SPACE POWER FACILITY
NASA PLUM BROOK STATION
SANDUSKY, OHIO

CLOSURE WORK PLAN
TASK ORDER 7059-004

AUGUST, 1995

PREPARED FOR:

NASA LEWIS RESEARCH CENTER
21000 BROOKPARK ROAD
CLEVELAND, OHIO 44135

PREPARED BY:

URS CONSULTANTS
23355 MERCANTILE ROAD
CLEVELAND, OHIO 44122

TABLE OF CONTENTS

SECTION		PAGE NO.
1.0	INTRODUCTION	1-1
2.0	NASA PLUM BROOK FACILITY DESCRIPTION	2-1
2.1	Site Description and History	2-1
2.2	Site Regulatory History	2-3
2.2.1	Facility Environmental Permits and Other Regulatory Activities	2-3
2.2.2	Facility Environmental Remediation History	2-3
3.0	SPACE POWER FACILITY	3-1
3.1	Site Specific Conditions	3-1
3.1.1	Topography	3-1
3.1.2	Surficial Geology/Soil Conditions	3-1
3.1.3	Bedrock Geology	3-1
3.1.4	Surficial Groundwater	3-1
3.2	Past Waste Management Activities	3-2
3.3	Previous Site Investigations	3-3
3.3.1	Underground Storage Tank Removal	3-3
3.3.2	UST Closure Assessment	3-4
3.3.3	Soil Gas Survey	3-4
3.3.4	Soil and Groundwater Sampling and Analyses - October, 1990	3-4
3.3.5	Soil and Groundwater Sampling and Analyses - April, 1993	3-5
3.3.6	Summary of Previous Site Investigations	3-5
4.0	SAMPLING AND ANALYSIS PLAN	4-1
4.1	Soil Sampling	4-1
4.1.1	Background Soil Samples	4-1
4.1.2	Site Soil Samples	4-2
4.2	Groundwater Monitoring System	4-5
4.2.1	Monitor Well Location	4-5
4.3	Analytical Parameters	4-6

TABLE OF CONTENTS (CONTINUED)

SECTION		PAGE NO.
4.4	Field Procedures	4-6
4.4.1	Soil Sampling	4-6
4.4.2	Monitoring Well Installation	4-8
4.4.3	Well Development	4-9
4.4.4	Groundwater Measurement	4-10
4.4.5	Groundwater Sampling	4-10
4.4.6	Sample Handling	4-12
4.5	Decontamination Procedures	4-12
4.5.1	Decontamination Facility	4-12
4.5.2	Decontamination of Large Equipment	4-13
4.5.3	Decontamination of Sampling Equipment	4-13
4.6	Procedures for Handling and Disposition of Waste Generated Through Closure Plan Activity	4-14
4.6.1	Contaminated Soil	4-14
4.6.2	Personal Protection Equipment and Decontamination Material	4-14
4.6.3	Rinsate Water and Monitoring Well Development/Purge Water	4-15
4.6.4	Identification of Off-Site Waste Management Facilities	4-15
4.7	Internal Quality Control Checks for Field and Laboratory Operations	4-16
4.7.1	Field Quality Control	4-16
4.7.2	Laboratory Quality Control	4-16
4.7.3	Quality Assurance Objectives for Chemical Measurements Data	4-18
4.7.4	Analytical Procedures	4-21
4.7.5	Sample Custody	4-22
4.8	Review of Laboratory Data	4-25
5.0	DATA ASSESSMENT	5-1
5.1	Nature and Extent of Contamination	5-1

TABLE OF CONTENTS (CONTINUED)

SECTION		Page No.
5.2	Risk Assessment Methodology	5-1
5.2.1	Selection of Chemicals of Concern	5-2
5.2.2	Assessment of Exposure	5-2
5.2.3	Toxicity Assessment	5-6
5.2.4	Risk Characterization	5-7
5.2.5	Risk-Based Remediation Standards	5-8
6.0	CLOSURE SCHEDULE	6-1
7.0	AMENDMENT OF WORK PLAN	7-1
8.0	CLOSURE CERTIFICATION DOCUMENTATION	8-1
8.1	Waivers of Exemptions	8-1
8.2	Status of Facility After Closure	8-1
9.0	REFERENCES	9-1

LIST OF FIGURES

Figure		Page No.
2-1	Facility Location Map	2-5
3-1	Site Location Map	3-6
3-2	Groundwater Contour Map - January, 1991	3-7
3-3	Groundwater Contour Map - May, 1991	3-8
3-4	Extent of Operations	3-9
4-1	Background Soil Sampling Locations	4-26
4-2	Soil Sampling Plan	4-27
4-3	Groundwater Monitoring Well Locations	4-28
4-4	Decontamination Facility Diagram	4-29
6-1	Closure Schedule	6-2

LIST OF TABLES

Table		Page No.
3-1	Chemicals Managed at Tank #24	3-10
3-2	Chemicals Potentially Managed at Tank #24	3-11
3-3	Soil Analytical Results, UST Closure Assessment, September 1989	3-12
3-4	Soil Analytical Results, Site Assessment, October 1990	3-14
3-5	Soil Analytical Results, Phase II UST Study, April 1993	3-15
3-6	Groundwater Analytical Results, Phase II UST Study, April 1993	3-16
4-1	Summary of Laboratory Analysis	4-30
4-2	Summary of QA/QC Samples	4-31
4-3	Method Detection Limits/Practical Quantitation Limits - Volatile Organic Compounds	4-32
4-4	Method Detection Limits/Practical Quantitation Limits - Semivolatile Organic Compounds	4-35
4-5	Method Detection Limits/Practical Quantitation Limits - Total Metals	4-38
4-6	Practical Quantitation Limits - Miscellaneous Analytical Parameters	4-39
4-7	F001-F005 Spent Solvents, Treatment Standards	4-40
4-8	Maximum Concentration of Contaminants for the Toxicity Characteristic (TCLP)	4-42
4-9	Sample Bottle Requirements Preservation and Holding Times	4-44
5-1	Summary of Constants for Potential Chemicals of Concern	5-10
5-2	Summary of Assumed Exposure Factors	5-11

LIST OF TABLES (CONTINUED)

5-3 Summary of Dermal Values for Potential Chemicals of Concern 5-12

5-4 Summary of Toxicity Values for Potential Chemicals of Concern 5-13

APPENDICES

APPENDIX A	Health and Safety Plan
APPENDIX B	Previous Site Investigation Summaries
APPENDIX B-1	UST Closure Assessment, September 1989
APPENDIX B-2	Soil Gas Survey
APPENDIX B-3	Site Assessment - October, 1990
APPENDIX B-4	Phase II UST Study - April, 1993
APPENDIX C	Waste Manifests

ABBREVIATIONS AND ACRONYMS

BUSTR	Bureau of Underground Storage Tank Regulations
DNAPL	Dense Non-Aqueous Phase Liquid
DSHWM	Division of Solid and Hazardous Waste Management
EIS	Environmental Impact Statement
ERD	Environmental Resources Document
ESOI	Envirosafe Services of Ohio, Inc.
FS	Field Screening
GMA	Garage/Maintenance Area
GC	Gas Chromatography
GM	Groundwater Monitoring
LeRC	Lewis Research Center
LNAPL	Light Non-Aqueous Phase Liquid
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MDL	Method Detection Limit
μg/kg	Micrograms Per Kilogram (see ppb)
μg/l	Micrograms Per Liter
mg/kg	Milligram per Kilogram (see ppm)
MW	Monitoring Well
B	Morrison Knudsen Boring
NACA	National Advisory Committee for Aeronautics
NASA	National Aeronautics and Space Administration
NPDES	National Pollutant Discharge Elimination System
OAC	Ohio Administrative Code
OEPA	Ohio Environmental Protection Agency
ppb	Parts Per Billion
ppm	Parts Per Million
PBOW	Plum Brook Ordnance Works
PBRF	Plum Brook Reactor Facility
PBS	Plum Brook Station
PCB	Polychlorinated Biphenyl
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation Recovery Act
SPF	Space Power Facility
TPH	Total Petroleum Hydrocarbons
UST	Underground Storage Tank
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds

1.0 INTRODUCTION

Under the direction of the National Aeronautics and Space Administration (NASA), URS Consultants has prepared this site Closure Work Plan for the Space Power Facility (SPF) located at the NASA Plum Brook Station (PBS) facility near Sandusky, Ohio. The purpose of this Work Plan is to establish specific site procedures that will be used by NASA to determine the presence and extent of contamination and the associated risks of a waste management unit that consisted of one underground storage tank (UST), tank #24, located adjacent to the south side of Building 1411, the SPF.

In 1989, tank #24 and an adjacent tank, #25, were removed from the SPF. Tank #24 contained waste oil and solvents generated at the SPF and was in use up to the time of removal. Tank #25 contained fuel oil and was out of service at time of removal.

This Closure Work Plan addresses the following activities:

- Identification and complete delineation of the horizontal and vertical extent of soil and groundwater contamination at the SPF as a result of waste management operations;
- Preparation of a risk assessment;
- Development of remediation standards for contaminants in soil and groundwater if recommended risk levels are exceeded.

This document was prepared in response to an Ohio Environmental Protection Agency (OEPA) request that NASA submit a Work Plan demonstrating how they intend to fully characterize and remediate any contamination at the SPF as a result of waste storage operations at the site.

This Work Plan has been prepared in accordance with the closure performance standards and associated requirements as promulgated in the Ohio Administrative Code (OAC) Chapters 3745-52-34(A)(1) and applicable sections of 3745-66. The Work Plan also follows the guidance presented in Closure Plan Review Guidance, September 1993 issued as an interim final by the OEPA, Division of Solid and Hazardous Waste Management (DSHWM) (OEPA, 1993).

2.0 NASA PLUM BROOK FACILITY DESCRIPTION

2.1 FACILITY DESCRIPTION AND HISTORY

Plum Brook Station is 50 miles west of the NASA Lewis Research Center (LeRC) in Cleveland, Ohio, and is approximately 4 miles south of the Lake Erie port of Sandusky, Ohio, in an area that is primarily agricultural and rural. The area surrounding Plum Brook Station is mostly used for crop production. Plum Brook Station is generally undisturbed, forested land and is located in Perkins and Oxford townships. Small portions of the site along the eastern boundary extend into Huron and Milan townships. Plum Brook Station is located on what was originally a flat lake bottom from glacial melt waters. The facility derives its name from Plum Brook, the major stream that flows through its boundary.

Plum Brook Station is approximately 6,400 acres. The northernmost boundary of Plum Brook Station occurs at latitude 41°23'39" and extends as far south as latitude 41°20'04". The westernmost longitude occurs at 82°43'12" and extends as far east as 82°38'39". NASA's LeRC controls the land associated with Plum Brook Station through the following: ownership of title; use of easements, leases, and permits; and ownership of development rights. NASA LeRC management has responsibility for both the Cleveland Center and Plum Brook Station.

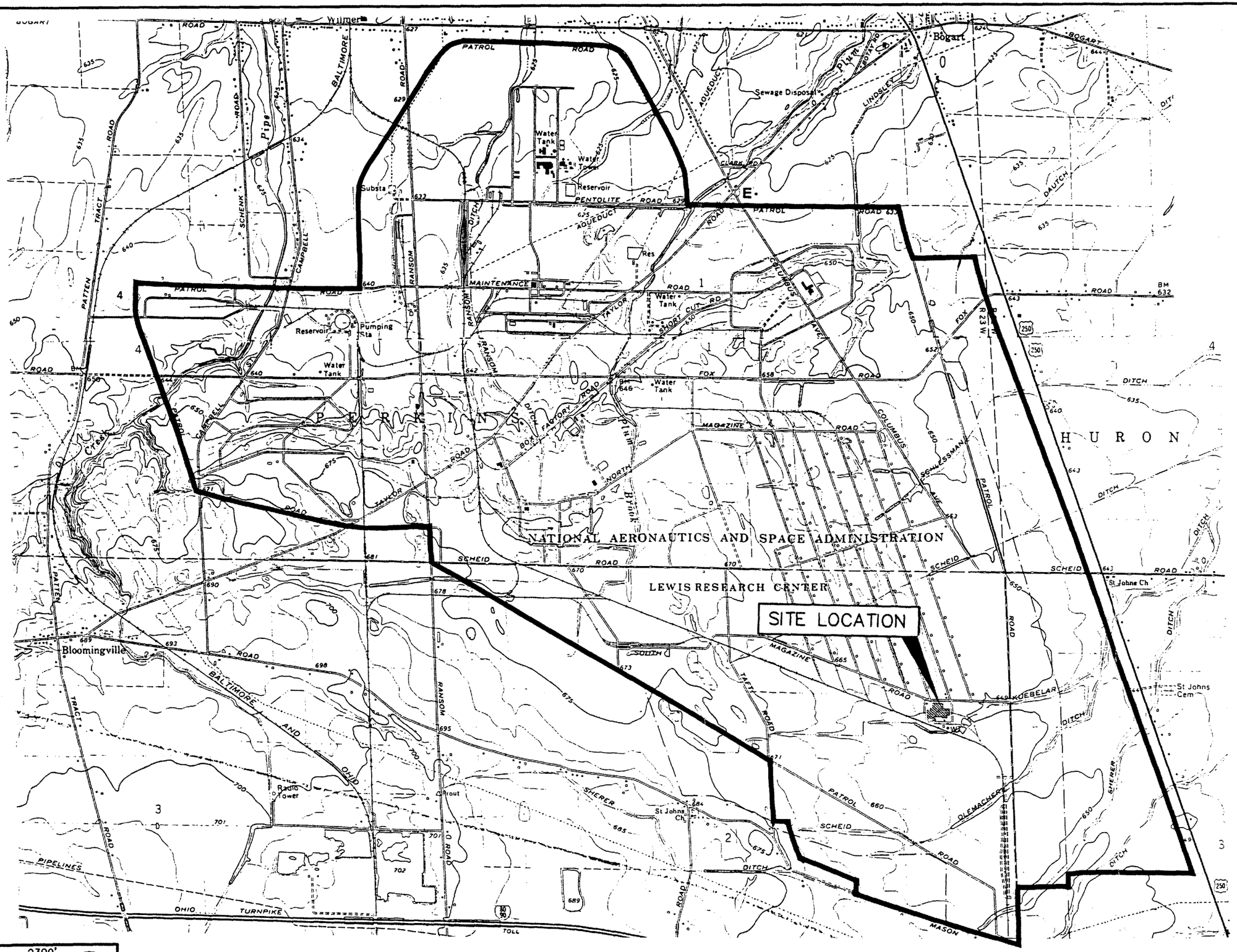
Figure 2-1 is a facility map of Plum Brook Station and identifies the area of concern, the SPF, in the southeast portion of the facility. There are approximately 149 permanent buildings and structures on the Plum Brook Station site and 99 munitions bunkers, which were constructed when the facility was an ordnance plant. The munitions bunkers are currently used for the storage of supplies, equipment, and records. The buildings and structures include offices, test facilities, mechanical or process equipment, shipping and receiving areas, substations, sanitary wastewater treatment facilities, and cooling towers. All the test facilities located at the site are remotely located from each other, as original use dictated hazard-exclusion distances.

Electric power is provided to the facility by Ohio Edison Company. Potable water is supplied by the City of Sandusky. Raw water, used for cooling, testing, and fire protection, is provided by two Plum Brook Station-owned intakes in Lake Erie (Big Island and Rye Beach Pump Stations). Plum Brook Station has three sanitary waste treatment systems; one is operated continuously and the other two are operated intermittently.

An 8-foot-high security fence surrounds 5,400 acres of Plum Brook Station. Unauthorized site access is prohibited. Access to the site is gained through the security guard house located on Columbus Avenue. The guard house is manned by armed guards 24 hours a day.

During each eight-hour shift, a security guard patrols the inside perimeter road (Patrol Road) of the facility. Persons gain access to the station by showing the guard a badge that authorizes entry into the station.

In addition to NASA activities currently conducted at PBS, the Department of Agriculture, Department of the Interior, Department of Labor, the Immigration and Naturalization Services, and the Federal Bureau of Investigation have offices located at PBS for non-aerospace activity.



0 2300'
SCALE 1" = 2300'
0 276 552 828M
SCALE 1CM = 276M

SOURCE: USGS 7.5 MIN SERIES QUADRANGLE(S):
SANDUSKY, OHIO 1969(PHOTO REVISED 1979)
KIMBALL, OHIO 1969

NASA Lewis Research Center
SPF, Plum Brook Station

Figure 2-1
Facility Location Map

URS CONSULTANTS

2.2 FACILITY REGULATORY HISTORY

This section of the report contains information on environmental permits, known hazardous material releases, and previous and current remediation activities.

2.2.1 Facility Environmental Permits and Other Regulatory Activities

Environmental permits currently held by NASA PBS and other on-going regulatory activities include;

- Open Burning Permit, and
- National Pollutant Discharge Elimination System (NPDES) Permit
- Air Permits
- National Environmental Policy Act Documentation
- RCRA Generator Activities

The Northwest District Office of the OEPA in Bowling Green, Ohio is responsible for the administration and enforcement of PBS's permits.

2.2.1.1 Open Burning Permit - The PBS Open Burning Permit is a written authorization obtained on a yearly basis from the OEPA. PBS requests it yearly to allow the burning of open fields each spring. The field burning is conducted in order to eradicate noxious weeds and to propagate the growth of field grasses that the site wildlife feed upon. A burn campaign, lasting approximately three months, is conducted each year, alternating burns between the northern and southern halves of the facility, terminating prior to the nesting of PBS wildlife.

2.2.1.2 NPDES Permit - NASA PBS has a NPDES permit (Application No. OH0001392) for seven outfalls. The United States Environmental Protection Agency (USEPA) has transferred primary authority for the NPDES permit program for federal facilities in Ohio to OEPA. Three of the seven permitted outfalls are process/stormwater discharges at Kuebelar Ditch (outfall 001), Ransom Brook (outfall 002), and Plum Brook at Pentolite Road (outfall 003). Two outfalls (005 and 006) are for effluent from PBS sewage treatment plants, which discharge to Kuebelar Ditch and Plum Brook. Outfall 008 is for effluent from the B Control Building sewage package plant, which ultimately discharges to the Box Factory Road Ditch. Outfall 009 is for non-contact cooling water from K Site that is discharged onto the ground a distance of 100 feet from the building.

The most recent NPDES permit issued by the OEPA (OEPA Permit No. 21000002*ED) has an effective date of April 1, 1995.

2.2.1.3 Air Permits - In order to comply with the Federal Clean Air Act (CAA), the State of Ohio through its CAA State Implementation Program requires Permits to Install (PTI) New Sources of Pollution for sources installed since 1974 and Permits to Operate (PTO) for all air pollution sources. Small emissions sources (typically less than 10 tons/year) often receive "Registration Status" or "T Status" on the OEPA records. In response to a 1972 request from

the Ohio Board of Health, PBS pre-registered potential air pollution sources with the Ohio Air Pollution Control Board for informational purposes only. PBS currently holds five Ohio EPA air permits and has 28 sources on registration status. Many of the test facilities remain inactive today; therefore, many potential air emission sources are not operating at this time. Potential sources include rocket testing activities, gas/liquid storage, degreasers, cooling towers, boilers, a paint-spray booth, an incinerator, and construction activities.

PBS conducted an air pollution source inventory during the fall of 1993. If a significant portion of PBS was reactivated or a new source was installed, emissions would be evaluated to determine which, if any, required permitting. Air permits for boilers have been issued.

2.2.1.4 National Environmental Policy Act Documentation - NASA prepared an Environmental Impact Statement (EIS) in 1971 for both the LeRC and PBS facilities in accordance with the requirements of the National Environmental Policy Act. The 1971 EIS was superseded by a 1978 EIS which NASA submitted to the OEPA. Environmental Resources Documents (ERDs) were prepared to supplement the 1978 EIS. The current ERD was prepared in August 1990 and addresses management of hazardous substances and hazardous wastes at LeRC and PBS.

2.2.1.5 Resource Conservation and Recovery Act Activities - PBS has registered with the OEPA as a generator of Resource Conservation and Recovery Act (RCRA) hazardous waste and has received an EPA identification number - OH3800015379. Wastes generated from routine operations are managed in Building 9206 under the limitations of the 90-day storage requirements. No RCRA hazardous wastes are treated or disposed of onsite. Although NASA PBS is a hazardous waste generator under RCRA, no operations have required the submission of Part A or Part B permit applications.

2.2.2 Facility Environmental Remediation History

The OEPA conducted a Preliminary Assessment (PA) of PBS in 1983. The areas of interest were the red water ponds, a byproduct of the US Army's production of explosives in the 1940s, and a 1981 spill of approximately 170 gallons of polychlorinated biphenyls (PCBs) at Building 9206. An onsite inspection of these areas was conducted by the OEPA DSHWM to determine the potential for groundwater and surface water contaminant migration from these areas. In 1990, after site remediation, post remediation groundwater monitoring, and discussion with the USEPA, groundwater monitoring was discontinued at the site of the PCB spill because no contamination was detected.

Following a 1989 assessment by Ebasco Environmental (Ebasco), 19 USTs used during various PBS operations were identified and earmarked for removal. The following list summarizes the removal of these USTs.

- 9 USTs at the Garage/Maintenance Area (Building 7121, 7131 and 7132);
- 1 UST at the Pump Station (Building 8133);
- 2 USTs at the Space Power Facility (Building 1411);
- 3 USTs at the Plum Brook Reactor Facility (Building 1131);

- 2 USTs at the "B" Site Boiler Building (Building 5231); and
- 2 USTs at the Fuel Storage Tank (Building 8951).

Four of the USTs removed contained waste oil mixed with solvents. Nine USTs contained water prior to their removal, but at some point during their operating lifetime contained solvents, fuel oil, gasoline, or diesel fuel. Six of the removed USTs contained either fuel oil (4), gasoline (1) or diesel fuel (1). All of the USTs showed evidence of leaking or spillage while in the ground with the exception of the USTs located at the Fuel Storage Tank. All excavations exhibited some amount of visible contamination. Visibly contaminated soil was removed from the excavations and replaced with clean sand. In April, 1993, MK/NASA performed a Site Assessment of the UST areas and a Site Investigation of the entire PBS was performed in June/July, 1993.

3.0 THE SPACE POWER FACILITY

3.1 SITE-SPECIFIC CONDITIONS

As mentioned previously in this report, the Plum Brook Facility is very extensive in size, approximately 6,400 acres. Physical conditions change considerably across the facility. The following is a site-specific description of the southern boundary of Plum Brook Station which includes the Space Power Facility. Figure 3-1 shows the Space Power Facility and the location of the former UST pit adjacent to the south wall of Building 1411.

3.1.1 Topography

The SPF is located on relatively flat country characterized by topography that slopes gently north and east toward Lake Erie. Ground surface has an average slope of less than six percent. Surficial deposits and landforms were produced by glacial processes. Approximate elevation at the SPF is 660 feet mean sea level (MSL).

3.1.2 Surficial Geology/Soil Conditions

Six soil borings in the vicinity of the SPF have identified surface soil to be predominantly a grey mottled clayey silt. Gravel with brown sandy silt were found near the surface to a depth of 2 feet in a borehole at the northeast corner of the tank area. This fill is underlain by the grey mottled clayey silt to a thickness of 4 feet. The unit is then underlain by approximately 2-feet of grey silty clay followed by a 1-foot thick layer of grey fine sand. Bedrock, consisting of grey shale, is encountered at a depth of about 9 feet below the ground surface, corresponding to an elevation of approximately 645 feet. The soil is consistent with that identified in mapping by the Ohio Department of Natural Resources (ODNR) as the Prout Association, which occurs in the southern and eastern portions of PBS.

3.1.3 Bedrock Geology

Borings have generally encountered bedrock at a depth of eight to nine feet at the SPF. The bedrock is a dark blue/gray shale. Below nine feet the shale appears massive in nature. Borings have not advanced below a depth of ten feet. The shale appears consistent in nature to that described as the Ohio Shale, which is common to the southern portions of PBS. This generalization, however, is based on the six boreholes drilled in 1990.

3.1.4 Surficial Groundwater

The overburden lying above the bedrock is a poor water bearing material. The high clay/silt content of the soil makes it a poor source of groundwater. Monitoring wells installed at the SPF location did not produce sufficient water to complete the purging operation, as was reported in the description of the well development activities.

Figures 3-2 and 3-3 present the surficial groundwater aquifer elevation contours developed from the January 9, 1991 and May 9, 1991 groundwater level measurements, respectively. Groundwater flow direction indicated for both the January and May measurements was toward the northeast. The January groundwater contours exhibited a pattern of relatively steep gradients such that groundwater moves into the area beneath Building 1411 and 1441 from the northwest and the southeast and then

January groundwater contours exhibited a pattern of relatively steep gradients such that groundwater moves into the area beneath Building 1411 and 1441 from the northwest and the southeast and then turns toward the northeast. The January contours give the impression of an underground trough draining to the northeast. Groundwater contours for May exhibit this same overall pattern, but with gradients which are much less pronounced. These lower gradients result in flows that move toward the north and east, converging on the northeast direction. It appears that the SPF building influences the local groundwater flow. Possibly the combination of a high water table and building footer drains create a minor trough adjacent to the building, however, general flow is to the northeast.

The tanks were formerly located directly above the bedrock. The saturated zone extends to two to three feet directly above the bedrock. Accounting for the maximum theoretical hydraulic conductivity for the various soil units observed to be present at this site, the maximum horizontal groundwater flow velocities associated with the January and May 1991 were calculated to be 2.0 and 3.1 feet per year, respectively. It must be emphasized that this estimate is based on the theoretical performance of a homogeneous water-bearing layer consisting entirely of the most transmissive soil type. The calculated theoretical horizontal groundwater velocities would suggest that horizontal migration of the UST contaminants in the overburden aquifer would be relatively slow and not significant relative to preferential migration along buried lines or structures. According to a groundwater zone map developed by the Ohio Department of Natural Resources, the underlying shale bedrock can supply domestic wells. Limited groundwater flow (<3gpm) may be obtained from thin, discontinuous sand and gravel deposits interbedded in fine sandy clay seams.

3.2 PAST WASTE MANAGEMENT ACTIVITIES

The two underground storage tanks (#24 and #25) were situated in a common excavation adjacent to the south side of Building 1411. In some reports these tanks are referred to respectively as #1411-1 and #1411-2. Tank #24 was used for the management of waste oil and solvents. Tank #25 was used only for the storage of #2 fuel oil. Both steel tanks were 1,000 gallons in size, installed in 1968 and removed in 1989. Neither tank had secondary containment nor a release detection system.

Figure 3-4 shows the area of waste management operations at the SPF. The two underground storage tanks were located end-to-end at approximately a right angle to each other as shown by the former tank pit. Tank #24 was located on the eastern edge of the excavation and tank #25 was located on the western end of the excavation. Also identified as part of the waste management unit are the approximate locations of two area where excavated soil was placed on the ground adjacent to the tank excavation.

Records listing the identities and quantities of waste solvents stored in tank number #24 could not be found, but discussions with facility personnel provided the following information: acetone, methylene chloride, methyl ethyl ketone, methanol, 1,1,1-trichloroethane, and trichloroethylene were known to have been used and are likely to have been placed in the tank. Carbon tetrachloride was commonly used during the 1970's and could have been placed in the tank during that time period. Waste oil and solvents were allowed to accumulate in tank #24 until it was approximately full. Maximum inventory of waste in tank #24 is estimated at 800 gallons. Tank # 24 was in service for 21 years and the throughput of the tank is estimated at approximately 17,000 gallons.

Table 3-1 is a list of chemical solvents which are known to have been managed at tank #24. Table 3-2 shows the additional chemicals that were found at the site during past investigations and are potentially associated with tank #24 as either chemicals that were used or degradation products

thereof. The combination of Tables 3-1 and 3-2 constitutes the list of the potential chemicals of concern for site closure.

3.3 PREVIOUS SITE INVESTIGATIONS

During the past six years there have been a number of environmental investigations at Plum Brook Station that provide site-specific background information for the SPF.

3.3.1 Underground Storage Tank Removals

On September 18th and 19th, 1989, the permanent closure-by-removal of underground storage tanks #24 and #25 was performed at the SPF. Mr. Jack Graves of the State Fire Marshal's Office was on site to oversee the removal of the tanks. EMPACO Incorporated and Independence Excavating were retained as subcontractors to Turner Construction to remove the tanks. No as-built or engineering drawings were available for the USTs. A scaled drawing of the UST layout was obtained and is included in Appendix B-1. Waste generated as a result of tank removal includes the following:

- The total volume of the tank contents and rinsate solutions for tank #24 was listed as 6,000 gallons. The total volume of the tank contents and rinsate solutions for tank #25 was listed at 4,500 gallons. Tank contents and rinsate was sampled and characterized prior to removal from the site. The waste was transported and disposed of at Hukill Chemical Corporation in Bedford, Ohio. Waste manifests and tank characterizations are included in Appendix C.

- In March of 1990, soil generated through the removal of the USTs was transported by Myers Chemical Transport and disposed at the Envirosafe landfill in Oregon, Ohio. Uniform Hazardous Waste Manifests which document soil disposal are included in Appendix C. A total of 55.19 tons of soil was disposed at the landfill. Discussions with facility personnel indicate that only enough soil was removed from around the tank to allow for tank removal and sample collection. Some samples were collected with the excavator bucket. The tanks were located in an "L" shaped excavation as shown on Figure 3-4. The total size of the excavation was approximated at 15 feet x 30 feet x 10 feet deep. Backfill was brought in from an on-site location.

- Site personnel have stated that the storage tanks were cut open and rendered useless prior to removal from the site and disposed as scrap steel. There is no available documentation as to the final disposition of the tanks nor their ancillary piping.

In regards to health and safety during the 1989 tank removal, NASA requires a site-specific health and safety plan from each contractor that performs work on site. The health and safety plan was reviewed by NASA Health and Safety personnel. During this removal, all work was performed in accordance with OSHA 29CFR 1910.120. These regulations include site worker 40-hour training, environmental monitoring for organic vapors and explosive environment, and personal protection with respect to clothing and decontamination.

3.3.2 UST Closure Assessment

As part of the UST removal, a closure assessment was completed in September, 1989, that included soil sampling and analyses. A total of nine soil samples (SS1 through SS9) from beneath the tank, the sidewalls of the excavation pit, and from excavated soils were collected from the tank cavity at the time of UST removal in order to determine if a release of tank contents had occurred during the active life of the tank. The performance of the closure assessments indicated that varying degrees of contamination were present. The following is a summary of significant findings of the closure assessments. A complete set of laboratory results is located in Appendix B-1. The soil samples were analyzed using SW-846 Method 8240 for VOCs, TPH by 418.1, EP Toxicity Lead, and ignitability. Table 3-3 is a summary of chemicals identified in the soil listed with their highest detected concentrations. Additional information concerning the UST closure site assessment can be found in Appendix B-1.

There were also detectable levels of total petroleum hydrocarbons (TPH) in the area of both tank #24 and tank #25. Nine samples were analyzed for TPH and concentrations ranged from a low of 93 ppm to a high of 2030 ppm.

Lead leachate concentrations were below the detection limits in all of the samples and a flashpoint >200° F was measured in each of the samples indicating the soils are not considered hazardous by virtue of their toxicity characteristic or ignitability.

3.3.3 Soil Gas Survey

In October of 1989, a soil gas survey was conducted at the SPF. A total of 22 sample points were sampled and analyzed. The sample points targeted the tank excavation area, the building foundation, and buried utility lines. A portable gas chromatograph was used and calibrated to quantify dichloroethene, benzene, trichloroethene, toluene, tetrachloroethene, and xylene. The majority of the soil gas samples indicated contamination from fuel products with highest concentrations detected on the western and southern side of the building. Contamination in this area may be due to contaminant migration from the former tank area to the west side of the building. The only sample location displaying one of the target solvents was located on the southeast side of the building and showed trichloroethene at 700 ppb. This isolated reading could indicate that a spill could have occurred at that location. A summary of the compounds detected through the soil gas survey are listed below. Additional information concerning the soil gas survey may be found in Appendix B-2.

Chemical	Highest Concentration (ppb)
benzene	2000
trichloroethene	700
toluene	470
xylene	280

3.3.4 Soil and Groundwater Sampling and Analyses-October, 1990

Ebasco Services performed a Site Assessment utilizing directed soil sampling and monitor well installation in October of 1990 to characterize the area further away from Building 1411 at the SPF. Six borings (SP-SB01 through SP-SB06), five completed as monitoring wells (SP-GW01,SP-GW03 through SP-GW06), were installed to help characterize the extent of potential contaminant migration.

Composite soil samples were collected over the total depth of the boring and analyzed for SVOCs, metals/cyanide, and pesticides/PCBs. Discrete soil samples were collected at depths of four and ten feet and analyzed for VOCs. No pesticides or PCBs were detected in these soil samples. The soil analytical results are shown in Table 3-4.

Only two of the installed monitoring wells were sampled; one that was expected to be clean (SP-GW01) and one that was expected to be contaminated (SP-GW06). Groundwater was sampled for volatile organic compounds, semivolatile organic compounds, and total metals. The only contaminant that was detected in the groundwater was endosulfan sulfate at 0.24 ppb in SP-GW06. Endosulfan sulfate was also detected in a soil sample blank.

The analytical method for VOC analysis was SW-846 Method 8240. Analytical methods for other parameters are not known, though they are believed to be consistent with SW-846 methodology.

Sediment samples were collected as part of the field investigation. Two samples were collected at the Space Power Facility from a drainage channel near the former tank location. Appendix B-3 contains the sediment sample data and the relevant sections of the site assessment report including a map showing sample locations.

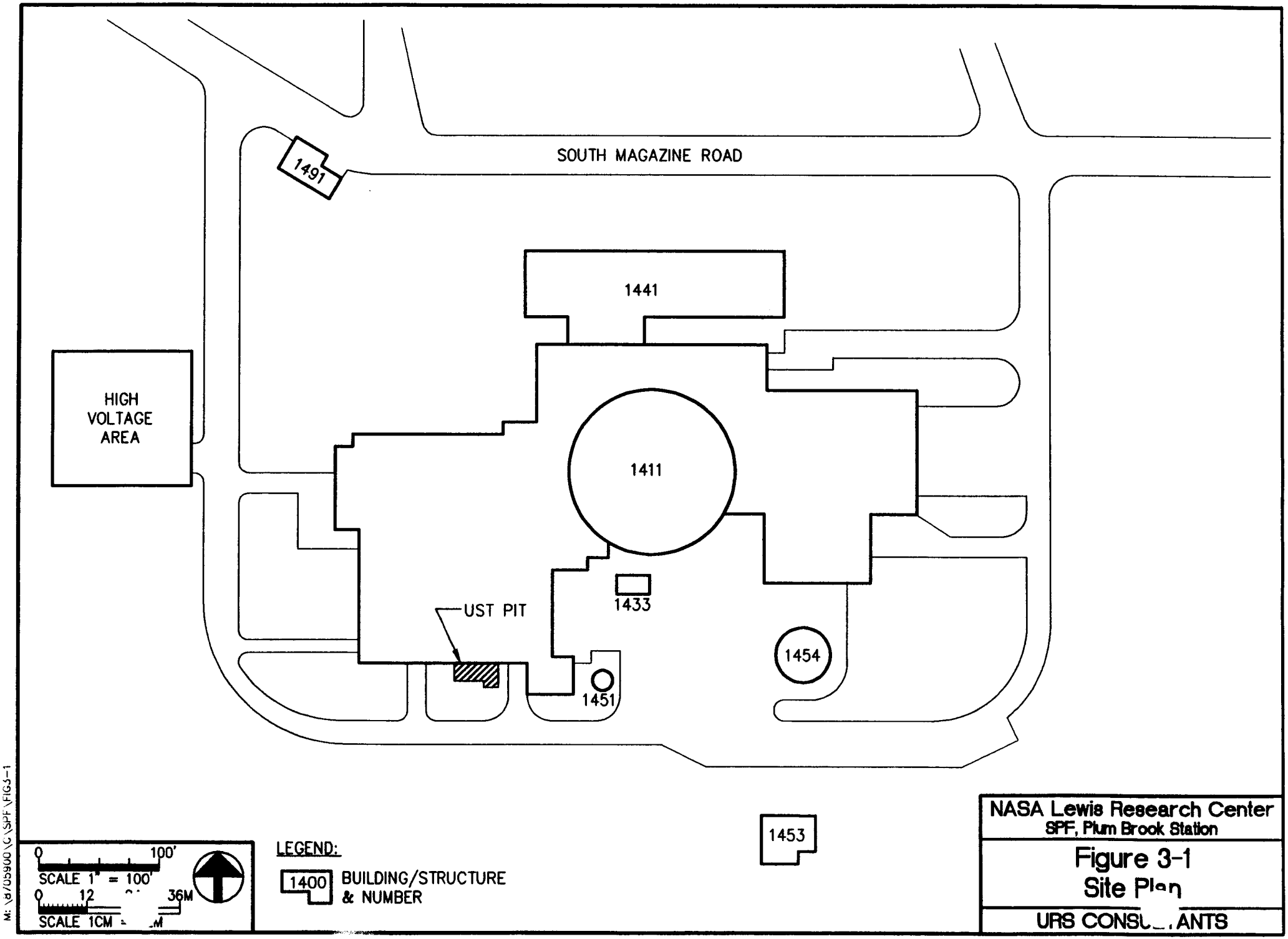
3.3.5 Soil and Groundwater Sampling and Analysis-April,1993

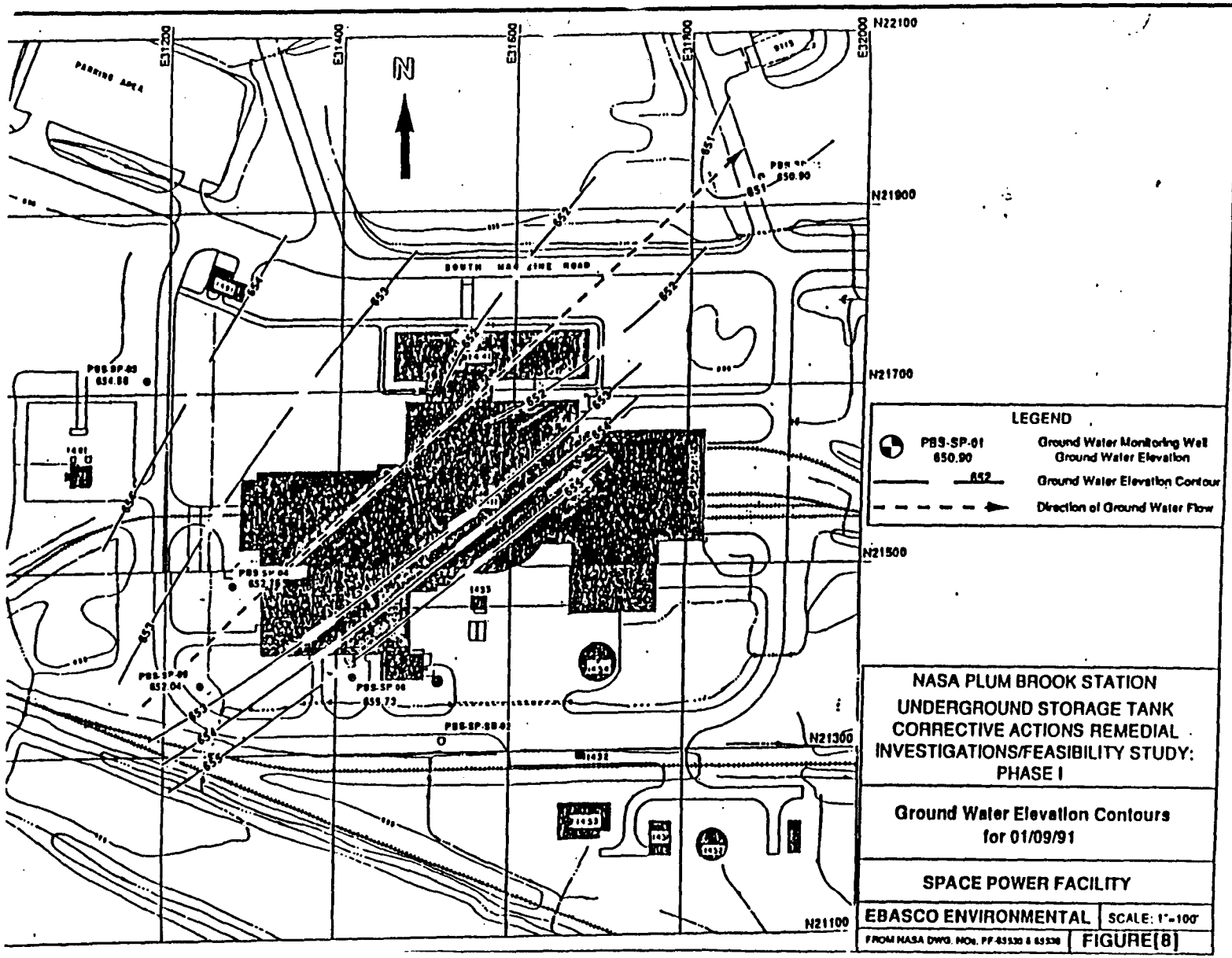
Soil sampling and the installation of a groundwater monitoring well were completed at the SPF in April of 1993 by the MK-Ferguson Company. Four borings (B-1 through B-4) were advanced to a depth of eight feet and one boring, B-4, was completed as a monitoring well (M-1). Soil samples were collected at depths of 0-2 feet, 2-4 feet and 6-8 feet. Soil samples were analyzed by SW-846 methods as follows: VOCs (8240), PNAs (8100), TPH (9071), and BTEX (8020). Soil analytical results for April 1993 are found in Table 3-5. Monitoring wells M-1 and the existing wells installed by Ebasco in 1990 (renamed EB-1 through EB-5) were sampled and analyzed. Groundwater analytical results are in Table 3-6. Complete analytical results are included in Appendix B-4.

3.3.6 Summary of Previous Site Investigations at SPF

Based on soil and groundwater sample analyses of the previous site investigations, it is apparent that soil contamination and the potential for groundwater contamination exist at the site as a result of waste and fuel management operations at the SPF. Ohio EPA has commented on the above mentioned investigations used in a previous submittal. (NASA Plum Brook Station, Space Power Facility Risk Assessment Closure Plan, December, 1993). After review and discussions with Ohio EPA, NASA agrees that the SPF site has not been adequately characterized for extent and that much of the analytical data used to support the risk assessment may not have the required validation.

NASA intends to define the full vertical and horizontal extent soil and groundwater contamination at the Space Power Facility. A Sampling and Analysis Plan located in Section 4 details how NASA intends to fully determine the extent of contamination. The results of the previous investigations will be used as qualitative information to direct a more efficient site characterization.

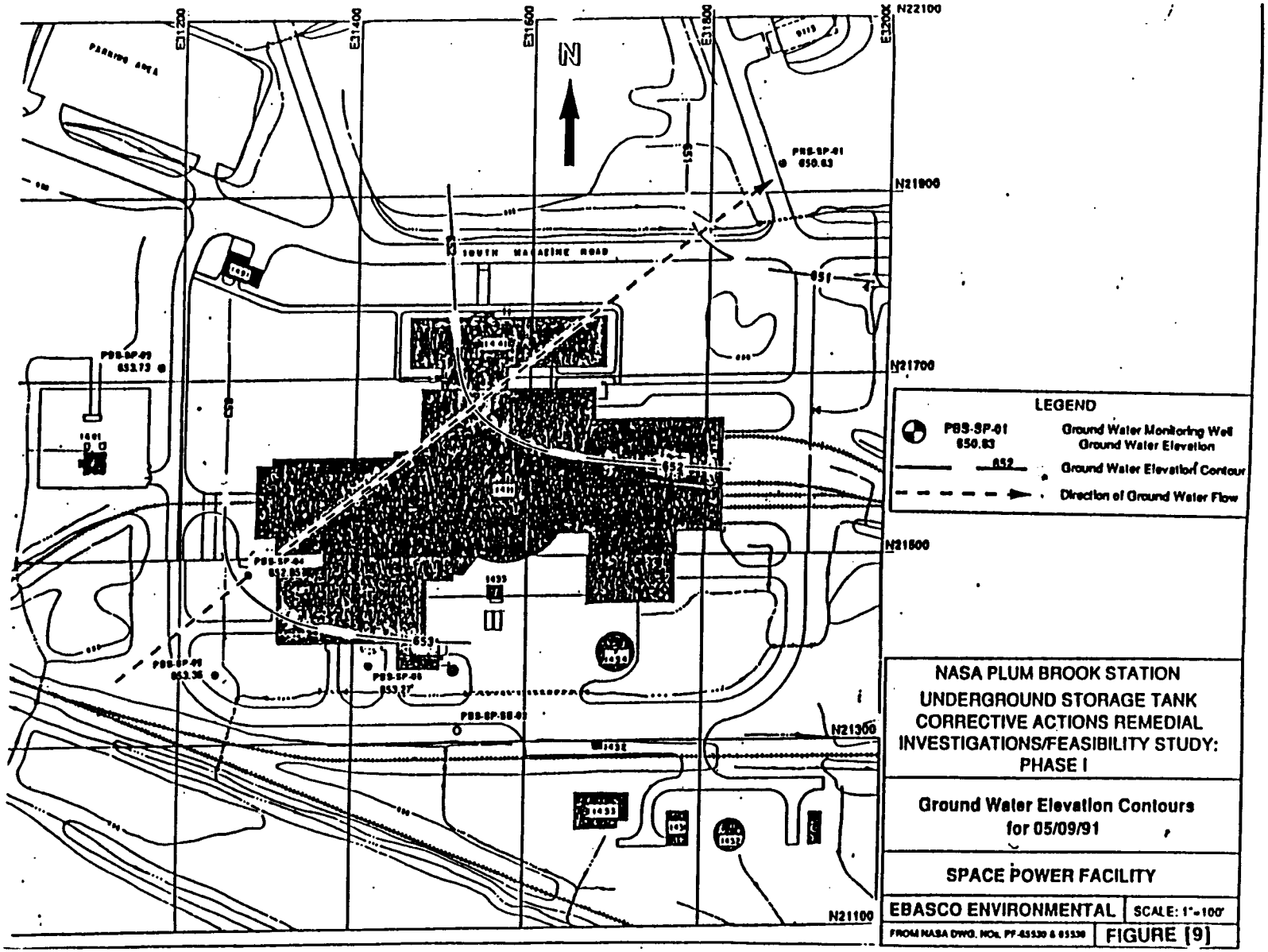

SOUTH MAGAZINE ROAD
1491
1441
HIGH VOLTAGE AREA
1411
1433
UST PIT
1454
1451
1453
0 100'
SCALE 1" = 100'
0 12 36M
SCALE 1CM =
LEGEND:
1400 BUILDING/STRUCTURE & NUMBER
NASA Lewis Research Center
SPF, Plum Brook Station
Figure 3-1
Site Plan
URS CONSULTANTS



NASA Lewis Research Center
Plum Brook Station and SPF

Figure 3-2
Groundwater Elevation
Contours - Jan. 1991

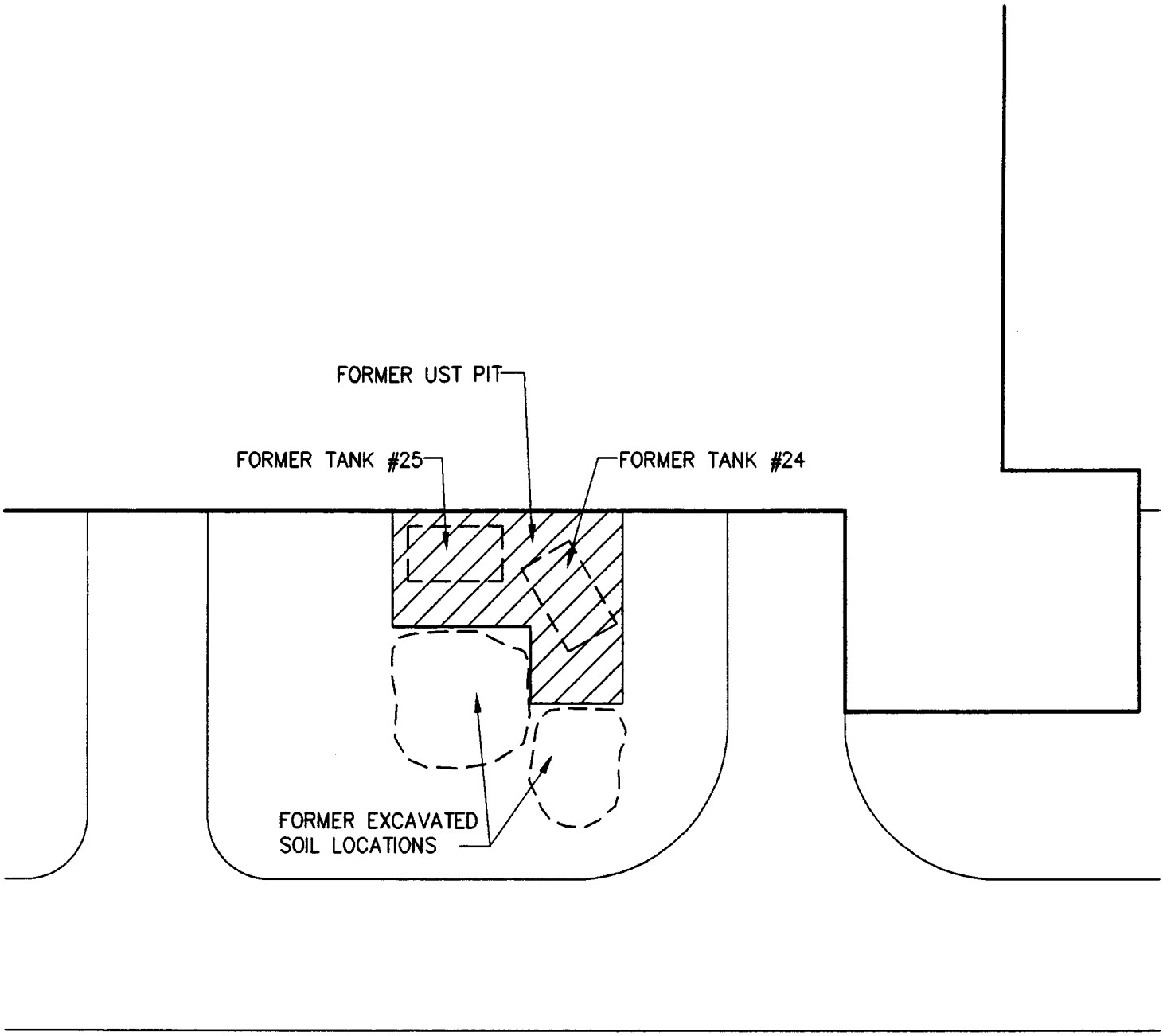
URS CONSULTANTS

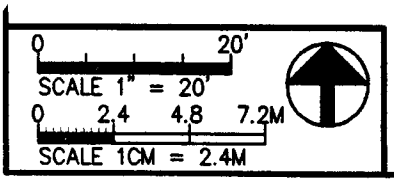


NASA Lewis Research Center
Plum Brook Station and SPF

Figure 3-3
Groundwater Elevation
Contours - May 1991

URS CONSULTANTS





NASA Lewis Research Center
SPF, Plum Brook Station

Figure 3-4
Extent Of
Operations

URS CONSULTANTS

M:\8705900\C FIG3-4

Table 3-1

Chemicals Managed at Tank #24
Space Power Facility, Plum Brook Station

CHEMICAL	HAZARDOUS WASTE CODE
acetone	F003
2-butanone	F005
carbon tetrachloride	F001,F002
methanol	F003
methylene chloride	F001,F002
1,1,1-trichloroethane	F001,F002
trichloroethene	F001,F002
trichlorofluoromethane	F002

Table 3-2

Chemicals Potentially Managed at Tank #24
Space Power Facility, Plum Brook Station

Chemical
butylbenzene
2-chlorotoluene
1,2-dichlorobenzene
1,1-dichloroethane
1,1-dichloroethene
cis-1,2-dichloroethene
trans-1,2-dichloroethene
2-hexanone
isopropylbenzene
isopropyltoluene
4-methyl-2-pentanone
naphthalene
propylbenzene
tetrachloroethene
toluene
1,2,3-trichlorobenzene
1,2,4-trichlorobenzene
1,1-trichloroethane
1,2,4-trimethylbenzene
1,3,5-trimethylbenzene
xylenes

Table 3-3

Soil Analytical Results, UST Closure Assessment, September 1989
Space Power Facility, Plum Brook Station

CHEMICAL	HIGHEST CONCENTRATION ug/kg	SAMPLE NUMBER
trichlorofluoromethane	93	SS2
1,1- dichloroethene	22	SS1
methylene chloride	164	SS5
trans-1,2-dichloroethene	17	SS2
1,1 dichloroethane	228	SS1
cis-1,2 dichloroethene	362	SS2
1,1,1-trichloroethane	1254	SS5
carbon tetrachloride	213	SS5
1,2- dichloroethane	5	SS8
benzene	11	SS8
trichloroethene	1432	SS5
toluene	16	SS1
tetrachloroethene	342	SS1
ethylbenzene	45	SS1
m & p-xylenes	43	SS1
o-xylene	33	SS2
isopropylbenzene	31	SS1
n-propylbenzene	76	SS1
1,3,5 trimethylbenzene	496	SS1
4-chlorotoluene	3	SS8
2-chlorotoluene	3	SS8
tert-butylbenzene	70	SS1
1,2,4- trimethylbenzene	541	SS1

Table 3-3 (Continued)

CHEMICAL	HIGHEST CONCENTRATION ug/kg	SAMPLE NUMBER
sec-butylbenzene	37	SS1
p-isopropyltoluene	74	SS1
1,2- dichlorobenzene	8	SS2
1,2,4 trichlorobenzene	10	SS4
napthalene	1094	SS1
1,2,3- trichlorobenzene	40	SS8
acetone	54	SS9
carbon disulfide	1	SS9
4-methyl-2-pentanone	10	SS9
2-hexanone	39	SS9
1,1,2-trichloroethane	11	SS3

Table 3-4

Soil Analytical Results, Site Assessment, October 1990
Space Power Facility, Plum Brook Station

CHEMICAL	HIGHEST CONCENTRATION ug/kg	SAMPLE NUMBER
methylene chloride*	71	SP-SB06
acetone*	130 B	SP-SB06
trichloroethene	2 J	SP-SB02
naphthalene	56 J	SP-SB06
2-methylnaphthalene	670	SP-SB06
endosulfan sulfate	55 B	SP-SB02
phenanthrene	330 J	SP-SB06

* Probable Laboratory Contaminants
J Estimated, Value Below the Quantitation Limit
B Analyte Found in Associated Blank

Table 3-5

Soil Analytical Results, Phase II UST Study, April 1993
Space Power Facility, Plum Brook Station

CHEMICAL	MAXIMUM CONCENTRATION ug/kg	SAMPLE NUMBER
acenaphthene	302	B-4 2'-4'
benzo(k)fluoranthene	216	B-1 0'-2'
chrysene	918	B-2 0'-2'
phenanthrene	186	B-4 6'-8'
pyrene	315	B-2 6'-8'
toluene	4.94	B-2 6'-8'
1,1,1-trichloroethane	21.7	B-4 2'-4'
m & p- xylenes	2.15	B-2 6'-8'

J Estimated, Below Quantitation Limit
B Analyte found in Associated Blank

Table 3-6

Groundwater Analytical Results, Phase II UST Study, April 1993
Space Power Facility, Plum Brook Station

CHEMICAL	MAXIMUM CONCENTRATION ug/L	SAMPLE NUMBER
acenaphthene	1.66	MW-1-A
acenaphthylene	1.33	MW-1
benzene	0.808 J	EB-2
1,1-dichloroethane	0.917 J	MW-1
dichlorodifluoromethane	1.08 B	MW-1-A
phenanthrene	1.42	EB-1

J Estimated, Below Quantitation Limit
B Analyte found in Associated Blank

4.0 SAMPLING AND ANALYSIS PLAN

This section of the Closure Work Plan details the methods which will be employed during field investigation and data collection activities in support of site closure. The objective of the sampling program is to determine the extent and concentration of contamination in the soil and groundwater at the SPF and to collect enough data to conduct a risk assessment. Field operations that will be conducted at the SPF will include:

- collection of soil samples to be used to establish background conditions for inorganics in the soil;
- collection of site soil samples which will determine the extent and concentration of potential contamination in the soil;
- installation of three downgradient groundwater monitoring wells;
- sampling of one existing upgradient and the three downgradient monitoring wells to determine extent and concentration of potential contaminants in the groundwater.

Figure 3-4 shows the area of former waste management operations at the SPF. The figure identifies the extent of the former tank excavation and the location and approximate extent of two waste piles created through the direct placement of excavated soil on the ground. NASA intends to sample and characterize the soil in and adjacent to the former tank cavity and the soil below the former waste piles. NASA also intends to sample away from the tank excavation and waste piles, circumscribing the waste management unit until the full extent of contamination has been identified.

Appendix A contains a generic Hazardous Waste Operations Health and Safety Plan. The contractor will provide their own site-specific health and safety plan, which will be reviewed and approved by NASA Health and Safety personnel prior to initiation of field work.

4.1 SOIL SAMPLING

Soil samples will be collected at SPF for two distinct purposes: 1) Background soil samples to establish background concentration of inorganics in soil, and 2) Site soil samples to determine the extent and concentrations of contaminants in soil for comparison to remediation standards.

4.1.1 Background Soil Samples

Figure 4-1 shows the tentative location of 12 sample points which will be used to establish background conditions for naturally occurring compounds in the soil at the SPF. A soils map of Plum Brook Station was used to determine the location of sample points where the:

- background soil horizon is similar to SPF;
- background soil samples have not been affected by the SPF waste management unit or any other waste management operation;
- sample locations are representative of the matrix of interest.

Final locations will be selected during the field effort to avoid ditches, railroad tracks, roadways or other waste management units.

4.1.2 Site Soil Samples

Site samples will be used to determine the extent and concentration of chemical contamination at the SPF. The samples will also be used to support risk assessment and determine remedial goals if remediation is necessary.

Soil sample locations will be selected in an effort to determine the full horizontal and vertical extent of all potential contaminants in the soil including those previously specified in Table 3-1. Sampling will proceed until the full extent is adequately determined. Rectangular grid sampling will be conducted in the horizontal (x - y) plane utilizing the algorithm presented in Section 3.13 of the OEPA Closure Plan Review Guidance. A grid interval for soil sampling in a "Hot Spot" contamination scenario has been developed as follows:

Step 1: Determine the Potency of Carcinogens

CHEMICAL	POTENCY Slope Factor(mg/kg-d)$^{-1}$	SCORE
benzene	2.90E-02	1
bis(2-ethylhexyl)phthalate	1.4E-02	1
carbon tetrachloride	1.3E-01	2
1,4-dichlorobenzene	2.4E-02	1
1,2-dichloroethane	9.1E-02	2
methylene chloride	7.5E-03	1
trichloroethene	1.1E-02	1
7 chemical constituents	Total Score	9
Average Score = Total Score/Chemical Constituents = 9/7=1.29		

Step 2: Determine the Potency of Systemic Toxicants

CHEMICAL	POTENCY RfD(mg/kg-d)	SCORE
acetone	1E-01	1
bis (2-ethylhexyl)phthalate	2E-02	1
butylbenzylphthalate	2E-01	1
carbon tetrachloride	7E-04	3
carbon disulfide	1E-01	1
cis-1,2-dichloroethane	1E-02	2
dibromochloromethane	2E-02	2
1,1-dichloroethane	5E-01	1
isopropylbenzene	4E-02	2
ethylbenzene	1E-01	1
methanol	5E-01	1
methylene chloride	6E-02	1
methyl ethyl ketone	6E-01	1
naphthalene	4E-02	2
2-chlorotoluene	2E-02	2
1,1,1-trichloroethane	9E-02	1
1,2-dichlorobenzene	9E-02	1
4-methyl-2-pentanone	8E-02	1
di-n-octylphthalate	2E-02	2
1,2,4-trichlorobenzene	1E-02	2
toluene	2E-01	1
tetrachloroethene	1E-02	2
xylene	2E+00	1
23 chemicals with RfDs	Total Score	33
Average= Total Score/Chemical constituents = 33/23 = 1.43		

Step 3: Determine the Average Risk of Exposure (ROE)

RISK OF EXPOSURE (ROE)	SCORE
Facility has 24-hour guard and limited access.	1
Depth to groundwater is approximately four feet.	3
Soil Permeability is 10^{-7} cm/sec.	2
Unit design had no secondary containment and is considered outdated.	2
Adjacent land use is a mixture of residential and agricultural	3
Presence of contaminants has been confirmed.	3
Contaminant K_{OC} is > 2 mg/l.	1
Average ROE = Total Score/Exposures = 15/7 = 2.14	Total Score = 15

Step 4: Determine the Soil Sampling Intensity Matrix

SOIL SAMPLING INTENSITY MATRIX	
CRITERION	**Sample Intensity Factor (SIF)**
Potency of Carcinogens	1.29
Potency of Systemic Toxicants	1.43
Average ROE	2.14
Composite SIF = (1.29 + 1.43 + 2.14) =	4.86

Step 5: Determine the Grid Interval for Soil Sampling

GRID INTERVAL FOR SOIL SAMPLING	
COMPOSITE SIF	**GRID INTERVAL**
< 4	24 Feet
4 - 6	16 Feet
> 6	11 Feet

By utilizing the above algorithm, a composite SIF of 4.86 is computed. A composite SIF of 4.86 will require a 16 feet sampling grid to be used as a guide in defining the extent of soil contamination at the SPF. The grid will be laid out over the area of concern and a discrete sample will be collected at each grid intersection.

Soil samples at each grid intersection will be collected at intervals of 0-1 foot and from 2 feet above the bedrock, at approximately 6-8 feet. Intervals for soil sampling are based on the following criteria:

- The waste management unit at the SPF was an underground storage tank. Surficial or shallow samples generally would not be taken to characterize a UST site because the waste is stored at a depth below the surface. A release of waste would be detected at depth, especially considering the fact that most of the chemicals suspected of being stored in the tank are heavier than water. However, when the USTs were removed in 1989, the soil surrounding the former USTs was excavated and placed on the ground surface adjacent to the tank excavation - thus creating a waste pile. Though the waste piles have been removed, it is necessary to sample the soil directly below and adjacent to the former piles to determine if any waste remains at the site or if any waste has leached to the shallow soil. Shallow soil samples (0-1 foot) will be collected to examine the soil directly below the waste piles and to define the extent of potential soil contamination resulting from the waste piles.

- It is proposed that samples be collected at a depth interval just above the soil/bedrock interface (approximately 6-8 feet) to characterize and define the vertical extent of potential waste solvents released from the tank. Soil samples will be collected at this interval to target the depth at which contaminants would appear in the soil from the UST. It also targets the area just above the shale bedrock. The shale could act as an aquitard and many of the solvents stored in the UST could accumulate along this boundary in the saturated zone, possibly flowing downgradient with the groundwater.

The sample locations shown on Figure 4-2 are the minimum number of locations on the grid that will be sampled. The grid will be expanded outward and additional samples will be collected at grid intersections until the full extent of contamination has been determined. Laboratory analysis demonstrating non-detect in a soil sample will identify a horizontal and vertical extent of contamination. If shallow soil samples detect contamination, it will be necessary to sample the 1-2 foot interval for signs of contamination. If soil samples detect contamination at the 6-8 feet interval, it will be necessary to sample the underlying shale to determine the vertical extent of contamination. NASA will continue sampling in the horizontal and vertical directions until the full extent of contamination is determined.

4.2 GROUNDWATER MONITORING SYSTEM

4.2.1 Monitoring Well Location

The current groundwater monitoring network at the Space Power Facility identifies groundwater moving into the area beneath Building Nos. 1411 and 1441 from the northwest and the southeast, and forming an underground trough draining to the northeast. Eight to nine feet of overburden material at the Space Power Facility Area overlies grey shale bedrock. The overburden material is generally composed of grey mottled clayey silt, and based on previous well development and sampling, is a poor water bearing unit. In general, the static water elevation is approximately two feet above the bedrock. The tanks were situated in the saturated zone above the bedrock adjacent to the southwest wall of the building.

Six shallow monitoring wells are located at the SPF. Three monitoring wells are located at the south and southwest side of the building, well #PBS-SP-06, #PBS-SP-07, and #PBS-SP-05. Boring #PBS-SP-02 was not developed into a monitoring well. Three monitoring wells, #PBS-SP-03, #PBS-SP-

04, and #PBS-SP-07 are directly west of the building, and one monitoring well, PBS-SP-01, is approximately 450 feet away from the tank excavation to the northeast. The current groundwater monitoring network is insufficient to detect a release from the former UST area.

The new monitoring wells must be located at the limit of the waste management unit to detect a release, and to determine if the groundwater has been impacted. A direct north downgradient well from the tank excavation is not possible due to the presence of Building 1411; however, wells may be placed close to Building 1141. The closest northeast downgradient proposed well locations would be well #PBS-SP-08, #PBS-SP-09, and #PBS-SP-10 (Figure 4-3). An upgradient well #PBS-SP-06 exists directly to the south of the excavated tanks and can be used as the upgradient well. The Well #PBS-SP-06 is constructed at the same hydrostatic position as the current wells and will be at the same position as the proposed wells.

The wells will be shallow, approximately 8-9 feet in depth and screened five feet in the saturated zone directly above the bedrock. The rationale for determining the depth of the wells and well screens is based on identifying a contiguous water bearing zone that could be monitored for contamination migration from the former UST. The current wells were drilled to determine the uppermost saturated zone below the tanks.

This initial phase of groundwater monitoring will detect if there has been a release from the former UST area. Groundwater samples will be collected from each of the three proposed downgradient wells and from the existing upgradient well, #PBS-SP-06. If contamination is detected in the uppermost saturated zone, the need for monitoring the next deepest saturated zone in order to identify vertical extent of contamination will be evaluated.

4.3 ANALYTICAL PARAMETERS

The chemicals of concern have been identified in Tables 3-1 and 3-2. Soil and groundwater samples collected to define the extent and concentration of contamination and data used in support of site closure will be analyzed in the laboratory for all the contaminants of concern and their potential degradation products. Table 4-1 is a summary of samples which will be collected under this closure plan, the parameters for which they will be analyzed, and the analytical methods used. Section 4.7 of this report further identifies potential contaminants which will be analyzed and their method detection limits.

4.4 FIELD PROCEDURES

4.4.1 Soil Sampling

A stainless steel hand auger will be used to collect soil samples used in the determination of background levels for inorganics. Prior to initial sample collection and between all borings, the auger will be decontaminated as described in Section 4.5. At each background sample location, all organic debris (leaves, grass) will be removed from the upper one inch of soil. The hand auger will be rotated with downward pressure to retrieve the soil sample. Soil will be collected from the full length of the 0-1 foot boring and placed in a decontaminated stainless steel mixing bowl. The soil in the bowl will be homogenized and the required quantity placed in the proper laboratory supplied container. The sample will be labeled and placed in a cooler with ice prior to shipment to the lab.

The use of a hollow-stem auger drilling rig will be employed in the collection of all site soil samples. The use of a hollow-stem auger is a standard method of subsurface drilling which enables the recovery of an undisturbed representative subsurface samples for soil description and laboratory testing. The borings will be advanced by rotating the augers the desired depth into the subsurface. Samples will be collected continuously with a stainless steel split-spoon sampler in accordance with American Society for Testing and Materials (ASTM) D-1586 procedure. The following procedures will be followed for split-spoon sampling:

- For the 0-1 foot sample interval, the split-spoon sampler will be attached to the drill rod and placed on the ground surface on the sample grid intersection. The drive head sub and hammer will rest on the drill rod.

- Two six-inch intervals will be marked on the rod stem to a reference point on the drill rig. The sampler will be driven into the ground with the 140 lb. hammer falling freely from 30 inches until the sampler has penetrated 12 inches. The number of blows per every six inches will be recorded. Fifty blows per six inch interval will indicate spoon refusal.

- The split-spoon will be pulled from the ground and opened to retrieve the soil sample. The portion of the sample to be used for VOC analysis will be immediately placed into the sample container. The remaining sample will be described and the percent recovery noted. Soil for the other sample parameters will be placed into their respective sample containers. If additional sample volume is required, another split-spoon will be advanced from 0-1 feet, using the same methodology, adjacent to the previous sample.

- The center plug will be attached to the drill stem, and the auger will be advanced to a depth of six feet. The plug will be removed, and the split-spoon will be attached to the drill stem and lowered to the bottom of the auger column. Four six-inch intervals will be marked on the rod stem to a reference point on the drill rig. The sampler will be driven into the ground with the 140 lb. hammer falling freely from 30 inches until the sampler has penetrated 24 inches. The number of blows per every six inches will be recorded. Fifty blows per six inch interval will indicate spoon refusal.

- The split-spoon will be pulled from the ground and opened to retrieve the soil sample. The portion of the sample to be used for VOC analysis will be collected first and immediately placed into the sample container. The remaining sample will be described and the percent recovery noted. Soil for the other sample parameters will be placed into their respective sample containers in the following order, SVOCs, metals and pH.

