HAFB04

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August 29, 2006

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New Mexico Environment Department
Hazardous Waste Bureau
Permits Management Program
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303

Attention: Mr. John E. Kieling
Program Manager

Subject: SS-61 Voluntary Corrective Measures Work Plan, Holloman Air Force Base, New Mexico

Dear Mr. Kieling,

Bhate Environmental Associates, Inc. (Bhate) is pleased to submit the above referenced document for your review and comment.

If you have any questions, please feel free to call me at 303-815-1762.

Sincerely,
Bhate Environmental Associates, Inc.

Frank Gardner, PG
Program Manager

Cc w/ enclosure:

Cornelius Amindyas (NMED HWB)
James Harris (US EPA Region 6)

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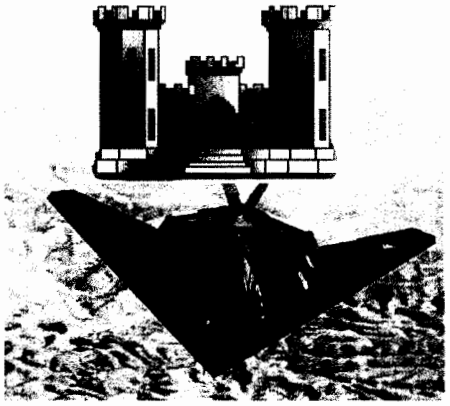
VOLUNTARY CORRECTIVE MEASURES WORK PLAN
SITE SS-61 SOIL REMEDIATION
HOLLOMAN AFB, NEW MEXICO



Holloman Air Force Base
New Mexico

August 2006

Contract No.: DACA45-03-D-0023
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Headquarters, Air Combat Command
Langley Air Force Base, Virginia

49 CES/CEV
Holloman Air Force Base, New Mexico

FINAL VOLUNTARY CORRECTIVE MEASURES WORK PLAN SITE SS-61 SOIL REMEDIATION HOLLOMAN AFB, NEW MEXICO

Prepared for:

49 CES/CEV
Holloman Air Force Base
New Mexico

Under Contract To:

U.S. Army Corps of Engineers
Omaha District
Omaha, Nebraska

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Task Order No. 021

August 2006

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FINAL VOLUNTARY CORRECTIVE MEASURES WORK PLAN SS-61 SOIL REMEDIATION HOLLOMAN AFB, NEW MEXICO

REVIEW SHEET

This Work Plan has been reviewed and approved by:

John Hymer Site Manager	Signature	Date
Jim Moore, P.G. Project Manager	Signature	Date
Frank Gardner, P.G. Program Manager	Signature	Date

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FINAL VOLUNTARY CORRECTIVE MEASURES WORK PLAN SS-61 SOIL REMEDIATION HOLLOMAN AFB, NEW MEXICO

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Appendix E SiteLAB® UVF-3100 Operating Manual, 2006

Appendix F *NMED TPH Screening Guidelines,* November 2005

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Appendix J NMED *Technical Background Document for Development of Soil Screening Levels*, *Revision 4.0*, Appendix A, June 2006

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ACRONYMS AND ABBREVIATIONS

AAF	Army Air Field
AFB	Air Force Base
AFCESA	Air Force Civil Engineer Support Agency
AF Fm	Air Force Form
amsl	Above mean sea level
ANSI	American National Standards Institute
AOC	Area of Concern
AST	Aboveground storage tank
ASTM	American Society for Testing and Materials
bgs	Below ground surface
Bhate	Bhate Environmental Associates, Inc.
BTEX	Benzene, toluene, ethylbenzene, and xylenes
CES/CEV	Civil Engineering Squadron/Environmental Flight
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
COC	Chain-of-custody
COPCs	Chemicals of potential concern
COR	Contracting Officer's Representative
CSM	Conceptual site model
CRZ	Contamination reduction zone
cu yds	Cubic yards
DCA	1,2-Dichloroethane
DO	Dissolved oxygen
DPT	Direct push technology
DQO	Data quality objective
DRO	Diesel range organics
EMI	Electromagnetic induction
ERP	Environmental Restoration Program
ERPIMS	Environmental Restoration Program Information Management System
EZ	Exclusion zone
°F	Degrees Fahrenheit
FID	Flame ionization detector
ft	Feet
ft/ft	Foot per foot
FWENC	Foster Wheeler Environmental Corporation
GC	Gas chromatogram
GPS	Global positioning system
GRO	Gasoline range organics
GTI	Groundwater Technology Government Services, Inc.
HAFB	Holloman Air Force Base
HASP	Health and Safety Plan

ACRONYMS AND ABBREVIATIONS (CONTINUED)

HSA	Hollow stem auger
IDW	Investigation-Derived Waste
IRP	Installation Restoration Program
ISEA	International Safety Equipment Association
JP-4	Jet propulsion fuel, Type 4
ln ft	Linear feet
µg	Micrograms
µg/kg	Micrograms per kilogram
µg/L	Micrograms per liter
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
mL	Milliliter
MNA	Monitored natural attenuation
MS	Matrix spike
MSD	Matrix spike duplicate
NAD	North American Datum
NAVFAC	Naval Facilities Engineering Command
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
NOD	Notice of Deficiency
ORO	Oil range organics
ORP	Oxidation reduction potential
OSHA	Occupational Safety and Health Administration
OVA	Organic vapor analyzer
PCS	Petroleum contaminated soil
P.G.	Professional Geologist
PID	Photo ionization detector
PPE	Personal protective equipment
ppm	Parts per million
PVC	Polyvinyl chloride
QA	Quality assurance
QC	Quality control
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RI	Remedial Investigation
SS-61	Spill Site 61
SSHO	Site Safety and Health Officer
SSL	Soil screening level
SOP	Standard Operating Procedure

ACRONYMS AND ABBREVIATIONS (CONTINUED)

SVOC	Semi-volatile organic compound
SWMU	Solid Waste Management Unit
SWPPP	Storm Water Pollution Prevention Plan
SZ	Support zone
TCLP	Toxicity Characteristic Leaching Procedure
TCE	Trichloroethylene
TDS	Total dissolved solids
TNT	2,4,6-Trinitrotoluene
TPH	Total petroleum hydrocarbons
TRPH	Total recoverable petroleum hydrocarbons
UFGS	Unified Facilities Guide Specifications
USCS	Unified Soil Classification System
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UVF	Ultra violet flourometer
VCMs	Voluntary Corrective Measures
VOC	Volatile organic compound
WRCC	Western Regional Climate Center
WSMR	White Sands Missile Range
WWTP	Wastewater Treatment Plant

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1 INTRODUCTION

Bhate Environmental Associates, Inc., (Bhate) has been retained by the U.S. Army Corps of Engineers (USACE), under contract DACA45-03-D-0023, Task Order No. 021, to conduct Voluntary Corrective Measures (VCMs) at several of the Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) at Holloman Air Force Base (HAFB), New Mexico. This document is to provide a work plan that will serve as the primary working document for the additional investigation and excavation activities of the petroleum contaminated soil (PCS) located at Spill Site 61 (SS-61). The PCS source area is believed to be associated with an abandoned east-west trending underground fuel pipeline that connected two concrete vaults with a former aboveground storage tank (AST) system and/or an adjacent debris pile. The pipeline, concrete vaults, former AST system, and debris pile are located on the north side of a large concrete pad that is approximately 100 feet (ft) west of Building 1072. This VCM Work Plan provides the relevant site specific information and requirements as outlined in the two Notice of Deficiencies (NODs) issued by the New Mexico Environment Department (NMED) in January 2006 (Attachment A) for remedial activities at SS-61.

The objective of the additional characterization is to fill in the data gaps to completely identify and define the presumed PCS source area. Once the source area has been delineated, the primary objective of this VCM is to remove, through excavation, and properly dispose the PCS associated with the east-west trending pipeline that runs through the site to the former AST system. Groundwater conditions surrounding the SS-61 PCS source area will also be evaluated in this VCM Work Plan. During this process, required data will be collected to support a SS-61 risk based evaluation based on guidance from the NMED. The ultimate objective is to achieve approval for site closure from NMED. It should be noted that groundwater and soil contaminated with trichloroethylene (TCE) associated with the nearby new Environmental Restoration Program (ERP) Site SS-73 (this site is located to the east-southeast of SS61-MW02) will be evaluated under a separate Work Plan.

This document has been written to provide relevant information on the geologic, hydrologic, and other environmental conditions for HAFB and at the site and the procedures by which this VCM will be completed. Information is provided for the entire Base and its surrounding environ as well as SS-61, specifically. This VCM calls for the removal of all PCS (above the NMED soil screening levels) at the site through excavation with verification of complete removal via confirmation sampling from the excavation.

1.1 Base and Site Description

HAFB is situated in south central New Mexico, in the northwest central part of Otero County, approximately 75 miles north-north-east of El Paso, Texas (Figure 1-1). HAFB has a population of 6,000 and occupies about 50,000 acres in the northeast quarter of Section 1, Township 17 South, Range 8 East. The White Sands Missile Range testing facilities occupy additional land extending northward from the Base. Private and public owned lands border the remainder of

HAFB. The major highway servicing HAFB is Highway 70, which runs southwest from the town of Alamogordo and separates HAFB from publicly owned lands to the south. Alamogordo which has a population of approximately 35,000 is located approximately 7 miles east of the base.

1.1.1 Holloman Air Force Base

HAFB was first established in 1942 as Alamogordo Army Air Field (AAF). From 1942 through 1945, Alamogordo AAF served as the training grounds for over 20 different flight groups, flying primarily B-17s, B-24s, and B-29s. After World War II, most operations had ceased at the base. In 1947, Air Material Command announced the air field would be its primary site for the testing and development of un-manned aircraft, guided missiles, and other research programs. On January 13, 1948, the Alamogordo installation was renamed Holloman Air Force Base, in honor of the late Col. George V. Holloman; a pioneer in guided missile research. In 1968, the 49th Tactical Fighter Wing arrived at HAFB and has remained since. Today, HAFB also serves as the training center for the German Air Force's Tactical Training Center.

1.1.2 Spill Site 61

SS-61 is located in an industrial area in the central part of HAFB (Figure 1-2). The site is located north of two hangars, Buildings 1079 and 1080, and is divided into two study sections by DeZonia Drive (Figure 1-3). The northern section of the site consists of a concrete pad, located southeast of Building 1001 and immediately west of Building 1072, which may have been used for dispensing fuel. Northwest of this pad was a debris pile that covered approximately 1,500 square feet. The pile contained concrete pieces, asphalt rubble, and some piping. Northeast of the concrete pad and debris pile were two ASTs that have been removed. The ground surface rises approximately 10 feet toward the former AST area. A partial outline of the containment berm in the area of the former northern AST is still visible. The circular berm is approximately 180 feet in diameter, rising approximately 8 feet above grade, and approximately 10 feet wide at the base. No remnant of a berm is visible for the former southern AST. An 8-inch diameter steel pipe emerging from the ground at a 45° angle, oriented north to south is located within the former southern AST area. The steel pipe has been capped with a steel plate and eight 1-inch bolts. The underground piping was traced to an apparent T-junction located 400 feet south of the southern AST area. A geophysical survey conducted during the 1999 Phase I Remedial Investigation (RI), traced one branch of the main north-south pipeline west from the T-junction to an area directly north of the concrete pad to two concrete vaults (Foster Wheeler, 1999). Based on the results of the geophysical survey it is assumed that the pipeline is buried 4-6 feet below ground surface. The location of the east-west trending pipeline that is connected to the two concrete vaults and a former AST system (presumed SS-61 PCS source area) is shown on Figure 1-4. The other piping branch runs south toward the hangar area (Building 1079).

The historic southern portion of SS-61, south of DeZonia Drive, consists of two hangars, Building 1079 and Building 1080 (Figure 1-3). South of the hangars is the tarmac. The eastern hangar, Building 1080, is the newer of the two buildings. The western hangar, Building 1079,

dates to the 1940s. A concrete sump is located outside the northwest entrance to the hangar (Building 1079). A shallow surface depression, approximately 100 ft x 70 ft by 3 ft deep, is located in the north parking lot to Building 1079. It was used as a stormwater collection basin. A geophysical survey conducted during the Phase II RI (Foster Wheeler, 1999), traced the main north-south trending pipeline from the T-junction (described above) to the south underneath Building 1087 and past the southeast corner of the western hanger (Building 1079) toward the tarmac.

1.2 Physiography and Topography

Holloman AFB is located within the Sacramento Mountains Physiographic Province on the western edge of the Sacramento Mountains. HAFB is approximately 59,600 acres in area, and is located at a mean elevation of 4,093 feet above mean sea level (amsl). The region is characterized by high tablelands with rolling summit plains; cuesta-formed mountains dipping eastward and of west-facing escarpments with the wide bracketed basin forming the basin and range complex. The Base is located in the Tularosa Sub-basin which is part of the Central Closed Basins. The bordering mountains rise abruptly to altitudes of 7,000 to 12,000 feet amsl. The San Andres Mountains bound the basin to the west (about 30 miles) with the Sacramento Mountains approximately 10 miles to the east (Figure 1-1). At its widest, the basin is about 60 miles east to west and stretches approximately 150 miles north to south.

SS-61 and the surrounding area are relatively flat with a gentle southwest slope. The area is bounded to the west by SWMU 104 (LF-29) and to the south by Building 1001. The eastern edge of the site is unbounded by physical features. The primary vegetation is salt cedar, sage brush and grasses with occasional bush vegetation. The boundary with the former Army Landfill (LF-29) is defined by a three-foot high earthen berm. A debris pile approximately 100 feet in diameter and composed of construction rubble is located southwest of well MW-29-05.

1.3 Surface Water and Hydrology

The Tularosa Basin contains all of the surface flow in its boundaries. The nearest inflow of surface waters to the Base comes from the Lost River, located in the north-central region of the Base. The upper reaches of the Three Rivers and the Sacramento River are perennial in the basin. HAFB is dissected by several southwest trending arroyos that control the surface drainage. Hay Draw arroyo is located in the far north. Malone and Rita's Draw, which drain into the Lost River and Dillard Draw arroyos, are located along the eastern perimeter of the Base. Approximately 10,000 years ago, indications are of a much wetter climate. The present day Lake Otero encompassed a much larger area, possibly upwards of several hundred square miles. Its remains are the Alkali Flat and Lake Lucero. Lake Lucero is a temporary feature of merely a few inches in depth during the rainy season.

Ancient lakes and streams deposited water bearing deposits over the older bedrock basement material. Fractures, cracks, and fissures in the Permian and Pennsylvanian bedrock yield small

quantities of relatively good quality water in the deeper peripheral. Potable water is only found from wells near the edges of the basin with more saline water towards the center. Two of the principal sources of potable water are a long narrow area on the upslope sides of Tularosa and Alamogordo with the other in the far southwestern part of the basin. A portion of Alamogordo's water, as well as the Base's, is supplied from Lake Bonito (which is in the Pecos River Basin).

1.4 Geology

1.4.1 Regional Geology

The sedimentary rocks which make up the adjacent mountain ranges are between 500 and 250 million years old (White Sands Missile Range (WSMR), 2003). During the period when the area was submerged under the shallow intra-continental sea, the layers of limestone, shale, gypsum, and sandstone were deposited. In time, these layers were pushed upward through various tectonic forces forming a large bulge on the surface. Approximately 10 million years ago the center began to subside resulting in a vertical drop of thousands of feet leaving the edges still standing (the present day Sacramento and San Andres mountain ranges). In the millions of years following, rainfall, snowmelt, and wind eroded the mountain sediments depositing them in the valley (i.e. Tularosa Basin). Water carrying eroded gypsum, limestone, dolomite, gravel, and other alluvial matter continues to flow into the basin with no route of exit.

The Tularosa Sub-basin is geologically described as a bolson, which is an extensive flat alluvium-floored depression, into which drainage from the surrounding mountains flows toward a central playa. The overlying alluvium generally consists of unconsolidated gravels (limestone, dolomite, and gypsum), sands, and clays. A fining sequence from the San Andreas and Sacramento Ranges towards the basin's center characterizes the area with the near surface soils as alluvial, eolian, and lacustrine deposits. The alluvial fan deposits are laterally discontinuous units of interbedded sand, silt, and clay while the eolian deposits consist primarily of gypsum sands. The eolian and alluvial deposits are usually indistinguishable due to the reworking of the alluvial sediment by eolian processes. The playa, or lacustrine deposits, consist of silty clay containing gypsum and are contiguous with the alluvial fan and eolian deposits.

Mesozoic rocks in the northwest mark the Colorado Plateau, topped by younger Tertiary strata. Quaternary age sediments have washed off the Southern Rockies into the open basins and the Rio Grande Rift, a failed spreading center or aulacogen. This would-be ocean basin runs up the center of the state with the Rio Grande flowing down its middle, exposing the Paleozoic and Precambrian rocks on its uplifted flanks. Later Cenozoic volcanic intrusions of Quaternary and Tertiary age are also associated with the rifting.

The great Permian Basin of Texas continues into the state from the southeast with younger Quaternary-Tertiary sediments of the Great Plains cover the whole eastern edge. Basin-and-range terrain of Tertiary sediments and volcanics appear in the extreme southwest coupled with wide dry basins choked with Quaternary coarse sediments eroded from the blocks of uplifted older rocks.

1.4.2 Site SS-61 Geology

Soil borings installed during the Phase I and II Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) (Foster Wheeler and Groundwater Technology Government Services, Inc. [GTI], 1997) are the most representative of the subsurface soil conditions at the site. The stratigraphy consists primarily of silty to clayey layers. Drilling logs compiled during the Phase II RFI indicate the subsurface to be 0 to 12 feet of silt and sand overlying clays and clayey sands from 12 to 24 feet. The clay layers are underlain with silty sand that contains occasional clay lenses to a depth of 30 feet (Foster Wheeler and GTI, 1996).

During both phases of the RFI, soil cores were examined and logged in accordance with the United Soil Classification System. Selected borehole logs from the presumed PCS source area are included in Appendix A. Soils underlying the site were mostly fine-grained silts, clays, and sands. From grade to approximately 14 feet, soils were predominantly dry silty sands and sandy silts. Gypsum cementation and crystals pervaded sand clay, clayey sand, and silty sand from approximately 14 feet to groundwater. The groundwater table occurs at approximately 14 to 30 feet below ground surface (bgs).

1.5 Hydrogeology

1.5.1 Regional Hydrogeology

The predominance of the groundwater occurs as an unconfined aquifer in the unconsolidated deposits of the central basin, with the primary source of recharge as rainfall percolation and minor amounts of stream run-off along the western edge of the Sacramento Mountains. Surface water/rainfall migrates downward into the alluvial sediments at the edge of the shallow aquifer near the ranges, and flows downgradient through progressively finer-grained sediments towards the central basin. Because the Tularosa Basin is a closed system, water that enters the area only leaves either through evaporation or percolation. This elevated amount of percolation results in a fairly high water table. Beneath HAFB, groundwater ranges from 5 to 50 feet. Flow for the Base is generally towards the southwest with localized influences from the variations in the topography of the Base. Near the arroyos, groundwater flows directly toward the surface drainage feature.

Groundwater quality in the Tularosa Basin is of potable quality at the recharge areas in close proximity to the Sacramento Mountains and becomes increasingly mineralized toward the central portion of the basin and discharge areas (Radian, 1993). The majority (over 70 %) of the ERP Sites / SWMUs / AOCs located across HAFB, have groundwater monitoring wells containing water with an average total dissolved solids (TDS) concentration greater than 10,000 milligrams per liter (mg/L). This TDS data supports the hypothesis that TDS concentrations below 10,000 mg/L at Holloman AFB are caused by dilution of natural groundwater from leaking water lines and surface irrigation from the domestic water supply. TDS concentrations greater than 10,000 mg/L exceed the New Mexico Water Quality Control Commission (NMWQCC) limit as potable

water and thus, the groundwater beneath HAFB has been designated as unfit for human consumption. Likewise, U.S. Environmental Protection Agency (USEPA) guidelines have identified the groundwater as a Class IIIB water source, characterized by TDS concentrations exceeding 10,000 mg/L.

In addition, there are no potable water wells on HAFB. Potable water for the base and the city of Alamogordo is derived from the nearby Sacramento Mountains. The only production water well, used for livestock irrigation, is located approximately 12 miles southwest of SS-61.

1.5.2 Site SS-61 Hydrogeology

During the Phase II RFI, groundwater elevations were measured at 15 locations across the site on June 5, 1997. Depth to water ranged from 14.22 feet at MWAOC-4 (SS61-MW04) to 30.69 feet below the top of casing at MWAOC-1 (SS61-MW01). Groundwater elevations and contour maps and well completion logs from the RI and RFI are included in Appendix A. Historically the local groundwater flow direction was generally toward the west-northwest, which is different than the general south-southwest flow direction for HAFB, at an average gradient of 0.003 foot per foot (ft/ft).

Recent water level data from June 2004 indicates that the localized groundwater flow direction is to the west-northwest (Figure 1-5) and the hydraulic gradient varies from approximately 0.0017 ft/ft to 0.002 ft/ft.

1.6 Climate

As a whole, New Mexico has a mild, arid to semi-arid continental climate characterized by light precipitation totals; abundant sunshine, relatively low humidity and relatively large annual and diurnal temperature range (Western Regional Climate Center [WRCC], 2003). The climate of the Central Closed Basins varies with elevation. The Base is found in the low areas and is characterized by warm temperatures and dry air. Daytime temperatures often exceed 100 degrees Fahrenheit (°F) in the summer months and middle 50s in the winter. A preponderance of clear skies and relatively low humidity permits rapid night time cooling resulting in average diurnal temperature ranges of 25 to 35°F. Potential evapotranspiration, at 67 inches per year, significantly exceeds annual precipitation, usually less than 10 inches. The very low rainfall amounts resulting in the arid conditions, which with the topographically induced wind patterns combining with the sparse vegetation, tend to cause localized "dust devils". Much of the precipitation falls during the mid-summer monsoonal period (July and August) as brief, yet frequent, intense thunderstorms culminating to 30 – 40% of the annual total rainfall.

1.7 Water Use

HAFB is located in the Tularosa Sub-basin. Potable water is available from municipal wells along the margins of the basin with more saline water towards the center. The principle sources of potable water are located in a long narrow north-south trending area east of Alamogordo and

Tularosa and in the far southern part of the basin. HAFB is also supplied potable water from Lake Bonito, which is in the Pecos River Basin.

Within the boundaries of SS-61, storm water run-off is controlled by the minimal topographic relief as per the existing grade and landscaping. Appurtenances can be found along the perimeter for collection into the Base storm water drainage system.

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2 HISTORICAL DATA REVIEW AND CONCEPTUAL SITE MODEL

This section presents an overview of the previous investigations and the preliminary conceptual site model for SS-61. Since 1996, Spill Site 61 has been the subject of a series of environmental investigations related to evaluating the soil and groundwater conditions to determine the source of volatile organic compounds (VOCs) contamination detected in groundwater monitoring well MW-29-05. This section provides a historical overview and chronology of the previous investigations conducted at SS-61 and AOC-1001 from 1996 through 2005.

Contamination was initially detected in the vicinity of SS-61 (AOC-1001) during the Phase II RFI Table 1 Investigation that was conducted at nearby SWMU 104, the Former Army Landfill (Radian, 1995). This SWMU is also known as Installation Restoration Program (IRP) Site LF-29. During the Phase II Table 1 RFI, four additional groundwater monitoring wells (MW-29-05 through MW-29-08) were installed and a complete round of groundwater sampling and analysis was conducted at LF-29 (8 groundwater monitoring wells). Upgradient well MW-29-05 contained benzene at 3,100 micrograms per liter [µg/L], 1,2-dichloroethane (1,2-DCA) at 350 µg/L, 2,4,6-trinitrotoluene (TNT) at 0.23 µg/L, and 1,3,5-trinitrobenzene at 2.6 µg/L. Since the source of the upgradient contamination was expected to be to the southeast of the well (MW-29-05) and to the east of Building 1001, AOC-1001 was identified. Phase I and II RFIs were conducted at AOC 1001 during 1996 and 1997. As a result of the RFI, the area previously referred to as AOC-1001 was designated as IRP site SS-61 in December 1997 (Foster Wheeler, 2000).

The chronology of previous investigations at the site, based on reports reviewed is outlined below. Boring logs and sampling locations for these previous RFI and RI investigations are included in Appendix A of this report.

- Phase I RCRA Facility Investigation, Site AOC-1001, 1996 (Foster Wheeler and Groundwater Technology, Inc.)
- Phase II RCRA Facility Investigation, Site AOC-1001, 1997 (Foster Wheeler and Groundwater Technology, Inc.)
- Phase I Remedial Investigation for Spill Site 61, 1999 (Foster Wheeler)
- Phase II Remedial Investigation for SS-61 – Spill Site 61, 2000 (Foster Wheeler)
- Monitored Natural Attenuation for SS-61 (AOC-1001), 2005 (Bhate Associates)

2.1 Phase I and Phase II RFI

GTI was contracted by Foster Wheeler Environmental Corporation (FWENC) to conduct a RFI of AOC-1001 at HAFB. The purpose of the characterization was to determine the source and if possible, extent of VOC contamination detected in monitoring well MW-29-05 (LF-29/SWMU 104) during the Phase II Table 1 Investigation (Radian, 1995). The AOC-1001 RFI was conducted in two phases. The first phase (Phase I) field activities were conducted from May to June 1996. Phase II activities were conducted from May to June 1997 (Foster Wheeler and GTI, 1997). The following two sections present the findings from the Phase I and II RFI.

2.1.1 Phase I RFI at AOC-1001

The following section presents AOC-1001 information taken from the *Draft Final Phase I and II RCRA Facility Investigation Report, Site AOC-1001, Holloman AFB, NM* (Foster Wheeler and GTI, 1997). The Phase I scope of the RFI included the following field activities in the area upgradient of well MW-29-05:

- A passive soil vapor survey which included 49 sample points (Gore-Sorbers™) were installed 3 feet below ground surface with a 50-foot spacing. The intent of the soil vapor survey was to identify "target" areas for soil and groundwater sample collection. The soil vapor samples were analyzed for VOCs, semi-volatile organic compounds (SVOCs), and explosives.

- Based upon the results of the soil vapor survey, 10 soil borings (DP-01 through DP-10) were installed and soil and groundwater samples were collected for chemical analysis using Direct Push Technology (DPT). These sampling locations were all upgradient or crossgradient of monitoring well MW-29-05. Three soil samples and one groundwater sample from each DPT boring were selected for chemical analysis. The soil and groundwater samples were analyzed for VOCs and explosives.

A trace of toluene (0.80 micrograms [μg]) and total xylenes (0.32 μg) was detected in one soil vapor sample collected on the northwest side of the northern bermed area. No SVOCs or explosives were detected above the method reporting limits in any of the soil vapor samples.

Methylene chloride was detected in the soil samples collected from borings DP-09A and DP-10 at concentrations ranging from 10 to 17 micrograms per kilogram (μg/kg). No other VOCs were detected in the soil samples. The soil sample collected from DP-08 from 15 to 18 ft bgs contained two explosives, tetryl at 1,000 μg/kg and TNT at 1,000 μg/kg.

Benzene was detected in groundwater samples collected from 7 of the 10 DPT borings. Benzene concentrations in these seven borings ranged from 80 μg/L (DP-09A) to 7,200 μg/L in DP-02. Ethylbenzene (890 μg/L) was detected in DP-02 and xylene was detected in DP-02 (13 μg/L), DP-03 (31 μg/L), and DP-06 (18 μg/L). Concentrations of 1,2-DCA were also detected in

groundwater samples collected from DP-05 (140 µg/L) and DP-09A (18 µg/L). No other VOCs and explosives were detected in the groundwater samples collected during the Phase I RFI.

The analytical results and sample locations for the soil vapor, subsurface soil, and groundwater samples collected during the Phase I RFI are included in Appendix A.

2.1.2 Phase II RFI at AOC-1001

The following section presents AOC-1001 information taken from the *Draft Final Phase I and II RCRA Facility Investigation Report, Site AOC-1001, Holloman AFB, NM* (Foster Wheeler and GTI, 1997). The Phase II RFI included the following field activities in the area south of the bermed areas and east of Building 1001, and east of SWMU 104:

- Collection of soil and groundwater samples with a DPT rig with onsite sample analysis using a mobile laboratory. Fourteen soil borings (DP-11 through DP-20) and DP-22 through DP-25) were installed to delineate a benzene, toluene, ethylbenzene, and xylenes (BTEX) source northeast of Building 1001. Soil samples were collected from 9 of the 14 DPT boreholes and analyzed for VOCs by the mobile laboratory. Groundwater sampling was conducted by installing and sampling 14 DPT well points. Twenty percent of the samples were split and analyzed for VOCs by a fixed-base laboratory.

- Installation and sampling of four new monitoring wells in critical areas identified through DPT sampling to better define groundwater quality and flow direction. One existing well, MW-29-05, was also sampled. Additionally, four soil samples were collected during the installation of the four monitoring wells (MWAOC-1 through MWAOC-4). All groundwater and soil samples collected from these locations were analyzed for VOCs.

- Installation and gauging of four piezometers (PZ-01 through PZ-04) to better characterize groundwater elevation and flow direction across the entire site.

Nine soil samples collected from the DPT boreholes were analyzed onsite for specific halogenated hydrocarbons and BTEX. Total BTEX was detected in two samples AOC-1001-DP-22 (11 to 12 ft bgs) and AOC-1001-DP-23 (17 to 20 ft bgs) with concentrations of 37.97 and 0.43 mg/kg respectively. No other VOCs were detected in the soil samples analyzed by the mobile laboratory. Six DPT soil samples were analyzed by the fixed-base lab for halogenated hydrocarbons and BTEX. Benzene (3.2 µg/kg) was detected in the 20- to 22-foot sample collected from MWAOC-2. The soil sample collected from MWAOC-3 at 18-20 ft bgs contained 446.4 µg/kg total BTEX and 37 µg/kg 1, 2-DCA. No other VOCs were detected in the soil samples analyzed by the fixed-base lab.

A total of 17 groundwater samples (including 3 duplicates) were obtained from 14 DPT points. Eleven DPT samples were analyzed by the onsite mobile laboratory. Six samples were analyzed offsite by a fixed-base laboratory. BTEX constituents associated with gasoline hydrocarbons

were detected in 14 of 17 DPT groundwater samples. Benzene was detected in 14 groundwater samples and ranged in concentration from 2.8 µg/L (DP-15) to 8,640 µg/L (DP-22). Ethylbenzene was detected at six DPT locations, ranging from 40 µg/L (DP-17) to 523 µg/L (DP-22). Toluene was detected in four DPT groundwater samples, and ranged from 460 µg/L (DP-23) to 3,620 µg/L (DP-22). Total xylenes concentrations were detected at eight locations, ranging from 4.9 µg/L (DP-13) to 3,800 µg/L (DP-24).

VOCs not associated with gasoline hydrocarbons were detected in up to 13 DPT well point locations sampled during Phase II. 1,2-DCA was detected in 15 of the 17 Phase II groundwater DPT samples including 2 duplicates and ranged from 3.8 µg/L (DP-15) to 315 µg/L (DP-17). TCE was the only other VOC detected in groundwater samples collected from DP-15 (5.6 µg/L) and DP-20 (14 µg/L). The groundwater sample from DP-16 was also analyzed for gasoline, diesel and oil. Only gasoline was detected in the groundwater collected from DP-16 with a concentration of 41,000 µg/L.

The off-site laboratory analyzed groundwater samples from six of the DPT well points for explosives. Explosives were detected only in the groundwater sample from DP-22 where four compounds were detected at levels ranging from 1.6 µg/L to 35 µg/L.

Six groundwater samples (including one duplicate) were collected from five monitoring wells at the site and analyzed for VOCs. Benzene was detected in all wells except MWAOC-1 at concentrations ranging from 0.43 µg/L (MWAOC-2) to 11,000 µg/L (MWAOC-3). Maximum total BTEX concentrations (19,165 µg/L) were detected in MWAOC-3. 1,2-DCA was also detected in all wells except MWAOC-1; levels ranged from 1.8 µg/L (MWAOC-2) to 940 µg/L (MWAOC-3). Trichloroethene was detected in MWAOC-2 (45 µg/L) and MWAOC-3 (1.8 µg/L). Low levels of various other VOCs were detected in the samples from all wells except MWAOC-1.

The analytical results and sample locations for the subsurface soil and groundwater samples collected during the Phase II RFI are included in Appendix A. Results from soil sampling during the Phase I and II RFI field activities in 1996 and 1997 indicated detections of BTEX and 1,2-DCA. Groundwater contaminants detected during these investigations included BTEX; 1,2-DCA; and TCE. The results of these investigations indicated possible soil contamination in the area of the concrete pad and a broad groundwater contaminant plume extending downward form the concrete pad, cross-gradient to the east and northeast and possibly upgradient.

The Phase I and II RFI Report recommended additional investigations in the debris mound and in the area of sample location DP-22 to determine if a potential source (such as drums or tanks) for the elevated BTEX and 1,2-DCA levels was present. The report also recommended that two monitoring wells be installed across Dezonia Drive, where the 46th Test Group is located, to delineate the impacted area to the south.

2.2 Remedial Investigation (Phase I)

The following section presents SS-61 (AOC-1001) information taken from the *Final Remedial Investigation Report for Spill Site 61, Holloman AFB, NM* (Foster Wheeler, 1999). The Phase I Remedial Investigation area included two former ASTs, underground piping, a debris pile, and a concrete pad that may have been a fuel dispensing area located north of DeZonia Drive. Historical operations information on this area is limited because part of the area was used for classified operations conducted by Strategic Air Command. Aerial photographs indicated that operations at the concrete pad and ASTs began after 1945 and had ended by 1972. The Phase I Remedial Investigation was performed in March and April 1999 and included the following field activities in the area north of DeZonia Drive:

- Conducted electromagnetic induction (EMI) geophysical survey (200 x 250 ft) immediately north of DeZonia Drive and east of Building 1072 to delineate potential sources of contamination in the northern part of the site such as underground storage tanks, metallic pipes, and buried debris.

- Seven subsurface soil samples, including one duplicate, were collected from three DPT locations (DP-30 through DP-32) and analyzed offsite for VOCs and total recoverable petroleum hydrocarbons (TRPH).

- Eight surface soil (0 to 0.5 ft bgs) samples (SS61-SS01 through SS61-SS06) including one duplicate and one sediment sample (SS61-SD01) were collected and analyzed for VOCs and TRPH.

- One soil sample (SS61-TP01) was collected at a depth of 13 ft through excavation of a test pit on the north side of the western vault and analyzed for VOCs and TRPH.

- Installation and sampling of two new monitoring wells (SS61-MW05 and SS61-MW06) to evaluate the water quality upgradient of SS-61.

- Sampling eight existing groundwater monitoring wells in the area associated with SS-61 and SWMU 104. Note: Groundwater monitoring wells MWAOC-1 through MWAOC-4 installed during the Phase II RFI were renamed SS61-MW01 through SS61-MW04 for the Phase I RI.

- Twenty four groundwater samples (including 2 duplicates) were collected from 12 DPT locations (DP-26 through DP-37) and from 10 monitoring wells (SS61-MW01 through SS61-MW04 and MW-29-02, -03, -05 and -06) and analyzed for VOCs.

The EMI geophysical survey identified several anomalies that were the result of underground pipelines and the vaults in the vicinity of the concrete pad. The most noticeable anomalies were related to two vertical pipes located in the middle of the large concrete pad that are connected by underground pipes to two concrete vaults. Another underground pipe appears to enter the area

from the east (from the main north-south trending pipeline) and extends west across the survey area to the two concrete vaults. A map showing the Channel 2 EMI response for the Phase I geophysical survey is included in Appendix A.

TRPH was detected in 11 of the 17 soil samples collected during the RI (including 1 duplicate). Of the 11 soil samples containing TRPH, six were collected from surface soil and sediment locations in the vicinity of the concrete pad. Surface soil and sediment TRPH concentrations ranged from 23 to 270 milligrams per kilogram (mg/kg). TRPH was also detected in four subsurface soil samples and one duplicate sample in the unsaturated zone at concentrations ranging from 54 to 99 mg/kg from the samples collected from the test pit and DP-30. TRPH was also detected in the saturated zone (14 -16 ft bgs) in DP-31 at a concentration of 250 mg/kg. VOCs were detected in only one soil sample collected from 16 to 18 ft bgs at DP-30, and like the TRPH, are associated with contaminated groundwater. The VOCs detected in the soil sample from DP-30 are associated with gasoline hydrocarbons, and the only BTEX compound detected was ethylbenzene (630 µg/kg). Benzene was not detected in any soil samples collected during the Phase I RI.

VOCs were detected in groundwater samples collected from all 12 DPT locations and 8 monitoring wells sampled during the Phase I RI. BTEX compounds were detected in groundwater across the site as far south as DP-35 and downgradient of the concrete pad in the groundwater sampled at MW-29-05. Benzene was the contaminant most frequently detected and occurred at the highest concentrations of all of the BTEX compounds at levels ranging from 7 µg/L (SS61-MW02) to 19,000 µg/L (DP-33). Toluene, ethylbenzene, and xylenes were also detected in the groundwater at SS-61. Besides BTEX, other VOCs detected in groundwater include 1,2-dibromoethane; 1,2-dichlorobenzene; isopropylbenzene; n-propylbenzene; sec-butylbenzene; tert-butylbenzene; and trimethylbenzene isomers. VOCs not related to gasoline detected in groundwater during the Phase I RI include 1,2-DCA, trichloroethene, and chloroform. The source of these low level VOCs may be upgradient in the area of the hangars.

The analytical results and sample locations for the surface soil, sediment, subsurface soil, and groundwater samples collected during the Phase I RI are included in Appendix A. The *Remedial Investigation Report for Spill Site 61* (Foster Wheeler, 1999) recommended annual groundwater sampling in four wells (SS61-MW03, SS61-MW04, SS61-MW06, and upgradient well SS61-MW05) in the vicinity of the concrete pad. The report also recommended continued monitoring in wells MW-29-03, MW-29-05, and SS61-MW02 for VOCs to track contaminant levels for a five year period. In addition, a Phase II RI was recommended to delineate contamination and identify a potential additional source area to the south of the previously investigated part of SS-61.

2.3 Phase II Remedial Investigation

The following section presents SS-61 information taken from the *Final Phase II Remedial Investigation Report for SS-61- Spill Site 61, Holloman AFB, NM* (Foster Wheeler, 2000). The area investigated during the Phase II RI was the southern portion of the site, which includes two

aircraft hangars, and additional contaminant sources that were suspected based on the results of the Phase I RI. The Phase II Remedial Investigation was performed in March through June 2000 and included the following field activities:

- Conducted interviews with site personnel familiar with the past operations in and around Buildings 1079 and 1080. Reviewed as-built drawings to identify potential sources.
- Conducted EMI geophysical survey (400 x 450 ft) immediately north and east of Building 1079 to delineate an extension of the pipeline that extends from the former ASTs northeast of Buildings 1079 and 1080.
- Performed initial DPT soil and groundwater sampling at 10 locations (DP-38 through DP-47) for selecting potential source locations for further characterization.
- Selected remaining 10 DPT soil and groundwater sampling locations (DP-48 through DP-57) to complete the characterization of areas upgradient and crossgradient of Buildings 1079 and 1080.
- Nine shallow soil samples (1 to 2 ft bgs) were collected from eight locations (DP-39, DP-40, DP-43, DP-44, DP-45, DP-46, DP-49, and DP-50) to determine where historical site activities may have directly impacted soil and to support the risk assessment.
- Installed six new groundwater monitoring wells (SS61-MW07 through SS61-MW12) in the vicinity of Buildings 1079 and 1080 and the underground pipeline.
- Collected groundwater samples from the six new monitoring wells, six existing wells in the vicinity of SS-61 (SS61-MW01 through SS61-MW06) and four wells associated with SWMU 104 (MW-29-02, MW-29-03, MW-29-05, and MW-29-06).

The EMI geophysical survey identified components of an underground pipeline extending from the former AST system in the northern portion of SS-61. Underground piping was traced form the former locations of two ASTs to the concrete pad north of DeZonia Drive, which was apparently once used to dispense fuel; and piping was also traced to the tarmac southeast of Building 1079. A map showing the Channel 2 EMI response for the Phase II geophysical survey is included in Appendix A.

A total of 40 soil samples were collected during the Phase II RI to determine the nature and extent of fuel contamination in the soil and groundwater in the southern portion of SS-61. The soil samples were analyzed for VOCs and TRPH. TRPH was detected at four of the 20 DPT locations. TRPH was detected in DP-39 and DP-40 in the 1- to 2-ft interval at concentrations of 260- and 7,800 mg/kg, respectively. At DP-41 TRPH was detected in the 8- to 9-ft interval at a concentration of 210 mg/kg. TRPH was also detected at DP-44 in the 11- to 12-ft interval with a concentration of 46 mg/kg.

Several VOCs were detected in one sample collected at 21 to 22 ft bgs from DP-43: benzene (2,800 µg/kg), ethylbenzene, isopropylbenzene, n-propylbenzene, toluene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, o-xylene, and m-xylene. This sample was collected from groundwater-saturated soil at the capillary fringe. Ispropylbenzene was also detected in DP-49 in the 15- to 16-ft interval at a concentration of 1,100 µg/kg. Styrene occurred as an isolated detection at DP-49 at 11.5 to 12.5 ft bgs at a concentration of 1,400 µg/kg. No other VOCs were detected in the soil samples collected during the Phase II RI.

A total of 36 groundwater samples were collected during the Phase II from the 20 DPT points and 16 monitoring wells. These groundwater samples were analyzed for VOCs and total petroleum hydrocarbons (TPH) as Jet Propulsion Fuel, Type 4 (JP-4). JP-4 was detected in groundwater locations at nine DPT locations. Concentrations ranged from 530 to 60,000 µg/L. JP-4 contamination was concentrated around Building 1079. JP-4 was also detected in three samples collected from monitoring wells SS61-MW03, SS61-MW04, and SS61-MW06 that are located in the vicinity of the concrete pad north of DeZonia Drive. Concentrations of JP-4 in these wells ranged form 650 to 2,500 µg/L.

VOCs were detected in nine groundwater samples collected from DPT locations and 11 samples collected from monitoring wells. The most commonly detected VOC was benzene, which was detected in 10 groundwater samples ranging in concentration from 0.86 to 13,000 µg/L. Isopropylbenzene was detected in nine groundwater samples, ranging in concentration from 7.8 to 5,600 µg/L. Most of the DPT groundwater samples had sporadic detections of VOCs, with the exception of DP-43 and DP-49. Nine VOCs were detected in the groundwater at DP-43 and 10 VOCs were detected in DP-49. In the southern portion of SS-61 benzene was detected in four samples collected from DP-39 located south of Building 1079, and DP-43, DP-49, and DP-50, all located on the south side of DeZonia Drive, northwest of Building 1079.

The highest levels of VOCs in groundwater were detected in monitoring wells SS61-MW03, SS61-MW04, and SS61-MW06 which are all located north of DeZonia Drive in the vicinity of the concrete pad. Gasoline fuel-related VOCs detected in all three samples included benzene, ethylbenzene, isopropylbenzene, toluene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, and m-xylene. 1,2-Dichlorobenzene and p-xylenes were also detected at SS61-MW03. Sec-butylbenzene, tert-butylbenzene, 1,2-dichlorobenzene, 2-hexanone, n-propylbenzene, styrene, and o-xylene were additional VOCs detected in SS61-MW04. Additional VOCs detected at SS61-MW06 included sec-butylbenzene, naphthalene, n-propylbenzene, and o-xylene.

VOCs consisting of chlorinated solvents (chloroform, 1,1-dichloroethane, 1,2-DCA, and TCE) not related to gasoline were detected at low levels at the site. These chlorinated solvents were detected in samples collected from DPT locations on the east side of SS-61 in the vicinity of the eastern hangar, Building 1080.

The analytical results and sample locations for the shallow soil, subsurface soil, and groundwater samples collected during the Phase II RI are included in Appendix A. Based on the comparison of maximum contaminant concentrations detected to action levels for soil and groundwater the

Final Phase II Remedial Investigation Report for SS-61 – Spill Site 61 (Foster Wheeler, 1999), determined that no further action was needed to protect human health or the environment in the southern portion of SS-61.

2.4 Monitored Natural Attenuation at SS-61 (AOC-1001)

The following section presents the sampling results and field parameter measurements that were collected to assess the status of natural attenuation at SS-61. The following section presents SS-61 information taken from the *Monitored Natural Attenuation Report for SS-61 (AOC-1001), Holloman AFB, NM* (Bhate, 2005).

As defined by the USEPA, Natural Attenuation is the physical, chemical, and biological processes that, under favorable conditions, act to reduce the mass, toxicity, mobility, volume, or concentrations of contaminants in soil and groundwater (USEPA, September 1998). The processes that affect natural attenuation include advection, dispersion, sorption, volatilization, and biodegradation of contaminants.

Selected monitoring wells located at SS-61 were sampled quarterly for one year. The sampling activities and results to support monitored natural attenuation (MNA) for the site are presented below. Monitoring wells included in the sampling scheme were:

- The three monitoring wells located inside the plume: SS61-MW03, SS61-MW04, and SS61-MW06.
- A monitoring well located outside the plume area to provide background information: SS61-MW01.
- A monitoring well located downgradient/side gradient on the periphery of the plume: SS61-MW08.
- Quarterly sampling was conducted for these monitoring wells in April 2004, June 2004, September 2004, and December 2004/January 2005. Prior to sampling a round of groundwater level measurements were collected from the monitoring wells sampled.
- Groundwater samples collected from the five monitoring wells were analyzed by an offsite laboratory for VOCs, TDS, methane, ethane, ethane, chloride, nitrate/nitrite, sulfate, total organic carbon, and alkalinity.
- Groundwater samples were also analyzed in the field at the time of collection for temperature, pH, dissolved oxygen (DO), specific conductance, oxidation reduction potential (ORP), and ferrous iron.

The ranges of BTEX concentrations detected in the groundwater samples collected during the MNA investigation are as follows:

- BTEX constituents were below detection limits in the samples collected from monitoring well MW-01.

- Concentrations of BTEX constituents in samples collected from monitoring well MW-03 during the monitoring period showed an increasing trend when compared to historical data. Specifically:

  - Benzene concentrations in samples from MW-03 varied between 7,180 µg/L in April 2004 to 16,900 µg/L in January 2005.

  - Toluene concentrations in samples from monitoring well MW-03 varied between 734 µg/L in April 2004 to 4,060 µg/L in January 2005.

  - Ethylbenzene concentrations in samples collected from MW-03 varied between below laboratory detection limits (April 2004) to 309 µg/L (January 2005).

  - Total xylenes concentrations in samples from monitoring well MW-03 varied between 1,870 µg/L in April 2004 to 4,370 µg/L in January 2005.

  - Monitoring well MW-03 was monitored weekly for the presence of free product using an interface probe from April to July 2004. Free product was not encountered during these monitoring events (Appendix A).

- No BTEX constituents were detected in any of the samples collected from monitoring well MW-04 with the exception of one. The sample collected in September 2004 had a benzene concentration of 1.5 µg/L.

A summary of the laboratory analytical results and natural attenuation parameters data including the quarterly groundwater elevations and potentiometric maps are presented in Appendix A. The *Monitored Natural Attenuation Report for SS-61 (AOC-1001) Holloman AFB, NM* (Bhate, 2005) concluded that BTEX is being actively degraded at SS-61.

2.5 Conceptual Site Model

The previous sections have presented a detailed history of the environmental data collected at Site SS-61 and the surrounding areas. Other sites near SS-61 that have been investigated include AOC-1001, LF-29, and SS-73. AOC-1001 and LF-29 are to the west and northwest of the site, respectively. SS-73, a recently identified area with trichloroethylene groundwater contamination, is to the east (and upgradient) of the site. This section presents a preliminary conceptual site model (CSM), and identifies the data gaps for the site. A conceptual site model provides a convenient format to compile all the relevant data and provides an overall understanding of the site. The CSM provides a framework for the entire project, and, in particular, can help identify specific data needs. It is an important communication tool for regulators, responsible parties, and stakeholders.

SS-61 is rectangular in shape and occupies approximately three acres in the north-central industrial area of HAFB. Aircraft maintenance activities have been ongoing in the area for over 50 years, and future activities are expected to remain the same. Currently, two structures, Building 1072 and 1087, are located within SS-61 site boundary (Figure 1-3). A fenced area containing spare/unused equipment and materials is located north of Building 1072. Additionally, a concrete pad and two concrete vaults, historically used to dispense fuel during past operations at the base, are located in the western half of the site.

The base is serviced by a public water supply. Groundwater at the site and across the base is not used as a drinking water source due to high concentrations of TDS, which generally exceed the drinking water standard of 10,000 mg/L, except in localized areas. Occurrence of TDS concentrations below 10,000 mg/L is primarily due to anthropogenic activities including irrigation and leaks from water pipes.

The subsurface soils beneath SS-61 are primarily comprised of silty sand with some interdispersed layers of clay and silty clay. Static groundwater levels at SS-61 are between 14 and 21 feet below ground surface. Groundwater flow is towards the west and northwest with a hydraulic gradient of between 0.0017 and 0.002 ft/ft.

2.5.1 Summary of Previous Investigative Data

Previous Investigative activities conducted at SS-61 and the surrounding areas were described in Sections 2.1 through 2.4. The following data was collected within the boundaries of the site SS-61 source area:

- Surficial soil analytical data from eight soil borings (SS61-SS01 through SS61-SS06, DP-30, and SS61-SD01)
- Subsurface soil analytical data from seven DPT borings (DP-22 through DP-24, DP-30, DP-31, DP-32, and TP-01) and two monitoring well borings (SS61-MW03 and SS61-MW04)
- Four DPT borings (DP-26, DP-27, DP-33, and DP-35) and two monitoring well borings (SS61-MW04 and SS61-MW05) were not sampled but were screened with a Photo Ionization Detector
- Groundwater analytical data for the SS-61 source area is available from 11 DPT borings (DP-19, DP-22 through DP-24, DP-26, DP-27, DP-30 through DP-33, and DP-35) and 4 monitoring wells (SS61-MW03, SS61-MW04, SS61-MW05, and SS61-MW06)

Soil and groundwater analytical data is also available from numerous DPT borings and monitoring wells located around and north of the site. Chemicals of concern in soil and groundwater include BTEX and 1,2-DCA. One historical use for 1,2-DCA was as an anti-knock additive in aviation fuel products.

2.5.2 Distribution of Chemicals in Soil

None of the eight surficial soil samples (0-5 ft bgs) showed detections for BTEX or 1,2-DCA. Of the nine subsurface soil borings, only DP-22 had detectable concentrations above the capillary fringe between 11 and 12 ft bgs. These detections are indicators of a surface source because they are above the capillary fringe and thus can not be attributed to groundwater impacts. All other DPT borings and monitoring well borings were non-detect for BTEX and 1,2-DCA when sampled above the capillary fringe. Additionally, borings that were not sampled but were field screened with an organic vapor analyzer (OVA) all had very low or non-detect concentrations above the capillary fringe.

2.5.3 Distribution of Chemicals in Groundwater

The highest on-site BTEX detections in groundwater have been in monitoring wells SS61-MW03, SS61-MW06, and DPT borings DP-30, DP-32, and DP-33. Groundwater impacts extend north of the site towards SWMU 104 (Former Army Landfill, LF-29) as indicated by numerous DPT borings between SS-61 and LF-29 and monitoring well MW-29-05. Monitoring wells west of the site, including MW-29-03, MW-29-04, and SS61-MW07, have historically been non-detect for BTEX and 1,2-DCA. It should be noted that these three wells, especially MW-29-03 and MW-29-04, are hydraulically downgradient from the site per flow direction. This appears to be in conflict with the primary direction of plume migration, as evidenced by analytical data that is towards the north-northwest.

2.5.4 Source of Contamination

The source area of soil and groundwater contamination has not been identified. Two potential on-site sources include: (i) an abandoned pipeline and (ii) an area of debris. The pipeline, originating from the location of two former ASTs (northwest of the site), runs north to south along the eastern part of the site. A branch of the pipeline runs west across the site and connects with two concrete vaults. A rectangular area (approximately 80 x 120 ft) of debris is located between SS61-MW03 and DP-22 immediately north of the east-west trending pipeline and the two concrete vaults (Figure 1-3)

Based on the above, following are the data gaps that need to be filled to complete the CSM:

1. Soil and groundwater analytical data to identify sources, and

2. Geotechnical parameters to perform a risk assessment.

An overview of the proposed data collection activities are presented in the following sections.

2.5.5 Source Area Characterization

2.5.5.1 Abandoned Pipeline

It is assumed that the abandoned pipeline is buried approximately 4 to 6 feet below ground surface, and that use of the pipe was discontinued in the 1970s. It is not known whether the pipe was clean closed or closed-in-place. In order to locate historical leaks, soil borings will be advanced approximately every 50 linear feet along the pipeline. At each boring, the following activities will be performed:

1. Each boring will be drilled to 10 to 15 ft bgs.
2. Continuous OVA readings will be collected during each soil boring.
3. If the OVA (flame ionization detector [FID]) reading is less than 50 ppm, no soil samples will be collected for offsite analysis.
4. If the OVA reading is greater than 50 ppm, (i) a soil sample will be collected from the interval with the highest OVA reading between the ground surface and the water table, (ii) drilling will continue to the water table, (iii) OVA readings will continue until readings are less than 50 ppm, and (iv) one soil sample will be collected in the capillary fringe
5. All pipeline subsurface soil samples will be analyzed for VOCs, SVOCs, TPH, and RCRA 8 metals.

2.5.5.2 Debris Pile

A debris pile is located north of the concrete pad where the former AST system was located. Subsurface soil samples collected from the boreholes drilled in and around the debris pile will be collected using the same criteria as outlined above for the pipeline area. Subsurface soil samples will be analyzed for VOCs, SVOCs, TPH, and RCRA 8 metals.

2.5.5.3 Geotechnical Data Acquisition

Additionally, six soil samples will be collected for geotechnical analysis for the site-specific analysis of risk. Soil samples selected for geotechnical analysis will be analyzed for moisture content, dry bulk density, specific gravity and fractional organic carbon content. A complete discussion of chemical and geochemical subsurface soil sampling including sampling locations and analytical parameters is presented in Section 3.2 of this Work Plan.

2.5.6 Data Evaluation

Subsequent to the collection of the additional chemical and geotechnical data and PCS soil removal, a risk-based evaluation will be performed to ensure that the risks to future receptors are acceptable at SS-61. The risk based evaluation will be presented in the Site SS-61 Closeout Report.

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3 ADDITIONAL INVESTIGATION ACTIVITIES

The primary objective of the additional investigation component of this VCM Work Plan is to collect sufficient subsurface soil data to delineate the presumed PCS source area located in the vicinity of the abandoned east-west underground pipeline associated with the former AST system, west of Building 1072. Groundwater conditions in the vicinity of the presumed SS-61 PCS source area will also be evaluated. A risk assessment to evaluate exposure pathways relative to current and future industrial/commercial workers and residents will be conducted after the investigation and excavation activities have been completed. A complete description of the risk evaluation process is presented in Section 6.3 of this Work Plan. The second component of this VCM is to remove, through excavation, and properly dispose the PCS (see Section 4 of this Work Plan).

The objectives of the SS-61 PCS source area investigation will be accomplished by collecting two subsurface soil samples from 15 DPT boreholes. The DPT boreholes will be drilled in the vicinity of the pipeline, concrete pad, and the former AST system (Figure 3-1). If PCS is detected by headspace analysis or visual observation, two soil samples will be collected from each borehole and analyzed at an offsite laboratory for VOCs, SVOCs, RCRA 8 metals, and TPH. Six undisturbed geotechnical samples will be collected from 3 of the 15 DPT boreholes and analyzed for moisture content, dry bulk density, specific gravity, and fractional organic carbon content. Groundwater samples will also be collected from each DPT borehole that encounters PCS (based on elevated OVA readings) or in boreholes that are downgradient and away from the pipeline (e.g., DP-66, and DP-70 through DP-72). In addition, groundwater conditions will be evaluated by installing two new groundwater monitoring wells downgradient of the source area (Figure 3-2). The two new wells along with selected wells from the existing groundwater monitoring well network will be sampled for VOCs, SVOCs, RCRA 8 metals, TPH, and TDS. Based on the existing groundwater monitoring wells installed at SS-61, it is anticipated that the new monitoring wells will be installed to a depth of 25 to 30 feet, which would be approximately 5 feet below the local water table (Foster Wheeler, 2000). Because the total area of disturbance is less than one acre, a project Storm Water Pollution Prevention Plan is not required.

During this investigation, the SS-61 PCS source area will be sufficiently mapped to scale with particular notation of the perimeter of the source area and ancillary structures, sampling locations, and existing monitoring wells and surveyed via Global Positioning System methods. This map shall show all buildings, roads, sidewalks, paved, and unpaved areas.

3.1 Pre-investigation Requirements

Before site activities can begin, there are several pre-investigation documents and approval requirements to be met, including Air Force Form (AF Fm) 332 approval, Base dig permit with utility clearances, site security measures, and facility manager notification of the intended operations. Bhate will coordinate project requests for Base installation support services through

the 49th Civil Engineering Squadron/Environmental Flight (CES/CEV). Pertinent to the start of activities, a pre-construction meeting and site walk-through will be conducted with the USACE Resident Engineer, HAFB personnel, and Bhate Site Manager, to inspect site conditions for site/equipment access, equipment staging, and decontamination area(s), potential site hazards, and emergency evacuation routes. Also reviewed at this time will be project procedures in accordance with the schedule and planned activities.

3.1.1 AF Form 332

Prior to initiating excavation activities a completed and approved AF Fm 332, will be obtained. This form authorizes construction work at HAFB and is required for the initiation of any construction work. This work order describes what activities will take place at the location.

3.1.2 Dig Permit/Utility Clearances

Prior to the submittal of the dig permit (AF Fm 103), the area of excavation will be clearly delineated with marker flags, stakes, or paint, as appropriate to the surface material. Utility clearance approvals will be completed by the appropriate HAFB utility office (e.g., telephone, sewer, water, natural gas etc.). Upon receipt of the approved dig permit (AF Form 103) with the utility clearances, the Bhate Site Manager or other authorized project personnel will complete a site walk-through confirming the dig permit authorizations and make any required changes.

3.1.3 Site Security

Site security is concerned with safety at the site during all drilling activities, and areas surrounding the drilling activity, and will be addressed as outlined in the *Basewide Health and Safety Plan* (HASP) (Bhate, 2003b). At a minimum the exclusion zone will be secured with caution tape, and traffic cones surrounding the perimeter of the site. The size of the exclusion zone will be determined by the size of the drilling and support equipment, and the prevailing site conditions. Open boreholes will not be left unattended without first securing the immediate area surrounding the borehole, and covering the opening so that it does not become a hazard.

3.2 Investigation Requirements

Field activities will be performed in accordance with the Site-Specific Addendum to the Basewide Health and Safety Plan, the Quality Assurance Project Plan (QAPP) Addendum (Appendices B and C, respectively), as well as other USACE mandated procedures for laboratories and activities such as groundwater sampling. The field work for this additional investigation will be conducted in accordance with HAFB Standard Operating Procedures (SOPs) provided in the *Basewide Quality Assurance Project Plan* (Bhate, 2003a) and the *Bhate Standard Operating Procedures* (Bhate, 2002). These SOPs outline methodologies for soil boring advancement, soil sampling, soil sample description, field screening, sample management, equipment decontamination, and chain-of-custody procedures. Sample

nomenclature will follow the Environmental Restoration Program Information Management System (ERPIMS) format. The specific HAFB SOPs for this sampling event are listed below:

HAFB SOP-1 Documentation, Sample Handling, Chain-of Custody, and Shipping

HAFB SOP-2 Sampling Equipment Documentation

HAFB SOP-3 Staking, Utility Clearance, and Permitting

HAFB SOP-4 Direct Push Sampling for Soil and Groundwater

HAFB SOP-5 Soil Sampling for Chemical Analysis

HAFB SOP-6 Procedure for Field Screening of Volatile Organics

HAFB SOP-7 Lithologic Description and Geotechnical Sampling

HAFB SOP-8 Groundwater Sampling for Chemical Analysis

HAFB SOP-9 Field Management of Investigation-Derived Waste

HAFB SOP-10 Borehole Abandonment and Site Restoration

The following sections describe the locations and procedures for DPT soil and groundwater sampling and the groundwater monitoring well installation, sampling, and analysis to be performed.

3.2.1 Laboratory Analytical Methods

The chemical analysis of soil and groundwater samples collected during this additional investigation at SS-61 will follow the USEPA SW-846 protocol. The soil and groundwater samples will be analyzed as follows:

- VOCs by USEPA Method 8260B
- SVOCs by USEPA Method 8270C
- TPH (Gasoline Range Organics [GRO], Diesel Range Organics [DRO], Oil Range Organics [ORO]) by modified USEPA Method 8015M
- RCRA 8 Metals (arsenic, barium, chromium, cadmium, lead, mercury, selenium, and silver) by USEPA Method 6010B/7470A

The groundwater samples collected from monitoring wells will also be analyzed for:

- TDS by USEPA Method 160.1

A total of 33 soil samples (based on 15 DPT boreholes/2 samples per borehole), including three field duplicate samples, and 37 groundwater samples including four duplicate samples will be submitted to the laboratory for analysis. All samples for VOC analysis will require a trip blank. The samples will be placed on ice and shipped under strict chain-of-custody to Accutest Laboratories in Orlando, Florida. Residual soil from the soil sampling will be discarded in accordance with the waste management procedures established in Section 3.4, Investigation-Derived Waste (IDW) Management.

3.2.2 DPT Soil Sampling

Soil samples will be collected continuously from soil borings using DPT methodology in accordance with HAFB SOP No. 4. Each boring will be visually classified and lithology described in the field according to HAFB SOP No. 7 and the Unified Soil Classification System (USCS) (American Society for Testing and Materials [ASTM] D 2487-92 and ASTM D 2488-90). The specific locations of the borings may be modified based on site-specific (access, any observed or underground utilities, etc.) field conditions.

Fifteen DPT soil borings (DP-58 to DP-72) will be completed at the locations shown in Figure 3-1. In order to determine the boundaries of the PCS source area(s) associated with the pipeline and/or debris pile it may be necessary to relocate and/or add a few additional DPT soil boring locations during the investigation. Samples will be collected continuously at four foot intervals. Soils will be field screened in accordance with HAFB SOP No. 6 using an OVA with soil-headspace screening techniques at two foot intervals. Notation will also be made of any visual (discoloration) and/or aromatic observations that are indicative of potential contamination.

A qualified surveyor will locate the DPT boreholes using a global positioning system (GPS). All horizontal coordinates will be referenced to the State Plane Coordinate System, New Mexico Central and surveyed to an accuracy of +/- 1.0 ft.

A maximum of two soil samples per boring will be collected and sent for offsite laboratory testing as per the following methodology:

- Each boring should be drilled to 10 - 15 ft bgs (below the anticipated bottom of the pipeline)
- Continuous OVA readings will be collected during each soil boring
- If the OVA (FID) reading is less than 50 ppm, no soil samples will be collected for offsite analysis
- If the OVA reading is greater than 50 ppm, (i) a soil sample will be collected from the interval with the highest OVA reading between the ground surface and the water table, (ii)

drilling will continue to the water table, (iii) drilling will continue until OVA readings are less than 50 ppm, and (iv) one soil sample will be collected in the capillary fringe

A total of 33 soil samples (based on 15 DPT boreholes/2 samples per borehole), including three duplicate samples will be collected. Each soil sample will be analyzed by an offsite laboratory for VOCs, SVOCs, TPH (DRO/GRO/ORO), and RCRA 8 metals. Samples selected for laboratory analysis will be labeled, handled, and prepared for shipment in accordance with HAFB SOP-1. The soil samples which will be submitted for chemical analysis are summarized in Table 3-1.

3.2.2.1 Geotechnical Soil Sampling

A total of six undisturbed geotechnical samples are to be collected from three of the 15 DPT boreholes (Figure 3-1). The geotechnical data will be utilized for the risk based evaluation that will be included in the closure report. The soil samples will be collected from borings that have not been impacted by PCS, therefore these boring/geotechnical sampling locations will be determined during the additional investigation. The undisturbed soil samples (two per borehole) will be collected from 0 to 1 ft bgs and at a depth above the water table where the lithology is representative of the site. To ensure that these samples have not been impacted, OVA readings for soil collected from this zone should not be above background. The geotechnical soil samples collected during this investigation will be analyzed as follows:

- Moisture Content by USEPA Method 160.3M
- Dry Bulk Density by ASTM Method D2937
- Specific Gravity by ASTM Method D1429
- Fractional Organic Carbon Content by ASTM Method D2974

The soil samples for geotechnical analysis will be collected in a thin-walled tube sampler, the tube ends will be capped and the top and bottom ends of the tube labeled. The soil core samples will be shipped to Accutest Laboratories in Orlando, Florida for analysis. The soil samples which will be submitted for geotechnical analysis are also summarized in Table 3-1.

3.2.3 DPT Groundwater Sampling

Each DPT soil borehole (DP-58 to DP-72) that encounters PCS (based on elevated OVA readings) or boreholes that are downgradient and away from the pipeline (e.g., DP-66, and DP-70 through DP-72) will be converted to a groundwater sampling point by extending the probe to at least three feet below the water table (Figure 3-1). Groundwater will be collected for laboratory analysis directly from the aquifer after releasing the drive point and partially retracting the rods. Either a bailer or a peristaltic pump and Teflon tubing will be inserted through the drive rods and used to retrieve the sample. Low flow or low stress techniques will

be used during purging activities for sampling to minimize the disturbance of the water column and generation of IDW. Procedures for DPT groundwater sampling are outlined in HAFB SOP-4. A single volume of the sampling device will be purged prior to sample collection (i.e., one volume of Teflon tubing or one bailer volume).

Due to the fine-grained, low permeability soil, the aquifer may not produce sufficient flow to immediately sample the groundwater. In the event that a DPT borehole location exhibits a very slow recharge or an insufficient volume of water for sampling, a temporary polyvinyl chloride (PVC) well will be left in place while additional borings at the site are completed. The temporary well will be sampled after sufficient recharge has occurred. Following sampling, the well will be completely removed from the ground and the borehole will be sealed in accordance with HAFB SOP-10.

A total of 17 groundwater samples (based on one groundwater sample from each DPT boring) including two duplicate samples will be collected and analyzed by an offsite laboratory for VOCs, SVOCs, TPH (DRO/GRO/ORO), and RCRA 8 metals. Samples selected for laboratory analysis will be labeled, handled, and prepared for shipment in accordance with HAFB SOP-1. The DPT groundwater samples which will be submitted for chemical analysis are summarized in Table 3-2.

In addition, a minimum of two additional DPT soil borings (DP-73 and DP-74) will be installed to assist with determining the distal edge of the PCS source area BTEX (benzene) groundwater plume (Figure 3-2). These two DPT soil borings will be sampled for groundwater (VOC analysis only, Table 3-2) to aid in locating the two additional permanent groundwater monitoring wells as discussed in Section 3.2.4.

3.2.4 Monitoring Well Installation Activities

Two additional groundwater monitoring wells (SS61-MW-13 and SS61-MW-14) will be installed during this investigation to delineate the downgradient extent of the BTEX (benzene) groundwater plume emanating from the presumed PCS source located in the vicinity of Building 1072 (Figure 3-2).

3.2.4.1 Monitoring Well Locations

The locations of the two new monitoring wells will be determined by sampling the groundwater for VOCs from a minimum of two additional DPT soil borings. Based on the most recent potentiometric surface maps the groundwater flow direction is to the west-northwest at the site (Figure 1-5). It is anticipated that the two additional DPT soil borings will be installed approximately 500 feet west of the presumed source area between existing monitoring wells MW-29-03 and SS61-MW07 (Figure 3-2). The two new monitoring wells will serve as sentinel wells and will be utilized to monitor the horizontal extent of plume migration. The groundwater from the two additional DPT soil borings will analyzed by an offsite laboratory for VOCs with a 48-hour turnaround time for the analytical results. The final locations of the two monitoring

wells will be determined during the field program based on the results of the initial DPT groundwater samples. It is anticipated that the locations of the two monitoring wells will be in the same location as the two DPT locations presented on Figure 3-2. If significant changes in the final monitoring well locations are recommended following evaluation of the DPT groundwater data, these changes will be submitted to the USACE Contracting Officer's Representative (COR) for advance approval using a field change request.

3.2.4.2 Monitoring Well Installation and Development

The two new monitoring wells will be constructed using DPT drilling techniques. A geologist or engineer will log each borehole. Based upon the known depth to groundwater determined from the DPT soil borings, the subsequent monitoring wells will be installed to a depth of approximately 25-30 feet. Each monitoring well will extend to a minimum depth of 5 feet below the water table and completed with 10 feet of 1-inch diameter 0.010 or 0.020 inch slotted PVC screen. The remaining borehole casing will be comprised of flush threaded 1-inch PVC casing. The annular space surrounding the screen will be backfilled with 10/20 Colorado silica sand capped with at least 2 feet of bentonite pellets. The remaining annular space will be backfilled with neat cement. The surface completion will consist of a lockable and tamper proof 6-inch diameter steel cover, concrete pad (3 feet square) and four bumper posts.

The completed wells will be developed to remove fine particulate and improve hydraulic communication with the surrounding saturated material. Well development will begin no sooner than 48 hours after grouting. Monitoring well development will take place by over-pumping each well until at least five well volumes have been removed, and the turbidity, pH, specific conductivity and temperature have stabilized by +/- 10 percent for at least three consecutive readings.

3.2.5 Monitoring Well Groundwater Sampling

Fourteen existing monitoring wells will be sampled under this Work Plan. These wells include SS61-MW-02, SS61-MW-03, SS61-MW-05 to SS61-MW-10, SS61-MW-12, MW-29-02 to MW-29-05, and MW-29-08 and are shown on Figure 3-2. In addition the two new monitoring wells (SS61-MW-13 and SS61-MW-14) will also be sampled during this event (Figure 3-2).

A total of 18 groundwater samples including two duplicate samples will be will be collected from the 16 monitoring wells will analyzed by an offsite laboratory for VOCs, SVOCs, TPH (DRO/GRO/ORO), RCRA 8 metals, and TDS. Monitoring well groundwater samples will be labeled, handled, and prepared for shipment in accordance with HAFB SOP-1. The groundwater samples which will be submitted for chemical analysis are summarized in Table 3-3.

3.2.5.1 Surveying

A registered New Mexico Surveyor will survey the two new permanent monitoring well locations in accordance with methods described in the Basewide QAPP (Bhate, November

2003a). Horizontal locations will be relative to the State Plane Coordinate System, New Mexico Central and surveyed to an accuracy of +/- 1.0 ft. Vertical elevations will be referenced to the North American Datum (NAD) 1983. The top of casing (vertical control) will be used to determine the depth and elevation of the groundwater and surveyed to an accuracy of +/-0.01 ft. During this investigation the source area(s) will be mapped to scale showing ancillary structures, sampling locations, buildings, roads, sidewalks, paved and unpaved areas. Additionally, all maps will include a coordinate system (e.g., latitude/longitude) and the site boundaries.

3.2.5.2 Groundwater Elevations

During the sampling of monitoring wells under this Work Plan, groundwater elevations will be measured. Elevations will be measured for the 16 wells listed in Section 3.2.5, and also from monitoring wells SS61-MW-01, MW-29-01, MW-29-06, and MW-29-07 (Figure 3-2). A current potentiometric surface map of SS-61 will be developed from the groundwater elevation data collected during this investigation.

3.3 Sample Identification System

Each environmental sample collected will be identified on the sample label and chain-of-custody (COC) records, regardless of type. Sample documentation, handling, and shipping will be in accordance with HAFB SOP-1. Table 3-4 provides the sample collection information inclusive of the container type and quantity for the soil and groundwater samples collected during the additional investigation at SS-61. The field duplicate samples will appear in sequence with the regular samples. The sample identification nomenclature for soil samples collected from DPT boreholes will be as follows:

SS61-DP58-12-a

Site alpha-numeric identifier: SS61 = Spill Site 61

Sample type identifier: DP = direct push boring

Sequential direct push boring number: 58, 59, etc.

Ending depth of sample interval: 12

Reserved for quality assurance (QA) sample identifiers: a = field duplicate, TB = trip blank, MS = matrix spike, MSD = matrix spike duplicate

The sample identification nomenclature groundwater samples collected from direct push boreholes will be as follows:

SS61-GP58-a

Site alpha-numeric identifier: SS61 = Spill Site 61

Sample type identifier: GP = groundwater direct push boring

Sequential direct push boring number: 58, 59, etc.

Reserved for QA sample identifiers: a = field duplicate, TB = trip blank, MS = matrix spike, MSD = matrix spike duplicate

The sample identification nomenclature groundwater samples collected from monitoring wells will be as follows:

SS61-MW01-a

Site alpha-numeric identifier: SS61 = Spill Site 61

Sample type identifier: MW = monitoring well

Monitoring well number: 01, 02, etc.

Reserved for QA sample identifiers: a = field duplicate, TB = trip blank, MS = matrix spike, MSD = matrix spike duplicate

3.4 Investigation-Derived Waste Management

IDW will be managed and characterized according to HAFB SOP-9. Whenever possible, waste minimization techniques will be used to reduce the amount of IDW. IDW generated by installing the new monitoring wells and subsequent groundwater sampling activities will be managed and characterized according to the following guidelines. The borehole cuttings (generated from hollow stem auger [HSA] drilling only) will be screened with a photo ionization detector (PID) or OVA for the presence of organic vapors. If the soil is free of organic vapors, it will be spread on the ground surrounding the well. If PID screening of the soil indicates the presence of organic vapors, the soil will be placed in the FT-31 landfarm at HAFB. Purged groundwater from development and sampling activities will be containerized and maintained by Bhate until disposal through the HAFB Wastewater Treatment Plant (WWTP), pending laboratory analysis. Other liquid wastes, such as decontamination rinses, are anticipated to be non-hazardous and as such, can be disposed of through the HAFB WWTF. Personal protective equipment (PPE) and other site non-hazardous debris/waste shall be disposed in standard trash receptacles.

3.4.1 General Decontamination Procedures

Small equipment, such as sampling tools, will be decontaminated in accordance with HAFB SOP-2. Heavy equipment such as the HSA drill rig, DPT rig, HSA augers etc., will be decontaminated by steam cleaning at a temporary decontamination pad set up at the site. The containers and decontamination pad will be managed in a secure area and the decontamination water will be either allowed to evaporate or combined with the purged groundwater and discharged to the HAFB WWTP. Sediment remaining in the decontamination pad area after the water has either evaporated or been discharged to the WWTP, will be combined with the soil to be remediated in the onsite landfarm or spread on the ground.

3.4.2 Personal Protective Equipment

Prior to disposal, used PPE, disposable items, and the decontamination pad liner will be rinsed clean with tap water and diluted detergent solution. Cleaned PPE and presumed clean, based upon non-contact with contaminated soils, water, or equipment, and other disposable clean items will be contained in trash bags and disposed of at the applicable onsite sanitary waste receptacle.

3.5 Site Restoration

Upon completion of the site inspection activities, the site will be restored to the original condition. Sampling locations will have been backfilled or grouted to the surface. The site will be canvassed for trash, debris, etc.

4 EXCAVATION PROCEDURES

The objective of the soil remediation at SS-61 is to excavate, transport, and dispose the PCS source area located in the vicinity of the abandoned east-west underground pipeline associated with the former AST system, west of Building 1072 as defined by the 15 DPT soil borings. Subsurface soils either contaminated by TPH at levels exceeding 940 mg/kg (TPH screening guideline for kerosene and jet fuel, NMED, 2005b) or soils posing a risk due to exposures to VOCs, SVOCs, and/or metals as established by the NMED soil screening guidance (NMED, 2006) will be removed. Contaminated soils will be removed to approximately one foot below the site's encountered groundwater table. This depth will ensure complete removal of PCS and account for any potential smear zone. Horizontally, the excavation will be completed based upon TPH levels of greater than 940 mg/kg as determined by soil samples collected subsequent to the excavation and analyzed at a fixed-base laboratory.

The construction general permit requires a project Storm Water Pollution Prevention Plan (SWPPP) to be submitted for excavation sites which will disturb greater than one acre of surface soils. For the planned activities, inclusive of the temporary clean soil stock piles, the total area of disturbance and/or excavation is less than one acre. Therefore, a project SWPPP will not be prepared and submitted.

At this time, the extent of the SS-61 PCS is unknown, however it is assumed that the PCS is in the vicinity of the east-west pipeline, the T-junction, and the north-south trending pipeline that are adjacent to Building 1072 (Figure 4-1). The boundaries of the SS-61 PCS will be determined by the results of the analytical soil samples collected from the 15 DPT borings. Prior to the initiation of excavation activities the capped 8-inch steel pipe that emerges from the ground (located in the former southern AST location shown on Figure 1-3) will be opened and inspected to insure that it is empty. In the event that the pipeline contains product, a waste characterization profile sample will be collected. Pending the results of the profile sample, a vacuum truck will be mobilized to remove the product from the pipeline for offsite disposal. Except where noted below, the excavation activities will be conducted in accordance with the procedures outlined in Unified Facilities Guide Specifications (UFGS) Section 02111 *Excavation and Handling of Contaminated Material* (Appendix D) and the *USACE Safety and Health Requirements Manual, EM 385-1-1* (USACE, 2003). The UFGS are a joint effort of the USACE, the Naval Facilities Engineering Command (NAVFAC), and the Air Force Civil Engineer Support Agency (AFCESA). The UFGS are for use in providing construction specifications and guidelines for the military services.

4.1 Pre-Excavation Activities

Before excavation and other site activities can begin, there are several pre-construction documents and approval requirements to be met, including: Form 332 approval, dig permit with utility clearances, site security measures, and facility manager notification of the intended operations. Bhate will coordinate project requests for Base installation support services through

the 49th CES/CEV. Pertinent to the start of activities, a pre-construction meeting and site walk-through will be conducted with HAFB personnel, and the Bhate Site Manager to inspect site conditions for site/equipment access, equipment staging area(s), soil stockpile areas, potential site hazards, and emergency evacuation routes. Also reviewed at this time will be project procedures in accordance with the schedule and planned activities.

Prior to initiating excavation activities, a subsurface soil sample will be collected (5 - 12 ft bgs) adjacent to the most contaminated soil sample collected during the DPT investigation. The soil sample will be analyzed by the Toxicity Characteristic Leaching Procedure (TCLP) for VOCs, SVOCs, and metals to characterize the contaminated soil prior to treatment at the FT-31 landfarm.

4.1.1 AF Form 332

Prior to initiating excavation activities a completed and approved AF Fm 332, will be obtained. This form authorizes construction work at HAFB and is required for the initiation of any construction work. This work order describes what activities will take place at the location.

4.1.2 Dig Permit/Utility Clearances

Prior to the submittal of the dig permit (AF Fm 103), the area of excavation will be clearly delineated with marker flags, stakes, or paint, as appropriate to the surface material. Utility clearance approvals will be completed by the appropriate HAFB utility office (e.g., telephone, sewer, water, natural gas etc.). Upon receipt of the approved dig permit (AF Form 103) with the utility clearances, the Bhate Site Manager or other authorized project personnel will complete a site walk-through confirming the dig permit authorizations and make any required changes.

4.1.3 Excavation Area Site Safety

As an Occupational Safety and Health Administration (OSHA) Class II excavation, site safety is concerned with the excavation and the areas around the excavation. Concerns include: the proper designation and demarcation of excavation boundaries (i.e. exclusion zone [EZ], contamination reduction zone [CRZ], and support zone [SZ]), compliance with excavation requirements, posting of potential hazards, and control of un-authorized site personnel. This is discussed in the 2003 *Basewide Health and Safety Plan* (Bhate, 2003b). Although the excavation will occur in a relatively low pedestrian traffic area, site control will still be paramount for the safety at the site. Notification of the excavation activities, duration, and alternate routes for pedestrian traffic will have been provided to the appropriate personnel in Building 1072 prior to the initiation of any field activities.

At a minimum, the site will be secured with caution tape surrounding the perimeter of the site delineating the outer boundary of the SZ. This is essential in the utility clearance process and it serves as the demarcation of the site for both project and non-project persons. A CRZ and/or EZ will be established as guided by the HASP and prevailing site conditions. The depth to the

bottom of the excavation is expected to reach 13 to 16 ft below grade (check existing soil data for depths). At the immediate edge of the excavation, a temporary construction fence will be erected completely around the excavation site. Postings will indicate the excavation hazard as well. In addition, when workers will be in or around an excavation, a certified competent person (as per 29 Code of Federal Regulations [CFR] Part 1926 Subpart P) shall inspect the excavation, the adjacent areas, and protective systems daily, as needed throughout the work shifts, and after every rainstorm or other hazard-increasing occurrence (USACE, 2003).

4.2 Decontamination Procedures

Small equipment, such as sampling tools, will be decontaminated in accordance with the *Basewide Quality Assurance Project Plan* (Bhate, 2003a). Heavy equipment, such as the backhoe, trackhoe, etc., will be decontaminated at a temporary decontamination pad set up at the site.

4.3 Excavation Activities

4.3.1 Excavation Boundary

The approximate limit of the area to be excavated during activities outlined under this VCM Work Plan is shown on Figure 4-1 (hatched area). Based upon the estimated horizontal extent of contamination, up to 350 cubic yards of overburden will be required to be removed. This material will be temporarily stockpiled on site in an area to be determined. Excavated material shall be placed at least 2 feet from the edge of the excavation (USACE, 2003).

4.3.2 Excavation Shoring

During the excavation activities, personnel will not enter the excavation at any time. Shoring or benching may need to be erected ensuring that the excavation sidewalls do not collapse. The determination will be made as the excavation progresses. If any slumping or sidewall failure is evident, then shoring and/or benching will be implemented.

Excavation activities associated with other soil remediation projects at Holloman AFB (e.g., SS-02/05, FT-31 and SS-17) indicate that the native soils demonstrate significant stability achieving near vertical walls during these excavations. The soils, in the vicinity of the presumed PCS source area are native as determined from the previous investigations. At this time, shoring of the excavation is not intended however sidewall benching may be required.

4.3.3 Soil Excavation

Excavation activities will utilize the appropriate excavation equipment and a wheel loader to assist with soil management. Workers exposed to vehicular or equipment traffic including signalpersons, spotters or inspectors, shall wear high visibility apparel meeting American

National Standards Institute/International Safety Equipment Association (ANSI/ISEA) 107 Class 3 requirements (USACE, 2003). All overburden soils determined to be clean will be removed prior to the removal of the contaminated soils. The clean overburden soils will be temporarily stockpiled for subsequent backfilling. Soil stockpiles will be managed as to not allow for any material to be removed or transported off-site via wind or precipitation (Section 7, *Waste Management*).

The contaminated subsurface smear zone is estimated to begin at 12 to 15 feet above the groundwater table. Applicable HAFB SOPs for completing this excavation are located in Appendix A of the *Basewide Quality Assurance Project Plan* (Bhate, 2003a). All contaminated soils will be live loaded and directly transported to the FT-31 Base landfarm or previously approved offsite disposal facility.

4.3.3.1 Soil Screening

Throughout the excavation, observation of discoloration and unusual odors will be documented. Potential PCSs will be field screened for petroleum hydrocarbon contamination using the SiteLAB® Analytical Test Kit Ultraviolet Flourometer for petroleum hydrocarbons in accordance with the UVF-3100 Operating Manual (included as Appendix E of this Work Plan). Excavated soil will be segregated in the field based on visual observation, headspace readings, and onsite analysis of TPH with laboratory confirmation. Soils that demonstrate a field screened TPH concentration above 940 mg/kg exceed the regulatory limit for PCS and will be managed in accordance with Section 7, *Waste Management,* of this Work Plan. Soils demonstrating a concentration below 940 mg/kg will be stockpiled for backfill once the excavation is complete. All soil stockpiled for backfill will undergo laboratory analysis to verify that no TPH hazardous constituents (e.g., VOCs and SVOCs) in excess of NMED residential soil screening levels are present. The excavation sampling quantities and analyses are summarized in Table 4-1.

The field screening incorporates the initial screening for the segregation of the excavated soils between contaminated and un-contaminated and the corresponding Quality Assurance/Quality Control (QA/QC) confirmation and validation analyses. The soil screening is comprised of three phases: 1) initial field screening, 2) field confirmatory, and 3) laboratory validation. These steps are detailed in Section 5, *Excavation Soil Sampling and Analysis,* of this work plan.

4.3.3.2 Soil Segregation

The 940 mg/kg action level for PCS is found listed in Table 2b of the NMED Residential Direct Exposure Limit for kerosene and jet fuel in the TPH Screening Guidelines, November, 2005 (included in Appendix F of this Work Plan). This cleanup level is part of a previous agreement between HAFB and NMED. The concentrations for the TPH carbon fractions will be summed for the total TPH value as the comparison to the NMED TPH allowable limit of 940 mg/kg for kerosene and jet fuel contaminated PCS.

The **un-impacted soils** are the overburden soils which have historically demonstrated no contamination and the source of the contamination is not from a surface release. These soils will be determined during the first phase of excavation covered under this VCM Work Plan. **Suspected contaminated soils** are those primarily within the smear zone. These are typically contained in a 1 to 2 foot zone above the contaminated soils. The **contaminated soils** are those that are definitively contaminated as validated by laboratory analytical data. Suspected contaminated soils will be handled as though they are contaminated, directly loaded, and transported to the FT-31 Landfarm for treatment or stockpiling.

4.3.3.3 Confirmation Soil Sampling

After the excavation is complete, and all suspected petroleum contaminated soils have been removed, sidewall confirmation samples will be collected. Samples will be collected using the bucket of the back-hoe. A soil sample will be obtained from the interior of the bucket to minimize the potential for outside source contamination. Samples will be collected at a minimum frequency of 2 per 18 linear feet (ln ft) per side wall at mid-depth of the contamination zone. At a minimum, 1 sample per side wall will be collected for side walls less than 18 ln ft.

4.3.4 Excavation Backfilling and Compaction

Clean soils will be obtained for backfill as needed from the HAFB borrow area or FT-31 Landfarm. Backfill adjacent to any and all types of structures shall be placed and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials to prevent wedging action or eccentric loading upon or against the structure. The material shall be placed in successive horizontal layers of loose material not more than 8 inches in depth. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. The compaction of the final two base lifts will be confirmed by determination of the soil density via an in-place nuclear or similar method per ASTM Method D 2922 (located in Appendix G of this Work Plan). If applicable, the final 12-inches of backfill will adhere to the specifications of Subgrade Preparation found in UFGS Section 02770A *Concrete Sidewalks and Curbs and Gutters* (located in Appendix H of this Work Plan).

4.3.5 Soil Disposal

Contaminated soils exceeding 940 mg/kg of TPH will be transported to the permitted FT-31 Landfarm for treatment/processing, or stockpiling. Prior to the mobilization of the excavation effort, if the permitted base landfarm is at operational capacity, disposal of the soils will be to a previously approved off-site facility. Soils will be handled, transported, and managed in accordance with the NMED guidelines and respective facility's requirements.

4.3.6 Site Restoration

Upon completion of site excavation and backfill activities, the site will be restored to its original appearance. Construction equipment and debris will be removed. The site will be canvassed for trash, debris, etc. Final grade for areas of the site which will not have a surface improvement upon them will allow for positive drainage in accordance with the surrounding area.

If any section(s) of walk way are removed or damaged during the excavation they will be replaced in similar construction and match in appearance to that which was removed. The design and construction, inclusive of materials, will be completed in accordance with the UFGS specifications for concrete sidewalks and gutters, Section 02770A *Concrete Sidewalks and Curbs and Gutters*, March 2004 (located in Appendix H of this Work Plan). Matching of the new sidewalk to the existing sidewalk has primacy over the UFGS guideline. The guideline should be adhered to utilizing best management practices and holding to the intent of the guideline. The guideline shall be implemented in its entirety except for the following Parts and/or subparts:

Sections 1.1 through 1.3	Sections 2.2.2 and 2.2.3
Section 1.6.2	Sections 3.7.1.1 and 3.7.1.3

Sections 2.1.3-Reinforcement Steel; 3.5.3-Reinforcement Steel Placement; and 3.7.4-Protective Coating are only applicable if the existing sidewalk is constructed in a similar manner.

5 EXCAVATION SOIL SAMPLING AND ANALYSIS

Table-5-1 provides the analytical methods and container requirements for samples collected for offsite laboratory analysis. The rationale, methods, and frequency for screening samples was previously detailed in Table 4-1.

5.1 Excavation Sampling

The excavation soil sampling requirements, detailed in Table 4-1, include field screening of overburden soils with headspace analysis via an OVA and SiteLAB® UVF, laboratory analysis of stockpiled soils for backfill characterization purposes, and excavation confirmation samples to denote the extent of excavation. Excavated soil that is suspect or visibly contaminated will be directly loaded into trucks and transported to the FT-31 Landfarm for treatment.

5.1.1 Overburden Field Screening

At the beginning of excavation activities initial field screening (headspace analysis with an OVA) will be performed on overburden soil at a frequency of one per every 25 cubic yards of excavated soil. If the headspace analysis reveals the presence of significant contamination (>300 ppm on the OVA), the soil will be transported to the FT-31 Landfarm for treatment. Otherwise the overburden soil will be stockpiled on site for backfill purposes. Every 50 cubic yards of stockpiled soil will undergo confirmatory field TPH analysis with the field fluorometer (SiteLAB® Analytical Test Kit UVF-3100A) in accordance with the Operating Manual (included in Appendix E of this Work Plan). From these samples, final QA confirmation analysis in accordance with the NMED specified gas chromatogram (GC) methods will be accomplished via a fixed-base laboratory.

5.1.2 Overburben Stockpile Sampling

For backfill characterization purposes, laboratory validation sampling will be performed at a frequency of one sample per every 200 cubic yards of stockpiled overburden soil. The samples will be analyzed for TPH (DRO, GRO, ORO), VOCs, and SVOCs. Laboratory analyses will be completed at an expedited turn-around time of 24 hours.

5.1.3 Excavation Confirmation Sampling

Excavation confirmation samples will be collected at a frequency of two per 18 linear feet (ln ft) per side wall at mid-depth of the contamination zone. At a minimum, one sample per side wall will be collected for side walls less than 18 ln ft. Analytical confirmation sampling from the bottom of the excavation is not required because the excavation will be terminated at one to two feet below the water table. Samples will be analyzed by a fixed-base laboratory for TPH, -DRO and –GRO, using USEPA Method 8015M, VOCs (USEPA Method 8260B), and SVOCs (USEPA Method 8270C). If any single sample demonstrates an exceedance of NMED

residential soil screening levels (SSLs), excavation will continue along that face or to greater depth until field screening deems termination with re-evaluation via laboratory confirmation analysis.

Soil data collected will adhere to project data quality objective (DQO) requirements, method reporting limits, duplicate field samples, and QA samples as established within the Basewide QAPP (Bhate, 2003a). Sample quantities, containers, methods of preservation, and holding times will be consistent with the requirements of associated method protocols. Laboratory analyses will be completed at a standard turn-around time of 7 days.

5.1.4 Analytical Methods

Each laboratory soil sample (including the field duplicates) will be analyzed for their respective analytes in accordance with Table 5-2. Samples will be analyzed for BTEX, as VOCs, by Method 8260B, SVOCs, by Method 8270C, and TPHs by Method 8015M.

Laboratory analyzed samples will be completed by Accutest Laboratories in Orlando, Florida. A copy of their USACE validation is included in Appendix I of this Work Plan.

