

FINAL

Confirmation Sampling and Analysis Report for SWMU 55 (IRP Site FT-03)



**Charleston Air Force Base
South Carolina**

Prepared For

**Air Force Center for Environmental Excellence
Brooks Air Force Base,
Texas**

and

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**437 CES/CEVR
Charleston Air Force Base,
South Carolina**

April 1999

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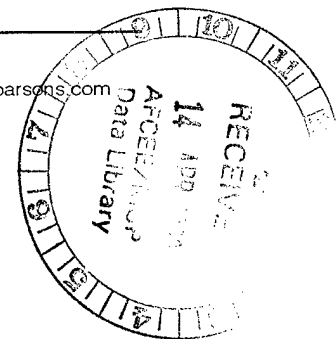
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TC
ERT



12 April 1999

Major Ed Marchand
AFCEE/ERT
3207 North Road, Bldg. 532
Brooks AFB, Texas 78235-5363

Subject: Final Confirmation Sampling and Analysis Report for SWMU 55 (IRP Site FT-03),
Charleston Air Force Base, South Carolina (Contract F41624-92-D-8036, Order 17)

Dear Major Marchand:

Please find enclosed three (3) copies of the Final Confirmation Sampling and Analysis Report for Solid Waste Management Unit (SWMU) 55 (IRP Site FT-03), Charleston Air Force Base (AFB), South Carolina. This final report was prepared by Parsons Engineering Science, Inc. (Parsons ES) for the Air Force Center for Environmental Excellence, Technology Transfer Division (AFCEE/ERT) and the 437th Civil Engineering Squadron, Environmental Group (437 CES/CEVR) at Charleston AFB. Copies of this final report have also been sent to Mr. Al Urrutia at the 437 CES/CEVR. Comments received from AFCEE/ERT and the 437 CES/CEVR have been incorporated into this final report. This is the final deliverable for SWMU 55 under the AFCEE Extended Bioventing Project.

Should you have any questions regarding this deliverable, please feel free to call Mr. Ted Hartfelder or Mr. John Ratz at (303) 831-8100.

Sincerely,
PARSONS ENGINEERING SCIENCE, INC.

Ted Hartfelder
Site Manager

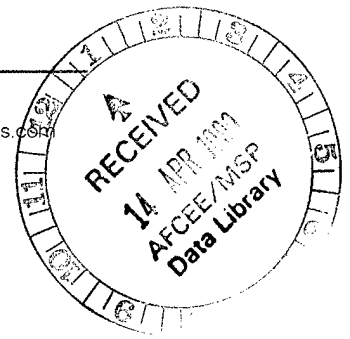
John Ratz, P.E.
Project Manager

Enclosures

cc: Mr. Al Urrutia, 437 CES/CEVR (3 copies)
Mr. Steve Ratzlaff, Parsons ES-Atlanta
Mr. Steve Czekalski, Parsons ES-Cary
File 726876.28123.M
File 726876.01000.H (letter of transmittal only)

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12 April 1999

Major Ed Marchand
AFCEE/ERT
3207 North Road, Bldg. 532
Brooks AFB, TX 78235-5363

Subject: Response to Comments on the Draft Confirmation Sampling and Analysis Report for SWMU 55 (IRP Site FT-03), Charleston Air Force Base, South Carolina (Contract F41624-92-D-8036, Order 17)

Dear Major Marchand:

This letter has been written to provide a response to comments received on the Draft Confirmation Sampling and Analysis Report for Solid Waste Management Unit 55 (Installation Restoration Program [IRP] Site FT-03), Charleston Air Force Base (AFB), South Carolina. The draft report was prepared by Parsons Engineering Science, Inc. (Parsons ES) for the Air Force Center for Environmental Excellence, Technology Transfer Division (AFCEE/ERT), Brooks AFB, Texas. Copies of the draft report were provided on 08 March 1999 to Major Ed Marchand at AFCEE/ERT and Mr. Al Urrutia, 437th Civil Engineering Squadron, Environmental Group (437 CES/CEVR), Charleston AFB.

The following are Parsons ES' responses to comments received from Major Ed Marchand (AFCEE/ERT) and Mr. Bo Camp (437 CES/CEVR) on the subject SAP.

Responses to AFCEE/ERT Comments: 17 March 1999 e-mail from Major Ed Marchand to Mr. John Ratz (Parsons ES).

Comment 1) 1) Page 1-7, Section 1.2.5, second line. Change from "by AFCEE" to "through AFCEE". 2) End of same paragraph. If the only location for the data is in the 30 October 1997 letter, then include it as an Appendix.

Parsons ES Response: 1) The requested change will be incorporated into the final report. 2) This data is also summarized in the *Draft Final Confirmation Soil Sampling and Analysis Plan for SWMU 55 (IRP Site FT-03)*, provided as Appendix A of the Confirmation Sampling Report. Reference to this fact will be incorporated into the final report.



- Comment 2) Page 1-10, top of page. Need to add short summary of results either as a new paragraph or to the end of the existing one.

Parsons ES Response: The following text will be incorporated into the final report: "Following expanded-scale bioventing treatment, soil gas TVH and BTEX concentrations decreased at all the MPs. The greatest reduction was observed at location MPH, where TVH and BTEX concentrations were reduced by 99.6 and 97.6 percent, respectively. At MPE where "tight" soils are present, TVH and BTEX concentrations were reduced by 67.0 and 59.7 percent, respectively. All locations, with the exception of MPE and MPG, experienced TVH concentrations reductions to below 1,000 ppmv. These data indicate that although TVH levels at SWMU 55 remain relatively elevated (above 1,000 ppmv) at two locations, both TVH and BTEX compounds are being biodegraded during bioventing system operation.

Low oxygen and high TVH concentrations were measured in soil gas samples collected from MPs on the south side of the site, indicating the presence of widespread vapor-phase contamination and anaerobic conditions. Soil gas samples collected from MPs on the north side of the burn area had significantly higher oxygen concentrations. Although the north side of the burn area had undergone bioventing treatment prior to operating the expanded bioventing system, limited oxygen utilization, indicative of microbial biorespiration, was still occurring in these soils. During June 1998, fuel biodegradation rates ranged from 220 mg/kg/year at MPI, to 1,940 mg/kg/year at MPE. The very low biodegradation rates at most locations correspond to the low TVH concentrations at these locations."

- Comment 3) Page 2-3, third line above Section 2.2. Need to add "in a headspace sample" between "VOC reading" and "of 819 ppmv".

Parsons ES Response: The recommended change will be incorporated into the final report.

- Comment 4) Page 2-3, first line of text in Section 2.2.1. Change "was" to "were".

Parsons ES Response: The recommended change will be incorporated into the final report.

- Comment 5) Page 2-4,5. What was the plastic sheeting used for? Was it throughout the site? The text indicates that the patch was not sealed, but just laid on the original sheeting. Is this true? Did that follow the specifications for the site?

Parsons ES Response: The plastic sheeting in conjunction with a covering of four to six inches of residual soil make up a "composite" cover which limits the infiltration of precipitation into subsurface soils within the immediate vicinity of the horizontal vent well, and increases the area of influence of VW-2. This cover is only located over the horizontal vent within the southern portion of the site. The cover is constructed atop the ground surface and extends approximately 16 feet on each side of the horizontal vent well. Where penetrated during confirmation sampling, the cover system was repaired by 1) exposing the original sheeting within the immediate vicinity of the penetration, 2) placing a 6-foot square patch of 6-mil plastic sheeting over the penetration and adjoining sheeting, and 3) covering with approximately 4 to 6 inches of residual soil. In accordance with the project-specific operations and maintenance manual, these penetrations would have ideally been repaired by allowing for a five feet overlap (an approximately 100-foot square patch). Given that each penetration was approximately 3 inches in diameter and along the outer edge of the cover, the implemented repair is both technically and economically appropriate. No modifications to the report text will be made.

Comment 6) Page 3-14. The ITS issue is still not resolved? Any idea of impact? Are they still working on it?

Parsons ES Response: The ITS issue is not resolved yet, and it may be a long time before the Method SW8260 data at Charleston AFB and Maxwell AFB is reevaluated. ITS has informed Parsons that the schedule for reevaluating the aforementioned data has now been pushed back from the previous scheduled date of March 1999 to June 1999 due to reevaluation of data on other projects. Based on a comparison of the analytical data reported by ITS against field observations/measurements and historical data, Parsons believes that the data provided by ITS is relatively accurate. As an example, in the final Maxwell AFB, Gunter Annex Site ST-001 report, analyte concentrations provided by ITS fit the observed trend in contaminant reduction very well at GMW-4 (see Figure 4.1 of the final report for the Maxwell site). No changes have been made to the final report.

Comment 7) 1) Page 3-15, second line from the top. There is no indication anywhere that free-phase or even a sheen exists at the site is there? The inference is that it is "out there" and we just haven't found it. This needs to be corrected. Recommend removing "free-phase or" from the text. 2) At the end of the page, suggest adding "which are in an area that has only been subjected to bioventing for 1.5 years" at the end of the sentence.

Parsons ES Response: 1) Correct, a review of project field records confirms that there has never been visible evidence of free-phase

petroleum hydrocarbons at the project site. The recommended change will be incorporated into the final report. 2) This recommended change will also be incorporated into the final report.

Comment 8) Page 4-1, fourth line from the bottom of the first paragraph. Recommend replacing "throughout some" with "at portions".

Parsons ES Response: The recommended change will be incorporated into the final report.

In addition to the above, Parsons ES performed a data quality assessment of the laboratory analytical results. The data quality assessment report has been included as Appendix C of the final report. The assessment indicated that no data should be rejected based on the validation, and that all data are usable for the purposes intended.

Responses to Charleston AFB Comments: 30 March 1999 phone communication between Bo Camp (437 CES/CEVR) and Mr. John Ratz (Parsons ES).

Comment 1) Reword both the report and sampling and analysis plan (Appendix A) text to remove references to lengths of system operation (i.e., globally replace "4.5 years of pilot-scale system operation" with "pilot-scale operation", and replace "1.5 years of expended-scale system operation" with "expanded-scale system operation").

Parsons ES Response: The requested modifications will be incorporated into the final report.

Comment 2) Page 1-2, Section 1.2.1, third line. Replace "burn pit" with "burn area".

Parsons ES Response: The requested modification will be incorporated into the final report.

Comment 3) Page 1-3. Update Figure 1.1. The figure is hard to read and is out of date. For example, Charleston Municipal Airport (shown on Figure 1.1) was taken down years ago.

Parsons ES Response: The requested modification will be incorporated into the final report.

Comment 4) Page 2-1, Section 2.1. Delete from "Depth of water..." to the end of the paragraph.

Parsons ES Response: The requested modification will be incorporated into the final report.

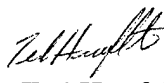
Major Ed Marchand
12 April 1999
Page 5

Comment 5) Page 2-4, second paragraph, last line. Correct the spelling of "photoionization".

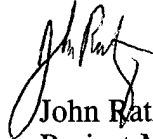
Parsons ES Response: The recommended change will be incorporated into the final report.

Parsons ES will be preparing the final version of the Confirmation Sampling and Analysis Report for SWMU 55 which will conform to the comments and responses provided above. Should you require further clarification or have additional questions, please feel free to call Mr. Ted Hartfelder or Mr. John Ratz at (303) 831-8100.

Sincerely,
PARSONS ENGINEERING SCIENCE, INC.



Ted Hartfelder
Site Manager



John Ratz, P.E.
Project Manager

cc: Al Urrutia, 437 CES/CEVR
File: 726876.28123.K

FINAL

**CONFIRMATION SAMPLING AND ANALYSIS REPORT
FOR SWMU 55 (IRP SITE FT-03)
CHARLESTON AIR FORCE BASE, SOUTH CAROLINA**

Prepared for:

**Air Force Center for Environmental Excellence
Brooks AFB, Texas**

and

**437 CES/CEVR
Charleston Air Force Base AFB, South Carolina
Contract F41624-92-8036, Delivery Order 17**

April 1999

Prepared by:

**Parsons Engineering Science, Inc.
1700 Broadway, Suite 900
Denver, Colorado 80290**

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ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CES/CEVR	Civil Engineering Squadron, Environmental Group
CMS	Corrective Measures Study
COC	constituent of concern
DRO	diesel-range organics
ES	Engineering-Science, Inc.
GRO	gasoline-range organics
hp	horsepower
IRP	Installation Restoration Program
$\mu\text{g}/\text{kg}$	micrograms per kilogram
mg/kg	milligrams per kilogram
MP	monitoring point
PAH	polynuclear aromatic hydrocarbon
Parsons ES	Parsons Engineering Science, Inc.
ppmv	parts per million, volume per volume
QA/QC	quality assurance/quality control
Radian	Radian International, LLC
RCRA	Resource and Conservation Recovery Act
RFI	RCRA Facility Investigation
RPD	relative percent difference
SAI	Specialized Assays, Inc.
SAIC	Science Applications International Corporation
SAP	sampling and analysis plan
SCDHEC	South Carolina Department of Health and Environmental Control
SWMU	solid waste management unit
TMB	trimethylbenzene
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
TVH	total volatile hydrocarbons
USEPA	US Environmental Protection Agency
VOC	volatile organic compound
VW	vent well

SECTION 1

INTRODUCTION

1.1 PURPOSE

This confirmation sampling and analysis report for solid waste management unit (SWMU) 55 at Charleston Air Force Base (AFB), South Carolina, was prepared by Parsons Engineering Science, Inc. (Parsons ES, formerly known as Engineering-Science, Inc. [ES]) for submittal to the US Air Force Center for Environmental Excellence (AFCEE), Brooks AFB, Texas, and the 437 Civil Engineering Squadron, Environmental Group (CES/CEVR), Charleston AFB, South Carolina. SWMU 55, a former fire training area, is also known as Installation Restoration Program (IRP) Site FT-03, and has been referenced as such in many previous documents related to the investigation and remediation of the site. This report has been prepared as part of the AFCEE Extended Bioventing Project (Contract F41624-92-8036, Delivery Order 17).

The purposes of this report are to 1) present the results of confirmation soil sampling performed at the site in January 1999, 2) assess the degree of soil remediation that has occurred as a result of pilot-scale and expanded-scale bioventing system operation, and 3) evaluate the need for continued bioventing. Confirmation soil sampling was conducted to assess the effectiveness of pilot-scale and expanded-scale bioventing treatment in reducing the concentrations of petroleum hydrocarbons in near-surface soils. In preparation for the confirmation soil sampling, a site-specific sampling and analysis plan (SAP) was prepared by Parsons ES (Parsons ES, 1998a). A copy of this SAP is provided as Appendix A.

A draft final corrective measures study (CMS) has been prepared for the site by Radian International, LLC (Radian, 1998). The CMS concluded that there are no constituents of concern (COCs) in vadose zone soils at the site. Although a dissolved contaminant plume originating at the site may require remedial action, this project addresses only the vadose zone soils at SWMU 55. The CMS is currently being reviewed by the South Carolina Department of Health and Environmental Control (SCDHEC), and regulatory approval of the CMS has not yet been granted. The SCDHEC regulates compliance with the Resource Conservation and Recovery Act (RCRA) program under which SWMU 55 is listed on Charleston AFB's RCRA Part B Permit.

1.2 SITE AND PROJECT BACKGROUND

1.2.1 Site Description and Background

SWMU 55 is located in the extreme southeastern part of Charleston AFB (Figure 1.1). The 2-acre site was once used for controlled burning of flammable wastes during Base fire training exercises. During its operation, the facility consisted of one burn area lined with limestone gravel and surrounded by an earthen berm. A steel tank used as a mock aircraft was located inside the burn area, and a concrete building was located outside the burn area at the southwestern corner of the site (Figure 1.2). During fire training exercises, flammable liquids were sprayed onto these structures and the ground, ignited, and then extinguished using various agents such as aqueous film-forming foam, and dry chemicals. It is reported that JP-4 jet fuel was the primary flammable liquid burned at the site; however, it is believed that other industrial wastes may have been burned when the facility was first established (Halliburton NUS, 1995).

The site has not been used for fire training exercises since the early 1980s, and is currently overgrown and heavily wooded around its perimeter. The steel tank, concrete building, and remnants of the earthen berm are still present at the site. Remnants of the berm hindered surface drainage from the burn area, which often contained several inches of water after precipitation events. A channel was cut in the berm in 1997 to facilitate drainage and to enhance the effectiveness of the installed bioventing system (Parsons ES, 1997a and 1997b).

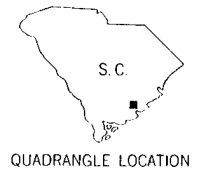
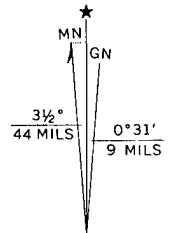
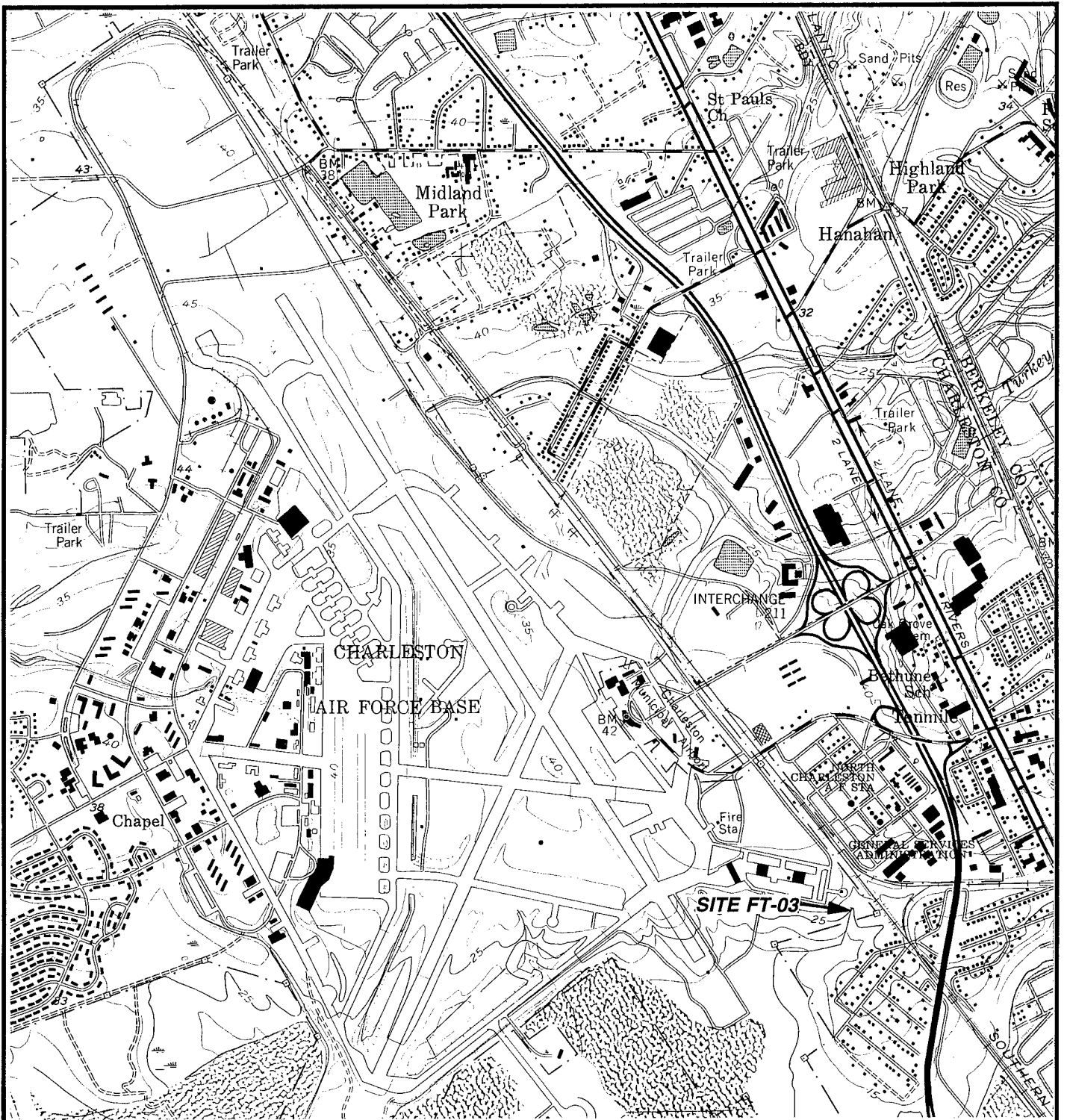
1.2.2 Site Geology and Hydrogeology

Soils beneath SWMU 55 are primarily silty sands with traces of silt and clay. Fill material consisting of silt, sand, and crushed aggregate is encountered within the berm that surrounds the burn area (Halliburton NUS, 1995). Groundwater beneath the site is encountered in the unconfined alluvial aquifer at an average depth of 4 feet below ground surface (bgs). Precipitation is the primary mode of shallow aquifer recharge at the site. The water table fluctuates in response to precipitation and exhibits seasonal elevation changes. After extended periods of precipitation, the water table has been observed at less than 2 feet bgs in the burn area (ES, 1993). The predominant direction of shallow groundwater flow is to the south and southeast toward a tributary of Filbin Creek. Potentiometric maps provided in the CMS indicate little seasonal variation in groundwater flow direction (Radian, 1998).

1.2.3 Previous Investigations

Multiple investigations conducted at Charleston AFB have addressed SWMU 55. These investigations are discussed briefly in this section. Further information regarding these investigations is provided in the Draft Final Confirmation SAP (Appendix A).

Two phases of a remedial investigation were executed by Science Applications International Corporation (SAIC) and by Versar, Inc. at SWMU 55 from 1985 through 1990 (Versar, Inc., 1992). Field activities performed during the investigation included



QUADRANGLE LOCATION

UTM GRID AND 1979 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Source: USGS, 1958 (Photorevised 1979).

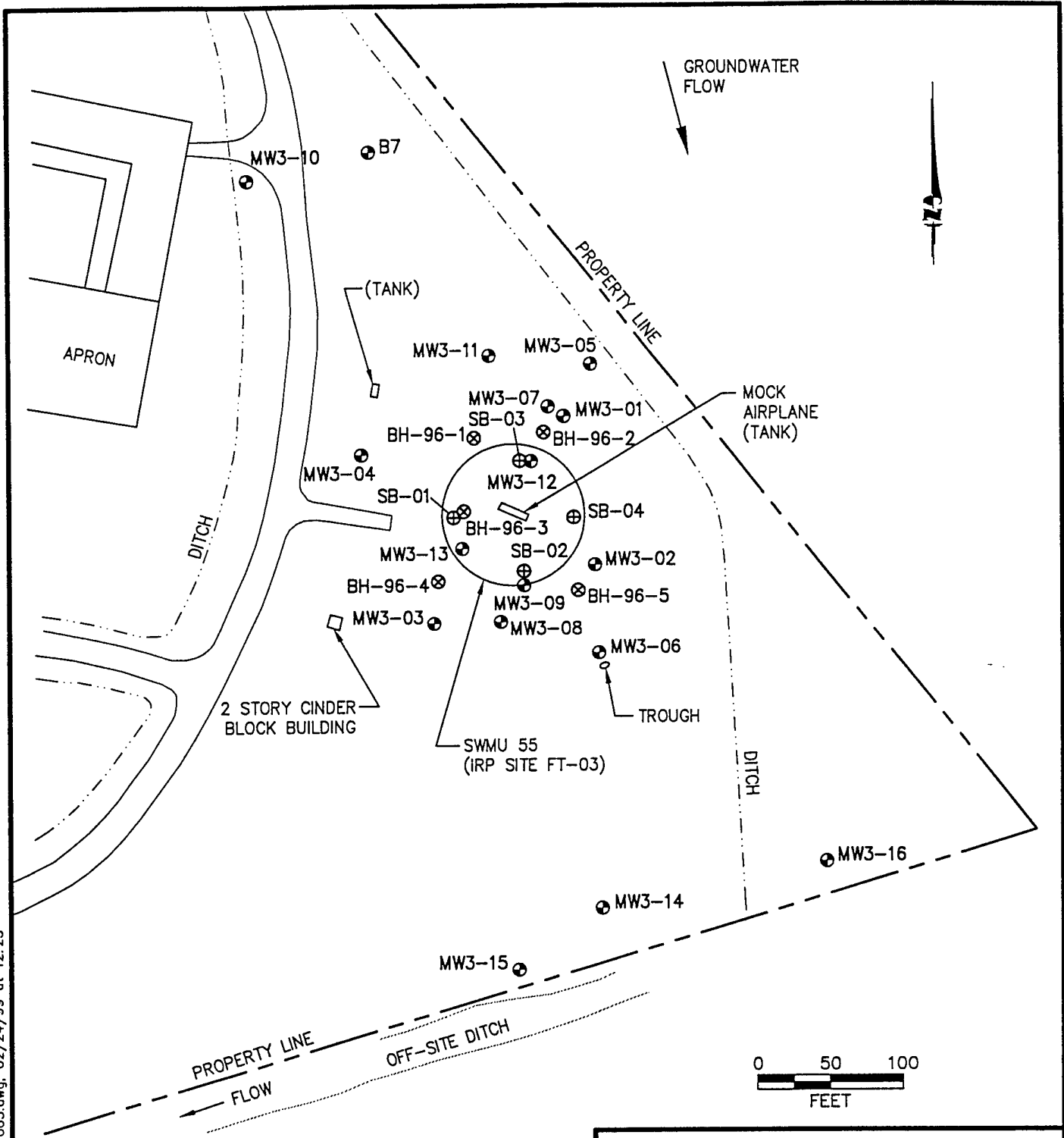
FIGURE 1.1

SITE LOCATION

SWMU 55 (IRP Site FT-03)
Charleston AFB, South Carolina

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado



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- LEGEND**
- MW3-16 ● GROUNDWATER MONITORING WELL
 - BH-96-5 ⊗ SOIL BORING/SAMPLING LOCATION (PARSONS ES, FEB. 1997)
 - SB-01 ⊕ SOIL BORING/SAMPLING LOCATION (RADIAN, NOV. 1996)

Map and Data Source: Radian, 1998
(Modified by Parsons ES)

FIGURE 1.2

SITE LAYOUT

SWMU 55 (IRP Site FT-03)
Charleston AFB, South Carolina

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Denver, Colorado

installation and sampling of groundwater monitoring wells MW3-1 through MW3-7 (Figure 1.2), aquifer testing, soil sampling, sediment sampling, surface water sampling, and a soil gas survey. Near-surface soil samples collected during the investigation exhibited total recoverable petroleum hydrocarbon (TRPH) concentrations as high as 7,770 milligrams per kilogram (mg/kg).

From 1992 through 1994, additional soil, sediment, and groundwater sampling and aquifer testing were conducted by Halliburton NUS as part of a base-wide RCRA Facility Investigation (RFI) (Halliburton, 1995). Three additional groundwater monitoring wells, designated MW3-8, MW3-9, and B-7 (Figure 1.2), were installed at SWMU 55 during this time.

Radian completed additional RFI activities and conducted a CMS for SWMU 55 in 1996 and 1997 (Radian, 1998). This investigation filled data gaps and completed the RFI investigations at the site. Additional soil and groundwater investigations were conducted at the site, including a groundwater screening survey using direct-push technology sampling methods. Seven additional groundwater monitoring wells, designated MW3-10 through MW3-16 (Figure 1.2), were installed and sampled during this time. Surface and subsurface soil samples were collected at locations SB-01 through SB-04 (Figure 1.2) within the historical burn area in November 1996 during the RFI.

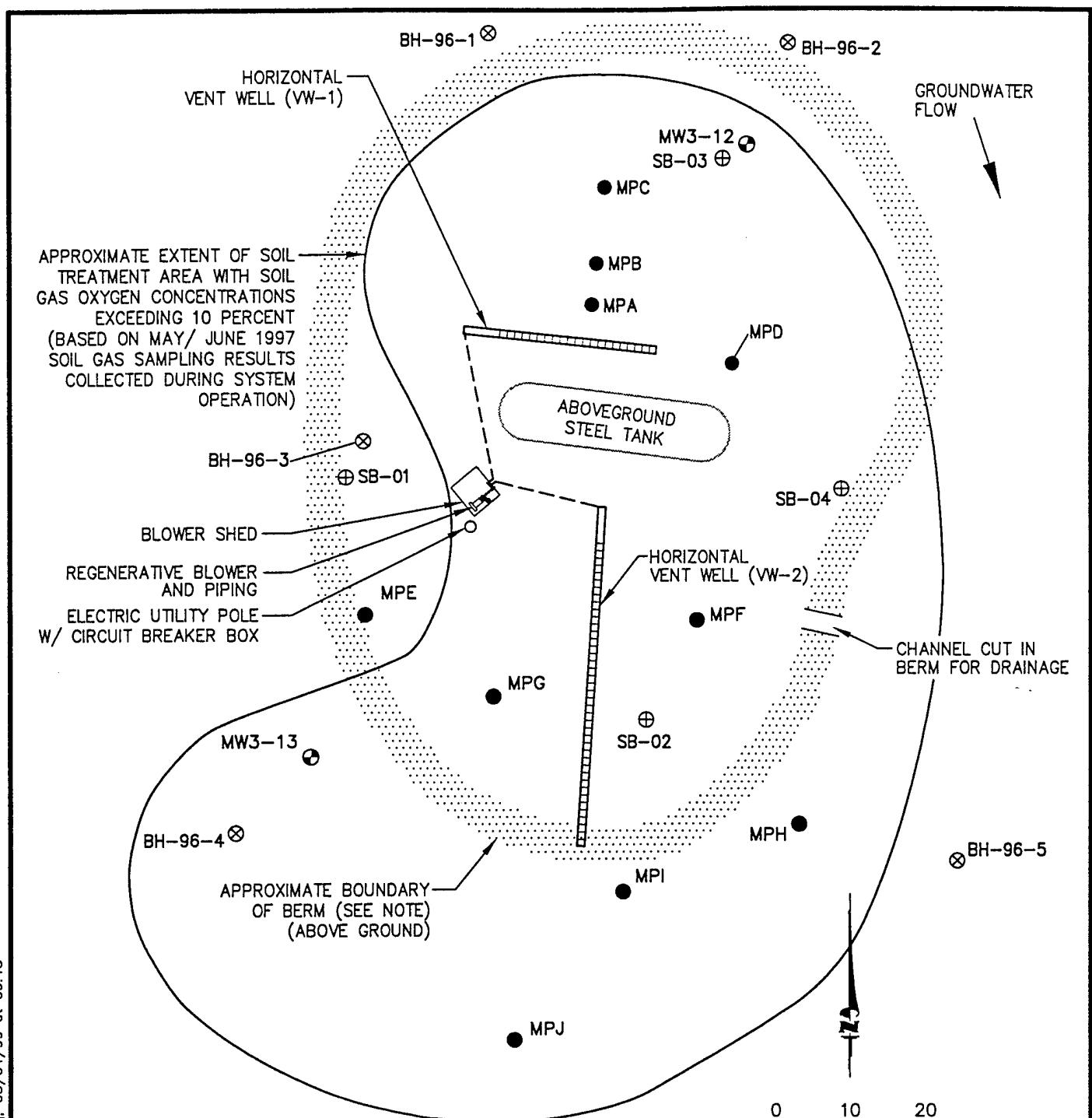
1.2.4 Bioventing Pilot Test

In October 1992, ES installed a bioventing pilot test system at SWMU 55 to remediate soils impacted by jet fuels, reclaimable mixed fuels, and other flammable wastes that were used during fire training exercises at the site (ES, 1993). The pilot-scale system consisted of one 4-inch-diameter horizontal air-injection vent well (VW) (VW-1), four permanent soil vapor monitoring points (MPs) (MPA, MPB, MPC, and MPD), and several temporary soil MPs installed in fuel-impacted soils on the north side of the former burn area (Figure 1.3). A 1-horsepower (hp) blower was used for the pilot-scale system. This system was operated and monitored by ES (1993) as a pilot study for 1 year, from November 1992 through November 1993. Soil and soil gas data collected before and after the pilot test confirmed significant fuel contaminant reduction in the pilot test treatment area (AFCEE, 1994; Parsons ES, 1998a). Following the pilot study, the Base operated the pilot-scale system.

1.2.5 Expanded-Scale Bioventing System Installation

Based on positive results from the bioventing pilot test, funding was provided through AFCEE to design and install an expanded-scale system for continued bioventing treatment of vadose zone soils at SWMU 55. The expanded bioventing system consisted of one new 4-inch-diameter horizontal VW (VW-2), six new MPs (MPE, MPF, MPG, MPH, MPI, and MPJ), a new 1.5-hp blower system, and associated piping, controls, and electrical service (Figure 1.3). The four existing permanent MPs installed in 1992 (MPA, MPB, MPC, and MPD) and the original pilot test VW (VW-1) also were incorporated into the full-scale system. The 1-hp

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- LEGEND**
- MW3-12 ⊕ GROUNDWATER MONITORING WELL
 - MPF ● SOIL VAPOR MONITORING POINT
 - BH-96-5 ⊗ SOIL BORING/SAMPLING LOCATION (PARSONS ES, FEB. 1997)
 - SB-01 ⊕ SOIL BORING/SAMPLING LOCATION (RADIAN, NOV. 1996)
 - AIR INJECTION HEADER PIPE (BURIED)

NOTE:
 SOIL BERM HAS APPROXIMATE ELLIPTICAL DIMENSIONS AND VARYING WIDTHS/HEIGHTS, LOCATIONS OF TANK, VENT WELLS, AND UTILITY POLE WITHIN BERM ARE ESTIMATED.

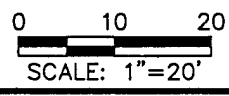


FIGURE 1.3

BIOVENTING SYSTEM LAYOUT

SWMU 55 (IRP Site FT-03)
 Charleston AFB, South Carolina

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regenerative blower system that had been used for pilot-scale testing was shut down, dismantled, and removed from the site. The new system was installed by Parsons ES during three mobilizations occurring between February and May 1997. Additional record drawings showing the final design details for the expanded-scale system are provided in the operations and maintenance manual for the system (Parsons ES, 1997b). A summary of field activities, initial sampling results, and initial monitoring results from the 1997 installation were provided in a 30 October 1997 letter to Major Ed Marchand at AFCEE (Parsons ES, 1997b). The aforementioned sampling and monitoring results are also summarized in the Draft Final Confirmation SAP for SWMU 55 (Appendix A).

Five baseline soil and soil gas samples were collected by Parsons ES for laboratory analysis during expanded system installation and prior to system startup. Baseline soil samples were collected from boreholes installed for the MPs. Analytical results for these soil samples indicated that total petroleum hydrocarbon (TPH) concentrations were highest in the immediate vicinity of the former fire training area. The highest detected TPH concentration (combined diesel-range organics [DRO] and gasoline-range organics [GRO]) was 5,890 mg/kg at MPF (Table 2.1 of the Draft Final Confirmation SAP [Appendix A]). Benzene, toluene, ethylbenzene, and xylene (BTEX) compounds were detected in each of the five soil samples. Polynuclear aromatic hydrocarbons (PAHs) also were detected in four of the five soil samples.

Baseline soil gas samples also were collected at MPs. These samples exhibited total volatile hydrocarbon (TVH) concentrations ranging up to 10,000 parts per million, volume per volume (ppmv). Vapor-phase BTEX compounds also were detected. Hydrocarbon vapors were detected in soil gas throughout the former burn area.