- The sample containers will be labeled and placed in a chilled cooler until onsite work has been completed, at which time the samples will be prepared for transport to the analytical laboratory.

- The split spoon sampler will be decontaminated between sample retrieval.

The drilling rig will be set up and operated in accordance with standard drilling practices and in a manner that will ensure the safe and efficient operation of the equipment. The drilling contractor will eliminate or prevent hydraulic system leaks, as well as lubricant and fuel leaks on the drill rig. All equipment used in the drilling operations will be steam-cleaned upon arrival at the site. All equipment and tools that come in contact with soil during drilling will be decontaminated before

resampling, moving to the next drilling location, or leaving the project site. Decontamination procedures are outlined in Section 4.5. Once sampling is complete, boreholes will be sealed with sodium bentonite chips to the ground surface elevation. The lithologic descriptions for the unconsolidated materials collected during sampling will be recorded in the field log book as follows:

- Names of unconsolidated materials shall follow the name of the predominant particle size (e.g., clay, silt, sand).

- Dimensions of the predominant and secondary sizes shall be recorded using the metric system.

- The grain size and name of the deposit shall be accompanied by the predominant mineral content, accessory minerals, color, moisture, density, plasticity, odor, particle angularity, and other characteristics.

- Symbols of the Unified Soil Classification System and ASTM lithologic symbols will be included with the description.

The Field Team members will document all drilling and sampling activities and observations in the field log book. Information will be recorded with indelible ink in a permanently bound notebook with sequentially numbered pages.

Information recorded will include:

- Location
- Date and Time
- Identity of people and subcontractor performing activities
- Weather conditions
- Boring identification
- Location of borings in relation to easily identifiable landmark, determined using a tape and compass
- Sampling intervals
- Blow counts
- Sample lithologic descriptions
- Collection time of samples
- Identity and calibration of field instruments
- Depth at which saturated conditions were encountered
- Termination depths of borings
- Field instrument readings, background, borehole, and samples
- Drilling method
- Size of downhole equipment
- Drilling rates.

4.4.2 Monitoring Well Installation

A drill rig utilizing a hollow stem auger will be employed, using 4.25 inch inside diameter (ID) auger flights, which will result in an approximate 8-inch diameter borehole. The borehole will be four inches larger than the well casing and screen allowing adequate space for the sand pack filter. The wells will be constructed using two inch (ID) stainless steel screen and riser. Five-foot well screens will be used. Screen and riser will be threaded flush joints. All well material will be

steam-cleaned prior to installation in the borehole. The screen slots will be sized to retain 90% of the sandpack material. The aquifer at the SPF is known to be very fine grained, and a 10-mm slot size will be used. The screened interval will extend from the top of the shale bedrock to approximately four feet from the ground surface and should intercept any floating, sinking or dissolved phase contaminant as the entire thickness of the aquifer will be screened.

The monitoring well boreholes will be advanced one foot into the shale bedrock. The auger plug will be removed, the augers will be raised incrementally, and No. 5 or 6 silica sand pack will be added. The incremental lifting of the augers and the emplacement of the sand pack will continue until the sand pack extends just above the shale/soil interface. At this point the well screen and riser pipe will be lowered into the auger flights to rest on the sand pack. The incremental lifting of the augers and emplacement of the sand pack will continue until the sand pack extends one foot above the screen. Periodic sounding with a decontaminated weighted tape will ensure a continuous sand pack.

After the sand pack has been emplaced and measurements ensure its proper vertical location, two feet of bentonite pellets will be placed as a seal on top of the sand pack. The bentonite seal will be hydrated with potable water. A cement and bentonite grout will be paced on top of the bentonite seal and will extend to two feet from ground surface. The cement and bentonite mixture will consist of 94 lbs. of Type I or II portland cement and five pounds pure bentonite per 6.5 gallons of potable water.

A protective surface casing capable of being locked to prevent unauthorized entry will be installed within 48 hours of well installation. A concrete pad with a minimum diameter of two feet will be built around the casing and will be sloped away from the monitoring well to ensure proper drainage.

All monitoring wells will be surveyed by an Ohio licensed surveyor to establish horizontal and vertical location. Vertical elevations will be determined for the ground elevation adjacent to the monitoring well and for the top of the inner well casing. The elevation of the riser pipes will also be taken at the highest point on the riser, and the riser will be notched at the point where the elevation is taken.

4.4.3. Well Development

Following completion of drilling and no sooner than 24 hours after well installation, each monitoring well will be developed by pumping or bailing until the discharged water is relatively sediment free and the indicator parameters (pH, temperature, and specific conductance) have reached steady state. Developing the well not only removes any sediment but also may improve the hydraulic properties of the sand pack. All drilling fluids, if any, used during well construction will be removed during development.

Development procedures are as follows:

Wells will be developed using surge blocks, bailers and/or pumps. All items used in well development will be decontaminated prior to use. Well development will proceed by repeated removal of water from the well until turbidity measures less than 5 NTUs and stabilization criteria are met or until a maximum of 10 well volumes have been removed. Stabilization is achieved when variation in temperature, pH and electrical conductivity is within ± 10 percent for a minimum of

three sequential samples. All measurements, including the volume of water removed, the discharge water color and physical criteria will be recorded in the field log book.

4.4.4. Groundwater Measurement

Groundwater measurements will be taken after all the wells have been installed, developed, and the water level allowed to recover to a static level. All groundwater measurements will be taken within a 24 hour period. Any condition that may affect the water levels will be recorded in the field log book. Water level measurements will be taken with a decontaminated electronic water level recorder. Groundwater levels will be measured to the nearest 0.01 foot. Static water level will be measured each time a well is sampled. The presence and thickness of any LNAPL or DNAPL will be measured with an electronic interface probe.

4.4.5 Groundwater Samples

In order for representative groundwater samples to be collected, groundwater wells must be adequately purged prior to sampling no sooner than 24 hours after development. Purging will require the removal of three to five volumes standing water in rapidly recharging wells, and at least one volume from wells with slow recharge rates.

Samples will be collected after the water level has recovered to 80 percent of its static level or between 16 and 24 hours after completion of purging, whichever occurs first. The upgradient monitoring well will be sampled first. Monitoring wells with highest levels of known contamination or suspected contamination will be sampled last.

Sampling procedures are as follows:

The well cover will be unlocked and carefully removed in a manner that prevents any foreign material from entering the well. The interior of the riser pipe and the breathing zone will be monitored for organic vapors using an OVM. If a reading of greater than 5 ppm is recorded, the well will be vented until levels are below 5 ppm before purging begins.

The water level below the top of the riser pipe or inner casing will be measured using an electronic water level indicator. All measurements will be recorded in the field log book. The total depth of the well and the depth to water will allow calculation of the volume of water in the well. The water level detector will be washed with detergent and water and rinsed with deionized water between wells.

A suction-lift, hydrolift pump, or bailer will be used to remove three to five times the well volume, measured into a calibrated pail. Dedicated new polyethylene discharge and intake tubing (3/8" I.D. low-density polyethylene) will be used for each well when a pump is used.

The well volume will be defined as the volume of water standing inside the casing measured prior to evacuation. The well volume in gallons will be calculated as follows:

> Where D = inner diameter of the casing in inches; A = total length of the well in feet; B = water level below the top of casing in feet; and 7.48 is the conversion factor from cubic feet to gallons.

$$V - 7.48 * \pi\left(\frac{D}{24}\right)^2 * (A - B)$$

Where D = inner diameter of the casing in inches; A = total length of the well in feet; B = water level below the top of casing in feet; and 7.48 is the conversion factor from cubic feet to gallons.

During this evacuation of the well, the intake opening of the pump tubing will be positioned just below the surface of the well water. If the water level drops, then the tubing will be lowered as needed to maintain flow. Pumping from the top of the water column will ensure proper flushing of the well. Pumping will continue until the required volumes are removed.

If the well purges to dryness and recharges rapidly (within 15 minutes), water will continue to be removed as it recharges until the required volumes are removed. If the well purges to dryness and is slow to recharge (greater than 15 minutes), evacuation will be terminated. Purged water will be collected in 55 gallon drums or temporary storage tanks. Storage containers will be labeled with monitoring well identification and date. The disposal method of the water will be determined based on the results of the laboratory analysis. The handling and disposition of waste water is discussed in Section 4.6.3.

Measurements for pH, turbidity, temperature, and conductivity will be taken and recorded initially and after each ½ well volume has been purged. The stability of these measurements with time will be used to guide the decision to discontinue purging. If the parameters have not stabilized after 6 well volumes have been removed, purging will be discontinued.

After well purging is completed and the well has recharged sufficiently, a sample will be collected with a disposable teflon bailer and placed into the appropriate laboratory supplied containers and preserved, if required. The bailer will be attached to a clean, dedicated ¼-inch nylon line. The bailer will be lowered slowly and retrieved gently to minimize splashing or jarring. Sample containers will be filled slowly using a bottom emptying device.

Samples will be collected in the following order of volatilization sensitivity: VOCs, SVOCs, metals, and pH.

VOC vials will be carefully filled until there is a convex meniscus over the top. After the cap is replaced, the vial will be inverted and gently tapped to verify that no air bubbles are entrapped in the sample. If air bubbles are present the vial will be discarded and a new sample will be collected into a new vial.

Duplicate samples will be collected using the same sampling equipment.

All sample bottles will be labeled using waterproof ink with date, time of collection, sample designation, and analysis to be performed. The samples will be placed in a cooler with ice.

The following information will be recorded in the field log book each time a well is purged and sampled:

- Depth to water before and after purging
- Well bore volume calculation
- Sounded total depth of the monitoring well
- The thickness of any phase separated hydrocarbons
- Field parameters, such as pH, temperature, specific conductance, and turbidity, including the date and time of each set of reading
- Total purged volume
- Date and time of sample collection and parameters sampled for.

4.4.6 Sample Handling

Completed chain-of-custody forms placed inside self-sealing bags will be taped to the underside of the cooler lids. The front and back of cooler lids will be custody sealed and taped closed. All sealing, labeling, and chain-of-custody procedures will conform to SW-846, 3rd Edition, 1986. Samples will be shipped on a daily basis to the analytical laboratory by an overnight courier. Shipments will be labeled and documented in accordance with applicable Ohio EPA and Department of Transportation (DOT) Regulations. The individual leading the sampling effort will contact the laboratory daily to verify receipt of samples. Upon completion of analyses, copies of fully-executed chain-of-custody forms will be returned to the contractor performing the sampling.

All sampling and analysis will be conducted in accordance with rigorous QA/QC procedures. Field QA/QC will include field blanks, field duplicates, equipment rinse samples, and trip blanks. Laboratory QA/QC will include duplicates and spikes. Further detail on field and laboratory QA/QC can be found in Section 4.7.

4.5 DECONTAMINATION PROCEDURES

To ensure that cross-contamination or outside contamination will not be introduced into the sample, all equipment used during the field investigation will be decontaminated. All decontamination will be performed in a specified area on a water-tight decontamination pad established during mobilization. All decontamination water will be collected and containerized. The following cleaning protocols will be applied:

4.5.1 Decontamination Facility

A decontamination facility for large and small sampling equipment will be constructed in the paved area south of Building 1411 during site mobilization. A scaled drawing of the decontamination facility is presented in Figure 4-4. The facility will be delineated with orange fencing and appropriate signage as part of the contamination reduction zone. The equipment decontamination facility will be constructed on a sound base capable of supporting a drill rig. The base of the facility will be constructed of a 20 mil high density polyethylene (HDPE) liner draped over straw bales and sloped to a sump. Rinse water will flow into the sump and will be pumped into 55 gallon drums for temporary storage. The drums will be labeled for contents and dated pending analytical results prior

to disposal. A single sheet of HDPE will be used to cover the entire base of the decontamination facility. The sheeting will be weighted down on the hay bales by decontamination facility sand bags or other devices to secure the plastic in place at all times including periods of high winds. The liner will be visually inspected prior to use on a daily basis to detect possible failures of the liner material. This liner will be inspected for:

- evidence of tears and holes;
- evidence of seepage;
- that the sheeting is adequately fastened to the side walls;
- that the liner adequately covers the straw bales at the end sections and is secured by sandbags; and
- that expected quantities of generated liquids can be contained until collected for disposal.

If any damage is detected, the decontamination facility will be repaired or replaced before further use. Records will be maintained specifying decontamination facility construction materials and methods, disposition of liquids, and any repairs and/or breaches of liner integrity.

At the completion of all field activity and after all equipment has received its final decontamination, the decontamination facility will be decontaminated with a high pressure or steam cleaning. All materials used in construction (hay bales, sand bags, lumber) that did not come into contact with potentially contaminated rinsate may be reused. Prior to leaving the site, the liner will be cut into manageable pieces and disposed along with the personal protection equipment that will be disposed with the soil cuttings. When the decontamination facility is dismantled, the underlying soil will be visually inspected for signs of contamination (seepage). Evidence of a potential release will require the same sampling and analyses as describe in the closure work plan to ensure that no spread of contamination has occurred through decontamination activities.

4.5.2 Decontamination of Large Equipment

The drill rig and drilling equipment will be steam cleaned upon arrival at the site, between boreholes, and prior to leaving the site. The following will be used to decontaminate the rig, augers, pipe, and rods:

- Clean external surfaces of equipment with a steam cleaner or high-pressure hot water and Alconox, or equivalent laboratory grade detergent. If necessary, scrub until all visible signs of contamination (primarily soil) have been removed. Inside surfaces of augers and pipes will also be cleaned.
- Rinse with potable water.
- Allow equipment to air dry.

4.5.3 Decontamination of Sampling Equipment

The following procedure will be used to decontaminate split-spoon samplers, bailers, and other tools:

- Scrub the equipment with a solution of potable water and Alconox, or equivalent laboratory-grade detergent.

- Rinse with potable water.

- Rinse with American Society for Testing and Materials (ASTM) Type II Reagent Water (deionized water).

- Allow equipment to air dry on a clean surface or on a rack elevated at least two feet above the ground.

- If equipment will not be used immediately, wrap in aluminum foil.

4.6 PROCEDURES FOR HANDLING AND DISPOSITION OF WASTE GENERATED THROUGH CLOSURE PLAN ACTIVITY

Three types of waste will be generated during closure activity: 1) Contaminated soil generated as soil cuttings during soil sample collection; 2) Potentially contaminated rinsate water generated through decontamination procedures and water generated through development/purging of monitor wells; and 3) Personal protection equipment and other waste such as plastic from decontamination activity. The procedures for handling and disposing of each type of waste are described in the following sections. All waste containers will be labeled, dated, manifested, placarded, and transported in accordance with all applicable Ohio EPA and DOT regulations. Copies of executed manifests and certificates of treatment and/or disposal, as appropriate, will be obtained by NASA and will be submitted with the closure documentation.

4.6.1 Contaminated Soil

All soil generated in the course of closure activity will be placed in DOT 17H containers for off-site disposal. The drums will be identified as to the contents, the boring from which the waste was generated, and dated. All soil will be managed as hazardous waste in accordance with the land disposal restriction requirements applicable to the chemical constituents present until demonstrated otherwise. The soil will be sampled and analyzed for soil disposal parameters identified on Table 4-1. The soil may be considered hazardous by characteristic or by listed hazardous constituent. If the soil is nonhazardous, it will be transported offsite and disposed as solid waste. Hazardous waste will be transported offsite and disposed. It is anticipated that ten, 55-gallon drums of soil will be generated during closure activity. Appropriate offsite facilities able to accept, treat, and dispose of contaminated soil are identified in Section 4.6.4.

4.6.2 Personal Protection Equipment and Decontamination Material

Equipment such as tyvek, gloves, plastic sheeting, disposable booties, bailers, etc. will require disposal at the completion of work activity. These discarded materials will be placed in plastic bags and disposed along with the soil from the borings with which they were generated, as long as they are consistent with that waste stream.

4.6.3 Rinsate Water and Monitoring Well Development/Purge Water

Rinsate water will be generated during decontamination procedures, which should eliminate the potential of cross-contamination during sampling activity. The bulk of the decontamination fluid will be generated during decontamination of the drill rig and auger flights. Fluids should be kept to a minimum through the use of a steam cleaner or sprayer which utilizes a high pressure/low volume wash.

It is expected that approximately 200 gallons of rinsate will be generated through decontamination. The rinsate will be pumped and poured into temporary storage containers which will be labeled for contents and date of generation. At completion of the work activities, the containers will be sampled and analyzed for the disposal parameters identified on Table 4-1. If analytical results indicate the water is non-hazardous, permission will be sought to discharge the rinsate to the PBS sanitary sewer system. Hazardous rinsate will be transported off-site to a disposal facility capable of handling hazardous liquids.

The new monitoring wells installed to support closure will require development, and all wells to be sampled will require purging. As mentioned previously in this report, the uppermost aquifer that will be sampled is a poor water bearing unit and monitor wells are slow to recharge. Development and purge water from each newly installed well will be temporarily stored in 55-gallon drums. The drums will be labeled to identify from which monitor well the water was generated and the date which it was generated. Based on previous well development activity at the SPF, it is anticipated that less than one drum will be generated from each well. All purge water from the existing wells will be contained in the same temporary storage container. All existing wells have been previously sampled and were determined to be clean based on laboratory analytical results and will be managed as one waste stream. Disposal will be based on laboratory results and will be handled in a similar method as rinsate water.

4.6.4 Identification of Off-Site Waste Management Facilities

All the wastes generated during closure activities could be contaminated with organic compounds and may require treatment to ensure that land disposal restriction requirements are met for all constituents. For contaminated soils, the following facilities have the appropriate permits and treatment technologies to handle the anticipated waste types and contaminants:

Laidlaw Environmental Services: incineration, stabilization, and land disposal.
1-800-251-1227

Trade Waste Incineration: incineration, land disposal.
1-618-271-2804

If aqueous waste can not be discharged to the PBS sanitary sewer system, the following facility can be used for waste treatment and/or disposal:

Chemtron Corporation
1-216-871-8048

Solid (non-liquid) wastes that meet the land disposal restriction requirements may be sent for pretreatment prior to disposal at:

4.7 INTERNAL QUALITY CONTROL CHECKS FOR FIELD AND LABORATORY OPERATIONS

4.7.1 Field Quality Control

QC samples collected include equipment blanks (or field blanks), field duplicates/replicates, and trip blanks. Definitions for these samples are listed below.

4.7.1.1 Equipment Blanks - An equipment blank is Type II, reagent-grade water (preferably supplied by the laboratory) that is poured into or pumped through the sampling device after decontamination has been performed, transferred to the appropriate sample container(s), and transported to the laboratory for analysis. All parameters performed on the associated field samples are required to be performed on the equipment blank. One equipment blank shall be collected for every ten environmental samples.

4.7.1.2 Field Duplicate Samples - A field duplicate sample is a second sample collected independently at the same location as the original sample during a single act of sampling. Duplicate sample results are used to assess precision, including variability associated with both the laboratory analysis and the sample collection process. Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. Ten percent of all water samples shall be field duplicates. Both duplicates shall be analyzed for the same parameters in the laboratory.

4.7.1.3 Field Replicate Samples - A field replicate sample is a single sample divided into two equal parts for analysis. Replicate sample results are used to assess precision, including variability associated with both the laboratory analysis and the sample collection process. Replicate samples are treated in an identical manner during storage, transportation, and analysis. Ten percent of all soil samples shall be field replicates. Both replicates shall be analyzed for the same parameters in the laboratory.

4.7.1.4 Trip Blanks - A trip blank is a volatile sample vial filled in the laboratory with organic-free water (Type II, reagent grade water), transported to the site, handled like a sample, and returned to the laboratory for analysis. Trip blanks are prepared only for volatile samples and are subjected to the same handling as other samples. Trip banks shall not be opened in the field. Trip blanks serve to identify contamination from sample containers or transportation and storage procedures. For every cooler containing soil or water samples collected for VOC analysis, one trip blank will be added to the cooler and analyzed for the presence of VOCs.

4.7.2 Laboratory Quality Control

The principle criteria for verification of data quality is the continuous monitoring of analytical accuracy, precision, and overall method performance through systematic analysis of quality control samples. Each analytical method used in the laboratory utilizes specific quality control procedures to continually monitor acceptable analytical method accuracy and precision. These method quality

control procedures involve the mandatory systematic insertion of quality control samples into 10% of all laboratory analysis, in addition to strict adherence to instrument performance and calibration specifications. These procedures are thoroughly detailed in the laboratory Standard Operating Procedures (SOPs) and are based upon USEPA methods guidance.

The following subsections identify the types of laboratory QC terminology and QC samples and how they are evaluated.

4.7.2.1 Analytical Batch - An analytical batch consists of samples (not to exceed 20) that are similar in composition (matrix), extracted or digested at the same time and with the same lot of reagents. For each preparation batch, one method blank and an Laboratory Control Sample (LCS) must be included. When required, each sample must be spiked with the method-specified surrogates. The identity of each preparation batch shall be unambiguously reported with the analytical data so that the reviewer can identify the QC samples and the associated environmental samples.

4.7.2.2 Calibration Standards - Initial calibration is performed as required for each analytical method, usually using a range of calibration standards with the low standard at or near the PQL for that analyte. These standards are used to determine the quantitation range for each instrument. Initial and continuing calibration standards must include all target analytes.

4.7.2.3 Method Blanks - A method blank is defined as laboratory-demonstrated analyte-free water that is carried through the entire analytical procedure. A method blank is prepared and analyzed for each batch of samples for all applicable parameters. The method blank is used to determine the level of laboratory background contamination. Unfavorable method blank performance renders associated data suspect and requires corrective action and/or data qualification.

4.7.2.4 Matrix Spike/Matrix Spike Duplicate Samples - An aliquot of a matrix (water or soil) is fortified (spiked) with a known concentration of the compounds of interest or (for organic analyses) a representative subset of the target analytes. The matrix spike and matrix spike duplicate (MS/MSD) are subjected to the entire analytical procedure in order to indicate both accuracy and precision of the method for the matrix by measuring the percent recovery and the Relative Percent Difference (RPD) of the two spiked samples. These samples are used to assess matrix interference effects on the method, as well as to evaluate instrument performance. The MS/MSDs do not control the analytical process. Matrix spike/matrix spike duplicates are analyzed for each matrix for every 20 environmental samples in order to maintain continuous surveillance of acceptable method performance.

4.7.2.5 Duplicate Samples - A second aliquot of the sample is subjected to the same analytical procedure as the original sample in order to determine the precision of the method by measuring the RPD of the two results.

4.7.2.6 Laboratory Control Samples (LCS) - An aliquot of a contaminant free matrix is fortified (spiked) with known concentration of all compounds of interest or a representative subset. The laboratory prepares and analyzes a LCS for each batch of samples for all applicable parameters. The LCS is subjected to the entire analytical procedures in order to continuously evaluate method performance. Percent recovery determination from these check

samples are monitored to provide a continuous measure of each method's accuracy. Laboratory quality control charts are constructed from this data in order to monitor and compare actual check sample data with established laboratory method performance criteria. When an analyte in an LCS exceeds the control limits, corrective action must be performed. If corrective action is not performed the appropriate validation flag shall be applied to all affected results.

4.7.2.7 Surrogate Spike - A surrogate spike consisting of an organic compound that is similar to the target analyte(s) in chemical composition and behavior in the analytical process, but not normally found in environmental samples, is added to GC/MS analyses, GC volatile analyses, and GC pesticide and herbicide analyses to evaluate acceptable method performance. Surrogate spike recoveries must compare favorably to the laboratory performance limits in order for an analysis to be acceptable. Unfavorable surrogate spike recoveries render associated data suspect and require corrective action.

4.7.3 Quality Assurance Objectives for Chemical Measurements Data

The overall QA objective for this project is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will provide results which are legally defensible in a court of law.

Chemical measurements data are evaluated in terms of its precision, accuracy, representativeness, completeness, and comparability (PARCC). In addition, the sensitivity required for each analysis will be established and appropriate analytical methods selected prior to the initiation of analytical work.

4.7.3.1 Definitions - General definitions and methods for evaluating data in terms of the PARCC parameters and requirements for data sensitivity are given below. All data quality requirements and methods for evaluating data quality and accepting or rejecting data will be in accordance with USEPA guidelines.

4.7.3.2 Precision - The laboratory objective for precision is to equal or exceed the precision demonstrated for the applied analytical methods on samples of similar matrix. For this investigation, precision is evaluated using analyses of laboratory duplicates and/or matrix spike/matrix spike duplicates, which not only exhibit sampling and analytical precision, but also the reproducibility of the analytical results. Relative Percent Difference (%RPD) criteria are used to evaluate precision. In general, a matrix spike/matrix spike duplicate or duplicate sample will be prepared for analysis at a frequency based upon:

- each batch of field samples, or
- each 20 field samples in a batch, or
- each group of samples of a similar concentration level (soils only), or
- each 14 calendar day period during which samples in a batch were received (said period beginning with the receipt of the first sample in that batch), <u>whichever is more frequent</u>

Requirements for the %RPD for each analysis will be as set by the laboratory data quality requirements and chosen methodologies. The formula for calculating the %RPD is provided below.

$$\%RPD = \frac{(X1 - X2)}{(X1 + X2)/2} * 100$$

Where: X1 = the initial sample result
X2 = the duplicate result

Requirements for the %RPD for each analysis will be as set by the laboratory data quality requirements and chosen methodologies.

4.7.3.3 Accuracy - Percent recovery criteria determined from laboratory performance data are used to estimate accuracy based on recovery of the Laboratory Control Samples (LCS), surrogates, matrix spike, and matrix spike duplicate samples. The laboratory objective for accuracy is to equal or exceed the accuracy demonstrated for the applied analytical methods on samples of similar matrix. For volatile, semivolatile, and pesticide/PCB analyses, accuracy is also determined by the addition of surrogate standards to all environmental samples, blanks, and QC. The surrogates, spike, and spike duplicate will give an indication of matrix effects that may be affecting the target compounds, and are also a good gauge of the method efficiency. A LCS is performed with each batch of samples and must demonstrate that the process is in control. A matrix spike/matrix spike duplicate will be prepared for analysis at a frequency based upon:

- each batch of field samples, or
- each 20 field samples in a batch, or
- each group of samples of a similar concentration level (soils only), or
- each 14 calendar day period during which samples in a batch were received (said period beginning with the receipt of the first sample in that batch), <u>whichever is more frequent</u>

Requirements for the %Recovery for each analysis will be as set by the laboratory data quality requirements and chosen methodologies. The formula for calculating the %Recovery is provided below.

$$\%Recovery = \frac{(X - B)}{Z} * 100$$

Where: X = the total amount of the spiked compound found (for MS; spike plus sample concentration)
B = the unspiked sample result (0 for LCS)
Z = the true amount of compound spiked into the sample

4.7.3.4 Representativeness - Representativeness expresses the degree to which data accurately and precisely represent the environmental condition, characteristics of a population, parameter variation at a sampling point, or a process condition. The representativeness of the data from the sampling sites depends in part on the sampling procedures. The sampling procedures have been designed with the goal of obtaining representative samples for each of the different matrices.

Representativeness of the analytical data is also a function of the procedures used in processing the samples. Representativeness may be determined for this objective by a comparison of the quality control data for these samples other against other data for similar samples analyzed at the same time.

4.7.3.5 Comparability - Analytical results are comparable to results of other laboratories because of the following procedures and programs: instrument standards traceable to National Institute of Standards and Technology (NIST) or reputable sources; the use of standard methodology; reporting results from similar matrices in consistent units; applying appropriate levels of quality control within the context of the laboratory quality assurance program; and participation in interlaboratory studies to document laboratory performance. By using traceable standards and standard methods, the analytical results may be compared to other laboratories operating similarly. The QA Program documents internal performance. Periodic laboratory proficiency studies are instituted as a means of monitoring interlaboratory performance.

4.7.3.6 Completeness - The completeness of the sample set is defined as the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. The percent valid data will be expressed for each method analyte in each sample matrix. If a method provides results for multiple analytes (e.g., VOAs, SVOAs, metals, etc.), the percent Valid data for each analyte will be expressed. For completeness requirements, valid results are all results not qualified with an "R" flag. The formula for calculating percent Valid Data is provided below.

$$\text{Completeness} = \frac{A}{B} * 100$$

Where: X = the number of valid results
B = the total number of possible results

4.7.3.7 Goals - Equipment blanks, trip blanks, method blanks, duplicates, Laboratory Control Samples (LCS), and matrix spike samples will be analyzed to assess the quality of the data resulting from the field sampling and analytical programs.

The general level of the QC effort will be one field duplicate and one equipment blank for every 10 or fewer investigative samples. One volatile organic analysis (VOA) trip blank consisting of Type II, reagent grade water will be included along with each shipment of samples analyzed for volatile organic compounds (VOCs). The frequency of field QC samples to be collected are listed in Table 4-2.

The goals for completeness are 90% for soil samples and 95% for aqueous samples. For completeness requirements, valid results are all results not qualified with an "R" flag. If

there are any instances of samples that could not be analyzed for any reason (holding time violations in which resampling and analysis were not possible, samples spilled or broken, etc.), the numerator of this calculation would become the number of valid results minus the number of possible results not reported.

4.7.4 Analytical Procedures

4.7.4.1 Identification of Methods - Table 4-3 lists all analytical methods to be used for this project with the source for each method referenced.

4.7.4.2 Practical Quantitation Limits -

4.7.4.2.1 Terminology - Method Detection Limits (MDL) - 40 CFR 136, Appendix B defines the MDL as the "minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte."
Practical Quantitation Limits (PQL) - The PQL as defined in Chapter 1 of Test Methods for Evaluation of Solid Waste (SW846): "The lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions." PQLs must be supported by a MDL study, in which the determined MDL must be equal to or below the PQL.

4.7.4.2.2 Procedures - The laboratory shall establish method detection limits (MDLs) for each target analyte. The laboratory must demonstrate the MDLs for each method of analysis using the instructions defined in 40 CFR 136, Appendix B. The laboratories must verify the existing MDLs on an annual basis. The laboratory must also verify that the PQLs are routinely reported and reliably achieved by including a standard at or below the PQL as the lowest point on the calibration curve.

4.7.4.2.3 Reported Values - Tables 4-4 through 4-6 lists the method MDLs, PQLs, and reporting units for all methods to be used for this investigation. Laboratory-derived MDLs will be included once the contract laboratory has been selected. The laboratory is required to report concentrations down to the MDL. Any positive value which is between the MDL and the PQL must be qualified by the laboratory as estimated.

4.7.4.3 Method Calibration - Analytical instruments shall be calibrated in accordance with the specified methods. The multipoint calibration curve must include a standard at a concentration at or near the practical quantitation limits (PQL) listed in Tables 4-4 through 4-6. The initial and the continuing calibrations must include all target analytes reported (including multi-response analytes) for each method listed in Table 4-3. The initial calibrations must be checked at the frequency specified by the method and by a second source standard. These calibrations must meet the acceptance criteria of the specified method. Records of standards preparation and instrument calibration must be maintained in such a manner to unambiguously trace the preparation of standards, their use in calibration, and the quantitation of sample results. Inorganic calibration standards must be traceable to available National Institute of Standards and Technology (NIST) materials when available. Calibration

standards for organic analytes must be traceable to materials certified by Cooperative Research and Development Agreement (CRADA), NIST, Contract Laboratory Program-Standard Reference Material (CLP-SRM), or the American Association for Laboratory Accreditation (A_2LA) when available.

4.7.4.4 Sample Container, Preservation, and Holding Time Requirements - The selection of sample containers is based on both the media being samples and the analysis of interest. Table 4-7 summarizes the sample container requirements for various media and analytical parameters. In addition this table details the preservation requirements and holding times which will be followed to ensure integrity of all environmental samples.

4.7.5 Sample Custody

A sample is physical evidence collected from a site or from the environment. As such, each sample must be documented in a manner that makes it legally defensible and which provides all information necessary for proper analysis.

Custody is one of several factors which is necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. A sample or evidence file is "Under Custody" if:

1. It is in actual possession of a person, or

2. It is in the view of the person, after being in actual possession, or

3. It was in actual possession but is locked up to prevent tampering, or

4. It is in a designated and identified secure area.

Procedures to ensure the custody and integrity of samples are initiated at the time of sample collection and continue through sample transport, sample receipt, preparation, analysis and storage, data generation and reporting, and sample disposal. Records concerning the custody and condition of the samples must be maintained in field and laboratory documentation. The following sections discuss operations for sample handling and custody.

4.7.5.1 Field Operations - At the time of the sampling, the Field Team member will record the sample information in a logbook and on a chain-of-custody form, noting on each any difficulties encountered in sampling. All label, logbook, and chain-of-custody form entries shall be made in waterproof ink. The sample information recorded in the logbooks should be at least as detailed as that recorded on labels, and should indicate the type of sample (e.g., groundwater, soil, waste, etc.), preservation technique, and sampling location, in sufficient detail as to allow resampling at the same location.

Affixed to each sample container will be a non-removable (when wet) label. The following information will be written with permanent marker:

- Site name
- Sample identification
- Project number

- Date/time
- Sampler's initials
- Sample preservation
- Analysis required

After samples are collected, the Field Team member will place the filled containers in coolers. The field technician will maintain custody of all samples until they are shipped to the laboratory. Samples submitted to the laboratory are accompanied by the chain-of-custody to ensure adequate documentation. These forms are completed and sealed within the cooler to be opened and examined by the Laboratory Sample Custodian. Information to be included on the chain-of-custody is as follows:

- Client
- Project or Sampling Location
- Sample Identification Number or Designation
- Sample Description
- Sample Container Numbers and Volumes
- Cooler Identification Number
- Analysis Required
- Preservatives (if applicable)
- Signatures of Persons Involved in Chain-of-Custody
- Date and Time of Possession

All entries on the chain-of-custody form must correspond to the field log book and sample labels.

Custody seals are provided with the sample containers and are used to detect unauthorized tampering with samples prior to laboratory acceptance. Custody seals are affixed to the cooler in a manner that requires seal breakage in order to open the cooler. Unauthorized seal breakage indicates possible tampering and will render a sample suspect.

4.7.5.2 Laboratory Operations - The following information describes the laboratory operations for sample handling, identification, and sample custody records.

4.7.5.2.1 Sample Handling - Upon receipt in the laboratory, the integrity of the shipping container is checked by verifying that the custody seal on the cooler is not broken. Custody seals are used to detect unauthorized tampering of samples prior to laboratory acceptance. The custody seals are affixed to the sample transport container in a manner that requires seal breakage in order to open the container. Unauthorized seal breakage indicates possible tampering and will render samples suspect. Samples are to be maintained at 2°C to 6°C. When, in the judgement of the laboratory, the temperature of the samples upon receipt may have affected the stability of the analytes of interest, the problem must be discussed with the URS Project Manager. The samples are checked for breakage, leakage, damage, and the contents of the shipping container are verified against the chain-of-custody documentation. Custody seal integrity, temperature, and sample preservation must be documented. Any problems are documented on the chain-of-custody and/or in a format traceable to the sample(s) and the Project Manager is notified immediately. If the samples and documentation are acceptable, each sample is assigned a unique

laboratory identification number from the Laboratory Information Management System (LIMS) database. If the samples, documentation, or coolers are not acceptable, the Project Manager is notified. All corrective actions must be clearly documented.

The following sample information, at a minimum, is required and stored on LIMS:

- Date of sample collection
- Date of sample receipt
- Sample laboratory number
- Number of samples
- Source of samples
- Analytical test(s) requested
- Final disposition of the sample

When LIMS log-in has been completed, the samples are transferred to the appropriate storage areas with restricted access. Separate refrigerators are used for samples receiving analysis for volatile compounds. The sample refrigerators are maintained at 2°C to 6°C and their temperatures are recorded daily with thermometers calibrated against NIST thermometers.

Samples are retained for a minimum of thirty days after a laboratory report has been generated and mailed to the client. The samples are then transferred to a sample disposal area where they are then prepared for proper disposal. Final transfer from the sample control area to disposal must be documented in LIMS and/or in the final evidence files. Samples may be stored to meet specific project requirements if prior arrangements have been made with the laboratory.

4.7.5.2.2 Sample Identification - As discussed above, once samples have been received by the laboratory and the samples and corresponding documentation are determined to be acceptable, each sample is assigned a unique laboratory identification number. Samples are tracked through the laboratory with this number.

Sample analysis is performed by preparation batches or lots. Analyses which do not include a preparatory step are batched in the same manner at time of analysis. Analyses which require a preparatory step must be batched at time of sample preparation. Laboratory QC samples (e.g., blanks, LCS, MS/MSDs) must be included in the preparation batch with the environmental samples. A batch is a group of samples (not to exceed 20) that are similar in matrix and that are extracted or digested at the same time and with the same lots of reagents. The identification of each batch shall be unambiguously reported with the analyses so that the reviewer can clearly identify the QC samples with the associated environmental samples. The type of QC samples and the frequency of these samples are discussed in section 4.7.1 of this plan.

4.7.5.2.3 Sample Custody Records - All entries on the Laboratory chain-of-custody form must correspond to the Laboratory Sample Labels. The Laboratory is to maintain complete laboratory documentation measures to ensure the integrity and legal validity of all sample analytical results. These documentation measures

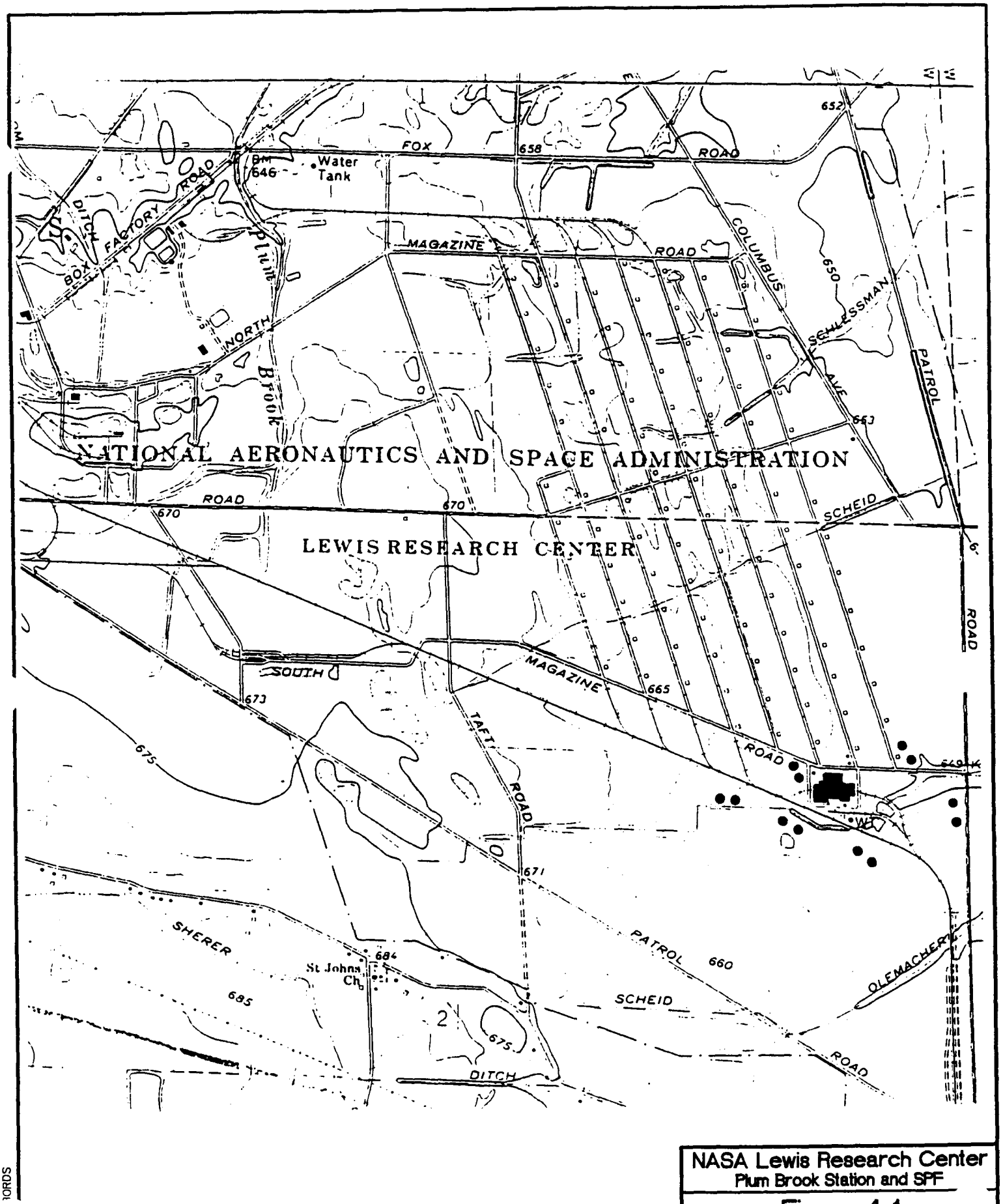
encompass all analytical activities to create a traceable, legal history of each sample's subsequent analysis. These records are retained in accordance to the Laboratory retention policy meeting state and regulatory requirements.

4.8 REVIEW OF LABORATORY DATA

All laboratory data generated are reviewed for accuracy and completeness by the laboratory prior to reporting. The analyst who generates the analytical data has the prime responsibility for the correctness and completeness of the data.

The review of laboratory data received from the laboratory shall focus on the following items:

- Chain-of-custody forms.
- Holding times. (If exceeded, evidence of resampling and analysis or written variances shall be noted.)
- Method calibration limits. (Reviewed to assure conformance to acceptance criteria and completeness of records)
- Method blanks.
- Laboratory verification of quantitation limits.
- Preparatory batch control records.
- Corrective actions. (Samples with out-of-control QC data shall be identified in the Technical Report and an assessment of the usability of the data shall be recorded.)
- Formulas used for analyte quantitation. (Formulas used and sample calculations shall be provided.)
- Examples of analyte quantitation. (Quantitation reports shall be reviewed to assure correctness and completeness of calculated results.)
- Completeness of data.
- Use of current control limits. Exceedances are identified.
- Field duplicate results.
- Field and laboratory blank results.
- Sample matrix effects.



NASA Lewis Research Center
Plum Brook Station and SPF

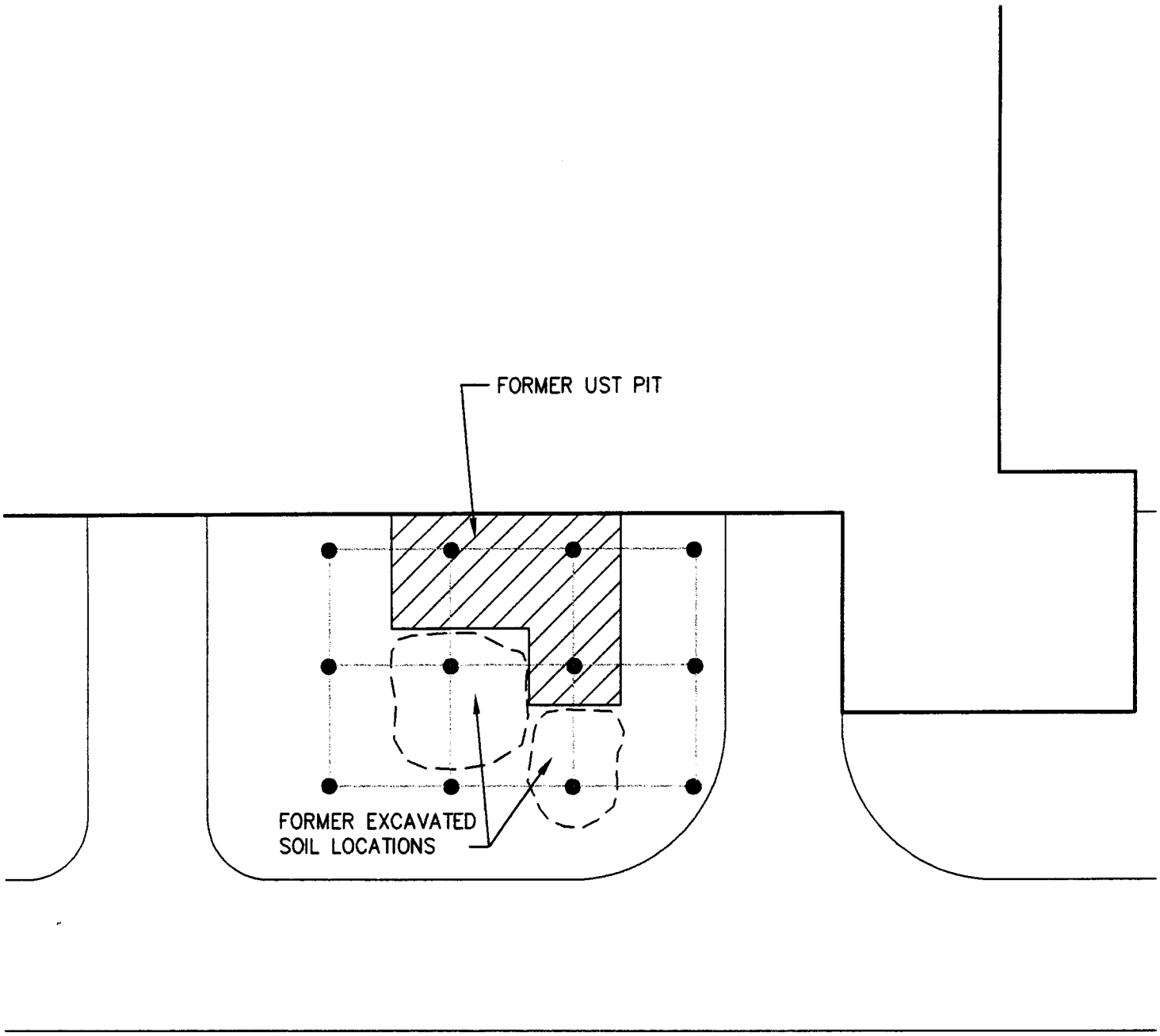
Figure 4-1
Background Soil Sampling Locations

URS CONSULTANTS

0 1500'
SCALE 1" = 1500'
0 180 360 540M
SCALE 1CM = 180M

LEGEND:
● SOIL SAMPLING LOCATION
SAMPLE INTERVAL 0-1'

M:\8705900\



LEGEND:

● SOIL SAMPLING LOCATION
SAMPLE COLLECTION INTERVALS
0-1' AND 6-8'

16' GRID

0 20'
SCALE 1" = 20'
0 2.4 4.8 7.2M
SCALE 1CM = 2.4M

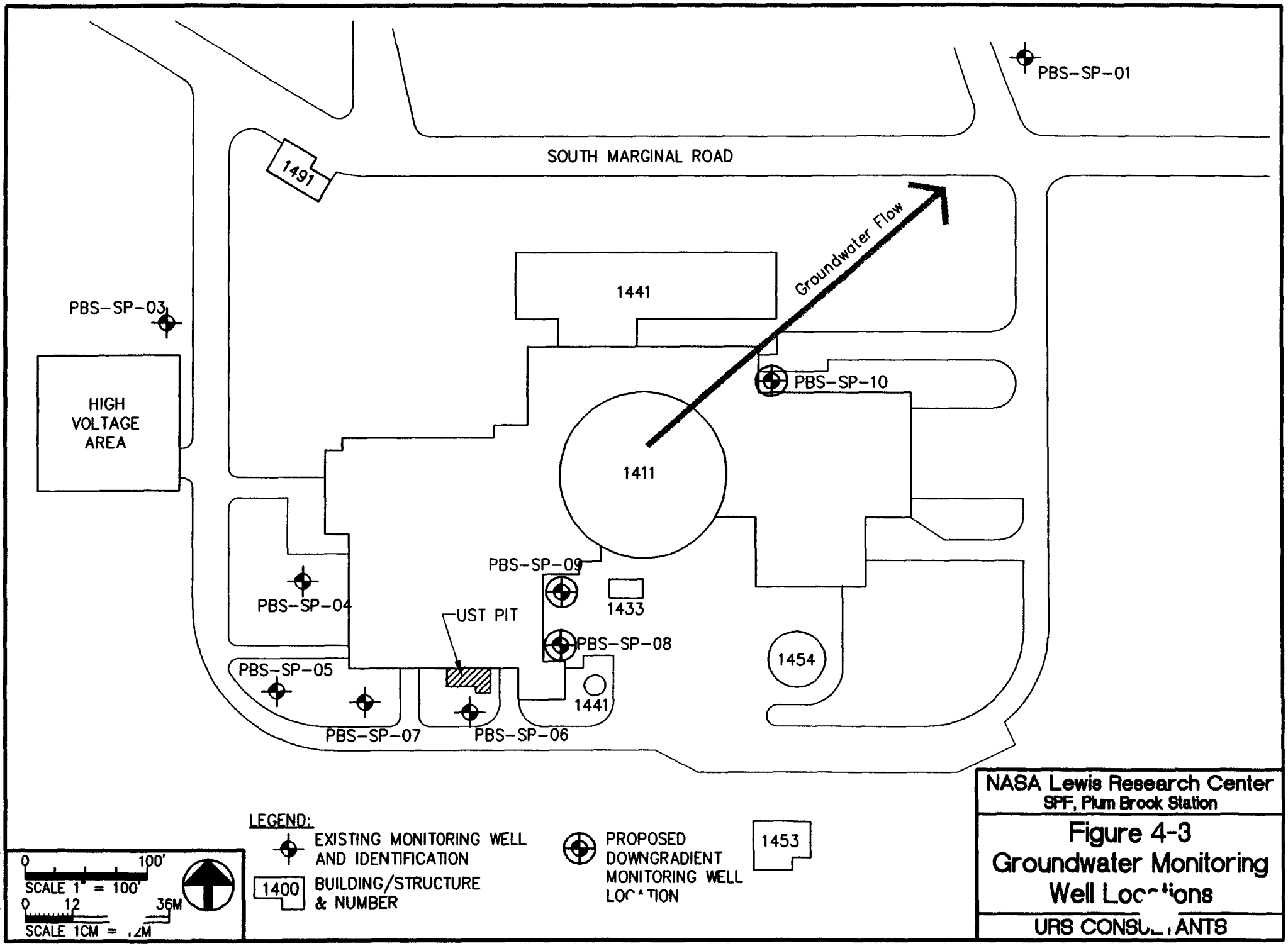
NASA Lewis Research Center
SPF, Plum Brook Station

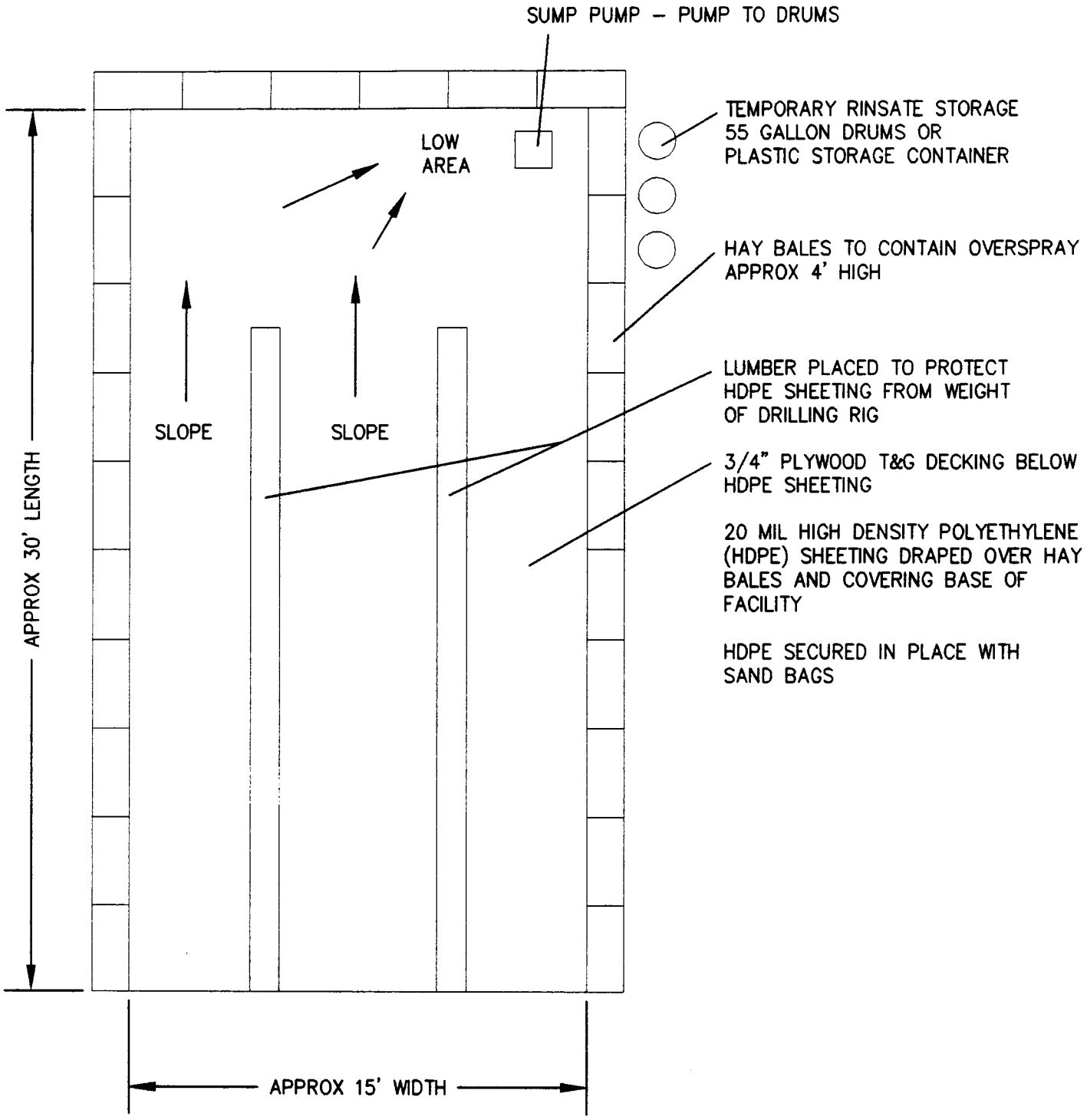
Figure 4-2
Soil Sampling
Plan

URS CONSULTANTS

1G4-2

M:\8705900\C


PBS-SP-01
SOUTH MARGINAL ROAD
1491
Groundwater Flow
1441
PBS-SP-03
HIGH VOLTAGE AREA
PBS-SP-10
1411
PBS-SP-09
1433
PBS-SP-04
UST PIT
PBS-SP-08
1454
PBS-SP-05
1441
PBS-SP-07
PBS-SP-06
LEGEND:
EXISTING MONITORING WELL AND IDENTIFICATION
1400
BUILDING/STRUCTURE & NUMBER
PROPOSED DOWNGRADIENT MONITORING WELL LOCATION
1453
0
100'
SCALE 1" = 100'
0
12
36M
SCALE 1CM =
NASA Lewis Research Center
SPF, Plum Brook Station
Figure 4-3
Groundwater Monitoring Well Locations
URS CONSULTANTS



FACILITY WILL BE CONSTRUCTED
IN PARKING LOT ADJACENT TO
BUILDING 1411,

0 5'
SCALE 1" = 5'
0 .6 1.2 1.8M
SCALE 1CM = .6M

NASA Lewis Research Center
SPF, Plum Brook Station

Figure 4-4
Decontamination
Facility

URS CONSULTANTS

M:\8705900\C FIG4-4

Table 4-1

Summary of Laboratory Analysis
Space Power Facility, Plum Brook Station

MEDIA TYPE	SAMPLE PARAMETER		SAMPLE METHOD[1,2]	
Background Soil Samples	RCRA Metals		RCRA Metals	
	arsenic	lead	SW7060	SW6010
	barium	mercury	SW6010	SW7471
	cadmium	selenium	SW6010	SW7740
	chromium	silver	SW6010	SW6010
Site Soil Samples	Volatile Organic Compounds		SW8260	
	Semi-Volatile Organic Compounds		SW3510B/3550/8270	
	RCRA Metals		methods as above	
	pH		SW9045	
Site Groundwater Samples	Volatile Organic Compounds		SW8260	
	Semi-Volatile Organic Compounds		SW3510/3550/8270	
	RCRA Metals		methods as above	
	pH		SW9040	
Soil Disposal Samples (as required by disposal facility)	F001-F005 Scan		SW8260/8270/8015	
	TCLP Volatiles		SW1311/8260	
	TCLP Semivolatiles		SW1311/8270	
	TCLP Pesticides		SW1311/8080	
	TCLP Herbicides		SW1311/8150	
	TCLP Metals		SW1311/6010/7470	
	Ignitability		SW1010	
	Corrosivity		SW9045	
	Reactivity (Cyanide and Sulfide)		SW Sections 7.3.3.2/7.4.3.1	
	Paint Filter		SW9095	
Water Disposal Samples (as required by disposal facility)	Volatile Organic Compounds		SW8260	
	Semi-Volatile Organic Compounds		SW8270	
	RCRA Metals		SW6010/7470	
	Ignitability		SW1010	
	Corrosivity		SW9040	
	Oil & Grease		EPA 413.2	

References:

(1) *SW846 Test Methods for Evaluating Solid Waste*, USEPA, November 1986, SW-846 Third Edition, and Update I, July 1992; Update II, September 1994; Update IIB, January 1995

(2) *Methods for Chemical Analysis of Water and Waste*, Revised March 1983, EPA-600/4-79-020

j:\adm\nasa\reports\pbs\tables4

Table 4-2

Summary of QA/QC Samples for Background and Site Samples
Space Power Facility, Plum Brook Station

Matrix	Analysis	No. of Env. Samples[1]	Equip. Blanks[2]	Field Rep/Dup[3]	Trip Blanks[4]	MS/MSD[5]	Total No. of Env. and QC Samples[6]
Water	Volatiles	4	1	1	1	1	8
	Semivolatiles	4	1	1	0	1	7
	Metals (8 RCRA)	4	1	1	0	1	7
	pH	4	1	1	0	1	7
Soil	Volatiles	24	3	3	3	4	37
	Semivolatiles	24	3	3	0	4	34
	Metals (8 RCRA)	36	4	4	0	4	48
	pH	36	0	4	0	0	40

1. Number of Environmental Samples - Environmental samples include background samples.
2. Equipment Blanks - One equipment blank shall be collected for every ten environmental samples per matrix.
3. Field Replicates/Duplicates - One field replicate or duplicate will be collected for every ten environmental samples per matrix (replicates for soil, duplicates for water). Analysis to include all parameters requested from the associated ten samples.
4. Trip Blanks - For every cooler containing environmental samples collected for VOC analysis, one trip blank will be added to the cooler and analyzed for the presence of VOCs only.
5. Matrix Spike/Matrix Spike Duplicate (MS/MSD) - One MS/MSD sample pair (2 samples) shall be analyzed for every 20 environmental samples per matrix type. Analysis to include all parameters requires for the associated 20 samples.
6. Total number of environmental and QA/QC samples.

NOTE: Table 4-2 reflects the minimum number of samples that will be collected to support site closure. NASA intends to fully define the vertical and horizontal extent of contamination at the SPF. Additional environmental and QA/QC samples may be required to define extent.

j:\adm\nasa\reports\pbs\tables4

Table 4-3

Method Detection Limits (MDL)/Practical Quantitation Limits (PQL)
Volatiles by GC/MS
Space Power Facility, Plum Brook Station

Target Analyte	CAS Number	Method Detection Limits (MDLs)[1]		Practical Quantitation Limits (PQLs)[2]	
GC/MS Volatiles (by SW8260A):		Water (µg/L)	Low Soil (µg/Kg)	Water (µg/L)	Low Soil (µg/Kg)
Chloromethane	74-87-3			2	10
Bromomethane	74-83-9			2	10
Butylbenzene, Total	---			2	10
Vinyl chloride	75-01-4			2	10
Chloroethane	75-00-3			1	5
2-Chlorotoluene	95-49-8			1	5
Methylene Chloride	75-09-2			1	5
Acetone	67-64-1			20	100
Carbon Disulfide	75-15-0			20	100
1,1-Dichloroethene	75-35-4			1	5
1,1-Dichloroethane	75-34-3			2	10
1,2-Dichloroethene (total)	540-59-0			2	10
Dichlorofluoromethane				1	5
Chloroform	67-66-3			1	5
1,2-Dichloroethane	107-06-2			1	5
2-Butanone	78-93-3			20	100
Isopropylbenzene	98-82-8			2	10
Isopropyltoluene	99-87-6			2	10
Propylbenzene	103-65-1			1	5
1,1,1-Trichloroethane	71-55-6			1	5
Carbon Tetrachloride	56-23-5			2	10
Bromodichloromethane	75-27-4			1	5

j:\adm\nasa\reports\pbs\tables4

Table 4-3 (Continued)

Target Analyte	CAS Number	Method Detection Limits (MDLs)[1]		Practical Quantitation Limits (PQLs)[2]	
GC/MS Volatiles (by SW8260A):		**Water (µg/L)**	**Low Soil (µg/Kg)**	**Water (µg/L)**	**Low Soil (µg/Kg)**
Dichlorodifluoromethane	75-71-8			1	5
1,2-Dichloropropane	78-87-5			1	5
cis-1,3-Dichloropropene	10061-01-5			1	5
Trichloroethene	79-01-6			2	10
Dibromochloromethane	124-48-1			1	5
1,1,2-Trichloroethane	79-00-5			1	5
Benzene	71-43-2			1	5
trans-1,3-Dichloropropene	10061-02-6			1	5
Bromoform	75-25-2			1	5
4-Methyl-2-pentanone	108-10-1			5	50
2-Hexanone	591-78-6			5	50
Tetrachloroethene	127-18-4			2	10
1,2,4-Trimethylbenzene	95-63-6			2	10
1,3,5-Trimethylbenzene	108-67-8			1	5
Trichlorofluoromethane	75-69-4			1	5
Toluene	108-88-3			1	5
1,1,1,2-Tetrachloroethane	630-20-6			1	5
1,1,2,2-Tetrachloroethane	79-34-5			1	5
1,2,3-Trichloropropane	96-18-4			1	5
Chlorobenzene	108-90-7			1	5
Ethyl Benzene	100-41-4			1	5
Styrene	100-42-5			1	5
Xylenes (Total)	1330-20-7			1	5

NOTE: Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment calculated on a dry weight basis will be higher.

j:\adm\nasa\reports\pbs\tables4

Table 4-3 (Continued)

Footnotes:

1. MDLs must be supplied by the selected laboratory. Data are required to be reported down to the MDLs for background and site samples only.

2. PQLs for water are approximately 10x the method detection limits in the cited method and are based on a 25 mL purge. Soil PQLs are 5x the water PQLs based on a 5 g. sample aliquot and 5 mL purge.

Reference: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Method 8260A, Revision 1, September 1994.

j:\adm\nasa\reports\pbs\tables4

Table 4-4

Method Detection Limits (MDL)/Practical Quantitation Limits (PQL)
Semivolatiles by GC/MS
Space Power Facility, Plum Brook Station

Target Analyte	CAS Number	Method Detection Limits (MDLs)[1]		Practical Quantitation Limits (PQLs)[2]	
Semivolatiles (by SW8270B):		Water (µg/L)	Low Soil (µg/Kg)	Water (µg/L)	Low Soil (µg/Kg)
Phenol	108-95-2			10	660
bis(2-Chloroethyl)ether	111-44-4			10	660
2-Chlorophenol	95-57-8			10	660
1,3-Dichlorobenzene	541-73-1			10	660
1,4-Dichlorobenzene	106-46-7			10	660
1,2-Dichlorobenzene	95-50-1			10	660
2-Methylphenol	95-48-7			10	660
2,2'-oxybis (1-Chloropropane)#	108-60-1			10	660
4-Methylphenol	106-44-5			10	660
N-Nitroso-di-n-propylamine	621-64-7			10	660
Hexachloroethane	67-72-1			10	660
Nitrobenzene	98-95-3			10	660
Isophorone	78-59-1			10	660
2-Nitrophenol	88-75-5			10	660
2,4-Dimethylphenol	105-67-9			10	660
bis(2-Chloroethoxy) methane	111-91-1			10	660
2,4-Dichlorophenol	120-83-2			10	660
1,2,4-Trichlorobenzene	120-82-1			10	660
Naphthalene	91-20-3			10	660
4-Chloroaniline	106-47-8			20	1300
Hexachlorobutadiene	87-68-3			10	660
4-Chloro-3-methylphenol	59-50-7			20	1300
2-Methylnaphthalene	91-57-6			10	660
Hexachlorocyclopentadiene	77-47-4			10	660

j:\adm\nasa\reports\pbs\tables4

Table 4-4 (Continued)

Target Analyte	CAS Number	Method Detection Limits (MDLs)[1]		Practical Quantitation Limits (PQLs)[2]	
Semivolatiles (by SW8270B):		Water (µg/L)	Low Soil (µg/Kg)	Water (µg/L)	Low Soil (µg/Kg)
2,4,6-Trichlorophenol	88-06-2			10	660
2,4,5-Trichlorophenol	95-95-4			10	660
2-Chloronaphthalene	91-58-7			10	660
2-Nitroaniline	88-74-4			50	3300
Dimethylphthalate	131-11-3			10	660
Acenaphthylene	208-96-8			10	660
2,6-Dinitrotoluene	606-20-2			10	660
3-Nitroaniline	99-09-2			50	3300
Acenaphthene	83-32-9			10	660
2,4-Dinitrophenol	51-28-5			50	3300
4-Nitrophenol	100-02-7			50	3300
Dibenzofuran	132-64-9			10	660
2,4-Dinitrotoluene	121-14-2			10	660
Diethylphthalate	84-66-2			10	660
4-Chlorophenyl-phenyl ether	7005-72-3			10	660
Fluorene	86-73-7			10	660
4-Nitroaniline	100-01-6			20	1300
4,6-Dinitro-2-methylphenol	534-52-1			50	3300
N-nitrosodiphenylamine	86-30-6			10	660
4-Bromophenyl-phenylether	101-55-3			10	660
Hexachlorobenzene	118-74-1			10	660
Pentachlorophenol	87-86-5			50	3300
Phenanthrene	85-01-8			10	660
Anthracene	120-12-7			10	660
Carbazole	86-74-8			10	660
Di-n-butylphthalate	84-74-2			10	660

j:\adm\nasa\reports\pbs\tables4

Table 4-4 (Continued)

Target Analyte	CAS Number	Method Detection Limits (MDLs)[1]		Practical Quantitation Limits (PQLs)[2]	
Semivolatiles (by SW8270B):		**Water** (µg/L)	**Low Soil** (µg/Kg)	**Water** (µg/L)	**Low Soil** (µg/Kg)
Fluoranthene	206-44-0			10	660
Pyrene	129-00-0			10	660
Butylbenzylphthalate	85-68-7			10	660
3,3'-Dichlorobenzidine	91-94-1			20	1300
Benzo(a)anthracene	56-55-3			10	660
Chrysene	218-01-9			10	660
bis(2-Ethylhexyl)phthalate	117-81-7			10	660
Di-n-octylphthalate	117-84-0			10	660
Benzo(b)fluoranthene	205-99-2			10	660
Benzo(k)fluoranthene	207-08-9			10	660
Benzo(a)pyrene	50-32-8			10	660
Indeno(1,2,3-cd)pyrene	193-39-5			10	660
Dibenz(a,h)anthracene	53-70-3			10	660
Benzo(g,h,i)perylene	191-24-2			10	660

NOTE: Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment calculated on a dry weight basis will be higher.

#Previously known by the name bis(2-Chloroisopropyl)ether.

Footnotes:

1. MDLs must be supplied by the selected laboratory. Data are required to be reported down to the MDLs for background and site samples only.

2. PQLs are from the cited method.

Reference: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846 Method 8270B, Revision 2, September 1994

j:\adm\nasa\reports\pbs\tables4

Table 4-5

Method Detection Limits (MDL)/Practical Quantitation Limits (PQL)
Total Metals by ICP/AA
Space Power Facility, Plum Brook Station

Target Analyte	Determinative Method	Method Detection Limits (MDLs)[1]		Practical Quantitation Limits (PQLs)	
Metals (by SW-6010A/7000A)		**Water (μg/L)**	**Soil (mg/Kg)**	**Water (μg/L)**	**Soil (mg/Kg)**
Arsenic	SW 7060A			10	2.0
Barium	SW 6010A			200	40
Cadmium	SW 6010A			5	1.0
Chromium	SW 6010A			10	2.0
Lead	SW 6010A/ 7421			3	0.6
Mercury	SW 7470A/ 7471A			0.2	0.1
Selenium	SW 7740			5	1.0
Silver	SW 6010A			10	2.0

NOTE: Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment calculated on a dry weight basis will be higher.

Footnote:

1. MDLs must be supplied by the selected laboratory. Data are required to be reported down to the MDL for background and site samples only.

Reference: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Methods 6010A and 7000A, Revision 1, July 1992 and Revision 2, September 1994.

j:\adm\nasa\reports\pbs\tables4

Table 4-6

Practical Quantitation Limits (PQL)
Miscellaneous Analytical Parameters
Space Power Facility, Plum Brook Station

Target Analyte	Determinative Method	Practical Quantitation Limits (PQLs)[1]	
		Water (mg/L)	Soil (mg/Kg)
Reactive Cyanide	SW846 Section 7.3.3.2	200	200
Reactive Sulfide	SW846 Section 7.4.3.1	200	200
Oil & Grease	EPA 413.2	1.0	10

NOTE: Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment calculated on a dry weight basis will be higher.