6 RISK BASED CLEAN-UP APPROACH

The objective of the excavation activities presented is to remove the remaining PCS from the SS-61 source area to support closure of the site. Data collected as a result of field screening will be evaluated based upon the DQO's for the project. The results from the offsite laboratory confirmation samples from the sidewalls of the excavation will be evaluated to determine whether excavation activities at the site have removed the contaminated soil to the point where there is an acceptable risk due to exposure at the site. If the completed evaluation indicates an acceptable risk, then no further excavation will be required and the site can be considered for closure with no further action.

6.1 Evaluation of TPH

Based on the direction provided by NMED, pertaining to the remediation of petroleum-impacted sites at HAFB, a TPH screening level of 940 mg/kg will be used to evaluate the data provided by the offsite analytical laboratory. The 940 mg/kg action level for PCS is the Residential Direct Exposure Limit for kerosene and jet fuel that is listed in Table 2b of the NMED TPH Screening Guidelines, November, 2005 (included in Appendix F of this Work Plan).

6.2 Evaluation of VOCs and SVOCs

For any VOCs or SVOCs that are detected in excavated soil, the concentration will be evaluated against the screening levels provided in the revised NMED guidance document *Technical Background Document for Development of Soil Screening Levels, Revision* 4.0, June 2006, (NMED, 2006). Tables containing the SSLs from this guidance document are provided in Appendix J. Laboratory data for each collected soil sample will be compared to these SSLs.

6.3 Risk Based Evaluation

Subsequent to the investigative and excavation activities detailed in this work plan, a risk based evaluation will be performed to ensure that the risks to future receptors are acceptable at SS-61. The risk based evaluation will be included in the Site SS-61 Closeout Report. The following sections present the various steps that will be included in the risk assessment.

6.3.1 Review of Available Analytical Data

As a first step in the risk assessment process, soil and groundwater data produced by this source area investigation will be combined with the historical data. The data will then be reviewed to determine (i) the most probable source(s) of contamination, (ii) that soil and groundwater impacts have been adequately delineated, and (iii) if any additional chemicals were detected that were not previously of concern at the site. Additionally, the data will be evaluated to ensure it meets standards for data quality established in the NMED *Technical Background Document for Development of Soil Screening Levels, Revision 4.0* (NMED, June 2006).

6.3.2 Revision of the Conceptual Site Model

Following a review of available data, the CSM will be revised. This includes (i) re-assessing the distribution of chemicals of potential concern (COPCs) in soil and groundwater, (ii) verifying current and future land use, and (iii) verifying site stratigraphy and hydrogeology. To date, the COPCs identified in soil and groundwater at SS-61 are benzene, toluene, ethylbenzene, xylenes, and 1-2-dichloroethane. However, additional COPCs may be identified during the review of data collected during the source investigation.

6.3.3 Development of the Exposure Model

Once the conceptual site model has been refined, an exposure model will be developed. The exposure model is based on the CSM, and identifies the following:

- Media of concern,
- Current and future receptors, and
- Complete and incomplete exposure pathways

Media of concern included surficial soil, subsurface soil, soil to depth of construction, and groundwater. Based on current information available for SS-61, receptors include (i) a current and future commercial/industrial worker, and (ii) a future construction worker. Complete routes of exposure for each media of concern/COPC/receptor combination will be identified based on the above information.

6.3.4 Preliminary Screening Evaluation

As a first step, maximum concentrations for each COPC in each media of concern will be compared with the NMED Screening Levels presented in Table A-1 of the *Technical Background Document for Development of Soil Screening Levels, Revision 4.0* (NMED, June 2006). If the maximum concentration of each COPC in soil and groundwater is below its respective SSL, no additional analysis will be performed, and the findings will be reported to NMED. Depending on the results of the screening evaluation, site-specific screening levels may be developed for all complete routes of exposure identified in the exposure model. Development of site-specific screening levels is described below.

6.3.5 Calculation of Site-Specific SSLs

Parameters required for the calculation of site-specific SSLs include:

- Carcinogenic toxicity values (Slope Factors),
- Non-carcinogenic toxicity values (Reference Doses),
- Exposure Factors, and
- Fate and Transport Parameters.

Default toxicity values and exposure factors will be obtained from Tables C-1 and B-1 (respectively) of the *Technical Background Document for Development of Soil Screening Levels, Revision 4.0* (NMED, June 2006). Site-specific fate and transport parameters will be obtained from available reports for the site. Using the above information, site-specific screening levels will be calculated using equations presented in the *Technical Background Document for Development of Soil Screening Levels, Revision 4.0* (NMED, June 2006).

6.3.6 Site-Specific Screening Level Evaluation

The site-specific screening levels will be compared with the representative concentration of each COPC in each media of concern. If any COPC exceeds its respective site-specific screening level, target levels for the COPC will be developed during the risk-based evaluation.

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7 WASTE MANAGEMENT

Investigation-Derived Waste (IDW) generated by the activities of this excavation will include excavated soil, decontamination residuals, and PPE (Table 7-1). Each waste stream will be managed and characterized according to the following guidelines. Waste containers and the decontamination pad will be managed in a secure area.

7.1 Excavated Soil

7.1.1 Clean Soils – Stockpiles

The clean soil stockpiles will be constructed in accordance with best management practices to mitigate soil loss due to erosion, wind, and run-off. They will employ the use of a plastic liner, straw bales for berming or silt fencing and a cover. Soils will be placed on thick plastic sheeting within a constructed berm for protection from off-site transportation by wind and rain until characterization is complete. If laboratory analysis indicates concentrations are below the SSL for TPH of 940 mg/kg, and the SSL for each individual VOC and SVOC constituent, the stockpiled soil will be used as backfill once the excavation activities are complete.

7.1.2 Contaminated Soils – Base Landfarm

Excavated contaminated soils will be handled in accordance with Sections 4 and 5 of this Work Plan. Contaminated soils will be live loaded and transported to the selected location for treatment/disposal; either the FT-31 Landfarm or an offsite subcontractor location.

7.2 Decontamination Water

Decontamination water is anticipated to be non-hazardous and as such, can be disposed of through the HAFB WWTP. When feasible, decontamination water will be allowed to evaporate from the decontamination pad area. Sediment remaining in the decontamination pad area after the water has either evaporated or has been discharged to the WWTP will be combined with the excavated contaminated soil for treatment at the FT-31 Landfarm.

7.3 Personal Protective and Disposable Sampling Equipment

PPE and other site non-hazardous debris/waste shall be placed in plastic trash bags and disposed in a standard trash dumpster or receptacle as directed by HAFB personnel.

7.4 Construction Rubble

Unless visibly stained, all construction debris (sidewalk and/or asphalt if encountered) is assumed to be non-hazardous, non-contaminated, and will be disposed of accordingly at the Base re-use facility.

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8 PROJECT QUALITY ASSURANCE

The laboratory performing the chemical sample analysis will follow the *Basewide Quality Assurance Project Plan* (Bhate, 2003a) and the Quality Assurance Project Plan Addendum (Appendix C of this Work Plan).

8.1 Standard Operating Procedures

Applicable SOPs for completing this excavation are located in Appendix A of the *Basewide QAPP* (Bhate, 2003a).

8.2 Sample Identification

Each environmental sample will be identified on the sample label and COC records for each sample collected, regardless of type. Field duplicates will be paired with another field sample and will be classified as blind samples. The duplicate samples will appear in sequence with the regular samples. The identifier nomenclature will adhere to the procedures and guidelines established in the *Basewide QAPP*. Sample labeling will adhere to the format provided in the *Basewide QAPP*.

8.3 Project Documentation

The field operations documentation will provide consistent procedures and formats for documentation and management of field records and collected samples.

8.3.1 Sample Documentation

Sample documentation, identification, and tracking will adhere to the prescribed methods found in the *Basewide QAPP*. All sampling activities will include documentation of significant activities, potential environmental influences during sampling, field variances, and sample identification information. At a minimum, field logbooks will be utilized to record dates and times, sampling protocols, project numbers, and sampler's name. Daily Quality Assurance Reports will be completed and submitted weekly to the HAFB Project Manager. Other pertinent information will include COC numbers and air-bill tracking number. Chain-of-custody forms will be completed and included with each sample shipment; one COC per cooler.

At a minimum, the following sample collection information will be logged in the field book:

- Date and time
- Sample identification number
- Project number
- Sampler name
- Preservative (if any)
- Analysis
- Map or schematic of sampling location

If no map of sampling locations is available prior to sampling, a drawing of the site will be sketched on the left page of the field logbook to provide an illustration of all sampling points. Measured distances from sampling points to a fixed reference point will be recorded.

8.3.2 Field Logbook

Personnel will use only bound field logbooks for the maintenance of field records. The Project Manager will ensure that all field notes can be efficiently traced, filed, and retrieved. All entries will be recorded in indelible, waterproof ink. If errors are made, corrections will be made by crossing a single line through the error, correcting the information, and initialing and dating the correction. Entries will be made in the following format:

Documentation and reporting of events and activities will be made in chronological order on the right page of an open logbook. All entries will be dated and time of entry recorded. At the beginning of each day, the first two entries will be "personnel/contractors on site" and "weather". At the end of each day's entry, the personnel will draw a diagonal line originating from the bottom left corner of the page to the conclusion of the entry and sign along the line indicating the conclusion of the entry or the day's activity. Once completed, the field logbooks become accountable documents and will be maintained as part of the project files.

The following general requirements apply to field logbooks:

- The left page of the logbook will be used for auxiliary reporting such as sketches, tables, etc.
- The date will be recorded at the top of every page in the left-hand corner of the right page.
- The time of entry recordings will be in columnar form down the left-hand side of the right page.

8.3.3 Field Analytical Data

The field analytical data collected at the site will include the field screening readings for selection of PPE, as well as field screening for headspace analysis. The breathing zone of the site will be screened for VOCs in the field at the time of sample collection utilizing an OVA. If a high humidity condition exists at the time of sample collecting, an FID is recommended since a PID is not a completely reliable screening instrument under these conditions. The field screening data will be recorded in the field logbook.

8.3.4 Data Reporting

Data obtained during the excavation, confirmation or field screening samples, will be reported according to the *Basewide QAPP* (Bhate, 2003a). In accordance with USACE EM200-1-6, the

investigative data is classified as definitive data. The data will be generated using rigorous, analyte-specific analytical methods where analyte identifiers and quantitations are confirmed and QA/QC requirements have been satisfied. For this project, regular, field duplicate, and MS/MSD samples are to be collected concurrently. The data will meet the objectives of the project for level of accuracy and precision required, intended use of the data, analytical methods, time constraints, and allowable decision errors. Risk evaluation and sampling results will be tabulated and summarized in the VCM report for the site. An ERPIMS submittal is not required for the excavation phase of this project.

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9 HEALTH AND SAFETY REQUIREMENTS

Project Health and Safety practices will adhere to the *Basewide Health and Safety Plan* (Bhate, 2003b) and the Site Specific Addendum to the *Basewide HASP*, as included in Appendix B of this Work Plan, for the excavation activities. All work will be conducted in accordance with the USACE *Safety and Health Requirements Manual, EM 385-1-1,* 3 November 2003. It is anticipated that no greater than modified level D PPE will be required to complete the site inspection and sampling activities. This includes: OSHA approved safety shoes, ANSI approved safety glasses (Z87.1) and hard hat (Z89.1-1997: Type I), sleeved shirt and long pants, and as required, hearing protection, leather work gloves, and/or nitrile gloves during sampling.

Site security is part of safety at the site for the excavation. Items of concern include the proper designation and demarcation of the investigation boundaries (i.e., SZ, CRZ, and EZ), as appropriate. Likewise, compliance with any intrusive work requirements, posting of potential hazards, and control of un-authorized site personnel will be completed. This is discussed in the *Basewide HASP*.

At a minimum, the site will be secured with caution tape surrounding the perimeter of the site delineating the outer boundary of the SZ. This is essential in the utility clearance process and it serves as the demarcation of the site for both project and non-project persons. A CRZ and/or EZ will be established as guided by the HASP and site prevailing conditions.

Excavation depths are expected to exceed 4 ft, and be less than 20 ft; therefore sidewall benching may be required.

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10 ORGANIZATION AND SCHEDULE

Mr. Jim Moore, Professional Geologist (P.G.), will serve as the Bhate Field Manager during the additional investigation phase of this VCM project. During the corrective measures (excavation) phase of the project at SS-61, Mr. John Hymer will serve as the Bhate Site Manager and as the Site Safety and Health Officer (SSHO) overseeing and directing all excavation and soil screening and confirmation sampling activities. Mr. Hymer will also provide on-site management of any sub-contractors for the project. Mr. Moore is also the Bhate Project Manager and will ensure required project documents, permits, contractual agreements, and other program tasks are completed. Key project personnel are listed in Table 10-1. The additional investigation and excavation activities are anticipated to begin in the Fall 2006 and will last approximately 6 weeks.

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11 REFERENCES

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ATTACHMENT A

SS-61 NOTICE OF DEFICIENCIES (HWB-HAFB-05-007 AND HWB-HAFB-05-008)

State of New Mexico
ENVIRONMENT DEPARTMENT
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Telephone (505) 428-2500
Fax (505) 428-2567
www.nmenv.state.nm.us

BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

DERRITH WATCHMAN-MOORE
DEPUTY SECRETARY

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

January 17, 2006

Ms. Debbie Hartell
Chief,
Environmental Flight
49 CES/CEV
550 Tabosa Ave.
Holloman AFB, NM 88330-8458

SUBJECT: NOTICE OF DEFICIENCY: ADDITIONAL GROUNDWATER MONITORING WORK PLAN FOR SS-61 (AOC 1001), MAY 2005 HOLLOMAN AIR FORCE BASE EPA ID NO. NM6572124422 HWB-HAFB-05-008

Dear Ms. Hartell:

The New Mexico Environment Department (NMED) has reviewed the subject document, which was submitted toward the establishment of a groundwater sampling program at site SS-61 at Holloman Air Force Base (HAFB) as directed by the NMED. This work plan will allow the assessment of monitored natural attenuation (MNA) as a viable corrective measure for this site. Based on this review, NMED has determined that the Work Plan cannot be approved at this time, as revisions are necessary. The following are the deficiencies that HAFB (the Permittee) is required to address before the Work Plan can be approved.

WORK PLAN DEFICIENCIES

1. **Page 1-1, Section 1.0, Introduction, 2nd Paragraph**

In a letter from NMED dated February 4, 2005 (which prompted submittal of the subject work plan), the Permittee was advised that a separate plume of 1,1,2-trichloroethylene (TCE) might emanate from a possible source located to the east-southeast of the subject site's monitoring well MW-02. NMED required that the Permittee perform an additional investigation of the potential TCE plume. This paragraph of the work plan indicated that the TCE plume would be designated as a separate area of concern (AOC) and would receive separate funding for an investigation. Since no timetable for this action was provided, the Permittee must submit a tentative timetable for AOC designation and RCRA Facility Investigation work plan submittal in response to this Notice of Deficiency.

2. **Page 2-1, Section 2.1, Groundwater Sampling and Appendix D, Quality Assurance Project Plan Addendum, Table 4-1, Summary of Field QC Samples, "Number of Field Samples"**

This Section and Table indicate that only 10 field samples would be collected per sampling event. However, sampling of 11 monitoring wells is proposed.

HAFB must provide clarification of this apparent discrepancy.

3. **Page 2-1, Section 2.1, Groundwater Sampling**

This Section indicates that monitoring well MW-04 was added to the monitoring program. Due to this well's close proximity to MW-06 and its historically low levels of contaminants. This well shall be deleted from the monitoring program and replaced with monitoring well MW-07 to provide monitoring of the western periphery of the plume. This is in addition to the other 10 wells to be monitored.

This Section also indicates that monitoring wells will be sampled twice per year for two years. In order for the NMED to consider MNA as a viable corrective measure at this site, HAFB is required to conduct quarterly sampling and reporting for a two-year period.

4. **Page 3-1, Section 3.0, Groundwater Monitoring Report**

This Section indicates that Monitoring Reports would be submitted, but it does not indicate when the reports will be submitted.

HAFB is required to submit quarterly Monitoring Reports for the two-year sampling cycle, prepared in accordance with NMED's Position Paper entitled "General Reporting Requirements for GW Monitoring". This paper is located on the NMED Hazardous Waste Bureau (HWB) website at http://www.nmenv.state.nm.us/hwb/guidance.html.

5. **Appendix D, Quality Assurance Project Plan Addendum, Table 4-2, Summary of Laboratory QC Limits**

Table 4-2 provides the Estimated Quantitation Limits (**EQLs**), not Method Detection Limits (**MDLs**), for the various constituents to be sampled. The following constituents have EQLs that are higher than the groundwater quality standards established by the NM Water Quality Control Commission (**NMWQCC**):

Constituent	EQL (µg/L)	NMWQCC Standard (µg/L)
1,2-Dibromoethane (EDB)	5	0.1
Vinyl Chloride	5	1
Benzo(a)pyrene	10	0.7

The Permittee must ensure that the MDLs for these and all constituents will be lower than the NMWQCC Standards. Note also that the MCL for EDB is 0.00005 mg/L.

6. The November 2003 Feasibility Study Work Plan for Spill Site SS-61 indicated in Section 4.1.2, Groundwater Sampling Schedule, that monitoring well MW-03 would be monitored weekly for the presence of free product for a period of one year. There is no indication in subsequent reports that this monitoring was ever conducted.

If this monitoring was conducted, the Permittee is required to provide the data and a discussion regarding the results. If it was not conducted, the Permittee is required to conduct this monitoring for a period of one year and provide the results in the quarterly monitoring reports. In the event that more than 1/8-inch of free product (non-aqueous phase liquid) is discovered during a monitoring event, the Permittee must notify the NMED within five calendar days.

Please respond to this Notice of Deficiency within thirty (30) calendar days of receipt of this letter.

If you have any questions regarding this matter or if you would like to discuss the comments prior to your response, please contact David Strasser of my staff at (505) 222-9526 or at the above address.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

JPB:dcs

cc: J. Kieling, NMED, HWB
W. Moats, NMED, HWB
C. Amindyas, NMED, HWB
D. Strasser, NMED, HWB
D. Tellez, EPA, Region 6 (6PD-F)
D. Holmquist, HAFB

File: Reading and HAFB 2005

State of New Mexico
ENVIRONMENT DEPARTMENT
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Telephone (505) 428-2500
Fax (505) 428-2567
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BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

DERRITH WATCHMAN-MOORE
DEPUTY SECRETARY

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

January 27, 2006

Ms. Debbie Hartell
Chief
Environmental Flight
49 CES/CEV
550 Tabosa Ave.
Holloman AFB, NM 88330-8458

SUBJECT: NOTICE OF DEFICIENCY: MONITORED NATURAL ATTENUATION REPORT FOR SS-61 (AOC 1001), JUNE 2005
HOLLOMAN AIR FORCE BASE, EPA ID# NM6572124422
HWB-HAFB-05-007

Dear Ms. Hartell:

The New Mexico Environment Department (NMED) has reviewed the subject document, which was submitted to support the use of monitored natural attenuation (MNA) as a corrective measure at Holloman Air Force Base (HAFB). HAFB (the Permittee) is hereby advised that for the NMED to consider MNA as a viable corrective measure at this site, the Permittee is required to conduct quarterly monitoring and reporting for a two-year period. This monitoring shall be conducted in accordance with the "*Additional Groundwater Monitoring Work Plan for SS-61 (AOC 1001)*", dated May 2005, and the subsequent NMED Notice of Deficiency dated January 17, 2006. Should substantial improvement in groundwater quality not be shown during this two-year period, the Permittee shall be required to submit a Corrective Measures Study (CMS) that proposes alternative remedies. If MNA is determined to be a potential remedy for this site, the Permittee will need to proceed through the CMS process as outlined in Appendix 4-C of the HAFB Permit.

Based upon review of the MNA Report, NMED has noted the following deficiencies.

REPORT DEFICIENCIES

1. Analytical results obtained during the 2004/5 quarterly sampling events for total dissolved solids, conductivity, alkalinity and chloride are very different between sampling points. Therefore, it appears that monitoring wells MW-04 and MW-08 may be in a hydrogeologic zone that is different from monitoring wells MW-01, MW-03 and MW-06.

   The Permittee is required to submit a discussion on this possibility and, if this scenario is possible, its ramifications.

2. Analytical results obtained during the 2004/5 quarterly sampling events indicate that concentrations of volatile organic compounds (VOCs) in monitoring well MW-03 had increased substantially between the April 2004 and January 2005 sampling events. The following table provides these concentrations (in µg/L):

Constituent	NMWQCC Standard	April 2004	June 2004	September 2004	January 2005
Benzene	10	7,180	10,600	12,600	16,900
Ethylbenzene	750	ND	231	295	309
Toluene	750	734	1,950	3,460	4,060
Xylenes	620	1,870	3,050	4,150	4,370
1,2-dichloroethane (EDC)	10	ND	395	477	602

ND – Non-Detect

   This increase in concentrations may indicate that a source of VOCs is still present at the subject site. Various documents submitted for this site refer to the possible presence of an oil and water separator at the southeast corner of Building 1079 and a concrete sump located at the northwest corner of Building 1079. None of the documents submitted indicate that these locations were ever investigated as a possible source nor was the operational status of either structure provided.

   The Permittee is required to submit a discussion regarding the status of these structures and their potential to act as a continuing source of VOC contamination at this site. This discussion must include a figure depicting the locations of these structures. Depending on the response, NMED may require additional soil investigation at these two locations.

Please respond to this Notice of Deficiency within thirty (30) calendar days from the date you receive this letter.

If you have any questions regarding this matter or if you would like to discuss the comments prior to your response, please contact David Strasser of my staff at (505) 222-9526.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

JPB/dcs

cc: J. Kieling, NMED, HWB
W. Moats, NMED, HWB
C. Amindyas, NMED, HWB
D. Strasser, NMED, HWB
D. Tellez, EPA, Region 6 (6PD-F)
D. Holmquist, HAFB

File: Reading and HAFB, 2006

Table 3-1
DPT Soil Sampling and Analysis
SS-61 Soil Remediation
Voluntary Corrective Measures Work Plan
Holloman AFB, New Mexico
Bhate Project No. 9050361.01.02

Analysis	Method	Primary	Duplicates	MS/MSD	Trip blanks *	Total
VOC	EPA 8260B	30	3	2	4	39
SVOC	EPA 8270C	30	3	2	0	35
RCRA 8 Metals	EPA 6010B/7471A	30	3	2	0	35
DRO	EPA 8015M	30	3	2	0	35
GRO	EPA 8015M	30	3	2	0	35
ORO	EPA 8015M	30	3	2	0	35
Moisture Content	EPA 160.3M	6	0	0	0	6
Dry Bulk Density	ASTM D2937	6	0	0	0	6
Specific Gravity	ASTM D1429	6	0	0	0	6
Fractional Organic Carbon Content	ASTM D2974	6	0	0	0	6

Notes:
ASTM = American Society for Testing and Materials
EPA = Environmental Protection Agency
MS/MSD = Matrix Spike/Matrix Spike Duplicate
VOC = Volatile Organic Compounds
SVOC = Semi-volatile Organic Compounds
RCRA = Resource Conservation and Recovery Act
DRO = Diesel Range Orangics
GRO = Gasoline Range Organics
ORO = Oil Range Organics
* Estimated, one trip blank will accompany every shipment of VOC samples

Table 3-2
DPT Groundwater Sampling and Analysis
SS-61 Soil Remediation
Voluntary Corrective Measures Work Plan
Holloman AFB, New Mexico
Bhate Project No. 9050361.01.02

Analysis	EPA Method	Primary	Duplicates	MS/MSD	Trip blanks *	Total
VOC	8260B	17	2	1	2	22
SVOC	8270C	15	2	1	0	18
RCRA 8 Metals	6010B/7470A	15	2	1	0	18
DRO	8015M	15	2	1	0	18
GRO	8015M	15	2	1	0	18
ORO	8015M	15	2	1	0	18

Notes:
EPA = Environmental Protection Agency
MS/MSD = Matrix Spike/Matrix Spike Duplicate
VOC = Volatile Organic Compounds
SVOC = Semi-volatile Organic Compounds
RCRA = Resource Conservation and Recovery Act
DRO = Diesel Range Orangics
GRO = Gasoline Range Organics
ORO = Oil Range Organics
* Estimated, one trip blank will accompany every shipment of VOC samples

Table 3-3
Monitoring Well Groundwater Sampling and Analysis
SS-61 Soil Remediation
Voluntary Corrective Measures Work Plan
Holloman AFB, New Mexico
Bhate Project No. 9050361.01.02

Analysis	EPA Method	Primary	Duplicates	MS/MSD	Trip blanks *	Total
VOC	8260B	16	2	1	2	21
SVOC	8270C	16	2	1	0	19
RCRA 8 Metals	6010B/7470A	16	2	1	0	19
DRO	8015M	16	2	1	0	19
GRO	8015M	16	2	1	0	19
ORO	8015M	16	2	1	0	19
TDS	160.1	16	2	1	0	19

Notes:
EPA = Environmental Protection Agency
MS/MSD = Matrix Spike/Matrix Spike Duplicate
VOC = Volatile Organic Compounds
SVOC = Semi-volatile Organic Compounds
RCRA = Resource Conservation and Recovery Act
DRO = Diesel Range Orangics
GRO = Gasoline Range Organics
ORO = Oil Range Organics
TDS = Total Dissolved Solids
* Estimated, one trip blank will accompany every shipment of VOC samples

Table 3-4

Sample Containers by Sample Media

SS-61 Soil Remediation
Voluntary Corrective Measures Work Plan
Holloman AFB, New Mexico
Bhate Project No. 9050361.01.02

MEDIA	ANALYTE GROUP (Method)				
	TPH DRO/GRO/ORO (8015M)	VOCs (8260B)	SVOCs (8270C)	RCRA 8 Metals (6010B/7471A)	Total Dissolved Solids
Soil	8 oz glass jar	Encore	4 oz glass jar	8 oz glass jar	NA
	1	3	1	1	NA
Groundwater	40-mL vials (pre-tared)	40-mL vials	1-L amber	1-L amber	1-L amber
	1	3	1	1	1

Notes:

TPH = Total Petroleum Hydrocarbons

DRO = Diesel Range Organics

GRO = Gasoline Range Organics

ORO = Oil Range Organics

NA = Not Applicable

mL = Milliliter

L = Liter

Table 4-1

Excavation Sampling Quantities and Analysis

SS-61 Soil Remediation
Voluntary Corrective Measures Work Plan
Holloman AFB, New Mexico
Bhate Project No. 9050361.01.02

Sample Type	Contamination Profile	Purpose	Frequency	Estimated Quantity	Method/ Analyses	Requested Analyses Time
Overburden	Un-impacted Soils	Initial Field Screening	Every 25 cu yds	20	OVA / VOCs	Real Time
		Field Confirmatory	Every 50 cu yds	10	UVF / TPH	
Stock Pile (Overburden)	Un-impacted Soils	Backfill Characterization (Lab validation)	Every 200 cu yds	3	Laboratory/ TPH, VOCs, and SVOCs	24 hours
Excavation Confirmation	Clean wall denoting extent of excavation	Closure	2 every 18 ln ft, at mid-depth within contamination zone, minimum of 1 per side wall if < 18 ln ft	44	Laboratory/ TPH, VOCs, and SVOCs	7 days

Notes:
cu yds = Cubic yards
ln ft = Linear feet
TPH = Total Petroleum Hydrocarbons
VOCs = Volatile organic compounds
SVOCs = Semi-volatile organic compounds
UVF = Ultraviolet fluorometer
OVA = Organic Vapor Analyzer

Table 5-1

Excavation Sample Collection Information

SS-61 Soil Remediation
Voluntary Corrective Measures Work Plan
Holloman AFB, New Mexico
Bhate Project No. 9050361.01.02

Soil Collection Information	ANALYTE METHOD						
	VOC (8260B)	SVOC (8270C)	TPH (8015M)	Soil Moisture	TCLP VOC (1311/8260B)	TCLP SVOC (1311/8270C)	TCLP Metals (1311/6010/7000)
Container	Encore	4 oz glass jar	Non-preserved 40-mL vial (Terra-core)	8 oz glass jar	8 oz glass jar	8 oz glass jar	8 oz glass jar
Container Quantity	3	1	1	1	1	1	1
Holding Time	48 hours	7 days	7 days	14 days	14 days	14 days	180 days

Notes:
oz = Ounce
mL = Milliliter
TPH = Total Petroleum Hydrocarbons
VOCs = Volatile Organic Compounds
SVOCs = Semi-Volatile Organic Compounds
TCLP = Toxicity Characteristic Leaching Procedure

Table 5-2

Excavation Sample Analysis and Methodologies

SS-61 Soil Remediation
Voluntary Corrective Measures Work Plan
Holloman AFB, New Mexico
Bhate Project No. 9050361.01.02

Analysis	Soil and Groundwater
BTEX (VOCs)	EPA Method 8260B
PAH (SVOCs)	EPA Method 8270C
TPH (GRO/DRO/ORO)	EPA Method 8015M
TCLP VOCs	EPA Method 1311/8260B
TCLP SVOCs	EPA Method 1311/8270C
TCLP Metals	EPA Method 1311/6010/7000

Notes:
BTEX = Benzene, toluene, ethylbenzene, and xylenes
TPH = Total Petroleum Hydrocarbons
VOCs = Volatile Organic Compounds
SVOCs = Semi-Volatile Organic Compounds
GRO = Gasoline Range Organics
DRO = Diesel Range Organics
ORO = Oil Range Organics
TCLP = Toxicity Characteristic Leaching Procedure
PAH = Polynuclear Aromatic Hydrocarbons
EPA = Environmental Protection Agency

Table 7-1

Proposed Waste Streams

SS-61 Soil Remediation
Voluntary Corrective Measures Work Plan
Holloman AFB, New Mexico
Bhate Project No. 9050361.01.02

Activity	Waste Stream			
	PPE	Soil	Water	Debris
Equipment Decontamination	■	■	■	
Excavation	■	■		■

Note:

PPE = Personal protective equipment

Table 10-1

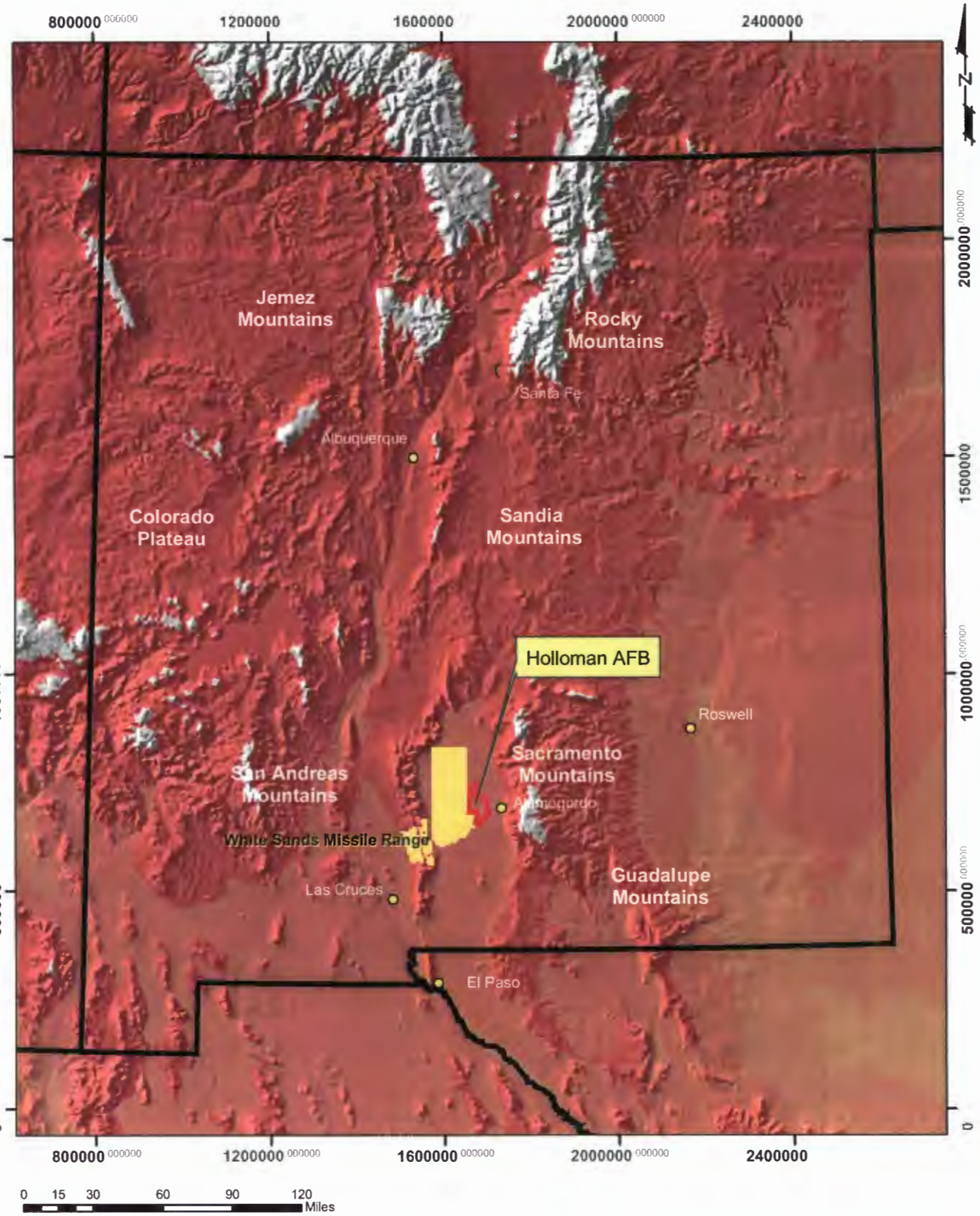
Key Personnel and Responsibilities

SS-61 Soil Remediation
Voluntary Corrective Measures Work Plan
Holloman AFB, New Mexico
Bhate Project No. 9050361.01.02

Name	Project Title/Assigned Role	Phone Numbers
Mr. John Hymer	Site Manager/SSHO	Work: (505) 491-9171
Mr. Jim Moore, P.G.	Field Team Leader/Senior Geologist (Additional Investigation)	Work: (303) 929-4840
Mr. Frank Gardner, P.G.	Bhate Program Manager	Work: (303) 386-6454
Mr. Jim Moore, P.G.	Project Manager	Work: (303) 929-4840
Mr. Brian Muller, CIH, CHMM	Health and Safety Specialist	Work: (205) 918-4000

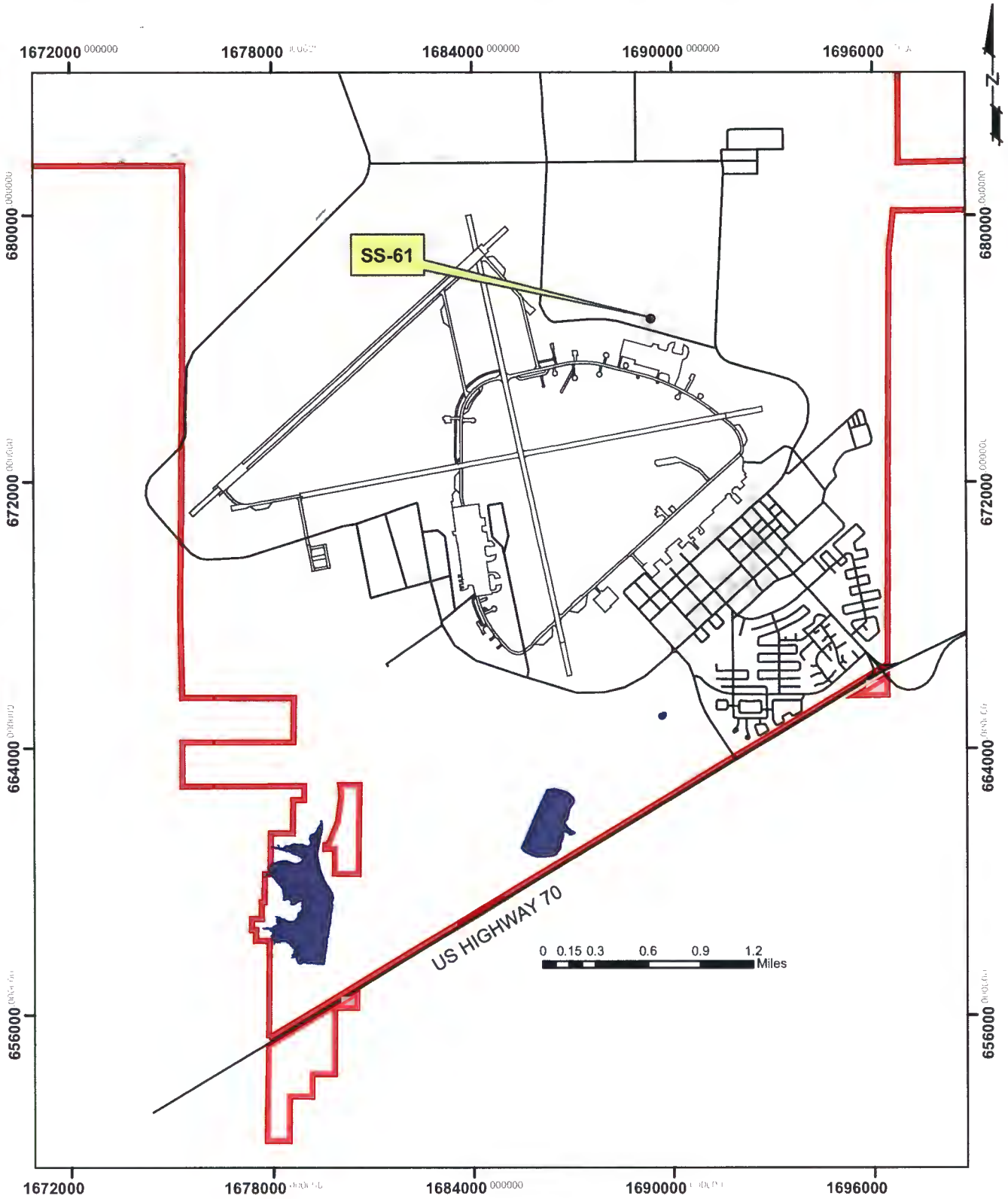
Notes:
P.G. = Professional Geologist
SSHO = Site Safety and Health Officer
CIH = Certified Industrial Hygienist
CHMM = Certified Hazardous Materials Manager

FIGURES



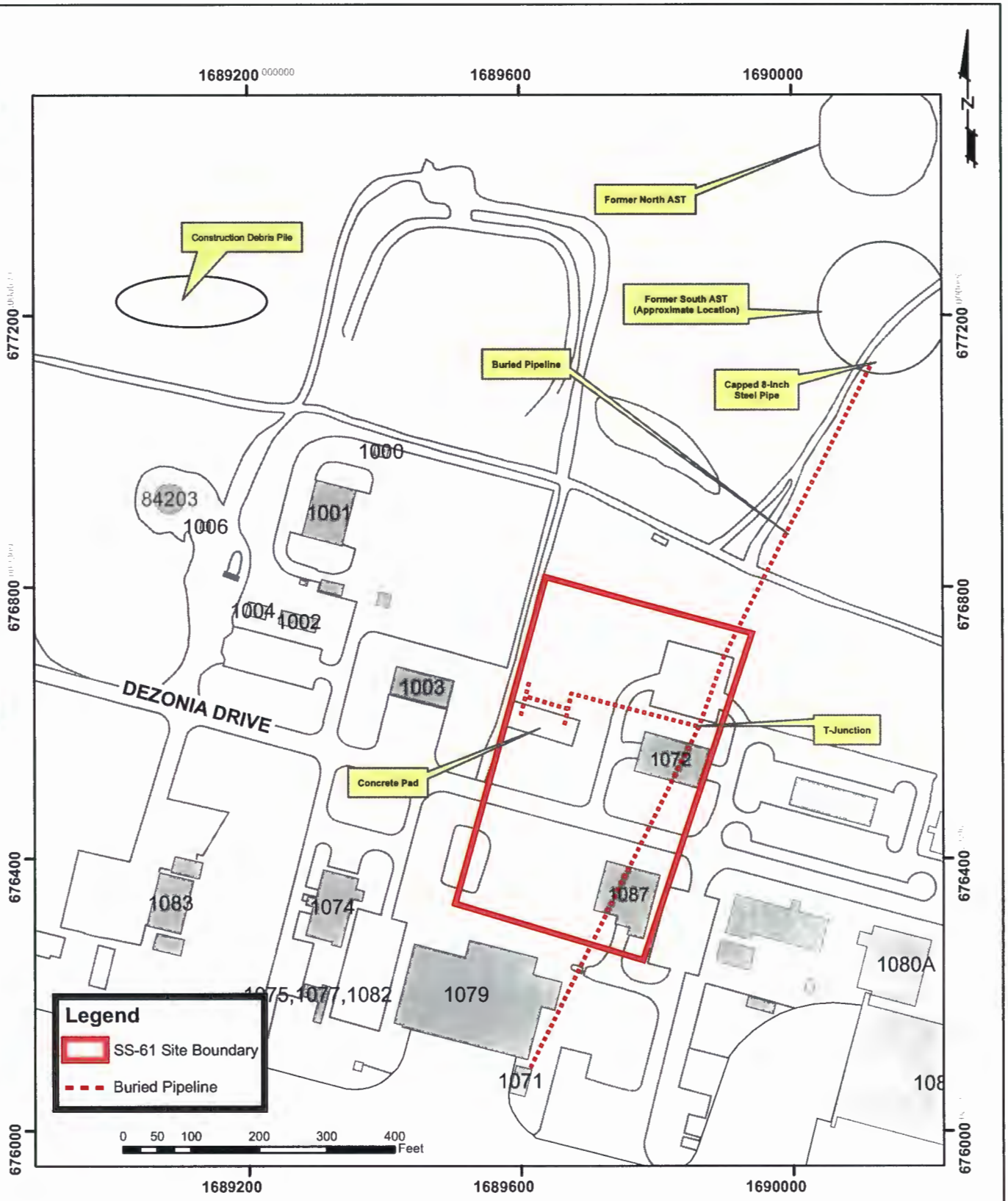
bhate associates
ENGINEERING, SCIENCE AND CONSTRUCTION

Holloman AFB, NM Location Map				Voluntary Corrective Measures Work Plan Site SS-61
PROJECT NO. 9050361	SCALE Shown	DATE 5/9/06	DRAWN BY: cm DRAWING NO: Figure 1-1	Figure 1-1



bhate associates
ENGINEERING, SCIENCE AND CONSTRUCTION

SS-61 Site Location Map				Voluntary Corrective Measures Work Plan Site SS-61
PROJECT NO.	SCALE	DATE	DRAWN BY: cm	
9050361	Shown	5/9/06	DRAWING NO: Figure 1-2	Figure 1-2



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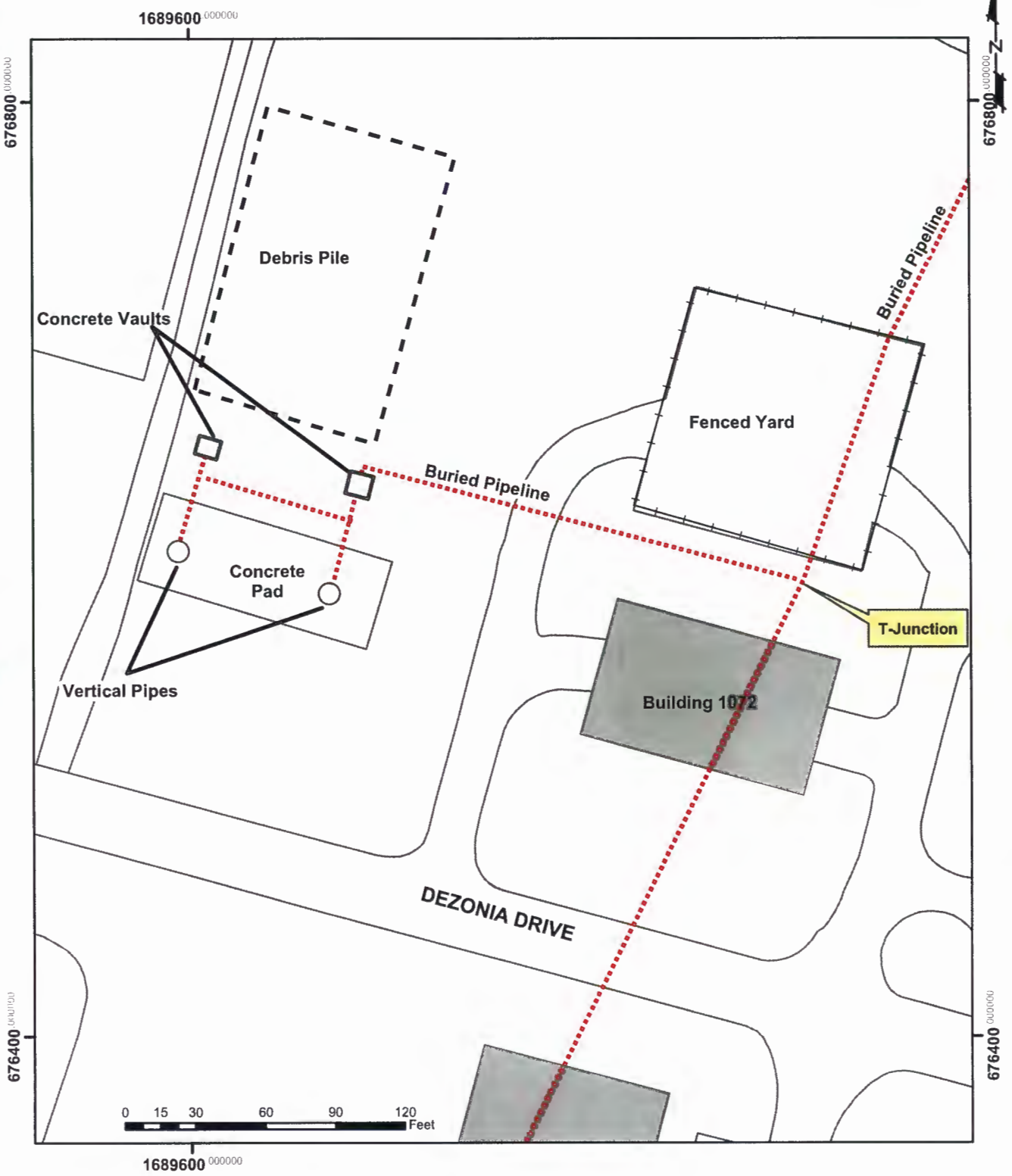
ENGINEERING, SCIENCE AND CONSTRUCTION

SS-61 Site Plan				Voluntary Corrective Measures Work Plan Site SS-61
PROJECT NO.	SCALE	DATE	DRAWN BY: cm	
9050361	1"=200'	5/9/06	DRAWING NO: Figure 1-3	Figure 1-3



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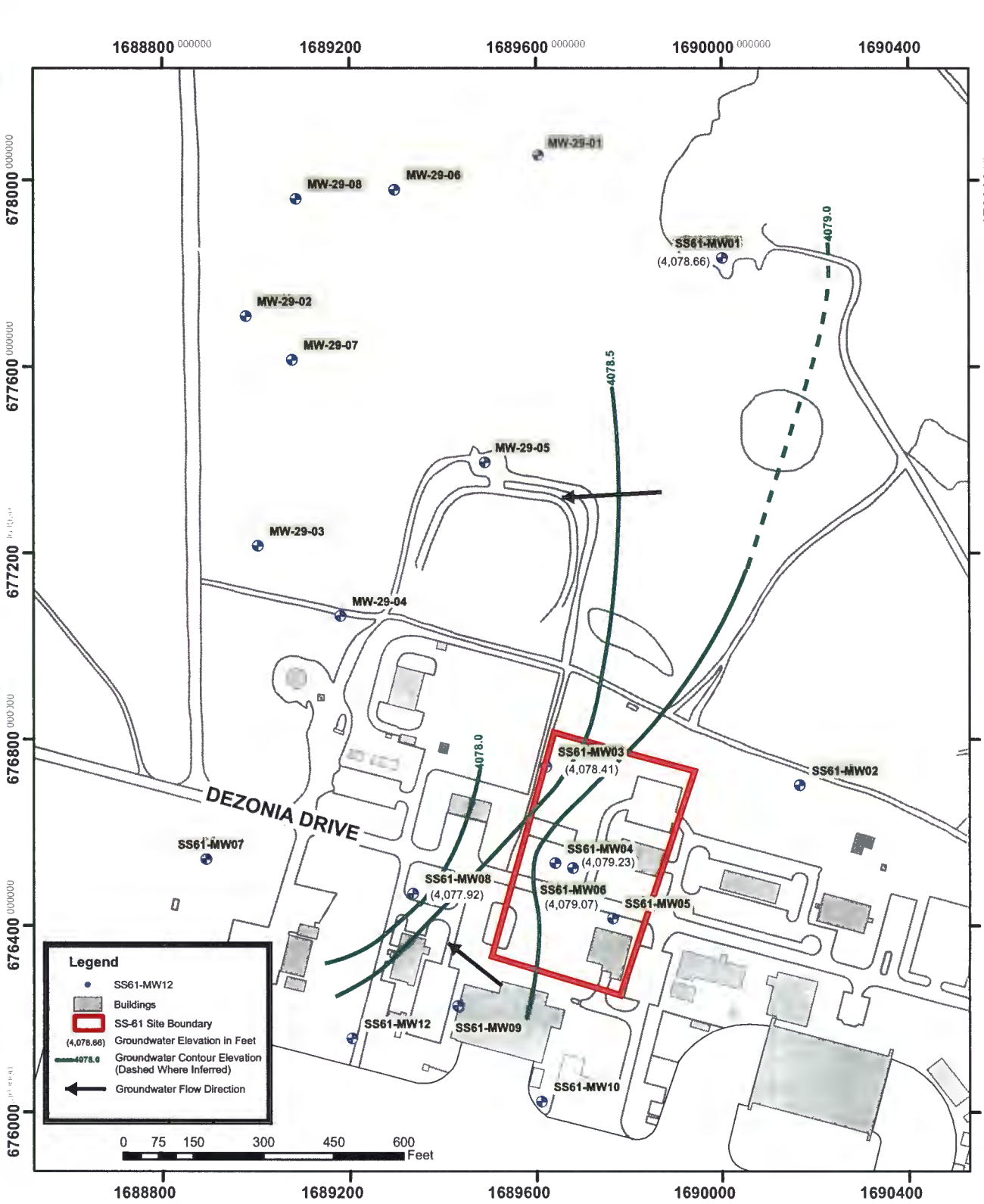
SS-61
Presumed Petroleum Contaminated Soil Source Area

PROJECT NO.	SCALE	DATE	DRAWN BY:
9050361	1"=60'	5/9/06	cm
			DRAWING NO: Figure 1-4

Voluntary Corrective Measures Work Plan
Site SS-61

Figure 1-4



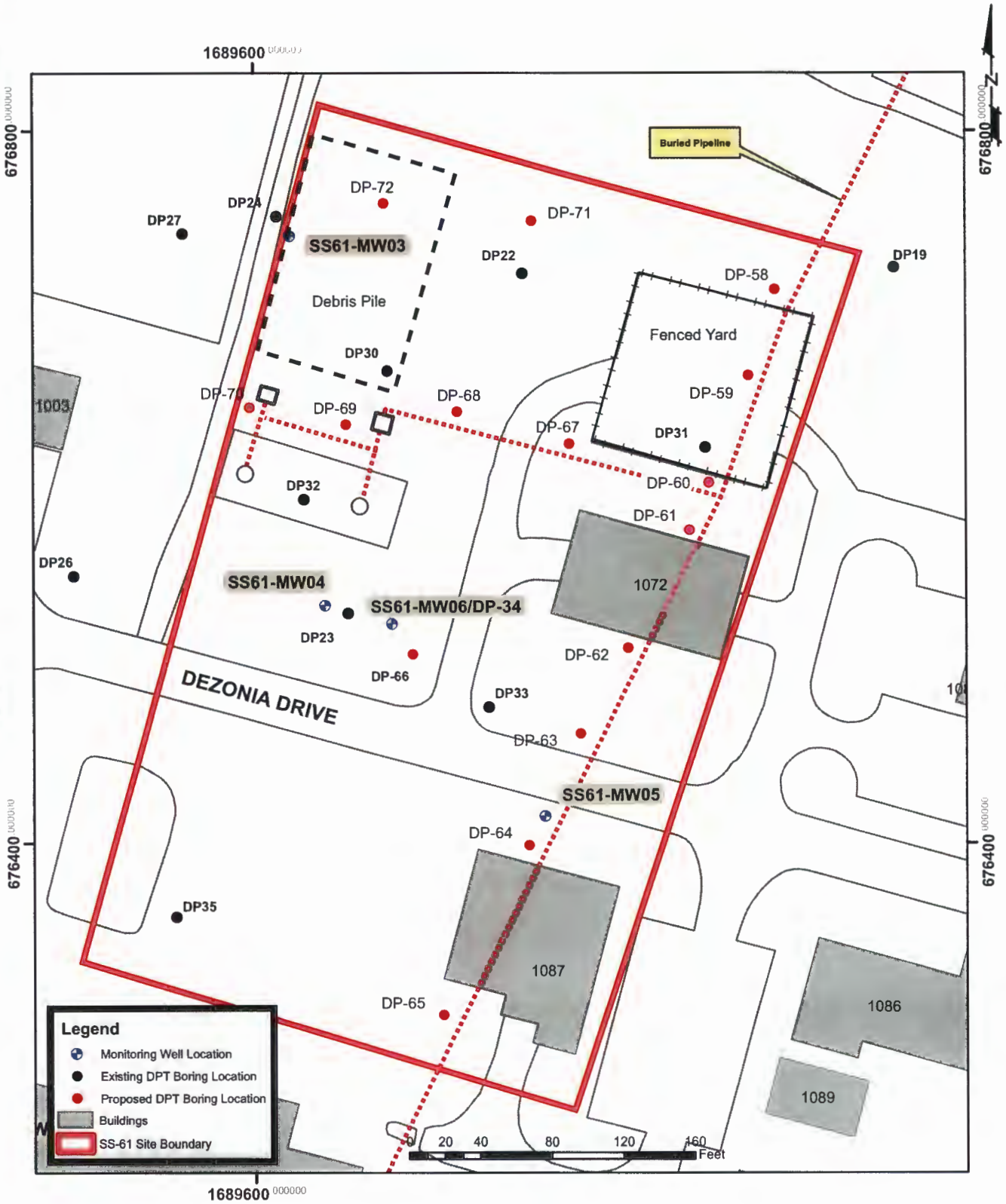
bhate associates
ENGINEERING, SCIENCE AND CONSTRUCTION

Potentiometric Surface Map (June 2004)

PROJECT NO.	SCALE	DATE	DRAWN BY:
9050361	1"=300'	5/9/06	cm
			DRAWING NO: Figure 1-5

Voluntary Corrective Measures
Work Plan
Site SS-61

Figure 1-5



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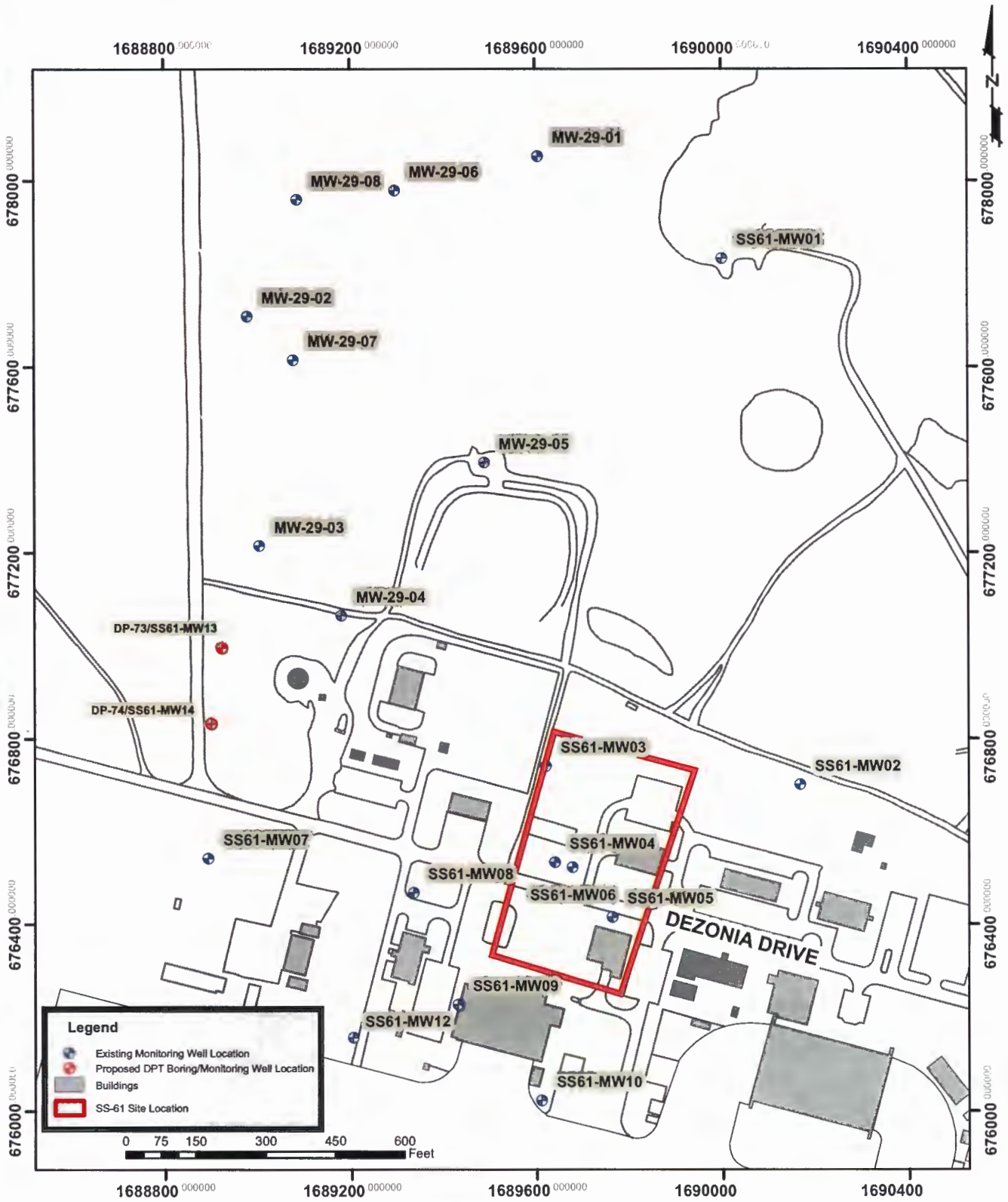
SS-61
Proposed Additional DPT Boring Locations
PCS Source Area

PROJECT NO.	SCALE	DATE	DRAWN BY:
9050361	1"=80'	5/9/06	cm
			DRAWING NO: Figure 3-1

Voluntary Corrective Measures
Work Plan
Site SS-61

Figure 3-1



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SS-61 Proposed Additional
DPT Borings and Monitoring Well Locations

PROJECT NO.	SCALE	DATE	DRAWN BY:
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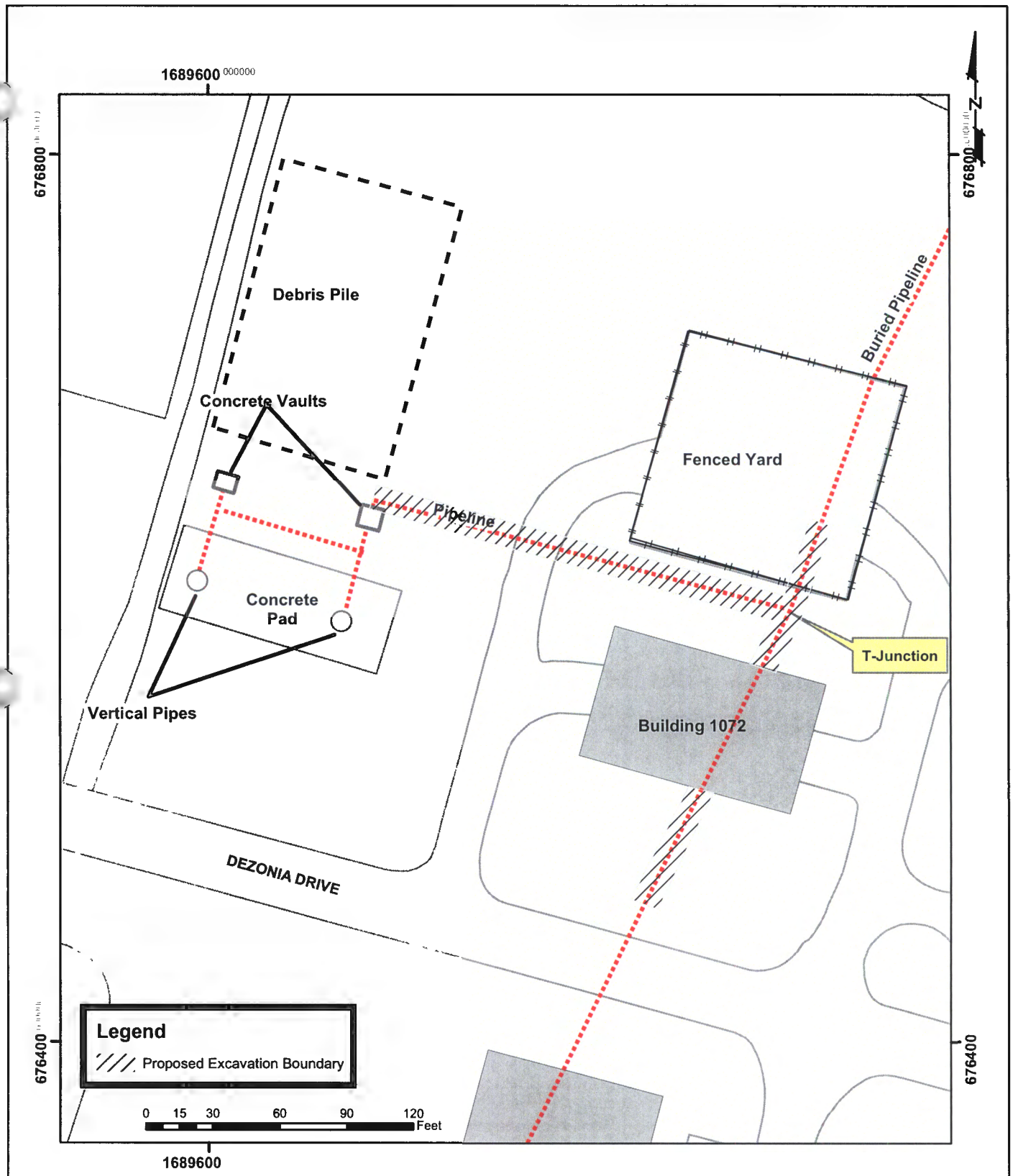
			DRAWING NO: Figure 3-2

Voluntary Corrective Measures
Work Plan
Site SS-61

Figure 3-2



bhate associates
ENGINEERING, SCIENCE AND CONSTRUCTION

SS-61
Soil Remediation and
Excavation Boundary

PROJECT NO.	SCALE	DATE	DRAWN BY:
9050361	1"=60'	5/9/06	cm
			DRAWING NO: Figure 4-1

Voluntary Corrective Measures
Work Plan
Site SS-61

Figure 4-1

APPENDIX A

HISTORICAL DATA FROM PREVIOUS INVESTIGATIONS

Appendix A-1

***Draft Final Phase I and Phase II RCRA Facility Investigation Report Site AOC-1001, Holloman Air Force Base, New Mexico,* Foster Wheeler Environmental Corporation and Groundwater Technology Government Services, Inc., December 1997.**

DRAFT FINAL
PHASE I AND PHASE II
RCRA FACILITY INVESTIGATION REPORT
SITE AOC-1001
HOLLOMAN AIR FORCE BASE, NEW MEXICO

Prepared for:

49 CES/CEVR
Holloman Air Force Base, NM

and

HQ ACC/ESVR
Langley Air Force Base, VA

Prepared by:

Foster Wheeler Environmental Corporation
143 Union Blvd., Suite 1010
Lakewood, Colorado 80228-1824

and

Groundwater Technology
Government Services, Inc.
2501 Yale Blvd., S.E.
Albuquerque, New Mexico 87106

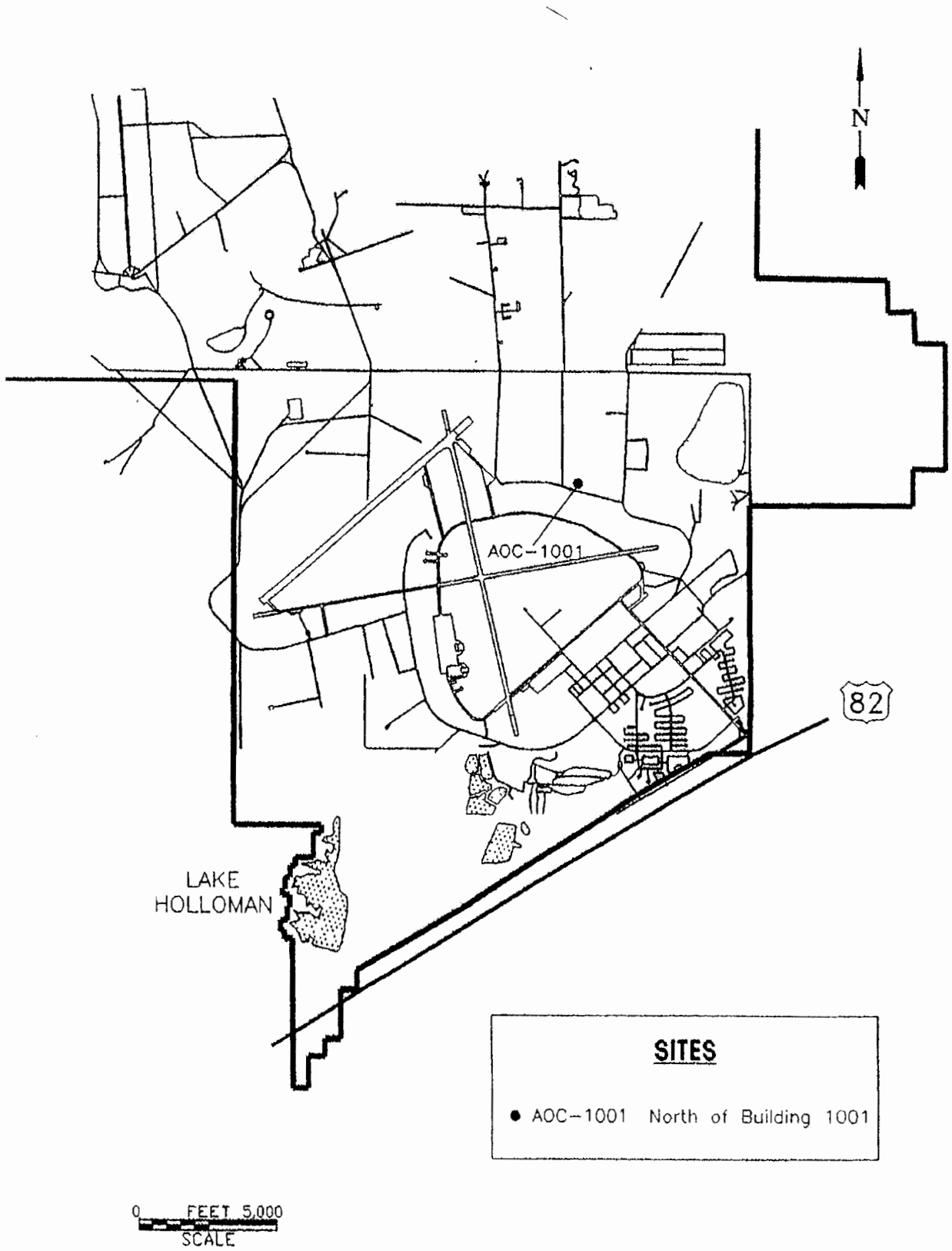
Under Contract No. DACW-45-94-D-0003

Delivery Order 8, Work Authorization Directive 29

U.S. Army Corps of Engineers
Omaha District
Omaha, Nebraska

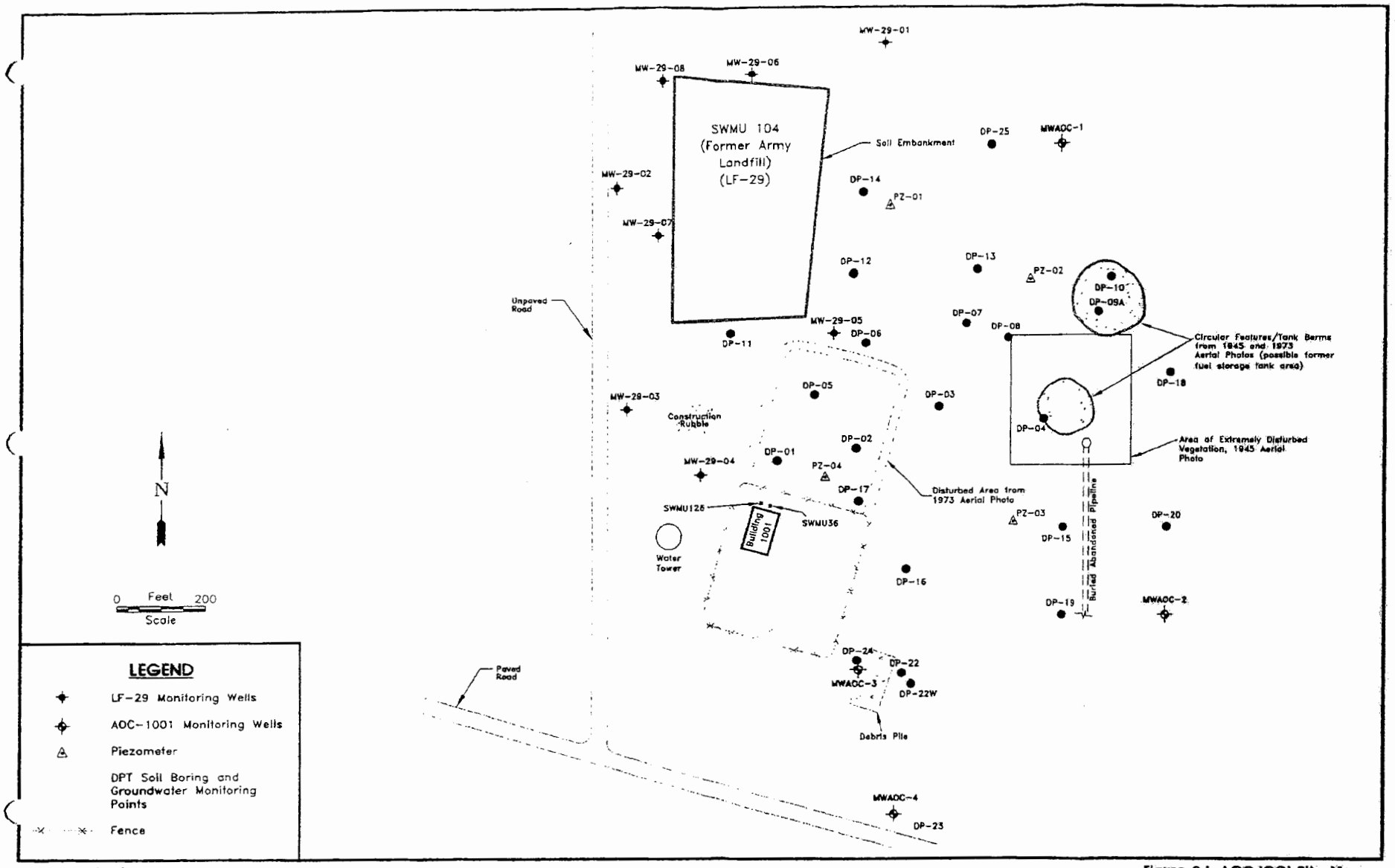
December 1997

HAFB\AOC1001.RPT



2208SITE

FIGURE 1-1. Site Location Map



0502-SP.DWG (1:200) 11-24-97

Figure 2-1: AOC-1001 Site Map

TABLE 2-1
SOIL VAPOR SURVEY ANALYTICAL RESULTS
FOR AOC-1001
HOLLOMAN AFB, NEW MEXICO
JUNE 1996

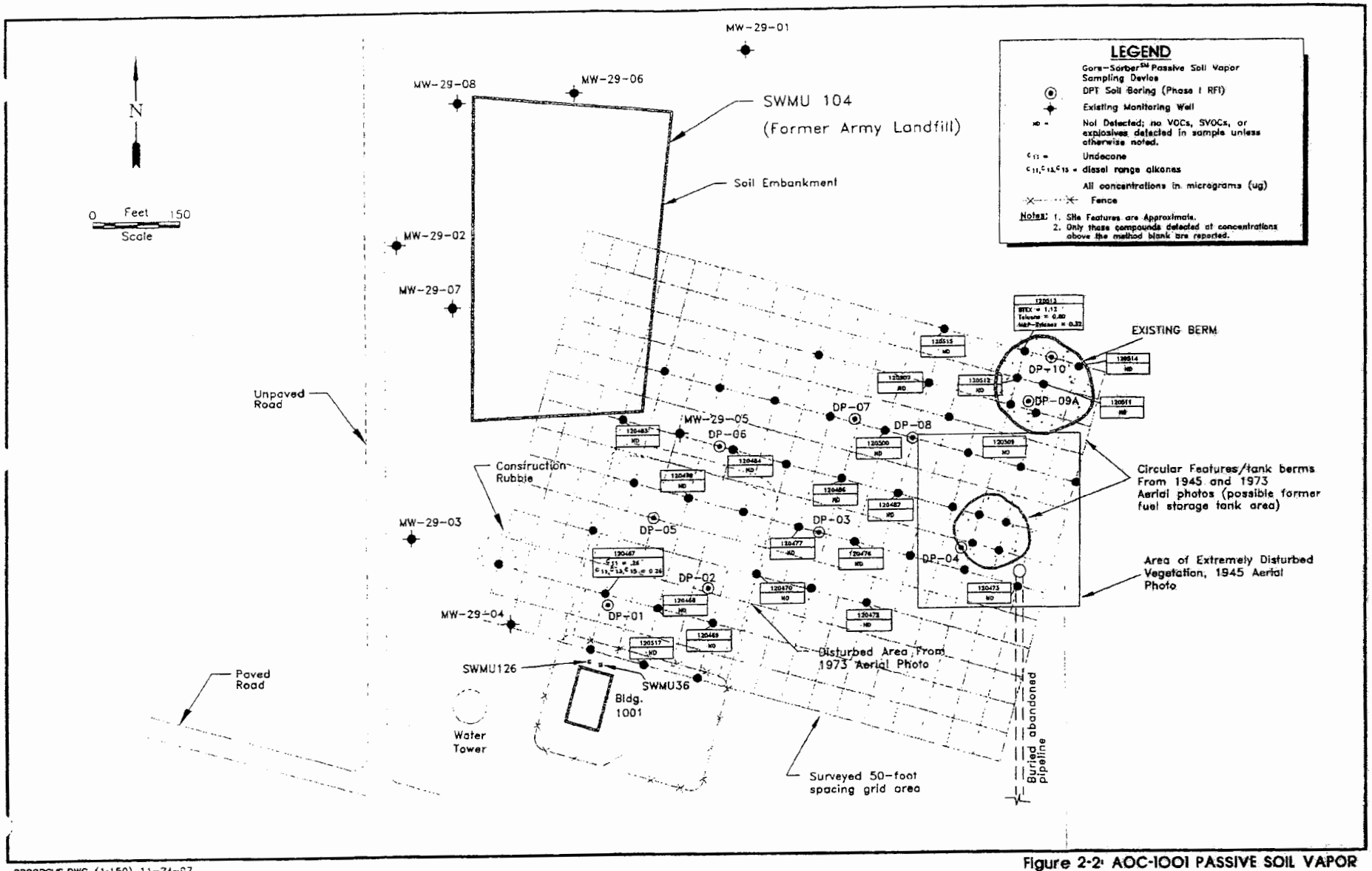
SAMPLE NO.	BTEX (µg)	TOLUENE (µg)	m+p XYLENES (µg)	C11, C13, C15 (µg)	UNDECANE (µg)
120467	0	0	0	0 26	0 26
120513	1.12	0.80	0 32	<MB	<MB

1 Samples analyzed by thermal desorption, gas chromatography, mass selective detection

2 Only those compounds with concentrations above the method blank are reported in table. Method blank "BLK1" contained 0.10 µg C11, C13, and C15 and 0 10 µg undecane.

<MB Indicates compound detected at concentration less than method blank concentration

µg Micrograms



2208PSVS.DWG (1:150) 11-24-97

Figure 2-2: AOC-1001 PASSIVE SOIL VAPOR SURVEY ANALYTICAL RESULTS, JUNE 1996

TABLE 2-2
SOIL ANALYTICAL RESULTS
FOR AOC-1001
HOLLOMAN AFB, NEW MEXICO
PHASE I RFI, JUNE 1996

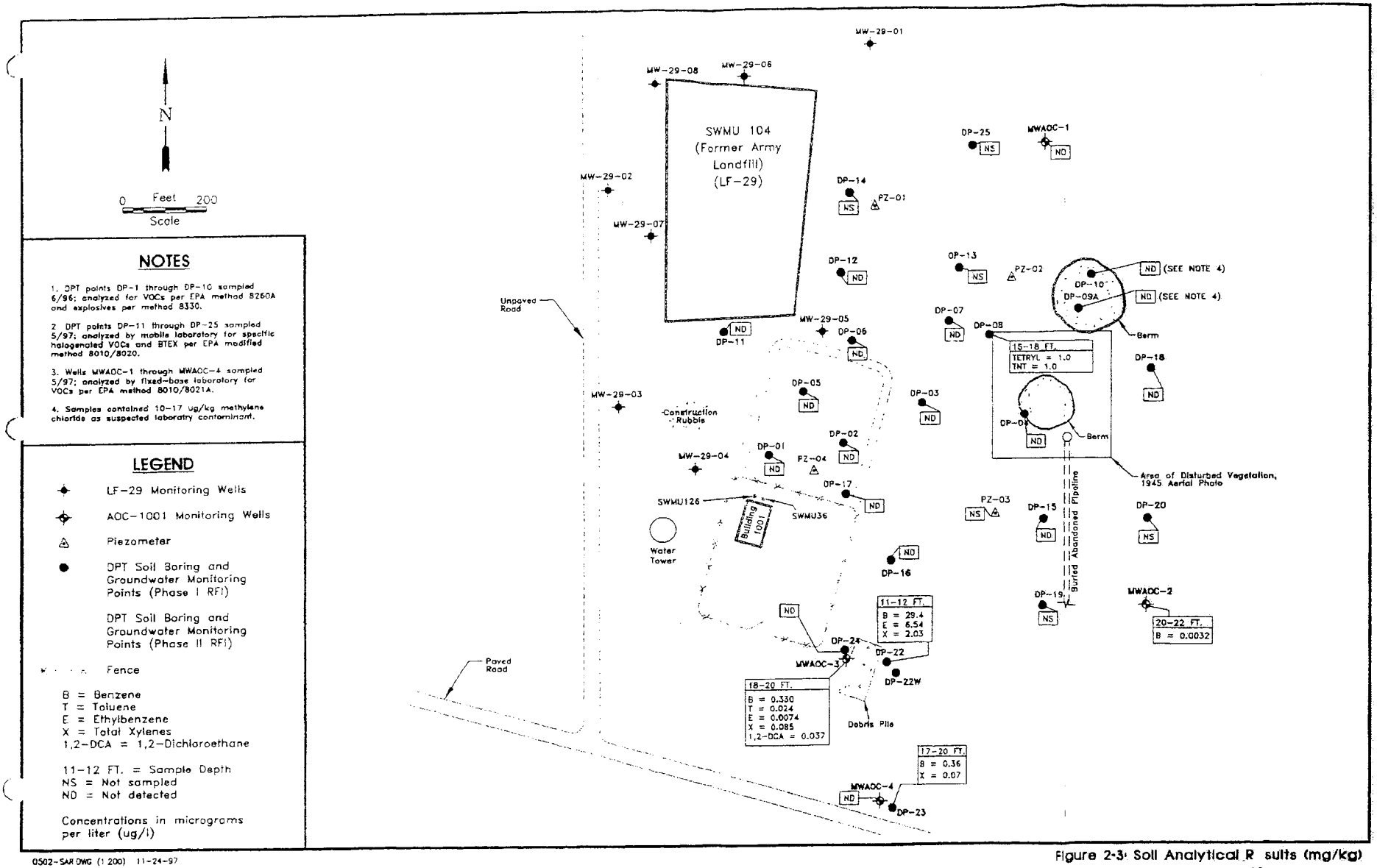
SAMPLE ID	SAMPLE DEPTH (ft)	VOCs (EPA 8260A) (µg/kg)	EXPLOSIVES (EPA 8330) (µg/kg)
1001-DP01-9-12	9-12	<RL	<QL
1001-DP01-15-18	15-18	<RL	<QL
1001-DP01-18-21	18-21	<RL	<QL
1001-DP02-9-12	9-12	<RL	<QL
1001-DP02-15-18	15-18	<RL	<QL
1001-DP02-18-21	18-21	<RL	<QL
1001-DP03-9-12	9-12	<RL	<QL
1001-DP03-15-18	15-18	<RL	<QL
1001-DP03-18-21	18-21	<RL	<QL
1001-DP04-9-12	9-12	<RL	<QL
1001-DP04-15-18	15-18	<RL	<QL
1001-DP04-24-27	24-27	<RL	<QL
1001-DP05-9-12	9-12	<RL	<QL
1001-DP05-12-15	12-15	<RL	<QL
1001-DP05-15-18	15-18	<RL	<QL
1001-DP06-6-9	6-9	<RL	<QL
1001-DP06-12-15	12-15	<RL	<QL
1001-DP06-18-21	18-21	<RL	<QL
1001-DP07-9-12	9-12	<RL	<QL
1001-DP07-15-18	15-18	<RL	<QL
1001-DP07-18-21	18-21	<RL	<QL
1001-DP08-9-12	9-12	<RL	<QL
1001-DP08-15-18	15-18	<RL	Tetryl 1,000 TNT 1,000

TABLE 2-2 (Concluded)
SOIL ANALYTICAL RESULTS
FOR AOC-1001
HOLLOMAN AFB, NEW MEXICO
PHASE I RFI, JUNE 1996

SAMPLE ID	SAMPLE DEPTH (ft)	VOCs (EPA 8260A) (µg/kg)	EXPLOSIVES (EPA 8330) (µg/kg)
1001-DP08-21-24	21-24	<RL	<QL
1001-DP09A-18-21	18-21	<RL	<QL
1001-DP09A-21-24	21-24	Methylene chloride 13 (1)	<QL
1001-DP09A-24-27	24-27	Methylene chloride 17	<QL
1001-DP10-18-21	18-21	Methylene chloride 10	<QL
1001-DP10-21-24	21-24	Methylene chloride 15	<QL
1001-DP10-24-27	24-27	Methylene chloride 17	<QL

1 Only detected constituents are presented in the table.
(1) Methylene chloride detected in method blank at 3.86 µg/l

< Indicates compound not detected at or above the RL
QL Quantitation limit
RL Reporting limit
TNT 2,4,6-Trinitrotoluene
ug/kg Micrograms per kilogram
VOCs Volatile organic compounds



0502-SAR DWG (1:200) 11-24-97

Figure 2-3: Soil Analytical Results (mg/kg)

TABLE 2-3
SOIL ANALYTICAL RESULTS
FOR AOC-1001
HOLLOMAN AFB, NEW MEXICO
PHASE II RFI - MOBILE LABORATORY
MAY 1997

SAMPLE ID	SAMPLE DEPTH (ft)	VOCs (EPA Modified 8010/8020) (mg/kg)
AOC-1001 DP-11 16-19	16-19	ND
AOC-1001 DP-11 16-19DUP	16-19	ND
AOC-1001 DP-12 16-19	16-19	ND
AOC-1001 DP-13	No Sample	NA
AOC-1001 DP-14	No Sample	NA
AOC-1001 DP-15 18-21	18-21	ND
AOC-1001 DP-16 12-15	12-15	ND
AOC-1001 DP-17 14-17	14-17	ND
AOC-1001 DP-18 19-22	19-22	ND
AOC-1001 DP-18 19-22DUP	19-22	ND
AOC-1001 DP-19	No Sample	NA
AOC-1001 DP-20	No Sample	NA
AOC-1001 DP-22 11-12	11-12	Benzene 29.4 Ethylbenzene 6.54 Xylenes 2 03
AOC-1001 DP-23 17-20	17-20	Benzene 0 36 Xylenes 0.07
AOC-1001 DP-24 17-20	17-20	ND
AOC-1001 DP-25	No Sample	NA

1 Only detected constituents are presented in the table

DUP Duplicate sample
mg/kg Milligrams per kilogram
NA Not analyzed
ND Not detected at the detection limit
VOCs Volatile organic compounds

TABLE 2-4
SOIL ANALYTICAL RESULTS
FOR AOC-1001
HOLLOMAN AFB, NEW MEXICO
PHASE II RFI - FIXED-BASE LABORATORY
MAY 1997

SAMPLE ID	SAMPLE DEPTH (ft)	VOCs (EPA 8010/8021A) (µg/kg)	
AOC1001DP11	16-19	<RL	
AOC1001DP18	19-22	<RL	
MWAOC-1	30-32	<RL	
MWAOC-2	20-22	benzene	3 2
MWAOC-3	18-20	benzene	330
		toluene	24
		ethylbenzene	7.4
		xylenes	85
		1,2-DCA	37
MWAOC-4	15-17	<RL	

1 Only detected constituents are presented in the table

< Indicated compound not detected at or above the RL
1,2-DCA 1,2-Dichloroethane
RL Reporting limit
ug/kg Micrograms per kilogram
VOCs Volatile organic compounds

TABLE 2-5
GROUNDWATER ANALYTICAL RESULTS
FOR AOC-1001
HOLLOMAN AFB, NEW MEXICO
PHASE I RFI, JUNE 1996

ANALYTES	1001-GP01	1001-GP02	1001-GP03	1001-GP04	1001-GP05	1001-GP06	1001-GP07	1001-GP08	1001-GP09A	1001-GP10
VOCs - EPA Method 8260A (µg/l)										
Benzene	<5.0	7,200	3,400	96	<5.0	6,000	1,900	570	80	<5.0
Ethylbenzene	<5.0	890	<5.0	<5 0	<5.0	<50	<5.0	<5.0	<5.0	<5 0
Toluene	<5 0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Total xylenes	<5.0	13	31	<5.0	<5 0	18	<5.0	<5.0	<5.0	<5.0
1,2-Dichloroethane	<5.0	<5.0	<5.0	<5.0	140	<50	<5.0	<5.0	18	<5.0
Explosives - EPA Method 8330 (µg/l)										
All constituents	<QL	<QL	<QL	<QL	<QL	<QL	<QL	<QL	<QL	<QL

1 Only detected constituents are presented in the table.

< Indicates compound not detected at the stated reporting limit or quantitation limit
QL Quantitation limit
µg/l Micrograms per liter
VOCs Volatile organic compounds

TABLE 2-6
GROUNDWATER ANALYTICAL RESULTS - DPT POINTS
FOR AOC-1001
HOLLOMAN AFB, NEW MEXICO
PHASE II RFI, MAY 1997

ANALYTES	AOC-1001 GP-11 (1)	AOC-1001 GP-11Dup	AOC-1001 GP-12	AOC-1001 GP-12Dup	AOC-1001 GP-13	AOC-1001 GP-14	AOC-1001 GP-15 (1)	AOC-1001 (1) GP-16	AOC-1001 GP-17	AOC-1001 GP-18	AOC-1001 GP-18Dup
VOCs - EPA Method 8010/8020 (µg/l) (Mobile Laboratory)											
Benzene	7.9	10.1	1,900*	2,200	704	1,420	2.8	4,080	3,900	<1	<1
Ethylbenzene	<1	<1	<1	<50	<1	<1	<1	308	40	<1	<1
Toluene	<1	<1	<1	<50	<1	<1	<1	2,600	<1	<1	<1
Total xylenes	<1	<1	<1	<50	4 9	30	<1	2,400	17	<1	<1
1,2-Dichloroethane	87	104	118*	102	47	60	3 8	178	315	<1	<1
Trichloroethene	<1	<1	<1	<50	<1	<1	5.6	<1	<1	<1	<1
Explosives - EPA Method 8330 (µg/l) (Fixed-Base Laboratory)											
All constituents	ND	NA	ND	NA	ND	ND	ND	NA	NA	NA	NA

TABLE 2-6 (Continued)
GROUNDWATER ANALYTICAL RESULTS - DPT POINTS
FOR AOC-1001
HOLLOMAN AFB, NEW MEXICO
PHASE II RFI, MAY 1997

ANALYTES	AOC-1001 GP-19	AOC-1001 GP-20	AOC-1001 GP-22	AOC-1001 GP-23	AOC-1001 GP-24	AOC-1001 GP-25
VOCs - EPA Method 8010A/8020A (µg/l) (Mobile Laboratory)						
Benzene	922	59	8,640	640	5,100	<1
Ethylbenzene	336	<1	523	140	230	<1
Toluene	<1	<1	3,620	460	1,030	<1
Total xylenes	6	<1	1,140	940	3,800	<1
1,2-Dichloroethane	13.1	<1	310	21	288	<1
Trichloroethene	<1	14	<80	<1	<20	<1
Explosives - EPA Method 8330 (µg/l) (Fixed-Base Laboratory)						
RDX	NA	NA	35	NA	NA	NA
Nitrobenzene	NA	NA	7 4	NA	NA	NA
1,3,5-Trinitrobenzene	NA	NA	13	NA	NA	NA
Tetryl	NA	NA	1.6*	NA	NA	NA
All other constituents	NA	NA	ND	NA	NA	NA

TABLE 2-6 (Concluded)
GROUNDWATER ANALYTICAL RESULTS - DPT POINTS
FOR AOC-1001
HOLLOMAN AFB, NEW MEXICO
PHASE II RFI, MAY 1997

*	Concentration is estimated
1	Only detected constituents are presented in the table.
(1)	Split samples also analyzed at fixed-base laboratory (EPA 8010/8021A) Compounds detected include (µg/l):

DP-11		DP-15	
methylene chloride	3.6	chloroform	0.24
chloroform	1 1	1,2-DCA	5.3
1,2-DCA	57	1,1-DCA	0.41
benzene	1 4	TCE	14
		1,3-dichlorobenzene	1.1
		1,2-dichlorobenzene	8.9
		benzene	4.6
		ethlybenzene	0.21

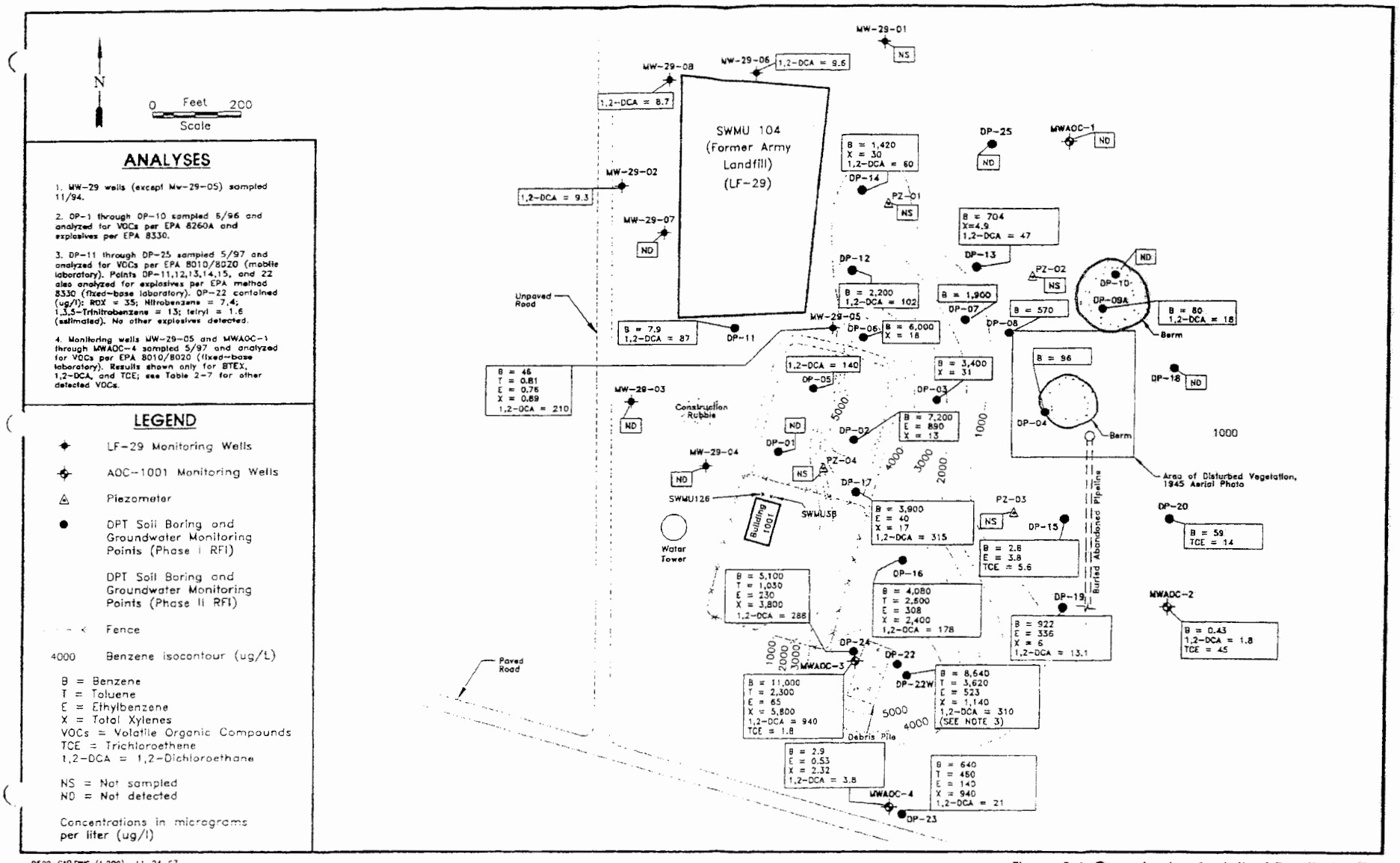
(2)	Sample also analyzed for gasoline, diesel, and oil by Modified EPA Method 8015 (mobile laboratory) Only gasoline detected at 41,000 µg/l.
<	Indicates compound not detected at the stated reporting limit.
NA	Not analyzed
ND	Not detected to the sample detection limit
µg/l	Micrograms per kilogram
VOCs	Volatile organic compounds

TABLE 2-7
GROUNDWATER ANALYTICAL RESULTS - MONITORING WELLS FOR AOC-1001 HOLLOMAN AFB, NEW MEXICO PHASE II RFI, JUNE 1997

ANALYTES	MW-29-05	MWAOC-1	MWAOC-2	MWAOC-3	MWAOC-4	MWAOC-4 DP
VOCs - EPA Method 8010/8020 (µg/l)						
Benzene	46	<RL	0.43	11,000	2 9	2.2
Toluene	0.81	<RL	<RL	2,300	<RL	<RL
Ethylbenzene	0 76	<RL	<RL	65	0.53	<RL
Total xylenes	0.89	<RL	<RL	5,800	2 32	3.2
Chloroform	0.26	<RL	2.5	3.6	0.52	0.29
1,2-Dichloroethane	210	<RL	1.8	940	3 8	3.4
1,2-Dichloropropane	0 40	<RL	<RL	1 6	<RL	<RL
Dibromomethane	0.30	<RL	<RL	6.8	<RL	<RL
cis-1,3-Dichloropropene	0.27	<RL	<RL	<RL	<RL	<RL
trans-1,3-Dichloropropene	0.22	<RL	<RL	<RL	<RL	<RL
Chlorobenzene	0.65	<RL	<RL	<RL	<RL	<RL
Chloromethane	<RL	<RL	0.22	<RL	0 20	<RL
1,1-Dichloroethane	<RL	<RL	1.1	<RL	<RL	<RL
Trichloroethene	<RL	<RL	45	1 8	<RL	<RL
1,3-Dichlorobenzene	<RL	<RL	1.9	<RL	<RL	<RL
1,4-Dichlorobenzene	<RL	<RL	1.2	<RL	<RL	<RL
1,2-Dichlorobenzene	<RL	<RL	5.3	<RL	<RL	<RL
Chloroethane	<RL	<RL	<RL	5 4	<RL	<RL
Bromoform	<RL	<RL	<RL	1 6	<RL	<RL

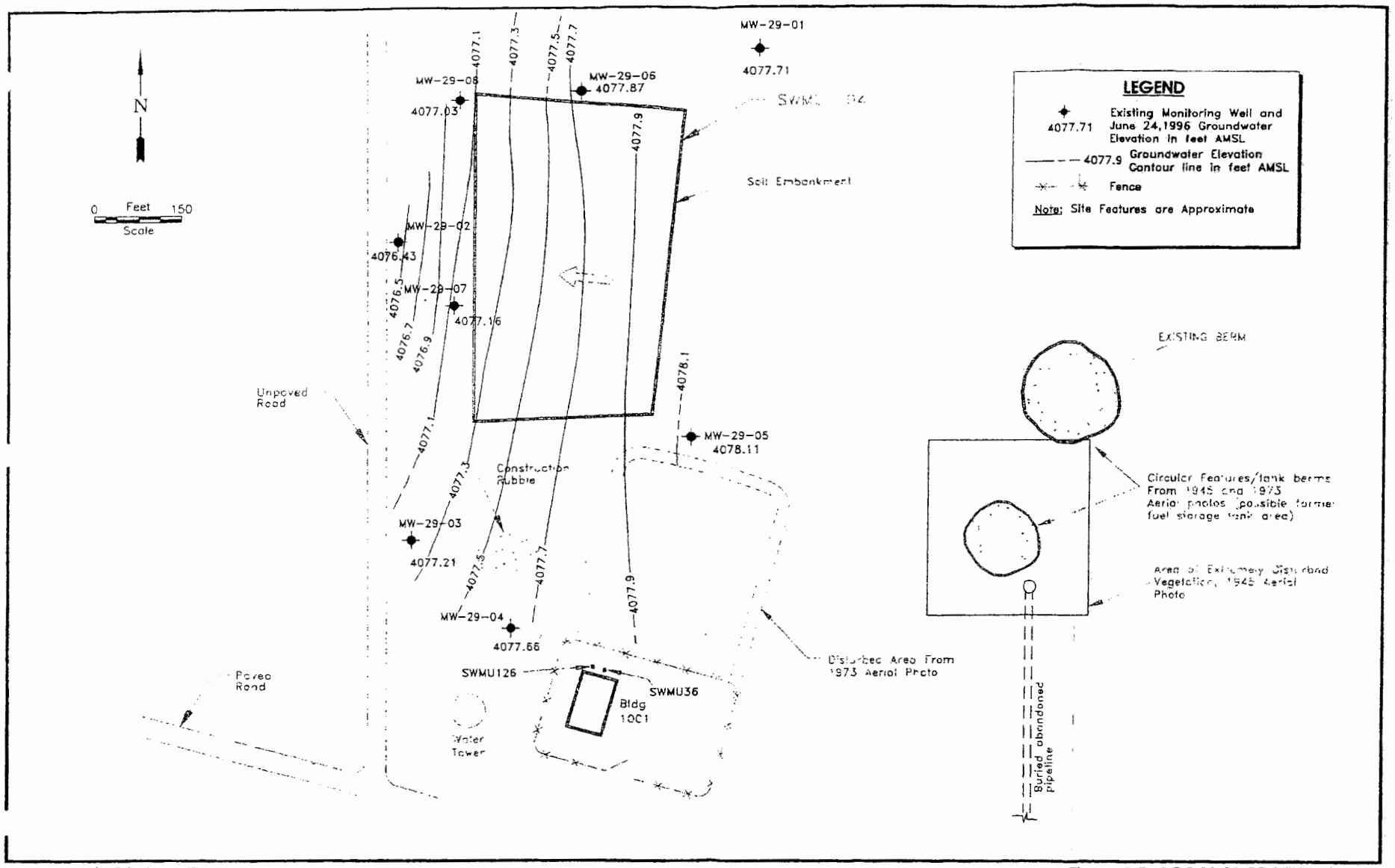
1 Only detected constituents are presented in the table.