To further assess the extent of soil contamination at the site, five shallow exploratory soil borings (BH-96-1 through BH-96-5) were advanced throughout the site (Figure 1.3). Field screening of soil samples collected during advancement of borings BH-96-1, BH-96-2, and BH-96-5 exhibited volatile organic compound (VOC) headspace readings ranging from 13 to 192 ppmv, indicating that these soils were not significantly impacted by volatile fuel constituents. Soil samples collected from borings BH-96-3 and BH-96-4 exhibited VOC headspace readings of >2,500 ppmv and 819 ppmv, respectively. Soil samples collected from these borings were not submitted for laboratory analysis.

1.2.6 Expanded-Scale Bioventing Soil Gas Sampling and *In Situ* Respiration Testing

In June 1998, following expanded-scale bioventing system operation, Parsons ES (1998b) conducted Option 1 soil gas sampling and *in situ* respiration testing. The system was shut down 1 month prior to soil gas sampling to allow soils and soil gas to equilibrate in order to compare initial and current conditions. The blower system was re-started and optimized following testing to continue bioventing treatment of site soils.

Following expanded-scale bioventing treatment, soil gas TVH and BTEX concentrations decreased at all the MPs. The greatest reduction was observed at location MPH, where TVH and BTEX concentrations were reduced by 99.6 and 97.6 percent, respectively. At MPE where "tight" soils are present, TVH and BTEX concentrations were reduced by 67.0 and 59.7 percent, respectively. All locations, with the exception of MPE and MPG, experienced TVH concentrations reductions to below 1,000 ppmv. These data indicate that although TVH levels at SWMU 55 remain relatively elevated (above 1,000 ppmv) at two locations, both TVH and BTEX compounds are being biodegraded during bioventing system operation.

Low oxygen and high TVH concentrations were measured in soil gas samples collected from MPs on the south side of the site, indicating the presence of widespread vapor-phase contamination and anaerobic conditions. Soil gas samples collected from MPs on the north side of the burn area had significantly higher oxygen concentrations. Although the north side of the burn area had undergone bioventing treatment prior to operating the expanded bioventing system, limited oxygen utilization, indicative of microbial biorespiration, was still occurring in these soils. During June 1998, fuel biodegradation rates ranged from 220 mg/kg/year at MPI, to 1,940 mg/kg/year at MPE. The very low biodegradation rates at most locations correspond to the low TVH concentrations at these locations.

Based on the June 1998 data, residual BTEX and TVH compounds in soils at SWMU 55 have been greatly reduced as the result of bioventing remediation. Although aerobic biodegradation rates were still significant at several locations, soil gas conditions indicate that the discrete vadose zone soils (i.e., those soils encountered from ground surface to a mean depth of approximately 4 feet bgs) are being treated by air-injection bioventing. Soil gas TVH and BTEX concentrations were very low at most locations, indicating that little residual fuel contamination remains to be treated. Based on these results, Parsons ES recommended that the Air Force proceed with confirmation soil sampling pursuant to closure of the soil unit at this site. This report presents the results of this confirmation soil sampling.

1.3 SUMMARY OF CONFIRMATION SAMPLING RESULTS

Confirmation soil sampling was conducted to assess the effectiveness of pilot-scale and expanded-scale bioventing treatment in reducing the concentration of petroleum hydrocarbons in near-surface soils. In preparation for the confirmation soil sampling, a site-specific SAP was prepared by Parsons ES (Parsons ES, 1998a). A copy of this SAP is provided as Appendix A. Following AFCEE and Charleston AFB approval of the SAP, confirmation soil sampling was conducted at SWMU 55 on 25 January 1999. Confirmation soil sampling activities consisted of advancing 12 boreholes to depths of approximately 2.5 to 3.5 feet bgs and submitting soil samples collected during advancement for TPH (both DRO and GRO), VOC, and PAH analyses. A total of 14 samples from 12 boreholes were submitted for laboratory analysis.

Based on analytical data for soil samples collected during the January 1999 confirmation sampling event, bioventing treatment at SWMU 55 has significantly

reduced the concentration of petroleum hydrocarbons contamination in vadose zone soils. As would be expected, VOCs have experienced the most significant reductions. Data generated during the soil gas sampling and respiration testing conducted at the site in June 1998 support this conclusion (Parsons ES, 1998b). Areas exhibiting elevated concentrations of petroleum hydrocarbon contamination persist in the southern half of the former burn area. Remediation appears to have been completed in soils in the northern half of the former burn area. Parsons ES recommends that Charleston AFB continue to operate the bioventing system until the CMS has been approved by the SCDHEC.

1.4 REPORT ORGANIZATION

This site confirmation sampling and analysis report consists of five sections, including this introduction, and two appendices. Section 2 includes a description of the confirmation soil sampling and analysis activities conducted at the site. Section 3 summarizes confirmation sampling analytical results and compares the confirmation results to pre-treatment contaminant concentrations. Section 4 presents conclusions and recommendations. References used in preparation of this report are provided in Section 5.

Appendix A presents a copy of the Draft Final Confirmation SAP for SWMU 55, which includes a detailed summary of previous site investigations. Appendix B provides the field notes generated during the confirmation sampling event. Appendix C presents the Parsons ES data quality assessment report. Appendix D presents the analytical data for site environmental and quality assurance/quality control (QA/QC) samples, and chain-of-custody forms.

SECTION 2

CONFIRMATION SOIL SAMPLING AND ANALYSIS ACTIVITIES

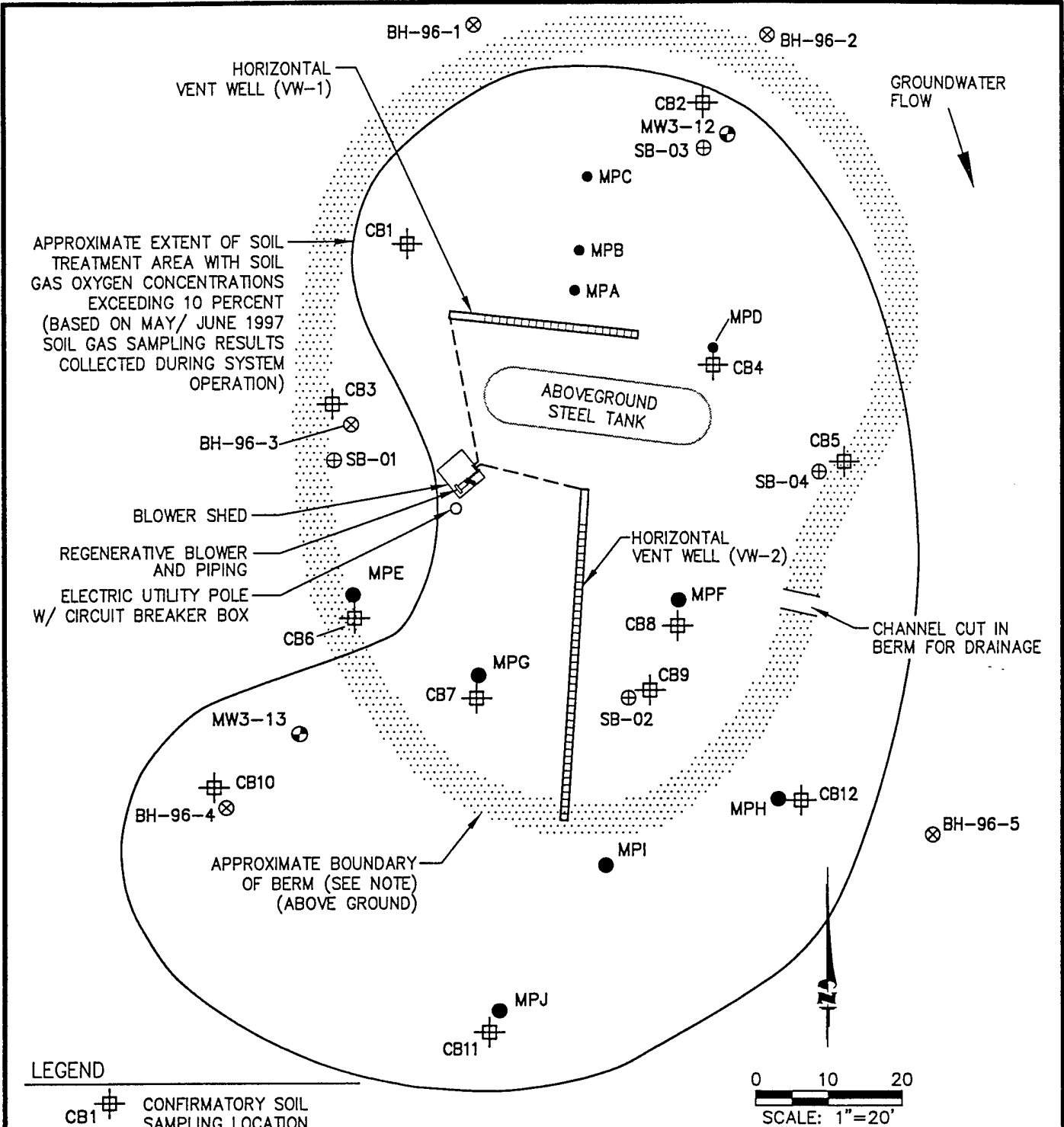
This section summarizes confirmation soil sampling activities, including sampling locations and depths, sampling procedures, analytical methods, and QA/QC procedures followed. These procedures are described in more detail in the Draft Final Confirmation SAP for SWMU 55 (Appendix A). The SAP was implemented by qualified Parsons ES scientists trained in conducting soil sampling, records documentation, and chain-of-custody procedures. Environmental sample analyses were performed by Specialized Assays Inc. (SAI) of Nashville, Tennessee, a State of South Carolina-certified analytical laboratory.

2.1 BOREHOLE LOCATIONS AND SAMPLING DEPTHS

Confirmatory soil sampling was conducted at the site on 25 January 1999. Soil sampling consisted of advancing 12 soil borings (CB-1 through CB-12) throughout the project site. The locations of these soil borings are shown on Figure 2.1. Each borehole was manually advanced to the groundwater surface (approximately 2.5 to 3.5 feet bgs) using a stainless steel hand auger. At each location, soil samples were obtained from the top of the capillary fringe. Field notes generated during the confirmation sampling event are provided in Appendix B.

To more accurately assess the degree of soil remediation that has occurred as a result of pilot-scale testing and expanded-scale bioventing treatment at the project site, most confirmatory soil samples were collected at approximately the same location and depth as the previously collected baseline samples. Exceptions to this include the samples collected from borings CB-1 and CB-10. Boring CB-1 was advanced to assess the concentration of contaminants within the northwestern corner of the project site immediately inside the soil berm. No historical analytical data exist for this area. Boring CB-10 was advanced to assess the concentration of contaminants within the southwestern corner of the project site outside the soil berm. This location is in the immediate vicinity of boring BH-96-4 which was advanced in 1997 to assess the extent of contamination within this portion of the project site. Soil samples collected during advancement of boring BH-96-4 exhibited an elevated VOC reading in a headspace sample of 819 ppmv. No soil samples collected from boring BH-96-4 were submitted for laboratory analysis.

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LEGEND

- CB1 CONFIRMATORY SOIL SAMPLING LOCATION
- MW3-12 GROUNDWATER MONITORING WELL
- MPF SOIL VAPOR MONITORING POINT
- BH-96-5 SOIL BORING/SAMPLING LOCATION (PARSONS ES, FEB. 1997)
- SB-01 SOIL BORING/SAMPLING LOCATION (RADIAN, NOV. 1996)
- AIR INJECTION HEADER PIPE (BURIED)

NOTE:
 SOIL BERM HAS APPROXIMATE ELLIPTICAL DIMENSIONS AND VARYING WIDTHS/HEIGHTS, LOCATIONS OF TANK, VENT WELLS, AND UTILITY POLE WITHIN BERM ARE ESTIMATED.

FIGURE 2.1

CONFIRMATORY SOIL SAMPLING LOCATIONS

SWMU 55 (IRP Site FT-03)
 Charleston AFB, South Carolina

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado

2.2 BORING ADVANCEMENT AND SAMPLING PROCEDURES

2.2.1 Soil Sampling Procedures

Each of the 12 soil borings were manually advanced using a stainless steel hand auger. Prior to use at the project site and between sampling locations, the hand auger was decontaminated using a solution of potable water and Alconox®, followed by successive potable and distilled water rinses. To assess the effectiveness of the field decontamination, an equipment rinseate blank was collected by pouring analyte-free (i.e., reagent grade) water through the interior of the auger bucket and collecting this rinseate in laboratory-prepared sample containers.

Soil samples were collected directly from the auger bucket. To minimize loss of volatile organic compounds from the core, the sample aliquots for TPH and VOC analyses were collected immediately upon retrieval of the auger bucket from the subsurface. Sample aliquots for VOC analysis were collected first using the EnCore™ sampler and associated dedicated sampling cylinders. The sample aliquot for TPH analysis was then expeditiously removed from the auger bucket and placed directly into the appropriate laboratory-prepared sample containers. Soils were packed tightly into these containers to minimize void space and to prevent settling during transportation.

In order to obtain consistent and representative headspace measurements, the sample aliquot for headspace analysis was collected next. The headspace analysis involved sealing a portion of collected soil sample (approximately equal in volume at each sample interval) in a plastic bag, allowing the collected material to equilibrate to atmospheric temperature, and measuring the concentration of volatile hydrocarbon vapors collected within the bag with a photoionization detector.

Following collection of the VOC, TPH, and headspace aliquots, the remainder of the collected soil was logged. Visual observations on lithology, moisture content, presence or absence of staining, and any other pertinent observations were recorded in the field log book. Following soil description, the sample aliquots for PAH analysis were placed into the appropriate laboratory-prepared sample containers.

Soil samples submitted for laboratory analysis were labeled with the site name and borehole number, sample depth, date of collection, and other pertinent data. Sample containers were then packaged to prevent breakage and were placed in an insulated shipping container packed with ice. Samples for laboratory analysis were shipped via overnight courier under standard chain-of-custody procedures to SAI in Nashville, Tennessee.

Upon completion of soil sampling activities at a given location, residual soils generated during sampling were placed back in the borehole, and the remainder of the borehole was abandoned with bentonite chips. Plastic sheeting penetrated during borehole advancement was repaired by placing a 6-foot-square patch of 6-mil plastic sheeting over the penetration and covering with soil.

2.2.2 Soil Sample Analysis

A total of 12 primary and 2 replicate soil samples were submitted to SAI in Nashville, Tennessee, for analysis. Each samples was analyzed for TPH in accordance with United States Environmental Protection Agency (USEPA) Method SW8015, modified for DRO and GRO; VOCs in accordance with USEPA Method SW8260B; and PAHs in accordance with USEPA Method SW8310. A summary of the soil samples collected during the confirmatory sampling event, and the analyses performed, is provided in Table 2.1.

2.3 FIELD AND LABORATORY DATA QUALITY ASSURANCE/QUALITY CONTROL

Laboratory and field QA/QC procedures established for the site were followed to ensure that the analytical data generated during the January 1999 confirmation sampling event would be technically sound, statistically valid, and properly documented. QA/QC requirements are detailed in the SAP (Appendix A). Parsons ES also preformed a Level III validation of the SWMU 55 analytical data. Results of this assessment indicate that no data should be rejected based on validation, and that all data are useable for the purposes intended. A copy of the data quality assessment report has been provided as Appendix C.

2.3.1 Laboratory QA/QC Procedures and Results

Generated analytical data were evaluated by the test laboratory in accordance with their internal laboratory QC program, which certifies that the data generated are of reliable quality. Analytical data quality was measured through a system of analyzing blanks, spike samples, and standards and statistically evaluating the results. With respect to the data generated during confirmation sampling, all laboratory QC parameters were within required acceptance limits.

To ensure product quality, Parsons ES also provided an assessment of the generated data in accordance with their own internal procedures. Elements of this assessment included, but were not limited to, the following: sample holding times, analytical methods used, reporting limits, dilution factors, and consistency between hardcopy and electronic analytical data deliverables. Based on this assessment, the analytical data generated during the confirmation sampling event is useable for its intended purpose (i.e., assessing the degree of remediation attained as a result of bioventing treatment).

2.3.2 Field QA/QC Procedures and Results

To assess the variability due to the sample collection process or inherent in the media sample, two replicate soil samples were collected in the field during confirmation sampling. These samples were identified as CB-D1 (replicate of CB-8) and CB-D2 (replicate of CB-7). Each replicate sample was collected at the same time, location, and depth as its associated primary counterpart, and submitted to the same laboratory for identical analysis. Relative percent difference (RPD) values were calculated to evaluate how closely the analytical results between the replicate and primary sample

TABLE 2.1
SUMMARY OF CONFIRMATION SOIL SAMPLES AND ANALYSES
SWMU 55 (IRP SITE FT-03)
CHARLESTON AFB, SOUTH CAROLINA

Sample Location	Sample Identifier	Sample Depth (feet bgs) ^{a/}	Date Sampled	Analyses Requested		
				Total Petroleum Hydrocarbons USEPA ^{b/} SW8015	Volatile Organic Compounds USEPA SW8260B	Polynuclear Aromatic Hydrocarbons USEPA SW8310
CB-1	CB-1	2.5	25 Jan 99	X	X	X
CB-2	CB-2	3.3	25 Jan 99	X	X	X
CB-3	CB-3	3	25 Jan 99	X	X	X
CB-4	CB-4	3	25 Jan 99	X	X	X
CB-5	CB-5	3.5	25 Jan 99	X	X	X
CB-6	CB-6	3.2	25 Jan 99	X	X	X
CB-7	CB-7	3.5	25 Jan 99	X	X	X
CB-7	CB-D2 ^{d/}	3.5	25 Jan 99	X	X	X
CB-8	CB-8	3.3	25 Jan 99	X	X	X
CB-8	CB-D1 ^{d/}	3.3	25 Jan 99	X	X	X
CB-9	CB-9	3	25 Jan 99	X	X	X
CB-10	CB-10	3.5	25 Jan 99	X	X	X
CB-11	CB-11	3	25 Jan 99	X	X	X
CB-12	CB-12	3.3	25 Jan 99	X	X	X

^{a/} feet bgs = feet below ground surface.

^{b/} USEPA = US Environmental Protection Agency.

^{c/} Replicate of Sample CB-7.

^{d/} Replicate of Sample CB-8.

agree. In general, there is good agreement between the replicate and primary samples, as indicated by the relatively low RPDs computed. Relatively high RPD values were, however, computed for DRO petroleum hydrocarbons and o-xylene for the replicate/primary samples collected at location CB-7. Based on a review of the analytical laboratory's QA/QC data, these differences are likely the result of sample heterogeneity. It should be noted that there are no established QA/QC limits for RPD values for replicate samples, and the high RPDs are likely the result of heterogeneity of the sample matrix.

To identify potential contaminants introduced during sample handling, one trip blank was collected during confirmation sampling. The trip blank was prepared at the laboratory and consisted of analyte-free (i.e., reagent/laboratory-grade) water. Upon preparation the sample was shipped to the sampling site, handled as an environmental sample during field, and returned to the laboratory accompanying the VOC samples. The trip blank was analyzed for VOCs in accordance with USEPA Method SW8260B. No VOCs were detected in the trip blank sample. Analytical results for the trip blank are included in Appendix D.

A rinseate blank was collected to demonstrate that the decontamination procedure used to clean the sampling equipment was sufficient (i.e., there was no residual contamination remaining on the device which might contaminate the next sample). The rinseate blank was prepared by field personnel at the sampling site by pouring analyte-free water over the sampling device following sample collection and subsequent decontamination. Generated rinse solution was collected in the appropriate sample collection bottles. The rinseate blank was analyzed for VOCs in accordance with USEPA Method SW8260B. No VOCs were detected in the rinseate blank sample. Analytical results for the equipment rinseate blank are included in Appendix D.

SECTION 3

CONFIRMATION SAMPLING RESULTS

The January 1999 confirmation sampling event at SWMU 55 focused on evaluating the effectiveness of pilot-scale and expanded-scale bioventing soil remediation. The purpose of this section is to describe confirmation soil sample analytical results and compare these results with pre-treatment soil contaminant concentrations.

3.1 SOIL ANALYTICAL RESULTS

A total of 12 primary and 2 replicate soil samples were collected during the January 1999 confirmation sampling event and submitted to SAI in Nashville, Tennessee, for analysis. Each sample was analyzed for TPH (both DRO and GRO) in accordance with USEPA Method SW8015, VOCs in accordance with USEPA Method SW8260B, and PAHs in accordance with USEPA Method SW8310 (Table 2.1). Soil analytical results for TPH, VOCs, and PAHs are summarized in Tables 3.1, 3.2, and 3.3, respectively. Soil analytical data from SAI are provided in Appendix D.

Field headspace screening data for soil samples collected during confirmation sampling is summarized in Table 3.1. Headspace VOC readings ranged from 0 to 550 ppmv. The highest concentration (550 ppmv) was exhibited by the sample collected at location CB-6. Based on these headspace screening data, residual soil contamination appears to be limited to locations CB-6, CB-7, CB-8, and CB-9, located in the southern half of the former burn area (Figure 2.1). Headspace readings at these locations ranged from 15 ppmv (CB-9) to 550 ppmv (CB-6).

3.1.1 Total Petroleum Hydrocarbons

Concentrations of both DRO and GRO petroleum hydrocarbons were detected in the soil samples collected during the confirmation sampling event (Table 3.1). The highest concentrations were detected in the southwestern portion of the former burn area. DRO petroleum hydrocarbons were detected in soil samples collected at all 12 locations at concentrations ranging from a laboratory-estimated concentration of 3.71J mg/kg to 8,940 mg/kg. The primary soil sample collected at location CB-7 exhibited the highest DRO concentration (8,940 mg/kg) and the associated replicate sample exhibited a concentration of 971 mg/kg. Elevated DRO concentrations were also observed at CB-3 (513 mg/kg) and CB-6 (6,620 mg/kg). DRO concentrations at all other locations were low, ranging from 3.71J to 116 mg/kg. GRO petroleum hydrocarbons were detected in soil samples collected at locations CB-3, CB-6, and CB-7. GRO concentrations ranged from 1.2 mg/kg to 582 mg/kg (Table 3.1). The primary soil sample collected at

TABLE 3.1
SUMMARY OF FIELD HEADSPACE READINGS AND TOTAL PETROLEUM HYDROCARBONS
IN CONFIRMATION SOIL SAMPLES
SWMU 55 (IRP SITE FT-03)
CHARLESTON AFB, SOUTH CAROLINA

Sampling Location:	CB-1	CB-2	CB-3	CB-4	CB-5	CB-6	CB-7	CB-D2 ^{d/}	CB-8	CB-D1 ^{b/}	CB-9	CB-10	CB-11	CB-12
Sample Depth (feet bgs) ^{c/} :	2.5	3.3	3	3	3.5	3.2	3.5	3.5	3.3	3.3	3	3.5	3	3.3
Parameter														
Diesel-Range Organics (mg/kg) ^{d/}	4.73 J ^{e/}	5.33 J	513	6.58 J	41.7	6,620	8,940	971	116	97.4	58.4 J	14.2	21.8	3.71 J
Gasoline-Range Organics (mg/kg)	1.14 U ^{f/}	1.28 U	1.2	1.11 U	1.2 U	17.2	582	421	1.18 U	1.18 U	1.16 U	1.16 U	1.27 U	1.2 U
Field Headspace Readings (ppmv) ^{g/}	0	0	0	0	0	550	92	---	210	---	15	0	2	0.1

Note: Detected and laboratory-estimated concentrations are outlined. Samples analyzed for DRO and GRO by Method SW8015 by Specialized Assays, Inc., Nashville, Tennessee.

^{a/} Replicate of sample CB-7.

^{b/} Replicate of sample CB-8.

^{c/} feet bgs - feet below ground surface.

^{d/} mg/kg - milligrams per kilogram.

^{e/} J - Reported concentration is a laboratory estimate.

^{f/} U - Parameter not detected at or above the cited quantitation limit.

^{g/} ppmv - parts per million, volume per volume.

--- Not analyzed.

TABLE 3.2
SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN CONFIRMATION SOIL SAMPLES
SWMU 55 (IRP SITE FT-03)
CHARLESTON AFB, SOUTH CAROLINA

Compound	CB-1 2.5	CB-2 3.3	CB-3 3	CB-4 3	CB-5 3.5	CB-6 3.2	CB-7 3.5	CB-D2 ^d 3.5	CB-8 3.3	CB-D1 ^b 3.3	CB-9 3	CB-10 3.5	CB-11 3	CB-12 3.3
1,1,1,2-Tetrachloroethane (ug/kg) ^d	3.4 U ^e	3.8 U	3.6 U	3.3 U	3.6 U	17.2 U	3.5 U	3.7 U	3.5 U	3.5 U	3.5 U	3.5 U	3.8 U	3.6 U
1,1,1-Trichloroethane (ug/kg)	4.5 U	5.1 U	4.8 U	4.4 U	4.8 U	23 U	4.7 U	4.9 U	4.7 U	4.7 U	4.7 U	4.7 U	5.1 U	4.8 U
1,1,2,2-Tetrachloroethane (ug/kg)	2.3 U	2.6 U	2.4 U	2.2 U	2.4 U	11.5 U	2.4 U	2.4 U	2.4 U	2.4 U	2.3 U	2.3 U	2.5 U	2.4 U
1,1,2-Trichloroethane (ug/kg)	5.7 U	6.4 U	6 U	5.6 U	6 U	28.7 U	5.9 U	6.1 U	5.9 U	5.9 U	5.8 U	5.8 U	6.3 U	6 U
1,1-Dichloroethane (ug/kg)	2.3 U	2.6 U	2.4 U	2.2 U	2.4 U	11.5 U	2.4 U	2.4 U	2.4 U	2.4 U	2.3 U	2.3 U	2.5 U	2.4 U
1,1-Dichloroethene (ug/kg)	6.8 U	7.7 U	7.2 U	6.7 U	7.2 U	34.5 U	7.1 U	7.3 U	7.1 U	7.1 U	7 U	7 U	7.6 U	7.2 U
1,1-Dichloropropene (ug/kg)	5.7 U	6.4 U	6 U	5.6 U	6 U	28.7 U	5.9 U	6.1 U	5.9 U	5.9 U	5.8 U	5.8 U	6.3 U	6 U
1,2,3-Trichlorobenzene (ug/kg)	2.3 U	2.6 U	2.4 U	2.2 U	2.4 U	11.5 U	2.4 U	2.4 U	2.4 U	2.4 U	2.3 U	2.3 U	2.5 U	2.4 U
1,2,3-Trichloropropane (ug/kg)	22.7 U	25.6 U	24.1 U	22.2 U	24.1 U	115 U	23.5 U	24.4 U	23.5 U	23.5 U	23.3 U	23.3 U	25.3 U	24.1 U
1,2,4-Trichlorobenzene (ug/kg)	2.3 U	2.6 U	2.4 U	2.2 U	2.4 U	11.5 U	2.4 U	2.4 U	2.4 U	2.4 U	2.3 U	2.3 U	2.5 U	2.4 U
1,2,4-Trimethylbenzene (ug/kg)	8 U	9 U	8.4 U	7.8 U	8.4 U	707	8.2 U	48.8	3.5 U ^f	46.5	46.5	8.1 U	8.9 U	8.4 U
1,2-Dibromo-3-chloropropane (ug/kg)	1.1 U	1.3 U	1.2 U	1.1 U	1.2 U	5.7 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.3 U	1.2 U
1,2-Dibromochloroethane (ug/kg)	3.4 U	3.8 U	3.6 U	3.3 U	3.6 U	17.2 U	3.5 U	3.7 U	3.5 U	3.5 U	3.5 U	3.5 U	3.8 U	3.6 U
1,2-Dichlorobenzene (ug/kg)	2.3 U	2.6 U	2.4 U	2.2 U	2.4 U	11.5 U	2.4 U	2.4 U	2.4 U	2.4 U	2.3 U	2.3 U	2.5 U	2.4 U
1,2-Dichloroethane (ug/kg)	3.4 U	3.8 U	3.6 U	3.3 U	3.6 U	17.2 U	3.5 U	3.7 U	3.5 U	3.5 U	3.5 U	3.5 U	3.8 U	3.6 U
1,2-Dichloropropane (ug/kg)	2.3 U	2.6 U	2.4 U	2.2 U	2.4 U	11.5 U	2.4 U	2.4 U	2.4 U	2.4 U	2.3 U	2.3 U	2.5 U	2.4 U
1,3,5-Trimethylbenzene (ug/kg)	3.4 U	3.8 U	3.6 U	3.3 U	3.6 U	241	2.4 U	3.7 U	3.5 U	3.5 U	4.7	3.5 U	3.8 U	3.6 U
1,3-Dichlorobenzene (ug/kg)	6.8 U	7.7 U	7.2 U	6.7 U	7.2 U	34.5 U	7.1 U	7.3 U	7.1 U	7.1 U	7 U	7 U	7.6 U	7.2 U
1,3-Dichloropropane (ug/kg)	2.3 U	2.6 U	2.4 U	2.2 U	2.4 U	11.5 U	2.4 U	2.4 U	2.4 U	2.4 U	2.3 U	2.3 U	2.5 U	2.4 U
1,4-Dichlorobenzene (ug/kg)	2.3 U	2.6 U	2.4 U	2.2 U	2.4 U	11.5 U	2.4 U	2.4 U	2.4 U	2.4 U	2.3 U	2.3 U	2.5 U	2.4 U
1-Chlorohexane (ug/kg)	2.8 U	3.2 U	3 U	2.8 U	3 U	14.4 U	2.9 U	3 U	2.9 U	2.9 U	2.9 U	2.9 U	3.2 U	3 U
2,2-Dichloropropane (ug/kg)	22.7 U	25.6 U	24.1 U	22.2 U	24.1 U	115 U	23.5 U	24.4 U	23.5 U	23.5 U	23.3 U	23.3 U	25.3 U	24.1 U
2-Chlorotoluene (ug/kg)	2.3 U	2.6 U	2.4 U	2.2 U	2.4 U	11.5 U	2.4 U	2.4 U	2.4 U	2.4 U	2.3 U	2.3 U	2.5 U	2.4 U
4-Chlorotoluene (ug/kg)	3.4 U	3.8 U	3.6 U	3.3 U	3.6 U	17.2 U	3.5 U	3.7 U	3.5 U	3.5 U	3.5 U	3.5 U	3.8 U	3.6 U
4-Isopropyltoluene (ug/kg)	6.8 U	7.7 U	7.2 U	6.7 U	7.2 U	224	7.1 U	7.3 U	7.1 U	7.1 U	7 U	7 U	7.6 U	7.2 U
Benzene (ug/kg)	2.3 U	2.6 U	2.4 U	2.2 U	2.4 U	11.5 U	2.4 U	2.4 U	2.4 U	2.4 U	10.5	2.3 U	2.5 U	2.4 U
Bromobenzene (ug/kg)	2.3 U	2.6 U	2.4 U	2.2 U	2.4 U	11.5 U	2.4 U	2.4 U	2.4 U	2.4 U	2.3 U	2.3 U	2.5 U	2.4 U
Bromochloromethane (ug/kg)	2.3 U	2.6 U	2.4 U	2.2 U	2.4 U	11.5 U	2.4 U	2.4 U	2.4 U	2.4 U	2.3 U	2.3 U	2.5 U	2.4 U
Bromodichloromethane (ug/kg)	4.5 U	5.1 U	4.8 U	4.4 U	4.8 U	23 U	4.7 U	4.9 U	4.7 U	4.7 U	4.7 U	4.7 U	5.1 U	4.8 U
Bromoforn (ug/kg)	6.8 U	7.7 U	7.2 U	6.7 U	7.2 U	34.5 U	7.1 U	7.3 U	7.1 U	7.1 U	7 U	7 U	7.6 U	7.2 U
Bromomethane (ug/kg)	5.7 U	6.4 U	6 U	5.6 U	6 U	28.7 U	5.9 U	6.1 U	5.9 U	5.9 U	5.8 U	5.8 U	6.3 U	6 U
Carbon tetrachloride (ug/kg)	11.4 U	12.8 U	12 U	11.1 U	12 U	57.5 U	11.8 U	12.2 U	11.8 U	11.8 U	11.6 U	11.6 U	12.7 U	12 U
Chlorobenzene (ug/kg)	2.3 U	2.6 U	2.4 U	2.2 U	2.4 U	11.5 U	2.4 U	2.4 U	2.4 U	2.4 U	2.3 U	2.3 U	2.5 U	2.4 U
Chloroethane (ug/kg)	5.7 U	6.4 U	6 U	5.6 U	6 U	28.7 U	5.9 U	6.1 U	5.9 U	5.9 U	5.8 U	5.8 U	6.3 U	6 U
Chloroform (ug/kg)	2.3 U	2.6 U	2.4 U	2.2 U	2.4 U	11.5 U	2.4 U	2.4 U	2.4 U	2.4 U	2.3 U	2.3 U	2.5 U	2.4 U
Chloromethane (ug/kg)	8 U	9 U	8.4 U	7.8 U	8.4 U	40.2 U	8.2 U	8.5 U	8.2 U	8.2 U	8.1 U	8.1 U	8.9 U	8.4 U
cis-1,2-Dichloroethene (ug/kg)	6.8 U	7.7 U	7.2 U	6.7 U	7.2 U	34.5 U	7.1 U	7.3 U	7.1 U	7.1 U	7 U	7 U	7.6 U	7.2 U
cis-1,3-Dichloropropene (ug/kg)	5.7 U	6.4 U	6 U	5.6 U	6 U	28.7 U	5.9 U	6.1 U	5.9 U	5.9 U	5.8 U	5.8 U	6.3 U	6 U
Dibromochloromethane (ug/kg)	3.4 U	3.8 U	3.6 U	3.3 U	3.6 U	17.2 U	3.5 U	3.7 U	3.5 U	3.5 U	3.5 U	3.5 U	3.8 U	3.6 U

TABLE 3.2 (continued)
 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN CONFIRMATION SOIL SAMPLES
 SWMU 55 (IRP SITE FT-03)
 CHARLESTON AFB, SOUTH CAROLINA

Compound	CB-1	CB-2	CB-3	CB-4	CB-5	CB-6	CB-7	CB-D2 ^d	CB-8	CB-D1 ^b	CB-9	CB-10	CB-11	CB-12
Sampling Location: Sample Depth (feet bgs) ^e :	2.5	3.3	3	3	3.5	3.2	3.5	3.5	3.3	3.3	3	3.5	3	3.3
Dihromomethane (ug/kg)	11.4 U	12.8 U	12 U	11.1 U	12 U	57.5 U	11.8 U	12.2 U	11.8 U	11.8 U	11.6 U	11.6 U	12.7 U	12 U
Dichlorodifluoromethane (ug/kg)	5.7 U	6.4 U	6 U	5.6 U	6 U	28.7 U	5.9 U	6.1 U	5.9 U	5.9 U	5.8 U	5.8 U	6.3 U	6 U
Ethylbenzene (ug/kg)	3.4 U	3.8 U	3.6 U	3.3 U	3.6 U	86.2 U	3.5 U	3.7 U	3.5 U	3.5 U	27.9 U	3.5 U	3.8 U	3.6 U
Hexachlorobutadiene (ug/kg)	5.7 U	6.4 U	6 U	5.6 U	6 U	28.7 U	5.9 U	6.1 U	5.9 U	5.9 U	5.8 U	5.8 U	6.3 U	6 U
Isopropylbenzene (ug/kg)	9.1 U	10.3 U	9.6 U	8.9 U	9.6 U	46 U	9.4 U	9.8 U	9.4 U	9.4 U	3.5 J	9.3 U	10.1 U	9.6 U
m,p-Xylene (ug/kg)	3.4 U	3.8 U	3.6 U	3.3 U	3.6 U	132 U	3.5 U	3.7 U	4.7 U	3.5 U	22.1 U	3.5 U	3.8 U	3.6 U
o-Xylene (ug/kg)	5.7 U	6.4 U	6 U	5.6 U	6 U	28.7 U	51.8 U	20.7 U	5.9 U	5.9 U	5.8 U	5.8 U	6.3 U	6 U
Methylene chloride (ug/kg)	2.3 U	2.6 U	2.4 U	2.2 U	4.8 U	11.5 U	2.4 U	2.4 U	2.4 U	2.4 U	2.3 U	2.3 U	10.1B ^f	2.4 U
n-Butylbenzene (ug/kg)	5.7 U	6.4 U	6 U	5.6 U	6 U	28.7 U	5.9 U	6.1 U	5.9 U	5.9 U	5.8 U	5.8 U	6.3 U	6 U
n-Propylbenzene (ug/kg)	2.3 U	2.6 U	2.4 U	2.2 U	2.4 U	121 U	2.4 U	2.4 U	2.4 U	2.4 U	7 U	2.3 U	2.5 U	2.4 U
sec-Butylbenzene (ug/kg)	8 U	9 U	8.4 U	7.8 U	8.4 U	51.7 U	8.2 U	8.5 U	8.2 U	8.2 U	8.1 U	8.1 U	8.9 U	8.4 U
Styrene (ug/kg)	2.3 U	2.6 U	2.4 U	2.2 U	2.4 U	11.5 U	2.4 U	2.4 U	2.4 U	2.4 U	2.3 U	2.3 U	2.5 U	2.4 U
t-Butylbenzene (ug/kg)	8 U	9 U	8.4 U	7.8 U	8.4 U	11.5 J	8.2 U	8.5 U	8.2 U	8.2 U	8.1 U	8.1 U	8.9 U	8.4 U
Tetrachloroethene (ug/kg)	8 U	9 U	8.4 U	7.8 U	8.4 U	40.2 U	8.2 U	8.5 U	8.2 U	8.2 U	8.1 U	8.1 U	8.9 U	8.4 U
Toluene (ug/kg)	5.7 U	6.4 U	6 U	5.6 U	6 U	28.7 U	5.9 U	6.1 U	5.9 U	5.9 U	5.8 U	5.8 U	6.3 U	6 U
trans-1,2-Dichloroethene (ug/kg)	3.4 U	3.8 U	3.6 U	3.3 U	3.6 U	17.2 U	3.5 U	3.7 U	3.5 U	3.5 U	3.5 U	3.5 U	3.8 U	3.6 U
trans-1,3-Dichloropropene (ug/kg)	5.7 U	6.4 U	6 U	5.6 U	6 U	28.7 U	5.9 U	6.1 U	5.9 U	5.9 U	5.8 U	5.8 U	6.3 U	6 U
Trichloroethene (ug/kg)	11.4 U	12.8 U	12 U	11.1 U	12 U	57.5 U	11.8 U	12.2 U	11.8 U	11.8 U	11.6 U	11.6 U	12.7 U	12 U
Trichlorofluoromethane (ug/kg)	4.5 U	5.1 U	4.8 U	4.4 U	4.8 U	23 U	4.7 U	4.9 U	4.7 U	4.7 U	4.7 U	4.7 U	5.1 U	4.8 U
Vinyl chloride (ug/kg)	10.2 U	11.5 U	10.8 U	10 U	10.8 U	51.7 U	10.6 U	11 U	10.6 U	10.6 U	10.5 U	10.5 U	11.4 U	10.8 U

Note: Detected and laboratory-estimated concentrations are outlined. Samples analyzed for VOCs by Method SW8260B by Specialized Assays, Inc., Nashville, Tennessee.