1. Data are required to be reported down to the MDL for background and site samples only. Disposal samples are reported down to the specified PQL. The PQLs listed above are maximum values to meet regulatory requirements. Lower PQLs are acceptable.

References:

(1) *SW846 Test Methods for Evaluating Solid Waste*, USEPA, November 1986, SW-846 Third Edition, and Update I, July 1992; Update II, September 1994; Update IIB, January 1995

(2) *Methods for Chemical Analysis of Water and Waste*, Revised March 1983, EPA-600/4-79-020

j:\adm\nasa\reports\pbs\tables4

Table 4-7

F001-F005 Spent Solvents
Treatment Standards
Space Power Facility, Plum Brook Station

Target Analyte	CAS Number	Treatement Standard
F001-F005 Spent Solvents		**Soil (mg/Kg)**
Acetone	67-64-1	160
Benzene	71-43-2	10
n-Butyl alcohol	71-36-3	2.6
Carbon tetrachloride	56-23-5	6.0
Chlorobenzene	108-90-7	6.0
o-cresol	95-48-7	5.6
m-cresol	108-39-4	5.6
p-cresol	106-44-5	5.6
Cresols (total)	---	11.2
p-Dichlorobenzene	95-50-1	6.0
Ethyl acetate	141-7-6	33
Ethyl benzene	100-41-4	10
Ethyl ether	60-29-7	160
Isobutyl alcohol	78-83-1	170
Methylene chloride	75-9-2	30
Methyl ethyl ketone	78-93-3	36
Methyl isobutyl ketone	108-10-1	33
Nitrobenzene	98-95-3	14
Pyridine	110-86-1	16
Tetrachloroethylene	127-18-4	6.0
Toluene	108-88-3	10
1,1,1-Trichloroethane	71-55-6	6.0
1,1,2-Trichloroethane	79-00-5	6.0
Trichloroethylene	79-01-6	6.0

j:\adm\nasa\reports\pbs\tables4

Table 4-7 (Continued)

Target Analyte	CAS Number	Treatement Standard
1,1,2-Trichloro-1,2,2-trifluoromethane	76-13-1	30
Trichloromono-fluoromethane	75-69-4	30
Xylenes (total)	---	30
Carbon disulfide	75-15-0	96
Cyclohexanone	108-94-1	15
Methanol	67-56-1	15

1. *Environmental Reporter, ER-Federal Regulations*, 161:3678 - 161:3679, [Sec. 268.40(f)], The Bureau of National Affairs, Inc., 3/3/95

j:\adm\nasa\reports\pbs\tables4

Table 4-8

Maximum Concentration of Contaminants for the Toxicity Characteristic (TCLP)
Space Power Facility, Plum Brook Station

EPA HW No.[1]	Target Analyte	CAS Number[2]	Regulatory Level (mg/L)
D004	Arsenic	7440-38-2	5.0
D005	Barium	7440-39-3	100.0
D018	Benzene	71-43-2	0.5
D006	Cadmium	7440-43-9	1.0
D019	Carbon tetrachloride	56-23-5	0.5
D020	Chlordane	57-74-9	0.03
D021	Chlorobenzene	108-90-7	100.0
D022	Chloroform	67-66-3	6.0
D007	Chromium	7440-47-3	5.0
D023	*o*-Cresol	95-48-7	200.0[4]
D024	*m*-Cresol	108-39-4	200.0[4]
D025	*p*-Cresol	106-44-5	200.0[4]
D026	Cresol, total	---	200.0[4]
D016	2,4-D	94-75-7	10.0
D027	1,4-Dichlorobenzene	106-46-7	7.5
D028	1,2-Dichloroethane	107-06-2	0.5
D029	1,1-Dichloroethylene	75-35-4	0.7
D030	2,4-Dinitrotoluene	121-14-2	0.13[3]
D012	Endrin	72-20-8	0.02
D031	Heptachlor (and its epoxide)	76-44-8	0.008
D032	Hexachlorobenzene	118-74-1	0.13[3]
D033	Hexachlorobutadiene	87-68-3	0.5
D034	Hexachloroethane	67-72-1	3.0
D008	Lead	7439-92-1	5.0
D013	Lindane	58-89-9	0.4
D009	Mercury	7439-97-6	0.2

j:\adm\nasa\reports\pbs\tables4

Table 4-8 (Continued)

EPA HW No.[1]	Target Analyte	CAS Number[2]	Regulatory Level (mg/L)
D014	Methoxychlor	72-43-5	10.0
D035	Methyl ethyl ketone	78-93-3	200.0
D036	Nitrobenzene	98-95-3	2.0
D037	Pentachlorophenol	87-86-5	100.0
D038	Pyridine	110-86-1	5.0[3]
D010	Selenium	7782-49-2	1.0
D011	Silver	7440-22-4	5.0
D039	Tetrachloroethylene	127-18-4	0.7
D015	Toxaphene	8001-35-2	0.5
D040	Trichloroethylene	79-01-6	0.5
D041	2,4,5-Trichlorophenol	95-95-4	400.0
D042	2,4,6-Trichlorophenol	88-06-2	2.0
D017	2,4,5-TP (Silvex)	93-72-1	1.0
D043	Vinyl chloride	75-01-4	0.2

Footnotes:

1. Hazardous Waste Number
2. Chemical Abstracts Service number
3. Quantitation limit may be greater than the calculated regulatory number. The quantitation limit therefore becomes the regulatory level.
4. If *o*-, *m*-, and *p*-Cresol concentrations cannot be differentiated, the toal cresol (D026) concentration is used. The regulatory level of total cresol is 200 mg/L

Reference: 40 CFR Ch. I, Part 261.24, Table 1

j:\adm\nasa\reports\pbs\tables4

Table 4-9

Sample Bottle Requirements
Preservation and Holding Times
Space Power Facility, Plum Brook Station

Container/Volume Requirements		# of Containers		Preservative		Holding Time*	
Soil	Water	Soil	Water	Soil	Water	Soil	Water
Hydrogen ion (pH, SW846 9040/9045)							
Glass or polyethylene \ 50 g	Glass or poly-ethylene \ 100 mL	1	1	None re-quired	None required	Analyze immediately	Analyze immediately
Volatile Organics by Gas Chromatography/Mass Spectrometry (GC/MS, SW846 8240, 8260)							
Glass with teflon-lined lid (120 wide-mouth)/50 g	40 mL glass with teflon-lined septa	2	2	Cool - 4°C	Cool - 4°C HCl to pH <2	14 days	14 days
Semi-Volatile Organics by Gas Chromotography/Mass Spectrometry (GC/MS, SW846 8270)							
Glass with teflon-lined lid \ 100 g	Amber glass with teflon-lined Lid \1000 mL	1	2	Cool - 4°C	Cool - 4°C	Extract within 14 days, analyze within 40 days following extrac-tion	Extract within 7 days, analyze within 40 days following extrac-tion

Table 4-9 (Continued)

Container/Volume Requirements		# of Containers		Preservative		Holding Time*	
Soil	Water	Soil	Water	Soil	Water	Soil	Water
Metals (except Mercury, SW846 6010/7000)							
Glass or polyethylene \ 50 g	Glass or poly-ethylene \ 1000 mL	1	1	Cool - 4°C	Cool - 4°C HNO_3 to pH <2 (dissolved metals filtered prior to pres-ervation)	180 days	180 days
Metals (Mercury, SW846 7470/7471)							
Glass or polyethylene \ 50 g	Glass or poly-ethylene \ 1000 mL	1	1	Cool - 4°C	Cool - 4°C HNO_3 to pH <2 (dissolved metals filtered prior to pres-ervation)	28 days	28 days
TCLP Volatiles (SW846 1311/8260)							
Glass with teflon-lined lid \ 50 g	40 mL glass with teflon-lined septa	2	4	Cool - 4°C	Cool - 4°C	14 days to TCLP extraction; 14 days from extrac-tion to analysis	14 days

Table 4-9 (Continued)

Container/Volume Requirements		# of Containers		Preservative		Holding Time*	
Soil	Water	Soil	Water	Soil	Water	Soil	Water
TCLP Semivolatiles, Pesticides, and Herbicides (SW846 1311/8270/8080/8150)							
Glass with teflon-lined lid \200 g	Amber glass with teflon-lined lid \1000 mL	1	2	Cool - 4°C	Cool - 4°C	14 days to TCLP extraction; 7 days from TCLP extraction to prep. extraction; 40 days from prep. to analysis	14 days to TCLP extraction; 7 days from TCLP extraction to prep. extraction; 40 days from prep. to analysis
TCLP Metals, except Mercury (SW846 1311/6010/7000)							
Glass or polyethylene \ 200 g	Glass or polyethylene \ 1000 mL	1	1	Cool - 4°C	Cool - 4°C	180 days to TCLP extraction; 180 days from extraction to analysis	180 days to TCLP extraction; 180 days from extraction to analysis
TCLP Mercury (SW 846 1311/7470)							
Glass or polyethylene \ 200 g	Glass or polyethylene \ 1000 mL	1	1	Cool - 4°C	Cool - 4°C	28 days to TCLP extraction; 28 days from extraction to analysis	28 days to TCLP extraction; 28 days from extraction to analysis
Reactive Cyanide (SW846 Section 7.3.3.2)							
Glass or polyethylene \50 g	Glass or polyethylene \500 mL	1	1	Cool - 4°C	Cool - 4°C, NaOH to pH >12	14 days	14 days

j:\adm\nasa\reports\pbs\tables4

Table 4-9 (Continued)

Container/Volume Requirements		# of Containers		Preservative		Holding Time*	
Soil	Water	Soil	Water	Soil	Water	Soil	Water
Reactive Sulfide (SW846 Section 7.4.3.1)							
Glass or polyethylene \50 g	Glass or polyethylene \500 mL	1	1	Cool - 4°C	Cool - 4°C, NaOH to pH >12, plus 2 mL zinc acetate	7 days	7 days
Paint Filter (SW846 9095)							
Glass or polyethylene \100 g	Glass or polyethylene \100 mL	1	1	None required	None required	N/A	N/A
Oil and Grease (EPA 413.2)							
Glass only \50 g	Glass only \1 liter	1	1	Cool - 4°C	Cool - 4°C, HCl to pH<2	28 days	28 days

* Holding time begins from time of sample collection

5.0 DATA ASSESSMENT

This section of the work plan describes how the data collected will be used to determine the nature and extent of contamination, the quantification of risks associated with these contaminants, and, if necessary, the development of remediation standards. Since preliminary risk analysis based on previous sampling suggests that the site meets OEPA recommended risk levels, this plan does not include a description of remedial actions. If remedial action is needed, an amended plan will be developed and resubmitted after completion of the risk assessment.

5.1 NATURE AND EXTENT OF CONTAMINATION

The environmental data collected in the proposed sampling effort will be used to determine the nature and extent of contamination. Positive results will be presented in tabular format in the closure report along with descriptions of contaminant levels found either in soil or groundwater. Interpretation of this information will be based on two criteria:

- Any organic compound positively detected will be considered evidence of contamination and will be assessed as to its relevance to the RCRA waste management unit.

- Any inorganic chemical present above background will be considered evidence of contamination.

Background action levels will be calculated from the results of the background sample analyses according to the OEPA guidance (OEPA, 1993). The action level for each constituent will be the mean of the background population plus two standard deviations. The data from both the background and site samples will be tested for normality using probability plots and either the Shapiro-Wilk test or the Kolmogorov-Smirnov test with Lilliefors critical values. If the data are not normally distributed, it will be transformed to make it approximately normal (i.e., a lognormal distribution will be assumed).

The information in this characterization process will then form the basis for the quantification of risks.

5.2 RISK ASSESSMENT METHODOLOGY

The framework that will be used to characterize risks based on the results of the proposed sampling is described in the following sections. The results of the risk assessment will be 1) compared to OEPA Agency recommended risk limits to determine if cleanup is needed and 2) used to establish health-based remediation standards for cleanup if those risk levels are exceeded.

Risk assessment in general is a four-step process involving data evaluation, the assessment of exposure potential, the determination of toxicity and the calculation of risk estimates. The following subsections discuss the methodologies that will be followed in each step.

The methodologies presented in this work plan conform to the requirements contained in the OEPA's Closure Plan Review Guidance for RCRA Facilities (OEPA, 1993). The information in this guidance has been supplemented, where necessary, with details provided in similar U.S. Environmental Protection Agency Guidance documents.

5.2.1 Selection of Chemicals of Concern

The first step in the risk assessment process is the determination of the useability of the sampling data for risk characterization and the selection of the chemicals for risk quantification.

Only the reviewed data results from the sampling effort described in this plan will be used in risk quantification. Any result rejected by the data validation process, will be eliminated from the data set used in the risk assessment. Any otherwise qualified data will be utilized.

All chemicals detected in this sampling effort will be included in risk quantification with the following exceptions.

Exclusions Not Related to the Site: The risk assessment will include all organic chemicals which NASA has determined could reasonably have been managed in the waste tank plus those chemicals which Ohio EPA personnel indicated, during a meeting June 28, 1995, that they believe potentially could have been managed in the waste tank. As agreed upon between OEPA and NASA, benzene and ethylbenzene will not be considered chemicals of concern. Therefore, the risk assessment will include all chemicals listed in the tables in Section 5.0 if they are detected in the planned site sampling. Any other organic compounds detected in site samples that could have been managed in the waste tank will also be included in the risk assessment.

Blank Contamination: If sampling results are qualified to indicate possible field or laboratory blank contamination, that chemical will be evaluated for possible exclusion from risk quantification. The procedure for exclusion will be based on the comparison of concentrations in the sample with concentrations in the associated blank. For common laboratory contaminants (e.g. acetone, methylene chloride, 2-butanone, phthalate esters), the sample results will be considered positive only if the concentrations in the sample exceed ten times the maximum amount detected in the blank. For all other chemicals, the sample results will be considered positive only if the concentrations in the sample exceed five times the concentrations reported in the blank (USEPA, 1989).

Comparison to Background: The sampling results obtained from the background samples will be compared to results from site samples. A criterion for elimination will be established as the mean plus two standard deviations of the background population (OEPA, 1993), as described previously. If no site sample exceeds the background criterion, that chemical will be eliminated from the risk assessment. Chemicals detected above the criterion will be included in risk calculations.

5.2.2 Assessment of Exposure

The OEPA requires the assumption of an unrestricted future land use in establishing a risk-based cleanup. Therefore the appropriate exposure scenario to be utilized is residential, including both adult and child (ages 1 through 6) populations. These two populations are assumed to live on site and to be exposed to site contaminants via a number of exposure pathways. These include:

- Ingestion of and dermal contact with soil
- Inhalation of volatiles or particulates released from soil
- Ingestion of groundwater, dermal contact while bathing and inhalation of volatiles released from groundwater during showering

Standard exposure factors recommended by OEPA (1993) will be used for each of the pathways quantified.

At this site there does not appear to be a potential for particulate releases for two reasons. The very small area contains nonerodible elements (vegetation, gravel, stones, etc.) thus reducing and even preventing the ability of particulates to become windborne. Furthermore, the majority of contaminants are volatile organic compounds. These chemical compounds are more likely to volatilize into the ambient air rather than be associated with windborne particulate material. These conditions would not change under any future residential land use of the site. Therefore, only the release of volatiles from the soil will be quantified.

Exposure is generally quantified by calculating an average daily intake for each chemical evaluated. The general equation for this is:

$$DI = \frac{C \times IR \times EF \times ED}{BW \times AT}$$

Where:

DI = Average daily intake, mg/kg/day
C = Chemical concentration in the medium of concern, mg/kg soil, mg/L water, mg/m^3 air.
IR = Intake rate, units depending on medium
EF = Exposure frequency, days or events
ED = Exposure duration, years
BW = Body weight, kg
AT = Averaging time, days. Equal to the exposure duration for noncarcinogens and 70 years for carcinogens

Exposure potential is quantified in two steps: the calculation of exposure point concentrations (EPCs) in each medium of concern and the assumption of values for the remaining terms of the equation, the exposure factors, for each population of concern.

5.2.2.1 Calculation of Exposure Point Concentrations - An EPC is the arithmetic mean concentration of a chemical in a medium, averaged over the area over which exposure is expected to occur. Because of the uncertainty in estimating the true mean from a limited number of samples, the upper 95th percent confidence limit (95UCL) will be used as the EPC. The 95UCL will be calculated according to Gilbert (1987), assuming that the environmental concentration data set is lognormally distributed. In the event that the 95UCL exceeds the maximum detected value, the maximum detected value will be utilized as the EPC.

There are two adjustments to the data that will be necessary in calculating the EPC. Field duplicates will be averaged before including them in the EPC calculation; sample results that are reported by the laboratory as nondetects will be included in the calculation at one-half the sample quantitation limit.

Since it is assumed that the site's future use would be a residence, all soil sampling locations across the site will be used in calculating an EPC. It is possible that the future use could

include excavation for a residence thus bringing deeper, more contaminated soils to the surface. Therefore, soil samples taken at depth will also be included in the exposure point concentration calculation.

In order to calculate an air concentration of volatiles released from the soil a volatile emission model and a dispersion model will be used. The concentration of volatile organic chemicals (VOCs) in air that result from releases from soil is a complex function of soil, chemical and meteorological parameters. Estimation of the concentration values can be approached in two steps: first, the emission rate of each volatile from soil is calculated, and then the resultant concentration in air is calculated.

Hwang (1986) developed a mathematical model for estimating the average emission rate of a chemical from soil that considers the physical-chemical properties of the chemical and the characteristics of the soil. The model assumes that the concentrations decrease over time, therefore the emission rate also decreases as a function of time. The basic equation is:

$$Q = Cs \times \frac{2 \times E \times De \times H'}{(\pi \times a \times t)^{0.5} K_d}$$

Where:

Q = The average emission rate (g/cm^2 sec.) of a chemical emitted from soil over the exposure time period.

Cs = The concentration of the chemical in soil (g/g).

E = The soil porosity. A default value of 0.35 is assumed, indicative of soils found at this site (USEPA, 1991).

De = The effective diffusivity (cm^2/sec.) of each chemical, calculated from the chemical-specific molecular diffusivity constant (D) and the soil porosity by the following equation:

$$De = D*E^{1/3}$$

H′ = The nondimensional Henry's law constant (atm-m^2/mol) calculated from the chemical-specific Henry's law as follows:

$$H' = H/RT$$

where: R = Gas Constant (8.2E-05 atm-m^3/mol-K)
T = Temperature (K), 20°C

a = The term that describes several soil- and chemical-specific parameters, as follows:

$$a = \frac{De \times E}{E + P_s\,(1 - E)\,(K_d/H')}$$

The values of De, E and H′ have been discussed. The term P_s is the average moist bulk density of the soil, assumed to be 2.65 g/cm^3 (USEPA, 1991). The value of K_d is described below.

K_d = The soil-water partition coefficient (cm^3/g). It is a soil- and chemical-specific term calculated as follows:

$$K_d = K_{oc} \times f_{oc}$$

where:

K_{oc} = Organic carbon binding constant (cm^3/g)

f_{oc} = Soil organic carbon fraction. A default of 2% is assumed (USEPA, 1991).

t = The time (seconds) over which the emission rate is averaged. Since the exposure assessment includes exposure durations of 6 and 30 years, emission rates will be calculated for these two time periods.

The concentrations of volatile chemicals in air that result from soil emissions will be estimated using a box model approach (Hanna et al., 1982). The basic equation is:

$$C = \frac{Q \times X}{(H/2) \times U}$$

Where:

C = concentration in air (mg/m^3)

Q = emission rate from the Hwang model (in units of mg/m^2-sec.)

X = crosswind width of the box (m)

H = the mixing height of the box (m)

U = the average windspeed across the box (m/sec)

The distance from the upwind to downwind edge of the box (assumed to be square) is the approximate size of the site.

The mixing height is a function of distance from the source and turbulence of the air which, in turn, is a function of the roughness of the terrain. The value of H at the upwind edge of the site is zero. At the downwind edge, the value of H is calculated as follows:

$$X = 6.25Z_0[(H/Z_0) \times \ln(H/Z_0) - 1.58(H/Z_0) + 1.58]$$

A roughness height (Z_0) of 0.1m based on the terrain at the site is assumed.

The average windspeed for Plum Brook, obtained from the on-site meteorological station, will be used.

Chemical-specific values required in this modeling include: Henry's Law Constant (H), the soil-water partition coefficient (K_{oc}), and the molecular diffusivity constant (D). These values will be obtained from the open literature for each chemical. Only chemicals detected in the soils that have a Henry's Law Constant greater than or equal to 1E-05 atm-m^3/mol and a molecular weight less than 200 g/mol will be modeled (USEPA, 1991). Table 5-1 summarizes these values for potential chemicals of concern identified for this site.

For groundwater, the EPC will be calculated utilizing the most heavily contaminated portion of any plume detected. The indoor air concentration of chemicals volatilizing from groundwater during showering is a complex function of water temperature, shower flow rate, bathroom size and the physical/chemical properties of each contaminant. Since site-specific data are not available to support a detailed calculation of indoor air during showering, an air/water concentration ratio of 0.5 will be assumed (USEPA, 1991).

5.2.2.2 Estimation of Exposure Factors - The remaining terms of the exposure equation (collectively referred to as the Human Intake Factor or HIF) describe the human activity patterns and the physiological variables necessary for quantifying the magnitude of exposure. Since there is no site-specific information available to describe these terms, the exposure factors that will be used in the risk assessment are those recommended values in OEPA (1993), Appendix E, Tables 1 through 4. These values are summarized in Table 5-2.

Two additional, chemical-specific parameters are required to evaluate dermal pathways. These are the absorption factor (ABS), which accounts for the desorption of a chemical from soil and its absorption across the skin and the dermal permeability constant (PC) which accounts for the movement of the chemical from water across the skin. The USEPA's Dermal Guidance will be used as the source for the PC values (USEPA 1992). Published literature values will be used to estimate the ABS term. In the absence of published ABS terms, the following default assumptions will be utilized: 25% for volatile organic compounds, 10% for semivolatile organic compounds, and 1% for inorganic compounds (OEPA, 1993). These values for potential chemicals of concern at this site are summarized in Table 5-3.

5.2.3 Toxicity Assessment

The toxic effects of a chemical depend not only upon its inherent toxicity and the level of exposure, but also on the route (oral, inhalation, dermal) and the duration of exposure (subchronic, chronic, lifetime). Numeric values that are used to quantify the toxicity and carcinogenicity of a chemical have been derived by the USEPA. For noncancer health effects these values are termed Reference Doses (RfDs) and for cancer the value is termed a Slope Factor (SF). The RfD is route- and duration-specific and estimates the average daily intake that could occur without appreciable risk of any adverse effect. The SF is route-specific and is derived by extrapolating from observed data at

high dose levels of chemicals in their pure form. In addition, USEPA assigns a cancer weight-of-evidence category to each chemical ("A" through "E") that reflects the overall confidence that a chemical is likely to cause cancer in humans.

The RfD and SF values are available from USEPA in its Integrated Risk Information System (IRIS) data base and on Health Effects Assessment Summary Tables (HEAST) (USEPA, 1995 & 1994). These two sources will be utilized in determining the appropriate toxicity values for use in this risk assessment. Table 5-4 provides the currently available toxicity values and weight-of-evidence classification for those chemicals preliminarily identified as chemicals of concern at this site.

For some chemicals, there are no toxicity values available on IRIS or HEAST. This can occur for several reasons-- either there is insufficient toxicological information on a particular chemical, or the available information is being reviewed for possible changes. Any values obtained from sources other than IRIS or HEAST are footnoted on the table. In general, further investigation beyond USEPA sources (including the USEPA Technical Support Office) will not be done to obtain a toxicity value.

The USEPA has not established dermal toxicity values. These can be obtained by extrapolating from the oral values. This will be done by multiplying the oral RfD values by the chemical's oral absorption fraction and dividing the oral slope factor by the oral absorption fraction (USEPA, 1989). If an oral absorption factor (AF_0) is not available for a particular organic compound, then the value assumed will be 1.0 (i.e., 100% oral absorption). Table 5-3 includes these values for potential chemicals of concern identified for this site.

Table 5-4 indicates that a number of chemicals that are expected to be included in this risk assessment are classified as "C" carcinogens (i.e., possible human carcinogen). Only chemicals classified as "A" (known human carcinogen) and "B" (probable human carcinogen) will be included in the carcinogenic risk quantification (OEPA, 1993). However, chemicals that are classified as "C" carcinogens but have no RfD values will be included in the risk characterization.

5.2.4 Risk Characterization

Risk characterization integrates the results of the exposure and toxicity assessments into a quantitative description of potential cancer risks and noncancer effects. The risk of cancer from exposure to a chemical is described in terms of the probability that an individual exposed for his or her entire lifetime will develop cancer by age 70. This value is calculated from the daily intake averaged over a lifetime (DI_L) and the SF for each chemical (classified as an A or B carcinogen), as follows:

$$\text{Cancer Risk} = \text{DI(lifetime)} \times \text{SF}$$

Cancer risks are summed for each chemical and each pathway relevant to a particular population. The OEPA recommends a risk limit of 1E-06 (OEPA, 1993). Results from the site risk estimation will be compared to this value to conclude whether risks are within the recommended limit thus indicating remedial action is not warranted.

For noncarcinogens, toxicity is evaluated based on the threshold principle -- that a range of exposures from zero to some finite level can be tolerated without an adverse effect expressed. The RfD identifies the upper bound of this range. Thus, the potential for noncancer effects from exposure to a chemical is evaluated by comparing the estimated intake of the chemical over a specified time

exposure for adults will be compared to chronic RfD values. The comparisons result in a noncancer hazard quotient (HQ), as follows:

$$HQ = DI/RfD$$

Since exposure occurs simultaneously to more than one chemical, HQ values are summed to develop a Hazard Index (HI). Additionally, exposure occurs by more than one pathway therefore, HI values are further summed for each pathway that contributes to the exposure of an individual in a given population. The OEPA recommends that the population HI not exceed the value of 1.0 (OEPA, 1993). Summing HQ values across all chemicals and HI values across all pathways assumes that all noncancer effects are additive. Since this is not usually true, when a population total HI exceeds one it may be appropriate to re-examine the noncancer effects and segregate them by effect (USEPA, 1989). The results of hazard estimates for this site will be compared to the OEPA-recommended value, segregated where appropriate, to determine the need for remedial action.

There are a number of factors that will introduce uncertainty into any exposure and risk estimate. The key ones that affect this site will be identified as part of the risk characterization process.

5.2.5 Risk-Based Remediation Standards

The results of the risk characterization, when compared to OEPA recommended risk guidelines will indicate whether remediation standards are required. If either the risk level exceeds 1E-06 for a given population, or a population HI exceeds one, then remediation standards will be selected based on either method detection limits or the risk asssessment. If risk-based remediation standards are selected, the exposure and risk equations will be re-arranged to solve for the chemical concentrations that would result in meeting OEPA's recommended limits.

In general, the equation for carcinogens is as follows:

$$RS = \frac{TR}{HIF \times SF}$$

where:

RS	=	Risk-Based Remediation Standard
TR	=	Target Risk Level, 1E-06
HIF	=	Human Intake Factor-lifetime. This is the term in each pathway intake equation which accounts for all the terms <u>except</u> the concentration term.
SF	=	Slope factor, the route-specific toxicity value.

This equation will be expanded to account for all relevant pathways for the particular population under evaluation.

The general equation for noncarcinogens is as follows:

$$RS = \left(\frac{HIF}{RfD}\right)^{-1}$$

where:

RS	=	Risk-Based Remediation Standard
HIF	=	Human Intake Factor (chronic or subchronic), as defined in the previous equation.
RfD	=	Reference Dose (chronic or subchronic), the route-specific toxicity value which estimates acceptable exposures to noncarcinogenic chemicals.

This equation will be expanded to account for all relevant pathways for the particular population under evaluation.

If there is a concern for the contribution of soil contamination to the groundwater, the proposed soil remediation standards will be used to predict leachate levels based on solubility and partitioning constants. These will be compared to a risk-based remediation standard calculated for groundwater to ensure that proposed chemical concentrations in the soil would be protective of groundwater. If the calculation indicates that they are not, then the soil remediation standard will be modified accordingly.

TABLE 5-1
Summary of Constants for Potential Chemicals of Concern (a)
Space Power Facility, Plum Brook Station

Chemical	CAS Number	Henry's Law Constant (a)	Koc (a)	Molecular Diffusivity Constant (b)
Acetone	67-64-1	2.06E-05	2.20E+00	1.22E-01
2-Butanone	78-93-3	2.74E-05	4.50E+00	1.06E-01
n-Butylbenzene	104-51-8	1.25E-02	--	--
sec-Butylbenzene	135-98-8	1.14E-02	--	--
tert-Butylbenzene	98-06-6	1.17E-02	--	--
Carbon tetrachloride	56-23-5	2.41E-02	4.39E+02	9.45E-02
2-Chlorotoluene	95-49-8	--	--	--
Dibromochloromethane	124-48-1	7.83E-04	--	--
1,2-Dichlorobenzene	95-50-1	2.95E-03	1.70E-03	7.79E-02
1,3-Dichlorobenzene	541-73-1	3.24E-03	--	7.79E-02
1,4-Dichlorobenzene	106-46-7	4.30E-03	1.70E-03	7.79E-02
1,1-Dichloroethane	75-34-3	4.31E-03	3.00E+01	1.08E-01
1,2-Dichloroethane	107-06-2	9.79E-04	1.40E+01	1.08E-01
1,1-Dichloroethene	75-35-4	3.40E-02	6.50E+01	9.38E-02
cis-1,2-Dichloroethene	156-59-2	7.58E-03	4.90E+01	9.38E-02
trans-1,2-Dichloroethene	156-60-5	6.56E-03	5.90E+01	9.38E-02
2-Hexanone	591-78-6	1.75E-03	--	--
Isopropylbenzene	98-82-8	1.46E-02	--	--
p-Isopropyltoluene	99-87-6	--	--	--
Methanol	67-56-1	--	2.19E+00	1.87E-01
Methylene chloride	75-09-2	2.03E-03	8.80E+00	1.16E-01
4-Methyl-2-pentanone	108-10-1	1.49E-05	--	--
Naphthalene	91-20-3	4.83E-04	9.40E+01	1.20E-01
Propylbenzene	103-65-1	1.02E-02	--	--
Tetrachloroethene	127-18-4	2.59E-02	3.64E+02	8.78E-02
Toluene	108-88-3	6.37E-03	3.00E+02	9.28E-02
1,2,4-Trichlorobenzene	120-82-1	1.40E-03	9.20E+03	7.40E-01
1,1,1-Trichloroethane	71-55-6	1.44E-02	1.52E+02	9.45E-02
1,1,2-Trichloroethane	79-00-5	1.17E-03	5.60E+01	9.45E-02
Trichloroethene	79-01-6	9.10E-03	1.26E+02	9.63E-02
Trichlorofluoromethane	75-69-4	9.70E-02	1.59E+02	9.31E-02
Trimethylbenzenes	25551-13-7	--	--	--
Xylenes, mixture	1330-20-7	7.04E-03	2.40E+02	8.50E-02

(a) Sources: provided by OEPA or from other literature sources
(b) Source: Superfund Exposure Assessment Manual
(c) -- Not available

TABLE 5-2

SUMMARY OF ASSUMED EXPOSURE FACTORS

Exposure Parameter	Assumed Value, Adult	Assumed Value, Child
Body Weight, kg	70	15
Exposure Frequency, days/yr	350	350
Exposure Duration, yr	30	6
Exposure Time-indoor/outdoor	24	24
Exposure Time-showering hr/day	0.2	0.2
Averaging Time (cancer), days	25,550	25,550
Averaging Time (noncancer), days	10,950	2,190
Soil Intake, mg/day	100	200
Fraction from contaminated area	1	1
Inhalation Rate, m^3/hr	0.83	0.83
Inhalation Rate-Showering, m^3/hr	0.6	0.6
Drinking Water Intake, L/day	2	2
Skin Surface Area, soil, cm^2	5,000	2,000
Skin Surface Area, showering, cm^2	20,000	7,000
Soil to Skin Adherence Factor, mg/cm^2	1.0	1.0

TABLE 5-3
Summary of Dermal Values for Potential Chemicals of Concern
Space Power Facility, Plum Brook Station

Chemical	CAS Number	ABS	AFo (a)	PC (b)
Acetone	67-64-1	0.25	1.00E+00	5.69E-04
2-Butanone	78-93-3	0.25	1.00E+00	4.50E-03
n-Butylbenzene	104-51-8	0.25	1.00E+00	--
sec-Butylbenzene	135-98-8	0.25	1.00E+00	--
tert-Butylbenzene	98-06-6	0.25	1.00E+00	--
Carbon tetrachloride	56-23-5	0.25	5.00E-01	2.24E-02
2-Chlorotoluene	95-49-8	0.25	1.00E+00	--
Dibromochloromethane	124-48-1	0.25	1.00E+00	--
1,2-Dichlorobenzene	95-50-1	0.25	1.00E+00	6.10E-02
1,3-Dichlorobenzene	541-73-1	0.25	1.00E+00	8.70E-02
1,4-Dichlorobenzene	106-46-7	0.25	1.00E+00	6.20E-02
1,1-Dichloroethane	75-34-3	0.25	1.00E+00	8.86E-03
1,2-Dichloroethane	107-06-2	0.25	1.00E+00	5.34E-03
cis-1,2-Dichloroethene	156-59-2	0.25	9.00E-01	1.02E-02
trans-1,2-Dichloroethene	156-60-5	0.25	9.00E-01	1.49E-02
2-Hexanone	591-78-6	0.25	1.00E+00	4.45E-03
Isopropylbenzene	98-82-8	0.25	1.00E+00	--
p-Isopropyltoluene	99-87-6	0.25	1.00E+00	--
Methanol	67-56-1	0.25	1.00E+00	1.60E-03
Methylene chloride	75-09-2	0.25	8.00E-01	4.46E-03
4-Methyl-2-pentanone	108-10-1	0.25	1.00E+00	--
Naphthalene	91-20-3	0.1	1.00E+00	6.94E-02
Propylbenzene	103-65-1	0.25	1.00E+00	--
Tetrachloroethene	127-18-4	0.25	1.00E+00	4.00E-01
Toluene	108-88-3	0.25	1.00E+00	1.00E+00
1,2,4-Trichlorobenzene	120-82-1	0.1	1.00E+00	9.98E-02
1,1,1-Trichloroethane	71-55-6	0.25	1.00E+00	1.71E-02
1,1,2-Trichloroethane	79-00-5	0.25	1.00E+00	8.35E-03
Trichloroethene	79-01-6	0.25	5.00E-01	2.00E-01
Trichlorofluoromethane	75-69-4	0.25	5.00E-01	1.73E-02
Trimethylbenzenes	25551-13-7	0.1	1.00E+00	--
Xylenes, mixture	1330-20-7	0.25	1.00E+00	7.04E-02

(a) Sources: OEPA provided. Value of 1.0 assumed in absence of data.
(b) Source: USEPA Dermal Guidance.

Table 5-4

Summary of Toxicity Values for Potential Chemicals of Concern
Space Power Facility, Plum Brook Station

Chemical	CAS Number	Oral RfD mg/kg/day		Inhalation RfD mg/kg/day (a)		Weight of Evidence	Oral SF $(mg/kg/day)^{-1}$	Inhal SF (b) $(mg/kg/day)^{-1}$
		Chronic	Subchronic	Chronic	Subchronic			
Acetone	67-64-1	1.00E-01	1.00E+00	--	--	--	--	--
2-Butanone	78-93-3	6.00E-01	2.00E+00	2.90E-01	2.90E-01	D	--	--
n-Butylbenzene	104-51-8	--	--	--	--	--	--	--
sec-Butylbenzene	135-98-8	--	--	--	--	--	--	--
tert-Butylbenzene	98-06-6	--	--	--	--	--	--	--
Carbon tetrachloride	56-23-5	7.00E-04	7.00E-03(c)	--	--	B2	1.30E-01	5.30E-02
2-Chlorotoluene	95-49-8	2.00E-02	2.00E-01	--	--	--	--	--
Dibromochloromethane	124-48-1	2.00E-02	2.00E-01	--	--	C	8.40E-02	--
1,2-Dichlorobenzene	95-50-1	9.00E-02	9.00E-01(c)	5.70E-02	5.70E-01	D	--	--
1,3-Dichlorobenzene	541-73-1	--	--	--	--	D	--	--
1,4-Dichlorobenzene	106-46-7	--	--	2.30E-01	7.10E-01	B2	2.40E-02	--
1,1-Dichloroethane	75-34-3	1.00E-01	1.00E+00	1.40E-01	1.40E+00	C	--	--
1,2-Dichloroethane	107-06-2	--	--	--	--	B2	9.10E-02	9.10E-02
1,1-Dichloroethene	75-35-4	9.00E-03	9.00E-03	--	--	C	6.00E-01	1.80E-01
cis-1,2-Dichloroethene	156-59-2	1.00E-02	1.00E-01	--	--	D	--	--
trans-1,2-Dichloroethene	156-60-5	2.00E-02	2.00E-01	--	--	--	--	--
2-Hexanone	591-78-6	Data inadequate for quantitative risk assessment.						
Isopropylbenzene	98-82-8	4.00E-02	4.00E-01	2.60E-03		--	--	--
p-Isopropyltoluene	99-87-6	--	--	--	--	--	--	--
Methanol	67-56-1	5.00E-01	5.00E+00	--	--	--	--	--
Methylene chloride	75-09-2	6.00E-02	6.00E-02	3.00E+00	3.00E+00	B2	7.50E-03	1.60E-03
4-Methyl-2-pentanone	108-10-1	8.00E-02	--	2.30E-02	--	--	--	--
Naphthalene	91-20-3	4.0E-02(d)	4.0E-02(d)	--	--	D	--	--
Propylbenzene	103-65-1	--	--	--	--	--	--	--
Tetrachloroethene	127-18-4	1.00E-02	1.00E-01	--	--	B2/C	5.2E-02(d)	2.0E-03(d)
Toluene	108-88-3	2.00E-01	2.00E+00	1.10E-01	--	D	--	--
1,2,4-Trichlorobenzene	120-82-1	1.00E-02	1.00E-02	5.70E-02	5.70E-01	D	--	--
1,1,1-Trichloroethane	71-55-6	9.00E-02(c)	9.00E-01(c)	--	--	D	--	--
1,1,2-Trichloroethane	79-00-5	4.00E-03	4.00E-02	--	--	C	5.70E-02	5.70E-02
Trichloroethene	79-01-6	6.0E-03(d)	--	--	--	B2/C	1.10E-02(d)	6.00E-03(d)
Trichlorofluoromethane	75-69-4	3.00E-01	7.00E-01	2.00E-01	2.00E+00	--	--	--
Trimethylbenzenes	25551-13-7	Data inadequate for quantitative risk assessment.						
Xylenes, mixture	1330-20-7	2.00E+00	4.00E+00(c)	--	--	D	--	--

Source: All values from IRIS(1995) or HEAST (USEPA 1994) unless otherwise referenced.
(a) Inhalation RfD values calculated from Reference Concentration values using formula in OEPA (1993).
(b) Inhalation SF values calculated from inhalation unit risk values using formula in OEPA(1993).
(c) Value obtained from USEPA's Technical Support Center.
(d) Provisional value provided by USEPA's Technical Support Center.

n:\1316jad\toxspf

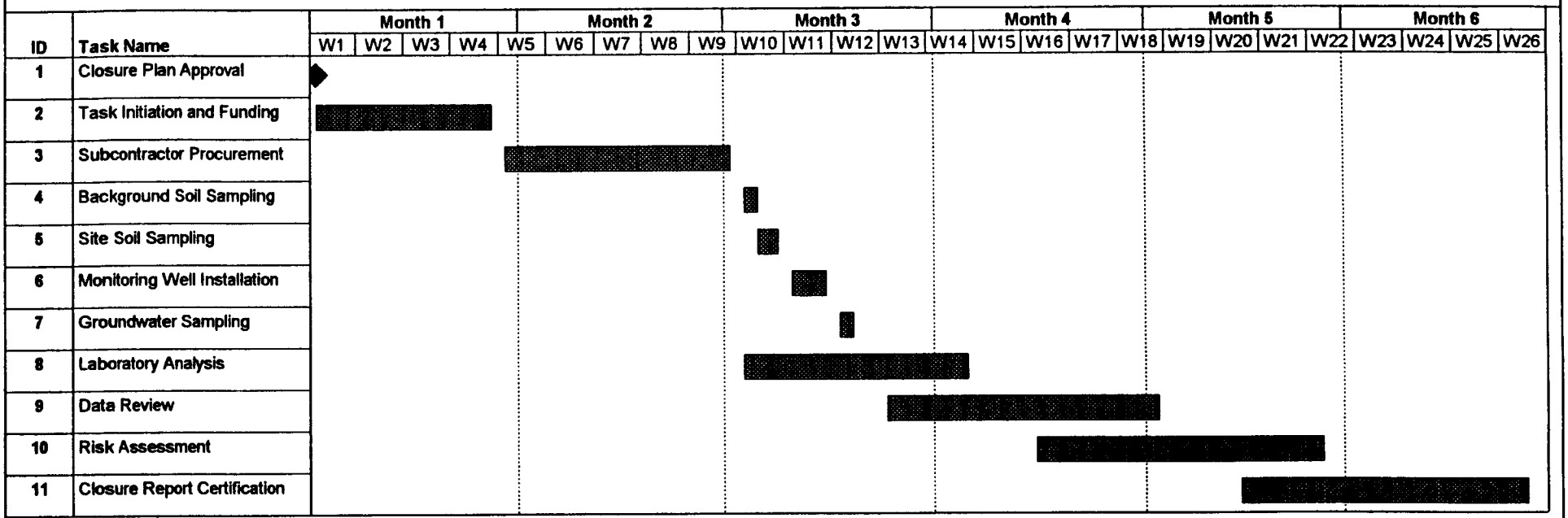
6.0 CLOSURE SCHEDULE

Implementation of this Work Plan for the Closure of the SPF waste management unit is expected to commence upon Ohio EPA approval of this Closure Work Plan. NASA will notify Ohio EPA Director 30 days prior to the initiation of closure activities. A tentative schedule is shown in Figure 6-1.

Implementation will only begin after receiving Ohio EPA concurrence on this closure plan and NASA obtaining a contractor to perform the work. A schedule for work plan activities is provided.

NASA PBS will contact the Ohio EPA District Inspector at least five business days in advance of critical closure activities for their observation, if desired. Critical activities would include: soil sampling; groundwater well installation, development and sampling; and waste disposal.

Figure 6-1
Closure Schedule
Space Power Facility, Plum Brook Station



Project: Plum Brook Station
Date: 8/15/95

Task Progress Milestone

h:\1244jeb\...sa\ra1.mpp

URS Consultants

7.0 AMENDMENT OF WORK PLAN

NASA fully expects to implement this closure plan as described in Section 3.0 and in accordance with the schedule in Section 6.0. A number of issues may arise during the implementation of this Closure Work Plan. Most will be resolved during the normal course of operations and work will continue as outlined. There may be, however, some problems that arise which would require additional sampling/testing, equipment modification, or supplemental investigations of existing conditions. This closure plan may be amended if any of the following events occur:

- Inclement weather or other unexpected event during closure;
- The horizontal and vertical extent of soil and/or groundwater contamination is more extensive than known conditions indicate and additional sampling is required;
- The additional sampling reveals site conditions are significantly different than expected.

NASA will verbally notify the Ohio EPA District inspector prior to significant modifications being made to the work plan included in the approved closure plan.

8.0 CLOSURE CERTIFICATION DOCUMENTATION

The completed closure of the waste management unit at the SPF shall be certified according to the requirements of OAC 3745-50-42 and will include the exact wording found in OAC 3745-50-42(D).

At a minimum, the certification document shall include the following information:

- The certificate statement;
- The approved Closure Work Plan or reference to the approved plan;
- The volume of waste removed or closed in place;
- All correspondence regarding closure activity after OEPA approval;
- Details of sampling and analysis methods;
- Laboratory records;
- A narrative describing all activities during closure;
- Details including as-built drawings, for landfill closures;
- Post-closure cleanup documentation;
- The signature of the owner/operator and of a qualified, independent, registered, professional engineer;
- A qualified, independent, registered professional engineer shall submit the closure certification; and
- The qualified professional engineer or his/her representative will be present for all critical activities such as geoprobe sampling, treatment system installation and system startup.

8.1 WAIVERS OR EXEMPTIONS

No waivers or exemptions are anticipated to be requested or required for generator closure of this facility. Activities will be conducted in accordance with requirements described in this document.

8.2 STATUS OF FACILITY AFTER CLOSURE

Tank #24 has been removed from the site and that area will not be utilized in the future for the management of hazardous waste or fuels. The Space Power Facility will remain a generator of hazardous waste and will continue to accumulate hazardous wastes in satellite storage drums. When full they are moved to Building 9206.

9.0 REFERENCES

Gilbert, RO. 1987. Statistical Methods for Environmental Pollution Monitoring. New York, NY: Van Nostrand Reinhold.

Hanna, SR, Briggs, GA, Hosker RP, J. 1982. Handbook on Atmospheric Diffusion. Oak Ridge, TN: U.S. Department of Energy.

Hwang, ST, Falco, JW, Nauman CH. 1986. Development of Advisory Levels for Polychlorinated Biphenyls (PCBs) Cleanup. Washington, DC: U.S. Environmental Protection Agency.

OEPA, 1993. Ohio Environmental Protection Agency. Division of Hazardous Waste Management. Closure Plan Review Guidance for RCRA Facilities. Interim Final, September 1, 1993.

USEPA, 1995. U.S. Environmental Protection Agency. Integrated Risk Information System (IRIS) Data retrieval on chemicals detected at the Plum Brook SPF.

USEPA, 1994. U.S. Environmental Protection Agency. Office of Research and Development. Health Effects Assessment Summary Tables. Annual FY 1994. Washington, DC: U.S. Environmental Protection Agency. Office of Emergency and Remedial Response. Publication 9200.6-303(94-1).

USEPA, 1992. U.S. Environmental Protection Agency. Office of Health and Environmental Assessment. Dermal Exposure Assessment: Principles and Applications. Washington, DC: U.S. Environmental Protection Agency. EPA/600/8-91/011B.

USEPA, 1991. U.S. Environmental Protection Agency. Office of Emergency and Remedial Response. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Part B. Washington, DC: U.S. Environmental Protection Agency. Publication 9285.7-01B

USEPA, 1989. U.S. Environmental Protection Agency. Office of Emergency and Remedial Response. Risk Assessment Guidance for Superfund. Volume I, Human Health Evaluation Manual, Part A. Washington, DC: U.S. Environmental Protection Agency. EPA/600/8-89/043.

APPENDIX A

HEALTH AND SAFETY PLAN

PLUM BROOK STATION

TASK ORDER 7059-004

_____

Employee Signature Date

has read and understands this Health and Safety Plan.

This form must be signed and returned to the Site Safety Officer prior to working on site.

TABLE OF CONTENTS

Page No.

1.0 Introduction 1-1

2.0 Responsibilities 2-1

2.1 Project Manager 2-1
2.2 Project Health and Safety Officer 2-1
2.3 Site Health and Safety Officer 2-1
2.4 Field Team Personnel 2-2

3.0 Training Requirements 3-1

4.0 Medical Surveillance Requirements 4-1

5.0 Site Hazard Evaluation 5-1

5.1 Chemical Hazards 5-1
5.2 Physical Hazards 5-1
5.2.1 Trauma 5-1
5.2.2 Tripping Hazards 5-1
5.2.3 Noise Hazards 5-1
5.2.4 Cuts and Lacerations 5-2
5.2.5 Animal Bites 5-2
5.2.6 Lifting Hazards 5-2
5.2.7 Heat Stress 5-2
5.2.8 Cold Stress 5-2
5.3 Site Communications 5-3

6.0 Site Control 6-1

6.1 General 6-1
6.2 Site Visitation 6-1

7.0 Personal Protection 7-1

7.1 Personal Protective Equipment Use 7-1
7.2 Personal Protection Equipment Selection 7-1
7.3 Evaluation of Onsite Chemical Hazards 7-4
7.4 Personal Use Factors 7-4
7.5 Respirator Fit Testing 7-5
7.6 In-Use Monitoring 7-5
7.7 Inspection of Personal Protective Equipment 7-5
7.8 Maintenance and Storage of Personal Protective Equipment 7-8
7.7.1 Personal Protective Equipment Maintenance 7-8

TABLE OF CONTENTS (Continued)

Page No.

7.7.2 Clothing Storage 7-8
7.7.3 Respirator Storage 7-8
7.9 Evaluation of Effectiveness of the PPE Program 7-8

8.0 Air Monitoring 8-1

8.1 Total Volatiles 8-1
8.2 Explosive Atmosphere/Oxygen Content 8-1
8.3 Work Stoppage Responses 8-1
8.4 Calibration of Air Monitoring Equipment 8-1

9.0 Handling of Samples 9-1

10.0 Decontamination Procedures 10-1
10.1 Decontamination of Personnel 10-1

11.0 Emergency Action Plan 11-1

11.1 General 11-1
11.2 Implementation 11-1
11.3 Evacuation 11-1
11.4 Fire or Explosion 11-1
11.5 Personal Injury 11-2
11.6 Overt Chemical Exposure 11-2
11.7 Spill Containment Program 11-2

12.0 CONFINED SPACE SAFETY REQUIREMENTS 12-1

LIST OF TABLES

7-1 Components of Personal Protection Levels 7-2

7-2 Personal Protective Equipment Inspection Checklists 7-6

8-1 Action Levels During Sampling Activities 8-2

EMERGENCY CONTACTS

Emergency Phone Contacts:

Chemtrec		(800) 424-9300
TSCA Hotline		(800) 424-9065
		(202) 544-1404
ATSDR	Days	(404) 329-2888
	Night	(404) 566-7777
AT&F (Explosives)		(800) 424-9555
National Response Center		(800) 424-8802
Pesticide Information Service		(800) 845-7633
EPA Emergency Response Team		(201) 321-6660
RCRA Hotline		(800) 424-9346
CMA Chemical Referral Center		(800) 262-8200
National Poison Control Center		(800) 942-5969
U.S. DOT	Days Only	(202) 366-0656

NASA Representative:	**Renee Palyo**	(216) 433-6460
NASA COTR:	**Les Main**	(216) 433-6345

1.0 INTRODUCTION

The purpose of this Health and Safety Plan (HASP) is to set forth, in an orderly and logical fashion, appropriate health and safety procedures to be followed during on site investigative activities at the NASA Plum Brook Station project location. Activities for the project will consist of the sampling of potentially contaminated soil samples, installation of monitoring wells, and sampling of groundwater. This document will serve not only to explain the chemical and physical hazards associated with working on the Project, but will also outline approved measures for dealing with such hazards.

In order to be easily accessible, a list of emergency contacts are attached at the front of this HASP.

The procedures presented in this plan comply with the following regulatory or guidance documents:

- OSHA Occupational Safety and Health Regulations, 29 CFR 1910/1926, U.S. Department of Labor, Occupational Safety and Health Administration, OSHA, March 6, 1990.
- OSHA Occupational Safety and Health Standards, 29CFR 1926.62.
- OSHA Occupational Safety and Health Standards, 29 CFR 1910.120.
- USEPA Order 1440.2, Health and Safety Requirements for Employees Engaged in Field Activities, July 12, 1981.
- NIOSH/OSHA/USCG/USEPA, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, October 1985.
- Standard Operating Safety Guides, United States Environmental Protection Agency, Office of Emergency and Remedial Response, November 1984.
- URS Health and Safety Manual, February 1994.

All personnel involved in onsite activities under this Health and Safety Plan will be required to follow the HASP protocols, as directed by the Site Health and Safety Officer (HSO).

All personnel who will be involved in these activities onsite have completed the appropriate waste site worker training as required by OSHA 1910.120(e)(2), 1910.120(e)(3), and 1910.120-(e)(8), as applicable, and the required medical surveillance as required by OSHA 1910.120(f). Copies of training certificates and medical surveillance certification for all URS field personnel will be maintained onsite.

2.0 RESPONSIBILITIES

A qualified individual and a backup will be designated for each key position. The following is a summary of the health and safety responsibilities of various project personnel.

2.1 PROJECT MANAGER

The Project Manager (PM) is responsible for implementing and ensuring compliance with this Health and Safety Plan. However, the PM may delegate authority, as necessary, to expedite and facilitate the implementation of any of the elements described herein.

2.2 PROJECT HEALTH AND SAFETY OFFICER

The responsibilities of the Project Health and Safety Officer (HSO) are to develop and coordinate the Site Health and Safety Program and provide necessary direction and supervision to the Site HSO and Project Manager. He will review and confirm changes in personal protection requirements when site conditions are found to be different than those originally anticipated.

The Project Health and Safety Officer will be involved, as necessary, in all discussions on health and safety matters with NASA personnel, Occupational Safety and Health Administration (OSHA), local health authorities, or other governmental or labor representatives. In addition, this individual will provide the Site Health and Safety Officer with details concerning the task-specific health and safety considerations. The Project HSO may also perform at least one unannounced onsite health and safety audit. The Project HSO reports directly to the Project Manager. URS will designate a qualified backup for the Project Health and Safety Officer prior to the initiation of onsite activities.

2.3 SITE HEALTH AND SAFETY OFFICER

The responsibilities of the Site Health and Safety Officer (HSO) are as follows:

- Implement this HASP onsite
- Contact the local health department, hospital, police, and fire departments prior to the initiation of work onsite
- Conduct the initial site-specific training session (Onsite Health and Safety Briefing)
- Enforce day-to-day health and safety protocols in effect onsite
- Require that all workers who will be involved in the sampling activities on the site have had appropriate waste site worker training and medical examinations, and review and maintain training and medical certifications onsite
- Require that all personnel entering the site understand the provisions of this HASP
- Conduct periodic training sessions in proper use and maintenance of personal protective equipment and safety practices

- Conduct periodic emergency response drills
- Conduct daily health and safety meetings each morning
- Direct and advise onsite URS personnel, visitors, and subcontractor(s) HSO(s) on all aspects, especially changes, related to health and safety requirements at the site
- Conduct necessary health and safety monitoring
- Administer air monitoring program
- Monitor site conditions and determine all necessary changes in levels of personal protection and, if warranted, execute work stoppages
- Report changes in site conditions and changes in personal protection requirements to the Project HSO
- Prepare accident/incident reports

The Site HSO reports directly to the Project HSO. The site contractor will designate a qualified backup for the Site Health and Safety Officer prior to the initiation of onsite activities.

2.4 FIELD TEAM PERSONNEL

Field team personnel will be responsible for understanding and complying with site health and safety requirements. One member of the project field team will be assigned the responsibility of cleaning and maintaining the personal protective equipment and the decontamination equipment. Field team personnel who will be involved in sampling activities will have completed the required waste site worker training to comply with 29 CFR, Part 1910.120.

3.0 TRAINING REQUIREMENTS

All personnel conducting field activities onsite are required to be certified in health and safety practices for hazardous waste operations as specified in the Federal OSHA Regulations (29 CFR 1910.120) (revised March 6, 1990). Paragraph (e) (2) of the above-referenced regulations requires that each employee, at the time of job assignment, receive a minimum of 40 hours of initial instruction off the site, and a minimum of three days of supervised field experience.

Paragraph (e) (3) of the above referenced regulations requires that all onsite management and supervisory personnel directly responsible for, or who supervise employees engaged in hazardous waste operations, must initially receive eight hours of additional specialized training. Management and supervisory training must emphasize health and safety practices related to managing hazardous waste work. Paragraph (e)(8) of the above referenced regulations requires that workers and supervisors must receive eight hours of refresher training annually on the items specified in Paragraph (e)(1) and/or (e)(3). Additionally, all personnel must receive adequate site-specific training, in the form of an Onsite Health and Safety Briefing given by the Site HSO prior to participating in onsite field work, which will involve a review of this Health and Safety Plan with emphasis on the following:

- Protection of the adjacent community from hazardous vapors which may be released during intrusive activities,
- Attention to health effects and hazards of substances known to be present onsite,
- Hazards and protection against heat/cold,
- The need for vigilance in personal protection, and the importance of attention to proper use, fit, and care of personal protective equipment,
- The effectiveness and limitations of personal protective equipment,
- Prescribed decontamination procedures,
- Site control, including work zones, access, and security,
- The proper observance of daily health and safety practices, such as the entry and exit of work zones and site, proper hygiene during lunch, break, etc.,
- Recognition in oneself or in others of physical conditions requiring immediate medical attention, and application of simple first aid measures, and
- Emergency procedures to be followed (with rehearsals) in cases of fire, explosion, or sudden release of hazardous gases.

Health and Safety Meetings will be conducted daily by the Site Health and Safety Officer and will cover protective clothing and other equipment to be used that day, potential chemical and physical hazards, emergency procedures, and conditions and activities from the previous day. All visitors entering potentially contaminated areas will be required to receive the necessary site-

specific training from the Site HSO, must be equipped with the proper personal protective equipment, and if not equipped with fit test certification, will be required to pass an irritant smoke respirator fit test.

4.0 MEDICAL SURVEILLANCE REQUIREMENTS

All personnel who engage in onsite activities for 30 days or more per year participate in the Medical Surveillance Program. This examination must take place annually and must be conducted by a physician who is board-certified in occupational medicine. The physician will have been made familiar with the job-related duties of each worker examined.

Components of the Medical Surveillance Program are consistent with OSHA regulations as defined in 29CFR 1910.120. The physician must certify whether the individual is fit to conduct work on hazardous waste sites using personal protection, or whether he or she must work within certain restrictions. Personnel may be excluded from this site for medical reasons. Copies of medical examination reports are given to each employee. Employees are encouraged to forward copies to their personal physician. Any person exposed to high levels of hazardous substances will be required to undergo a repeat medical exam at or before the conclusion of the project to determine possible health impacts. Any person suffering a lost-time injury or illness must have medical approval prior to returning to work onsite. When employment is terminated for any reason, the employee must receive an exit medical examination. All medical records will be held by the employer for the period of employment plus at least 30 years, in accordance with OSHA regulations on confidentiality and any other applicable regulations and will be made available to OSHA upon request.

5.0 SITE HAZARD EVALUATION

5.1 CHEMICAL HAZARDS

Contact with chemically contaminated materials will generally be of short duration. URS will ensure worker exposures do not exceed allowable limits by developing and adhering to conservative procedures for sampling activities. Exposures will be minimized by engineering controls, limiting exposure times, proper selection and use of PPE, and a field monitoring program. Exposures involved with the planned sampling activities will be highly transient with potential brief peak exposures. Threshold limit values (TLV) will be the most important control levels to be monitored. Selection of PPE and control measures are based upon the degree to which the TLV is measured in the worker breathing zone. Sampling activities could result in worker exposure to a variety of organic chemicals.

The historic usage of the site and the information generated from previous studies indicate that chlorinated solvents may be encountered in the subsurface soils. Possible exposure may be through ingestion, dermal contact, or inhalation depending on the type and concentration of compounds encountered during field activities.

5.2 PHYSICAL HAZARDS

Physical hazards range from the dangers of tripping and falling on uneven ground to those associated with moving vehicles. The following are physical hazards which may be encountered during the sampling activities.

5.2.1 Trauma

The use of excavation equipment carries with it the risk of being struck by, caught between or under, or pinched by various moving components. Limiting access to areas where equipment is operating, physical guarding, and the use of substantial work gloves will be employed as a means of minimizing this exposure.

5.2.2 Tripping Hazards

Any debris or wet surface at the site may add to this difficulty as do holes, deep crevices, steep grades, and loosely packed fill. Work boots with substantial soles and the elimination of debris will reduce this hazard.

5.2.3 Noise Hazards

Drilling equipment, large trucks, and other local noise sources such as vehicular traffic and rocket testing may result in noise levels which require the use of hearing protection. Hearing protection will be worn when conditions warrant. NASA PBS policy requires hearing protection when noise levels exceed 85dBA. Noise exposure is generally not constant and difficult to control. Controls such as increasing the distance of workers to the noise source and limiting exposure time will be implemented. When hearing protection is necessary, ear muffs and inserts/plugs are acceptable devices to reduce noise level exposure.

5.2.4 Cuts and Lacerations

Field activities that involve sampling could result contact with various types of equipment or from flying or falling objects. Hard hats and safety glasses with side shields will be worn to prevent these types of injuries. At least one person onsite must be currently American Red Cross certified in first aid and CPR. Personnel trained and certified in first aid should be prepared to take care of cuts and bruises as well as other minor injuries. A first aid kit approved by the American Red Cross will be present and available during all field activities.

5.2.5 Animal Bites

Animals and some insects may bite and thereby pose a health hazard in the form of irritation, illness, or poisoning. Anyone bitten should be given immediate first aid as necessary, and shall be transported to the nearest medical facility. Members of the field investigation team will be properly briefed regarding the potential for encountering insects and animals.

5.2.6 Lifting Hazards

Improper lifting by workers is one of the leading causes of industrial injuries. Sampling personnel may be required to move heavy objects including the lifting of the hand auger and soil accumulated on the auger. Therefore, all members of the field crew will be trained in the proper methods of lifting heavy objects. All workers will be cautioned against lifting objects too heavy for one person.

5.2.7 Heat Stress

The combination of high ambient temperature, high humidity, physical exertion, and personal protective apparel which limits the dissipation of body heat and moisture can cause heat stress. The Site HSO will be responsible for monitoring heat stress in the field team personnel.

Personnel will be trained to recognize the symptoms of heat stress and apply the appropriate treatment. Means of prevention include:

- Provide plenty of liquids
- Provide cooling devices
- Adjustment of the work schedule

When ambient temperatures exceed 75 degrees Fahrenheit, breaks should be taken at regular intervals of two (2) hours, or more frequently, if necessary. Decrease the work by 30 minutes for every 5 degree increase in temperature above 75 degrees Fahrenheit.

5.2.8 Cold Stress

Personnel can be susceptible to cold stress while conducting field work during cold weather months. To guard against cold stress and to prevent cold injuries, appropriate warm clothing should be worn, warm shelter must be previously identified and readily available, rest periods should be adjusted as needed, and the physical conditions of onsite field personnel should be closely

monitored. All personnel working onsite must be able to recognize the signs and symptoms of cold stress and apply first aid as needed. The Site HSO is responsible for monitoring the signs and symptoms of cold stress among field personnel.

5.3 SITE COMMUNICATIONS

Successful communication between members of the field team is essential. Since verbal communications may be limited due to the wearing of air-purifying respirators or high noise levels, the following hand signals will be utilized to convey emergency information:

- Hand gripping throat - Can't breathe.
- Grip partner's wrist, or place both hands around wrist - Leave area immediately, no debate!
- Hands on top of head - Need assistance.
- Thumbs up - I am all right, OK, I understand.
- Thumbs down - No, negative.

6.0 SITE CONTROL

6.1 GENERAL

In order to prevent the potential spread of contaminants from the work site, the site will be divided into three controlled zones: the exclusion zone, the contamination reduction zone, and the support zone.

- The exclusion zone is the general work area where soil contamination has been identified, and where excavation activity will take place. The outer boundary of the exclusion zone, the hotline, will be identified with hazard tape, barricades and temporary orange fencing. Flow of workers and equipment into the exclusion zone will be controlled. All personnel in the exclusion zone will wear the proper PPE and have the required OSHA training. All personnel entry to and exit from the exclusion zone will be logged in the project log book.

- The contamination reduction zone is the transition area between the exclusion zone (the contaminated area) and the support zone (clean area). The purpose of the contamination reduction zone is to limit the potential spread of contaminants from the exclusion zone by providing a specific area where equipment and personnel may be decontaminated. All potentially contaminated equipment, tools, and PPE will be cleaned and/or disposed in this area prior to removal from the site.

- The support zone is the area outside the contaminated area or the hotline. No equipment, tools, or personnel should enter the support zone from the exclusion zone without first exiting through the contamination reduction zone. All administrative and support functions will be performed from the support zone.

6.2 SITE VISITATION

Visitors will be permitted in the immediate area of field activities only with prior approval from the NASA-COTR. Approval to enter certain areas may require physical examination and compliance with training requirements. All site visitors shall be briefed on appropriate sections of the Emergency Action Plan section of this HASP prior to entry into potentially hazardous areas. The Site HSO will maintain a visitor log.

7.0 PERSONAL PROTECTION

7.1 PERSONAL PROTECTIVE EQUIPMENT USE

Personal protective equipment (PPE) can offer a high degree of protection only if it is used properly. This section covers the following aspects of PPE use:

- PPE Selection
- Chemical Hazard Evaluation
- Training
- Work Mission Duration
- Personnel Use Factors
- Donning and Doffing
- Fit Testing
- In-Use Monitoring
- Inspection
- Maintenance and Storage

7.2 PERSONAL PROTECTIVE EQUIPMENT SELECTION

There is potential for personnel exposure to hazardous contaminants through inhalation and dermal contact during excavation, decontamination, and sampling activities. Varying levels of personal protection equipment will be mandatory for all site personnel. The purpose of personal protective equipment is to isolate personnel working onsite from the chemical, physical, and biological hazards present onsite. Careful selection of adequate personal protective equipment should protect the respiratory system, skin and body, face and eyes, feet and hands, head, and hearing.

It is anticipated that Level D+ protection will be utilized during the sampling activities. If a higher level of personal protection is required at any time, the Site HSO will instruct personnel to upgrade and the Project HSO will be contacted. Components of all applicable levels of personal protection are listed in Table 7-1.

Some modification in safety apparel (e.g., switching from poly-coated disposable suits to standard disposable suits) may be implemented by the Site HSO in order to balance concerns for full contaminant protection against concerns for the possibility of heat stress resulting from the need to wear more restrictive protective clothing. The use of respiratory protective equipment shall comply with OSHA's requirements as set forth in 29CFR 1910.134.

Level C respiratory protection will normally be provided using NIOSH/MSHA-approved full-face respirators, with HEPA combination filter cartridges approved for removal of specific organic and inorganic vapors, particulates, gases, and fumes. The HEPA filter cartridges will be changed at the end of each work day or when breakthrough occurs, whichever comes first. All team members will be fit-tested for respirators using irritant smoke. Due to difficulties in achieving a proper seal between face and mask, persons with facial hair that interferes with the mask-to-face seal will not be allowed to work in areas requiring respiratory protection.

TABLE 7-1

NASA PLUM BROOK STATION
COMPONENTS OF PERSONAL PROTECTION LEVELS

Level D Protection	Level D+ Protection	Level C Protection
Safety glasses with side shields (or goggles)	Safety glasses with side shields (or goggles)	Hard hat
Hard hat	Hard hat	Poly-coated disposable (or standard disposable) coveralls
Face shield (optional)	Face shield (optional)	Inner gloves of snug-fitting latex or vinyl
Ordinary coveralls	Standard disposable coveralls	Outer gloves of neoprene or nitrile
Ordinary work gloves	Inner gloves of snug-fitting latex or vinyl	Steel-toe, steel-shank work shoes or boots (chemical resistant)
Steel-toe, steel-shank work shoes or boots (chemical resistant)	Outer gloves of neoprene or nitrile	Outer boots of neoprene or butyl rubber
Outer boots of neoprene or butyl rubber (optional)	Steel-toe, steel-shank work shoes or boots (chemical resistant)	Disposable outer "booties"
Disposable outer "booties" (optional)	Outer boots of neoprene or butyl rubber (optional)	Full-face air-purifying respirator (to be worn)**
	Disposable outer "booties"	Taping of gloves and boots to disposable coveralls
	Full-face air-purifying respirator (immediately available)**	

* Respirator to be fitted with NIOSH/MSHA-approved high-efficient filter (HEPA) combination respirator cartridges approved for organic vapors, particulates, gases, and fumes.

** Half-face respirator, face shield, and safety glasses with side shields (or goggles) may be substituted with approval of Health and Safety Officer.

TABLE 7-1 (Continued)

NASA PLUM BROOK STATION
COMPONENTS OF PERSONAL PROTECTION LEVELS
(Continued)

Level B Protection	Level A Protection
Hard hat	Hard hat
Poly-coated disposable (or standard disposable) coveralls	Fully encapsulating, chemical-resistant suit
Inner gloves of snug-fitting latex or vinyl	Inner gloves of snug-fitting latex or vinyl
Outer gloves of neoprene or nitrile	Outer gloves of neoprene or nitrile
Steel-toe, steel-shank work shoes or boots (chemical resistant)	Steel-toe, steel-shank work shoes or boots (chemical resistant)
Outer boots of neoprene or butyl rubber	Disposable outer "booties"
Disposable outer "booties"	Pressure-demand supplied air respirator
Pressure-demand supplied air respirator	5-minute escape bottle
5-minute escape bottle	Two-way radio communications
Two-way radio communications	
Taping of gloves and boots to disposable coveralls	

7.3 EVALUATION OF ONSITE CHEMICAL HAZARDS

For the fullest protection of site personnel, organic and inorganic vapor emissions, oxygen and combustible gas, and airborne dust will be monitored at closely spaced intervals during environmental sampling activities. Monitoring will be accomplished by real-time monitoring equipment, to include an HNu photoionization detector (PID), or equivalent, explosive atmosphere oxygen content will be monitored with a Gastech Model 1641, or equivalent, explosimeter.