< Indicates compound not detected at the stated reporting limit
DP Duplicate sample
RL Reporting Limit
VOC Volatile organic compounds
µg/l Micrograms per liter



0502-GAR DWG (1:200) 11-24-97

Figure 2-4: Groundwater Analytical Results (ug/l)



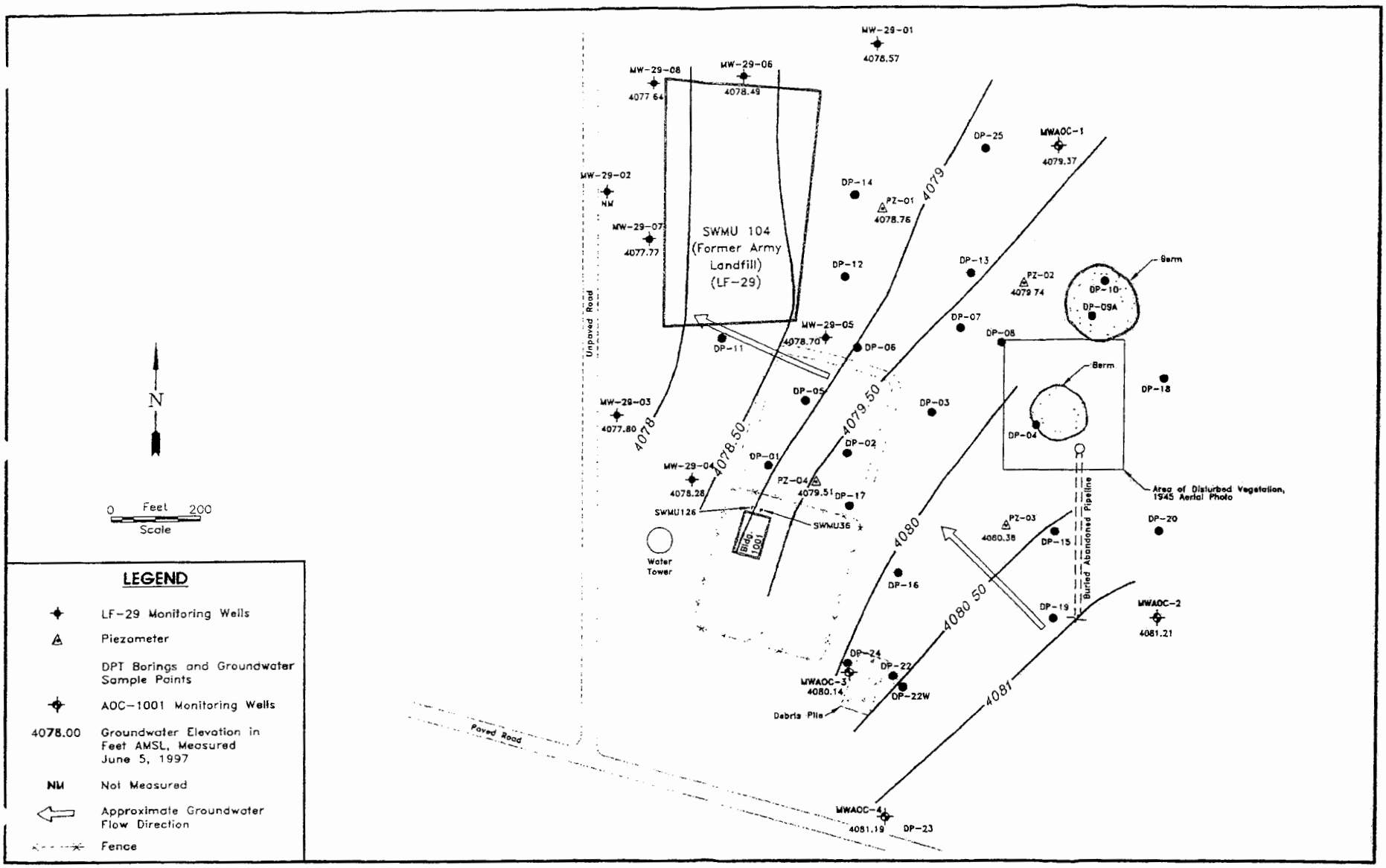
2208GCM DWG (1:150) 11-24-97

Figure 2-5: AOC-1001 GROUNDWATER CONTOUR MAP

TABLE 2-8
GROUNDWATER LEVEL DATA
FOR AOC-1001
HOLLOMAN AFB, NEW MEXICO
1996-1997

Well	TOC Elevation (ft)	DTW (ft)		Groundwater Elevation (ft)	
		6/24/96	6/5/97	6/24/96	6/5/97
MW-29-01	4103.42	25.71	24.85	4077 71	4078 57
MW-29-02	4097.81	21 41	NM	4076.40	NM
MW-29-03	4097 14	19.93	19 34	4077.21	4077.80
MW-29-04	4098 54	20.90	20.26	4077.64	4078.28
MW-29-05	4101.70	23 59	23 00	4078.11	4078.70
MW-29-06	4101 94	24.07	23.45	4077.87	4078.49
MW-29-07	4098.56	21.40	20.79	4077.16	4077.77
MW-29-08	4100.72	23.69	23.08	4077.03	4077.64
AOC-MW-1	4110 06	NA	30.69	NA	4079.37
AOC-MW-2	4103.11	NA	21.90	NA	4081.21
AOC-MW-3	4098.41	NA	18.27	NA	4080.14
AOC-MW-4	4095.41	NA	14.22	NA	4081.19
PZ-01	4104.17	NA	25.41	NA	4078 76
PZ-02	4110 08	NA	30 34	NA	4079.74
PZ-03	4103.10	NA	22.72	NA	4080.38
PZ-04	4100.64	NA	21.13	NA	4079.51

DTW Depth to water
NA Not analyzed
NM Not measured
TOC Top of casing elevation



0502-JUN DWG (1:200) 11-24-97

Figur 2-6 Groundwat r Countour Map
Jun 1997

Appendix A-2

Final Remedial Investigation Report for Spill Site 61, **Foster Wheeler Environmental Corporation, August 1999.**

AR 1065

FINAL
REMEDIAL INVESTIGATION REPORT
FOR SPILL SITE 61

Prepared for:

49 CES/CEVR

Holloman Air Force Base, NM

and

HQ ACC CES/ESV

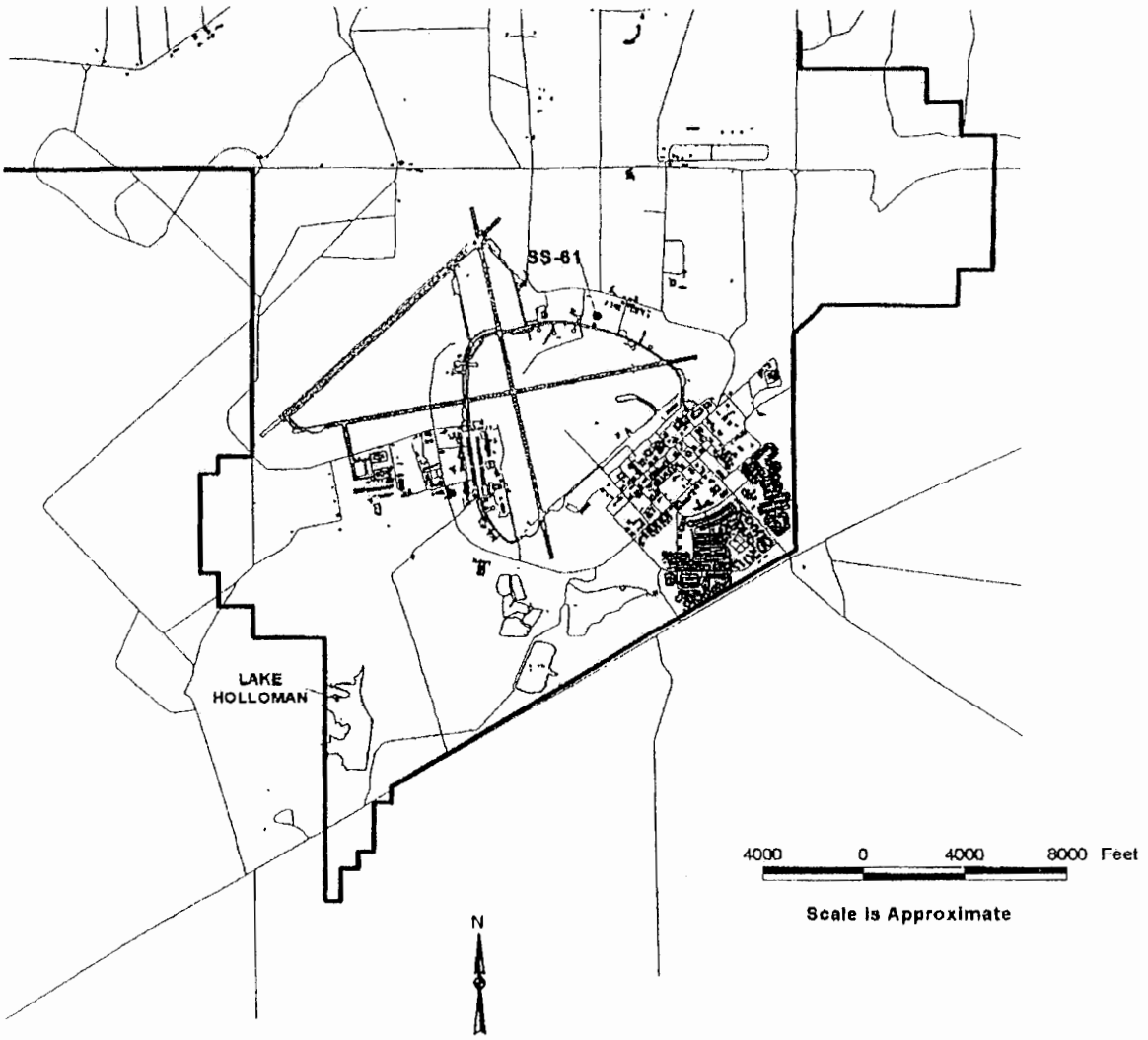
Langley Air Force Base, VA

Prepared by:

Foster Wheeler Environmental Corporation
143 Union Blvd., Suite 1010
Lakewood, CO 80228-1824

Contract No. DACW45-94-D-0003
Delivery Order 22, Work Authorization Directive 03
U.S. Army Corps of Engineers
Omaha District
Omaha, NE

August 1999



Roads

Airfield

Water Bodies

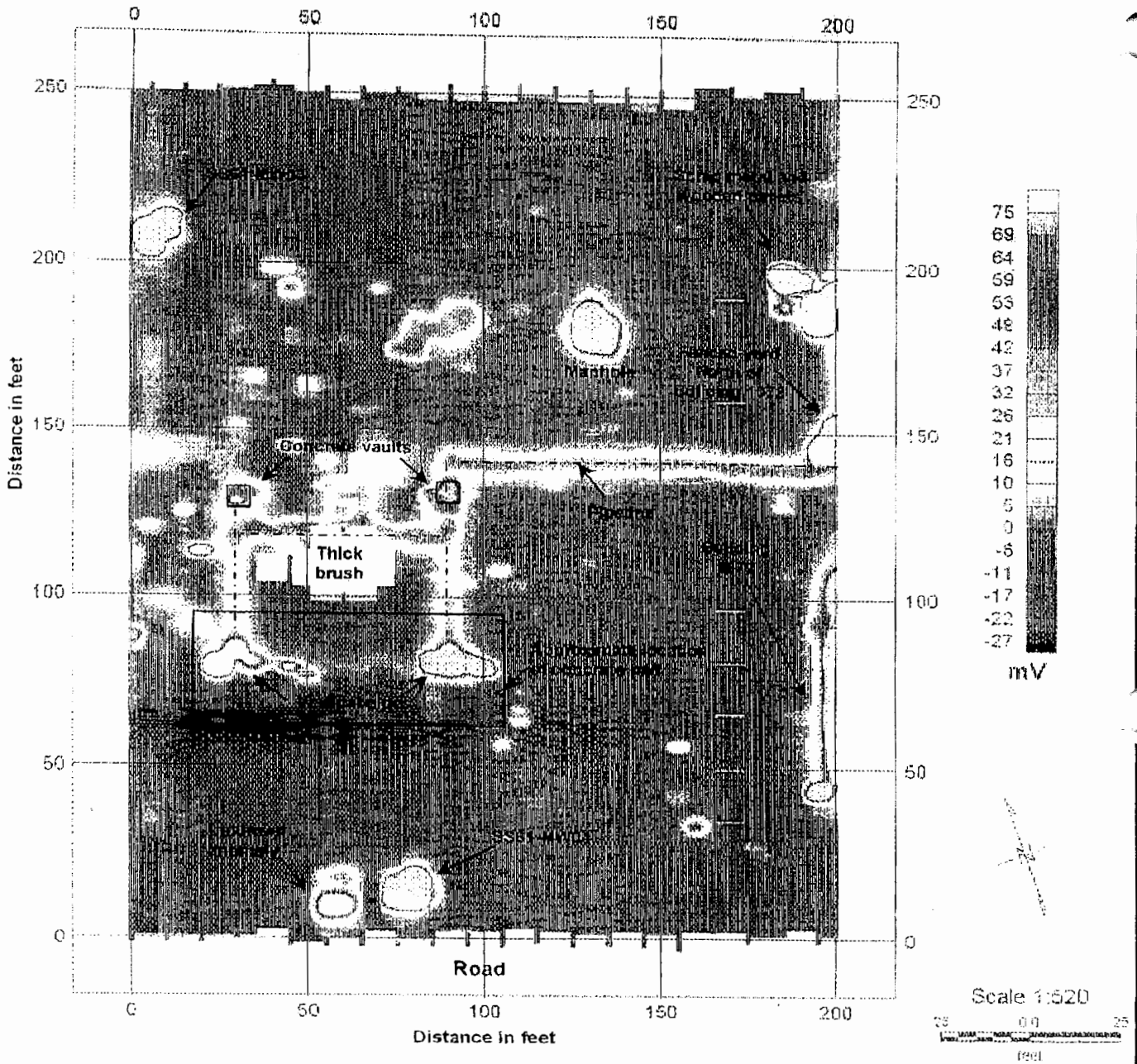
Buildings

Installation Boundary

SS-61 REMEDIAL INVESTIGATION REPORT
Holloman Air Force Base, New Mexico
U.S. Army Corps of Engineers, Omaha District

Figure 1-2
SS-61 Location Map

Foster Wheeler Environmental Corporation



Note: Survey completed in March 1999

SS-61 REMEDIAL INVESTIGATION REPORT
Holloman Air Force Base, New Mexico
U.S. Army Corps of Engineers, Omaha District

Figure 2-1
Geophysical Survey and Cultural Features

Foster Wheeler Environmental Corporation

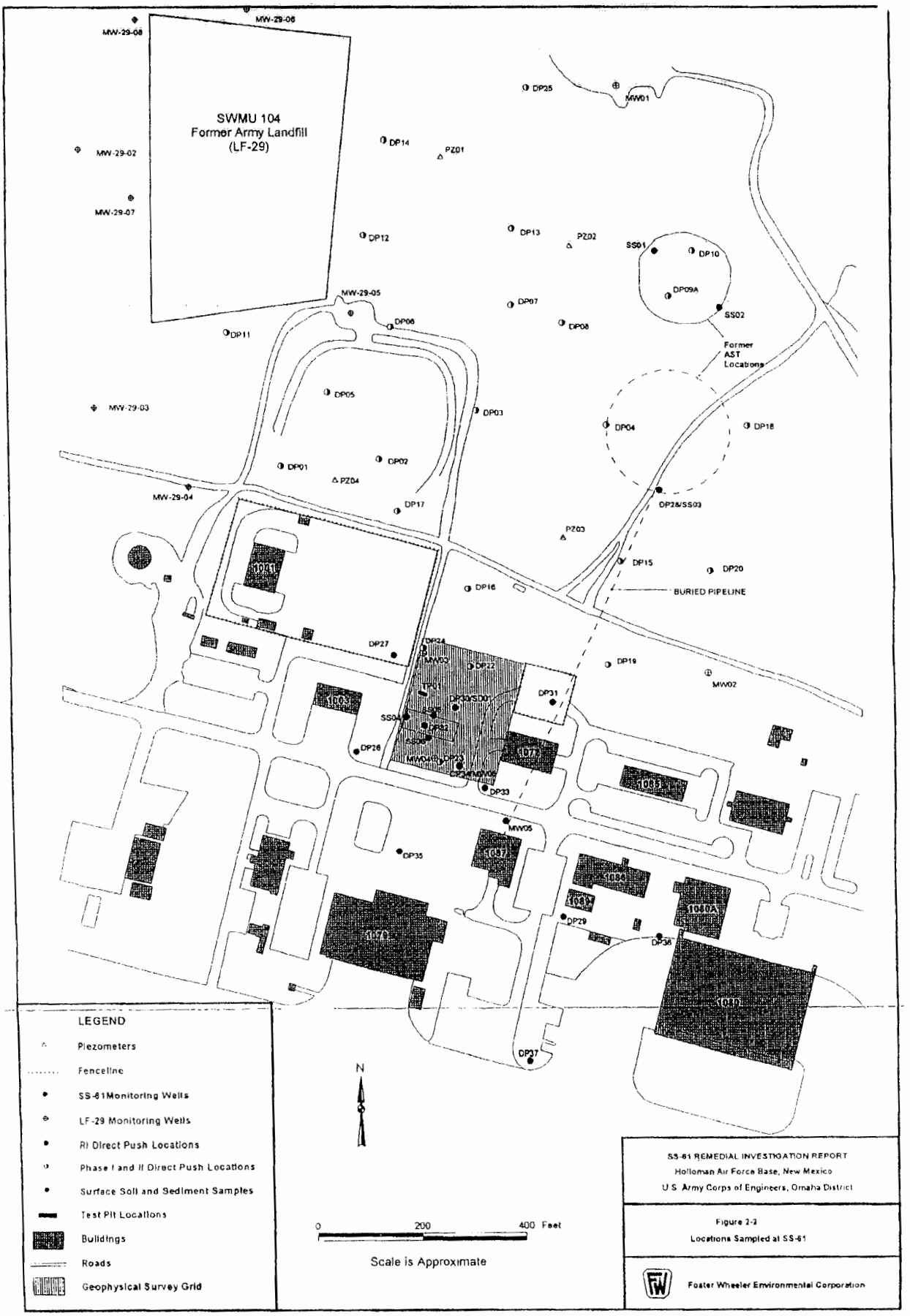

SWMU 104
Former Army Landfill
(LF-29)
MW-29-08
MW-29-06
MW-29-02
MW-29-07
MW-29-05
MW-29-03
MW-29-04
DP25
MW01
DP14
PZ01
DP12
DP13
PZ02
SS01
DP10
DP09A
SS02
DP07
DP08
DP06
DP11
Former
AST
Locations
DP05
DP03
DP04
DP18
DP01
DP02
PZ04
DP17
DP28/SS03
PZ03
DP15
DP20
DP16
BURIED PIPELINE
DP27
DP24
MW03
DP22
DP19
MW02
DP31
DP30/SD01
SS04
DP32
DP26
MW04
DP23
DP33
MW05
DP35
DP29
DP36
DP37
N
LEGEND
Piezometers
Fenceline
SS-61Monitoring Wells
LF-29 Monitoring Wells
RI Direct Push Locations
Phase I and II Direct Push Locations
Surface Soil and Sediment Samples
Test Pit Locations
Buildings
Roads
Geophysical Survey Grid
0
200
400 Feet
Scale is Approximate
SS-61 REMEDIAL INVESTIGATION REPORT
Holloman Air Force Base, New Mexico
U.S. Army Corps of Engineers, Omaha District
Figure 2-2
Locations Sampled at SS-61
Foster Wheeler Environmental Corporation

Table 3-1

SS-61 Groundwater Elevation Data Collected in 1996, 1997, and 1999

Well	TOC Elevation (feet msl)	Depth to Water from TOC (feet)			Groundwater Elevation (feet msl)		
		June 1996	June 1997	April 1999	June 1996	June 1997	April 1999
SS61-MW01	4110 06	--	30.69	30 52	--	4079.37	4079 54
SS61-MW02	4103 11	--	21.90	22.50	--	4081.21	4080.61
SS61-MW03	4098 41	--	18.27	19.12	--	4080.14	4079 29
SS61-MW04	4095.41	--	14 22	19 10	--	4081.19	4076.31
SS61-MW05	4097.68	--	--	16 50	--	--	4081.18
SS61-MW06	4096.32	--	--	16 10	--	--	4080.22
MW-29-01	4103.42	25.71	24.85	--	4077.71	4078.57	--
MW-29-02	4097 81	21.41	--	20.93	4076.40	--	4076 88
MW-29-03	4097.14	19 93	19.34	19.64	4077.21	4077.80	4077.50
MW-29-04	4098.54	20.90	20 26	--	4077 64	4078.28	--
MW-29-05	4101.70	23 59	23.00	23 02	4078.11	4078 70	4078 68
MW-29-06	4101.94	24.07	23.45	23.32	4077 87	4078 49	4078.62
MW-29-07	4098 56	21.40	20 79	--	4077.16	4077.77	--
MW-29-08	4100.72	23 69	23 08	--	4077.03	4077.64	--
PZ-01	4104.17	--	25 41	--	--	4078.76	--
PZ-02	4110.08	--	30.34	--	--	4079 74	--
PZ-03	4103.10	--	22.72	--	--	4080 38	--
PZ-04	4100 64	--	21 13	--	--	4079.51	--

Notes

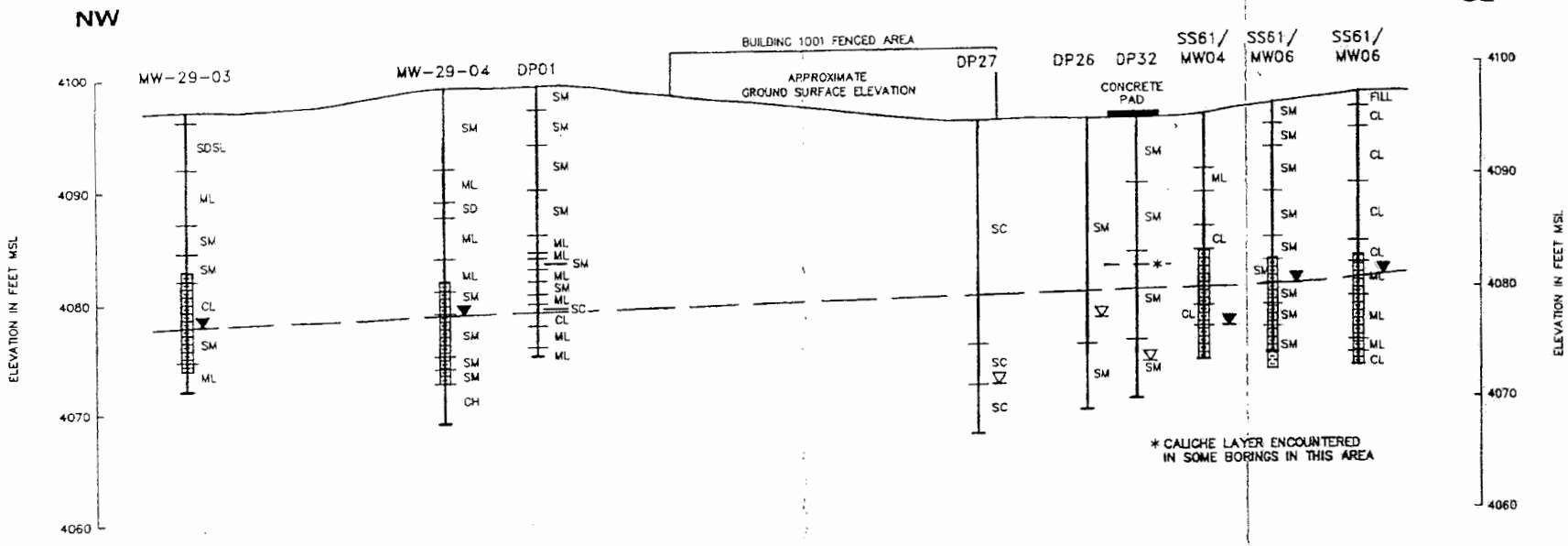
-- = not measured

msl = mean sea level

MW = monitoring well

PZ = piezometer

TOC = top of polyvinyl chloride casing



LEGEND

SM SILTY SAND, SAND SILT MIXTURE

SC CLAYEY SAND, SAND CLAY MIXTURE

CL LEAN CLAY, INORGANIC CLAY OF LOW-MEDIUM PLASTICITY, GRAVELLY CLAY, SANDY CLAY, SILTY CLAY

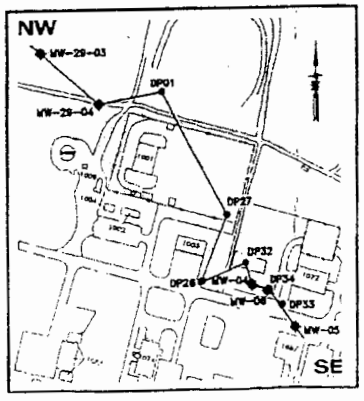
ML SILT AND VERY FINE SAND, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY

CH FAT CLAY, INORGANIC CLAY OF HIGH PLASTICITY

▽ WATER LEVEL DURING DRILLING

▼ GROUND WATER LEVEL (MEASURED IN APRIL 1999 EXCEPT FOR MW-29-04, MEASURED JUNE 1997

SCREENED INTERVAL



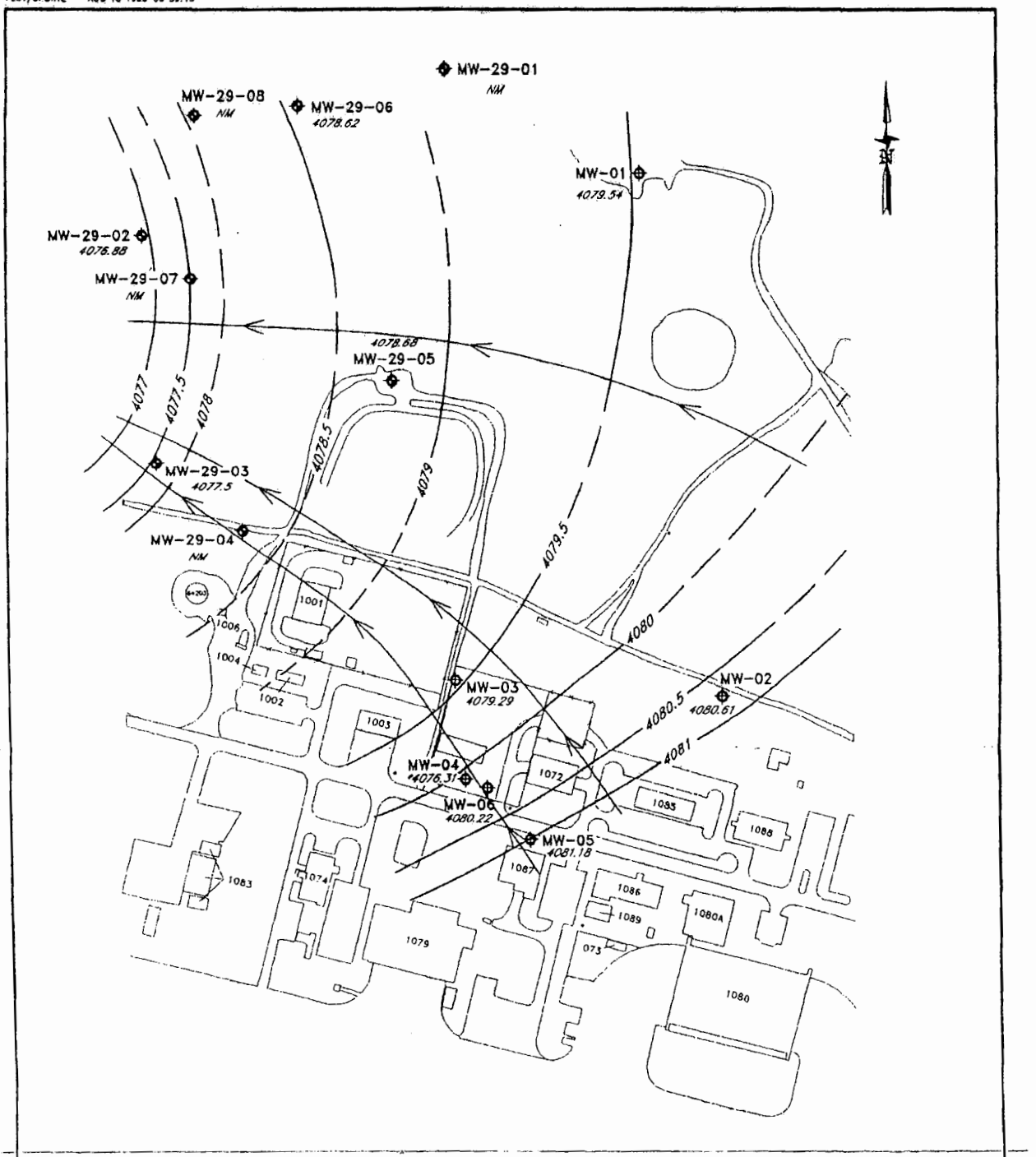
CROSS-SECTION LOCATION MAP
NTS

0 50 100 200
HORIZONTAL SCALE IN FEET

FOSTER WHEELER ENVIRONMENTAL ORPORATION	SS-61 REMEDIAL INVESTIGATION REPORT U. S. ARMY CORPS. OF ENGINEERS OMAHA DISTRICT	FIGURE 3-2
DESIGNED: C. BIENIULIS DRAFTED: L.GAMBLE CHECKED: APPROVED: CHARCS DWG DATE: DATE: 8-19-99 DATE: DATE:	HOLLOMAN AIR FORCE BASE, NEW MEXICO GEOLOGIC CROSS-SECTION	

D:\PROJECTS\H1550023\DWG\PLOT\FIGS.DWG
PLOT/UPDATE: AUG 19 1999 11:12:41

D:\PROJECTS\51[redacted]2\DWG\EHOLFG01.DWG
PLOT/UPDATE: AUG 18 1999 09:59:13



LEGEND

- LF-29 MONITOR WELL LOCATION
- SS-61 MONITOR WELL LOCATION
- FENCE LINE
- 4079 GROUNDWATER POTENTIOMETRIC CONTOUR (DASHED WHERE INFERRED)
- NM GROUNDWATER FLOW DIRECTION
- GROUNDWATER FLOW DIRECTION

NOTES:

GROUNDWATER ELEVATIONS FOR THE SHALLOW WATER-BEARING ZONE ARE PRESENTED FOR APRIL 1999 AND ARE PROVIDED IN FEET ABOVE MEAN SEA LEVEL.

* NOT USED TO CONTOUR THE POTENTIOMETRIC SURFACE.

0 100 200 400
SCALE IN FEET

FOSTER WHEELER ENVIRONMENTAL CORPORATION	SS-61 REMEDIAL INVESTIGATION REPORT U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT	FIGURE 3-3
DESIGNED: C.BIENIUUS DATE: DRAFTED: L.GAMBLE DATE: 8/30/99 CHECKED: DATE: APPROVED: DATE	HOLLOMAN AIR FORCE BASE, NEW MEXICO	
FILE: EHOLFG01.DWG	GROUNDWATER POTENTIOMETRIC SURFACE FOR APRIL 1999	

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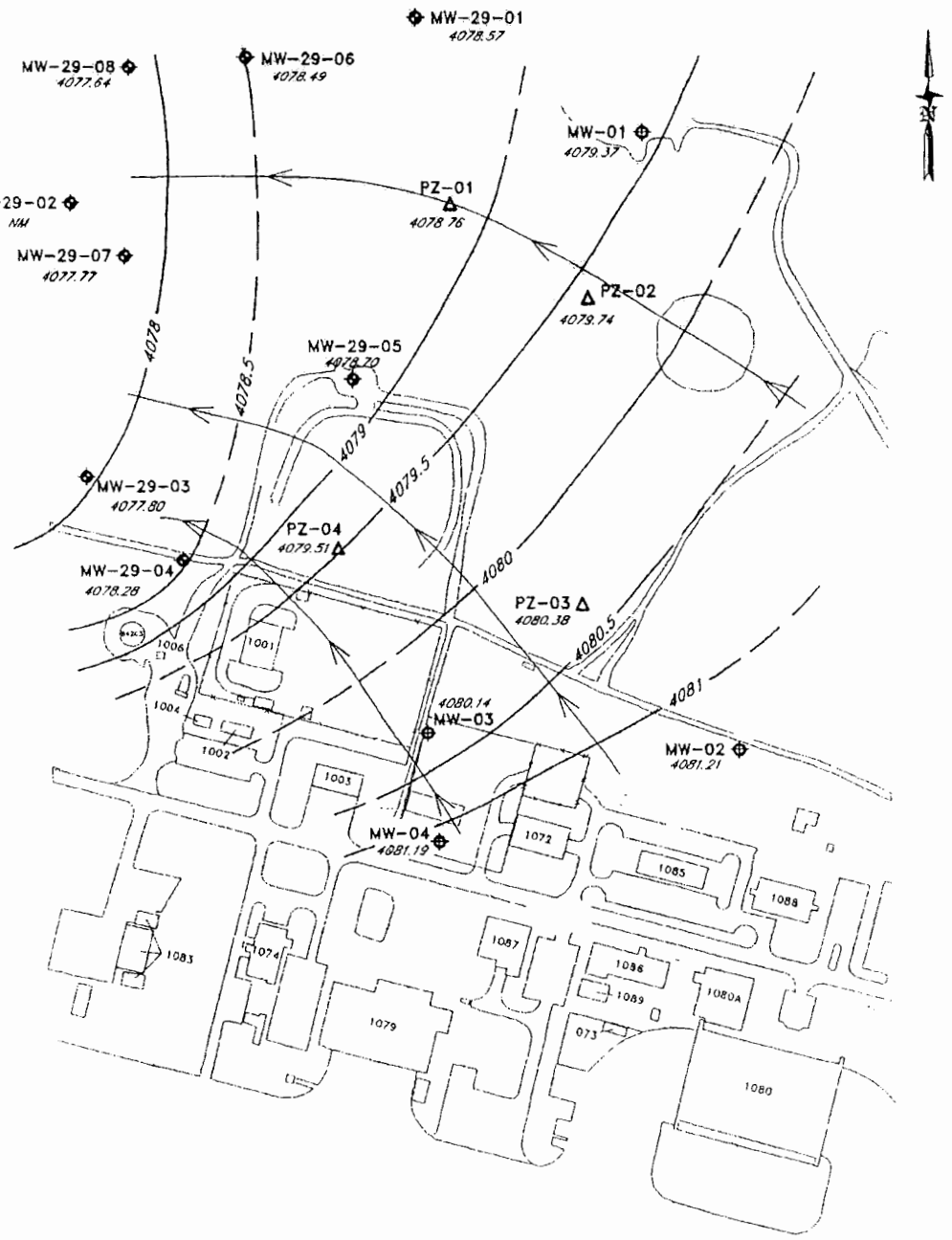
PLOT/UPDATE: AUG 18 1999 09:58:26



LEGEND

- LF-29 MONITOR WELL LOCATION
- SS-61 MONITOR WELL LOCATION
- PIEZOMETERS
- FENCE LINE
- 4079 GROUNDWATER POTENTIOMETRIC CONTOUR (DASHED WHERE INFERRED)
- NM NOT MEASURED
- GROUNDWATER FLOW DIRECTION

NOTES:

GROUNDWATER ELEVATIONS FOR THE SHALLOW WATER-BEARING ZONE ARE PRESENTED FOR JUNE 1997 AND ARE PROVIDED IN FEET ABOVE MEAN SEA LEVEL

0 100 200 400
SCALE IN FEET

FOSTER WHEELER ENVIRONMENTAL CORPORATION	SS-61 REMEDIAL INVESTIGATION REPORT U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT	FIGURE 3-4
DESIGNED: C BIENIUUS DATE DRAFTED: L GAMBLE DATE: 6/30/99 CHECKED: DATE: APPROVED: DATE: FILE: EHOLFG02.DWG	HOLLOMAN AIR FORCE BASE, NEW MEXICO GROUNDWATER POTENTIOMETRIC SURFACE FOR JUNE 1997	

T[illegible]5-1
Analytical Results for Soil Detections
Phases I and II RFI Site Characterization
(1996 and 1997)

Location	Depth Interval	Detected VOC Concentrations (µg/kg)						Detected Explosives Concentrations (µg/kg)	
		Benzene	1,2-Dichloroethane	Ethylbenzene	Toluene	Total Xylenes	Methylene Chloride	Tetryl	Trinitrotoluene
Off-Site Fixed Laboratory Analyses									
Phase I									
SS61-DP01	9-12 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP01	15-18 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP01	18-21 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP02	9-12 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP02	15-18 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP02	18-21 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP03	9-12 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP03	15-18 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP03	18-21 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP04	9-12 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP04	15-18 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP04	24-27 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP05	9-12 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP05	15-18 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP05	18-21 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP06	6-9 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP06	12-15 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP06	18-21 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP07	9-12 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP07	15-18 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP07	18-21 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP08	9-12 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP08	15-18 ft	< RL	< RL	< RL	< RL	< RL	< RL	1,000	1,000
SS61-DP08	21-24 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP09A	18-21 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP09A	21-24 ft	< RL	< RL	< RL	< RL	< RL	13,000	< RL	< RL
SS61-DP09A	24-27 ft	< RL	< RL	< RL	< RL	< RL	17,000	< RL	< RL
SS61-DP10	18-21 ft	< RL	< RL	< RL	< RL	< RL	10,000	< RL	< RL
SS61-DP10	21-24 ft	< RL	< RL	< RL	< RL	< RL	15,000	< RL	< RL
SS61-DP10	24-27 ft	< RL	< RL	< RL	< RL	< RL	17,000	< RL	< RL
On-Site Mobile Laboratory Analyses									
Phase II									
SS61-DP11	16-19 ft	< RL	< RL	< RL	< RL	< RL	< RL	NR	NR
SS61-DP11 (dup)	16-19 ft	< RL	< RL	< RL	< RL	< RL	< RL	NR	NR
SS61-DP12	16-19 ft	< RL	< RL	< RL	< RL	< RL	< RL	NR	NR
SS61-DP15	18-21 ft	< RL	< RL	< RL	< RL	< RL	< RL	NR	NR
SS61-DP16	12-15 ft	< RL	< RL	< RL	< RL	< RL	< RL	NR	NR
SS61-DP17	14-17 ft	< RL	< RL	< RL	< RL	< RL	< RL	NR	NR
SS61-DP18	19-22 ft	< RL	< RL	< RL	< RL	< RL	< RL	NR	NR
SS61-DP18 (dup)	19-22 ft	< RL	< RL	< RL	< RL	< RL	< RL	NR	NR
SS61-DP22	11-12 ft	29,400	< RL	6,540	< RL	2,030	< RL	NR	NR
SS61-DP23	17-20 ft	360	< RL	< RL	< RL	70	< RL	NR	NR
SS61-DP24	17-20 ft	< RL	< RL	< RL	< RL	< RL	< RL	NR	NR

T[illegible]-1
Analytical Results for Soil Detections
Phases I and II RFI Site Characterization
(1996 and 1997)

Location	Depth Interval	Detected VOC Concentrations (µg/kg)						Detected Explosives Concentrations (µg/kg)	
		Benzene	1,2-Dichloroethane	Ethylbenzene	Toluene	Total Xylenes	Methylene Chloride	Tetryl	Trinitrotoluene
Off-Site Fixed Laboratory Analyses									
SS61-DP11	16-19 ft	< RL	< RL	< RL	< RL	< RL	< RL	NR	NR
SS61-DP18	19-22 ft	< RL	< RL	< RL	< RL	< RL	< RL	NR	NR
SS61-MW01	30-32 ft	< RL	< RL	< RL	< RL	< RL	< RL	NR	NR
SS61-MW02	20-22 ft	3.2	< RL	< RL	< RL	< RL	< RL	NR	NR
SS61-MW03	18-20 ft	330	37	7.4	24	85	< RL	NR	NR
SS61-MW04	15-17 ft	< RL	< RL	< RL	< RL	< RL	< RL	NR	NR

Notes
ft = feet
µg/kg = micrograms per kilogram
NR = Analysis not requested
< RL = less than the reporting limit, analyte not detected
VOC = volatile organic compound

[redacted]5-2
Analytical Resu[redacted]r Soil Detections
Remedial Investigation (April 1999)

Location	Depth Interval	TRPH (mg/kg)	Detected VOC Concentrations (µg/kg)															
			Benzene	sec-Butyl-benzene	tert-Butyl-benzene	Chloroform	1,2-Dibromo-ethane	1,2-Dichloro-benzene	1,2-Dichloro-ethane	Ethyl-benzene	Isopropyl-benzene	n-Propyl-benzene	Toluene	Trichloro-ethene	1,2,4-Trimethyl-benzene	1,3,5-Trimethyl-benzene	o-Xylene	m,p-Xylenes
SS61-DP30	0-0.5 ft	61	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP30	8-10 ft	54	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP30	16-18 ft	99	< RL	< RL	< RL	< RL	< RL	< RL	< RL	630	1,700	760	< RL	< RL	12,000	10,000	< RL	< RL
SS61-DP31	4-6 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP31	14-16 ft	250	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP32	3-5 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP32	12-14 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-SS01	0-0.5 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-SS02	0-0.5 ft	23	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-SS03	0-0.5 ft	93	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-SS04	0-0.5 ft	33	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-SS05	0-0.5 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-SS06	0-0.5 ft	51	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-SD01	0-0.5 ft	270	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-TP01	13-13.5 ft	91	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-SS01(dup)	0-0.5 ft	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP31(dup)	4-6 ft	31	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL

Notes
ft = feet
mg/kg = milligrams per kilogram
< RL = less than the reporting limit, analyte not detected
TRPH = total recoverable petroleum hydrocarbons
µg/kg = micrograms per kilogram
VOC = volatile organic compound

[redacted]5-3
Analytical Results for G[redacted]water Detections of VOCs
Phases I and II RFI Site Characterization
(1996 and 1997)

Location	Detected VOC Concentrations (µg/L)									
	Benzene	Bromoform	Chlorobenzene	Chloroethane	Chloroform	Chloromethane	Dibromomethane	1,2-Dichlorobenzene	1,3-Dichlorobenzene	1,4-Dichlorobenzene
Off-Site Fixed Laboratory Analyses										
Phase I										
SS61-DP01	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP02	7,200	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP03	3,400	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP04	96	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP05	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP06	6,000	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP07	1,900	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP08	570	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP09A	80	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP10	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
On-Site Mobile Laboratory Analyses										
Phase II										
MW-29-05	46	< RL	0 65	< RL	0 26	< RL	0 3	< RL	< RL	< RL
SS61-DP11	7 9	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP11 (dup)	10 1	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP12	1,900	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP12 (dup)	2,200	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP13	704	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP14	1,420	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP15	2 8	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP16 (a)	4,080	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP17	3,900	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP18	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP18 (dup)	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP19	922	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP20	59	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP22	8,640	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP23	640	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP24	5,100	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP25	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-MW01	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-MW02	0 43	< RL	< RL	< RL	2 5	0 22	< RL	5 3	1 9	1 2
SS61-MW03	11,000	1 6	< RL	5 4	3 6	< RL	6 8	< RL	< RL	< RL
SS61-MW04	2 9	< RL	< RL	< RL	0 52	0 2	< RL	< RL	< RL	< RL
SS61-MW04 (dup)	2 2	< RL	< RL	< RL	0 29	< RL	< RL	< RL	< RL	< RL

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Analytical Results for G[illegible]dwater Detections of VOCs
Phases I and II RFI Site Characterization
(1996 and 1997)

Location	Detected VOC Concentrations (µg/L)									
	1,1-Dichloroethane	1,2-Dichloroethane	1,2-Dichloropropane	cis-1,3-Dichloropropene	trans-1,3-Dichloropropene	Ethylbenzene	Toluene	Total Xylenes	Methylene Chloride	Trichloroethene
Off-Site Fixed Laboratory Analyses										
Phase I										
SS61-DP01	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP02	< RL	< RL	< RL	< RL	< RL	890	< RL	13	< RL	< RL
SS61-DP03	< RL	< RL	< RL	< RL	< RL	< RL	< RL	31	< RL	< RL
SS61-DP04	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP05	< RL	140	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP06	< RL	< RL	< RL	< RL	< RL	< RL	< RL	18	< RL	< RL
SS61-DP07	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP08	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP09A	< RL	18	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP10	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
On-Site Mobile Laboratory Analyses										
Phase II										
MW-29-05	< RL	210	0 4	0 27	0 22	0 76	0 81	0 89	< RL	< RL
SS61-DP11	< RL	87	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP11 (dup)	< RL	104	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP12	< RL	118	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP12 (dup)	< RL	102	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP13	< RL	47	< RL	< RL	< RL	< RL	< RL	4 9	< RL	< RL
SS61-DP14	< RL	60	< RL	< RL	< RL	< RL	< RL	30	< RL	< RL
SS61-DP15	< RL	3 8	< RL	< RL	< RL	< RL	< RL	< RL	< RL	5 6
SS61-DP16(a)	< RL	178	< RL	< RL	< RL	308	2,600	2,400	< RL	< RL
SS61-DP17	< RL	315	< RL	< RL	< RL	40	< RL	17	< RL	< RL
SS61-DP18	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP18 (dup)	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP19	< RL	13 1	< RL	< RL	< RL	336	< RL	6	< RL	< RL
SS61-DP20	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	14
SS61-DP22	< RL	310	< RL	< RL	< RL	523	3,620	1,140	< RL	< RL
SS61-DP23	< RL	21	< RL	< RL	< RL	140	460	940	< RL	< RL
SS61-DP24	< RL	288	< RL	< RL	< RL	230	1,030	3,800	< RL	< RL
SS61-DP25	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-MW01	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-MW02	1 1	1 8	< RL	< RL	< RL	< RL	< RL	< RL	< RL	45
SS61-MW03	< RL	940	1 6	< RL	< RL	65	2,300	5,800	< RL	1 8
SS61-MW04	< RL	3 8	< RL	< RL	< RL	0 53	< RL	2 32	< RL	< RL
SS61-MW04 (dup)	< RL	3 4	< RL	< RL	< RL	< RL	< RL	3 2	< RL	< RL

Notes
(a) Also analyzed for gasoline, diesel, and oil
< RL = less than the reporting limit, analyte not detected
µg/L = micrograms per liter
VOC = volatile organic compound

Analytical Results for Grou[illegible]ter Detections of Explosives
Phases I and II RFI Site Characterization
(1996 and 1997)

Location	Detected Explosive Concentrations (µg/L)			
	Nitrobenzene	RDX	Tetryl	1,3,5-Trinitrobenzene
Off-Site Fixed Laboratory Analyses				
Phase I				
SS61-DP01	< RL	< RL	< RL	< RL
SS61-DP02	< RL	< RL	< RL	< RL
SS61-DP03	< RL	< RL	< RL	< RL
SS61-DP04	< RL	< RL	< RL	< RL
SS61-DP05	< RL	< RL	< RL	< RL
SS61-DP06	< RL	< RL	< RL	< RL
SS61-DP07	< RL	< RL	< RL	< RL
SS61-DP08	< RL	< RL	< RL	< RL
SS61-DP09A	< RL	< RL	< RL	< RL
SS61-DP10	< RL	< RL	< RL	< RL
Phase II				
MW-29-05	< RL	< RL	< RL	< RL
SS61-DP11	< RL	< RL	< RL	< RL
SS61-DP11 (dup)	< RL	< RL	< RL	< RL
SS61-DP12	< RL	< RL	< RL	< RL
SS61-DP12 (dup)	< RL	< RL	< RL	< RL
SS61-DP13	< RL	< RL	< RL	< RL
SS61-DP14	< RL	< RL	< RL	< RL
SS61-DP15	< RL	< RL	< RL	< RL
SS61-DP16 (a)	< RL	< RL	< RL	< RL
SS61-DP17	< RL	< RL	< RL	< RL
SS61-DP18	< RL	< RL	< RL	< RL
SS61-DP18 (dup)	< RL	< RL	< RL	< RL
SS61-DP19	< RL	< RL	< RL	< RL
SS61-DP20	< RL	< RL	< RL	< RL
SS61-DP22	74	35	16	13
SS61-DP23	< RL	< RL	< RL	< RL
SS61-DP24	< RL	< RL	< RL	< RL
SS61-DP25	< RL	< RL	< RL	< RL
SS61-MW01	< RL	< RL	< RL	< RL
SS61-MW02	< RL	< RL	< RL	< RL
SS61-MW03	< RL	< RL	< RL	< RL
SS61-MW04	< RL	< RL	< RL	< RL
SS61-MW04 (dup)	< RL	< RL	< RL	< RL

Notes
(a) Also analyzed for gasoline, diesel, and oil
< RL = less than the reporting limit, analyte not detected
µg/L = micrograms per liter

5-5

Analytical Results oundwater Detections

Remedial Investigation (April 1999)

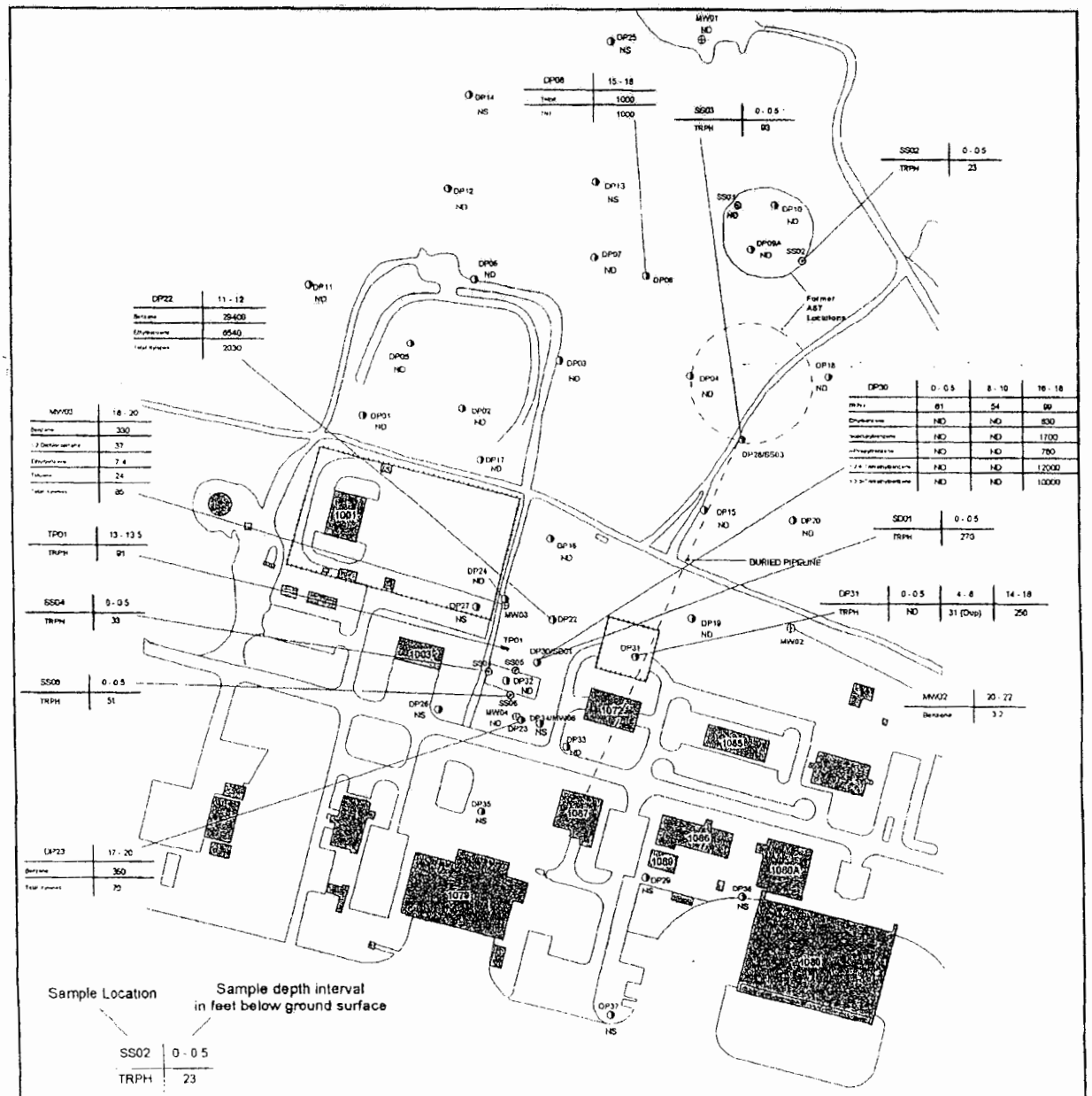
Location	Detected VOC Concentrations (µg/L)															
	Benzene	sec-Butyl-benzene	tert-Butyl-benzene	Chloroform	1,2-Dibromo-ethane	1,2-Dichloro-benzene	1,2-Dichloro-ethane	Ethyl-benzene	Isopropyl-benzene	p-Propyl-benzene	Toluene	Trichloro-ethene	1,2,4-Trimethyl-benzene	1,3,5-Trimethyl-benzene	o-Xylene	m,p-Xylenes
SS61-DP26	2,900	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-DP27	6,900	< RL	< RL	< RL	< RL	< RL	< RL	< RL	1,700	< RL	2,000	< RL	< RL	< RL	1,500	2,400
SS61-DP28	440	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	6	< RL	< RL	< RL	3	5
SS61-DP29	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	3	< RL	< RL	< RL	< RL	< RL
SS61-DP30	15,000	< RL	< RL	< RL	1,400	< RL	< RL	1,700	5,400	< RL	20,000	< RL	1,100	< RL	3,100	7,400
SS61-DP31	8,700	< RL	< RL	< RL	< RL	< RL	< RL	670	1,400	< RL	960	< RL	< RL	< RL	640	1,100
SS61-DP32	18,000	28	< RL	< RL	49	< RL	< RL	1,100	3,300	53	1,200	< RL	< RL	< RL	530	1,400
SS61-DP33	19,000	< RL	< RL	< RL	110	< RL	< RL	750	650	27	14,000	< RL	< RL	< RL	1,600	3,300
SS61-DP34	8,100	< RL	< RL	< RL	< RL	< RL	< RL	1,400	2,700	< RL	600	< RL	1,600	940	2,200	5,100
SS61-DP35	89	11	6	< RL	< RL	< RL	< RL	290	1,900	94	3	< RL	< RL	< RL	9	< RL
SS61-DP36	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	8	< RL	< RL	16	< RL	< RL	< RL	< RL
SS61-DP37	< RL	< RL	< RL	8	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-MW01	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-MW02	7	< RL	< RL	< RL	< RL	9	< RL	3	< RL	< RL	< RL	34	< RL	< RL	< RL	< RL
SS61-MW03	8,200	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	900	< RL	< RL	< RL	770	1,200
SS61-MW04	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	94	< RL	< RL	< RL	24	12	5	13
SS61-MW05	< RL	< RL	< RL	< RL	< RL	< RL	< RL	3	66	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-MW06	14,000	< RL	< RL	< RL	< RL	< RL	< RL	1,300	2,600	< RL	6,800	< RL	1,400	< RL	3,300	7,800
MW-29-02	< RL	< RL	< RL	< RL	< RL	< RL	27	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
MW-29-03	< RL	< RL	< RL	9	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
MW-29-05	440	< RL	< RL	< RL	< RL	< RL	190	< RL	640	< RL	< RL	< RL	< RL	< RL	< RL	< RL
MW-29-06	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
SS61-MW04D	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	160	< RL	< RL	< RL	41	21	8	23
SS61DP31WD	14,000	< RL	< RL	< RL	< RL	< RL	< RL	1,900	3,400	< RL	1,900	< RL	1,100	< RL	1,800	3,300

Notes

µg/L = micrograms per liter

< RL = less than the reporting limit, analyte not detected

VOC = volatile organic compound



Sample Location

Sample depth interval in feet below ground surface

SS02	0 - 0.5
TRPH	23

Analyte

Analyte concentration

Notes

Analyte concentration for VOCs are presented in micrograms per kilogram (ug/kg). TRPH concentrations are presented in milligrams per kilogram (mg/kg)

ND - Analyte not detected

NS - Location not sampled

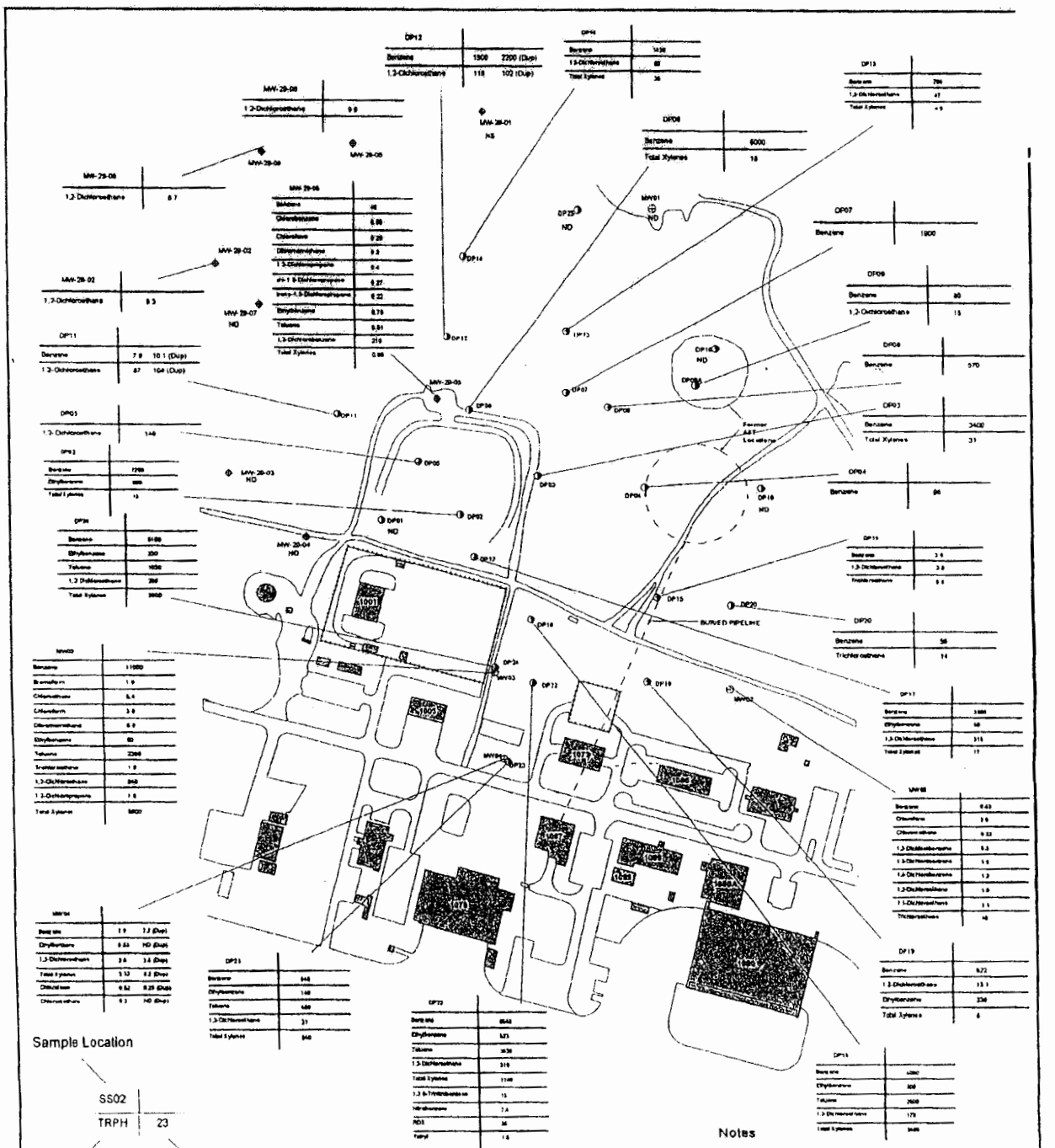
LEGEND

- Piezometers
- Fenceline
- SS-61Monitoring Wells
- LF-29 Monitoring Wells
- Direct Push Samples
- Surface Soil and Sediment Samples
- Buildings
- Roads

SS-61 REMEDIAL INVESTIGATION REPORT
Holloman Air Force Base, New Mexico
U.S. Army Corps of Engineers, Omaha District

Figure 5-1
Distribution of VOCs, Explosives, and TRPH Detected in Soil During the 1999 RI and Previous Investigations

Foster Wheeler Environmental Corporation



Notes

Analyte concentrations are presented in micrograms per liter (ug/L)

All groundwater samples were collected from the upper portion (less than 10 feet) of the shallow water-bearing zone

ND - Analyte not detected

NS - Location not sampled

LEGEND

- Piezometers
- Fenceline
- SS-61 Monitoring Wells
- LF-29 Monitoring Wells
- Direct Push Samples
- Buildings
- Roads

N

0 300 600 Feet

Scale is Approximate

SS-61 REMEDIAL INVESTIGATION REPORT

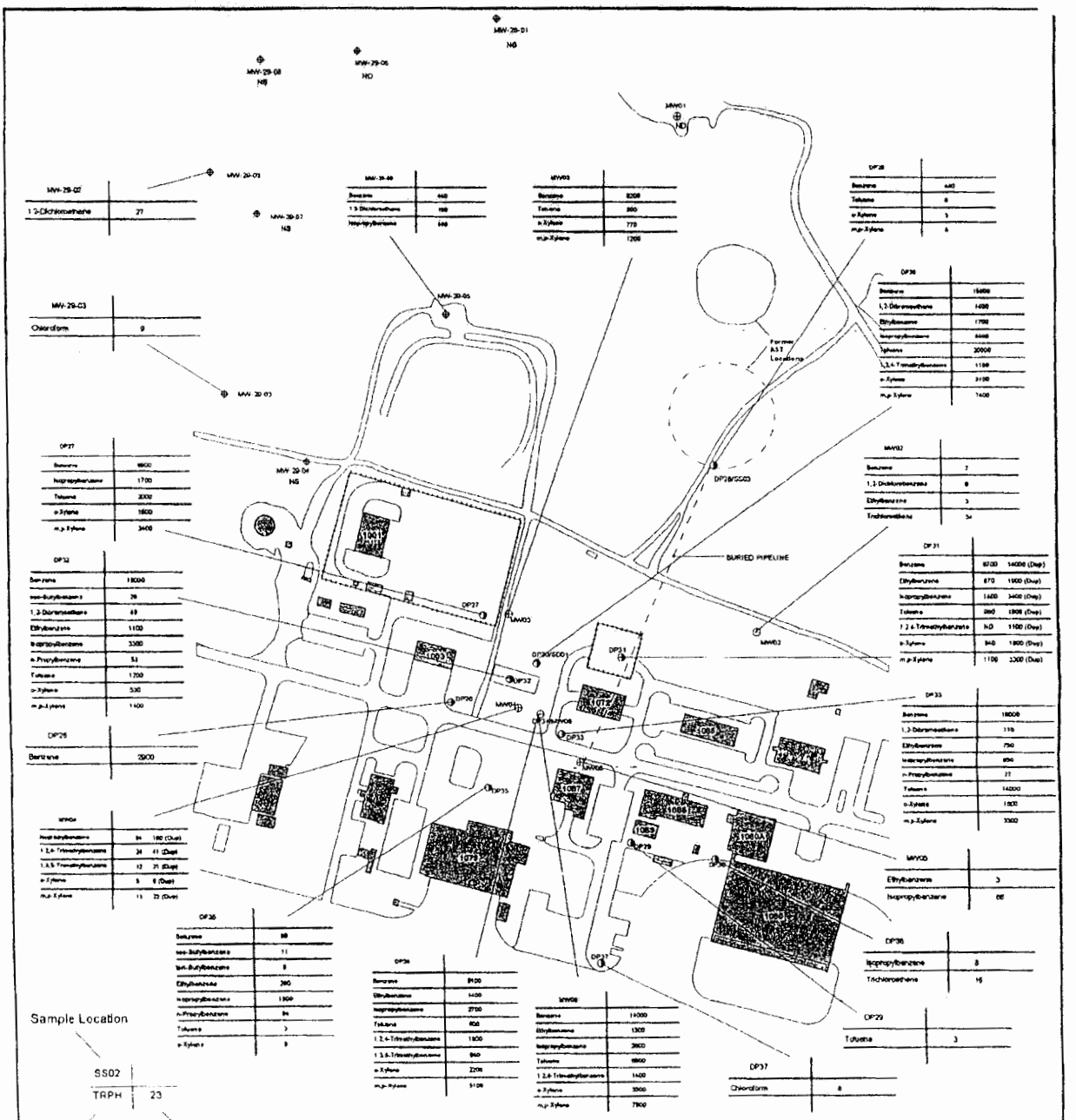
Holloman Air Force Base, New Mexico

U.S. Army Corps of Engineers, Omaha District

Figure 5-2

Distribution of VOCs and Explosives Detected in Groundwater During the Phase I and Phase II RFI Site Characterization

Foster Wheeler Environmental Corporation


MW-29-01
NS
MW-29-08
NS
MW-29-06
ND
MW01
ND
MW-29-02
1,2-Dichloroethane 27
MW-29-03
Chloroform 9
MW-29-04
NS
DP28
Benzene 440
Toluene 6
o-Xylene 3
m,p-Xylene 6
DP30
Benzene 15000
1,2-Dibromoethane 1400
Ethylbenzene 1700
Isopropylbenzene 5400
Xylenes 20000
1,3,4-Trimethylbenzene 1100
o-Xylene 3100
m,p-Xylene 7400
MW03
Benzene 8200
Toluene 300
o-Xylene 770
m,p-Xylene 1200
DP27
Benzene 6600
Isopropylbenzene 1700
Toluene 2000
o-Xylene 1600
m,p-Xylene 3400
MW02
Benzene 7
1,2-Dichlorobenzene 8
Ethylbenzene 3
Trichloroethene 54
DP32
Benzene 18000
sec-Butylbenzene 28
1,2-Dibromoethane 49
Ethylbenzene 1100
Isopropylbenzene 3300
n-Propylbenzene 53
Toluene 1700
o-Xylene 530
m,p-Xylene 1400
DP31
Benzene 8700 14000 (Dup)
Ethylbenzene 870 1900 (Dup)
Isopropylbenzene 1400 3400 (Dup)
Toluene 860 1900 (Dup)
1,2,4-Trimethylbenzene ND 1100 (Dup)
o-Xylene 940 1800 (Dup)
m,p-Xylene 1100 2300 (Dup)
DP26
Benzene 2900
DP33
Benzene 18000
1,2-Dibromoethane 110
Ethylbenzene 750
Isopropylbenzene 890
n-Propylbenzene 27
Toluene 14000
o-Xylene 1800
m,p-Xylene 3900
MW04
Isopropylbenzene 94 180 (Dup)
1,2,4-Trimethylbenzene 24 41 (Dup)
1,3,5-Trimethylbenzene 12 21 (Dup)
o-Xylene 5 6 (Dup)
m,p-Xylene 11 23 (Dup)
MW05
Ethylbenzene 3
Isopropylbenzene 68
DP36
Benzene 68
sec-Butylbenzene 11
tert-Butylbenzene 8
Ethylbenzene 390
Isopropylbenzene 1300
n-Propylbenzene 94
Toluene 3
o-Xylene 8
DP38
Isopropylbenzene 8
Trichloroethene 16
DP29
Toluene 3
DP37
Chloroform 6
DP34
Benzene 9100
Ethylbenzene 1400
Isopropylbenzene 2700
Toluene 400
1,2,4-Trimethylbenzene 1800
1,3,5-Trimethylbenzene 840
o-Xylene 2200
m,p-Xylene 5100
MW08
Benzene 14000
Ethylbenzene 1300
Isopropylbenzene 2800
Toluene 6800
1,2,4-Trimethylbenzene 1400
o-Xylene 3000
m,p-Xylene 7900
DP28/SGCD
DP30/SGCD
BURIED PIPELINE
Former AST Location
1001
1003
1006
1007
1008
1009
1010
1010A
1010B
1010C
1010D
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1010F
1010G
1010H
1010I
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1010N
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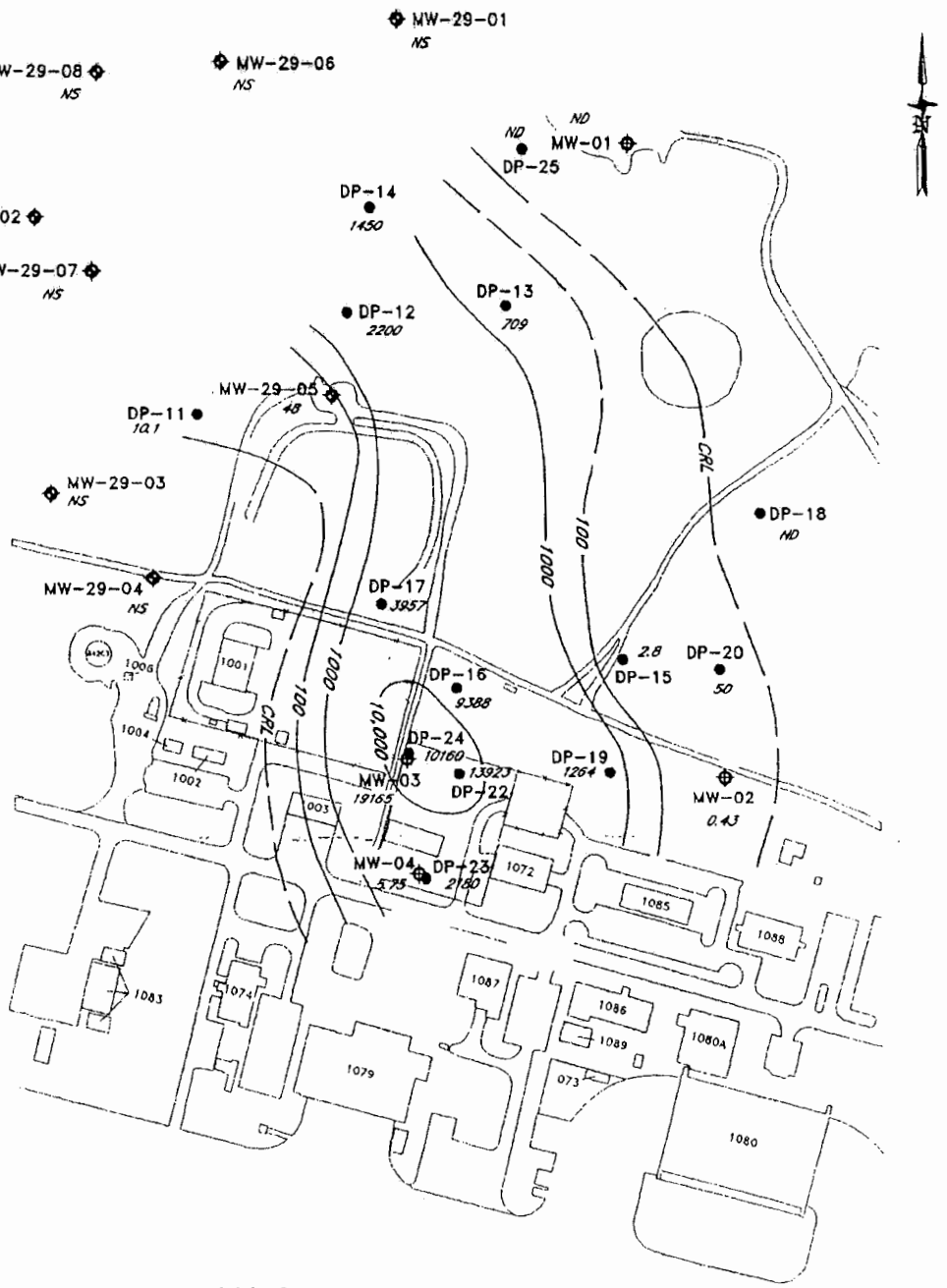
1010ZX
1010ZY
1010ZZ
Sample Location
SS02
TRPH 23
Analyte
Analyte concentration
LEGEND
Piezometers
Fenceline
SS-61 Monitoring Wells
LF-29 Monitoring Wells
Direct Push Samples
Surface Soil and Sediment Samples
Buildings
Roads
N
0 300 600 Feet
Scale is Approximate
Notes
Analyte concentrations are presented in micrograms per liter (ug/L).
All groundwater samples were collected from the upper portion (less than 10 feet) of the shallow water-bearing zone
ND - Analyte not detected
NS - Location not sampled
SS-61 REMEDIAL INVESTIGATION REPORT
Holloman Air Force Base, New Mexico
U.S. Army Corps of Engineers, Omaha District
Figure 5-3
Distribution of VOCs Detected in Groundwater During the RI (April 1999)
Foster Wheeler Environmental Corporation

0 \PROJECTS\5[illegible]22\DWG\EHOLFG04.DWG
PLOT/UPDATE AUG 18 1999 10:24 36



LEGEND

- LF-29 MONITOR WELL LOCATION
- SS-61 MONITOR WELL LOCATION
- DIRECT PUSH SAMPLES
- FENCE LINE
- CRL GROUNDWATER CONTAMINANT CONTOUR CONCENTRATION IN ug/L (DASHED WHERE INFERRED)
- ND ANALYTE NOT DETECTED
- NS NOT SAMPLED
- CRL CERTIFIED REPORTING LIMIT

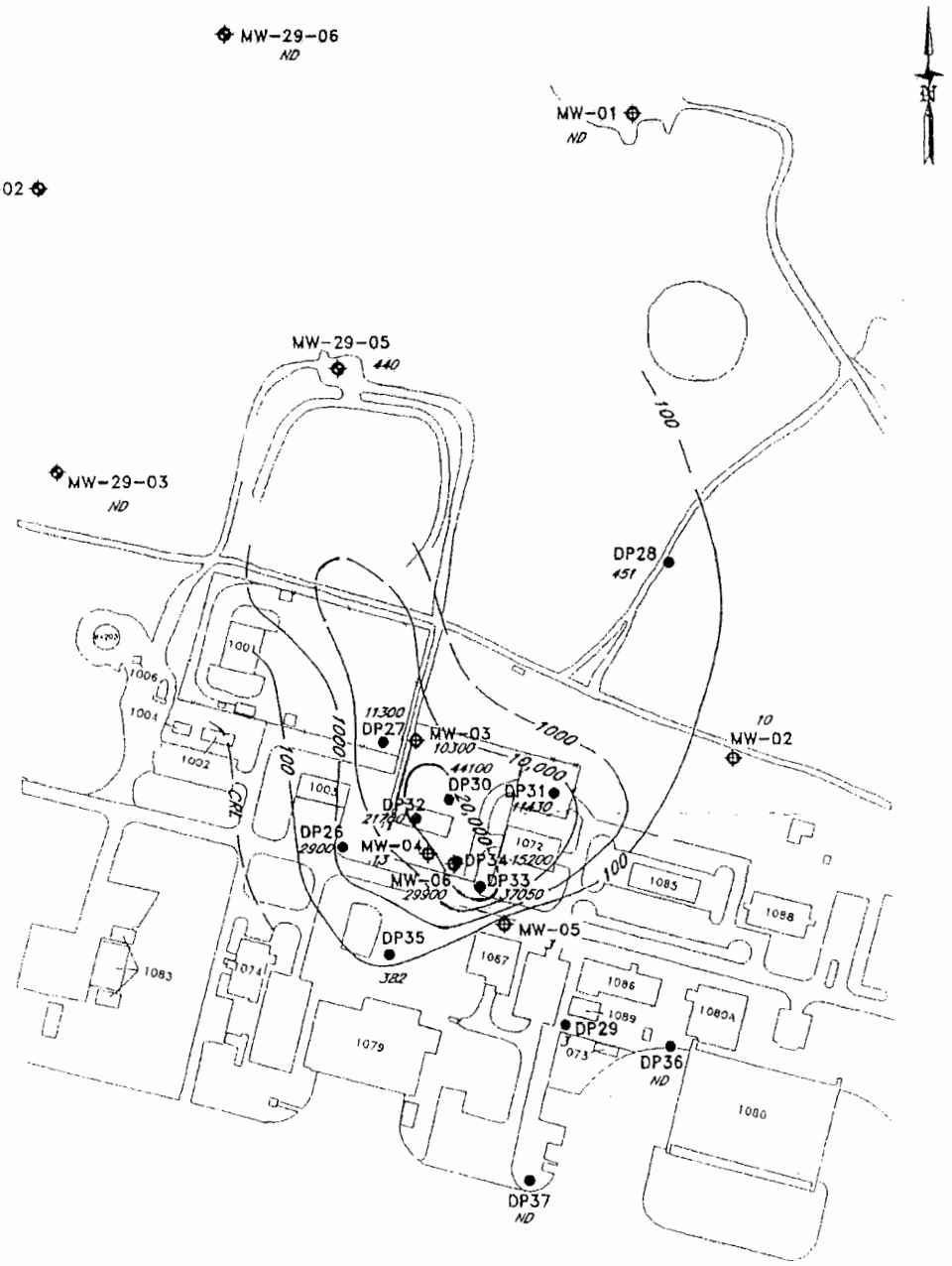
NOTES:

ANALYTICAL RESULTS ARE PROVIDED FOR SAMPLES COLLECTED FROM THE UPPER 10 FEET OF THE SHALLOW WATER-BEARING ZONE IN JUNE 1997

0 100 200 400
SCALE IN FEET

FOSTER WHEELER ENVIRONMENTAL CORPORATION	SS-61 REMEDIAL INVESTIGATION REPORT U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT	FIGURE 5-4
DESIGNED: C.BIENIUUS DATE: DRAFTED: L GAMBLE DATE: 7/2/99 CHECKED: DATE: APPROVED: DATE: FILE: EHOLFG04.DWG	HOLLOMAN AIR FORCE BASE, NEW MEXICO	
	TOTAL BTEX GROUNDWATER PLUME FOR JUNE 1997	

D:\PROJECTS\51[redacted]22\DWG\EHOLFG03.DWG
PLOT/UPDATE: AUG 18 1999 10:12:24



LEGEND

- LF-29 MONITOR WELL LOCATION
- SS-81 MONITOR WELL LOCATION
- DIRECT PUSH SAMPLES
- FENCE LINE
- CRL — GROUNDWATER POTENTIOMETRIC CONTOUR CONCENTRATION IN ug/L (DASHED WHERE INFERRED)
- CRL — CERTIFIED REPORTING LIMIT
- ND — ANALYTE NOT DETECTED

NOTE:

TOTAL BTEX PRESENTED REFLECT ANALYTICAL RESULTS FOR SAMPLES COLLECTED FROM THE UPPER 10 FEET OF THE SHALLOW WATER-BEARING ZONE IN APRIL 1999.

0 100 200 400
SCALE IN FEET

FOSTER WHEELER ENVIRONMENTAL CORPORATION	SS-61 REMEDIAL INVESTIGATION REPORT U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT	FIGURE 5-5
DESIGNED: C.BIENIUUS DATE: DRAFTED: L.GAMBLE DATE: 7/5/99 CHECKED: DATE: APPROVED: DATE:	HOLLOMAN AIR FORCE BASE, NEW MEXICO	
FILE: EHOLFG03.DWG	TOTAL BTEX GROUNDWATER PLUME FOR APRIL 1999	

HTRW DRILLING LOG

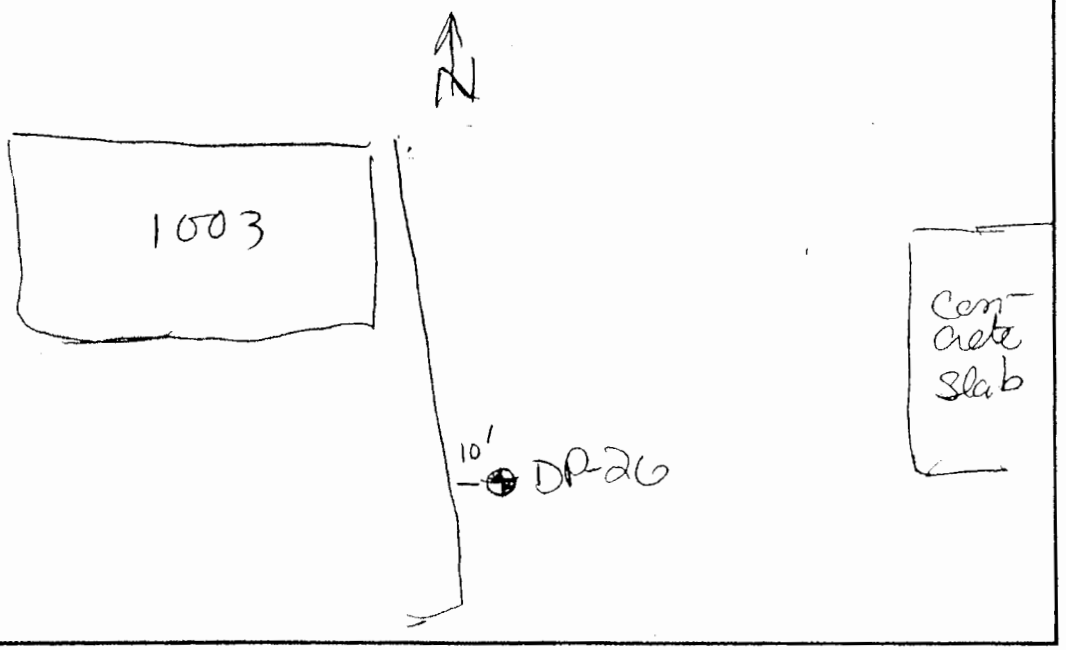
DISTRICT: OMAHA	HOLE NO.: SS61-DP26	
1. COMPANY NAME: FOSTER WHEELER ENVIRONMENTAL CORPORATION	2. DRILLING SUBCONTRACTOR: Alliance Environmental, Inc.	SHEET 1 OF 2
3. SITE: SS-61, Holloman AFB, NM	4. LOCATION: SE OF BUILDING 1003	
5. NAME OF DRILLER: Oscar	6. MANUFACTURERS DESIGNATION OF DRILL: Geoprobe H40	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Geoprobe; 1.25" Sampler W/ sleeves	8. HOLE LOCATION: Southeast of Building 1003	
	9. SURFACE ELEVATION: NA	
	10. DATE STARTED: 4/9/99	11. DATE COMPLETED: 4/9/99
12. OVERBURDEN THICKNESS: N/A	15. DEPTH GROUNDWATER ENCOUNTERED: NA	
13. DEPTH DRILLED INTO ROCK: NA	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: NA	
14. TOTAL DEPTH OF HOLE: 26 ft	17. OTHER WATER LEVEL MEASURMENTS (SPECIFY): NA	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES: N/A
none	N/A	N/A	

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHERS (SPECIFY)	OTHERS (SPECIFY)	OTHERS (SPECIFY)	21. TOTAL CORE REC. %
SS61-DP26W WATER ONLY	8260	NA	NA	NA	NA	100
	X					NA CLB 4/30/99

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHERS (SPECIFY)	23. SIGNATURE OF INSPECTOR
Abandoned / Backfilled	X	—	—	[signature]
	~~PVC~~ Bentonite			

LOCATION SKETCH/COMMENTS:



PROJECT #:	SITE:	LOCATION:
5155.0022.0003.H0000	SS-61, Holloman AFB, NM	SS61-DP26

HTRW DRILLING LOG	DISTRICT	LOCATION:
	OMAHA	SS 61
1. PROJECT # 5155.0022.0003.H0000	2. INSPECTOR Schick	SHEET 2 OF 2

ELEV.	DEPTH (feet)	FIELD SCREEN RESULTS	USCS CLASS.	MATERIAL DESCRIPTION	COMMENTS
	2			0'–18' NO SAMPLE	1300 –
	4				
	6				
	8				
	10				
	12				
	14			– Drilling very difficult at 13 feet,	1330
	16				
	18				
	20	0.0	SM	18-20 Red brown silty sand (2.5YR5/4) from 18 to 19 feet. moist, 19-20 feet light gray (2.5YR7/1) silty sand, wet, no odor, no stains.	1350 100% ~~Recovery~~ – recovery
	22	25.0	SM	20-22 light gray (2.5YR7/1) silty sand, no stains, wet, hydro carbon odor	1405 100% recovery
	24				
	26			– BOH @ 26 feet Pulled back to 24 feet for sampling.	Sampled water at 1420
	28				

HTRW DRILLING LOG

DISTRICT OMAHA	**HOLE NO.** SS61DP27	
1. COMPANY NAME FOSTER WHEELER ENVIRONMENTAL CORPORATION	**2. DRILLING SUBCONTRACTOR** Alliance Environmental, Inc.	**SHEET 1 OF 2**
3. SITE SS-61, Holloman AFB, NM	**4. LOCATION** SS61 inside fenced area of 1001	
5. NAME OF DRILLER Oscar	**6. MANUFACTURERS DESIGNATION OF DRILL** Geoprobe H40	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT Geoprobe 1.25" barrel w/ sleeves	**8. HOLE LOCATION** See Above	
	9. SURFACE ELEVATION	
	10. DATE STARTED 4/9/99	**11. DATE COMPLETED** 4/9/99
12. OVERBURDEN THICKNESS NA	**15. DEPTH GROUNDWATER ENCOUNTERED** 23.75	
13. DEPTH DRILLED INTO ROCK NA	**16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED** NA	
14. TOTAL DEPTH OF HOLE 28	**17. OTHER WATER LEVEL MEASURMENTS (SPECIFY)** NA	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES:
none	N/A	N/A	N/A

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHERS (SPECIFY)	OTHERS (SPECIFY)	OTHERS (SPECIFY)	21. TOTAL CORE REC.
water only SS61DP27W	8260	NA	NA			% 62

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHERS (SPECIFY)	23. SIGNATURE OF INSPECTOR
Backfilled	~~Bentonite~~ X	—	—	[signature]

LOCATION SKETCH/COMMENTS:

INSIDE FENCED compound for Building 1001.