^a Replicate of sample CB-7.

^b Replicate of sample CB-8.

^c feet bgs - feet below ground surface.

^d ug/kg - micrograms per kilogram.

^e U - Compound not detected at or above the cited quantitation limit.

^f J - Reported concentration is a laboratory estimate.

^g Compound was also detected in associated laboratory blank sample.

TABLE 3.3

SUMMARY OF POLYNUCLEAR AROMATIC HYDROCARBON COMPOUNDS IN CONFIRMATION SOIL SAMPLES

SWMU 55 (IRP SITE FT-03)
CHARLESTON AFB, SOUTH CAROLINA

Compound	CB-1	CB-2	CB-3	CB-4	CB-5	CB-6	CB-7	CB-D2 ^{d/}	CB-8	CB-D1 ^{b/}	CB-9	CB-10	CB-11	CB-12
Sample Depth (feet bgs) ^{e/} :	2.5	3.3	3	3	3.5	3.2	3.5	3.5	3.3	3.3	3	3.5	3	3.3
Acenaphthene (ug/kg) ^{d/}	38 U ^{e/}	42 U	40 U	37 U	40 U	38 U	7060 U	40 U	39 U	39 U	14000 U	38 U	42 U	40 U
Acenaphthylene (ug/kg)	76 U	86 U	81 U	74 U	81 U	77 U	9060 U	82 U	79 U	79 U	17900 U	78 U	85 U	81 U
Anthracene (ug/kg)	25 U	28 U	27 U	24 U	27 U	25 U	2590 U	27 U	26 U	26 U	5120 U	26 U	28 U	27 U
Benzo(a)anthracene (ug/kg)	5 U	6 U	5 U	5 U	5 U	5 U	53 U	5 U	5 U	5 U	198	5 U	5 U	5 U
Benzo(a)pyrene (ug/kg)	3 U	4 U	4 U	3 U	11	8	88 U	4 U	4 U	4 U	310	3 U	4 U	4 U
Benzo(b)fluoranthene (ug/kg)	7 U	8 U	7 U	7 U	7 U	8	71 U	7 U	7 U	7 U	271	7 U	8 U	7 U
Benzo(g,h,i)perylene (ug/kg)	28 U	32 U	30 U	28 U	30 U	29 U	294 U	30 U	29 U	29 U	221 J ^{f/}	29 U	32 U	30 U
Benzo(k)fluoranthene (ug/kg)	7 U	8 U	7 U	7 U	7 U	7 U	65 U	7 U	7 U	7 U	148	7 U	8 U	7 U
Chrysene (ug/kg)	6 U	6 U	6 U	6 U	6 U	6 U	588 U	6 U	6 U	6 U	279 J	6 U	6 U	6 U
Dibenzo(a,h)anthracene (ug/kg)	11 U	13 U	12 U	11 U	12 U	11 U	118 U	12 U	12 U	12 U	233 U	12 U	13 U	12 U
Fluoranthene (ug/kg)	8 U	9 U	8 U	8 U	14	15	824 U	9 U	8 U	8 U	655 J	8 U	9 U	8 U
Fluorene (ug/kg)	8 U	9 U	8 U	8 U	8 U	8 U	824 U	9 U	8 U	9	1630 U	8 U	9 U	8 U
Indeno(1,2,3-cd)pyrene (ug/kg)	16 U	18 U	17 U	16 U	17 U	16 U	176 U	17 U	16 U	16 U	224 J	16 U	18 U	17 U
Naphthalene (ug/kg)	38 U	42 U	40 U	37 U	40 U	348	585 J	40 U	39 U	100	14000 U	38 U	42 U	40 U
Phenanthrene (ug/kg)	24 U	27 U	25 U	23 U	25 U	24 U	2470 U	26 U	25 U	25 U	66 J	24 U	27 U	25 U
Pyrene (ug/kg)	10 U	12 U	11 U	10 U	11 U	10 U	1060 U	11 U	11 U	11 U	279 J	10 U	11 U	11 U

Note: Detected and laboratory-estimated concentrations are outlined. Samples were analyzed by Method SW8310 by Specialized Assays, Inc., Nashville, Tennessee.

^{a/} Replicate of sample CB-7.

^{b/} Replicate of sample CB-8.

^{c/} feet bgs - feet below ground surface

^{d/} ug/kg - micrograms per kilogram

^{e/} U - Compound not detected at or above the cited quantitation limit.

^{f/} J - Reported concentration is a laboratory estimate.

location CB-7 exhibited the highest concentration (582 mg/kg); the associated replicate sample exhibited a concentration of 421 mg/kg. Borehole CB-7 was located in the southwestern portion of the former burn area (Figure 2.1).

3.1.2 Volatile Organic Compounds

Thirteen VOCs were detected in the collected soil samples. Detectable concentrations were limited to samples collected at locations CB-5, CB-6, CB-7, CB-8, CB-9 and CB-11 (Table 3.2). VOCs were detected at very low concentration (only slightly above quantitation limits) at all locations except for CB-6, CB-7, and CB-9, where concentrations of some constituents exceeded 25 micrograms per kilogram ($\mu\text{g}/\text{kg}$). CB-6, CB-7, and CB-9 are located in the southern and southwestern portions of the former burn area (Figure 2.1). These detected VOCs and their reported concentrations are discussed below.

- 1,2,4-Trimethylbenzene (TMB) was detected in soil samples collected at locations CB-6, CB-7, CB-8, and CB-9. These samples exhibited concentrations ranging from a laboratory-estimated 3.5J $\mu\text{g}/\text{kg}$ to 707 $\mu\text{g}/\text{kg}$. The highest concentration was exhibited by the sample collected at location CB-6 (707 $\mu\text{g}/\text{kg}$). The replicate soil sample collected at location CB-7 exhibited a concentration of 48.8 $\mu\text{g}/\text{kg}$; however, the compound was not detected in the associated primary sample at the quantitation limit of 8.2 $\mu\text{g}/\text{kg}$. The primary soil sample collected at location CB-8 exhibited a laboratory-estimated concentration of 3.5 $\mu\text{g}/\text{kg}$; however, no detectable concentration was exhibited in the associated replicate sample at the quantitation limit of 8.2 $\mu\text{g}/\text{kg}$ (Table 3.2).
- 1,3,5-TMB was detected in soil samples collected at locations CB-6, CB-7, and CB-9. These samples exhibited concentrations ranging from 4.7 to 241 $\mu\text{g}/\text{kg}$. The highest concentration was exhibited by the sample collected at location CB-6 (241 $\mu\text{g}/\text{kg}$). The primary soil sample collected at location CB-7 exhibited a concentration of 116 $\mu\text{g}/\text{kg}$; however, no detectable 1,3,5-TMB concentration was exhibited in the associated replicate sample at the quantitation limit of 3.7 $\mu\text{g}/\text{kg}$.
- 4-Isopropyltoluene was detected only in the soil sample collected at location CB-6. This sample exhibited a concentration of 224 $\mu\text{g}/\text{kg}$.
- Benzene was detected only in the soil sample collected at location CB-9. This sample exhibited a concentration of 10.5 $\mu\text{g}/\text{kg}$.
- Ethylbenzene was detected in soil samples collected at locations CB-6, CB-8, and CB-9 at concentrations ranging from 3.5 to 86.2 $\mu\text{g}/\text{kg}$ (Table 3.2). The highest concentration was exhibited by the sample collected at location CB-6 (86.2 $\mu\text{g}/\text{kg}$). The primary soil sample collected at location CB-8 exhibited a concentration of 3.5 $\mu\text{g}/\text{kg}$; however, no detectable concentration was exhibited in the associated replicate sample at the quantitation limit of 3.5 $\mu\text{g}/\text{kg}$.

- Isopropylbenzene was detected in soil samples collected at locations CB-6 and CB-9 at laboratory-estimated concentrations of 3.5J $\mu\text{g}/\text{kg}$ and 46J $\mu\text{g}/\text{kg}$, respectively.
- *m,p*-Xylene was detected in soil samples collected at locations CB-6, CB-8, and CB-9. These samples exhibited concentrations ranging from 4.7 to 132 $\mu\text{g}/\text{kg}$. The highest concentration was exhibited by the sample collected at location CB-6 (132 $\mu\text{g}/\text{kg}$). The primary soil sample collected at location CB-8 exhibited a concentration of 4.7 $\mu\text{g}/\text{kg}$; these xylene isomers were not detected in the associated replicate sample at the quantitation limit of 3.5 $\mu\text{g}/\text{kg}$.
- *o*-Xylene was detected in soil samples collected at locations CB-7 and CB-9. These samples exhibited concentrations ranging from 5.8 to 51.8 $\mu\text{g}/\text{kg}$. The primary soil sample collected at location CB-7 exhibited the highest concentration (51.8 $\mu\text{g}/\text{kg}$). The replicate sample collected at this location exhibited a concentration of 20.7 $\mu\text{g}/\text{kg}$.
- Methylene chloride was detected in soil samples collected at locations CB-5 and CB-11 at concentrations of 4.8 and 10.1B $\mu\text{g}/\text{kg}$, respectively.
- *n*-Propylbenzene was detected in soil samples collected at locations CB-6 and CB-9 at concentrations of 121 and 7 $\mu\text{g}/\text{kg}$, respectively.
- *sec*-Butylbenzene was detected only in the soil sample collected at location CB-6. This sample exhibited a concentration of 51.7 $\mu\text{g}/\text{kg}$.
- *t*-Butylbenzene was detected only in the soil sample collected at location CB-6. This sample exhibited a laboratory-estimated concentration of 11.5J $\mu\text{g}/\text{kg}$.
- Toluene was detected in soil samples collected at locations CB-8 and CB-9 at laboratory-estimated concentrations of 2.4J $\mu\text{g}/\text{kg}$ and 8.1 $\mu\text{g}/\text{kg}$, respectively. The primary soil sample collected at location CB-8 exhibited a laboratory-estimated concentration of 2.4J $\mu\text{g}/\text{kg}$; no detectable concentration was exhibited in the associated replicate sample at the quantitation limit of 5.9 $\mu\text{g}/\text{kg}$.

3.1.3 Polynuclear Aromatic Hydrocarbons

Twelve PAHs were detected in the soil samples collected during the confirmation sampling event (Table 3.3). Detectable concentrations were limited to samples collected at locations CB-5, CB-6, CB-7, CB-8, and CB-9. PAHs were detected at very low concentrations (only slightly above the quantitation limits) at CB-5, but were detected at concentrations of 100 $\mu\text{g}/\text{kg}$ or greater at CB-6, CB-7, CB-8 and CB-9, located in the southern half of the former burn area (Figure 2.1). These compounds, and associated concentrations exhibited in the collected samples, are discussed below.

- Benzo(a)anthracene was detected only in the soil sample collected at location CB-9. This sample exhibited a concentration of 198 $\mu\text{g}/\text{kg}$.

- Benzo(a)pyrene was detected in soil samples collected at locations CB-5, CB-6, and CB-9. These samples exhibited concentrations ranging from 8 to 310 $\mu\text{g}/\text{kg}$. The highest concentration was exhibited by the sample collected at location CB-9 (310 $\mu\text{g}/\text{kg}$).
- Benzo(b)fluoranthene was detected in soil samples collected at locations CB-6 and CB-9 at concentrations of 8 and 271 $\mu\text{g}/\text{kg}$, respectively.
- Benzo(g,h,i)perylene was detected only in the soil sample collected at location CB-9. This sample exhibited a laboratory-estimated concentration of 221J $\mu\text{g}/\text{kg}$.
- Benzo(k)fluoranthene was detected only in the soil sample collected at location CB-9. This sample exhibited a concentration of 148 $\mu\text{g}/\text{kg}$.
- Chrysene was detected only in the soil sample collected at location CB-9. This sample exhibited a laboratory-estimated concentration of 279J $\mu\text{g}/\text{kg}$.
- Fluoranthene was detected in soil samples collected at locations CB-5, CB-6, and CB-9. These samples exhibited concentrations ranging from 14 $\mu\text{g}/\text{kg}$ to 655J $\mu\text{g}/\text{kg}$. The highest concentration was exhibited by the sample collected at location CB-9 (655 $\mu\text{g}/\text{kg}$).
- Fluorene was detected only in the replicate soil sample collected at location CB-8. This sample exhibited a laboratory-estimated concentration of 9J $\mu\text{g}/\text{kg}$. No detectable concentration was exhibited in the associated primary sample at the quantitation limit of 8 $\mu\text{g}/\text{kg}$.
- Indeno(1,2,3-cd)pyrene was detected only in the soil sample collected at location CB-9. This sample exhibited a laboratory-estimated concentration of 224J $\mu\text{g}/\text{kg}$.
- Naphthalene was detected in soil samples collected at locations CB-6, CB-7, and CB-8. These samples exhibited concentrations ranging from 100 $\mu\text{g}/\text{kg}$ to 585J $\mu\text{g}/\text{kg}$. The primary soil sample collected at location CB-7 exhibited the highest concentration (585J $\mu\text{g}/\text{kg}$); no detectable concentration was exhibited in the associated replicate sample at the quantitation limit of 40 $\mu\text{g}/\text{kg}$. The replicate soil sample collected at location CB-8 exhibited a concentration of 100 $\mu\text{g}/\text{kg}$; however, no detectable concentration was exhibited in the associated primary sample at the quantitation limit of 39 $\mu\text{g}/\text{kg}$.
- Phenanthrene was detected only in the soil sample collected at location CB-9. This sample exhibited a laboratory-estimated concentration of 66J $\mu\text{g}/\text{kg}$.
- Pyrene was detected only in the soil sample collected at location CB-9. This sample exhibited a laboratory-estimated concentration of 279 $\mu\text{g}/\text{kg}$.

3.2 COMPARATIVE ASSESSMENT

The primary purpose of this sampling effort was to assess the degree of soil remediation that has occurred as a result of pilot-scale and expanded-scale bioventing treatment at the project site. In the absence of identified contaminants of concern in vadose zone soils, an effective way to assess the remediation that has occurred is to compare the concentrations of contaminants in site soils before and after remediation. Table 3.4 provides a comparison of pre- and post-bioventing soil analytical results for TPH, BTEX, and PAHs. Pre-expanded-scale bioventing contaminant levels are based on data for soil samples collected by Parsons ES in November 1993 following one year of pilot scale operations (AFCEE, 1994), soil samples collected by Radian (1998) in November 1996 during RFI activities, and soil samples collected by Parsons ES (1997b) in February 1997 prior to expanded-scale bioventing system startup. To increase the accuracy of this assessment, most confirmatory soil samples were collected at approximately the same locations and depths as previously collected samples. Exceptions to this include the sample collected from borings CB-1 and CB-10 (see Section 2.1). No comparative data are available for either of these locations.

Comparing pre- and post-bioventing soil analytical results, significant reductions in TPH concentrations were observed at two (CB-8 and CB-9) of the ten confirmatory sampling locations for which comparisons are made. No significant reduction in TPH concentrations was observed at locations CB-3, CB-6, and CB-7. In fact, TPH concentrations appear to have increased at these locations. This increase is possibly the result of changing groundwater levels smearing dissolved petroleum hydrocarbons into soil at and just above the capillary fringe. Also, the organic contaminants are distributed non-uniformly in soils, and the confirmation samples may simply have been collected from areas where higher concentrations were present. The remaining locations exhibited TPH concentrations at or near the quantitation limit. BTEX concentrations have been significantly reduced to non-detectable or very low concentrations at all locations for which comparisons could be made. These reductions are most apparent at locations CB-3, CB-7, CB-8, and CB-9. PAH concentrations were observed to have decreased at all sampling locations except location CB-9. No significant reduction in PAH concentrations was observed at location CB-9 (Tables 3.3 and 3.4).

The overall reduction in soil fuel hydrocarbon concentrations, as summarized in Table 3.4 indicates that operation of the expanded-scale bioventing system is effectively reducing residual fuel hydrocarbon concentrations in site soils. Localized areas of higher contaminant concentrations persist in the vicinities of CB-6, CB-7, and CB-9, which are in an area that has only been subject to expanded-scale bioventing treatment.

TABLE 3.4
COMPARISON OF PRE- AND POST-BIOVENTING SOIL SAMPLE ANALYTICAL RESULTS
SWMU 55 (RP SITE FT-03)
CHARLESTON AFB, SOUTH CAROLINA

	Sampling Location: No Comparable Data Available		CB-1	SB-03	CB-2	SB-01	CB-3	MPD	CB-4
	Sample Depth (feet bgs) ^d :	Sample Collection Date ^e :	2.5 Jan-99	3-4 Nov-96	3.3 Jan-99	3-4 Nov-96	3 Jan-99	3-4 Nov-93	3 Jan-99
Total Petroleum Hydrocarbons^d									
Diesel-Range Organics (mg/kg) ^d	NA ^d	NA	4.73 J ^f	1.75 B ^g	5.33 J	151	513	---	6.58 J
Gasoline-Range Organics (mg/kg)	NA	NA	1.14 U ^g	0.191 J,B	1.28 U	613	1.2	---	1.11 U
Total Recoverable Petroleum Hydrocarbons (mg/kg)	NA	NA	---	---	---	---	---	2200	---
Volatile Organic Compounds									
Benzene (µg/kg)/I	NA	NA	2.3 U	6.73	2.6 U	174	2.4 U	540 U	2.2 U
Toluene (µg/kg)	NA	NA	5.7 U	18.6	6.4 U	120	6 U	540 U	5.6 U
Ethylbenzene (µg/kg)	NA	NA	3.4 U	0.322 J	3.8 U	751	3.6 U	540 U	3.3 U
Total Xylenes (µg/kg)	NA	NA	---	4.59	---	421	---	750 U	---
m,p-Xylenes (µg/kg)	NA	NA	3.4 U	---	3.8 U	---	3.6 U	---	3.3 U
o-Xylenes (µg/kg)	NA	NA	5.7 U	---	6.4 U	---	6 U	---	5.6 U
Polynuclear Aromatic Hydrocarbons									
Acenaphthene (µg/kg)	NA	NA	38 U	---	42 U	---	40 U	---	37 U
Acenaphthylene (µg/kg)	NA	NA	76 U	---	86 U	---	81 U	---	74 U
Anthracene (µg/kg)	NA	NA	25 U	---	28 U	---	27 U	---	24 U
Benzo(a)anthracene (µg/kg)	NA	NA	5 U	23.5 U	6 U	71.1	5 U	---	5 U
Benzo(a)pyrene (µg/kg)	NA	NA	3 U	40.1 U	4 U	79.9	4 U	---	3 U
Benzo(b)fluoranthene (µg/kg)	NA	NA	7 U	36.3 U	8 U	135 J	7 U	---	7 U
Benzo(g,h,i)perylene (µg/kg)	NA	NA	28 U	---	32 U	---	30 U	---	28 U
Benzo(k)fluoranthene (µg/kg)	NA	NA	7 U	---	8 U	---	7 U	---	7 U
Chrysene (µg/kg)	NA	NA	6 U	27.2 U	6 U	77.3	6 U	---	6 U
Dibenzo(a,h)anthracene (µg/kg)	NA	NA	11 U	---	13 U	---	12 U	---	11 U
Fluoranthene (µg/kg)	NA	NA	8 U	22 U	9 U	71.1	8 U	---	8 U
Fluorene (µg/kg)	NA	NA	8 U	---	9 U	---	8 U	---	8 U
Indeno(1,2,3-cd)pyrene (µg/kg)	NA	NA	16 U	24.3 U	18 U	41.3	17 U	---	16 U
Naphthalene (µg/kg)	NA	NA	38 U	110 U	42 U	897	40 U	---	37 U
Phenanthrene (µg/kg)	NA	NA	24 U	25.6 U	27 U	25.2 U	25 U	---	23 U
Pyrene (µg/kg)	NA	NA	10 U	27.1 U	12 U	70.4	11 U	---	10 U

TABLE 3.4 (continued)
 COMPARISON OF PRE- AND POST-BIOVENTING SOIL SAMPLE ANALYTICAL RESULTS
 SWMU 55 (IRP SITE FT-03)
 CHARLESTON AFB, SOUTH CAROLINA

Sampling Location: Sample Depth (feet bgs)†: Sample Collection Date:	SB-04	CB-5	MPE	CB-6	MPG	CB-7	MPF	CB-8
	3-4 Nov-96	3.5 Jan-99	3-4 Feb-97	3.2 Jan-99	2.5-3.5 Feb-97	3.5 Jan-99	2.5-3.5 Feb-97	3.3 Jan-99
Total Petroleum Hydrocarbons								
Diesel-Range Organics (mg/kg)	6.51	41.7	138	6620	2010	8940	4220	116
Gasoline-Range Organics (mg/kg)	0.148 J,B	1.2 U	106	17.2	513	582	1670	1.18 U
Total Recoverable Petroleum Hydrocarbons (mg/kg)	---	---	---	---	---	---	---	---
Volatile Organic Compounds								
Benzene (µg/kg)	5.87	2.4 U	17.5	11.5 U	557 U	2.4 U	58.1 U	2.4 U
Toluene (µg/kg)	18.8	6 U	21.1	28.7 U	1230	5.9 U	58.1 U	2.4 J
Ethylbenzene (µg/kg)	1.03 U	3.6 U	270	86.2	4760	3.5 U	1580	3.5
Total Xylenes (µg/kg)	4.35	---	358.7	---	17560	---	2160	---
m,p-Xylenes (µg/kg)	---	3.6 U	---	132	---	3.5 U	---	4.7
o-Xylenes (µg/kg)	---	6 U	---	28.7 U	---	51.8	---	5.9 U
Polynuclear Aromatic Hydrocarbons								
Acenaphthene (mg/kg)	---	40 U	---	38 U	---	7060 U	---	39 U
Acenaphthylene (mg/kg)	---	81 U	---	77 U	---	9060 U	---	79 U
Anthracene (mg/kg)	---	27 U	---	25 U	---	2590 U	---	26 U
Benzo(a)anthracene (mg/kg)	22.8 U	5 U	366 U	5 U	368 U	53 U	1,920 U	5 U
Benzo(a)pyrene (mg/kg)	38.9 U	11	366 U	8	368 U	88 U	1,920 U	4 U
Benzo(b)fluoranthene (mg/kg)	35.2 U	7 U	366 U	8	368 U	71 U	1,920 U	7 U
Benzo(g,h,i)perylene (mg/kg)	---	30 U	---	29 U	---	294 U	---	29 U
Benzo(k)fluoranthene (mg/kg)	---	7 U	366 U	7 U	---	65 U	1,920 U	7 U
Chrysene (mg/kg)	26.4 U	6 U	366 U	6 U	368 U	588 U	1,920 U	6 U
Dibenzo(a,h)anthracene	---	12 U	---	11 U	---	118 U	---	12 U
Fluoranthene (mg/kg)	21.4 U	14	366 U	15	368 U	824 U	1,920 U	8 U
Fluorene (mg/kg)	---	8 U	---	8 U	---	824 U	---	8 U
Indeno(1,2,3-cd)pyrene (mg/kg)	23.6 U	17 U	366 U	16 U	368 U	176 U	1,920 U	16 U
Naphthalene (mg/kg)	106 U	40 U	366 U	348	4190	585 J	9580	39 U
Phenanthrene (mg/kg)	24.8 U	25 U	366 U	24 U	368 U	2470 U	1,920 U	25 U
Pyrene (mg/kg)	26.3 U	11 U	366 U	10 U	368 U	1060 U	1,920 U	11 U

TABLE 3.4 (continued)
 COMPARISON OF PRE- AND POST-BIOVENTING SOIL SAMPLE ANALYTICAL RESULTS
 SWMU 55 (IRP SITE FT-03)
 CHARLESTON AFB, SOUTH CAROLINA

	SB-02	CB-9	CB-10	MPJ	CB-11	MPH	CB-12
Sampling Location:	3-4	3	No Comparable Data Available	3-4	3	1.5-2.5	3.3
Sample Depth (feet bgs) ^a :	Nov-96	Jan-99	Jan-99	Feb-97	Jan-99	Feb-97	Jan-99
Sample Collection Date:							
Total Petroleum Hydrocarbons							
Diesel-Range Organics (mg/kg)	80.5	58.4	14.2	10 U	21.8	25.6	3.71 J
Gasoline-Range Organics (mg/kg)	2.03	1.16 U	1.16 U	0.38	1.27 U	0.4	1.2 U
Total Recoverable Petroleum Hydrocarbons (mg/kg)	---	---	---	---	---	---	---
Volatile Organic Compounds							
Benzene (µg/kg)	127	10.5	2.3 U	7.65	2.5 U	26.9	2.4 U
Toluene (µg/kg)	167	8.1	5.8 U	6 U	6.3 U	5.77 U	6 U
Ethylbenzene (µg/kg)	53.5	27.9	3.5 U	15	3.8 U	28.6	3.6 U
Total Xylenes (µg/kg)	28.2	---	---	56.1	---	63.2	---
m,p-Xylenes (µg/kg)	---	22.1	3.5 U	---	3.8 U	---	3.6 U
o-Xylenes (µg/kg)	---	5.8	5.8 U	---	6.3 U	---	6 U
Polynuclear-Aromatic Hydrocarbons							
Acenaphthene (mg/kg)	---	14000 U	38 U	---	42 U	---	40 U
Acenaphthylene (mg/kg)	---	17900 U	78 U	---	85 U	---	81 U
Anthracene (mg/kg)	---	5120 U	26 U	---	28 U	---	27 U
Benzo(a)anthracene (mg/kg)	216	198	5 U	396 U	5 U	1200	5 U
Benzo(a)pyrene (mg/kg)	282	310	3 U	396 U	4 U	873	4 U
Benzo(b)fluoranthene (mg/kg)	428 J	271	7 U	396 U	8 U	1580	7 U
Benzo(g,h,i)perylene (mg/kg)	---	221 J	29 U	---	32 U	---	30 U
Benzo(k)fluoranthene (mg/kg)	---	148	7 U	396 U	8 U	550	7 U
Chrysene (mg/kg)	188	279 J	6 U	396 U	6 U	1190	6 U
Dibenzo(a,h)anthracene	---	233 U	12 U	---	13 U	---	12 U
Fluoranthene (mg/kg)	241	655 J	8 U	396 U	9 U	2450	8 U
Fluorene (mg/kg)	---	1630 U	8 U	---	9 U	---	8 U
Indeno(1,2,3-cd)pyrene (mg/kg)	142	224 J	16 U	396 U	18 U	382	17 U
Naphthalene (mg/kg)	173 J	14000 U	38 U	396 U	42 U	381 U	40 U
Phenanthrene (mg/kg)	129	66 J	24 U	396 U	27 U	1060	25 U
Pyrene (mg/kg)	233	279 J	10 U	396 U	11 U	2620	11 U

1997 data was provided by Method SW8260 by Intertek Testing Services (ITS), Richardson, Texas. ITS has disclosed that inappropriate manual peak area integration has occurred in their Richardson, Texas laboratory, and the VOC data that appears in this table is potentially impacted. The 1999 data was analyzed by Specialized Assays, Inc., Nashville, Tennessee.

^a feet bgs - feet below ground surface.

^b 1992 sampling performed by Haliburton NUS 1993, 1997 and 1999 sampling performed by Parsons ES.

^c Diesel- and gasoline-range organics analyzed in accordance with USEPA Method SW8015. Total recoverable petroleum hydrocarbons analyzed in accordance with USEPA Method 418.1.

^d mg/kg - milligrams per kilogram.

^e NA - Not available

^f J - Reported concentration is a laboratory estimate.

^g B - Analyte detected in method blank.

^h --- = not analyzed.

ⁱ U = Analyzed analyzed for, but not detected at or above the cited quantitation limit.

^j µg/kg = micrograms per kilogram.

SECTION 4

CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

Bioventing treatment of vadose zone soils at SWMU 55 have significantly reduced the concentrations of BTEX, PAHs, and TPH in vadose zone soils. Based on the June 1998 data, residual BTEX and TPH compounds in site soils have been greatly reduced as the result of bioventing remediation. Although aerobic biodegradation rates are still significant at several locations, soil gas conditions indicate that the discrete contaminant interval, located from the ground surface to the water table (at an average depth of approximately 4 feet below ground surface), is being treated by air injection bioventing. Static oxygen concentrations may become deficient (<5 percent) within portions of the site without continued bioventing; however, soil gas TVH and BTEX concentrations are very low at most locations, indicating that little residual fuel contamination remains to be treated.

Based on analytical data for soil samples collected during the January 1999 confirmation sampling event, bioventing treatment at SWMU 55 has significantly reduced the concentration of petroleum hydrocarbons contamination in vadose zone soils (i.e., those soils encountered from ground surface to a depth of approximately 4 feet bgs). Data generated during the soil gas sampling and respiration testing conducted at the site in June 1998 support this conclusion (Parsons ES, 1998b). Areas exhibiting elevated concentrations of petroleum hydrocarbon contamination, persist within the southern half of the former burn area. Remediation appears to be completed in soils in the northern half of the former burn area.

No significant reduction in TPH concentrations were observed at locations CB-3, CB-6, and CB-7. In fact, TPH concentrations appear to have increased at these locations. These increases are likely the result of changing groundwater levels smearing free-phase or dissolved petroleum hydrocarbons into the capillary-fringe soils, and the result of soil sample heterogeneity. The remaining locations exhibited TPH concentrations at or near the quantitation limit. Fuel VOCs, which are most susceptible to aerobic biodegradation, experienced the most significant reductions. BTEX concentrations have been significantly reduced to non-detect or very low concentrations at all locations for which comparisons were made. These reductions are most apparent at locations CB-3, CB-7, CB-8, and CB-9. With the exception of location CB-9, PAH concentrations were observed to have decreased at all sampling locations. No significant reduction in PAH concentrations was observed at location CB-9. Where detected, PAH compounds were present at relatively low concentrations. The overall

reduction in soil fuel hydrocarbon concentrations indicates that operation of the expanded-scale bioventing treatment system is effectively reducing residual fuel hydrocarbon concentrations in site soils.

4.2 RECOMMENDATIONS

Parsons ES recommends that Charleston AFB continue to operate the existing bioventing system until the CMS has been approved by the SCDHEC. Sustained bioventing system operation will continue to oxygenate soils and enhance aerobic biodegradation of residual petroleum hydrocarbon contamination that could continue to leach from the contaminant zone into site groundwater. In addition, continued bioventing system operation will promote oxygen delivery to the saturated zone through diffusion. If the SCDHEC approves the CMS as currently written (i.e., no contaminants of concern in vadose zone soils), then the bioventing system can be shut off and dismantled.

SECTION 5

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APPENDIX A

CONFIRMATION SAMPLING AND ANALYSIS PLAN

DRAFT FINAL

Confirmation Soil Sampling and Analysis Plan for SWMU 55 (IRP Site FT-03)



**Charleston Air Force Base
South Carolina**

Prepared For

**Air Force Center for Environmental Excellence
Technology Transfer Division
Brooks Air Force Base
San Antonio, Texas**

and

**437 CES/CEVR
Charleston Air Force Base
South Carolina**

December 1998



DRAFT FINAL

**CONFIRMATION SOIL SAMPLING AND ANALYSIS PLAN
FOR SWMU 55 (IRP SITE FT-03)**

**CHARLESTON AIR FORCE BASE,
SOUTH CAROLINA**

Prepared for:

**Air Force Center for Environmental Excellence
Technology Transfer Division
Brooks Air Force Base, Texas**

and

**437 CES/CEVR
Charleston Air Force Base, South Carolina**

December 1998

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ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CES/CEVR	Civil Engineering Squadron, Environmental Group
cfm	cubic feet per minute
CMS	Corrective Measures Study
COC	constituent of concern
COPC	chemical of potential concern
DRO	diesel-range organics
ES	Engineering-Science, Inc.
ft/day	feet per day
ft/ft	foot per foot
ft ² /day	square feet per day
GRO	gasoline-range organics
HSWMB	Hazardous and Solid Waste Management Bureau
ICM	Interim Corrective Measure
IRP	Installation Restoration Program
mg/kg	milligrams per kilogram
MP	monitoring point
NFRAP	no further response action planned
PAH	polynuclear aromatic hydrocarbon
Parsons ES	Parsons Engineering Science, Inc.
PCE	perchloroethene
PID	photoionization detector
ppmv	parts per million, volume per volume
QC	quality control
Radian	Radian International, LLC
RBC	risk-based concentration
RBCA	risk-based corrective action
RBSL	risk-based screening level
RCRA	Resource and Conservation Recovery Act
RFI	RCRA Facility Investigation
RI/FS	remedial investigation/feasibility study
SAIC	Science Applications International Corporation
SAP	sampling and analysis plan
SCDHEC	South Carolina Department of Health and Environmental Control
SSL	soil screening level
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TCE	trichloroethene
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
TVH	total volatile hydrocarbons
TVHA	total volatile hydrocarbon analyzer
US	United States
USEPA	US Environmental Protection Agency
VOC	volatile organic compound
VW	vent well

SECTION 1

INTRODUCTION

This confirmation soil sampling and analysis plan (SAP) for solid waste management unit (SWMU) 55 at Charleston Air Force Base (AFB), South Carolina, was prepared by Parsons Engineering Science, Inc. (Parsons ES) for submittal to the South Carolina Department of Health and Environmental Control (SCDHEC); the US Air Force Center for Environmental Excellence (AFCEE), Brooks AFB, Texas; and the 437 Civil Engineering Squadron, Environmental Group (CES/CEVR), Charleston AFB, South Carolina. SCDHEC regulates compliance with the Resource Conservation and Recovery Act (RCRA) program under which SWMU 55 is listed on Charleston AFB's RCRA Part B Permit. SWMU 55, a former fire training area, also is known as Installation Restoration Program (IRP) Site FT-03, and has been referenced as such in many previous documents related to the investigation and remediation of the site.