The primary purpose of air monitoring is to (1) assess the adequacy of respiratory protection and (2) assess potential hazards in the work area. When any action level presented in Table 9-1 is exceeded during sampling operations, the appropriate responses will be immediately implemented. The specifics of the air monitoring program are provided in Section 8.0.

7.4 PERSONAL USE FACTORS

Certain personal features may jeopardize work safety during equipment use. Precautionary measures will be taken as indicated.

Facial hair and long head hair interfere with respirator fit and visibility. Any facial hair that passes between the face and the sealing surface of the respirator will be prohibited. Even a few days growth of stubble will allow excessive contaminant penetration. Long head hair must be effectively contained within protective hair coverings. OSHA regulations require removal of facial hair that interferes with respirator fit tests.

Punctured ear drums allow contaminants to enter the respiratory tract. Persons with punctured ear drums either should not be allowed onsite or should be required to wear only respirator/suit ensembles which enclose the entire head.

Eyeglasses with conventional earpiece bars may interfere with the full-facepiece respirator-to-face seal. A spectacle kit will be installed in the face masks of workers requiring vision correction.

Contact lenses may absorb vapors and trap contaminants and/or particulates between the lens and the eye, causing irritation, damage, absorption, and an urge to remove the respirator. Contact lens use is not recommended onsite. A spectacle kit will be installed in the face masks of workers requiring vision correction.

Facial features such as scars, hollow temples, very prominent cheekbones, deep skin creases, dentures, or missing teeth may interfere with the respirator-to-face seal. Full dentures should be retained when wearing a respirator; partial dentures may or may not have to be removed, depending on the possibility of swallowing them. Gum and tobacco chewing are prohibited during respirator use and at all times while in the Exclusion Zone or Contamination Reduction Zone.

7.5 RESPIRATOR FIT TESTING

The "fit" or integrity of the facepiece-to-face seal of a respirator affects its performance. A secure fit is important with positive-pressure equipment, and is essential to the safe functioning of negative-pressure equipment, such as air-purifying respirators. Fit test certification will be required for all persons using respirators.

7.6 IN-USE MONITORING

During equipment use, workers will be encouraged to report any perceived problems or difficulties to the Site HSO. These malfunctions include, but are not limited to:

- Discomfort
- Resistance to breathing
- Fatigue due to respirator use
- Interference with vision or communication
- Restriction of movement

7.7 INSPECTION OF PERSONAL PROTECTIVE EQUIPMENT

An effective PPE inspection program features five different inspections:

- Inspection and operational testing of equipment received from the factory or distributor
- Inspection of equipment as it is issued to workers
- Inspection after use or training and prior to maintenance
- Periodic inspection of stored equipment
- Periodic inspection when a question arises concerning the appropriateness of the selected equipment, or when problems with similar equipment arise

Each inspection will cover somewhat different areas in varying degrees of depth. Detailed inspection procedures, where appropriate, are usually available from the manufacturer. Table 7-2 provides PPE inspection checklists.

TABLE 7-2
PLUM BROOK STATION
PERSONAL PROTECTIVE EQUIPMENT INSPECTION CHECKLISTS

CLOTHING

Before use:

- Determine that the clothing material is correct for the specified task at hand.
- Visually inspect for:
  - imperfect seams
  - non-uniform coatings
  - tears
  - malfunctioning closures
- Hold up to light and check for pinholes.
- Flex product:
  - observe for cracks
  - observe for other signs of shelf deterioration
- If the product has been used previously, inspect inside and out for signs of chemical attack:
  - discoloration
  - swelling
  - stiffness

During the work task, periodically inspect for:

- Evidence of chemical attack such as discoloration, swelling, stiffening, and softening. Keep in mind, however, that chemical permeation can occur without any visible effects.
- Closure failure.
- Tears.
- Punctures.
- Seam discontinuities.

TABLE 7-2
(CONTINUED)

GLOVES

Before use:

Pressurize glove to check for pinholes. Either blow into glove, then roll gauntlet towards fingers or inflate glove and hold under water. In either case, no air should escape.

Air-Purifying Respirators

- Inspect air-purifying respirators:
  - before each use to be sure they have been adequately cleaned
  - after each use
  - during cleaning
  - monthly if in storage
- Check material conditions for:
  - signs of pliability
  - signs of deterioration
  - signs of distortion
- Examine cartridges or canisters to ensure that:
  - they are the proper type for the intended use
  - the expiration date has not been passed
  - they have not been opened or used previously
- Check faceshields and lenses for:
  - cracks
  - crazing
  - fogginess

7.8 MAINTENANCE AND STORAGE OF PERSONAL PROTECTIVE EQUIPMENT

7.8.1 Personal Protective Equipment Maintenance

Maintenance of PPE will be performed only by those having specialized training and equipment. The following classification scheme will be used to divide maintenance into three levels:

Level 1: User or wearer maintenance, requiring a few common tools or no tools at all.

Level 2: Shop maintenance which can be performed by the owner's maintenance shop.

Level 3: Specialized maintenance which can be performed only by the factory or an authorized repair depot.

Clothing and respirators must be stored properly to prevent damage or malfunction due to exposure to dust, moisture, sunlight, damaging chemicals, extreme temperatures, and impact. Many equipment failures can be directly attributed to improper storage.

7.8.2 Clothing Storage

- Contaminated clothing will be stored in an area separate from street clothing.
- Contaminated clothing will be stored in a well-ventilated area, with good air flow around each item, if possible.
- Different types and materials of clothing and gloves will not be mixed in storage.

7.8.3 Respirator Storage

- Air-purifying respirators will be dismantled, washed, and disinfected after each use.
- Air-purifying respirators will be stored individually in their original carton or carrying case, or in heat-sealed or resealable plastic bags.

7.9 EVALUATION OF EFFECTIVENESS OF THE PPE PROGRAM

The evaluation of the effectiveness of a PPE program is an ongoing process. The type of equipment used and the overall level of protection will be reevaluated periodically as the amount of information about the site increases, and as workers are required to perform different tasks. Personnel will be encouraged to provide feedback to the Site HSO regarding their perception of the effectiveness of the PPE being used. Personnel will be instructed to upgrade their level of protection if, after discussion with the Site HSO, they feel it is necessary and the Project HSO approves. Any downgrading of personal protection levels must be approved by the Project HSO.

8.0 AIR MONITORING

Air monitoring will be performed throughout the sampling program by trained personnel. Monitoring frequency will be as deemed appropriate by the Site HSO. Air monitoring equipment will be calibrated daily and all data will be recorded in the field notebook and transferred to Instrument Reading Logs. Air will be monitored for total volatiles with a photoionization detector (HNu Model PI 101, or equivalent). Explosive atmosphere/oxygen content will be monitored with an explosimeter (Gastech Model 1641, or equivalent). All air monitoring results indicating zero or non-detect values, and meteorological data (e.g., temperature range, wind speed, wind direction, etc.) will be recorded in the field notebook and will be transferred to Instrument Reading Logs.

8.1 TOTAL VOLATILES

During sampling activities, air monitoring for total volatiles (organic vapors) will be performed using a photoionization detector (HNu Model PI 101, or equivalent) equipped with the standard probe which contains a 10.2 eV lamp. When readings of 5 ppm above background in the breathing zone are consistently observed, work will be stopped and the level of personal protection will be increased to Level C. Following resumption of work, monitoring will take place at least every 10 minutes or for every sample retrieved. If readings from 5-50 ppm above background in the breathing zone are observed, and all other air monitoring action levels indicate that sampling can proceed, monitoring will take place continuously. If organic vapor readings exceed 50 ppm above background in the breathing zone, sampling will be halted and the level of protection used by onsite personnel will be reassessed.

8.2 EXPLOSIVE ATMOSPHERE/OXYGEN CONTENT

A Gastech explosimeter Model 1641, or equivalent, will be used to monitor for explosive atmosphere, and percent oxygen content. Monitoring frequencies during sampling activities will be as summarized in Table 9-1. Readings greater than 10% LEL, less than 19.5% oxygen, or greater than 25% oxygen, will require temporary suspension of activities until the Project HSO determines a safe re-entry level.

8.3 WORK STOPPAGE RESPONSES

The following responses will be initiated whenever one or more of the action levels necessitating a work stoppage is exceeded:

- The Site HSO will be consulted immediately.
- All personnel (except as necessary for continued monitoring and contaminant mitigation, if applicable) will be cleared from the work area.

Any chemical release to air, water, or soil must be reported to the Site HSO at once. Any exposure resulting from protective equipment failure must be immediately reported to the Site HSO and to the Project HSO in writing within 24 hours.

8.4 CALIBRATION OF AIR MONITORING EQUIPMENT

Calibration will be performed in accordance with the manufacturers recommended procedures.

TABLE 8-1

NASA PLUM BROOK STATION
ACTION LEVELS DURING SAMPLING ACTIVITIES

Instrument readings in breathing zone unless otherwise noted.
Each action level is independent of all other action levels in determining responses.

Organic Vapors (PID)	Combustibles	Oxygen	Mercury Vapors	Responses
0-5 ppm Above Background	0-10% LEL	19.5-21%	<.05 mg/m³	• Continue sampling • Level D+ protection • Continue monitoring every 10 minutes/every sample retrieved.
5-25 ppm Above Background, Sustained Reading	10-20% LEL	19.5-21%	.05-.5mg/m³	• Continue sampling • Level C protection • Continue monitoring every 10 minutes/every sample retrieved.
>25 ppm Above Background, Sustained Reading	>20% LEL	<19.5 or >21%	>.5 mg/m³	• Discontinue Sampling • Withdraw from area; shut off all engine ignition sources. • Continuous monitoring for organic vapors 200 ft. downwind. • Continuous monitoring for LEL, determination made of safe re-entry. • Continuous 0_2 monitoring, determination made of safe re-entry. • Continuous monitoring for mercury vapor,determination made of safe re-entry.
Visual Dust Monitoring	No Visible Airborne Dust			Continued Operations in Level D+ protection.
	Visible Airborne Dust			Continued operations in Level C protection.

NOTES:

- Air monitoring for action levels will occur in the breathing zone and 24" above ground surface.
- Should organic vapors measure above 5ppm <u>and</u> mercury vapors measure above .05mg/m³ <u>simultaneously</u>, discontinue sampling until determination is made to re-enter area and potential upgrade to Level B protection.
- If action levels for any one of the monitoring parameters is exceeded, the appropriate responses listed in the right hand column should be taken.

A. Photoionization Detector: The photoionization detector will be calibrated to a benzene surrogate daily (prior to field activities) and the results will be recorded in the field log book and transferred to Instrument Reading Logs.

B. Explosimeter: Once a day, the explosimeter will be calibrated to a methane gas standard. Prior to each use, the oxygen sensor will be air-calibrated at an upwind location. This calibration involves adjusting the meter to read 20.5%, the concentration of oxygen in ambient air.

9.0 HANDLING OF SAMPLES

The collection and analysis of environmental samples will require caution, not only to ensure safety of site sampling and support personnel, but also to ensure accuracy of results. To minimize hazards to lab personnel, sample volumes will be no larger than necessary, and the outside of all sample containers will be wiped clean prior to shipment.

All samples will be prepared for shipment in a designated area, and will be transported only in designated vehicles. In order to preserve sample integrity and to prevent contaminant escape, packaging of samples shall follow standard sampling protocols. All samples will be placed in a sealed shipping container prior to shipment.

10.0 DECONTAMINATION PROCEDURES

10.1 DECONTAMINATION OF PERSONNEL

Decontamination of personnel will be based on the USEPA-approved decontamination procedures (see *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001). Use of disposable sampling equipment where possible will limit decontamination requirements.

Protective clothing, boots, and gloves, will be decontaminated before leaving the sampling area by a thorough soap-and-water wash. Liquid and solid wastes produced during decontamination will be collected and disposed of properly. Disposable items will be bagged, labeled and placed in 55-gallon drums pending disposal. Proper disposal of contaminated PPE will be the responsibility of the SHO. Personnel performing sampling will be advised that all clothing worn under protective clothing (i.e., underwear, shirts, socks, trousers) should be laundered separately from street clothing before re-wearing. If protective clothing is breached and personal clothing becomes contaminated, the personal clothing will be disposed of.

At present, shower facilities will not be provided and personnel will be instructed to take a shower daily upon returning to the hotel or place of residence.

11.0 EMERGENCY ACTION PLAN

11.1 GENERAL

The project management shall make contact with site, fire, security, and other off-site emergency response agencies such as but not limited to, police, fire, ambulance service and hospital emergency rooms prior to beginning work on site. In these contacts, project management shall inform the emergency provider about the nature and duration of work expected on the site and the type of contaminants and the potential health or safety effects of emergencies involving these contaminants. Also at this time the project and the emergency response units shall make arrangements to handle any emergencies that might be anticipated. Contacts have been listed at the front of this HASP.

11.2 IMPLEMENTATION

The on-site supervisor shall implement the Emergency Plan whenever conditions at the site warrant such action. The on-site supervisor will be responsible for assuring the evacuation, emergency treatment, emergency transport of the site personnel as necessary, and notification of emergency response units and the appropriate Management staff. The following conditions may require implementation of the Emergency Plan:

- Fire or explosion on site.
- Serious personal injury.
- Combustible gases or vapors in excess of 10% LEL in the work area.
- Release of hazardous materials, including gases or vapors at levels greater than the maximum use concentrations of the respirators.
- Unsafe working conditions, such as inclement weather.

11.3 EVACUATION

Evacuation of the immediate work area or the site may be required if certain emergency conditions exist as indicated below:

- Immediate Work Area Evacuation - Evacuation of the immediate work area and withdrawal to the designated assembly area will be required if air contaminant concentrations exceed action levels for the level of protection worn.
- Site Evacuation - In the event of a major emergency situation, such as fire, explosion, or significant release of toxic gases, all personnel will evacuate to the assigned assembly areas.

11.4 FIRE OR EXPLOSION

If concentrations of combustible gases or vapors are above 10% LEL in the work zone, or if an actual fire or explosion has taken place, emergency steps may be necessary. These steps may include;

evacuation of the work area, and notification of the fire department or other appropriate emergency response groups as necessary.

11.5 PERSONAL INJURY

At the beginning of field activities, the Project HSO will contact hospital personnel regarding the potential hazards at the site.

First aid for personal injuries will be administered onsite as appropriate by the Site HSO or his designee. If a site worker should require further treatment, he will be decontaminated if possible, depending on the severity of the injury, and transported to the hospital in a vehicle maintained onsite for this purpose. If necessary, an ambulance will be summoned. The onsite vehicle will carry written directions to the hospital as well as a copy a map showing the route to the hospital. Written directions to the hospital are included on the list of emergency contacts attached at the front of this HASP.

All accidents, however insignificant, will be reported to the Onsite Coordinator and the Site HSO, who will report the accident to the Project HSO. All personnel designated to administer first aid will have received a minimum of eight hours training in first aid and CPR, and be certified by the American Red Cross.

11.6 OVERT CHEMICAL EXPOSURE

Skin Contact:	Use copious amounts of soap and water. Wash/rinse affected area thoroughly, then provide appropriate medical attention.
Eye Contact:	Eyewash solution will be provided onsite as appropriate. Eyes should be rinsed for 15 minutes (minimum) upon chemical contamination.
Inhalation:	Move to fresh air and/or, if necessary decon/transport to hospital.
Ingestion:	Decontaminate and transport to emergency medical facility.
Puncture Wound: or Laceration:	Decontaminate and transport to emergency medical facility.

11.7 SPILL CONTAINMENT PROGRAM

The procedures defined in this section outline the actions to be taken to prevent spills and/or address spills associated with the sampling activities.

- All drums and bulk containers used during site activities shall meet the appropriate DOT, OSHA, and EPA regulations for the waste that they will contain.
- Drums and containers shall be inspected and their integrity assured prior to being moved. Drums or containers that cannot be inspected before being moved because of storage conditions, shall be positioned in an accessible location and inspected prior to further handling.
- Operations will be organized so as to minimize the amount of drum or container movement.

- Employees involved with drum or container operations shall be warned of the hazards associated with the containers.

- Where spills, leaks, or ruptures may occur, adequate quantities of spill containment equipment (sorbents) will be stationed in the immediate area. The spill containment program must be sufficient to contain and isolate the entire volume of hazardous substances being transferred.

- Drums or containers that cannot be moved without failure, shall be transferred to a sound container.

- Fire extinguishing equipment meeting 29 CFR part 1910 subpart 1 shall be on hand and ready for use to control fires.

- Bulk containers (temporary water storage tanks, roll-off boxes) will be inspected by the SHO on a daily basis to insure that no liquids are leaking from any container and that roll-offs are properly covered.

- The decontamination facility will be inspected by the SHO on a daily basis to ensure the facility liner is intact and that no leakage has occurred at the facility.

12.0 CONFINED SPACE SAFETY REQUIREMENTS

The scope of services being performed will not require an entry into a confined space. If a confined space entry is deemed necessary, a confined space permit will be applied for from NASA as far in advance as possible. Notification of the possible entry must be far enough in advance to allow for a thorough assessment of the associated hazards and revision of the HASP.

j:\adm\nasa\reports\h&s

SITE ASSESSMENT FOR TANKS 24, 25, 28, 29, 30, 31, 32, AND 39

AT PLUM BROOK STATION

FOR

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PLUM BROOK STATION
SANDUSKY, OHIO

PREPARED BY:

EBASCO SERVICES, INC.
5000 BRADENTON AVENUE, SUITE 200
DUBLIN, OHIO 43017

TABLE OF CONTENTS

SECTION		PAGE
1.0	INTRODUCTION	1
2.0	TANK REMOVAL	1
2.1	Tank No.s 29, 30, 31	1
2.2	Tank No. 28	2
2.3	Tank No. 32	4
2.4	Tank No. 39	6
2.5	Tank No.s 24 and 25	6
3.0	DISCUSSION AND RECOMMENDATIONS	9

APPENDICES

Appendix A Laboratory Results of the Soil Sampling.

2.4 Tank No 39

Tank No. 39 was removed September 18th. This 250 gallon tank was not in use before its removal. In the past, this tank had been used for gasoline storage. When this tank was removed, holes were found in it. The soil in the tank pit was visibly contaminated. After the tank was removed, water slowly began to seep into the pit. Water which was draining from beneath Building No. 8133 continued to fill the pit until the water level was approximately 2 feet below the ground surface. A tank truck was used to pump the water out of the excavated area in order to sample the soil. Additional contaminated soil was then removed and a water main was discovered approximately 7 feet below the ground surface. Three (3) soil samples were collected at this tank site. Table 6 indicates where each sample was collected and the lab analyses performed.

TABLE 6
Tank No. 32 Sample IDs, Locations, and Analyses

Sample ID	Location	Lab Analyses
PBS-8133-SS-1	Excavated soil	TPH, Ignitability, EP Toxicity for lead; Benzene, Toluene, Ethylbenzene, Total Xylenes (BTEX)
PBS-8133-SS-2	Excavated soil	TPH, Ignitability, EP Toxicity for lead, BTEX
PBS-8133-SS-3	Center of tank	TPH, Ignitability, EP Toxicity for lead, BTEX

The following table shows the concentrations for total petroleum hydrocarbons (TPH) and benzene, toluene, ethylbenzene and total xylenes (BTEX).

TABLE 7
Concentrations of TPH and BTEX at Tank No. 39

Sample ID	TPH mg/kg	Benzene ug/kg	Toluene ug/kg	Ethylbenzene ug/kg	Total Xylenes ug/kg
PBS-8133-SS-1	655	1400.	7200.	4400.	16000.
PBS-8133-SS-2	< 44	62.	103.	15.	65.
PBS-8133-SS-3	< 42	0.19	0.77	U 0.27	0.94

Measured concentrations for sample SS-1 indicated high levels of TPH and BTEX. Sample SS-2 had much lower concentrations than SS-1, but still had elevated levels of BTEX. Sample SS-3 had very low levels of BTEX, while total petroleum hydrocarbons were undetected in the sample. Samples SS-1 and SS-2 were taken from the excavated soils, while sample SS-3 was taken from the pit bottom. Since the contaminant concentrations in SS-3 are negligible, this may indicate that there is limited contamination. Specifically, this may indicate that contamination is limited to soils in the immediate vicinity of the tank.

2.5 Tank No.s 24 and 25

Tank No. 24 was removed September 18th, and Tank No. 25 was removed September 19th. Sampling was performed at both locations on September 19th. Tank No.s 24 and 25 were located south of Building No. 1411. Tank No. 24 contained waste oil and solvents, while Tank No. 25 contained fuel oil. Nine (9) soil samples were collected at this area. The location and analyses for

each sample is listed in Table 8.

TABLE 8
Tank No.s 24, 25 Sample IDs, Locations, and Analyses

Sample ID	Location	Analyses
PBS-1411-SS-1	South wall, Tank Area 24	VOCs, TPH, EP Toxicity for Lead Ignitability
PBS-1411-SS-2	East wall, Tank Area 24	VOCs, TPH
PBS-1411-SS-3	North wall, Tank Area 24	VOCs, TPH
PBS-1411-SS-4	Excavated Soil	VOCs, TPH, EP Toxicity for Lead, Ignitability
PBS-1411-SS-5	Excavated Soil	VOCs, TPH, EP Toxicity for Lead, Ignitability
PBS-1411-SS-6	East end, Tank Area 25	VOCs, TPH
PBS-1411-SS-7	West wall, Tank Area 25	VOCs, TPH
PBS-1411-SS-8	Excavated Soil	VOCs, TPH, EP Toxicity for lead, Ignitability
PBS-1411-SS-9	Excavated Soil	VOCs, TPH, EP Toxicity for lead, Ignitability

Samples SS-6 and SS-7 were taken using the backhoe bucket because the walls of the excavation pit were unstable. During excavation, shale bedrock was encountered approximately 12 feet below the ground surface. Lead concentrations were below the detection limits in all of the samples and a flashpoint >200°F was measured in each of the samples indicating the soils are not considered hazardous by virtue of their toxicity or ignitability. The TPH concentrations for each sample are listed below.

TABLE 9
TPH Concentrations for Samples Collected at Tank No.s 24 and 25

Tank No. 24		Tank No. 25	
Sample ID	TPH mg/kg	Sample ID	TPH mg/kg
PBS-1411-SS-1	244	PBS-1411-SS-6	317
PBS-1411-SS-2	411	PBS-1411-SS-7	1120
PBS-1411-SS-3	2030	PBS-1411-SS-8	93
PBS-1411-SS-4	686	PBS-1411-SS-9	1050
PBS-1411-SS-5	243		

There are elevated concentrations of total petroleum hydrocarbons in the area of both Tank No.s 24 and 25. Samples SS-3, SS-7, and SS-9 have the highest concentrations of TPH of the eight (8) tanks removed September 18th and 19th.

The following table shows the highest concentrations for selected volatile organic aromatics. Figure 3 shows the area of Tank Pit 24 and 25. Sampling locations are shown with their respective soil concentrations for TPH and four (4) volatile organic compounds.

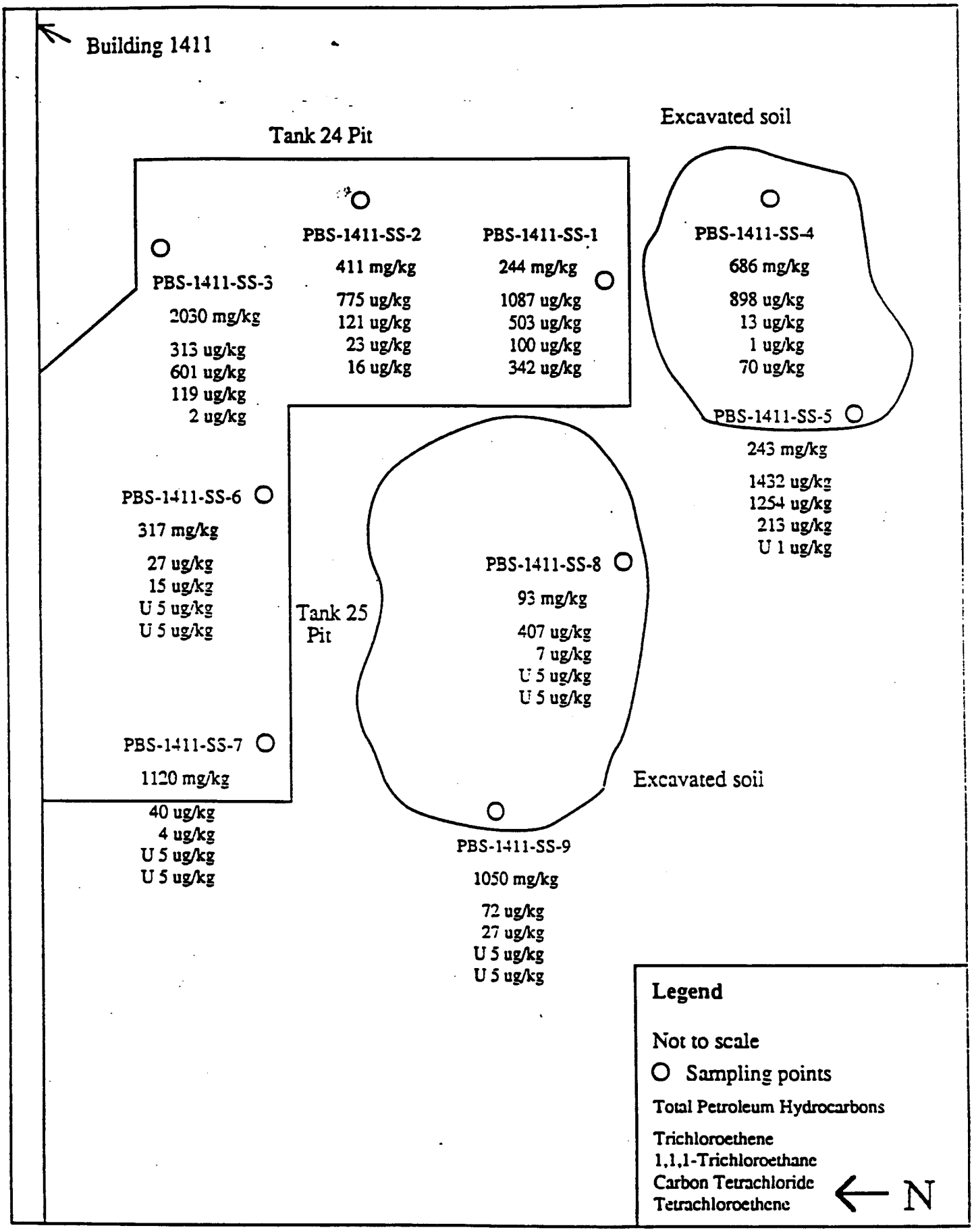


Figure 3; Tanks 24 and 25, south of building 1411
location of soil sampling points and sample concentrations

TABLE 10
Maximum Concentrations of Volatile Organics at Tank No.s 24 and 25 Pit Area

Compound	Concentration
trichlorofluoromethane	93
methylene chloride	164
1,1-dichloroethane	17
cis-1,2-dichloroethene	362
1,1,1-trichloroethane	1254
carbon tetrachloride	213
trichloroethene	1432
toluene	16
tetrachlorethene	342
ethylbenzene	45
m + p-xylenes	43
o-xylene	23
n-propylbenzene	76
1,3,5-trimethylbenzene	496
tert-butylbenzene	70
1,2,4-trimethylbenzene	541
p-isopropyltoluene	74
naphthalene	1094

3.0 Discussion and Recommendations

It is apparent from the visual inspection and also the laboratory analyses results that contamination has occurred at each of the sites of the eight (8) excavated underground storage tanks. The extent of contamination varies at each tank pit area, from visible contamination at Tank Pit 28, Tank Pit 24 and 25, and Tank Pit 39 to very limited contamination at Tank Pit 32. Levels of contamination at the sites can be compared to the clean up goals of the Ohio State Fire Marshal's Office; Bureau of Underground Storage Tank Regulation (BUSTR). According to Tom Forbes of BUSTR acceptable levels of total petroleum hydrocarbons are approximately 100 mg/kg in soil and 5 ug/kg for volatile organics in soil.

At the pit area of Tanks 29, 30 and 31 contamination is basically limited to elevated levels of trichloroethene (TCE), 1,1,1-trichloroethane and to a lesser extent, carbon tetrachloride. Levels of these three chlorinated organics ranged from undetectable levels to 610 ug/kg in the four soil samples taken from this area. Levels of total petroleum hydrocarbons in the four samples ranged from undetectable levels in two of the samples to 287 mg/kg.

At the Tank 28 pit area there was visible contamination when the tank was removed and the lab analyses showed relatively high levels of contamination of chlorinated organics. Levels of TCE were as high as 21142 ug/kg (21 ppm), while levels of 1,1,1-trichloroethane, carbon tetrachloride, and tetrachlorethene were as high as 10 ppm, levels of total petroleum hydrocarbons ranged from undetectable levels to 284 mg/kg.

At the Tank 32 pit area there was no visible contamination at the time of excavation. The volatile organics analyses showed levels of TCE that ranged from undetectable levels to 606 ug/kg. Concentrations of Total Petroleum Hydrocarbons were as high as 244 mg/kg.

Visible contamination was found at the Tank 39 pit area. Three samples were taken from the pit and excavated soils. The one sample taken from the pit bottom (8133-SS-3) could be considered clean according to the standards set by the Bureau of Underground Storage Tank Regulation. Sample 8133-SS-1 was very contaminated, and was taken from the excavated soil surrounding the tank. The tank was found to have holes in it when it was excavated. This would seem to indicate that contamination is limited to the immediate area where the tank had been buried.

At the pit area of Tanks 24 and 25 elevated levels of total petroleum hydrocarbons and volatile organics were reported in the laboratory analysis results. Total petroleum hydrocarbon levels were as high as 2030 mg/kg. Levels of chlorinated organics (TCE, 1,1,1-trichloroethane, carbon tetrachloride, tetrachloroethene) ranged from undetectable concentrations to 1432 ug/kg.

From the initial soil sampling, it appears that the areas around tank 28 and tanks 24, 25 are the most contaminated. The area of tank 39 has unacceptable levels of TPH and volatile organics, but does not appear to be as contaminated as the areas of tank 28 and tanks 24, 25. The area of tank 32 seems to have very limited contamination. The lab analyses indicated that soil contamination was present around tanks 29, 30 and 31, further investigation will consider the area of tanks 29, 30, and 31 and the area of tank 28 as a single contaminant area due to their proximity.

Because there is soil contamination and possibly groundwater contamination at each of the tank pit areas, it was determined that further investigation and possible remediation will be necessary to accomplish clean closure of each area. A soil gas survey of each of the areas was performed in an effort to determine the lateral extent of the contamination. Preliminary results indicate the need for a complete site characterization to support the screening of the currently available remedial alternatives. Because the majority of the tank areas involve contamination due to solvents and waste oils, OEPA and the Bureau of Underground Storage Tank Regulation (BUSTR) have determined that OEPA will be responsible for future regulatory activity. The Ohio EPA's clean up standards are background or undetectable levels or health based remediation levels supported by risk assessment. According to Hallie Serazin, of the Division of Emergency and Remedial Response, OEPA is developing a statewide background standard for total petroleum hydrocarbons (TPH) and also health based standards for volatile organics. These standards are being developed presently therefore BUSTR's approximate values for undetectable levels of TPH and volatiles in soils are used for reference purposes, when discussing soil contaminant levels at the tank pit areas.

A comprehensive remedial investigation, to include an extensive field sampling program, will be conducted at each of the areas to further quantify the lateral and vertical extent, and the degree of contamination in the soil and groundwater. The Ohio Environmental Protection Agency (OEPA), is the regulatory agency responsible for approving the upcoming site investigation and possible remedial activity.

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>AI070	Method Number:	8240
Lab Sample Name:	PBS1411SS1 #S468	Date Analyzed:	890922
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	1.3	Date Received:	890920

Sample Info.: GC/MS A,TN,ESI7019,5g,5uL IS,SS/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit
Dichlorodifluoromethane		1. U
Chloromethane		1. U
Vinyl Chloride		1. U
Bromomethane		1. U
Chloroethane		1. U
Trichlorofluoromethane	19.	
1,1-Dichloroethene	22.	
Methylene Chloride	12.	
trans-1,2-Dichloroethene		1. U
1,1-Dichloroethane	229.	
cis-1,2-Dichloroethene	6.	
2,2-Dichloropropane		1. U
Chloroform		1. U
Bromochloromethane		1. U
1,1,1-Trichloroethane	503.	
1,1-Dichloropropene		1. U
Carbon Tetrachloride	100.	
1,2-Dichloroethane		1. U
Benzene	2.	
Trichloroethene	509.	
1,2-Dichloropropane		1. U
Bromodichloromethane		1. U
Dibromomethane		1. U
Toluene	1.	J
1,1,2-Trichloroethane		1. U
1,3-Dichloropropane		1. U
Tetrachloroethene		1. U
Dibromochloromethane		1. U
1,2-Dibromoethane - EDB		1. U
Chlorobenzene		1. U
Ethylbenzene	27.	
1,1,1,2-Tetrachloroethane		1. U
m + p-Xylenes	34.	

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>AI070	Method Number:	8240
Lab Sample Name:	PBS141155I #5468	Date Analyzed:	890922
Matrix:	Soil	Date Collected:	890910
Dilution Factor:	1:3	Date Received:	890920

Sample Info.: GC/MS A,TN,ESI7019,5g,5uL IS,SS/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit
o-Xylene	15.	
Styrene		1. U
1,1,2,2-Tetrachloroethane		1. U
Isopropylbenzene	31.	
Bromoform		1. U
1,2,3-Trichloropropane		1. U
n-Propylbenzene	76.	
Bromobenzene		1. U
1,3,5-Trimethylbenzene	496.	
4-Chlorotoluene		1. U
2-Chlorotoluene		1. U
tert-Butylbenzene	70.	
1,2,4-Trimethylbenzene	541.	
sec-Butylbenzene	37.	
p-Isopropyltoluene	74.	
1,3-Dichlorobenzene		1. U
1,4-Dichlorobenzene		1. U
n-Butylbenzene		1. U
1,2-Dichlorobenzene		1. U
1,2-Dibromo-3-Chloropropane		1. U
1,2,4-Trichlorobenzene		1. U
Hexachlorobutadiene		1. U
Naphthalene	563.	
1,2,3-Trichlorobenzene		1. U

QUANT REPORT

Operator ID: [illegible] Quant Rev: 6 Quant Time: 890922 21:46
Output File: DA10/01:[illegible] Injected at: 890922 20:50
Data File: DA10/01:A1 Dilution Factor: 1.111000
Name: PR5741[illegible] #5468
Misc: HP/MS A,IN,[illegible],50,500 15,55/5min PRI

ID File: DDVAH2::ID
Title: [illegible]
Last Calibration: 890922 16:21

	Compound	R.T.	Scan#	Area	Conc	Units
1)	*Fluorobenzene	17.28	203	94784	500.00	ng/ml
2)	Trichlorofluoromethane	6.54	46	6658	19.10	ng/mL
8)	1,1-Dichloroethene	7.53	73	8354	27.45	ng/ml
9)	Methylene Chloride	8.26	93	5745	12.13	ng/ml
11)	1,1-Dichloroethane	9.39	124	184744	229.70	ng/mL
12)	cis-1,2-Dichloroethene	10.38	151	3876	8.12	ng/mL
16)	1,1,1-Trichloroethane	11.29	176	233372	507.35	ng/mL
18)	Carbon Tetrachloride	11.29	176	35875	111.23	ng/mL
20)	Benzene	11.90	195	2848	2.00	ng/ml
21)	Trichloroethene	12.93	221	234000	513.53	ng/mL
25)	Toluene	15.06	279	1063	1.25	ng/ml
26)	BROMOFLUOROBENZENE (SURR)	19.74	407	24451	39.57	ng/
33)	Ethylbenzene	17.83	355	39130	27.30	ng/ml
35)	m + p-Xylenes	17.83	355	19152	33.84	ng/mL
36)	o-Xylene	18.64	377	8514	14.94	ng/ml
39)	*1,4-Dichlorobenzene-d4	21.97	478	1105134	500.00	ng/mL
40)	Isopropylbenzene	19.76	394	14262	30.91	ng/ml
43)	n-Propylbenzene	19.99	414	46316	76.62	ng/mL
45)	1,3,5-Trimethylbenzene	20.17	419	167337	500.55	ng/ml
48)	tert-Butylbenzene	21.02	442	24467	71.13	ng/mL
49)	1,2,4-Trimethylbenzene	21.07	447	189360	545.17	ng/mL
50)	sec-Butylbenzene	21.34	451	20271	57.25	ng/mL
51)	p-Isopropyltoluene	21.49	455	28636	75.02	ng/ml
59)	Naphthalene	26.47	591	192548	567.69	ng/mL
61)	BROMOFLUOROBENZENE (SURR)	19.74	407	24451	129.24	ng/ml

* Compound is ISTD

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
PRS1411SS1

Lab Name: Hittman Ebasco Contract: ESI 7019

Lab Code: HITMAN Case No: NASA SAS No: N.A. SDG No: N.A.

Matrix: SOIL Lab Sample ID: HE#5468

Sample wt/vol: 5 G Lab File ID: >A1070

Level: LOW Date Received: 09/20/89

% Moisture: not dec.____ Date Analyzed: 9/22/89

Column: W.B. Dilution Factor: 1.3110

Number TICs found: 20 CONCENTRATION UNITS: (ug/L or ug/Kg) ug/Kg

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	3726474	Cyclopentane, 1-ethyl-3-meth	16.33	100.	
2.	611143	Benzene, 1-ethyl-2-methyl- (	20.80	120.	
3.	95636	Benzene, 1,2,4-trimethyl- (8	21.97	550.	
4.	1074551	Benzene, 1-methyl-4-propyl-	22.22	310.	
5.	1758889	Benzene, 2-ethyl-1,4-dimethy	22.37	180.	
6.		Unknown	22.53	330.	
7.	874419	Benzene, 1-ethyl-2,4-dimethy	22.95	220.	
8.	535773	Benzene, 1-methyl-3-(1-methy	23.14	310.	
9.	1587048	Benzene, 1-methyl-2-(2-prope	23.39	200.	
10.		Unknown	23.58	310.	
11.	95932	Benzene, 1,2,4,5-tetramethyl	23.87	350.	
12.	527537	Benzene, 1,2,3,5-tetramethyl	24.02	600.	
13.		Unknown	24.79	300.	
14.	488233	Benzene, 1,2,3,4-tetramethyl	24.90	350.	
15.		Unknown	25.11	600.	
16.		Unknown	25.59	320.	
17.		Unknown	25.96	350.	
18.	112403	Dodecane (8C19C1)	28.04	120.	
19.	91576	Naphthalene, 2-methyl- (8C19	29.00	700.	
20.	90120	Naphthalene, 1-methyl- (8C19	29.69	400.	
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>AI097	Method Number:	8240
Lab Sample Name:	PBS1411SS1 #5468 1.5	Date Analyzed:	890925
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	6.6	Date Received:	890920

Sample Info.: GC/MS A,RC,ESI7019,5g,5uL IS,SS/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit	
Dichlorodifluoromethane		7.	U
Chloromethane		7.	U
Vinyl Chloride		7.	U
Bromomethane		7.	U
Chloroethane		7.	U
Trichlorofluoromethane		7.	U
1,1-Dichloroethene		7.	U
Methylene Chloride	4.		J
trans-1,2-Dichloroethene		7.	U
1,1-Dichloroethane	181.		
cis-1,2-Dichloroethene		7.	U
2,2-Dichloropropane		7.	U
Chloroform		7.	U
Bromochloromethane		7.	U
1,1,1-Trichloroethane	479.		
1,1-Dichloropropene		7.	U
Carbon Tetrachloride	93.		
1,2-Dichloroethane		7.	U
Benzene	1.		J
Trichloroethene	1087.		
1,2-Dichloropropane		7.	U
Bromodichloromethane		7.	U
Dibromomethane		7.	U
Toluene	16.		
1,1,2-Trichloroethane		7.	U
1,3-Dichloropropane		7.	U
Tetrachloroethene	342.		
Dibromochloromethane		7.	U
1,2-Dibromoethane - EDB		7.	U
Chlorobenzene		7.	U
Ethylbenzene	45.		
1,1,1,2-Tetrachloroethane		7.	U
m + p-Xylenes	43.		

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>AI097	Method Number:	8240
Lab Sample Name:	PBS1411SS1 #5468 115	Date Analyzed:	890925
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	6.6	Date Received:	890920

Sample Info.: GC/MS A,RC,ESI7019,5g,5uL IS,SS/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit
o-Xylene	23.	
Styrene		7. U
1,1,2,2-Tetrachloroethane		7. U
Isopropylbenzene	21.	
Bromoform		7. U
1,2,3-Trichloropropane		7. U
n-Propylbenzene	61.	
Bromobenzene		7. U
1,3,5-Trimethylbenzene	400.	
4-Chlorotoluene		7. U
2-Chlorotoluene		7. U
tert-Butylbenzene	60.	
1,2,4-Trimethylbenzene	497.	
sec-Butylbenzene	33.	
p-Isopropyltoluene	64.	
1,3-Dichlorobenzene		7. U
1,4-Dichlorobenzene		7. U
n-Butylbenzene		7. U
1,2-Dichlorobenzene		7. U
1,2-Dibromo-3-Chloropropane		7. U
1,2,4-Trichlorobenzene		7. U
Hexachlorobutadiene		7. U
Naphthalene	1094.	
1,2,3-Trichlorobenzene		7. U

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

PRS141155 1/5

Lab Name: Hittman Ebasco Contract: ESI 7019

Lab Code: HITMAN Case No: NASA SAS No: N.A. SDG No: N.A.

Matrix: SOIL Lab Sample ID: #5468 1:5

Sample (wt/vol): 5 G Lab File ID: >A1097

Level: LOW Date Received: 09/20/89

% Moisture: not dec.____

Column: W.B. Date Analyzed: 9/25/89

Dilution Factor: 6.5555

Number TICs found: 20

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	611143	Benzene, 1-ethyl-2-methyl- (	20.79	77.	
2.		Unknown	22.40	62.	
3.		Unknown	22.58	170.	
4.	1758889	Benzene, 2-ethyl-1,4-dimethyl	22.99	140.	
5.	874419	Benzene, 1-ethyl-2,4-dimethyl	23.13	140.	
6.		Unknown	23.43	86.	
7.		Unknown	23.61	120.	
8.	527537	Benzene, 1,2,3,5-tetramethyl	23.87	140.	
9.	95932	Benzene, 1,2,4,5-tetramethyl	24.05	220.	
10.		Unknown	24.78	130.	
11.	488233	Benzene, 1,2,3,4-tetramethyl	24.93	160.	
12.		Unknown	25.15	200.	
13.		Unknown	25.62	230.	
14.		Unknown	25.95	90.	
15.		Unknown	27.12	54.	
16.	17057828	1H-Indene, 2,3-dihydro-1,2-d	27.52	66.	
17.		Unknown	27.71	61.	
18.		Unknown	28.11	64.	
19.	90120	Naphthalene, 1-methyl- (8C19	28.99	370.	
20.	91576	Naphthalene, 2-methyl- (8C19	29.68	230.	
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>AI071	Method Number:	8240
Lab Sample Name:	PBS1411SS2 #5469	Date Analyzed:	890922
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	1.3	Date Received:	890920

Sample Info.: GC/MS A,TN,ESI7019,5g,5uL IS,SS/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit
Dichlorodifluoromethane		1. U
Chloromethane		1. U
Vinyl Chloride		1. U
Bromomethane		1. U
Chloroethane		1. U
Trichlorofluoromethane	93.	
1,1-Dichloroethene	18.	
Methylene Chloride	4.	
trans-1,2-Dichloroethene	17.	
1,1-Dichloroethane	179.	
cis-1,2-Dichloroethene	362.	
2,2-Dichloropropane		1. U
Chloroform		1. U
Bromochloromethane		1. U
1,1,1-Trichloroethane	121.	
1,1-Dichloropropene		1. U
Carbon Tetrachloride	23.	
1,2-Dichloroethane	3.	
Benzene	1.	J
Trichloroethene	545.	
1,2-Dichloropropane		1. U
Bromodichloromethane		1. U
Dibromomethane		1. U
Toluene	9.	
1,1,2-Trichloroethane		1. U
1,3-Dichloropropane		1. U
Tetrachloroethene	16.	
Dibromochloromethane		1. U
1,2-Dibromoethane - EDB		1. U
Chlorobenzene		1. U
Ethylbenzene	23.	
1,1,1,2-Tetrachloroethane		1. U
m + p-Xylenes	25.	

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>AI071	Method Number:	8240
Lab Sample Name:	PBS1411SS2 #5469	Date Analyzed:	890922
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	1.3	Date Received:	890920

Sample Info.: GC/MS A,TN,ESI7019,5g,5uL IS,SS/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit
o-Xylene	29.	
Styrene		1. U
1,1,2,2-Tetrachloroethane		1. U
Isopropylbenzene	8.	
Bromoform		1. U
1,2,3-Trichloropropane		1. U
n-Propylbenzene	23.	
Bromobenzene		1. U
1,3,5-Trimethylbenzene	328.	
4-Chlorotoluene		1. U
2-Chlorotoluene		1. U
tert-Butylbenzene	29.	
1,2,4-Trimethylbenzene	225.	
sec-Butylbenzene	17.	
p-Isopropyltoluene	55.	
1,3-Dichlorobenzene		1. U
1,4-Dichlorobenzene		1. U
n-Butylbenzene		1. U
1,2-Dichlorobenzene	8.	
1,2-Dibromo-3-Chloropropane		1. U
1,2,4-Trichlorobenzene	1.	J
Hexachlorobutadiene		1. U
Naphthalene	467.	
1,2,3-Trichlorobenzene	3.	

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
PHS141155Z

Lab Name: Hittman Ebasco Contract: ESI 7019

Lab Code: HITMAN Case No: NASA SAS No: N.A. SDG No: N.A.

Matrix: SOIL Lab Sample ID: HE#5469

Sample wt/vol: 5 G Lab File ID: >A1U71

Level: LOW Date Received: 09/20/89

% Moisture: not dec.____ Date Analyzed: 9/22/89

Column: W.B. Dilution Factor: 1.2844

Number TICs found: 20 CONCENTRATION UNITS: (ug/L or ug/Kg) ug/Kg

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	76131	Ethane, 1,1,2-trichloro-1,2,	7.23	210.	
2.	111842	Nonane (8C19C1)	17.29	29.	
3.		Unknown	18.82	25.	
4.	1074437	Benzene, 1-methyl-3-propyl-	22.23	36.	
5.	1758889	Benzene, 2-ethyl-1,4-dimethyl	22.33	19.	
6.	535773	Benzene, 1-methyl-3-(1-methyl	23.14	23.	
7.		Unknown	23.47	21.	
8.	95932	Benzene, 1,2,4,5-tetramethyl	23.87	26.	
9.	527537	Benzene, 1,2,3,5-tetramethyl	24.02	62.	
10.		Unknown	24.28	19.	
11.		Unknown	24.79	20.	
12.	1758889	Benzene, 2-ethyl-1,4-dimethyl	24.90	29.	
13.		Unknown	25.12	31.	
14.		Unknown	25.59	46.	
15.		Unknown	25.96	34.	
16.	62238124	Decane, 2,3,6-trimethyl- (9C	28.05	37.	
17.	90120	Naphthalene, 1-methyl- (8C19	29.00	99.	
18.	91576	Naphthalene, 2-methyl- (8C19	29.70	64.	
19.	575439	Naphthalene, 1,6-dimethyl- (	32.00	34.	
20.	571619	Naphthalene, 1,5-dimethyl- (	32.74	33.	
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>AI098	Method Number:	8240
Lab Sample Name:	PBS1411SS2 #5469 1.5	Date Analyzed:	890925
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	6.4	Date Received:	890920

Sample Info.: GC/MS A,RC,ESI7019,5g,5uL IS,SS/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit
Dichlorodifluoromethane		6. U
Chloromethane		6. U
Vinyl Chloride		6. U
Bromomethane		6. U
Chloroethane		6. U
Trichlorofluoromethane		6. U
1,1-Dichloroethene		6. U
Methylene Chloride		6. U
trans-1,2-Dichloroethene		6. U
1,1-Dichloroethane	68.	
cis-1,2-Dichloroethene	162.	
2,2-Dichloropropane		6. U
Chloroform		6. U
Bromochloromethane		6. U
1,1,1-Trichloroethane	52.	
1,1-Dichloropropene		6. U
Carbon Tetrachloride	.7.	
1,2-Dichloroethane		6. U
Benzene		6. U
Trichloroethene	775.	
1,2-Dichloropropane		6. U
Bromodichloromethane		6. U
Dibromomethane		6. U
Toluene	7.	
1,1,2-Trichloroethane		6. U
1,3-Dichloropropane		6. U
Tetrachloroethene	15.	
Dibromochloromethane		6. U
1,2-Dibromoethane - EDB		6. U
Chlorobenzene		6. U
Ethylbenzene	25.	
1,1,1,2-Tetrachloroethane		6. U
m + p-Xylenes	18.	

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>A1098	Method Number:	8240
Lab Sample Name:	PBS1411SS2 #5469 1.5	Date Analyzed:	890925
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	6.4	Date Received:	890920

Sample Info.: GC/MS A,RC,ESI7019,5g,5uL IS,SS/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit
o-Xylene	33.	
Styrene		6. U
1,1,2,2-Tetrachloroethane		6. U
Isopropylbenzene		6. U
Bromoform		6. U
1,2,3-Trichloropropane		6. U
n-Propylbenzene	15.	
Bromobenzene		6. U
1,3,5-Trimethylbenzene	236.	
4-Chlorotoluene		6. U
2-Chlorotoluene		6. U
tert-Butylbenzene	23.	
1,2,4-Trimethylbenzene	178.	
sec-Butylbenzene	15.	
p-Isopropyltoluene	48.	
1,3-Dichlorobenzene		6. U
1,4-Dichlorobenzene		6. U
n-Butylbenzene		6. U
1,2-Dichlorobenzene	8.	
1,2-Dibromo-3-Chloropropane		6. U
1,2,4-Trichlorobenzene		6. U
Hexachlorobutadiene		6. U
Naphthalene	992.	
1,2,3-Trichlorobenzene		6. U

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO

PBS141155Z/5

Lab Name: Hittman Ebasco Contract: ESI 7019

Lab Code: HITMAN Case No: NASA SAS No: N.A. SDG No: N.A.

Matrix: SOIL Lab Sample ID: #5469 1:5

Sample wt/vol: 5 G Lab File ID: >A1098

Level: LOW Date Received: 09/20/89

% Moisture: not dec.____ Date Analyzed: 9/25/89

Column: W.B. Dilution Factor: 6.4220

Number TICs found: 20

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.		Unknown	22.25	67.	
2.		Unknown	22.36	110.	
3.	874419	Benzene, 1-ethyl-2,4-dimethyl	23.13	89.	
4.		Unknown	23.60	76.	
5.	527537	Benzene, 1,2,3,5-tetramethyl	23.86	110.	
6.	95932	Benzene, 1,2,4,5-tetramethyl	24.04	270.	
7.		Unknown	24.78	110.	
8.	488233	Benzene, 1,2,3,4-tetramethyl	24.92	150.	
9.	824226	1H-Indene, 2,3-dihydro-4-met	25.14	160.	
10.	4175535	1H-Indene, 2,3-dihydro-1,3-d	25.62	250.	
11.		Unknown	25.98	140.	
12.	6682719	1H-Indene, 2,3-dihydro-4,7-d	27.12	96.	
13.		Unknown	27.52	140.	
14.		Unknown	27.70	93.	
15.		Unknown	28.03	180.	
16.	90120	Naphthalene, 1-methyl- (8C19	28.98	670.	
17.		Unknown	29.39	140.	
18.	91576	Naphthalene, 2-methyl- (8C19	29.68	460.	
19.	575439	Naphthalene, 1,6-dimethyl- (	32.02	180.	
20.	569415	Naphthalene, 1,8-dimethyl- (	32.79	160.	
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>AI072	Method Number:	8240
Lab Sample Name:	PBS1411SS3 #5470	Date Analyzed:	890922
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	1.3	Date Received:	890920

Sample Info.: GC/MS A,TN,ESI7019,5g,5uL IS,SS/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit
Dichlorodifluoromethane		1. U
Chloromethane		1. U
Vinyl Chloride		1. U
Bromomethane		1. U
Chloroethane		1. U
Trichlorofluoromethane		1. U
1,1-Dichloroethene		1. U
Methylene Chloride	3.	
trans-1,2-Dichloroethene		1. U
1,1-Dichloroethane	36.	
cis-1,2-Dichloroethene		1. U
2,2-Dichloropropane		1. U
Chloroform		1. U
Bromochloromethane		1. U
1,1,1-Trichloroethane	601.	
1,1-Dichloropropene		1. U
Carbon Tetrachloride	119.	
1,2-Dichloroethane		1. U
Benzene		1. U
Trichloroethene	116.	
1,2-Dichloropropane		1. U
Bromodichloromethane		1. U
Dibromomethane		1. U
Toluene		1. U
1,1,2-Trichloroethane	11.	
1,3-Dichloropropane		1. U
Tetrachloroethene	2.	
Dibromochloromethane		1. U
1,2-Dibromoethane - EDB		1. U
Chlorobenzene		1. U
Ethylbenzene		1. U
1,1,1,2-Tetrachloroethane		1. U
m + p-Xylenes		1. U

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>AI072	Method Number:	8240
Lab Sample Name:	PBS1411SS3 #5470	Date Analyzed:	890922
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	1.3	Date Received:	890920

Sample Info.: GC/MS A,TN,ESI7019,5g,5uL IS,SS/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit
o-Xylene		1. U
Styrene		1. U
1,1,2,2-Tetrachloroethane		1. U
Isopropylbenzene		1. U
Bromoform		1. U
1,2,3-Trichloropropane		1. U
n-Propylbenzene		1. U
Bromobenzene		1. U
1,3,5-Trimethylbenzene	2.	
4-Chlorotoluene		1. U
2-Chlorotoluene		1. U
tert-Butylbenzene		1. U
1,2,4-Trimethylbenzene	2.	
sec-Butylbenzene		1. U
p-Isopropyltoluene		1. U
1,3-Dichlorobenzene		1. U
1,4-Dichlorobenzene		1. U
n-Butylbenzene		1. U
1,2-Dichlorobenzene		1. U
1,2-Dibromo-3-Chloropropane		1. U
1,2,4-Trichlorobenzene		1. U
Hexachlorobutadiene		1. U
Naphthalene	14.	
1,2,3-Trichlorobenzene		1. U

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

PBS1411SS3

Lab Name: Hittman Ebasco Contract: ESI 7019

Lab Code: HITMAN Case No: NASA SAS No: N.A. SDG No: N.A.

Matrix: SOIL Lab Sample ID: HE#5470

Sample wt/vol: 5 G Lab File ID: >A1072

Level: LOW Date Received: 09/20/89

% Moisture: not dec.____ Date Analyzed: 9/22/89

Column: W.B. Dilution Factor: 1.2740

Number TICs found: 20 CONCENTRATION UNITS: (ug/L or ug/Kg) ug/Kg

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.		Unknown	17.65	6.	
2.		Unknown	18.12	6.	
3.	14676290	Heptane, 3-ethyl-2-methyl- (	18.45	9.	
4.		Unknown	18.82	19.	
5.	15869940	Octane, 3,6-dimethyl- (8C19C	19.04	6.	
6.		Unknown	19.44	6.	
7.		Unknown	19.95	17.	
8.		Unknown	20.65	7.	
9.		Unknown	21.23	13.	
10.		Unknown	21.34	6.	
11.		Unknown	21.78	18.	
12.		Unknown	22.26	80.	
13.		Unknown	22.55	76.	
14.		Unknown	23.25	20.	
15.		Unknown	23.50	24.	
16.		Unknown	23.61	20.	
17.		Unknown	23.87	7.	
18.	2958761	Naphthalene, decahydro-2-met	24.09	23.	
19.		Unknown	24.24	17.	
20.	4453901	1,4-Methanonaphthalene, 1,4-	28.99	9.	
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>AI099	Method Number:	8240
Lab Sample Name:	PBS1411SS3 #5470 115	Date Analyzed:	890925
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	6.4	Date Received:	890920

Sample Info.: GC/MS A,RC,ESI7019,5g,5uL IS,SS/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit
Dichlorodifluoromethane		6. U
Chloromethane		6. U
Vinyl Chloride		6. U
Bromomethane		6. U
Chloroethane		6. U
Trichlorofluoromethane		6. U
1,1-Dichloroethene		6. U
Methylene Chloride		6. U
trans-1,2-Dichloroethene		6. U
1,1-Dichloroethane	7.	
cis-1,2-Dichloroethene		6. U
2,2-Dichloropropane		6. U
Chloroform		6. U
Bromochloromethane		6. U
1,1,1-Trichloroethane	210.	
1,1-Dichloropropene		6. U
Carbon Tetrachloride		6. U
1,2-Dichloroethane		6. U
Benzene		6. U
Trichloroethene	313.	
1,2-Dichloropropane		6. U
Bromodichloromethane		6. U
Dibromomethane		6. U
Toluene		6. U
1,1,2-Trichloroethane		6. U
1,3-Dichloropropane		6. U
Tetrachloroethene		6. U
Dibromochloromethane		6. U
1,2-Dibromoethane - EDB		6. U
Chlorobenzene		6. U
Ethylbenzene		6. U
1,1,1,2-Tetrachloroethane		6. U
m + p-Xylenes		6. U

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>AI099	Method Number:	8240
Lab Sample Name:	PBS1411SS3 #5470 125	Date Analyzed:	890925
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	6.4	Date Received:	890920

Sample Info.: GC/MS A,RC,ESI7019,5g,5uL IS,SS/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit
o-Xylene		6. U
Styrene		6. U
1,1,2,2-Tetrachloroethane		6. U
Isopropylbenzene		6. U
Bromoform		6. U
1,2,3-Trichloropropene		6. U
n-Propylbenzene		6. U
Bromobenzene		6. U
1,3,5-Trimethylbenzene		6. U
4-Chlorotoluene		6. U
2-Chlorotoluene		6. U
tert-Butylbenzene		6. U
1,2,4-Trimethylbenzene		6. U
sec-Butylbenzene		6. U
p-Isopropyltoluene		6. U
1,3-Dichlorobenzene		6. U
1,4-Dichlorobenzene		6. U
n-Butylbenzene		6. U
1,2-Dichlorobenzene		6. U
1,2-Dibromo-3-Chloropropane		6. U
1,2,4-Trichlorobenzene		6. U
Hexachlorobutadiene		6. U
Naphthalene	100.	
1,2,3-Trichlorobenzene		6. U

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO

PRS141155837/5

Lab Name: Hittman Ebasco Contract: ESI 7019

Lab Code: HITMAN Case No: NASA SAS No: N.A. SDG No: N.A.

Matrix: SOIL Lab Sample ID: #5470 1:5

Sample wt/vol: 5 G Lab File ID: >R1099

Level: LOW Date Received: 09/20/89

% Moisture: not dec.____ Date Analyzed: 9/25/89

Column: W.B. Dilution Factor: 6.3700

Number TICs found: 20

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	1487629U	Heptane, 3-ethyl-2-methyl- (	18.45	26.	
2.		Unknown	18.81	49.	
3.		Unknown	20.05	37.	
4.	17302282	Nonane, 2,6-dimethyl- (8C19C	20.20	93.	
5.		Unknown	20.38	28.	
6.		Unknown	21.15	130.	
7.		Unknown	21.37	88.	
8.		Unknown	21.77	51.	
9.		Unknown	22.25	310.	
10.		Unknown	22.54	240.	
11.		Unknown	23.09	30.	
12.		Unknown	23.24	86.	
13.		Unknown	23.50	97.	
14.		Unknown	23.61	42.	
15.	2958761	Naphthalene, decahydro-2-met	24.08	100.	
16.		Unknown	24.23	64.	
17.	90120	Naphthalene, 1-methyl- (8C19	28.98	47.	
18.	91576	Naphthalene, 2-methyl- (8C19	29.68	31.	
19.	575371	Naphthalene, 1,7-dimethyl- (	32.02	23.	
20.	581408	Naphthalene, 2,3-dimethyl- (	32.71	23.	
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
PBS141554

Lab Name: Hittman Ebasco Contract: ESI 7019

Lab Code: HITMAN Case No: NASA SAS No: N.A. SDG No: N.A.

Matrix: SOIL Lab Sample ID: 5471

Sample wt/vol: 5 G Lab File ID: >C1081

Level: LOW Date Received: N.A.

% Moisture: not dec.____ Date Analyzed: 9/23/89

Column: PACK Dilution Factor: 1.0924

Number TICs found: 20

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.		Unknown	21.78	13.	
2.		Unknown	22.15	15.	
3.		Unknown	22.59	22.	
4.		Unknown	22.92	18.	
5.		Unknown	23.14	12.	
6.		Unknown	23.47	29.	
7.		Unknown	23.61	28.	
8.	62238135	Decane, 2,3,7-trimethyl- (9C	23.87	71.	
9.		Unknown	24.05	36.	
10.		Unknown	24.27	64.	
11.		Unknown	24.64	18.	
12.		Unknown	24.82	25.	
13.	1618220	Naphthalene, decahydro-2,6-d	25.04	88.	
14.		Unknown	25.23	34.	
15.	62016335	Octane, 2,3,6-trimethyl- (9C	25.37	92.	
16.	61179/1	Dodecane, 4-methyl- (8C19C1)	26.00	60.	
17.		Unknown	26.33	53.	
18.	74645980	Dodecane, 2,7,10-trimethyl-	27.46	120.	
19.	62238113	Decane, 2,3,5-trimethyl- (9C	28.05	73.	
20.		Unknown	31.20	82.	
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>AI112	Method Number:	8240
Lab Sample Name:	PBS141155S4 #5471 /:5	Date Analyzed:	890925
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	5.5	Date Received:	890920

Sample Info.: GC/MS A,TN,ESI7019,1g.,5uL IS,SS/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit
Dichlorodifluoromethane		5. U
Chloromethane		5. U
Vinyl Chloride		5. U
Bromomethane		5. U
Chloroethane		5. U
Trichlorofluoromethane		5. U
1,1-Dichloroethene		5. U
Methylene Chloride	113.	
trans-1,2-Dichloroethene		5. U
1,1-Dichloroethane		5. U
cis-1,2-Dichloroethene		5. U
2,2-Dichloropropane		5. U
Chloroform		5. U
Bromochloromethane		5. U
1,1,1-Trichloroethane		5. U
1,1-Dichloropropene		5. U
Carbon Tetrachloride		5. U
1,2-Dichloroethane		5. U
Benzene		5. U
Trichloroethene	898.	
1,2-Dichloropropane		5. U
Bromodichloromethane		5. U
Dibromomethane		5. U
Toluene		5. U
1,1,2-Trichloroethane		5. U
1,3-Dichloropropane		5. U
Tetrachloroethene	70.	
Dibromochloromethane		5. U
1,2-Dibromoethane - EDB		5. U
Chlorobenzene		5. U
Ethylbenzene		5. U
1,1,1,2-Tetrachloroethane		5. U
m + p-Xylenes		5. U

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>CI081	Method Number:	8240
Lab Sample Name:	PBS1411SS4 #5471	Date Analyzed:	890923
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	1.1	Date Received:	890920

Sample Info.: GC/MS A,LB,ESI7019,5g,5uL IS,SS/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit
Dichlorodifluoromethane		1. U
Chloromethane		1. U
Vinyl Chloride		1. U
Bromomethane		1. U
Chloroethane		1. U
Trichlorofluoromethane	13.	
1,1-Dichloroethene		1. U
Methylene Chloride	1.	J
trans-1,2-Dichloroethene		1. U
1,1-Dichloroethane	2.	
cis-1,2-Dichloroethene		1. U
2,2-Dichloropropane		1. U
Chloroform		1. U
Bromochloromethane		1. U
1,1,1-Trichloroethane	13.	
1,1-Dichloropropene		1. U
Carbon Tetrachloride	1.	J
1,2-Dichloroethane	2.	
Benzene	0.	J
Trichloroethene	688.	
1,2-Dichloropropane		1. U
Bromodichloromethane		1. U
Dibromomethane		1. U
Toluene	2.	
1,1,2-Trichloroethane		1. U
1,3-Dichloropropane		1. U
Tetrachloroethene	23.	
Dibromochloromethane		1. U
1,2-Dibromoethane - EDB		1. U
Chlorobenzene		1. U
Ethylbenzene	1.	
1,1,1,2-Tetrachloroethane		1. U
m + p-Xylenes	1.	J

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>CI081	Method Number:	8240
Lab Sample Name:	FBS1411SS4 #5471	Date Analyzed:	890923
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	1.1	Date Received:	890920

Sample Info.: GC/MS A,LB,ESI7019,5g,5uL IS,SS/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit	
o-Xylene	0.		J
Styrene		1.	U
1,1,2,2-Tetrachloroethane		1.	U
Isopropylbenzene		1.	U
Bromoform		1.	U
1,2,3-Trichloropropane		1.	U
n-Propylbenzene		1.	U
Bromobenzene		1.	U
1,3,5-Trimethylbenzene	8.		
4-Chlorotoluene	0.		J
2-Chlorotoluene	0.		J
tert-Butylbenzene		1.	U
1,2,4-Trimethylbenzene	7.		
sec-Butylbenzene		1.	U
p-Isopropyltoluene		1.	U
1,3-Dichlorobenzene		1.	U
1,4-Dichlorobenzene		1.	U
n-Butylbenzene		1.	U
1,2-Dichlorobenzene		1.	U
1,2-Dibromo-3-Chloropropane		1.	U
1,2,4-Trichlorobenzene	10.		
Hexachlorobutadiene		1.	U
Naphthalene	26.		
1,2,3-Trichlorobenzene		1.	U

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>AI112	Method Number:	8240
Lab Sample Name:	PBS1411SS4 #5471 1.5	Date Analyzed:	890925
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	5.5	Date Received:	890920

Sample Info.: GC/MS A,TN,ESI7019,1g,5uL IS,SS/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit
o-Xylene		5. U
Styrene		5. U
1,1,2,2-Tetrachloroethane		5. U
Isopropylbenzene		5. U
Bromoform		5. U
1,2,3-Trichloropropane		5. U
n-Propylbenzene		5. U
Bromobenzene		5. U
1,3,5-Trimethylbenzene		5. U
4-Chlorotoluene		5. U
2-Chlorotoluene		5. U
tert-Butylbenzene		5. U
1,2,4-Trimethylbenzene	11.	
sec-Butylbenzene		5. U
p-Isopropyltoluene		5. U
1,3-Dichlorobenzene		5. U
1,4-Dichlorobenzene		5. U
n-Butylbenzene		5. U
1,2-Dichlorobenzene		5. U
1,2-Dibromo-3-Chloropropane		5. U
1,2,4-Trichlorobenzene		5. U
Hexachlorobutadiene		5. U
Naphthalene	17.	
1,2,3-Trichlorobenzene		5. U

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

PBS141155A /S7

Lab Name: Hittman Ebasco Contract: ESI 7019

Lab Code: HITMAN Case No: NASA SAS No: N.A. SDG No: N.A.