PROJECT #:	SITE:	LOCATION:
5155.0022.0003.H0000	SS-61, Holloman AFB, NM	SS61DP27

HTRW DRILLING LOG	DISTRICT	LOCATION:
	OMAHA	SS61
1. PROJECT # 5155.0022.0003.H0000	2. INSPECTOR Schick	SHEET 2 OF 2

ELEV.	DEPTH (feet)	FIELD SCREEN RESULTS	USCS CLASS.	MATERIAL DESCRIPTION	COMMENTS
	2			0-18' No samples	1050 START
	4				
	6				
	8				
	10				
	12				
	14				
	16				
	18				
	20	0.0	SC	18-20 Red brown (2.5YR 5/3) Silty sand, ~~dry~~ w/ grayish, dry no odor, wet	1100 25% recovery
	22	0.2	SC	20-22 Red brown (2.5YR 5/3) same as above.	1120 100% recovery
	24	125	SC / SM	22-23.75 same as above 23.75-24 Wet light gray silty sand (2.5YR 7/1) strong hydrocarbon odor	1135 100% recovery
				Push to 28.0 Ft pull back to 26 feet for water sampler BOHC as. water sample from 26 feet.	Water sample collected at 1215

HTRW DRILLING LOG

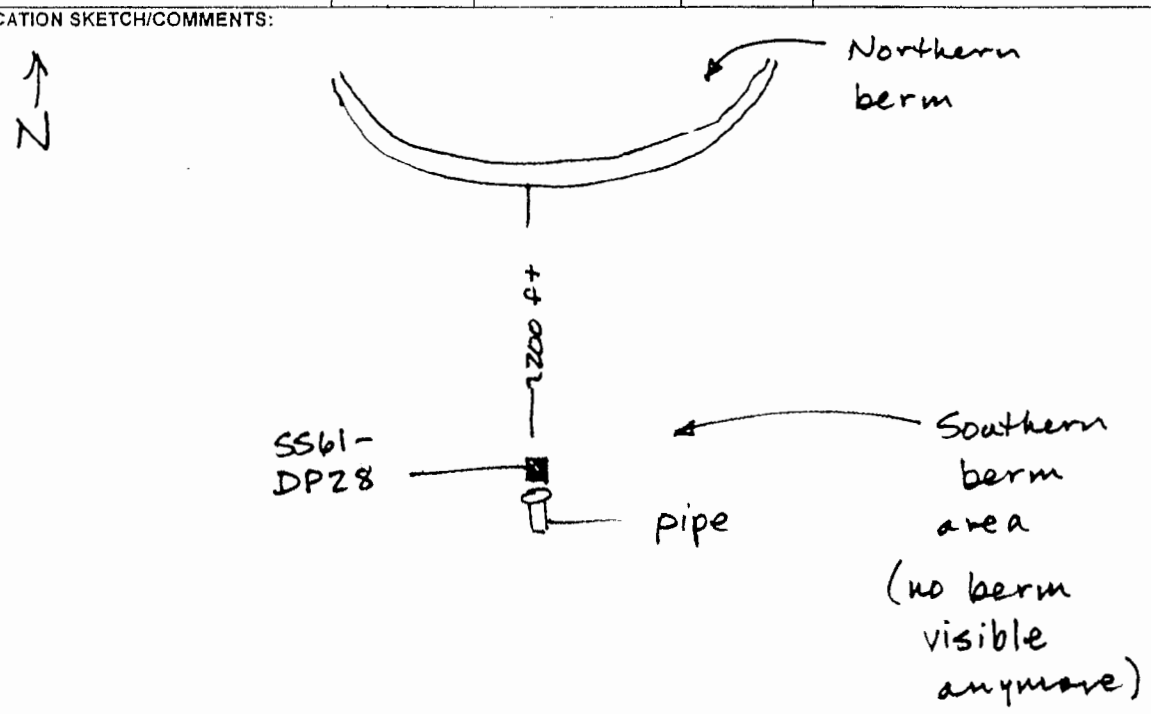
DISTRICT: OMAHA		HOLE NO.: DP28
1. COMPANY NAME: FOSTER WHEELER ENVIRONMENTAL CORPORATION	2. DRILLING SUBCONTRACTOR: Alliance Environmental, Inc.	SHEET 1 OF 3 ~~SS61 - DP28~~ 041299 CLB
3. SITE: SS-61, Holloman AFB, NM	4. LOCATION: SS61- DP28	
5. NAME OF DRILLER: Oscar Medrano	6. MANUFACTURERS DESIGNATION OF DRILL: Geoprobe GH-40	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 1.25 in. core barrel	8. HOLE LOCATION: Near pipe located in south berm area	
	9. SURFACE ELEVATION: N/A	
	10. DATE STARTED: 4-12-99	11. DATE COMPLETED: 4-12-99
12. OVERBURDEN THICKNESS: N/A	15. DEPTH GROUNDWATER ENCOUNTERED: 28 ft	
13. DEPTH DRILLED INTO ROCK: N/A	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 28 ft	
14. TOTAL DEPTH OF HOLE: 31 ft	17. OTHER WATER LEVEL MEASURMENTS (SPECIFY): N/A	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES:
none	N/A	N/A	N/A

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHERS (SPECIFY)	OTHERS (SPECIFY)	OTHERS (SPECIFY)	21. TOTAL CORE REC. %
	Water 8260B	NA	Water TRPH	NA	NA	70
	X		418.1/9010			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHERS (SPECIFY)	23. SIGNATURE OF INSPECTOR
Abandoned	X	—	—	C L Brennilis
	Bentonite			

LOCATION SKETCH/COMMENTS:



PROJECT #:	SITE:	LOCATION:
5155.0022.0003.H0000	SS-61, Holloman AFB, NM	SS61-DP28

HTRW DRILLING LOG	DISTRICT	LOCATION:
	OMAHA	DP28
1. PROJECT # 5155.0022.0003.H0000	2. INSPECTOR Carol Bieniulis	SHEET 2 OF 3

ELEV.	DEPTH (feet)	FIELD SCREEN RESULTS	USCS CLASS.	MATERIAL DESCRIPTION	COMMENTS
	1			DPT driving to 20ft	
	2			~No recovery	
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				
	11				
	12				
	13				
	14				
	15				
	16				
	17				
	18				
	19				
	20				

PROJECT #:	SITE:	LOCATION:
5155.0022.0003.H0000	SS-61, Holloman AFB, NM	SS61 - DP28

HTRW DRILLING LOG

DISTRICT	LOCATION:
OMAHA	

1. PROJECT #	2. INSPECTOR	
5155.0022.0003.H0000	Carol Bieniulis	SHEET 3 OF 3

ELEV.	DEPTH (feet)	FIELD SCREEN RESULTS	USCS CLASS.	MATERIAL DESCRIPTION	COMMENTS
	21	BKGD	CL-SM	Silty clay, low plasticity, gypsum crystals, well graded, tr. moisture, 5YR 5/4	20-22 ft Recovery = 1.75 ft
	22	BKGD	SM	Clayey silt, low plasticity, well graded, gypsum crystal, slightly moist 5YR 6/4	
	23	BKGD	~~SM~~ ML CLB 041194		
	24	BKGD		Clay silt w/ some sand, well graded, slightly moist, not plastic, trace gypsum crystals, 7.5 YR 5/8	22-24 ft Recovery = 1.5 ft
	25				
	26	BKGD	ML	Silt w/ much gypsum, well-graded, trace moisture, no plasticity, 10 YR 8.2	24-26 ft Recovery = 2.0 ft
	27				
	28				
	29		ML	Sandy silt, well graded, gypsum crystals, slightly moist, no plasticity, 2.5 YR 5/6	26-28 ft Recovery = 2.0 ft
	~~30~~	CLB 041294			
	30				
	31	2.9 ppm		Fine sand and silt, well graded, gypsum ~~s~~ crystals CLB moist, 5YR 5/8	
				Hit water at 28 ft	Lith. logging goes to 28 ft
				TD = 31 ft	

HTRW DRILLING LOG

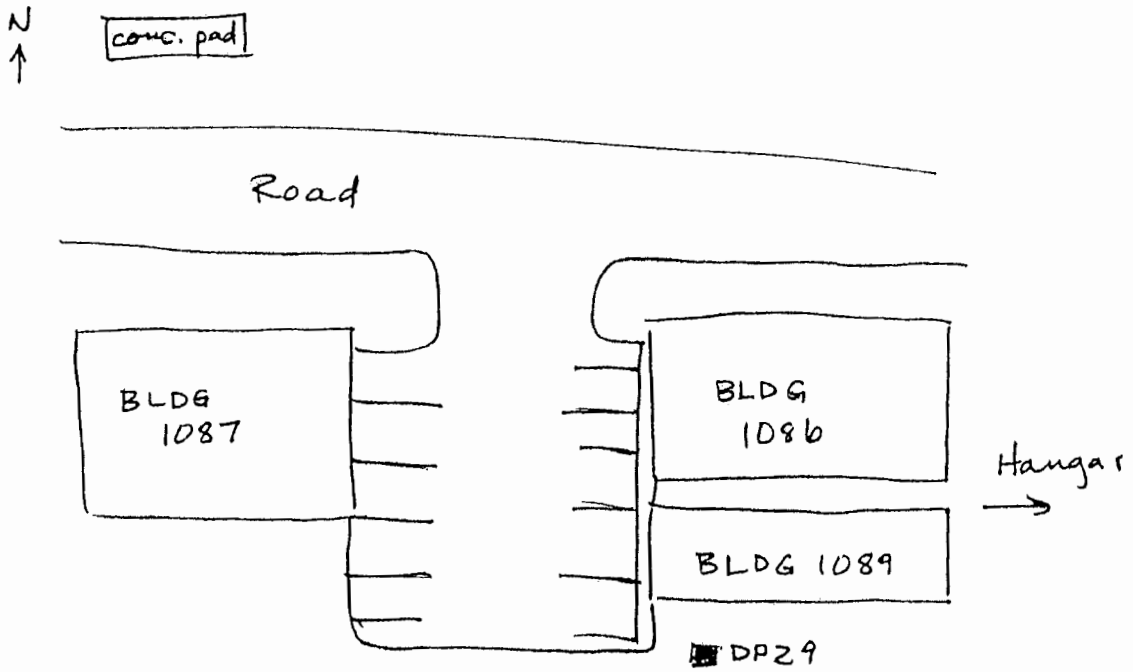
DISTRICT: OMAHA	HOLE NO.: DP29	
1. COMPANY NAME: FOSTER WHEELER ENVIRONMENTAL CORPORATION	2. DRILLING SUBCONTRACTOR: Alliance Environmental, Inc.	SHEET 1 OF 3
3. SITE: SS-61, Holloman AFB, NM	4. LOCATION: SS61 - DP29	
5. NAME OF DRILLER: Oscar Medrano	6. MANUFACTURERS DESIGNATION OF DRILL: Geoprobe GH-40	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: sampler: 1.25 in core barrel	8. HOLE LOCATION: off pkg lot, adjacent and south of Bldg 1089	
	9. SURFACE ELEVATION: N/A	
	10. DATE STARTED: 4-12-99	11. DATE COMPLETED: 4-12-99
12. OVERBURDEN THICKNESS: NA	15. DEPTH GROUNDWATER ENCOUNTERED: 21 ft	
13. DEPTH DRILLED INTO ROCK: NA	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 21 ft	
14. TOTAL DEPTH OF HOLE: 24 ft	17. OTHER WATER LEVEL MEASURMENTS (SPECIFY): N/A	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES: N/A
none	N/A	N/A	

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHERS (SPECIFY)	OTHERS (SPECIFY)	OTHERS (SPECIFY)	21. TOTAL CORE REC. %
	Water 8260 B	NA	NA	NA	NA	70
	X					

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHERS (SPECIFY)	23. SIGNATURE OF INSPECTOR
Abandoned	Bentonite	—	—	Carol Biemulis
	X			

LOCATION SKETCH/COMMENTS:



PROJECT #:	SITE:	LOCATION:
5155.0022.0003.H0000	SS-61, Holloman AFB, NM	SS61-DP29

HTRW DRILLING LOG	DISTRICT	LOCATION:
	OMAHA	DP29
1. PROJECT # 5155.0022.0003.H0000	2. INSPECTOR Carol Bieniulis	SHEET 2 OF 3

ELEV.	DEPTH (feet)	FIELD SCREEN RESULTS	USCS CLASS.	MATERIAL DESCRIPTION	COMMENTS
	1			Driving Geoprobe to 12 ft ~No recovery	
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				
	11				
	12				
	13	BKGD	ML	Fine-grained sand and silt tr. moisture, well graded, 5YR 7/4	12-14 ft Recovery = 1.25 ft
	14				
	15	3.7 ppm	ML	Fine-grained sand and silt, slightly moist, well graded, caliche, 7.5 YR 7/4	14-16 ft Recovery = 2.0 ft
	16				
	17	3.9 ppm		same as above except that soil is moist; color change to 7.5 YR 6/4	16-18 ft Recovery = 2.0 ft
	18	6.7 ppm	SM	Fine grained sand and silt w/ minor gravel, moist, moderately graded to poorly graded, 5 YR 5/4, gypsum xtals	18-20 ft Recovery = 2.0 ft
	19				
	20				

PROJECT #:	SITE:	LOCATION:
5155.0022.0003.H0000	SS-61, Holloman AFB, NM	SS61-DP29

HTRW DRILLING LOG	DISTRICT	LOCATION:
	OMAHA	DP29
1. PROJECT # 5155.0022.0003.H0000	2. INSPECTOR Carol Bieniulis	SHEET 3 OF 3

ELEV.	DEPTH (feet)	FIELD SCREEN RESULTS	USCS CLASS.	MATERIAL DESCRIPTION	COMMENTS
	21			same as above, with exception of minor black streaks in soil, more gypsum xtals.	▽ 21 ft
	22			same as above, but now soil is saturated throughout the entire recovery. Water at 20.5 - 21 ft. Will drive to 24 ft	
				TD = 24 ft	

HTRW DRILLING LOG

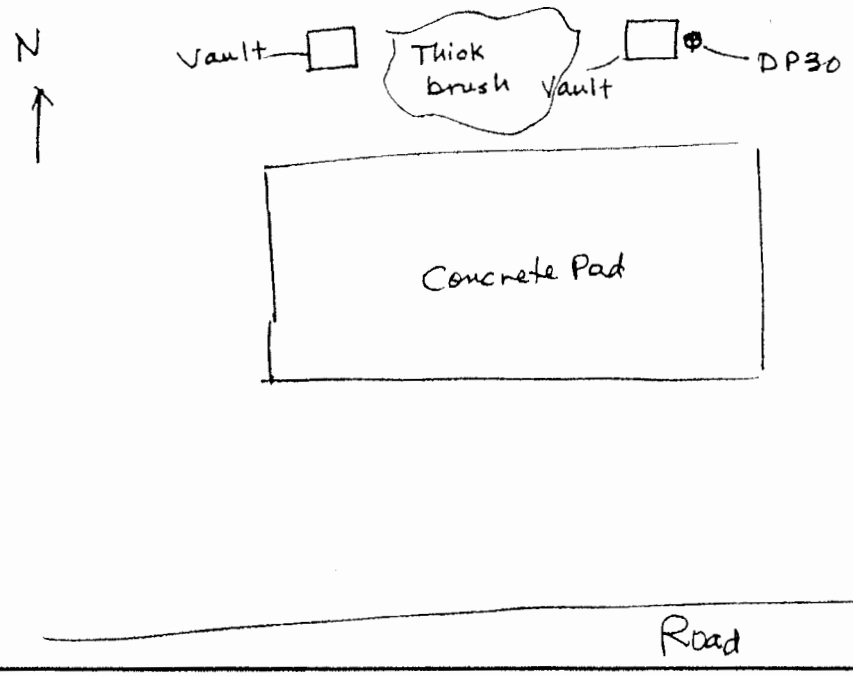
DISTRICT	OMAHA
HOLE NO.	SS61-DP30
1. COMPANY NAME	FOSTER WHEELER ENVIRONMENTAL CORPORATION
2. DRILLING SUBCONTRACTOR	Alliance Environmental, Inc.
SHEET	1 OF 2
3. SITE	SS-61, Holloman AFB, NM
4. LOCATION	SS-61
5. NAME OF DRILLER	Oscar
6. MANUFACTURERS DESIGNATION OF DRILL	GEOPROBE GH-40
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	DPT 1.25" Core
8. HOLE LOCATION	Adacent to vault.
9. SURFACE ELEVATION	N/A
10. DATE STARTED	4/6/99 1030
11. DATE COMPLETED	4/6/99 1145
12. OVERBURDEN THICKNESS	NA
15. DEPTH GROUNDWATER ENCOUNTERED	~ 22 feet
13. DEPTH DRILLED INTO ROCK	NA
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	NA
14. TOTAL DEPTH OF HOLE	NA
17. OTHER WATER LEVEL MEASURMENTS (SPECIFY)	NA

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES:
none	N/A	N/A	N/A

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHERS (SPECIFY)	OTHERS (SPECIFY)	OTHERS (SPECIFY)	21. TOTAL CORE REC. %
2-Soils 8-10' B & 12-14' C	X	NA	TRPH	NA	NA	63
1-water roc's only	8260		418.1			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHERS (SPECIFY)	23. SIGNATURE OF INSPECTOR
Backfilled	X	—	—	C. Schick
	Bentonite			

LOCATION SKETCH/COMMENTS:



PROJECT #:	SITE:	LOCATION:
5155.0022.0003.H0000	SS-61, Holloman AFB, NM	SS61-DP30

HTRW DRILLING LOG	DISTRICT OMAHA	LOCATION: SS-61
1. PROJECT # 5155.0022.0003.H0000	2. INSPECTOR	SHEET 2 OF 2

ELEV.	DEPTH (feet)	FIELD SCREEN RESULTS	USCS CLASS.	MATERIAL DESCRIPTION	COMMENTS
				0-2 No sample Rx's on surface would jam sampler	10:30 AM
	2				
		0 ppm	SM	2-4 pale brown 10YR 8/3 silty sand w/ Rx fragments, dry, no odor	50% recovery
	4				
	6				
	8				
		0 ppm	SM	light red-brown 2.5YR 7/3 silty sand w/ no odor, dry	50% recovery 1050 AM SAMPLE No. SS61-DP30C
	10				
	12			No sample - material hard.	
	14				
	16				
		0 ppm	SM	light red-brown 2.5YR 7/3 silty sand w/ gypsum x-stals damp, slight odor.	75% recovery 1100 SAMPLE No. SS-61-DP30C
	18				
	20				
	22				
		0 ppm	SM	same as above, wet.	80% recovery
	24				
	26			BOH @ 25 feet. pulled back to 24 feet collected water sample. SS61-DP30W	

HTRW DRILLING LOG

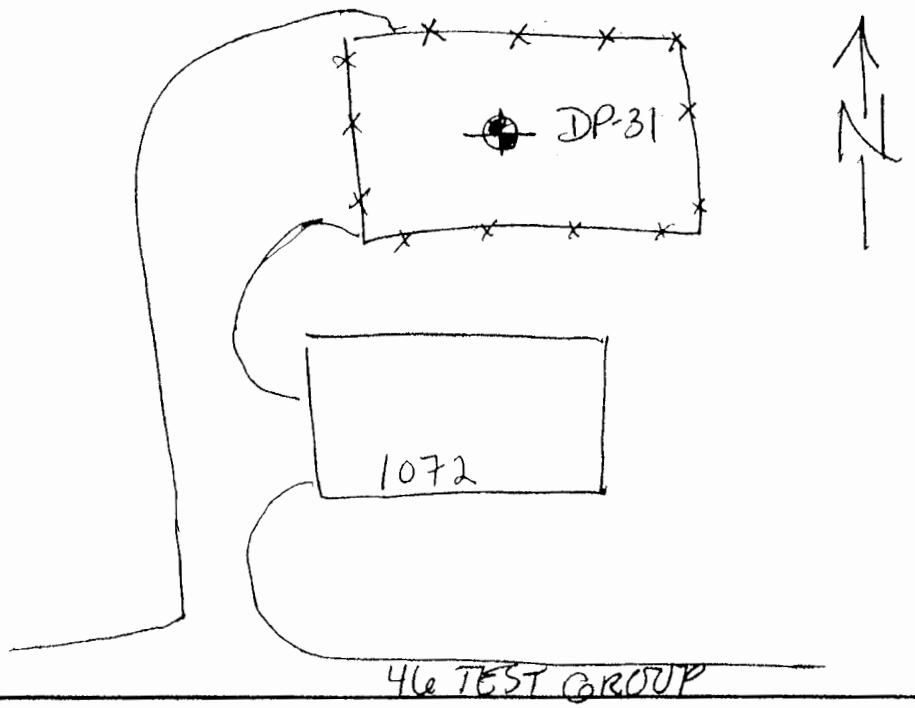
DISTRICT: OMAHA	HOLE NO.: SS61-DP31	
1. COMPANY NAME: FOSTER WHEELER ENVIRONMENTAL CORPORATION	2. DRILLING SUBCONTRACTOR: Alliance Environmental, Inc.	SHEET 1 OF 12
3. SITE: SS-61, Holloman AFB, NM	4. LOCATION: SS-61	
5. NAME OF DRILLER: Oscar	6. MANUFACTURERS DESIGNATION OF DRILL: Geoprobe GH40	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT — 1.25" core	8. HOLE LOCATION: Fenced compound behind #1072 N 32°51.586' W 106°05.324'	
	9. SURFACE ELEVATION:	
	10. DATE STARTED: 4/6/99 1330	11. DATE COMPLETED: 4/6/99 1500
12. OVERBURDEN THICKNESS: NA	15. DEPTH GROUNDWATER ENCOUNTERED: ~20 feet	
13. DEPTH DRILLED INTO ROCK: NA	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: NA	
14. TOTAL DEPTH OF HOLE: 27 ft	17. OTHER WATER LEVEL MEASURMENTS (SPECIFY): NA	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES: N/A
none	N/A	N/A	

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHERS (SPECIFY)	OTHERS (SPECIFY)	OTHERS (SPECIFY)	21. TOTAL CORE REC. %
Soil SS61-DP31B, SS61-DP31C		NA				55
WATER SS61-DP31W TOC's water only	8260		TRPH	moisture		

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHERS (SPECIFY)	23. SIGNATURE OF INSPECTOR
Abandoned	X Bentonite	—	—	[signature]

LOCATION SKETCH/COMMENTS:



PROJECT #:	SITE:	LOCATION:
5155.0022.0003.H0000	SS-61, Holloman AFB, NM	SS61-DP-31

HTRW DRILLING LOG	DISTRICT	LOCATION:
	OMAHA	SS-61
1. PROJECT # 5155.0022.0003.H0000	2. INSPECTOR Schick	SHEET 2 OF 2

ELEV.	DEPTH (feet)	FIELD SCREEN RESULTS	USCS CLASS.	MATERIAL DESCRIPTION	COMMENTS
	2	0 ppm	SM	0-2' light pale brown 10YR 8/3 silty sand w/ Rx fragments, dry no odor	80% Recovery
	4	0 ppm	SM	4-6 light reddish brown 2.5YR 7/3 silty sand. dry, no odor	75% Recovery SAMPLE NO SS61-DP31B SS61-DP3SD 1400hrs
	6				
	8	0ppm	SM	Same as above, dry, no odor	50% Recovery
	10				
	12			No samples, poor recovery	
	14				
	16	0ppm	SM	light red-brown 2.5YR 7/3 silty sand, moist no odor	75% recovery SS61-DP31C 1425 hrs
	18				
	20	No Sample		Broke split sampler at 20-22. no sample water at ~~[illegible]~~ 20 feet.	0% recovery
	22				
	24				
	26			27 feet to collect water Duplicate sample ~~SS61-DP31-W~~ SS61-DP31W @ 1645	Duplicate water samples SS61-DP31-WD 1645 hrs.
	28				
				TD = 27 ft	

HTRW DRILLING LOG

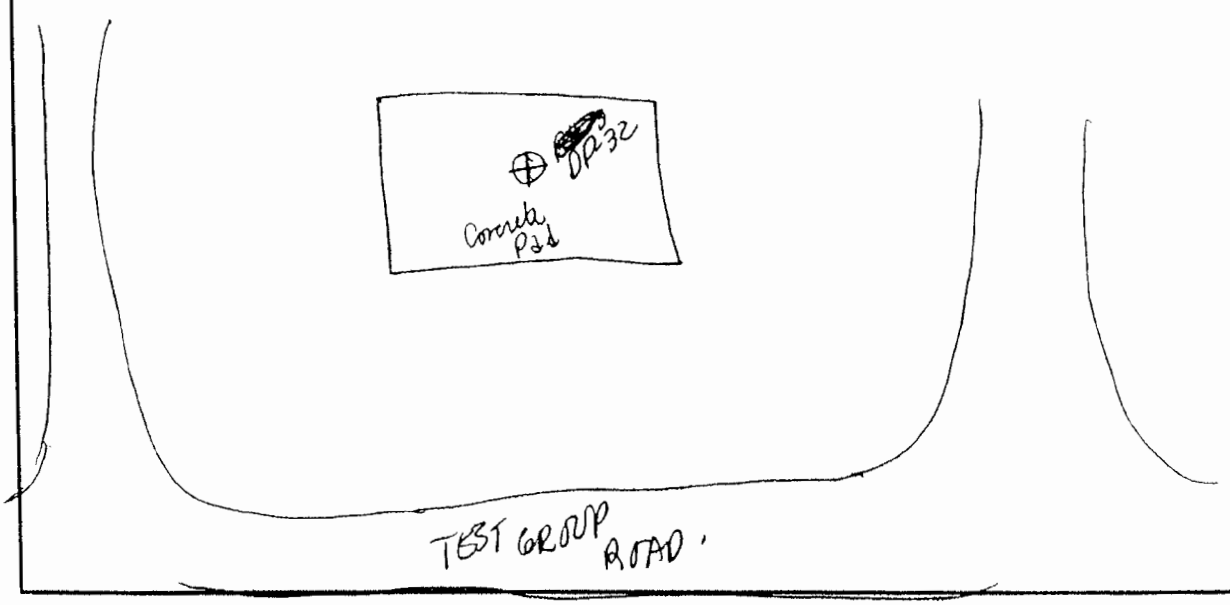
DISTRICT	OMAHA
HOLE NO.	SS61-DP32
1. COMPANY NAME	FOSTER WHEELER ENVIRONMENTAL CORPORATION
2. DRILLING SUBCONTRACTOR	Alliance Environmental, Inc.
SHEET	1 OF 2
3. SITE	SS-61, Holloman AFB, NM
4. LOCATION	SS-61
5. NAME OF DRILLER	Oscar
6. MANUFACTURERS DESIGNATION OF DRILL	Geoprobe 6H-40
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	DPT CORE; 1.25" CORE
8. HOLE LOCATION	Center of concrete slab, N 32°51.598', W 106°05.389'
9. SURFACE ELEVATION	N/A
10. DATE STARTED	4-6-99 720Am
11. DATE COMPLETED	4-6-99 1000Am
12. OVERBURDEN THICKNESS	NA
15. DEPTH GROUNDWATER ENCOUNTERED	22 feet
13. DEPTH DRILLED INTO ROCK	NA
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	NA
14. TOTAL DEPTH OF HOLE	25
17. OTHER WATER LEVEL MEASURMENTS (SPECIFY)	NA

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES:
none	N/A	N/A	N/A

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHERS (SPECIFY)	OTHERS (SPECIFY)	OTHERS (SPECIFY)	21. TOTAL CORE REC. %
2-Soils 3-5' feet and 12-14' for VOC & TRPH, 1-water for VOCs	X	NA	TRPH	NA	NA	80
	8260B		418.1			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHERS (SPECIFY)	23. SIGNATURE OF INSPECTOR
Backfilled	X	—	—	[signature]
	Bentonite			

LOCATION SKETCH/COMMENTS:



PROJECT #:	SITE:	~~LOCATION:~~ Borehole No SS61-DP32
5155.0022.0003.H0000	SS-61, Holloman AFB, NM	

HTRW DRILLING LOG	DISTRICT OMAHA	LOCATION: SS61
1. PROJECT # 5155.0022.0003.H0000	2. INSPECTOR Schick	SHEET 2 OF 2

ELEV.	DEPTH (feet)	FIELD SCREEN RESULTS	USCS CLASS.	MATERIAL DESCRIPTION	COMMENTS
				0-2 Concrete and sub base coarse.	7:40 AM
	2				
		0 ppm	SM	3-5 Pale Brown silty sand dry, no odor 10YR 8/3	Sample No SS61-DP30B 100% recovery
	4				
	6		SM	6-8 pink-white 5YR 8/2 silty sand, no odor dry	100% recovery
		0 ppm			
	8				
	10			10-12' No sample, broke core barrel	
	12				
		0 ppm	SM	12'-14' light red 2.5YR 7/3 brown silty sand, damp no odor	Sample No SS61-DP30C 100% recovery
	14				
	16			Broken sleeves, no sample	0% recovery
	18				
	20			20-22 light red brown 2.5YR 7/3 silty sand, wet, ~~no odor~~ cvs strong petroleum odor	75% recovery
		~~0~~ cvs 0.2 ppm	SM		
	22				
	24				
				25 Ft BGS pulled sampler back to 24 feet for GW sample	
	26				

HTRW DRILLING LOG

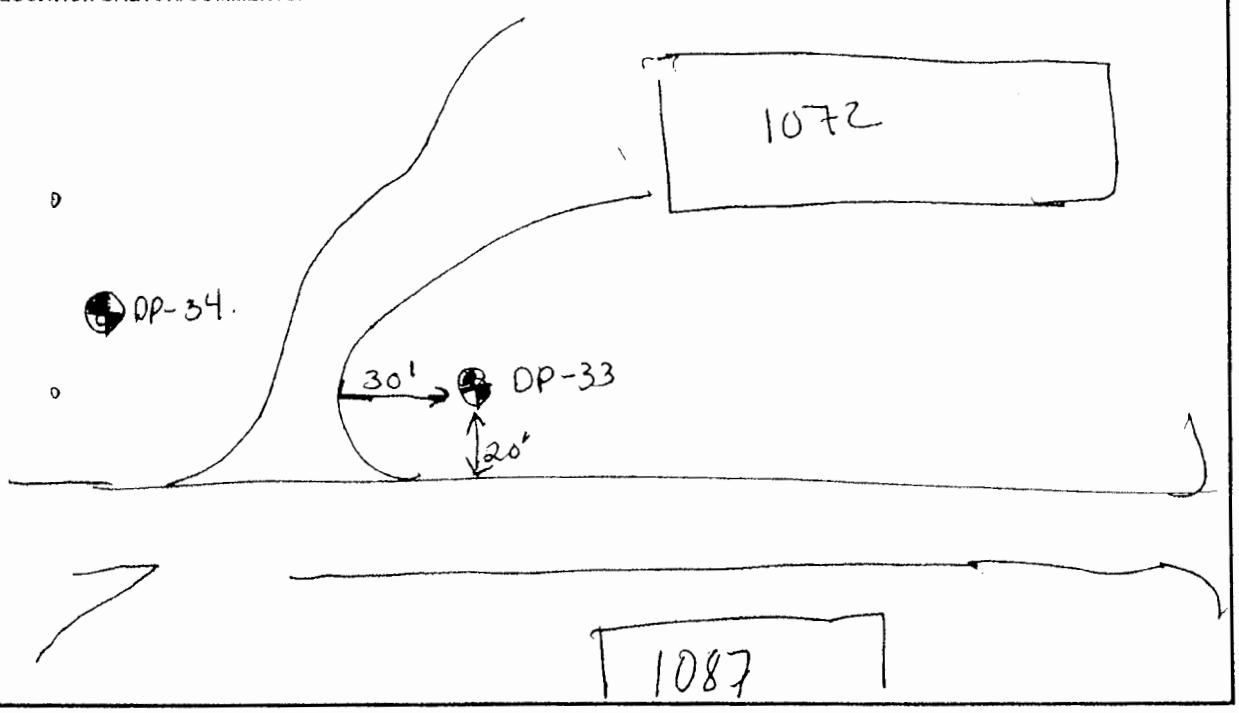
DISTRICT: OMAHA	HOLE NO.: SS61DP33	
1. COMPANY NAME: FOSTER WHEELER ENVIRONMENTAL CORPORATION	2. DRILLING SUBCONTRACTOR: Alliance Environmental, Inc.	SHEET 1 OF 2
3. SITE: SS-61, Holloman AFB, NM	4. LOCATION: DP-34 N32°51' 585 W 106°05'. 367	
5. NAME OF DRILLER: Oscar / Alliance	6. MANUFACTURERS DESIGNATION OF DRILL: Geoprobe GH-40	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT- 1.25"	8. HOLE LOCATION: SS-61 N32° 51' 585' W106° 05 367	
	9. SURFACE ELEVATION: N/A	
	10. DATE STARTED: 4-5-99 4:55pm	11. DATE COMPLETED: 4-5-99 7:00pm
12. OVERBURDEN THICKNESS: NA	15. DEPTH GROUNDWATER ENCOUNTERED: ~22 feet	
13. DEPTH DRILLED INTO ROCK: N/A	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: N/A	
14. TOTAL DEPTH OF HOLE: 25 feet	17. OTHER WATER LEVEL MEASURMENTS (SPECIFY): N/A	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES: N/A
none	N/A	N/A	

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHERS (SPECIFY)	OTHERS (SPECIFY)	OTHERS (SPECIFY)	21. TOTAL CORE REC. %
WATER ONLY	8260 B	NA	NA	NA	NA	NA
	X					

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHERS (SPECIFY)	23. SIGNATURE OF INSPECTOR
Backfilled bentonite	X	—	—	[signature]

LOCATION SKETCH/COMMENTS:



PROJECT #:	SITE:	~~LOCATION~~:
5155.0022.0003.H0000	SS-61, Holloman AFB, NM	Hole Location SS61-DP-33

HTRW DRILLING LOG	DISTRICT	LOCATION:
	OMAHA	SS-61

1. PROJECT #	2. INSPECTOR	SHEET 2 OF 2
5155.0022.0003.H0000	Schick	

ELEV.	DEPTH (feet)	FIELD SCREEN RESULTS	USCS CLASS.	MATERIAL DESCRIPTION	COMMENTS
	0	0 ppm	SM	Pale Brown silty sand with Rx fragments, damp. No odor 10YR 8/3	455pm start.
	2				
	4	0 ppm	SM	Same as above.	
	6	0 ppm	SM	Pinkish-white silty sand, no Rocks, damp, No odor, 5YR 8/2	
	8	0 ppm	SM	same as above	5:15pm
	10	0 ppm	SM	Same as above	
	12	0 PP	SM	Same	
	14	0 ppm	SM	light red brown silty sand w/ gypsum x-stals. dry, no odor 2.5YR 7/3	5:30pm
	16	0 ppm	SM	same as above	
	18	0 ppm	SM	same as above except, moist	550pm
	20	0 ppm	SM	Same as above, moist	6:30pm.
	22	0 ppm	SM	same as above, moist	
	24	0 ppm	SM	same / wet	
				Boh at 25 Ft.	
				Collected water sample SS61-DP33W 0	
				1900 hrs.	

HTRW DRILLING LOG

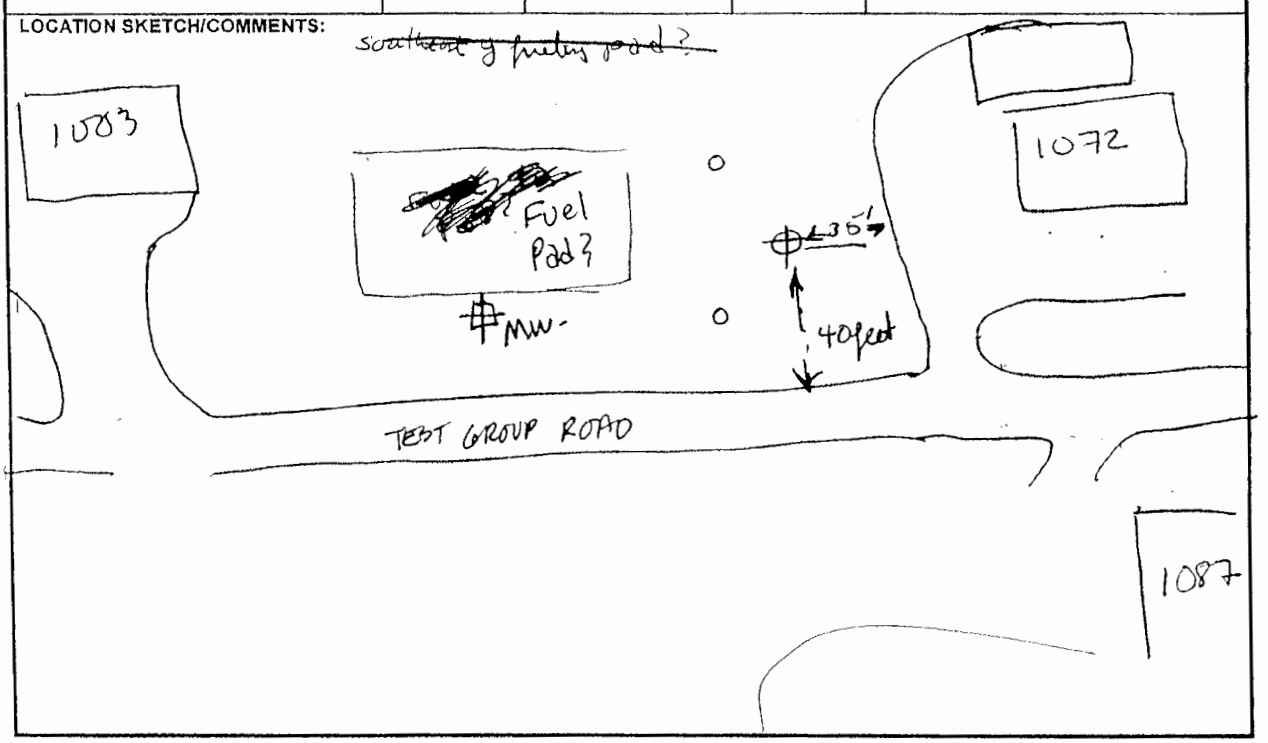
DISTRICT: OMAHA		HOLE NO. SS61DP34
1. COMPANY NAME: FOSTER WHEELER ENVIRONMENTAL CORPORATION	2. DRILLING SUBCONTRACTOR: Alliance Environmental, Inc.	SHEET 1 OF 2
3. SITE: SS-61, Holloman AFB, NM	4. LOCATION: SS-61 @ Holloman AFB	
5. NAME OF DRILLER: Alliance / Oscar	6. MANUFACTURERS DESIGNATION OF DRILL: Geoprobe CoH-40	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT 2" + CVS; 1.25"	8. HOLE LOCATION: N 32°51'.592' W 106°05' 390' ~~4 Coordinates~~ 3 CS	
	9. SURFACE ELEVATION: NA	
	10. DATE STARTED: 4-5-99 1:54pm	11. DATE COMPLETED: 4-5-99 3:44pm
12. OVERBURDEN THICKNESS: -0-	15. DEPTH GROUNDWATER ENCOUNTERED: 19 Feet	
13. DEPTH DRILLED INTO ROCK: -0-	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: NA	
14. TOTAL DEPTH OF HOLE: 22 feet	17. OTHER WATER LEVEL MEASURMENTS (SPECIFY): Est From Drill core work	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES:
none	N/A	N/A	N/A

20. SAMPLES FOR CHEMICAL ANALYSIS water only	VOC	METALS	OTHERS (SPECIFY)	OTHERS (SPECIFY)	OTHERS (SPECIFY)	21. TOTAL CORE REC. %
	8260	NA	NA	NA	NA	85
	X					

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHERS (SPECIFY)	23. SIGNATURE OF INSPECTOR
	Bentonite	—	—	[signature]

LOCATION SKETCH/COMMENTS: ~~Southeast of fueling pad?~~



PROJECT #:	SITE:	~~LOCATION~~: Hole No.
5155.0022.0003.H0000	SS-61, Holloman AFB, NM	SS61DP34

HTRW DRILLING LOG	DISTRICT	LOCATION:
	OMAHA	SS-61
1. PROJECT # 5155.0022.0003.H0000	2. INSPECTOR Schiere	SHEET 2 OF 2

ELEV.	DEPTH (feet)	FIELD SCREEN RESULTS	USCS CLASS.	MATERIAL DESCRIPTION	COMMENTS
	0	0 ppm	SM	0-2, SM pale brown, fine silty sand w/ Rx fragments, soft no odor 10YR 8/3	100% recovery 1:54pm
	2	0 ppm	SM	2-4, SM, pinkish white 5YR8/2 silty sand, damp, no odor	50% recovery
	4			4-8 SM, pinkish white	
	6	0 ppm	SM	silty sand, ~~clean~~, No odor	100% recovery Change to 2" barrel
	8			8-12 SM, pinkish white 5YR8/2 silty sand, damp, no odor,	
	10	0 ppm	SM		
	12	0 ppm	SM	12-14 SM, light reddish brown silty sand, loose, no odor, dry. 2.5YR 7/3.	75% recovery small barrel.
	14	0 ppm	SM	14-16 SM, light reddish brown silty sand w/ 30% sm x-stals, ~~stg~~ damp, No odor	100% recovery
	16	ppm 0.2	SM	16-18 SM, Same as above except Strong pet odor, Rx PID reading	100% recovery
	18	0.1 ppm	SM	18-20 SM, wet, 2.5YR 7/3 strong petroleum odor.	water at 19 Ft
	20	0.1 ppm	SM	20-22 SAME AS Above	
	22			BOHC 22 feet collected grab sample SS61-DP34W	3:45pm
	24				
	26				
	28				
	30				

HTRW DRILLING LOG

DISTRICT: OMAHA	HOLE NO. SS61 DP35 CLB	
1. COMPANY NAME: FOSTER WHEELER ENVIRONMENTAL CORPORATION	2. DRILLING SUBCONTRACTOR: Alliance Environmental, Inc.	SHEET 1 OF 2 041599

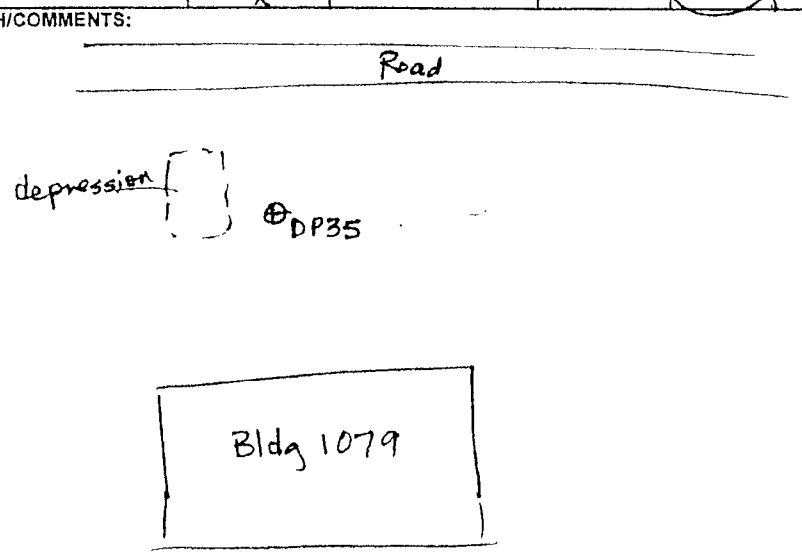
3. SITE: SS-61, Holloman AFB, NM	4. LOCATION: NORTH OF #1079
5. NAME OF DRILLER: Oscar	6. MANUFACTURERS DESIGNATION OF DRILL: Geoprobe H40
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Geoprobe; 1.25 Sampler w/ Brass	8. HOLE LOCATION: North of Building 1079
	9. SURFACE ELEVATION:
	10. DATE STARTED: 4/15/99 — 11. DATE COMPLETED: 4/15/99
12. OVERBURDEN THICKNESS: NA	15. DEPTH GROUNDWATER ENCOUNTERED: 18.5 Soil Sampler.
13. DEPTH DRILLED INTO ROCK: NA	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: NA
14. TOTAL DEPTH OF HOLE: 24	17. OTHER WATER LEVEL MEASURMENTS (SPECIFY): NA

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES:
none	N/A	N/A	N/A

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHERS (SPECIFY)	OTHERS (SPECIFY)	OTHERS (SPECIFY)	21. TOTAL CORE REC. %
Water only	8260B	NA	NA	NA	NA	NA
SS61DP30W	X					

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHERS (SPECIFY)	23. SIGNATURE OF INSPECTOR
Abandoned	Bentonite	—	—	[signature]
	X			

LOCATION SKETCH/COMMENTS:



PROJECT #:	SITE:	LOCATION:
5155.0022.0003.H0000	SS-61, Holloman AFB, NM	SS61-DP30 CLB 0915

HTRW DRILLING LOG	DISTRICT	LOCATION:
	OMAHA	SS61-DP30
1. PROJECT # 5155.0022.0003.H0000	2. INSPECTOR SCHICK	SHEET 2 OF 2

ELEV.	DEPTH (feet)	FIELD SCREEN RESULTS	USCS CLASS.	MATERIAL DESCRIPTION	COMMENTS
	2			0-18 No SAMPLES, PUSH only	0845 Start
	4				
	6				
	8				
	10				
	12			12-14 feet HARD LAYER	
	14				
	16				
	18				
	20	80	SM	18-20 Dark gray + black HC stained silty sand, wet at 18.5' strong HC odor	0905
	22			22-24' same as above	0920
	24			BOHC 24 feet, set screen for sample sampled SS61-DP30 @ 0945	0945

HTRW DRILLING LOG

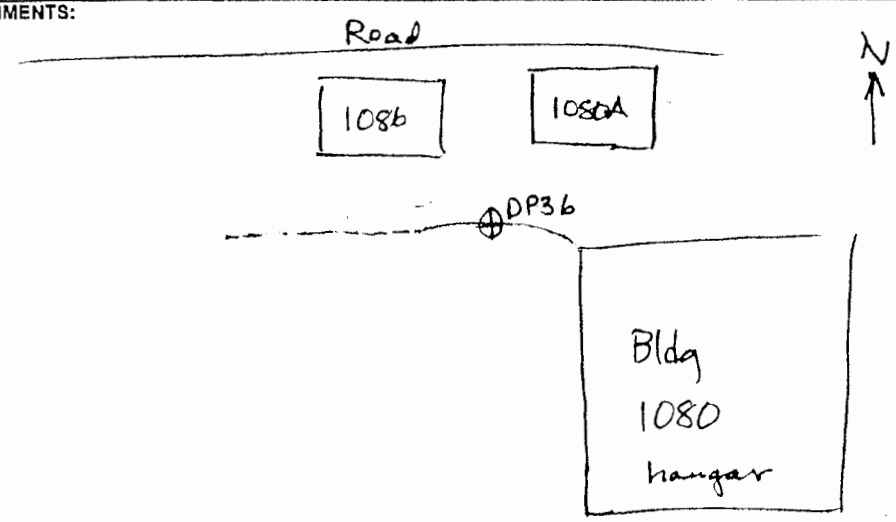
DISTRICT: OMAHA	HOLE NO.: SS61 DP-3b	
1. COMPANY NAME: FOSTER WHEELER ENVIRONMENTAL CORPORATION	2. DRILLING SUBCONTRACTOR: Alliance Environmental, Inc.	SHEET 1 OF 2
3. SITE: SS-61, Holloman AFB, NM	4. LOCATION:	
5. NAME OF DRILLER: OSCAR	6. MANUFACTURERS DESIGNATION OF DRILL: Geoprobe H40	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT Geoprobe; 1.25" Sleeves	8. HOLE LOCATION: See map	
	9. SURFACE ELEVATION:	
	10. DATE STARTED: 4/15/99	11. DATE COMPLETED: 4/15/99
12. OVERBURDEN THICKNESS:	15. DEPTH GROUNDWATER ENCOUNTERED:	
13. DEPTH DRILLED INTO ROCK: NA	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: NA	
14. TOTAL DEPTH OF HOLE: NA	17. OTHER WATER LEVEL MEASURMENTS (SPECIFY): NA	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES:
none	N/A	N/A	N/A

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHERS (SPECIFY)	OTHERS (SPECIFY)	OTHERS (SPECIFY)	21. TOTAL CORE REC. %
water only SS61-DP31W	8260					
	X					

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHERS (SPECIFY)	23. SIGNATURE OF INSPECTOR
Abandoned w/ Bentonite	Bentonite			[signature]
	X			

LOCATION SKETCH/COMMENTS:



PROJECT #:	SITE:	LOCATION:
5155.0022.0003.H0000	SS-61, Holloman AFB, NM	SS61-DP36

HTRW DRILLING LOG	DISTRICT	LOCATION:
	OMAHA	SS61 DP36
1. PROJECT # 5155.0022.0003.H0000	2. INSPECTOR SCHICK	SHEET 2 OF 2

ELEV.	DEPTH (feet)	FIELD SCREEN RESULTS	USCS CLASS.	MATERIAL DESCRIPTION	COMMENTS
					1002 start
	2			0-16 feet, no samples	
	4				
	6				
	8				
	10				
	12				
	14				
	16				
	18		SC	16-18 feet Red brown sandy clay moist (2.5YR5/4), no odor, no stains	1010 100% Recov
	20			18-20' same as above, very moist no water no stains + odor	1025 100% Recov.
			SM	20-22' wet - Red brown silty sand no odor, no stains	1050 100%
	22				
	24				
	26			- 26 Ft BOH and Screen collected water sample SS61DP31W @ 1120 hrs.	
	27				

HTRW DRILLING LOG

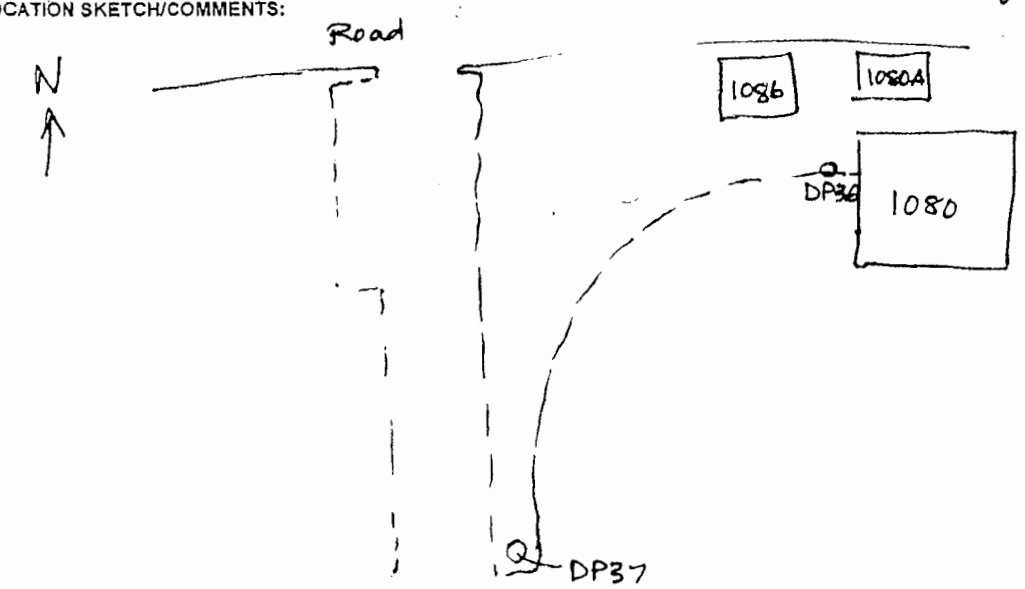
DISTRICT: OMAHA	HOLE NO.: SS61-DP37	
1. COMPANY NAME: FOSTER WHEELER ENVIRONMENTAL CORPORATION	2. DRILLING SUBCONTRACTOR: Alliance Environmental, Inc.	SHEET 1 OF 2
3. SITE: SS-61, Holloman AFB, NM	4. LOCATION: NEXT TO FLIGHTLINE ENTRANCE	
5. NAME OF DRILLER: Oscar	6. MANUFACTURERS DESIGNATION OF DRILL: GEOPROBE H40	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Geoprobe DPT; 1.25 Sampler w/ Brass	8. HOLE LOCATION: SEE MAP	
	9. SURFACE ELEVATION: N/A	
	10. DATE STARTED: 4/15/99	11. DATE COMPLETED: 4/15/99
12. OVERBURDEN THICKNESS: NA	15. DEPTH GROUNDWATER ENCOUNTERED: ~ 23 ft	
13. DEPTH DRILLED INTO ROCK: NA	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: NA	
14. TOTAL DEPTH OF HOLE: 26 ft	17. OTHER WATER LEVEL MEASURMENTS (SPECIFY): NA	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES:
none	N/A	N/A	N/A

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHERS (SPECIFY)	OTHERS (SPECIFY)	OTHERS (SPECIFY)	21. TOTAL CORE REC. %
WATER ONLY SS61-DP32W	8260	NA	NA	NA	NA	NA
	X					

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHERS (SPECIFY)	23. SIGNATURE OF INSPECTOR
Abandoned	Bentonite	—	—	
	X			

LOCATION SKETCH/COMMENTS:



PROJECT #:	SITE:	LOCATION:
5155.0022.0003.H0000	SS-61, Holloman AFB, NM	SS61DP-32 CLB 041599

HTRW DRILLING LOG	DISTRICT OMAHA	LOCATION: SS61-DP32 041599
1. PROJECT # 5155.0022.0003.H0000	2. INSPECTOR SCHICK	SHEET 2 OF 2

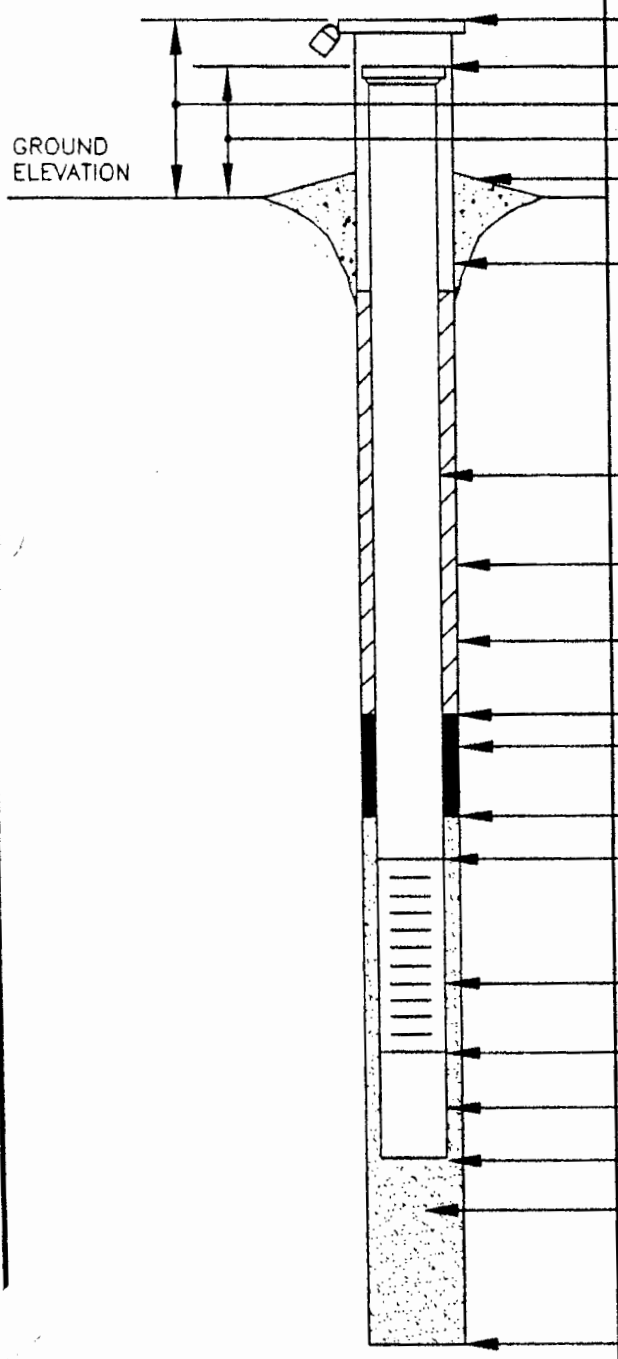
ELEV.	DEPTH (feet)	FIELD SCREEN RESULTS	USCS CLASS.	MATERIAL DESCRIPTION	COMMENTS
	2				
	4				
	6				
	8				
	10				
	12				
	14				
	16				
	18			18-20' moist Red brown silty clay (2.5YR 5/4), moist, no odor no stains	1330
	20		SC	20-22 wet brown silty clay, some sand, no odor, no stains	1345
	22				
	24				
	26			Bolt @ 26 feet for screen Collect water samp SS61-DP32W @ 1410	

WELL NO. SS61-MW05

OVERBURDEN
MONITORING WELL SHEET

PROJECT: SS-61 RI
PROJECT NO.: 5155.0022.0003 BORING NO.: SS61-MW05
ELEVATION: N/A DATE: 4/9/99
FIELD GEOLOGIST: Carol Bieniulis

DRILLER: D. Hogan-Alliance
DRILLING METHOD: HSA
DEVELOPMENT METHOD: Teflon bailer/pump



ELEVATION OF TOP OF SURFACE CASING: N/A
ELEVATION OF TOP OF RISER PIPE: N/A
STICK-UP TOP OF SURFACE CASING: 4.0 ft from pad surface
STICK-UP RISER PIPE: 3.5 ft from pad surface
TYPE OF SURFACE SEAL: Concrete
I.D. OF SURFACE CASING: 6 in.
TYPE OF SURFACE CASING: steel
RISER PIPE I.D.: 2 in.
TYPE OF RISER PIPE: PVC
BOREHOLE DIAMETER: 6 ~~8~~ in. CLB 091699
TYPE OF BACKFILL: grout-bentonite/concrete
ELEVATION/DEPTH TOP OF SEAL: 9.5 ft bgs
TYPE OF SEAL: bentonite
PDSCo bentonite chips
DEPTH OF SAND PACK: 12.5 ft bgs
ELEVATION/DEPTH TOP OF SCREEN: 14.5 ft bgs
TYPE OF SCREEN: PVC slotted pipe CLB 081399
SLOT SIZE X LENGTH: 0.10 slot, 10 ft length
TYPE OF SAND PACK: 10/20 Colorado silica sand
ELEVATION/DEPTH BOTTOM OF SCREEN: 24 ft bgs
TYPE OF SUMP: PVC cap
LENGTH OF SUMP 0.5 ft
ELEVATION/DEPTH BOTTOM OF SAND PACK: 25 ft
TYPE OF BACKFILL BELOW OBSERVATION WELL: None
ELEVATION/DEPTH OF HOLE: 25 ft

NOT TO SCALE

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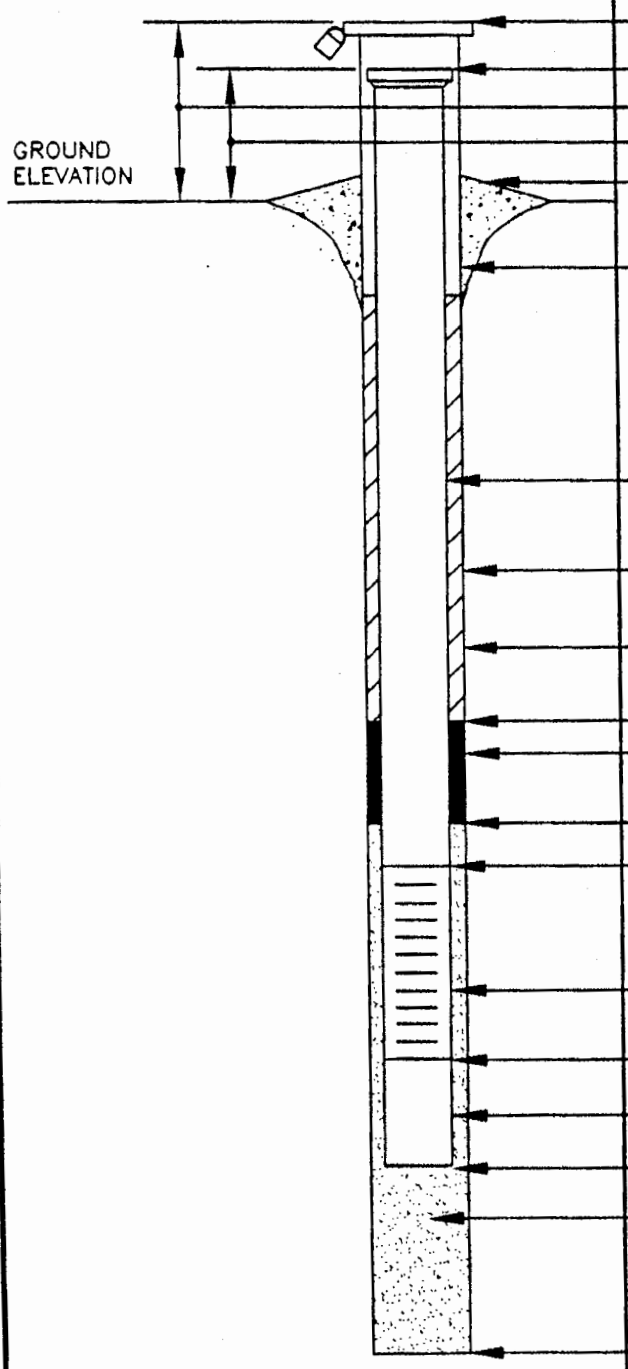
WELL NO. SS61-MW06

OVERBURDEN
MONITORING WELL SHEET

PROJECT: SS61 RI
PROJECT NO.: 5155.0022.0003 BORING NO.: SS61-MW06
ELEVATION: N/A DATE: 4/8/99
FIELD GEOLOGIST: Carol Bieniulis

DRILLER: D. Hogan - Alliance
DRILLING METHOD: HSA
DEVELOPMENT METHOD: Teflon bailer / pump



ELEVATION OF TOP OF SURFACE CASING: N/A
ELEVATION OF TOP OF RISER PIPE: N/A
STICK-UP TOP OF SURFACE CASING: 2.9 ft from pad surface
STICK-UP RISER PIPE: 2.8 ft from pad surface
TYPE OF SURFACE SEAL: concrete
I.D. OF SURFACE CASING: 6 in.
TYPE OF SURFACE CASING: steel
RISER PIPE I.D.: 2 in.
TYPE OF RISER PIPE: PVC
BOREHOLE DIAMETER: 6 in
TYPE OF BACKFILL: grout - bentonite/concrete
ELEVATION/DEPTH TOP OF SEAL: 8.0 ft
TYPE OF SEAL: bentonite
PDSCo bentonite chips
DEPTH OF SAND PACK: 11.8 ft
ELEVATION/DEPTH TOP OF SCREEN: 14.0 ~~11.8~~ ft CLB 041699
TYPE OF SCREEN: PVC slotted pipe CLB 081399
SLOT SIZE X LENGTH: 0.10 slot, 10 ft length
TYPE OF SAND PACK: 10/20 Colorado silica sand
ELEVATION/DEPTH BOTTOM OF SCREEN: 24.0 ft
TYPE OF SUMP: PVC cap
LENGTH OF SUMP 0.5 ft
ELEVATION/DEPTH BOTTOM OF SAND PACK:
TYPE OF BACKFILL BELOW OBSERVATION WELL: none
ELEVATION/DEPTH OF HOLE: 24.5 ft

NOT TO SCALE

D:\PROJECTS\5155KIRK\Mw_log(blank).DWG

HTRW DRILLING LOG

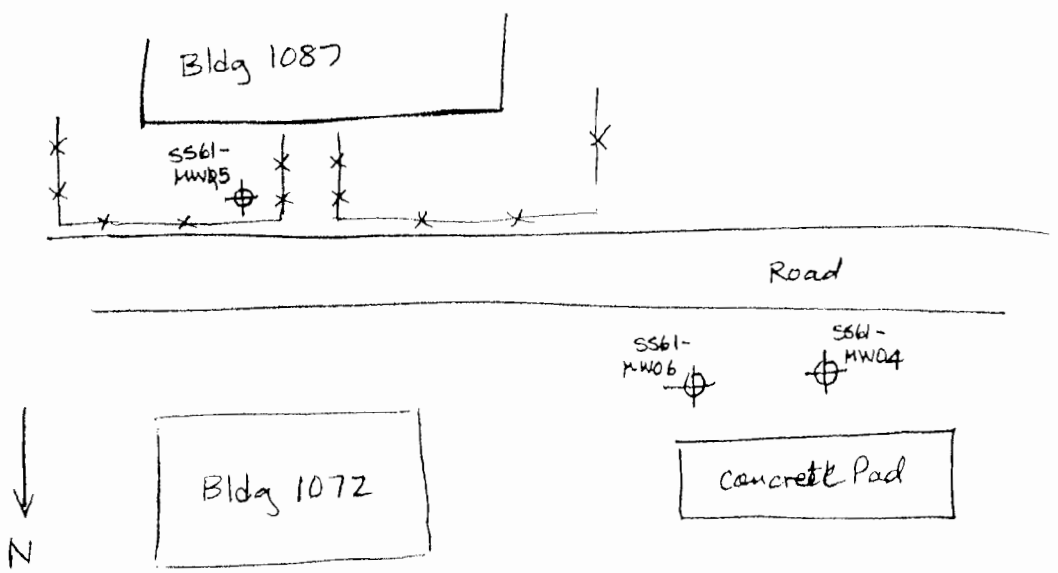
DISTRICT: OMAHA		HOLE NO.: SS61-MW05
1. COMPANY NAME: FOSTER WHEELER ENVIRONMENTAL CORPORATION	2. DRILLING SUBCONTRACTOR: Alliance Environmental, Inc.	SHEET 1 OF 3
3. SITE: SS-61, Holloman AFB, NM	4. LOCATION: SS61-MW05	
5. NAME OF DRILLER:	6. MANUFACTURERS DESIGNATION OF DRILL: Mobile Drill, model B-61	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Hollow-stem auger 4.25 in ID 8.5 in OD	8. HOLE LOCATION: with yard north of Bldg. 1087	
	9. SURFACE ELEVATION: N/A	
	10. DATE STARTED: 4-9-99	11. DATE COMPLETED: 4-9-99
12. OVERBURDEN THICKNESS: N/A	15. DEPTH GROUNDWATER ENCOUNTERED: ~19 ft	
13. DEPTH DRILLED INTO ROCK: N/A	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 18.5 ft	
14. TOTAL DEPTH OF HOLE: 24.5 ft	17. OTHER WATER LEVEL MEASURMENTS (SPECIFY):	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES: N/A
none	N/A	N/A	

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHERS (SPECIFY)	OTHERS (SPECIFY)	OTHERS (SPECIFY)	21. TOTAL CORE REC. %
None	NA	NA	NA	NA	NA	100

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHERS (SPECIFY)	23. SIGNATURE OF INSPECTOR
Install monitoring well	—	X	—	Carol Bienulis

LOCATION SKETCH/COMMENTS:



PROJECT #:	SITE:	LOCATION:
5155.0022.0003.H0000	SS-61, Holloman AFB, NM	SS61-MW05

HTRW DRILLING LOG	DISTRICT	LOCATION: SS61-MW05
	OMAHA	
1. PROJECT # 5155.0022.0003.H0000	2. INSPECTOR Carol Bieniulis	SHEET 2 OF 3

ELEV.	DEPTH (feet)	FIELD SCREEN RESULTS	USCS CLASS.	MATERIAL DESCRIPTION	COMMENTS
	1.0	BKGD		Fill material, poorly sorted	
	2	BKGD	CL	Clayey sand w/ some gravel, slightly moist, low plasticity, 10YR 6/2, poorly sorted	
	3				
	4	BKGD	CL	Clay with some sand and silt, med plasticity, slight. moist, 10YR 7/4	
	5				
	6			same as above	
	7	BKGD			
	8				
	9		SC	Clayey sand w/ some gravel, slightly moist, poorly sorted, 7.5 YR 7/2	
	10				
	11	BKGD			
	12				
	13				
	14	BKGD	CL	Sandy clay, slightly moist, low plasticity, well sorted/graded, 7.5 YR 7/2 CLB 091099	
	15				
	16			Silty clay, no sand or gravel, well graded, low plasticity, slightly moist, 7.5 YR 6/4	
	17				
	18				
	19	BKG	ML	Clay w/ silt, well graded, slightly moisty, high plasticity, 7.5YR 7/4 CLB	▽ Water
	20				

PROJECT #:	SITE:	LOCATION:
5155.0022.0003.H0000	SS-61, Holloman AFB, NM	SS61-MW05

HTRW DRILLING LOG	DISTRICT	LOCATION:
	OMAHA	SS61-MW05
1. PROJECT # 5155.0022.0003.H0000	2. INSPECTOR Carol Bieniulis	SHEET 3 OF 3

ELEV.	DEPTH (feet)	FIELD SCREEN RESULTS	USCS CLASS.	MATERIAL DESCRIPTION	COMMENTS
	21			Same as above	
	22	BKGD			
	23				
	24	BKGD	ML	Clay w/ silt, well graded. saturated, very plastic, 5YR 6/4.	Strong petroleum odor
			CL	silty clay w/ some sand, saturated, med plasticity, well graded, 10YR 5/1	Very Strong Petroleum Odor
				TD = 24.5 ft	
				Water at 18.5 ft (0820)	
				Measured at 14.3 ft (0945)	Need to take water level again

HTRW DRILLING LOG

DISTRICT: OMAHA		HOLE NO.: SS61-MW06
1. COMPANY NAME: FOSTER WHEELER ENVIRONMENTAL CORPORATION	2. DRILLING SUBCONTRACTOR: Alliance Environmental, Inc.	SHEET 1 OF 3
3. SITE: SS-61, Holloman AFB, NM	4. LOCATION: SS61-MW06	
5. NAME OF DRILLER: Dave Hogain - Alliance	6. MANUFACTURERS DESIGNATION OF DRILL: Mobile Drill, model B-61	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Hollow-stem auger, 4.25 in ID, 8.5 in OD	8. HOLE LOCATION: South of east end of concrete pad	
	9. SURFACE ELEVATION: N/A	
	10. DATE STARTED: 4-8-99	11. DATE COMPLETED: 4-8-99
12. OVERBURDEN THICKNESS: N/A	15. DEPTH GROUNDWATER ENCOUNTERED: ~19 ft	
13. DEPTH DRILLED INTO ROCK: N/A	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 19.5 ft	
14. TOTAL DEPTH OF HOLE: 24.5	17. OTHER WATER LEVEL MEASURMENTS (SPECIFY):	

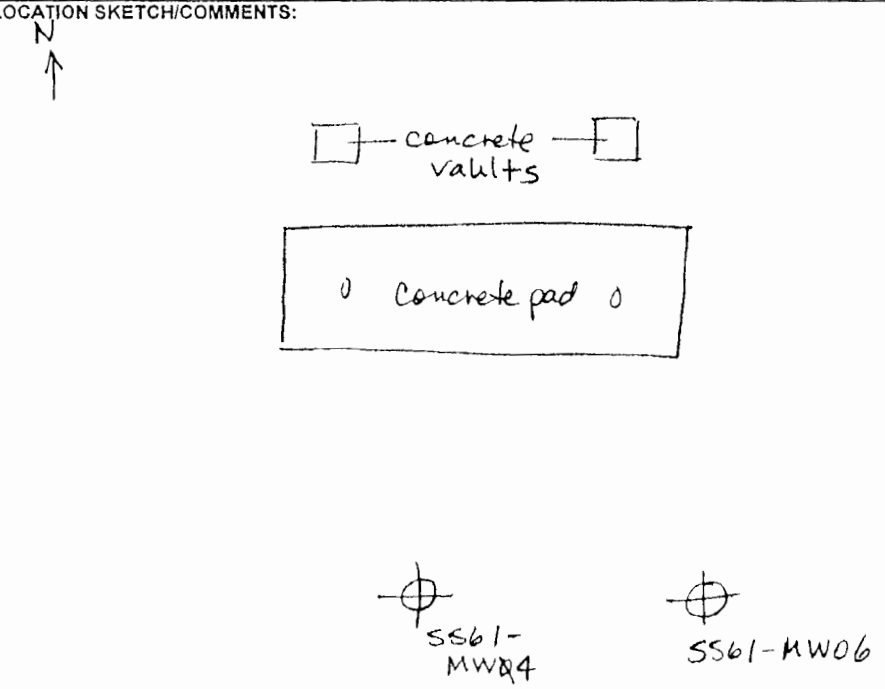
18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES:
none	N/A	N/A	N/A

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHERS (SPECIFY)	OTHERS (SPECIFY)	OTHERS (SPECIFY)	21. TOTAL CORE REC.
none	NA	NA	NA	NA	NA	% ~~100~~ NA

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHERS (SPECIFY)	23. SIGNATURE OF INSPECTOR
Monitoring well installation		X		Carl Brennlis

4/30/99

LOCATION SKETCH/COMMENTS:



PROJECT #:	SITE:	LOCATION:
5155.0022.0003.H0000	SS-61, Holloman AFB, NM	SS61- MW06

HTRW DRILLING LOG

DISTRICT	LOCATION:
OMAHA	SS61- MW06

1. PROJECT #	2. INSPECTOR	SHEET 2 OF 3
5155.0022.0003.H0000	Carol Bieniulis	

ELEV.	DEPTH (feet)	FIELD SCREEN RESULTS	USCS CLASS.	MATERIAL DESCRIPTION	COMMENTS
	1	BKGD		See HTRW Drilling Log for SS61-DP34 for lithologic descriptions to 22.0 ft in depth	
	2				
	3				
	4				
	5	BKGD			
	6				
	7				
	8				
	9				
	10	BKGD			
	11				
	12				
	13				
	14				
	15	BKGD			
	16				
	17				
	18				
	19	12 ppm			▽ water
	20				

PROJECT #:	SITE:	LOCATION:
5155.0022.0003.H0000	SS-61, Holloman AFB, NM	SS61-MW06

HTRW DRILLING LOG	DISTRICT	LOCATION:
	OMAHA	MW06
1. PROJECT # 5155.0022.0003.H0000	2. INSPECTOR Carol Bieniulis	SHEET 3 OF 3

ELEV.	DEPTH (feet)	FIELD SCREEN RESULTS	USCS CLASS.	MATERIAL DESCRIPTION	COMMENTS
	21				
	22				
	23	30ppm	SC-SM	Clayey and sandy silt, well-graded, saturated, med to poor plasticity, 2.5 YR 7/1	Strong petroleum odor
	24				
				TD = 24.5 ft water encountered at ~19 ft	

Appendix A-3

Final Phase II Remedial Investigation Report for SS-61 - Spill Site 61, Holloman Air Force Base, New Mexico, **Foster Wheeler Environmental Corporation, December 2000.**

Headquarters, Air Combat Command
Langley Air Force Base,
Virginia

Final
Phase II Remedial Investigation Report for SS-61—Spill Site 61

Holloman Air Force Base,
New Mexico

December 2000

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49 CES/CEV
Holloman Air Force Base,
New Mexico

Project Number: KWRD20007002

Table 2-1. Summary of Sampling Conducted During the Phase II Remedial Investigation

Site ID	Location and Rationale	Summary of Analytes Detected	Field Observations
DPT Sample Locations (soil and groundwater sampled)			
SS61-DP38	Southeast of Building 1080 adjacent to taxiway used to define areal of contamination	No detections	No odor or staining noted
SS61-DP39	Southeast of Building 1079 adjacent to taxiway used to define areal of contamination downgradient of bldg 1079	JP-4 in soil and groundwater; benzene and related fuel constituents in groundwater	Petroleum staining and odor noted in saturated cuttings and in water
SS61-DP40	Southwest of Building 1079 adjacent to taxiway used to define areal extent of contamination	JP-4 in shallow soil	Slight petroleum odor in shallow soil
SS61-DP41	Northwest of SD-28, former washrack used to define areal of extent of contamination	JP-4 in soil	Slight petroleum odor in soil
SS61-DP42	Northeast of DP41, south of DeZonia Drive used to define areal extent of contamination	JP-4 in groundwater	Slight petroleum odor in water
SS61-DP43	South of Building 1003 and DeZonia Drive adjacent to roadway sampled to define areal extent of contamination at north end of south area	JP-4 in groundwater; benzene and fuel-related constituents in capillary fringe soil and groundwater	Heavy petroleum odor noted in saturated cuttings and in water
SS61-DP44	West side of Building 1079 sampled to define contamination on west side of Building 1079	JP-4 and tert-butylbenzene in groundwater	Petroleum staining and odor
SS61-DP45	North side Building 1079 south of DP35 near concrete sump sampled to define contamination on north side of Building 1079	Fuel constituents in groundwater	Petroleum staining and odor
SS61-DP46	East side of Building 1079 sampled to define contamination on east side of Building 1079	JP-4 and 1,2-dichlorobenzene in groundwater	Slight petroleum staining and odor
SS61-DP47	North of Building 1086 adjacent to DeZonia Drive sampled to define areal extent of contamination	TCE in groundwater	No odor or staining noted
SS61-DP48	300 ft southeast of DP38 in culvert east of taxiway sampled as possible dump area upgradient of DP-38	No detections	No odor or staining noted
SS61-DP49	Center of surface water run-off basin in Building 1079 parking lot sampled to define extent of contamination in stormwater catch basin	JP-4, benzene and related fuel constituents in groundwater; fuel constituents in soil	Heavy petroleum odor noted in saturated cuttings and in water
SS61-DP50	West of DP-63, south of DeZonia Drive sampled to define contaminant plume	JP-4, benzene and related fuel constituents in groundwater	Slight petroleum staining and odor
SS61-DP51	Northwest of MW12 sampled to define contaminant plume	JP-4 in groundwater	Slight petroleum odor in water
SS61-DP52	On taxiway south of DP51 sampled to define contaminant plume	No detections	No odor or staining noted
SS61-DP53	On taxiway south of DP39 sampled to define contaminant plume	No detections	No odor or staining noted
SS61-DP54	Northwest of DP41, south of DeZonia Drive sampled to define contaminant plume	JP-4 in groundwater	Slight petroleum odor in water
SS61-DP55	East of DP41 sampled to define contaminant plume	No detections	No odor or staining noted
SS61-DP56	East of DP46 and north of DP37 sampled to define contaminant plume	1,1-DCA and TCE in groundwater	No odor or staining noted
SS61-DP57	Northwest of DP55 and southeast of DP54 sampled to define contaminant plume	No detections	No odor or staining noted

Table 2-1. Summary of Sampling Conducted During the Phase II Remedial Investigation

Site ID	Location and Rationale	Summary of Analytes Detected	Field Observations
Monitoring Wells			
SS61-MW01[1]	North of former AST in northern part of site; sampled to define contaminant plume	No detections	No odor or staining noted
SS61-MW02[1]	Northeast of Building 1085; sampled to define contaminant plume	Benzene and fuel constituents in groundwater	Petroleum odor in water
SS61-MW03[1]	Southeast corner of Building 1001 fenced area; sampled to define contaminant plume	JP-4 and benzene and related fuel constituents in groundwater	Petroleum odor in water
SS61-MW04[1]	South of concrete pad; sampled to define contaminant plume	JP-4 and benzene and related fuel constituents in groundwater	Petroleum odor in water
SS61-MW05[2]	Adjacent and north of Building 1087; sampled to define contaminant plume	No detections	No odor or staining noted
SS61-MW06[2]	East of MW04; sampled to define contaminant plume	JP-4 and benzene and related fuel constituents in groundwater	Petroleum odor in water
SS61-MW07[3]	Co-located with DP54 and installed as a cross-gradient well	No detections	No odor noted
SS61-MW08[3]	Co-located with DP50 and installed to monitor groundwater quality downgradient of the source within the plume	Benzene in groundwater	No odor noted
SS61-MW09[3]	Co-located with DP44 and installed to monitor groundwater contamination within the plume west of Building 1079	Chloroform in groundwater	No odor noted
SS61-MW10[3]	Co-located with DP39 and installed to monitor upgradient groundwater quality near the source within the plume	No detections	No odor noted
SS61-MW11[3]	Upgradient well located south of taxiway approximately 300 ft south of Building 1079 and installed as a suspected upgradient well outside the plume	Chloroform in groundwater	No odor noted
SS61-MW12[4]	East of DP40 and southeast of DP51 near taxiway entrance and installed to monitor cross-gradient groundwater quality	No detections	No odor noted
MW-29-02[4]	East of LF-29 (SWMU 104); sampled to define contaminant plume	Chloroform and 1,2-DCA in groundwater	No odor noted
MW-29-03[4]	Southwest of LF-29 (SWMU 104); sampled to define contaminant plume	Chloroform in groundwater	No odor noted
MW-29-05[4]	Southeast of LF-29 (SWMU 104); sampled to define contaminant plume	1,2-DCA and benzene and related fuel constituents in groundwater	Petroleum odor in water
MW-29-06[4]	North of LF-29 (SWMU 104); sampled to define contaminant plume	1,2-DCA and toluene in groundwater	No odor noted

Notes:

The following analyses were performed on groundwater and soil samples:

Groundwater: VOCs by EPA SW-846 Method 8260B
TPH as JP-4 by EPA SW-846 Method Modified 8015

Soil: VOCs by EPA SW-846 Methods 5030/8260B
TRPH by EPA SW-846 Methods 9071/418.1

[1] Installed prior to Phase I RI
[2] Installed during Phase I RI
[3] Installed during Phase II RI
[4] Installed during RFI at Landfill 29 (LF-29)

Table 3-1. SS-61 Groundwater Elevation Data Collected in 1996, 1997, 1999, and 2000

Well	TOC Elevation (ft msl)	Depth to Water from TOC (ft)				Groundwater Elevation (ft msl)			
		June 1996	June 1997	April 1999	May 2000	June 1996	June 1997	April 1999	May 2000
SS61-MW01	4110.06	--	30.69	30.52	30.98	--	4079.37	4079.54	4079.08
SS61-MW02	4103.11	--	21.90	22.50	21.59	--	4081.21	4080.61	4081.52
SS61-MW03	4098.41	--	18.27	19.12	19.11	--	4080.14	4079.29	4079.30
SS61-MW04	4095.41	--	14.22	19.10	15.39	--	4081.19	4076.31	4080.02
SS61-MW05	4097.68	--	--	16.50	15.93	--	--	4081.18	4081.75
SS61-MW06	4096.32	--	--	16.10	15.81	--	--	4080.22	4080.51
SS61-MW07	4093.43	--	--	--	17.65	--	--	--	4075.78
SS61-MW08	4093.94	--	--	--	15.33	--	--	--	4078.61
SS61-MW09	4094.58	--	--	--	15.41	--	--	--	4079.17
SS61-MW10	4091.94	--	--	--	11.15	--	--	--	4080.79
SS61-MW11	4087.71	--	--	--	11.12	--	--	--	4076.59
SS61-MW12	4090.61	--	--	--	13.10	--	--	--	4077.51
MW-29-01	4103.42	25.71	24.85	--	25.39	4077.71	4078.57	--	4078.03
MW-29-02	4097.81	21.41	--	20.93	21.52	4076.40	--	4076.88	4076.29
MW-29-03	4097.14	19.93	19.34	19.64	20.53	4077.21	4077.80	4077.50	4076.61
MW-29-04	4098.54	20.90	20.26	--	21.61	4077.64	4078.28	--	4076.93
MW-29-05	4101.70	23.59	23.00	23.02	23.68	4078.11	4078.70	4078.68	4078.02
MW-29-06	4101.94	24.07	23.45	23.32	23.95	4077.87	4078.49	4078.62	4077.99
MW-29-07	4098.56	21.40	20.79	--	21.50	4077.16	4077.77	--	4077.06
MW-29-08	4100.72	23.69	23.08	--	23.72	4077.03	4077.64	--	4077.00
PZ-01	4104.17	--	25.41	--	--	--	4078.76	--	--
PZ-02	4110.08	--	30.34	--	--	--	4079.74	--	--
PZ-03	4103.10	--	22.72	--	--	--	4080.38	--	--
PZ-04	4100.64	--	21.13	--	--	--	4079.51	--	--

Notes:

-- - Not measured

ft - Feet

msl - Mean sea level

MW - Monitoring well

PZ - Piezometer

TOC - Top of polyvinyl chloride casing

Table 5-1. Analytical Results for Soil Detections, Phases I and II RFI Site Characterization (1996 and 1997)

Location	Depth Interval	VOC (µg/kg)						Explosives (µg/kg)	
		Benzene	1,2-Dichloroethane	Ethylbenzene	Toluene	Total Xylenes	Methylene Chloride	Tetryl	Trinitrotoluene
On-Site Mobile Laboratory Analyses									
Phase I									
SS61-DP01	9-12	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP01	15-18	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP01	18-21	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP02	9-12	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP02	15-18	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP02	18-21	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP03	9-12	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP03	15-18	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP03	18-21	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP04	9-12	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP04	15-18	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP04	24-27	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP05	9-12	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP05	15-18	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP05	18-21	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP06	6-9	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP06	12-15	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP06	18-21	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP07	9-12	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP07	15-18	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP07	18-21	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP08	9-12	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP08	15-18	ND	ND	ND	ND	ND	ND	**1,000**	**1,000**
SS61-DP08	21-24	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP09A	18-21	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP09A	21-24	ND	ND	ND	ND	ND	**13,000**	ND	ND
SS61-DP09A	24-27	ND	ND	ND	ND	ND	**17,000**	ND	ND
SS61-DP10	18-21	ND	ND	ND	ND	ND	**10,000**	ND	ND
SS61-DP10	21-24	ND	ND	ND	ND	ND	**15,000**	ND	ND
SS61-DP10	24-27	ND	ND	ND	ND	ND	**17,000**	ND	ND
Phase II									
SS61-DP11	16-19	ND	ND	ND	ND	ND	ND	NR	NR
SS61-DP11 (dup)	16-19	ND	ND	ND	ND	ND	ND	NR	NR
SS61-DP12	16-19	ND	ND	ND	ND	ND	ND	NR	NR
SS61-DP15	18-21	ND	ND	ND	ND	ND	ND	NR	NR
SS61-DP16	12-15	ND	ND	ND	ND	ND	ND	NR	NR
SS61-DP17	14-17	ND	ND	ND	ND	ND	ND	NR	NR
SS61-DP18	19-22	ND	ND	ND	ND	ND	ND	NR	NR
SS61-DP18 (dup)	19-22	ND	ND	ND	ND	ND	ND	NR	NR
SS61-DP22	11-12	**29,400**	ND	**6,540**	ND	**2,030**	ND	NR	NR
SS61-DP23	17-20	**360**	ND	ND	ND	**70**	ND	NR	NR
SS61-DP24	17-20	ND	ND	ND	ND	ND	ND	NR	NR

Table 5-1. Analytical Results for Soil Detections, Phases I and II RFI Site Characterization (1996 and 1997)

Location	Depth Interval	VOC (µg/kg)						Explosives (ug/kg)	
		Benzene	1,2-Dichloroethane	Ethylbenzene	Toluene	Total Xylenes	Methylene Chloride	Tetryl	Trinitrotoluene
Off-Site Fixed Laboratory Analyses									
SS61-DP11	16-19	ND	ND	ND	ND	ND	ND	NR	NR
SS61-DP18	19-22	ND	ND	ND	ND	ND	ND	NR	NR
SS61-MW01	30-32	ND	ND	ND	ND	ND	ND	NR	NR
SS61-MW02	20-22	**3.2**	ND	ND	ND	ND	ND	NR	NR
SS61-MW03	18-20	**330**	**37**	**7.4**	**24**	**85**	ND	NR	NR
SS61-MW04	15-17	ND	ND	ND	ND	ND	ND	NR	NR

Notes:

ft - feet

mg/kg - Milligrams per kilogram

NR - Analysis not requested

ND - Analyte detected or reported at less that the detection limit

VOC - Volatile organic compound

Table 5-2. Analytical Results for Soil Detections, Phase I Remedial Investigation

Location	Depth Interval (ft)	TRPH (mg/kg)	VOCs (µg/kg)															
			Benzene	sec-Butyl-benzene	tert-Butyl-benzene	Chloroform	1,2-Dibromo-ethane	1,2-Dichloro-benzene	1,2-Dichloro-ethane	Ethyl-benzene	Isopropyl-benzene	n-Propyl-benzene	Toluene	Trichloro-ethene	1,2,4-Trimethyl-benzene	1,3,5 Trimethyl-benzene	o-Xylene	m,p-Xylenes
SS61-DP30	0-0.5	61	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP30	8-10	54	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP30	16-18	99	ND	ND	ND	ND	ND	ND	ND	630	1,700	760	ND	ND	12,000	10,000	ND	ND
SS61-DP31	4-6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP31	14-16	250	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP32	3-5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP32	12-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-SS01	0-0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-SS02	0-0.5	23	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-SS03	0-0.5	93	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-SS04	0-0.5	33	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-SS05	0-0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-SS06	0-0.5	51	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-SD01	0-0.5	270	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-TP01	13-13.5	91	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-SS01(dup)	0-0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP31(dup)	4-6	31	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes:

ft - feet

mg/kg - milligrams per kilogram

ND - Analyte detected or reported at less that the detection limit

TRPH - total recoverable petroleum hydrocarbons

VOC - volatile organic compound

µg/kg - micrograms per kilogram

Table 5-3. Summary of Analytical Results for Soil Samples Collected During the Phase II RI