The SAP is intended to guide soil sampling at the former fire training area to document the effectiveness of the bioventing system being used as an interim corrective measure (ICM) at SWMU 55. The proposed soil sampling described in Section 4, targets petroleum hydrocarbons and chlorinated organic compounds in vadose zone soils in the vicinity of the former fire training area. This SAP does not address groundwater or other contaminated media at the site. A RCRA Facility Investigation (RFI) was completed by Radian International, LLC (Radian, 1998) in 1997, a Corrective Measures Study (CMS) was developed, and groundwater remediation consisting of engineered systems and natural attenuation is being implemented. The objective of the proposed soil sampling program is to obtain soil analytical data after air injection bioventing to estimate the contaminant reductions achieved using bioventing as the ICM, and based on this information determine the need for continued bioventing. This SAP details the sampling and analysis procedures to be used during this soil sampling event, which was initially proposed in the *Final Interim Measures Work Plan, Expanded Bioventing System, SWMU 55 (IRP Site FT-03), Charleston Air Force Base, South Carolina* (Parsons ES, 1997a).

SWMU 55 is the location of former Fire Protection Training Area 03, where a variety of flammable wastes were poured into an unlined, bermed area and ignited for fire fighting exercises. The primary waste burned at the site was JP-4 jet fuel, although other types of waste fuels and flammable liquids also may have been used (Haliburton NUS, 1995). In 1992, an initial bioventing pilot test was initiated at SWMU 55 under an AFCEE nationwide bioventing demonstration program. The pilot-scale bioventing program achieved significant reductions in concentrations of petroleum hydrocarbon compounds in soils. Based on these results, SWMU 55 was selected as a site for the

AFCEE Extended Bioventing Program. This ongoing program involves 52 *in situ* bioventing sites at 32 military installations nationwide, and provides funding for pilot- and full-scale bioventing system installations, and extended operation of installed bioventing systems. The program allows completion of confirmatory soil sampling and site closure documents if extended bioventing testing results indicate adequate site remediation has been achieved. An expanded bioventing system was installed at SWMU 55 in 1997 to remediate the remaining hydrocarbon-contaminated soils in and around the fire training area. The expanded system was implemented as a RCRA ICM and has been operated almost continuously since May 1997.

This SAP consists of nine sections, including this introduction. Section 2 includes a site description, history, and summaries of previous investigations and remediation activities. Section 3 summarizes risk-based screening levels (RBSLs) and related regulatory cleanup guidelines. A detailed SAP is presented in Section 4. Analytical results will be presented in a sampling report as described in Section 5. Section 6 lists Charleston AFB support requirements, and Section 7 presents the proposed project schedule. Air Force, regulatory, and contractor points of contact are provided in Section 8, and the cited references are provided in Section 9.

SECTION 2

SITE DESCRIPTION

2.1 SITE LOCATION AND HISTORY

SWMU 55, also referred to as IRP Site FT-03 (Fire Protection Training Area No. 3), is located in the extreme southeastern part of Charleston AFB (Figure 2.1). The site layout is shown on Figure 2.2. The 2-acre site was once used for controlled burning of flammable wastes during base fire training exercises. During its operation, the facility consisted of a steel tank used as a mock aircraft surrounded by an earthen berm and lined with limestone gravel. A concrete building was located outside the bermed area at the southwestern corner of the site. During fire training exercises, flammable liquids were sprayed on these structures and on the ground, ignited, and then extinguished using various agents such as aqueous film-forming foam, halon, and dry chemicals. It is reported that JP-4 jet fuel was the primary flammable liquid burned at the site; however, it is believed that other industrial wastes may have been burned when the facility was first established (Halliburton NUS, 1995). The site has not been used for fire training exercises since the early 1980s. It is currently overgrown and heavily wooded around its perimeter. The steel tank, concrete building, and remnants of the earthen berm are still present at the site.

2.2 SITE GEOLOGY AND HYDROGEOLOGY

A more detailed discussion of the site lithology and hydrogeology can be found in the *Draft Interim Bioventing Pilot Test Results Report for Fire Protection Training Area IRP Site FT-03, Charleston AFB, South Carolina* (Engineering-Science, Inc. [ES], 1993), and the *Phase II RCRA Facility Investigation Report, Charleston AFB, South Carolina* (Halliburton NUS, 1995). Charleston AFB is located in the Lower Coastal Plain physiographic province of South Carolina. Sediments beneath the base are characterized as a thick sequence of interbedded sands, silts, and clays formed by fluvial and marine processes. These interbedded layers are grouped into regional formations and aquifers based on lithologic and water quality characteristics. Surficial soils around the base are generally sandy and highly permeable at shallow depths, but may contain zones of clay and organic deposits. The area is marked by low geomorphic relief.

The subsurface lithology was characterized across the site during previous investigations (ES, 1993; Halliburton NUS, 1995; Radian, 1998). The shallow subsurface material was identified as part of the Ladson Formation, which consists of a fine- to medium-grained sand with traces of silt, intermittent clays, and some clay

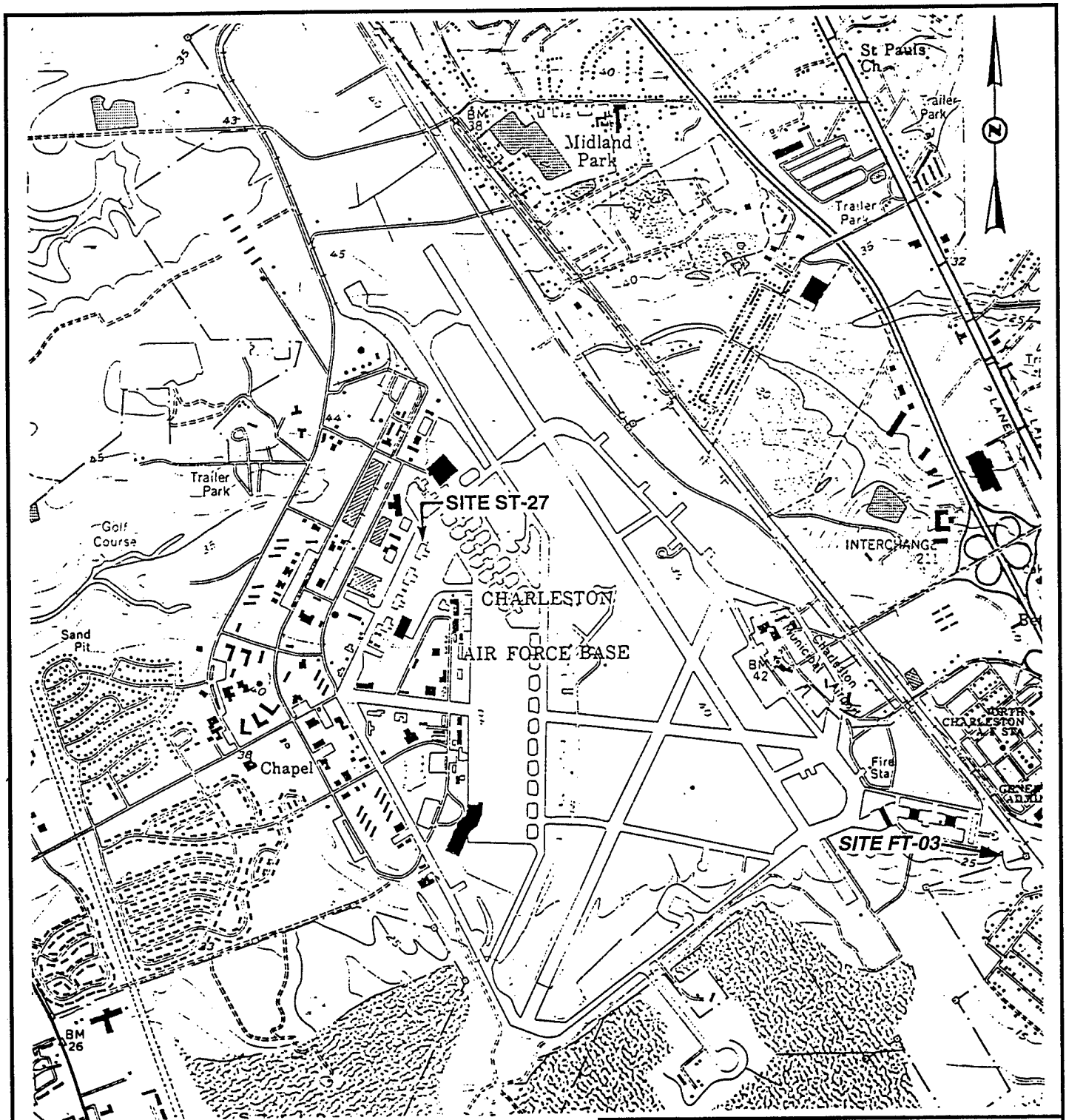


FIGURE 2.1

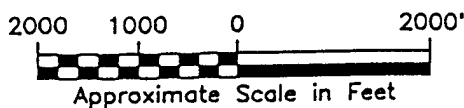
**SITE
LOCATION**

SWMU 55 (IRP Site FT-03)
Charleston AFB, South Carolina

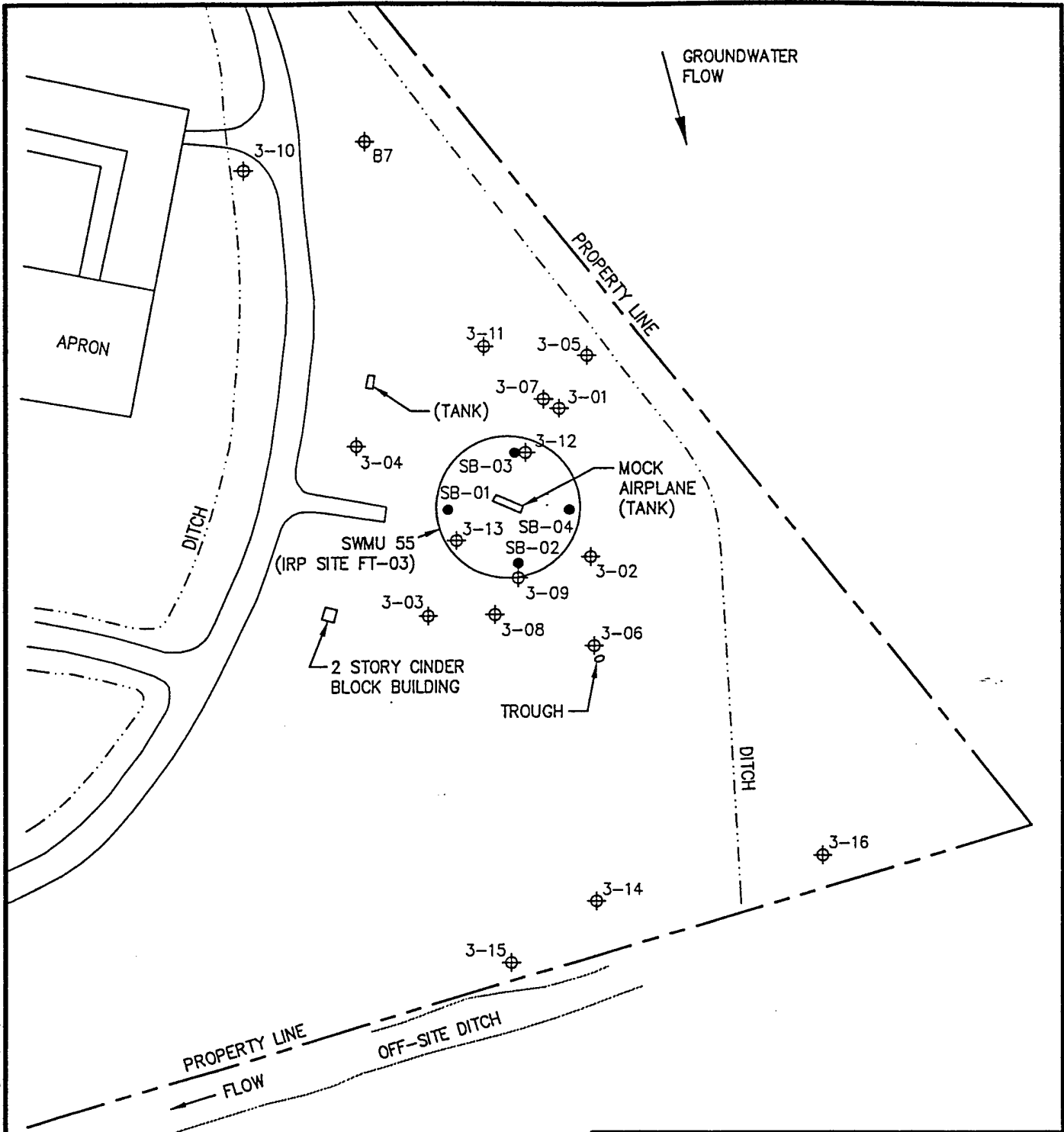
**PARSONS
ENGINEERING SCIENCE, INC.**

Denver, Colorado

Map Source:
Ladson, South Carolina Quadrangle
(7.5 Minute Series)



Source: USGS, 1958 (Photorevised 1979).



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LEGEND

- 3-16 ⊕ GROUNDWATER MONITORING WELL
- SB-01 ● MONITORING WELL

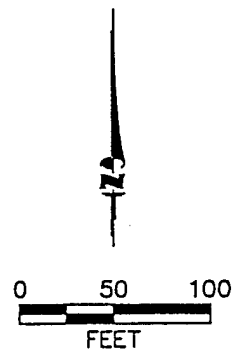


FIGURE 2.2

SITE LAYOUT

SWMU 55 (IRP Site FT-03)
Charleston AFB, South Carolina

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado

Map and Data Source: Radian, 1998
(Modified by Parsons ES)

stringers. The Cooper Marl Formation forms the base of the surficial aquifer, and was identified from 38 to 55 feet below ground surface (bgs) in borings at the site. Unsaturated soils in the vicinity of SWMU 55 are primarily silty sand with traces of silt and clay. Fill material consisting of silt, sand, and crushed aggregate was encountered within the berm that surrounds the burn area (Halliburton NUS, 1995). Remnants of the berm, which was constructed of soil and limestone aggregate, are still present at the site. The berm hinders surface drainage from the burn area, which often contains several inches of water after precipitation events. A channel was cut in the berm in 1997 to facilitate drainage and enhance the effectiveness of the installed bioventing system (Parsons ES, 1997a and b).

Groundwater in the surficial aquifer is encountered at an average depth of 4 feet bgs in the vicinity of the burn area on IRP Site FT-03. The surficial aquifer consists of a silty sand matrix. Precipitation is the primary mode of aquifer recharge at the site. The water table fluctuates in response to precipitation and exhibits seasonal elevation changes. After extended periods of precipitation, the water table has been observed as shallow as 2 feet bgs in the burn area (ES, 1993).

The predominant direction of shallow groundwater flow is to the south and southeast toward a tributary of Filbin Creek. Potentiometric maps provided in the RFI/CMS indicated little seasonal variation with respect to groundwater flow direction (Radian, 1998). For the northern portion of the site (upgradient) an average groundwater gradient of approximately 0.011 foot per foot (ft/ft) was reported (Radian, 1998). For the southern portion of the site (downgradient) an average groundwater gradient of approximately 0.024 ft/ft was calculated (Radian, 1998). An aquifer transmissivity value of 809 square feet per day (ft²/day) was calculated using results of two pump tests conducted at the site (Halliburton NUS, 1995). Aquifer storativity ranged from 0.016 to 0.00006, with an average value of 0.0006. An average hydraulic conductivity of 21 feet per day (ft/day) was calculated, based on an aquifer thickness of 38 feet. Using these data and an estimated effective porosity of 0.30, the average linear groundwater flow velocity in the vicinity of IRP Site FT-03 is 1.1 ft/day, or 380 feet per year (Halliburton NUS, 1995).

2.3 PREVIOUS INVESTIGATIONS

2.3.1 Previous Remedial Investigations and RFI/CMS Activities

A total of 17 groundwater monitoring wells have been installed at SWMU 55 (Figure 2.2). Seven of the wells were installed from 1985 through 1990, during two phases of remedial site investigations executed by Science Applications International Corporation (SAIC) and by Versar, Inc. As referenced in the Phase II remedial investigation/feasibility study (RI/FS) stage 2 report (Versar, Inc., 1992), five of the original wells (3-1 through 3-5) reportedly had submerged well screens during several water level measuring events. Wells 3-6 and 3-7 were installed with screens reportedly above the water table. In addition to the monitoring well installation and sampling, other activities performed during this period included soil sampling, sediment sampling, surface water sampling, aquifer testing, and a soil gas survey. Total

petroleum hydrocarbon (TRPH) concentrations as high as 7,770 milligrams per kilogram (mg/kg) were detected in shallow soils during these earlier investigations.

From 1992 through 1994, three additional monitoring wells (3-8, 3-9, B-7) were installed at the site by Halliburton NUS (1995) during a base-wide RFI. Well 3-8 was installed between wells 3-3 and 3-6 to further delineate groundwater contaminants in the downgradient direction. Well B-7 was installed upgradient from SWMU 55 to monitor background groundwater conditions. Well 3-9, installed during 1994, was constructed as a deep well and is screened across the lower 10 feet of the surficial aquifer to assess groundwater quality near the base of the surficial aquifer. Halliburton NUS conducted additional soil, sediment, and groundwater sampling and aquifer testing during the 1992-1994 RFI.

Radian (1998) completed additional RFI activities and conducted a CMS for SWMU 55 in 1996 and 1997. This investigation filled data gaps and completed the RFI investigations at the site. Additional soil and groundwater investigations were conducted at the site, including a groundwater screening survey using direct-push technology sampling methods. Seven additional monitoring wells (3-10 through 3-16) were installed and sampled during this time. Surface and subsurface soil samples were collected at four sampling locations (SB-01 through SB-04) within the historical burn area in November 1996 during the RFI. Several polynuclear aromatic hydrocarbons (PAHs), total petroleum hydrocarbon (TPH) fractions, and metals were detected in soil above their respective RBSLs. These results are presented in the *Draft Final RFI/CMS Report for SWMU 55, Fire Training Area No. 3, Charleston AFB, South Carolina* (Radian, 1998). Detections of TPH and volatile organic compounds (VOCs) at soil sampling locations SB-01 through SB-04 are summarized in Table 2.1, and detections of PAHs are summarized in Table 2.2. The draft final RFI/CMS report determined that there are no constituents of concern (COCs) in site soils or sediments. The draft final RFI/CMS report is currently being reviewed by SCDHEC, and has not yet been approved by them.

2.3.2 Initial Bioventing Pilot Test

Parsons ES (formerly Engineering-Science, Inc. [ES]) performed an initial bioventing pilot test at the site. During October 1992, a horizontal air-injection vent well (VW-1) and four vapor monitoring points (MPA, MPB, MPC and MPD) were installed on the north side of the burn area. Figure 2.3 shows the location of the pilot test components. From November 1992 through November 1993, the bioventing pilot test was performed at IRP Site FT-03 to determine if *in situ* bioventing would be a feasible cleanup technology for the hydrocarbon-contaminated soils in the vadose zone. Due to the successful results of the pilot test, operation of the pilot-scale system continued for several more years. Further details on the pilot test procedures and results are presented in the *Draft Interim Bioventing Pilot Test Results Report for Fire Protection Training Area Site FT-03, Charleston AFB, South Carolina* (ES, 1993). A summary letter report of the pilot test results was provided by AFCEE (1994) to the base.

TABLE 2.1
PREVIOUS SOIL ANALYTICAL RESULTS FOR TPH AND VOCs
SWMU 55 (IRP SITE FT-03)
CHARLESTON AFB, SOUTH CAROLINA

Previous Sample Location	Sample Depth (feet bgs) ^b	Date	Analyte ^d										
			TVPH (mg/kg) ^e	TEPH (mg/kg)	TRPH (mg/kg)	Benzene (µg/kg) ^e	Toluene (µg/kg)	Ethylbenzene (µg/kg)	Xylenes (µg/kg)	TCE (µg/kg)	Cis-1,2-DCE (µg/kg)	PCE (µg/kg)	Vinyl chloride (µg/kg)
Bioventing Pilot Test (Parsons ES)^f													
VW1	3.5-4.5	Oct-92	— ^g	—	1,100	730U ^h	2,600	1,600	4,600	—	—	—	—
VW1	3.5-4.5	Nov-93	—	—	170	2.7U	2.7U	2.7U	3.8U	—	—	—	—
MPA	2.5-3.5	Oct-92	—	—	51	720U	2,700	600U	1,300	—	—	—	—
MPA	2.5-3.5	Nov-93	—	—	12	0.6U	0.6U	0.6U	0.6U	—	—	—	—
MPD	3-4	Oct-92	—	—	2,200	1,400U	1,100U	1,600U	2,100U	—	—	—	—
MPD	3-4	Nov-93	—	—	2,200	540U	540U	540U	750U	—	—	—	—
RFI Soil Sampling (Radian)^h													
SB01	0-1	Nov-96	7.13	ND ⁱ	—	0.746U	0.783U	1.05U	3.50U	0.948U	0.498U	1.05U	1.91U
SB01	3-4	Nov-96	613	151	—	174	120	751	421	4.66U	2.45U	5.17U	9.4U
SB02	0-1	Nov-96	7.46	220	—	29	24.8	2.21	4.37	0.449JB ^j	4.69J	1.04U	1.88U
SB02	3-4	Nov-96	2.03	80.5	—	127	167	53.5	28.2	4.84U	2.54U	5.36U	9.75U
SB03	0-1	Nov-96	15.2	40.2	—	11.8	36.7	1.01U	5.57	0.911U	0.479U	1.01U	1.84U
SB03	3-4	Nov-96	0.191JB	1.75B	—	6.73	18.6	0.322J	4.59	0.957U	0.503U	1.06U	1.93U
SB04	0-1	Nov-96	0.860	20.8	—	12.2	22.6	6.68	7.55	0.878J	0.482U	1.02U	1.85U
SB04	3-4	Nov-96	0.148JB	6.51	—	5.87	18.8	1.03U	4.35	0.933U	0.490U	1.03U	1.88U
Expanded-Scale Bioventing (Parsons ES)^f													
MPE	3-4	Feb-97	106	138	—	17.5	21.1	270	358.7	5.55U	5.55U	5.55U	2.22U
MPF	2.5-3.5	Feb-97	1,670	4,220	—	58.1U	58.1U	1,580	2,160	58.1U	58.1U	58.1U	23.3U
MPG	2.5-3.5	Feb-97	513	2,010	—	557U	1,230	4,760	17,560	557U	557U	557U	223U
MPH	1.5-2.5	Feb-97	0.4	25.6	—	26.9	5.77U	28.6	63.2	5.77U	5.77U	5.77U	2.31U
MPJ	3-4	Feb-97	0.38	10U	—	7.65	6.00U	15.0	56.1	6.00U	6.00U	6.00U	2.4U

Note: Results for most of the analytes that have been detected are presented in this table. Sec-butylbenzene, n-butylbenzene, methylene chloride, 1,2,4-TMB, 1,3,5-TMB, isopropylbenzene, p-isopropyltoluene, and n-propylbenzene have been detected above the method detection limit (Radian, 1998).

^a TVPH (total volatile petroleum hydrocarbons) and TEPH (total extractable petroleum hydrocarbons) by USEPA Method SW8015M;

TRPH (total recoverable petroleum hydrocarbons) by USEPA Method 418.1 (1992-1993) or USEPA Method SW8015M (1996);

VOCs by USEPA Method SW8020A (1992-1993) or SW8260 (1996-1997); TCE (trichloroethene); DCE (dichloroethene); PCE (tetrachloroethene).

^b bgs = below ground surface.

^c mg/kg = milligrams per kilogram.

^d µg/kg = micrograms per kilogram.

^e Soil samples collected in October 1992 (prior to pilot testing) and November 1993 (after 1-year of testing) by Engineering-Science, Inc. (AFCEE, 1994).

^f — = not analyzed.

^g U = analyte not detected above the method detection limit shown.

^h Soil samples collected in November 1996 by Radian International, LLC, prior to expanded-scale bioventing system startup (Radian, 1998).

ⁱ ND = analyte not detected (method detection limit is unavailable).

^j B = compound also detected in the blank; J = compound detected above method detection limit but below the practical quantitation limit. Reported concentration is a laboratory estimate.

^k Soil samples collected in February 1997 by Parsons ES, prior to expanded-scale bioventing system startup (Parsons ES, 1997b).

TABLE 2.2
 PREVIOUS SOIL ANALYTICAL RESULTS FOR PAHs
 SWMU 55 (IRP SITE FT-03)
 CHARLESTON AFB, SOUTH CAROLINA

Previous Sample Location	Sample Depth (feet bgs) ^v	Date	Analyte ^w										
			Benzo(a)anthracene (mg/kg) ^v	Benzo(b)fluoranthene (mg/kg)	Benzo(k)fluoranthene (mg/kg)	Indeno(1,2,3-cd)pyrene (mg/kg)	2-Methylnaphthalene (mg/kg)	Benzo(a)pyrene (mg/kg)	Chrysene (mg/kg)	Fluoranthene (mg/kg)	Naphthalene (mg/kg)	Phenanthrene (mg/kg)	Pyrene (mg/kg)
RFI Soil Sampling (Radian) ^u													
SB01	0-1	Nov-96	0.116U ^v	0.18U	— ^p	0.121U	0.580U	0.199U	0.135U	0.109U	0.545U	0.127U	0.134U
SB01	3-4	Nov-96	0.0711	0.135J ^v	—	0.0413	0.860	0.0799	0.0773	0.0711	0.897	0.0252U	0.0704
SB02	0-1	Nov-96	0.979J	0.879	—	0.492J	0.566U	0.865J	1.03J	2.21J	0.532U	1.18J	1.63J
SB02	3-4	Nov-96	0.216	0.428J	—	0.142	0.122J	0.282	0.188	0.241	0.173J	0.129	0.233
SB03	0-1	Nov-96	0.111U	0.172U	—	0.115U	0.553U	0.19U	0.129U	0.104U	0.520U	0.121U	0.128U
SB03	3-4	Nov-96	0.0235U	0.0363U	—	0.0243U	0.117U	0.0401U	0.0272U	0.022U	0.110U	0.0256U	0.0271U
SB04	0-1	Nov-96	0.0224U	0.0346U	—	0.0232U	0.111U	0.0382U	0.026U	0.021U	0.105U	0.0244U	0.0258U
SB04	3-4	Nov-96	0.0228U	0.0352U	—	0.0236U	0.113U	0.0389U	0.0264U	0.0214U	0.106U	0.0248U	0.0263U
Expanded-Scale Bioventing (Parsons ES) ^w													
MPE	3-4	Feb-97	0.366U	0.366U	0.366U	0.366U	0.397	0.366U	0.366U	0.366U	0.366U	0.366U	0.366U
MPF	2.5-3.5	Feb-97	1.92U	1.92U	1.92U	1.92U	15.2	1.92U	1.92U	1.92U	9.58	1.92U	1.92U
MPG	2.5-3.5	Feb-97	0.368U	0.368U	0.368U	0.368U	4.73	0.368U	0.368U	0.368U	4.19	0.368U	0.368U
MPH	1.5-2.5	Feb-97	1.20	1.58	0.550	0.382	0.381U	0.873	1.19	2.45	0.381U	1.06	2.62
MPJ	3-4	Feb-97	0.396U	0.396U	0.396U	0.396U	0.396U	0.396U	0.396U	0.396U	0.396U	0.396U	0.396U

Note: Only those PAH analytes that were detected by Parsons ES in February 1997 are presented in this table.

^v Polynuclear aromatic hydrocarbons (PAHs) by USEPA Method SW8270.

^w bgs = below ground surface.

^u mg/kg = milligrams per kilogram.

^v Soil samples collected in November 1996 by Radian International, LLC prior to expanded-scale bioventing system startup (Radian, 1998).

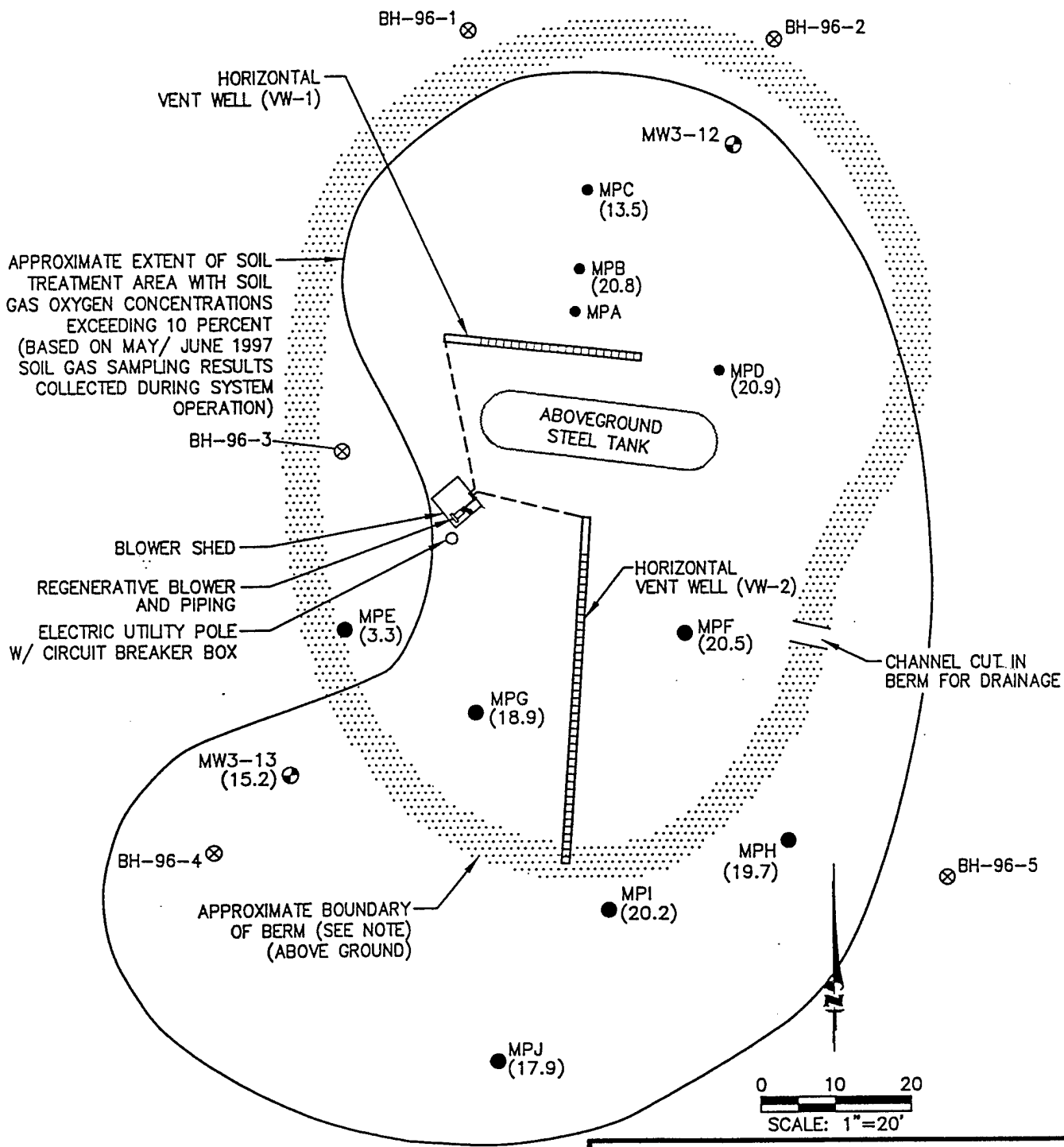
^v U = analyte not detected above the MDL shown.

^p --- = compound not analyzed for.

^v J = compound detected above method detection limit and less than practical quantitation limit. Reported concentration is a laboratory estimate.

^v Soil samples collected on February 25-26, 1997 by Parsons ES, prior to expanded-scale bioventing system startup (Parsons ES, 1997b).

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- LEGEND**
- MW3-12 ⊕ GROUNDWATER MONITORING WELL
 - MPF ● SOIL VAPOR MONITORING POINT
 - (20.5) SOIL GAS OXYGEN CONCENTRATION (%)
 - BH-96-5 ⊗ SOIL BORING/ SAMPLING LOCATION
 - AIR INJECTION HEADER PIPE (BURIED)

NOTE:
 SOIL BERM HAS APPROXIMATE ELLIPTICAL DIMENSIONS AND VARYING WIDTHS, LOCATIONS OF TANK, VENT WELLS, AND UTILITY POLE WITHIN BERM ARE ESTIMATED.

FIGURE 2.3

BIOVENTING SYSTEM LAYOUT

SWMU 55 (IRP Site FT-03)
 Charleston AFB, South Carolina

PARSONS ENGINEERING SCIENCE, INC.
 Denver, Colorado

Soil and soil gas data collected before and after the pilot test confirmed significant fuel contaminant reduction in the pilot test treatment area. Soil results are provided in Table 2.1, and soil gas results are provided in Table 2.3. Laboratory results showed significant reductions in total volatile hydrocarbons (TVH) in soil gas, and significant reductions in TRPH concentrations in soil. Initial concentrations of benzene, toluene, ethylbenzene, and xylenes (BTEX) in the soil and soil gas were low at the site. BTEX concentrations were reduced to nondetectable levels in all soil and soil gas samples that were collected at the end of the pilot test. In addition, the pilot test demonstrated that significant oxygen utilization and biodegradation were continuing in the pilot test area, and that continued bioventing would promote additional fuel biodegradation.

2.3.3 Expanded Bioventing System

The success of the bioventing pilot test at this site supported the recommendation for an expanded (full-scale) bioventing system as the most economical approach for remediating the remaining hydrocarbon-contaminated soils at SWMU 55. The expanded bioventing system was designed to remediate soil contamination in the unsaturated zone, which also is expected to reduce leaching of BTEX and other soluble contaminants to groundwater by removing the primary source of these contaminants. Bioventing is currently being implemented as an ICM in support of other CMS recommendations for the site. The technology currently is being used to reduce the source of organic fuel compounds in groundwater and as a means to further reduce potential risks associated with contaminants at this site. The RFI risk assessment conducted by Radian concluded that the risks to human health from soil contamination are low at SWMU 55. The CMS prepared by Radian (1998) proposed continued bioventing as the only corrective action required for site soils.