Matrix: SOIL Lab Sample ID: #5471 1:5

Sample wt/vol: 1 G Lab File ID: >A1112

Level: LOW Date Received: 09/20/89

% Moisture: not dec.____ Date Analyzed: 9/25/89

Column: W.B. Dilution Factor: 5.4620

Number TICs found: 19

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.		Unknown	22.62	570.	
2.		Unknown	22.95	180.	
3.		Unknown	23.50	200.	
4.		Unknown	23.65	290.	
5.		Unknown	23.94	670.	
6.		Unknown	24.09	460.	
7.		Unknown	24.27	550.	
8.		Unknown	24.64	160.	
9.		Unknown	24.82	170.	
10.		Unknown	25.07	770.	
11.		Unknown	25.26	300.	
12.	62016346	Octane, 2,3,7-trimethyl- (9C	25.37	1200.	
13.	27126223	Heptane, 4-azido- (8C19C1)	25.99	570.	
14.		Unknown	26.32	660.	
15.		Unknown	26.76	370.	
16.		Unknown	27.46	1300.	
17.	62238124	Decane, 2,3,6-trimethyl- (9C	28.04	850.	
18.	62016335	Octane, 2,3,6-trimethyl- (9C	29.36	880.	
19.		Unknown	31.19	370.	
20.					
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>CI082	Method Number:	8240
Lab Sample Name:	PBS1411SS5 #5472	Date Analyzed:	890923
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	1.2	Date Received:	890920

Sample Info.: GC/MS A,LB,ESI7019,5g,5uL IS,SS/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit
Dichlorodifluoromethane		1. U
Chloromethane		1. U
Vinyl Chloride		1. U
Bromomethane		1. U
Chloroethane		1. U
Trichlorofluoromethane		1. U
1,1-Dichloroethene		1. U
Methylene Chloride		1. U
trans-1,2-Dichloroethene		1. U
1,1-Dichloroethane	93.	
cis-1,2-Dichloroethene		1. U
2,2-Dichloropropane		1. U
Chloroform		1. U
Bromochloromethane		1. U
1,1,1-Trichloroethane	1254.	
1,1-Dichloropropene		1. U
Carbon Tetrachloride	213.	
1,2-Dichloroethane		1. U
Benzene		1. U
Trichloroethene	1432.	
1,2-Dichloropropane		1. U
Bromodichloromethane		1. U
Dibromomethane		1. U
Toluene		1. U
1,1,2-Trichloroethane		1. U
1,3-Dichloropropane		1. U
Tetrachloroethene		1. U
Dibromochloromethane		1. U
1,2-Dibromoethane - EDB		1. U
Chlorobenzene		1. U
Ethylbenzene		1. U
1,1,1,2-Tetrachloroethane		1. U
m + p-Xylenes		1. U

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>CI022	Method Number:	8240
Lab Sample Name:	PBS1411SS5 #5472	Date Analyzed:	890923
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	1.2	Date Received:	890920

Sample Info.: GC/MS A,LB,ESI7019,5g,5uL IS,SS/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit
o-Xylene		1. U
Styrene		1. U
1,1,2,2-Tetrachloroethane		1. U
Isopropylbenzene		1. U
Bromoform		1. U
1,2,3-Trichloropropane		1. U
n-Propylbenzene		1. U
Bromobenzene		1. U
1,3,5-Trimethylbenzene		1. U
4-Chlorotoluene		1. U
2-Chlorotoluene		1. U
tert-Butylbenzene		1. U
1,2,4-Trimethylbenzene		1. U
sec-Butylbenzene		1. U
p-Isopropyltoluene		1. U
1,3-Dichlorobenzene		1. U
1,4-Dichlorobenzene		1. U
n-Butylbenzene		1. U
1,2-Dichlorobenzene		1. U
1,2-Dibromo-3-Chloropropane		1. U
1,2,4-Trichlorobenzene		1. U
Hexachlorobutadiene		1. U
Naphthalene	22.	
1,2,3-Trichlorobenzene		1. U

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>AI113	Method Number:	8240
Lab Sample Name:	PBS1411SS5 #5472 1/10	Date Analyzed:	890925
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	12.1	Date Received:	890920

Sample Info.: GC/MS A,TN,ESI7019,.5g,5uL IS,SS/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit
Dichlorodifluoromethane		12. U
Chloromethane		12. U
Vinyl Chloride		12. U
Bromomethane		12. U
Chloroethane		12. U
Trichlorofluoromethane		12. U
1,1-Dichloroethene		12. U
Methylene Chloride	164.	
trans-1,2-Dichloroethene		12. U
1,1-Dichloroethane	48.	
cis-1,2-Dichloroethene		12. U
2,2-Dichloropropane		12. U
Chloroform		12. U
Bromochloromethane		12. U
1,1,1-Trichloroethane	620.	
1,1-Dichloropropene		12. U
Carbon Tetrachloride		12. U
1,2-Dichloroethane		12. U
Benzene		12. U
Trichloroethene	1416.	
1,2-Dichloropropane		12. U
Bromodichloromethane		12. U
Dibromomethane		12. U
Toluene		12. U
1,1,2-Trichloroethane		12. U
1,3-Dichloropropane		12. U
Tetrachloroethene		12. U
Dibromochloromethane		12. U
1,2-Dibromoethane - EDB		12. U
Chlorobenzene		12. U
Ethylbenzene		12. U
1,1,1,2-Tetrachloroethane		12. U
m + p-Xylenes		12. U

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>AI113	Method Number:	8240
Lab Sample Name:	PBS1411SS5 #5472 1:10	Date Analyzed:	890925
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	12.1	Date Received:	890920

Sample Info.: GC/MS A,TN,ESI7019,.5g,5uL IS,SS/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit
o-Xylene		12. U
Styrene		12. U
1,1,2,2-Tetrachloroethane		12. U
Isopropylbenzene		12. U
Bromoform		12. U
1,2,3-Trichloropropane		12. U
n-Propylbenzene		12. U
Bromobenzene		12. U
1,3,5-Trimethylbenzene		12. U
4-Chlorotoluene		12. U
2-Chlorotoluene		12. U
tert-Butylbenzene		12. U
1,2,4-Trimethylbenzene		12. U
sec-Butylbenzene		12. U
p-Isopropyltoluene		12. U
1,3-Dichlorobenzene		12. U
1,4-Dichlorobenzene		12. U
n-Butylbenzene		12. U
1,2-Dichlorobenzene		12. U
1,2-Dibromo-3-Chloropropane		12. U
1,2,4-Trichlorobenzene		12. U
Hexachlorobutadiene		12. U
Naphthalene		12. U
1,2,3-Trichlorobenzene		12. U

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
PBS141155570

Lab Name: Hittman Ebasco Contract: ESI 7019

Lab Code: HITMAN Case No: NASA SAS No: N.A. SDG No: N.A.

Matrix: SOIL Lab Sample ID: #5472 1:10

Sample wt/vol: .5 G Lab File ID: >A1113

Level: LOW Date Received: 09/20/89

% Moisture: not dec.____ Date Analyzed: 9/25/89

Column: W.B. Dilution Factor: 12.1270

Number TICs found: 6 CONCENTRATION UNITS: (ug/L or ug/Kg) ug/Kg

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.		Unknown	25.99	960.	
2.	31081182	Nonane, 3-methyl-5-propyl- (	27.45	2100.	
3.		Unknown	28.04	2000.	
4.	17301303	Undecane, 3,8-dimethyl- (8CI	29.39	2700.	
5.		Unknown	30.52	1000.	
6.		Unknown	31.15	1000.	
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>CI082	Method Number:	8240
Lab Sample Name:	PBS1411SS6,H#5443	Date Analyzed:	890920
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	1.2	Date Received:	890920

Sample Info.: GC/MS C,LB,ESI-7019,10ul IS-21,SS-20/5gms P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/kg	Detection Limit	
Chloromethane		12	U
Bromomethane		12	U
Vinyl Chloride		12	U
Chloroethane		12	U
Methylene Chloride	3		J
Acetone	22		
Acrylonitrile		6	U
Acrolein		6	U
Trichlorofluoromethane	3		J
Carbon Disulfide		6	U
1,1-Dichloroethene		6	U
1,1-Dichloroethane	29		
1,2-Dichloroethene (Total)	3		J
Chloroform		6	U
1,2-Dichloroethane		6	U
2-Butanone		6	U
1,1,1-Trichloroethane	15		
Carbon Tetrachloride		6	U
Vinyl Acetate		12	U
Bromodichloromethane		6	U
1,2-Dichloropropane		6	U
trans-1,3-Dichloropropene		6	U
Trichloroethene	27		
Dibromochloromethane		6	U
1,1,2-Trichloroethane		6	U
Benzene	1		J
cis-1,3-Dichloropropene		6	U
2-Chloroethylvinylether		6	U
Bromoform		6	U
4-Methyl-2-Pentanone		12	U
2-Hexanone	9		J
Tetrachloroethene		6	U
1,1,2,2-Tetrachloroethane		6	U

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>CI082	Method Number:	8240
Lab Sample Name:	PBS1411SS6,H#5443	Date Analyzed:	890920
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	1.2	Date Received:	890920

Sample Info.: GC/MS C,LB,ESI-7019,10ul IS-21,SS-20/5gms P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/kg	Detection Limit	
Toluene		6	U
Chlorobenzene		6	U
Ethylbenzene		6	U
Styrene		6	U
Xylenes (Total)		6	U
m-Xylene		6	U
o + p-Xylene		6	U
1,3 Dichlorobenzene		6	U
1,2 Dichlorobenzene		6	U
1,4 Dichlorobenzene		6	U

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

PBS1411SS6

Lab Name: Hittman Ebasco Contract: ESI 7019

Lab Code: HITMAN Case No: NASA SAS No: N.A. SDG No: N.A.

Matrix: SOIL Lab Sample ID: HE#5443

Sample wt/vol: 5 6 Lab File ID: >CI082

Level: LOW Date Received: 09/20/89

% Moisture: not dec.____ Date Analyzed: 9/20/89

Column: PACK Dilution Factor: 1.2000

Number TICs found: 10 CONCENTRATION UNITS: (ug/L or ug/Kg) ug/Kg

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.		Unknown	1.19	76.	
2.		Unknown	1.33	78.	
3.	3073663	Cyclohexane, 1,1,3-trimethyl	27.34	31.	
4.		Unknown	27.61	19.	
5.		Unknown	28.11	14.	
6.	6236880	Cyclohexane, 1-ethyl-4-methy	28.89	29.	
7.		Unknown	29.80	34.	
8.		Unknown	31.90	61.	
9.	63830693	4-Nonene, 3-methyl-, (Z)- (S	34.14	68.	
10.		Unknown	36.15	39.	
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>CI083	Method Number:	8240
Lab Sample Name:	PBS1411SS7,H#5444	Date Analyzed:	890920
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	1.0	Date Received:	890920

Sample Info.: GC/MS C,LB,ESI-7019,10ul IS-21,SS-20/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/kg	Detection Limit	
Chloromethane		10	U
Bromomethane		10	U
Vinyl Chloride		10	U
Chloroethane		10	U
Methylene Chloride	3		J
Acetone	13		
Acrylonitrile		5	U
Acrolein		5	U
Trichlorofluoromethane	5		J
Carbon Disulfide		5	U
1,1-Dichloroethene		5	U
1,1-Dichloroethane	1		J
1,2-Dichloroethene (Total)		5	U
Chloroform		5	U
1,2-Dichloroethane		5	U
2-Butanone		5	U
1,1,1-Trichloroethane	4		J
Carbon Tetrachloride		5	U
Vinyl Acetate		10	U
Bromodichloromethane		5	U
1,2-Dichloropropene		5	U
trans-1,3-Dichloropropene		5	U
Trichloroethene	40		
Dibromochloromethane		5	U
1,1,2-Trichloroethane		5	U
Benzene		5	U
cis-1,3-Dichloropropene		5	U
2-Chloroethylvinylether		5	U
Bromoform		5	U
4-Methyl-2-Pentanone	4		J
2-Hexanone	19		
Tetrachloroethene		5	U
1,1,2,2-Tetrachloroethane		5	U

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>CI083	Method Number:	8240
Lab Sample Name:	PBS1411557,H#5444	Date Analyzed:	890920
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	1.0	Date Received:	890920

Sample Info.: GC/MS C,LB,ESI-7019,10ul IS-21,SS-20/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/kg	Detection Limit	
Toluene		5	U
Chlorobenzene		5	U
Ethylbenzene		5	U
Styrene		5	U
Xylenes (Total)	9		
m-Xylene	5		J
o + p-Xylene	5		J
1,3 Dichlorobenzene		5	U
1,2 Dichlorobenzene		5	U
1,4 Dichlorobenzene		5	U

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

PBS1411SS7

Lab Name: Hittman Ebasco Contract: ESI 7019

Lab Code: HITMAN Case No: NASA SAS No: N.A. SDG No: N.A.

Matrix: SOIL Lab Sample ID: HE#5444

Sample wt/vol: 5 6 Lab File ID: >CI083

Level: LOW Date Received: 09/20/89

% Moisture: not dec.____ Date Analyzed: 9/20/89

Column: PACK Dilution Factor: 1.0296

Number TICs found: 9 CONCENTRATION UNITS: (ug/L or ug/Kg) ug/Kg

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.		Unknown	1.05	8.	
2.		Unknown	1.19	150.	
3.	109660	Pentane (ACN)(DOT)(8CI9CI)	14.65	5.	
4.	95377	Cyclopentene, methyl- (8CI9C	16.16	5.	
5.	96140	Pentane, 3-methyl- (8CI9CI)	19.99	7.	
6.		Unknown	22.96	10.	
7.		Unknown	25.11	10.	
8.	281232	Tricyclo[3.3.1.13,7]decane (	26.39	19.	
9.	63830693	4-Nonene, 3-methyl-, (Z)- (9	34.12	38.	
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

PRS1411555

Lab Name: Hittman Ehasco Contract: ESI 7019

Lab Code: HITMAN Case No: NASA SAS No: N.A. SDG No: N.A.

Matrix: SOIL Lab Sample ID: 5472

Sample wt/vol: 5 G Lab File ID: >C1082

Level: LOW Date Received: 09/20/89

% Moisture: not dec.____ Date Analyzed: 9/23/89

Column: PACK Dilution Factor: 1.2127

Number TICs found: 20 CONCENTRATION UNITS: (ug/L or ug/Kg) ug/Kg

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.		Unknown	8.15	21.	
2.		Unknown	8.77	29.	
3.		Unknown	16.84	21.	
4.		Unknown	17.32	17.	
5.		Unknown	17.50	34.	
6.		Unknown	18.49	27.	
7.		Unknown	19.29	19.	
8.		Unknown	20.17	25.	
9.		Unknown	23.14	20.	
10.		Unknown	24.05	54.	
11.		Unknown	24.27	86.	
12.	62016346	Octane, 2,3,7-trimethyl- (9C	25.37	170.	
13.		Unknown	25.99	170.	
14.		Unknown	26.28	80.	
15.		Unknown	27.01	170.	
16.	17302328	Nonane, 3,7-dimethyl- (8C19C	27.45	550.	
17.	62238113	Decane, 2,3,5-trimethyl- (9C	28.04	520.	
18.	17301303	Undecane, 3,8-dimethyl- (8C1	29.36	700.	
19.	629629	Pentadecane (8C19C1)	30.49	380.	
20.		Unknown	33.64	88.	
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>CI093	Method Number:	8240
Lab Sample Name:	PBS1411SS7MS,#5444MS	Date Analyzed:	890922
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	1.0	Date Received:	890920

Sample Info.: 6C4MS C,LB,ESI-7019,10ul IS-21,SS-20,MS-16/5gms P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/kg	Detection Limit	
Chloromethane		10	U
Bromomethane		10	U
Vinyl Chloride		10	U
Chloroethane		10	U
Methylene Chloride	3		J
Acetone	35		
Acrylonitrile		5	U
Acrolein		5	U
Trichlorofluoromethane	1		J
Carbon Disulfide		5	U
1,1-Dichloroethene			
1,1-Dichloroethane	3		J
1,2-Dichloroethene (Total)		5	U
Chloroform		5	U
1,2-Dichloroethane		5	U
2-Butanone		5	U
1,1,1-Trichloroethane	6		
Carbon Tetrachloride		5	U
Vinyl Acetate		10	U
Bromodichloromethane		5	U
1,2-Dichloropropane		5	U
trans-1,3-Dichloropropene		5	U
Trichloroethene			
Dibromochloromethane		5	U
1,1,2-Trichloroethane		5	U
Benzene			
cis-1,3-Dichloropropene		5	U
2-Chloroethylvinylether		5	U
Bromoform		5	U
4-Methyl-2-Pentanone		10	U
2-Hexanone	5		J
Tetrachloroethene		5	U
1,1,2,2-Tetrachloroethane		5	U

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>CI093	Method Number:	8240
Lab Sample Name:	PBS1411SS7MS,#5444MS	Date Analyzed:	890922
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	1.0	Date Received:	890920

Sample Info.: GC/MS C,LB,ESI-7019,10ul IS-21,SS-20,MS-16/5gms P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/kg	Detection Limit	
Toluene			
Chlorobenzene			
Ethylbenzene		5	U
Styrene		5	U
Xylenes (Total)	2		J
m-Xylene	1		J
o + p-Xylene	1		J
1,3 Dichlorobenzene		5	U
1,2 Dichlorobenzene		5	U
1,4 Dichlorobenzene		5	U

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>CI094	Method Number:	8240
Lab Sample Name:	PBS141155 7MSD,5444MSD	Date Analyzed:	890922
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	1.0	Date Received:	890920

Sample Info.: GC/MS C,LB,ESI-7019,10ul IS-21,SS-20,MS-16/5gms P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/kg	Detection Limit	
Chloromethane		10	U
Bromomethane		10	U
Vinyl Chloride		10	U
Chloroethane		10	U
Methylene Chloride	2		J
Acetone	13		
Acrylonitrile		5	U
Acrolein		5	U
Trichlorofluoromethane	1		J
Carbon Disulfide		5	U
1,1-Dichloroethene			
1,1-Dichloroethane		5	U
1,2-Dichloroethene (Total)		5	U
Chloroform		5	U
1,2-Dichloroethane		5	U
2-Butanone		5	U
1,1,1-Trichloroethane	6		
Carbon Tetrachloride		5	U
Vinyl Acetate		10	U
Bromodichloromethane		5	U
1,2-Dichloropropane		5	U
trans-1,3-Dichloropropene		5	U
Trichloroethene			
Dibromochloromethane		5	U
1,1,2-Trichloroethane		5	U
Benzene			
cis-1,3-Dichloropropene		5	U
2-Chloroethylvinylether		5	U
Bromoform		5	U
4-Methyl-2-Pentanone		10	U
2-Hexanone	7		J
Tetrachloroethene		5	U
1,1,2,2-Tetrachloroethane		5	U

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>CI094	Method Number:	8240
Lab Sample Name:	PBS1411SS7MSD,5444MSD	Date Analyzed:	890922
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	1.0	Date Received:	890920

Sample Info.: GC/MS C*,LB,ESI-7019,10ul, IS-21,SS-20,MS-16/5gms P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/kg	Detection Limit	
Toluene			
Chlorobenzene			
Ethylbenzene		5	U
Styrene		5	U
Xylenes (Total)	3		J
m-Xylene	1		J
o + p-Xylene	1		J
1,3 Dichlorobenzene		5	U
1,2 Dichlorobenzene		5	U
1,4 Dichlorobenzene		5	U

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>AI056	Method Number:	8240
Lab Sample Name:	PBS1411SS8 #5445 bottle 1	Date Analyzed:	890921
Matrix:	Soil 9/12/89	Date Collected:	890918
Dilution Factor:	1.3	Date Received:	890920

Sample Info.: GC/MS A,TN,ESI7019,5uL IS,SS/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit	
Dichlorodifluoromethane		1.	U
Chloromethane		1.	U
Vinyl Chloride		1.	U
Bromomethane		1.	U
Chloroethane		1.	U
Trichlorofluoromethane		1.	U
1,1-Dichloroethene		1.	U
Methylene Chloride	8.		
trans-1,2-Dichloroethene	7.		
1,1-Dichloroethane	151.		
cis-1,2-Dichloroethene	126.		
2,2-Dichloropropane		1.	U
Chloroform		1.	U
Bromochloromethane		1.	U
1,1,1-Trichloroethane	3.		
1,1-Dichloropropene		1.	U
Carbon Tetrachloride		1.	U
1,2-Dichloroethane		1.	U
Benzene	8.		
Trichloroethene	407.		
1,2-Dichloropropane		1.	U
Bromodichloromethane		1.	U
Dibromomethane		1.	U
Toluene	0.		J
1,1,2-Trichloroethane		1.	U
1,3-Dichloropropane		1.	U
Tetrachloroethene		1.	U
Dibromochloromethane		1.	U
1,2-Dibromoethane - EDB		1.	U
Chlorobenzene		1.	U
Ethylbenzene		1.	U
1,1,1,2-Tetrachloroethane		1.	U
m + p-Xylenes		1.	U

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>AI056	Method Number:	8240
Lab Sample Name:	PBS1411SS8 #5445	Date Analyzed:	890921
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	1.3	Date Received:	890920

Sample Info.: GC/MS A,TN,ESI7019,5uL IS,SS/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit	
o-Xylene		1.	U
Styrene		1.	U
1,1,2,2-Tetrachloroethane		1.	U
Isopropylbenzene		1.	U
Bromoform		1.	U
1,2,3-Trichloropropane		1.	U
n-Propylbenzene		1.	U
Bromobenzene		1.	U
1,3,5-Trimethylbenzene		1.	U
4-Chlorotoluene		1.	U
2-Chlorotoluene		1.	U
tert-Butylbenzene		1.	U
1,2,4-Trimethylbenzene		1.	U
sec-Butylbenzene		1.	U
p-Isopropyltoluene		1.	U
1,3-Dichlorobenzene		1.	U
1,4-Dichlorobenzene		1.	U
n-Butylbenzene		1.	U
1,2-Dichlorobenzene		1.	U
1,2-Dibromo-3-Chloropropane		1.	U
1,2,4-Trichlorobenzene		1.	U
Hexachlorobutadiene		1.	U
Naphthalene	1.		J
1,2,3-Trichlorobenzene		1.	U

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

PBS1411SS8
batch 1
4/22/89

Lab Name: Hittman Ebasco Contract: ESI 7019

Lab Code: HITMAN Case No: NASA SAS No: N.A. SDG No: N.A.

Matrix: SOIL Lab Sample ID: HE#5445

Sample wt/vol: 5 6 Lab File ID: >AI056

Level: LOW Date Received: 09/20/89

% Moisture: not dec.____ Date Analyzed: 9/21/89

Column: W.B. Dilution Factor: 1.25

Number TICs found: 14

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.		Air	4.04	590.	
2.		Unknown	6.27	4.	
3.		Unknown	23.60	8.	
4.	62108229	Decane, 2,5,9-trimethyl- (9C	23.78	25.	
5.	17312457	Decane, 3,4-dimethyl- (8CI9C	24.59	8.	
6.	17312764	Undecane, 6,6-dimethyl- (8CI	24.88	62.	
7.		Unknown	25.50	9.	
8.		Unknown	25.79	7.	
9.		Unknown	26.45	14.	
10.		Unknown	26.63	15.	
11.	31295564	Dodecane, 2,6,11-trimethyl-	26.93	41.	
12.	62108218	Decane, 6-ethyl-2-methyl- (9	27.48	10.	
13.		Unknown	28.46	20.	
14.	62108252	Decane, 2,6,7-trimethyl- (9C	28.72	50.	
15.					
16.					
17.					
18.					
19.					
20.					
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File: >AI061
Lab Sample Name: PBS1411SS8 #5445 bottle 2 TW 9/22/89
Matrix: Soil
Dilution Factor: 3.1
Sample Info.: GC/MS A,TN,ESI7019,2grams,5uL IS,SS/5mls P&T

Method Number: 8240
Date Analyzed: 890921
Date Collected: 890918
Date Received: 890920

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit
Dichlorodifluoromethane		3. U
Chloromethane		3. U
Vinyl Chloride		3. U
Bromomethane		3. U
Chloroethane		3. U
Trichlorofluoromethane		3. U
1,1-Dichloroethene		3. U
Methylene Chloride		3. U
trans-1,2-Dichloroethene	11.	
1,1-Dichloroethane	220.	
cis-1,2-Dichloroethene	155.	
2,2-Dichloropropane		3. U
Chloroform		3. U
Bromochloromethane		3. U
1,1,1-Trichloroethane	7.	
1,1-Dichloropropene		3. U
Carbon Tetrachloride		3. U
1,2-Dichloroethane	5.	
Benzene	11.	
Trichloroethene	315.	
1,2-Dichloropropane		3. U
Bromodichloromethane		3. U
Dibromomethane		3. U
Toluene	1.	J
1,1,2-Trichloroethane		3. U
1,3-Dichloropropane		3. U
Tetrachloroethene		3. U
Dibromochloromethane		3. U
1,2-Dibromoethane - EDB		3. U
Chlorobenzene		3. U
Ethylbenzene	16.	
1,1,1,2-Tetrachloroethane		3. U
m + p-Xylenes		3. U

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>AI061	Method Number:	8240
Lab Sample Name:	PBS1411SS6 #5445	Date Analyzed:	890921
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	3.1	Date Received:	890920

bottle 2 9/22/89

Sample Info.: GC/MS A,TN,ESI7019,2grams,5uL IS,SS/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/Kg	Detection Limit	
o-Xylene	2.		J
Styrene		3.	U
1,1,2,2-Tetrachloroethane		3.	U
Isopropylbenzene	11.		
Bromoform		3.	U
1,2,3-Trichloropropane		3.	U
n-Propylbenzene	21.		
Bromobenzene		3.	U
1,3,5-Trimethylbenzene	43.		
4-Chlorotoluene	3.		
2-Chlorotoluene	3.		
tert-Butylbenzene	7.		
1,2,4-Trimethylbenzene	48.		
sec-Butylbenzene	17.		
p-Isopropyltoluene	34.		
1,3-Dichlorobenzene		3.	U
1,4-Dichlorobenzene		3.	U
n-Butylbenzene		3.	U
1,2-Dichlorobenzene		3.	U
1,2-Dibromo-3-Chloropropane		3.	U
1,2,4-Trichlorobenzene		3.	U
Hexachlorobutadiene		3.	U
Naphthalene	111.		
1,2,3-Trichlorobenzene	40.		

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

PBS1411SS8
bottle 2
TLN 9/22/89

Lab Name: Hittman Ebasco Contract: ESI 7019

Lab Code: HITMAN Case No: ESI SAS No: N.A. SDG No: N.A.

Matrix: SOIL Lab Sample ID: 5445

Sample wt/vol: 2 6 Lab File ID: >AI061

Level: LOW Date Received: 9/20/89

% Moisture: not dec.____ Date Analyzed: 9/21/89

Column: WIDEBOR Dilution Factor: 3.12

TLN 9/22/89

Number TICs found: 20

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.		Air	4.17	450.	
2.	3726474	Cyclopentane, 1-ethyl-3-meth	16.38	85.	
3.	111842	Nonane (8CI9CI)	17.36	12.	
4.	15869939	Octane, 3,5-dimethyl- (8CI9C	18.86	21.	
5.	4926903	Cyclohexane, 1-ethyl-1-methy	22.30	68.	
6.	1632708	Undecane, 5-methyl- (8CI9CI)	22.63	52.	
7.	62108229	Decane, 2,5,9-trimethyl- (9C	22.96	11.	
8.	17302339	Undecane, 6-methyl- (8CI9CI)	23.18	32.	
9.	7045718	Undecane, 2-methyl- (8CI9CI)	23.33	36.	
10.	4292925	Cyclohexane, pentyl- (8CI9CI	23.55	53.	
11.	62238124	Decane, 2,3,6-trimethyl- (9C	23.92	29.	
12.	112403	Dodecane (8CI9CI)	24.14	59.	
13.	6044719	Dodecane, 6-methyl- (8CI9CI)	24.32	130.	
14.		Unknown (C13H28)	24.87	22.	
15.	17301289	Undecane, 3,6-dimethyl- (8CI	25.13	47.	
16.	6117971	Dodecane, 4-methyl- (8CI9CI)	25.31	24.	
17.	26730143	Tridecane, 7-methyl- (8CI9CI	25.46	63.	
18.	6117971	Dodecane, 4-methyl- (8CI9CI)	26.08	24.	
19.	61141728	Dodecane, 4,6-dimethyl- (9CI	26.37	25.	
20.		Unknown (C14H30)	29.05	32.	
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>CI085	Method Number:	8240
Lab Sample Name:	PBS1411SS9,H#5446	Date Analyzed:	890920
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	1.2	Date Received:	890920

Sample Info.: GC/MS C,LB,ESI-7019,10ul IS-21,SS-20/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/kg	Detection Limit	
Chloromethane		12	U
Bromomethane		12	U
Vinyl Chloride		12	U
Chloroethane		12	U
Methylene Chloride	4		J
Acetone	54		
Acrylonitrile		6	U
Acrolein		6	U
Trichlorofluoromethane	3		J
Carbon Disulfide	1		J
1,1-Dichloroethene		6	U
1,1-Dichloroethane	21		
1,2-Dichloroethene (Total)	3		J
Chloroform		6	U
1,2-Dichloroethane		6	U
2-Butanone		6	U
1,1,1-Trichloroethane	27		
Carbon Tetrachloride		6	U
Vinyl Acetate		12	U
Bromodichloromethane		6	U
1,2-Dichloropropane		6	U
trans-1,3-Dichloropropene		6	U
Trichloroethene	72		
Dibromochloromethane		6	U
1,1,2-Trichloroethane		6	U
Benzene	2		J
cis-1,3-Dichloropropene		6	U
2-Chloroethylvinylether		6	U
Bromoform		6	U
4-Methyl-2-Pentanone	10		J
2-Hexanone	39		
Tetrachloroethene		6	U
1,1,2,2-Tetrachloroethane		6	U

HITTMAN EBASCO ASSOCIATES, Inc.
VOLATILE ORGANIC ANALYSIS - TABULATED REPORT

Lab Data File:	>CI085	Method Number:	8240
Lab Sample Name:	PBS1411SS9,H#5446	Date Analyzed:	890920
Matrix:	Soil	Date Collected:	890918
Dilution Factor:	1.2	Date Received:	890920

Sample Info.: GC/MS C,LB,ESI-7019,10ul IS-21,SS-20/5mls P&T

U = not detected
J = estimated value, below detection limit

Compound	Concentration ug/kg	Detection Limit
Toluene	8	
Chlorobenzene		6 U
Ethylbenzene	23	
Styrene		6 U
Xylenes (Total)	47	
m-Xylene	16	
o + p-Xylene	26	
1,3 Dichlorobenzene		6 U
1,2 Dichlorobenzene		6 U
1,4 Dichlorobenzene		6 U

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

PBS1411SS9

Lab Name: Hittman Ebasco Contract: ESI 7019

Lab Code: HITMAN Case No: NASA SAS No: N.A. SDG No: N.A.

Matrix: SOIL Lab Sample ID: HE#5446

Sample wt/vol: 5 6 Lab File ID: >CI085

Level: LOW Date Received: 09/20/89

% Moisture: not dec.____ Date Analyzed: 9/20/89

Column: PACK Dilution Factor: 1.1829

Number TICs found: 12

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.		Unknown	1.05	91.	
2.		Unknown	1.14	260.	
3.	78784	Butane, 2-methyl- (8CISCI)	13.09	9.	
4.	109660	Pentane (ACN)(DOT)(8CISCI)	14.65	21.	
5.	95377	Cyclopentane, methyl- (8CISC	16.15	20.	
6.	96140	Pentane, 3-methyl- (8CISCI)	19.99	14.	
7.	1759586	Cyclopentane, 1,3-dimethyl-,	20.63	6.	
8.		Unknown	22.96	20.	
9.		Unknown	25.29	11.	
10.	3073663	Cyclohexane, 1,1,3-trimethyl	27.35	38.	
11.	4926903	Cyclohexane, 1-ethyl-1-methy	28.90	33.	
12.		Unknown	34.12	140.	
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

detected for the VOCs analyzed. Also shown are the VOCs not detected in the SPF soil samples. The compounds 1,1,1-Trichloroethane, Trichloroethene, and Naphthalene were detected in all soil samples at maximum concentrations of approximately 1.0 to 1.5 ppm. Trimethylbenzene, both 1,3,5- and 1,2,4-, were detected at 500 ppb levels. All other VOCs detected were at concentrations less than 400 ppb.

Lead concentrations from the EP Toxicity tests were below the detection limit and Flashpoints were greater than 200 °F for all of the samples, indicating that the soils were not hazardous due to their toxicity or ignitability.

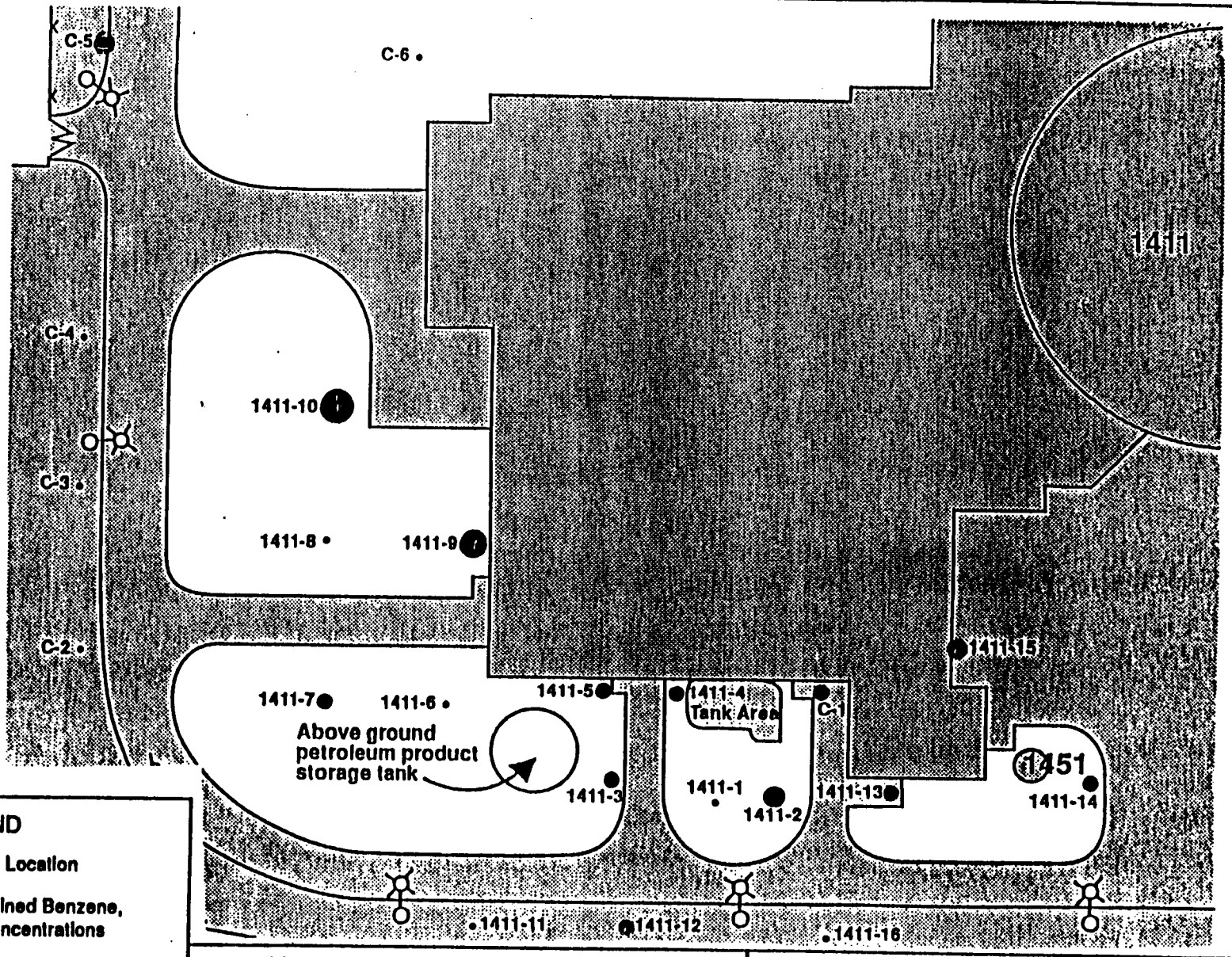
There were elevated levels of Total Petroleum Hydrocarbons in all soil samples taken from the former Tank Area, as shown in Table 3-9. The TPH concentrations ranged from a low of 93 mg/kg to a high of 2030 mg/kg. The highest concentrations of TPH were found in samples collected from the north and west walls of the pit (near the Building) and in the excavated soil taken from these areas.

3.2.1.2 Soil Gas Survey

In October, 1989, a soil gas survey was conducted at the Space Power Facility. A total of 22 soil gas samples were collected and analyzed. The locations of the survey points were determined based on several factors, including the distribution of underground utilities. Buried pipelines and conduits are generally packed in gravel or other highly transmissive materials which can affect the rate and direction of contaminant movement by providing a preferential pathway for migration. Contaminants also tend to migrate along building foundations and follow the ground surface topography.

Soil gas samples were collected in the following manner. A solid steel probe was advanced 3 to 4 feet into the ground and then withdrawn. A sampling probe with a slightly larger diameter was then advanced 2 feet into the hole. Gas was purged from the sampling probe using a hand-operated vacuum pump. A sample was then collected from the top of the sampling probe upstream of the vacuum pump. A 1.0 ml sample was extracted, injected into a portable gas chromatograph (GC), and analyzed. The GC was calibrated to quantify Dichloroethene (DCE), Benzene, Trichloroethene (TCE), Toluene, Tetrachlorethene (PCE), and Xylene. All concentrations were reported in microliters of analyte vapor per 1,000 liters of air (parts per billion (ppb)).

The results of the soil gas survey are shown in Table 3-10. Figures 3-19 and 3-20 show the sampling locations, compounds detected and the compound concentrations. Figure 3-19 highlights the relative distribution of the fuel-related compounds while Figure 3-20 focuses on the distribution of detected organic solvent materials. Most of the areas sampled showed measurable levels of one or more of the target compounds. The highest concentrations detected were found near former UST locations, along building foundations, roadbeds, railroad tracks or along buried utility lines.



LEGEND

A-1 Soil Gas Sampling Location

Key to Symbols for Combined Benzene, Toluene and Xylene Concentrations

- Not Detected
- Detected <100 ppb
- 100 - 500 ppb
- 500 - 1000 ppb
- 1000 - 5000 ppb
- >500

NASA PLUM BROOK STATION
UNDERGROUND STORAGE TANK
CORRECTIVE ACTIONS REMEDIAL
INVESTIGATION/FEASIBILITY STUDY:
PHASE I

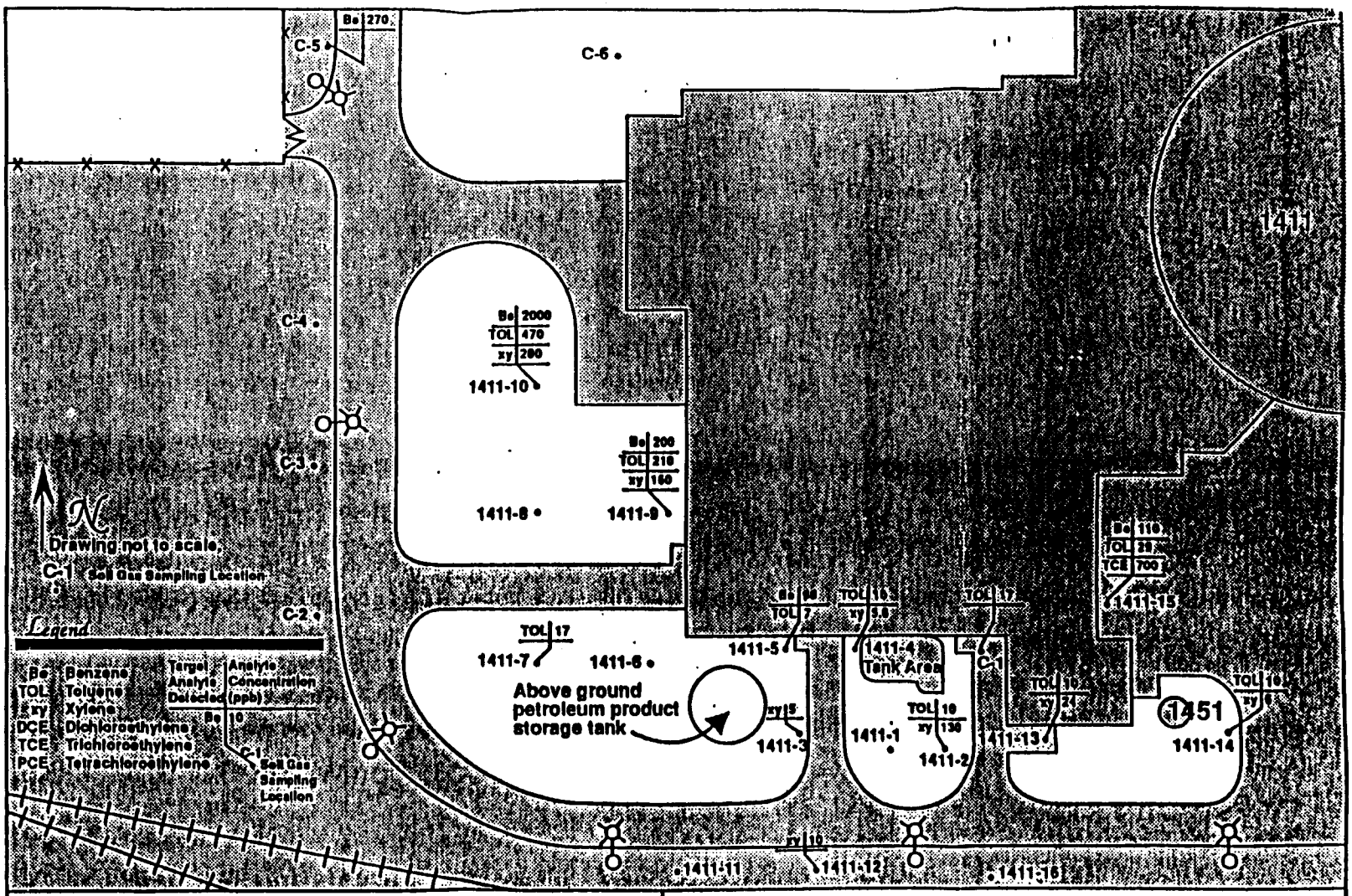
EBASCO ENVIRONMENTA

NOT TO SCALE

Soil Gas Sampling Locations and Results for Benzene, Toluene and Xylene

SPACE POWER FACILITY

FIGURE 3-19



Prepared for: National Aeronautics and Space Administration

Prepared by: Ebasco Environmental

Figure 2

Detection of Target Analytes at the Building 1411 Site
Plum Brook Station; Sandusky, Ohio

The majority of the soil gas samples indicated contamination only from fuel products. The highest concentrations of fuel products in the soil gas were found on the west side of the Building. Sample 1411-10 had the highest fuel product concentration at this site, with a total Benzene-Toluene-Xylene concentration of approximately 3,000 ppb. Samples 1411-9, 1411-10 and C-5 showed elevated concentrations of these compounds. These samples are aligned in a northwest direction and have a concentration gradient of 10% to 50% towards the northwest for a distance of several hundred feet. The relative location of these samples and their concentrations indicate the possibility of ground water contamination.

Fuel products also were detected on the southern side of the Building. The highest concentration in this area was at sample point 1411-2, just south of the Tank Area, which had an elevated Toluene and Xylene concentration. The contamination in this area may be due to contaminant migration from the former Tank Area or west side of the Building, or it could be from an independent source. Samples south of the Building, in the vicinity of the removed USTs, showed concentrations of Benzene, Toluene, and Xylene ranging from 10 to 130 ppb. All of the samples south of the Building show similar concentrations with no steep concentration gradient in any direction, which is generally indicative of ground water contamination.

The only location displaying one of the target solvents was 1411-15, on the southeast side of the Building, which showed TCE at 700 ppb. This isolated reading could indicate that a spill may have occurred at this location.

3.2.2 Current Investigation and Results

The field activities at the Space Power Facility Area associated with the current investigation were conducted on the following dates:

Soil Sampling: 12/10/90, 12/11/90 and 12/12/90
Ground Water Sampling: 1/16/91
Sediment Sampling: 1/11/91
Ground Water Level Measurements: 1/9/91, 5/9/91

The results of these sampling and analysis activities, are presented below.

3.2.2.1 Soil Sampling and Analyses

At the Space Power Facility, six borings were completed and five of these locations were finished as ground water monitoring wells. All six borings at the Space Power Facility encountered shale bedrock from 7 feet to 9.5 feet below the ground surface. Location PBS-SP-02 was planned to be finished as a monitoring well but upon completion of the

NASA PLUM BROOK STATION

UNDERGROUND STORAGE TANK
CORRECTIVE ACTIONS REMEDIAL INVESTIGATION/FEASIBILITY STUDY

- PHASE I REPORT -
November 1991

Prepared for:

WARNER/OSBORN/PARDEE
26777 Lorain Road
Suite 500
North Olmsted, Ohio 44070

For Submittal to:

NASA LEWIS RESEARCH CENTER
21000 Brookpark Road
Cleveland, Ohio 44135

Prepared by:

EBASCO ENVIRONMENTAL
A Division of Ebasco Services Incorporated

5000 Bradenton Avenue
Suite 200
Dublin, Ohio 43017

1.0 INTRODUCTION

This report summarizes the work performed during the first phase of an underground storage tank (UST) Corrective Actions Remedial Investigation / Feasibility Study (RI/FS) at the NASA Plum Brook Station (PBS). The projected scope of the overall investigation was detailed in the PBS UST Corrective Actions RI/FS Work Plan developed by NASA and Ebasco Environmental (August, 1990 - Final Draft).

1.1 Objectives

The USTs at PBS have been the subject of study since new UST regulations went into effect in 1988. The ultimate objective of the federally and state-mandated UST corrective actions requirements is the cleanup of contaminated soil and ground water associated with leaking USTs. The purpose of the overall Corrective Actions RI/FS project of which the current investigation is an initial element, is to: characterize the nature and extent of any contamination in the soil, ground or surface water which has resulted from leaking UST systems at four (4) separate areas at PBS; evaluate the currently available remedial alternatives for addressing this contamination; and develop a Corrective Actions Plan for the UST sites for managing the associated risks to human health and the environment.

The primary objectives of the current investigation were to compile all the currently available data from the previous and current investigations for each of the four (4) Tank Areas, determine the contaminants present at each Tank Area (and consequently, the contaminants not present), conclude which detected contaminants were logically and physically linked to the reported contents of the former USTs and identify the pathways by which the residual contamination present may spread. A secondary objective of the investigation was to document either the presence or absence of contaminants at each Tank Area so that a more efficient, targeted analytical program could be designed for any future characterization work that may be required.

1.2 Project Background

To comply with the 1988 regulations, twenty (20) USTs at the NASA Lewis Research Center (LeRC) and nineteen (19) USTs at PBS were identified as requiring study under a UST Compliance Program. The tanks were designated for study based on information contained in LeRC and PBS UST inventory listings. In the fall of 1989, three more tanks at LeRC were located, identified, and scheduled for removal. All forty-two tanks contained petroleum products, hazardous spent solvents or unknown products.

A UST Compliance Program was designed by Ebasco Environmental and NASA to assure that the LeRC (which administratively includes PBS) was in compliance with the applicable state and federal regulatory requirements for USTs. As part of implementing

this program, the fourteen (14) tanks at PBS were removed, and UST Closure Assessments were conducted by Ebasco. The locations of these former tank areas are shown in Figure 1-1. Table 1-1 summarizes the principal events of the PBS UST project history. Sampling and monitoring performed during the closure assessments indicated that the tanks had been leaking or that spills had apparently occurred. As a result, a 3-phase Corrective Actions Remedial Investigation / Feasibility Study (RI/FS) for the PBS was developed to characterize the nature and extent of any contamination, and to evaluate the currently available remedial alternatives for addressing the contamination. Phase I was the preliminary characterization effort aimed at describing current conditions at the tank areas. Phase II of the plan was the Remedial Investigation, and Phase III was the Feasibility Study.

Previously, the tank areas were assessed during tank closure activities, and during an initial field program which included limited soil excavation, soil sampling, ground water monitoring well installation, and soil gas surveys. The additional characterization activities performed in this study focus on determining the full nature of the residual contamination, and the potential for off-site migration of contaminants.

1.3 Facility Background Information

The Plum Brook Station is located approximately 4 miles south of Sandusky, Ohio, and covers approximately 6500 acres. Approximately 160 structures, many of them storage facilities, are located at the Plum Brook Station (Environmental Resources Document for NASA Lewis Research Center, May 1983). Much of the facilities at PBS are inactive currently. Activities associated with the four primary areas of investigation during the Phase 1 study are discussed as follows. Building 7131 at the Garage and Maintenance area continues to be used for vehicle and equipment maintenance, and is currently staffed with two to three employees. The remaining buildings in the Garage and Maintenance area, Buildings 7122 and 7121, are not staffed and are not in active use. During the Phase 1 investigation, operations were taking place at the Space Power Facility (SPF) and are expected to continue on an intermittent basis during the near future as various projects are undertaken at the SPF. The pump station, Building 8133, is staffed by two employees currently. The reactor area is inactive currently and no staff is assigned to the area. In total there are approximately 100 people working at the Plum Brook Station, most of whom are not regularly in the four Phase 1 areas of concern.

Acreage within the boundary of the site is primarily unused open space comprised of woodland, brushland and grassland. Approximately 23% of the site is associated with facilities and site operations (Environmental Resources Document for NASA Lewis Research Center, 1990).

The land immediately surrounding the site is used as a rural residential area with homes along the adjacent roadways. Farm fields and open fields with some wooded tracts

account for the remainder of the immediate surrounding properties.

There are 130 ground water well beyond the Plum Brook Station boundary which are within a four mile radius of the site. None of these ground water wells are within 3/4 of a mile of any of the tank areas included in the Phase 1 investigation.

The Plum Brook Station is underlain by lucustrine glacial deposits and consolidated sedimentary rock. The lucustrine deposits are composed of clays and silts. These deposits were settled out of glacial lakes. The lake sediments are approximately 5 to 20 feet thick. Lucustrine deposits are poorly drained (Environmental Resources Document for NASA Lewis Research Center, May 1983).

The bedrock of the area is consolidated sedimentary rock. The regional dip of the strata is easterly, and younger rocks crop out progressively from west to east. The bedrock is limestone in the western part of the facility and shale in the eastern portion. The limestone formations have considerable variation in physical and chemical structure; nevertheless, the limestone has high porosity and makes excellent aquifers. The shale material has little porosity, except for fractures near the surface (Environmental Resources Document for NASA Lewis Research Center, May 1983).

1.4 Previous Investigations

Nineteen (19) USTs at PBS were identified as requiring study under a UST Compliance Program developed by Ebasco in 1989. From late June through December of 1989, fourteen (14) USTs were removed from the PBS in accordance with this program. Table 1-2 identifies the tanks, indicates the areas from which they were removed, and notes the type of material reported to have been stored in each tank given the best available records.

The removal of the USTs included the performance of a closure assessment as required by regulation. In addition, an initial remediation effort was conducted at the Garage and Maintenance Area (Building No. 7132), and soil gas surveys were performed at three of the four tank areas as indicated in Table 1-1. The results of each of these prior investigations is included in the appropriate subsections of Section 3.0.

TABLE 1-2

PBS USTs Removed During the 1989 Calendar Year

Location	No. of Tanks	Capacity (Gallons)	Contents
Garage and Maintenance Area:			
Building 7121	1	3,000	waste oil and solvents
	3	700	acetone, TCE, and TCA, respectively
Building 7131	1	1,500	waste oil
Building 7132	3	9,000	gasoline
Space Power Facility:			
Building 1411	2	1,000	waste oil
Pump Station:			
Building 8133	1	750	gasoline/diesel
Reactor Area:			
Building 1131	2	7,900	gasoline/diesel and fuel
	1	500	waste oil and solvents

2.0 ASSESSMENT METHODOLOGY

2.1 Overview of the Phase I Field Investigation Program

This section details the sampling locations and describes the sampling methods which were used during the Phase I field investigation, which started in November 1990 and continued into May 1991. The following sections outline the procedures which were used and the locations of samples collected during each portion of the field program. The field activities involved in the Phase I field investigation included soil borings and sampling, well installation, ground water sampling, and sediment sampling.

2.1.1 Sample and Sample Location Identifiers

All of the field samples and the sampling locations in the Phase I field investigation are identified by a standard nomenclature. The location identifiers (IDs) have three segments to the character string, while the sample identifiers have the same three segments and a fourth segment indicating the sample medium. Both the location and sample IDs have as the first segment of the identifier PBS, indicating Plum Brook Station. Both also have as the second portion of the identifier an area code, either GM (Garage and Maintenance Area), SP (Space Power Facility), PS (Pump Station), or RA (Reactor Area). During the previous closure assessments the four digit building number, such as 1411 for the Space Power Facility, was used as the location code. Following the area code, the field samples have a segment identifying the sample medium, either SB (soil boring), GW (ground water), or SS (sediment). Both the sample and location identifiers end in the sequential number assigned to each location in each area of concern. An example of a location code would be PBS-GM-06, denoting the sixth boring location at the Garage and Maintenance Area. An example of a sample code would be PBS-RA-SB-04, denoting a soil boring sample at the fourth boring location at the Reactor Area.

2.1.2 Soil Borings and Monitoring Well Installations

Soil borings were completed at 23 locations at the four different UST areas of concern at the Plum Brook Station. Of these 23 soil borings, 20 were completed as ground water monitoring wells. Although it was expected that 22 of the 23 soil boring locations would be completed as wells, two locations were not completed as wells because of a lack of ground water. The boring log for each location can be found in Appendix E.

All of the well casing materials, including screens, risers and bottom caps, was 304 stainless steel. A sand pack of #5 Medium Blast sand was poured around the screened portion of each well. A bentonite seal was then placed above the sand pack to prevent infiltration. All of the wells were then finished with a concrete base and an above ground

aluminum well protector. Well logs with well construction diagrams and elevations can be found in Appendix F. As the final part of the well installation and prior to the ground water sampling, each of the 20 monitoring wells was developed. Well development consisted of removing from 4 to 5 well volumes with a hand bailer.

2.1.3 Subsurface Soil Sample Collection

Hollow stem auger drilling, using 4 1/4" augers, was used to complete all of the soil borings during the Phase I field effort. Continuous split spoon sampling was performed during the drilling at each boring location. The split spoons used were 24" in length and 2" in diameter.

The split spoon samples were scanned with a photoionization detector (PID) and any readings above background levels were noted. The recovery, composition, consistency, and color of the soil samples were recorded in the field log book and are reported in the boring logs in Appendix E.

A portion of each split spoon sample was placed in a stainless steel bowl to be composited and then placed in sample containers for transport to the analytical laboratory. The exception to this routine involved the collection of the volatiles sample. One split spoon was selected between 5 feet and 15 feet below the ground surface to be the volatiles sample. The depth at which the volatiles sample was taken was determined by scanning with the PID for elevated levels of volatiles. The sample containers for the volatiles analysis were immediately filled and sealed after the split spoon was opened and scanned with the PID.

Prior to setting up at each boring location, the split spoons and drilling equipment, including augers, rods, drill bit and tools, were decontaminated. A portable steam washer was used to decontaminate this equipment. Potable water was used for the steam wash. No solvents were used during the decontamination process.

2.1.4 Ground Water Sample Collection

Ground water sampling was conducted at one background location and one contaminated location for each of the four areas for a total of eight unique ground water samples. The schedule below lists the wells that were sampled at each area and also denotes whether the well was considered to be a contaminated location or a background location prior to sampling:

TANK AREA	PRESUMED BACKGROUND LOCATION	PRESUMED CONTAMINATED LOCATION
Garage and Maintenance Area	PBS-GM-02	PBS-GM-06
Space Power Facility	PBS-SP-01	PBS-SP-06
Pump Station	PBS-PS-04	PBS-PS-02
Reactor Area	PBS-RA-01	PBS-RA-04

Each of the eight wells sampled was purged of three well volumes prior to taking the ground water samples. Both the well purging and the sampling was done with a stainless steel bailer which was decontaminated prior to use at each monitoring well. The bailers were disassembled and washed in a solution of distilled water and trisodium phosphate, and then rinsed with distilled water. No solvents were used during the decontamination of the bailers.

2.1.5 Sediment/Surface Water Grab Sample Collection

Five sediment samples were collected as part of the field investigation. Two samples each were collected at the Garage and Maintenance Area and the Space Power Facility, and one was collected at the Pump Station. All of the samples collected were sampled from the drainage channels near the former tank locations. As there were no drainage channels near the former tank locations at the Reactor Area, no sediment sample was collected at that area. The sediment samples from other areas were collected using a stainless steel trowel and were placed in the sample jars for transport to the laboratory.

2.1.6 Sample Shipment and Chain of Custody

All of the field samples collected, including subsurface soils, ground water and sediment, were submitted to Hittman Ebasco for laboratory analysis. Chain of custody forms were submitted to the laboratory with each set of samples submitted. Chain of custody forms included each sample identifier, the sample matrix, the required analyses, and sample collection date. Samples were submitted via an overnight delivery service on a daily basis and were received by the laboratory within 24 hours of shipment. Samples were logged in at the lab and the chain of custody forms were returned. Chain of custody forms are included in Appendix G.

2.1.7 Ground Water Level Measurements

Two rounds of ground water level measurements were taken. The first set of ground water level measurements was taken during well development in January 1991. The

second set of measurements was taken on May 9, 1991 to get a second set of data for determining ground water flow characteristics. An electronic ground water level indicator was used both times to obtain the water levels relative to the top of the well casings. These data along with the surveying information provided by the NASA Facilities Engineering Division were used to assess ground water flow at the four former UST areas.

2.2 Overview of the Data Evaluation Process

2.2.1 Laboratory Data Quality Assurance and Quality Control

All of the samples collected during the Phase I field program were analyzed by Hittman Ebasco Associates. All analytical laboratory data was generated using Data Quality Objective (DQO) Level 4. This level requires full laboratory analytical procedures in accordance with USEPA recognized quality control. Since the primary use of Phase I data, at this time, is to focus Phase II, DQO Level 4 was not employed for independent data validation of data from the laboratory. Data validation was performed by the laboratory in accordance with Contract Laboratory Protocols (CLP) and independent data validation can be completed in the future to qualify the data for use in the risk assessment.

All of the field samples, duplicates and field blanks were analyzed for the Target Compound List (TCL) volatiles, semivolatiles, and pesticides/PCBs and Target Analyte List (TAL) metals and cyanide and Total Petroleum Hydrocarbons (TPH). Trip blanks were analyzed for TCL volatiles. The TCL/TAL analyses were completed following USEPA Contract Laboratory Protocols (CLP) for laboratory data quality standards. The TPH analysis was performed in accordance with EPA method 418.1. The laboratory results for the TCL/TAL analyses were reported following stringent quality requirements for laboratory blanks and laboratory data validation. The laboratory sample data reporting forms (Form 1) are shown in Appendix H for each sample. A number of samples were reanalyzed due to inconsistencies in lab quality control, such as matrix spike recoveries out of the acceptable range. For samples that had more than one sample result both sample results were reported.

Following the TCL volatiles and semivolatiles analysis Hittman Ebasco conducted a library search to identify Tentatively Identified Compounds (TICs). Numerous TICs were identified for various samples and these TICs are shown on the Form 1 for each sample in Appendix H. The TICs were not considered in the analysis of the Phase I data for various reasons, first the very nature of TICs, i.e. compounds that are tentatively identified, makes them very suspect, also according the Hittman Ebasco representatives TICs can often be an indication of natural background hydrocarbons, related to this is the fact that no correlation was found between the TICs and compounds suspected to be

stored in the removed underground storage tanks.

The Contract Required Quantitation Limits (CRQL) for TCL/TAL analyses as set forth in the CLP were met for the field samples and QA samples during the Phase I operations. Soil sample results from Hittman Ebasco were reported on a wet weight basis as CLP requires, because of this the soil samples results have slightly varying quantitation limits due to variations in moisture content of the various soil samples. This is not unusual with soil samples because of the varying soil characteristics and water content of each unique sample. Sample quantitation limits that vary greatly from the CRQL are a result of sample dilution due to elevated levels of contaminants in the sample.

2.2.2 Analytical Results for Organic Compounds

The results of analyses for organic compounds in the soil, ground water and sediment samples taken at the site during past studies and the current investigation have been compiled and presented for each Tank Area in Section 3. In general, the set of organics analyzed for in the past studies varied somewhat between studies and across the Tank Areas. Consistent analyses were performed for all samples taken during the current investigation. In this Report, results for all detected and undetected (but tested for) organics have been presented as they appeared in the earlier original study reports. Contaminant data from the previous investigations were summarized in a manner chosen to best convey the nature and extent of any organics contamination present in a manner consistent with the number of samples taken, the analyses performed on those samples, and the quality of the data.

The organics data from the current investigation related to Volatile Organic Compounds, semivolatile organic compounds (B/N/A extractables), pesticides, polychlorinated biphenyls (PCBs), and Total Petroleum Hydrocarbons (TPH). With very few exceptions, the organic compounds analyzed for in the soil, ground water, and sediment samples are not naturally occurring at levels detectable by standard techniques. As such, finding such a compound in a sample at a concentration above the detection limit is indicative of anthropogenic contamination. All detected organics were, therefore, highlighted in this Report. A notable exception to this generality may be the Total Petroleum Hydrocarbons. Natural oil-bearing shales and limestones are present in the PBS area. The soil borings conducted for the current investigation encountered shale bedrock beneath two of the Tank Areas (areas where the borings were terminated at the bedrock). It is possible that rock samples from these areas may contain some detectable concentration of natural TPH. However, the soil samples taken from the borings made for the current investigation consisted of the overburden material (either naturally occurring or fill) which would not be expected to have detectable TPH content. As such, the TPH detected in the current overburden samples was generally taken to be indicative of UST leakage or spills especially if concentrations exceeded about 40-50 mg/Kg.

The procedure used to compile and review the analytical data generated during the current investigation involved the following:

1. The raw data sheets from the laboratory were examined and the data was compiled into a series of comprehensive data tables. A data table was constructed for each Tank Area/environmental medium combination. This amounted to a total of 15 major tables, representing the results of soil, ground water, and sediment testing at each of the four areas (except for sediments at the Reactor Area), and four tables showing the results of the trip blanks and the soil, ground water, and sediment field blanks. These tables are included as Appendices A (soil results), B (ground water results), C (sediment results), and D (blank results). A separate table was constructed for each Tank Area within Appendices A, B and C, with Table 1 pertaining to the Garage and Maintenance Area, Table 2 to the Space Power Facility, Table 3 to the Pump Station and Table 4 to the Reactor Area. Each appendix table contains the results of each analysis or reanalysis performed for every sample in that Tank Area, and includes all analytes, whether or not they were detected. Undetected results were noted by the appropriate quantitative detection limit and the "U" qualifier. Each appendix table lists the analytical results in the following order: volatile organic compounds, semivolatile organic compounds, pesticides/PCBs, metals, cyanide, and TPH. The identification number, type, depth of collection and date of collection also are noted for each individual sample.

2. The full set of data for each Tank Area was examined with respect to QA/QC, observation of contamination in blanks, and identification of possible laboratory contaminants. This review included direct discussions with the laboratory. Based on this review and analysis, six organic compounds were identified to be probable laboratory contaminants (Methylene Chloride, Acetone, Carbon Disulfide, bis (2-Ethylhexyl)phthalate, Butylbenzylphthalate and Di-n-Octylphthalate) and one pesticide (Endosulfan Sulfate) was determined to be spurious due to its general presence in the blanks. These compounds were not further considered in relation to UST contamination.

3. The reviewed data on organics were summarized in both graphical and tabular form for each Tank Area. Contaminant maps were developed which identified where the various contaminants were detected at each area and at what concentration. A separate contaminant map was developed for the soil, ground water, and sediment data for each area. These are presented and discussed below. The identified laboratory and blank contaminants were not included on these contaminant maps. Secondly, summary tables of the organics detected at each tank area were compiled. These tables list all detected organics and identify the maximum

concentration of each compound detected in each of the three environmental media and at what frequency they were detected (e.g., 3/7 representing detections in 3 out of 7 samples taken in that medium at that Tank Area). These summary tables also are presented and discussed in Section 3.

2.2.3 Analytical Results for Inorganic Compounds

Inorganics were not analyzed in any of the prior investigations, but were analyzed during the current investigation. Metals may have been associated with the USTs, in that metal complexes have historically been added to fuels and lubricating oils, to enhance their performance. Examples include zinc, barium, nickel, lead, and vanadium. Waste solvents may also have become contaminated with metals through physical or chemical reaction mechanisms. These inorganics represent possible contamination from the former fuel, waste oil, and waste solvent USTs.

Unlike the vast majority of the organics tested for, the inorganics are naturally occurring in soils. Many of these inorganics, however, are not associated with significant health risks in connection with a broad range of soil concentrations and plausible exposures, and others are actually required by the body. As such, detection of an inorganic in a soil sample is not automatically a concern. The natural presence of inorganics in soils dictates that some criteria be developed for judging if the level of the inorganic detected is significantly greater than naturally occurring levels. Frequently, the "background" concentration is used as this criterion. As the natural background level of an inorganic typically varies by 2 or 3 orders of magnitude, depending on where in the United States the soil is, a measurement of local background concentration is required for making judgments about possible anthropogenic sources of inorganics contamination.

As was previously noted, a set of the soil borings were located in areas thought not to be influenced by the contamination from the leaking USTs. Two locations were chosen from each of the four Tank Areas. However, upon review of the laboratory results of the soil analyses from these samples, four of the eight samples were found to contain organics contamination (PBS-GM-SB-02, PBS-PS-SB-01, PBS-PS-SB-04, PBS-SP-SB-02). As organics contamination could be linked to inorganics contamination, the four samples showing organics contamination were not considered in calculating the local background inorganics concentration statistics used in this Report. The concentrations measured in the remaining four samples (PBS-GM-SB-01, PBS-RA-SB-01, PBS-RA-SB-06, and PBS-SP-SB-01) were used to characterize the local background inorganics concentrations for this study.

In keeping with the newly established OEPA "How Clean is Clean Policy" (OEPA, July 26,1991), the following equation was used to calculate "Upper Confidence

Limits" (UCLs) as criteria to compare to on-site inorganic concentrations to dtermine if they are statistically greater than background:

$$X + k(a)$$

where, X = mean background concentration of compound
a = relative standard deviation of background data
k = tolerance factor.

These are shown for inorganics in Table 2-1. When available, Table 2-1 also shows two other criteria with regard to the inorganics. The first was published ranges of natural soil inorganics concentrations for the United States. As has been noted, these ranges are characteristically wide, displaying significant regional variability. The second criteria examined was the Soil Clean-Up Criteria being enforced by the State of New Jersey. While these criteria are not enforceable in Ohio, they provide an indication of the cut-off levels of inorganics that have been used as soil remediation targets in other places. The State of Ohio currently has not established criteria for inorganic clean-up in soils.

Taken together, the method used to evaluate the analytical results for inorganics in the soils from the current investigation was to (refer to Table 2-1):

1. Establish the "local background" concentration of each inorganic tested for by averaging the four background samples and calculating their standard deviation.

2. Calculating the OEPA criteria for comparison to background (i.e., the UCLs).

3. Compare the measured inorganics concentrations from each soil sample to the UCL determined in Step 2. If this concentration was not exceeded, determine that no problem was indicated. If this concentration was exceeded, proceed to Step 4.

4. Determine if the inorganic exceeding the UCL is a natural nutrient or element not typically of concern for health reasons. If the inorganic is not typically considered a health risk in soils at these levels, determine that no problem was indicated. If the inorganic did not fall into one of these two categories, proceed to Step 5.

5. Compare the sample concentration to the United States background range and the New Jersey Soil Clean-Up Criteria (when these criteria exist). Determine whether the measured concentration fell outside the United States range or exceeded the New Jersey criteria. If it did neither,

determine that no problem was indicated, otherwise, flag the inorganic and location as a possible concern.

The results of applying this sequential data analysis approach to the information collected during the current investigation is reported for each Tank Area in Section 3.

2.2.4 Ground Water Level Contours

The two sets of monitoring well ground water level measurements, taken in May and January, were combined with the wellhead surveying data to generate ground water contour maps for each Tank Area. Separate contour maps were drawn for May and January for each location. These maps showed the apparent local ground water flow patterns at each Tank Area, including the influence of existing structures and topography.

In addition, the May ground water level measurements from each Tank Area were combined to create an overall PBS ground water contour map. This map depicts the overall site ground water flow direction, when local influences are netted out. The ground water contour maps for each Tank Area and time of year, as well as the overall site contour map, are presented and discussed in Section 3.

2.2.5 Boring Logs and Well Logs

Field measurements and observations during the installation of the boreholes and monitoring wells in the current investigation were used to develop the Boring Logs and Well Logs contained in Appendices E and F, respectively. This information was used to develop a general characterization of the soils and near surface stratigraphy at each of the four Tank Areas. These descriptions are presented and discussed in Section 3.

TABLE 2-1
Criteria Used for Comparisons
of Inorganics in Soils to Background Levels

INORGANICS	Mean Conc. in Bkgd. Samples (n=4) (mg/Kg)	Standard Deviation	k Tolerance Factor	OEPA Criteria Mean + k x s.d.	Range of U.S. Bkgd. Conc.(1) (mg/Kg)	New Jerse Soil Cleanu Criteria(1) (mg/Kg)
Aluminum	9845	3650	5.145	28624.25	NA	NA
Antimony	1.83	0.08	5.145	2.24	NA	NA
Arsenic	6.53	2.65	5.145	20.16	1.1-16.7	20
Barium	79.8	42.6	5.145	298.98	NA	400
Beryllium	0.46	0.04	5.145	0.67	1-7	NA
Cadmium	2.48	0.95	5.145	7.37	0.01-1	3
Calcium (N)	16165	8380	5.145	59280.10	NA	NA
Chromium	16.1	4.51	5.145	39.30	1-1500	100
Cobalt	11.1	6.7	5.145	45.57	NA	NA
Copper	18	5.4	5.145	45.78	2-200	170
Iron (N)	25075	9036	5.145	71565.22	NA	NA
Lead	9.95	3.16	5.145	26.21	2-200	250-1000
Magnesium (N)	5630	1728	5.145	14520.56	NA	NA
Manganese (N)	590	478	5.145	3049.31	NA	NA
Mercury	0.11	0.007	5.145	0.15	0.01-4.8	1
Nickel	33	20.36	5.145	137.75	3-550	100
Potassium	964	597	5.145	4035.57	NA	NA
Selenium	3.82	5.3	5.145	31.09	0.01-6	4
Silver	0.63	0.05	5.145	0.89	0.01-5	5
Sodium (N)	585	270	7.655	2651.85	NA	NA
Thallium	0.86	0.04	5.145	1.07	NA	NA
Vanadium	26.5	12.1	5.145	88.75	NA	NA
Zinc	59	24.4	5.145	184.54	10-3000	350
Cyanide	1.23	0.08	5.145	1.64	NA	NA

NOTES
NA Not Available
(N) Nutrient / Not of Health Concern under These Conditions
(1) NJDEP, Summary of Approaches to Soil Cleanup Levels, Table 1

3.0 SITE CHARACTERIZATION FINDINGS

This section summarizes the studies conducted at each of the four tank areas, presents the results of the studies, describes the contamination observed and the potential pathways for contaminant migration. The locations of the four former PBS UST Areas are shown on Figure 3-1.