Location	Depth Interval (ft)	TRPH (mg/kg)	VOCs (µg/kg)									
			Benzene	Ethyl-benzene	Isopropyl-benzene	n-Propyl-benzene	Styrene	Toluene	1,2,4-Trimethyl-benzene	1,3,5-Trimethyl-benzene	o-Xylene	m-Xylenes
DPT Soil Samples												
SS61-DP38	5 - 6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP38	10 - 11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP39	1 - 2	260	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP39	10 - 11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP39	16 - 17	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP40	1 - 2	7,800	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP40	5 - 6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP40	8.5 - 9.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP41	3 - 4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP41	8 - 9	210	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP42	6 -7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP42	9 - 10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP43	1 - 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP43	17 - 18	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP43	21 - 22	ND	2,800	7,400	17,000	1,400	ND	21,000	13,000	6,200	14,000	34,000
SS61-DP44	1 - 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP44	7 - 8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP44	11 - 12	46	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP45	1 - 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP45	9 - 10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP45	12 - 13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP46	1 - 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP46	5 - 6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP46	9 - 10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP47	8 - 9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP47	11 - 12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP48	11 - 12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP49	1 - 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP49	11.5 - 12.5	ND	ND	ND	ND	ND	1,400	ND	ND	ND	ND	ND
SS61-DP49	15 - 16	ND	ND	ND	1,100	ND	ND	ND	ND	ND	ND	ND
SS61-DP50	1 - 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP50	10 - 11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP50	15 - 16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP51	14 - 15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP52	15 - 16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP53	15 - 16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP54	14 - 15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP55	12 - 13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP56	15 - 16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP57	11 - 12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes:

DPT - Direct push technology
ft - Feet
mg/kg - Milligrams per kilogram
ND - Not detected
TRPH - Total recoverable petroleum hydrocarbons
VOCs - Volatile organic compounds
µg/kg - Micrograms per kilogram

Table 5-4. Analytical Results for Groundwater Detections, Phases I and II RFI Site Characterization (1996 and 1997)

Location	VOCs (ug/L)							
	Benzene	Bromoform	Chlorobenzene	Chloroethane	Chloroform	Chloromethane	Dibromomethane	1,2-Dichlorobenzene
On-Site Mobile Laboratory Analyses								
Phase I								
SS61-DP01	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP02	7,200	ND	ND	ND	ND	ND	ND	ND
SS61-DP03	3,400	ND	ND	ND	ND	ND	ND	ND
SS61-DP04	96	ND	ND	ND	ND	ND	ND	ND
SS61-DP05	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP06	6,000	ND	ND	ND	ND	ND	ND	ND
SS61-DP07	1,900	ND	ND	ND	ND	ND	ND	ND
SS61-DP08	570	ND	ND	ND	ND	ND	ND	ND
SS61-DP09	80	ND	ND	ND	ND	ND	ND	ND
SS61-DP10	ND	ND	ND	ND	ND	ND	ND	ND
Phase II								
SS61-DP11 (dup)	10.1	ND	ND	ND	ND	ND	ND	ND
SS61-DP12 (dup)	2,200	ND	ND	ND	ND	ND	ND	ND
SS61-DP16	4,080	ND	ND	ND	ND	ND	ND	ND
SS61-DP17	3,900	ND	ND	ND	ND	ND	ND	ND
SS61-DP18	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP18 (dup)	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP19	922	ND	ND	ND	ND	ND	ND	ND
SS61-DP20	59	ND	ND	ND	ND	ND	ND	ND
SS61-DP23	640	ND	ND	ND	ND	ND	ND	ND
SS61-DP24	5,100	ND	ND	ND	ND	ND	ND	ND
SS61-DP25	ND	ND	ND	ND	ND	ND	ND	ND
MW-29-05	46	ND	0.65	ND	0.26	ND	0.3	ND
SS61-MW01	ND	ND	ND	ND	ND	ND	ND	ND
SS61-MW02	0.43	ND	ND	ND	2.5	0.22	ND	5.3
SS61-MW03	11,000	1.6	ND	5.4	3.6	ND	6.8	ND
SS61-MW04	2.9	ND	ND	ND	0.52	0.2	ND	ND
SS61-MW04 (Dup)	2.2	ND	ND	ND	0.29	ND	ND	ND
Off-Site Fixed Laboratory Analyses								
SS61-DP11	7.9	ND	ND	ND	ND	ND	ND	ND
SS61-DP12	1,900	ND	ND	ND	ND	ND	ND	ND
SS61-DP13	704	ND	ND	ND	ND	ND	ND	ND
SS61-DP14	1,420	ND	ND	ND	ND	ND	ND	ND
SS61-DP15	2.8	ND	ND	ND	ND	ND	ND	ND
SS61-DP22	8,640	ND	ND	ND	ND	ND	ND	ND

Note: The sample collected at SS61-DP16 was also analyzed for gasoline, diesel, and oil

ND - Analyte detected or reported at less that the detection limit

VOC - Volatile organic compound

µg/L - Micrograms per liter

Table 5-4. Analytical Results for Groundwater Detections, Phases I and II RFI Site Characterization (1996 and 1997)

Location	VOCs (µg/L)							
	1,3-Dichlorobenzene	1,4-Dichlorobenzene	1,1-Dichloroethane	1,2-Dichloroethane	1,2-Dichloropropane	cis-1,3-Dichloropropene	trans-1,3-Dichloropropene	Ethylbenzene
On-Site Mobile Laboratory Analyses								
Phase I								
SS61-DP01	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP02	ND	ND	ND	ND	ND	ND	ND	890
SS61-DP03	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP04	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP05	ND	ND	ND	140	ND	ND	ND	ND
SS61-DP06	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP07	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP08	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP09	ND	ND	ND	18	ND	ND	ND	ND
SS61-DP10	ND	ND	ND	ND	ND	ND	ND	ND
Phase II								
SS61-DP11 (dup)	ND	ND	ND	104	ND	ND	ND	ND
SS61-DP12 (dup)	ND	ND	ND	102	ND	ND	ND	ND
SS61-DP16	ND	ND	ND	178	ND	ND	ND	308
SS61-DP17	ND	ND	ND	315	ND	ND	ND	40
SS61-DP18	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP18 (dup)	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP19	ND	ND	ND	13.1	ND	ND	ND	336
SS61-DP20	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP23	ND	ND	ND	21	ND	ND	ND	140
SS61-DP24	ND	ND	ND	288	ND	ND	ND	230
SS61-DP25	ND	ND	ND	ND	ND	ND	ND	ND
MW-29-05	ND	ND	ND	210	0.4	0.27	0.22	0.76
SS61-MW01	ND	ND	ND	ND	ND	ND	ND	ND
SS61-MW02	1.9	1.2	1.1	1.8	ND	ND	ND	ND
SS61-MW03	ND	ND	ND	940	1.6	ND	ND	65
SS61-MW04	ND	ND	ND	3.8	ND	ND	ND	0.53
SS61-MW04 (Dup)	ND	ND	ND	3.4	ND	ND	ND	ND
Off-Site Fixed Laboratory Analyses								
SS61-DP11	ND	ND	ND	87	ND	ND	ND	ND
SS61-DP12	ND	ND	ND	118	ND	ND	ND	ND
SS61-DP13	ND	ND	ND	47	ND	ND	ND	ND
SS61-DP14	ND	ND	ND	60	ND	ND	ND	ND
SS61-DP15	ND	ND	ND	3.8	ND	ND	ND	ND
SS61-DP22	ND	ND	ND	310	ND	ND	ND	523

Note: The sample collected at SS61-DP1(

ND - Analyte detected or reported at less t

VOC - Volatile organic compound

µg/L - Micrograms per liter

Table 5-4. Analytical Results for Groundwater Detections, Phases I and II RFI Site Characterization (1996 and 1997)

Location	VOCs (ug/L)			Explosives (µg/L)			
	Toluene	Total Xylenes	Trichloroethene	Nitrobenzene	RDX	Tetryl	1,3,5-Trinitrobenzene
On-Site Mobile Laboratory Analyses							
Phase I							
SS61-DP01	ND	ND	ND	ND	ND	ND	ND
SS61-DP02	ND	13	ND	ND	ND	ND	ND
SS61-DP03	ND	31	ND	ND	ND	ND	ND
SS61-DP04	ND	ND	ND	ND	ND	ND	ND
SS61-DP05	ND	ND	ND	ND	ND	ND	ND
SS61-DP06	ND	18	ND	ND	ND	ND	ND
SS61-DP07	ND	ND	ND	ND	ND	ND	ND
SS61-DP08	ND	ND	ND	ND	ND	ND	ND
SS61-DP09	ND	ND	ND	ND	ND	ND	ND
SS61-DP10	ND	ND	ND	ND	ND	ND	ND
Phase II							
SS61-DP11 (dup)	ND	ND	ND	ND	ND	ND	ND
SS61-DP12 (dup)	ND	ND	ND	ND	ND	ND	ND
SS61-DP16	2,600	2,400	ND	ND	ND	ND	ND
SS61-DP17	ND	17	ND	ND	ND	ND	ND
SS61-DP18	ND	ND	ND	ND	ND	ND	ND
SS61-DP18 (dup)	ND	ND	ND	ND	ND	ND	ND
SS61-DP19	ND	6	ND	ND	ND	ND	ND
SS61-DP20	ND	ND	14	ND	ND	ND	ND
SS61-DP23	460	940	ND	ND	ND	ND	ND
SS61-DP24	1,030	3,800	ND	ND	ND	ND	ND
SS61-DP25	ND	ND	ND	ND	ND	ND	ND
MW-29-05	0.81	0.89	ND	ND	ND	ND	ND
SS61-MW01	ND	ND	ND	ND	ND	ND	ND
SS61-MW02	ND	ND	45	ND	ND	ND	ND
SS61-MW03	2,300	5,800	1.8	ND	ND	ND	ND
SS61-MW04	ND	2.32	ND	ND	ND	ND	ND
SS61-MW04 (Dup)	ND	3.2	ND	ND	ND	ND	ND
Off-Site Fixed Laboratory Analyses							
SS61-DP11	ND	ND	ND	ND	ND	ND	ND
SS61-DP12	ND	ND	ND	ND	ND	ND	ND
SS61-DP13	ND	4.9	ND	ND	ND	ND	ND
SS61-DP14	ND	30	ND	ND	ND	ND	ND
SS61-DP15	ND	ND	5.6	ND	ND	ND	ND
SS61-DP22	3,620	1,140	ND	7.4	35	1.6	13

Note The sample collected at SS61-DP1

ND - Analyte detected or reported at less t

VOC - Volatile organic compound

ug/L - Micrograms per liter

Table 5-5. Analytical Results for Groundwater Detections in the Phase I Remedial Investigation

Location	Detected VOC Concentrations (µg/L)															
	Benzene	sec-Butyl-benzene	tert-Butyl-benzene	Chloroform	1,2-Dibromo-ethane	1,2-Dichloro-benzene	1,2-Dichloro-ethane	Ethyl-benzene	Isopropyl-benzene	n-Propyl-benzene	Toluene	Trichloro-ethene	1,2,4-Trimethyl-benzene	1,3,5-Trimethyl-benzene	o-Xylene	m,p-Xylenes
SS61-DP26	2,900	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP27	6,900	ND	ND	ND	ND	ND	ND	ND	1,700	ND	2,000	ND	ND	ND	1,500	2,400
SS61-DP28	440	ND	ND	ND	ND	ND	ND	ND	ND	ND	6	ND	ND	ND	3	5
SS61-DP29	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3	ND	ND	ND	ND	ND
SS61-DP30	15,000	ND	ND	ND	1,400	ND	ND	1,700	5,400	ND	20,000	ND	1,100	ND	3,100	7,400
SS61-DP31	8,700	ND	ND	ND	ND	ND	ND	670	1,400	ND	960	ND	ND	ND	640	1,100
SS61-DP32	18,000	28	ND	ND	49	ND	ND	1,100	3,300	53	1,200	ND	ND	ND	530	1,400
SS61-DP33	19,000	ND	ND	ND	110	ND	ND	750	650	27	14,000	ND	ND	ND	1,600	3,300
SS61-DP34	8,100	ND	ND	ND	ND	ND	ND	1,400	2,700	ND	600	ND	1,600	940	2,200	5,100
SS61-DP35	89	11	6	ND	ND	ND	ND	290	1,900	94	3	ND	ND	ND	9	ND
SS61-DP36	ND	ND	ND	ND	ND	ND	ND	ND	8	ND	ND	16	ND	ND	ND	ND
SS61-DP37	ND	ND	ND	8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-MW01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-MW02	7	ND	ND	ND	ND	9	ND	3	ND	ND	ND	34	ND	ND	ND	ND
SS61-MW03	8,200	ND	ND	ND	ND	ND	ND	ND	ND	ND	900	ND	ND	ND	770	1,200
SS61-MW04	ND	ND	ND	ND	ND	ND	ND	ND	94	ND	ND	ND	24	12	5	13
SS61-MW05	ND	ND	ND	ND	ND	ND	ND	3	66	ND	ND	ND	ND	ND	ND	ND
SS61-MW06	14,000	ND	ND	ND	ND	ND	ND	1,300	2,600	ND	6,800	ND	1,400	ND	3,300	7,800
MW-29-02	ND	ND	ND	ND	ND	ND	27	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-29-03	ND	ND	ND	9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-29-05	440	ND	ND	ND	ND	ND	190	ND	640	ND	ND	ND	ND	ND	ND	ND
MW-29-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-MW04D	ND	ND	ND	ND	ND	ND	ND	ND	160	ND	ND	ND	41	21	8	23
SS61DP31WD	14,000	ND	ND	ND	ND	ND	ND	1,900	3,400	ND	1,900	ND	1,100	ND	1,800	3,300

Notes:

µg/L - micrograms per liter

ND - Analyte detected or reported at less that the detection limit

VOC - Volatile organic compound

Table 5-6. Analytical Results for Groundwater Detections, Phase II Remedial Investigation

Location	TPH JP-4 (µg/L)	VOCs (µg/L) Benzene	Chloroform	sec-Butyl-benzene	tert-Butyl-benzene	1,2-Dibromo-ethane	1,2-Dichloro-benzene	1,2-Dichloroethane	1,1-Dichloro-ethane	Ethyl-benzene	2-Hexanone
DPT Groundwater Samples											
SS61-DP38	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP39	5,600 J	8,900	ND	ND	85	ND	ND	ND	ND	ND	ND
SS61-DP40	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP41	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP42	1,100 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP43	60,000	9,100	ND	ND	ND	ND	ND	ND	ND	940	ND
SS61-DP44	3,400 J	ND	ND	ND	7.3	ND	ND	ND	ND	ND	ND
SS61-DP45	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP46	530 J	ND	ND	ND	ND	ND	6.2	ND	ND	ND	ND
SS61-DP47	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP48	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP49	3,600	200 J	ND	15 J	8 J	ND	ND	ND	ND	3,700 J	ND
SS61-DP50	860 J	270 J	ND	ND	6.9 J	ND	ND	ND	ND	ND	ND
SS61-DP51	760 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP52	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP53	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP54	840	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP55	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP56	ND	ND	ND	ND	ND	ND	ND	ND	15	ND	ND
SS61-DP57	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Monitoring Well Samples											
SS61-MW01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-MW02	ND	0.86	0.63	ND	ND	ND	5.6	ND	ND	ND	ND
SS61-MW03	1,400 J	7,300 J	ND	ND	ND	18 J	160 J	ND	ND	22 J	ND
SS61-MW04	650	1,100 J	ND	10 J	5.7 J	ND	49 J	ND	ND	5.5 J	16 J
SS61-MW05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-MW06	2,500 J	13,000 J	ND	14 J	ND	ND	ND	ND	ND	720 J	ND
SS61-MW07	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-MW08	ND	3.3	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-MW09	ND	ND	0.54	ND	ND	ND	ND	ND	ND	ND	ND
SS61-MW10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-MW11	ND	ND	2.6 J	ND	ND	ND	ND	ND	ND	ND	ND
SS61-MW12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-29-02	ND	ND	1.3	ND	ND	ND	ND	22	ND	ND	ND
MW-29-03	ND	ND	6	ND	ND	ND	ND	ND	ND	ND	ND
MW-29-05	ND	79	ND	3.5	2.2	ND	ND	160	ND	ND	ND
MW-29-06	ND	ND	ND	ND	ND	ND	ND	3.1	ND	ND	ND

Notes:

DPT - Direct push technology

ND - Not detected above the reporting limit

TPH - Total petroleum hydrocarbons

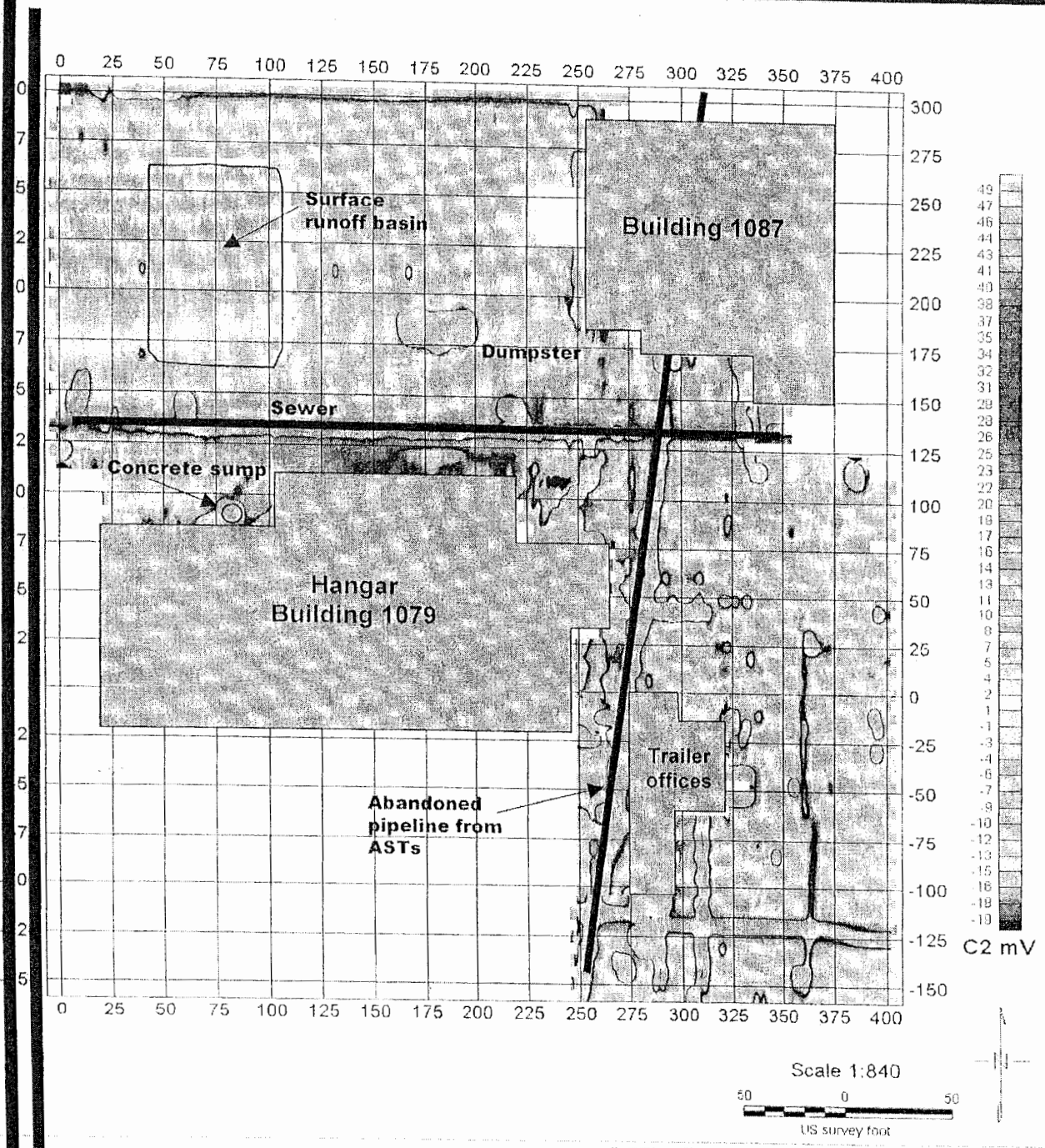
VOCs - Volatile organic compounds

µg/L - Micrograms per liter

Table 5-6. Analytical Results for Groundwater Detections, Phase II Remedial Investigation

Location	VOCs (µg/L)										
	Isopropyl-benzene	Naph-thalene	n-Propyl-benzene	Styrene	Toluene	Trichloro-ethene	1,2,4-Trimethyl-benzene	1,3,5-Trimethyl-benzene	o-Xylene	m-Xylene	p-Xylene
DPT Groundwater Samples											
SS61-DP38	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP39	620	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP40	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP41	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP42	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP43	4,400	ND	170	ND	7,900	ND	560	200	2,700	5,300	ND
SS61-DP44	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP45	96	ND	5.1	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP46	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP47	ND	ND	ND	ND	ND	6.3	ND	ND	ND	ND	ND
SS61-DP48	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP49	5,600 J	ND	170 J	ND	ND	ND	910 J	370 J	190 J	1,200 J	ND
SS61-DP50	7.8 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP51	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP52	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP53	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP54	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP55	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-DP56	ND	ND	ND	ND	ND	21	ND	ND	ND	ND	ND
SS61-DP57	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Monitoring Well Samples											
SS61-MW01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-MW02	ND	ND	ND	ND	ND	21	ND	ND	ND	ND	ND
SS61-MW03	270 J	ND	ND	ND	400 J	ND	71 J	35 J	ND	610 J	760 J
SS61-MW04	810 J	ND	14 J	6.4 J	91 J	ND	85 J	24 J	160 J	240 J	ND
SS61-MW05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-MW06	1,600 J	5.9 J	58 J	ND	600 J	ND	740 J	170 J	1,600 J	2,000 J	2 J
SS61-MW07	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-MW08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-MW09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-MW10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-MW11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SS61-MW12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-29-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-29-03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-29-05	400	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-29-06	ND	ND	ND	ND	1.2	ND	ND	ND	ND	ND	ND

DPT - Direct push technology
ND - Not detected
TPH - Total petroleum hydrocarbons
VOCs - Volatile organic compounds
ug/L - Micrograms per liter



Note: Survey was completed in March 2000.

SS-61 REMEDIAL INVESTIGATION REPORT

Holloman Air Force Base, New Mexico

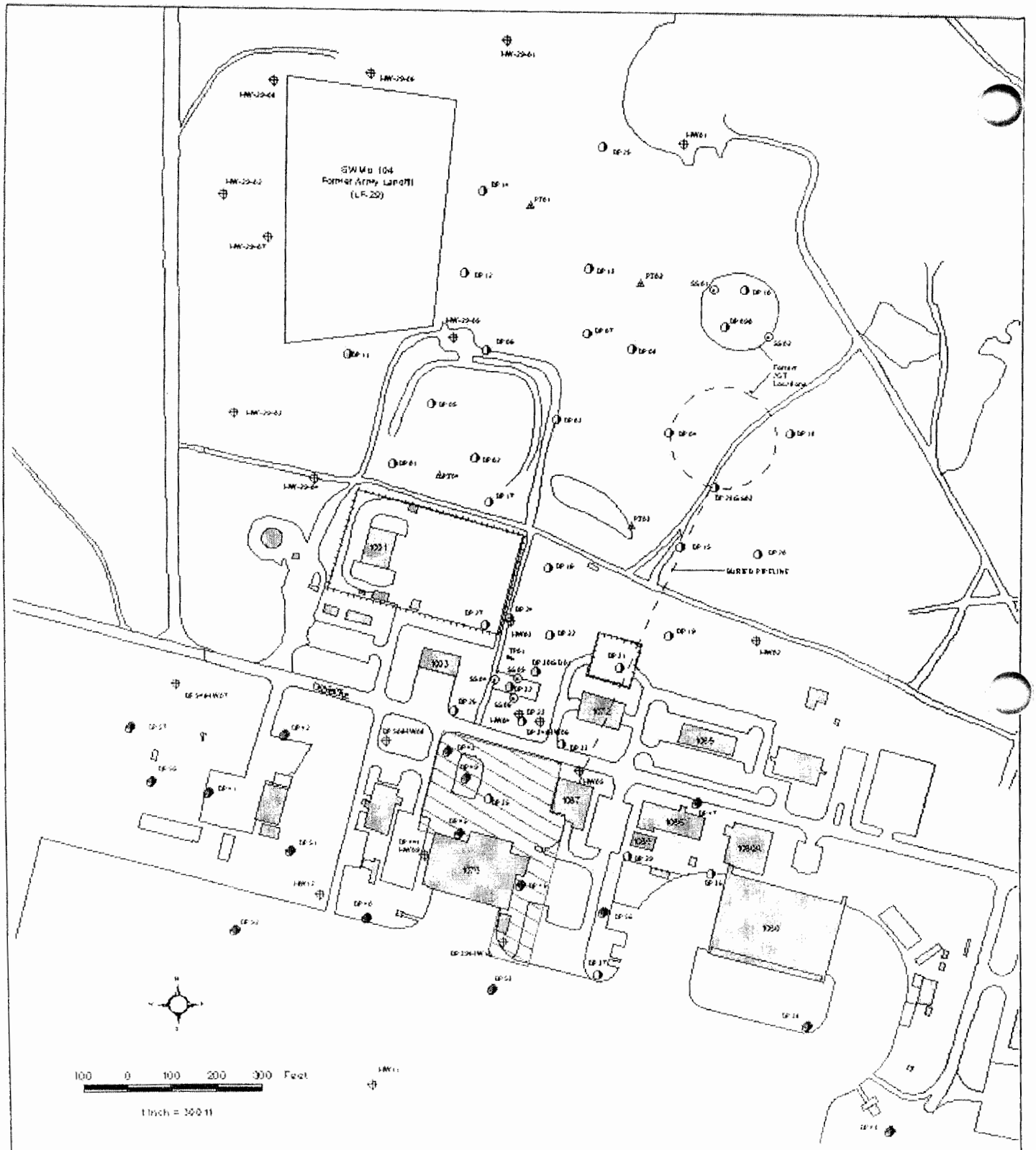
U.S. Army Corps of Engineers, Omaha District

Figure 2-1

Geophysical Survey and Cultural Features

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Revision Date: 12/13/2000



- Geophysical Survey
- Phase II Monitoring Well Locations
- Phase II Direct Push Sample Locations
- Piezometers
- Fenceline
- Monitoring Wells
- Previous Direct Push Sample Locations
- Previous Surface Soil and Sediment Samples
- Test Pit Locations
- Buildings
- Roads

SS-61 PHASE II RI

Holloman Air Force Base, New Mexico

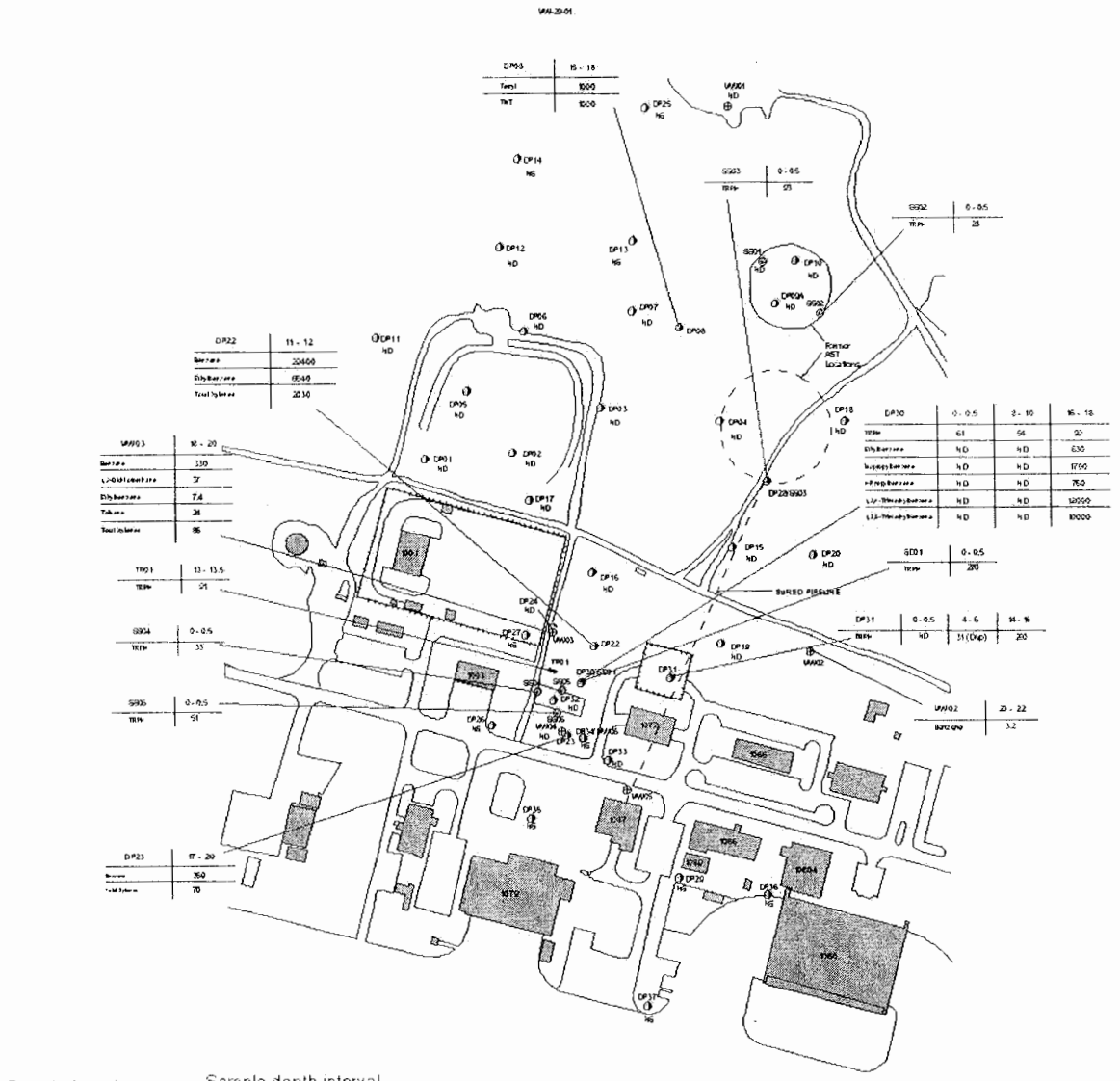
U.S. Army Corps of Engineers, Omaha District

Figure 2-2

Sample Locations at SS-61

Foster Wheeler Environmental Corporation

Revision Date: 12-12-00



LEGEND

- Piezometers
- Fenceline
- SS-61Monitoring Wells
- LF-29 Monitoring Wells
- Direct Push Samples
- Surface Soil and Sediment Samples
- Buildings
- Roads

Notes:

Analyte concentration for VOCs are presented in micrograms per kilogram (ug/kg). TRPH concentrations are presented in milligrams per kilogram (mg/kg).

ND - Analyte not detected

NS - Location not sampled

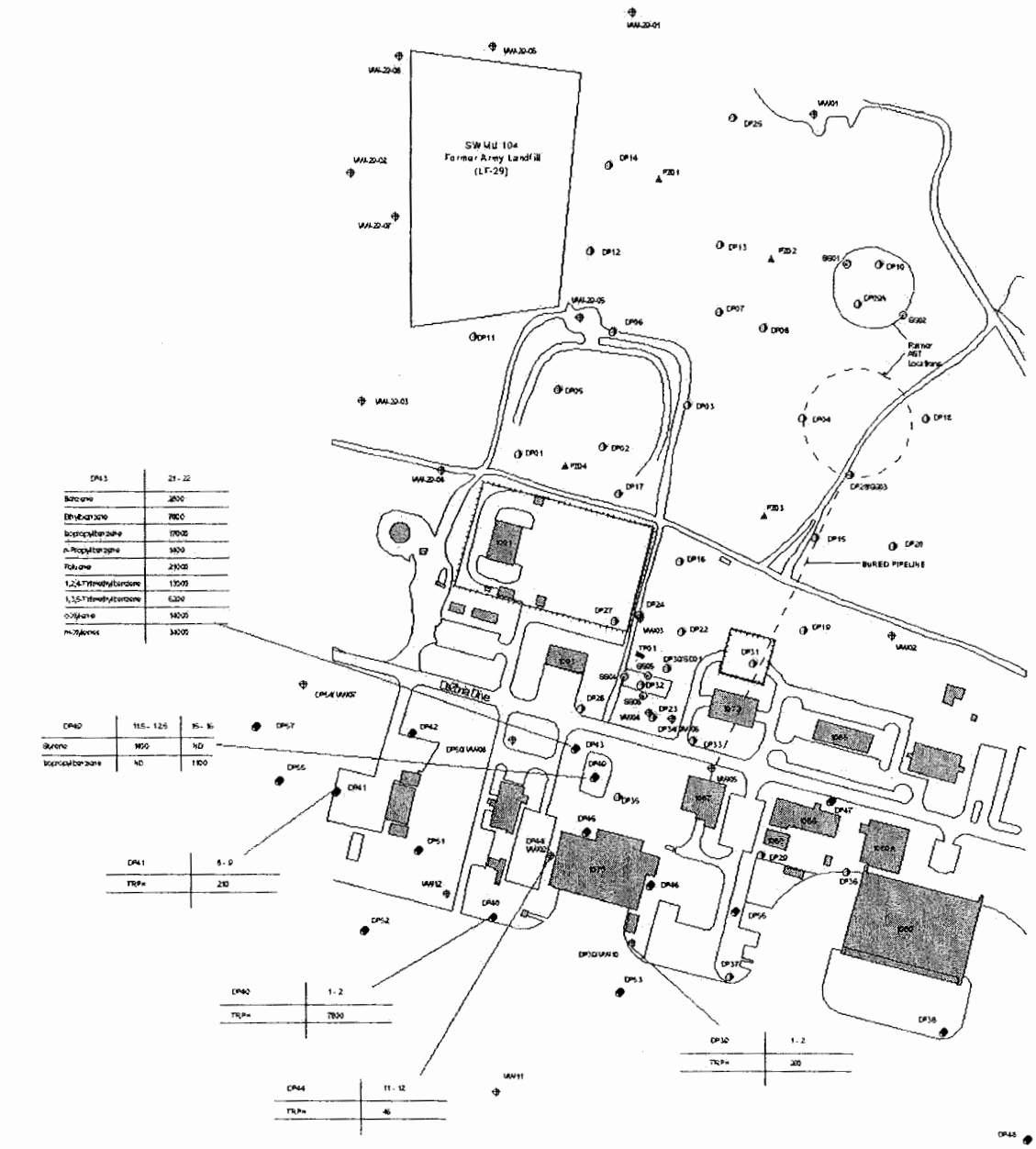
Blue denotes Phase I RI data

SS-61 REMEDIAL INVESTIGATION REPORT
Holloman Air Force Base, New Mexico
U.S. Army Corps of Engineers, Omaha District

Figure 5-1
Distribution of Analytes Detected in Soil During the Phase I RI and Previous Investigations

Foster Wheeler Environmental Corporation

Revision Date: 12-12-00



Sample Location

SS02	
TRPH	23

Analyte — Analyte concentration

250 0 250 500 Feet

1 inch = 250 ft

- Piezometers
- Phase II Monitoring Wells
- Existing Monitoring Wells
- Phase II Direct Push Samples
- Previous Direct Push Samples
- Surface Soil and Sediment Samples
- Buildings
- Roads
- Fenceline

Notes:

Analyte concentration for VOCs are presented in micrograms per kilogram (ug/kg). TRPH concentrations are presented in milligrams per kilogram (mg/kg).

All groundwater samples were collected from the upper portion (less than 10 feet) of the shallow water-bearing zone

ND - Analyte not detected

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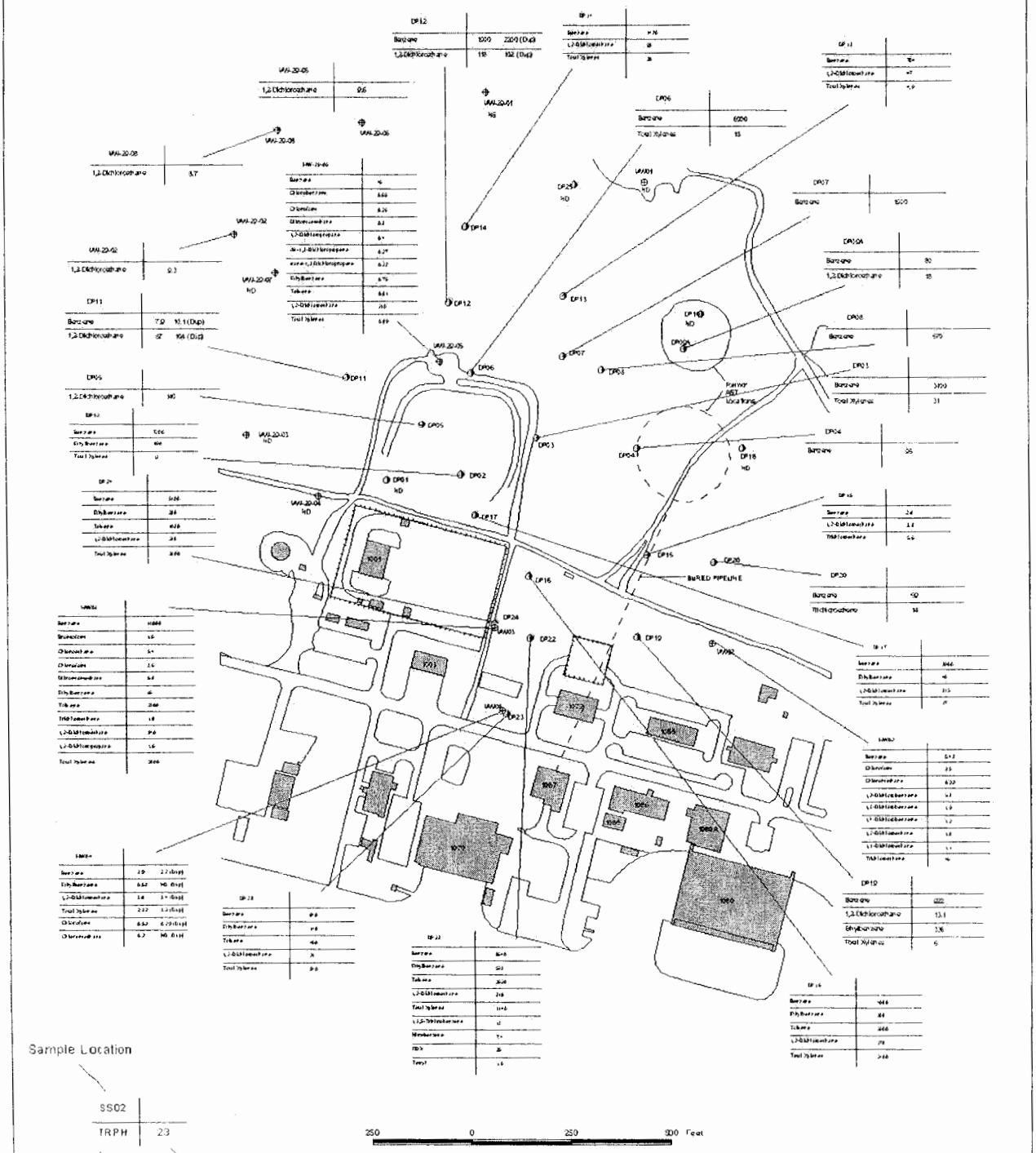
Holloman Air Force Base, New Mexico
U.S. Army Corps of Engineers, Omaha District

Figure 5-2
Distribution of Analytes Detected in Soil During the Phase II RI

Foster Wheeler Environmental Corporation

Revision Date: 12-12-00



LEGEND

- Piezometers
- Fenceline
- SS-61 Monitoring Wells
- LF-29 Monitoring Wells
- Direct Push Samples
- Buildings
- Roads

Notes:

Analyte concentrations are presented in micrograms per liter (ug/L).

All groundwater samples were collected from the upper portion (less than 10 feet) of the shallow water-bearing zone.

ND - Analyte not detected

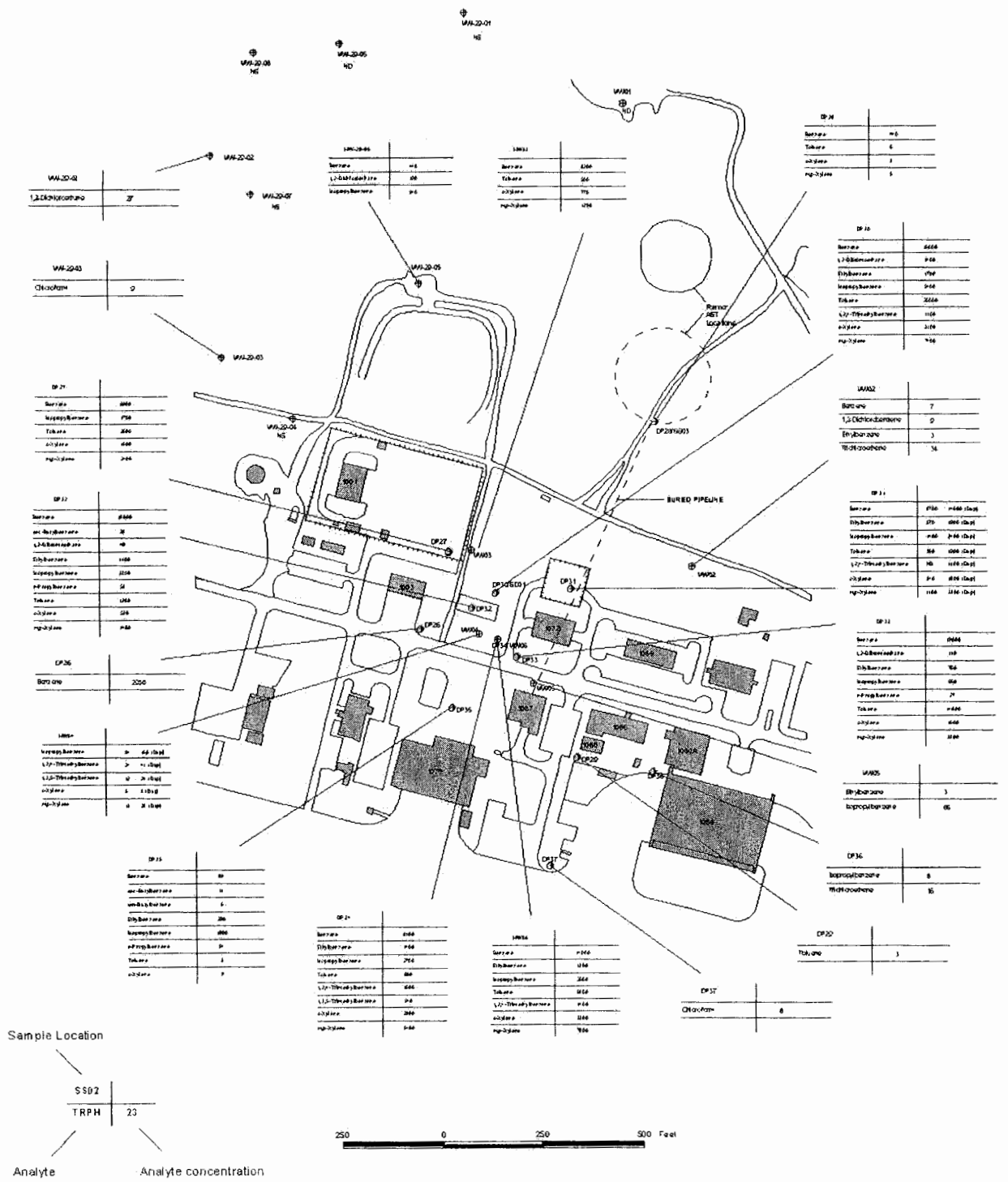
NS - Location not sampled

SS-61 REMEDIAL INVESTIGATION REPORT
Holloman Air Force Base, New Mexico
U.S. Army Corps of Engineers, Omaha District

Figure 5-3
Distribution of Analytes Detected in Groundwater During the RFI

Foster Wheeler Environmental Corporation

Revision Date: 12-12-00



LEGEND

- Piezometers
- Fenceline
- SS-61 Monitoring Wells
- LF-29 Monitoring Wells
- Direct Push Samples
- Surface Soil and Sediment Samples
- Buildings
- Roads

Notes:

Analyte concentrations are presented in micrograms per liter (ug/L).

All groundwater samples were collected from the upper portion (less than 10 feet) of the shallow water-bearing zone

ND - Analyte not detected

NS - Location not sampled

SS-61 REMEDIAL INVESTIGATION REPORT

Holloman Air Force Base, New Mexico

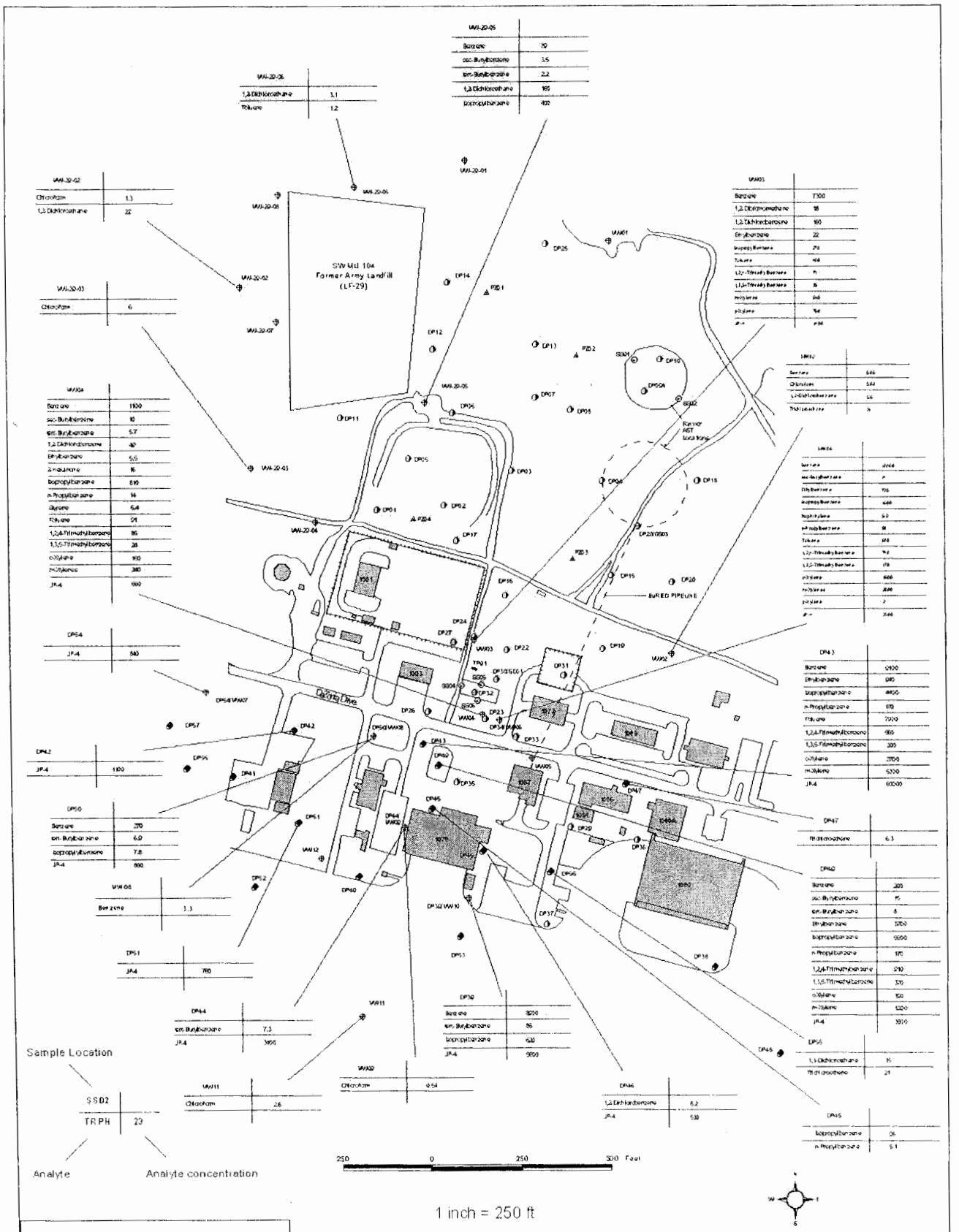
U.S. Army Corps of Engineers, Omaha District

Figure 5-4

Distribution of Analytes Detected in Groundwater During the Phase I RI

Foster Wheeler Environmental Corporation

Revision Date: 12-12-00



- Piezometers
- Phase II Monitoring Wells
- Existing Monitoring Wells
- Phase II Direct Push Samples
- Previous Direct Push Samples
- Surface Soil and Sediment Samples
- Buildings
- Roads
- Fenceline

Notes:

Analyte concentrations are presented in micrograms per liter (ug/L).

All groundwater samples were collected from the upper portion (less than 10 feet) of the shallow water-bearing zone

ND - Analyte not detected

NS - Location not sampled

SS-61 REMEDIAL INVESTIGATION REPORT
Holloman Air Force Base, New Mexico
U.S. Army Corps of Engineers, Omaha District

Figure 6-8
Distribution of Analytes Detected in Groundwater During the Phase II RI

Foster Wheeler Environmental Corporation

Revision Date: 12-12-00

HTRW DRILLING LOG

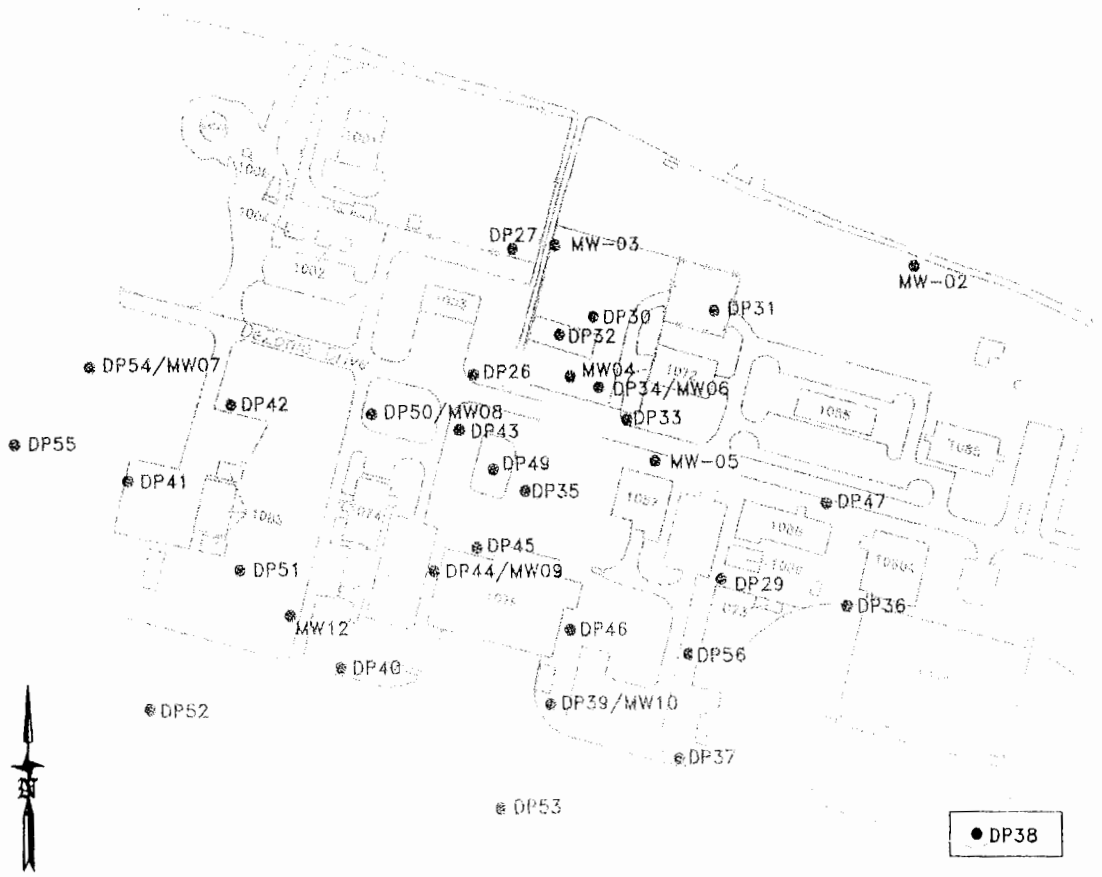
DISTRICT: OMAHA		HOLE NUMBER: SS61-DP38
1.COMPANY NAME: Foster Wheeler Environmental Corp	2.DRILL SUBCONTRACTOR: Indian Fire and Safety	SHEET 1 OF SHEETS 2
3.PROJECT: 5155.0027.0007 H2000	4.LOCATION: SS-61, Holloman AFB	
5.NAME OF DRILLER: Rafe Jones	6.MANUFACTURER'S DESIGNATION OF DRILL	
7.SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	8.HOLE LOCATION: SS61-DP38	
	9.SURFACE ELEVATION: N/A	
	10.DATE STARTED: 5/3/00	11.DATE COMPLETED: 5/4/00
12.OVERBURDEN THICKNESS: N/A	15.DEPTH GROUNDWATER ENCOUNTERED: 12.5 ft bgs	
13.DEPTH DRILLED INTO ROCK: N/A	16.DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 7 ft bgs/ day later	
14.TOTAL DEPTH OF HOLE: 12.5 ft	17.OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A	

18.GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19.TOTAL NUMBER OF CORE BOXES
None	N/A	N/A	N/A

20.SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21.TOTAL CORE RECOVERY %
	water and soil	N/A		TRPH - soil	TPH-JP4 -water	

22.DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23.SIGNATURE OF INSPECTOR
	w/ bentonite	N/A		

LOCATION SKETCH/COMMENTS — SCALE 1 inch = 300 feet



PROJECT 5155.0027.0007 — HOLE NO. SS61-DP38

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP38

PROJECT 5155.0027.0007 H2000

INSPECTOR Luke Darragh

SHEET 2 OF 2 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
	2	0-6' - asphalt Brown Clayey SILT with fine to medium Sand, moist, soft					ML
	4	Reddish brown Silty CLAY with fine white Sand lenses, moist, medium stiffness, low plasticity			SS61DP38S503		CL
	6 8	Same as above with some oxide staining Same as above, color change to gray			SS61DP38S901		CL
	10	Grey Silty Clay with fine to medium Sand, trace coarse Sand, moist, stiff					CL
	12	Light brown Clayey SAND with fine Sand and some Silt, loose and wet					SC
	14 16	Water encountered at 12.5 feet water sample collected - SS61DP38W8					

PROJECT 5155.0027.0007 H2000

HOLE NO. SS61-DP38

ENG FORM 5056A-R, AUG 94

(Proponent: CECW-EG)

HTRW DRILLING LOG

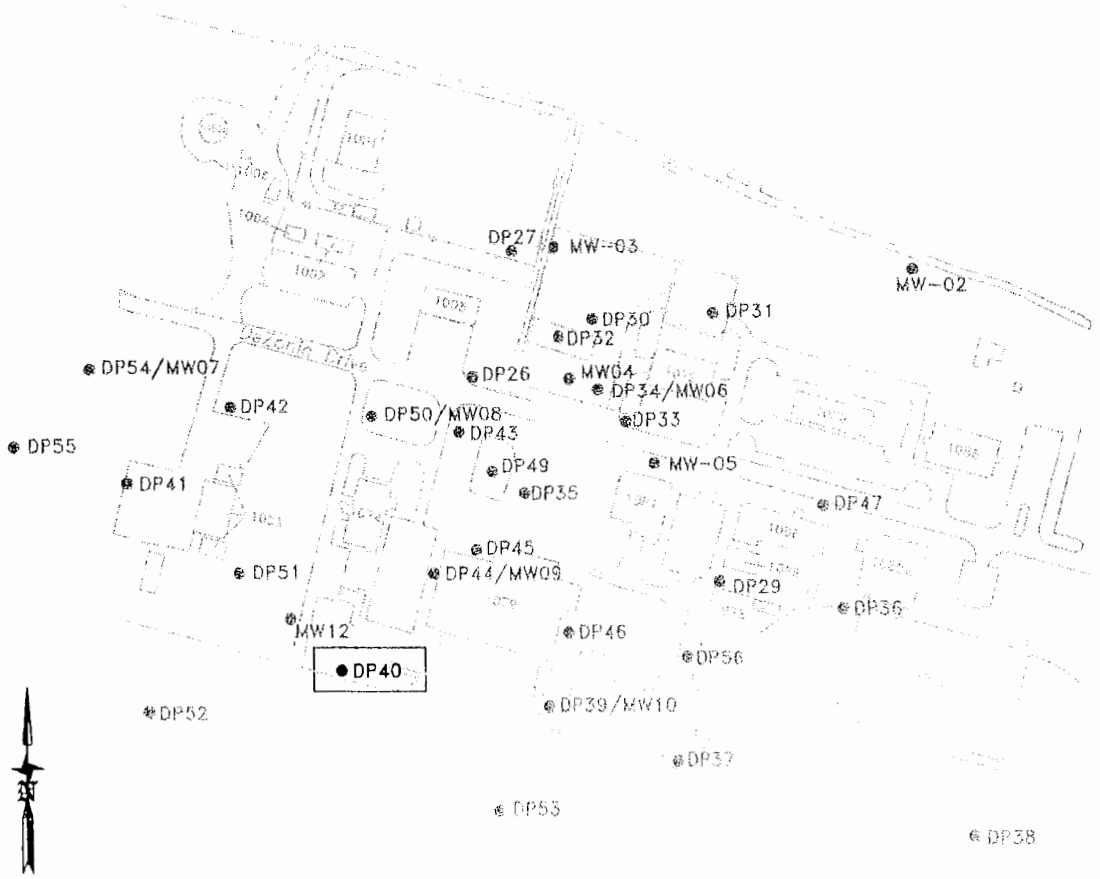
DISTRICT: OMAHA		HOLE NUMBER: SS61-DP40
1.COMPANY NAME: Foster Wheeler Environmental Corp	2.DRILL SUBCONTRACTOR: Indian Fire and Safety	SHEET 1 OF SHEETS 2
3.PROJECT: 5155.0027.0007 H2000	4.LOCATION: SS-61, Holloman AFB	
5.NAME OF DRILLER: Rafe Jones	6.MANUFACTURER'S DESIGNATION OF DRILL:	
7.SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT Rig	8.HOLE LOCATION: SS61-DP40	
	9.SURFACE ELEVATION: N/A	
	10.DATE STARTED: 5/4/00	11.DATE COMPLETED: 5/4/00
12.OVERBURDEN THICKNESS: N/A	15.DEPTH GROUNDWATER ENCOUNTERED: 13 ft	
13.DEPTH DRILLED INTO ROCK: N/A	16.DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 17.3' prior to sampling, about 10 min.	
14.TOTAL DEPTH OF HOLE: 20.5 ft	17.OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A	

18.GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19.TOTAL NUMBER OF CORE BOXES
None	N/A	N/A	N/A

20.SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21.TOTAL CORE RECOVERY %
	water and soil	N/A		TRPH - soil	TPH-JP4 -water	

22.DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23.SIGNATURE OF INSPECTOR
	w/ bentonite	N/A		Luke Darragh

LOCATION SKETCH/COMMENTS — SCALE 1 inch = 300 feet



PROJECT 5155.0027.0007 — HOLE NO. SS61-DP40

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER: SS61-DP40

PROJECT: 5155.0027.0007 H2000

INSPECTOR: Luke Darragh

SHEET 2 OF 2 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
	2	Brown, fine, Silty SAND, trace medium Sand, dry, loose					SM
	4	Grey Silty CLAY, very moist, medium, plasticity, trace fine to medium Sand					CL
	6	Light brown Sandy SILT, fine Sand, trace medium Sand, damp			SS61DP40S501		ML
	8	Light brown Silty SAND, damp, well graded, some gravel (0-10 mm)			SS61DP40S801		SM
	10	Grey Silty CLAY with Sand, moist, soft, slight plasticity, trace rounded gravel (0-10mm)					CL
	12	Light brown Silty CLAY, damp, moist, medium plasticity, trace fine Sadn, medium stiffness					CL
	14	Light brown Sandy Silty CLAY, moist, soft, fine to medium Sand					CL
	16	Light brown Silty CLAY, trace fine Sand, moist, high plasticity, soft					CL CL
	18	Light brown Silty CLAY, moist/wet, stiff, high plasticity with medium sand lenses, rounded Sand TD = 20.5 ft					CL

PROJECT 5155.0027.0007 H2000 HOLE NO. SS61-DP40

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG

DISTRICT: OMAHA		HOLE NUMBER: SS61-DP41
1. COMPANY NAME: Foster Wheeler Environmental Corp	2. DRILL SUBCONTRACTOR: Indian Fire and Safety	SHEET 1 OF 3 SHEETS
3. PROJECT: 5155.0027.0007 H2000	4. LOCATION: SS-61, Holloman AFB	
5. NAME OF DRILLER: Rafe Jones	6. MANUFACTURER'S DESIGNATION OF DRILL	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT Rig	8. HOLE LOCATION: SS61-DP41	
	9. SURFACE ELEVATION: N/A	
	10. DATE STARTED: 5/1/00	11. DATE COMPLETED: 5/1/00
12. OVERBURDEN THICKNESS: N/A	15. DEPTH GROUNDWATER ENCOUNTERED: 20 ft	
13. DEPTH DRILLED INTO ROCK: N/A	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 15.25' bgs 1 hour after drilling	
14. TOTAL DEPTH OF HOLE: 23 ft	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None			

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	soil and water	N/A	soil- TRPH	water- TPH-JP4		

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	w/ bentonite	N/A		Luke Darragh

LOCATION SKETCH/COMMENTS — SCALE 1 inch = 300 feet

PROJECT 5155.0027.0007 — HOLE NO. SS61-DP41

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER: SS61-DP41

PROJECT: 5155.0027.0007 H2000

INSPECTOR: Luke Darragh

SHEET 2 OF 3

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
	2 4	0-4 inches - asphalt Tan Silty SAND, loose, dry, fine to medium Sand, trace coarse Sand	2.22 ppm		SS61DP41S301		SM
	6	Reddish brown Sandy SILT, dry, soft, fine Sand	0.68 ppm				ML
	8 10	Dark grey Silty SAND, dry, loose, fine to medium Sand, trace coarse sand Same as above, color change to reddish brown	1.15 ppm		SS61DP41S801		slight discoloration in soils SM
	12 14	Grey Clayey SILT, moist, some fine Sand and trace medium Sand moist at 14 ft	0.22 ppm				ML
	16	Reddish brown Silty CLAY, moist/damp, stiff, medium plasticity, trace fine Sand	0.44 ppm				CL
	18	Same as above, wet at tip- about 20 ft	1.13 ppm				CL

PROJECT 5155.0027.0007 H2000 HOLE NO. SS61-DP41

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP41

PROJECT 5155.0027.0007 H2000

INSPECTOR Luke Darragh

SHEET 3 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
		Silty CLAY- same as above					CL
	22	Greenish grey Silty CLAY, wet, low plasticity, fine Sand, oxide stains	9.55 ppm				CL
	24	TD = 23 ft					

PROJECT 5155.0027.0007 H2000

HOLE NO. SS61-DP41

ENG FORM 5056A-R, AUG 94

(Proponent: CECW-EG)

HTRW DRILLING LOG

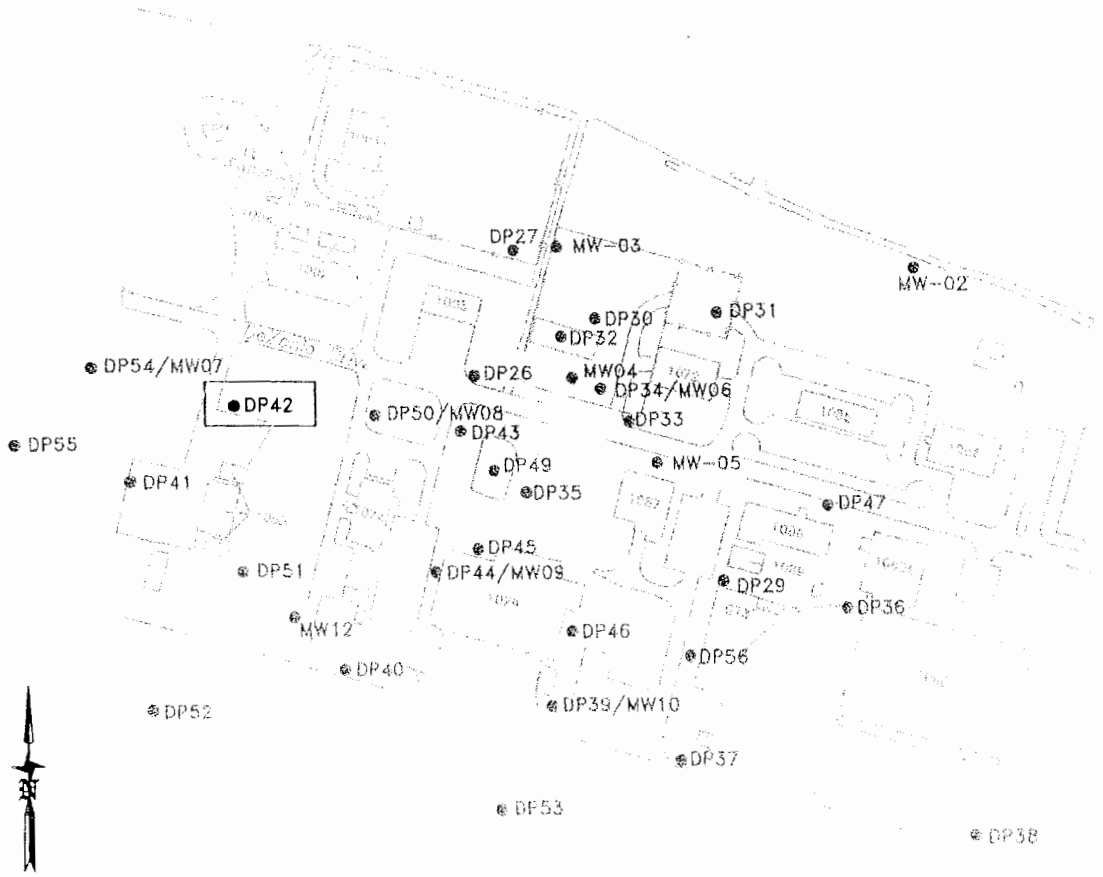
DISTRICT: OMAHA	HOLE NUMBER: SS61-DP42	
1.COMPANY NAME: Foster Wheeler Environmental Corp	2.DRILL SUBCONTRACTOR: Indian Fire and Safety	SHEET 1 OF SHEETS 2
3.PROJECT: 5155.0027.0007	4.LOCATION: SS-61, Holloman, AFB	
5.NAME OF DRILLER: Rafe Jones	6.MANUFACTURER'S DESIGNATION OF DRILL:	
7.SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT Rig	8.HOLE LOCATION: SS61-DP42	
	9.SURFACE ELEVATION: N/A	
	10.DATE STARTED: 5/1/00	11.DATE COMPLETED: 5/1/00
12.OVERBURDEN THICKNESS: N/A	15.DEPTH GROUNDWATER ENCOUNTERED: 18.5 ft	
13.DEPTH DRILLED INTO ROCK: N/A	16.DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 14.65 ft after 1 hour	
14.TOTAL DEPTH OF HOLE: 23.5 ft	17.OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A	

18.GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19.TOTAL NUMBER OF CORE BOXES
None	N/A	N/A	

20.SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21.TOTAL CORE RECOVERY %
	soil and water		soil - TRPH	water - TPH-JP4		

22.DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23.SIGNATURE OF INSPECTOR
	w/ bentonite	N/A		Luke Darragh

LOCATION SKETCH/COMMENTS — SCALE 1 inch = 300 feet



PROJECT 5155.0027.0007 — HOLE NO. SS61-DP42

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP42

PROJECT 5155.0027.0007 H2000 | INSPECTOR Luke Darragh | SHEET 2 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
	2	Dark brown Clayey SILT, dry, soft, low plasticity, trace fine Sand	0.60 ppm				ML
	4	Tan Silty SAND with gravel, loose, dry, well graded, sub-rounded gravel 0-10 mm in size tip of sampler wet at 4 ft	0.35 ppm				SW
	6	Brown Silty SAND, dry, medium density, fine to medium Sand, some Clay	0.62 ppm				SM
	8	Tan/reddish brown Sandy SILT, stiff, fine Sand			SS61DP42S601		ML
		Grey Sandy Gravel, dry, subangular gravel 0-20 mm in size, coarse Sand, trace Silt			SS61DP42S801		GW
	10	Tan/reddish brown Clayey SILT with Sand, moist, fine to medium Sand with a trace of coarse Sand	0.60 ppm				ML
	12 14	Reddish brown Silty CLAY with Sand, fine Sand and some coarse Sand, moist, trace gravel 10 mm in size, low plasticity	0.65 ppm				CL DTW 14.65 prior to sampling
	16 18	Reddish brown Silty CLAY, moist, medium plasticity, some fine Sand and trace medium coarse Sand	0.45 ppm				CL
		Grey Clayey Gravel (to 20 mm), wet, subangular, trace fine Sand	0.95 ppm				GC
		Reddish brown Silty CLAY, wet, low plasticity, some fine to medium Sand					CL

PROJECT 5155.0027.0007 H2000 | HOLE NO. SS61-DP42

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP42

PROJECT 5155.0027.0007 H2000

INSPECTOR Luke Darragh

SHEET 3 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
	22	Same as Above (Silty CLAY)	2.05 ppm				CL
	24	TD = 23.5 ft					

PROJECT 5155.0027.0007 H2000

HOLE NO. SS61-DP42

ENG FORM 5056A-R, AUG 94

(Proponent: CECW-EG)

HTRW DRILLING LOG

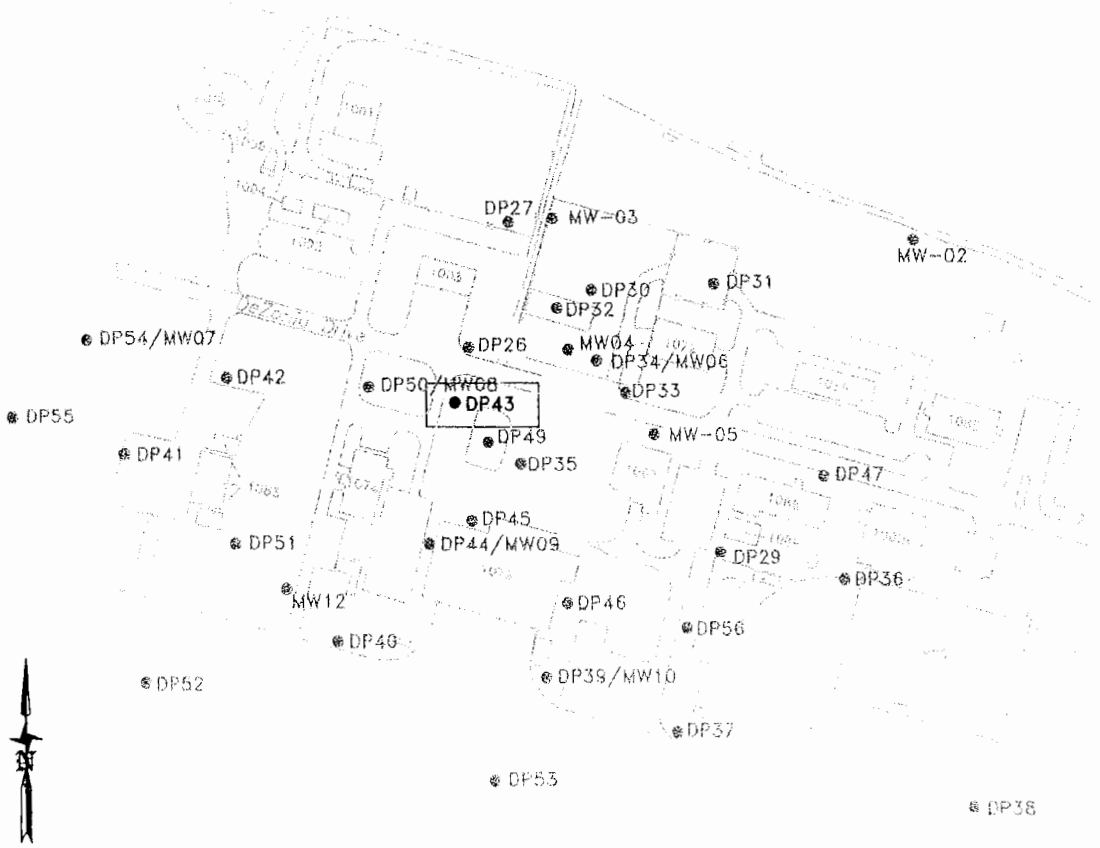
DISTRICT: OMAHA		HOLE NUMBER: SS61-DP43
1.COMPANY NAME: Foster Wheeler Environmental Corp.	2.DRILL SUBCONTRACTOR: Indian Fire and Safety	SHEET 1 OF 3 SHEETS
3.PROJECT: 515.0027.0007 H2000	4.LOCATION: SS-61, Holloman AFB	
5.NAME OF DRILLER: Rafe Jones	6.MANUFACTURER'S DESIGNATION OF DRILL	
7.SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT Rig	8.HOLE LOCATION: SS61-DP43	
	9.SURFACE ELEVATION: N/A	
	10.DATE STARTED: 5/2/00	11.DATE COMPLETED: 5/2/00
12.OVERBURDEN THICKNESS: N/A	15.DEPTH GROUNDWATER ENCOUNTERED: 23 ft	
13.DEPTH DRILLED INTO ROCK: N/A	16.DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 12.45 ft bgs at 1200 on 5/3/00	
14.TOTAL DEPTH OF HOLE: 25.5 ft	17.OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A	

18.GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19.TOTAL NUMBER OF CORE BOXES
None	N/A	N/A	

20.SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21.TOTAL CORE RECOVERY %
	soil and water		soil -TRPH	water - TPH-JP4		

22.DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23.SIGNATURE OF INSPECTOR
	w/ bentonite	N/A		Luke Darragh

LOCATION SKETCH/COMMENTS — SCALE 1 inch = 300 feet



PROJECT 5155.0027.0007 — HOLE NO. SS61-DP43

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP43

PROJECT 5155.0027.0007 H2000 | INSPECTOR Luke Darragh | SHEET 2 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
		Tan Silty SAND, dry, loose, fine to medium Sand, trace coarse Sand	1.0 ppm				SM
	2	Brown Silty CLAY, dry, soft, low plasticity, trace fine Sand					CL
	4	Brown/Tan Clayey SAND, moist, medium density, fine to medium Sand, trace coarse Sand	0.30 ppm				SC
	6	Grey/Tan Silty CLAY, moist, soft, low plasticity, trace fine Sand					CL
	8	same as above - color change to brown					
	10	Brown Clayey SILT, moist, soft, fine Sand, trace medium and coarse Sand	1.0 ppm				ML
	12	Brown Silty CLAY, moist, medium stiffness, medium plasticity, some fine Sand	7.95 ppm				CL
	14	same as above, Silty CLAY	53.25 ppm				CL
	16	Grey/Green Silty CLAY, moist, stiff, slight plasticity, some fine Sand					CL
		same as above - strong odor	45.22 ppm				CL
	18	Brown Silty CLAY, moist, stiff, fine Sand and small crystals	33.5 ppm				CL

PROJECT 5155.0027.0007 H2000 | HOLE NO. SS61-DP43

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP43

PROJECT 5155.0027.0007 H2000

INSPECTOR Luke Darragh

SHEET 3 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
		Brown Silty CLAY, moist, stiff, medium plasticity, some fine Sand and crystals, strong odors	2000 ppm				CL
	22	Same as above, (SIlty CLAY) Wet at about 23 ft	2022 ppm				CL
	24	Same as above but saturated	1795 ppm				CL
	26	TD = 25.5 ft					

PROJECT 5155.0027.0007 H2000

HOLE NO. SS61-DP43

ENG FORM 5056A-R, AUG 94

(Proponent: CECW-EG)

HTRW DRILLING LOG

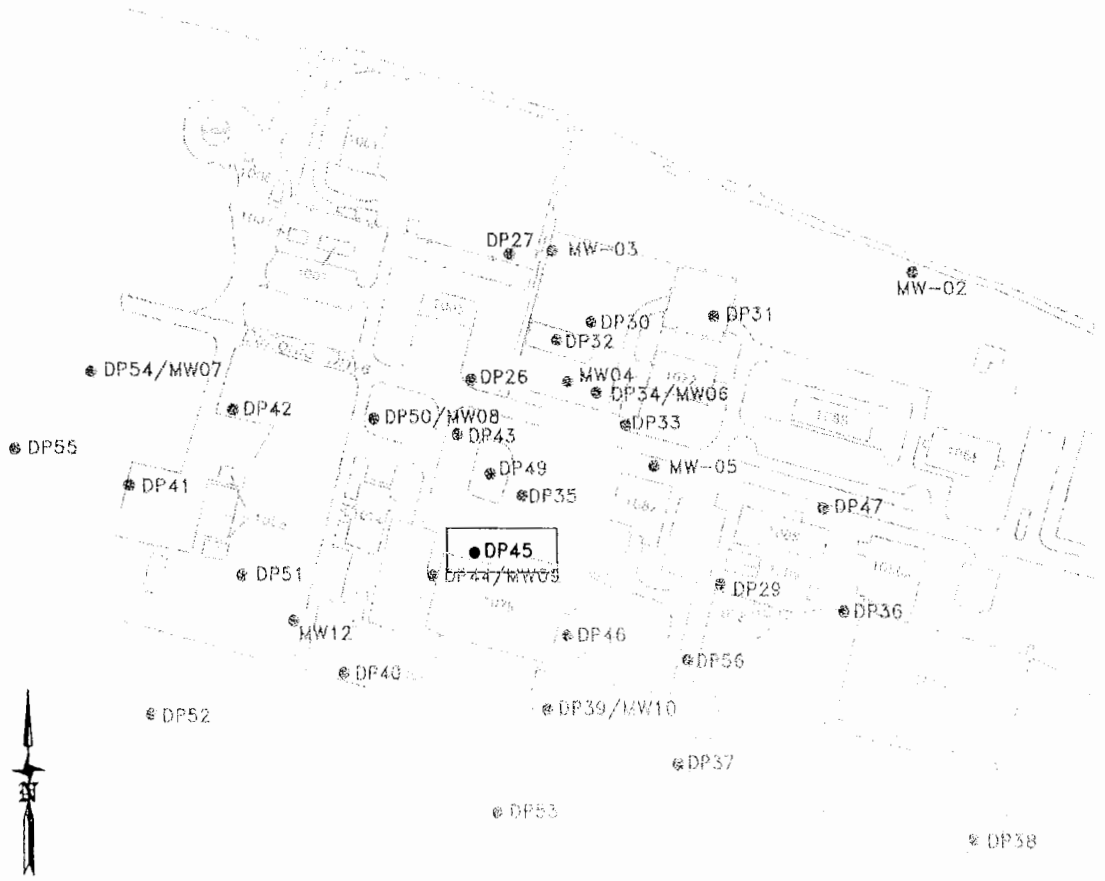
DISTRICT ☐MAHA		HOLE NUMBER SS61-DP45
1.COMPANY NAME Foster Wheeler Environmental Corp.	2.DRILL SUBCONTRACTOR Indian Fire and Safety	SHEET 1 OF SHEETS 2
3.PROJECT 5155.0027.0007	4.LOCATION SS-61, Holloman AFB	
5.NAME OF DRILLER Rafe Jones	6.MANUFACTURER'S DESIGNATION OF DRILL	
7.SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT Rig	8.HOLE LOCATION SS61-DP45	
	9.SURFACE ELEVATION N/A	
	10.DATE STARTED 5/2/00	11.DATE COMPLETED 5/2/00
12.OVERBURDEN THICKNESS N/A	15.DEPTH GROUNDWATER ENCOUNTERED 13 ft	
13.DEPTH DRILLED INTO ROCK N/A	16.DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED 11.60 ft bgs on 5/3/00	
14.TOTAL DEPTH OF HOLE 19.5 ft	17.OTHER WATER LEVEL MEASUREMENTS (SPECIFY) N/A	

18.GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19.TOTAL NUMBER OF CORE BOXES
None			

20.SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21.TOTAL CORE RECOVERY %
	soil and water	N/A	soil - TRPH	water - TPH-JP4		

22.DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23.SIGNATURE OF INSPECTOR
	w/ bentonite	N/A		Luke Darragh

LOCATION SKETCH/COMMENTS — SCALE 1 inch = 300 feet



PROJECT 5155.0027.0007 — HOLE NO. SS61-DP45

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP45

PROJECT 5155.0027.0007 H2000

INSPECTOR Luke Darragh

SHEET 2 OF 2 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
	2 4	Brown Clayey SILT with fine Sand, dry, soft tip of sampler wet at 4 ft	1.30 ppm				ML
	6	Grey/Tan Clayey SILT with fine Sand, very moist, soft, trace medium Sand	1.25 ppm				ML
	8	Grey, well graded SAND with Gravel, dry, loose, trace Silt, gravel rounded to 10 mm in size					SW
	10	Tan Silty CLAY, very moist, soft, fine to medium Sand	0.79 ppm		SS61DP45S901 SS61DP45S902		CL
	12	Same as above with a trace of rounded gravel to 10 mm in size	1.5 ppm		SS61DP45S1201		CL
	14	Same as abvoe except wet at about 13 ft	0.47 ppm				CL
	16	Brown Silty CLAY, wet soft, low plasticity, some fine to medium Sand, trace coarse Sand	240 ppm				CL
	18	Same as above (Silty CLAY) but stained grey/green from 18.5 to 19.5 ft, odor	1329 ppm				CL
		TD = 19.5 ft					

PROJECT 5155.0027.0007 H2000 HOLE NO. SS61-DP45

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG

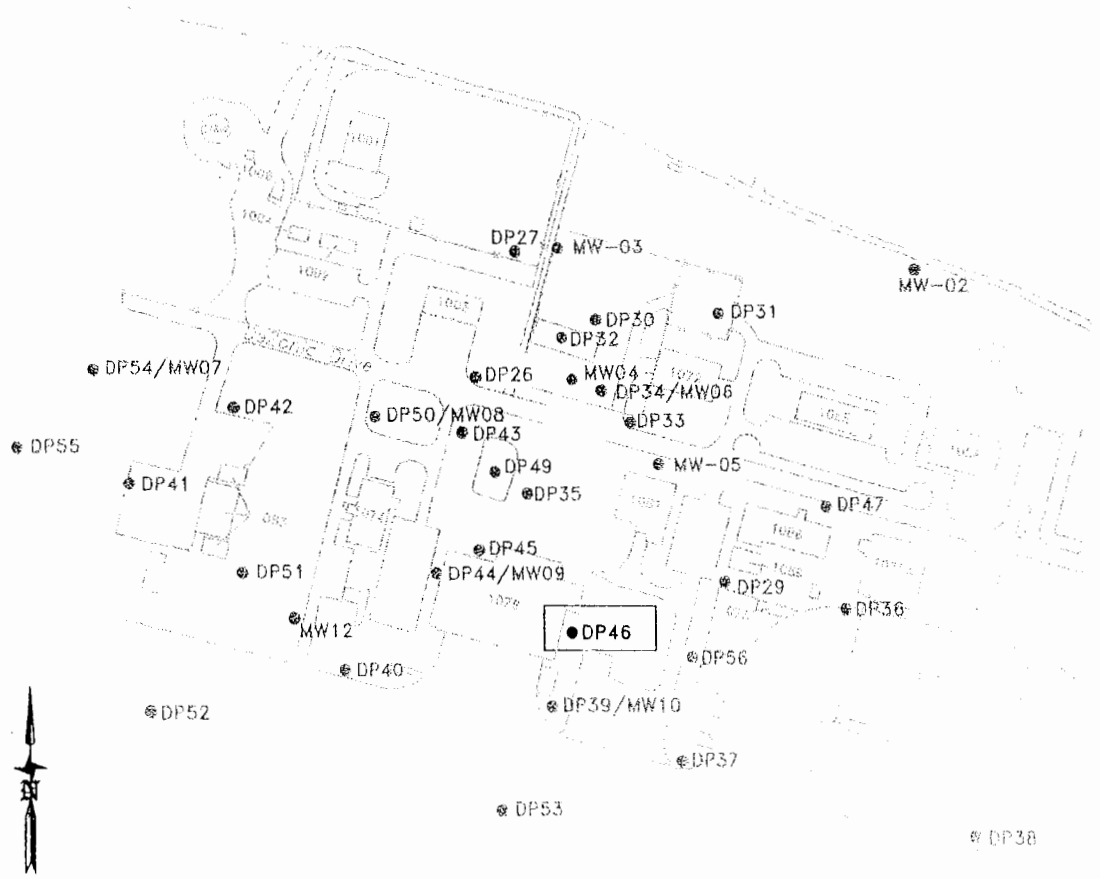
DISTRICT: OMAHA	HOLE NUMBER: SS61-DP46	
1.COMPANY NAME: Foster Wheeler Environmental Corp.	2.DRILL SUBCONTRACTOR: Indian Fire and Safety	SHEET 1 OF SHEETS 1
3.PROJECT: 5155.0027.0007	4.LOCATION: SS-61, Holloman AFB	
5.NAME OF DRILLER: Rafe Jones	6.MANUFACTURER'S DESIGNATION OF DRILL:	
7.SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT Rig	8.HOLE LOCATION: SS61-DP46	
	9.SURFACE ELEVATION: N/A	
	10.DATE STARTED: 5/3/00	11.DATE COMPLETED: 5/3/00
12.OVERBURDEN THICKNESS: N/A	15.DEPTH GROUNDWATER ENCOUNTERED: 12 ft	
13.DEPTH DRILLED INTO ROCK: N/A	16.DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 11.04 ft 15 minutes after drilling	
14.TOTAL DEPTH OF HOLE: 20 ft	17.OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A	

18.GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19.TOTAL NUMBER OF CORE BOXES
None	N/A	N/A	

20.SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21.TOTAL CORE RECOVERY %
	soil and water	N/A	soil - TRPH	water - TPH-JP4		

22.DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23.SIGNATURE OF INSPECTOR
	w/ bentonite	N/A		Luke Darragh

LOCATION SKETCH/COMMENTS — SCALE 1 inch = 300 feet



PROJECT 5155.0027.0007 — HOLE NO. SS61-DP46

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP46

PROJECT 5155.0027.0007 H2000 | INSPECTOR Luke Darragh | SHEET 2 OF 2 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
		gravel and stone (road cover)					
	2 4	Grey Silty SAND, dry, loose, fine to medium Sand, trace coarse Sand	0.31 ppm				SM
	6 8	Grey Sandy SILT, dry, soft, fine Sand	0.40 ppm		SS61DP46S501		ML
		Grey/Brown poorly graded SAND, dry, dense, medium to coarse Sand, very little fines			SS61DP46S901		SP
	10 12	Grey/Tan Silty CLAY, very moist, soft, trace medium Sand, low plasticity Same as above- color change to brown	0.43 ppm				CL
	14	Tan/Grey Clayey SILT, wet, soft, some medium Sand	0.57 ppm				ML
	16	Black/Grey well graded SAND, moist, loose, some angular gravel up to 20 mm in size					SW
	18	Brown Silty CLAY, wet, stiff, medium Plasticity, some medium Sand, white crystals	0.91 ppm				CL
		Same as Above, slight odor, color change to tan at 19 ft TD = 20 ft	2.53 ppm				CL

PROJECT 5155.0027.0007 H2000 | HOLE NO. SS61-DP46

HTRW DRILLING LOG

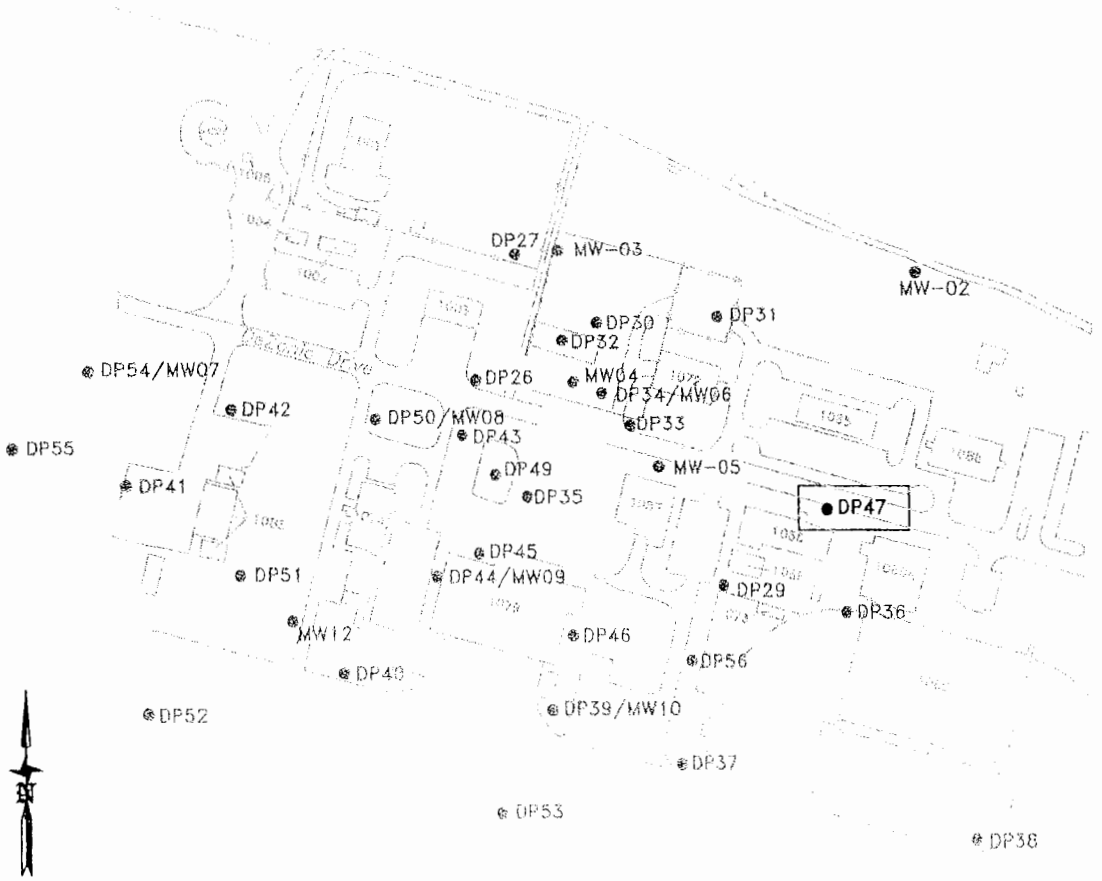
DISTRICT: OMAHA		HOLE NUMBER: SS61-DP47
1. COMPANY NAME: Foster Wheeler Environmental Corp.	2. DRILL SUBCONTRACTOR: Indian Fire and Safety	SHEET 1 OF 2 SHEETS
3. PROJECT: 5155.0027.0007 H2000	4. LOCATION: SS-61, Holloman AFB	
5. NAME OF DRILLER: Rafe Jones	6. MANUFACTURER'S DESIGNATION OF DRILL	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT Rig	8. HOLE LOCATION: SS61-DP47	
	9. SURFACE ELEVATION: N/A	
	10. DATE STARTED: 5/4/00	11. DATE COMPLETED: 5/4/00
12. OVERBURDEN THICKNESS: N/A	15. DEPTH GROUNDWATER ENCOUNTERED: 14.8 ft	
13. DEPTH DRILLED INTO ROCK: N/A	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 13.75 ft at 1145 hours on 5/5/00	
14. TOTAL DEPTH OF HOLE: 19.5 ft	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	N/A	N/A	