The expanded bioventing system consists of one new 4-inch-diameter horizontal VW (VW-2), six new monitoring points (MPE, MPF, MPG, MPH, MPI and MPJ), a new blower system, and associated piping, controls, and electrical service. Figure 2.3 shows the locations of the bioventing system components. The four existing permanent MPs installed during previous pilot testing efforts (MPA, MPB, MPC, MPD) were retained to monitor system performance. The original pilot test vent well (VW-1) also was incorporated into the full-scale system for air injection.

The new system was installed by Parsons ES and subcontractors during three mobilizations occurring between February and May 1997. The system at IRP Site FT-03 was installed as described in the *Final Interim Measures Work Plan, Expanded Bioventing System, SWMU 55 (IRP Site FT-03), Charleston Air Force Base, South Carolina* (Parsons ES, 1997a). There were no deviations from the work plan during system installation.

2.3.3.1 Soil and Soil Gas Sampling

Five baseline soil samples and five baseline soil gas samples were collected by Parsons ES for laboratory analysis during expanded system installation and prior to system startup. Additionally, five soil gas samples were collected for laboratory

TABLE 2.3
SOIL GAS FIELD AND LABORATORY ANALYTICAL RESULTS
SWMU 55 (SITE FT-03)
CHARLESTON AFB, SOUTH CAROLINA

Sample Location	Sample Depth (ft bgs) ^w	Sampling Date	Field Screening Data			Laboratory Analytical Data ^v				
			Oxygen (percent)	Carbon Dioxide (percent)	TVH (ppmv) ^d	TVH (ppmv)	Benzene (ppmv)	Toluene (ppmv)	Ethylbenzene (ppmv)	Xylenes (ppmv)
MPA	3.5	11/10/92	0.0	8.2	5,000	27	0.002U	0.002U	0.002U	0.002U
		5/13/93	0.0	5.1	64	—	—	—	—	—
		11/11/93	—	—	—	0.47	0.002U	0.002U	0.002U	0.002U
MPB	3.5	11/10/92	0.0	7.8	1,400	— ^d	—	—	—	—
		5/13/93	0.0	3.5	56	—	—	—	—	—
		4/25/97	18.5	0.8	170	—	—	—	—	—
		6/23/98	14.3	8.4	32	—	—	—	—	—
MPC	3.2	11/10/92	0.0	6.3	200	—	—	—	—	—
		5/5/93	0.0	8.0	160	—	—	—	—	—
		11/11/93	—	—	—	0.78	0.002U	0.002U	0.002	0.002U
		4/25/97	10.5	1.8	140	—	—	—	—	—
MPD	3.9	11/10/92	0.0	8.4	>20,000	—	—	—	—	—
		5/6/93	0.0	6.8	164	790	0.04U	0.04U	0.12	0.22
		11/11/93	—	—	—	13	0.002U	0.002U	0.002U	0.002U
		4/25/97	15.2	1.5	140	—	—	—	—	—
		6/23/98	5.0	13.9	76	—	—	—	—	—
MPE	3.2	4/25/97	0.5	8.0	4,200	10,000	20M ^d	120M	31	36
		6/23/98	2.0	>25 ^f	3,600	3,300	1.9	0.35U ^g	21	60M
MPF	3.3	4/25/97	0.0	7.8	2,000	3,000	4	8	16	27M
		6/23/98	0.0	15.0	180	100	0.17	0.0095U	0.32	1.4M
MPG	3.3	4/25/97	2.0	7.00	5,600	9,600	25M	100M	37	90
		6/23/98	0.0	19.0	1,080	950	0.20	0.080U	6.5	17M
MPH	2.8	4/25/97	3.4	6.5	8,200	8,200	47	14	10	22M
		6/23/98	0.0	13.0	90	36/35 ^h	0.18/0.16	0.0029U/ 0.0029U	0.46/0.45	.6M/1.7M
MPI	3	4/25/97	0.8	7.0	5,400	—	—	—	—	—
		6/23/98	10.9	9.2	30	—	—	—	—	—
MPJ	3	4/25/97	2.2	7.5	4,800	6,300	24	14	3	5
		6/23/98	3.9	19.0	110	85	0.23	0.012U	0.092	0.25M
MW3-13	5.8-7	4/25/97	0.0	4.3	8,000	—	—	—	—	—
		6/23/98	0.9	18.0	220	—	—	—	—	—

^v Laboratory analysis of soil gas performed using USEPA Method TO-3, referenced to jet fuel (molecular weight = 156)

^w ft bgs = feet below ground surface.

^d TVH=total volatile hydrocarbons; ppmv = parts per million, volume per volume.

^e — = not analyzed.

^f M = Laboratory reported value may be biased due to apparent matrix interferences.

^g > = denotes field measurement greater than maximum meter reading.

^h U = compound analyzed for, but not detected. Number shown represents the laboratory method detection limit.

^h primary/replicate sample results.

analyses after the expanded system had operated for 1 year and had then been shut down for 30 days to allow subsurface conditions to reach equilibrium.

The soil samples were collected from boreholes installed for the MPs. Additionally, five shallow exploratory soil borings (BH-96-1 through BH-96-5) were advanced around the site to further define the extent of soil contamination (Figure 2.3). Field screening showed that soil samples from exploratory borings BH-96-1, BH-96-2, and BH-96-5 had VOC headspace readings ranging from 13 to 192 parts per million by volume (ppmv), indicating that these soils were not significantly impacted by fuels. Soil samples collected from borings BH-96-3 and BH-96-4 had maximum headspace VOC readings of >2,500 ppmv and 819 ppmv, respectively.

Soil samples from the MPs were analyzed by Intertek Testing Services (formerly Inchcape Testing Services) of Richardson, Texas, for BTEX and other VOCs by Method SW8260a; TPH by Method SW8015 modified for diesel-range organic (DRO) extractables and gasoline-range organic (GRO) purgeables as jet fuel; PAHs by Method SW8270; and metals by Methods SW6010 and SW7060.

The soil gas samples were analyzed by Air Toxics, Ltd. of Folsom, California for BTEX and TVH by Method TO-3. Prior to the collection of laboratory soil gas samples, soil gas samples from the MPs were analyzed in the field by Parsons ES for oxygen, carbon dioxide, and TVH using direct-reading instruments. The results of the field screening were used to select the samples submitted for laboratory analysis. Soil analytical results for BTEX and TPH are summarized in Table 2.1. Table 2.2 provides the February 1997 soil analytical results for detected PAH compounds. Soil gas sampling results are summarized in Table 2.3.

2.3.3.2 Initial Operating Parameters

The expanded bioventing system was started on May 20, 1997. The system pressures and air injection rate for each horizontal VW were adjusted twice during the next 3 weeks to allow the system to reach equilibrium and assure optimum air distribution to the contaminated soils. On June 11, 1997, air was being injected into VW-1 at a rate of approximately 12.9 cubic feet per minute (cfm), and into well VW-2 at a rate of approximately 24.8 cfm at a blower pressure of 57.5 inches of water. During this time, pressure responses measured at the MPs ranged from a maximum of 33 inches of water at MPG-3.3, to a minimum of 1.36 inches of water at MPC-3.2. The pressure-relief valve was readjusted, and the pressure was subsequently reduced to 50 inches of water. Air flows to the VWs at this reduced pressure were 9.8 cfm (VW-1) and 18.5 cfm (VW-2). Subsequent measurements demonstrated that the system pressures and flow rates fluctuate over time, probably due to changes soil moisture and the water table elevation.

Oxygen, carbon dioxide, and TVH soil gas concentrations also were measured at the MPs before and after system optimization to confirm that the entire soil volume designated for remediation is being oxygenated (greater than 10 percent oxygen) by the expanded bioventing system. The area of oxygen influence designated for remediation

is shown on Figure 2.3. This general area was designated for remediation based on soil gas survey results from June 1996 (Parsons ES, 1997).

Soil gas oxygen concentrations measured in May and June 1997 during the expanded system operation exceeded 10 percent in all but one of the MPs located within the area designated for remediation. Soil gas oxygen measurements indicated that shallow soil at MPE were not receiving sufficient oxygen. Soil gas measurements taken on July 30, 1997 showed oxygen concentrations as high as 17.2 percent (at MPJ), although the oxygen concentration remained at less than 1 percent at point MPE. The lack of significant oxygen influence at MPE after several months of bioventing appears to be a localized anomaly. Point MPE is located 30 feet from VW-2; however, other MPs located between 25 to 36 feet from the same VW were receiving sufficient oxygen (e.g., MPH, MPJ, MW3-13). It is possible that some sort of buried obstruction is located between MPE and VW-2, which could minimize soil gas advection in this area.

2.3.3.3 Baseline Soil Sampling Results For Expanded Bioventing System

Baseline soil sampling results indicated that soil TPH concentrations were highest in the immediate vicinity of the former fire training area prior to operating the expanded bioventing system. The highest detected TPH concentration (combined DRO and GRO) was 5,890 mg/kg at MPF, as shown in Table 2.1. Sample MPG-2.5 had a TPH concentration of 2,513 mg/kg. BTEX compounds were detected in each of the five soil samples. PAHs also were detected in four of the five soil samples. Baseline soil TPH concentrations detected during the previous pilot study initiated in 1992 ranged from 51 mg/kg to 2,200 mg/kg on the north side of the burn area (ES, 1993).

2.3.3.4 Soil Gas Sampling Results For Expanded System

Soil gas sampling for laboratory analyses was conducted at multiple MPs before starting the expanded bioventing system and after the system had operated for 1 year. Vapor-phase hydrocarbons were detected in soil gas at the site. Prior to operating the expanded bioventing system as an ICM, soil gas laboratory analyses detected TVH concentrations up to 10,000 ppmv, and vapor-phase BTEX compounds also were detected (see Table 2.3). Soil gas hydrocarbons were detected throughout the former burn area.

Field soil gas TVH concentrations have decreased at all the MPs, and laboratory soil gas TVH and BTEX concentrations have decreased similarly. At all locations except MPE and MPG, TVH concentrations have been reduced below 1,000 ppmv. The greatest reduction was observed at MPH-2.8, where TVH were reduced by 99.6 percent, and total BTEX were reduced by 97.6 percent. At MPE-3.2, where tight soils are present, TVH were reduced by 67.0 percent, and BTEX were reduced by 59.7 percent. These data indicate that although TVH levels at SWMU 55 remain high (above 1,000 ppmv) at two locations, both TVH and the risk driving BTEX compounds are being biodegraded during bioventing system operation.

Soil laboratory analyses confirm previous soil gas survey results (Parsons ES, 1997b) and indicate that soil hydrocarbon contamination has not migrated far from the source areas. Low oxygen and high TVH concentrations were measured in soil gas

samples collected from the MPs on the south side of the site, indicating the presence of widespread vapor-phase contamination and anaerobic conditions. Soil gas samples collected in June 1998 from MPs on the north side of the burn area had significantly higher oxygen concentrations (see Table 2.3). Although the north side of the burn area had undergone pilot-scale bioventing treatment prior to operating the expanded bioventing system, limited oxygen utilization (see Section 2.3.3.5), indicative of microbial biorespiration, was still occurring in these soils.

2.3.3.5 Respiration Testing and Results

Respiration tests can be used as a qualitative guide to determine the degree of soil remediation that has been achieved due to aerobic biodegradation. Field respiration testing has been conducted three times during bioventing at SWMU 55. The first two test events were associated with the initial bioventing pilot study in 1992 and 1993, and were conducted before and after the 1-year pilot scale test. The third respiration testing event was conducted in June 1998 following 30 days of shut down of the expanded bioventing system. Observed rates of oxygen utilization were used to estimate aerobic fuel biodegradation rates following 1 year of expanded-scale bioventing. Initial and final respiration and fuel biodegradation rates for site soils are shown in Table 2.4.

As can be seen in Table 2.4, significant reductions occurred in respiration and fuel biodegradation rates at MPA and MPB following 1 year of pilot-scale system operation. MPD-3.9 is the only location that has been tested during each sampling event. The biodegradation rate at MPD-3.9 increased from 580 mg/kg/year in November 1992 to 1,690 mg/kg/year in May 1993, indicating that seasonal groundwater fluctuations may have caused the transfer of contaminants from saturated zone into the vadose zone over this time period. Biodegradation rates decreased from May 1993 to November 1993, indicating that significant reductions in contaminant concentrations may have been achieved during this time frame. Another slight decrease was observed between November 1993 (450 mg/kg/year) and June 1998 (240 mg/kg/year). Because the June 1998 biodegradation rate (240 mg/kg/year) is much lower than the May 1993 rate, which was measured at approximately the same time of the year, significant remediation of smear zone soils associated with the groundwater table has been indicated. During June 1998, fuel biodegradation rates ranged from 220 mg/kg/year at MPI-3, to 1,940 mg/kg/year at MPE-3.2 (Table 2.4). The very low biodegradation rates at most locations correspond to the low TVH concentrations at these locations, which were measured after 1 month of system shutdown.

TABLE 2.4
RESPIRATION AND FUEL BIODEGRADATION RATES
 SWMU 55 (IRP SITE FT-03)
 CHARLESTON AFB, SOUTH CAROLINA

Sampling Location-Depth (feet bgs) ^{a/}	Pilot-Scale Test						Expanded-Scale Operation	
	Initial Results (November 1992)		6-Month Results (May 1993)		1-Year Results (November 1993)		Final Results (June 1998)	
	O ₂ Utilization (% O ₂ /hour)	Biodegradation Rate ^{b/} (mg/kg/year) ^{c/}	O ₂ Utilization (% O ₂ /hour)	Biodegradation Rate ^{d/} (mg/kg/year)	O ₂ Utilization (% O ₂ /hour)	Biodegradation Rate ^{e/} (mg/kg/year)	O ₂ Utilization (% O ₂ /hour)	Biodegradation Rate ^{f/} (mg/kg/year)
MPA-3.5	--- ^{g/}	---	0.276	270	0.051	120	---	---
MPB-3.5	---	---	0.108	110	0.027	60	---	---
MPC-3.25	---	---	---	---	0.022	70	---	---
MPD-1.8	---	---	0.186	370	0.168	510	---	---
MPD-3.9	0.528	580	0.84	1,690	0.15	450	0.120	240
MPE-3.2	---	---	---	---	---	---	1.99	1,940 ^{h/}
MPF-3.3	---	---	---	---	---	---	0.361	730
MPG-3.3	---	---	---	---	---	---	0.774	1,560
MPH-3.3	---	---	---	---	---	---	0.118	240
MPI-3.0	---	---	---	---	---	---	0.108	220

^{a/} bgs = below ground surface.

^{b/} Assumes moisture content of the soil is equal to the initial results at MPD-3.

^{c/} Assumes moisture content of the soil is equal to the average initial (1992) and 1-year (1993) results.

^{d/} Assumes moisture content of the soil is equal to the 1-year (1993) results.

^{e/} Moisture content is estimated to be 9.6%, based on sample results from nearby vapor MPs.

^{f/} Milligrams of hydrocarbons per kilogram of soil per year.

^{g/} --- = Respiration test not conducted.

^{h/} Moisture content is estimated to be 12.6%.

SECTION 3

SITE CLEANUP REQUIREMENTS

3.1 SITE CHARACTERIZATION REQUIREMENTS

The objective of the proposed soil sampling is to determine the degree of soil remediation that has occurred as a result of expanded bioventing system operation. Based on a comparative analysis of pre-bioventing and post-bioventing analytical data, a recommendation will be made for future action at the site (i.e., to continue or discontinue bioventing operation). Results obtained from implementing this soil SAP will be used to supplement proposed corrective measures (Radian, 1998) for groundwater, which will be implemented by IT and the Atlanta office of Parsons ES. This SAP targets unsaturated soils in the source area of the former fire training area and other locations where previous investigations have detected soil contamination.

3.2 REGULATORY CLEANUP STANDARDS

SWMU 55 is regulated by the SCDHEC, Hazardous and Solid Waste Management Bureau (HSWMB), although federal guidance and regulations directed the CMS development. Specifically, the US Environmental Protection Agency (USEPA, 1994) document RCRA Corrective Action Plan was used to develop the CMS. Actions at this site are subject to conditions of the Charleston AFB RCRA Part B Permit and are to be performed in compliance with the Corrective Action Objectives presented in the CMS for SWMU 55 (Radian, 1998). In compliance with previous investigations, RFI work plans, and the RCRA Corrective Action Program requirements for SWMU 55, this soil sampling and analyses will target a variety of organic analytes that may have been present in the flammable wastes that were burned at the site.

The identification of chemicals of potential concern (COPCs) that may present an unacceptable risk that requires remediation were determined by a combination of regulatory screening levels in the RFI risk assessment (Radian, 1998). The initial screening of site soil samples collected during 1991-1997 was used to determine if any compound exceeds its respective RBSL. The RBSLs presented in the RFI (Radian, 1998) were calculated by using the USEPA Region III (1997) risk-based concentrations (RBC) for residential or industrial scenarios. Cleanup standards derived for the CMS were based on the following alternatives:

- Remediate site contaminants to background levels and/or to federal and state residential levels or to federal/state industrial levels;

- Remediate site contaminants to standards established by risk assessment calculations; or
- Reduce exposure to site contaminants through the use of control technologies.

Because risk assessment criteria are based on current or foreseeable land uses and human and/or ecological receptor exposure scenarios, a review of available information is provided below.

3.2.1 Land Use and Potential Receptors

Research into current zoning and future land use plans was conducted by Radian (1998) as part of the RFI/CMS risk assessment. The current and future uses of land at SWMU 55 are classified as open space. Current land use adjacent to the site also is classified as open space in the RFI/CMS, although there are some commercial and residential areas nearby. The property boundaries of Charleston AFB border SWMU 55, with private land located east and south of the site. For purposes of risk evaluation, an industrial exposure scenario was used for onsite soil contaminants that will not migrate off site. A residential land use scenario was used as a very conservative estimate for risk assessment of contaminants that could potentially migrate off site in groundwater.

Based on these land use and exposure assumptions and the site description presented in Section 2, current and future onsite workers represent the primary potential human receptors. However, residential receptors also may represent a conservative potential future exposure scenario if plume migration continues downgradient from the original source area, and if future residential development occurs in downgradient areas. It is possible that some ecological receptors could be exposed to contaminants in site media under current or anticipated future land uses. The ecological risk assessment conducted by Radian (1998) showed minimal to no risk to ecological receptors.

Currently there is no on-Base beneficial use of groundwater from the shallow aquifer. Charleston AFB and surrounding businesses and residences obtain their drinking water from the local municipality. Therefore, exposure of onsite and off-site human receptors to site contaminants through ingestion or inhalation of, or dermal contact with, contaminants in groundwater extracted for potable use is unlikely. Nonetheless, groundwater contaminant fate and transport modeling indicates that several organic compounds are predicted to migrate away from SWMU 55 and cross the Base boundary in concentrations that exceed the residential RBSLs. Adjacent land in the direction of plume migration (i.e., south) is not controlled by the Base. Based on this information, it is anticipated that the most significant contaminant migration pathway resulting from soil contamination at SWMU 55 is the leaching of contaminants from soil to groundwater.

3.2.2.2 Regulatory Cleanup Criteria for Soils

Only those COPCs that exceed the regulatory and/or risk-based standards are considered constituents of concern (COCs) that require remediation. The RFI/CMS (Radian, 1998) developed for SWMU 55 determined that there are no COCs in site

soils or sediments. The RFI/CMS is currently being reviewed by SCDHEC, and has not yet received regulatory approval.

Recommendations for continued bioventing will be based on a comparison of soil analytical results of chemicals that were previously detected (see Table 3.1).

TABLE 3.1
MAXIMUM PRE-BIOVENTING SOIL CONTAMINANT CONCENTRATIONS
SWMU 55 (IRP SITE FT-03)
CHARLESTON AFB, SOUTH CAROLINA

Analyte	Units ^{a/}	Pre-Bioventing Site Maximum Concentration
TRPH	mg/kg	2,200
TVPH	mg/kg	1,670
TEPH	mg/kg	4,220
Benzene	mg/kg	1.4U ^{b/}
Toluene	mg/kg	2.7
Ethylbenzene	mg/kg	4.76
Xylenes (total)	mg/kg	17.56
Benzo(a)pyrene	mg/kg	0.873
Naphthalenes	mg/kg	9.58
Fluoranthene	mg/kg	2.45
Pyrene	mg/kg	2.62
Benzo(a)anthracene	mg/kg	1.20
Chrysene	mg/kg	1.19
Benzo(b)fluoranthene	mg/kg	1.58
Benzo(k)fluoranthene	mg/kg	1.92U
Indeno(1,2,3-cd)pyrene	mg/kg	1.92U
Cis-1,2-Dichloroethene	mg/kg	.557U
Trichloroethene (TCE)	mg/kg	.557U
Tetrachloroethene (PCE)	mg/kg	.557U
Vinyl Chloride	mg/kg	.223U

^{a/} mg/kg = milligrams per kilogram.

^{b/} U = analyte not detected above the method detection limit shown.

SECTION 4

SOIL SAMPLING AND ANALYSIS PLAN

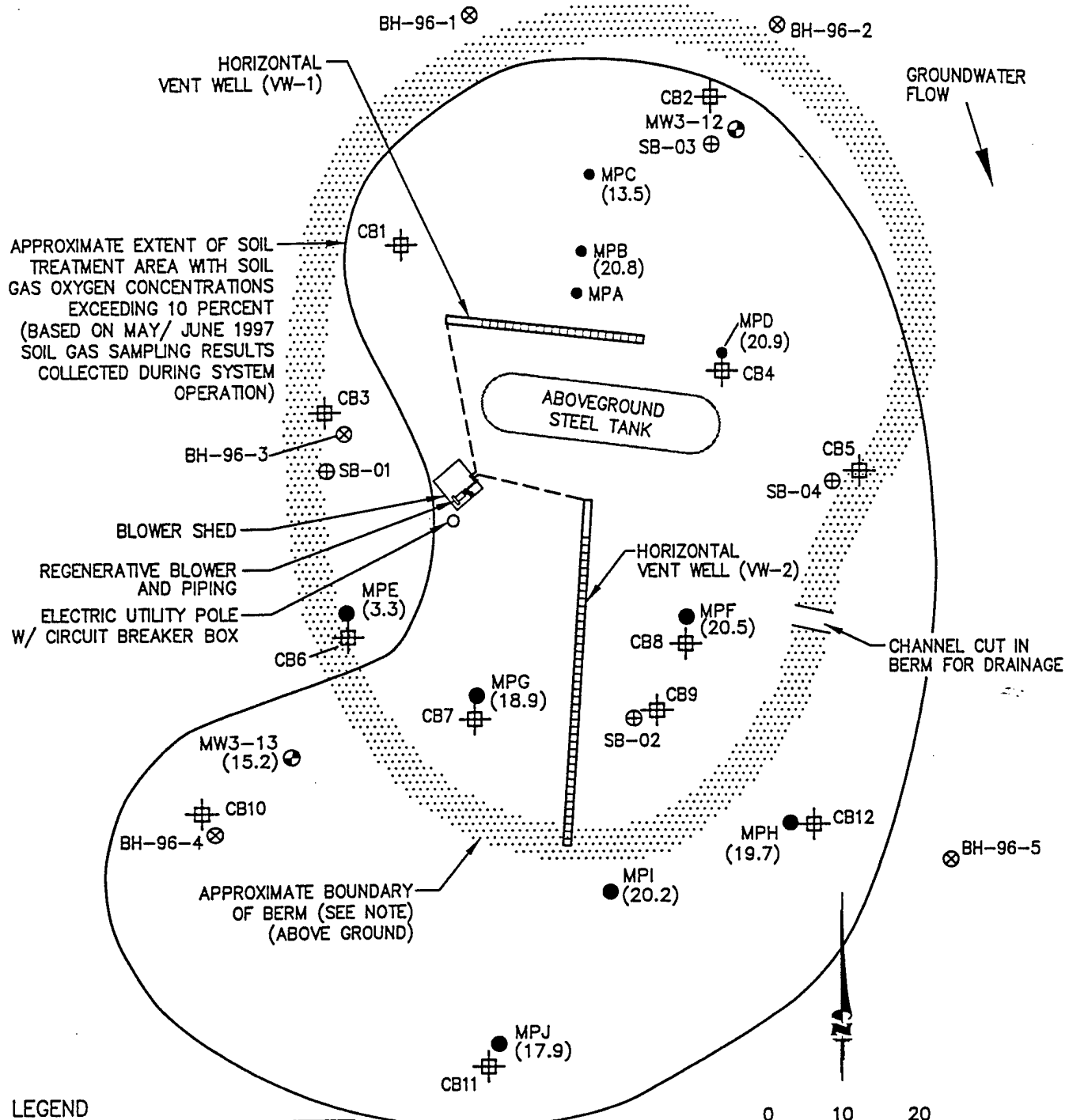
The following SAP describes the sampling locations and procedures and the analytical methods proposed to collect sufficient data to document remediation of vadose zone soils at SWMU 55 during expanded-scale air injection bioventing. Sampling and laboratory testing will follow the procedures and analytical methods presented in the RFI/CMS report (Radian, 1998) to maintain consistency for data evaluation at the site.

Parsons ES proposes to auger and sample boreholes in the vicinity of the former fire training area and within the area of previously identified contamination (Figure 4.1). Several locations that were sampled prior to bioventing will be resampled to determine the levels of soil remediation that have occurred during the ICM activities.

4.1 SOIL SAMPLING

This section describes the scope of work for collecting soil samples at SWMU 55. An estimated twelve boreholes will be hand-augered and sampled in the areas where soil contamination was previously identified. Proposed borehole locations are shown on Figure 4.1. With the exception of proposed confirmatory borehole CB1, the proposed borehole locations will be placed adjacent to previous boreholes from which soil samples were submitted for laboratory analyses prior to the extended bioventing system startup. At least one soil sample will be collected from each borehole at the approximate depth as the previous samples, unless field screening results indicate greater contaminant concentrations at a different depth, in which case two samples will be submitted to the laboratory. Confirmatory borehole CB1 will be installed in the northwest portion of the burn area where soil sampling has not yet been performed. Confirmatory boreholes CB2, CB3, CB5, and CB9 will be installed next to soil boreholes SB-03, SB-01, and SB-04, SB-02, respectively (Radian, 1998) to determine current contaminant concentrations at these locations. Confirmatory boreholes CB4, CB6, CB7, CB8, CB10, CB11, and CB12 will be installed adjacent to existing MPs to determine contaminant reductions achieved and current contaminant concentrations at these locations. A maximum of two additional boreholes may be hand augered and sampled if field screening results indicate significant contamination extending beyond the proposed sampling area.

S:\ES\cod\AFCEE\726876\CHARLSTON\98DN0825.dwg, 11/17/98 at 10:46



LEGEND

- CB1 PROPOSED CONFIRMATORY SOIL SAMPLING LOCATION
- MW3-12 GROUNDWATER MONITORING WELL
- MPF ● (20.5) SOIL VAPOR MONITORING POINT
SOIL GAS OXYGEN CONCENTRATION (%)
- BH-96-5 SOIL BORING/SAMPLING LOCATION (PARSONS ES, FEB. 1997)
- SB-01 SOIL BORING/SAMPLING LOCATION (RADIAN, NOV. 1996)
- AIR INJECTION HEADER PIPE (BURIED)

NOTE:
SOIL BERM HAS APPROXIMATE ELLIPTICAL DIMENSIONS AND VARYING WIDTHS, LOCATIONS OF TANK, VENT WELLS, AND UTILITY POLE WITHIN BERM ARE ESTIMATED.

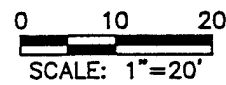


FIGURE 4.1

PROPOSED CONFIRMATORY SOIL SAMPLING LOCATIONS

SWMU 55 (IRP Site FT-03)
Charleston AFB, South Carolina

**PARSONS
ENGINEERING SCIENCE, INC.**

Denver, Colorado

Soil sampling will be conducted by qualified Parsons ES scientists and technicians trained in the conduct of soil sampling, records documentation, and environmental sample chain-of-custody procedures. Detailed records of the sampling event will be maintained by the Parsons ES field representative. In addition, sampling personnel will have thoroughly reviewed this SAP prior to sample collection and will have a copy available onsite for reference.

4.1.1 Hand-Augering, Sampling, and Equipment Decontamination

Parsons ES personnel qualified in the collection of soil samples will perform hand-augering at twelve locations shown in Figure 4.1. Boreholes will not be drilled below the groundwater table surface. Total borehole depths are expected to be between 4 feet and 6 feet bgs. Soil samples, suitable for chemical analysis, will be obtained from each borehole by collecting the required volume of soil directly from the hand-auger bucket. Soil types will be classified according to the Unified Soil Classification System and described in accordance with the standard Parsons ES soil description format. All soil samples will be visually examined and field analyzed using a photoionization detector (PID) or a total volatile hydrocarbon analyzer (TVHA). Based on field screening results, one sample with the greatest apparent contamination from each boring will be selected and submitted for laboratory analysis. For soil borings located next to existing MPs, a sample will be collected from the same approximate depth as the previous soil sample from the adjacent MP borehole. If field screening results indicate that a different interval is the most contaminated interval, then an additional soil sample will be submitted for laboratory analysis.

Samples collected for laboratory analysis will be transferred directly from the auger bucket to EnCore® samplers (for VOCs) and other appropriate sample containers (for TPH and PAHs), and sealed according to manufacturer-recommended procedures. The sample containers will be immediately placed in an insulated cooler containing ice. The soil samples will be maintained in a chilled condition until delivered to the analytical laboratory.

The hand-auger and other downhole equipment will be cleaned before use and between boreholes to prevent cross-contamination. Sampling equipment will be cleaned with Alconox® detergent, followed by successive potable and distilled water rinses. Decontamination water and auger cuttings will be managed as described in Section 4.4. Boreholes not completely backfilled with soil cuttings will be abandoned using bentonite chips following drilling and sampling.

4.1.2 Soil Sample Analyses

Proposed soil sample analytical methods, estimated number of samples, and reporting limits are presented in Table 4.1. All samples will be analyzed by Specialized Assays, Inc. (SAI), located in Nashville, Tennessee. SAI is a State of South Carolina-certified laboratory. Parsons ES proposes to analyze soil samples from SWMU 55 for TPH by USEPA Method SW8015B, modified for diesel- and gasoline-range organics; for VOCs by USEPA Method SW8260B; and PAHs by USEPA Method SW8310. Quality control (QC) samples also will be analyzed to assess laboratory methods. The laboratory will perform analyses on one matrix spike, one laboratory control, and one laboratory blank for each analytical method requested.

TABLE 4.1
PROPOSED SOIL SAMPLE ANALYTICAL METHODS,
REPORTING LIMITS, AND NUMBERS OF SAMPLES
SWMU 55 (IRP SITE FT-03)
CHARLESTON AFB, SOUTH CAROLINA

Analytical Method	Number of Samples ^{a/}	Reporting Limit ^{b/}	Units ^{c/}
Total Petroleum Hydrocarbons (TPH)			
USEPA Method SW8015B			
Diesel-Range Organics	12	10	mg/kg
Gasoline-Range Organics	12	1	mg/kg
Volatile Organic Compounds (VOCs)			
USEPA Method SW8260B			
Benzene	12	2.0	µg/kg
Ethylbenzene	12	3.0	µg/kg
m-Xylene	12	3.0	µg/kg
o-Xylene	12	5.0	µg/kg
p-Xylene	12	7.0	µg/kg
Toluene	12	5.0	µg/kg
Perchloroethene	12	7.0	µg/kg
Trichloroethene	12	10.0	µg/kg
Vinyl Chloride	12	9.0	µg/kg
Polynuclear Aromatic Hydrocarbons (PAHs)			
USEPA Method SW8310			
Benzo(a)anthracene	12	0.009	mg/kg
Benzo(a)pyrene	12	0.015	mg/kg
Benzo(b)fluoranthene	12	0.012	mg/kg
Benzo(k)fluoranthene	12	0.011	mg/kg
Chrysene	12	0.1	mg/kg
Naphthalene	12	1.2	mg/kg
Fluoranthene	12	0.14	mg/kg
Indeno(1,2,3-cd)pyrene	12	0.03	mg/kg
2-Methylnaphthalene	12	1.2	mg/kg
Phenanthrene	12	0.42	mg/kg
Pyrene	12	0.18	mg/kg

^{a/} Excludes QC samples. If optional boreholes are required, one additional soil sample per optional borehole also will be collected and analyzed.

^{b/} Project reporting limit as specified in subcontract for analytical services.

^{c/} mg/kg = milligrams per kilogram; µg/kg = micrograms per kilogram.

4.1.3 Sample Handling

Sample containers and appropriate container lids will be provided by the laboratory. The sample containers will be filled as described in Section 4.1.1 and the container lids will be tightly closed. The sample containers will be labeled with the site name, boring number, sample depth, date of collection, project name, and other pertinent data. Samples will be properly prepared for transportation to the laboratory by placing the samples in an insulated cooler containing ice to maintain a shipping temperature of approximately 4 degrees centigrade. Chain-of-custody records will be prepared in the field as described in Section 4.2 and will accompany the samples to the analytical laboratory. The analytical laboratory retained for this effort is SAI, located in Nashville, Tennessee.

4.2 CHAIN-OF-CUSTODY CONTROL

After the samples for laboratory analysis have been collected, chain-of-custody procedures will be followed to establish a written record of sample handling and movement between the sampling site and the laboratory. Samples collected for onsite field analyses will not require chains-of-custody. Each shipping container will have a chain-of-custody form completed in triplicate by the sampling personnel. One copy of this form will be kept by the Parsons ES field manager after sample delivery to the analytical laboratory, and the other two copies will accompany the samples to the laboratory. One of the laboratory copies will become a part of the permanent record for the sample and will be returned with the sample analytical results. The chain-of-custody will contain the following information:

- Site name;
- Sample identification number;
- Sample collector's printed name and signature;
- Date and time of collection;
- Place of collection;
- Type of sample, i.e. composite, grab, etc.;
- Sample matrix (soil or water);
- Chemical preservatives added;
- Analytical laboratory to be utilized;
- Analyses requested;
- Signatures of individuals involved in the chain of possession; and
- Inclusive dates of possession.

The chain-of-custody documentation will be placed inside the shipping container so that it will be immediately apparent to the laboratory personnel receiving the container, but will not be damaged or lost during transport. The shipping container will be sealed so that it will be obvious if the seal has been tampered with or broken.

4.3 QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

Samples must be collected, preserved, transported, and analyzed in such a manner that sampling results yield information that provides a reliable representation of the soil quality at the site. To meet this requirement, the procedures described in Section 4.1 will be followed during sample collection, handling, and analysis. In addition, laboratory QC samples will be analyzed as described in Sections 4.1.2.

Soil quality assurance sampling will include two replicates (minimum frequency of 10 percent), one rinseate blank, and one trip blank for each cooler with samples designated for VOC and SVOC analysis.

Parsons ES will assess the usability of analytical data collected during this field effort. Any limitations on data use will be expressed quantitatively to the extent practicable and will be documented in any reporting of the data. This data usability review will include a review of the analytical methods, quantitation limits, and other factors important in determining the precision, accuracy, completeness, and representativeness of the final data set. The outcome of this data evaluation will be a data set appropriate to support a recommendation for future soil remediation at the site (i.e., continued bioventing or shut down of the system).

4.4 MANAGEMENT OF INVESTIGATION-DERIVED WASTES

Soil cuttings generated during hand-auger soil sampling will be minimal. Residual cuttings not prepared for laboratory analysis will be returned to their respective soil borehole prior to plugging the top of the borehole with bentonite chips, if necessary. Equipment decontamination and rinseate water will be discharged to the sanitary sewer drain.