For purposes of gaining some perspective on ground water flow, the theoretical Darcy's Law flow velocity was calculated for the overburden aquifer using the measured ground water level gradients and the theoretical hydraulic conductivity values for the soil units encountered at each Tank Area (a maximum of 10^{-5} meters per second for fine sand to a minimum of 10^{-13} for clay, silt, or glacial till). It must be highlighted that the hydraulic conductivities used were characteristic published values reported to correspond to the standard soil types encountered. No Tank Area-specific hydraulic conductivity (aquifer) tests were conducted. As such, the calculational results must be considered to be illustrative at best. Taking the maximum theoretical hydraulic conductivity for the various soil units observed to be present at each Tank Area, the maximum horizontal ground water flow velocities associated with the January and May 1991 were calculated as

$$V_{df} = [K (h_1 - h_2)]/L$$

where,

V_{df}	=	Darcy's Flow Velocity
K	=	Theoritical hydraulic conductivity
$(h_1 - h_2)$	=	Difference in hydraulic head
L	=	Distance along the flow path between the points where h_1 and h_2 were measured.

It must be emphasized that this estimate is based on the theoretical performance of a homogeneous water-bearing layer consisting entirely of the most transmissive soil type. This would generally be expected to be conservative, or leading to flow velocities higher than what might actually be observed. All of the boreholes exhibited multiple soil units, and many of these units are reported to have characteristic hydraulic conductivities many orders of magnitude lower than the value used to scale the maximum flow velocity. These factors would indicate that horizontal flow velocities in undisturbed areas (i.e., areas with no buried utility lines, building foundations, or other preferential pathway structures) would be lower than the calculated values. On the other hand, a coarse gravel utility trench or roadbed would be expected to allow for faster ground water migration along its length. These preferential migration rates typically would be many times larger than the theoretical Darcy Law rates that were calculated.

The ground water flow direction and velocity in the bedrock aquifer have not been investigated.

3.2 Space Power Facility

On September 18 and 19, 1989 two (2) USTs were removed from the Space Power Facility (SPF). The tanks were located in a common pit adjacent to the south foundation wall of Building No. 1411, near the boiler room. Figure 3-1 shows the location of the SPF at the Plum Brook Station. Both of the 1,000 gallon-capacity steel tanks were installed in 1968. Tank 1411-1 (#24) contained waste oil and solvents, and was in use until it was removed. Tank 1411-2 (#25) previously contained fuel oil, but was out of use and contained water when it was removed.

3.2.1 Previous Investigations and Results

The activities conducted at the Space Power Facility have included a closure assessment and a soil gas survey. These activities are reviewed below.

3.2.1.1 UST Closure Assessment

As part of the UST removal operation, a closure assessment was completed. The assessment included a visual site inspection, soil sample collection and analysis, and examination of the tanks after removal. The tanks were inspected by the Ebasco representatives onsite and by John Graves of the Inspection Division of the State Fire Marshall's Office.

Tank 1411-1 (#24) was removed on September 18, 1989 and Tank 1411-2 (#25) was removed on September 19, 1989 from the area south of Building No. 1411 between two driveways. During excavation, shale bedrock was encountered approximately twelve (12) feet below the ground surface. Soil sampling was performed in the excavation on September 19th. A total of nine (9) soil samples were collected. Four (4) samples were taken from the pile of excavated material, and analyzed for VOCs, TPH, EP Toxicity lead and ignitability. The remaining five (5) samples were taken from the walls and bottom of the pit. One of these was analyzed for VOCs, TPH, EP Toxicity lead, and ignitability, and the others were analyzed for VOCs and TPH. These sampling locations are identified on Figure 3-18.

VOC contamination was found in the soils. A total of 35 different compounds were detected in the soil samples analyzed. Table 3-9 shows the highest concentrations

detected for the VOCs analyzed. Also shown are the VOCs not detected in the SPF soil samples. The compounds 1,1,1-Trichloroethane, Trichloroethene, and Naphthalene were detected in all soil samples at maximum concentrations of approximately 1.0 to 1.5 ppm. Trimethylbenzene, both 1,3,5- and 1,2,4-, were detected at 500 ppb levels. All other VOCs detected were at concentrations less than 400 ppb.

Lead concentrations from the EP Toxicity tests were below the detection limit and Flashpoints were greater than 200 °F for all of the samples, indicating that the soils were not hazardous due to their toxicity or ignitability.

There were elevated levels of Total Petroleum Hydrocarbons in all soil samples taken from the former Tank Area, as shown in Table 3-9. The TPH concentrations ranged from a low of 93 mg/kg to a high of 2030 mg/kg. The highest concentrations of TPH were found in samples collected from the north and west walls of the pit (near the Building) and in the excavated soil taken from these areas.

3.2.1.2 Soil Gas Survey

In October, 1989, a soil gas survey was conducted at the Space Power Facility. A total of 22 soil gas samples were collected and analyzed. The locations of the survey points were determined based on several factors, including the distribution of underground utilities. Buried pipelines and conduits are generally packed in gravel or other highly transmissive materials which can affect the rate and direction of contaminant movement by providing a preferential pathway for migration. Contaminants also tend to migrate along building foundations and follow the ground surface topography.

Soil gas samples were collected in the following manner. A solid steel probe was advanced 3 to 4 feet into the ground and then withdrawn. A sampling probe with a slightly larger diameter was then advanced 2 feet into the hole. Gas was purged from the sampling probe using a hand-operated vacuum pump. A sample was then collected from the top of the sampling probe upstream of the vacuum pump. A 1.0 ml sample was extracted, injected into a portable gas chromatograph (GC), and analyzed. The GC was calibrated to quantify Dichloroethene (DCE), Benzene, Trichloroethene (TCE), Toluene, Tetrachlorethene (PCE), and Xylene. All concentrations were reported in microliters of analyte vapor per 1,000 liters of air (parts per billion (ppb)).

The results of the soil gas survey are shown in Table 3-10. Figures 3-19 and 3-20 show the sampling locations, compounds detected and the compound concentrations. Figure 3-19 highlights the relative distribution of the fuel-related compounds while Figure 3-20 focuses on the distribution of detected organic solvent materials. Most of the areas sampled showed measurable levels of one or more of the target compounds. The highest concentrations detected were found near former UST locations, along building foundations, roadbeds, railroad tracks or along buried utility lines.

The majority of the soil gas samples indicated contamination only from fuel products. The highest concentrations of fuel products in the soil gas were found on the west side of the Building. Sample 1411-10 had the highest fuel product concentration at this site, with a total Benzene-Toluene-Xylene concentration of approximately 3,000 ppb. Samples 1411-9, 1411-10 and C-5 showed elevated concentrations of these compounds. These samples are aligned in a northwest direction and have a concentration gradient of 10% to 50% towards the northwest for a distance of several hundred feet. The relative location of these samples and their concentrations indicate the possibility of ground water contamination.

Fuel products also were detected on the southern side of the Building. The highest concentration in this area was at sample point 1411-2, just south of the Tank Area, which had an elevated Toluene and Xylene concentration. The contamination in this area may be due to contaminant migration from the former Tank Area or west side of the Building, or it could be from an independent source. Samples south of the Building, in the vicinity of the removed USTs, showed concentrations of Benzene, Toluene, and Xylene ranging from 10 to 130 ppb. All of the samples south of the Building show similar concentrations with no steep concentration gradient in any direction, which is generally indicative of ground water contamination.

The only location displaying one of the target solvents was 1411-15, on the southeast side of the Building, which showed TCE at 700 ppb. This isolated reading could indicate that a spill may have occurred at this location.

3.2.2 Current Investigation and Results

The field activities at the Space Power Facility Area associated with the current investigation were conducted on the following dates:

Soil Sampling: 12/10/90, 12/11/90 and 12/12/90
Ground Water Sampling: 1/16/91
Sediment Sampling: 1/11/91
Ground Water Level Measurements: 1/9/91, 5/9/91

The results of these sampling and analysis activities, are presented below.

3.2.2.1 Soil Sampling and Analyses

At the Space Power Facility, six borings were completed and five of these locations were finished as ground water monitoring wells. All six borings at the Space Power Facility encountered shale bedrock from 7 feet to 9.5 feet below the ground surface. Location PBS-SP-02 was planned to be finished as a monitoring well but upon completion of the

boring, not enough ground water was present to justify installing a monitoring well. The remaining five borings were completed as monitoring wells. Locations PBS-SP-01 and PBS-SP-02 were intended to be background locations, while locations PBS-SP-03, PBS-SP-04, PBS-SP-05 and PBS-SP-06 were selected to help characterize the extent of contamination associated with this area. The six locations are shown on Figure 3-21.

3.2.2.1.1 Physical and General Stratigraphic Characteristics

Based on the six boreholes made at the Space Power Facility Area as part of the current investigation, the overburden material at the Space Power Facility Area has an average thickness of 8 feet. Figure 3-22 presents the generalized stratigraphic section for the Space Power Facility Area showing the types of soils and the order of occurrence of the soil units encountered. This generalization is based only on the six boreholes made for this study. The surface soil in this area is predominantly grey mottled clayey silt. Gravel with brown sandy silt were found near the surface to a depth of 2 feet at borehole PBS-SP-01 in the northeast corner of the Tank Area. This fill is underlain by the grey mottled clayey silt to a thickness of 4 feet. This unit is then underlain by approximately 2 feet of grey silty clay followed by a 1 foot thick layer of grey fine sand. Bedrock, consisting of grey shale, is encountered at a depth of about 9 feet below the ground surface, corresponding to an elevation of approximately 645 feet.

At the remaining borehole locations, the grey mottled clayey silt varies in thickness from 2.5 to 7 feet. This unit is then immediately underlain by the grey shale bedrock or, in places, the clayey silt grades into the grey shale. At these locations, the bedrock occurs at a depth of about 7 feet below ground surface, at an elevation of approximately 650 feet. With the exception of PBS-SP-01, the silty clay and sand units were not present in the boring samples examined for this Tank Area. At these boreholes, representing most of the site, the overburden lying above the bedrock is a poor water bearing material. The wells installed at these locations would not produce sufficient water to complete the purging operation, as was reported in the description of the well development activities.

3.2.2.1.2 Nature and Extent of Contamination

Six soil borings were made at the Space Power Facility Area as part of the current investigation. The samples were composited over the total depth of the boring except for the volatiles samples which were taken at depths ranging from 4 to 9.5 feet below the ground surface. The complete results of the chemical analyses of these samples are presented in Table A-2 in Appendix A. A summary of the detected organic compounds is presented in Table 3-11. Excluding the probable laboratory contaminants, only one (1) volatile organic compound was detected in this set of samples and three (3) semivolatile organics were found. No pesticides or PCBs were detected in these soil samples. Trichloroethene was found in one of the six samples at a concentration of 2 ppb. 2-

Methylnaphthalene was found at a concentration of 670 ppb (slightly higher than the sample detection limits of 560 ppb) in one of the soil samples. The other two semivolatile organic compounds reported, Naphthalene and Phenanthrene, were estimated by the laboratory to be present at concentrations less than the sample detection limit (at roughly 10% and 60% of the sample detection limits, respectively). No other semivolatile organic compounds were detected or reported by the laboratory. Four of the six samples contained none of the organics tested for at detectable levels excluding the lab contaminants. The distribution of the organics detected in the soils at this Tank Area is presented in Figure 3-23. Highlighted in this figure is the relative lack of detected organics contamination at this former Tank Area. The lone solvent detected (Trichloroethene estimated at 2 ppb at PBS-SP-SB-02) can practically be considered to be below detection levels. No other samples showed solvent compounds. As noted, the three semivolatiles reported for this area were associated with only the soil sample taken directly next to the former UST location, and these compounds were reported at concentrations of 10% to 120% of the sample detection limit. The only significant organics contamination of note appears to be TPH. The highest concentration of TPH measured in this area was again at the borehole made right next to the former tank location (288 ppm). The two nearest other soil samples taken about 100 feet on eigher side of this boring did not show TPH contamination. A near detection level concentration of TPH was reported for the soil sample taken on the west side of Building No. 1411. Again, TPH was not reported in any of the adjacent soil samples. This low concentration may, therefore, be associated with an isolated surface spill or leak. Alternately, TPH at this location may be due to migration of contamination from the former leaking tanks along the Building No. 1411 foundation and backfill. The near detection level TPH concentration detected at PBS-SP-SB-01 was somewhat unexpected, as this boring was selected as a background sample for this Tank Area. This amount of TPH may, again, be attributable to an isolated spill or runoff from the nearby roadway.

Using the inorganics comparison methodology and criteria described earlier, a number of inorganics were measured at levels exceeding the UCL criteria for determining significantly higher than background levels (see Table 2-1). These include arsenic, beryllium, cobalt, copper, mercury and thallium. Two of these are generally of concern with respect to health effects - arsenic and mercury. Arsenic was present in two of the six soil samples at levels (22 and 37 mg/Kg) exceeding the UCL for this element. These two samples were both within 150 feet of the former tank locations. The levels of Arsenic reported at the two locations were outside the range of U.S. soil background levels and higher than the N.J. Soil Clean-up Criterion. A logical relationship of Arsenic to the contents of the former USTs has not been made, and other nearby sources (e.g., the railroad line, combustion stack to the east, etc.) may be the source of this contamination.

Mercury was detected at concentrations exceeding the calculated UCL for mercury (see Table 2-1) in three samples (1.1, 6.8 and 0.2 mg/kg). One measurement (6.8 mg/kg)

exceeded both the published U.S. background range and the N.J. Soil Clean-up Criterion. The isolated nature of this finding in a near surface soil sample may indicate a surfac spill.

3.2.2.2 Ground Water Sampling and Analysis

3.2.2.2.1 Nature and Extent of Contamination

Two ground water samples were taken at the Space Power Facility Area as part of the current investigation, one from a well expected to be heavily contaminated (PBS-SP-06) and one from a well expected to be clean (PBS-SP-01). The complete results of the chemical analyses of these samples are presented in Table B-2 in Appendix B. A summary of the detected organic compounds is presented in Table 3-11. As can be seen, no volatile or semivolatile organics, pesticides, PCBs, or TPH were detected in either of these two samples.

3.2.2.2.2 Ground Water Flow

Figures 3-24 and 3-25 present the local ground water elevation contours developed from the January 9, 1991 and May 9, 1991 ground water level measurements, respectively. The ground water flow direction indicated for both the January and May measurements was toward the northeast (NE). As can be seen, the January ground water contours exhibited a pattern of relatively steep gradients such that ground water moves into the area beneath Building Nos. 1411 and 1441 from the northwest and the southeast and then turns toward the northeast. The January contours give the impression of an underground trough draining to the northeast. The ground water contours for May exhibit this same overall pattern, but with gradients which are much less pronounced. These lower gradients result in flows which move toward the north and east, converging on the northeast direction. These Tank Area-specific ground water contours should also be compared to the ground water level contours developed for the entire Plum Brook Station based on the May 1991 data. This site map is presented in Figure 3-15. This larger scale ground water contour map shows an overall flow direction toward the NNW in this general area of the PBS.

The original location of the excavated tanks was at the current level of the ground water table. The tanks were directly above the bedrock and the saturated zone comprises the few feet directly above the bedrock.

Taking the maximum theoretical hydraulic conductivity for the various soil units observed to be present at this Tank Area, the maximum horizontal ground water flow velocities associated with the January and May 1991 were calculated to be 2.0 and 3.1 feet per year,

respectively. It must be emphasized that this estimate is based on the theoretical performance of a homogeneous water-bearing layer consisting entirely of the most transmissive soil type. The theoretical horizontal ground water velocities calculated would suggest that horizontal migration of the UST contaminants in the overburden aquifer would be relatively slow and not significant relative to preferential migration along buried lines or structures.

3.2.2.3 Sediment Sampling and Analysis

Two sediment samples were taken at the Space Power Facility Area as part of the current investigation, both from drainage ditches directly south of the former UST location. The location of these two samples as shown in Figure 3-26. The first location (PBS-SP-SS-01) was approximately 40 feet south of the former USTs on the side of the road nearest Building No. 1411 while the second location (PBS-SP-SS-02) was directly across the road between the road and the railroad tracks. The complete results of the chemical analyses of these samples are presented in Table C-2 in Appendix C. A summary of the detected organic compounds is presented in Table 3-11.

3.2.2.3.1 Nature and Extent of Contamination

Excluding the compounds identified as being probable laboratory contaminants, no volatile organic compounds were detected in the sediment samples at this location. Table 3-11 also indicates that a broad range of semivolatile polycyclic aromatic hydrocarbons (PAHs) were detected in the ditch sediments at concentrations less than 1 ppm. Aroclor-1254, a PCB, also was detected in the ditch nearest the Building at a concentration of 1.6 ppm. Aroclor-1254 contains a mixture of 11% tetra-, 49% penta-, 34% hexa- and 6% heptachlorobiphenyls. Arochlor-1254 was used in heat transfer and hydraulic fluids, lubricants and insecticides. TPH was detected in both sediment samples, at 1320 and 127 ppm on the near-side and far-side of the road, respectively. The distribution of the organics detected in the sediments at this tank area is presented in Figure 3-27.

PAHs, as was previously noted, are typically formed as a result of incomplete combustion of organic compounds in the presence of insufficient oxygen. Common sources of PAHs are fossil fuel (coal and oil) derivatives and combustion sources (e.g., automobiles, incinerators, asphalt, fires). PAHS characteristically exhibit a great tendency to adhere to soils and sediments. Given these properties, and the fact that no PAHs were detected in the subsurface soil or ground water at this Tank Area, the source of the contamination represented in Table 3-11 is indicated to be surface materials containing PAHs or soil particles with PAHs adhering to them which have been washed into the drainage ditches. As both sediment sampling locations were very near asphalt or macadam road surfaces, it is likely that the detected semivolatile PAHs in the Space Power Facility Area ditch

sediments are due to roadway run-off, gasoline and diesel vehicle tailpipe emissions, or the nearby stack emissions, and not to the former USTs or their contents.

The presence of TPH in these sediments at concentrations nearly equal to or greater than in the soil sample taken next to the former UST location, and a lack of TPH in the close-by soil samples of PBS-SP-SB-02 and -05 would tend to indicate that the sediment TPH contamination may not be due to migration of TPH contamination from the former USTs. Instead, surface spillage or leakage and run-off of fuel product might be indicated. Preferential migration of TPH away from Building No. 1411 toward the ditch along buried utility lines and conduits cannot, however, be completely ruled out.

3.2.3 Conclusions for Space Power Facility Area

In combination, the results of the previous and current investigations at the Space Power Facility indicate an area of low level residual fuel product contamination apparently associated with the former USTs and possible pockets of low level solvent contamination possibly due to isolated spills, surface activity or leakage from the waste oil tank.

The Space Power Facility USTs had leaked based on the initial soil sampling performed. Elevated concentrations of both solvent compounds and fuel products (including TPH) were detected in the tank pit soil samples. The follow-up soil gas survey indicated low levels of contamination in the areas surrounding the former UST location on the south and western sides of Building No. 1411. Migration of contaminants with ground water flow along and under the building foundation and along the buried water, natural gas and power lines off the southwestern corner of the building was indicated. No target solvent compounds were detected near the former UST location by the soil gas survey. The lone detection at a point further to the east would appear to be due to migration along and under the Building or to an isolated spill not associated with the former USTs. The most recent sampling also indicated some trace levels of residual volatiles contamination in the soil near the former tank location and the more widespread presence of low levels of TPH. No contamination was detected in the ground water samples taken at this Tank Area during the current investigation. Elevated TPH concentrations also were found in the sediment samples taken from the drainage ditches just south of the former UST location on both sides of the road. Trace levels of semivolatile PAHs and a PCB compound also were found in the drainage ditch closest to the former UST location.

UST contamination at the Space Power Facility was limited to a range of volatile organic compounds and TPH. The trace levels of semivolatile compounds and the PCB found in the Space Power Facility sediment samples would not appear to be associated with the former USTs. Two metals, arsenic and mercury, were highlighted as potentially problematic in the soils at certain locations in this area. However, there is currently no clear linkage of these metals to the contents of the former USTs.

Transport and migration of contamination from the former UST locations at this Tank Area would appear to be linked to ground water movement. Migration along preferential flow pathways associated with man-made structures would appear to dominate migration through the undisturbed soil. These preferential pathways have themselves become secondary sources of contamination in some areas.

TABLE 3-9
Results of Soil Analyses for the Building 1411 Tank Area at the Space Power Facility

, UST Closure Assessment, Sept 1989

Volatile Organic Compounds	Maximum Concentration Detected in Soil: Building 1411 Tanks #24, 25 ug/Kg	Frequency
Dichlorodifluoromethane	ND	-
Chloromethane	ND	-
Vinyl Chloride	ND	-
Bromomethane	ND	-
Chloroethane	ND	-
Trichlorofluoromethane	93	6 / 9
1,1 Dichloroethene	22	2 / 9
Methylene Chloride	164	9 / 9
trans-1,2-Dichloroethene	17	2 / 6
1,1 Dichloroethane	228	9 / 9
cis-1,2 Dichloroethene	362	3 / 6
2,2 Dichloropropane	ND	-
Chloroform	ND	-
Bromochloromethane	ND	-
1,1,1-Trichloroethane	1254	9 / 9
1,1 Dichloropropene	ND	-
Carbon Tetrachloride	213	5 / 9
1,2 Dichloroethane	5	3 / 9
Benzene	11	5 / 9
Trichloroethene	1432	9 / 9
1,2 Dichloropropane	ND	-
Bromodichloromethane	ND	-
Dibromomethane	ND	-
Toluene	16	5 / 9
1,1,2-Trichloroethane	11	1 / 9
1,3 Dichloropropane	ND	-
Tetrachloroethene	342	4 / 9
Dibromochloromethane	ND	-
1,2-Dibromomethane-EDB	ND	-
Chlorobenzene	ND	-
Ethylbenzene	45	5 / 9
1,1,1,2-Tetrachloroethane	ND	-
m & p -Xylenes	43	5 / 9
o-Xylene	33	5 / 9
Styrene	ND	-
1,1,2,2-Tetrachloroethane	ND	-
Isopropylbenzene	31	3 / 6
Bromoform	ND	-
1,2,3- Trichloropropane	ND	-
n-Propylbenzene	76	3 / 6
Bromobenzene	ND	-
1,3,5 Trimethylbenzene	496	5 / 6

ND Not Detected

TABLE 3-9 Continued
Results of Soil Analyses for the Building 1411 Tank Area
at the Space Power Facility

	Maximum Concentration Detected in Soil	
	Building 1411 Tanks #24, 25	
Volatile Organic Compounds	ug/Kg	Frequency
4-Chlorotoluene	3	1 / 6
2-Chlorotoluene	3	1 / 6
tert-Butylbenzene	70	3 / 6
1,2,4 Trimethylbenzene	541	5 / 6
sec-Butylbenzene	37	3 / 6
p-Isopropyltoluene	74	3 / 6
1,3 Dichlorobenzene	ND	-
1,4 Dichlorobenzene	ND	-
n-Butylbenzene	ND	-
1,2 Dichlorobenzene	8	1 / 9
1,2-Dibromo-3-Chloropropane	ND	-
1,2,4 Trichlorobenzene	10	2 / 6
Hexachlorobutadiene	ND	-
Naphthalene	1094	6 / 6
1,2,3 Trichlorobenzene	40	2 / 6
Acetone	54	3 / 3
Acrylonitrile	ND	-
Acrolein	ND	-
Carbon Disulfide	1	1 / 3
1,2-Dichloroethene (Total)	3	2 / 3
2-Butanone	ND	-
Vinyl Acetate	ND	-
trans-1,3-Dichloropropene	ND	-
cis-1,3-Dichloropropene	ND	-
2-Chloroethylvinylether	ND	-
4-Methyl-2-Pentanone	10	2 / 3
2-Hexanone	39	3 / 3
TPH (mg/Kg)	2030	9 / 9

ND Not Detected

TABLE 3-10
Soil Gas Survey Results for
the Space Power Facility Tank Area

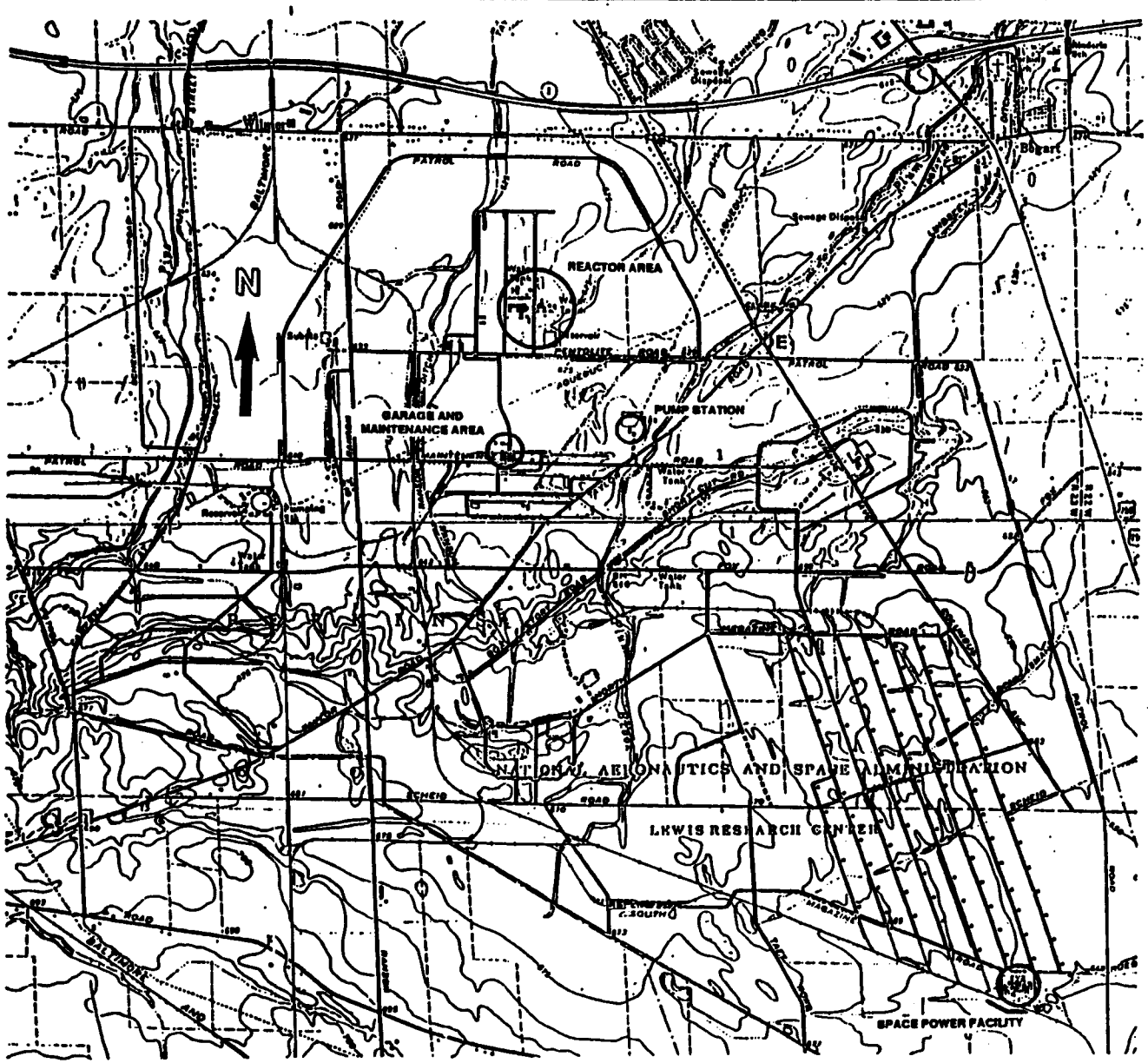
SAMPLE ID	CONCENTRATIONS (ppb) DCE	BENZENE	TCE	TOLUENE	PCE	XYLENE	NOTES
	dl=5	dl=5	dl=5	dl=5	dl=5	dl=5	
1411-1							
1411-2				60		130	*
1411-3						5.1	
1411-4							
1411-5		98		6.7			*
1411-6							
1411-7				35			*
1411-8							
1411-9				210		160	*
1411-9		200		71		16	*
1411-10				470		280	*
1411-10		2000				130	*
1411-11							
1411-12							*
1411-12						9.6	*
1411-13				10		24	*
1411-14				10		5.6	*
1411-15			700	29			*
1411-15		110		26			*
1411-16							
C1				17			*
C2							*
C3							*
C4							*
C5		270		150			*
C6							

NOTES:
Blank cell indicates below detection limit (<dl)
A sample listed twice is a field duplicate
* indicates multiple peak response commonly associated with a fuel product

TABLE 3-11
SUMMARY OF ORGANIC CONTAMINANTS DETECTED AT THE
SPACE POWER FACILITY AREA

SPACE POWER FACILITY AREA	MAXIMUM CONCENTRATION DETECTED IN					
	SOIL		GROUND WATER		SEDIMENT	
VOLATILE ORGANIC COMPOUNDS	ug/Kg	Freq.	ug/L	Freq.	ug/Kg	Freq.
Methylene Chloride *	71	6/6	ND		4 J	1/2
Acetone *	130 B	5/6	ND		ND	
Trichloroethene	2 J	1/6	ND		ND	
SEMIVOLATILE ORGANIC COMPOUNDS	ug/Kg	Freq.	ug/L	Freq.	ug/Kg	Freq.
Naphthalene	56 J	1/6	ND		ND	
2-Methylnaphthalene	670	1/6	ND		ND	
Phenanthrene	330 J	1/6	ND		200 J	1/2
Fluoranthene	ND		ND		890 J	1/2
Pyrene	ND		ND		980	1/2
Benzo(a)anthracene	ND		ND		490 J	1/2
Chrysene	ND		ND		590 J	1/2
bis(2-Ethylhexyl)phthalate *	ND		ND		490 J	1/2
Benzo(b)fluoranthene	ND		ND		680 J	1/2
Benzo(k)fluoranthene	ND		ND		890 J	1/2
Benzo(a)pyrene	ND		ND		680 J	1/2
Indeno(1,2,3-cd)pyrene	ND		ND		490 J	1/2
PESTICIDE / PCBs COMPOUNDS	ug/Kg	Freq.	ug/L	Freq.	ug/Kg	Freq.
Aroclor-1254	ND		ND		1600	1/2
TOTAL PETROLEUM HYDROCARBONS	mg/Kg	Freq.	mg/L	Freq.	mg/Kg	Freq.
TPH	288	3/6	ND		1320	2/2

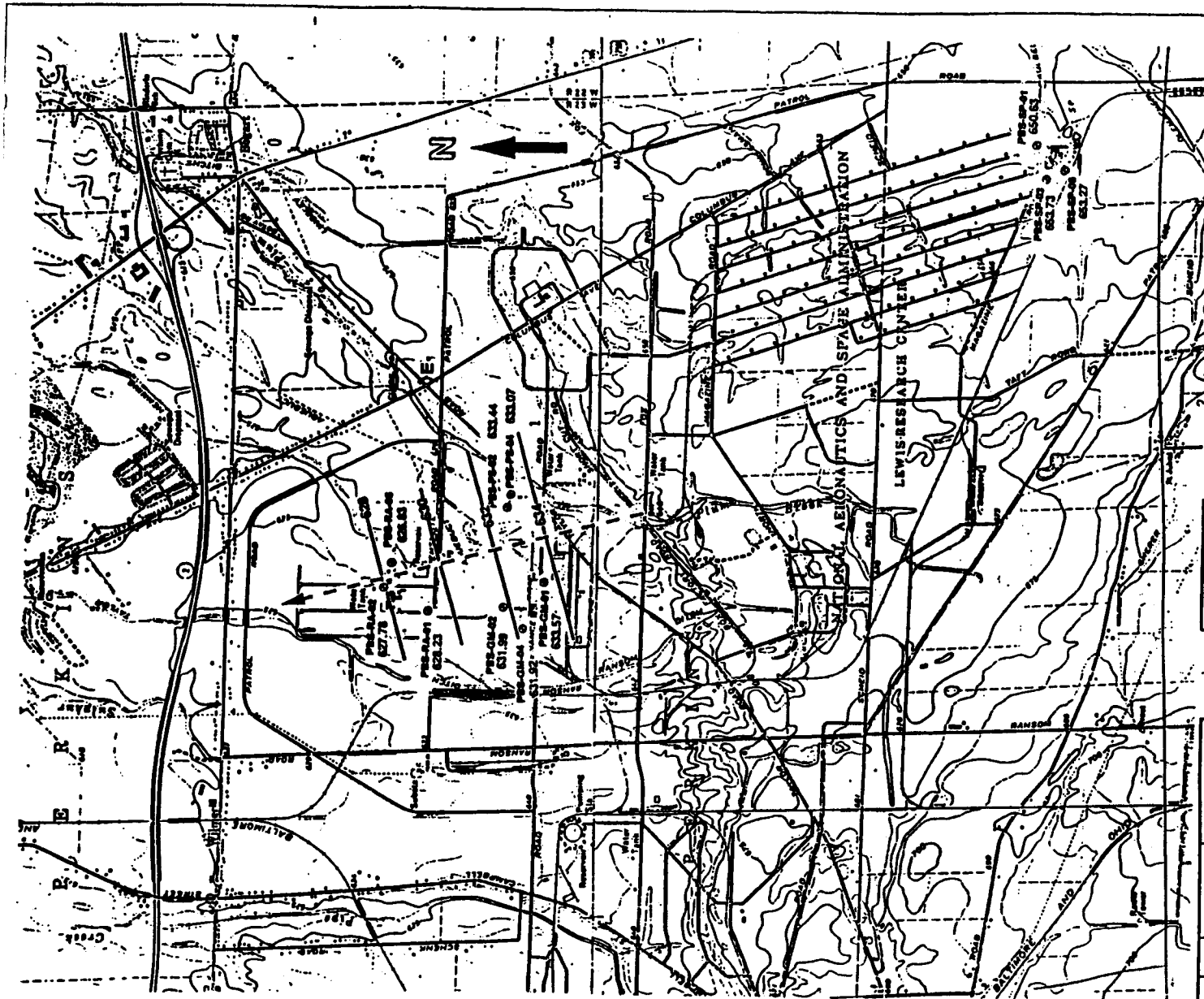
NOTES : * Probable Laboratory Contaminants (See Text)
J Estimated, Value Below the Quantitation Limit
B Analyte Found in Associated Blank
ND Not Detected



NASA PLUM BROOK STATION
UNDERGROUND STORAGE TANK
CORRECTIVE ACTIONS REMEDIAL
INVESTIGATION/FEASIBILITY STUDY:
PHASE I

Locations of the Four Former Underground Storage Tank Areas at the NASA Plum Brook Station

EBASCO ENVIRONMENTAL	SCALE: 1"=2000'
FROM USGS SANDUSKY & KIMBALL, OHIO 7.5 MINUTE QUADRANGLE TOPO MAPS	FIGURE 3-1



LEGEND

PBS-GM-01 633.57	Ground Water Monitoring Well Ground Water Elevation
634.0	Ground Water Elevation Contour
	Direction of Ground Water Flow

NASA PLUM BROOK STATION
UNDERGROUND STORAGE TANK CORRECTIVE ACTIONS REMEDIAL INVESTIGATIONS/FEASIBILITY STUDY: PHASE I

Regional Ground Water Elevation Contours for the Plum Brook Station (Based on the 05/09/91 Data)

EBASCO ENVIRONMENTAL	SCALE: 1"=2000'
FROM USGS SANDUSKY & KIMBELL, OHIO 7.5 MINUTE QUADRANGLE TOPO MAPS	FIGURE 3-15

Soil Unit	Range of Unit Thickness at the Tank Area
OVERBURDEN	
* Cobbles or Brown Sandy Clayey Silt	1' - 2'
Grey Mottled Clayey Silt	2.5' - 7'
* Grey Silty Clay	2'
* Grey Fine Sand	1'
* Grey Clayey Silt with Shale	0.5' - 4.5'
BEDROCK	
Grey Shale	

* Unit not encountered at all borehole locations

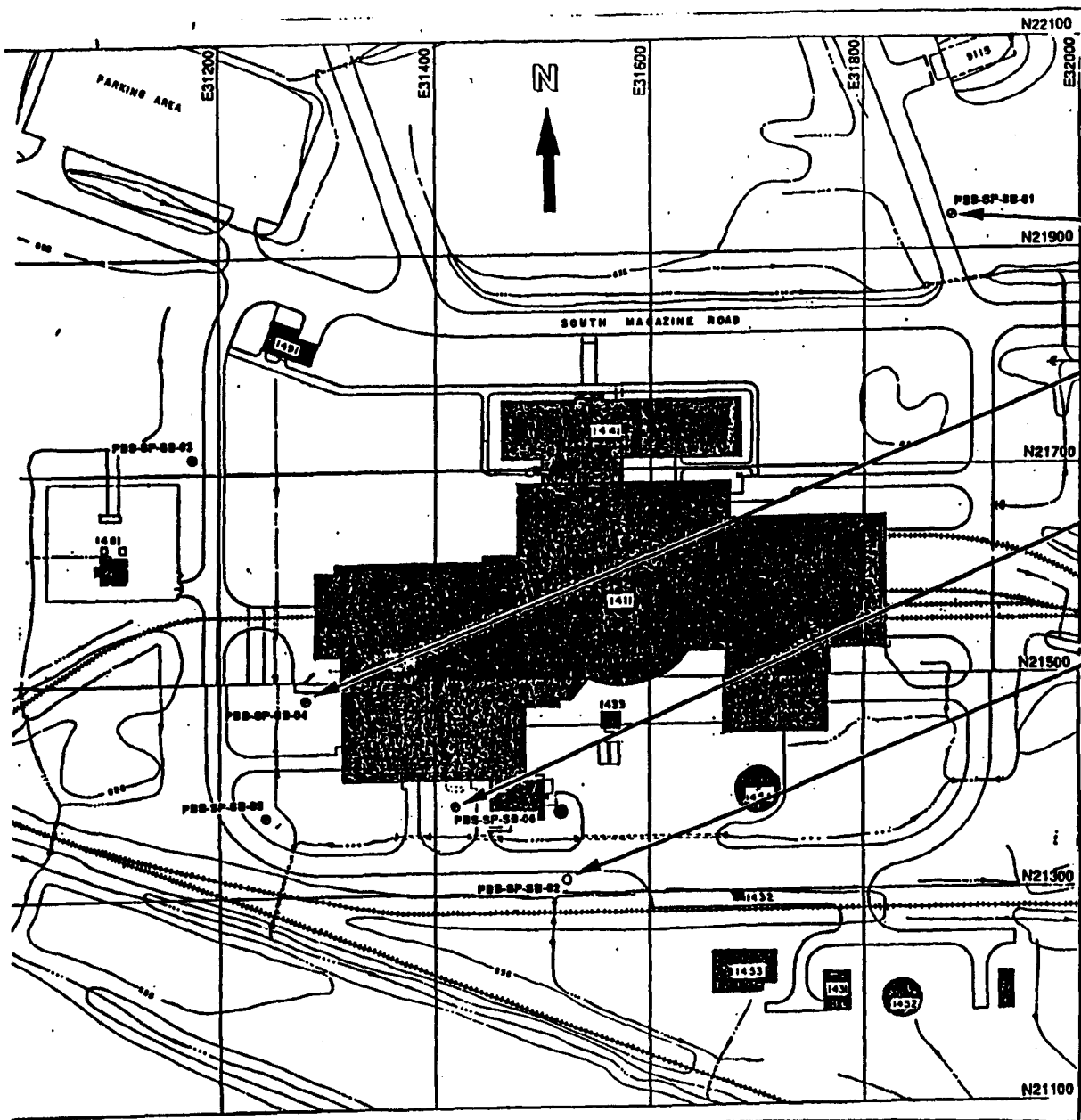
NASA PLUM BROOK STATION
UNDERGROUND STORAGE TANK
CORRECTIVE ACTIONS REMEDIAL
INVESTIGATION/FEASIBILITY STUDY:
PHASE I

Generalized Stratigraphic Section

SPACE POWER FACILITY

EBASCO ENVIRONMENTAL | NOT TO SCALE

FIGURE 3-22



PBS-SP-SB01	Conc.
Total Petroleum Hydrocarbons	44 mg/Kg

PBS-SP-SB04	Conc.
Total Petroleum Hydrocarbons	35 mg/Kg

PBS-SP-SB06	Conc.
Naphthalene	56 J ug/Kg
2-Methylnaphthalene	670 ug/Kg
Phenanthrene	330 J ug/Kg
Total Petroleum Hydrocarbons	288 mg/Kg
J = Estimated	

PBS-SP-SB02	Conc.
Trichloroethene	2 J ug/Kg
J = Estimated	

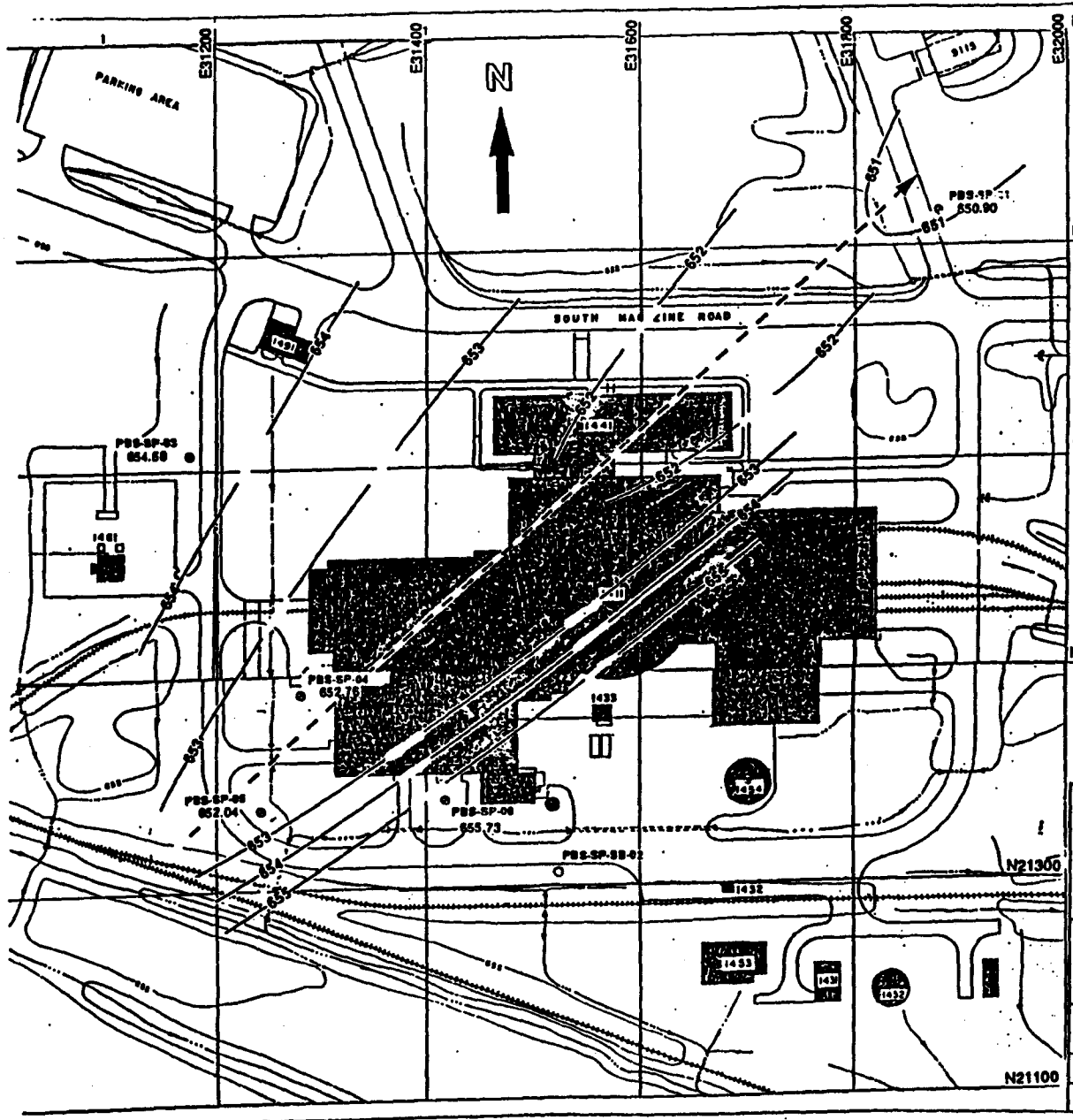
NASA PLUM BROOK STATION
UNDERGROUND STORAGE TANK CORRECTIVE ACTIONS REMEDIAL INVESTIGATIONS/FEASIBILITY STUDY: PHASE I

Organic Contaminant Concentrations in Soil

SPACE POWER FACILITY

EBASCO ENVIRONMENTAL | SCALE: 1"=100'

FROM NASA DWG. NOs. PF-65530 & 65536 | **FIGURE 3-23**



LEGEND

PBS-SP-01 650.90	Ground Water Monitoring Well Ground Water Elevation
652	Ground Water Elevation Contour
	Direction of Ground Water Flow

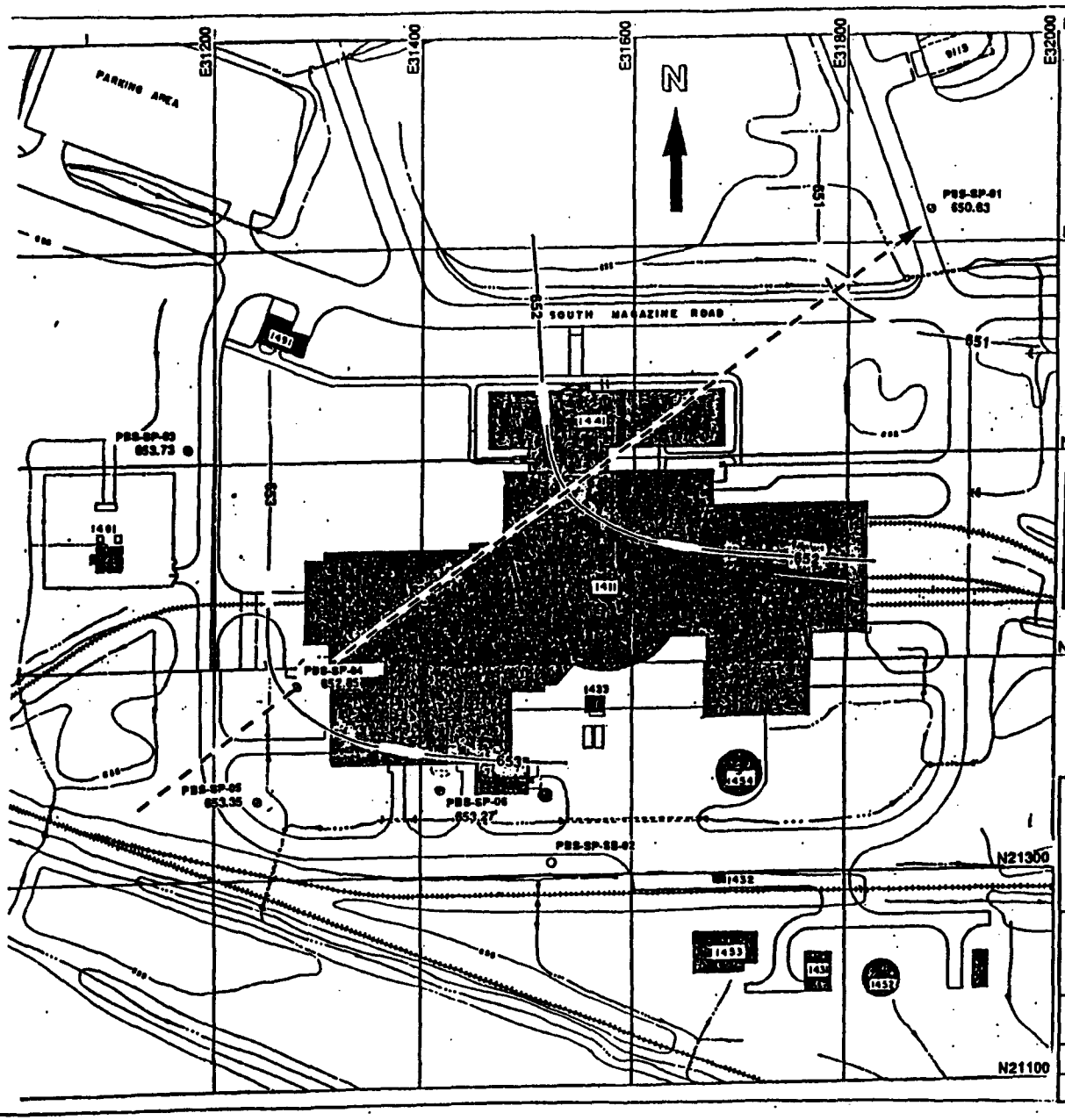
NASA PLUM BROOK STATION
UNDERGROUND STORAGE TANK CORRECTIVE ACTIONS REMEDIAL INVESTIGATIONS/FEASIBILITY STUDY: PHASE I

Ground Water Elevation Contours for 01/09/91

SPACE POWER FACILITY

EBASCO ENVIRONMENTAL | SCALE: 1"=100'

FROM NASA DWG. NOs. PF-65530 & 65530 | **FIGURE 3-24**



LEGEND

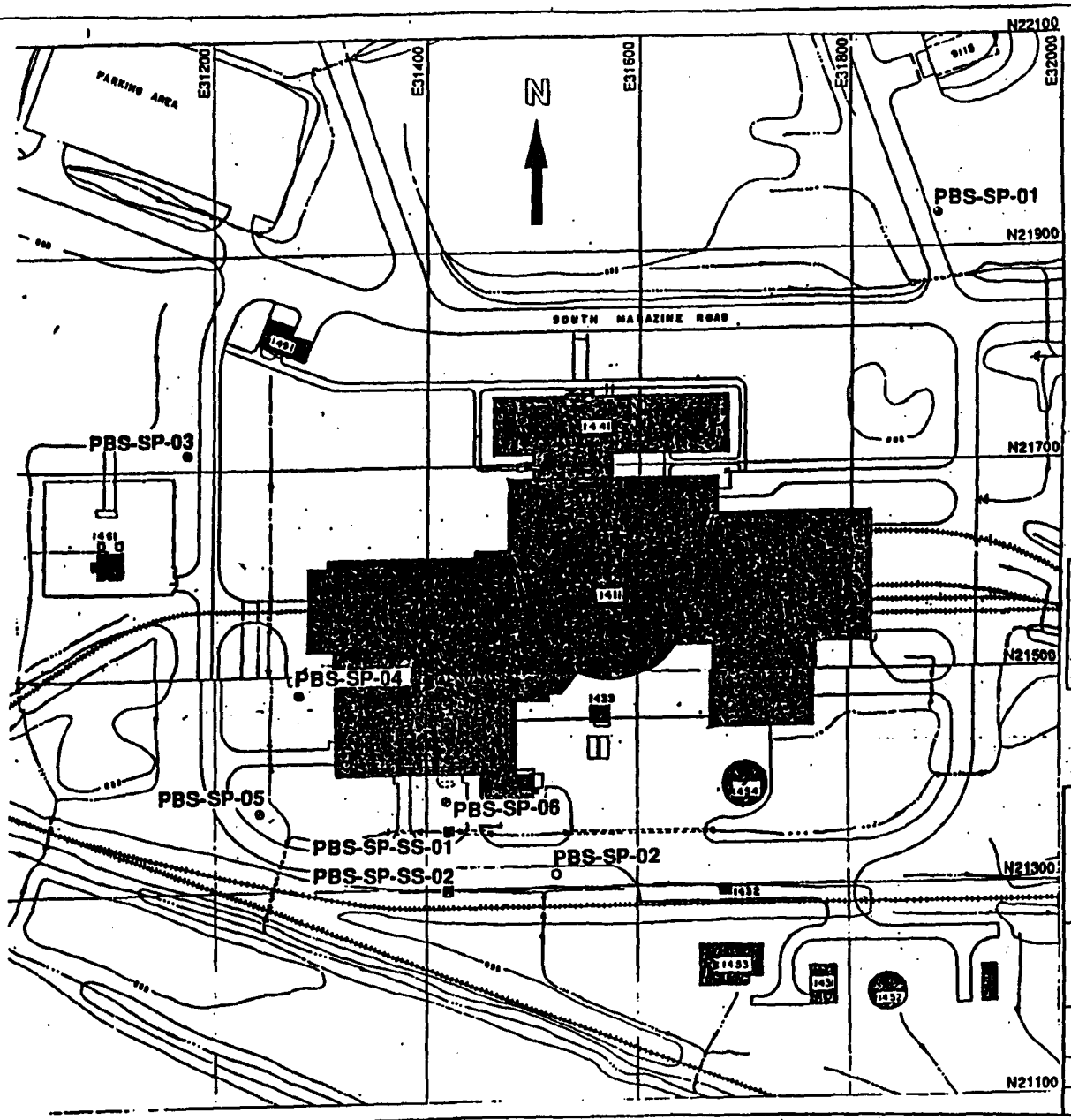
PBS-SP-01 650.63	Ground Water Monitoring Well Ground Water Elevation
652	Ground Water Elevation Contour
	Direction of Ground Water Flow

NASA PLUM BROOK STATION
UNDERGROUND STORAGE TANK CORRECTIVE ACTIONS REMEDIAL INVESTIGATIONS/FEASIBILITY STUDY: PHASE I

Ground Water Elevation Contours for 05/09/91

SPACE POWER FACILITY

EBASCO ENVIRONMENTAL	SCALE: 1"=100'
FROM NASA DWG. NOs. PF-65530 & 65530	FIGURE 3-25



LEGEND

- Ground Water Monitoring Well Location
- Soil Boring Location
- Sediment Sample Location

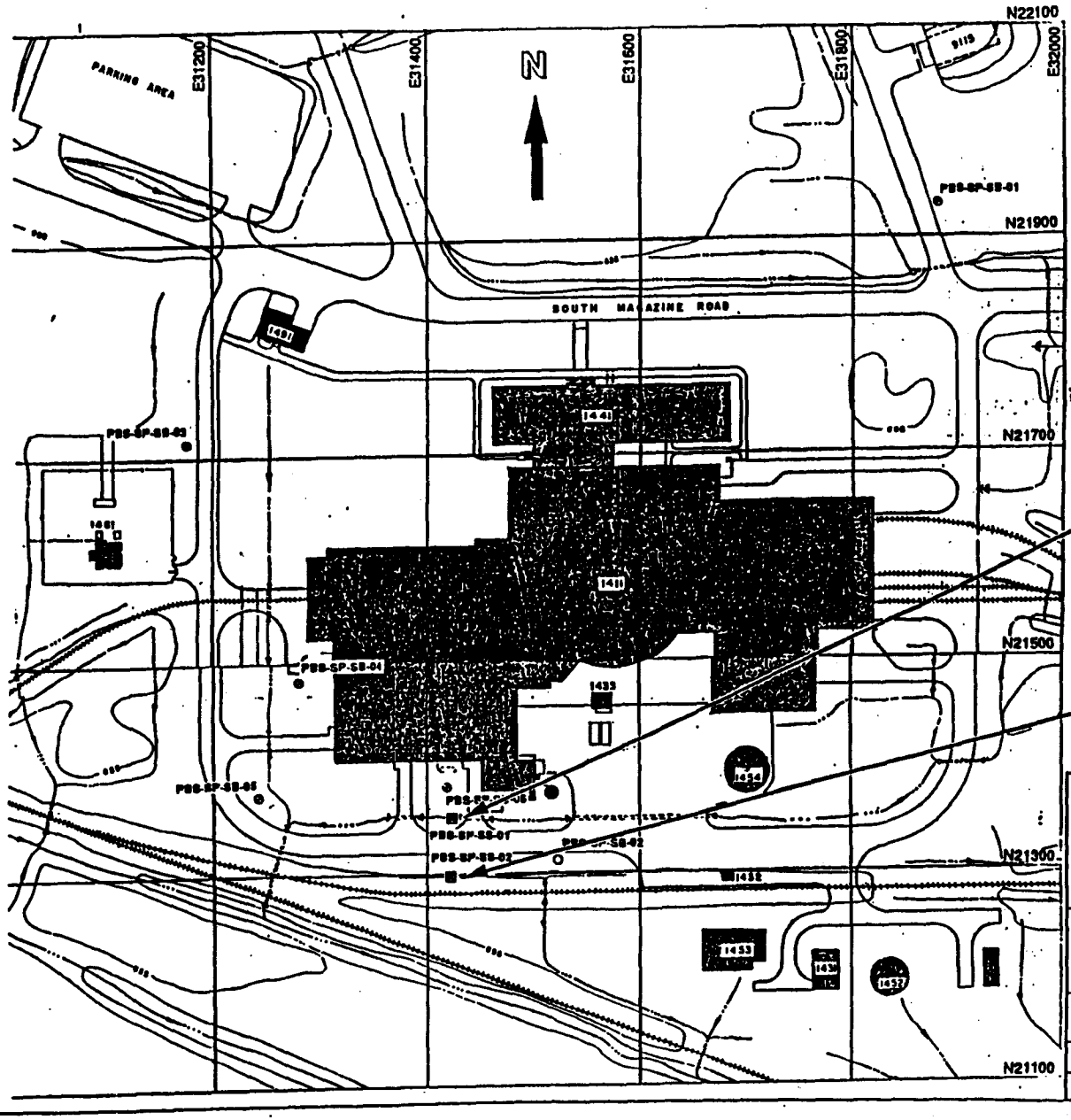
NASA PLUM BROOK STATION
UNDERGROUND STORAGE TANK CORRECTIVE ACTIONS REMEDIAL INVESTIGATION/FEASIBILITY STUDY: PHASE I

Locations of Sediment Samples

SPACE POWER FACILITY

EBASCO ENVIRONMENTAL | SCALE: 1"=100'

FROM NASA DWG. NOs. PF-85530 & 85538 | FIGURE 3-26



PBS-SP-SS-01	Conc.
Phenanthrene	200 J ug/Kg
Fluoranthene	890 J ug/Kg
Pyrene	980 ug/Kg
Benzo(a)anthracene	490 J ug/Kg
Chrysene	590 J ug/Kg
Benzo(b)fluoranthene	680 J ug/Kg
Benzo(k)fluoranthene	890 J ug/Kg
Benzo(a)pyrene	680 J ug/Kg
Indeno(1,2,3-cd)pyrene	490 J ug/Kg
Aroclor-1254	1600 ug/Kg
Total Petroleum Hydrocarbons	1320 mg/Kg

J = Estimated

PBS-SP-SS-02	Conc.
Total Petroleum Hydrocarbons	127 mg/Kg

NASA PLUM BROOK STATION
UNDERGROUND STORAGE TANK CORRECTIVE ACTIONS REMEDIAL INVESTIGATIONS/FEASIBILITY STUDY: PHASE I

Organic Contaminant Concentrations in Sediment

SPACE POWER FACILITY

EBASCO ENVIRONMENTAL | SCALE: 1"=100'

FROM NASA DWG. NOs. PF-65530 & 65536 | **FIGURE 3-27**

TABLE 4-1

Summary of Current Site Characterization Results for the Plum Brook Station Former UST Locations

Tank Area / Former UST Location	UST Contaminated Media			UST Contamination Detected or Indicated to be Potentially Problematic							Level of Residual UST Contamination Present	Potential Ground Water Migration Routes	
	Sub-surface Soil	Ground Water	Surface Sediment	VOCs	Semi-vols	Pesti-cides	PCBs	Metals	CN	TPH		Through Natural Overburden	Along Prefer-ential Pathways
Garage and Maintenance Area													
/ Tanks #33, #34, and #35 (Building 7132)	X	X	-							X	Very Low	X	Buried Water Line
/ Tanks #28, #29, #30 and #31 (Building 7121)	X	X	(1)	X	(1)	(2)				X	Significant	X	Buried Water and Sewer Lines Roadbed Building Foundation
/ Tank #32 (Building 7131)	-	-	(1)	X	(1)	(2)				X	Very Low	X	Buried Sewer, Water and Natural Gas Lines Roadbed Building Foundation Ground Water Break-out and Run-off
Space Power Facility													
/ Tanks #24 and #25 (Building 1411)	X	-	(1)	X	X(1)		(3)	(4)		X	Low	X	Buried Sewer, Water and Natural Gas Lines Roadbed Building Foundation
Pump Station													
/ Tank #39 (Building 8133)	X	-	(1)	X	(1)					X	Very Low	X	Buried Water Lines Building Foundation
Reactor Area													
/ Tanks #21, #22, and #23 (Building 1131)	X	-		X	(1)	(2)				X	Low	X	Underground Tunnel Dewatering and Discharge Buried Sewer and Water Lines Buried Electrical Conduit Channels

NOTES

- Not detected in current investigation
(1) Detected PAHs in sediment samples are not indicated to be related to the former USTs
(2) Detected Pesticide in ground water samples is not indicated to be related to the former USTs
(3) Detected PCB compound in sediment samples is not ind' 'to be related to the former USTs
(4) Detected Metals (Arsenic and Mercury) are not currently to former UST contents

TABLE A-2

SOIL SAMPLE RESULTS FOR THE SPACE POWER FACILITY

SAMPLE IDENTIFICATION	SP-SB01	(SP-SB01)	SP-SB02	(SP-SB02)	SP-SB03	SP-SB04	(SP-SB04)	SP-SB05	(SP-SB05)
Sample Type	Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Depth Below Surface	8'-9.5'	8'-9.5'	6'-7'	6'-7'	6'-7'	6'-7'	6'-7'	4'-6'	4'-6'
Date Sampled	12-10-90	12-10-90	12-11-90	12-11-90	12-11-90	12-11-90	12-11-90	12-11-90	12-11-90
VOLATILE ORGANIC COMPOUNDS (ug/Kg)	SP-SB01	(SP-SB01)	SP-SB02	(SP-SB02)	SP-SB03	SP-SB04	(SP-SB04)	SP-SB05	(SP-SB05)
Chloromethane	11 U	11 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Bromomethane	11 U	11 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Vinyl Chloride	11 U	11 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Chloroethane	11 U	11 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Methylene Chloride	6 U	10	20	34	6	10	62	7	41
Acetone	77	11 U	12 U	36 B	12 U	12 U	75 B	12 U	110 B
Carbon Disulfide	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
1,1-Dichloroethene	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
1,1-Dichloroethane	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
1,2-Dichloroethene (Total)	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
Chloroform	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
1,2-Dichloroethane	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
2-Butanone	11 U	11 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
1,1,1-Trichloroethane	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
Carbon Tetrachloride	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
Vinyl Acetate	11 U	11 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Bromodichloromethane	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
1,2-Dichloropropane	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
cis-1,3-Dichloropropene	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
Trichloroethene	6 U	6 U	6 U	2 J	6 U	6 U	6 U	6 U	6 U
Dibromochloromethane	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
1,1,2-Trichloroethane	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U

Notes
( ) Denotes Sample Reanalysis

Qualifiers
U Undetected
J Estimated, Value Below the Quantitation Limit
B Analyte found in associated blank

Laboratory; Hittman Ebasco

SAMPLE IDENTIFICATION	SP-SB01	(SP-SB01)	SP-SB02	(SP-SB02)	SP-SB03	SP-SB04	(SP-SB04)	SP-SB05	(SP-SB05)
Sample Type	Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Sample Depth Below Surface	8'-9.5'	8'-9.5'	6'-7'	6'-7'	6'-7'	6'-7'	6'-7'	4'-6'	4'-6'
Date Sampled	12-10-90	12-10-90	12-11-90	12-11-90	12-11-90	12-11-90	12-11-90	12-11-90	12-11-90
VOLATILE ORGANIC COMPOUNDS (ug/Kg)	SP-SB01	(SP-SB01)	SP-SB02	(SP-SB02)	SP-SB03	SP-SB04	(SP-SB04)	SP-SB05	(SP-SB05)
Benzene	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
trans-1,3-Dichloropropene	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
Bromoform	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
4-Methyl-2-Pentanone	11 U	11 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
2-Hexanone	11 U	11 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Tetrachloroethene	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
1,1,2,2-Tetrachloroethane	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
Toluene	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
Chlorobenzene	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
Ethylbenzene	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
Styrene	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
Xylenes (Total)	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U

Notes
( ) Denotes Sample Reanalysis

Qualifiers
U Undetected
J Estimated, Value Below the Quantitation Limit
B Analyte found in associated blank

Laboratory; Hittman Ebasco

SOIL SAMPLE RESULTS FOR THE SPACE POWER FACILITY

SAMPLE IDENTIFICATION	SP-SB06	(SP-SB06)
Sample Type	Grab	Grab
Sample Depth Below Surface	6'-8'	6'-8'
Date Sampled	12-12-90	12-12-90
VOLATILE ORGANIC COMPOUNDS (ug/Kg)	SP-SB06	(SP-SB06)
Chloromethane	12 U	12 U
Bromomethane	12 U	12 U
Vinyl Chloride	12 U	12 U
Chloroethane	12 U	12 U
Methylene Chloride	6 U	71
Acetone	12 U	130 B
Carbon Disulfide	6 U	6 U
1,1-Dichloroethene	6 U	6 U
1,1-Dichloroethane	6 U	6 U
1,2-Dichloroethene (Total)	6 U	6 U
Chloroform	6 U	6 U
1,2-Dichloroethane	6 U	6 U
2-Butanone	12 U	12 U
1,1,1-Trichloroethane	6 U	6 U
Carbon Tetrachloride	6 U	6 U
Vinyl Acetate	12 U	12 U
Bromodichloromethane	6 U	6 U
1,2-Dichloropropane	6 U	6 U
cis-1,3-Dichloropropene	6 U	6 U
Trichloroethene	6 U	6 U
Dibromochloromethane	6 U	6 U
1,1,2-Trichloroethane	6 U	6 U

Notes
( ) Denotes Sample Reanalysis

Qualifiers
U Undetected
J Estimated, Value Below the Quantitation Limit
B Analyte found in associated blank

Laboratory; Hittman Ebasco

SAMPLE IDENTIFICATION	SP-SB06	(SP-SB06)
Sample Type	Grab	Grab
Sample Depth Below Surface	6'-8'	6'-8'
Date Sampled	12-12-90	12-12-90
VOLATILE ORGANIC COMPOUNDS (ug/Kg)	SP-SB06	(SP-SB06)
Benzene	6 U	6 U
trans-1,3-Dichloropropene	6 U	6 U
Bromoform	6 U	6 U
4-Methyl-2-Pentanone	12 U	12 U
2-Hexanone	12 U	12 U
Tetrachloroethene	6 U	6 U
1,1,2,2-Tetrachloroethane	6 U	6 U
Toluene	6 U	6 U
Chlorobenzene	6 U	6 U
Ethylbenzene	6 U	6 U
Styrene	6 U	6 U
Xylenes (Total)	6 U	6 U

Notes
( ) Denotes Sample Reanalysis

Qualifiers
U Undetected
J Estimated, Value Below the Quantitation Limit
B Analyte found in associated blank