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	soil and water	N/A	soil - TRPH	water - TPH-JP4		

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	w/ bentonite	N/A		Luke Darragh

LOCATION SKETCH/COMMENTS — SCALE 1 inch = 300 feet



PROJECT 5155.0027.0007 — HOLE NO. SS61-DP47

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP47

PROJECT 5155.0027.0007 H2000 | INSPECTOR Luke Darragh | SHEET 2 OF 2 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
	2	Grey/Tan Silty SAND, dry, loose, medium Sand some coarse Sand					SM
	4	Same as above, color change to Brown					SM
	6	Light brown SILT, damp, soft, trace fine Sand					ML
	8	Same as above but dry	1.21 ppm		SS61DP47SB01		ML
	10	Light brown Sandy SILT, damp, soft, fine Sand			SS61DP47S1101		ML
	12						
	14	Light brown Silty CLAY, very moist, soft, low plasticity, some fine Sand					CL
	16	Light brown Silty CLAY, damp, stiff, fine white Sand lenses (caliche)					CL
	18	same as above, very moist					CL
		Grey Silty SAND, very moist, fine Sand lenses, some coarse Sand, some Clay					SM
		Total Depth=19.5 ft					

PROJECT 5155.0027.0007 H2000 | HOLE NO. SS61-DP47

HTRW DRILLING LOG

DISTRICT: OMAHA	HOLE NUMBER: SS61-DP48	
1. COMPANY NAME: Foster Wheeler Environmental Corp.	2. DRILL SUBCONTRACTOR: Indian Fire and Safety	SHEET 1 OF 2 SHEETS
3. PROJECT: 5155.0027.0007	4. LOCATION: SS-61, Holloman AFB	
5. NAME OF DRILLER: Rafe Jones	6. MANUFACTURER'S DESIGNATION OF DRILL	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT Rig	8. HOLE LOCATION: SS61-DP48	
	9. SURFACE ELEVATION: N/A	
	10. DATE STARTED: 5/10/00	11. DATE COMPLETED: 5/10/00
12. OVERBURDEN THICKNESS: N/A	15. DEPTH GROUNDWATER ENCOUNTERED: 15.0 ft	
13. DEPTH DRILLED INTO ROCK: N/A	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 10.51 ft, 2 hours after drilling	
14. TOTAL DEPTH OF HOLE: 19.5 ft	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	N/A	N/A	

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	soil and water	N/A	soil - TRPH	water - TPH-JP4		

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	W/ Bentonite	N/A		Luke Darragh

LOCATION SKETCH/COMMENTS — SCALE 1 inch = 300 feet

DP48 not shown

PROJECT 5155.0027.0007 — HOLE NO. SS61-DP48

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG

DISTRICT ☐MAHA		HOLE NUMBER SS61-DP48
1.COMPANY NAME Foster Wheeler Environmental Corp.	2.DRILL SUBCONTRACTOR Indian Fire and Safety	SHEET 1 OF SHEETS 2
3.PROJECT 5155.0027.0007 H2000	4.LOCATION SS-61, Holloman AFB	
5.NAME OF DRILLER Rafe Jones	6.MANUFACTURER'S DESIGNATION OF DRILL	
7.SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	8.HOLE LOCATION SS61-DP48	
	9.SURFACE ELEVATION N/A	
	10.DATE STARTED 5/10/00	11.DATE COMPLETED 5/10/00
12.OVERBURDEN THICKNESS N/A	15.DEPTH GROUNDWATER ENCOUNTERED 15.0 ft	
13.DEPTH DRILLED INTO ROCK N/A	16.DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED 10.51 ft, 2 hours after drilling	
14.TOTAL DEPTH OF HOLE 19.5 ft	17.OTHER WATER LEVEL MEASUREMENTS (SPECIFY) N/A	

18.GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19.TOTAL NUMBER OF CORE BOXES
None	N/A	N/A	

20.SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21.TOTAL CORE RECOVERY %
	soil and water	N/A	soil - TRPH	water - TPH-JP4		

22.DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23.SIGNATURE OF INSPECTOR
	W/ Bentonite	N/A		

LOCATION SKETCH/COMMENTS	SCALE

PROJECT 5155.0027.0007 H2000	HOLE NO. SS61-DP48

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP48

PROJECT 5155.0027.0007 H2000 | INSPECTOR Luke Darragh | SHEET 2 OF 2 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
	2 4	Light Brown SILT, dry, soft, trace fine to medium Sand					ML
	6	Light brown Silty CLAY, dry, medium Stiffness, low plasticity, trace fine Sand					CL
	8 10	Grey Silty CLAY, dry, stiff, low plasticity, fine white Sand lenses throughout					CL
	12	Reddish brown Silty CLAY, damp, soft, low plasticity, trace fine to medium Sand, white sand lenses, moist at 13 ft.					CL
	14	Grey Clayey SAND, damp, medium density, medium to coarse Sand					SC
	16	Light brown Silty SAND, wet, loose, fine Sand					SM
	18	Grey Sandy CLAY, wet, stiff, low plasticity, fine Sand					CL
		Total Depth = 19.5 ft					

PROJECT 5155.0027.0007 H2000 | HOLE NO. SS61-DP48

HTRW DRILLING LOG

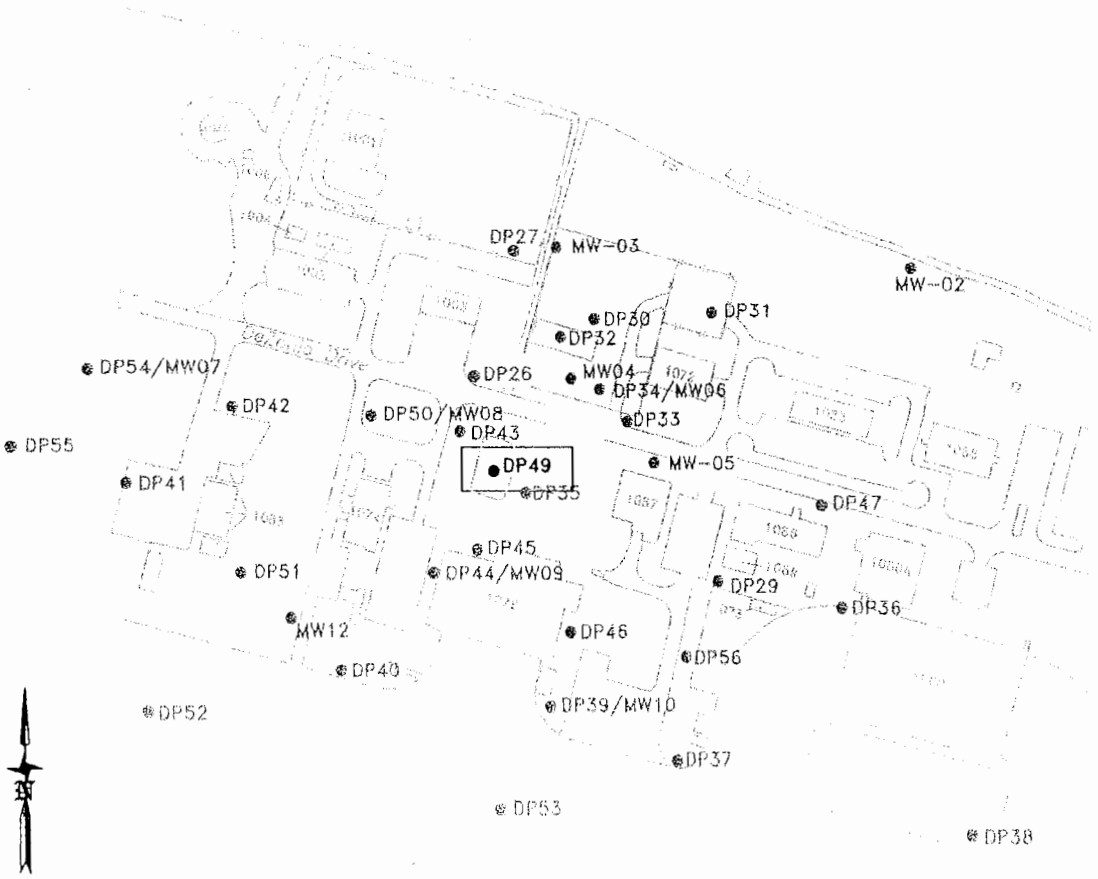
DISTRICT: OMAHA	HOLE NUMBER: SS61-DP49	
1. COMPANY NAME: Foster Wheeler Environmental Corp.	2. DRILL SUBCONTRACTOR: Indian Fire and Safety	SHEET 1 OF 3 SHEETS
3. PROJECT: 5155.0027.0007	4. LOCATION: SS-61, Holloman AFB	
5. NAME OF DRILLER: Rafe Jones	6. MANUFACTURER'S DESIGNATION OF DRILL	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT Rig	8. HOLE LOCATION: SS61-DP49	
	9. SURFACE ELEVATION: N/A	
	10. DATE STARTED: 5/10/00	11. DATE COMPLETED: 5/10/00
12. OVERBURDEN THICKNESS: N/A	15. DEPTH GROUNDWATER ENCOUNTERED: 16.5 ft	
13. DEPTH DRILLED INTO ROCK: N/A	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 8.75 ft prior to sampling about 30 minutes after drilling	
14. TOTAL DEPTH OF HOLE: 21.5 ft	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	N/A	N/A	

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	soil and water	N/A	soil - TRPH	water - TPH-JP4		

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	w/ bentonite			Luke Darragh

LOCATION SKETCH/COMMENTS — SCALE 1 inch = 300 feet



PROJECT 5155.0027.0007 — HOLE NO. SS61-DP49

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP49

PROJECT 5155.0027.0007 H2000

INSPECTOR Luke Darragh

SHEET 2 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
	2 4	Light Brown Clayey SILT with Sand, damp/moist, soft, fine Sand, some medium Sand					ML
	6	Grey/Tan Silty SAND, moist, loose, medium Sand, trace coarse Sand					SM
	8 10	Brown Silty CLAY, damp, stiff, low plasticity, fine white Sand lenses	0.56 ppm				CL
	12 14	Brown Silty CLAY, damp, medium stiffness, low plasticity, trace medium Sand	69 ppm		SS61DP49S1101		CL
	16	Light brown Silty CLAY, damp, stiff, low plasticity, fine Sand lenses, trace crystals Discoloration and odor from 16-16.5 ft, very moist			SS61DP491601		CL
	18	Grey Silty CLAY, wet, stiff, low plasticity, large crystals and white Sand lenses					CL

PROJECT 5155.0027.0007 H2000 HOLE NO. SS61-DP49

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP49

PROJECT 5155.0027.0007 H2000

INSPECTOR Luke Darragh

SHEET 3 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
		Grey Silty SAND, wet, loose, fine Sand, trace medium Sand, discoloration, odor					SM
	22	TD = 21.5 ft					

PROJECT 5155.0027.0007 H2000

HOLE NO. SS61-DP49

ENG FORM 5056A-R, AUG 94

(Proponent: CECW-EG)

HTRW DRILLING LOG

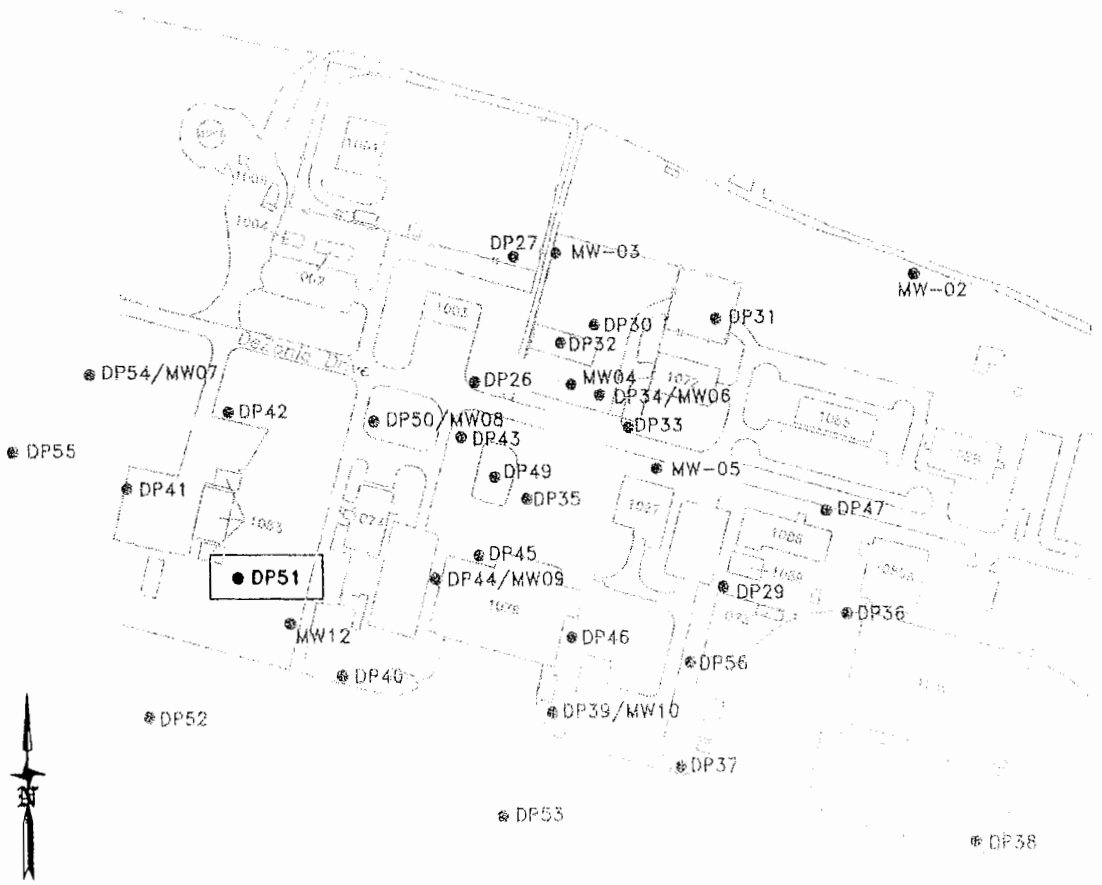
DISTRICT: OMAHA		HOLE NUMBER: SS61-DP51
1.COMPANY NAME: Foster Wheeler Environmental Corp.	2.DRILL SUBCONTRACTOR: Indian Fire and Safety	SHEET 1 OF SHEETS 2
3.PROJECT: 5155.0027.0007	4.LOCATION: SS-61, Holloman AFB	
5.NAME OF DRILLER: Rafe Jones	6.MANUFACTURER'S DESIGNATION OF DRILL:	
7.SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT Rig	8.HOLE LOCATION: SS61-DP51	
	9.SURFACE ELEVATION: N/A	
	10.DATE STARTED: 5/11/00	11.DATE COMPLETED: 5/11/00
12.OVERBURDEN THICKNESS: N/A	15.DEPTH GROUNDWATER ENCOUNTERED: 15.5 ft	
13.DEPTH DRILLED INTO ROCK: N/A	16.DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:	
14.TOTAL DEPTH OF HOLE: 20.5 ft	17.OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A	

18.GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19.TOTAL NUMBER OF CORE BOXES
None	N/A	N/A	

20.SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21.TOTAL CORE RECOVERY %
	soil and water	N/A	Soil - TRPH	water - TPH-JP4		

22.DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23.SIGNATURE OF INSPECTOR
	w/ bentonite	N/A		Luke Darragh

LOCATION SKETCH/COMMENTS — SCALE 1 inch = 300 feet



PROJECT 5155.0027.0007 — HOLE NO. SS61-DP51

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP51

PROJECT 5155.0027.0007 H2000

INSPECTOR Luke Darragh

SHEET 2 OF 2 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
	2	Brown Silty CLAY, dry, soft, fine white Sand lenses throughout, low plasticity					CL
	4						
	6	Light brown Sandy SILT with fine sand, damp, soft, trace medium Sand					ML
	8						
	10	Grey/Tan Clayey SILT, some medium Sand, moist, soft, trace coarse Sand					ML
	12	Same as above with more medium Sand and coarse Sand (rounded)					ML
	14	Brown Silty CLAY, moist, soft, low plasticity, medium to coarse rounded Sand			SS61DP51S1401 SS61DP51S1402		CL
	16	Grey Silty CLAY, wet, soft, some medium to coarse Sand					CL
	18	Reddish brown Silty CLAY, very moist, fine to medium white Sand lenses, some small crystals, low plasticity					CL
		Grey/Green Silty CLAY, wet, soft, low plasticity, some medium to coarse Sand, discoloration and odor TD = 20.5 ft					CL

PROJECT 5155.0027.0007 H2000 HOLE NO. SS61-DP51

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG

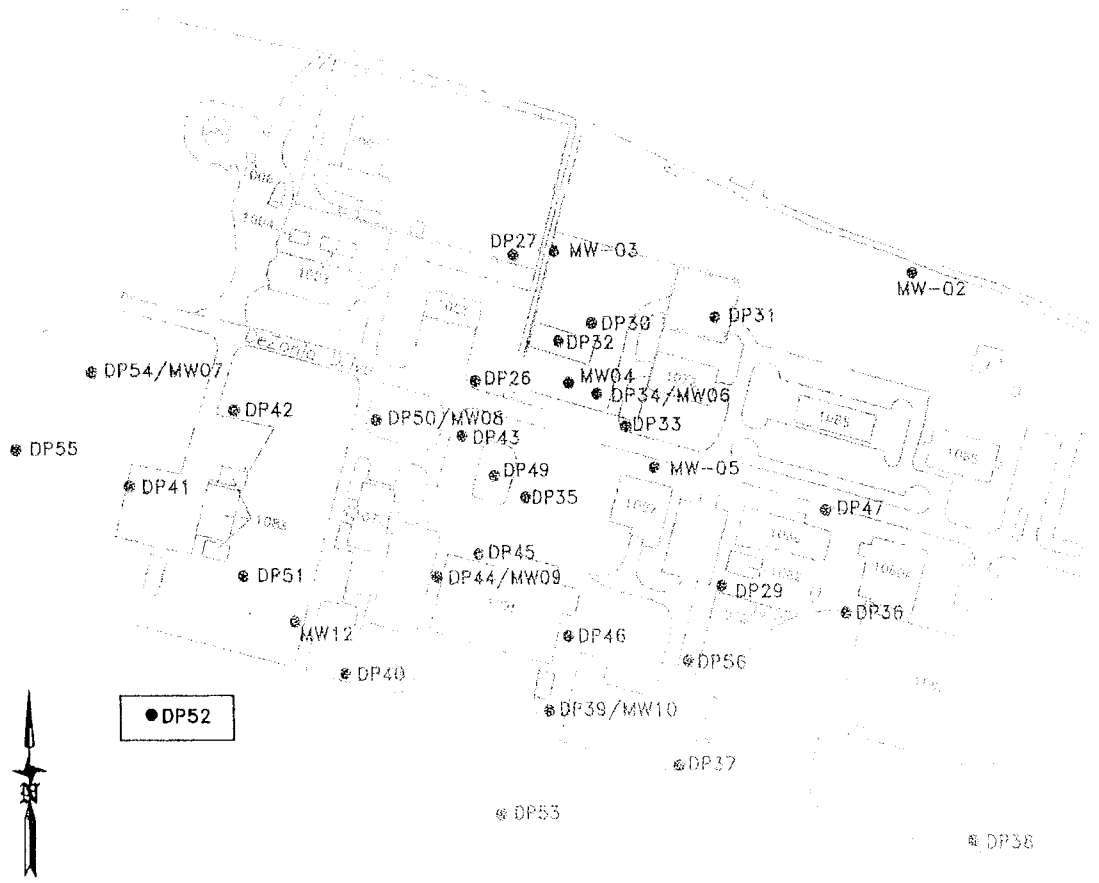
DISTRICT: OMAHA		HOLE NUMBER: SS61-DP52
1.COMPANY NAME: Foster Wheeler Environmental Corp.	2.DRILL SUBCONTRACTOR: Indian Fire and Safety	SHEET 1 OF SHEETS 3
3.PROJECT: 5155.0027.0007	4.LOCATION: SS-61, Holloman AFB	
5.NAME OF DRILLER: Rafe Jones	6.MANUFACTURER'S DESIGNATION OF DRILL	
7.SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT Rig	8.HOLE LOCATION: SS61-DP52	
	9.SURFACE ELEVATION: N/A	
	10.DATE STARTED: 5/11/00	11.DATE COMPLETED: 5/11/00
12.OVERBURDEN THICKNESS: N/A	15.DEPTH GROUNDWATER ENCOUNTERED: 18 ft	
13.DEPTH DRILLED INTO ROCK: N/A	16.DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 16.25 ft, 5 minutes after drilling	
14.TOTAL DEPTH OF HOLE: 24.5 ft	17.OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A	

18.GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19.TOTAL NUMBER OF CORE BOXES
None	N/A	N/A	

20.SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21.TOTAL CORE RECOVERY %
	soil and water	N/A	soil - TRPH	water - TPH-JP4		

22.DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23.SIGNATURE OF INSPECTOR
	w/ bentonite	N/A		Luke Darragh

LOCATION SKETCH/COMMENTS — SCALE 1 inch = 300 feet



PROJECT 5155.0027.0007 — HOLE NO. SS61-DP52

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP52

PROJECT 5155.0027.0007 H2000

INSPECTOR Luke Darragh

SHEET 2 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
		0-13 inches- black top and cement					
	2	Tan Silty SAND, dry, loose, medium to coarse Sand, trace subrounded gravel 7 mm in size					SM
	4	Tan Sandy SILT, damp, soft, medium Sand, trace fine Sand					ML
	6	Tan Silty SAND, damp, loose, medium Sand, some subangular gravel 10 mm in size					SM
	8	Reddish brown SILT, dry, soft, trace fine to medium Sand					ML
	10	Brown Silty SAND, damp, loose, medium Sand, trace coarse Sand					SM
	12	Reddish brown Silty CLAY, damp, soft, small crytals throughout, trace large crystals 20 mm in size, medium plasticity, fine white Sand lenses (caliche)					CL
	14						
	16				SS61DP52S1501		
	18	Reddish brown Silty CLAY, wet, medium plasticity, soft, white and brown Sand lenses throughout, small crystals					CL

PROJECT 5155.0027.0007 H2000

HOLE NO. SS61-DP52

ENG FORM 5056A-R, AUG 94

(Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP52

PROJECT 5155.0027.0007 H2000

INSPECTOR Luke Darragh

SHEET 3 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
		Same as above					CL
	22	Brown/Tan Clayey SILT with Sand, wet, soft, medium Sand, trace coarse Sand					ML
	24	TD = 24.5 ft					

PROJECT 5155.0027.0007 H2000

HOLE NO. SS61-DP52

ENG FORM 5056A-R, AUG 94

(Proponent: CECW-EG)

HTRW DRILLING LOG

DISTRICT: OMAHA		HOLE NUMBER: SS61-DP53
1. COMPANY NAME: Foster Wheeler Environmental Corp.	2. DRILL SUBCONTRACTOR: Indian Fire and Safety	SHEET 1 OF 3 SHEETS
3. PROJECT: 5155.0027.0007	4. LOCATION: SS-61, Holloman AFB	
5. NAME OF DRILLER: Rafe Jones	6. MANUFACTURER'S DESIGNATION OF DRILL	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT Rig	8. HOLE LOCATION: SS61-DP53	
	9. SURFACE ELEVATION: N/A	
	10. DATE STARTED: 5/11/00	11. DATE COMPLETED: 5/11/00
12. OVERBURDEN THICKNESS: N/A	15. DEPTH GROUNDWATER ENCOUNTERED: 22.5 ft	
13. DEPTH DRILLED INTO ROCK: N/A	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 11.59 ft, 5 minutes after drilling	
14. TOTAL DEPTH OF HOLE: 24.5 ft	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	N/A	N/A	

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
	soil and water	N/A	soil - TRPH	water - TPH-JP4		x

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	w/bentonite	N/A		Luke Darragh

LOCATION SKETCH/COMMENTS — SCALE 1 inch = 300 feet

PROJECT 5155.0027.0007 — HOLE NO. SS61-DP53

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP53

PROJECT 5155.0027.0007 H2000

INSPECTOR Luke Darragh

SHEET 2 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
		asphalt/ concrete					
	2	Tan Silty CLAY, moist, soft, Trace fine and medium Sand					CL
	4 6	Tan Sandy SILT, moist, soft, fine to medium Sand					ML
	8 10	Brown Silty CLAY with Sand, damp/ moist, soft, fine to medium Sand very wet from 8.5 to 9.0 ft					CL
	12 14	Light brown Silty CLAY, damp, soft, some fine white Sand lenses throughout, medium plasticity					CL
		Brown Silty CLAY with Sand, damp, soft, medium to coarse Sand					CL
	16	Reddish Brown Clayey SILT, damp, medium stiffness, trace fine Sand					ML
	18	Reddish Brown Silty CLAY, damp, medium stiffness, medium plasticity, fine Sand lenses and small crystals					CL
		Same as above but very moist at 19 ft					CL

PROJECT 5155.0027.0007 H2000 HOLE NO. SS61-DP53

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP53

PROJECT 5155.0027.0007 H2000

INSPECTOR Luke Darragh

SHEET 3 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
		Reddish Brown Silty CLAY, very moist, soft, sand lenses and crystals					CL
	22	Silty SAND, moist, loose, fine Sand, some medium Sand					SM
		Same as above but wet					SM
	24	Reddish Brown Silty CLAY, wet, stiff, some medium Sand					CL
		TD = 24.5 ft					
	26						

PROJECT 5155.0027.0007 H2000

HOLE NO. SS61-DP53

ENG FORM 5056A-R, AUG 94

(Proponent: CECW-EG)

HTRW DRILLING LOG

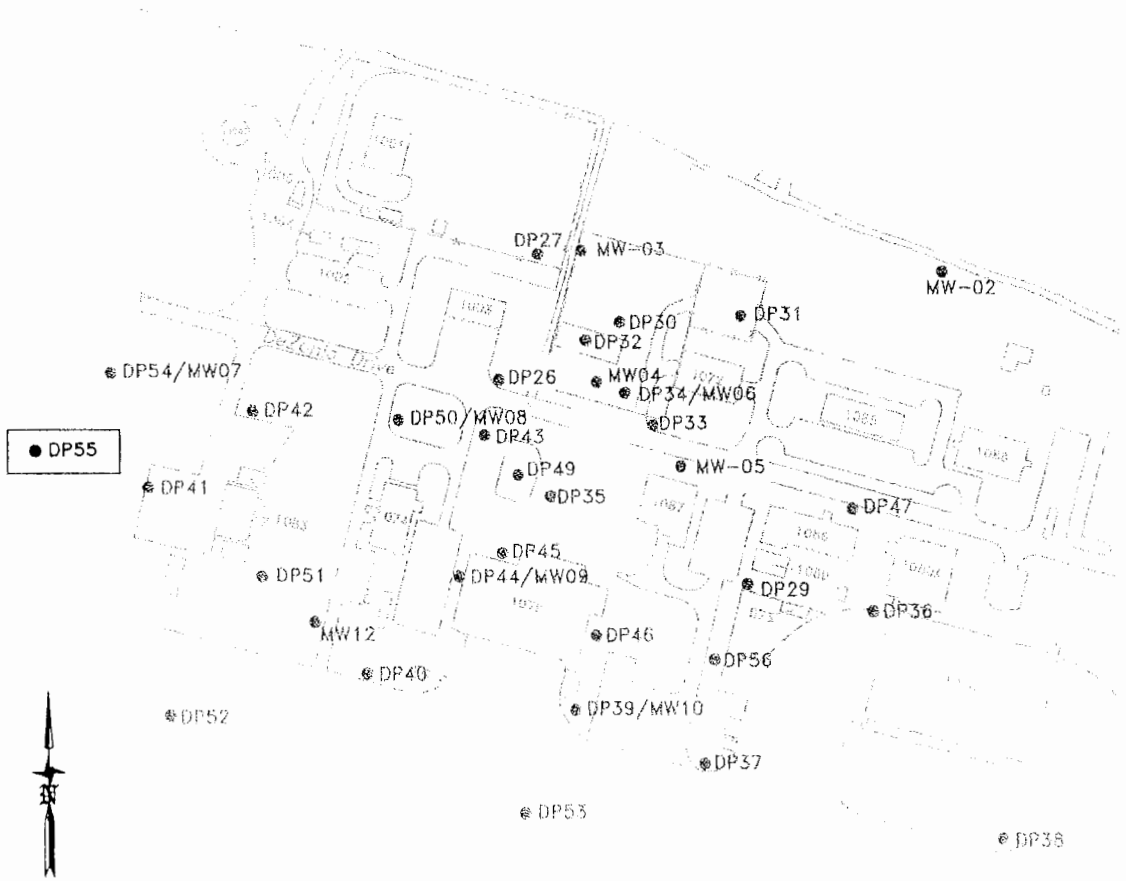
DISTRICT: OMAHA		HOLE NUMBER: SS61-DP55
1.COMPANY NAME: Foster Wheeler Environmental Corp.	2.DRILL SUBCONTRACTOR: Indian Fire and Safety	SHEET 1 OF SHEETS 2
3.PROJECT: 5155.0027.0007	4.LOCATION: SS-61, Holloman AFB	
5.NAME OF DRILLER: Rafe Jones	6.MANUFACTURER'S DESIGNATION OF DRILL	
7.SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT Rig	8.HOLE LOCATION: SS61-DP55	
	9.SURFACE ELEVATION: N/A	
	10.DATE STARTED: 5/12/00	11.DATE COMPLETED: 5/12/00
12.OVERBURDEN THICKNESS: N/A	15.DEPTH GROUNDWATER ENCOUNTERED: 16.0 ft	
13.DEPTH DRILLED INTO ROCK: N/A	16.DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 14.95 ft, 5 minutes after drilling	
14.TOTAL DEPTH OF HOLE: 19.0 ft	17.OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A	

18.GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19.TOTAL NUMBER OF CORE BOXES
None	N/A	N/A	

20.SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21.TOTAL CORE RECOVERY %
	soil and water	N/A	soil - TRPH	water - TPH-JP4		

22.DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23.SIGNATURE OF INSPECTOR
	w/ bentonite	N/A		Luke Darragh

LOCATION SKETCH/COMMENTS — SCALE 1 Inch = 300 feet



PROJECT 5155.0027.0007 — HOLE NO. SS61-DP55

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP55

PROJECT 5155.0027.0007 H2000

INSPECTOR Luke Darragh

SHEET 2 OF 2 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
		Some asphalt near surface Light brown Clayey SILT with Sand, damp, soft, fine to medium Sand					ML
	2	Light brown Silty CLAY with fine Sand, damp, soft, low plasticity					CL
	4	Reddish brown SILT, dry, soft, trace fine Sand					ML
	6	Grey/Tan SAND with Silt, well graded, dry, loose, some Clay					SW
	8	Brown Silty CLAY, damp, stiff, fine white Sand lenses, small crystals					CL
	10						
	12	Reddish brown Silty CLAY, damp, soft, moderate plasticity, some fine Sand			SS61DP55S1201		CL
	14	Grey Silty CLAY, wet, soft, some fine to medium Sand, trace coarse Sand					CL
	16	Reddish brown Silty CLAY with Sand, wet, soft, low plasticity, medium to coarse Sand					CL
	18						
		Total Depth = 19 ft					

PROJECT 5155.0027.0007 H2000 HOLE NO. SS61-DP55

HTRW DRILLING LOG

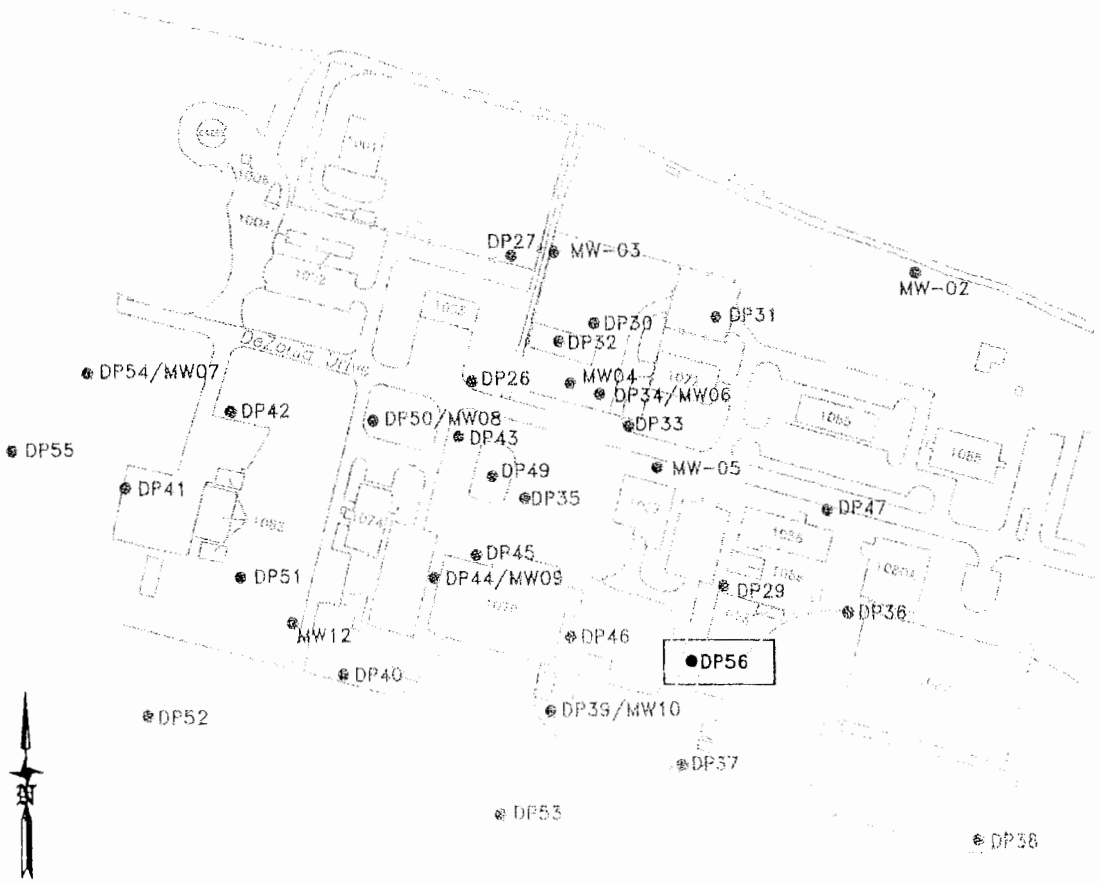
DISTRICT: OMAHA	HOLE NUMBER: SS61-DP56	
1. COMPANY NAME: Foster Wheeler Environmental Corp.	2. DRILL SUBCONTRACTOR: Indian Fire and Safety	SHEET 1 OF 3 SHEETS
3. PROJECT: 5155.0027.0007	4. LOCATION: SS-61, Holloman AFB	
5. NAME OF DRILLER: Rafe Jones	6. MANUFACTURER'S DESIGNATION OF DRILL	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT Rig	8. HOLE LOCATION: SS61-DP56	
	9. SURFACE ELEVATION: N/A	
	10. DATE STARTED: 5/12/00	11. DATE COMPLETED: 5/12/00
12. OVERBURDEN THICKNESS: N/A	15. DEPTH GROUNDWATER ENCOUNTERED: 18 ft	
13. DEPTH DRILLED INTO ROCK: N/A	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 18.03 ft, 5 minutes after drilling	
14. TOTAL DEPTH OF HOLE: 23.0 ft	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): 12.76 ft after sampling	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	N/A	N/A	

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	soil and water	N/A	soil - TRPH	water - TPH-JP4		

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	w/ bentonite	N/A		Luke Darragh

LOCATION SKETCH/COMMENTS — SCALE 1 inch = 300 feet



PROJECT 5155.0027.0007 — HOLE NO. SS61-DP56

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP56

PROJECT 5155.0027.0007 H2000

INSPECTOR Luke Darragh

SHEET 2 OF 3

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
	2	Reddish brown Silty SAND, dry, fine to medium Sand, trace coarse Sand					SM
	4	Reddish brown SILT, damp, soft, trace fine Sand					ML
	6						
	8	Reddish brown Sandy SILT, very moist/wet, soft, fine Sand					ML
	10	Grey Silty CLAY, damp, soft, some fine to medium Sand					CL
	12	Reddish brown Silty CLAY, damp/moist, stiff, fine grey Sand lenses, moderate plasticity					CL
	14	Light brown Clayey SILT, damp/moist, soft, trace fine Sand					ML
		Reddish brown Silty CLAY, moist, stiff, fine white Sand lenses (caliche), moderate plasticity					CL
	16	Same as above but very moist					CL
	18	Same as above but wet					CL
		Same as above but not as wet- moist					CL

PROJECT 5155.0027.0007 H2000

HOLE NO. SS61-DP56

ENG FORM 5056A-R, AUG 94

(Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP56

PROJECT 5155.0027.0007 H2000

INSPECTOR Luke Darragh

SHEET 3 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
		Reddish brown Silty CLAY, wet, stiff, fine white Sand lenses, moderate plasticity					CL
	22	Slight discoloration from 22 to 23 ft					
		Total Depth = 23 ft					
	24						

PROJECT 5155.0027.0007 H2000

HOLE NO. SS61-DP56

ENG FORM 5056A-R, AUG 94

(Proponent: CECW-EG)

HTRW DRILLING LOG

DISTRICT: OMAHA		HOLE NUMBER: SS61-DP57
1.COMPANY NAME: Foster Wheeler Environmental Corp.	2.DRILL SUBCONTRACTOR: Indian Fire and Safety	SHEET 1 OF SHEETS 2
3.PROJECT: 5155.0027.0007	4.LOCATION: SS-61, Holloman AFB	
5.NAME OF DRILLER: Rafe Jones	6.MANUFACTURER'S DESIGNATION OF DRILL	
7.SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT Rig	8.HOLE LOCATION: SS61-DP57	
	9.SURFACE ELEVATION: N/A	
	10.DATE STARTED: 5/12/00	11.DATE COMPLETED: 5/12/00
12.OVERBURDEN THICKNESS: N/A	15.DEPTH GROUNDWATER ENCOUNTERED: 13 ft	
13.DEPTH DRILLED INTO ROCK: N/A	16.DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 7.11 ft, 5 minutes after drilling	
14.TOTAL DEPTH OF HOLE: 15.0 ft	17.OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A	

18.GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19.TOTAL NUMBER OF CORE BOXES
None			

20.SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21.TOTAL CORE RECOVERY %
	soil and water	N/A	soil - TRPH	water - TPH-JP4		

22.DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23.SIGNATURE OF INSPECTOR
	w/ bentonite	N/A		Luke Darragh

LOCATION SKETCH/COMMENTS — SCALE 1 inch = 300 feet

PROJECT 5155.0027.0007 — HOLE NO. SS61-DP57

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP57

PROJECT 5155.0027.0007 H2000

INSPECTOR Luke Darragh

SHEET 2 OF 2 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
	2	Light brown Silty CLAY, very moist, soft, low plasticity, trace fine Sand					CL
	4	Reddish brown Silty CLAY with Sand, very moist, fine white Sand lenses, trace crystals					CL
	6	Brown Silty SAND, very moist, loose, fine and medium Sand, trace coarse Sand					SM
	8	Reddish brown Silty CLAY, moist, stiff, slight plasticity, fine white Sand lenses					CL
	10	Reddish brown Silty CLAY with Sand, moist, soft, fine Sand, trace medium Sand					CL
	12	Brown Clayey SAND, well graded, loose, trace subrounded gravel					SW
	14	Brown Silty CLAY, very moist, medium stiffness, low plasticity					CL
	16	Total Depth = 15.0 ft					
	18						

PROJECT 5155.0027.0007 H2000 HOLE NO. SS61-DP57

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG

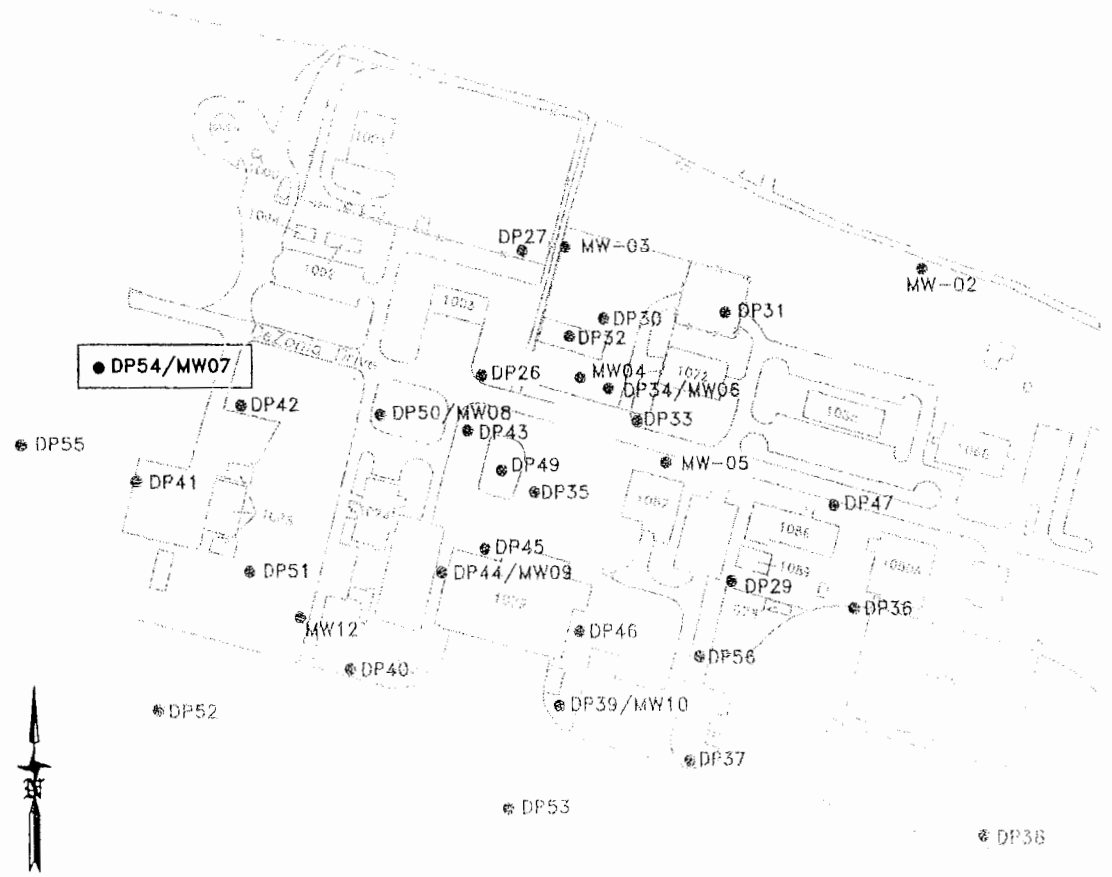
DISTRICT: OMAHA		HOLE NUMBER: SS61-DP54/MW07
1. COMPANY NAME: Foster Wheeler Environmental Corp.	2. DRILL SUBCONTRACTOR: Indian Fire and Safety	SHEET 1 OF SHEETS 3
3. PROJECT: 5155.0027.0007	4. LOCATION: SS-61, Holloman AFB	
5. NAME OF DRILLER: Rafe Jones	6. MANUFACTURER'S DESIGNATION OF DRILL	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT Rig	8. HOLE LOCATION: SS61-DP54/MW07	
	9. SURFACE ELEVATION: N/A	
	10. DATE STARTED: 5/12/00	11. DATE COMPLETED: 5/12/00
12. OVERBURDEN THICKNESS: N/A	15. DEPTH GROUNDWATER ENCOUNTERED: 19.0 ft	
13. DEPTH DRILLED INTO ROCK: N/A	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 15.25 ft, 10 minutes after drilling	
14. TOTAL DEPTH OF HOLE: 22 ft.	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	N/A	N/A	

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	soil and water	N/A	soil - TRPH	water - TPH-JP4		

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	w/ bentonite	N/A		Luke Darragh

LOCATION SKETCH/COMMENTS — SCALE 1 inch = 300 feet



PROJECT 5155.0027.0007 — HOLE NO. SS61-DP54/MW07

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP54/MW07

PROJECT 5155.0027.0007 H2000 | INSPECTOR Luke Darragh | SHEET 2 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
	2	Tan Silty SAND, dry, loose, medium to coarse Sand, trace subrounded gravel 15 mm in size					SM
	4	Light brown Silty CLAY with Sand, damp, soft, low plasticity, medium Sand					CL
	6	Light brown Sandy SILT, soft, fine to medium Sand					ML
		Tan Silty SAND, dry, loose, medium Sand					SM
	8	Tan Silty SAND, dry, loose, medium to coarse Sand					SM
	10	Reddish brown Silty CLAY, damp, soft, medium plasticity, trace medium white Sand lenses					CL
	12	Same as above with a medium stiffness					CL
	14	Same as above with medium to coarse Sand					CL
		Same as above with a color change to grey			SS61DP54S1401		CL
	16	Grey Silty CLAY, damp/moist, soft, some medium to coarse Sand					CL
	18						CL

PROJECT 5155.0027.0007 H2000 | HOLE NO. SS61-DP54/MW07

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP54/MW07

PROJECT 5155.0027.0007 H2000

INSPECTOR Luke Darragh

SHEET 3 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
		Reddish brown Silty CLAY, wet, medium stiffness, medium to high plasticity, trace medium Sand and 5 mm crystals					CL
	22	TD = 22 ft					

PROJECT 5155.0027.0007 H2000

HOLE NO. SS61-DP54/MW07

ENG FORM 5056A-R, AUG 94

(Proponent: CECW-EG)

HTRW DRILLING LOG

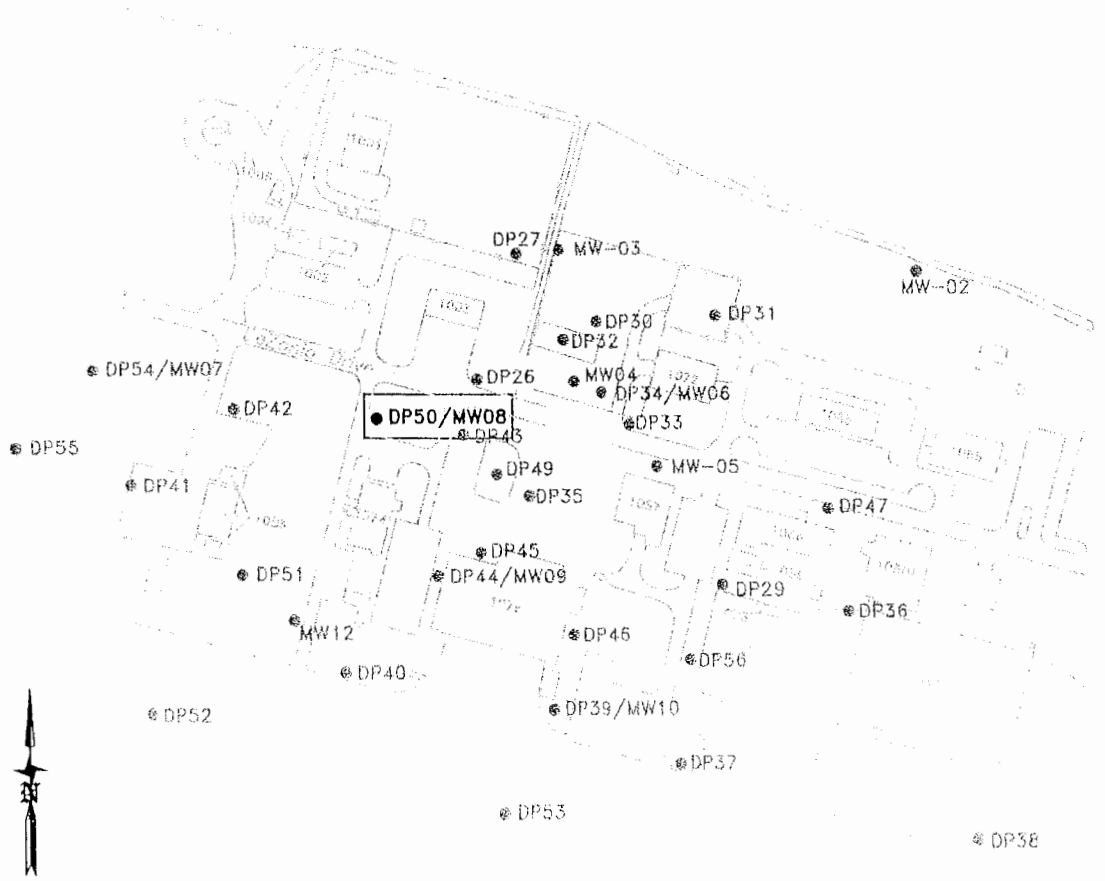
DISTRICT: OMAHA		HOLE NUMBER: SS61-DP50/MW08
1.COMPANY NAME: Foster Wheeler Environmental	2.DRILL SUBCONTRACTOR: Indian Fire and Safety	SHEET 1 OF 3 SHEETS
3.PROJECT: 5155.0027.0007	4.LOCATION: SS61, Holloman AFB	
5.NAME OF DRILLER: Rafe Jones	6.MANUFACTURER'S DESIGNATION OF DRILL	
7.SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT Rig	8.HOLE LOCATION: SS61-DP50/MW08	
	9.SURFACE ELEVATION: N/A	
	10.DATE STARTED: 5/11/00	11.DATE COMPLETED: 5/11/00
12.OVERBURDEN THICKNESS: N/A	15.DEPTH GROUNDWATER ENCOUNTERED: 20.5 ft	
13.DEPTH DRILLED INTO ROCK: N/A	16.DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 12.72 ft 4 hours after drilling	
14.TOTAL DEPTH OF HOLE: 22.5 ft	17.OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A	

18.GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19.TOTAL NUMBER OF CORE BOXES
None			

20.SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21.TOTAL CORE RECOVERY
	soil and water	N/A	soil - TRPH	water - TPH-JP4		X

22.DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23.SIGNATURE OF INSPECTOR
	w/ bentonite	Yes, MW-08		Luke Darragh

LOCATION SKETCH/COMMENTS — SCALE 1 inch = 300 feet



PROJECT 5155.0027.0007 — HOLE NO. SS61-DP50/MW08

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP50/MW08

PROJECT 5155.0027.0007 H2000 | INSPECTOR Luke Darragh | SHEET 2 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
		0-6 inches is gravel					
	2	Light brown Clayey SILT, dry, soft, some fine Sand					ML
	4	Light brown Sandy SILT with fine Sand, damp, soft, trace coarse Sand					ML
	6	Grey Silty CLAY, stiff, low plasticity, some medium Sand					CL
	8	Same as above but damp					CL
	10				SS61DP50S1001		
	12	Light Brown Silty CLAY with medium Sand, moist, soft Very moist from 12.5 to 13 ft					CL
	14	Light brown Silty CLAY, moist, low plasticity, medium stiffness, some fine Sand, trace medium Sand			SS61DP50S1501		CL
	16	Same as above but has moderate plasticity, slight odor	75.23 ppm				CL
	18	Grey Silty CLAY, moist, medium stiffness, fine white Sand lenses, some small crystals and some discoloration, odor	36.0 ppm				CL

PROJECT 5155.0027.0007 H2000 | HOLE NO. SS61-DP50/MW08

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP50/MW08

PROJECT 5155.0027.0007 H2000

INSPECTOR Luke Darragh

SHEET 3 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
	22	Grey Silty CLAY with fine to medium Sand, wet, soft, low plasticity, discoloration and an odor					CL
	24	TD = 22.5 ft					

PROJECT 5155.0027.0007 H2000

HOLE NO. SS61-DP50/MW08

ENG FORM 5056A-R, AUG 94

(Proponent: CECW-EG)

HTRW DRILLING LOG

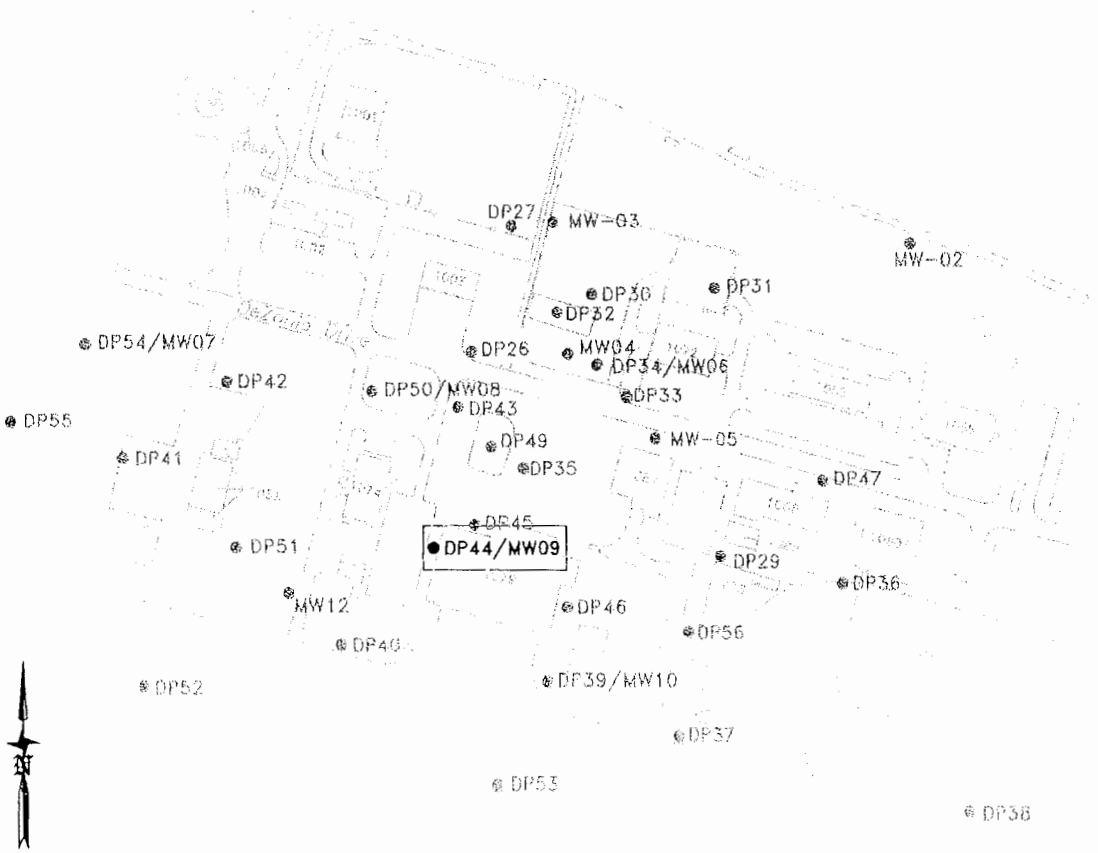
DISTRICT: OMAHA		HOLE NUMBER: SS61-DP44/MW09
1.COMPANY NAME: Foster Wheeler Environmental Corp.	2.DRILL SUBCONTRACTOR: Indian Fire and Safety	SHEET 1 OF SHEETS 2
3.PROJECT: 5155.0027.0007 H2000	4.LOCATION: SS-61, Holloman AFB	
5.NAME OF DRILLER: Rafe Jones	6.MANUFACTURER'S DESIGNATION OF DRILL	
7.SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT Rig	8.HOLE LOCATION: SS61-DP44/MW09	
	9.SURFACE ELEVATION: N/A	
	10.DATE STARTED: 5/2/00	11.DATE COMPLETED: 5/2/00
12.OVERBURDEN THICKNESS: N/A	15.DEPTH GROUNDWATER ENCOUNTERED: 14 ft	
13.DEPTH DRILLED INTO ROCK: N/A	16.DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 12.65 ft at 1200 hrs, 5/3/00	
14.TOTAL DEPTH OF HOLE: 21 ft	17.OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A	

18.GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19.TOTAL NUMBER OF CORE BOXES
None	N/A	N/A	

20.SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21.TOTAL CORE RECOVERY %
	soil and water		soil - TRPH	water - TPH-JP4		

22.DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23.SIGNATURE OF INSPECTOR
	w/ bentonite	yes, MW-09		Luke Darragh

LOCATION SKETCH/COMMENTS — SCALE 1 inch = 300 feet



PROJECT 5155.0027.0007 — HOLE NO. SS61-DP44/MW09

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP44/MW09

PROJECT 5155.0027.0007 H2000

INSPECTOR Luke Darragh

SHEET 2 OF 2 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
		FILL and gravel					
	2	Brown Silty CLAY with fine Sand, damp, soft, low plasticity	0.70 ppm				CL
	4	Brown Sandy SILT with fine Sand, very moist, soft wet from 5-6 ft	0.54 ppm				ML
	6						
	8	Light grey Silty CLAY with fine Sand, moist, soft	0.35 ppm				CL
	10						
	12	Same Silty Clay as above but wet at 14 ft and stained from 13-14 ft, odor	0.75 ppm				CL
	14	Grey/Tan Silty CLAY with some fine Sand, wet, low plasticity, odor	26.26 ppm				CL
	16	Brown Silty CLAY, fine Sand, wet, soft, low plasticity, trace odor	0.93 ppm				CL
	18	Same Silty Clay as above, odor					CL
		Grey Silty CLAY with gravel, wet, soft, odor (same down to TD of 21 ft) TD = 21 ft	119 ppm				CL

PROJECT 5155.0027.0007 H2000 HOLE NO. SS61-DP44/MW09

HTRW DRILLING LOG

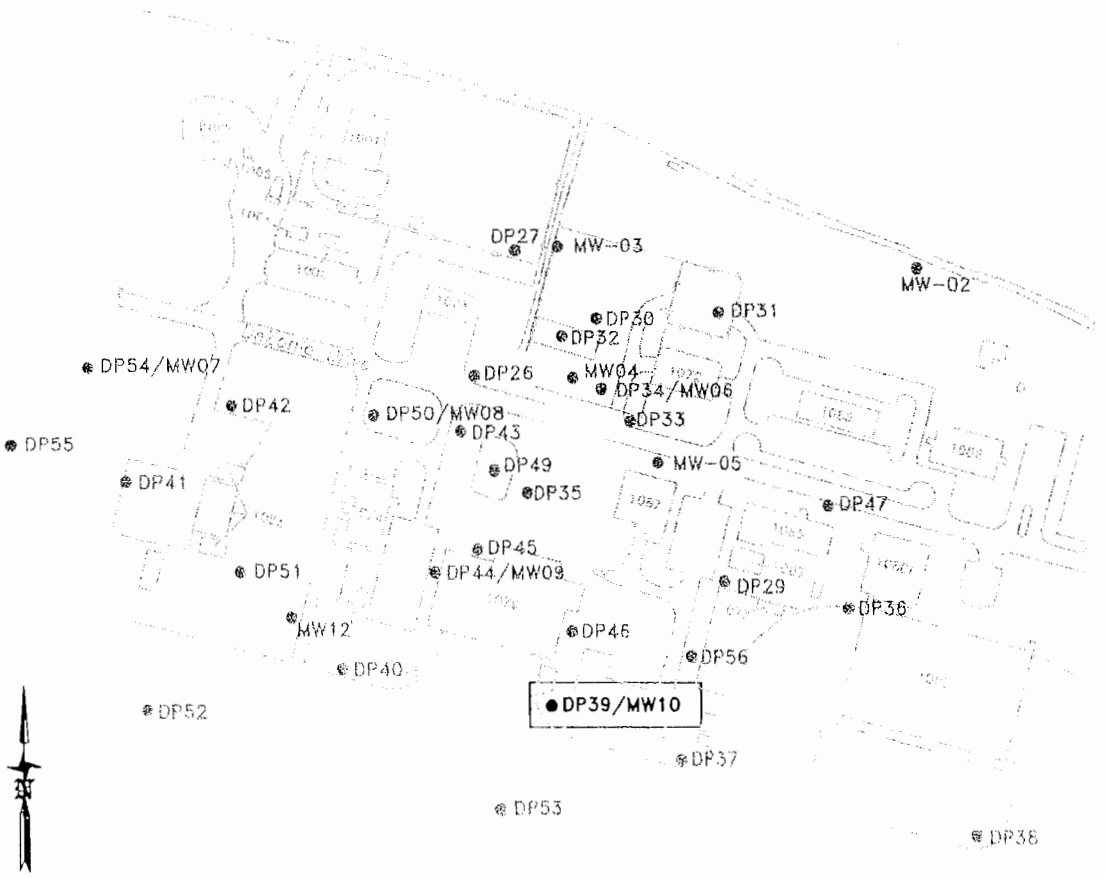
DISTRICT: OMAHA		HOLE NUMBER: SS61-DP39/MW10
1.COMPANY NAME: Foster Wheeler Environmental Corp	2.DRILL SUBCONTRACTOR: Indian Fire and Safety	SHEET 1 OF 2 SHEETS
3.PROJECT: 5155.0027.0007 H2000	4.LOCATION: SS-61, Holloman AFB	
5.NAME OF DRILLER: Rafe Jones	6.MANUFACTURER'S DESIGNATION OF DRILL	
7.SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT Rig	8.HOLE LOCATION: SS61-DP39	
	9.SURFACE ELEVATION: N/A	
	10.DATE STARTED: 5/3/00	11.DATE COMPLETED: 5/3/00
12.OVERBURDEN THICKNESS: N/A	15.DEPTH GROUNDWATER ENCOUNTERED: 18 ft	
13.DEPTH DRILLED INTO ROCK: N/A	16.DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 12.0ft, 10 minutes after drilling	
14.TOTAL DEPTH OF HOLE: 19 ft	17.OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A	

18.GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19.TOTAL NUMBER OF CORE BOXES
None	N/A	N/A	N/A

20.SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21.TOTAL CORE RECOVERY %
	water and soil	N/A		TRPH - soil	TPH-JP4 -water	

22.DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23.SIGNATURE OF INSPECTOR
	w/ bentonite	N/A		Luke Darragh

LOCATION SKETCH/COMMENTS — SCALE 1 inch = 300 feet



PROJECT 5155.0027.0007 — HOLE NO. SS61-DP39/MW10

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-DP39/MW10

PROJECT 5155.0027.0007 H2000

INSPECTOR Luke Darragh

SHEET 2 OF 2 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
	2	Grey Clayey SILT with medium Sand and some fine Sand, damp and soft	ND				ML
	4						
	6	Grey Sandy SILT, fine Sand, moist, soft	0.12 ppm				ML
	8	same as above but very moist					ML
	10	Grey Silty CLAY, moist, slight plasticity, some fine Sand, stiff	0.22 ppm		SS61DP39S1001		CL
	12	Brown Silty CLAY, slightly plastic, trace fine to medium Sand, moist, stiff	0.87 ppm				CL
	14						
	16	Brown Silty CLAY, slight plasticity, damp, stiff, trace fine to medium Sand 16-17' color change to grey, odor, stained	494 ppm		SS61DP39S1401		CL
	18	Same as above but wet at 18 ft	454 ppm				CL
		TD = 19.0 ft					

PROJECT 5155.0027.0007 H2000

HOLE NO. SS61-DP39/MW10

ENG FORM 5056A-R, AUG 94

(Proponent: CECW-EG)

HTRW DRILLING LOG

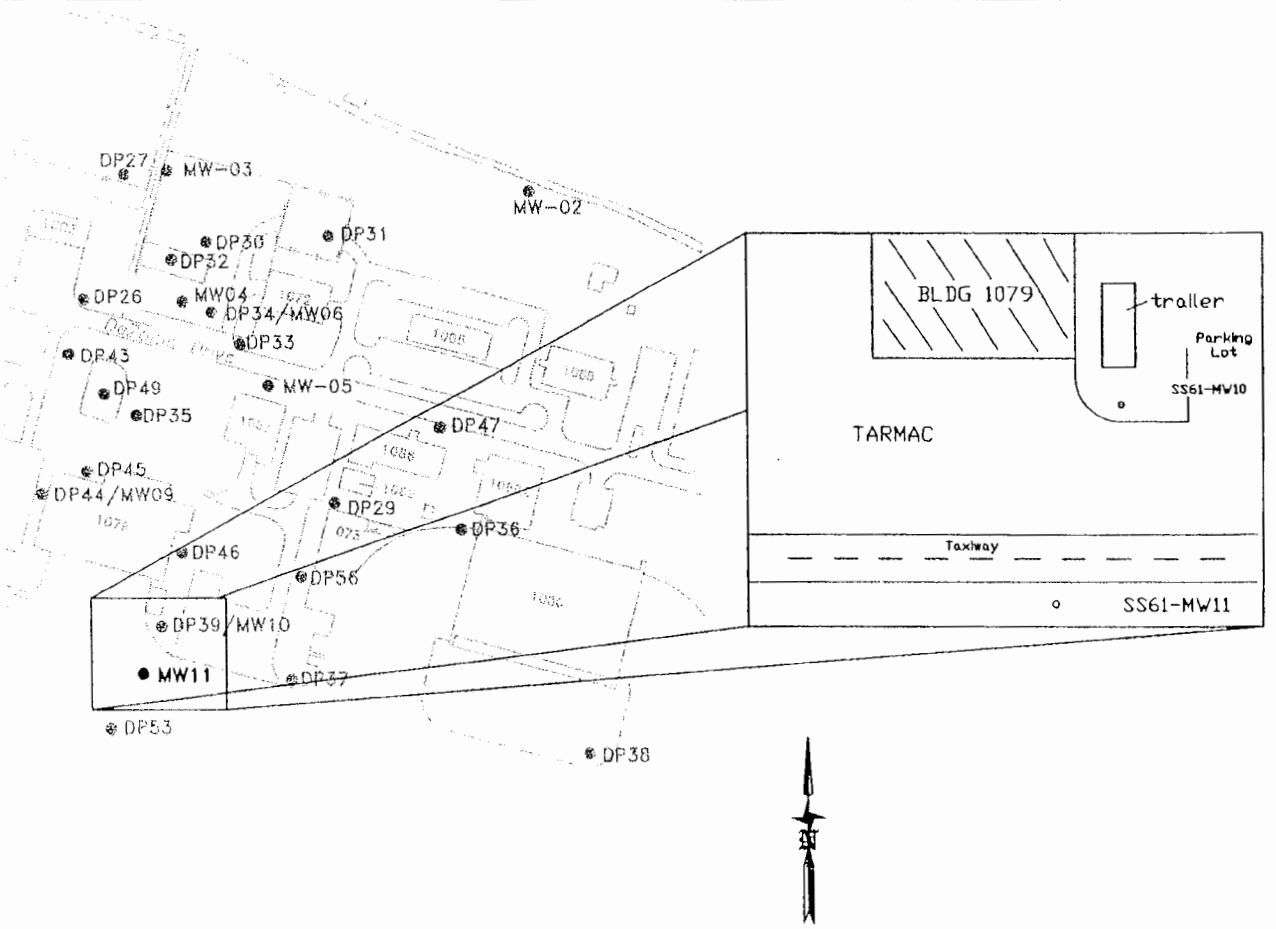
DISTRICT: OMAHA		HOLE NUMBER: SS61-MW11
1. COMPANY NAME: Foster Wheeler Environmental Corp.	2. DRILL SUBCONTRACTOR: Enviro-Drill	SHEET 1 OF 3 SHEETS
3. PROJECT: 5155.0027.0007	4. LOCATION: SS-61, Holloman AFB	
5. NAME OF DRILLER: D. Starnes	6. MANUFACTURER'S DESIGNATION OF DRILL: CME 75 hollow stem auger	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT Rig	8. HOLE LOCATION: SS61-MW11	
	9. SURFACE ELEVATION: N/A	
	10. DATE STARTED: 5/24/00	11. DATE COMPLETED: 5/24/00
12. OVERBURDEN THICKNESS: N/A	15. DEPTH GROUNDWATER ENCOUNTERED: 17.5 ft	
13. DEPTH DRILLED INTO ROCK: N/A	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: N/A	
14. TOTAL DEPTH OF HOLE: 23.0 ft	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None			

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	N/A	N/A	N/A			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		YES, MW-11		Luke Darragh

LOCATION SKETCH/COMMENTS — SCALE 1 inch = 300 feet



PROJECT 5155.0027.0007 — HOLE NO. SS61-MW11

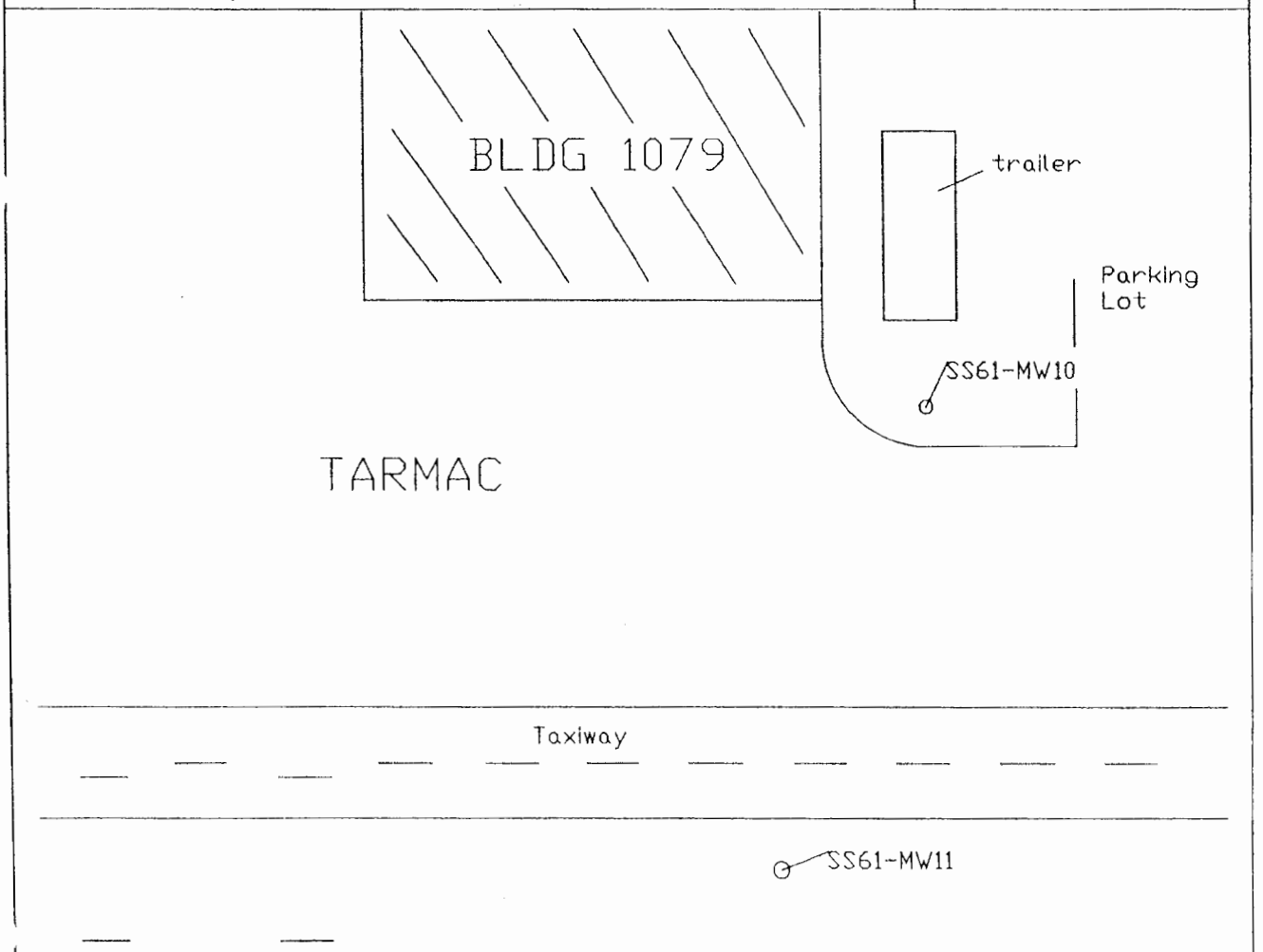
ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG

DISTRICT OMAHA		HOLE NUMBER SS61-MW11
1.COMPANY NAME Foster Wheeler Environmental Corp.	2.DRILL SUBCONTRACTOR Enviro-Drill	SHEET 1 OF SHEETS 3
3.PROJECT 5155.0027.0007 H2000	4.LOCATION SS-61, Holloman AFB	
5.NAME OF DRILLER D. Starnes	6.MANUFACTURER'S DESIGNATION OF DRILL CME 75 hollow stem auger	
7.SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	8.HOLE LOCATION SS61-MW11	
HSA 8 inch O.D. augers	9.SURFACE ELEVATION N/A	
	10.DATE STARTED 5/24/00	11.DATE COMPLETED 5/24/00
12.OVERBURDEN THICKNESS N/A	15.DEPTH GROUNDWATER ENCOUNTERED 17.5 ft	
13.DEPTH DRILLED INTO ROCK N/A	16.DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED N/A	
14.TOTAL DEPTH OF HOLE 23.0 ft	17.OTHER WATER LEVEL MEASUREMENTS (SPECIFY) N/A	

18.GEOTECHNICAL SAMPLES None	DISTURBED N/A	UNDISTURBED N/A	19.TOTAL NUMBER OF CORE BOXES			
20.SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21.TOTAL CORE RECOVERY %
	N/A	N/A	N/A			
22.DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23.SIGNATURE OF INSPECTOR		
		YES, MW-11				

LOCATION SKETCH/COMMENTS | SCALE



PROJECT 5155.0027.0007 H2000 | HOLE NO. SS61-MW11

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-MW11

PROJECT 5155.0027.0007 H2000 | INSPECTOR Jill Jefferson | SHEET 2 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
	2	Brown SILT with some Sand, trace moisture, well graded					SM
	4 6	Light reddish brown CLAY with some silt, moist, moderately plastic, well graded					CL
	8	Light reddish brown CLAY with Silt and fine grained Sand, slightly moist					CL
	10 12	Light brown SILT with some fine grained Sand, slightly moist					SM
	14	Light reddish brown CLAY with some Silt, not plastic, slightly moist					CL
	16	Medium reddish brown CLAY with some SILT, not plastic, slightly moist					CL
	18	Same as above but more dense Water encountered at 17.5 ft					CL

PROJECT 5155.0027.0007 H2000 | HOLE NO. SS61-MW11

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-MW11

PROJECT 5155.0027.0007 H2000

INSPECTOR Jill Jefferson

SHEET 3 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
	22	Same as above but more moist and moderately plastic					CL No visible contamination or odors
	24	Total Depth = 23.0 ft					

PROJECT 5155.0027.0007 H2000

HOLE NO. SS61-MW11

ENG FORM 5056A-R, AUG 94

(Proponent: CECW-EG)

HTRW DRILLING LOG

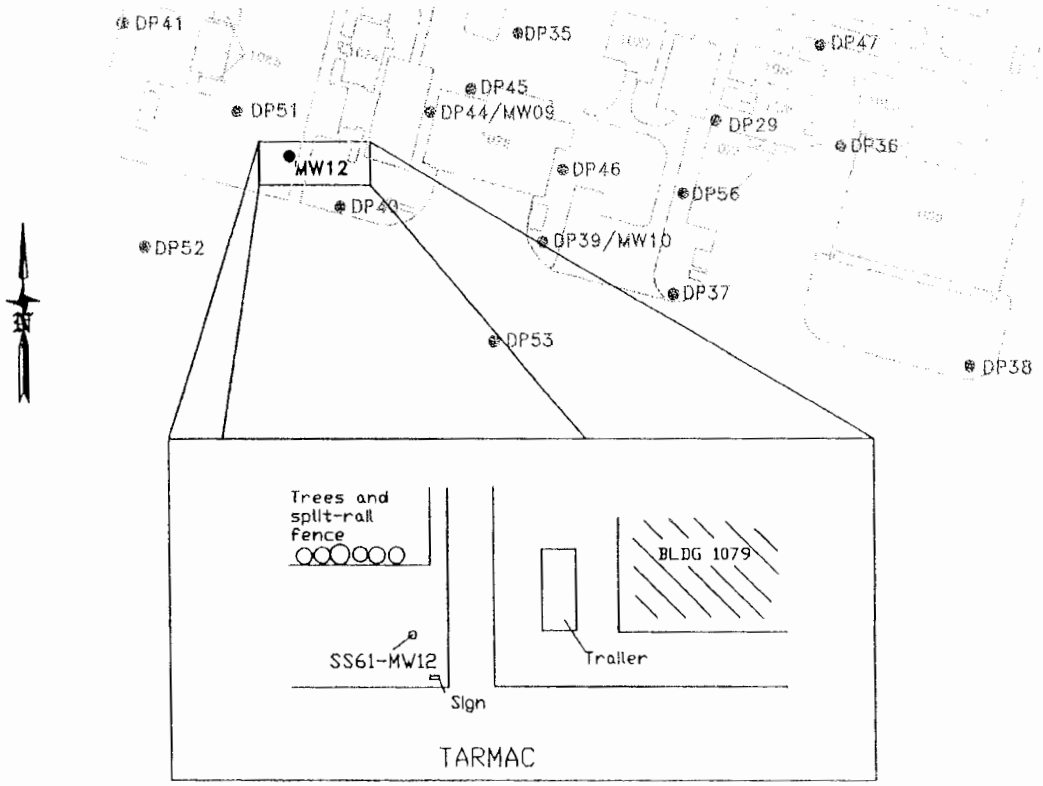
DISTRICT: OMAHA		HOLE NUMBER: SS61-MW12
1. COMPANY NAME: Foster Wheeler Environmental	2. DRILL SUBCONTRACTOR: Enviro-Drill	SHEET 1 OF 3 SHEETS
3. PROJECT: 5155.0027.0007	4. LOCATION: SS-61, Holloman AFB	
5. NAME OF DRILLER: D. Starnes	6. MANUFACTURER'S DESIGNATION OF DRILL: CME 75 hollow stem auger	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: DPT Rig	8. HOLE LOCATION: SS61-MW12	
	9. SURFACE ELEVATION: N/A	
	10. DATE STARTED: 5/23/00	11. DATE COMPLETED: 5/23/00
12. OVERBURDEN THICKNESS: N/A	15. DEPTH GROUNDWATER ENCOUNTERED: 17.5 ft	
13. DEPTH DRILLED INTO ROCK: N/A	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: N/A	
14. TOTAL DEPTH OF HOLE: 23.0 ft	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	N/A	N/A	

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	N/A	N/A	N/A			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		YES, MW-12		Luke Darragh

LOCATION SKETCH/COMMENTS — SCALE 1 inch = 300 feet



PROJECT 5155.0027.0007 — HOLE NO. SS61-MW12

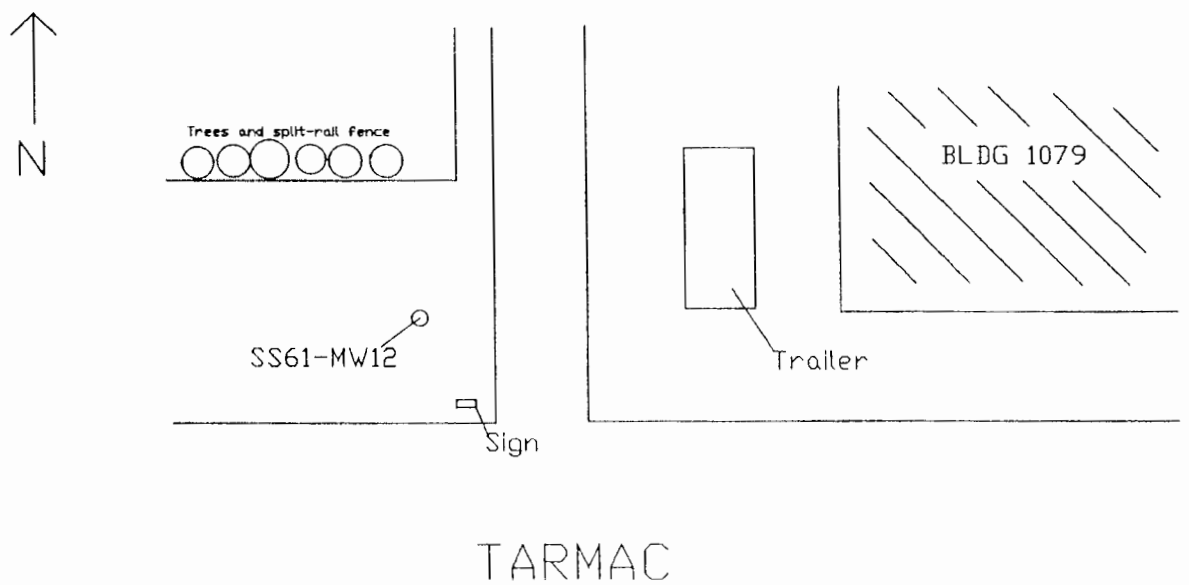
ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG

DISTRICT ☐MAHA		HOLE NUMBER SS61-MW12
1.COMPANY NAME Foster Wheeler Environmental	2.DRILL SUBCONTRACTOR Enviro-Drill	SHEET 1 OF 3 SHEETS
3.PROJECT 5155.0027.0007 H2000	4.LOCATION SS-61, Holloman AFB	
5.NAME OF DRILLER D. Starnes	6.MANUFACTURER'S DESIGNATION OF DRILL CME 75 hollow stem auger	
7.SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	8.HOLE LOCATION SS61-MW12	
HSA 8 inch O.D. augers	9.SURFACE ELEVATION N/A	
	10.DATE STARTED 5/23/00	11.DATE COMPLETED 5/23/00
12.OVERBURDEN THICKNESS N/A	15.DEPTH GROUNDWATER ENCOUNTERED 17.5 ft	
13.DEPTH DRILLED INTO ROCK N/A	16.DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED N/A	
14.TOTAL DEPTH OF HOLE 23.0 ft	17.OTHER WATER LEVEL MEASUREMENTS (SPECIFY) N/A	

18.GEOTECHNICAL SAMPLES None	DISTURBED N/A	UNDISTURBED N/A	19.TOTAL NUMBER OF CORE BOXES			
20.SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21.TOTAL CORE RECOVERY %
	N/A	N/A	N/A			
22.DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23.SIGNATURE OF INSPECTOR		
		YES, MW-12				

LOCATION SKETCH/COMMENTS | SCALE



PROJECT 5155.0027.0007 H2000	HOLE NO. SS61-MW12

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-MW12

PROJECT 5155.0027.0007 H2000 | INSPECTOR Jill Jefferson | SHEET 2 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
		Dark brown fill material with some Clay, moderately plastic, trace moisture					
	2	Light brown SILT with some Clay, no plasticity or cementation, trace moisture					ML
	4	Same as above but color change to light reddish brown					ML
	6	Light reddish brown fine grained SAND with some Silt, trace moisture, no cementation, well graded					SM
	8	Light reddish brown SILT with some Clay and caliche, trace moisture, no plasticity, well graded					ML
	10	Light reddish brown CLAY with trace of Silt, moderately plastic, slightly moist					CL
	12	Medium reddish brown CLAY with trace of Silt, moist, moderately plastic					CL
	14	Same as above but more moist and contains caliche nodules Groundwater encountered at 17.5 ft					CL
	16						
	18						

PROJECT 5155.0027.0007 H2000 | HOLE NO. SS61-MW12

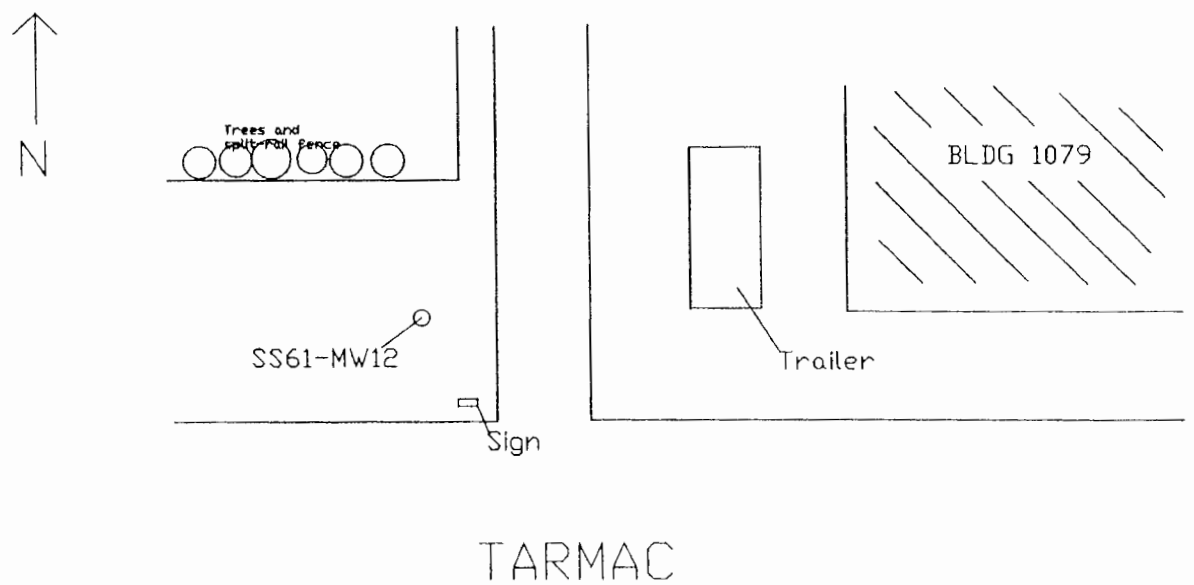
ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG

DISTRICT ☐MAHA		HOLE NUMBER SS61-MW12
1.COMPANY NAME Foster Wheeler Environmental	2.DRILL SUBCONTRACTOR Enviro-Drill	SHEET 1 OF SHEETS 3
3.PROJECT 5155.0027.0007 H2000	4.LOCATION SS-61, Holloman AFB	
5.NAME OF DRILLER D. Starnes	6.MANUFACTURER'S DESIGNATION OF DRILL CME 75 hollow stem auger	
7.SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	8.HOLE LOCATION SS61-MW12	
HSA 8 inch O.D. augers	9.SURFACE ELEVATION N/A	
	10.DATE STARTED 5/23/00	11.DATE COMPLETED 5/23/00
12.OVERBURDEN THICKNESS N/A	15.DEPTH GROUNDWATER ENCOUNTERED 17.5 ft	
13.DEPTH DRILLED INTO ROCK N/A	16.DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14.TOTAL DEPTH OF HOLE 23.0 ft	17.OTHER WATER LEVEL MEASUREMENTS (SPECIFY) N/A	

18.GEOTECHNICAL SAMPLES	DISTURBED N/A	UNDISTURBED N/A	19.TOTAL NUMBER OF CORE BOXES			
20.SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21.TOLAL CORE RECOVERY %
	N/A	N/A	N/A			
22.DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23.SIGNATURE OF INSPECTOR		
		YES, MW-12				

LOCATION SKETCH/COMMENTS | SCALE



PROJECT 5155.0027.0007 H2000 | HOLE NO. SS61-MW12

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER SS61-MW12

PROJECT 5155.0027.0007 H2000

INSPECTOR Jill Jefferson

SHEET 3 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
	22	Same as above					CL No visible contamination or odors
	24	Total Depth = 23.0 ft					

PROJECT 5155.0027.0007 H2000

HOLE NO. SS61-MW12

ENG FORM 5056A-R, AUG 94

(Proponent: CECW-EG)

Appendix A-4

Monitored Natural Attenuation Report for SS-61 (AOC-1001), Holloman Air Force Base, New Mexico, **Bhate Environmental Associates, Inc., June 2005.**

MONITORED NATURAL ATTENUATION REPORT FOR SS-61 (AOC 1001) HOLLOMAN AIR FORCE BASE, NEW MEXICO

Prepared for:

49 CES/CEV
Holloman Air Force Base
New Mexico

Under Contract To:

U.S. Army Corps of Engineers
Omaha, Nebraska
Under Contract No. DACA45-02-D-0012
Delivery Order No. 05, WAD 05

Prepared by:

Bhate Environmental Associates, Inc.
1608 13th Avenue South, Suite 300
Birmingham, Alabama 35205

Bhate Project No. 9030024.05.05.01

June 2005

Table 2
Groundwater Elevations
Monitored Natural Attenuation Report for SS-61
Holloman AFB, New Mexico

Monitoring Well	Top of Casing Elevation (ft amsl)	Depth to Water from TOC (ft)					
		April 1999	May 2000	April 2004	June 2004	September 2004	January 2005
SS61-MW01	4,110.06	30.52	30.98	31.42	31.40	31.48	31.10
SS61-MW03	4,098.41	19.12	19.11	19.98	20.00	19.82	18.76
SS61-MW04	4,095.41	19.10	15.39	15.92	16.18	15.80	14.23
SS61-MW06	4,096.32	16.10	15.81	17.12	17.25	16.70	15.57
SS61-MW08	4,093.94	--	15.33	15.14	16.02	14.78	14.27

Monitoring Well	Top of Casing Elevation (ft amsl)	Groundwater Elevation (ft amsl)					
		April 1999	May 2000	April 2004	June 2004	September 2004	January 2005
SS61-MW01	4,110.06	4079.54	4,079.08	4,078.64	4,078.66	4,078.58	4,078.96
SS61-MW03	4,098.41	4079.29	4,079.30	4,078.43	4,078.41	4,078.59	4,079.65
SS61-MW04	4,095.41	4076.31	4,080.02	4,079.49	4,079.23	4,079.61	4,081.18
SS61-MW06	4,096.32	4080.22	4,080.51	4,079.20	4,079.07	4,079.62	4,080.75
SS61-MW08	4,093.94	--	4,078.61	4,078.80	4,077.92	4,079.16	4,079.67

Notes:
amsl = Above mean sea level
ft = Feet
TOC = Top of casing
-- Not installed in 1999.

Table 3
Analytical Summary of Volatile Organic Compounds
Monitored Natural Attenuation Report for SS-61 (AOC-1001)
Holloman AFB, New Mexico
Bhate Proj. No.: 9030024

Well ID	Units	NMWQCC	SS61-MW01							SS61-MW01-a	SS61-MW03			
Sample Date		≤10,000 mg/L TDS	June 1996	April 1999	May 2000	April 2004	June 2004	September 2004	December 2004	April 2004	June 1996	April 1999	May 2000	April 2004
VOCs (8260B)														
1,2-Dibromomethane (EDB)	µg/L	0.1	NS	ND	ND	ND	ND	ND	ND	ND	NS	ND	18 J	ND
1,2-Dichlorobenzene	µg/L	NE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	160 J	ND
1,2-Dichloroethane	µg/L	10	ND	ND	ND	ND	ND	ND	ND	ND	940	ND	ND	ND
1,2-Dichloropropane	µg/L	NE	ND	NS	NS	ND	ND	ND	ND	ND	1.6	NS	NS	ND
1,2,4-Trimethylbenzene	µg/L	NE	NS	ND	NS	ND	ND	ND	ND	ND	NS	ND	NS	ND
1,3,5-Trimethylbenzene	µg/L	NE	NS	ND	NS	ND	ND	ND	ND	ND	NS	ND	NS	ND
2-Hexanone	µg/L	NE	NS	NS	ND	ND	ND	ND	ND	ND	NS	NS	ND	ND
Benzene	µg/L	10	ND	ND	ND	ND	ND	ND	ND	ND	11,000	8,200	7,300 J	7,180
Bromoform	µg/L	NE	ND	NS	NS	ND	ND	ND	ND	ND	1.6	NS	NS	ND
Chloroethane	µg/L	NE	ND	NS	NS	ND	ND	ND	ND	ND	5.4	NS	NS	ND
Chloroform	µg/L	100	ND	ND	ND	ND	ND	ND	ND	ND	3.6	ND	ND	ND
Dibromomethane	µg/L	NE	ND	NS	NS	ND	ND	ND	ND	ND	6.8	NS	NS	ND
Ethylbenzene	µg/L	750	ND	ND	ND	ND	ND	ND	ND	ND	65	ND	22 J	ND
Isopropylbenzene (Cumene)	µg/L	NE	NS	ND	NS	ND	ND	ND	ND	ND	NS	ND	NS	194 J
n-Propylbenzene	µg/L	NE	NS	ND	NS	ND	ND	ND	ND	ND	NS	ND	NS	ND
sec-Butyl benzene	µg/L	NE	NS	ND	ND	ND	ND	ND	ND	ND	NS	ND	ND	ND
tert-Butyl benzene	µg/L	NE	NS	ND	ND	ND	ND	ND	ND	ND	NS	ND	ND	ND
uene	µg/L	750	ND	ND	NS	ND	ND	ND	ND	ND	NS	900	NS	734
o-Xylene	µg/L	NE	NS	ND	NS	ND	NR	ND	NR	ND	NS	770	NS	NR
m,p-Xylene	µg/L	NE	NS	ND	NS	ND	NR	ND	NR	ND	NS	1,200	NS	NR
Total xylenes	µg/L	620	ND	NS	NS	ND	ND	ND	ND	ND	NS	NS	NS	1,870
TPH (JP-4)	µg/L	NE	ND	NS	ND	ND	ND	ND	ND	ND	NS	NS	1,400 J	ND

Notes:
NMWQCC - New Mexico Water Quality Control Commission
µg/L - Microgram per liter
VOCs - Volatile Organic compounds
EDB - Ethylene dibromide
mg/L - Milligrams per liter
NS - Not Sampled
ND - Not Detected
TPH - Total petroleum hydrocarbons
J - Analyte detected, but concentration is estimated
TDS - Total dissolved solids

TDS concentration not known
TDS concentration >10,000 mg/L
TDS concentration <10,000 mg/L

NE - No established standard
NR - Not reported

Groundwater quality standards are for waters with a TDS concentration less than 10,000 mg/L. Bold represents exceedances of NMWQCC standards in samples from wells with less than 10,000 mg/L TDS.