SECTION 5

SOIL SAMPLING REPORT FORMAT

Following receipt of the laboratory analytical results, a draft soil sampling report will be prepared and submitted to Charleston AFB and AFCEE.

The report will contain the following information for SWMU 55:

- Site plot plan showing sampling locations;
- Summary of field activities;
- Qualitative comparison of VOC, PAH, and TPH results to pretreatment analytical results;
- SCDHEC-required information, including SCDHEC boring log forms;
- Laboratory analytical reports and chain-of-custody forms; and
- Conclusions and recommendations for continued bioventing system operation or system shut down and well abandonment.

SECTION 6

CHARLESTON AFB SUPPORT REQUIREMENTS

The following Charleston AFB support is needed prior to the arrival of the Parsons ES team:

- Assistance in obtaining digging permits.
- Arrangement of site access for Parsons ES.
- Provision of a potable water supply for augering and decontamination activities.

SECTION 7
PROJECT SCHEDULE

The following schedule is contingent upon approval of this SAP and fulfillment of the Charleston AFB support requirements outlined in Section 6.

<u>Event</u>	<u>Date</u>
Submit Draft SAP to AFCEE and Charleston AFB	October 23, 1998
Receipt of Comments	November 12, 1998
Submit Draft Final SAP to AFCEE and Charleston AFB	December 23, 1998
Receipt of Comments	January 15, 1999
Submit Final SAP to AFCEE, Charleston AFB, and SCDHEC (if required)	January 22, 1999
Begin Soil Sampling	January 25, 1999
Submit Draft Soil Sampling Report to AFCEE and Charleston AFB	March 2, 1999
Receipt of AFCEE and Charleston AFB Comments	March 15, 1999
Submit Draft Final Soil Sampling Report to AFCEE and Charleston AFB	March 29, 1999

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SECTION 9

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APPENDIX B

CONFIRMATION SAMPLING FIELD NOTES

Charleston AFB - FT03

1/25/99 - Monday
 1100 S. Czekaalski, & M. Fahr
 arrived Charleston - pickup
 supplies for sampling - will
 meet w/ Bo. Camp @ 1330
 1210 Arrive at FT03 site.
 Collect replicate sample for
 2260 analysis - Sample
 from hand auger bucket
 1235 Bo Camp drops off keys
 1320 Collect sample for
 CB-11 (3') next to MJD-M.P.J.
 (3-4) beside BH-96-4
 1340 Collect sample for CB-12 (3.3') beside MPH
 1410 Collect sample CB4 (3.2') beside MPF
 1430 Collect sample CB5 (3.5') beside MPF
 1445 Collect sample ~~CB1~~ (3.3') beside MPF-SB04
 1505 Collect sample CB2 (3.3') beside SB03, MW3-12.
 (note - hit water @ ~3.5')
 1520 Collect sample CB1 (2.5') ~~beside~~ ^{MPF} (note - hit
 water @ 3')
 1535 Collect sample CB3 (3') beside SB-01
 1555 Collect sample CB4 (3') beside MPD
 1615 Collect sample CB9 (3') inside SB-02
 1630 Collect sample CB8 (3.3') beside MPF
 1635 Collect duplicate of CB8 (CB-D1)
 1650 Collect sample CB7 (3.5') near MP4
 (continued)

FT-03

Boothole	Time	DTW	PAW/Czekaalski	FID
CB10	1550	—		0
CB11	1553	2.70		2
CB12	1557	3.12		0.1
CB4	1615	—		0
CB2	1618	2.53		0
CB1	1620	2.86		0
CB3	1623	—		0
CB6	1655	2.90		550
CB5	1659	1.75		0 755-36
CB9	1650	—		15
CB8	1658	—		210
CB7	1657	—		92

APPENDIX C

DATA QUALITY ASSESSMENT REPORT

DATA QUALITY ASSESSMENT REPORT
SWMU 55 (IRP SITE FT-03)
CHARLESTON AIR FORCE BASE, SOUTH CAROLINA

D1.0 INTRODUCTION

A Parsons Engineering Science electronic Level III validation was performed for Charleston Air Force Base (AFB) Solid Waste Management Unit (SWMU) 55 and consisted of electronically and manually examining data deliverables to determine data quality. This included application of data qualifiers to the analytical results based on adherence to method protocols and project-specific quality assurance/quality control (QA/QC) limits. Method protocols reviewed included:

- analytical holding times,
- method blanks (MB),
- trip blanks (TB),
- surrogate spikes,
- matrix spikes/matrix spike duplicates (MS/MSDs),
- laboratory control samples (LCSs), and
- shipping cooler temperature.

Data qualifiers were applied to analytical results during the data validation process. All data were validated using method applicable guidelines and in accordance with the *National Functional Guidelines for Organic Data Review* (USEPA, 1994a) and the *National Functional Guidelines for Inorganic Data Review* (USEPA, 1994b).

The following definitions provide explanations of the USEPA (1994a and 1994b) qualifiers assigned to analytical results during data validation. The data qualifiers described were applied to both inorganic and organic results.

- U - The analyte was analyzed for and is not present above the reported sample quantitation limit (SQL).
- J - The analyte was analyzed for and was positively identified, but the associated numerical value may not be consistent with the amount actually present in the environmental sample. The data should be considered as a basis for decision-making and are usable for many purposes.

- R - The data are rejected as unusable for all purposes. The analyte was analyzed for, but the presence or absence of the analyte was not verified. Resampling and reanalysis are necessary to confirm the presence or absence of the analyte.
- UJ - The analyte analyzed for was not present above the reported SQL. The associated numerical value may not accurately or precisely represent the concentration necessary to detect the analyte in the sample.
- J1 The analyte is qualified as an estimated value solely because it is greater than the method detection limit (MDL) and less than the PQL indicating no laboratory quality issues.

D2.0 DATA QUALITY

Data quality for each QC parameter where problems were noted during the validation is summarized in this section. Only results that exceeded QA/QC criteria are presented. All frequency requirements for field sample collection of QA/QC samples (MS/MSDs and blanks) were met. The frequency requirements for laboratory specific method criteria QA/QC were met overall. In Attachment A, Tables A-1 and A-2 present the analytical methods performed for each samples and the samples that were qualified during the validation process, respectively.

D2.1 Surrogate Spikes

Table D2.1-1 lists all results for target analytes that were out of control with the percentage of out of control results calculated against the total number of samples collected. Method SW8015 displayed surrogate recovery problems on one sample for diesel range TPH. The surrogate recoveries were low indicating a low bias in the sample results. The results were qualified as estimated. Out-of-control surrogate recovery results that did not meet control criteria are believed to be caused by matrix interference.

Table D2.1-1
Out-Of-Control Surrogate Spike Impact
 SWMU 55 (IRP Site FT-03)
 Charleston AFB, South Carolina

Anal. Method	Prep. Method	Matri x	Analyte	Flag	# of Qualified Results	Total Number of Samples	Percent of Results Qualified
SW8015	SW3550	SO	TPH (Diesel Range)	J	1	14	7%

D2.2 Field Duplicates

Table D2.2-1 lists the field duplicate results for compounds where at least one sample in the duplicate pair was detected. The relative percent difference (RPD) or range was out of control for several compounds (bolded values). Although the soil samples are not true duplicates, the high variability between the replicates indicates

sampling precision is poor. This is probably due to the non-homogeneous nature of the soil within a borehole. The data is not qualified based on field duplicate results.

Table D2.2-1
Field Duplicates
SWMU 55 (IRP Site FT-03)
Charleston AFB, South Carolina

Location	Matrix	SBD	SED	Anal. Method	Prep. Method	Sample Dup Result	Sample Result	RPD	Range	Rep. Limit	Units	Analyte
CB-8	SO	3	3.5	SW8260	SW5030	0	3.5		3.5	3.5	UG/KG	Ethylbenzene
CB-8	SO	3	3.5	SW8260	SW5030	0	2.4		2.4	5.9	UG/KG	Toluene
CB-8	SO	3	3.5	SW8260	SW5030	0	3.5		3.5	8.2	UG/KG	1,2,4-Trimethylbenzene
CB-8	SO	3	3.5	SW8260	SW5030	0	4.7		4.7	3.5	UG/KG	m,p-Xylene
CB-7	SO	3.25	3.75	SW8260	SW5030	0	116		116	3.7	UG/KG	1,3,5-Trimethylbenzene
CB-7	SO	3.25	3.75	SW8310	SW3550	0	541		541	40	UG/KG	Naphthalene
CB-8	SO	3	3.5	SW8310	SW3550	100	0		100	39	UG/KG	Naphthalene
CB-8	SO	3	3.5	SW8310	SW3550	9	0		9	8	UG/KG	Fluorene
CB-7	SO	3.25	3.75	SW8260	SW5030	48.8	0		48.8	8.5	UG/KG	1,2,4-Trimethylbenzene
CB-7	SO	3.25	3.75	SW8015	SW5030	421000	582000	32%		1220	UG/KG	TPH (Gasoline Range)
CB-8	SO	3	3.5	SW8015	SW3550	97400	116000	17%		11800	UG/KG	TPH (Diesel Range)
CB-7	SO	3.25	3.75	SW8260	SW5030	20.7	51.8	86%		6.1	UG/KG	o-Xylene
CB-7	SO	3.25	3.75	SW8015	SW3550	971000	8940000	161%		12200	UG/KG	TPH (Diesel Range)

D3.0 CONCLUSIONS

Samples were collected and analyzed as specified in the methods with exception of those issues discussed in this report. All samples are representative of the site and comparable with previous and future investigations (when used in accordance with the validation qualifiers). All sample results qualified as "UJ or J" represent an association to non-compliant QC criteria that has caused the reported concentration to be estimated. Project objectives do not exclude the use of estimated concentrations. No data was rejected based on the validation, therefore completeness goals of 90 percent were met. Therefore, all data are usable for the purposes intended.

D4.0 REFERENCES

U.S. Environmental Protection Agency (USEPA). 1983. Methods for the Chemical Analysis of Water and Wastes. EPA 600/4-79-020. Cincinnati, OH.

USEPA. 1993. Data Quality Objectives Process for Superfund. EPA 540-R-93-071. Washington, DC. September, 1993.

USEPA. 1987-1996. SW-846, Test Methods for Evaluating Solid Waste, Physical and Chemical Methods, Third Edition. Washington, DC.

USEPA. 1994a. Agency National Functional Guidelines for Organic Data Review. PB 94-963502. Washington, DC.

USEPA. 1994b. Agency National Functional Guidelines for Inorganic Data Review. PB 94-963501. Washington, DC.

ATTACHMENT A
VALIDATED SAMPLES AND QUALIFIED ANALYTICAL
RESULTS

VALIDATED SAMPLES AND QUALIFIED ANALYTICAL RESULTS

Tables A-1 and A-2 list all qualified sample data based on the results of data validation. The following definitions of column headers will aide in the understanding and use of these tables.

- LOCID:** Sample location identifier, unique to each sample when used in conjunction of columns SBD and SED.
- MX:** Sample matrix identifier. "SO" is soil, "WG" is water.
- SA:** Sample analysis identifier. "N" is for primary field samples, "FR" is for field replicate samples. "N1" or "FR1" designates that the results associated to the original sample analysis. "N8" or "FR8" designates that the results associated to a composite of sample analysis results.
- SBD:** Sample beginning depth.
- SED:** Sample ending depth.
- COMPOUND NAME:** This column identifies the target compound name.
- VQ:** This column designates if a target compound was detected or not. An "=" denotes a detection above the project practical quantitation limit. A "ND" denotes a non-detection above the method detection limit. A "TR" denotes a detection above the method detection limit but below the project practical quantitation limit.
- PARVAL:** This is the concentration of detection for all detected sample results (TR or =). A zero is a placeholder, which associates to a non-detected compound. The zero does not imply that the compound was not detected at less than zero.
- LABDL:** This is the concentration at which the laboratory reports the project reporting limit. The project reporting limit is a practical quantitation limit in that it is related to a multiplier of the method detection limit.
- ANMCODE:** Analytical method code identifier.
- EXMCODE:** Analytical extraction method code identifier.

Q: This column represents the final validation qualifier applied to the sample result. It is a composite of all the validation qualifiers for that sample result.

The following column headers apply to the method criteria that are included in a data validation. All of the columns may not appear in Table A-2. Only those method criteria that resulted in qualifying sample results are listed.

HTM	Holding Time
MBM	Method Blank
TBM	Trip Blanks
EBM	Equipment Blanks
ABM	Ambient Blanks
MSRM	MS/MSD (%Recovery/Accuracy)
MSPM	MS/MSD (%RPD/Precision)
LCRM	LCS (%Recovery/Accuracy)
LCPM	LCS (%RPD/Precision)
SURM	Surrogate
TMPM	Temperature
PRSM	Preservation

Table A-1
Analytical Methods by Sample Location
SWMU 55 (IRP Site FT-03)
Charleston AFB, South Carolina

LOCID	SBD	SED	MATRIX	SW8015	SW8260	SW8310
CB-1	2.25	2.75	SO	X	X	X
CB-2	3	3.5	SO	X	X	X
CB-3	2.75	3.25	SO	X	X	X
CB-4	2.75	3.25	SO	X	X	X
CB-5	3.25	3.75	SO	X	X	X
CB-6	3	3.5	SO	X	X	X
CB-7	3.25	3.75	SO	X	X	X
CB-8	3	3.5	SO	X	X	X
CB-9	2.75	3.25	SO	X	X	X
CB-10	3.25	3.75	SO	X	X	X
CB-11	2.75	3.25	SO	X	X	X
CB-12	3	3.5	SO	X	X	X

Table A-2
 Qualified Analytical Results
 SWMU 55 (IRP Site FT-03)
 Charleston AFB, South Carolina

LOCID	SBD	SED	MATRIX	SA CODE	ANM CODE	EXM CODE	ANALYTE	PARVQ	PARVAL	LABDL	UNITS	FINAL Q	SURM
CB-9	2.75	3.25	SO	N1	SW8015	SW3550	TPH (Diesel Range)	=	58400	23300	UG/KG	J	J

Attachment A-4

APPENDIX D

LABORATORY ANALYTICAL RESULTS AND COC FORMS



SPECIALIZED ASSAYS INC. • 2960 Foster Creighton Dr. • P.O. Box 40566 • Nashville, Tennessee 37204-0566
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CASE NARRATIVE

Client: Parsons Engineering Science (8185)
Attn: John Ratz
1700 Broadway, Suite 900
Denver, CO 80290

Client Project: CHARLESTON AFB

Matrix: Soil/Water

Laboratory Project: 128680

Number samples: 14 + 2 water

Date Received: 01/26/99

Date Collected: 1/25/99

Sample Receipt Notes: All samples were received in good condition, properly preserved. There were no discrepancies noted on the cooler receipt form. Per fax from Parsons Engineering, all samples were run for TPH using method 8015B.

QA/QC Summary:

Volatile Organics – Batch 5693

Sample CB-10 was used for MS/MSD analysis for this analytical batch. All QC parameters were within required acceptance limits for the batch. Sample CB-6 required a secondary dilution to bring all analytes into the calibration range of the instrument. For compounds whose % RSD on the initial calibration was < 15 %, average response factor calibration was employed in the quantitation. All other compounds were quantified using linear regression.

Semivolatile Organics – Batch 7951

The sample used for MS/MSD analysis was not part of this sample delivery group. All recoveries on the MS/MSD and laboratory Control sample were within acceptance limits. Surrogate recoveries for CB-9 and CB-7 could not be determined from the undiluted analysis due to matrix interference. Also, due to sample matrix, many of the PAH target compounds could not be determined from the initial analysis on sample CB-7. These compounds are only reported from the diluted analysis.

TPH GRO – Batch 5702

All recoveries were within required acceptance limits. Sample CB-11 was used for MS/MSD analysis.

TPH DRO – Batch 9977

All recoveries were within acceptance limits for the QC analyses. The sample used for MS/MSD analysis was not a member of this sample delivery group.

The enclosed disk contains the IRPIMS deliverables for this sample delivery group. If you have any technical issues relating to the enclosed data, please call me at 1-800-765-0980.

Johnny A. Mitchell
Director of Technical Services



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

PARSONS ENGINEERING/AFOEE EXT 6185
JOHN RATZ
1700 BROADWAY STE 900
DENVER, CO 80290

PAGE 1/2

CHAIN OF CUSTODY

Project Number: 726876.28122 Supplier: MRP/SIC
 Project Name: CFB SWMU SS (FT-03) SAE Quote:

Lab No.	Field Number	Date	Time	Matrix	Grab	Comp	Bottles	8260/8021	5035 ENCORE	PAHS/PJAS	TRPH-GC/PAH-CAD	Analysis Requested
99-A10179	CB-11	1/25/99	1320	S	X		3	X	X	X	X	
99-A10180	CB-10	1/25/99	1340	S	X		3	X	X	X	X	
99-A10181	CB-12	1/25/99	1410	S	X		3	X	X	X	X	
99-A10182	CB-6	1/25/99	1430	S	X		3	X	X	X	X	
99-A10177	EQUIPMENT RINSEATE	1/25/99	1210	W	X		(HCL) 2	X				
99-A10183	CB-5	1/25/99	1445	S	X		3	X	X	X	X	
99-A10184	CB-2	1/25/99	1505	S	X		3	X	X	X	X	
99-A10185	CB-1	1/25/99	1520	S	X		3	X	X	X	X	
99-A10186	CB-3	1/25/99	1535	S	X		3	X	X	X	X	

Relinquished by: <i>MRZ</i>	D/T: 1/25/99 1800	Received by: <i>M. Beasley</i>	D/T: 1/26/99 9:00	Relinquished by:	D/T:	Received by:	D/T:
Relinquished by:	D/T:	Received by:	D/T:	Relinquished by:	D/T:	Received by:	D/T:

Cooler Temperature When Received: 4°C SPECIAL INSTRUCTIONS:

Laboratory Project Number: 126650

Cooler Seals Intact?

Fed-Air Bill Number:

000224

000001



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

PARSONS ENGINEERING/AFCEE EXT 8185
JOHN FATZ
1700 BROADWAY STE 900
DENVER, CO 80290

PAGE 2/2

CHAIN OF CUSTODY

Project Number: 726876.28122		Sampler: MRP/SJC		Analysis Requester:			
Project Name: CAFB SWMU55 (FT-03)		SAC Quota:					
Lab No.	Field Number	Date	Time	Matrix	Grab	Comp	Bottles
99-A10187	CB-4	1/25/99	1555	S	X		3
99-A10178	TRIP BLANK	—		W	X		1
99-A10188	CB-9	1/25/99	1615	S	X		3
99-A10189	CB8	1/25/99	1630	S	X		
99-A10190	CB-D1	1/25/99	1635	S	X		
99-A10191	CB-7	1/25/99	1650	S	X		
99-A10192	CB-D2	1/25/99	1655	S	X		

8260/8021
5035 ENCON
9445/PJAS
TRIP-GC/PAI-0A2

Relinquished by:	D/T	Received by:	D/T	Relinquished by:	D/T	Received by:	D/T
<i>[Signature]</i>	1/25/99 1800	MB	1/26/99 9:00				
Relinquished by:	D/T	Received by:	D/T	Relinquished by:	D/T	Received by:	D/T

Cooler Temperature When Received:	SPECIAL INSTRUCTIONS:
Laboratory Project Number:	
Cooler Seals Intact?	
Fed-X Air Bill Number:	

000002

Cooler Receipt Form

Client: Parsons

Cooler Received On: 11/26/99 And Opened On: 11/26/99 By: Mark Beasley

Mark Beasley
(Signature)

1. Temperature of Cooler when opened 4°C
2. Were custody seals on outside of cooler and intact?..... Yes No
- a. If yes, what kind and where: Tape 2 Front/Back
- b. Were the signature and date correct?..... Yes No
3. Were custody papers inside cooler?..... Yes No
4. Were custody papers properly filled out (ink, signed, etc)?..... Yes No
5. Did you sign the custody papers in the appropriate place?..... Yes No
6. What kind of packing material was used? Bubblewrap
7. Was sufficient ice used (if appropriate)?..... Yes No
8. Did all bottles arrive in good condition (unbroken)?..... Yes No
9. Were all bottle labels complete (#, date, signed, pres, etc)?..... Yes No
10. Did all bottle labels and tags agree with custody papers?..... Yes No
11. Were correct bottles used for the analysis requested?..... Yes No
12. If present, were VOA vials checked for absence of air bubbles and noted if found?..... Yes No
13. Was sufficient amount of sample sent in each bottle?..... Yes No
14. Were correct preservatives used?..... Yes No
15. Corrective action taken, if necessary:

a. Name of person contacted: _____

b. Date _____

000006

400000

FedEx. USA Airbill **808922896890**

FedEx Tracking Number

1 From 1/25/99 

Date 1/25/99 Sender's Name AAA-LIC Phone (191) 557-0521

Company PHISCOM ES

Address 401 MILLER GARDEN BLVD Dept./Floor/Suite/Room 200

City GA State NC ZIP 27513

2 Your Internal Billing Reference Information 726876.2922

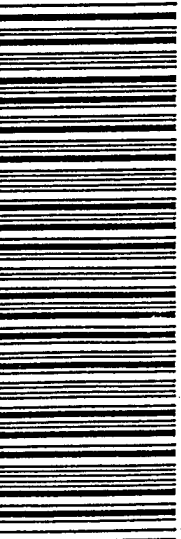
3 To Recipient's Name SAMPLE RECEIVING Phone (615) 726-0177

Company SPECIALIZED ASSAYS ENVIRON

Address 2760 FOSTER CREIGHTON DR Dept./Floor/Suite/Room

City NASHVILLE State TN ZIP 37204-3719

For HOLD at FedEx Location check here
 Hold Weekday (not available for FedEx Priority Overnight and FedEx 2Day only)
 Hold Saturday (not available at all locations) (available for FedEx Priority Overnight and FedEx 2Day only)
 Saturday Delivery (available for FedEx Priority Overnight only)



8 0 8 7 2 2 8 9 6 8 9 0

Form ID No. **0210** Recipient's Copy **SNAB1**

4a Express Package Service, Packages under 150 lbs.
 FedEx Priority Overnight (next business day)
 FedEx Standard Overnight (next business day)
 FedEx First Overnight (select next business morning delivery to select locations) (lit/flat rates apply)
 FedEx 2Day (next business day)
 FedEx Express Saver (next business day)
- FedEx letter rate not available. Minimum charge: One pound rate.

4b Express Freight Service, Packages over 150 lbs.
 FedEx Overnight Freight (next business day)
 FedEx 2Day Freight (second business day)
 FedEx Express Saver Freight (1-3 business days)
(Call for delivery schedule. See back for detailed descriptions of freight services.)

5 Packaging
 FedEx Letter
 FedEx Pak
 FedEx Tube
 FedEx Box
 Other (Other box must be checked)

6 Special Handling
Does this shipment contain dangerous goods?
 Dry Ice
 Dry Ice, UN 1845
 No
 Yes (Declare and not required)
 Cargo Aircraft Only
*Dangerous Goods cannot be shipped in FedEx packaging

7 Payment
Bill to: Sender (FedEx account)
 Recipient (FedEx account)
 Third Party (FedEx account)
 Credit Card
 Check

Total Packages 1 Total Weight 1 lbs. Total Declared Value* .00 \$ Total Charges .00 \$

8 Release Signature [Signature]

*When declaring a value higher than \$100 per shipment, you pay an additional charge. See SERVICE CONDITIONS, DECLARED VALUE, and LIMIT OF LIABILITY sections for further information.

Your signature authorizes Federal Express to deliver this shipment without obtaining a signature and agrees to indemnify and hold harmless Federal Express from any resulting claims.

Questions? Call 1-800-Go-FedEx® (800)463-3339

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321 0076892581

TPH-DRO
SUMMARY DATA

000532



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2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-1

Matrix: Soil
% Dry Weight: 88.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: PE-3
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A10185
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 15:29
Sample QC Group: 9977
Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	4730	.... J

000539



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CR-2

Matrix: Soil
% Dry Weight: 78.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: PE-3
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A10184
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 14:31
Sample QC Group: 9977
Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	5330	.... J

000538



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-3

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 5.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: PE-3
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A10186
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 15:59
Sample QC Group: 9977
Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	513000	....

000540



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-4

Matrix: Soil
% Dry Weight: 90.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: PE-3
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A10187
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 16:28
Sample QC Group: 9977

Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	6580	.... J

000541



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CE-5

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: PE-3
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A10183
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 14:02
Sample QC Group: 9977

Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	41700	....

000537



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-6

Matrix: Soil
% Dry Weight: 87.
Units: ug/kg dry weight
Dilution Factor: 100.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: PE-3
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A10182
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 13:33
Sample QC Group: 9977
Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	6620000	....

000536



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-7

Matrix: Soil
% Dry Weight: 85.
Units: ug/kg dry weight
Dilution Factor: 100.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: PE-3
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A10191
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 18:27
Sample QC Group: 9977
Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	8940000	....

000545



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CE-D2

Matrix: Soil
% Dry Weight: 82.
Units: ug/kg dry weight
Dilution Factor: 10.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: PE-3
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A10192
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 18:56
Sample QC Group: 9977
Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	971000	....

000546



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-8

Matrix: Soil
% Dry Weight: 85.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128480
Instrument: PE-3
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A10189
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 17:26
Sample QC Group: 9977
Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	116000	....

000543



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-D1

Matrix: Soil
% Dry Weight: 85.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: PE-3
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A10190
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 17:55
Sample QC Group: 9977

Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	97400	....

000544



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-9

Matrix: Soil
% Dry Weight: 86.
Units: ug/kg dry weight
Dilution Factor: 2.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: PE-3
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A10188
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 16:57
Sample GC Group: 9977
Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	58400	....

000542



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-10

Matrix: Soil
% Dry Weight: 84.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: PE-3
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A10180
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 12:35
Sample QC Group: 9977
Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	14200	....

000534



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-11

Matrix: Soil
% Dry Weight: 79.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: PE-3
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A10179
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 12:05
Sample QC Group: 9977
Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	21800	....

000533



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-12

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: PE-3
Grams Extracted: 25.0 g
Extract Vol: 1.0 ml

Lab Sample ID: 99-A10181
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 13:04
Sample QC Group: 9977
Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Diesel Range)	3710	.... J

000535

TPH-GRO
SUMMARY DATA

000417



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-1

Matrix: Soil
% Dry Weight: 88.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: HP-19

Lab Sample ID: 99-A10185
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/28/99
Analysis Time: 9:09
Sample QC Group: 5702

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Gasoline Range)	1140	.... U

000424



**SPECIALIZED
ASSAYS, INC.**

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-2

Matrix: Soil
% Dry Weight: 78.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: HP-19

Lab Sample ID: 99-A10184
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/28/99
Analysis Time: 8:31
Sample QC Group: 5702

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Gasoline Range)	1280	.... U

000423



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CE-3

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: HP-19

Lab Sample ID: 99-A10186
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/28/99
Analysis Time: 9:47
Sample QC Group: 5702

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Gasoline Range)	1200	....

000425



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CE-4

Matrix: Soil
% Dry Weight: 90.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: HP-19

Lab Sample ID: 99-A10187
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/28/99
Analysis Time: 11:39
Sample QC Group: 5702

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Gasoline Range)	1110	.... U

000426



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CR-5

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: HP-19

Lab Sample ID: 99-A10183
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/28/99
Analysis Time: 7:54
Sample QC Group: 5702

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Gasoline Range)	1200	.... U

000422



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CE-6

Matrix: Soil
% Dry Weight: 87.
Units: ug/kg dry weight
Dilution Factor: 5.
Analysis Method: SWS015
Delivery Group: 128680
Instrument: HP-19

Lab Sample ID: 99-A10182
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/28/99
Analysis Time: 7:16
Sample QC Group: 5702

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Gasoline Range)	17200	....

000421



**SPECIALIZED
ASSAYS, INC.**

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-7

Matrix: Soil
% Dry Weight: 65.
Units: ug/kg dry weight
Dilution Factor: 5.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: HP-19

Lab Sample ID: 99-A10191
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/28/99
Analysis Time: 14:09
Sample QC Group: 5702

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Gasoline Range)	582000	....

000431



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-D2

Matrix: Soil
% Dry Weight: 82.
Units: ug/kg dry weight
Dilution Factor: 5.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: HP-19

Lab Sample ID: 99-A10192
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/28/99
Analysis Time: 14:47
Sample QC Group: 5702

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Gasoline Range)	421000	....

000432



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-8

Matrix: Soil
% Dry Weight: 85.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: HP-19

Lab Sample ID: 99-A10189
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/28/99
Analysis Time: 12:54
Sample QC Group: 5702

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Gasoline Range)	1180	.... U

000429



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-D1

Matrix: Soil
% Dry Weight: 85.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: HF-19

Lab Sample ID: 99-A10190
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/28/99
Analysis Time: 13:32
Sample QC Group: 5702

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Gasoline Range)	1180	.... U

000430



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-9

Matrix: Soil
% Dry Weight: 66.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: HP-19

Lab Sample ID: 99-A10188
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/28/99
Analysis Time: 12:17
Sample QC Group: 5702

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Gasoline Range)	1160	.... U

00042:



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-10

Matrix: Soil
% Dry Weight: 86.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SWSQ15
Delivery Group: 128680
Instrument: HP-19

Lab Sample ID: 99-A10180
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/28/99
Analysis Time: 6:01
Sample GC Group: 5702

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Gasoline Range)	1160	.... U

000419



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-11

Matrix: Soil
% Dry Weight: 79.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8015
Delivery Group: 128680
Instrument: HP-19

Lab Sample ID: 99-A10179
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/28/99
Analysis Time: 5:24
Sample QC Group: 5702

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Gasoline Range)	1270	.... U

000418



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-12

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SWS015
Delivery Group: 128680
Instrument: HP-19

Lab Sample ID: 99-A10181
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/28/99
Analysis Time: 6:39
Sample QC Group: 5702

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
NA	TPH (Gasoline Range)	1200	.... U

000420

VOLATILE ORGANICS

SUMMARY DATA

000097



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CE-1

Matrix: Soil
% Dry Weight: 88.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8260B
Delivery Group: 128680
Instrument:

Lab Sample ID: 99-A10185
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/28/99
Analysis Time: 20:58
Sample QC Group: 5693

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
144-10-5	1-Chlorohexane	2.8	U
71-43-2	Benzene	2.3	UU
108-86-1	Bromobenzene	2.3	UUU
124-48-1	Bromochloromethane	2.3	UUU
75-25-2	Bromoform	6.8	UUU
74-83-9	Bromomethane	5.7	UUU
104-51-8	n-Butylbenzene	5.7	UUU
135-98-8	sec-Butylbenzene	8.0	UUU
98-06-6	t-Butylbenzene	8.0	UUU
56-23-5	Carbon tetrachloride	11.4	UUU
108-90-7	Chlorobenzene	2.3	UUU
75-00-3	Chloroethane	5.7	UUU
67-66-3	Chloroform	2.3	UUU
74-87-3	Chloromethane	8.0	UUU
95-49-8	2-Chlorotoluene	2.3	UUU
106-43-4	4-Chlorotoluene	3.4	UUU
96-12-8	1,2-Dibromo-3-chloropropane	1.1	UUU
124-48-1	Dibromochloromethane	3.4	UUU
74-95-3	1,2-Dibromoethane	3.4	UUU
74-95-3	Dibromomethane	11.4	UUU
95-50-1	1,2-Dichlorobenzene	2.3	UUU
541-73-1	1,3-Dichlorobenzene	6.8	UUU
106-46-7	1,4-Dichlorobenzene	2.3	UUU
75-71-8	Dichlorodifluoromethane	5.7	UUU
75-34-3	1,1-Dichloroethane	2.3	UUU
107-06-2	1,2-Dichloroethane	3.4	UUU
75-35-4	1,1-Dichloroethene	6.8	UUU
156-59-2	cis-1,2-Dichloroethene	6.8	UUU
156-60-5	trans-1,2-Dichloroethene	3.4	UUU
78-87-5	1,2-Dichloropropane	2.3	UUU
142-28-9	1,3-Dichloropropane	2.3	UUU
594-20-7	2,2-Dichloropropane	22.7	UUU
563-58-6	1,1-Dichloropropene	5.7	UUU
10061-01-5	cis-1,3-Dichloropropene	5.7	UUU
10061-02-6	trans-1,3-Dichloropropene	5.7	UUU
100-41-4	Ethylbenzene	3.4	UUU
87-68-3	Hexachlorobutadiene	5.7	UUU
98-82-8	Isopropylbenzene	9.1	UUU
99-87-6	4-Isopropyltoluene	6.8	UUU

000112



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CE-1

Matrix: Soil
% Dry Weight: SS.
Units: ug/kg dry weight

Lab Sample ID: 99-A10185
Date Sampled: 1/25/99
Date Received: 1/26/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
75-09-2	Methylene chloride	2.3	U
91-20-3	Naphthalene	2.3	U
103-65-1	n-Propylbenzene	2.3	U
100-42-5	Styrene	2.3	U
630-20-6	1,1,1,2-Tetrachloroethane	3.4	U
79-34-5	1,1,2,2-Tetrachloroethane	2.3	U
127-18-4	Tetrachloroethene	8.0	U
108-88-3	Toluene	5.7	U
87-61-6	1,2,3-Trichlorobenzene	2.3	U
120-82-1	1,2,4-Trichlorobenzene	2.3	U
71-55-6	1,1,1-Trichloroethane	4.5	U
79-00-5	1,1,2-Trichloroethane	5.7	U
79-01-6	Trichloroethene	11.4	U
96-18-4	1,2,3-Trichloropropane	22.7	U
95-63-6	1,2,4-Trimethylbenzene	8.0	U
108-67-8	1,3,5-Trimethylbenzene	3.4	U
75-01-4	Vinyl chloride	10.2	U
75-27-4	Bromodichloromethane	4.5	U
6615	o-Xylene	5.7	U
6616	m,p-Xylene	3.4	U
75-69-4	Trichlorofluoromethane	4.5	U

000113



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-2

Matrix: Soil
% Dry Weight: 78.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SWS260B
Delivery Group: 128680
Instrument:

Lab Sample ID: 99-A10184
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/28/99
Analysis Time: 20:18
Sample QC Group: 5693

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
144-10-5	1-Chlorohexane	3.2	U
71-43-2	Benzene	2.6	U
108-86-1	Bromobenzene	2.6	U
124-48-1	Bromochloromethane	2.6	U
75-25-2	Bromoform	7.7	U
74-83-9	Bromomethane	6.4	U
104-51-8	n-Butylbenzene	6.4	U
135-98-8	sec-Butylbenzene	9.0	U
98-06-6	t-Butylbenzene	9.0	U
56-23-5	Carbon tetrachloride	12.8	U
108-90-7	Chlorobenzene	2.6	U
75-00-3	Chloroethane	6.4	U
67-66-3	Chloroform	2.6	U
74-87-3	Chloromethane	9.0	U
95-49-8	2-Chlorotoluene	2.6	U
106-43-4	4-Chlorotoluene	3.8	U
96-12-8	1,2-Dibromo-3-chloropropane	1.3	U
124-48-1	Dibromochloromethane	3.8	U
74-95-3	1,2-Dibromoethane	3.8	U
74-95-3	Dibromomethane	12.8	U
95-50-1	1,2-Dichlorobenzene	2.6	U
541-73-1	1,3-Dichlorobenzene	7.7	U
106-46-7	1,4-Dichlorobenzene	2.6	U
75-71-8	Dichlorodifluoromethane	6.4	U
75-34-3	1,1-Dichloroethane	2.6	U
107-06-2	1,2-Dichloroethane	3.8	U
75-35-4	1,1-Dichloroethene	7.7	U
156-59-2	cis-1,2-Dichloroethene	7.7	U
156-60-5	trans-1,2-Dichloroethene	3.8	U
78-87-5	1,2-Dichloropropane	2.6	U
142-28-9	1,3-Dichloropropane	2.6	U
594-20-7	2,2-Dichloropropane	25.6	U
563-58-6	1,1-Dichloropropene	6.4	U
10061-01-5	cis-1,3-Dichloropropene	6.4	U
10061-02-6	trans-1,3-Dichloropropene	6.4	U
100-41-4	Ethylbenzene	3.8	U
87-68-3	Hexachlorobutadiene	6.4	U
98-82-8	Isopropylbenzene	10.3	U
99-87-6	4-Isopropyltoluene	7.7	U