Laboratory; Hittman Ebasco

TABLE A-2

SOIL SAMPLE RESULTS FOR THE SPACE POWER FACILITY

SAMPLE IDENTIFICATION	SP-SB01	SP-SB02	SP-SB03	SP-SB04	SP-SB05	SP-SB06
Sample Type	Composite	Composite	Composite	Composite	Composite	Composite
Sample Depth Below Surface	0'-9.5'	0'-7'	0'-7'	0'-7'	0'-7'	0'-8'
Date Sampled	12-10-90	12-11-90	12-11-90	12-11-90	12-11-90	12-12-90
SEMIVOLATILE ORGANIC COMPOUNDS (ug/Kg)	SP-SB01	SP-SB02	SP-SB03	SP-SB04	SP-SB05	SP-SB06
Phenol	390 U	440 U	440 U	420 U	420 U	560 U
bis(-2-Chloroethyl) Ether	390 U	440 U	440 U	420 U	420 U	560 U
2-Chlorophenol	390 U	440 U	440 U	420 U	420 U	560 U
1,3-Dichlorobenzene	390 U	440 U	440 U	420 U	420 U	560 U
1,4-Dichlorobenzene	390 U	440 U	440 U	420 U	420 U	560 U
Benzyl alcohol	390 U	440 U	440 U	420 U	420 U	560 U
1,2-Dichlorobenzene	390 U	440 U	440 U	420 U	420 U	560 U
2-Methylphenol	390 U	440 U	440 U	420 U	420 U	560 U
bis(-2-Chloroisopropyl) Ether	390 U	440 U	440 U	420 U	420 U	560 U
4-Methylphenol	390 U	440 U	440 U	420 U	420 U	560 U
N-Nitroso-Di-n-propylamine	390 U	440 U	440 U	420 U	420 U	560 U
Hexachloroethane	390 U	440 U	440 U	420 U	420 U	560 U
Nitrobenzene	390 U	440 U	440 U	420 U	420 U	560 U
Isophorone	390 U	440 U	440 U	420 U	420 U	560 U
2-Nitrophenol	390 U	440 U	440 U	420 U	420 U	560 U
2,4-Dimethylphenol	390 U	440 U	440 U	420 U	420 U	560 U
Benzoic acid	2000 U	2200 U	2200 U	2100 U	2100 U	2800 U
bis(-2-Chloroethoxy) methane	390 U	440 U	440 U	420 U	420 U	560 U
2,4-Dichlorophenol	390 U	440 U	440 U	420 U	420 U	560 U
1,2,4-Trichlorobenzene	390 U	440 U	440 U	420 U	420 U	560 U
Naphthalene	390 U	440 U	440 U	420 U	420 U	56 J
4-Chloroaniline	390 U	440 U	440 U	420 U	420 U	560 U

Notes
( ) Denotes Sample Reanalysis

Qualifiers
U Undetected
J Estimated, Value is below Detection Limit

Laboratory; Hittman Ebasco

TABLE A-2

SOIL SAMPLE RESULTS FOR THE SPACE POWER FACILITY

SAMPLE IDENTIFICATION	SP-SB01	SP-SB02	SP-SB03	SP-SB04	SP-SB05	SP-SB06
Sample Type	Composite	Composite	Composite	Composite	Composite	Composite
Sample Depth Below Surface	0'-9.5'	0'-7'	0'-7'	0'-7'	0'-7'	0'-8'
Date Sampled	12-10-90	12-11-90	12-11-90	12-11-90	12-11-90	12-12-90
SEMIVOLATILE ORGANIC COMPOUNDS (ug/Kg)	SP-SB01	SP-SB02	SP-SB03	SP-SB04	SP-SB05	SP-SB06
Hexachlorobutadiene	390 U	440 U	440 U	420 U	420 U	560 U
4-Chloro-3-methylphenol	390 U	440 U	440 U	420 U	420 U	560 U
2-Methylnaphthalene	390 U	440 U	440 U	420 U	420 U	670
Hexachlorocyclopentadiene	390 U	440 U	440 U	420 U	420 U	560 U
2,4,6-Trichlorophenol	390 U	440 U	440 U	420 U	420 U	560 U
2,4,5-Trichlorophenol	2000 U	2200 U	2200 U	2100 U	2100 U	2800 U
2-Chloronaphthalene	390 U	440 U	440 U	420 U	420 U	560 U
2-Nitroaniline	2000 U	2200 U	2200 U	2100 U	2100 U	2800 U
Dimethyl Phthalate	390 U	440 U	440 U	420 U	420 U	560 U
Acenaphthylene	390 U	440 U	440 U	420 U	420 U	560 U
2,6-Dinitrotoluene	390 U	440 U	440 U	420 U	420 U	560 U
3-Nitroaniline	2000 U	2200 U	2200 U	2100 U	2100 U	2800 U
Acenaphthene	390 U	440 U	440 U	420 U	420 U	560 U
2,4-Dinitrophenol	2000 U	2200 U	2200 U	2100 U	2100 U	2800 U
4-Nitrophenol	2000 U	2200 U	2200 U	2100 U	2100 U	2800 U
Dibenzofuran	390 U	440 U	440 U	420 U	420 U	560 U
2,4-Dinitrotoluene	390 U	440 U	440 U	420 U	420 U	560 U
Diethylphthalate	390 U	440 U	440 U	420 U	420 U	560 U
4-Chlorophenyl-phenylether	390 U	440 U	440 U	420 U	420 U	560 U
Fluorene	390 U	440 U	440 U	420 U	420 U	560 U
4-Nitroaniline	2000 U	2200 U	2200 U	2100 U	2100 U	2800 U
4,6-Dinitro-2-methylphenol	2000 U	2200 U	2200 U	2100 U	2100 U	560 U

Notes
( ) Denotes Sample Reanalysis

Qualifiers
U Undetected
J Estimated, Value is below Detection Limit

Laboratory; Hittman Ebasco

TABLE A-2

SOIL SAMPLE RESULTS FOR THE SPACE POWER FACILITY

SAMPLE IDENTIFICATION	SP-SB01	SP-SB02	SP-SB03	SP-SB04	SP-SB05	SP-SB06
Sample Type	Composite	Composite	Composite	Composite	Composite	Composite
Sample Depth Below Surface	0'-9.5'	0'-7'	0'-7'	0'-7'	0'-7'	0'-8'
Date Sampled	12-10-90	12-11-90	12-11-90	12-11-90	12-11-90	12-12-90
SEMIVOLATILE ORGANIC COMPOUNDS (ug/Kg)	SP-SB01	SP-SB02	SP-SB03	SP-SB04	SP-SB05	SP-SB06
N-Nitrosodiphenylamine	390 U	440 U	440 U	420 U	420 U	560 U
4-Bromophenyl-phenylether	390 U	440 U	440 U	420 U	420 U	560 U
Hexachlorobenzene	390 U	440 U	440 U	420 U	420 U	560 U
Pentachlorophenol	2000 U	2200 U	2200 U	2100 U	2100 U	2800 U
Phenanthrene	390 U	440 U	440 U	420 U	420 U	330 J
Anthracene	390 U	440 U	440 U	420 U	420 U	560 U
Di-n-butylphthalate	390 U	440 U	440 U	420 U	420 U	560 U
Fluoranthene	390 U	440 U	440 U	420 U	420 U	560 U
Pyrene	390 U	440 U	440 U	420 U	420 U	560 U
Butylbenzylphthalate	390 U	440 U	440 U	420 U	420 U	560 U
3,3'-Dichlorobenzidine	390 U	440 U	440 U	420 U	420 U	560 U
Benzo(a)anthracene	390 U	440 U	440 U	420 U	420 U	560 U
Chrysene	390 U	440 U	440 U	420 U	420 U	560 U
bis(2-Ethylhexyl)phthalate	390 U	440 U	440 U	420 U	420 U	560 U
Di-n-octyl Phthalate	390 U	440 U	440 U	420 U	420 U	560 U
Benzo(b)fluoranthene	390 U	440 U	440 U	420 U	420 U	560 U
Benzo(k)fluoranthene	390 U	440 U	440 U	420 U	420 U	560 U
Benzo(a)pyrene	390 U	440 U	440 U	420 U	420 U	560 U
Indeno(1,2,3-cd)pyrene	390 U	440 U	440 U	420 U	420 U	560 U
Dibenzo(a,h)anthracene	390 U	440 U	440 U	420 U	420 U	560 U
Benzo(g,h,i)perylene	390 U	440 U	440 U	420 U	420 U	560 U

Notes
( ) Denotes Sample Reanalysis

Qualifiers
U Undetected
J Estimated, Value is below Detection Limit

Laboratory; Hittman Ebasco

SOIL SAMPLE RESULTS FOR THE SPACE POWER FACILITY

SAMPLE IDENTIFICATION	SP-SB01	SP-SB02	SP-SB03	SP-SB04	SP-SB05	SP-SB06
Sample Type	Composite	Composite	Composite	Composite	Composite	Composite
Sample Depth Below Surface	0'-9.5'	0'-7'	0'-7'	0'-7'	0'-7'	0'-8'
Date Sampled	12-10-90	12-11-90	12-11-90	12-11-90	12-11-90	12-12-90
PESTICIDE/PCBs (ug/Kg)	SP-SB01	SP-SB02	SP-SB03	SP-SB04	SP-SB05	SP-SB06
Alpha-BHC	9.0 U	10.0 U	10.0 U	9.7 U	9.6 U	13.0 U
Beta-BHC	9.0 U	10.0 U	10.0 U	9.7 U	9.6 U	13.0 U
Delta-BHC	9.0 U	10.0 U	10.0 U	9.7 U	9.6 U	13.0 U
Gamma-BHC(Lindane)	9.0 U	10.0 U	10.0 U	9.7 U	9.6 U	13.0 U
Heptachlor	9.0 U	10.0 U	10.0 U	9.7 U	9.6 U	13.0 U
Aldrin	9.0 U	10.0 U	10.0 U	9.7 U	9.6 U	13.0 U
Heptachlor Epoxide	9.0 U	10.0 U	10.0 U	9.7 U	9.6 U	13.0 U
Endosulfan I	9.0 U	10.0 U	10.0 U	9.7 U	9.6 U	13.0 U
Dieldrin	18.0 U	20.0 U	20.0 U	19.0 U	19.0 U	25.0 U
4,4-DDE	18.0 U	20.0 U	20.0 U	19.0 U	19.0 U	25.0 U
Endrin	18.0 U	20.0 U	20.0 U	19.0 U	19.0 U	25.0 U
Endosulfan II	18.0 U	20.0 U	20.0 U	19.0 U	19.0 U	25.0 U
4,4-DDD	18.0 U	20.0 U	20.0 U	19.0 U	19.0 U	25.0 U
Endosulfan Sulfate	18.0 U	55.0 B	25.0 B	23.0 B	20.0 B	25.0 U
4,4-DDT	18.0 U	20.0 U	20.0 U	19.0 U	19.0 U	25.0 U
Methoxychlor	90.0 U	100.0 U	100.0 U	97.0 U	96.0 U	130.0 U
Endrin Ketone	18.0 U	20.0 U	20.0 U	19.0 U	19.0 U	25.0 U
Chlordane	90.0 U	100.0 U	100.0 U	97.0 U	96.0 U	130.0 U
Toxaphene	180.0 U	200.0 U	200.0 U	190.0 U	190.0 U	250.0 U
Aroclor-1016	90.0 U	100.0 U	100.0 U	97.0 U	96.0 U	130.0 U
Aroclor-1221	90.0 U	100.0 U	100.0 U	97.0 U	96.0 U	130.0 U
Aroclor-1232	90.0 U	100.0 U	100.0 U	97.0 U	96.0 U	130.0 U
Aroclor-1242	90.0 U	100.0 U	100.0 U	97.0 U	96.0 U	130.0 U
Aroclor-1248	90.0 U	100.0 U	100.0 U	97.0 U	96.0 U	130.0 U
Aroclor-1254	180.0 U	200.0 U	200.0 U	190.0 U	190.0 U	250.0 U
Aroclor-1260	180.0 U	200.0 U	200.0 U	190.0 U	190.0 U	250.0 U

Qualifiers
U Undetected
B Analyte found in associated blank

SOIL SAMPLE RESULTS FOR THE SPACE POWER FACILITY

SAMPLE IDENTIFICATION	SP-SB01	SP-SB02	SP-SB03	SP-SB04	SP-SB05	SP-SB06
Sample Type	Composite	Composite	Composite	Composite	Composite	Composite
Sample Depth Below Surface	0'-9.5'	0'-7'	0'-7'	0'-7'	0'-7'	0'-8'
Date Sampled	12-10-90	12-11-90	12-11-90	12-11-90	12-11-90	12-12-90
METALS/CYANIDE/TPH (mg/Kg)	SP-SB01	SP-SB02	SP-SB03	SP-SB04	SP-SB05	SP-SB06
Aluminum	10700.00	9920.00	12700.00	8210.00	6760.00	11500.00
Antimony	1.70 U	2.00 U	1.90 U	2.00 U	2.00 U	1.80 U
Arsenic	5.60	22.00	16.00	9.40	37.00	13.00
Barium	67.00	84.00	155.00	219.00	49.00	94.00
Beryllium	0.45	0.50	1.00	0.80	1.30	0.70
Cadmium	3.20	1.30 U	2.50	2.70	4.30	1.40
Calcium	15700.00	2180.00	4670.00	2740.00	1540.00	3570.00
Chromium	21.00	18.00	16.00	17.00	18.00	17.00
Cobalt	12.00	4.90	33.00	104.00	5.60	15.00
Copper	23.00	25.00	25.00	42.00	50.00	26.00
Iron	24600.00	21000.00	42200.00	43400.00	69700.00	31000.00
Lead	7.50	24.00	8.60	9.70	22.00	13.00
Magnesium	6030.00	3510.00	2980.00	2880.00	1460.00	3020.00
Manganese	302.00	143.00	1140.00	2530.00	49.00	292.00
Mercury	0.11 U	0.10 U	1.10	6.80	0.20	0.10
Nickel	31.00	32.00	50.00	71.00	33.00	41.00
Potassium	1930.00	888.00	955.00	617.00	760.00	1110.00
Selenium	0.74 U	1.00	0.80 U	0.80 U	1.50	0.80 U
Silver	0.56 U	0.70 U	0.70 U	0.70 U	0.70 U	0.70 U
Sodium	205.00	234.00	508.00	247.00	360.00	103.00
Thallium	0.79	1.10	0.80 U	0.90 U	1.40	0.90 U
Vanadium	22.00	22.00	27.00	19.00	30.00	20.00
Zinc	76.00	77.00	117.00	82.00	170.00	89.00
CYANIDE	1.10 U	1.20 U	1.20 U	1.20 U	1.20 U	1.20 U
TOTAL PETROLEUM HYDROCARBONS (TPH)	44.00	35.00 U	35.00 U	35.00	36.00 U	288.00

Qualifiers
U Undetected

Laboratory; Hillman Ebasco

SAMPLE IDENTIFICATION	PBS-SP-GW-01	PBS-SP-GW-06
Date Sampled	1-16-91	1-16-91
VOLATILE ORGANIC COMPOUNDS (ug/L)	PBS-SP-GW-01	PBS-SP-GW-06
Chloromethane	10 U	10 U
Bromomethane	10 U	10 U
Vinyl Chloride	10 U	10 U
Chloroethane	10 U	10 U
Methylene Chloride	5 U	5 U
Acetone	10 U	10 U
Carbon Disulfide	5 U	5 U
1,1-Dichloroethene	5 U	5 U
1,1-Dichloroethane	5 U	5 U
1,2-Dichloroethene (Total)	5 U	5 U
Chloroform	5 U	5 U
1,2-Dichloroethane	5 U	5 U
2-Butanone	10 U	10 U
1,1,1-Trichloroethane	5 U	5 U
Carbon Tetrachloride	5 U	5 U
Vinyl Acetate	10 U	10 U
Bromodichloromethane	5 U	5 U
1,2-Dichloropropane	5 U	5 U
cis-1,3-Dichloropropene	5 U	5 U
Trichloroethene	5 U	5 U
Dibromochloromethane	5 U	5 U
1,1,2-Trichloroethane	5 U	5 U
Benzene	5 U	5 U
trans-1,3-Dichloropropene	5 U	5 U
Bromoform	5 U	5 U
4-Methyl-2-Pentanone	10 U	10 U
2-Hexanone	10 U	10 U
Tetrachloroethene	5 U	5 U
1,1,2,2-Tetrachloroethane	5 U	5 U
Toluene	5 U	5 U
Chlorobenzene	5 U	5 U
Ethylbenzene	5 U	5 U
Styrene	5 U	5 U
Xylenes (Total)	5 U	5 U

Qualifiers
U Undetected

Laboratory; Hittman Ebasco

SAMPLE IDENTIFICATION	PBS-SP-GW-01	PBS-SP-GW-06
Date Sampled	1-16-91	1-16-91
SEMIVOLATILE ORGANIC COMPOUNDS (ug/L)	PBS-SP-GW-01	PBS-SP-GW-06
Phenol	10 U	10 U
bis(-2-Chloroethyl) Ether	10 U	10 U
2-Chlorophenol	10 U	10 U
1,3-Dichlorobenzene	10 U	10 U
1,4-Dichlorobenzene	10 U	10 U
Benzyl alcohol	10 U	10 U
1,2-Dichlorobenzene	10 U	10 U
2-Methylphenol	10 U	10 U
bis(-2-Chloroisopropyl) Ether	10 U	10 U
4-Methylphenol	10 U	10 U
N-Nitroso-Di-n-propylamine	10 U	10 U
Hexachloroethane	10 U	10 U
Nitrobenzene	10 U	10 U
Isophorone	10 U	10 U
2-Nitrophenol	10 U	10 U
2,4-Dimethylphenol	10 U	10 U
Benzoic acid	50 U	50 U
bis(-2-Chloroethoxy) methane	10 U	10 U
2,4-Dichlorophenol	10 U	10 U
1,2,4-Trichlorobenzene	10 U	10 U
Naphthalene	10 U	10 U
4-Chloroaniline	10 U	10 U
Hexachlorobutadiene	10 U	10 U
4-Chloro-3-methylphenol	10 U	10 U
2-Methylnaphthalene	10 U	10 U
Hexachlorocyclopentadiene	10 U	10 U
2,4,6-Trichlorophenol	10 U	10 U
2,4,5-Trichlorophenol	50 U	50 U
2-Chloronaphthalene	10 U	10 U
2-Nitroaniline	50 U	50 U
Dimethyl Phthalate	10 U	10 U
Acenaphthylene	10 U	10 U
2,6-Dinitrotoluene	10 U	10 U
3-Nitroaniline	50 U	50 U
Acenaphthene	10 U	10 U
2,4-Dinitrophenol	50 U	50 U
4-Nitrophenol	50 U	50 U
Dibenzofuran	10 U	10 U
2,4-Dinitrotoluene	10 U	10 U
Diethylphthalate	10 U	10 U
4-Chlorophenyl-phenylether	10 U	10 U

Qualifiers
U Undetected

Laboratory; Hittman Ebasco

SAMPLE IDENTIFICATION	PBS-SP-GW-01	PBS-SP-GW-06
Date Sampled	1-16-91	1-16-91
SEMIVOLATILE ORGANIC COMPOUNDS (ug/L)	PBS-SP-GW-01	PBS-SP-GW-06
Fluorene	10 U	10 U
4-Nitroaniline	50 U	50 U
4,6-Dinitro-2-methylphenol	50 U	50 U
N-Nitrosodiphenylamine	10 U	10 U
4-Bromophenyl-phenylether	10 U	10 U
Hexachlorobenzene	10 U	10 U
Pentachlorophenol	50 U	50 U
Phenanthrene	10 U	10 U
Anthracene	10 U	10 U
Di-n-butylphthalate	10 U	10 U
Fluoranthene	10 U	10 U
Pyrene	10 U	10 U
Butylbenzylphthalate	10 U	10 U
3,3'-Dichlorobenzidine	10 U	10 U
Benzo(a)anthracene	10 U	10 U
Chrysene	10 U	10 U
bis(2-Ethylhexyl)phthalate	10 U	10 U
Di-n-octyl Phthalate	10 U	10 U
Benzo(b)fluoranthene	10 U	10 U
Benzo(k)fluoranthene	10 U	10 U
Benzo(a)pyrene	10 U	10 U
Indeno(1,2,3-cd)pyrene	10 U	10 U
Dibenzo(a,h)anthracene	10 U	10 U
Benzo(g,h,i)perylene	10 U	10 U

Qualifiers
U Undetected

Laboratory; Hittman Ebasco

SAMPLE IDENTIFICATION	PBS-SP-GW-01	PBS-SP-GW-06
Date Sampled	1-16-91	1-16-91
PESTICIDE/PCBs (ug/L)	PBS-SP-GW-01	PBS-SP-GW-06
Alpha-BHC	0.051 U	0.050 U
Beta-BHC	0.051 U	0.050 U
Delta-BHC	0.051 U	0.050 U
Gamma-BHC(Lindane)	0.051 U	0.050 U
Heptachlor	0.051 U	0.050 U
Aldrin	0.051 U	0.050 U
Heptachlor Epoxide	0.051 U	0.050 U
Endosulfan I	0.051 U	0.050 U
Dieldrin	0.100 U	0.100 U
4,4-DDE	0.100 U	0.100 U
Endrin	0.100 U	0.100 U
Endosulfan II	0.100 U	0.100 U
4,4-DDD	0.100 U	0.100 U
Endosulfan Sulfate	0.100 U	0.240
4,4-DDT	0.100 U	0.100 U
Methoxychlor	0.510 U	0.500 U
Endrin Ketone	0.100 U	0.100 U
Chlordane	0.510 U	0.500 U
Toxaphene	1.000 U	1.000 U
Aroclor-1016	0.510 U	0.500 U
Aroclor-1221	0.510 U	0.500 U
Aroclor-1232	0.510 U	0.500 U
Aroclor-1242	0.510 U	0.500 U
Aroclor-1248	0.510 U	0.500 U
Aroclor-1254	1.000 U	1.000 U
Aroclor-1260	1.000 U	1.000 U

Qualifiers
U Undetected

Laboratory; Hittman Ebasco

SAMPLE IDENTIFICATION	PBS-SP-GW-01	PBS-SP-GW-06
Date Sampled	1-16-91	1-16-91
METALS/CYANIDE/ (ug/L) TPH (mg/L)	PBS-SP-GW-01	PBS-SP-GW-06
Aluminum	111	97 U
Antimony	3.4 U	3.4 U
Arsenic	3 U	3 U
Barium	45	63
Beryllium	1.6 U	1.6 U
Cadmium	5 U	5 U
Calcium	180000	128000
Chromium	2.2 U	2.2 U
Cobalt	10	8.7 U
Copper	11 U	11 U
Iron	152	93
Lead	28	1.5 U
Magnesium	56600	36200
Manganese	568	1200
Mercury	0.2 U	0.2 U
Nickel	22 U	31
Potassium	4580	1860
Selenium	3.3 U	3.3 U
Silver	2.5 U	2.5 U
Sodium	32400	13600
Thallium	2.4 U	2.4 U
Vanadium	9.2 U	9.2 U
Zinc	4.6 U	14
CYANIDE	10 U	10 U
TOTAL PETROLEUM HYDROCARBONS (TPH)	1 U	1 U

Qualifiers
U Undetected

Laboratory; Hittman Ebasco

SAMPLE IDENTIFICATION	PBS-SP-SS-01	(PBS-SP-SS-01)	PBS-SP-SS-02	(PBS-SP-SS-02)
Date Sampled	1-11-91	1-11-91	1-11-91	1-11-91
VOLATILE ORGANIC COMPOUNDS (ug/Kg)	PBS-SP-SS-01	(PBS-SP-SS-01)	PBS-SP-SS-02	(PBS-SP-SS-02)
Chloromethane	14 U	14 U	14 U	14 U
Bromomethane	14 U	14 U	14 U	14 U
Vinyl Chloride	14 U	14 U	14 U	14 U
Chloroethane	14 U	14 U	14 U	14 U
Methylene Chloride	7 U	4 J	7 U	7 U
Acetone	14 U	14 U	14 U	14 U
Carbon Disulfide	7 U	7 U	7 U	7 U
1,1-Dichloroethene	7 U	7 U	7 U	7 U
1,1-Dichloroethane	7 U	7 U	7 U	7 U
1,2-Dichloroethene (Total)	7 U	7 U	7 U	7 U
Chloroform	7 U	7 U	7 U	7 U
1,2-Dichloroethane	7 U	7 U	7 U	7 U
2-Butanone	14 U	14 U	14 U	14 U
1,1,1-Trichloroethane	7 U	7 U	7 U	7 U
Carbon Tetrachloride	7 U	7 U	7 U	7 U
Vinyl Acetate	14 U	14 U	14 U	14 U
Bromodichloromethane	7 U	7 U	7 U	7 U
1,2-Dichloropropane	7 U	7 U	7 U	7 U
cis-1,3-Dichloropropene	7 U	7 U	7 U	7 U
Trichloroethene	7 U	7 U	7 U	7 U
Dibromochloromethane	7 U	7 U	7 U	7 U
1,1,2-Trichloroethane	7 U	7 U	7 U	7 U
Benzene	7 U	7 U	7 U	7 U
trans-1,3-Dichloropropene	7 U	7 U	7 U	7 U
Bromoform	7 U	7 U	7 U	7 U
4-Methyl-2-Pentanone	14 U	14 U	14 U	14 U
2-Hexanone	14 U	14 U	14 U	14 U
Tetrachloroethene	7 U	7 U	7 U	7 U
1,1,2,2-Tetrachloroethane	7 U	7 U	7 U	7 U
Toluene	7 U	7 U	7 U	7 U
Chlorobenzene	7 U	7 U	7 U	7 U
Ethylbenzene	7 U	7 U	7 U	7 U
Styrene	7 U	7 U	7 U	7 U
Xylenes (Total)	7 U	7 U	7 U	7 U

Notes
( ) Denotes Sample Reanalysis

Qualifiers
U Undetected
J Estimated, Value is below Quantitation Limit

SAMPLE IDENTIFICATION	PBS-SP-SS-01	PBS-SP-SS-02
Date Sampled	1-11-91	1-11-91
SEMIVOLATILE ORGANIC COMPOUNDS (ug/Kg)	PBS-SP-SS-01	PBS-SP-SS-02
Phenol	980 U	1000 U
bis(-2-Chloroethyl) Ether	980 U	1000 U
2-Chlorophenol	980 U	1000 U
1,3-Dichlorobenzene	980 U	1000 U
1,4-Dichlorobenzene	980 U	1000 U
Benzyl alcohol	980 U	1000 U
1,2-Dichlorobenzene	980 U	1000 U
2-Methylphenol	980 U	1000 U
bis(-2-Chloroisopropyl) Ether	980 U	1000 U
4-Methylphenol	980 U	1000 U
N-Nitroso-Di-n-propylamine	980 U	1000 U
Hexachloroethane	980 U	1000 U
Nitrobenzene	980 U	1000 U
Isophorone	980 U	1000 U
2-Nitrophenol	980 U	1000 U
2,4-Dimethylphenol	980 U	1000 U
Benzoic acid	4900 U	5200 U
bis(-2-Chloroethoxy) methane	980 U	1000 U
2,4-Dichlorophenol	980 U	1000 U
1,2,4-Trichlorobenzene	980 U	1000 U
Naphthalene	980 U	1000 U
4-Chloroaniline	980 U	1000 U
Hexachlorobutadiene	980 U	1000 U
4-Chloro-3-methylphenol	980 U	1000 U
2-Methylnaphthalene	980 U	1000 U
Hexachlorocyclopentadiene	980 U	1000 U
2,4,6-Trichlorophenol	980 U	1000 U
2,4,5-Trichlorophenol	4900 U	5200 U
2-Chloronaphthalene	980 U	1000 U
2-Nitroaniline	4900 U	5200 U
Dimethyl Phthalate	980 U	1000 U
Acenaphthylene	980 U	1000 U
2,6-Dinitrotoluene	980 U	1000 U
3-Nitroaniline	4900 U	5200 U
Acenaphthene	980 U	1000 U
2,4-Dinitrophenol	4900 U	5200 U
4-Nitrophenol	4900 U	5200 U
Dibenzofuran	980 U	1000 U
2,4-Dinitrotoluene	980 U	1000 U
Diethylphthalate	980 U	1000 U
4-Chlorophenyl-phenylether	980 U	1000 U

Qualifiers
U Undetected
J Estimated, Value is below Detection Limit

SAMPLE IDENTIFICATION Date Sampled	PBS-SP-SS-01 1-11-91	PBS-SP-SS-02 1-11-91
SEMIVOLATILE ORGANIC COMPOUNDS (ug/Kg)	PBS-SP-SS-01	PBS-SP-SS-02
Fluorene	980 U	1000 U
4-Nitroaniline	4900 U	5200 U
4,6-Dinitro-2-methylphenol	4900 U	5200 U
N-Nitrosodiphenylamine	980 U	1000 U
4-Bromophenyl-phenylether	980 U	1000 U
Hexachlorobenzene	980 U	1000 U
Pentachlorophenol	4900 U	5200 U
Phenanthrene	200 J	1000 U
Anthracene	980 U	1000 U
Di-n-butylphthalate	980 U	1000 U
Fluoranthene	890 J	1000 U
Pyrene	980	1000 U
Butylbenzylphthalate	980 U	1000 U
3,3'-Dichlorobenzidine	980 U	1000 U
Benzo(a)anthracene	490 J	1000 U
Chrysene	590 J	1000 U
bis(2-Ethylhexyl)phthalate	490 J	1000 U
Di-n-octyl Phthalate	980 U	1000 U
Benzo(b)fluoranthene	680 J	1000 U
Benzo(k)fluoranthene	890 J	1000 U
Benzo(a)pyrene	680 J	1000 U
Indeno(1,2,3-cd)pyrene	490 J	1000 U
Dibenzo(a,h)anthracene	980 U	1000 U
Benzo(g,h,i)perylene	980 U	1000 U

Qualifiers
U Undetected
J Estimated, Value is below Detection Limit

SAMPLE IDENTIFICATION	PBS-SP-SS-01	PBS-SP-SS-02
Date Sampled	1-11-91	1-11-91
PESTICIDE/PCBs (ug/Kg)	PBS-SP-SS-01	PBS-SP-SS-02
Alpha-BHC	22 U	24 U
Beta-BHC	22 U	24 U
Delta-BHC	22 U	24 U
Gamma-BHC(Lindane)	22 U	24 U
Heptachlor	22 U	24 U
Aldrin	22 U	24 U
Heptachlor Epoxide	22 U	24 U
Endosulfan I	22 U	24 U
Dieldrin	44 U	48 U
4,4-DDE	44 U	48 U
Endrin	44 U	48 U
Endosulfan II	44 U	48 U
4,4-DDD	44 U	48 U
Endosulfan Sulfate	44 U	48 U
4,4-DDT	44 U	48 U
Methoxychlor	220 U	240 U
Endrin Ketone	44 U	48 U
Chlordane	220 U	240 U
Toxaphene	440 U	480 U
Aroclor-1016	220 U	240 U
Aroclor-1221	220 U	240 U
Aroclor-1232	220 U	240 U
Aroclor-1242	220 U	240 U
Aroclor-1248	220 U	240 U
Aroclor-1254	1600	480 U
Aroclor-1260	440 U	480 U

Qualifiers
U Undetected

TABLE C-2 SEDIMENT SAMPLE RESULTS FOR THE SPACE POWER FACILITY

SAMPLE IDENTIFICATION	PBS-SP-SS-01		PBS-SP-SS-02	
Date Sampled	1-11-91		1-11-91	
METALS/CYANIDE/TPH (mg/Kg)	PBS-SP-SS-01		PBS-SP-SS-02	
Aluminum	2910		19000	
Antimony	0.9	U	2.5	U
Arsenic	4.4		25	
Barium	31		40	
Beryllium	0.4	U	1.2	U
Cadmium	1.3	U	3.6	U
Calcium	153000		27000	
Chromium	8.4		49	
Cobalt	2.9		36	
Copper	11		50	
Iron	8430		43100	
Lead	13		53	
Magnesium	41000		8970	
Manganese	251		1510	
Mercury	0.13		0.32	U
Nickel	15		71	
Potassium	497		2670	
Selenium	0.9	U	2.4	U
Silver	0.7	U	1.8	U
Sodium	249		933	
Thallium	0.7	U	1.7	U
Vanadium	2.4	U	13	
Zinc	88		217	
CYANIDE	1.3	U	3.3	U
TOTAL PETROLEUM HYDROCARBONS (TPH)	1320		127	

Qualifiers
U Undetected

EBASCO SERVICES INCORPORATED

BOREHOLE LOG

BORING NO. PBS-SP-SB-01

SHEET 1 OF 1

PROJECT: NASA PBS CORRECTIVE ACTIONS RI/FS -PHASE 1 EFFORT-

DRILLER: R. FISHER / BELASCO DRILLING

COORDINATES: N- 21936 E- 31880

TOTAL DEPTH: 9.5'

TYPE OF BORING: HOLLOW STEM AUGER

ELEVATION: 654.290

GROUND WATER LEVEL & DATE TAKEN: 650.90 MSL 1/9/91

DATE STARTED: 12-10-90

DATE COMPLETED: 12-10-90

LOGGED BY: R. T. ROLLER

DEPTH (FEET)	ELEVATION (FEET)	BLOWS 6"	SAMPLE NO. AND TYPE	PERCENT RECOVERY	DESCRIPTION	VERTICAL BOREHOLE REMARKS
		1-5-6-7	VOA Sample SP-SB-01 SP-SB-01 B/N/A, Pest./PCBs, Metals, CN and TPH composited over depth	63	Brown sandy SILT GRAVEL, some to little sand, little silt	
		3-4-4-5		83	Grey clayey SILT, mottled	
5		3-5-8-13		83	Grey clayey SILT, little pebbles, mottled	
		5-9-32-24		67	Grey silty CLAY	
		6-48-50/3		58	Grey fine SAND, little silt, some gravel, SATURATED	VOA sample taken from 8'-9.5'
10					Grey SHALE Bedrock at 9.5' End of Boring at 9.5'	
15						
20						
25						

EBASCO SERVICES INCORPORATED

BOREHOLE LOG

BORING NO. PBS-SP-SB-02

SHEET 1 OF 1

PROJECT: NASA PBS CORRECTIVE ACTIONS RI/FS -PHASE 1 EFFORT-

DRILLER: R. FISHER / BELASCO DRILLING

COORDINATES: N- 19401 E- 31524

TOTAL DEPTH: 7'

TYPE OF BORING: HOLLOW STEM AUGER

ELEVATION: 656.590 MSL

GROUND WATER LEVEL & DATE TAKEN: Not finished as a ground water monitoring well

DATE STARTED: 12-11-90

DATE COMPLETED: 12-11-90

LOGGED BY: R. T. ROLLER

DEPTH (FEET)	ELEVATION (FEET)	BLOWS 6"	SAMPLE NO. AND TYPE	PERCENT RECOVERY	DESCRIPTION	VERTICAL BOREHOLE REMARKS
		3-7-9-12		50	Brown sandy clayey SILT, mottled	
		5-5-7-9		71	1/4" Shale layers at 4'3", 5'2", 5'4"	
5		5-5-6-6		79		
		5-50/5"	VOA Sample SP-SB-02	42	Grey clayey SILT, with shale	VOA sample taken from 6'-7'
					SHALE, some clay little silt, SATURATED — Grey SHALE	
					End of Boring, Bedrock at 7'	
10						
15						
20						
25						

SP-SB-02 B/N/A, Pest./PCBs, Metals, CN and TPH composited over depth

EBASCO SERVICES INCORPORATED

BOREHOLE LOG

BORING NO. PBS-SP-SB-03

SHEET 1 OF 1

PROJECT: NASA PBS CORRECTIVE ACTIONS RI/FS -PHASE 1 EFFORT-

DRILLER: R. FISHER / BELASCO DRILLING

COORDINATES: N- 21716 E- 31172

TOTAL DEPTH: 9.5'

TYPE OF BORING: HOLLOW STEM AUGER

ELEVATION: 657.285 MSL

GROUND WATER LEVEL & DATE TAKEN: 654.58 MSL 1/10/91

DATE STARTED: 12-11-90

DATE COMPLETED: 12-11-90

LOGGED BY: R. T. ROLLER

DEPTH (FEET)	ELEVATION (FEET)	BLOWS 6"	SAMPLE NO. AND TYPE	PERCENT RECOVERY	DESCRIPTION	VERTICAL BOREHOLE REMARKS
		2-4-8-10		67	Brown sandy clayey SILT	
					Brown clayey SILT, mottled	
		7-7-8-11		71		
5		4-5-5-5		79		
		5-39-50/2"	VOA Sample SP-SB-03	50	Grey clayey SILT, with shale	VOA sample taken from 6'-7'
					Grey SHALE	Split spoon sampling completed at 7', augering continued to 9.5' to install the ground water monitoring well
10					Bedrock at 7' End of Boring at 9.5'	
15						
20						
25						

SP-SB-03 B/N/A, Pest./PCBs, Metals, CN and TPH composited over depth

EBASCO SERVICES INCORPORATED

BOREHOLE LOG

BORING NO. PBS-SP-SB-04

SHEET 1 OF 1

PROJECT: NASA PBS CORRECTIVE ACTIONS RI/FS -PHASE 1 EFFORT-

DRILLER: R. FISHER / BELASCO DRILLING

COORDINATES: N- 21483 E- 31279

TOTAL DEPTH: 9.5'

TYPE OF BORING: HOLLOW STEM AUGER

ELEVATION: 657.650 MSL

GROUND WATER LEVEL & DATE TAKEN: 652.76 MSL 1/10/91

DATE STARTED: 12-11-90

DATE COMPLETED: 12-11-90

LOGGED BY: R. T. ROLLER

DEPTH (FEET)	ELEVATION (FEET)	BLOWS 6"	SAMPLE NO. AND TYPE	PERCENT RECOVERY	DESCRIPTION	VERTICAL BOREHOLE REMARKS
		6-6-6-7	VOA Sample SP-SB-04	71	Brown clayey SILT	
		3-4-7-9		63	Grey clayey SILT, with shale	
5		3-3-5-6		67		VOA sample taken from 6'-7'
		4-7-50/4"		58	1/4" Shale lenses at 6'4", 6'8", 6'10"	SATURATED
					Grey SHALE	Split spoon sampling completed at 7', augering continued to 9.5' to install the ground water monitoring well
10					Bedrock at 7' End of Boring at 9.5'	
15						
20						
25						

SP-SB-04 B/N/A, Pest./PCBs, Metals, CN and TPH composited over depth

EBASCO SERVICES INCORPORATED

BOREHOLE LOG

BORING NO. PBS-SP-SB-05

SHEET 1 OF 1

PROJECT: NASA PBS CORRECTIVE ACTIONS RI/FS -PHASE 1 EFFORT-

DRILLER: R. FISHER / BELASCO DRILLING

COORDINATES: N- 21371 E- 31242

TOTAL DEPTH: 9.5'

TYPE OF BORING: HOLLOW STEM AUGER

ELEVATION: 656.875 MSL

GROUND WATER LEVEL & DATE TAKEN: 652.04 MSL 1/16/91

DATE STARTED: 12-11-90

DATE COMPLETED: 12-11-90

LOGGED BY: R. T. ROLLER

DEPTH (FEET)	ELEVATION (FEET)	BLOWS 6"	SAMPLE NO. AND TYPE	PERCENT RECOVERY	DESCRIPTION	VERTICAL BOREHOLE REMARKS
		1-3-4-5	VOA Sample SP-SB-05	75	Brown m-f SAND, some silt	
					Grey clayey SILT, with shale, mottled, 1/2" sand lense at 1'1"	
		5-6-7-9		83		
5		2-3-4-14		83		VOA sample taken from 4'-6'
		18-50/5"		42	Grey SHALE, some silt, little clay	SATURATED
					Grey SHALE	Split spoon sampling completed at 7', augering continued to 9.5' to install the ground water monitoring well
10					Bedrock at 7' End of Boring at 9.5'	
15						
20						
25						

SP-SB-05 B/N/A, Pest./PCBs, Metals, CN and TPH composited over depth

EBASCO SERVICES INCORPORATED

BOREHOLE LOG

BORING NO. PBS-SP-SB-06

SHEET 1 OF 1

PROJECT: NASA PBS CORRECTIVE ACTIONS RI/FS -PHASE 1 EFFORT-

DRILLER: R. FISHER / BELASCO DRILLING

COORDINATES: N. 21381 E. 31418

TOTAL DEPTH: 9'

TYPE OF BORING: HOLLOW STEM AUGER

ELEVATION: 657.700 MSL

GROUND WATER LEVEL & DATE TAKEN: 655.73 MSL 1/10/91

DATE STARTED: 12-12-90

DATE COMPLETED: 12-12-90

LOGGED BY: R. T. ROLLER

DEPTH (FEET)	ELEVATION (FEET)	BLOWS 6"	SAMPLE NO. AND TYPE	PERCENT RECOVERY	DESCRIPTION	VERTICAL BOREHOLE REMARKS
		15-20-9-12	VOA Sample SP-SB-06 SP-SB-06 B/N/A, Pest./PCBs, Metals, CN and TPH composited over depth	50	GRAVEL	
					Grey clayey SILT, mottled	
		3-3-6-8		67		
5		3-3-5-6		79		
		3-6-11-19		92	Shale lenses at 6'2", 6'10", 7', 7'4", 7'8" SATURATED	VOA sample taken from 6'-8'
		50/4"		8	Grey SHALE	Split spoon sampling completed at 8', augering continued to 9' to install the ground water monitoring well
10					Bedrock at 8' End of Boring at 9'	
15						
20						
25						

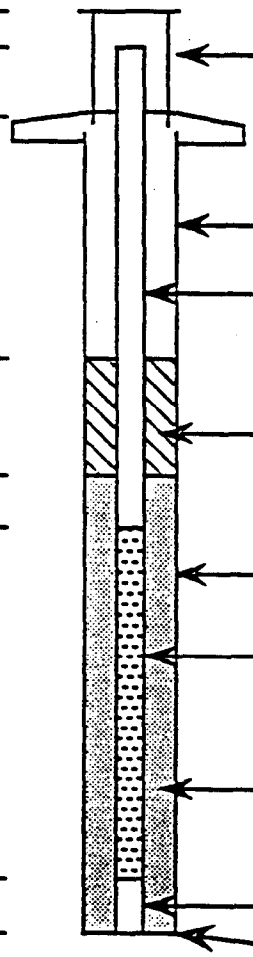
UNCONSOLIDATED MONITORING WELL INSTALLATION SKETCH

EBASCO

PROJECT NASA PBS CA-RI/FS -PHASE I EFFORT
JOB NO. WOP 2127.002
DRILLING SUBCONTRACTOR Belasco Drilling
DRILLER Rick Fisher

DRILLING METHOD Hollow Stem Auger
MONITORING WELL NUMBER PBS-SP-01
DATE OF WELL INSTALLATION 12-10-90
DATE OF WELL DEVELOPMENT 1-9-91
ENGINEER T. Roller

ELEVATION (M.S.L.)	DEPTH OR HEIGHT FROM GROUND SURFACE
657.435	3.145'
657.135	2.845'
654.290	0'
	2'
	3.25'
650	4.25'
645	9.25'
644.75	9.5'



I.D. OF SURFACE CASING	4"
TYPE OF SURFACE SEAL	Concrete
I.D. OF RISER PIPE	2"
TYPE OF RISER PIPE	304 Stainles
TYPE OF SEAL	Bentonite
EMPLACEMENT METHOD	Poured
DIAMETER OF BOREHOLE	4.25"
I.D. OF SCREEN	2"
TYPE OF SCREEN	304 Stainless St.
SCREEN SLOT SIZE	0.01"
SIZE OF FILTER SAND	#5 Medium Blast
EMPLACEMENT METHOD	Poured
LENGTH OF TAILPIPE	3"
BOTTOM OF BORING	

WATER LEVEL MEASUREMENTS

DATE	1-9-91	5-9-91								
DEPTH FROM TOP OF OUTER PROTECTIVE CASING	6.24	6.51								
ELEVATION	650.90	650.63								

UNCONSOLIDATED MONITORING WELL INSTALLATION SKETCH

EBASCO

PROJECT NASA PBS CA-RI/FS -PHASE I EFFORT

JOB NO. WOP 2127.002

DRILLING SUBCONTRACTOR Belasco Drilling

DRILLER Rick Fisher

DRILLING METHOD Hollow Stem Auger

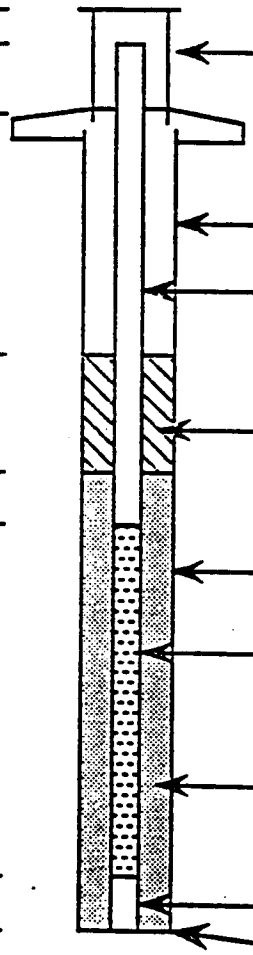
MONITORING WELL NUMBER PBS-SP-03

DATE OF WELL INSTALLATION 12-11-90

DATE OF WELL DEVELOPMENT 1-10-91

ENGINEER T. Roller

ELEVATION (M.S.L.)	DEPTH OR HEIGHT FROM GROUND SURFACE
660.015	2.73'
659.845	2.56'
657.285	0'
	2.25'
	3.25'
653	4.25'
648	9.25'
647.8	9.5'



I.D. OF SURFACE CASING	4"
TYPE OF SURFACE SEAL	Concrete
I.D. OF RISER PIPE	2"
TYPE OF RISER PIPE	304 Stainless St.
TYPE OF SEAL	Bentonite
EMPLACEMENT METHOD	Poured
DIAMETER OF BOREHOLE	4.25"
I.D. OF SCREEN	2"
TYPE OF SCREEN	304 Stainless St.
SCREEN SLOT SIZE	0.01"
SIZE OF FILTER SAND	#5 Medium Blast
EMPLACEMENT METHOD	Poured
LENGTH OF TAILPIPE	3"
BOTTOM OF BORING	

WATER LEVEL MEASUREMENTS

DATE	1-10-91	5-9-91								
DEPTH FROM TOP OF OUTER PROTECTIVE CASING	5.27	6.12								
ELEVATION	654.58	653.73								

UNCONSOLIDATED MONITORING WELL INSTALLATION SKETCH

EBASCO

PROJECT NASA PBS CA-RI/FS -PHASE I EFFORT

JOB NO. WOP 2127.002

DRILLING SUBCONTRACTOR Belasco Drilling

DRILLER Rick Fisher

DRILLING METHOD Hollow Stem Auger

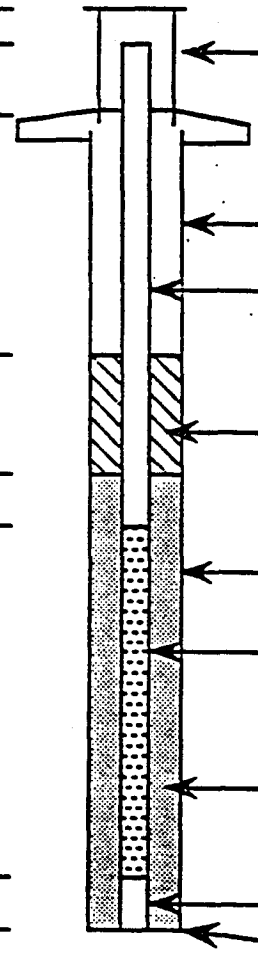
MONITORING WELL NUMBER PBS-SP-04

DATE OF WELL INSTALLATION 12-11-90

DATE OF WELL DEVELOPMENT 1-10-91

ENGINEER T. Roller

ELEVATION (M.S.L.)	DEPTH OR HEIGHT FROM GROUND SURFACE	
660.295	2.645'	
660.170	2.52'	I.D. OF SURFACE CASING: 4"
657.650	0'	
		TYPE OF SURFACE SEAL: Concrete
		I.D. OF RISER PIPE: 2"
	2.25'	TYPE OF RISER PIPE: 304 Stainle
		TYPE OF SEAL: Bentonite
	3.25'	EMPLACEMENT METHOD: Poured
653.4	4.25'	
		DIAMETER OF BOREHOLE: 4.25"
		I.D. OF SCREEN: 2"
		TYPE OF SCREEN: 304 Stainless St.
		SCREEN SLOT SIZE: 0.01"
		SIZE OF FILTER SAND: #5 Medium Blast
		EMPLACEMENT METHOD: Poured
648.4	9.25'	
648.15	9.5'	LENGTH OF TAILPIPE: 3"
		BOTTOM OF BORING



WATER LEVEL MEASUREMENTS

DATE	1-10-91	5-9-91								
DEPTH FROM TOP OF OUTER PROTECTIVE CASING	7.41	7.32								
ELEVATION	652.76	652.85								

UNCONSOLIDATED MONITORING WELL INSTALLATION SKETCH

EBASCO

PROJECT NASA PBS CA-RI/FS -PHASE I EFFORT

JOB NO. WOP 2127.002

DRILLING SUBCONTRACTOR Belasco Drilling

DRILLER Rick Fisher

DRILLING METHOD Hollow Stem Auger

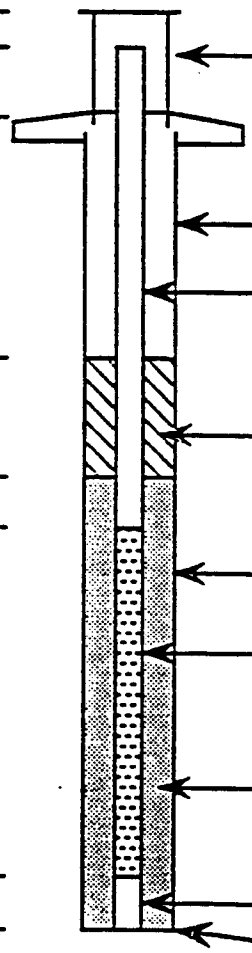
MONITORING WELL NUMBER PBS-SP-05

DATE OF WELL INSTALLATION 12-11-90

DATE OF WELL DEVELOPMENT 1-16-91

ENGINEER T. Roller

ELEVATION (M.S.L.)	DEPTH OR HEIGHT FROM GROUND SURFACE
659.360	2.485'
659.175	2.3'
656.875	0'
	2.25'
	3.25'
652.6	4.25'
647.6	9.25'
647.4	9.5'



I.D. OF SURFACE CASING	4"
TYPE OF SURFACE SEAL	Concrete
I.D. OF RISER PIPE	2"
TYPE OF RISER PIPE	304 Stainless St.
TYPE OF SEAL	Bentonite
EMPLACEMENT METHOD	Poured
DIAMETER OF BOREHOLE	4.25"
I.D. OF SCREEN	2"
TYPE OF SCREEN	304 Stainless St.
SCREEN SLOT SIZE	0.01"
SIZE OF FILTER SAND	#5 Medium Blast
EMPLACEMENT METHOD	Poured
LENGTH OF TAILPIPE	3"
BOTTOM OF BORING	

WATER LEVEL MEASUREMENTS

DATE	1-16-91	5-9-91								
DEPTH FROM TOP OF OUTER PROTECTIVE CASING	7.14	5.82								
ELEVATION	652.04	653.35								

UNCONSOLIDATED MONITORING WELL INSTALLATION SKETCH

EBASCO

PROJECT NASA PBS CA-RI/FS -PHASE I EFFORT

JOB NO. WOP 2127.002

DRILLING SUBCONTRACTOR Belasco Drilling

DRILLER Rick Fisher

DRILLING METHOD Hollow Stem Auger

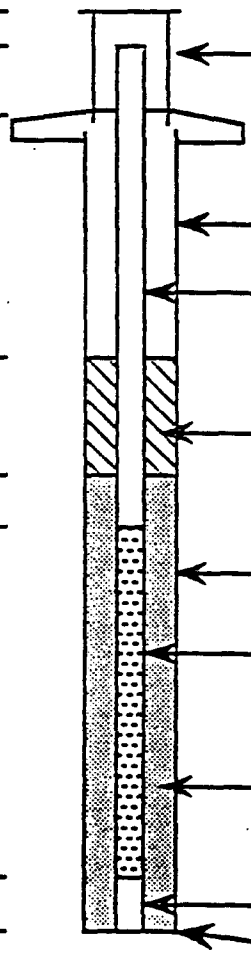
MONITORING WELL NUMBER PBS-SP-06

DATE OF WELL INSTALLATION 12-12-90

DATE OF WELL DEVELOPMENT 1-10-91

ENGINEER T. Roller

ELEVATION (M.S.L.)	DEPTH OR HEIGHT FROM GROUND SURFACE
660.755	2.485'
660.400	2.3'
657.700	0'
	2'
	3'
654	3.75'
649	8.75'
648.7	9'



I.D. OF SURFACE CASING	4"
TYPE OF SURFACE SEAL	Concrete
I.D. OF RISER PIPE	2"
TYPE OF RISER PIPE	304 Stainless
TYPE OF SEAL	Bentonite
EMPLACEMENT METHOD	Poured
DIAMETER OF BOREHOLE	4.25"
I.D. OF SCREEN	2"
TYPE OF SCREEN	304 Stainless St.
SCREEN SLOT SIZE	0.01"
SIZE OF FILTER SAND	#5 Medium Blast
EMPLACEMENT METHOD	Poured
LENGTH OF TAILPIPE	3"
BOTTOM OF BORING	

WATER LEVEL MEASUREMENTS

DATE	1-10-91	5-9-91								
DEPTH FROM TOP OF OUTER PROTECTIVE CASING	4.67	7.13								
ELEVATION	655.73	653.27								

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01283
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PHASE II UST STUDY
SPF B-1 4-6'
4/22/93 1325

analysis: GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

procedure: The sample was analyzed as outlined in US EPA "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", SW-846, Third Edition, November 1986, Method 8240.

results:

COMPOUND	METHOD PQL (µg/Kg)	RESULT (µg/Kg)
Acrolein	50	< 50
Acrylonitrile	50	< 50
Acetone	50	< 50
Benzene	5	< 5
Bromodichloromethane	5	< 5
Bromoform	5	< 5
Bromomethane	5	< 5
2-Butanone (MEK)	50	< 50
Carbon disulfide	5	< 5
Carbon tetrachloride	5	< 5
Chlorobenzene	5	< 5
Chlorodibromomethane	5	< 5
Chloroethane	10	< 10
2-Chloroethyl vinyl ether	10	< 10
Chloroform	5	< 5
Chloromethane	5	< 5
1,2-Dibromoethane (EDB)	5	< 5
Dibromomethane	5	< 5
1,2-Dichlorobenzene	5	< 5
1,3-Dichlorobenzene	5	< 5
1,4-Dichlorobenzene	5	< 5
1,4-Dichloro-2-butene	10	< 10
Dichlorodifluoromethane	5	< 5
1,1-Dichloroethane	5	< 5
1,2-Dichloroethane	5	< 5
1,1-Dichloroethene	5	< 5
cis-1,2-Dichloroethene	5	< 5
trans-1,2-Dichloroethene	5	< 5
1,2-Dichloropropane	5	< 5
cis-1,3-Dichloropropene	5	< 5

date completed	tech:	approved by:
5/1/93	LNT	[signature]

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01283
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PHASE II UST STUDY
SPF B-1 4-6'
4/22/93 1325

analysis: GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

results: Continued

COMPOUND	METHOD PQL (µg/Kg)	RESULT (µg/Kg)
trans-1,3-Dichloropropene	5	< 5
Ethyl acetate	10	< 10
Ethyl benzene	5	< 5
Ethyl ether	10	< 10
Ethyl methacrylate	5	< 5
2-Hexanone	10	< 10
Methylene chloride	5	< 5
Methyl iodide	5	< 5
4-Methyl-2-pentanone (MIBK)	50	< 50
Naphthalene	5	< 5
Styrene	5	< 5
1,1,1,2-Tetrachloroethane	5	< 5
1,1,2,2-Tetrachloroethane	5	< 5
Tetrachloroethene	5	< 5
Tetrahydrofuran	10	< 10
Toluene	5	< 5
1,1,1-Trichloroethane	5	< 5
1,1,2-Trichloroethane	5	< 5
Trichloroethene	5	< 5
Trichlorofluoromethane	5	< 5
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	5	< 5
1,2,3-Trichloropropane	5	< 5
Vinyl acetate	10	< 10
Vinyl chloride	5	< 5
m & p-Xylenes	5	< 5
o-Xylenes	5	< 5

date completed	tech.	approved by:
5/1/93	LNT	Edward Friesel

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307

1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01283
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PHASE II UST STUDY
SPF B-1 4-6'
4/22/93 1325

analysis: GAS CHROMOTOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

results: continued

Surrogate Recovery - Volatile Organics

Compound	% Recovery	Acceptable Range
1,2-Dichloroethane-d4	101%	70-121
Toluene-d8	87.0%	81-117
4-Bromofluorobenzene	85.2%	74-121

1) A value reported as "less than" indicates the analyte was not detected. The number is the quantification limit for the sample.

2) A value in parenthesis following a "less than" value indicates the analyte was detectable but below the limit of quantification. The value is an estimate only.

date completed	tech	approved by:
5/1/93	LNT	

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01284
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PHASE II UST STUDY
SPF B-1 6-8'
4/22/93 1325

analysis: GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

procedure: The sample was analyzed as outlined in US EPA "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", SW-846, Third Edition, November 1986, Method 8240.

results:

COMPOUND	METHOD PQL (µg/Kg)	RESULT (µg/Kg)
Acrolein	50	< 50
Acrylonitrile	50	< 50
Acetone	50	< 50
Benzene	5	< 5
Bromodichloromethane	5	< 5
Bromoform	5	< 5
Bromomethane	5	< 5
2-Butanone (MEK)	50	< 50
Carbon disulfide	5	< 5
Carbon tetrachloride	5	< 5
Chlorobenzene	5	< 5
Chlorodibromomethane	5	< 5
Chloroethane	10	< 10
2-Chloroethyl vinyl ether	10	< 10
Chloroform	5	< 5
Chloromethane	5	< 5
1,2-Dibromoethane (EDB)	5	< 5
Dibromomethane	5	< 5
1,2-Dichlorobenzene	5	< 5
1,3-Dichlorobenzene	5	< 5
1,4-Dichlorobenzene	5	< 5
1,4-Dichloro-2-butene	10	< 10
Dichlorodifluoromethane	5	< 5
1,1-Dichloroethane	5	< 5
1,2-Dichloroethane	5	< 5
1,1-Dichloroethene	5	< 5
cis-1,2-Dichloroethene	5	< 5
trans-1,2-Dichloroethene	5	< 5
1,2-Dichloropropane	5	< 5
cis-1,3-Dichloropropene	5	< 5

date completed	tech	approved by:
4/30/93	LNT	Edward Kraus

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01284
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PHASE II UST STUDY
SPF B-1 6-8'
4/22/93 1325

analysis: GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

results: Continued

COMPOUND	METHOD PQL (µg/Kg)	RESULT (µg/Kg)
trans-1,3-Dichloropropene	5	< 5
Ethyl acetate	10	< 10
Ethyl benzene	5	< 5
Ethyl ether	10	< 10
Ethyl methacrylate	5	< 5
2-Hexanone	10	< 10
Methylene chloride	5	< 5
Methyl iodide	5	< 5
4-Methyl-2-pentanone (MIBK)	50	< 50
Naphthalene	5	< 5
Styrene	5	< 5
1,1,1,2-Tetrachloroethane	5	< 5
1,1,2,2-Tetrachloroethane	5	< 5
Tetrachloroethene	5	< 5
Tetrahydrofuran	10	< 10
Toluene	5	< 5
1,1,1-Trichloroethane	5	< 5
1,1,2-Trichloroethane	5	< 5
Trichloroethene	5	< 5
Trichlorofluoromethane	5	< 5
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	5	< 5
1,2,3-Trichloropropane	5	< 5
Vinyl acetate	10	< 10
Vinyl chloride	5	< 5
m & p-Xylenes	5	< 5
o-Xylenes	5	< 5

date completed	tech	approved by
4/30/93	LNT	Edward Shiner

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01284
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PHASE II UST STUDY
SPF B-1 6-8'
4/22/93 1325

analysis: GAS CHROMOTOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

results: continued

Surrogate Recovery - Volatile Organics

Compound	% Recovery	Acceptable Range
1,2-Dichloroethane-d4	100%	70-121
Toluene-d8	92.7%	81-117
4-Bromofluorobenzene	91.3%	74-121

1) A value reported as "less than" indicates the analyte was not detected. The number is the quantification limit for the sample.

2) A value in parenthesis following a "less than" value indicates the analyte was detectable but below the limit of quantification. The value is an estimate only.

date completed	tech	approved by:
4/30/93	LNT	Edward Heinz

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01285
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PHASE II UST STUDY
SPF B-2 0-2'
4/22/93 1400

analysis: GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

procedure: The sample was analyzed as outlined in US EPA "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", SW-846, Third Edition, November 1986, Method 8240.

results:

COMPOUND	METHOD PQL (µg/Kg)	RESULT (µg/Kg)
Acrolein	50	< 50
Acrylonitrile	50	< 50
Acetone	50	< 50
Benzene	5	< 5
Bromodichloromethane	5	< 5
Bromoform	5	< 5
Bromomethane	5	< 5
2-Butanone (MEK)	50	< 50
Carbon disulfide	5	< 5
Carbon tetrachloride	5	< 5
Chlorobenzene	5	< 5
Chlorodibromomethane	5	< 5
Chloroethane	10	< 10
2-Chloroethyl vinyl ether	10	< 10
Chloroform	5	< 5
Chloromethane	5	< 5
1,2-Dibromoethane (EDB)	5	< 5
Dibromomethane	5	< 5
1,2-Dichlorobenzene	5	< 5
1,3-Dichlorobenzene	5	< 5
1,4-Dichlorobenzene	5	< 5
1,4-Dichloro-2-butene	10	< 10
Dichlorodifluoromethane	5	< 5
1,1-Dichloroethane	5	< 5
1,2-Dichloroethane	5	< 5
1,1-Dichloroethene	5	< 5
cis-1,2-Dichloroethene	5	< 5
trans-1,2-Dichloroethene	5	< 5
1,2-Dichloropropane	5	< 5
cis-1,3-Dichloropropene	5	< 5

date completed: 4/30/93
tech: LNT
approved by: Edward Hurst

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01285
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PHASE II UST STUDY
SPF B-2 0-2'
4/22/93 1400

analysis: GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

results: Continued

COMPOUND	METHOD PQL (µg/Kg)	RESULT (µg/Kg)
trans-1,3-Dichloropropene	5	< 5
Ethyl acetate	10	< 10
Ethyl benzene	5	< 5
Ethyl ether	10	< 10
Ethyl methacrylate	5	< 5
2-Hexanone	10	< 10
Methylene chloride	5	< 5
Methyl iodide	5	< 5
4-Methyl-2-pentanone (MIBK)	50	< 50
Naphthalene	5	< 5
Styrene	5	< 5
1,1,1,2-Tetrachloroethane	5	< 5
1,1,2,2-Tetrachloroethane	5	< 5
Tetrachloroethene	5	< 5
Tetrahydrofuran	10	< 10
Toluene	5	< 5
1,1,1-Trichloroethane	5	< 5
1,1,2-Trichloroethane	5	< 5
Trichloroethene	5	< 5
Trichlorofluoromethane	5	< 5
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	5	< 5
1,2,3-Trichloropropane	5	< 5
Vinyl acetate	10	< 10
Vinyl chloride	5	< 5
m & p-Xylenes	5	< 5
o-Xylenes	5	< 5

date completed	tech	approved by
4/30/93	LNT	[signature]

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307

1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01285
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PHASE II UST STUDY
SPF B-2 0-2'
4/22/93 1400

analysis: GAS CHROMOTOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

results: continued

Surrogate Recovery - Volatile Organics

Compound	% Recovery	Acceptable Range
1,2-Dichloroethane-d4	99.4%	70-121
Toluene-d8	93.9%	81-117
4-Bromofluorobenzene	95.2%	74-121

1) A value reported as "less than" indicates the analyte was not detected. The number is the quantification limit for the sample.

2) A value in parenthesis following a "less than" value indicates the analyte was detectable but below the limit of quantification. The value is an estimate only.

date completed	tech	approved by:
4/30/93	LNT	Edward Kleier

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01286
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PHASE II UST STUDY
SPF B-2 2'-4'
4/22/93 1400

analysis: GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

procedure: The sample was analyzed as outlined in US EPA "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", SW-846, Third Edition, November 1986, Method 8240.

results:

COMPOUND	METHOD PQL (µg/Kg)	RESULT (µg/Kg)
Acrolein	50	< 50
Acrylonitrile	50	< 50
Acetone	50	< 50
Benzene	5	< 5
Bromodichloromethane	5	< 5
Bromoform	5	< 5
Bromomethane	5	< 5
2-Butanone (MEK)	50	< 50
Carbon disulfide	5	< 5
Carbon tetrachloride	5	< 5
Chlorobenzene	5	< 5
Chlorodibromomethane	5	< 5
Chloroethane	10	< 10
2-Chloroethyl vinyl ether	10	< 10
Chloroform	5	< 5
Chloromethane	5	< 5
1,2-Dibromoethane (EDB)	5	< 5
Dibromomethane	5	< 5
1,2-Dichlorobenzene	5	< 5
1,3-Dichlorobenzene	5	< 5
1,4-Dichlorobenzene	5	< 5
1,4-Dichloro-2-butene	10	< 10
Dichlorodifluoromethane	5	< 5
1,1-Dichloroethane	5	< 5
1,2-Dichloroethane	5	< 5
1,1-Dichloroethene	5	< 5
cis-1,2-Dichloroethene	5	< 5
trans-1,2-Dichloroethene	5	< 5
1,2-Dichloropropane	5	< 5
cis-1,3-Dichloropropene	5	< 5

date completed	tech	approved by
5/3/93	LNT	Edward Hurst

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01286
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PHASE II UST STUDY
SPF B-2 2'-4'
4/22/93 1400

analysis: GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

results: Continued

COMPOUND	METHOD PQL (µg/Kg)	RESULT (µg/Kg)
trans-1,3-Dichloropropene	5	< 5
Ethyl acetate	10	< 10
Ethyl benzene	5	< 5
Ethyl ether	10	< 10
Ethyl methacrylate	5	< 5
2-Hexanone	10	< 10
Methylene chloride	5	< 5
Methyl iodide	5	< 5
4-Methyl-2-pentanone (MIBK)	50	< 50
Naphthalene	5	< 5
Styrene	5	< 5
1,1,1,2-Tetrachloroethane	5	< 5
1,1,2,2-Tetrachloroethane	5	< 5
Tetrachloroethene	5	< 5
Tetrahydrofuran	10	< 10
Toluene	5	< 5
1,1,1-Trichloroethane	5	< 5
1,1,2-Trichloroethane	5	< 5
Trichloroethene	5	< 5
Trichlorofluoromethane	5	< 5
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	5	< 5
1,2,3-Trichloropropane	5	< 5
Vinyl acetate	10	< 10
Vinyl chloride	5	< 5
m & p-Xylenes	5	< 5
o-Xylenes	5	< 5

date completed	tech	approved by:
5/3/93	LNT	Edward Shiers

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307

1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01286
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PHASE II UST STUDY
SPF B-2 2'-4'
4/22/93 1400

analysis: GAS CHROMOTOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

results: continued

Surrogate Recovery - Volatile Organics

Compound	% Recovery	Acceptable Range
1,2-Dichloroethane-d4	110%	70-121
Toluene-d8	92.5%	81-117
4-Bromofluorobenzene	96.2%	74-121

1) A value reported as "less than" indicates the analyte was not detected. The number is the quantification limit for the sample.

2) A value in parenthesis following a "less than" value indicates the analyte was detectable but below the limit of quantification. The value is an estimate only.

date completed: 5/3/93 | tech: LNT | approved by: Edward Kiesot

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01446
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PHASE II UST STUDY **10% DUP**
SPF B-2 2'-4' DUPLICATE OF 93C01286
4/22/93 1400

analysis: GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

procedure: The sample was analyzed as outlined in US EPA "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", SW-846, Third Edition, November 1986, Method 8240.

results:

COMPOUND	METHOD PQL (µg/Kg)	RESULT (µg/Kg)
Acrolein	50	< 50
Acrylonitrile	50	< 50
Acetone	50	< 50
Benzene	5	< 5
Bromodichloromethane	5	< 5
Bromoform	5	< 5
Bromomethane	5	< 5
2-Butanone (MEK)	50	< 50
Carbon disulfide	5	< 5
Carbon tetrachloride	5	< 5
Chlorobenzene	5	< 5
Chlorodibromomethane	5	< 5
Chloroethane	10	< 10
2-Chloroethyl vinyl ether	10	< 10
Chloroform	5	< 5
Chloromethane	5	< 5
1,2-Dibromoethane (EDB)	5	< 5
Dibromomethane	5	< 5
1,2-Dichlorobenzene	5	< 5
1,3-Dichlorobenzene	5	< 5
1,4-Dichlorobenzene	5	< 5
1,4-Dichloro-2-butene	10	< 10
Dichlorodifluoromethane	5	< 5
1,1-Dichloroethane	5	< 5
1,2-Dichloroethane	5	< 5
1,1-Dichloroethene	5	< 5
cis-1,2-Dichloroethene	5	< 5
trans-1,2-Dichloroethene	5	< 5
1,2-Dichloropropane	5	< 5
cis-1,3-Dichloropropene	5	< 5

reporting date	tech	approved by:
5/4/93	LNT	[signature]

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01446
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PHASE II UST STUDY **10% DUP.**
SPF B-2 2'-4' DUPLICATE OF 93C01286
4/22/93 1400

analysis: GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

results: Continued

COMPOUND	METHOD PQL (µg/Kg)	RESULT (µg/Kg)
trans-1,3-Dichloropropene	5	< 5
Ethyl acetate	10	< 10
Ethyl benzene	5	< 5
Ethyl ether	10	< 10
Ethyl methacrylate	5	< 5
2-Hexanone	10	< 10
Methylene chloride	5	< 5
Methyl iodide	5	< 5
4-Methyl-2-pentanone (MIBK)	50	< 50
Naphthalene	5	< 5
Styrene	5	< 5
1,1,1,2-Tetrachloroethane	5	< 5
1,1,2,2-Tetrachloroethane	5	< 5
Tetrachloroethene	5	< 5
Tetrahydrofuran	10	< 10
Toluene	5	< 5
1,1,1-Trichloroethane	5	< 5
1,1,2-Trichloroethane	5	< 5
Trichloroethene	5	< 5
Trichlorofluoromethane	5	< 5
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	5	< 5
1,2,3-Trichloropropane	5	< 5
Vinyl acetate	10	< 10
Vinyl chloride	5	< 5
m & p-Xylenes	5	< 5
o-Xylenes	5	< 5

date completed	tech	approved by
5/4/93	LNT	Edward Hiniet

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307

1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01446
p.o. no. 2F2-4065-2435

sample 4065-6105-006 PHASE II UST STUDY **10% DUP.**
description: SPF B-2 2'-4' DUPLICATE OF 93C01286
4/22/93 1400

analysis: GAS CHROMOTOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

esults: continued

Surrogate Recovery - Volatile Organics

Compound	% Recovery	Acceptable Range
1,2-Dichloroethane-d4	113%	70-121
Toluene-d8	94.8%	81-117
4-Bromofluorobenzene	101%	74-121

1) A value reported as "less than" indicates the analyte was not detected. The number is the quantification limit for the sample.