Table 3
Analytical Summary of Volatile Organic Compounds
Monitored Natural Attenuation Report for SS-61 (AOC-1001)
Holloman AFB, New Mexico
Bhate Proj. No.: 9030024

Well ID	Units	NMWQCC ≤10,000 mg/L TDS	May-00			SS61-MW04							SS61-MW04-a	
Sample Date			June 2004	September 2004	January 2005	June 1996	April 1999	May 2000	April 2004	June 2004	September 2004	January 2005	June 1996	June 2004
VOCs (8260B)														
1,2-Dibromomethane (EDB)	µg/L	0.1	ND	ND	ND	NS	ND	ND	ND	ND	ND	ND	NS	ND
1,2-Dichlorobenzene	µg/L	NE	ND	ND	ND	ND	ND	49 J	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	µg/L	10	395 J	477	602	3.8	ND	ND	1.1 J	1.4 J	1.1 J	ND	3.4	1.2 J
1,2-Dichloropropane	µg/L	NE	ND	ND	ND	NS	NS	NS	ND	ND	ND	ND	NS	ND
1,2,4-Trimethylbenzene	µg/L	NE	212 J	267	274 J	NS	24	NS	ND	ND	ND	ND	NS	ND
1,3,5-Trimethylbenzene	µg/L	NE	101 J	150 J	152 J	NS	12	NS	ND	ND	ND	ND	NS	ND
2-Hexanone	µg/L	NE	ND	ND	ND	NS	NS	16 J	ND	ND	ND	ND	NS	ND
Benzene	µg/L	10	10,600	12,600	16,900	2.9	ND	1,100 J	ND	ND	1.5	ND	2.2	ND
Bromoform	µg/L	NE	ND	ND	ND	ND	NS	NS	ND	ND	ND	ND	ND	ND
Chloroethane	µg/L	NE	ND	ND	ND	ND	NS	NS	ND	ND	ND	ND	ND	ND
Chloroform	µg/L	100	ND	ND	ND	0.52	ND	ND	ND	ND	ND	ND	0.29	ND
Dibromomethane	µg/L	NE	ND	ND	ND	ND	NS	NS	ND	ND	ND	ND	ND	ND
Ethylbenzene	µg/L	750	231 J	295	309 J	0.53	ND	5.5 J	ND	ND	ND	ND	ND	ND
Isopropylbenzene (Cumene)	µg/L	NE	354 J	393	426 J	NS	94	ND	ND	1 J	ND	ND	NS	1 J
n-Propylbenzene	µg/L	NE	ND	ND	ND	NS	ND	ND	ND	ND	ND	ND	NS	ND
sec-Butyl benzene	µg/L	NE	ND	ND	ND	NS	ND	10 J	ND	ND	ND	ND	NS	ND
tert-Butyl benzene	µg/L	NE	ND	ND	ND	NS	ND	5.7 J	ND	ND	ND	ND	NS	ND
uene	µg/L	750	1,950	3,460	4,060	NS	ND	NS	ND	ND	ND	ND	NS	ND
o-Xylene	µg/L	NE	NR	NR	NR	NS	5	NS	ND	ND	ND	NR	NS	ND
m,p-Xylene	µg/L	NE	NR	NR	NR	NS	13	NS	ND	ND	ND	NR	NS	ND
Total xylenes	µg/L	620	3,050	4,150	4,370	NS	NS	NS	ND	ND	ND	ND	NS	ND
TPH (JP-4)	µg/L	NE	ND	NA	NA	NS	NS	650	ND	ND	ND	ND	NS	ND

Notes:
NMWQCC - New Mexico Water Quality Control Commission
µg/L - Microgram per liter
VOCs - Volatile Organic compounds
EDB - Ethylene dibromide
mg/L - Milligrams per liter
NS - Not Sampled
ND - Not Detected
TPH - Total petroleum hydrocarbons
J - Analyte detected, but concentration is estimated
TDS - Total dissolved solids

TDS concentration not known

TDS concentration >10,000 mg/L

TDS concentration <10,000 mg/L

NE - No established standard
NR - Not reported

Groundwater quality standards are for waters with a TDS concentration less than 10,000 mg/L. Bold represents exceedances of NMWQCC standards in samples from wells with less than 10,000 mg/L TDS.

Table 3
Analytical Summary of Volatile Organic Compounds
Monitored Natural Attenuation Report for SS-61 (AOC-1001)
Holloman AFB, New Mexico
Bhate Proj. No.: 9030024

Well ID	Units	NMWQCC ≤10,000 mg/L TDS	SS61-MW06						SS61-MW08					SS61-MW08-a
Sample Date			April 1999	May 2000	April 2004	June 2004	September 2004	January 2005	May 2000	April 2004	June 2004	September 2004	January 2005	September 2004
VOCs (8260B)														
1,2-Dibromomethane (EDB)	µg/L	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	µg/L	NE	ND	NS	ND	ND	ND	ND	NS	ND	ND	ND	ND	ND
1,2-Dichloroethane	µg/L	10	ND	ND	ND	61	ND	8.5	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	µg/L	NE	NS	NS	ND	ND	ND	ND	NS	ND	ND	ND	ND	ND
1,2,4-Trimethylbenzene	µg/L	NE	1,400	NS	ND	76	ND	5.4	NS	ND	ND	ND	ND	ND
1,3,5-Trimethylbenzene	µg/L	NE	NS	NS	ND	ND	ND	ND	NS	ND	ND	ND	ND	ND
2-Hexanone	µg/L	NE	NS	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	µg/L	10	14,000	13,000 J	5,980	4,640	11,200	802	3.3	ND	**282**	**100**	ND	**105**
Bromoform	µg/L	NE	NS	NS	ND	ND	ND	ND	NS	ND	ND	ND	ND	ND
Chloroethane	µg/L	NE	NS	NS	ND	ND	ND	ND	NS	ND	ND	ND	ND	ND
Chloroform	µg/L	100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibromomethane	µg/L	NE	NS	NS	ND	ND	ND	ND	NS	ND	ND	ND	ND	ND
Ethylbenzene	µg/L	750	1,300	720 J	347	210	464	4.9 J	ND	ND	ND	ND	ND	ND
Isopropylbenzene (Cumene)	µg/L	NE	2,600	ND	1,260	1,330	1,670	352	ND	ND	15 J	5.2	ND	5.9
n-Propylbenzene	µg/L	NE	ND	ND	ND	11 J	ND	1.3 J	ND	ND	ND	ND	ND	ND
sec-Butyl benzene	µg/L	NE	ND	14 J	ND	ND	ND	4.7 J	ND	ND	ND	ND	ND	ND
tert-Butyl benzene	µg/L	NE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
uene	µg/L	750	6,800	NS	ND	22 J	ND	9.8	NS	ND	ND	ND	ND	ND
o-Xylene	µg/L	NE	3,300	NS	NR	NR	NR	NR	NS	ND	NR	NR	NR	ND
m,p-Xylene	µg/L	NE	7,800	NS	NR	NR	NR	NR	NS	ND	NR	NR	NR	ND
Total xylenes	µg/L	620	NS	NS	28 J	188	180 J	16	NS	ND	ND	ND	ND	ND
TPH (JP-4)	µg/L	NE	NS	2,500 J	ND	ND	NS	NS	ND	ND	ND	ND	ND	ND

Notes:
NMWQCC - New Mexico Water Quality Control Commission
µg/L - Microgram per liter
VOCs - Volatile Organic compounds
EDB - Ethylene dibromide
mg/L - Milligrams per liter
NS - Not Sampled
ND - Not Detected
TPH - Total petroleum hydrocarbons
J - Analyte detected, but concentration is estimated
TDS - Total dissolved solids

TDS concentration not known
TDS concentration >10,000 mg/L
TDS concentration <10,000 mg/L

NE - No established standard
NR - Not reported

Groundwater quality standards are for waters with a TDS concentration less than 10,000 mg/L. Bold represents exceedances of NMWQCC standards in samples from wells with less than 10,000 mg/L TDS.

Table 4
Natural Attenuation and Field Parameters
Monitored Natural Attemuation Report for SS-61 (AOC 1001)
Holloman AFB, New Mexico

Well ID	Units	NMWQCC (≤10,000 mg/L TDS)	SS61-MW01					SS61-MW03				SS61-MW04		
Date Sampled			4/13/2004	4/13/2004 D	6/8/2004	9/2/2004	12/28/2004	4/14/2004	6/9/2004	9/1/2004	1/10/2005	4/12/2004	6/11/2004	6/11/2004 D
Relative Location			Upgradient					Plume				Plume		
Natural Attenuation Parameters														
Chloride (300.0)	mg/L	250	7,630	7,580	7,770	7,520	7,890	7,610	9,280	9,510	8,920	**1,460**	**1,640**	1,680
Nitrate/Nitrite -N (300.0)	mg/L	10	NR	NR	NR	16.3	17.2	NR	ND	ND	ND	NR	NR	NR
Nitrate (300.0)	mg/L	10	79.5	76.0	80.8	NR	NR	ND	NR	NR	NR	**137**	**103**	106
Nitrite (300.0)	mg/L	NE	ND	ND	ND	NR	NR	ND	NR	NR	NR	ND	ND	ND
Sulfate (300.0)	mg/L	600	2,650	2,610	2,640	2,470	2,620	5,550	5,280	6,060	5,700	**4,430**	**4,850**	4,930
Alkalinity (310.1)														
as Calcium Carbonate	mg/L	NE	100	100	103	105	103	888	750	777	910	160	173	180
as Bicarbonate	mg/L	NE	122	122	125	128	125	1,080	915	949	1,110	195	210	220
as Carbonate	mg/L	NE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
as Hydroxide	mg/L	NE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TOC (415.1)	mg/L	NE	1.2	1.3	1.1	1.0	0.8	27	27	23	28	4.3	4.0	4.2
TDS (160.1)	mg/L	1,000	16,000	17,100	17,500	17,300	18,400	22,800	25,100	28,100	25,600	**9,670**	**9,740**	10,900
Ethane (RSK-175)	mg/L	NE	ND	ND	ND	ND	ND	0.013	ND	0.014	0.026	ND	ND	ND
Ethene (RSK-175)	mg/L	NE	ND	ND	ND	ND	ND	0.005	ND	0.006	0.011	ND	ND	ND
Methane (RSK-175)	mg/L	NE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Field Parameters														
Temperature	°C	NE	18.25		20.66	19.36	18.87	21.21	21.52	21.29	20.83	19.68	20.79	
pH	SU	6-9	6.61		13.39	6.82	6.49	6.31	6.38	6.19	5.64	7.11	7.41	
DO	mg/L	NE	7.17		5.53	5.43	5.33	5.51	0.15	5.28	1.50	5.57	3.04	
ORP	mV	NE	219.3		155	NM	110	-5.2	-34	NM	59	133.9	49	
Turbidity	NTU	NE	NM		NM	NM	NM	NM	NM	NM	NM	NM	NM	
Conductivity	mS/cm	NE	10.39		21.99	22.77	20.61	26.51	27.979	28.61	26.71	9.905	10.301	
Ferrous iron	mg/L	1.0	NM		0.5	0.01	ND	NM	0.62	0.18	0.5	NM	0.02	

Notes:
NMWQCC apply if TDS less than 10,000 mg/L.
Bold are exceedances when TDS less than 10,000 mg/L.

DO - dissolved oxygen
ORP - oxidation reduction potential
TDS - total dissolved solids
mg/L - milligrams per liter
NM - not measured
NE - Not established
D - Duplicate
NA - Not analyzed

°C - degrees Celsius
SU - standard units
mV - millivolts
mS/cm - millisiemens per centimeter
NR - not reported
NTU - nephelometric turbidity unit
ND - Not Detected
DO value in mg/L calculated from percent DO

Table 4
Natural Attenuation and Field Parameters
Monitored Natural Attenuation Report for SS-61 (AOC 1001)
Holloman AFB, New Mexico

Well ID	Units	NMWQCC (≤10,000 mg/L TDS)	SS61-MW04		SS61-MW06				SS61-MW08				
Date Sampled			9/2/2004	1/20/2005	4/6/2004	6/11/2004	9/3/2004	1/11/2005	4/12/2004	6/9/2004	9/3/2004	9/3/2004 D	1/21/2005
Relative Location			Plume		Plume				Downgradient				
Natural Attenuation Parameters													
Chloride (300.0)	mg/L	250	**1,280**	**633**	4,320	4,370	4,470	4,400	70.5	**447**	**304.0**	**287.0**	85
Nitrate/Nitrite -N (300.0)	mg/L	10	**20.2**	**10.6**	ND	NR	ND	20.7	NR	1.0	2.6	2.4	3.6
Nitrate (300.0)	mg/L	10	NR	NR	NR	16	NR	NR	**14.6**	NR	NR	NR	NR
Nitrite (300.0)	mg/L	NE	NR	NR	NR	ND	NR	NR	ND	NR	NR	NR	NR
Sulfate (300.0)	mg/L	600	**4,380**	**3,930**	6,270	6,490	6,300	5,890	**1,720**	**2,820**	**2,400**	**2,390**	**1,770**
Alkalinity (310.1)													
as Calcium Carbonate	mg/L	NE	167	143	1,140	883	1,300	450	98	437	303	285	133
as Bicarbonate	mg/L	NE	204	174	1,390	1,080	1,590	549	119	534	369	348	162
as Carbonate	mg/L	NE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
as Hydroxide	mg/L	NE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TOC (415.1)	mg/L	NE	3.4	2.9	16	16	19	8.8	1.6	3.7	2.7	2.7	1.5
TDS (160.1)	mg/L	1,000	**9,520**	**7,050**	17,200	16,700	18,100	18,700	**3,090**	**4,830**	**4,400**	**4,390**	**3,020**
Ethane (RSK-175)	mg/L	NE	ND	ND	0.022	0.041	0.030	0.012	ND	0.052	0.006	ND	ND
Ethene (RSK-175)	mg/L	NE	ND	ND	ND	ND	ND	ND	ND	ND	0.008	ND	ND
Methane (RSK-175)	mg/L	NE	ND	ND	0.042	0.023	0.062	0.037	ND	ND	0.020	0.016	ND
Field Parameters													
Temperature	°C	NE	21.47	18.17	22.17	20.79	22.45	19.43	19.75	21.77	21.85		18.23
pH	SU	6-9	7.03	6.83	6.33	6.62	6.27	6.22	7.01	6.64	6.67		6.62
DO	mg/L	NE	4.63	2.24	2.67	0.2	8.17	0.9	6.21	2.18	4.67		4.00
ORP	mV	NE	NM	117	-207.2	-220.0	NM	29.0	175.3	-188	NM		46
Turbidity	NTU	NE	NM	NM	NM	NM	NM	NM	NM	NM	NM		NM
Conductivity	mS/cm	NE	10.32	6.987	9.882	19.379	11.55	18.010	2.625	5.366	3.137		2.591
Ferrous iron	mg/L	1.0	0.25	ND	NM	0.45	1.19	0.19	NM	0.29	1.19		0.97

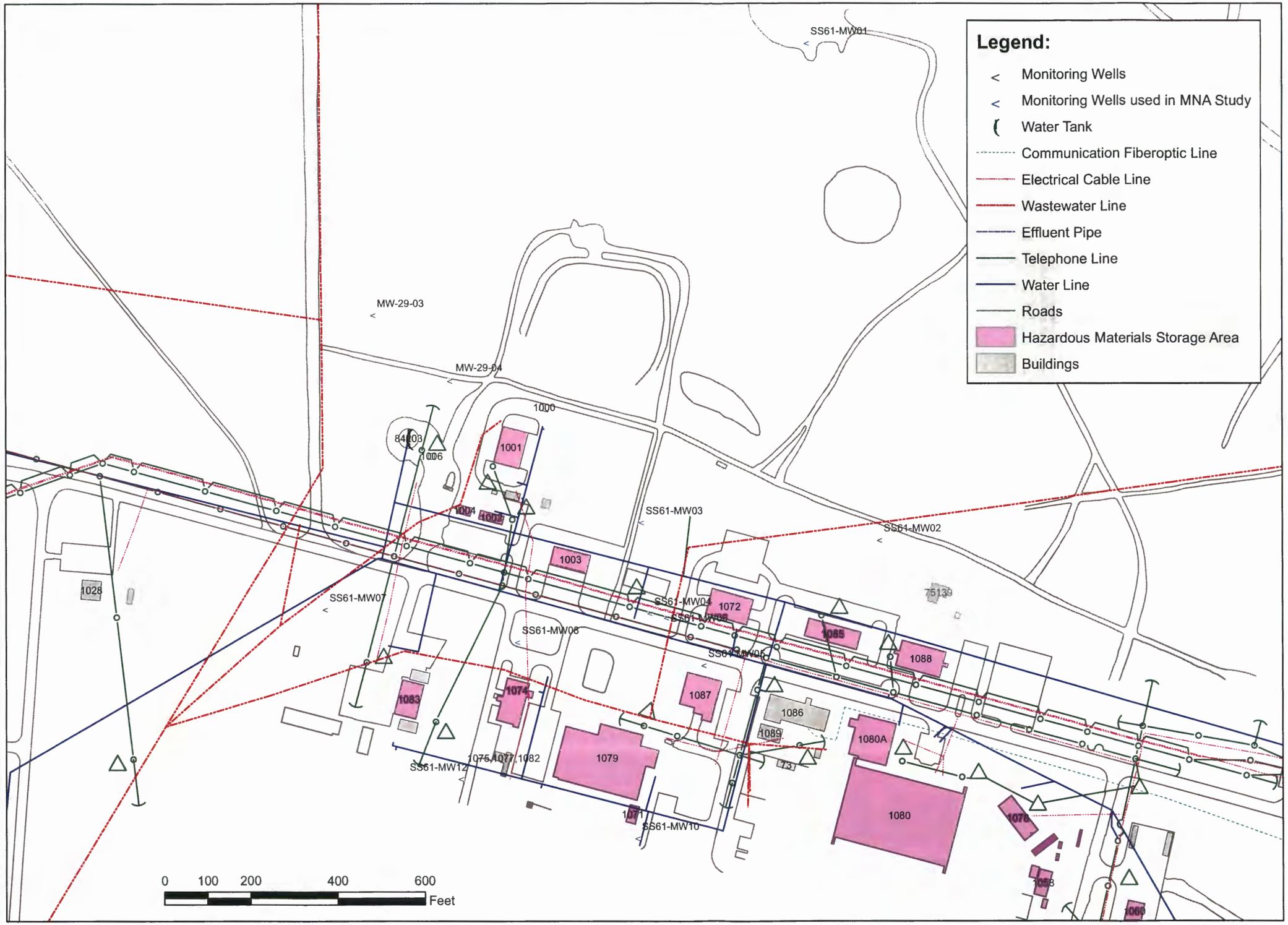
Notes:
NMWQCC apply if TDS less than 10,000 mg/L.
Bold are exceedances when TDS less than 10,000 mg/L.

DO - dissolved oxygen
ORP - oxidation reduction potential
TDS - total dissolved solids
mg/L - milligrams per liter
NM - not measured
NE - Not established
D - Duplicate
NA - Not analyzed

°C - degrees Celsius
SU - standard units
mV - millivolts
mS/cm - millisiemens per centimeter
NR - not reported
NTU - nephelometric turbidity unit
ND - Not Detected
DO value in mg/L calculated from percent DO

Weekly Monitoring of MW-03 at SS-61

DATE	TIME	INSTRUMENT	IP Detect Y/N	Visual Y/N	ODOR	DTW	INITIALS	IP Serial #	Comments
4/29/2004	900	Heron 100' IP	N	N	Slight	19.76'	KDG	01-1494	Rain event 4/10/04
5/3/2004	1130	Heron 100' IP	N	N	Slight	19.75'	GP	01-1494	
5/12/2004	730	Heron 100' IP	N	N	Slight	19.77'	JT	01-1494	
5/18/2004	1345	Heron 100' IP	N	N	Slight	19.81'	KDG	01-1494	
5/26/2004	1015	Heron 100' IP	N	N	Slight	19.83'	GP	01-1494	
6/3/2004	800	Heron 100' IP	N	N	Slight	19.83'	KDG	01-1494	
6/9/2004	1400	Heron 100' IP	N	N	Slight	20.00'	JT	01-1494	
6/15/2004	830	Heron 100' IP	N	N	Slight	19.98'	GP	01-1494	
6/23/2004	1200	Heron 100' IP	N	N	Slight	20.14'	GP	01-1494	Rain event 6/19/04
6/28/2004	1330	Heron 100' IP	N	N	Slight	20.14'	GP	01-1494	Rain event 6/24/04
7/9/2004	930	Heron 100' IP	N	N	Slight	20.11'	KDG	01-1494	Rain event 7/9 - 7/10/04
7/12/2004	1030	Heron 100' IP	N	N	Slight	20.11'	DT	01-1494	



MONITORED NATURAL ATTENUATION REPORT
SPILL SITE 61
U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

HOLLOMAN AIR FORCE BASE, NEW MEXICO

Figure 2

SITE PLAN WITH MONITORING WELL AND UTILITY LOCATIONS

DRAWN BY: CM/MRM

Figure 2

PROJECT	SCALE	DATE
9030024	AS SHOWN	6/01/05

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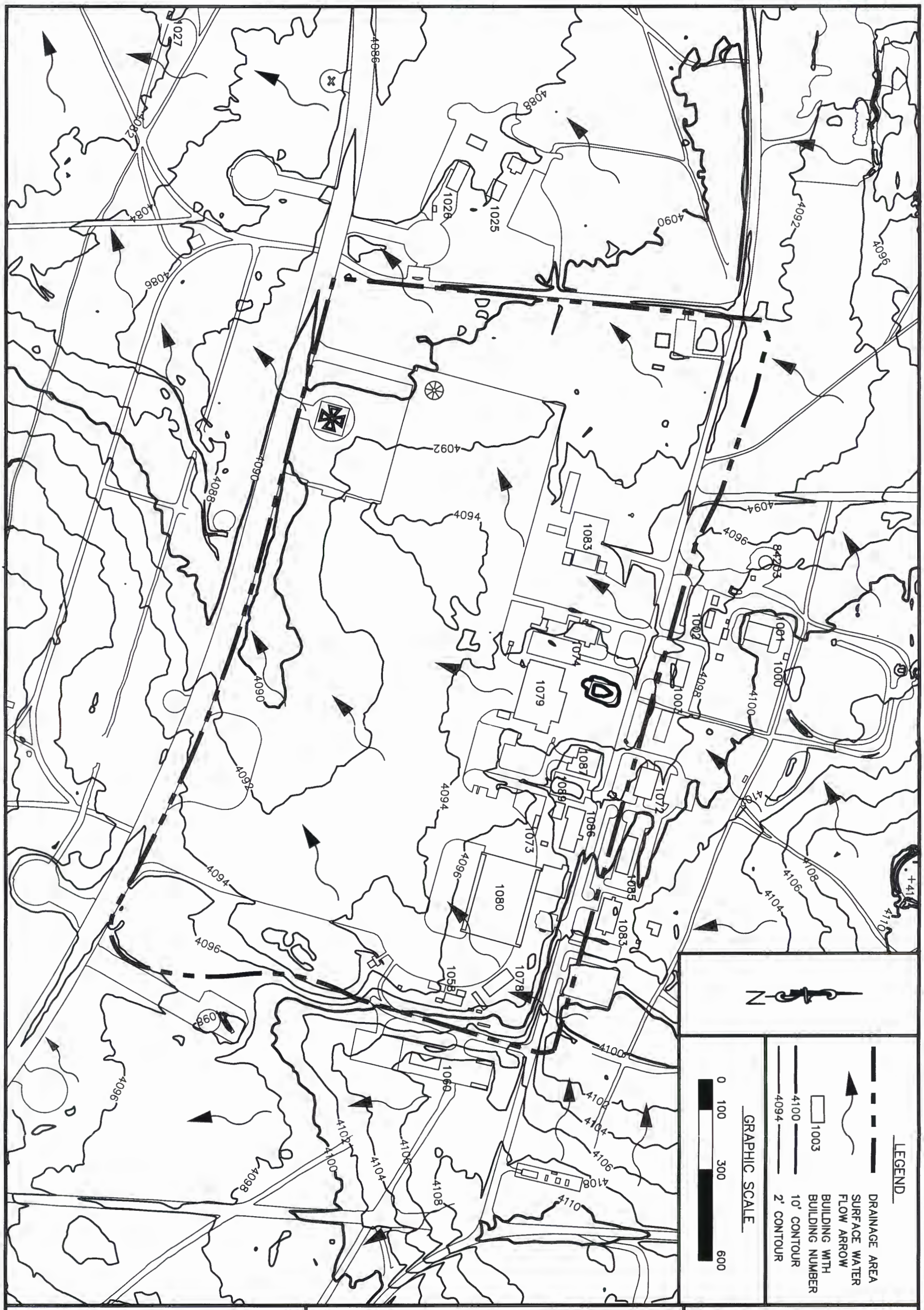

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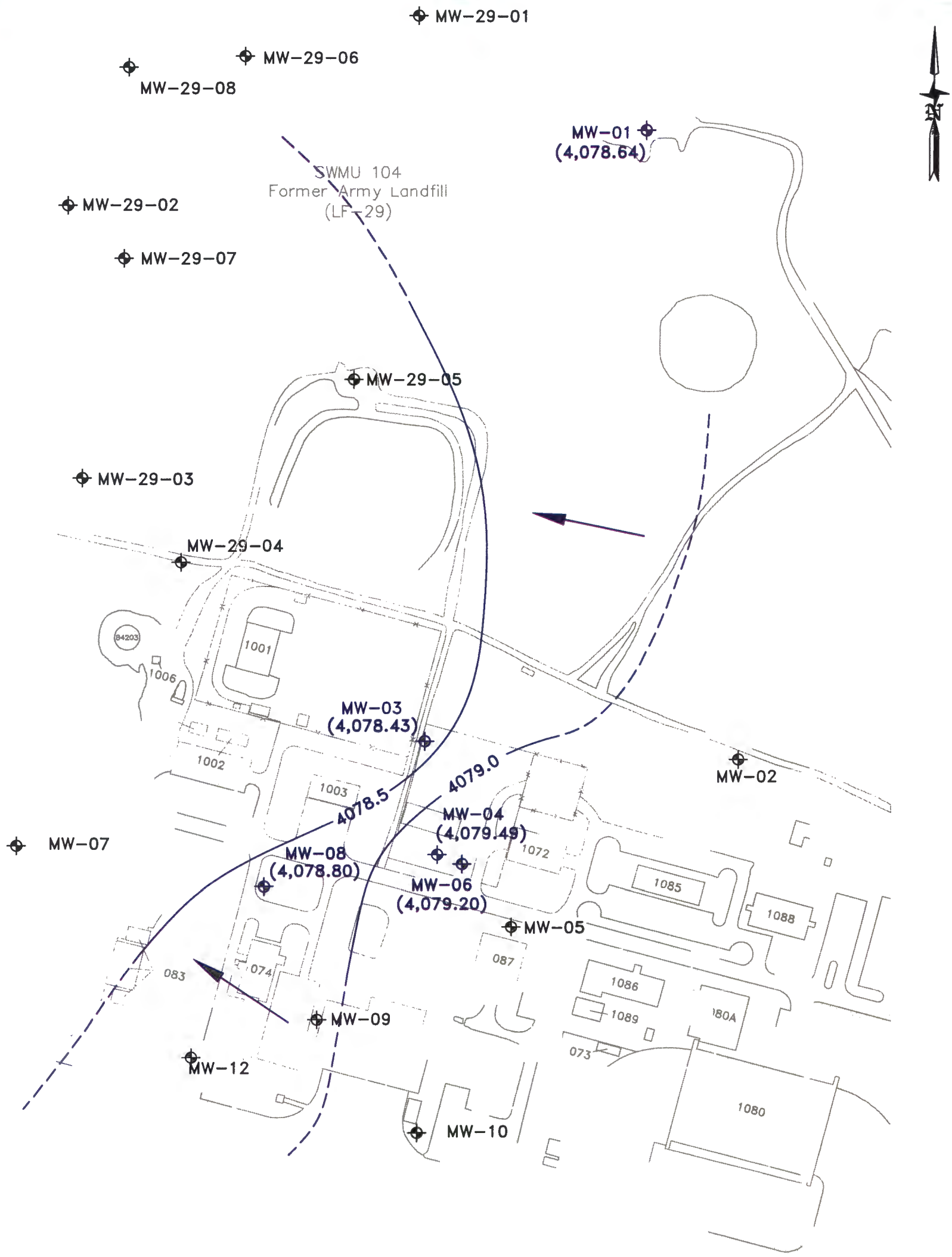
TOPOGRAPHIC MAP

PROJECT NO.	SCALE	DATE	DRAWN BY: SKN
9030024	1"=300'	5/27/05	DRAWING NO: DA_12

MONITORED NATURAL ATTENUATION REPORT
SPILL SITE 61
U.S. ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

HOLLOMAN AFB, NEW MEXICO

SHEET NO: FIGURE 4



LEGEND

- Monitoring Wells
- Monitoring Wells in MNA Sampling
- (4,079.20) Groundwater Surface Elevation
- —4,079.0— Groundwater Contour Elevation (Dashed Where Inferred)
- Groundwater Flow Direction

0 100 200 400
SCALE IN FEET

NOTES:

Drawing was taken from Foster Wheeler Environmental Corporation drawing entitled, "Extent of Groundwater Contamination During the RI", dated September 17, 2000.

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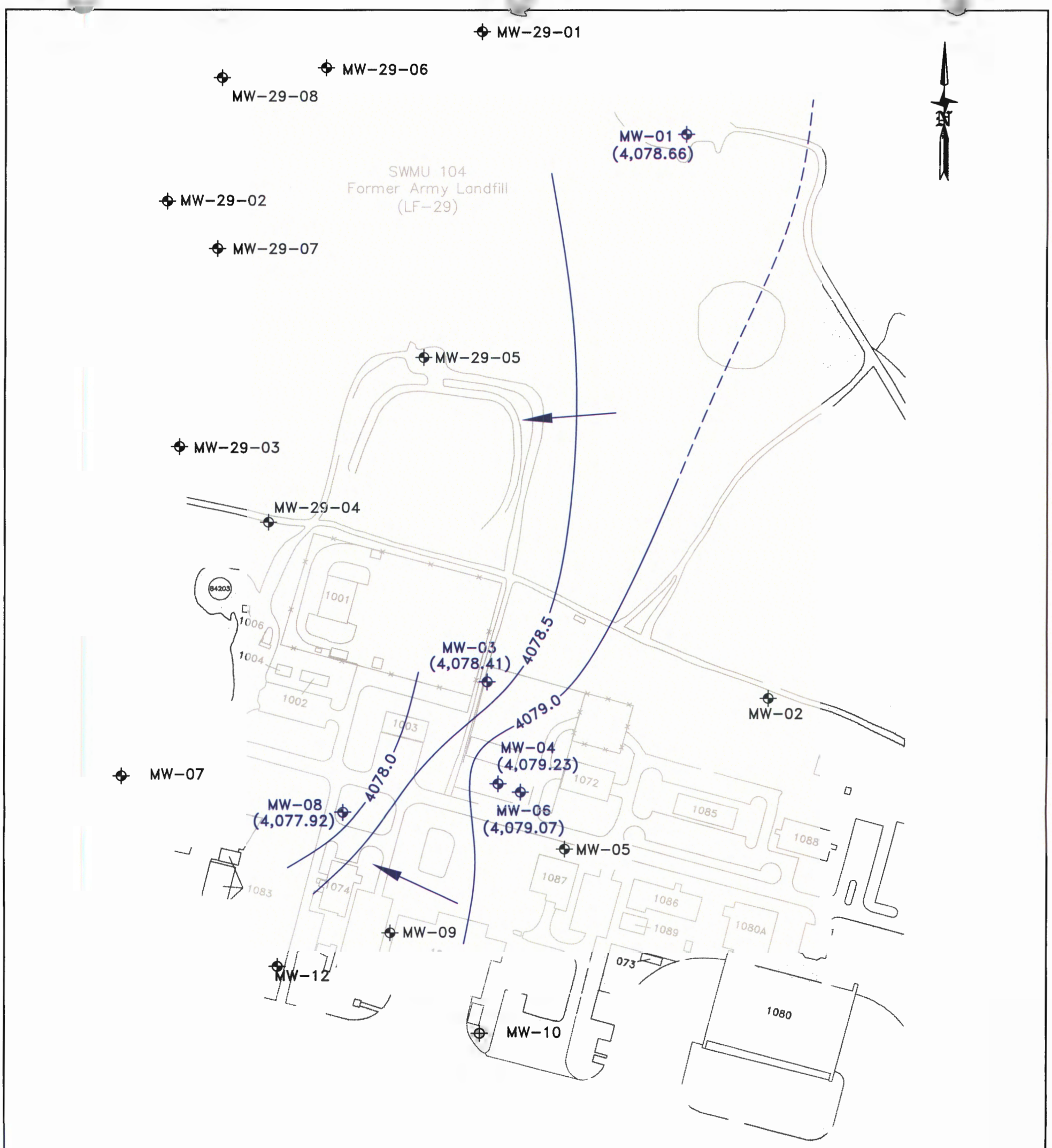
POTENTIOMETRIC SURFACE MAP
(APRIL 2004)

MONITORED NATURAL ATTENUATION REPORT
SPILL SITE 61
U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

PROJECT NO.	SCALE	DATE	DRAWN BY: EP/CEP/MRM	HOLLOMAN AIR FORCE BASE, NEW MEXICO
9030024	1"=200'	6/01/05	DRAWING NO: 9030024-05	Figure 5



LEGEND

- Monitoring Wells
- Monitoring Wells in MNA Sampling
- (4,078.66) Groundwater Surface Elevation
- —4,079.0— Groundwater Contour Elevation (Dashed Where Inferred)
- Groundwater Flow Direction

0 100 200 400
SCALE IN FEET

NOTES:

Drawing was taken from Foster Wheeler Environmental Corporation drawing entitled, "Extent of Groundwater Contamination During the RI", dated September 17, 2000.

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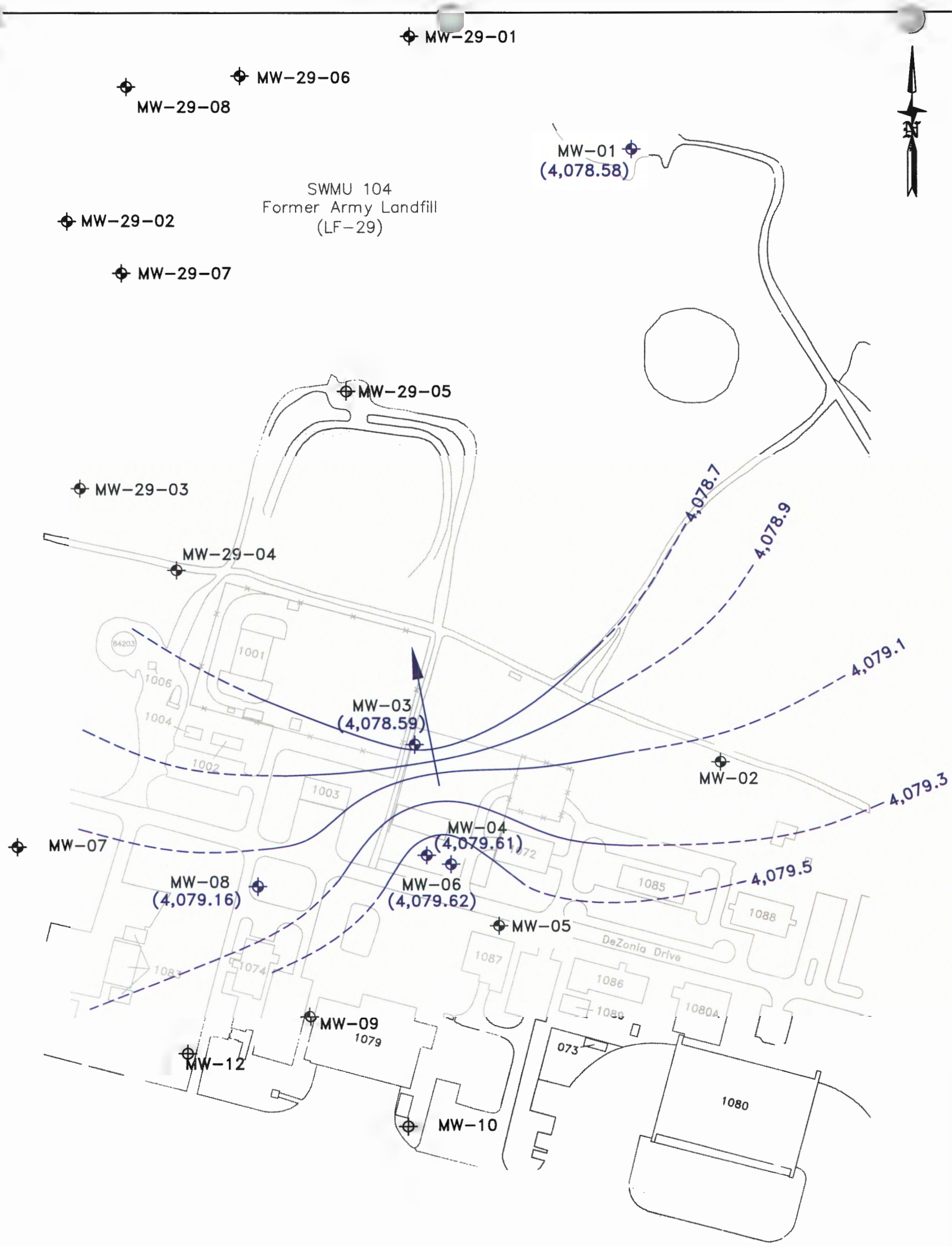
POTENTIOMETRIC SURFACE MAP
(JUNE 2004)

MONITORED NATURAL ATTENUATION REPORT
SPILL SITE 61
U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

PROJECT NO.	SCALE	DATE	DRAWN BY:	HOLLOMAN AIR FORCE BASE, NEW MEXICO
9030024	1"=200'	6/01/05	EP/CEP/MFM	
			DRAWING NO. 9030024-06	Figure 6



0 100 200 400
SCALE IN FEET

NOTES:

Information depicted was taken from Foster Wheeler Environmental Corporation drawing entitled, "Extent of Groundwater Contamination During the RI", dated September 17, 2000.

LEGEND:

⊕	MONITORING WELL LOCATION
⊕	MONITORING WELLS SAMPLED UNDER MNA
— 4,079.1 —	GROUNDWATER POTENTIOMETRIC CONTOUR (DASHED WHERE INFERRED)
(4,078.58)	GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
→	DIRECTION OF GROUNDWATER FLOW

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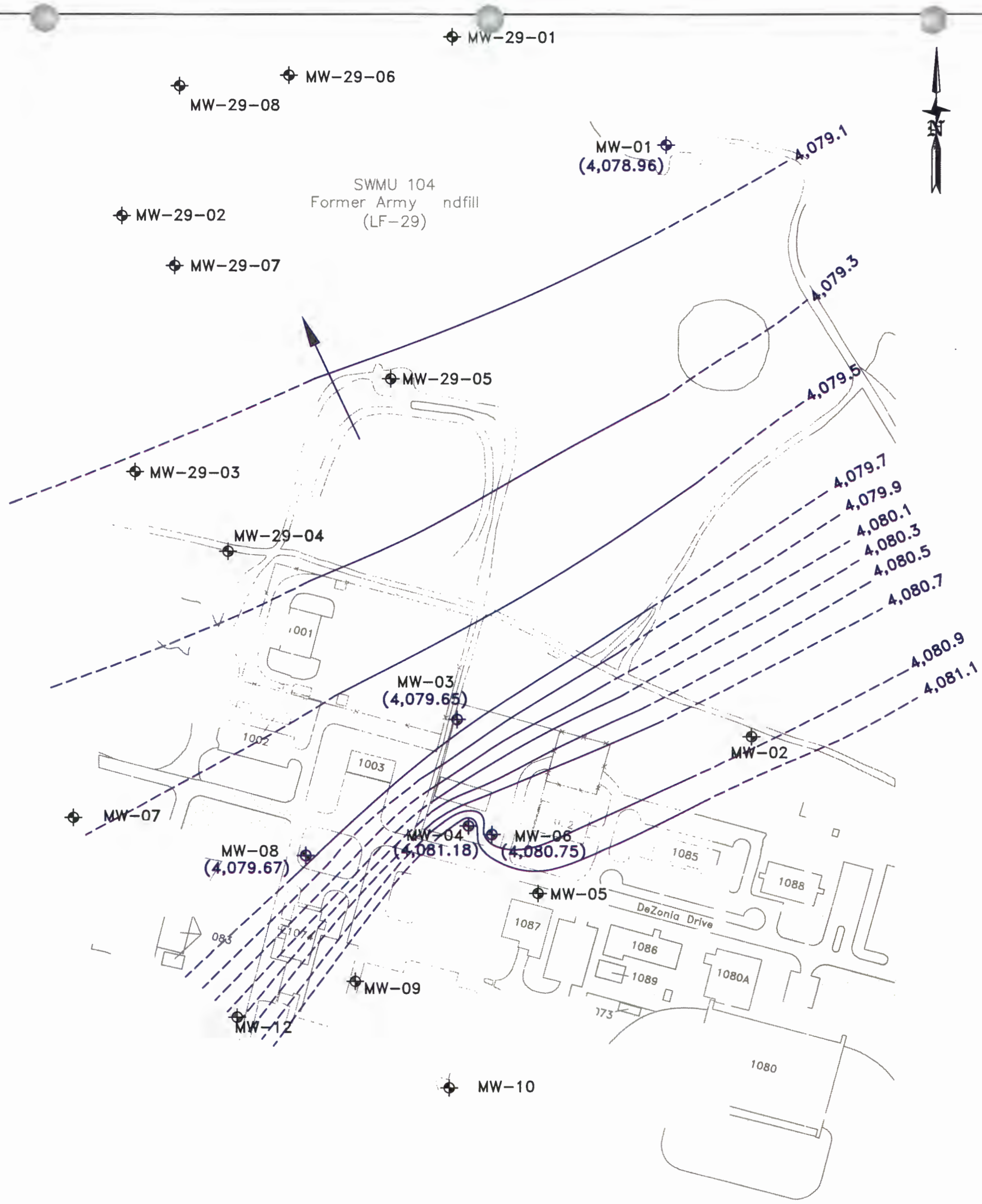
POTENTIOMETRIC SURFACE MAP
(SEPTEMBER 2004)

MONITORED NATURAL ATTENUATION REPORT
SPILL SITE 61
U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

PROJECT NO.	SCALE	DATE	DRAWN BY:	HOLLOMAN AIR FORCE BASE, NEW MEXICO
9030024	1"=200'	6/01/05	EP/GEP/MRM	
			DRAWING NO: 9030024-07	Figure 7



0 100 200 400

SCALE IN FEET

NOTES:

Information depicted was taken from Foster Wheeler Environmental Corporation drawing entitled, "Extent of Groundwater Contamination During the RI", dated September 17, 2000.

LEGEND:

⊕	MONITORING WELL LOCATION
⊕	MONITORING WELLS SAMPLED UNDER MNA
— 4,079.1 —	GROUNDWATER POTENTIOMETRIC CONTOUR (DASHED WHERE INFERRED)
(4,078.96)	GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
→	DIRECTION OF GROUNDWATER FLOW

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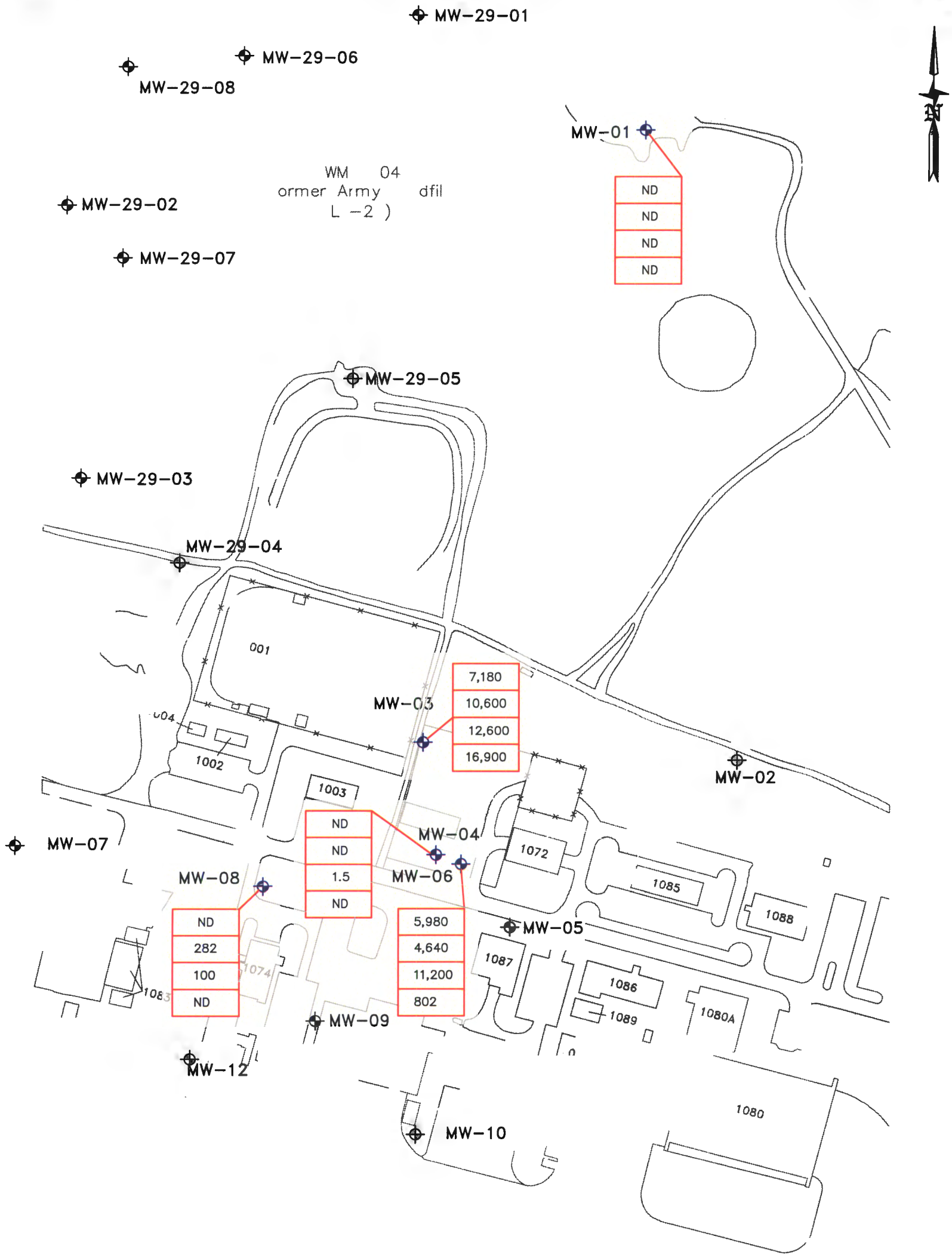
POTENTIOMETRIC SURFACE MAP
(JANUARY 2005)

MONITORED NATURAL ATTENUATION REPORT
SPILL SITE 61
U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

PROJECT NO.	SCALE	DATE	DRAWN BY:
9030024	1"=200'	6/01/05	EP/CEP/MRM
			DRAWING NO: 9030024-08

HOLLOMAN AIR FORCE BASE, NEW MEXICO

Figure 8



LEGEND

- Monitoring Wells
- Monitoring Wells in MNA Sampling
- ND Not Detected
- µg/L micrograms per Liter

Benzene (April 2004)	µg/L
Benzene (June 2004)	µg/L
Benzene (September 2004)	µg/L
Benzene (January 2005)	µg/L

0 100 200 400
SCALE IN FEET

NOTES:

Drawing taken from Foster Wheeler Environmental Corporation drawing entitled, "Extent of Groundwater Contamination During the RI", dated September 17, 2000.

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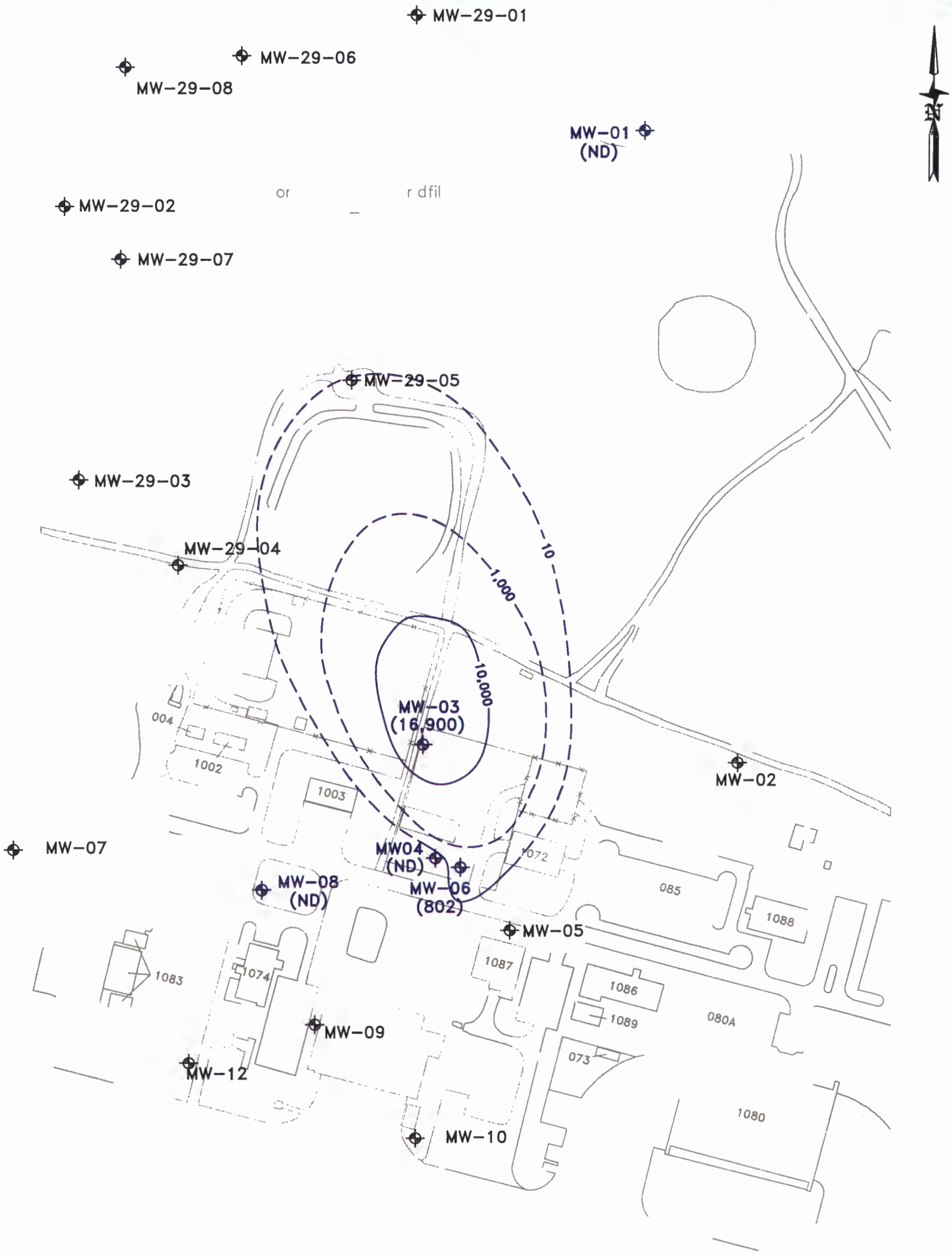
BENZENE CONCENTRATIONS

MONITORED NATURAL ATTENUATION REPORT
SPILL SITE 61
U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

PROJECT NO.	SCALE	DATE	DRAWN BY: EP/CEP/TES	HOLLOMAN AIR FORCE BASE, NEW MEXICO
9030024	1"=200'	6/01/05	DRAWING NO: 9030024-09	Figure 9



NOTES:

Drawing was taken from Foster Wheeler Environmental Corporation drawing entitled, "Extent of Groundwater Contamination During the RI", dated September 17, 2000.

0 100 200 400
SCALE IN FEET

LEGEND:

- Monitoring Wells
- Monitoring Wells in MNA Sampling
- — 10 — Benzene Isoconcentration Contour
- (802) Benzene Concentration
- (ND) Not Detected

All concentrations are reported in micrograms per liter (µg/L)

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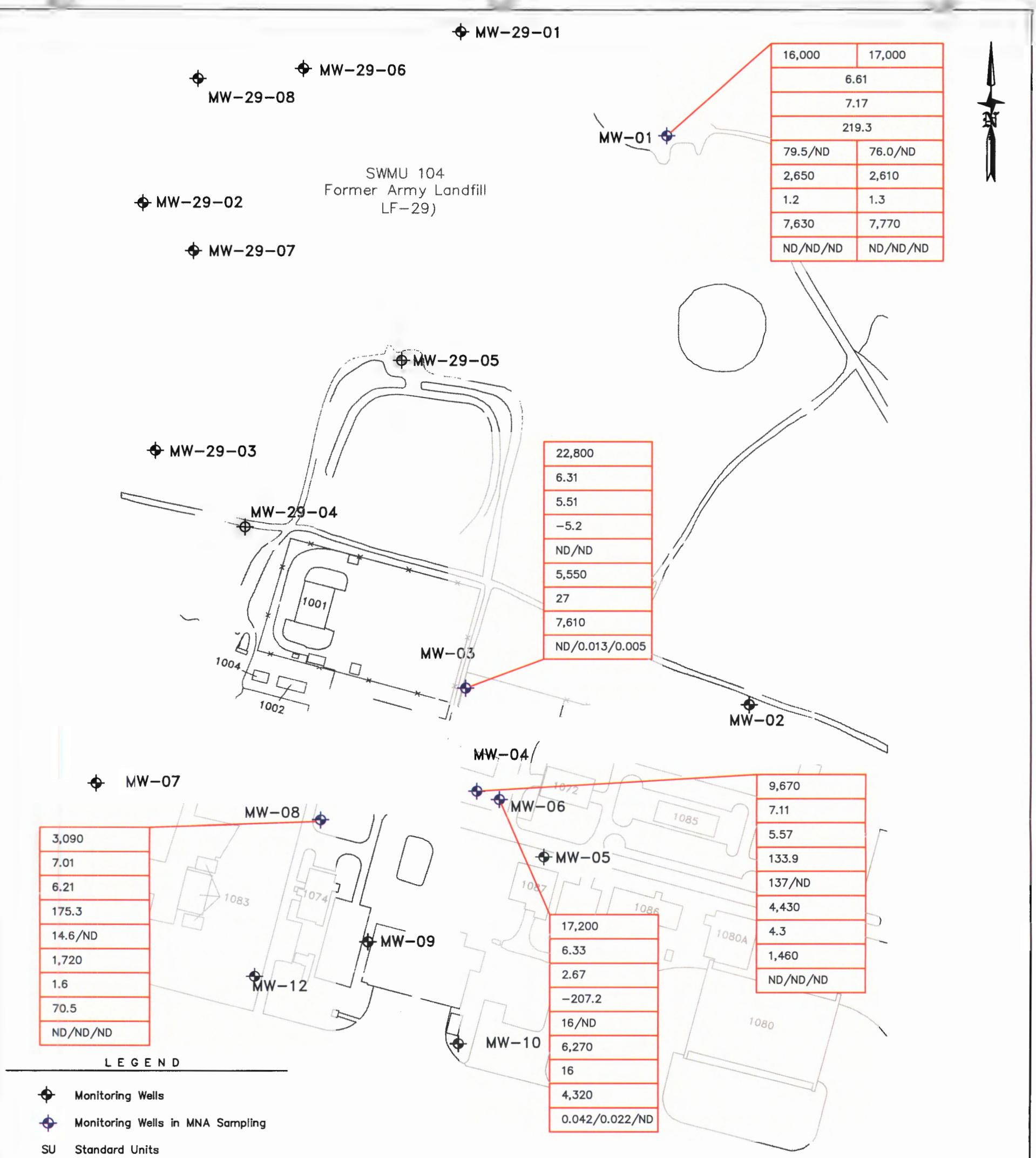
BENZENE ISOCONCENTRATION MAP
(JANUARY 2005)

MONITORED NATURAL ATTENUATION REPORT
SPILL SITE 61
U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

PROJECT NO.	SCALE	DATE	DRAWN BY: EP/CEP/MRM	HOLLOMAN AIR FORCE BASE, NEW MEXICO
9030024	1"=200'	6/01/05	DRAWING NO: 9030024-10	Figure 10



16,000	17,000
6.61	
7.17	
219.3	
79.5/ND	76.0/ND
2,650	2,610
1.2	1.3
7,630	7,770
ND/ND/ND	ND/ND/ND

22,800
6.31
5.51
−5.2
ND/ND
5,550
27
7,610
ND/0.013/0.005

3,090
7.01
6.21
175.3
14.6/ND
1,720
1.6
70.5
ND/ND/ND

9,670
7.11
5.57
133.9
137/ND
4,430
4.3
1,460
ND/ND/ND

17,200
6.33
2.67
−207.2
16/ND
6,270
16
4,320
0.042/0.022/ND

LEGEND

- Monitoring Wells
- Monitoring Wells in MNA Sampling
- SU Standard Units
- mg/L Milligrams per Liter
- ND Not Detected
- mV Millivolts

Total Dissolved Solids	mg/L
pH	SU
Dissolved Oxygen	mg/L
Oxidation Reduction Potential	mV
Nitrate/Nitrite	mg/L
Sulfate	mg/L
Total Organic Carbon	mg/L
Chloride	mg/L
Methane/Ethane/Ethene	mg/L

0 100 200 400
SCALE IN FEET

NOTES:

Drawing taken from Foster Wheeler Environmental Corporation drawing entitled, "Extent of Groundwater Contamination During the RI", dated September 17, 2000.

Duplicate analytical samples collected from MW-04 and MW-01.

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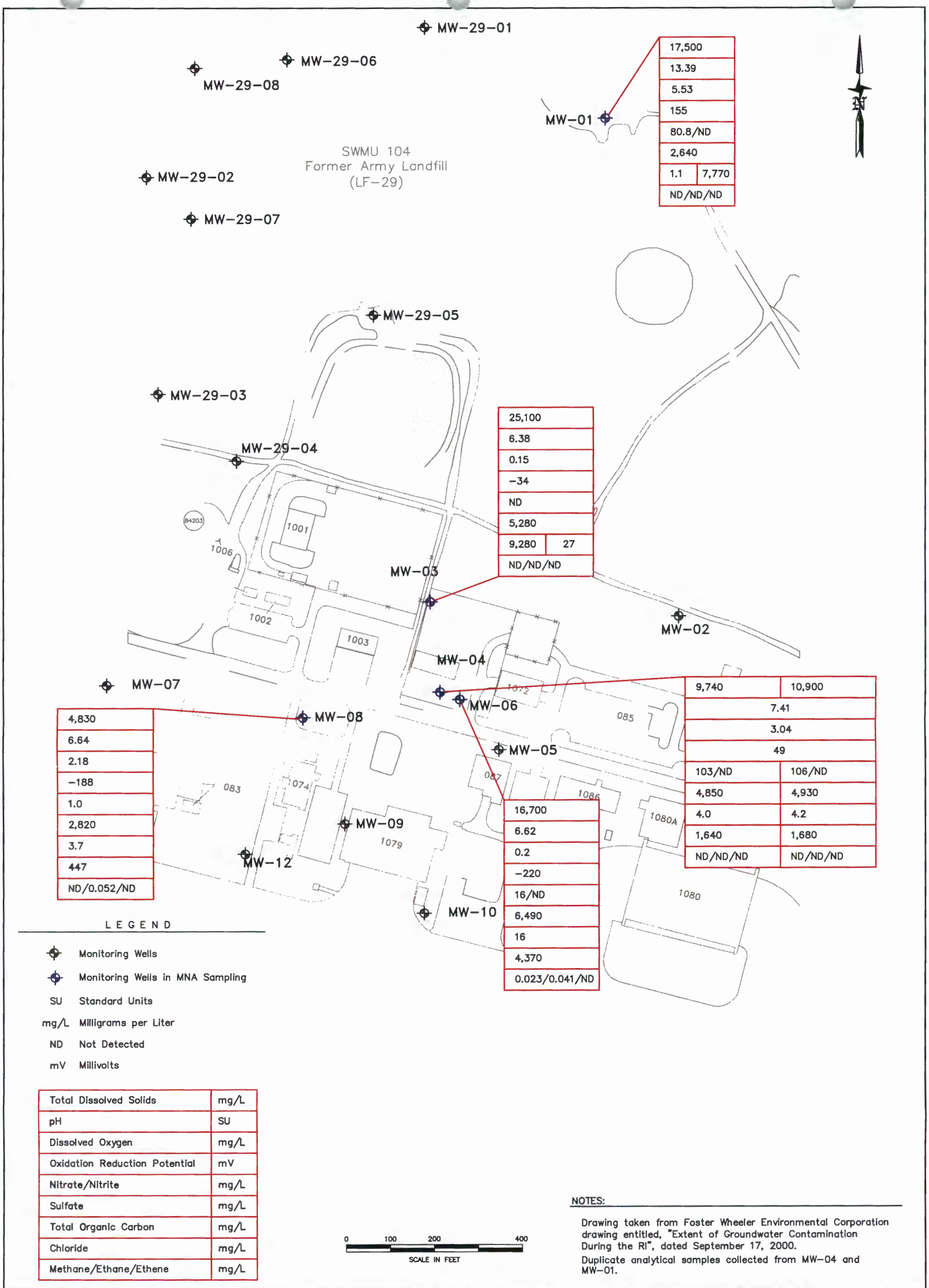
NATURAL ATTENUATION PARAMETERS
(APRIL 2004)

MONITORED NATURAL ATTENUATION REPORT
SPILL SITE 61
U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

PROJECT No.	SCALE	DATE	DRAWN BY:	HOLLOMAN AIR FORCE BASE, NEW MEXICO
9030024	1"=200'	6/01/05	EP/CEP/TES	
			DRAWING NO: 9030024-11	Figure 11



LEGEND

- Monitoring Wells
- Monitoring Wells in MNA Sampling
- SU Standard Units
- mg/L Milligrams per Liter
- ND Not Detected
- mV Millivolts

Total Dissolved Solids	mg/L
pH	SU
Dissolved Oxygen	mg/L
Oxidation Reduction Potential	mV
Nitrate/Nitrite	mg/L
Sulfate	mg/L
Total Organic Carbon	mg/L
Chloride	mg/L
Methane/Ethane/Ethene	mg/L

NOTES:

Drawing taken from Foster Wheeler Environmental Corporation drawing entitled, "Extent of Groundwater Contamination During the RI", dated September 17, 2000.

Duplicate analytical samples collected from MW-04 and MW-01.

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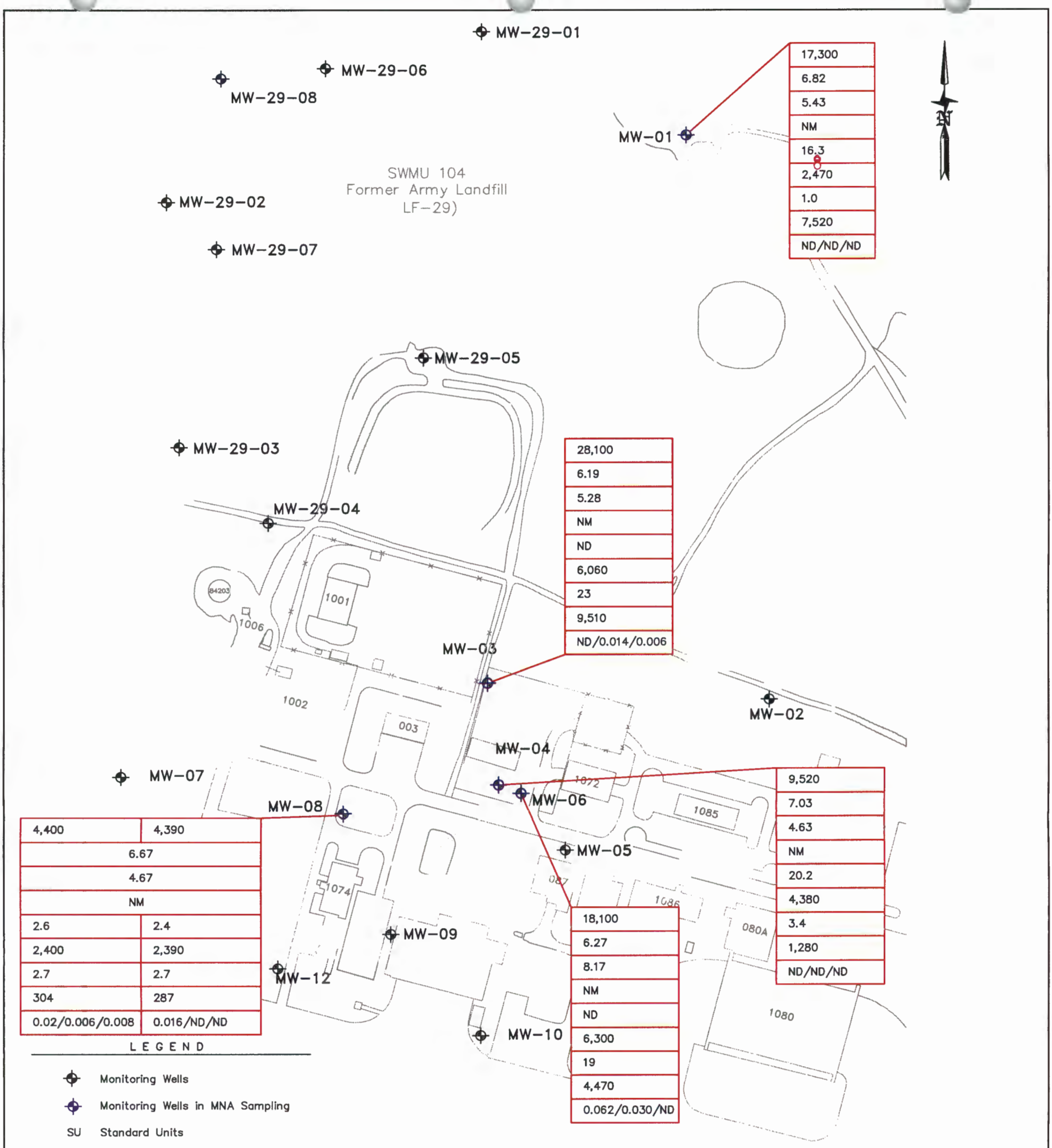
NATURAL ATTENUATION PARAMETERS
(JUNE 2004)

MONITORED NATURAL ATTENUATION REPORT
SPILL SITE 61
U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

PROJECT NO.	SCALE	DATE	DRAWN BY: EP/CEP/MRM	HOLLOMAN AIR FORCE BASE, NEW MEXICO
9030024	1"=200'	6/01/05	DRAWING NO: 9030024-12	Figure 12



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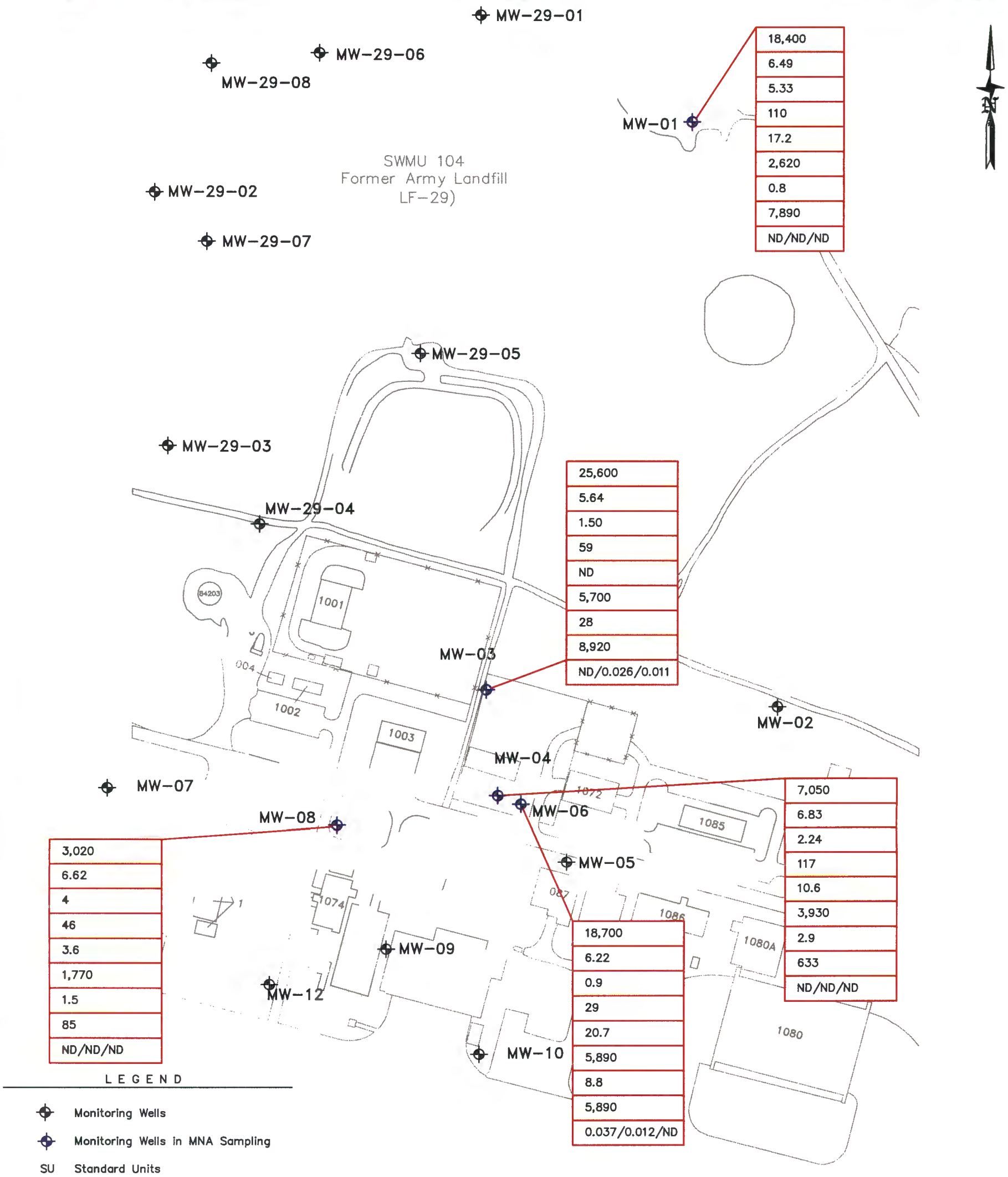
NATURAL ATTENUATION PARAMETERS
(SEPTEMBER 2004)

MONITORED NATURAL ATTENUATION REPORT
SPILL SITE 61
U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

PROJECT NO.	SCALE	DATE	DRAWN BY: EP/CEP/MRM	HOLLOMAN AIR FORCE BASE, NEW MEXICO
9030024	1"=200'	6/01/05	DRAWING NO: 9030024-13	Figure 13



LEGEND

- Monitoring Wells
- Monitoring Wells in MNA Sampling
- SU Standard Units
- mg/L Milligram per Liter
- ND Not Detected
- mV Millivolts

Total Dissolved Solids	mg/L
pH	SU
Dissolved Oxygen	mg/L
Oxidation Reduction Potential	mV
Nitrate/Nitrite	mg/L
Sulfate	mg/L
Total Organic Carbon	mg/L
Chloride	mg/L
Methane/Ethane/Ethene	mg/L

0 100 200 400
SCALE IN FEET

NOTES:

Drawing taken from Foster Wheeler Environmental Corporation drawing entitled, "Extent of Groundwater Contamination During the RI", dated September 17, 2000.

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NATURAL ATTENUATION PARAMETERS
(JANUARY 2005)

MONITORED NATURAL ATTENUATION REPORT
SPILL SITE 61
U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

PROJECT NO.	SCALE	DATE	DRAWN BY:	HOLLOMAN AIR FORCE BASE, NEW MEXICO
9030024	1"=200'	6/01/05	EP/CEP/MRM	
			DRAWING NO: 9030024-14	Figure 14

APPENDIX B

SITE-SPECIFIC ADDENDUM TO THE BASEWIDE HEALTH AND SAFETY PLAN

SITE-SPECIFIC ADDENDUM TO THE BASEWIDE HEALTH AND SAFETY PLAN

SS-61 SOIL REMEDIATION HOLLOMAN AIR FORCE BASE, NEW MEXICO

Prepared for:

49 CES/CEV
Holloman Air Force Base
New Mexico

Under Contract to:

U.S. Army Corps of Engineers
Omaha District
Omaha, Nebraska

Contract No. DACA45-03-D-0023
Task Order No. 021

Prepared by:

Bhate Environmental Associates, Inc.
1608 13th Avenue South, Suite 300
Birmingham, Alabama 35205

Bhate Project No. 9050361.01.02

August 2006

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SITE-SPECIFIC ADDENDUM TO THE BASEWIDE HEALTH AND SAFETY PLAN

SS-61 SOIL REMEDIATION HOLLOMAN AIR FORCE BASE, NEW MEXICO

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Attachments

A - Activity Hazards Analysis

B - Primary Contaminants of Concern

ACRONYMS AND ABBREVIATIONS

AF Fm	Air Force Form
AHA	Activity Hazard Analysis
ANSI	American National Standards Institute
AST	Aboveground storage tank
Bhate	Bhate Environmental Associates, Inc.
CPR	Cardiopulmonary Resuscitation
CES/CEV	Civil Engineering Squadron/Combat Engineer Vehicle
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
DPT	Direct push technology
EPA	Environmental Protection Agency
HAFB	Holloman Air Force Base
HASP	Health and Safety Plan
HSM	Health and Safety Manager
LTM	Long-term monitoring
mg/m^3	Milligrams per cubic meter
MSDS	Material Safety Data Sheet
NIOSH	National Institute for Occupational Safety and Health
PCS	Petroleum contaminated soil
PEL	Permissible exposure limit
P.G.	Professional Geologist
PID	Photoionization Detector
PPE	Personal protective equipment
ppm	Parts per million
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SPF	Sun protection factor
SS-61	Spill Site 61
SSA	Site-Specific Addendum
SSHO	Site Safety and Health Officer
SWMU	Solid Waste Management Unit
USACE	U.S. Army Corps of Engineers
VCM	Voluntary Corrective Measures
VOC	Volatile organic compound

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1 PROJECT SAFETY COORDINATION

The Bhate personnel who are responsible for safety and health issues at the Spill Site 61 (SS-61) project site are identified in Table 1-1. The respective personnel shall have reviewed and approved this Site-Specific Addendum to the Basewide Health and Safety Plan (HASP) submitted by Bhate Environmental Associates, Inc., (Bhate) for implementation on this scope of work prior to the start of field operations. The requirements of this site-specific addendum are applicable to Bhate employees, their subcontractors, and site visitors.

Table 1-1. Project Team Members with Project Health and Safety Responsibilities

Title	Name	Telephone
Site Manager	Mr. John Hymer	505-491-9171
Program Manager	Mr. Frank Gardner, P.G.	303-386-6454
Project Manager	Mr. Jim Moore, P.G.	303-929-4840
Health and Safety Manager	Mr. Brian Muller, CIH, CHMM	205-918-4000
Site Safety and Health Officer	Mr. Dave Rizzuto	505-430-3965
P.G. = Professional Geologist CIH = Certified Industrial Hygienist CHMM = Certified Hazardous Materials Manager		

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2 PROJECT BACKGROUND AND SCOPE

Since 1996, Spill Site 61 has been the subject of a series of environmental investigations related to evaluating the soil and groundwater conditions to determine the source of volatile organic compounds (VOCs) contamination detected in groundwater monitoring well MW-29-05. Contamination was initially detected in the vicinity of SS-61 (AOC-1001) during the Phase II Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Table 1 Investigation that was conducted at nearby Solid Waste Management Unit (SWMU) 104, the Former Army Landfill (LF-29) conducted by Radian in 1995. The subsequent Remedial Investigation by Foster Wheeler in 1999 did not adequately define the source of contamination found downgradient in MW-29-05.

The objective of the additional characterization at SS-61 is to fill in the data gaps to completely identify and define the petroleum contaminated soil (PCS) source area. Once the source area has been delineated, the primary objective of this Voluntary Corrective Measure (VCM) is to remove, through excavation, and properly dispose the PCS associated with the east-west trending pipeline that runs through the site to the former aboveground storage tank (AST) system. Groundwater conditions surrounding the SS-61 PCS source area will also be evaluated during implementation of the VCM Work Plan.

The objectives of the SS-61 source area investigation will be accomplished by collecting subsurface soil and groundwater samples from 17 direct push technology (DPT) soil borings. In addition two new monitoring wells will be installed and sampled along with the existing groundwater monitoring well network. This additional investigation is a necessary objective to collect sufficient data to support the completion of a risk assessment after the PCS source area has been excavated.

A detailed summary of the site history is included in the VCM Work Plan. The anticipated activities for this project include:

- Mobilization and demobilization of equipment;
- DPT Soil boring, subsurface soil sampling, monitoring well installation, and groundwater sampling;
- Soil excavation and loading;
- Confirmation soil sampling and screening;
- Excavated soils placement and land-farm maintenance, as applicable; and,
- Backfill excavation with clean soil.

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3 HAZARD ASSESSMENT AND CONTROLS

3.1 Task Hazard(s) Summary

The potential health and safety hazards of this task are summarized below in Table 3-1. The potential for encountering these hazards is ranked (high, moderate, or low) based on the work to be performed and the hazard control measures to be used.

Table 3-1. Task Hazards Summary

Summary	Hazard potential [High, Moderate, or Low]	Description of potential hazards
_v_ **Safety** (i.e. Walking and working surfaces, heavy equipment, traffic, falls, excavations, power and hand tools, materials handling, confined spaces, electrical safety, etc.)	• Moderate All tasks and their control measures are addressed in Task Specific Activity Hazard Analyses (AHAs) in Attachment A	• Walking and surfaces • Heavy equipment and vehicular traffic • Materials handling • Slips, trips, and falls • Excavation
_v_ **Utilities**	• Low	• Buried • Over head • Building Although these hazards should not be associated with this particular scope of work, it is necessary to verify that the hazards can be controlled.
_v_ **Chemical**	• Moderate	• Volatile Organic Compounds: Benzene, Toluene, Ethylbenzene and Xylenes (see Attachment B)
_v_ **Physical**	• Moderate	• Thermal stressors • Equipment noise
_v_ **Biological** (i.e. Plants, animals, insects, spiders, infectious waste)	• Low	• Insect stings and bites • Poisonous snakes/reptiles (Potential for contact should be minimal)

3.2 Hazard Control Measures

General safe work practices and control measures are identified and summarized in the *Basewide HASP* (Bhate, December 2003). Additional task-specific hazards and control measures are identified for non-routine tasks as part of the Activity Hazard Analysis (AHA) process. AHAs have been developed for each of the following activities and are included in Attachment A:

- General site activities/mobilization and demobilization

- Soil boring, subsurface soil sampling, monitoring well installation, groundwater sampling
- Soil excavation and loading
- Soils placement/land-farm maintenance and backfilling excavation with clean soil
- Soil confirmation sampling and screening

3.3 Written Safety Procedures and Programs

Table 3-2 provides a summary of the existing safety procedures and programs that will be used for this task. Copies of applicable procedures and programs are included in the *Basewide HASP*, as indicated.

Table 3-2. Written Safety Procedures and Programs

Reference Procedure or Program	Applicable Section(s)
Bhate Hazard Communication Program	All (Refer to Basewide HASP)
Bhate Respiratory Protection Program	All (Refer to Basewide HASP)
Bhate Hearing Conservation Program	All (Refer to Basewide HASP)

3.4 Permits

Before site activities can begin, there are several pre-construction documents and approval requirements to be met, including Air Force Form (AF Fm) 332 approval, Base dig permit with utility clearances, site security measures, and facility manager notification of the intended operations. Bhate will coordinate project requests for Base installation support services through the 49th Civil Engineering Squadron/Combat Engineer Vehicle (CES/CEV). Pertinent to the start of activities, a pre-construction meeting and site walk-through will be conducted with the U.S. Army Corps of Engineers (USACE) Resident Engineer, Holloman Air Force Base (HAFB) personnel, and Bhate Site Manager, to inspect site conditions for site/equipment access, equipment staging, and decontamination area(s), potential site hazards and emergency evacuation routes. Also reviewed at this time will be project procedures in accordance with the schedule and planned activities.

4 PERSONAL PROTECTIVE EQUIPMENT

The following personal protective equipment (PPE) as presented in Table 4-1 will be used for the identified activities based on the best available information about the work requirements and anticipated hazards.

Table 4-1. Personal Protective Equipment by Activity

Activity	Head/Face	Foot	Hands	Respiratory	Clothing
Mobilization / Demobilization	Hard Hat (for overhead hazards), Safety Glasses[1] with rigid side shields	Steel toed boots	Leather gloves as needed	None[3, 4]	Minimum of long pants and shirts with a minimum 4-inch sleeve
General Site Labor	Hard Hat (for overhead hazards), Safety Glasses[1] with rigid side shields	Steel toed boots	Leather gloves as needed	None[3, 4]	Minimum of long pants and shirts with a minimum 4-inch sleeve
Equipment Operation (Drilling, Landfarm Soil Placement, and Excavation Equipment)	Hard Hat[2] (for overhead hazards), Safety Glasses[1] with rigid side shields	Steel toed boots Boot covers for entering and exiting equipment	Leather gloves as needed	None[3, 4] N95 Air Purifying Respirator with Organic vapor cartridges based on monitoring	Minimum of long pants and shirts with a minimum 4-inch sleeve
Equipment Decontamination	Hard Hat[2] (for overhead hazards), Safety Glasses[1] with rigid side shields	Steel toed boots Boot covers	Chemical resistant gloves	None[3, 4] N95 Air Purifying Respirator with Organic vapor cartridges based on monitoring	Minimum of long pants and shirts with a minimum 4-inch sleeve Tyvek coveralls may be worn as recommended by the SSHO[5]
Soil, Groundwater, and Confirmation Soil Sampling/ Soil Screening	Hard Hat[2] (for overhead hazards), Safety Glasses[1] with rigid side shields	Steel toed boots	Chemical resistant gloves	None[3, 4] N95 Air Purifying Respirator with Organic vapor cartridges based on monitoring	Minimum of long pants and shirts with a minimum 4-inch sleeve Tyvek coveralls may be worn as recommended by the SSHO
Supervision of work	Hard Hat (for overhead hazards), Safety Glasses[1] with rigid side shields	Steel toed boots	Leather gloves as needed	None[3, 4]	Minimum of long pants and shirts with a minimum 4-inch sleeve

Notes:

[1] Safety Glasses with rigid side shields approved by American National Standards Institute (ANSI) Z-87 required at all times.

[2] Hard hats are not required inside fully enclosed equipment cabs.

[3] Voluntary use of respirators is authorized for comfort from nuisance dusts and odors, provided they are issued and used in accordance with established respiratory protection program procedures.

[4] Cartridge change out will occur at the following conditions:

- Damage to cartridge
- Cartridge is wet, restriction in breathing, unusual odors
- Cartridge is visibly clogged with dust, restriction in breathing
- After 40 hours of use with no continuous exposures over the established Permissible Exposure Limits (PELs)
- Changes that may be otherwise identified in 29 Code of Federal Regulations (CFR) §1910.120.

[5] SSHO = Site Safety and Health Officer

The following qualified person certifies that the selection of PPE is based on best available information about the work requirements and anticipated hazards.

Printed name:	**Signature:**	**Date:**
Brian Muller, CIH, CHMM **Bhate Health and Safety Manager**		

5 SITE MONITORING

Site monitoring will be conducted using direct-reading instruments primarily in the workers' breathing zone. To the extent feasible, site operations will be conducted and modified as needed to ensure that personnel are situated upwind of the well installation activities. Initial upwind background and work-zone readings will be obtained before the initiation of activities. Readings of breathing zones (unless location is otherwise specified) will be taken periodically during all activities. The Site Safety and Health Officer (SSHO) has the authority to modify the level of protection required for work at this site as well as halt operations as deemed necessary to control personal exposures. Monitoring results will be recorded on an Atmospheric Monitoring Log Field Health and Safety form maintained by the SSHO. Monitoring, calibrating, and maintaining instruments are the responsibility of the SSHO. Table 5-1 summarizes the site monitoring parameters and action levels applicable for direct reading exposure monitoring.

Table 5-1. Direct Reading Exposure Monitoring

Activity(s)	Compound / Instrument	Action Level(s) and Frequency	Actions
Soil boring and well installation	Total VOCs / Photoionization Detector (PID)	0 - 9 parts per million (ppm) Every 15 minutes during intrusive activities	Continue work in required PPE and continue monitoring.
		=10 ppm (sustained for more than 5 minutes)	Cease work and ensure personnel are upwind, notify the Site Manager. SSHO may upgrade PPE to Level C respiratory protection with organic vapor cartridge, as necessary.

(Continued)

Table 5-1 (Continued). Direct Reading Exposure Monitoring

Activity(s)	Compound / Instrument	Action Level(s) and Frequency	Actions
Excavation Soil Placement at and Maintenance of Land-farm Confirmation Soil Sampling and Screening	Total VOCs / PID	0 - 9 ppm Every 15 minutes during intrusive activities	Continue work in required PPE and continue monitoring.
		=10 ppm (sustained for more than 5 minutes)	Cease work and ensure personnel are upwind, notify the Site Manager. SSHO may upgrade PPE to Level C respiratory protection with organic vapor cartridge, as necessary. **Monitor for benzene**: If benzene is detected follow response actions outlined for benzene.
	Benzene / By colorimetric tube or similar (where indicted by PID readings)	No detection up to 0.2 ppm	Continue work activities in required protective equipment.
		> 0.2 ppm	Cease work, exit the area to upwind location and notify the Site Manager.
	Particulates / Personal DataRam or similar particulate monitor	=1.5 milligrams per cubic meter of air (mg/m^3) particulates (average) not to exceed 5.0 mg/m^3 5 minute monitoring periods as necessary if visible dust is present	Stop work and increase dust suppression.

6 SITE CONTROL

6.1 Site Activities

Site-specific site control measures will be used to control access to the work area. Tables 6-1 and 6-2 summarize the site control requirements applicable for both general work areas and work areas with potentially contaminated soils, respectively.

Table 6-1. Site Control for General Work Area(s)

Location	Site Control Procedure (discuss important elements such as signs, barricades, fencing, briefings, sign-in/out logs, etc.)
General Work Area	Due to the location of the project site, access will be coordinated with the Site Manager and HAFB Operations. Access will be made via a specified route.

Table 6-2. Site Control for Potentially Contaminated Area(s)

Location	Site Control Procedure (discuss important elements such as signs, barricades, briefings, qualifications, required supplies and equipment, sign-in/out logs, etc.)
Support Zone	Located outside of contaminated areas, access will be from clean areas or from the Exclusion Zone through the Contamination Reduction Zone.
Contamination Reduction Zone	The Contamination Reduction Zone will be demarcated with caution tape or temporary construction fencing. Decontamination stations will be located here.
Exclusion Zone	Exclusion Zone work areas will be clearly demarcated with caution tape or temporary construction fencing. All access to this area will require the use of a sign-in/out log.

6.2 Decontamination

Required decontamination procedures are described below in Table 6-3.

Table 6-3. Decontamination Procedures by Location

Type of decontamination	Decontamination Methods
Personnel decontamination	Personnel will be required to thoroughly wash hands and face prior to eating, drinking, or smoking. Disposable PPE will be collected for proper disposal. Additional decontamination procedures will be developed by the SSHO as needed.
Equipment decontamination	Work efforts will be made to minimize equipment contact with contaminated materials. Prior to leaving the work area and land-farm following placement of contaminated soils, equipment (tires, excavator/loader buckets, hand tools) will be dry decontaminated. Soils from the dry decontamination process will be disposed with the excavated materials. Decontamination tools may include brooms and shovels.

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7 COMMUNICATIONS

Cellular telephones will be available to summon emergency services as required. Refer to Sections 10, 11, and 12 of this Site-Specific Addendum (SSA) to the HASP for site specific guidance on emergency situations and appropriate actions. Site communication amongst workers shall be a combination of verbal and line of sight hand communications. **Cellular telephone use is not permitted while operating equipment.**

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8 MEDICAL SURVEILLANCE AND TRAINING

The medical surveillance and training requirements for Bhate's on-site personnel working on the soil boring, soil sampling, well installation, groundwater sampling, and soil excavation activities will follow the requirements outlined in the Basewide HASP Sections 7.4 and 5, respectively.

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9 HAZARDOUS CHEMICALS

Hazardous chemicals (as defined in 29 CFR §1910.1200) to be brought or used on-site are identified below. This chemical inventory and associated Material Safety Data Sheet (MSDSs) will be maintained by the SSHO.

Table 9-1. Hazardous Chemicals Brought On-Site

Chemical Name	Amount	Location	Purpose
Assorted fuels, lubricants, coolants, etc. necessary for equipment operation	No storage planned. Quantities limited to immediate use requirements of on-site equipment.	No storage planned. Materials to be brought on-site by vendor's maintenance vehicle.	Equipment Servicing and Operation

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10 EMERGENCY ACTION AND RESPONSE

Personnel responsible for coordinating emergency response actions during the SS-61 soil boring, well installation, soil and groundwater sampling, and PCS source area excavation activities are identified below in Table 10-1. A map showing directions to the authorized medical facility are included in Section 12.

Table 10-1. Emergency Coordinator and Alternate

Responsibility	Name	Phone Number(s)
Task Emergency Coordinator	Mr. John Hymer	Office (505) 679-2100 Cell (505) 491-9171
Alternate Emergency Coordinator	Mr. Dave Rizzuto	Office (505) 679-2100 Cell (505) 430-3965

If an emergency situation develops which requires evacuation of the work area, the evacuation procedures in Table 10-2 shall be followed.