000110



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-2

Matrix: Soil
% Dry Weight: 78.
Units: ug/kg dry weight

Lab Sample ID: 99-A10184
Date Sampled: 1/25/99
Date Received: 1/26/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
75-09-2	Methylene chloride	2.6	U
91-20-3	Naphthalene	2.6	U
103-65-1	n-Propylbenzene	2.6	U
100-42-5	Styrene	2.6	U
630-20-6	1,1,1,2-Tetrachloroethane	3.8	U
79-34-5	1,1,1,2-Tetrachloroethane	2.6	U
127-18-4	Tetrachloroethene	9.0	U
108-88-3	Toluene	6.4	U
87-61-6	1,2,3-Trichlorobenzene	2.6	U
120-82-1	1,2,4-Trichlorobenzene	2.6	U
71-55-6	1,1,1-Trichloroethane	5.1	U
79-00-5	1,1,2-Trichloroethane	6.4	U
79-01-6	Trichloroethene	12.8	U
96-18-4	1,2,3-Trichloropropane	25.6	U
95-63-6	1,2,4-Trimethylbenzene	9.0	U
108-67-8	1,3,5-Trimethylbenzene	3.8	U
75-01-4	Vinyl chloride	11.5	U
75-27-4	Bromodichloromethane	5.1	U
6615	o-Xylene	6.4	U
6616	m, p-Xylene	3.8	U
75-69-4	Trichlorofluoromethane	5.1	U

000111



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-3

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8260B
Delivery Group: 12B680
Instrument:

Lab Sample ID: 99-A10186
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/28/99
Analysis Time: 23:38
Sample QC Group: 5693

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
144-10-5	1-Chlorohexane	3.0	U
71-43-2	Benzene	2.4	U
108-86-1	Bromobenzene	2.4	U
124-48-1	Bromochloromethane	2.4	U
75-25-2	Bromoform	7.2	U
74-83-9	Bromomethane	6.0	U
104-51-8	n-Butylbenzene	6.0	U
135-98-8	sec-Butylbenzene	8.4	U
98-06-6	t-Butylbenzene	8.4	U
56-23-5	Carbon tetrachloride	12.0	U
108-90-7	Chlorobenzene	2.4	U
75-00-3	Chloroethane	6.0	U
67-66-3	Chloroform	2.4	U
74-87-3	Chloromethane	8.4	U
95-47-8	2-Chlorotoluene	2.4	U
106-43-4	4-Chlorotoluene	3.6	U
96-12-8	1,2-Dibromo-3-chloropropane	1.2	U
124-48-1	Dibromochloromethane	3.6	U
74-95-3	1,2-Dibromoethane	3.6	U
74-95-3	Dibromomethane	12.0	U
95-50-1	1,2-Dichlorobenzene	2.4	U
541-73-1	1,3-Dichlorobenzene	7.2	U
106-46-7	1,4-Dichlorobenzene	2.4	U
75-71-8	Dichlorodifluoromethane	6.0	U
75-34-3	1,1-Dichloroethane	2.4	U
107-06-2	1,2-Dichloroethane	3.6	U
75-35-4	1,1-Dichloroethene	7.2	U
156-59-2	cis-1,2-Dichloroethene	7.2	U
156-60-5	trans-1,2-Dichloroethene	3.6	U
78-87-5	1,2-Dichloropropane	2.4	U
142-28-9	1,3-Dichloropropane	2.4	U
594-20-7	2,2-Dichloropropane	24.1	U
563-58-6	1,1-Dichloropropene	6.0	U
10061-01-5	cis-1,3-Dichloropropene	6.0	U
10061-02-6	trans-1,3-Dichloropropene	6.0	U
100-41-4	Ethylbenzene	3.6	U
87-68-3	Hexachlorobutadiene	6.0	U
98-82-8	Isopropylbenzene	9.6	U
99-87-6	4-Isopropyltoluene	7.2	U

000114



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-3

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight

Lab Sample ID: 99-A10186
Date Sampled: 1/25/99
Date Received: 1/26/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
75-09-2	Methylene chloride	2.4	U
91-20-3	Naphthalene	2.4	U
103-65-1	n-Propylbenzene	2.4	U
100-42-5	Styrene	2.4	U
630-20-6	1,1,1,2-Tetrachloroethane	3.6	U
79-34-5	1,1,2,2-Tetrachloroethane	2.4	U
127-18-4	Tetrachloroethene	8.4	U
108-89-3	Toluene	6.0	U
87-61-6	1,2,3-Trichlorobenzene	2.4	U
120-82-1	1,2,4-Trichlorobenzene	2.4	U
71-55-6	1,1,1-Trichloroethane	4.8	U
79-00-5	1,1,2-Trichloroethane	6.0	U
79-01-6	Trichloroethene	12.0	U
96-18-4	1,2,3-Trichloropropane	24.1	U
95-63-6	1,2,4-Trimethylbenzene	8.4	U
108-67-8	1,3,5-Trimethylbenzene	3.6	U
75-01-4	Vinyl chloride	10.8	U
75-27-4	Bromodichloromethane	4.8	U
6615	o-Xylene	6.0	U
6616	m,p-Xylene	3.6	U
75-69-4	Trichlorofluoromethane	4.8	U

000115



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CE-4

Matrix: Soil
% Dry Weight: 90.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8260B
Delivery Group: 128680
Instrument:

Lab Sample ID: 99-A10187
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 0:18
Sample GC Group: 5693

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
144-10-5	1-Chlorohexane	2.8	U
71-43-2	Benzene	2.2	U
108-86-1	Bromobenzene	2.2	U
124-48-1	Bromochloromethane	2.2	U
75-25-2	Bromoform	6.7	U
74-83-9	Bromomethane	5.6	U
104-51-8	n-Butylbenzene	5.6	U
135-98-8	sec-Butylbenzene	7.8	U
98-06-6	t-Butylbenzene	7.8	U
56-23-5	Carbon tetrachloride	11.1	U
108-90-7	Chlorobenzene	2.2	U
75-00-3	Chloroethane	5.6	U
67-66-3	Chloroform	2.2	U
74-87-3	Chloromethane	7.8	U
95-49-8	2-Chlorotoluene	2.2	U
106-43-4	4-Chlorotoluene	3.3	U
96-12-8	1,2-Dibromo-3-chloropropane	1.1	U
124-48-1	Dibromochloromethane	3.3	U
74-95-3	1,2-Dibromoethane	3.3	U
74-95-3	Dibromomethane	11.1	U
95-50-1	1,2-Dichlorobenzene	2.2	U
541-73-1	1,3-Dichlorobenzene	6.7	U
106-46-7	1,4-Dichlorobenzene	2.2	U
75-71-8	Dichlorodifluoromethane	5.6	U
75-34-3	1,1-Dichloroethane	2.2	U
107-06-2	1,2-Dichloroethane	3.3	U
75-35-4	1,1-Dichloroethene	6.7	U
156-59-2	cis-1,2-Dichloroethene	6.7	U
156-60-5	trans-1,2-Dichloroethene	3.3	U
78-87-5	1,2-Dichloropropane	2.2	U
142-28-9	1,3-Dichloropropane	2.2	U
594-20-7	2,2-Dichloropropane	22.2	U
563-58-6	1,1-Dichloropropene	5.6	U
10061-01-5	cis-1,3-Dichloropropene	5.6	U
10061-02-6	trans-1,3-Dichloropropene	5.6	U
100-41-4	Ethylbenzene	3.3	U
87-68-3	Hexachlorobutadiene	5.6	U
98-82-8	Isopropylbenzene	8.9	U
99-87-6	4-Isopropyltoluene	6.7	U

0001



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CE-4

Matrix: Soil
% Dry Weight: 90.
Units: ug/kg dry weight

Lab Sample ID: 99-A10187
Date Sampled: 1/25/99
Date Received: 1/26/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
75-09-2	Methylene chloride	2.2	U
91-20-3	Naphthalene	2.2	U
103-65-1	n-Propylbenzene	2.2	U
100-42-5	Styrene	2.2	U
630-20-6	1, 1, 1, 2-Tetrachloroethane	3.3	U
79-34-5	1, 1, 2, 2-Tetrachloroethane	2.2	U
127-18-4	Tetrachloroethene	7.8	U
108-88-3	Toluene	5.6	U
87-61-6	1, 2, 3-Trichlorobenzene	2.2	U
120-82-1	1, 2, 4-Trichlorobenzene	2.2	U
71-55-6	1, 1, 1-Trichloroethane	4.4	U
79-00-5	1, 1, 2-Trichloroethane	5.6	U
79-01-6	Trichloroethene	11.1	U
96-18-4	1, 2, 3-Trichloropropane	22.2	U
95-63-6	1, 2, 4-Trimethylbenzene	7.8	U
108-67-8	1, 3, 5-Trimethylbenzene	3.3	U
75-01-4	Vinyl chloride	10.0	U
75-27-4	Bromodichloromethane	4.4	U
6615	o-Xylene	5.6	U
6616	m, p-Xylene	3.3	U
75-69-4	Trichlorofluoromethane	4.4	U

000117



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-5

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SWS26QB
Delivery Group: 128680
Instrument:

Lab Sample ID: 99-A10183
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 9:33
Sample QC Group: 5693

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
144-10-5	1-Chlorohexane	3.0	U
71-43-2	Benzene	2.4	U
108-86-1	Bromobenzene	2.4	U
124-48-1	Bromochloromethane	2.4	U
75-25-2	Bromoform	7.2	U
74-83-9	Bromomethane	6.0	U
104-51-8	n-Butylbenzene	6.0	U
135-98-8	sec-Butylbenzene	8.4	U
98-06-6	t-Butylbenzene	8.4	U
56-23-5	Carbon tetrachloride	12.0	U
108-90-7	Chlorobenzene	2.4	U
75-00-3	Chloroethane	6.0	U
67-66-3	Chloroform	2.4	U
74-87-3	Chloromethane	8.4	U
95-49-8	2-Chlorotoluene	2.4	U
106-43-4	4-Chlorotoluene	3.6	U
96-12-8	1,2-Dibromo-3-chloropropane	1.2	U
124-48-1	Dibromochloromethane	3.6	U
74-95-3	1,2-Dibromoethane	3.6	U
74-95-3	Dibromomethane	12.0	U
95-50-1	1,2-Dichlorobenzene	2.4	U
541-73-1	1,3-Dichlorobenzene	7.2	U
106-46-7	1,4-Dichlorobenzene	2.4	U
75-71-8	Dichlorodifluoromethane	6.0	U
75-34-3	1,1-Dichloroethane	2.4	U
107-06-2	1,2-Dichloroethane	3.6	U
75-35-4	1,1-Dichloroethene	7.2	U
156-59-2	cis-1,2-Dichloroethene	7.2	U
156-60-5	trans-1,2-Dichloroethene	3.6	U
78-87-5	1,2-Dichloropropane	2.4	U
142-28-9	1,3-Dichloropropane	2.4	U
594-20-7	2,2-Dichloropropane	24.1	U
563-58-6	1,1-Dichloropropene	6.0	U
10061-01-5	cis-1,3-Dichloropropene	6.0	U
10061-02-6	trans-1,3-Dichloropropene	6.0	U
100-41-4	Ethylbenzene	3.6	U
87-68-3	Hexachlorobutadiene	6.0	U
98-82-8	Isopropylbenzene	9.6	U
99-87-6	4-Isopropyltoluene	7.2	U

000108



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-5

Matrix: Soil
% Dry Weight: 53.
Units: ug/kg dry weight

Lab Sample ID: 99-A10183
Date Sampled: 1/25/99
Date Received: 1/26/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
75-09-2	Methylene chloride	4.8	....
91-20-3	Naphthalene	2.4	.... U
103-65-1	n-Propylbenzene	2.4	.... U
100-42-5	Styrene	2.4	.... U
630-20-6	1, 1, 1, 2-Tetrachloroethane	3.6	.... U
79-34-5	1, 1, 2, 2-Tetrachloroethane	2.4	.... U
127-18-4	Tetrachloroethene	8.4	.... U
108-88-3	Toluene	6.0	.... U
87-61-6	1, 2, 3-Trichlorobenzene	2.4	.... U
120-82-1	1, 2, 4-Trichlorobenzene	2.4	.... U
71-55-6	1, 1, 1-Trichloroethane	4.8	.... U
79-00-5	1, 1, 2-Trichloroethane	6.0	.... U
79-01-6	Trichloroethene	12.0	.... U
96-18-4	1, 2, 3-Trichloropropane	24.1	.... U
95-63-6	1, 2, 4-Trimethylbenzene	8.4	.... U
108-67-8	1, 3, 5-Trimethylbenzene	3.6	.... U
75-01-4	Vinyl chloride	10.8	.... U
75-27-4	Bromodichloromethane	4.8	.... U
6615	o-Xylene	6.0	.... U
6616	m, p-Xylene	3.6	.... U
75-69-4	Trichlorofluoromethane	4.8	.... U

000109



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-6

Matrix: Soil
% Dry Weight: 87.
Units: ug/kg dry weight
Dilution Factor: 5.
Analysis Method: SW8260B
Delivery Group: 128680
Instrument:

Lab Sample ID: 99-A10182
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 8:34
Sample QC Group: 5693

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
144-10-5	1-Chlorohexane	14.4	U
71-43-2	Benzene	11.5	U
108-86-1	Bromobenzene	11.5	U
124-48-1	Bromochloromethane	11.5	U
75-25-2	Bromoform	34.5	U
74-83-9	Bromomethane	28.7	U
104-51-8	n-Butylbenzene	28.7	U
135-98-8	sec-Butylbenzene	51.7	
98-06-6	t-Butylbenzene	11.5	J
56-23-5	Carbon tetrachloride	57.5	U
108-90-7	Chlorobenzene	11.5	U
75-00-3	Chloroethane	28.7	U
67-66-3	Chloroform	11.5	U
74-87-3	Chloromethane	40.2	U
95-49-8	2-Chlorotoluene	11.5	U
106-43-4	4-Chlorotoluene	17.2	U
96-12-8	1,2-Dibromo-3-chloropropane	5.7	U
124-48-1	Dibromochloromethane	17.2	U
74-95-3	1,2-Dibromoethane	17.2	U
74-95-3	Dibromomethane	57.5	U
95-50-1	1,2-Dichlorobenzene	11.5	U
541-73-1	1,3-Dichlorobenzene	34.5	U
106-46-7	1,4-Dichlorobenzene	11.5	U
75-71-8	Dichlorodifluoromethane	28.7	U
75-34-3	1,1-Dichloroethane	11.5	U
107-06-2	1,2-Dichloroethane	17.2	U
75-35-4	1,1-Dichloroethene	34.5	U
156-59-2	cis-1,2-Dichloroethene	34.5	U
156-60-5	trans-1,2-Dichloroethene	17.2	U
78-87-5	1,2-Dichloropropane	11.5	U
142-28-9	1,3-Dichloropropane	11.5	U
594-20-7	2,2-Dichloropropane	115.	U
563-58-6	1,1-Dichloropropene	28.7	U
10061-01-5	cis-1,3-Dichloropropene	28.7	U
10061-02-6	trans-1,3-Dichloropropene	28.7	U
100-41-4	Ethylbenzene	86.2	
87-68-3	Hexachlorobutadiene	28.7	U
98-82-8	Isopropylbenzene	46.0	
99-87-6	4-Isopropyltoluene	224.	

00010E



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-6

Matrix: Soil
% Dry Weight: 87.
Units: ug/kg dry weight

Lab Sample ID: 99-A10182
Date Sampled: 1/25/99
Date Received: 1/26/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
75-09-2	Methylene chloride	11.5	U
91-20-3	Naphthalene	379.	
103-65-1	n-Propylbenzene	121.	
100-42-5	Styrene	11.5	U
630-20-6	1, 1, 1, 2-Tetrachloroethane	17.2	U
79-34-5	1, 1, 2, 2-Tetrachloroethane	11.5	U
127-18-4	Tetrachloroethene	40.2	U
108-88-3	Toluene	28.7	U
87-61-6	1, 2, 3-Trichlorobenzene	11.5	U
120-82-1	1, 2, 4-Trichlorobenzene	11.5	U
71-55-6	1, 1, 1-Trichloroethane	23.0	U
79-00-5	1, 1, 2-Trichloroethane	28.7	U
79-01-6	Trichloroethene	57.5	U
95-18-4	1, 2, 3-Trichloropropane	115.	U
95-63-6	1, 2, 4-Trimethylbenzene	707.	
108-67-8	1, 3, 5-Trimethylbenzene	241.	
75-01-4	Vinyl chloride	51.7	U
75-27-4	Bromodichloromethane	23.0	U
6615	o-Xylene	28.7	U
6616	m, p-Xylene	132.	
75-69-4	Trichlorofluoromethane	23.0	U

000101



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-7

Matrix: Soil
% Dry Weight: 85.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8260B
Delivery Group: 128680
Instrument:

Lab Sample ID: 99-A10191
Data Sampled: 1/25/99
Data Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 2:57
Sample QC Group: 5693

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
144-10-5	1-Chlorohexane	2.9	U
71-43-2	Benzene	2.4	U
108-86-1	Bromobenzene	2.4	U
124-48-1	Bromochloromethane	2.4	U
75-25-2	Bromoform	7.1	U
74-83-9	Bromomethane	5.9	U
104-51-8	n-Butylbenzene	5.9	U
135-98-8	sec-Butylbenzene	8.2	U
98-06-6	t-Butylbenzene	8.2	U
56-23-5	Carbon tetrachloride	11.8	U
108-90-7	Chlorobenzene	2.4	U
75-00-3	Chloroethane	5.9	U
67-66-3	Chloroform	2.4	U
74-87-3	Chloromethane	8.2	U
95-49-8	2-Chlorotoluene	2.4	U
106-43-4	4-Chlorotoluene	3.5	U
96-12-8	1,2-Dibromo-3-chloropropane	1.2	U
124-48-1	Dibromochloromethane	3.5	U
74-95-3	1,2-Dibromoethane	3.5	U
74-95-3	Dibromomethane	11.8	U
95-50-1	1,2-Dichlorobenzene	2.4	U
541-73-1	1,3-Dichlorobenzene	7.1	U
106-46-7	1,4-Dichlorobenzene	2.4	U
75-71-8	Dichlorodifluoromethane	5.9	U
75-34-3	1,1-Dichloroethane	2.4	U
107-06-2	1,2-Dichloroethane	3.5	U
75-35-4	1,1-Dichloroethene	7.1	U
156-59-2	cis-1,2-Dichloroethene	7.1	U
156-60-5	trans-1,2-Dichloroethene	3.5	U
78-87-5	1,2-Dichloropropane	2.4	U
142-28-9	1,3-Dichloropropane	2.4	U
594-20-7	2,2-Dichloropropane	23.5	U
563-58-6	1,1-Dichloropropene	5.9	U
10061-01-5	cis-1,3-Dichloropropene	5.9	U
10061-02-6	trans-1,3-Dichloropropene	5.9	U
100-41-4	Ethylbenzene	3.5	U
87-68-3	Hexachlorobutadiene	5.9	U
98-82-8	Isopropylbenzene	9.4	U
99-87-6	4-Isopropyltoluene	7.1	U

000124



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-7

Matrix: Soil
% Dry Weight: 85.
Units: ug/kg dry weight

Lab Sample ID: 99-A10191
Date Sampled: 1/25/99
Date Received: 1/26/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
75-09-2	Methylene chloride	2.4	U
91-20-3	Naphthalene	2.4	U
103-65-1	n-Propylbenzene	2.4	U
100-42-5	Styrene	2.4	U
630-20-6	1, 1, 1, 2-Tetrachloroethane	3.5	U
79-34-5	1, 1, 2, 2-Tetrachloroethane	2.4	U
127-18-4	Tetrachloroethene	8.2	U
108-88-3	Toluene	5.9	U
87-61-6	1, 2, 3-Trichlorobenzene	2.4	U
120-82-1	1, 2, 4-Trichlorobenzene	2.4	U
71-55-6	1, 1, 1-Trichloroethane	4.7	U
79-00-5	1, 1, 2-Trichloroethane	5.9	U
79-01-6	Trichloroethene	11.8	U
96-18-4	1, 2, 3-Trichloropropane	23.5	U
95-63-6	1, 2, 4-Trimethylbenzene	8.2	U
108-67-8	1, 3, 5-Trimethylbenzene	116.	U
75-01-4	Vinyl chloride	10.6	U
75-27-4	Bromodichloromethane	4.7	U
6615	o-Xylene	51.8	U
6616	m, p-Xylene	3.5	U
75-69-4	Trichlorofluoromethane	4.7	U

000125



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-D2

Matrix: Soil
% Dry Weight: 82.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SWS260B
Delivery Group: 128680
Instrument:

Lab Sample ID: 99-A10192
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 3:38
Sample QC Group: 5693

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
144-10-5	1-Chlorohexane	3.0	U
71-43-2	Benzene	2.4	U
108-86-1	Bromobenzene	2.4	U
124-48-1	Bromochloromethane	2.4	U
75-25-2	Bromoform	7.3	U
74-83-9	Bromomethane	6.1	U
104-51-8	n-Butylbenzene	6.1	U
135-98-8	sec-Butylbenzene	8.5	U
98-06-6	t-Butylbenzene	8.5	U
56-23-5	Carbon tetrachloride	12.2	U
108-90-7	Chlorobenzene	2.4	U
75-00-3	Chloroethane	6.1	U
67-66-3	Chloroform	2.4	U
74-87-3	Chloromethane	8.5	U
95-49-8	2-Chlorotoluene	2.4	U
106-43-4	4-Chlorotoluene	3.7	U
96-12-8	1,2-Dibromo-3-chloropropane	1.2	U
124-48-1	Dibromochloromethane	3.7	U
74-95-3	1,2-Dibromoethane	3.7	U
74-95-3	Dibromomethane	12.2	U
95-50-1	1,2-Dichlorobenzene	2.4	U
541-73-1	1,3-Dichlorobenzene	7.3	U
106-46-7	1,4-Dichlorobenzene	2.4	U
75-71-8	Dichlorodifluoromethane	6.1	U
75-34-3	1,1-Dichloroethane	2.4	U
107-06-2	1,2-Dichloroethane	3.7	U
75-35-4	1,1-Dichloroethene	7.3	U
156-59-2	cis-1,2-Dichloroethene	7.3	U
156-60-5	trans-1,2-Dichloroethene	3.7	U
78-87-5	1,2-Dichloropropane	2.4	U
142-28-9	1,3-Dichloropropane	2.4	U
594-20-7	2,2-Dichloropropane	24.4	U
563-58-6	1,1-Dichloropropene	6.1	U
10061-01-5	cis-1,3-Dichloropropene	6.1	U
10061-02-6	trans-1,3-Dichloropropene	6.1	U
100-41-4	Ethylbenzene	3.7	U
87-68-3	Hexachlorobutadiene	6.1	U
98-82-8	Isopropylbenzene	9.8	U
99-87-6	4-Isopropyltoluene	7.3	U

000126



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-D2

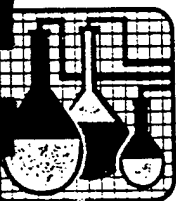
Matrix: Soil
% Dry Weight: 82.
Units: ug/kg dry weight

Lab Sample ID: 99-A10192
Date Sampled: 1/25/99
Date Received: 1/26/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
75-09-2	Methylene chloride	2.4	U
91-20-3	Naphthalene	2.4	U
103-65-1	n-Propylbenzene	2.4	U
100-42-5	Styrene	2.4	U
630-20-6	1,1,1,2-Tetrachloroethane	3.7	U
79-34-5	1,1,2,2-Tetrachloroethane	2.4	U
127-18-4	Tetrachloroethene	8.5	U
108-88-3	Toluene	6.1	U
87-61-6	1,2,3-Trichlorobenzene	2.4	U
120-82-1	1,2,4-Trichlorobenzene	2.4	U
71-55-6	1,1,1-Trichloroethane	4.9	U
79-00-5	1,1,2-Trichloroethane	6.1	U
79-01-6	Trichloroethene	12.2	U
96-18-4	1,2,3-Trichloropropane	24.4	U
95-63-6	1,2,4-Trimethylbenzene	48.8	U
108-67-8	1,3,5-Trimethylbenzene	3.7	U
75-01-4	Vinyl chloride	11.0	U
75-27-4	Bromodichloromethane	4.9	U
6615	o-Xylene	20.7	U
6616	m,p-Xylene	3.7	U
75-69-4	Trichlorofluoromethane	4.9	U

000127



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CE-8

Matrix: Soil
% Dry Weight: 85.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8260B
Delivery Group: 128680
Instrument:

Lab Sample ID: 99-A10189
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 1:37
Sample QC Group: 5693

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
144-10-5	1-Chlorohexane	2.9	U
71-43-2	Benzene	2.4	U
108-86-1	Bromobenzene	2.4	U
124-48-1	Bromochloromethane	2.4	U
75-25-2	Bromoform	7.1	U
74-83-9	Bromomethane	5.9	U
104-51-8	n-Butylbenzene	5.9	U
135-98-8	sec-Butylbenzene	8.2	U
98-06-6	t-Butylbenzene	8.2	U
56-23-5	Carbon tetrachloride	11.8	U
108-90-7	Chlorobenzene	2.4	U
75-00-3	Chloroethane	5.9	U
67-66-3	Chloroform	2.4	U
74-87-3	Chloromethane	8.2	U
95-49-8	2-Chlorotoluene	2.4	U
106-43-4	4-Chlorotoluene	3.5	U
96-12-8	1,2-Dibromo-3-chloropropane	1.2	U
124-48-1	Dibromochloromethane	3.5	U
74-95-3	1,2-Dibromoethane	3.5	U
74-95-3	Dibromomethane	11.8	U
95-50-1	1,2-Dichlorobenzene	2.4	U
541-73-1	1,3-Dichlorobenzene	7.1	U
106-46-7	1,4-Dichlorobenzene	2.4	U
75-71-8	Dichlorodifluoromethane	5.9	U
75-34-3	1,1-Dichloroethane	2.4	U
107-06-2	1,2-Dichloroethane	3.5	U
75-35-4	1,1-Dichloroethene	7.1	U
156-59-2	cis-1,2-Dichloroethene	7.1	U
156-60-5	trans-1,2-Dichloroethene	3.5	U
78-87-5	1,2-Dichloropropane	2.4	U
142-28-9	1,3-Dichloropropane	2.4	U
594-20-7	2,2-Dichloropropane	23.5	U
563-58-6	1,1-Dichloropropene	5.9	U
10061-01-5	cis-1,3-Dichloropropene	5.9	U
10061-02-6	trans-1,3-Dichloropropene	5.9	U
100-41-4	Ethylbenzene	3.5	U
87-68-3	Hexachlorobutadiene	5.9	U
98-82-8	Isopropylbenzene	9.4	U
99-87-6	4-Isopropyltoluene	7.1	U

000120



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CE-8

Matrix: Soil
% Dry Weight: 85.
Units: ug/kg dry weight

Lab Sample ID: 99-A10189
Date Sampled: 1/25/99
Date Received: 1/26/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
75-09-2	Methylene chloride	2.4	U
91-20-3	Naphthalene	2.4	U
103-65-1	n-Propylbenzene	2.4	U
100-42-5	Styrene	2.4	U
630-20-6	1, 1, 1, 2-Tetrachloroethane	3.5	U
79-34-5	1, 1, 2, 2-Tetrachloroethane	2.4	U
127-18-4	Tetrachloroethene	8.2	U
108-88-3	Toluene	2.4	J
87-61-6	1, 2, 3-Trichlorobenzene	2.4	U
120-82-1	1, 2, 4-Trichlorobenzene	2.4	U
71-55-6	1, 1, 1-Trichloroethane	4.7	U
79-00-5	1, 1, 2-Trichloroethane	5.9	U
79-01-6	Trichloroethene	11.8	U
96-18-4	1, 2, 3-Trichloropropane	23.5	U
95-63-6	1, 2, 4-Trimethylbenzene	3.5	J
108-67-8	1, 3, 5-Trimethylbenzene	3.5	U
75-01-4	Vinyl chloride	10.6	U
75-27-4	Bromodichloromethane	4.7	U
6615	o-Xylene	5.9	U
6616	m, p-Xylene	4.7	U
75-69-4	Trichlorofluoromethane	4.7	U

000121



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-D1

Matrix: Soil
% Dry Weight: 85.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8260B
Delivery Group: 128680
Instrument:

Lab Sample ID: 99-A10190
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 2:17
Sample QC Group: 5693

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
144-10-5	1-Chlorohexane	2.9	U
71-43-2	Benzene	2.4	U
108-86-1	Bromobenzene	2.4	U
124-48-1	Bromochloromethane	2.4	U
75-25-2	Bromoform	7.1	U
74-83-9	Bromomethane	5.9	U
104-51-8	n-Butylbenzene	5.9	U
135-98-8	sec-Butylbenzene	8.2	U
98-06-6	t-Butylbenzene	8.2	U
56-23-5	Carbon tetrachloride	11.8	U
108-90-7	Chlorobenzene	2.4	U
75-00-3	Chloroethane	5.9	U
67-66-3	Chloroform	2.4	U
74-87-3	Chloromethane	8.2	U
95-49-8	2-Chlorotoluene	2.4	U
106-43-4	4-Chlorotoluene	3.5	U
96-12-8	1,2-Dibromo-3-chloropropane	1.2	U
124-48-1	Dibromochloromethane	3.5	U
74-95-3	1,2-Dibromoethane	3.5	U
74-95-3	Dibromomethane	11.8	U
95-50-1	1,2-Dichlorobenzene	2.4	U
541-73-1	1,3-Dichlorobenzene	7.1	U
106-46-7	1,4-Dichlorobenzene	2.4	U
75-71-8	Dichlorodifluoromethane	5.9	U
75-34-3	1,1-Dichloroethane	2.4	U
107-06-2	1,2-Dichloroethane	3.5	U
75-35-4	1,1-Dichloroethene	7.1	U
156-59-2	cis-1,2-Dichloroethene	7.1	U
156-60-5	trans-1,2-Dichloroethene	3.5	U
78-87-5	1,2-Dichloropropane	2.4	U
142-28-9	1,3-Dichloropropane	2.4	U
594-20-7	2,2-Dichloropropane	23.5	U
563-58-6	1,1-Dichloropropene	5.9	U
10061-01-5	cis-1,3-Dichloropropene	5.9	U
10061-02-6	trans-1,3-Dichloropropene	5.9	U
100-41-4	Ethylbenzene	3.5	U
87-68-3	Hexachlorobutadiene	5.9	U
98-82-8	Isopropylbenzene	7.4	U
99-87-6	4-Isopropyltoluene	7.1	U

000122



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CE-D1

Matrix: Soil
% Dry Weight: 85.
Units: ug/kg dry weight

Lab Sample ID: 99-A10190
Date Sampled: 1/25/99
Date Received: 1/26/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
75-09-2	Methylene chloride	2.4	U
91-20-3	Naphthalene	2.4	U
103-65-1	n-Propylbenzene	2.4	U
100-42-5	Styrene	2.4	U
630-20-6	1, 1, 1, 2-Tetrachloroethane	3.5	U
79-34-5	1, 1, 2, 2-Tetrachloroethane	2.4	U
127-18-4	Tetrachloroethene	8.2	U
108-88-3	Toluene	5.9	U
87-61-6	1, 2, 3-Trichlorobenzene	2.4	U
120-82-1	1, 2, 4-Trichlorobenzene	2.4	U
71-55-6	1, 1, 1-Trichloroethane	4.7	U
79-00-5	1, 1, 2-Trichloroethane	5.9	U
79-01-6	Trichloroethene	11.8	U
96-18-4	1, 2, 3-Trichloropropane	23.5	U
95-63-6	1, 2, 4-Trimethylbenzene	8.2	U
108-67-8	1, 3, 5-Trimethylbenzene	3.5	U
75-01-4	Vinyl chloride	10.6	U
75-27-4	Bromodichloromethane	4.7	U
6615	o-Xylene	5.9	U
6616	m, p-Xylene	3.5	U
75-69-4	Trichlorofluoromethane	4.7	U

000123



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CE-9

Matrix: Soil
% Dry Weight: 86.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8260B
Delivery Group: 128690
Instrument:

Lab Sample ID: 99-A10188
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 0:58
Sample QC Group: 5693

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
144-10-5	1-Chlorohexane	2.9	U
71-43-2	Benzene	10.5	U
108-86-1	Bromobenzene	2.3	U
124-48-1	Bromochloromethane	2.3	U
75-25-2	Bromoform	7.0	U
74-83-9	Bromomethane	5.8	U
104-51-8	n-Butylbenzene	5.8	U
135-98-8	sec-Butylbenzene	8.1	U
98-06-6	t-Butylbenzene	8.1	U
56-23-5	Carbon tetrachloride	11.6	U
108-90-7	Chlorobenzene	2.3	U
75-00-3	Chloroethane	5.8	U
67-66-3	Chloroform	2.3	U
74-87-3	Chloromethane	8.1	U
95-49-8	2-Chlorotoluene	2.3	U
106-43-4	4-Chlorotoluene	3.5	U
96-12-8	1,2-Dibromo-3-chloropropane	1.2	U
124-48-1	Dibromochloromethane	3.5	U
74-95-3	1,2-Dibromoethane	3.5	U
74-95-3	Dibromomethane	11.6	U
95-50-1	1,2-Dichlorobenzene	2.3	U
541-73-1	1,3-Dichlorobenzene	7.0	U
106-46-7	1,4-Dichlorobenzene	2.3	U
75-71-8	Dichlorodifluoromethane	5.8	U
75-34-3	1,1-Dichloroethane	2.3	U
107-06-2	1,2-Dichloroethane	3.5	U
75-35-4	1,1-Dichloroethene	7.0	U
156-59-2	cis-1,2-Dichloroethene	7.0	U
156-60-5	trans-1,2-Dichloroethene	3.5	U
78-87-5	1,2-Dichloropropane	2.3	U
142-28-9	1,3-Dichloropropane	2.3	U
594-20-7	2,2-Dichloropropane	23.3	U
563-58-6	1,1-Dichloropropene	5.8	U
10061-01-5	cis-1,3-Dichloropropene	5.8	U
10061-02-6	trans-1,3-Dichloropropene	5.8	U
100-41-4	Ethylbenzene	27.9	U
87-68-3	Hexachlorobutadiene	5.8	U
98-82-8	Isopropylbenzene	3.5	U
99-87-6	4-Isopropyltoluene	7.0	U