2) A value in parenthesis following a "less than" value indicates the analyte was detectable but below the limit of quantification. The value is an estimate only.

completed	tech	approved by
5/4/93	LNT	[signature]

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01287
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PHASE II UST STUDY
SPF B-2 6-8'
4/22/93 1410

analysis: GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

procedure: The sample was analyzed as outlined in US EPA "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", SW-846, Third Edition, November 1986, Method 8240.

results:

COMPOUND	METHOD PQL (µg/Kg)	RESULT (µg/Kg)
Acrolein	50	< 50
Acrylonitrile	50	< 50
Acetone	50	< 50
Benzene	5	< 5
Bromodichloromethane	5	< 5
Bromoform	5	< 5
Bromomethane	5	< 5
2-Butanone (MEK)	50	< 50
Carbon disulfide	5	< 5
Carbon tetrachloride	5	< 5
Chlorobenzene	5	< 5
Chlorodibromomethane	5	< 5
Chloroethane	10	< 10
2-Chloroethyl vinyl ether	10	< 10
Chloroform	5	< 5
Chloromethane	5	< 5
1,2-Dibromoethane (EDB)	5	< 5
Dibromomethane	5	< 5
1,2-Dichlorobenzene	5	< 5
1,3-Dichlorobenzene	5	< 5
1,4-Dichlorobenzene	5	< 5
1,4-Dichloro-2-butene	10	< 10
Dichlorodifluoromethane	5	< 5
1,1-Dichloroethane	5	< 5
1,2-Dichloroethane	5	< 5
1,1-Dichloroethene	5	< 5
cis-1,2-Dichloroethene	5	< 5
trans-1,2-Dichloroethene	5	< 5
1,2-Dichloropropane	5	< 5
cis-1,3-Dichloropropene	5	< 5

date completed	tech	approved by
5/3/93	LNT	Edward Shuert

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01287
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PHASE II UST STUDY
SPF B-2 6-8'
4/22/93 1410

analysis: GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

results: Continued

COMPOUND	METHOD PQL (µg/Kg)	RESULT (µg/Kg)
trans-1,3-Dichloropropene	5	< 5
Ethyl acetate	10	< 10
Ethyl benzene	5	< 5
Ethyl ether	10	< 10
Ethyl methacrylate	5	< 5
2-Hexanone	10	< 10
Methylene chloride	5	< 5
Methyl iodide	5	< 5
4-Methyl-2-pentanone (MIBK)	50	< 50
Naphthalene	5	< 5
Styrene	5	< 5
1,1,1,2-Tetrachloroethane	5	< 5
1,1,2,2-Tetrachloroethane	5	< 5
Tetrachloroethene	5	< 5
Tetrahydrofuran	10	< 10
Toluene	5	< 5
1,1,1-Trichloroethane	5	< 5
1,1,2-Trichloroethane	5	< 5
Trichloroethene	5	< 5
Trichlorofluoromethane	5	< 5
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	5	< 5
1,2,3-Trichloropropane	5	< 5
Vinyl acetate	10	< 10
Vinyl chloride	5	< 5
m & p-Xylenes	5	< 5
o-Xylenes	5	< 5

date completed	tech:	approved by:
5/3/93	LNT	Edward Hunt

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01287
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PHASE II UST STUDY
SPF B-2 6-8'
4/22/93 1410

analysis: GAS CHROMOTOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

results: continued

Surrogate Recovery - Volatile Organics

Compound	% Recovery	Acceptable Range
1,2-Dichloroethane-d4	111%	70-121
Toluene-d8	90.9%	81-117
4-Bromofluorobenzene	88.0%	74-121

1) A value reported as "less than" indicates the analyte was not detected. The number is the quantification limit for the sample.

2) A value in parenthesis following a "less than" value indicates the analyte was detectable but below the limit of quantification. The value is an estimate only.

date completed	tech.	approved by
5/3/93	LNT	[signature]

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01288
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PHASE II UST STUDY
SPF B-3 6.5' AUGER
4/22/93 1440

analysis: GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

procedure: The sample was analyzed as outlined in US EPA "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", SW-846, Third Edition, November 1986, Method 8240.

results:

COMPOUND	METHOD PQL (µg/Kg)	RESULT (µg/Kg)
Acrolein	50	< 50
Acrylonitrile	50	< 50
Acetone	50	< 50
Benzene	5	< 5
Bromodichloromethane	5	< 5
Bromoform	5	< 5
Bromomethane	5	< 5
2-Butanone (MEK)	50	< 50
Carbon disulfide	5	< 5
Carbon tetrachloride	5	< 5
Chlorobenzene	5	< 5
Chlorodibromomethane	5	< 5
Chloroethane	10	< 10
2-Chloroethyl vinyl ether	10	< 10
Chloroform	5	< 5
Chloromethane	5	< 5
1,2-Dibromoethane (EDB)	5	< 5
Dibromomethane	5	< 5
1,2-Dichlorobenzene	5	< 5
1,3-Dichlorobenzene	5	< 5
1,4-Dichlorobenzene	5	< 5
1,4-Dichloro-2-butene	10	< 10
Dichlorodifluoromethane	5	< 5
1,1-Dichloroethane	5	< 5
1,2-Dichloroethane	5	< 5
1,1-Dichloroethene	5	< 5
cis-1,2-Dichloroethene	5	< 5
trans-1,2-Dichloroethene	5	< 5
1,2-Dichloropropane	5	< 5
cis-1,3-Dichloropropene	5	< 5

date completed	tech	approved by
5/3/93	LNT	Edward Theiert

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01288
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PHASE II UST STUDY
SPF B-3 6.5' AUGER
4/22/93 1440

analysis: GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

results: Continued

COMPOUND	METHOD PQL (µg/Kg)	RESULT (µg/Kg)
trans-1,3-Dichloropropene	5	< 5
Ethyl acetate	10	< 10
Ethyl benzene	5	< 5
Ethyl ether	10	< 10
Ethyl methacrylate	5	< 5
2-Hexanone	10	< 10
Methylene chloride	5	< 5
Methyl iodide	5	< 5
4-Methyl-2-pentanone (MIBK)	50	< 50
Naphthalene	5	< 5
Styrene	5	< 5
1,1,1,2-Tetrachloroethane	5	< 5
1,1,2,2-Tetrachloroethane	5	< 5
Tetrachloroethene	5	< 5
Tetrahydrofuran	10	< 10
Toluene	5	< 5
1,1,1-Trichloroethane	5	< 5
1,1,2-Trichloroethane	5	< 5
Trichloroethene	5	< 5
Trichlorofluoromethane	5	< 5
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	5	< 5
1,2,3-Trichloropropane	5	< 5
Vinyl acetate	10	< 10
Vinyl chloride	5	< 5
m & p-Xylenes	5	< 5
o-Xylenes	5	< 5

date completed	tech:	approved by:
5/3/93	LNT	Edward Kheiet

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307

1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01288
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PHASE II UST STUDY
SPF B-3 6.5' AUGER
4/22/93 1440

analysis: GAS CHROMOTOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

results: continued

Surrogate Recovery - Volatile Organics

Compound	% Recovery	Acceptable Range
1,2-Dichloroethane-d4	105%	70-121
Toluene-d8	94.5%	81-117
4-Bromofluorobenzene	102%	74-121

1) A value reported as "less than" indicates the analyte was not detected. The number is the quantification limit for the sample.

2) A value in parenthesis following a "less than" value indicates the analyte was detectable but below the limit of quantification. The value is an estimate only.

date completed: 5/3/93
tech: LNT
approved by: Edward Shrient

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01418
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 UST STUDY - PHASE II
SPF B-4 2'-4'
4/27/93 1510

analysis: GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

procedure: The sample was analyzed as outlined in US EPA "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", SW-846, Third Edition, November 1986, Method 8240.

results:

COMPOUND	METHOD PQL (µg/Kg)	RESULT (µg/Kg)
Acrolein	50	< 50
Acrylonitrile	50	< 50
Acetone	50	< 50
Benzene	5	< 5
Bromodichloromethane	5	< 5
Bromoform	5	< 5
Bromomethane	5	< 5
2-Butanone (MEK)	50	< 50
Carbon disulfide	5	< 5
Carbon tetrachloride	5	< 5
Chlorobenzene	5	< 5
Chlorodibromomethane	5	< 5
Chloroethane	10	< 10
2-Chloroethyl vinyl ether	10	< 10
Chloroform	5	< 5
Chloromethane	5	< 5
1,2-Dibromoethane (EDB)	5	< 5
Dibromomethane	5	< 5
1,2-Dichlorobenzene	5	< 5
1,3-Dichlorobenzene	5	< 5
1,4-Dichlorobenzene	5	< 5
1,4-Dichloro-2-butene	10	< 10
Dichlorodifluoromethane	5	< 5
1,1-Dichloroethane	5	< 5
1,2-Dichloroethane	5	< 5
1,1-Dichloroethene	5	< 5
cis-1,2-Dichloroethene	5	< 5
trans-1,2-Dichloroethene	5	< 5
1,2-Dichloropropane	5	< 5
cis-1,3-Dichloropropene	5	< 5

date completed:	tech:	approved by:
5/6/93	LNT	Edward Shirot

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01418
p.o. no. 2F2-4065-2435

ample description: 4065-6105-006 UST STUDY - PHASE II
SPF B-4 2'-4'
4/27/93 1510

nalysis: GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

esults: Continued

COMPOUND	METHOD PQL (µg/Kg)	RESULT (µg/Kg)
trans-1,3-Dichloropropene	5	< 5
Ethyl acetate	10	< 10
Ethyl benzene	5	< 5
Ethyl ether	10	< 10
Ethyl methacrylate	5	< 5
2-Hexanone	10	< 10
Methylene chloride	5	< 5
Methyl iodide	5	< 5
4-Methyl-2-pentanone (MIBK)	50	< 50
Naphthalene	5	< 5
Styrene	5	< 5
1,1,1,2-Tetrachloroethane	5	< 5
1,1,2,2-Tetrachloroethane	5	< 5
Tetrachloroethene	5	< 5
Tetrahydrofuran	10	< 10
Toluene	5	< 5
1,1,1-Trichloroethane	5	21.7
1,1,2-Trichloroethane	5	< 5
Trichloroethene	5	< 5
Trichlorofluoromethane	5	< 5
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	5	< 5
1,2,3-Trichloropropane	5	< 5
Vinyl acetate	10	< 10
Vinyl chloride	5	< 5
m & p-Xylenes	5	< 5
o-Xylenes	5	< 5

ate completed:	tech:	approved by:
5/6/93	LNT	Edward Stewart

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01418
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 UST STUDY - PHASE II
~~SPT/B-4~~ 2'-4'
4/27/93 1510

analysis: GAS CHROMOTOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

results: continued

Surrogate Recovery - Volatile Organics

Compound	% Recovery	Acceptable Range
1,2-Dichloroethane-d4	114%	70-121
Toluene-d8	99.2%	81-117
4-Bromofluorobenzene	93.7%	74-121

1) A value reported as "less than" indicates the analyte was not detected. The number is the quantification limit for the sample.

2) A value in parenthesis following a "less than" value indicates the analyte was detectable but below the limit of quantification. The value is an estimate only.

date completed:	tech:	approved by:
5/6/93	LNT	Edward Shuett

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01419
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 UST STUDY - PHASE II
SPF B-4 4'-6'
4/27/93 1530

analysis: GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

procedure: The sample was analyzed as outlined in US EPA "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", SW-846, Third Edition, November 1986, Method 8240.

results:

COMPOUND	METHOD PQL (µg/Kg)	RESULT (µg/Kg)
Acrolein	50	< 50
Acrylonitrile	50	< 50
Acetone	50	< 50
Benzene	5	< 5
Bromodichloromethane	5	< 5
Bromoform	5	< 5
Bromomethane	5	< 5
2-Butanone (MEK)	50	< 50
Carbon disulfide	5	< 5
Carbon tetrachloride	5	< 5
Chlorobenzene	5	< 5
Chlorodibromomethane	5	< 5
Chloroethane	10	< 10
2-Chloroethyl vinyl ether	10	< 10
Chloroform	5	< 5
Chloromethane	5	< 5
1,2-Dibromoethane (EDB)	5	< 5
Dibromomethane	5	< 5
1,2-Dichlorobenzene	5	< 5
1,3-Dichlorobenzene	5	< 5
1,4-Dichlorobenzene	5	< 5
1,4-Dichloro-2-butene	10	< 10
Dichlorodifluoromethane	5	< 5
1,1-Dichloroethane	5	< 5
1,2-Dichloroethane	5	< 5
1,1-Dichloroethene	5	< 5
cis-1,2-Dichloroethene	5	< 5
trans-1,2-Dichloroethene	5	< 5
1,2-Dichloropropane	5	< 5
cis-1,3-Dichloropropene	5	< 5

date completed	tech:	approved by:
5/6/93	LNT	Edward Friedt

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01419
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 UST STUDY - PHASE II
SPF B-4 4'-6'
4/27/93 1530

analysis: GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

results: Continued

COMPOUND	METHOD PQL (µg/Kg)	RESULT (µg/Kg)
trans-1,3-Dichloropropene	5	< 5
Ethyl acetate	10	< 10
Ethyl benzene	5	< 5
Ethyl ether	10	< 10
Ethyl methacrylate	5	< 5
2-Hexanone	10	< 10
Methylene chloride	5	< 5
Methyl iodide	5	< 5
4-Methyl-2-pentanone (MIBK)	50	< 50
Naphthalene	5	< 5
Styrene	5	< 5
1,1,1,2-Tetrachloroethane	5	< 5
1,1,2,2-Tetrachloroethane	5	< 5
Tetrachloroethene	5	< 5
Tetrahydrofuran	10	< 10
Toluene	5	< 5
1,1,1-Trichloroethane	5	< 5
1,1,2-Trichloroethane	5	< 5
Trichloroethene	5	< 5
Trichlorofluoromethane	5	< 5
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	5	< 5
1,2,3-Trichloropropane	5	< 5
Vinyl acetate	10	< 10
Vinyl chloride	5	< 5
m & p-Xylenes	5	< 5
o-Xylenes	5	< 5

date completed:	tech:	approved by:
5/6/93	LNT	Edward J. Kuerst

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01419
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 UST STUDY - PHASE II
SPF B-4 4'-6'
4/27/93 1530

analysis: GAS CHROMOTOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

results: continued

Surrogate Recovery - Volatile Organics

Compound	% Recovery	Acceptable Range
1,2-Dichloroethane-d4	115%	70-121
Toluene-d8	100%	81-117
4-Bromofluorobenzene	98.8%	74-121

1) A value reported as "less than" indicates the analyte was not detected. The number is the quantification limit for the sample.

2) A value in parenthesis following a "less than" value indicates the analyte was detectable but below the limit of quantification. The value is an estimate only.

date completed:	tech:	approved by:
5/6/93	LNT	Edward Stuart

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01420
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 UST STUDY - PHASE II
SPF B-4 6'-8'
4/27/93 1535

analysis: GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

procedure: The sample was analyzed as outlined in US EPA "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", SW-846, Third Edition, November 1986, Method 8240.

results:

COMPOUND	METHOD PQL (µg/Kg)	RESULT (µg/Kg)
Acrolein	50	< 50
Acrylonitrile	50	< 50
Acetone	50	< 50
Benzene	5	< 5
Bromodichloromethane	5	< 5
Bromoform	5	< 5
Bromomethane	5	< 5
2-Butanone (MEK)	50	< 50
Carbon disulfide	5	< 5
Carbon tetrachloride	5	< 5
Chlorobenzene	5	< 5
Chlorodibromomethane	5	< 5
Chloroethane	10	< 10
2-Chloroethyl vinyl ether	10	< 10
Chloroform	5	< 5
Chloromethane	5	< 5
1,2-Dibromoethane (EDB)	5	< 5
Dibromomethane	5	< 5
1,2-Dichlorobenzene	5	< 5
1,3-Dichlorobenzene	5	< 5
1,4-Dichlorobenzene	5	< 5
1,4-Dichloro-2-butene	10	< 10
Dichlorodifluoromethane	5	< 5
1,1-Dichloroethane	5	< 5
1,2-Dichloroethane	5	< 5
1,1-Dichloroethene	5	< 5
cis-1,2-Dichloroethene	5	< 5
trans-1,2-Dichloroethene	5	< 5
1,2-Dichloropropane	5	< 5
cis-1,3-Dichloropropene	5	< 5

date completed:	tech:	approved by:
5/6/93	LNT	

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01420
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 UST STUDY - PHASE II
SPF B-4 6'-8'
4/27/93 1535

analysis: GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

results: Continued

COMPOUND	METHOD PQL (µg/Kg)	RESULT (µg/Kg)
trans-1,3-Dichloropropene	5	< 5
Ethyl acetate	10	< 10
Ethyl benzene	5	< 5
Ethyl ether	10	< 10
Ethyl methacrylate	5	< 5
2-Hexanone	10	< 10
Methylene chloride	5	< 5
Methyl iodide	5	< 5
4-Methyl-2-pentanone (MIBK)	50	< 50
Naphthalene	5	< 5
Styrene	5	< 5
1,1,1,2-Tetrachloroethane	5	< 5
1,1,2,2-Tetrachloroethane	5	< 5
Tetrachloroethene	5	< 5
Tetrahydrofuran	10	< 10
Toluene	5	< 5
1,1,1-Trichloroethane	5	17.1
1,1,2-Trichloroethane	5	< 5
Trichloroethene	5	< 5
Trichlorofluoromethane	5	< 5
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	5	< 5
1,2,3-Trichloropropane	5	< 5
Vinyl acetate	10	< 10
Vinyl chloride	5	< 5
m & p-Xylenes	5	< 5
o-Xylenes	5	< 5

date completed:	tech:	approved by:
5/6/93	LNT	Edward Shuma

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01420
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 UST STUDY - PHASE II
SPF B-4 6'-8'
4/27/93 1535

analysis: GAS CHROMOTOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

results: continued

Surrogate Recovery - Volatile Organics

Compound	% Recovery	Acceptable Range
1,2-Dichloroethane-d4	115%	70-121
Toluene-d8	101%	81-117
4-Bromofluorobenzene	96.2%	74-121

1) A value reported as "less than" indicates the analyte was not detected. The number is the quantification limit for the sample.

2) A value in parenthesis following a "less than" value indicates the analyte was detectable but below the limit of quantification. The value is an estimate only.

date completed:	tech:	approved by:
5/6/93	LNT	Edward Shriver

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307

1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01638
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PLUM BROOK UST STUDY
SPF-MW-1
5/5/93 1300

analysis: Polynuclear Aromatic Hydrocarbons

procedure: The sample was analyzed as outlined in US EPA "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods", SW-846, Third Edition, November 1986, Method 8100.

results:

COMPOUND	METHOD PQL (µg/L)	RESULTS (µg/L)
Acenaphthene	less than 1.0	less than 1.0
Acenaphthylene	less than 1.0	1.33
Anthracene	less than 1.0	less than 1.0
Benzo (a) anthracene	less than 1.0	less than 1.0
Benzo (a) pyrene	less than 1.0	less than 1.0
Benzo (b) fluoroanthene	less than 1.0	less than 1.0
Benzo (k) fluoroanthene	less than 1.0	less than 1.0
Benzo (ghi) perylene	less than 1.0	less than 1.0
Chrysene	less than 1.0	less than 1.0
Dibenzo(a,h)anthracene	less than 1.0	less than 1.0
Fluoranthene	less than 1.0	less than 1.0
Fluorene	less than 1.0	less than 1.0
Indeno(1,2,3-cd)pyrene	less than 1.0	less than 1.0
Naphthalene	less than 1.0	less than 1.0
Phenanthrene	less than 1.0	1.07
Pyrene	less than 1.0	less than 1.0

Surrogate Recovery

Compound	% Recovery
2-Fluorobiphenyl	78.9%
p-Terphenyl-d14	95.0%

1) A value reported as "less than" indicates the analyte was not detected. The number is the quantification limit for the sample.

2) A value in parenthesis following a "less than" value indicates the analyte was detectable but below the limit of quantification. The value is an estimate only.

3) Due to the multi-component nature of petroleum hydrocarbon fuels, the majority of which fall within the retention time window which also includes PAH's, a strong possibility exists for the detection of false positives in samples where hydrocarbon fuels are detected.

date completed:	tech:	approved by:
5/18/93	AMG/GJB	Edward Thiner

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307

1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01639
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PLUM BROOK UST STUDY
SPF-MW-1-A
5/5/93 1300

analysis: Polynuclear Aromatic Hydrocarbons

procedure: The sample was analyzed as outlined in US EPA "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods", SW-846, Third Edition, November 1986, Method 8100.

results:

COMPOUND	METHOD PQL (µg/L)	RESULTS (µg/L)
Acenaphthene	less than 1.0	1.66
Acenaphthylene	less than 1.0	less than 1.0
Anthracene	less than 1.0	less than 1.0
Benzo (a) anthracene	less than 1.0	less than 1.0
Benzo (a) pyrene	less than 1.0	less than 1.0
Benzo (b) fluoroanthene	less than 1.0	less than 1.0
Benzo (k) fluoroanthene	less than 1.0	less than 1.0
Benzo (ghi) perylene	less than 1.0	less than 1.0
Chrysene	less than 1.0	less than 1.0
Dibenzo(a,h)anthracene	less than 1.0	less than 1.0
Fluoranthene	less than 1.0	less than 1.0
Fluorene	less than 1.0	less than 1.0
Indeno(1,2,3-cd)pyrene	less than 1.0	less than 1.0
Naphthalene	less than 1.0	less than 1.0
Phenanthrene	less than 1.0	less than 1.0
Pyrene	less than 1.0	less than 1.0

Surrogate Recovery

Compound	% Recovery
2-Fluorobiphenyl	61.1%
p-Terphenyl-d14	83.2%

1) A value reported as "less than" indicates the analyte was not detected. The number is the quantification limit for the sample.

2) A value in parenthesis following a "less than" value indicates the analyte was detectable but below the limit of quantification. The value is an estimate only.

3) Due to the multi-component nature of petroleum hydrocarbon fuels, the majority of which fall within the retention time window which also includes PAH's, a strong possibility exists for the detection of false positives in samples where hydrocarbon fuels are detected.

date completed:	tech:	approved by:
5/18/93	AMG/GJB	Edward Hurst

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307

1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01642
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PLUM BROOK UST STUDY
SPF - EB-1
5/5/93 1330

analysis: Polynuclear Aromatic Hydrocarbons

procedure: The sample was analyzed as outlined in US EPA "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods", SW-846, Third Edition, November 1986, Method 8100.

results:

COMPOUND	METHOD PQL (µg/L)	RESULTS (µg/L)
Acenaphthene	less than 1.0	less than 1.0
Acenaphthylene	less than 1.0	less than 1.0
Anthracene	less than 1.0	less than 1.0
Benzo (a) anthracene	less than 1.0	less than 1.0
Benzo (a) pyrene	less than 1.0	less than 1.0
Benzo (b) fluoroanthene	less than 1.0	less than 1.0
Benzo (k) fluoroanthene	less than 1.0	less than 1.0
Benzo (ghi) perylene	less than 1.0	less than 1.0
Chrysene	less than 1.0	less than 1.0
Dibenzo(a,h)anthracene	less than 1.0	less than 1.0
Fluoranthene	less than 1.0	less than 1.0
Fluorene	less than 1.0	less than 1.0
Indeno(1,2,3-cd)pyrene	less than 1.0	less than 1.0
Naphthalene	less than 1.0	less than 1.0
Phenanthrene	less than 1.0	1.42
Pyrene	less than 1.0	less than 1.0

Surrogate Recovery

Compound	% Recovery
2-Fluorobiphenyl	72.6%
p-Terphenyl-d14	97.4%

1) A value reported as "less than" indicates the analyte was not detected. The number is the quantification limit for the sample.

2) A value in parenthesis following a "less than" value indicates the analyte was detectable but below the limit of quantification. The value is an estimate only.

3) Due to the multi-component nature of petroleum hydrocarbon fuels, the majority of which fall within the retention time window which also includes PAH's, a strong possibility exists for the detection of false positives in samples where hydrocarbon fuels are detected.

date completed:	tech:	approved by:
5/20/93	GJB	Edward Thiert

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307

1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93001643
p.o. no. 2F2-4065-2435

Sample Description: 4065-6105-006 PLUM BROOK UST STUDY
SPF - EB-2
5/5/93 1345

Analysis: Polynuclear Aromatic Hydrocarbons

Procedure: The sample was analyzed as outlined in US EPA "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods", SW-846, Third Edition, November 1986, Method 8100.

Results:

COMPOUND	METHOD PQL (µg/L)	RESULTS (µg/L)
Acenaphthene	less than 1.0	1.12
Acenaphthylene	less than 1.0	less than 1.0
Anthracene	less than 1.0	less than 1.0
Benzo (a) anthracene	less than 1.0	less than 1.0
Benzo (a) pyrene	less than 1.0	less than 1.0
Benzo (b) fluoroanthene	less than 1.0	less than 1.0
Benzo (k) fluoroanthene	less than 1.0	less than 1.0
Benzo (ghi) perylene	less than 1.0	less than 1.0
Chrysene	less than 1.0	less than 1.0
Dibenzo(a,h)anthracene	less than 1.0	less than 1.0
Fluoranthene	less than 1.0	less than 1.0
Fluorene	less than 1.0	less than 1.0
Indeno(1,2,3-cd)pyrene	less than 1.0	less than 1.0
Naphthalene	less than 1.0	less than 1.0
Phenanthrene	less than 1.0	1.01
Pyrene	less than 1.0	less than 1.0

Surrogate Recovery

Compound	% Recovery
2-Fluorobiphenyl	70.9%
p-Terphenyl-d14	93.7%

1) A value reported as "less than" indicates the analyte was not detected. The number is the quantification limit for the sample.

2) A value in parenthesis following a "less than" value indicates the analyte was detectable but below the limit of quantification. The value is an estimate only.

3) Due to the multi-component nature of petroleum hydrocarbon fuels, the majority of which fall within the retention time window which also includes PAH's, a strong possibility exists for the detection of false positives in samples where hydrocarbon fuels are detected.

date completed:	tech:	approved by:
5/20/93	GJB	Edward Thirst

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307

1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01644
p.o. no. 2F2-4065-2435

sample description: 4065-6105-006 PLUM BROOK UST STUDY
SPF - EB-3
5/5/93 1400

analysis: Polynuclear Aromatic Hydrocarbons

procedure: The sample was analyzed as outlined in US EPA "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods", SW-846, Third Edition, November 1986, Method 8100.

results:

COMPOUND	METHOD PQL (µg/L)	RESULTS (µg/L)
Acenaphthene	less than 1.0	less than 1.0
Acenaphthylene	less than 1.0	less than 1.0
Anthracene	less than 1.0	less than 1.0
Benzo (a) anthracene	less than 1.0	less than 1.0
Benzo (a) pyrene	less than 1.0	less than 1.0
Benzo (b) fluoroanthene	less than 1.0	less than 1.0
Benzo (k) fluoroanthene	less than 1.0	less than 1.0
Benzo (ghi) perylene	less than 1.0	less than 1.0
Chrysene	less than 1.0	less than 1.0
Dibenzo(a,h)anthracene	less than 1.0	less than 1.0
Fluoranthene	less than 1.0	less than 1.0
Fluorene	less than 1.0	less than 1.0
Indeno(1,2,3-cd)pyrene	less than 1.0	less than 1.0
Naphthalene	less than 1.0	less than 1.0
Phenanthrene	less than 1.0	less than 1.0
Pyrene	less than 1.0	less than 1.0

Surrogate Recovery

Compound	% Recovery
2-Fluorobiphenyl	71.6%
p-Terphenyl-d14	93.0%

1) A value reported as "less than" indicates the analyte was not detected. The number is the quantification limit for the sample.

2) A value in parenthesis following a "less than" value indicates the analyte was detectable but below the limit of quantification. The value is an estimate only.

date completed:	tech:	approved by:
5/20/93	GJB	

MK-Ferguson
Nasa Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307

1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

lab no. 93C01645
p.o. no. 2F2-4065-2435

ample escription: 4065-6105-006 PLUM BROOK UST STUDY
SPF - EB-4
5/5/93 1415

alysis: Polynuclear Aromatic Hydrocarbons

rocedure: The sample was analyzed as outlined in US EPA "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods", SW-846, Third Edition, November 1986, Method 8100.

esults:

COMPOUND	METHOD PQL (µg/L)	RESULTS (µg/L)
Acenaphthene	less than 1.0	less than 1.0
Acenaphthylene	less than 1.0	less than 1.0
Anthracene	less than 1.0	less than 1.0
Benzo (a) anthracene	less than 1.0	less than 1.0
Benzo (a) pyrene	less than 1.0	less than 1.0
Benzo (b) fluoroanthene	less than 1.0	less than 1.0
Benzo (k) fluoroanthene	less than 1.0	less than 1.0
Benzo (ghi) perylene	less than 1.0	less than 1.0
Chrysene	less than 1.0	less than 1.0
Dibenzo(a,h)anthracene	less than 1.0	less than 1.0
Fluoranthene	less than 1.0	less than 1.0
Fluorene	less than 1.0	less than 1.0
Indeno(1,2,3-cd)pyrene	less than 1.0	less than 1.0
Naphthalene	less than 1.0	less than 1.0
Phenanthrene	less than 1.0	less than 1.0
Pyrene	less than 1.0	less than 1.0

Surrogate Recovery

Compound	% Recovery
2-Fluorobiphenyl	69.9%
p-Terphenyl-d14	88.9%

1) A value reported as "less than" indicates the analyte was not detected. The number is the quantification limit for the sample.

2) A value in parenthesis following a "less than" value indicates the analyte was detectable but below the limit of quantification. The value is an estimate only.

e completed:	tech:	approved by:
/20/93	GJB	Edward Shuert

MORRISON KNUDSEN CORPORATION
MK-FERGUSON GROUP
MK-FERGUSON PLAZA
1500 WEST 3RD STREET
CLEVELAND, OHIO 44113-1406

Transmittal Letter

Project Name: NASA LeRC	Transmittal No. TL-3412 / Work Order No. 4065-6105-008
	Date: Dec 21, 93
To: Mr. David Fiedler Management Operations Office NASA Lewis Research Center 21000 Brookpark Road Mail Stop 501-7 Cleveland, Ohio 44135	REFERENCES Item: SPF Volatiles / TCLP Vols Equipment No.: Purchase Order No.: Vendor Order No.:

TRANSMITTED HEREWITH	FOR STATUS NOTED
For: ☐ Review and comment ☐ Approval ☒ Record ☒ Information	Reviewed A Reviewed as Noted - Resubmit B Not Reviewed - Resubmit C For Information D

QUANTITY	ITEM	TITLE/DESCRIPTION

Enclosed are the SPF volatiles and TCLP volatiles data for the PBS-SPF Risk Assessment.

- TOC data is still in the lab
- Short "report" will be submitted with the entire data package.

Dist
L Main
R Paloyo
A Cedeon
D Easterling
C Cox
A Gower
E Allen / T Benson
D Wolcott

By: E Allen
Name: Elise E. Allen
Title: Environmental Manager

MK-Ferguson
NASA Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307

1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

sample description: SPF SPF-01
12/7/93 1145

analysis: TCLP-ZHE EXTRACTION

procedure: Federal Register, Vol. 55, No. 126, Friday, June 29, 1990.

TCLP-ZHE - A composite sample of 20.0 grams was extracted in 400 ml Extraction Fluid #1 for 18.00 hours in a zero headspace extractor and filtered through a glass fiber filter as outlined in TCLP methodology as stated in Federal Register, Vol. 55, No. 126, Friday, June 29, 1990. The filtered extract was collected in a Tedlar bag and then analyzed as outlined in US EPA "Test Methods for Evlauating Solid Wastes Physical/Chemical Methods", SW-846, Third Edition, November, 1986.

12/10/93 approved by

All reports are submitted as confidential communications. Authorization for duplication in whole or part is reserved pending our written approval, and mutual protection.

MK-Ferguson
NASA Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307

1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

sample description: SPF SPF-01
12/7/93 1145

analysis: Volatile Organics in the TCLP-ZHE extract

procedure: SW-846, Method 8240

results:

Compound	Limit	Result
Benzene	0.5 mg/L	less than 0.025 mg/L
Carbon tetrachloride	0.5 mg/L	less than 0.025 mg/L
Chlorobenzene	100 mg/L	less than 0.025 mg/L
Chloroform	6.0 mg/L	less than 0.025 mg/L
1,4-Dichlorobenzene	7.5 mg/L	less than 0.025 mg/L
1,2-Dichloroethane	0.5 mg/L	less than 0.025 mg/L
1,1-Dichloroethylene	0.7 mg/L	less than 0.025 mg/L
Methyl ethyl ketone	200 mg/L	less than 0.050 mg/L
Tetrachloroethylene	0.7 mg/L	less than 0.025 mg/L
Trichloroethylene	0.5 mg/L	less than 0.025 mg/L
Vinyl chloride	0.2 mg/L	less than 0.025 mg/L

SURROGATE RECOVERY

Compound	% Recovery	Acceptable Range
1,2-Dichloroethane-D4	93.1%	76-114
Toluene-d8	95.9%	88-110
4-Bromofluorobenzene	95.3%	86-115

PER CLIENTS REQUEST, ANALYSIS WAS NOT PERFORMED WITH MATRIX SPIKES FOR BIAS CORRECTIONS.

1) A value reported as "less than" indicates the analyte was not detected. The number is the quantification limit for the sample.

2) A value in parenthesis following a "less than" value indicates the analyte was detected but below the limit of quantification. The value is an estimate only.

All reports are submitted as confidential communications. Authorization for duplication in whole or part is reserved pending our written approval, as a mutual protection.

MK-Ferguson
NASA Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

sample description: SPF SPF-01
12/7/93 1145

analysis: GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

procedure: The sample was analyzed as outlined in US EPA "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", SW-846, Third Edition, November 1986, Method 8240.

results:

COMPOUND	MDL (µg/Kg)	RESULT (µg/Kg)
Acrolein	20.8	< 20.8
Acrylonitrile	18.5	< 18.5
Acetone	13.8	< 13.8
Benzene	1.49	< 1.49
Bromodichloromethane	0.878	< 0.878
Bromoform	2.10	< 2.10
Bromomethane	2.89	< 2.89
2-Butanone (MEK)	11.7	< 11.7
Carbon disulfide	4.78	< 4.78
Carbon tetrachloride	1.68	< 1.68
Chlorobenzene	0.987	< 0.987
Chlorodibromomethane	1.04	< 1.04
Chloroethane	3.28	< 3.28
2-Chloroethyl vinyl ether	27.9	< 27.9
Chloroform	0.931	< 0.931
Chloromethane	3.00	< 3.00
1,2-Dibromoethane (EDB)	2.44	< 2.44
Dibromomethane	3.02	< 3.02
1,2-Dichlorobenzene	1.46	< 1.46
1,3-Dichlorobenzene	2.01	< 2.01
1,4-Dichlorobenzene	2.28	< 2.28
1,4-Dichloro-2-butene	8.24	< 8.24
Dichlorodifluoromethane	3.89	< 3.89
1,1-Dichloroethane	1.52	< 1.52
1,2-Dichloroethane	1.97	< 1.97
1,1-Dichloroethene	2.22	< 2.22
cis-1,2-Dichloroethene	1.44	< 1.44
trans-1,2-Dichloroethene	2.03	< 2.03
1,2-Dichloropropane	0.882	< 0.882
cis-1,3-Dichloropropene	0.947	< 0.947

All reports are submitted as confidential communications. Authorization for duplication in whole or part is reserved pending our written approval, as a mutual protection.

MK-Ferguson
NASA Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

sample description: SPF SPF-01
12/7/93 1145

analysis: GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

results: Continued

COMPOUND	MDL (µg/Kg)	RESULT (µg/Kg)
trans-1,3-Dichloropropene	0.907	< 0.907
Ethyl acetate	3.51	< 3.51
Ethyl benzene	0.961	< 0.961
Ethyl ether	2.94	< 2.94
Ethyl methacrylate	2.98	< 2.98
2-Hexanone	8.63	< 8.63
Methylene chloride	2.31	< 2.31
Methyl iodide	3.00	< 3.00
4-Methyl-2-pentanone (MIBK)	13.7	< 13.7
Naphthalene	3.06	< 3.06
Styrene	1.37	< 1.37
1,1,1,2-Tetrachloroethane	1.12	< 1.12
1,1,2,2-Tetrachloroethane	2.77	< 2.77
Tetrachloroethene	2.38	< 2.38
Tetrahydrofuran	6.72	< 6.72
Toluene	1.24	< 1.24
1,1,1-Trichloroethane	1.18	< 1.18
1,1,2-Trichloroethane	1.69	< 1.69
Trichloroethene	1.36	< 1.36
Trichlorofluoromethane	3.66	< 3.66
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	1.30	4.08 See note 3
1,2,3-Trichloropropane	4.88	< 4.88
Vinyl acetate	4.24	< 4.24
Vinyl chloride	2.79	< 2.79
m & p-Xylenes	1.49	< 1.49
o-Xylenes	0.874	< 0.874

approved by

All reports are submitted as confidential communications. Authorization for publication in whole or part is reserved pending our written approval, as a matter of protection.

MK-Ferguson
NASA Lewis Research Center
Attn: Elise Allen
21000 Brookpark Road, M.S. 66-2
Cleveland, OH 44135

biological & environmental control laboratories, inc.
615 front street
toledo, ohio 43605
(419) 693-5307
1632 enterprise parkway
twinsburg, ohio 44087
(216) 425-8200

sample description: SPF SPF-01
12/7/93 1145

analysis: GAS CHROMOTOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS

results: continued

Surrogate Recovery - Volatile Organics

Compound	% Recovery	Acceptable Range
1,2-Dichloroethane-d4	101%	70-121
Toluene-d8	95.2%	81-117
4-Bromofluorobenzene	91.6%	74-121

1) A value reported as "less than" indicates the analyte was not detected. The number is the quantification limit for the sample.

2) A value in parenthesis following a "less than" value indicates the analyte was detectable but below the limit of quantification. The value is an estimate only.

3) The method blank contained 0.393 µg/L of trichlorotrifluoroethane. The approximate equivalent concentration is 1.55 µg/Kg in the sample. This is considered to be a significant contribution to the reported value.

All reports are submitted as confidential communications. Authorization for duplication in whole or part is reserved pending our written approval, and mutual protection.

biological and environmental control laboratories, inc.
1632 enterprise parkway
twinsburg, ohio 44087
telephone: (216) 425-8200 fax: (216) -425-1349

FACSIMILE COVER PAGE

To: elise Allen

Fax number: 267-3152

Company: MK - NASA

Date: 12-21

Re:

Number of Pages 6 including cover page.

THESE ARE TRANSMITTED:

☐ For your use ☐ As Requested ☐ For Approval

☐ For Review and Comment ☐ For Your Information

The original of this facsimile __ will __ will not be sent to the recipient.

Remarks:

Copy To: _____ Sent By: _____

If you have any difficulty receiving this fax, please call (216)425-8200 as soon as possible.

b.e.c. laboratories
TWINSBURG OHIO — TOLEDO OHIO

☒ RUSH-ADDITIONAL CHARGE
RESULTS BY _____
MUST CONFIRM WITH LABORATORY

Analysis Per Quote No. _____

REPORT TO: [illegible]
PHONE: 435-2439
COMPANY: [illegible]
FAX: 267-3152
ADDRESS: [illegible] Cleveland
STATE: [illegible] ZIP: 44135
SITE LOCATION:
SAMPLER (PRINT):

SAMPLE IDENTIFICATION	DATE TIME	COMPOSITE	GRAB	# CONTAINERS	SHIPPED VIA	MATRIX (WATER-W SOIL-S SLUDGE-SL DRUMS-D OTHER-O)	CHARACTERISTICS: TCLP: METALS☐ VOA☒ SVOA☐ PEST/HERB☐	FLASH POINT: OPEN CUP☐ CLOSED CUP☐	PAINT FILTER	pH	CYANIDE: TOTAL☐ REACTIVE☐	SULFIDE: TOTAL☐ REACTIVE☐	SOLIDS: TOTAL☐ DISS☐ SUSP☐ ASH☐	TOTALS: METALS: RCRA (8)☐ MICHIGAN (10)☐	VOLATILES: 624☐ 8240☒	SEMIVOLATILES: 625☐ 8270☐	PESTICIDES: 608☐ 8080☐	PCB'S: 608☐ 8080☐	HERBICIDES: 8150☐	PRIORITY POLLUTANTS: METALS☐ VOA☐ SVOA☐ PEST/PCB☐	UST: BTEX: 602☐ 8020☐ PLUS MTBE☐ PLUS TBA☐	TPH: GRO☐ DRO☐ 418.1☐	PAH: 8100☐ 8270☐	LEAD: TCLP☐ TOTAL☐	OTHER: TOC		
[illegible]	12-7-93 1145	✓		3 4oz		S	✓								✓										✓		
[illegible]	12-7-93 1115		✓	1 4oz		S																			✓		
[illegible]	12-7-93 1050		✓	1 4oz		S																			✓		
						S																					
[illegible]	"ADL"					S																					

COMMENTS AND SPECIAL HANDLING INSTRUCTIONS
PO SF3-4065-2616

RECEIVED BY SAMPLER:	DATE	TIME	RECEIVED BY:	DATE	TIME
[illegible]	12-8-93	[illegible]	[illegible]	12/8/93	0900
RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME

SAMPLE MAY BE RETURNED TO CLIENT AT BEC'S DISCRETION, UNLESS ARRANGEMENTS HAVE BEEN MADE PRIOR TO SAMPLE SUBMISSION.

Please print or type. (Form designed for use on elite (12-pitch) typewriter.)

Form Approved. OMB No. 2050-0039. Expires 9-30-9

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No. OH3800015379 Manifest Document No. 000003

2. Page 1 of 1

Information in the shaded areas is not required by Federal law.

3. Generator's Name and Mailing Address
NASA- Plum Brook Station
6100 Columbus Ave, Sandusky OH 44870

4. Generator's Phone (419) 621-3205

A. State Manifest Document Number

B. State Generator's ID

5. Transporter 1 Company Name
CHEM FREIGHT

6. US EPA ID Number
OHD986966190

C. State Transporter's ID

D. Transporter's Phone (216) 341-2500

7. Transporter 2 Company Name

8. US EPA ID Number

E. State Transporter's ID

F. Transporter's Phone

9. Designated Facility Name and Site Address
HUKILL CHEMICAL CORP.
7013 KRICK RD.
BEDFORD, OH 44146

10. US EPA ID Number
OHD001926740

G. State Facility's ID

H. Facility's Phone (216) 232-9400

11. US DOT Description (Including Proper Shipping Name, Hazard Class and ID Number)

	HM	11. US DOT Description	12. Containers No.	12. Containers Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste No.
a.	X	RQ, 1000 (454) HAZARDOUS WASTE- LIQUID N.O.S. ORM-E, NA9189 (D008- F002	1	TT	6000	G	F002 D008
b.							
c.							
d.							

J. Additional Descriptions for Materials Listed Above

K. Handling Codes for Wastes Listed Above

15. Special Handling Instructions and Additional Information

16. GENERATOR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

GENERATOR

Printed/Typed Name: Amy L. Bower
Signature: Amy L. Bower
Month Day Year: 09/15/89

17. Transporter 1 Acknowledgement of Receipt of Materials

TRANSPORTER

Printed/Typed Name: William Gordon
Signature: William Gordon
Month Day Year: 09/15/89

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name:
Signature:
Month Day Year:

19. Discrepancy Indication Space

FACILITY

20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.

Printed/Typed Name: Delbert H Sykes
Signature: Delbert H Sykes
Month Day Year: 09/15/89

Style F15 REV-6 LABELMASTER, Div. of AMERICAN LABELMARK CO., CHICAGO, IL 60646

EPA Form 8700-22 (Rev. 9-88) Previous editions are obsolete

Please print or type. (Form designed for use on elite (12-pitch) typewriter.)

Form Approved. OMB No. 2050-0039. Expires 9-30-9

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No. 0H3800015379 Manifest Document No. 000004

2. Page 1 of 1

Information in the shaded areas is not required by Federal law.

3. Generator's Name and Mailing Address
NASA - Plum Brook Station
6100 Columbus Ave Sandusky OH 44870

4. Generator's Phone (419) 621-3205

A. State Manifest Document Number

B. State Generator's ID

5. Transporter 1 Company Name: CHEM FREIGHT

6. US EPA ID Number: OH0986916619

C. State Transporter's ID

D. Transporter's Phone (216) 341-2500

7. Transporter 2 Company Name

8. US EPA ID Number

E. State Transporter's ID

F. Transporter's Phone

9. Designated Facility Name and Site Address
HUKILL CHEMICAL CORP
7013 KRICK RD.
BEDFORD HTS, OH 44146

10. US EPA ID Number: OH0010192617410

G. State Facility's ID

H. Facility's Phone (216) 232-9400

	11. US DOT Description (Including Proper Shipping Name, Hazard Class and ID Number)	HM	12. Containers No.	Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste No.
a.	RQ, 1000 (454) HAZARDOUS WASTE LIQUID, N.O.S. ORM-E, NA9189 (D008-F002)	Y	1	TT	454000	G	F002 D008
b.							
c.							
d.							

J. Additional Descriptions for Materials Listed Above

K. Handling Codes for Wastes Listed Above

15. Special Handling Instructions and Additional Information

16. GENERATOR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name: Amy L. Bower | Signature: Amy L. Bower | Month Day Year: 09 19 89

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name: KENNETH LAFARBE | Signature: Kenneth LaFarbe | Month Day Year: 09 19 89

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name | Signature | Month Day Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.

Printed/Typed Name: BOB LANG | Signature: Bob Lang | Month Day Year: 09 19 89

Style F15 REV-6 LABELMASTER, Div. of AMERICAN LABELMARK CO., CHICAGO, IL 60646

EPA Form 8700-22 (Rev. 9-88) Previous editions are obsolete

PRELIMINARY SAMPLE TEST FORM

RESEARCH OIL COMPANY
2655 TRANSPORT ROAD
CLEVELAND, OHIO 44115

Rust

Bill

Michael 9/1/89

SAMPLE # 083189 - 6276
DATE RECEIVED 8/31/89

GENERATOR : NASA Sandusky
GENERATOR CONTACT :
GENERATOR EPA ID# :
GENERATOR ADDRESS :

GENERATOR TEL # :

BROKER CONTACT : P. Sacko
BROKER COMPANY : Empaco
BROKER TEL # : 659-9393

TRANSPORTER : Research
MILES ROUND TRIP :

SALES REPRESENTATIVE : RJ

SAMPLE STORAGE BOX :

WASTE DESCRIPTION : waste water diesel #2 1411-2

PROCESS GENERATING WASTE :

% OIL: 40%
% WATER: 60%
% SOLIDS:

POUNDS/GAL: 8.0
pH: 6.5
COD: ppm
PCB's:
VISCOSITY: water, #2
SOLVENT ANALYSIS: Yes (No)

LAYERED: oil on top

APPEARANCE: oil brown
water clear

ODOR: Mineral Spirits

TOTAL CHLORINATION ND
VOL CHLORINATION ND

FLASH POINT 142°F

AQUEOUS METALS: Ag As
Ba Cd ND Cr ND Cu ND
Fe Hg Ni ND Pb 0.2
Se Zn 0.5 Other(s):
ppm

ORGANIC METALS: Ag As
Ba Cd Cr Cu
Fe Hg Ni Pb
Se Zn Other(s):
ppm

DOT DESCRIPTION:
SHIPPING NAME Combustible Liquids N.O.S
HAZARD CLASS Combustible Liquids
ID NUMBER NA 1993

SAMPLE ACCEPTED ✓
SAMPLE DECLINED
TESTS PERFORMED BY AMB/KB

EPA HAZARD CODE: NONE

ESTIMATED AMOUNT 1000 gal
STORAGE TYPE

PROCESSING RECOMMENDATIONS:

SUGGESTED PRICING:

NOTES:

PRELIMINARY SAMPLE TEST FORM

RESEARCH OIL COMPANY
2655 TRANSPORT ROAD
CLEVELAND, OHIO 44115

Bill

Verbal 9/1/89

SAMPLE # 083189 - 6275H
DATE RECEIVED 8/31/89

GENERATOR : NASA Sandusky
GENERATOR CONTACT :
GENERATOR EPA ID# :
GENERATOR ADDRESS : Plumbrook Station

GENERATOR TEL # :

BROKER CONTACT : Paul Backo
BROKER COMPANY : Emporio
BROKER TEL # : 659-9393

TRANSPORTER :
MILES ROUND TRIP :

SALES REPRESENTATIVE : RJ

SAMPLE STORAGE BOX :

WASTE DESCRIPTION : waste oil & solvents #24 1411-1

PROCESS GENERATING WASTE :

% OIL: 99%
% WATER: 1%
% SOLIDS:

POUNDS/GAL: 7.5
pH:
COD: ppm
PCB's:
VISCOSITY: 23
SOLVENT ANALYSIS: Yes No

LAYERED: NONE

APPEARANCE: Brown

ODOR: Mineral oil

TOTAL CHLORINATION 0.359%
VOL CHLORINATION 0.252%

FLASH POINT >200°F

AQUEOUS METALS: Ag As Ba Cd Cr Cu Fe Hg Ni Pb Se Zn Other(s):
ppm

ORGANIC METALS: Ag As Ba Cd Cr ND Cu 7.0 Fe Hg Ni Pb 41.0 Se Zn Other(s):
ppm

DOT DESCRIPTION:
SHIPPING NAME Hazardous Waste, liquids, N.O.S.
HAZARD CLASS ORM-E
ID NUMBER NA 9189

SAMPLE ACCEPTED ✓
SAMPLE DECLINED
TESTS PERFORMED BY DDR

EPA HAZARD CODE: F002

ESTIMATED AMOUNT 725 gal
STORAGE TYPE

PROCESSING RECOMMENDATIONS: Hazardous System

SUGGESTED PRICING: Hazardous for CL

NOTES:

a. RQ =	c. RQ =	RESPONSE CENTER (800) 424-8802, AND 911 PROVIDES EMERGENCY NUMBER OR LOCAL OPERATOR. EMERGENCY CONTACT:	
b. RQ =	d. RQ =	CHEMTREC (800) 424-9300	

minutes for generators, 15 minutes and 10 minutes for treatment, storage and disposal ... DC 20460, and to the Office of Information and Regulatory, Office of Management and Budget, Washington, DC 20640."

SEE SECTION 15

Please print or type. *(Form designed for use on elite (12-pitch) typewriter.)* *Form Approved. OMB No. 2050-0039. Expires 9-30-91*

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No. 0 H 3 8 0 0 0 1 5 3 7 9 9 0 0 1 3 — Manifest Document No.

2. Page 1 of 1

Information in the shaded areas is not required by Federal law.

Generator's Name and Mailing Address: NASA - Plum Brook Station, 6100 Columbus Avenue, Sandusky OH 44870

A. State Manifest Document Number

B. State Generator's ID

4. Generator's Phone (419) 625-1123

5. Transporter 1 Company Name: Myers Chemical Transport — 6. US EPA ID Number: P A D 0 4 1 2 5 5 1 7 5

C. State Transporter's ID

D. Transporter's Phone: 412-758-5606

7. Transporter 2 Company Name — 8. US EPA ID Number

E. State Transporter's ID

F. Transporter's Phone

9. Designated Facility Name and Site Address: Envirosafe, 876 Otter Creek Rd, Oregon OH 43616 — 10. US EPA ID Number: O H D 0 4 5 2 4 3 7 0 6

G. State Facility's ID

H. Facility's Phone: 419-255-5100

11. US DOT Description (Including Proper Shipping Name, Hazard Class, and ID Number)	12. Containers No.	Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste No.
a. RQ Hazardous Waste Solid NA9189 NOS F002	001	CM	25000 (Total)	P	F002
b.					
c.					
d.					

Additional Descriptions for Materials Listed Above: PCN 2123 AT

K. Handling Codes for Wastes Listed Above

15. Special Handling Instructions and Additional Information: 13.06T 26120P.

AGENCY DISPLAY OF ESTIMATED BURDEN

"Public reporting burden for this collection of information is estimated to average: 37 minutes for generators, 15 minutes for transporters, and 10 minutes for treatment, storage and disposal facilities. This includes time for reviewing instructions, gathering data and completing and reviewing the form. Send comments regarding the burden estimate, including suggestions for reducing this burden, to: Chief, Information Policy Branch, PM-223, U.S. Environmental Protection Agency, 401 M Street, SW., Washington, DC 20460; and to the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503."

16. **GENERATOR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

GENERATOR — Printed/Typed Name: Amy L. Bower — Signature: Amy L. Bower — Month Day Year: 03 09 90

TRANSPORTER — 17. Transporter 1 Acknowledgement of Receipt of Materials — Printed/Typed Name: X Donnie Jenkins — Signature: Donnie Jenkins — Month Day Year: 03 09 90

18. Transporter 2 Acknowledgement of Receipt of Materials — Printed/Typed Name — Signature — Month Day Year

FACILITY — 19. Discrepancy Indication Space

Facility Owner or Operator Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19. — Printed/Typed Name: Jerry Tickle — Signature — Month Day Year: 3 9 90

EPA Form 8700-22 (Rev. 9-88) Previous editions are obsolete. #1 - GENERATOR ORIGINAL COPY

a. RQ =	c. RQ =	EMERGENCY NUMBER OR LOCAL OPERATOR. EMERGENCY CONTACT:	
b. RQ =	d. RQ =	CHEMTREC (800) 424-9300	

SEE SECTION 15

minutes for generators, 15 minutes and 10 minutes for treatment, storage and disposal ... DC 20460; and to the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20640."

Please print or type. *(Form designed for use on elite (12-pitch) typewriter.)* *Form Approved. OMB No. 2050-0039. Expires 9-30-88* 91

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No. OH38000153799 Manifest Document No. 0014
2. Page 1 of 1
Information in the shaded areas is not required by Federal law.

3. Generator's Name and Mailing Address
NASA - Plum Brook Station
6100 Columbus Avenue
Sandusky, OH 44870

4. Generator's Phone (419) 625-1123

A. State Manifest Document Number
B. State Generator's ID

5. Transporter 1 Company Name: Myers Chemical Transport
6. US EPA ID Number: PAD041255175
C. State Transporter's ID
D. Transporter's Phone 412-758-5606

7. Transporter 2 Company Name
8. US EPA ID Number
E. State Transporter's ID
F. Transporter's Phone

9. Designated Facility Name and Site Address
Envirosafe
876 Otter Creek Rd
Oregon OH 43616
10. US EPA ID Number: OHD045243706
G. State Facility's ID
H. Facility's Phone 419-255-5100

GENERATOR

11. US DOT Description (Including Proper Shipping Name, Hazard Class, and ID Number)	12. Containers No.	Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste No.
a. RQ Hazardous Waste Solid NA9189 NOS F002	001	CM	26000	P	F002
b.					
c.					
d.					

J. Additional Descriptions for Materials Listed Above
PCN 2123 AT

K. Handling Codes for Wastes Listed Above
D81

15. Special Handling Instructions and Additional Information
12.87T 2574OP

AGENCY DISPLAY OF ESTIMATED BURDEN
"Public reporting burden for this collection of information is estimated to average: 37 minutes for generators, 15 minutes for transporters, and 10 minutes for treatment, storage and disposal facilities. This includes time for reviewing instructions, gathering data, and completing and reviewing the form. Send comments regarding the burden estimate, including suggestions for reducing this burden, to: Chief, Information Policy Branch, PM-223, U.S. Environmental Protection Agency, 401 M Street, SW., Washington, DC 20460; and to the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503."

16. **GENERATOR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name: Amy L. Bower
Signature: Amy L. Bower
Month Day Year: 03 09 90

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials
Printed/Typed Name: X Richard M. Reiser
Signature: Richard M Reiser
Month Day Year: 03 09 90

18. Transporter 2 Acknowledgement of Receipt of Materials
Printed/Typed Name
Signature
Month Day Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19
Printed/Typed Name: Jerry Pickle
Signature
Month Day Year: 03 10 90

EPA Form 8700-22 (Rev. 9-88) Previous editions are obsolete.

#1 - GENERATOR ORIGINAL COPY

a. RQ =	c. RQ =	EMERGENCY NUMBER OR LOCAL OPERATOR. EMERGENCY CONTACT:	
b. RQ =	d. RQ =	CHEMTREC (800) 424-9300	

SEE SECTION 15

DC 20460; and to the Office of Information and Regulatory, Office of Management and Budget, Washington, DC 20640."

Please print or type. *(Form designed for use on elite (12-pitch) typewriter.)* *Form Approved. OMB No 2050-0039 Expires 9-30-88* 91

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No: OH3800015379 Manifest Document No: 001 15
2. Page 1 of 1
Information in the shaded areas is not required by Federal law

3. Generator's Name and Mailing Address: NASA-Plum Brook Station, 6100 Columbus Avenue, Sandusky OH 44870
4. Generator's Phone (419) 625-1123

A. State Manifest Document Number
B. State Generator's ID

5. Transporter 1 Company Name: Myers Chemical Transport
6. US EPA ID Number: PAD041255175
C. State Transporter's ID
D. Transporter's Phone: 412-758-5606

7. Transporter 2 Company Name
8. US EPA ID Number
E. State Transporter's ID
F. Transporter's Phone

9. Designated Facility Name and Site Address: Envirosafe, 876 Otter Creek Rd, Oregon OH 43616
10. US EPA ID Number: OHD045243706
G. State Facility's ID
H. Facility's Phone: 419-255-5100

11. US DOT Description (Including Proper Shipping Name, Hazard Class, and ID Number)	12. Containers No.	Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste No.
a. RQ Hazardous Waste Solid NA 9189 NOS F002	001	CM	Est. 26000	P	F002
b.					
c.					
d.					

GENERATOR

Additional Descriptions for Materials Listed Above: PCN 2123 AT

K. Handling Codes for Wastes Listed Above: S01 I D81

15. Special Handling Instructions and Additional Information: 12.97 T 25940 P

AGENCY DISPLAY OF ESTIMATED BURDEN
"Public reporting burden for this collection of information is estimated to average: 37 minutes for generators, 15 minutes for transporters, and 10 minutes for treatment, storage and disposal facilities. This includes time for reviewing instructions, gathering data, and completing and reviewing the form. Send comments regarding the burden estimate, including suggestions for reducing this burden, to: Chief, Information Policy Branch, PM-223, U.S. Environmental Protection Agency, 401 M Street, SW., Washington, DC 20460; and to the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503."

16. **GENERATOR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name: Amy L. Bower — Signature: Amy L. Bower — Month Day Year: 03 12 90

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials
Printed/Typed Name: DONNIE JENKINS — Signature: Donnie Jenkins — Month Day Year: 03 12 90

18. Transporter 2 Acknowledgement of Receipt of Materials
Printed/Typed Name — Signature — Month Day Year

FACILITY

19. Discrepancy Indication Space

Facility Owner or Operator Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19
Printed/Typed Name: JEFF HARDING — Signature: Jeff Harding — Month Day Year: 03 12 90

EPA Form 8700-22 (Rev. 9-88) Previous editions are obsolete

FOR ORIGINAL COPY

a. RQ =	c. RQ =	EMERGENCY NUMBER OR LOCAL OPERATOR. EMERGENCY CONTACT:	
b. RQ =	d. RQ =	CHEMTREC (800) 424-9300	

SEE SECTION 15

DC 20460, and to the Office of Information and Regulatory, Office of Management and Budget, Washington, DC 20640"

Please print or type. *(Form designed for use on elite (12-pitch) typewriter.)*

Form Approved. OMB No. 2050-0039 Expires 9-30-86 91

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No. OH3800015379 Manifest Document No. 01 6

2. Page 1 of 1

Information in the shaded areas is not required by Federal law

3. Generator's Name and Mailing Address: NASA - Plum Brook Station, 6100 Columbus Avenue, Sandusky OH 44870

4. Generator's Phone (419) 625-1123

A. State Manifest Document Number

B. State Generator's ID

5. Transporter 1 Company Name: Myers Chemical Transport

6. US EPA ID Number: PAD041255175

C. State Transporter's ID

D. Transporter's Phone: 412-758-5606

7. Transporter 2 Company Name

8. US EPA ID Number

E. State Transporter's ID

F. Transporter's Phone

9. Designated Facility Name and Site Address: Envirosafe, 876 Otter Creek Rd, Oregon OH 43616

10. US EPA ID Number: OHD045243706

G. State Facility's ID

H. Facility's Phone: 419-255-5100

11. US DOT Description (Including Proper Shipping Name, Hazard Class, and ID Number)	12. Containers No.	Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste No.
a. RQ Hazardous Waste Solid NA9189 NOS F002	001	CM	Est. 26000	P	F002
b.					
c.					
d.					

J. Additional Descriptions for Materials Listed Above: PCN 2123 AT

K. Handling Codes for Wastes Listed Above: See ID81

15. Special Handling Instructions and Additional Information: 1629 T 32580

AGENCY DISPLAY OF ESTIMATED BURDEN

"Public reporting burden for this collection of information is estimated to average: 37 minutes for generators, 15 minutes for transporters, and 10 minutes for treatment, storage and disposal facilities. This includes time for reviewing instructions, gathering data, and completing and reviewing the form. Send comments regarding the burden estimate, including suggestions for reducing this burden, to: Chief, Information Policy Branch, PM-223, U.S. Environmental Protection Agency, 401 M Street, SW., Washington, DC 20460; and to the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503."

16. **GENERATOR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

GENERATOR

Printed/Typed Name: Amy L. Bower — Signature: Amy L. Bower — Month Day Year: 03 12 90

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name: Donnie Jenkins — Signature: Donnie Jenkins — Month Day Year: 03 12 90

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name — Signature — Month Day Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19

Printed/Typed Name: JEFF HARDING — Signature: Jeff Harding — Month Day Year: 03 12 90

EPA Form 8700-22 (Rev. 9-88) Previous editions are obsolete

ORIGINAL COPY

LAND DISPOSAL NOTIFICATION AND CERTIFICATION FORM

GENERATOR NAME NASA PLUM BROOK STATION PCN 2123AT

USEPA I.D. NO. OH3 8000/5379 MDOC. NO.

WASTE DESCRIPTION F002 CONTAM. SOIL EPA CODES F002

The generator named above hereby provides the following NOTIFICATION as required by 40 CFR 268.7 that the waste material being shipped under the above Manifest Document Number is subject to land disposal restrictions:

A [ ] § 268.7(a)(1): The waste does not meet the applicable treatment standards in 40 CFR 268 Subpart D and/or exceeds the applicable prohibition levels in 40 CFR 268.32 or RCRA § 3004(d) [California List] and may not be land disposed until it meets the standards listed below (or on the attached sheet).

B [X] § 268.7(a)(2): The waste meets the applicable treatment standards in 40 CFR 268 Subpart D and/or the applicable prohibition levels in 40 CFR 268.32 or RCRA § 3004(d) [California List] and may be land disposed without additional treatment.

C [ ] § 268.7(a)(3): The waste is subject to a § 268.5 exemption, a § 268.6 extension or a nationwide variance under 40 CFR 268 Subpart C and may be land disposed without additional treatment. The waste would otherwise be subject to the treatment standards listed below or on the attached sheet (per 40 CFR 268 Subpart D and/or 40 CFR 268.32 or RCRA § 3004(d) [California List]). The Exemption, Extension or Variance will remain in effect until the date indicated in the following Notification.

D [ ] § 268.7(a)(4): The waste is subject to the "Soft Hammer" prohibitions under 40 CFR 268.33(f) and is not subject to the prohibitions of 40 CFR 268.32 or RCRA § 3004(d) [California List]). The requirements of 40 CFR 268.8 have been met as indicated in the following Certification and the waste may be land disposed without additional treatment.

The generator named above hereby provides the following NOTIFICATION and/or CERTIFICATION as required by 40 CFR 268 that is applicable to the waste material being shipped under the above Manifest Document Number:

1 [ ] This waste is exempt from land disposal restrictions per 40 CFR 268.30 (a)(3) until November 8, 1988. *[Less than 1 % F001-F005 solvent exemption]*

2 [ ] This waste is exempt from land disposal restrictions per 40 CFR 268.30 (a)(1) until November 8, 1988. *[F001-F005 small quantity generator 100-1000 kg per month]*

3 [ ] This waste is exempt from land disposal restrictions per 40 CFR 268.32 (a) until November 8, 1988. *[HOC Solids greater than 1000 mg/Kg, HOC Liquids greater than 10,000 mg/L]*

4 [ ] This waste is exempt from land disposal restrictions per 40 CFR 268.1 (c)(3) or 268.30(a)(2) until November 8, 1988. *[General RCRA/CERCLA corrective action exemption]*

5 [ ] This waste is exempt from land disposal restrictions per 40 CFR 268.32 (d)(1) until July 8, 1989. *[California List Non-RCRA/CERCLA soil/debris exemption]*

6 [ ] This waste is exempt from land disposal restrictions per 40 CFR 268.30(c) or 268.32 (d)(2) until November 8, 1990. *[F001-F005 or California List RCRA/CERCLA soil/debris corrective action exemption]*

7 [ ] This waste is exempt from land disposal restrictions per 40 CFR 268.33 (b) until August 8, 1990. *[K048-52, K071 codes with 2 year variance from treat standards]*

8 [ ] This waste is exempt from land disposal restrictions per 40 CFR 268.33 (c) until August 8, 1990. *[Contaminated Soil & Debris with BDAT of Incineration]*

9 [ ] This waste is exempt from land disposal restrictions per 40 CFR 268.1 (c)(1) or 268.1 (c)(2) until _____. *[268.5 Exemption or 268.6 Extension]*

10 [X] § 268.7(a)(2)(ii): I certify under penalty of law that I personally have examined and am familiar with the waste through analysis and testing or through knowledge of the waste to support this certification that the waste complies with the treatment standards specified in 40 CFR Part 268 Subpart D and all applicable prohibitions set forth in 40 CFR 268.32 or RCRA section 3004(d). I believe that the information I submitted is true, accurate and complete. I am aware that there are significant penalties for submitting a false certification, including the possibility of a fine and imprisonment. *[Meets applicable California and Subpart D land-ban treatment standards in present form without additional treatment and may be land disposed]*

11 [ ] § 268.7(b)(2)(i): I certify under penalty of law that I have personally examined and am familiar with the treatment technology and operation of the treatment process used to support this certification and that, based on my inquiry of those individuals immediately responsible for obtaining this information, I believe that the treatment process has been operated properly so as to comply with the performance levels specified in 40 CFR Part 268 Subpart D and all applicable prohibitions set forth in 40 CFR 268.32 or RCRA section 3004(d) without dilution of the prohibited waste. I am aware that there are significant penalties for submitting a false certification, including the possibility of fine and imprisonment. *[Treatment has been performed and waste meets applicable California and Subpart D land-ban treatment standards; TCLP or Concentration]*

12 [ ] § 268.7(b)(2)(ii): I certify under penalty of law that the waste has been treated in accordance with 40 CFR 268.42. I am aware that there are significant penalties for submitting a false certification, including the possibility of fine and imprisonment. *[Has been treated using the required treatment technology]*

13 [ ] § 268.8(a)(2)(i): I certify under penalty of law that the requirements of 40 CFR 268.8(a)(1) have been met and that disposal in a landfill or surface impoundment is the only practical alternative to treatment currently available. I believe that the information submitted is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. *[Certification for land disposal of "Soft Hammer" wastes in 40 CFR 268.10, 268.11 and 268.12]*

14 [ ] § 268.12(a - e): This waste is exempt from land disposal restrictions per 40 CFR 268.12 until May 8, 1990. *[Leachate,etc and residues derived therefrom to be evaluated with the "third Third" per 40 CFR 268.12.]*

89-6.1

Signature _____ Date _____