzo(a,h)anthracene. The following comparison will be made for all compounds except for three listed:

Ho (null hypothesis): C>PAL at $\alpha = 0.05$

This comparison will allow the conclusion with 95 percent false positive probability that C is greater than the PAL.

Because the proposed action levels for benzo(a)anthracene, benzo(a)pyrene, and dibenzo(a,h)anthracene are below a practicable quantitation limit, a simple comparison between the population mean and the proposed action level will be made. This type of comparison does not allow for a significant level of confidence to be assigned to the comparison.

Concentrations of TPH, total PAH, and individual PAH compounds will be further analyzed to develop zero-order and first-order removal rates with respect to time. Regression analysis will be performed using a least-square fitting technique that utilizes all data points with non-detect values being assigned the MDL with the following exception; if > 35 percent of the observed values at any given time interval are below the MDL, data from this time interval will not be used in the regression. The following comparison will be made for the rates developed:

Ho (null hypothesis) = the regression coefficient = 0 at $\alpha = 0.05$

This comparison will allow the conclusion with 95 percent false positive probability that the regression curve does not describe the data. From this information a 95 percent confidence interval will be developed for the kinetic rates.

These rate kinetics will be further used to develop estimates of time required to achieve the targeted treatment levels for TPH, total PAHs, and individual PAH compounds. This information will give a clear estimate of active and passive treatment time required to meet the remediation goals using landfarming technology.

For Test Plot A, rate calculations will be made for the first landfarming phase, 0 to 16 weeks, and the MNA phase, 16 to 52 weeks. For Test Plot A1, rate calculations will be made for the second landfarming phase, 52 to 60 weeks. For Test Plot A2, rate calculations will be made for the MNA phase, 16 to 60 weeks, using data from Test Plot A and A2, and rate calculations will also be made for the second landfarming phase, 60 to 68 weeks. For Test Plot B, rate calculations will be made for the first landfarming phase, 0 to 16 weeks, the MNA phase, 16 to 52 weeks, and the second landfarming phase, 52 to 60 weeks.

Although the treatment of VOCs is not one of the goals of this pilot test, results from VOCs analysis will be used to provide a qualitative assessment of VOCs removal from the test soils.