000118



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-9

Matrix: Soil
% Dry Weight: 86.
Units: ug/kg dry weight

Lab Sample ID: 99-A10188
Date Sampled: 1/25/99
Date Received: 1/26/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
75-09-2	Methylene chloride	2.3	U
91-20-3	Naphthalene	18.6	
103-65-1	n-Propylbenzene	7.0	
100-42-5	Styrene	2.3	U
630-20-6	1,1,1,2-Tetrachloroethane	3.5	U
79-34-5	1,1,2,2-Tetrachloroethane	2.3	U
127-18-4	Tetrachloroethene	8.1	U
108-88-3	Toluene	8.1	
87-61-6	1,2,3-Trichlorobenzene	2.3	U
120-82-1	1,2,4-Trichlorobenzene	2.3	U
71-55-6	1,1,1-Trichloroethane	4.7	U
79-00-5	1,1,2-Trichloroethane	5.8	U
79-01-6	Trichloroethene	11.6	U
96-18-4	1,2,3-Trichloropropane	23.3	U
95-63-6	1,2,4-Trimethylbenzene	46.5	
108-67-8	1,3,5-Trimethylbenzene	4.7	
75-01-4	Vinyl chloride	10.5	U
75-27-4	Bromodichloromethane	4.7	U
6615	o-Xylene	5.8	
6616	m,p-Xylene	22.1	
75-69-4	Trichlorofluoromethane	4.7	U

000119



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-10

Matrix: Soil
% Dry Weight: 86.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8260B
Delivery Group: 128680
Instrument:

Lab Sample ID: 99-A10180
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/28/99
Analysis Time: 17:37
Sample QC Group: 5693

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
144-10-5	1-Chlorohexane	2.9	U
71-43-2	Benzene	2.3	U
108-86-1	Bromobenzene	2.3	U
124-48-1	Bromochloromethane	2.3	U
75-25-2	Bromoform	7.0	U
74-83-9	Bromomethane	5.8	U
104-51-8	n-Butylbenzene	5.8	U
135-98-8	sec-Butylbenzene	8.1	U
98-06-6	t-Butylbenzene	8.1	U
56-23-5	Carbon tetrachloride	11.6	U
108-90-7	Chlorobenzene	2.3	U
75-00-3	Chloroethane	5.8	U
67-66-3	Chloroform	2.3	U
74-87-3	Chloromethane	8.1	U
95-49-8	2-Chlorotoluene	2.3	U
106-43-4	4-Chlorotoluene	3.5	U
96-12-8	1,2-Dibromo-3-chloropropane	1.2	U
124-48-1	Dibromochloromethane	3.5	U
74-95-3	1,2-Dibromoethane	3.5	U
74-95-3	Dibromomethane	11.6	U
95-50-1	1,2-Dichlorobenzene	2.3	U
541-73-1	1,3-Dichlorobenzene	7.0	U
106-46-7	1,4-Dichlorobenzene	2.3	U
75-71-8	Dichlorodifluoromethane	5.8	U
75-34-3	1,1-Dichloroethane	2.3	U
107-06-2	1,2-Dichloroethane	3.5	U
75-35-4	1,1-Dichloroethene	7.0	U
156-59-2	cis-1,2-Dichloroethene	7.0	U
156-60-5	trans-1,2-Dichloroethene	3.5	U
78-87-5	1,2-Dichloropropane	2.3	U
142-28-9	1,3-Dichloropropane	2.3	U
594-20-7	2,2-Dichloropropane	23.3	U
563-58-6	1,1-Dichloropropene	5.8	U
10061-01-5	cis-1,3-Dichloropropene	5.8	U
10061-02-6	trans-1,3-Dichloropropene	5.8	U
100-41-4	Ethylbenzene	3.5	U
87-68-3	Hexachlorobutadiene	5.8	U
98-82-8	Isopropylbenzene	9.3	U
99-87-6	4-Isopropyltoluene	7.0	U

000100



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CE-10

Matrix: Soil
% Dry Weight: 26.
Units: ug/kg dry weight

Lab Sample ID: 99-A10180
Date Sampled: 1/25/99
Date Received: 1/26/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
75-09-2	Methylene chloride	2.3	U
91-20-3	Naphthalene	2.3	U
103-65-1	n-Propylbenzene	2.3	U
100-42-5	Styrene	2.3	U
630-20-6	1,1,1,2-Tetrachloroethane	3.5	U
79-34-5	1,1,2,2-Tetrachloroethane	2.3	U
127-18-4	Tetrachloroethene	8.1	U
108-88-3	Toluene	5.8	U
87-61-6	1,2,3-Trichlorobenzene	2.3	U
120-82-1	1,2,4-Trichlorobenzene	2.3	U
71-55-6	1,1,1-Trichloroethane	4.7	U
79-00-5	1,1,2-Trichloroethane	5.8	U
79-01-6	Trichloroethene	11.6	U
94-18-4	1,2,3-Trichloropropane	23.3	U
95-63-6	1,2,4-Trimethylbenzene	8.1	U
108-67-8	1,3,5-Trimethylbenzene	3.5	U
75-01-4	Vinyl chloride	10.5	U
75-27-4	Bromodichloromethane	4.7	U
6615	o-Xylene	5.8	U
6616	m,p-Xylene	3.5	U
75-69-4	Trichlorofluoromethane	4.7	U

000101



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-11

Matrix: Soil
% Dry Weight: 79.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8260B
Delivery Group: 128680
Instrument:

Lab Sample ID: 99-A10179
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 7:39
Sample QC Group: 5693

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
144-10-5	1-Chlorohexane	3.2	U
71-43-2	Benzene	2.5	U
108-86-1	Bromobenzene	2.5	U
124-48-1	Bromochloromethane	2.5	U
75-25-2	Bromoform	7.6	U
74-83-9	Bromomethane	6.3	U
104-51-8	n-Butylbenzene	6.3	U
135-98-8	sec-Butylbenzene	8.9	U
98-06-6	t-Butylbenzene	8.9	U
56-23-5	Carbon tetrachloride	12.7	U
108-90-7	Chlorobenzene	2.5	U
75-00-3	Chloroethane	6.3	U
67-66-3	Chloroform	2.5	U
74-87-3	Chloromethane	8.9	U
95-49-8	2-Chlorotoluene	2.5	U
106-43-4	4-Chlorotoluene	3.8	U
96-12-8	1,2-Dibromo-3-chloropropane	1.3	U
124-48-1	Dibromochloromethane	3.8	U
74-95-3	1,2-Dibromoethane	3.8	U
74-95-3	Dibromomethane	12.7	U
95-50-1	1,2-Dichlorobenzene	2.5	U
541-73-1	1,3-Dichlorobenzene	7.6	U
106-46-7	1,4-Dichlorobenzene	2.5	U
75-71-8	Dichlorodifluoromethane	6.3	U
75-34-3	1,1-Dichloroethane	2.5	U
107-06-2	1,2-Dichloroethane	3.8	U
75-35-4	1,1-Dichloroethene	7.6	U
156-59-2	cis-1,2-Dichloroethene	7.6	U
156-60-5	trans-1,2-Dichloroethene	3.8	U
78-87-5	1,2-Dichloropropane	2.5	U
142-28-9	1,3-Dichloropropane	2.5	U
594-20-7	2,2-Dichloropropane	25.3	U
563-58-6	1,1-Dichloropropene	6.3	U
10061-01-5	cis-1,3-Dichloropropene	6.3	U
10061-02-6	trans-1,3-Dichloropropene	6.3	U
100-41-4	Ethylbenzene	3.8	U
87-68-3	Hexachlorobutadiene	6.3	U
98-82-8	Isopropylbenzene	10.1	U
99-87-6	4-Isopropyltoluene	7.6	U

000098



**SPECIALIZED
ASSAYS, INC.**

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-11

Matrix: Soil
% Dry Weight: 79.
Units: ug/kg dry weight

Lab Sample ID: 99-A10179
Date Sampled: 1/25/99
Date Received: 1/26/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
75-09-2	Methylene chloride	10.1	B
91-20-3	Naphthalene	2.5	U
103-65-1	n-Propylbenzene	2.5	U
100-42-5	Styrene	2.5	U
630-20-6	1,1,1,2-Tetrachloroethane	3.8	U
79-34-5	1,1,2,2-Tetrachloroethane	2.5	U
127-18-4	Tetrachloroethene	8.9	U
108-88-3	Toluene	6.3	U
87-61-6	1,2,3-Trichlorobenzene	2.5	U
120-82-1	1,2,4-Trichlorobenzene	2.5	U
71-55-6	1,1,1-Trichloroethane	5.1	U
79-00-5	1,1,2-Trichloroethane	6.3	U
79-01-6	Trichloroethene	12.7	U
96-18-4	1,2,3-Trichloropropane	25.3	U
95-63-6	1,2,4-Trimethylbenzene	8.9	U
108-67-8	1,3,5-Trimethylbenzene	3.8	U
75-01-4	Vinyl chloride	11.4	U
75-27-4	Bromodichloromethane	5.1	U
6615	o-Xylene	6.3	U
6616	m,p-Xylene	3.8	U
75-69-4	Trichlorofluoromethane	5.1	U

000099



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-12

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8260B
Delivery Group: 128690
Instrument:

Lab Sample ID: 99-A10181
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/28/99
Analysis Time: 18:17
Sample QC Group: 5693

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
144-10-5	1-Chlorohexane	3.0	U
71-43-2	Benzene	2.4	U
108-86-1	Bromobenzene	2.4	U
124-48-1	Bromochloromethane	2.4	U
75-25-2	Bromoform	7.2	U
74-83-9	Bromomethane	6.0	U
104-51-8	n-Butylbenzene	6.0	U
135-98-8	sec-Butylbenzene	8.4	U
98-06-6	t-Butylbenzene	8.4	U
56-23-5	Carbon tetrachloride	12.0	U
108-90-7	Chlorobenzene	2.4	U
75-00-3	Chloroethane	6.0	U
67-66-3	Chloroform	2.4	U
74-87-3	Chloromethane	8.4	U
95-49-8	2-Chlorotoluene	2.4	U
106-43-4	4-Chlorotoluene	3.6	U
96-12-8	1,2-Dibromo-3-chloropropane	1.2	U
124-48-1	Dibromochloromethane	3.6	U
74-95-3	1,2-Dibromoethane	3.6	U
74-95-3	Dibromomethane	12.0	U
95-50-1	1,2-Dichlorobenzene	2.4	U
541-73-1	1,3-Dichlorobenzene	7.2	U
106-46-7	1,4-Dichlorobenzene	2.4	U
75-71-8	Dichlorodifluoromethane	6.0	U
75-34-3	1,1-Dichloroethane	2.4	U
107-06-2	1,2-Dichloroethane	3.6	U
75-35-4	1,1-Dichloroethene	7.2	U
156-59-2	cis-1,2-Dichloroethene	7.2	U
156-60-5	trans-1,2-Dichloroethene	3.6	U
78-87-5	1,2-Dichloropropane	2.4	U
142-28-9	1,3-Dichloropropane	2.4	U
594-20-7	2,2-Dichloropropane	24.1	U
563-58-6	1,1-Dichloropropene	6.0	U
10061-01-5	cis-1,3-Dichloropropene	6.0	U
10061-02-6	trans-1,3-Dichloropropene	6.0	U
100-41-4	Ethylbenzene	3.6	U
87-68-3	Hexachlorobutadiene	6.0	U
98-82-8	Isopropylbenzene	9.6	U
99-87-6	4-Isopropyltoluene	7.2	U

000102



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-12

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight

Lab Sample ID: 99-A10181
Date Sampled: 1/25/99
Date Received: 1/26/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
75-09-2	Methylene chloride	2.4	U
91-20-3	Naphthalene	2.4	U
103-65-1	n-Propylbenzene	2.4	U
100-42-5	Styrene	2.4	U
630-20-6	1, 1, 1, 2-Tetrachloroethane	3.6	U
79-34-5	1, 1, 2, 2-Tetrachloroethane	2.4	U
127-18-4	Tetrachloroethene	8.4	U
108-88-3	Toluene	6.0	U
87-61-6	1, 2, 3-Trichlorobenzene	2.4	U
120-82-1	1, 2, 4-Trichlorobenzene	2.4	U
71-55-6	1, 1, 1-Trichloroethane	4.8	U
79-00-5	1, 1, 2-Trichloroethane	6.0	U
79-01-6	Trichloroethene	12.0	U
96-18-4	1, 2, 3-Trichloropropane	24.1	U
95-63-6	1, 2, 4-Trimethylbenzene	8.4	U
108-67-8	1, 3, 5-Trimethylbenzene	3.6	U
75-01-4	Vinyl chloride	10.8	U
75-27-4	Bromodichloromethane	4.8	U
6615	o-Xylene	6.0	U
6616	m,p-Xylene	3.6	U
75-69-4	Trichlorofluoromethane	4.8	U

000103



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

EQUIPMENT RINSATE

Matrix: Water
pH:
Units: ug/l
Dilution Factor: 1.
Analysis Method: SWS260B
Delivery Group: 128680
Instrument:

Lab Sample ID: 99-A10177
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 18:47
Sample QC Group: 5698

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
144-10-5	1-Chlorohexane	2.5	U
71-43-2	Benzene	0.4	U
108-86-1	Bromobenzene	0.3	U
74-97-5	Bromochloromethane	0.4	U
75-25-2	Bromoform	1.2	U
74-83-9	Bromomethane	1.1	U
104-51-8	n-Butylbenzene	1.1	U
135-98-8	sec-Butylbenzene	1.3	U
98-06-6	t-Butylbenzene	1.4	U
56-23-5	Carbon tetrachloride	2.1	U
108-90-7	Chlorobenzene	0.4	U
75-00-3	Chloroethane	1.0	U
67-66-3	Chloroform	1.9	U
74-87-3	Chloromethane	1.3	U
95-49-8	2-Chlorotoluene	0.4	U
106-43-4	4-Chlorotoluene	0.6	U
96-12-8	1,2-Dibromo-3-chloropropane	2.6	U
124-48-1	Dibromochloromethane	0.5	U
106-93-4	1,2-Dibromoethane	0.6	U
74-95-3	Dibromomethane	2.4	U
95-50-1	1,2-Dichlorobenzene	0.3	U
541-73-1	1,3-Dichlorobenzene	1.2	U
106-46-7	1,4-Dichlorobenzene	0.3	U
75-71-8	Dichlorodifluoromethane	1.0	U
75-34-3	1,1-Dichloroethane	0.4	U
107-06-2	1,2-Dichloroethane	0.6	U
75-35-4	1,1-Dichloroethene	1.2	U
156-59-2	cis-1,2-Dichloroethene	1.2	U
156-60-5	trans-1,2-Dichloroethene	0.6	U
78-87-5	1,2-Dichloropropane	0.4	U
142-28-9	1,3-Dichloropropane	0.4	U
594-20-7	2,2-Dichloropropane	3.5	U
563-58-6	1,1-Dichloropropene	1.0	U
10061-01-5	cis-1,3-Dichloropropene	1.0	U
10061-02-6	trans-1,3-Dichloropropene	1.0	U
100-41-4	Ethylbenzene	0.6	U
87-68-3	Hexachlorobutadiene	1.1	U
98-82-8	Isopropylbenzene	0.5	U
99-87-6	4-Isopropyltoluene	1.2	U

000009



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

EQUIPMENT RINSATE

Matrix: Water
pH:
Units: ug/l

Lab Sample ID: 99-A10177
Date Sampled: 1/25/99
Date Received: 1/26/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
75-09-2	Methylene chloride	0.3	U
91-20-3	Naphthalene	0.4	U
103-65-1	n-Propylbenzene	0.4	U
100-42-5	Styrene	0.4	U
630-20-6	1,1,1,2-Tetrachloroethane	0.5	U
79-34-5	1,1,2,2-Tetrachloroethane	0.4	U
127-18-4	Tetrachloroethene	1.4	U
108-88-3	Toluene	1.1	U
87-61-6	1,2,3-Trichlorobenzene	0.3	U
120-82-1	1,2,4-Trichlorobenzene	0.4	U
71-55-6	1,1,1-Trichloroethane	0.8	U
79-00-5	1,1,2-Trichloroethane	1.0	U
79-01-6	Trichloroethene	1.0	U
96-18-4	1,2,3-Trichloropropane	3.2	U
95-63-6	1,2,4-Trimethylbenzene	1.3	U
108-67-8	1,3,5-Trimethylbenzene	0.5	U
75-01-4	Vinyl chloride	1.1	U
75-27-4	Bromodichloromethane	0.8	U
95-47-6	o-Xylene	1.1	U
108-38-3	m, p-Xylene	0.5	U
75-69-4	Trichlorofluoromethane	0.8	U

000010



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

TRIP BLANK

Matrix: Water
pH:
Units: ug/l
Dilution Factor: 1.
Analysis Method: SW8260B
Delivery Group: 128680
Instrument:

Lab Sample ID: 99-A10178
Date Sampled:
Date Received: 1/26/99
Analysis Date: 1/29/99
Analysis Time: 19:24
Sample QC Group: 5698

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
144-10-5	1-Chlorohexane	2.5	U
71-43-2	Benzene	0.4	U
108-86-1	Bromobenzene	0.3	U
74-97-5	Bromochloromethane	0.4	U
75-25-2	Bromoform	1.2	U
74-83-9	Bromomethane	1.1	U
104-51-8	n-Butylbenzene	1.1	U
135-98-8	sec-Butylbenzene	1.3	U
98-06-6	t-Butylbenzene	1.4	U
56-23-5	Carbon tetrachloride	2.1	U
108-90-7	Chlorobenzene	0.4	U
75-00-3	Chloroethane	1.0	U
67-66-3	Chloroform	1.0	U
74-87-3	Chloromethane	1.3	U
95-49-8	2-Chlorotoluene	0.4	U
106-43-4	4-Chlorotoluene	0.6	U
96-12-8	1,2-Dibromo-3-chloropropane	2.6	U
124-48-1	Dibromochloromethane	0.5	U
106-93-4	1,2-Dibromoethane	0.6	U
74-95-3	Dibromomethane	2.4	U
95-50-1	1,2-Dichlorobenzene	0.3	U
541-73-1	1,3-Dichlorobenzene	1.2	U
106-46-7	1,4-Dichlorobenzene	0.3	U
75-71-8	Dichlorodifluoromethane	1.0	U
75-34-3	1,1-Dichloroethane	0.4	U
107-06-2	1,2-Dichloroethane	0.6	U
75-35-4	1,1-Dichloroethene	1.2	U
156-59-2	cis-1,2-Dichloroethene	1.2	U
156-60-5	trans-1,2-Dichloroethene	0.6	U
78-87-5	1,2-Dichloropropane	0.4	U
142-28-9	1,3-Dichloropropane	0.4	U
594-20-7	2,2-Dichloropropane	3.5	U
563-58-6	1,1-Dichloropropene	1.0	U
10061-01-5	cis-1,3-Dichloropropene	1.0	U
10061-02-6	trans-1,3-Dichloropropene	1.0	U
100-41-4	Ethylbenzene	0.6	U
87-68-3	Hexachlorobutadiene	1.1	U
98-82-8	Isopropylbenzene	0.5	U
99-87-6	4-Isopropyltoluene	1.2	U

000011



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

TRIP BLANK

Matrix: Water

pH:

Units: ug/l

Lab Sample ID: 99-A10178

Date Sampled::

Date Received: 1/26/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
75-09-2	Methylene chloride	0.3	U
91-20-3	Naphthalene	0.4	U
103-65-1	n-Propylbenzene	0.4	U
100-42-5	Styrene	0.4	U
630-20-6	1,1,1,2-Tetrachloroethane	0.5	U
79-34-5	1,1,2,2-Tetrachloroethane	0.4	U
127-18-4	Tetrachloroethene	1.4	U
108-88-3	Toluene	1.1	U
87-61-6	1,2,3-Trichlorobenzene	0.3	U
120-82-1	1,2,4-Trichlorobenzene	0.4	U
71-55-6	1,1,1-Trichloroethane	0.8	U
79-00-5	1,1,2-Trichloroethane	1.0	U
79-01-6	Trichloroethene	1.0	U
96-18-4	1,2,3-Trichloropropane	3.2	U
95-63-6	1,2,4-Trimethylbenzene	1.3	U
108-67-8	1,3,5-Trimethylbenzene	0.5	U
75-01-4	Vinyl chloride	1.1	U
75-27-4	Bromodichloromethane	0.8	U
95-47-6	o-Xylene	1.1	U
108-38-3	m,p-Xylene	0.5	U
75-69-4	Trichlorofluoromethane	0.8	U

000012

SEMIVOLATILE ORGANICS - PAH

SUMMARY DATA

000302



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-1

Matrix: Soil
% Dry Weight: 88.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8310
Delivery Group: 128680
Instrument:
Grams Extracted: 30.0 g
Extract Vol: 1.00 ml

Lab Sample ID: 99-A10185
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 2/ 6/99
Analysis Time: 2:14
Sample QC Group: 7951
Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
.....	Naphthalene	38	.... U
.....	Acenaphthene	38	.... U
.....	Anthracene	25	.... U
.....	Fluoranthene	8	.... U
.....	Fluorene	8	.... U
.....	Pyrene	10	.... U
.....	Benzo(a)anthracene	4.9	.... U
.....	Benzo(a)pyrene	3	.... U
.....	Benzo(b)fluoranthene	7	.... U
.....	Benzo(k)fluoranthene	7	.... U
.....	Chrysene	6	.... U
.....	Dibenzo(a, h)anthracene	11	.... U
.....	Indeno(1, 2, 3-cd)pyrene	16	.... U
.....	Acenaphthylene	76	.... U
.....	Benzo(g, h, i)perylene	28	.... U
.....	Phenanthrene	24	.... U

000309



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-2

Matrix: Soil
% Dry Weight: 78.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8310
Delivery Group: 128680
Instrument:
Grams Extracted: 30.0 g
Extract Vol: 1.00 ml

Lab Sample ID: 99-A10184
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 2/ 6/99
Analysis Time: 0:59
Sample QC Group: 7951

Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
.....	Naphthalene	42	.... U
.....	Acenaphthene	42	.... U
.....	Anthracene	28	.... U
.....	Fluoranthene	9	.... U
.....	Fluorene	9	.... U
.....	Pyrene	12	.... U
.....	Benzo(a)anthracene	5.5	.... U
.....	Benzo(a)pyrene	4	.... U
.....	Benzo(b)fluoranthene	8	.... U
.....	Benzo(k)fluoranthene	8	.... U
.....	Chrysene	6	.... U
.....	Dibenzo(a,h)anthracene	13	.... U
.....	Indeno(1,2,3-cd)pyrene	18	.... U
.....	Acenaphthylene	86	.... U
.....	Benzo(g,h,i)perylene	32	.... U
.....	Phenanthrene	27	.... U

000308



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CE-3

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8310
Delivery Group: 128680
Instrument:
Grams Extracted: 30.0 g
Extract Vol: 1.00 ml

Lab Sample ID: 99-A10186
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 2/ 6/99
Analysis Time: 2:51
Sample GC Group: 7951

Extraction Data: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
.....	Naphthalene	40	.... U
.....	Acenaphthene	40	.... U
.....	Anthracene	27	.... U
.....	Fluoranthene	8	.... U
.....	Fluorene	8	.... U
.....	Pyrene	11	.... U
.....	Benzo(a)anthracene	5.2	.... U
.....	Benzo(a)pyrene	4	.... U
.....	Benzo(b)fluoranthene	7	.... U
.....	Benzo(k)fluoranthene	7	.... U
.....	Chrysene	6	.... U
.....	Dibenzo(a,h)anthracene	12	.... U
.....	Indeno(1,2,3-cd)pyrene	17	.... U
.....	Acenaphthylene	81	.... U
.....	Benzo(g,h,i)perylene	30	.... U
.....	Phenanthrene	25	.... U

000310



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-4

Matrix: Soil
% Dry Weight: 90.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8310
Delivery Group: 128680
Instrument:
Grams Extracted: 30.0 g
Extract Vol: 1.00 ml

Lab Sample ID: 99-A10187
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 2/ 6/99
Analysis Time: 3:28
Sample QC Group: 7951
Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
.....	Naphthalene	37	.... U
.....	Acenaphthene	37	.... U
.....	Anthracene	24	.... U
.....	Fluoranthene	8	.... U
.....	Fluorene	8	.... U
.....	Pyrene	10	.... U
.....	Benzo(a)anthracene	4.8	.... U
.....	Benzo(a)pyrene	3	.... U
.....	Benzo(b)fluoranthene	7	.... U
.....	Benzo(k)fluoranthene	7	.... U
.....	Chrysene	6	.... U
.....	Dibenzo(a, h)anthracene	11	.... U
.....	Indeno(1, 2, 3-cd)pyrene	16	.... U
.....	Acenaphthylene	74	.... U
.....	Benzo(g, h, i)perylene	28	.... U
.....	Phenanthrene	23	.... U

000311



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CE-5

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8310
Delivery Group: 128680
Instrument:
Grams Extracted: 30.0 g
Extract Vol: 1.00 ml

Lab Sample ID: 99-A10183
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 2/ 6/99
Analysis Time: 0:21
Sample QC Group: 7951
Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
.....	Naphthalene	40	.... U
.....	Acenaphthene	40	.... U
.....	Anthracene	27	.... U
.....	Fluoranthene	14	....
.....	Fluorene	8	.... U
.....	Pyrene	11	.... U
.....	Benzo(a)anthracene	5.2	.... U
.....	Benzo(a)pyrene	11	....
.....	Benzo(b)fluoranthene	7	.... U
.....	Benzo(k)fluoranthene	7	.... U
.....	Chrysene	6	.... U
.....	Dibenzo(a,h)anthracene	12	.... U
.....	Indeno(1,2,3-cd)pyrene	17	.... U
.....	Acenaphthylene	81	.... U
.....	Benzo(g,h,i)perylene	30	.... U
.....	Phenanthrene	25	.... U

000307



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-6

Matrix: Soil
% Dry Weight: 87.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8310
Delivery Group: 128680
Instrument:
Grams Extracted: 30.0 g
Extract Vol: 1.00 ml

Lab Sample ID: 99-A10182
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 2/ 5/99
Analysis Time: 23:44
Sample QC Group: 7951
Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
.....	Naphthalene	348	....
.....	Acenaphthene	38	.... U
.....	Anthracene	25	.... U
.....	Fluoranthene	15	....
.....	Fluorene	8	.... U
.....	Pyrene	10	.... U
.....	Benzo(a)anthracene	4.9	.... U
.....	Benzo(a)pyrene	8	....
.....	Benzo(b)fluoranthene	8	....
.....	Benzo(k)fluoranthene	7	.... U
.....	Chrysene	6	.... U
.....	Dibenzo(a,h)anthracene	11	.... U
.....	Indeno(1,2,3-cd)pyrene	16	.... U
.....	Acenaphthylene	77	.... U
.....	Benzo(g,h,i)perylene	29	.... U
.....	Phenanthrene	24	.... U

000306



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-7

Matrix: Soil
% Dry Weight: 85.
Units: ug/kg dry weight
Dilution Factor: 5.
Analysis Method: SWS310
Delivery Group: 128680
Instrument:
Grams Extracted: 30.0 g
Extract Vol: 1.00 ml

Lab Sample ID: 99-A10191
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 2/ 6/99
Analysis Time: 9:37
Sample QC Group: 7951

Extraction Date:

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
.....	Naphthalene	585	.... J
.....	Acenaphthene	7060	.... U
.....	Anthracene	2590	.... U
.....	Fluoranthene	824	.... U
.....	Fluorene	824	.... U
.....	Pyrene	1060	.... U
.....	Benzo(a)anthracene	52.9	.... U
.....	Benzo(a)pyrene	88	.... U
.....	Benzo(b)fluoranthene	71	.... U
.....	Benzo(k)fluoranthene	65	.... U
.....	Chrysene	588	.... U
.....	Dibenzo(a, h)anthracene	118	.... U
.....	Indeno(1, 2, 3-cd)pyrene	176	.... U
.....	Acenaphthylene	9060	.... U
.....	Benzo(g, h, i)perylene	294	.... U
.....	Phenanthrene	2470	.... U

000317



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-D2

Matrix: Soil
% Dry Weight: 82.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8310
Delivery Group: 128680
Instrument:
Grams Extracted: 30.0 g
Extract Vol: 1.00 ml

Lab Sample ID: 99-A10192
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 2/ 6/99
Analysis Time: 6:35
Sample QC Group: 7951
Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
.....	Naphthalene	40	.... U
.....	Acenaphthene	40	.... U
.....	Anthracene	27	.... U
.....	Fluoranthene	9	.... U
.....	Fluorene	9	.... U
.....	Pyrene	11	.... U
.....	Benzo(a)anthracene	5.2	.... U
.....	Benzo(a)pyrene	4	.... U
.....	Benzo(b)fluoranthene	7	.... U
.....	Benzo(k)fluoranthene	7	.... U
.....	Chrysene	6	.... U
.....	Dibenzo(a,h)anthracene	12	.... U
.....	Indeno(1,2,3-cd)pyrene	17	.... U
.....	Acenaphthylene	82	.... U
.....	Benzo(g,h,i)perylene	30	.... U
.....	Phenanthrene	26	.... U

000318



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-8

Matrix: Soil
% Dry Weight: 85.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SWS310
Delivery Group: 128680
Instrument:
Grams Extracted: 30.0 g
Extract Vol: 1.00 ml

Lab Sample ID: 99-A10189
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 2/ 6/99
Analysis Time: 4:43
Sample QC Group: 7951

Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
.....	Naphthalene	39	.... U
.....	Acenaphthene	39	.... U
.....	Anthracene	26	.... U
.....	Fluoranthene	8	.... U
.....	Fluorene	8	.... U
.....	Pyrene	11	.... U
.....	Benzo(a)anthracene	5.1	.... U
.....	Benzo(a)pyrene	4	.... U
.....	Benzo(b)fluoranthene	7	.... U
.....	Benzo(k)fluoranthene	7	.... U
.....	Chrysene	6	.... U
.....	Dibenzo(a,h)anthracene	12	.... U
.....	Indeno(1,2,3-cd)pyrene	16	.... U
.....	Acenaphthylene	79	.... U
.....	Benzo(g,h,i)perylene	29	.... U
.....	Phenanthrene	25	.... U

000314



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CE-D1

Matrix: Soil
% Dry Weight: 85.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8310
Delivery Group: 128680
Instrument:
Grams Extracted: 30.0 g
Extract Vol: 1.00 ml

Lab Sample ID: 99-A10190
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 2/ 6/99
Analysis Time: 5:20
Sample QC Group: 7951

Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
.....	Naphthalene	100	....
.....	Acenaphthene	39	.... U
.....	Anthracene	26	.... U
.....	Fluoranthene	8	.... U
.....	Fluorene	9	....
.....	Pyrene	11	.... U
.....	Benzo(a)anthracene	5.1	.... U
.....	Benzo(a)pyrene	4	.... U
.....	Benzo(b)fluoranthene	7	.... U
.....	Benzo(k)fluoranthene	7	.... U
.....	Chrysene	6	.... U
.....	Dibenzo(a,h)anthracene	12	.... U
.....	Indeno(1,2,3-cd)pyrene	16	.... U
.....	Acenaphthylene	79	.... U
.....	Benzo(g,h,i)perylene	29	.... U
.....	Phenanthrene	25	.... U

000315



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-9

Matrix: Soil
% Dry Weight: 26.
Units: ug/kg dry weight
Dilution Factor: 10.
Analysis Method: SW8310
Delivery Group: 128680
Instrument:
Grams Extracted: 30.0 g
Extract Vol: 1.00 ml

Lab Sample ID: 99-A10189
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 2/ 6/99
Analysis Time: 7:50
Sample QC Group: 7951
Extraction Date:

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
.....	Naphthalene	14000	.... U
.....	Acenaphthene	14000	.... U
.....	Anthracene	5120	.... U
.....	Fluoranthene	655	.... J
.....	Fluorene	1630	.... U
.....	Pyrene	279	.... J
.....	Benzo(a)anthracene	198	....
.....	Benzo(a)pyrene	310	....
.....	Benzo(b)fluoranthene	271	....
.....	Benzo(k)fluoranthene	148	....
.....	Chrysene	279	.... J
.....	Dibenzo(a,h)anthracene	233	.... U
.....	Indeno(1,2,3-cd)pyrene	224	.... J
.....	Acenaphthylene	17900	.... U
.....	Benzo(g,h,i)perylene	221	.... J
.....	Phenanthrene	66	.... J

090313



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CE-10

Matrix: Soil
% Dry Weight: 86.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8310
Delivery Group: 128680
Instrument:
Grams Extracted: 30.0 g
Extract Vol: 1.00 ml

Lab Sample ID: 99-A10180
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 2/ 5/99
Analysis Time: 22:29
Sample QC Group: 7951
Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
.....	Naphthalene	38	.... U
.....	Acenaphthene	38	.... U
.....	Anthracene	26	.... U
.....	Fluoranthene	8	.... U
.....	Fluorene	8	.... U
.....	Pyrene	10	.... U
.....	Benzo(a)anthracene	5	.... U
.....	Benzo(a)pyrene	3	.... U
.....	Benzo(b)fluoranthene	7	.... U
.....	Benzo(k)fluoranthene	7	.... U
.....	Chrysene	6	.... U
.....	Dibenzo(a,h)anthracene	12	.... U
.....	Indeno(1,2,3-cd)pyrene	16	.... U
.....	Acenaphthylene	78	.... U
.....	Benzo(g,h,i)perylene	29	.... U
.....	Phenanthrene	24	.... U

000304



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-11

Matrix: Soil
% Dry Weight: 79.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8310
Delivery Group: 128680
Instrument:
Grams Extracted: 30.0 g
Extract Vol: 1.00 ml

Lab Sample ID: 99-A10179
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 2/ 5/99
Analysis Time: 21:52
Sample QC Group: 7951
Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
.....	Naphthalene	42	.... U
.....	Acenaphthene	42	.... U
.....	Anthracene	28	.... U
.....	Fluoranthene	9	.... U
.....	Fluorene	9	.... U
.....	Pyrene	11	.... U
.....	Benzo(a)anthracene	5.4	.... U
.....	Benzo(a)pyrene	4	.... U
.....	Benzo(b)fluoranthene	8	.... U
.....	Benzo(k)fluoranthene	8	.... U
.....	Chrysene	6	.... U
.....	Dibenzo(a, h)anthracene	13	.... U
.....	Indeno(1, 2, 3-cd)pyrene	18	.... U
.....	Acenaphthylene	85	.... U
.....	Benzo(g, h, i)perylene	32	.... U
.....	Phenanthrene	27	.... U

000303



SPECIALIZED ASSAYS, INC.

2960 Foster Creighton Dr.
P.O. Box 40566
Nashville, TN 37204-0566
Phone 1-615-726-0177

Sample Identification

CB-12

Matrix: Soil
% Dry Weight: 83.
Units: ug/kg dry weight
Dilution Factor: 1.
Analysis Method: SW8310
Delivery Group: 128680
Instrument:
Grams Extracted: 30.0 g
Extract Vol: 1.00 ml

Lab Sample ID: 99-A10181
Date Sampled: 1/25/99
Date Received: 1/26/99
Analysis Date: 2/ 5/99
Analysis Time: 23:07
Sample QC Group: 7951
Extraction Date: 1/28/99

FORM I

CAS NUMBER	ANALYTE	CONCENTRATION	FLAG
.....	Naphthalene	40	.... U
.....	Acenaphthene	40	.... U
.....	Anthracene	27	.... U
.....	Fluoranthene	8	.... U
.....	Fluorene	8	.... U
.....	Pyrene	11	.... U
.....	Benzo(a)anthracene	5.2	.... U
.....	Benzo(a)pyrene	4	.... U
.....	Benzo(b)fluoranthene	7	.... U
.....	Benzo(k)fluoranthene	7	.... U
.....	Chrysene	6	.... U
.....	Dibenzo(a,h)anthracene	12	.... U
.....	Indeno(1,2,3-cd)pyrene	17	.... U
.....	Acenaphthylene	81	.... U
.....	Benzo(g,h,i)perylene	30	.... U
.....	Phenanthrene	25	.... U

000305