Table 10-2. Evacuation Procedures

Evacuation Step	Methods and comments:
Notify affected workers	Use of site communication methods as applicable
Evacuate to safe location	Assemble at the primary evacuation site (support area outside of the exclusion zone)
Assemble and account for workers	Emergency Coordinator shall account for personnel using site Sign in/Sign out sheet
Notify Fire and Emergency Services	Notification as needed
Complete incident report	Follow the Incident Reporting and Investigation Procedure

Table 10-3 summarizes potential emergency situations and response actions that are applicable for the SS-61 work site.

Table 10-3. Potential Emergency Situations

In case of	Response actions
Injury or illness	Treat injury with applicable First Aid. All work related injuries beyond first aid will result in notification of Emergency Services and notification of the employee supervisor. Any employee requiring advanced medical treatment will be accompanied by a knowledgeable company employee that can answer potential questions on job duties and hazards. Make notifications in accordance with the Incident Reporting and Investigation Procedure (found in Section 10.2.2 of the *Basewide Health and Safety Plan*, Bhate, December, 2003).
Chemical exposure	First Aid shall be provided such as but not limited to: move victim to fresh air, remove contaminated clothing, flush affected skin with water, and seek medical attention.
Fire or explosion	Notify emergency services immediately. All personnel shall evacuate the immediate area of the fire and move to an upwind location. Personnel shall not engage in fire fighting activities use of fire extinguisher) unless trained to do so and only in the incipient stages of fire.
Adverse weather	Tornados, lightning, or other threatening weather conditions will result in an immediate shut down of operations and evacuation of personnel. Lightning proximity will be determined by measuring the time interval between the visually observed lightning flash and the subsequent sound of thunder. An interval less than 30 seconds will prompt the shut down. Operations will be shut down for the period of the storm passing plus an additional 20 minutes.
Material spill or release	Vehicles and equipment will be maintained and inspected so as to prevent fluid leaks. Should any vehicle fluid leaks occur, the equipment will be taken out of service to make necessary repairs and any contaminated material will be cleaned-up and disposed of properly. Spill kits will be available to facilitate prompt containment and clean-up of spills. Notification will be made in accordance with the Incident Reporting and Investigation Procedure. Storage areas will be designed to have secondary containment as required, and work plans will be executed to accommodate stormwater runoff and minimize the potential for contamination spread.

11 EMERGENCY CONTACTS

In the event of an emergency, the following contacts should be made, as appropriate:

HAFB Emergency Number (using HAFB phone system).....9-911
Operators will assist with Medical, Fire, and Police emergencies

HAFB Security Force.....(505) 572-5037

HAFB Fire Protection.....(505) 572-1117

HAFB Hospital – 49th Medical Group (Main switchboard).....(505) 572-2778

Civilian Hospital (Alamogordo) Gerald Champion Regional Medical Center.....(505) 439-6100

After initial contacts have been made and the situation has stabilized, notify the Site Manager SSHO, Senior Project Manager, and/or Health and Safety Manager (HSM), as appropriate.

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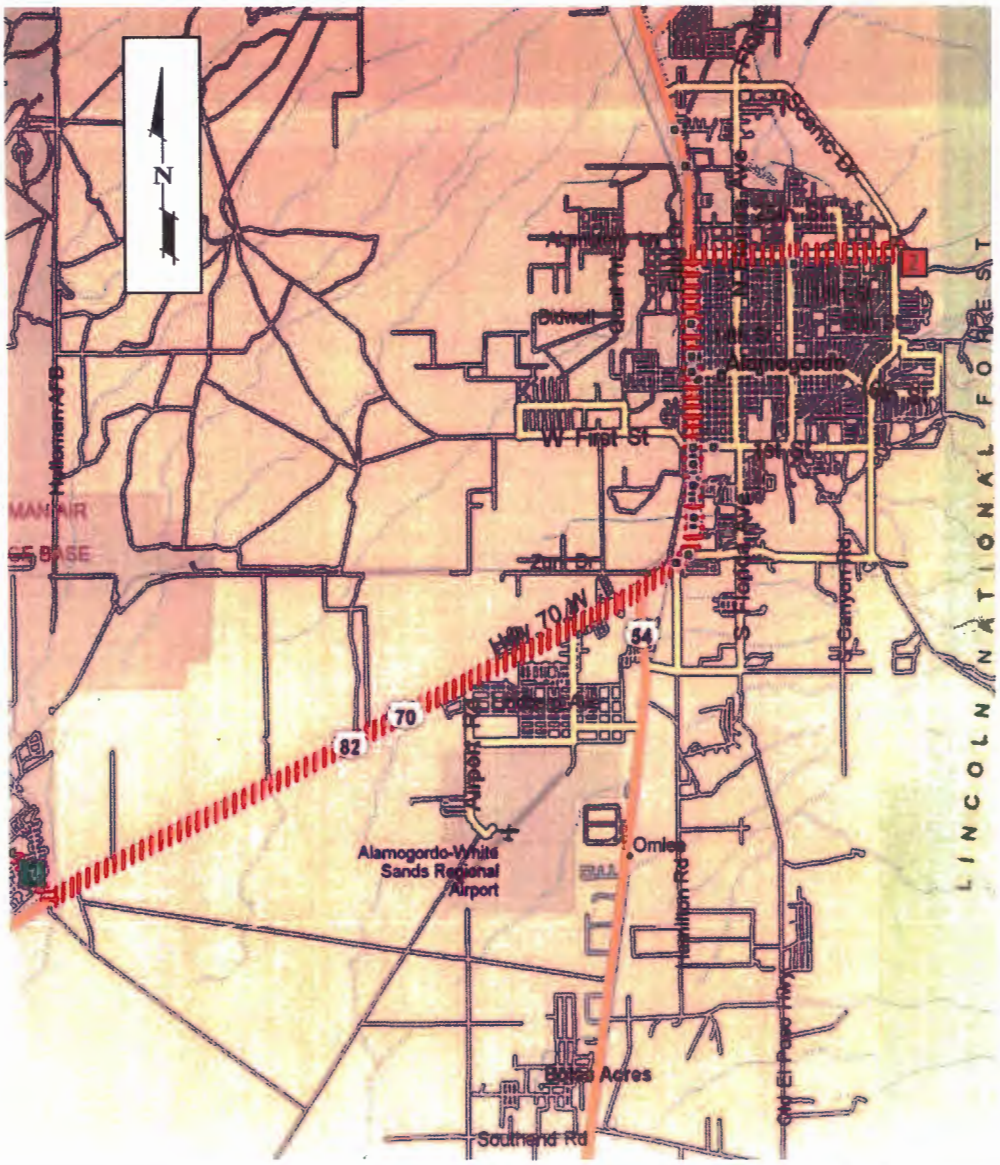
12 HOSPITAL DIRECTIONS

In the event of a true medical emergency ("life or limb"), HAFB Emergency Services should be used. Notification of any injury must be made to HAFB Emergency Services. Bhate personnel and subcontractors should not transport injured personnel to the HAFB Hospital without prior authorization from HAFB Emergency Services.

Other injuries should be treated as necessary at Gerald Champion Regional Medical Center at 2669 Scenic Drive, Alamogordo, NM 88330. From HAFB, exit the Main Gate and proceed east on US-70 onto US-54, continue north on US-54 to Indian Wells Road, turn right heading east to Scenic Drive, and turn left on Scenic proceed to the medical center. A map to this hospital is presented as Figure 12-1.

Figure 12-1. Hospital Route Map



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HOSPITAL ROUTE MAP
Holloman Air Force Base to
Gerald Champion Regional Hospital

Source: Microsoft Expedia Street Maps

Not to Scale

Date
August 2006

Site SS-61
Holloman Air Force Base
SSA to the HASP

Figure 12-1

ATTACHMENT A

ACTIVITY HAZARD ANALYSES (AHAs)

Activity Hazard Analysis (AHA) – 01

Task: Voluntary Corrective Measures for SS-61	**Bhate Project Number:** 9050361.01.02	
Minimum Personal Protective Equipment (PPE): Level D PPE (Long pants, shirts with minimum 4" sleeve, steel toe boots, safety glasses, hard hat for overhead hazards, leather work gloves, and hearing protection, as required)	**Location:** Holloman Air Force Base, New Mexico	
	Analysis Approved by: Brian Muller, CIH, CHMM	**Date:** August 2006

Activity	Potential Hazards	Recommended Controls
General Site Activities including Mobilization / Demobilization and Site Preparation Note: Each workday shall begin with a mandatory daily safety meeting for all on-site workers	Slips, trips, or falls on walking and working surfaces	• Determine the best access route prior to transporting equipment and tools • Continuously inspect the work area for slip, trip, and fall hazards • Pay attention; ensure safe and secure footing • Maintain clean work areas by following good housekeeping procedures • Be alert for uneven and variable terrain • Wear slip resistant footwear when walking/working on slippery surfaces or slopes
	Site Traffic	• Be aware of potential vehicle traffic while on site • Follow posted warnings and rules for travel around site
	Eye injury	• Use approved safety glasses with rigid side shields
	Overhead hazards	• Personnel will be required to wear hard hats that meet ANSI Standard Z89.1 in all areas with overhead hazards
	Cuts, punctures, and abrasions	• Wear leather work gloves when handling materials or using tools
	Dropped objects	• Steel toe boots meeting ANSI Standard Z41 will be worn
	Thermal Stressors (i.e. heat stress, cold stress)	• Employees will have appropriate clothing for variable weather • Use of long sleeves or application of sunscreen with a high sun protection factor (SPF) on exposed skin encouraged • Employees will take breaks and drink plenty of fluids to prevent heat stress • Warming breaks will be permitted as necessary to prevent cold stress
	Back Injury from Materials Handling	• Use proper lifting techniques • Loads greater than 50 pounds require assistance or mechanical equipment • Prior to lifting, check the load for jagged or sharp edges • Avoid torso twisting motions while handling or moving loads

AHA – 01 (Continued)

Activity	Potential Hazards	Recommended Controls
Mobilization/Demobilization and Site Preparation (continued)	Inclement weather (Thunderstorms and tornadoes)	• Halt activities immediately and take cover during thunderstorm or tornado warnings, shelter in a building if possible, stay away from windows • If outdoors, stay close to the ground • Listen to radio or television announcements for pending weather information • Do not try to outrun a tornado on foot or in a vehicle
	Biological hazards (spiders, snakes, etc.)	• Workers will inspect the work area carefully and avoid placing hands and feet into concealed areas • Look in direction of travel for biological hazards to avoid
Safety Equipment Used	**Inspection Requirements**	**Training Requirements**
Level D PPE First Aid Kit Fire Extinguisher	Informal daily work area inspections to be conducted by the SSHO	Site personnel have read and understand the SSHP Site personnel possess all of the required training as specified in the SSHP Site personnel received site specific safety indoctrination At least two individuals on-site will have current CPR and First Aid training

Activity Hazard Analysis (AHA) – 02

Task: Additional Investigation Requirements for SS-61	**Bhate Project Number:** 9050361.01.02
Minimum Personal Protective Equipment (PPE): Level D PPE (Long pants, shirts with minimum 4" sleeve, steel toe boots, safety glasses, hard hat for overhead hazards, leather work gloves, and hearing protection, as required)	**Location:** Holloman Air Force Base, New Mexico
	Analysis Approved by: Brian Muller, CIH, CHMM — **Date:** August 2006

Activity	Potential Hazards	Recommended Controls
Soil Boring and Sampling Hazards and recommended controls from AHA – 01 apply	Drill Rig Hazards Including but not limited to: Flying debris, falling objects, noise, hydraulic failures, unguarded machinery, equipment rollover, movement of large, heavy drilling tools, etc.	• Drill rig is to be operated and maintained by qualified operators • A Drill Rig Inspection Checklist should be completed daily to ensure that the rig is operating properly • The inspection will include fittings, cables, pins, connections, lubrication points, controls, emergency stops, etc. • To the extent possible, the terrain should be level and the condition of the ground such that unexpected movement of the rig is unlikely • Stabilize the rig prior to boring • Wear required PPE (hard hat, safety glasses, work gloves, ear muffs or plugs, steel toe work boots), ensure loose clothing is secured • Maintain good housekeeping on and around drill rig
	Overhead/buried utilities	• Conduct a utility locate to identify the location of underground utilities in boring locations and complete any required dig permits • Overhead utilities should be considered live until determined otherwise • Maintain a minimum distance of 15 feet from overhead utilities • All underground utilities must be clearly marked before beginning work • No borings shall be made within a 4 foot "Buffer Zone" of any utility marking
	Exposure to soil contaminants	• To the extent feasible, limit contact with subsurface materials • Wear required PPE when conducting intrusive activities • SSHO shall conduct breathing zone monitoring for VOCs with a PID in accordance with requirements for site monitoring • SSHO may require an upgrade in PPE or modification to work based on monitoring results • Use appropriate decontamination methods

AHA – 02 (Continued)

Activity	Potential Hazards	Recommended Controls
Monitoring Well Installation	Pinch points	• Utilize appropriate PPE (leather gloves) when handling well casings and tools
	Dust	• Use care when installing well materials (sand, bentonite, Portland cement) into monitoring well to prevent dust generation • Position body in an upwind location
Well Development / Groundwater depth measurement / Groundwater sampling	Exposure to groundwater contaminants	• Position body upwind from monitoring well prior to opening cap • Wear appropriate PPE including chemical resistant gloves and Tyvek coveralls to minimize potential contact with groundwater, as appropriate • Conduct work activities in a manner that minimizes potential contact with groundwater • Collect all PPE and disposable sampling equipment and dispose of properly • Wash hands and face prior to eating, drinking, or smoking
Safety Equipment Used	**Inspection Requirements**	**Training Requirements**
Level D PPE First Aid Kit Fire Extinguisher	Informal daily work area inspections to be conducted by the SSHO	Site personnel have read and understand the SSHP Site personnel possess all of the required training as specified in the SSHP Site personnel received site specific safety indoctrination At least two individuals on-site will have current CPR and First Aid training

Activity Hazard Analysis (AHA) – 03

Task: Excavation and Soil Loading for VCM at SS-61		**Bhate Project Number:** 9050361.01.02	
Minimum Personal Protective Equipment (PPE): Level D PPE (Long pants, shirts with minimum 4" sleeve, steel toe boots, safety glasses, hard hat for overhead hazards, leather work gloves, and hearing protection, as required)		**Location:** Holloman Air Force Base, New Mexico	
		Analysis Approved by: Brian Muller, CIH, CHMM	**Date:** August 2006
Activity	**Potential Hazard(s)**	**Recommended Controls**	
Excavation and Confirmation Soil Sampling Hazards and recommended controls from AHA – 01 apply	Overhead/buried utilities	• Completion of an HAFB Excavation Permit is required prior to the start of excavation activities • Overhead utilities should be considered live until determined otherwise • Maintain a minimum distance of 15 feet from overhead utilities • All underground utilities must be clearly marked before beginning work	
	Heavy equipment operation	• Access to the work area shall be coordinated with the Site Manager • Equipment (including trucks) shall be inspected and documented at the beginning of each shift • Maintain awareness of vehicle movement in work area • Exercise caution when approaching heavy equipment • Equipment will be equipped with functioning back-up alarms, signal lamps, and alerting horns • Operators are required to use seat belts • Signs, barricades, flagmen, and/or other traffic control devices will be used to control traffic in the work area • Buckets and attachments shall be placed on the ground if operator not at controls or if ground personnel approach	
	Excavation Safety	• Ensure equipment is placed so as to not contribute to a cave-in situation • No personnel will be allowed to enter the excavation unless the excavation has been properly inspected, shoring and means of egress installed as necessary, all heavy equipment has been moved away from the affected edges, and any spoils have been removed from the edge • Do not place spoil piles closer than 2 feet from the edge of the excavation	
	Exposure to soil contaminants	• Utilize appropriate PPE and decontamination procedures • Conduct work activities in a manner that minimizes potential contact with excavated materials	

AHA – 03 (continued)

Activity	Potential Hazard(s)	Recommended Controls
Soils Loading Hazards and Controls associated with Excavation apply	Falling materials and flying debris striking personnel	• Loading equipment must have cab protection, functioning back-up alarms, signal lamps, and alerting horns • Operators are required to use seat belts • Ground personnel are not permitted to approach equipment in motion or while materials being handled • Maintain clear radius of machine • Operator must minimize the amount of materials spilled on the exterior of trucks during loading operations
	Dust	• Adequate dust suppression with water should be utilized to minimize visible dust emissions • If visible dust is prevalent, utilize personal dust monitor to evaluate
	Striking heavy equipment and operators	• Only experienced personnel will operate equipment • Equipment will be operated with cab doors and windows closed
	Overloading capacity	• Load charts of all equipment will be reviewed and followed
Equipment Used	**Inspection Requirements**	**Training Requirements**
Level D PPE First Aid Kits Portable Eyewash Fire Extinguishers Heavy Equipment (Loader, Excavator, Haul Trucks)	Weekly inspections will be performed on fire extinguishers Weekly inspections will be performed on first aid kits Portable eye wash will be inspected weekly	Personnel have read and understand the work plan and AHA Site specific briefing At least two individuals on-site will have current CPR and First Aid training

Activity Hazard Analysis (AHA) – 04

Task: Soils Placement/Land-farm Maintenance and Backfilling Excavation with Clean Soil for SS-61		**Bhate Project Number:** 9050361.01.02
Minimum Personal Protective Equipment (PPE): Level D PPE (Long pants, shirts with minimum 4" sleeve, steel toe boots, safety glasses, hard hat for overhead hazards, leather work gloves, and hearing protection, as required)		**Location:** Holloman Air Force Base, New Mexico
		Analysis Approved by: Brian Muller, CIH, CHMM — **Date:** August 2006
Activity	**Potential Hazard(s)**	**Recommended Controls**
Soil Placement and Land-farm Maintenance Backfilling Excavation with Clean Soil Hazards and recommended controls from AHA – 01 and AHA-03 apply	Exposure to soil contaminants	• Utilize appropriate PPE and decontamination procedures • Conduct work activities in a manner that minimizes potential contact with excavated materials • Utilize placement method that minimizes haul truck traffic through contaminated material
	Heavy equipment operation	• Haul truck drivers should wait for signal from equipment operator to enter the land-farm soil placement area • Only experienced personnel will operate equipment • Ground personnel are not permitted to approach equipment in motion or while materials being handled • Maintain clear radius of machine • Equipment will be equipped with functioning back-up alarms, signal lamps and alerting horns • Operators are required to use seat belts • Signs, barricades, flagmen, and/or other traffic control devices will be used to control traffic in the work area • Only necessary personnel will be permitted in the delineated land-farm area
Equipment Used	**Inspection Requirements**	**Training Requirements**
Level D PPE First Aid Kits Portable Eyewash Fire Extinguishers Heavy Equipment (Tractor, Haul Trucks)	Weekly inspections will be performed on fire extinguishers Weekly inspections will be performed on first aid kits Portable eye wash will be inspected weekly	Personnel have read and understand the work plan and AHA Site specific briefing At least two individuals on-site will have current CPR and First Aid training

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ATTACHMENT B
PRIMARY CONTAMINANTS OF CONCERN

Properties of the Primary Contaminants of Concern

Contaminant	PEL	TLV	Route(s) of Exposure	Signs and Symptoms of Exposure		Target Organs	IP (eV)	Specific Gravity	VP (mm Hg)	Flash Point (°F)	LEL %	UEL %
				Acute	Chronic							
Benzene	1 ppm	0.5 ppm	Inhalation Ingestion Contact Absorption	Irritation of eyes, skin, nose, and throat, headache, dizziness, nausea, staggered gait, fatigue	Cancer (leukemia), adverse reproductive effects (female fertility, birth defects)	Eyes, skin, respiratory system, blood, central nervous system, bone marrow	9.24	0.88	75	12	1.2	7.8
Toluene	200 ppm (750 mg/m^3)	50 ppm (188 mg/m^3)	Inhalation Ingestion Contact Absorption	Irritation of eyes, skin, nose, drowsiness, fatigue, weakness, confusion, headache, nausea, dilated pupils	Liver and kidney damage	Eyes, skin, respiratory system, CNS, liver, kidneys	8.82	0.87	21	40	1.1	7.1
Ethylbenzene	100 ppm (435 mg/m^3)	100 ppm (434mg/m^3)	Inhalation Ingestion Contact Absorption	Irritation of eyes, and skin, may also cause conjunctivis (eyes)	CNS depression, pulmonary aspiration	CNS, eyes, skin, respiratory system	8.76	0.87	7	55	0.8	6.7
Xylenes (o-, m-, p-isomers)	100 ppm	100 ppm	Inhalation Ingestion Contact Absorption	Irritation of eyes, skin, nose	CNS permanent brain and nervous system damage	CNS, liver, and urinary system/kidneys	21	0.864	8	76	1.0	7.0

Notes:

PEL = Permissible Exposure Limit
TLV = Threshold Limit Value
IP = Ionization Potential
eV = Electron volt
VP = Vapor Pressure
mm Hg = Millimeters of mercury
°F = Degrees Fahrenheit
LEL = Lower Explosive Limit
UEL = Upper Explosive Limit
% = Percent
ppm = Parts per million
mg/m^3 = Milligrams per cubic meter of air
CNS = Central Nervous System

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APPENDIX C

QUALITY ASSURANCE PROJECT PLAN ADDENDUM

QUALITY ASSURANCE PROJECT PLAN ADDENDUM

SITE SS-61 SOIL REMEDIATION
HOLLOMAN AFB, NEW MEXICO

Prepared for:

49 CES/CEV
Holloman Air Force Base
New Mexico

Under Contract To:

U.S. Army Corps of Engineers
Omaha District
Omaha, Nebraska

Contract No. DACA45-03-D-0023
Task Order No. 021

August 2006

Prepared by:

Bhate Environmental Associates, Inc.
1608 13th Avenue South, Suite 300
Birmingham, Alabama 35205

Bhate Project No. 9050361.01.02

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QUALITY ASSURANCE PROJECT PLAN ADDENDUM

SITE SS-61 SOIL REMEDIATION

HOLLOMAN AFB, NEW MEXICO

REVIEW SHEET

COMMITMENT TO IMPLEMENT THIS QUALITY ASSURANCE PROJECT PLAN ADDENDUM		
Michael D'Auben Project Chemist	Signature	Date
Jim Moore Project Manager	Signature	Date
John Hymer Site Manager	Signature	Date

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QUALITY ASSURANCE PROJECT PLAN ADDENDUM

SITE SS-61 SOIL REMEDIATION

HOLLOMAN AFB, NEW MEXICO

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3-2 Summary of Definitive Data

4-1 Summary of Additional Investigation Field QC Samples

4-2 Summary of Soil Excavation Field QC Samples

4-3 Summary of Laboratory QC Limits

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LIST OF ACRONYMS

AFB	Air Force Base
AOC	Area of Concern
Bhate	Bhate Environmental Associates, Inc.
EDD	Electronic data deliverable
ERPIMS	Environmental Resources Program Information Management System
HAFB	Holloman Air Force Base
LCL	Lower Control Limit
LCS	Laboratory Control Sample
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NELAC	National Environmental Laboratory Accreditation Conference
PCS	Petroleum Contaminated Soil
QA	Quality Assurance
QAM	Quality Assurance Manual
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RPD	Relative Percent Difference
SOPs	Standard Operating Procedures
SS-61	Spill Site 61
SVOC	Semi-volatile Organic Compounds
SWMU	Solid Waste Management Unit
UCL	Upper Control Limit
µg/kg	Micrograms per kilogram
µg/L	Micrograms per liter
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
VCM	Voluntary Corrective Measures
VOC	Volatile Organic Compound

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PREFACE

This Quality Assurance Project Plan Addendum (QAPP Addendum) has been developed to assure that sample collection, analyses, and evaluations are legally and scientifically defensible for Voluntary Corrective Measures (VCM) at Spill Site 61 (SS-61) at Holloman Air Force Base (HAFB). This document is an addendum to the *Basewide Quality Assurance Project Plan, Holloman Air Force Base, New Mexico* (Bhate, November 2003) (Basewide QAPP) and must be used in conjunction with that document. This document contains the site specific information for the work at SS-61 outlined in the *Voluntary Corrective Measures Work Plan, Site SS-61 Soil Remediation, Holloman AFB, New Mexico* (Bhate, August 2006) (SS-61 Work Plan).

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1 INTRODUCTION

Bhate Environmental Associates, Inc., (Bhate) has been retained by the U.S. Army Corps of Engineers (USACE), under contract DACA45-03-D-0023, Task Order No. 021, to conduct VCMs at several of the Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) at HAFB, New Mexico, including SS-61.

The SS-61 VCM Work Plan involves an additional investigation and excavation of petroleum contaminated soil (PCS). The objective of the additional investigation is to fill in the data gaps to completely identify and define the presumed PCS source area. Once the source area has been delineated the primary objective of this VCM is to remove, through excavation, and properly dispose the PCS that is associated with a buried pipeline that runs through the site to the former aboveground storage tank system. See the Basewide QAPP (Bhate, 2003) and SS-61 Work Plan (Bhate, August 2006) for additional information on HAFB and the SS-61 site.

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2 PROJECT LABORATORY

The analytical work for this project will be preformed by Accutest Southeast of Orlando, Florida (Accutest).

Accutest Southeast
4405 Vineland Road, Suite C-15
Orlando, FL 32811
Phone: (407) 425-6700
Fax: (407) 425-0707

The laboratory personnel who will be involved with this project include:

Ms. Sue Bell, Accutest Project Manager

Ms. Svetlana Izosimova, Accutest Quality Assurance Officer

Accutest is certified by the National Environmental Laboratory Accreditation Conference (NELAC) and validated by USACE and has extensive previous experience in working on USACE projects. The Accutest Quality Assurance Manual (QAM) and Standard Operating Procedures (SOPs) have been reviewed by Bhate and found to meet all the requirements for this project. The QAM and SOPs are available for further review if required.

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3 DATA CATEGORIES

The data use determines the required levels of data quality. The two levels of data quality established by the USACE are screening and definitive. Under this QAPP Addendum, the data to be generated under each level in this investigation are presented in Table 3-1 (Screening) and Table 3-2 (Definitive). The screening data will be generated in the field using field instruments. The definitive data generated by the laboratory will be presented with limited data deliverables (i.e. Level II data packages), using a 21 day turn-around-time for soil and groundwater samples collected during the additional investigation and a 7 day turn-around-time for soil samples collected during the PCS excavation. All definitive data produced by the laboratory will also be presented in an Environmental Resources Program Information Management System (ERPIMS) format electronic data deliverable (EDD).

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4 DATA QUALITY ASSURANCE AND QUALITY CONTROL

The general data quality assurance (QA) and quality control (QC) requirements for HAFB are presented in the Basewide QAPP. The field QC requirements for this project are presented in Tables 4-1 and 4-2. The project specific laboratory QC limits are listed in Table 4-3.

All final definitive data will be reviewed and validated by a Bhate Senior Chemist based on the logic and guidelines of the United States Environmental Protection Agency (USEPA) National Functional Guidelines for Data Validation and the site specific laboratory QC limits presented in this QAPP Addendum.

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5 REFERENCES

Bhate, November 2003. *Final Basewide Quality Assurance Project Plan, Holloman Air Force Base, New Mexico.*

Bhate, August 2006. *Voluntary Corrective Measures Work Plan, Site SS-61 Soil Remediation, Holloman AFB, New Mexico.*

United States Environmental Protection Agency, July 2002. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review.*

United States Environmental Protection Agency, October 1999. *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review.*

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TABLES

Table 3-1
Summary of Screening Data

Parameter	Matrix	Testing Method
Volatile Organic Compounds (VOCs)	Soil	Organic Vapor Analyzer
Total Petroleum Hydrocarbons (TPH)	Soil	Ultra violet flourometer (UVF-3100A)
pH	Water	Multi-parameter sonde and a flow-through cell
Conductivity	Water	Multi-parameter sonde and a flow-through cell
Dissolved Oxygen	Water	Multi-parameter sonde and a flow-through cell
Temperature	Water	Multi-parameter sonde and a flow-through cell

Table 3-2
Summary of Definitive Data

Parameter	Matrix	Preparation Method	Analytical Method
Volatile Organic Compounds (VOCs)	Soil	USEPA Method 5035	USEPA Method 8260B
Semi-volatile Organic Compounds (SVOCs)	Soil	USEPA Method 3550B	USEPA Method 8270C
Total Petroleum Hydrocarbons (TPH)	Soil	USEPA Method 3550B	USEPA Method 8015M
RCRA Metals	Soil	USEPA Method 3050B	USEPA Methods 6010B and 7471A
Volatile Organic Compounds (VOCs)	Groundwater	USEPA Method 5030B	USEPA Method 8260B
Semi-volatile Organic Compounds (SVOCs)	Groundwater	USEPA Method 3510C	USEPA Method 8270C
Total Petroleum Hydrocarbons (TPH)	Groundwater	USEPA Method 3510C	USEPA Method 8015M
RCRA Metals	Groundwater	USEPA Method 3010A	USEPA Methods 6010B and 7470A
Total Dissolved Solids (TDS)	Groundwater	USEPA Method 160.1	USEPA Method 160.1

Notes:
USEPA = United States Environmental Protection Agency
RCRA = Resource Conservation and Recovery Act

Table 4-1
Summary of Additional Investigation Field QC Samples

Matrix	Analysis	Number of Field Samples	Equipment Blanks	Trip Blanks*	Field Duplicates	Field Splits	MS/MSD	Total
Soil	VOCs per EPA Method 8260B	30	0	4	3	0	2	39
	SVOCs per EPA Method 8270C	30	0	0	3	0	2	35
	TPHs per EPA Method 8015M	30	0	0	3	0	2	35
	RCRA Metals by EPA 6010B/7471A	30	0	0	3	0	2	35
Groundwater	VOCs per EPA Method 8260B	33	0	4	4	0	2	43
	SVOCs per EPA Method 8270C	31	0	0	4	0	2	37
	TPHs per EPA Method 8015M	31	0	0	4	0	2	37
	RCRA Metals by EPA 6010B/7471A	31	0	0	4	0	2	37
	Total Dissolved Solids by EPA Method 160.1	31	0	0	4	0	2	37

Notes:
*Estimated, one trip blank will accompany every shipment of volatile samples
EPA = Environmental Protection Agency
VOCs = Volatile Organic Compounds
SVOCs = Semi-volatile Organic Compounds
RCRA = Resource Conservation and Recovery Act
TPH = Total Petroleum Hydrocarbons

Table 4-2
Summary of Soil Excavation Field QC Samples

Matrix	Analysis	Number of Field Samples	Equipment Blanks	Trip Blanks*	Field Duplicates	Field Splits	MS/MSD	Total
Soil - Stock Pile (Overburden)	VOCs per EPA Method 8260B	3	0	3	1	0	1	8
	SVOCs per EPA Method 8270C	3	0	0	1	0	1	5
	TPHs per EPA Method 8015M	3	0	0	1	0	1	5
Soil - Excavation Confirmation	VOCs per EPA Method 8260B	44	0	14	5	0	3	66
	SVOCs per EPA Method 8270C	44	0	0	5	0	3	52
	TPHs per EPA Method 8015M	44	0	0	5	0	3	52

Notes:
*Estimated, one trip blank will accompany every shipment of volatile samples
EPA = Environmental Protection Agency
VOCs = Volatile Organic Compounds
SVOCs = Semi-volatile Organic Compounds
TPH = Total Petroleum Hydrocarbons

Table 4-3
Summary of Laboratory QC Limits

Parameter	RL		LCS				Matrix Spike Water			Matrix Spike Soil		
			Water		Soil		MS Recovery		MSD	MS Recovery		MSD
	Water	Soil	LCL	UCL	LCL	UCL	LCL	UCL	RPD	LCL	UCL	RPD
VOCs per EPA Method 8260B	µg/L	µg/kg	%	%	%	%	%	%	%	%	%	%
Acetone	25	50	45	127	51	136	44	142	15	14	140	33
Benzene	1	5	72	125	74	124	80	120	7	63	135	23
Bromodichloromethane	1	5	72	120	74	124	75	120	8	63	126	23
Bromoform	1	5	55	127	79	127	60	129	11	54	109	24
Chlorobenzene	1	5	79	113	78	117	82	112	7	64	130	24
Chloroethane	2	5	56	164	63	147	67	148	14	53	172	28
Chloroform	1	5	75	120	75	121	78	118	8	68	131	24
Carbon disulfide	2	5	60	151	59	148	65	147	12	47	165	29
Carbon tetrachloride	1	5	56	145	67	131	69	137	12	64	148	24
1,1-Dichloroethane	1	5	70	122	71	118	75	117	10	64	130	25
1,1-Dichloroethylene	1	5	61	137	64	126	67	134	15	55	149	28
1,2-Dichloroethane	1	5	64	124	72	120	68	121	7	60	114	22
1,2-Dichloropropane	1	5	74	123	74	126	78	122	8	65	128	23
Dibromochloromethane	1	5	63	119	78	120	68	118	9	60	119	23
cis-1,2-Dichloroethylene	1	5	74	125	75	124	81	120	9	66	132	24
cis-1,3-Dichloropropene	1	5	65	112	72	120	73	115	10	57	118	25
trans-1,2-Dichloroethylene	1	5	70	127	70	122	74	125	11	63	137	27
trans-1,3-Dichloropropene	1	5	59	116	75	118	69	115	11	58	115	25
Ethylbenzene	1	5	73	119	77	120	82	115	8	63	142	25
2-Hexanone	5	25	54	131	68	136	60	125	11	35	109	34
Isopropylbenzene	1	5	63	119	79	134	73	115	10	59	177	29
4-Methyl-2-pentanone	5	25	57	136	69	136	61	128	11	44	99	32
Methyl bromide	2	5	52	172	52	156	60	165	16	38	188	27
Methyl chloride	2	5	53	155	63	142	58	152	19	57	160	29
Methylene chloride	5	10	61	129	51	142	66	125	11	40	183	34
Methyl ethyl ketone	5	25	51	128	63	138	58	127	10	27	112	32
Styrene	1	5	64	124	74	120	58	125	11	54	130	26
1,1,1-Trichloroethane	1	5	72	133	70	131	78	132	8	70	149	25
1,1,2,2-Tetrachloroethane	1	5	64	120	76	121	67	119	10	45	121	33
1,1,2-Trichloroethane	1	5	72	116	77	118	74	115	9	60	114	25
Tetrachloroethylene	1	5	70	126	68	127	75	126	9	54	154	27
Toluene	1	5	67	123	74	118	81	114	8	62	142	29
Trichloroethylene	1	5	73	117	72	122	80	115	10	59	143	25
Vinyl chloride	1	5	63	161	64	144	70	151	18	64	165	27
Xylene (total)	3	15	73	122	78	122	81	118	7	64	142	24
Dibromofluoromethane (surr)	--	--	--	--	78	123	--	--	--	--	--	--
Toluene-D8 (surr)	--	--	--	--	71	137	--	--	--	--	--	--
4-Bromofluorobenzene (surr)	--	--	--	--	61	157	--	--	--	--	--	--
1,2-Dichloroethane-D4 (surr)	--	--	--	--	74	125	--	--	--	--	--	--

Table 4-3
Summary of Laboratory QC Limits

Parameter	RL		LCS				Matrix Spike Water			Matrix Spike Soil		
			Water		Soil		MS Recovery		MSD	MS Recovery		MSD
	Water	Soil	LCL	UCL	LCL	UCL	LCL	UCL	RPD	LCL	UCL	RPD
SVOCs by EPA Method 8270C	µg/L	µg/kg	%	%	%	%	%	%	%	%	%	%
Benzoic Acid	25	830	8	45	55	110	16	73	41	13	117	32
2-Chlorophenol	5	170	62	103	61	97	53	102	24	31	113	23
4-Chloro-3-methyl phenol	5	170	64	103	60	105	60	101	18	33	123	38
2,4-Dichlorophenol	5	170	59	103	64	102	55	100	24	54	105	20
2,4-Dimethylphenol	5	170	43	94	50	102	36	98	26	46	104	22
2,4-Dinitrophenol	25	830	12	125	41	120	14	135	39	5	110	46
4,6-Dinitro-o-cresol	10	330	47	119	59	123	40	127	24	27	119	35
2-Methylphenol	5	170	54	91	57	97	46	100	23	44	101	28
3&4-Methylphenol	5	170	48	86	56	98	43	100	23	38	107	31
2-Nitrophenol	5	170	64	104	62	100	53	104	25	38	111	21
4-Nitrophenol	25	830	22	50	52	116	32	81	28	44	111	22
Pentachlorophenol	25	830	50	111	54	111	44	118	16	42	110	25
Phenol	5	170	25	53	59	96	31	77	26	32	111	29
2,4,5-Trichlorophenol	5	170	66	104	65	104	61	102	18	53	108	19
2,4,6-Trichlorophenol	5	170	60	103	64	102	55	103	21	53	107	20
Acenaphthene	5	170	62	101	66	104	55	103	20	57	106	19
Acenaphthylene	5	170	65	113	66	106	55	113	20	55	110	18
Anthracene	5	170	69	107	66	109	66	105	14	59	109	21
Benzo(a)anthracene	5	170	68	106	66	111	65	103	16	52	120	20
Benzo(a)pyrene	5	170	70	114	65	115	65	113	16	48	124	21
Benzo(b)fluoranthene	5	170	68	110	64	115	62	110	17	50	122	21
Benzo(g,h,i)perylene	5	170	63	115	62	113	58	111	17	50	118	23
Benzo(k)fluoranthene	5	170	68	112	67	116	63	110	17	54	117	21
4-Bromophenyl phenyl ether	5	170	73	103	68	106	68	102	16	59	107	20
Butyl benzyl phthalate	5	330	69	108	62	114	65	108	17	57	118	20
Benzyl Alcohol	5	170	34	104	58	103	48	106	24	46	106	23
2-Chloronaphthalene	5	170	64	102	66	97	58	101	22	53	102	19
4-Chloroaniline	10	330	57	104	29	80	39	101	21	25	78	30
Carbazole	5	170	69	113	63	107	66	109	16	58	105	20
Chrysene	5	170	68	103	67	112	65	100	18	48	124	20
bis(2-Chloroethoxy)methane	5	170	57	103	57	89	49	100	24	45	94	19
bis(2-Chloroethyl)ether	5	170	64	106	61	95	54	103	24	47	99	24
bis(2-Chloroisopropyl)ether	5	170	52	120	56	100	49	109	22	44	100	23
4-Chlorophenyl phenyl ether	5	170	71	104	68	103	65	103	18	59	105	18
1,2-Dichlorobenzene	5	170	62	100	61	91	50	101	22	44	95	26
1,3-Dichlorobenzene	5	170	59	99	59	88	50	100	23	41	91	28
1,4-Dichlorobenzene	5	170	60	101	59	90	51	101	23	42	93	27
2,4-Dinitrotoluene	5	170	65	111	60	108	60	110	16	44	118	26

Table 4-3
Summary of Laboratory QC Limits

Parameter	RL		LCS				Matrix Spike Water			Matrix Spike Soil		
			Water		Soil		MS Recovery		MSD	MS Recovery		MSD
	Water	Soil	LCL	UCL	LCL	UCL	LCL	UCL	RPD	LCL	UCL	RPD
SVOCs by EPA Method 8270C	µg/L	µg/kg	%	%	%	%	%	%	%	%	%	%
2,6-Dinitrotoluene	5	170	77	111	63	106	60	111	19	48	115	20
3,3'-Dichlorobenzidine	10	330	42	110	30	90	18	112	22	15	90	31
Dibenzo(a,h)anthracene	5	170	62	115	63	110	57	111	20	45	121	23
Dibenzofuran	5	170	69	104	65	99	64	102	17	57	101	19
Di-n-butyl phthalate	5	330	68	109	62	110	63	107	17	55	112	20
Di-n-octyl phthalate	5	330	63	120	59	132	58	126	23	58	134	23
Diethyl phthalate	5	330	64	110	64	109	59	110	18	59	107	19
Dimethyl phthalate	5	330	44	120	66	105	40	116	25	56	108	20
bis(2-Ethylhexyl)phthalate	5	330	64	115	60	118	55	120	22	55	125	21
Fluoranthene	5	170	68	111	63	108	62	108	17	47	119	25
Fluorene	5	170	66	105	65	109	60	105	17	59	108	18
Hexachlorobenzene	5	170	69	103	65	106	64	102	16	56	107	21
Hexachlorobutadiene	5	170	55	90	55	93	45	93	26	42	94	25
Hexachlorocyclopentadiene	5	170	26	95	34	95	20	92	34	13	91	25
Hexachloroethane	5	170	59	104	58	91	51	105	26	40	93	32
Indeno(1,2,3-cd)pyrene	5	170	63	118	59	115	61	111	19	50	118	26
Isophorone	5	170	64	107	60	102	59	103	23	52	101	19
2-Methylnaphthalene	5	170	66	100	63	93	56	100	23	42	103	22
2-Nitroaniline	10	330	65	111	60	110	61	107	18	55	108	20
3-Nitroaniline	10	330	61	106	41	90	47	107	26	38	92	20
4-Nitroaniline	10	330	60	113	53	103	48	119	21	42	101	23
Naphthalene	5	170	62	101	64	94	52	102	23	42	105	24
Nitrobenzene	5	170	61	106	60	96	51	103	25	42	105	21
N-Nitroso-di-n-propylamine	5	170	64	109	54	99	57	103	24	41	107	23
N-Nitrosodiphenylamine	5	170	69	114	68	108	62	112	16	59	111	21
Phenanthrene	5	170	68	104	67	110	64	103	15	60	110	21
Pyrene	5	170	64	105	65	115	59	107	21	50	126	25
1,2,4-Trichlorobenzene	5	170	64	101	64	94	54	102	24	49	98	23
2-Fluorophenol (surr)	--	--	19	90	45	114	--	--	--	--	--	--
Phenol-d5 (surr)	--	--	10	68	44	124	--	--	--	--	--	--
2,4,6-Tribromophenol (surr)	--	--	36	137	50	128	--	--	--	--	--	--
Nitrobenzene-d5 (surr)	--	--	49	119	41	123	--	--	--	--	--	--
2-Fluorobiphenyl (surr)	--	--	45	118	46	122	--	--	--	--	--	--
Terphenyl-d14 (surr)	--	--	46	135	45	135	--	--	--	--	--	--
RCRA Metals by EPA Method 6010B/7470A/7471A	µg/L	mg/kg	--	--	--	--	--	--	--	--	--	--
Arsenic	10.00	0.50	80	120	80	120	83	116	12	75	113	20
Barium	200.00	20.00	80	120	80	120	82	116	13	75	122	20
Chromium	5.00	0.40	80	120	80	120	80	115	13	75	116	20

Table 4-3
Summary of Laboratory QC Limits

Parameter	RL		LCS				Matrix Spike Water			Matrix Spike Soil		
			Water		Soil		MS Recovery		MSD	MS Recovery		MSD
	Water	Soil	LCL	UCL	LCL	UCL	LCL	UCL	RPD	LCL	UCL	RPD
RCRA Metals by EPA Method 6010B/7470A/7471A	**µg/L**	**mg/kg**	--	--	--	--	--	--	--	--	--	--
Cadmium	10.00	1.00	80	120	80	120	82	120	12	75	125	20
Lead	5.00	10.00	80	120	80	120	84	118	10	75	121	20
Mercury	0.05	0.01	80	120	80	120	62	131	20	47	157	20
Selenium	10.00	10.00	80	120	80	120	84	121	13	75	110	20
Silver	10.00	1.00	80	120	80	120	77	125	14	75	120	20
Total Petroleum Hydrocarbons (TPH) by EPA Method 8015M	**µg/L**	**µg/kg**	%	%	%	%	%	%	%	%	%	%
TPH-GRO (C6-C10)	0.25	8.3	63	126	66	122	67	171	31	37	142	17
4-Bromofluorobenzene (surr)	--	--	62	135	62	135	--	--	--	--	--	--
aaa-Trifluorotoluene (surr)	--	--	65	118	65	118	--	--	--	--	--	--
TPH (C10-C22)	0.25	8.3	50	150	50	150	50	150	30	50	150	30
TPH (>C22-C36)	0.1	5.0	50	150	50	150	50	150	30	50	150	30
o-Terphenyll (surr)	--	--	57	115	57	115	--	--	--	--	--	--
Total Dissolved Solids by EPA Method 160.1	**mg/L**	**mg/kg**	%	%	%	%	%	%	%	%	%	%
Total Dissolved Solids	10	--	90	110	--	--	--	--	--	--	--	--

Notes:

µg/kg = Micrograms per kilogram
µg/L = Micrograms per liter
EPA = United States Environmental Protection Agency
LCL = Lower Control Limit
LCS = Laboratory Control Sample
mg/kg = Milligrams per kilogram
mg/L = Milligrams per liter
MS = Matrix Spike
MSD = Matrix Spike Duplicate
RL = Reporting Limit
RPD = Relative Percent Difference
UCL = Upper Control Limit
VOCs = Volatile Organic Compounds
SVOCs = Semi-volatile Organic Compounds
RCRA = Resource Conservation and Recovery Act

APPENDIX D

UFGS SECTION 02111
EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL

SEPTEMBER 2003

GUIDE SPECIFICATION FOR CONSTRUCTION

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DIVISION 02 - SITE CONSTRUCTION

SECTION 02111

EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL

09/03

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GUIDE SPECIFICATION FOR CONSTRUCTION

SECTION 02111

EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL
09/03

NOTE: This guide specification covers the requirements for excavation, handling, and temporary storage of contaminated material.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

PART 1 GENERAL

NOTE: The following information should be shown on the project drawings:

a. Overall site plan, borrow areas, stockpile areas, storage areas, security requirements, special shoring requirements, boring logs, and access routes.

b. Individual site plans of each area of contamination with site features such as buildings, roads, utilities, topography, trees, shrubs, surface conditions, etc.

c. Limits of pavement removal, fence removal, and the location of ancillary equipment to be removed.

All specific chemical testing procedures (including air emissions analysis) should be addressed in the Sampling and Analysis Plan required by Section 01450 CHEMICAL DATA QUALITY CONTROL.

When applicable, the use of onsite field screening or field analysis (supported at a prescribed frequency by fixed laboratory analysis) should be encouraged to avoid prolonged delays or equipment downtime. Details on the appropriate application and use of field analyses can be found in Appendix H of EM 200-1-3.

****

1.1 REFERENCES

****

NOTE: Issue (date) of references included in project specifications need not be more current than provided by the latest guide specification. Use of SpecsIntact automated reference checking is recommended for projects based on older guide specifications.

****

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2002) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2167	(1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(2000) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(2001) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 422	(1963; R 2002) Particle-Size Analysis of Soils
ASTM D 5434	(1997; R 2003) Field Logging of Subsurface Explorations of Soil and Rock
ASTM D 698	(2000a) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2003) Safety and Health Requirements Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926	Safety and Health Regulations for Construction
40 CFR 302	Designation, Reportable Quantities, and Notification

1.2 MEASUREMENT AND PAYMENT

****
NOTE: These paragraphs should be deleted if the work is in one lump-sum contract price. Coordinate requirements of these paragraphs with the bidding schedule.
****

1.2.1 Measurement

****
NOTE: Modify this paragraph if the method of payment will be on a weight basis.
****

Measurement for excavation and on-site transportation shall be based on the actual number of cubic meters yards of contaminated material in-place prior to excavation. Determination of the volume of contaminated material excavated shall be based on cross-sectional volume determination reflecting the differential between the original elevations of the top of the contaminated material and the final elevations after removal of the contaminated material. Measurement for backfilling of excavated areas shall be based on in-place cubic meters yards of compacted fill. Measurement for construction of stockpile areas shall be based on the number of square meters yards of stockpile liner constructed.

1.2.2 Payment

1.2.2.1 Excavation and Transportation

Compensation for excavation and onsite transportation of contaminated material will be paid as a unit cost. This unit cost shall include any other items incidental to excavation and handling not defined as having a specific unit cost.

1.2.2.2 Backfilling

Compensation for backfill soil, transportation of backfill, backfill soil conditioning, backfilling, compaction, and geotechnical testing will be paid as a single unit cost.

1.2.2.3 Stockpiling

Compensation for construction of stockpile areas will be paid for as a unit cost. This unit cost shall include all aspects of grading, preparation, handling, placement, maintenance, removal, treatment, and disposal of stockpile cover materials and liner materials and all other items incidental to construction of stockpiles.

1.3 SUBMITTALS

****

NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

****

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Surveys; G, [_____]

Separate cross-sections of each area before and after excavation and after backfilling.

SD-03 Product Data

Work Plan; G, [_____]

Work Plan within [30] [_____] calender days after notice to proceed. No work at the site, with the exception of site inspections and surveys, shall be performed until the Work Plan is approved. The Contractor shall allow [30] [_____] calender days

in the schedule for the Government's review. No adjustment for time or money will be made if resubmittals of the Work Plan are required due to deficiencies in the plan. At a minimum, the Work Plan shall include:

a. Schedule of activities.

b. Method of excavation and equipment to be used.

c. Shoring or side-wall slopes proposed.

d. Dewatering plan.

e. Storage methods and locations for liquid and solid contaminated material.

f. Borrow sources and haul routes.

g. Decontamination procedures.

h. Spill contingency plan.

Closure Report; G, [_____]

[_____] copies of the Closure Report within [14] [_____] calender days of work completion at the site.

SD-06 Test Reports

Backfill; G, [_____]
Surveys; G, [_____]
Confirmation Sampling and Analysis; G, [_____]
Sampling of Stored Material; G, [_____]
Sampling Liquid; G, [_____]
Compaction; G, [_____]

Test results.

1.4 SURVEYS

Surveys shall be performed immediately prior to and after excavation of contaminated material to determine the volume of contaminated material removed. Surveys shall also be performed immediately after backfill of each excavation. The Contractor shall provide cross-sections on [7.6] [_____] meter [25] [_____] foot intervals and at break points for all excavated areas. Locations of confirmation samples shall also be surveyed and shown on the drawings. Surveys shall be performed in accordance with Section: [_____].

1.5 REGULATORY REQUIREMENTS

1.5.1 Permits and Licenses

****
NOTE: Include additional site specific requirements in this paragraph.
****

The Contractor shall obtain required federal, state, and local permits for

excavation and storage of contaminated material. Permits shall be obtained at no additional cost to the Government.

1.5.2 Air Emissions

****

NOTE: An air pathway analysis should be performed during design to determine what air monitoring and controls are required. Guidance on air pathway analyses is provided in EP 1110-1-21 Air Pathway Analysis for the Design of Hazardous, Toxic, and Radioactive Waste (HTRW) Remedial Action Projects. Specify perimeter air monitoring requirements in Section 01355 ENVIRONMENTAL PROTECTION.

****

Air emissions shall be monitored and controlled in accordance with Section 01355.

1.6 DESCRIPTION OF WORK

****

NOTE: Include any pertinent information regarding project/site conditions in this paragraph, the appendices to the specifications, or on the drawings.

If oversize material such as debris and foundations are present, the specification should describe treatment, handling, and disposal requirements for this material. Measurement and payment procedures should also be described for this material.

If clean soil overlies the contaminated material, the specification should describe how this material will be measured, removed, stored, and tested to verify they are clean.

****

The work shall consist of excavation and temporary storage of approximately [_____] cubic meters yards of contaminated material. Approximate locations of contaminated material are shown on the drawings. Characterization data on the nature and extent of the contaminated material is shown in Appendix [_____]. Subsurface conditions are shown [on the drawings] [in Appendix [_____]]. The Contractor shall submit a Work Plan as specified in the Submittals paragraph. The Contracting Officer shall be notified within [24] [_____] hours, and before excavation, if contaminated material is discovered that has not been previously identified or if other discrepancies between data provided and actual field conditions are discovered. Backfill material is [not available onsite] [available onsite and typically consists of [_____]]. Ground water is approximately [_____] meters feet below pre-excavation ground surface.

1.7 CHEMICAL TESTING

Required sampling and chemical analysis shall be conducted in accordance with Section 01450A CHEMICAL DATA QUALITY CONTROL.

1.8 SCHEDULING

The Contractor shall notify the Contracting Officer [_____] calender days prior to the start of excavation of contaminated material. The [Contracting Officer will] [Contractor shall] be responsible for contacting regulatory agencies in accordance with the applicable reporting requirements.

PART 2 PRODUCTS

2.1 BACKFILL

****

NOTE: If contaminated material removal is part of a larger project and a backfilling specification is needed for the project as a whole, refer to another specification such as Section 02315 EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS for Buildings, for backfill requirements and delete the following paragraphs.

In many cases, the degree of engineering control of the materials used as backfill may not need to be as stringent as described in this paragraph. In other cases, such as under pavements, special compaction and material requirements may apply and the specification will need to be revised to address these special requirements or another specification section should be referenced.

Backfill and topsoil brought in from offsite is usually tested to verify the material is clean. Quality assurance samples taken by the Government may also be prudent to verify the seller's claims by analyzing for target analytes. Backfill is commonly tested for the site specific contaminants being cleaned up and/or is based on suspicion of contamination at the site from which the backfill is originating.

At some sites, previously contaminated material which has been removed from the excavation is reused as backfill following treatment to remove the contaminant of concern.

****

Backfill material shall be obtained from [the location indicated on the drawings] [offsite sources approved by the Contracting Officer]. Backfill shall be classified in accordance with ASTM D 2487 as GW, GP, GM, GC, SW, SP, SM, SC, ML, MH, CL, or CH and shall be free from roots and other organic matter, trash, debris, snow, ice or frozen materials. Backfill material shall be tested for the parameters listed below at a frequency of once per [3000] [_____] cubic meters yards. A minimum of one set of classification tests shall be performed per borrow source. [One] [_____] backfill sample per borrow source shall also be collected and tested for the chemical parameters listed below.

Physical Parameter	Criteria	Test Method
Grain Size	[_____]	ASTM D 422
Compaction	[_____]	ASTM D 698
[_____]	[_____]	[_____]

Chemical Parameter	Test Frequency	Criteria
[_____]	[_____]	[_____]

Backfill shall not be used until borrow source chemical and physical test results have been submitted and approved.

2.2 SPILL RESPONSE MATERIALS

The Contractor shall provide appropriate spill response materials including, but not limited to the following: containers, adsorbents, shovels, and personal protective equipment. Spill response materials shall be available at all times when contaminated materials/wastes are being handled or transported. Spill response materials shall be compatible with the type of materials and contaminants being handled.

PART 3 EXECUTION

3.1 EXISTING STRUCTURES AND UTILITIES

No excavation shall be performed until site utilities have been field located. The Contractor shall take the necessary precautions to ensure no damage occurs to existing structures and utilities. Damage to existing structures and utilities resulting from the Contractor's operations shall be repaired at no additional cost to the Government. Utilities encountered that were not previously shown or otherwise located shall not be disturbed without approval from the Contracting Officer.

3.2 CLEARING

****

NOTE: Grubbing is typically not required at sites where contaminated soil is being excavated for treatment and/or disposal. Typically, vegetation that is cut off above a certain height is defined as clean and any stumps and brush below this height are defined as contaminated.

****

Clearing shall be performed to the limits shown on the drawings in accordance with Section 02231 CLEARING AND GRUBBING.

3.3 CONTAMINATED MATERIAL REMOVAL

****

NOTE: Excavations should be marked and secured in accordance with the requirements specified in Section 01351 SAFETY, HEALTH, AND EMERGENCY RESPONSE (HTRW/UST).

****

3.3.2 Excavation

****

NOTE: For large excavations, more than one excavation log may be required.

****

Areas of contamination shall be excavated to the depth and extent shown on the drawings and not more than [60] [_____] mm [0.2] [_____] feet beyond the depth and extent shown on the drawings unless directed by the Contracting Officer. Excavation shall be performed in a manner that will limit spills and the potential for contaminated material to be mixed with uncontaminated material. An excavation log describing visible signs of contamination encountered shall be maintained for each area of excavation. Excavation logs shall be prepared in accordance with ASTM D 5434.

3.3.3 Shoring

If workers must enter the excavation, it shall be evaluated, shored, sloped or braced as required by EM 385-1-1 and 29 CFR 1926 section 650.

3.3.4 Dewatering

****

NOTE: Dewatering can significantly increase the cost of a project involving the excavation of contaminated material and should be carefully considered during design. TM 5-818-5 Dewatering and Groundwater Control provides guidance on the design of dewatering systems.

If water from dewatering operations will be allowed to discharge on or into the ground, an NPDES permit for dewatering is required. Reference the permits paragraph of Section 01355 ENVIRONMENTAL PROTECTION for permit requirements.

****

Surface water shall be diverted to prevent entry into the excavation. [Dewatering shall be limited to that necessary to assure adequate access, a safe excavation, prevent the spread of contamination, and to ensure that compaction requirements can be met.] [No dewatering shall be performed without prior approval of the Contracting Officer.]

3.4 CONFIRMATION SAMPLING AND ANALYSIS

****

NOTE: Confirmation samples and analyses are used to verify cleanup criteria have been met. These test results should be of relatively high quality. For this reason, the designer should consider the regulatory requirements, the complexity of the monitoring needed, and quantitative Data Quality Objectives in determining the analytical methods specified.

The number of confirmation samples must be based on the size of the excavation and regulatory requirements. For small excavations, a minimum of

one sample should be taken from near the center of the excavation (or where there is the highest potential for contamination). Additional samples may be oriented symmetrically relative to the center sample and the limits of the excavation.

Many military facilities have base-wide sampling and analysis plans which have been approved by the applicable regulatory agencies. These plans may specify the number of confirmation samples which must be taken.

For larger excavations, EPA 230/02-89-042 Methods of Evaluation and Attainment of Cleanup Standards provides guidance on the design of statistically based sampling intervals.

With regulator approval, confirmation sampling and analysis may be accomplished using an averaging technique for comparison to cleanup criteria. This is based on the fact that most soil risk exposure scenarios do not model contamination as existing in discrete hot spots but as a more disperse phenomenon. Two ways to accomplish this averaging technique are to take discrete samples and average the data or by compositing sample material before analysis. A composite sample typically consists of 4 to 6 samples which are mixed together. One sample is then obtained from the composite sample for analysis. EM 200-1-3 provides guidance on compositing samples. Composite samples are not applicable to volatile organic contaminants because the compositing process will result in volatilization of contaminants. If composite samples are required, Section 01450 CHEMICAL DATA QUALITY CONTROL should be edited by a qualified chemist to describe procedures for compositing samples.

Confirmation sampling at a site with radioactive contamination in surface soils or on building surfaces will be performed in accordance with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), NUREG-1575, EPA 402-R-97-016. This manual is a guide for confirmation survey design (planning) and for data evaluation. Its primary purpose is to acquire legally defensible data concerning the post excavation residual radioactivity at the site to demonstrate that the site meets release criteria.

****

The Contracting Officer shall be present to inspect the removal of contaminated material from each site. After all material suspected of being contaminated has been removed, the excavation shall be examined for evidence of contamination. If the excavation appears to be free of contamination, field analysis shall be used to determine the presence of [_____] contamination using [a real time vapor monitoring instrument] [immunoassay field kits] [_____]. Excavation of additional material shall

be as directed by the Contracting Officer. After all suspected contaminated material is removed, confirmation samples shall be collected and analyzed for the following contaminants:

Chemical Parameter	Action Level
[_____]	[_____]

Samples shall be collected at a frequency of one per [_____] square meters yards from the bottom [and each of the side walls] or as directed by the Contracting Officer. A minimum of one sample shall be collected from the bottom [and each side wall] of the excavation. Based on test results, the Contractor shall propose any additional excavation which may be required to remove material which is contaminated above action levels. Additional excavation shall be subject to approval by the Contracting Officer. Locations of samples shall be marked in the field and documented on the as-built drawings.

3.5 CONTAMINATED MATERIAL STORAGE

****

NOTE: For CERCLA sites, permits are not required to store hazardous waste in a stockpile. However, storage structures and conditions must be in compliance the Applicable, Relevant, and Appropriate Regulations (ARARs). For RCRA sites, permits are required to store hazardous waste in a stockpile. However, for RCRA sites, hazardous waste can be stored in a drum or roll-off unit for up to 90 days without a permit.

For temporary storage of more than 90 days, dual containment of hazardous liquid and some hazardous solids may be required. Containment system requirements are described in 40 CFR 264.175. For stock piles that meet the definition of a waste pile, see 40 CFR 264.250.

To provide secondary containment, tanks and roll-off units are sometimes stored on lined areas similar in design to what is described in paragraph Stockpiles.

****

Material shall be placed in temporary storage [immediately after excavation] [after treatment while awaiting test results]. The following paragraphs describe acceptable methods of material storage. Storage units shall be in good condition and constructed of materials that are compatible with the material or liquid to be stored. If multiple storage units are required, each unit shall be clearly labeled with an identification number and a written log shall be kept to track the source of contaminated material in each temporary storage unit.

3.5.1 Stockpiles

****

NOTE: Check state regulations to determine the minimum requirements for stockpiles and modify this paragraph accordingly. For contaminated material with high moisture content, the subgrade for the

stockpile must be sloped and a sump should be provided.

Scrim reinforced geomembranes are commonly specified for stockpile covers and liners. Due to their higher strength properties, scrim reinforced geomembranes can generally be thinner than non-reinforced geomembranes.

For post treatment stockpiles, chemical testing is usually required to determine if material is contaminated or clean. Maximum stockpile size should be based on the required frequency of chemical testing. For example, if chemical tests are required at a frequency of one per 1,000 cubic meters (cubic yards), then stockpiles should be no greater than 1,000 cubic meters (cubic yards) in size.

****

Stockpiles shall be constructed to isolate stored contaminated material from the environment. The maximum stockpile size shall be [_____] cubic meters. yards. Stockpiles shall be constructed to include:

a. [A chemically resistant geomembrane liner free of holes and other damage. Non-reinforced geomembrane liners shall have a minimum thickness of [0.5] [_____] mm. [20] [_____] mils. Scrim reinforced geomembrane liners shall have a minimum weight of 20 kg/100 square meters. 40 lbs. per 1000 square feet. The ground surface on which the geomembrane is to be placed shall be free of rocks greater than 12 mm 0.5 inches in diameter and any other object which could damage the membrane.] [Pavement shall be used as the liner system. Pavement shall be constructed in accordance with Section [_____]].

b. Geomembrane cover free of holes or other damage to prevent precipitation from entering the stockpile. Non-reinforced geomembrane covers shall have a minimum thickness of 0.25 mm. 10 mils. Scrim reinforced geomembrane covers shall have a minimum weight of 13 kg/100 square meters 26 lbs. per 1000 square feet. The cover material shall be extended over the berms and anchored or ballasted to prevent it from being removed or damaged by wind.

c. Berms surrounding the stockpile, a minimum of 300 mm 12 inches in height. Vehicle access points shall also be bermed.

d. The liner system shall be sloped to allow collection of leachate. Storage and removal of liquid which collects in the stockpile, in accordance with paragraph Liquid Storage.

3.5.2 Roll-Off Units

Roll-off units used to temporarily store contaminated material shall be water tight. A cover shall be placed over the units to prevent precipitation from contacting the stored material. The units shall be located [as shown on the drawings] [_____]. Liquid which collects inside the units shall be removed and stored in accordance with paragraph Liquid Storage.

3.5.3 Liquid Storage

Liquid collected from excavations and stockpiles shall be temporarily stored in {220 L barrels} [[2000] [_____] L tanks]. {55 gallon barrels} [[500] [_____] gallon tanks]. Liquid storage containers shall be water-tight and shall be located {as shown on the drawings} [_____].

3.6 SAMPLING

3.6.1 Sampling of Stored Material

****

NOTE: Additional samples are sometimes collected from excavated material to determine the contaminants present prior to treatment or disposal.

Composite samples are often collected from stockpiled material. However, composite samples cannot be taken if the samples are being analyzed for volatile organic contaminants.

At sites with radioactive contamination, ex-situ sampling of excavated material is typically performed to ensure that the material meets disposal facility acceptance criteria and, in some cases, to assist with the preparation of shipping papers. The ex-situ sampling regime is site-specific. It is usually determined in consultation with the disposal facility and its regulatory agency.

****

Samples of stored material shall be collected at a frequency of once per [_____] cubic meters. yards. Samples shall be tested for the following:

Chemical Parameter	Action Level
[_____]	[_____]

Stored material with contaminant levels that exceed the action levels shall be treated {offsite. Analyses for contaminated material to be taken to an offsite treatment facility shall conform to local, state, and federal criteria as well as to the requirements of the treatment facility. Documentation of all analyses performed shall be furnished to the Contracting Officer. Additional sampling and analyses to the extent required by the approved offsite treatment, storage or disposal (TSD) facility shall be the responsibility of the Contractor and shall be {performed at no additional cost to the Government} {subject to approval by the Contracting Officer}.} {onsite. Treatment shall be in accordance with Section [_____].}

3.6.2 Sampling Liquid

****

NOTE: Liquid should generally be tested for the same contaminants as are found in the contaminated solid material being removed. The frequency of testing should be determined on a site specific basis. Offsite disposal will generally require additional testing and analysis prior to disposal.

NPDES requirements must be considered for onsite disposal of liquids.

****

Liquid collected from [excavations] [storage areas] [decontamination facilities] shall be sampled at a frequency of once for every [2,000] [_____] L [500] [_____] gallons of liquid collected. Samples shall be tested for the following:

Chemical Parameter	Action Level
[_____]	[_____]

Liquid with contaminant levels that exceed action levels shall be treated [offsite. Analyses for contaminated liquid to be taken to an offsite treatment facility shall conform to local, state, and federal criteria as well as to the requirements of the treatment facility. Documentation of all analyses performed shall be furnished to the Contracting Officer. Additional sampling and analysis to the extent required by the approved offsite treatment, storage or disposal (TSD) facility receiving the material shall be the responsibility of the Contractor and shall be [performed at no additional cost to the Government] [subject to approval by the Contracting Officer].] [onsite. Treatment shall be in accordance with Section [_____].]

3.6.3 Sampling Beneath Storage Units

****

NOTE: At some sites, samples are collected to verify the soil on which a storage unit is placed has not become contaminated.

Sampling along any connecting pipelines that transport contaminated liquid may also be appropriate. A standard practice is to sample at 6 m (20 foot) intervals under piping and at connections such as bends, elbows, or tees.

****

Samples from beneath each storage unit shall be collected prior to construction of and after removal of the storage unit. Samples shall be collected at a frequency of one per each [_____] square meters yards from a depth interval of [0 to 0.15] [_____] m [0 to 0.5] [_____] feet and shall be tested for the following:

Chemical Parameter	Action Level
[_____]	[_____]

Based on test results, soil which has become contaminated above action levels shall be removed at no additional cost to the Government. Contaminated material which is removed from beneath the storage unit shall be handled in accordance with paragraph Sampling of Stored Material. As directed by the Contracting Officer and at no additional cost to the Government, additional sampling and testing shall be performed to verify areas of contamination found beneath stockpiles have been cleaned up to below action levels.

3.7 SPILLS

****

NOTE: Regarding preestablished spill reporting procedures, the designer should consult CEMP-RT memorandum of 20 July 1995, Subject: Spill Reporting Procedures for USACE Personnel Involved in HTRW Projects.

Evaluate whether a contingency plan is needed per 40 CFR 262.34. This regulation is a potential requirement for large quantity generators of hazardous waste. At military installations, a plan is typically already in place.

****

In the event of a spill or release of a hazardous substance (as designated in 40 CFR 302), pollutant, contaminant, or oil (as governed by the Oil Pollution Act (OPA), 33 U.S.C. 2701 et seq.), the Contractor shall notify the Contracting Officer immediately. If the spill exceeds the reporting threshold, the Contractor shall follow the pre-established procedures as described in the [RCRA Contingency Plan] [Base Wide Contingency Plan] [_____] for immediate reporting and containment. Immediate containment actions shall be taken to minimize the effect of any spill or leak. Cleanup shall be in accordance with applicable federal, state, and local regulations. As directed by the Contracting Officer, additional sampling and testing shall be performed to verify spills have been cleaned up. Spill cleanup and testing shall be done at no additional cost to the Government.

3.8 BACKFILLING

****

NOTE: If allowed by the regulatory authority, field analyses should be used to reduce laboratory turn-around time and minimize the duration an excavation must be left open.

After completion of backfilling, a 0.15 meter (6 inch) layer of top soil is typically placed in areas that are not paved. The topsoil is placed in a single lift to the lines and grades shown on the drawings. Top soil and seeding requirements should be described in a different section of the specification package.

****

3.8.1 Confirmation Test Results

Excavations shall be backfilled immediately after all contaminated materials have been removed and confirmation test results have been approved. Backfill shall be placed and compacted to the lines and grades shown on the drawings.

3.8.2 Compaction

****

NOTE: The following paragraph outlines density requirements for in-place backfill. If the density

of the backfill is not critical, modify this paragraph by replacing the density testing requirements with procedural requirements for compaction.

****

Approved backfill shall be placed in lifts with a maximum loose thickness of [200] [_____] mm. [8] [_____] inches. Soil shall be compacted to [90] [_____] percent of [ASTM D 698] [ASTM D 1557] maximum dry density. Density tests shall be performed at a frequency of once per [930] [_____] square meters [10,000] [_____] square feet per lift. A minimum of [one density test] [[_____] density tests] shall be performed on each lift of backfill placed. Field in-place dry density shall be determined in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. If ASTM D 2922 is used, a minimum of one in ten tests shall be checked using ASTM D 1556 or ASTM D 2167. Test results from ASTM D 1556 or ASTM D 2167 shall govern if there is a discrepancy with the ASTM D 2922 test results.

3.9 DISPOSAL REQUIREMENTS

Offsite disposal of contaminated material shall be in accordance with Section 02120A TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS.

3.10 CLOSURE REPORT

****

NOTE: In addition to progress photos, video tapes have been used at some sites to record site activities.

****

[_____] copies of a Closure Report shall be prepared and submitted within [14] [_____] calender days of completing work at the site. The report shall be labeled with the contract number, project name, location, date, name of general contractor, and the Corps of Engineers District contracting for the work. The Closure Report shall include the following information as a minimum:

a. A cover letter signed by a [responsible company official] [Professional Engineer registered in the State of [_____] who is a responsible company official] certifying that all services involved have been performed in accordance with the terms and conditions of the contract documents and regulatory requirements.

b. A narrative report including, but not limited to, the following:

(1) site conditions, ground water elevation, and cleanup criteria;

(2) excavation logs;

(3) field screening readings;

(4) quantity of materials removed from each area of contamination;

(5) quantity of water/product removed during dewatering;

(6) sampling locations and sampling methods;

(7) sample collection data such as time of collection and method of preservation;

(8) sample chain-of-custody forms; and

(9) source of backfill.

c. Copies of all chemical and physical test results.

d. Copies of all manifests and land disposal restriction notifications.

e. Copies of all certifications of final disposal signed by the responsible disposal facility official.

f. Waste profile sheets.

g. Scale drawings showing limits of each excavation, limits of contamination, known underground utilities within 15 m 50 feet of excavation, sample locations, and sample identification numbers. On-site stockpile, storage, treatment, loading, and disposal areas shall also be shown on the drawings.

h. Progress Photographs. Color photographs shall be used to document progress of the work. A minimum of four views of the site showing the location of the area of contamination, entrance/exit road, and any other notable site conditions shall be taken before work begins. After work has been started, activities at each work location shall be photographically recorded [daily] [weekly]. Photographs shall be a minimum of 76.2 x 127.0 mm 3 x 5 inches and shall include:

(1) Soil removal and sampling.

(2) Dewatering operations.

(3) Unanticipated events such as spills and the discovery of additional contaminated material.

(4) Contaminated material/water storage, handling, treatment, and transport.

(5) Site or task-specific employee respiratory and personal protection.

(6) Fill placement and grading.

(7) Post-construction photographs. After completion of work at each site, the Contractor shall take a minimum of four views of each excavation site.

A digital version of all photos shown in the report shall be included with the Closure Report. Photographs shall be a minimum of 76mm by 127 mm 3 inches by 5 inches and shall be mounted back-to-back in double face plastic sleeves punched to fit standard three ring binders. Each print shall have an information box attached. The box shall be typewritten and arranged as follows:

Project Name:
Location:
Photograph No.:

Direction of View:
Date/Time:
Description of View:

-- End of Section --

APPENDIX E

SiteLAB® UVF-3100 Operating Manual, 2006

siteLAB®
Environmental Testing Solutions
Test Soil & Water On-site for Petroleum Hydrocarbons

UVF•3100 Operating Manual

for all Sitelab Petroleum Hydrocarbon Applications

Online @site-lab.com For Technical Support Call:
Toll Free 877-SITELAB or Dial (USA) 978-363-2299

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UVF-3100 Standard Operating Procedures Version 6.0

User's Manual

All test procedures require these three very important components (right).

The standard operating procedures and instructions listed in this manual are grouped into sections. If you are looking for a specific topic, go to the categories located at the bottom of each page.

Use Sitelab's Quick Reference Guide when needed. Additional instructions are also provided with each Sitelab Calibration Kit.

Need to order more supplies? Need assistance or help getting started?

For sales or technical support:
Call USA: (978) 363-2299
Email: support@site-lab.com

1 Equipment Required

Model UVF-3100A:
For GRO, VPH, EPH/PAHs, DRO and other TPH Applications.

Model UVF-3100D:
For all 3100A applications plus Target PAH analysis.

Portable analyzer includes field case with all tools needed to perform tests. Warranty, tech support, CD-ROM with software and manual also included.

2 Use Extraction Kits

Product No. EXTR010-20
40 Test Tubes
20 Sitelab® Filters
20 Extraction Jars
20 Syringes + 20 Pipette Tips

Easy to use, disposable kits contain everything you need to prepare samples for analysis, quickly, accurately and quality controlled. Each kit contains enough supplies to test up to twenty soil, sediment or water samples. Solvent not included.

3 Select a Sitelab Calibration Kit

Certified, linear standards used for Sitelab's UVF-3100 analyzer. These products are specially designed to correlate to U.S. EPA GC Methods. All Calibration Kits are reusable for 3 months from date of purchase.

Each kit includes five linear calibrators, plus a Reference Standard, product certificate with instructions and MSDS.

Custom made, certified kits are also available using oil form you site. Call for details

WARNING! These products contain flammable alcohols. Dispose solvent waste properly.

Popular calibration kits available, which best correlate/match certified laboratory methods:

- Product No. CAL-025: GRO or VPH C6-C10 Gasoline Range Hydrocarbons (BTEX). Compares to EPA Method 8015-GRO
- Product No. CAL-042: TPH-EDRO C10-C40 Extended Diesel Range Hydrocarbons. Compares to EPA Method 8015-DRO
- Product No. CAL-060: Target PAHs for Polyaromatic Hydrocarbon Applications. Compares to EPA Method 8270 GC/MS PAHs
- Product No CAL-010: EPH C11-C22 Aromatic Hydrocarbon Fraction (Total PAHs). Compares to State TPH GC Methods for EPH
- Product No. CAL-057: TPH-Oil for Lubricating Oils, Motor/Waste Oil or Crude Oil Applications. Compares well to TPH Methods 418.1 or 1664

How Ultraviolet Fluorescence Technology Works...

Sitelab's portable Ultraviolet Fluorescence (UVF) technology is a very selective detection method. Aromatic hydrocarbons, which includes benzene, benzo[a]pyrene and other carcinogenic compounds found in petroleum, both excite and emit energy at specific wavelengths. Soil, sediment and water samples are first extracted in solvent using disposable test kits and the fluorescence response of each sample is then quantitated by the UVF-3100 analyzer on a linear, 5-point calibration curve using certified standards sensitive to the wavelengths of interest.

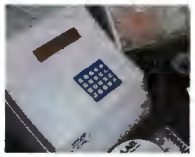
The analyzer contains a UV Lamp which first energizes petroleum hydrocarbons.

After solvent extraction, a sample is poured into a glass cuvette and placed into the analyzer for analysis.

The UVF-3100 is fitted with movable optical Excitation & Emission filters used to detect gasoline range, diesel range and polyaromatic range compounds separately from one another.

Accuracy & Lab Correlation...

- For maximum performance, select and use Sitelab Calibration Kits which are similar to the certified laboratory methods you are using for confirmatory analysis (see examples above).
- If you do not know which laboratory method is going to be used for comparison, or no confirmatory lab analysis is planned for your application, use a Sitelab Calibration Kit that best matches the type or source of the petroleum contamination found on your site. If the type of contamination is unknown or may involve different types of petroleum contaminants, ask Sitelab which calibration products are the most suitable.
- Use response factors to adjust and improve correlation to account for any technology differences (UVF vs. GC), sample homogeneity or other issues where the field screening results do not directly correlate. If the results are proportionately higher or lower, when compared to the lab, apply an 'average' response factor to the UVF concentrations. A new or different calibration kit may also be required.



Laboratory Setup Instructions

for Sitelab UVF•3100 Petroleum Hydrocarbon Applications

Online @site-lab.com For Technical Support Call:
Toll Free 877-SITELAB or Dial (USA) 978-363-2299

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Setup your Work Space...

Setup Work Space

- Before you begin, clear enough table space to set up your Sitelab equipment. Work space should be in a clean, dust-free area having a temperature range from 35 to 100 degrees (F).
- Connect power cords to analyzer and plug into an electric outlet. Use the DC inverter if operating from a car or truck.
- Have your Sitelab 20 Sample Extraction Kits and Calibration Kits nearby (needed to begin).

Solvent Dispenser Bottle

- Fill the dispenser bottle with methanol solvent (HPLC grade).
- Place a small cup below the nozzle to capture drips. Use this cup to collect waste solvent when cleaning/rinsing the glass cuvette during operations.

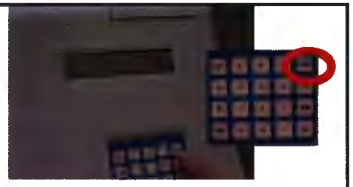
Methanol Solvent Required!

Always use "HPLC Grade" or high laboratory grade methanol only.

WARNING! Flammable alcohols. Dispose solvent waste properly.

Glass Cuvette Preparation

- Using the solvent dispenser bottle, rinse the glass cuvette with methanol several times between uses to avoid cross contamination. Pour/empty rinse solvent into the waste cup.
- When finished rinsing place cuvette upside down onto clean tissue wipes to drain.
- Handle the cuvette with care. A second cuvette is provided for back up – in case the original is scratched or damaged.



Turn On UVF-3100 Analyzer

- Turn on using the on/off switch located in the back. A 600 second warm-up countdown is displayed. Let the instrument finish it's warm up cycle at the beginning of each day or event.
- If analyzer is already warmed up, press the "H/HOME" key at any time to bypass the warm up sequence and go to the HOME screen. The HOME screen is the main screen used for testing samples or starting a calibration.

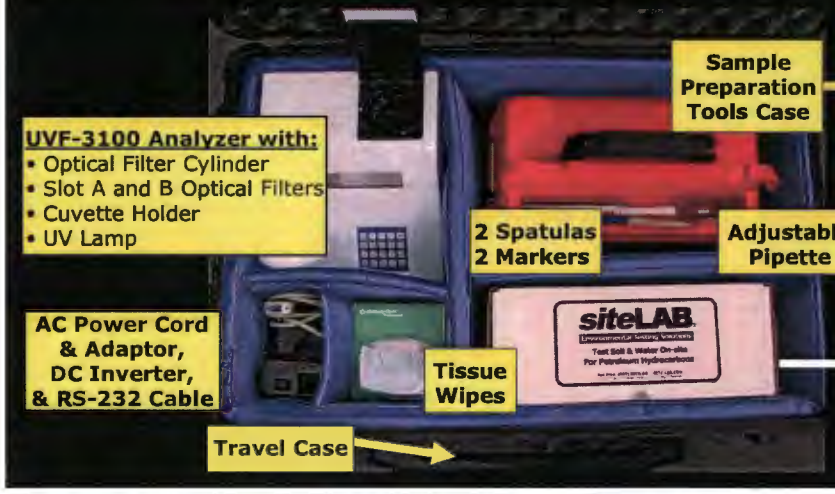
Check Lamp for UV Light

- Slide/pull out the optical filter cylinder and look down into chamber. When on, the UV lamp's blue light should be visible (fan should also be on)

Inspect/Change UV Lamp

- Open rear panel and check mercury vapor lamp. Be sure lamp is secure in socket and not damaged after shipping.
- Do not unplug fan. If you do, be sure to plug it back in!

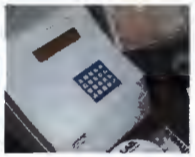
UVF-3100 Test Equipment Check List...



Storage space to hold one:
20 Sample Extraction Kit
Product No. EXTR010-20
40 Test Tubes (for extracts & dilutions)
20 Sitelab® Filters
20 Extraction Jars
20 Syringes + 20 Pipette Tips

Quick Reference Guide & CD-ROM, including:

- Instruction Manual with Standard Operating Procedures
- Software Programs
- Warranty Information



Sample Testing Instructions

for Sitelab UVF•3100 Petroleum Hydrocarbon Applications

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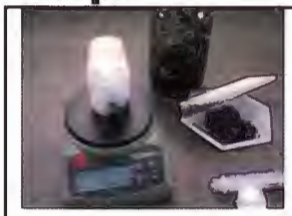
Sample Extraction & Dilution Procedures...



Testing Soil?

- Turn on scale. Place extraction jar on top of scale. Tare weight to zero.
- Measure 5 grams of soil (recommended) into jar using the metal spatulas. Weight should be within 0.1 gram (+/-).

10 grams may also be used, but clays or loamy soils may absorb too much solvent (added in the next step), making it difficult to filter.

Testing Water?

- Using a plastic test tube, measure out 10 mL of water and pour into extraction jar.
- Hydrocarbons in your water sample may be floating on the surface. Before measuring out your sample, shake the sample first to ensure water is homogenized.

2. Add Solvent

- Fill the solvent dispenser bottle with methanol and squeeze out 10 mL of solvent into a test tube and add to extraction jar containing the soil or water sample. Cap and tighten jars when finished.
- Important! Use a marker to label jar with the sample ID and "2X" dilution.

3. Shake Extract

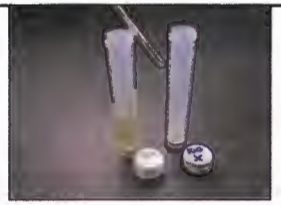
- Shake soil extract jars for several minutes, allowing ample time for the solvent to dissolve the contaminant. Use a timer or wrist watch, if necessary. Let extracts settle for several minutes afterward. This avoids clogs in the next step.
- Shake water extract jars for ten to twenty seconds.

4. Syringe & Filter Extract

- Remove lid and suck up 2 to 4 mL of extract from the jar's surface using a syringe.
- If syringe becomes clogged, let jar sit a few moments longer to let mud and debris settle to bottom, leaving a clear extract layer on top.
- Attach/screw a Sitelab Filter to the syringe and dispense contents back into test tube.

5. Label Extracts

- Label test tube with the sample ID and the dilution created. Examples:
- "2X" if 5 g soil extracted with 10 mL solvent.
- "1X" if 10 g soil extracted with 10 mL solvent.
- "2X" if 10 mL of a water sample was extracted with 10 mL solvent (50/50).



6. Dilute Extract ...Why?

In order for the sample to be detected within the analyzer's calibration range, a dilution must be prepared using the extract for analysis.

- We recommend you start with a 100X or 1,000X first, depending on how contaminated the sample is.
- Avoid testing Extracts! Only test Extracts if the sample has no odor OR no yellowish color.

Pipette...		Dilute To...	
Setting	Volume	5 mL	10 mL
"020"	20 uL	500X	1,000X
"100"	100 uL	100X	200X
"250" x2	500 uL	20X	40X

Note: Dilutions here include 2X from Extract

7. Prepare Dilution

Attach a tip to pipette by pressing down on the dial to extend the teeth and fit/snap in place. Be sure the tip functions properly.

- Adjust the setting on the pipette and transfer extract to a second test tube.
- Dilute with solvent to 5 mL or 10 mL line.

8. Put Dilution in Cuvette

- Fill the glass cuvette about ¾ full with sample dilution. You need enough liquid in the cuvette to clear the two windows on the bottom of the cuvette holder (~3 mL).
- Hold the top of the cuvette with one hand. With the other hand, clean the cuvette with a tissue wipe to remove any excess liquids or fingerprints.

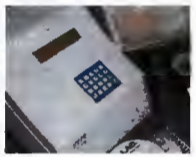
9. Use the Cuvette Holder

- Open the lid on top of the analyzer. Pull out the black cuvette holder from the optical filter cylinder.
- Carefully place glass cuvette into the holder, held in tight by the leaf springs. Be sure to avoid spills.
- The cuvette's position in the holder does not matter – all four sides are identical.

10. Lower into Analyzer

- Lower the cuvette holder back into the analyzer's optical filter cylinder until snug between the grooves
- Important! Be sure the arrow shaped handle of the cuvette holder always points to the silver dot (to the left of the lid).

Continue to Next Step



Sample Testing Instructions

for Sitelab UVF•3100 Petroleum Hydrocarbon Applications

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Analyze Sample & Record Results...

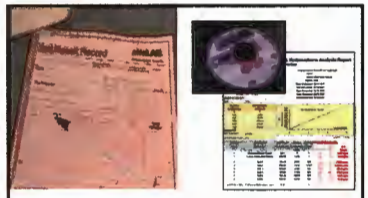
11. Wait for Reading

- Close the lid. Always read samples from the HOME screen.
- The analyzer will then display the sample's concentration.
- Allow a few seconds for the reading to stabilize.
- Concentration units are shown as "ppm" (default mode)

In soil or sediment: ppm as mg/Kg
In water: ppm as mg/mL

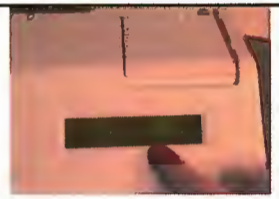
12. Calculate Final Result

- Multiply the reading on the display by the sample dilution being tested.
- If you are testing a 100X dilution, for example, and the sample reads "0.542 ppm," multiply the value by 100. The final result is 54.2 ppm.



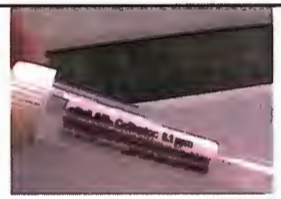
13. Record Test Results

- Manually record test results using the Test Result Record included with each Sitelab Extraction Kit.
- If connected to a computer, from the HOME screen, press "D" on keypad to send data. See 'Software' section for details.
- To view the sample's raw fluorescence value, press "8" and then return to the HOME screen.



14. "OVER" Readings

- If the sample you're testing reads "OVER," the sample is above the calibration range and a larger dilution is necessary.
- Empty out the test tube and prepare a higher dilution using the Extract and re-analyze.
- If testing a 1,000X dilution, which reads "OVER," pour out all but 1 mL and re-dilute tube to the 10 mL line for a 10,000X.



15. Non-Detect Readings

- Readings between zero and the lowest calibrator should not be reported. Prepare a smaller dilution and re-analyze.
- Or report sample as "ND" by multiplying the dilution tested by the concentration of the lowest calibrator. For example, a 100X sample reads below the 0.1 ppm TPH EDRO calibrator; 100X x 0.1 = ND <10 ppm.

Helpful Pointers Testing Dilutions...

Pipetting Dilutions:

- Sitelab's Gilson® adjustable pipette has an accurate range from 20 to 250 uL (microliters), using special capillary/piston disposable tips, allowing high precision volumetric dilutions.
- After installing, be sure each tip functions properly.
- Always replace a new tip between samples. To remove, push down on the dial firmly until the tip falls off.
- Avoid air bubbles in tip when making dilutions.
- Wipe outside tip with tissue to remove excess liquid, if necessary.

Reading Samples:

- Ideally, report samples which have readings between the lowest to highest calibration standards; in the middle of the calibration curve.
- Remember! if reading is between the lowest calibrator and zero, report as ND or prepare a smaller dilution and re-analyze or test the Extract if no quenching is suspected.
- When preparing dilutions, try to be as accurate as possible when adding solvent to the test tube's 5 mL line or 10 mL line. The meniscus should be as close as possible to the tube's graduations.

Example testing three samples:

Calibrated to Total PAHs:
Linear Range = 0 to 2 ppm
Highest Calibrator = 1.5 ppm
Lowest Calibrator = 0.05 ppm (detection limit)

Dilution:	Reading:	Comments:
1: 100X	"0.550"	OK, report as 55 ppm
2: 100X	"OVER"	Perform a bigger dilution
2: 1,000X	"1.250"	OK, report as 1,250 ppm
3: 100X	"0.020"	Report as ND = <5 ppm (100X x 0.05 = 5) or perform a smaller dilution
3: 10X	"0.210"	OK to report as 2.1 ppm

Quality Controls to Perform...

Sample Quenching?

- Highly concentrated samples and/or samples having a yellowish color when extracted may sometimes "quench" or swamp the detector. Instead of producing an "OVER" reading, the UVF-3100 may display a negative or false-low reading instead.
- Non-experienced operators may not be aware a sample dilution is required. This is why we strongly recommend you prepare and test a dilution first, even if you think the sample is clean. Avoid testing Extracts!
- Quenching is more common when testing GRO, VPH or BTEX.

Check for Quenching:

- Check for quenching by running two dilutions on the same sample. If results are not within 20% from one another, quenching may be occurring.
- At a minimum, always start by testing a sample at a 100X dilution first, or higher, if necessary.
- Empty out first dilution and use the Extract to prepare a higher dilution. Or, simply add more solvent to your current dilution going from the tube's 5 mL line to 10 mL line, which doubles the dilution factor (100X becomes a 200X).

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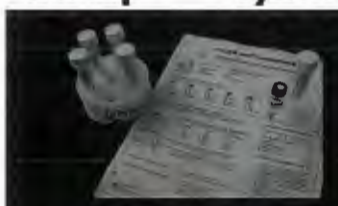
Setup Analyzer...



Choose a Calibration Kit

Select a Sitelab Calibration Kit for your application. Popular tests include GRO, EDRO, PAHs and TPH. Custom-made kits are also available using oil from your site. Ask Sitelab for details.

When to Calibrate?

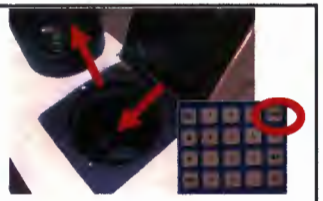
Recalibrate whenever a different analysis is being performed or if the instrument suffers from drift.

Optical Filter Alignment

Pull out and rotate the optical filter cylinder so that the correct filter slots A,B,C or D are aligned next to the silver dot located to the left of the lid. See your Calibration Kit Certificate for details or use the following:

Slot A: EDRO, EPH/PAH, TPH-Oil
Slot B: VPH, GRO (BTEX)
Slot C: Other applications/PCBs
Slot D: Target PAHs

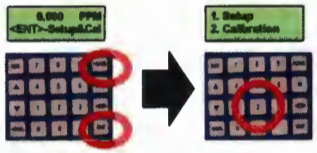
Start a New Calibration...



1. Begin from HOME Screen

Turn on analyzer. Let warm up if necessary. Confirm the lamp is on by sliding the optical filter cylinder out and looking down inside chamber (blue light should be visible). Return/align cylinder back to proper slot (A, B, C or D)

• Start a new calibration from the HOME screen. Press "ENT" from the HOME screen and Press "2" for Calibration.



2. Enter the Max Range

The Max Range setting appears. This sets the upper limit of the calibration curve. Enter the value listed with your Calibration Kit or use the following:

Max Range Values to Use:

Enter "12" for GRO, VPH, BTEX
Enter "20" for TPH-Oil
Enter "6" for TPH-EDRO
Enter "2" for EPH and PAHs

2. Max Range - Continued

• Press "1" if Max Range is OK or "9" to change it.

• When pressing 9, type in the new Max Range concentration and then press "ENT."

• Press "1" to accept the new Max Range you entered and go to next step.

Make a mistake? Press the "ESC" key at any time during the calibration process to abort and return to the HOME screen.

3. Enter Number of Stds

• The UVF-3100 will display the number of standards you want to use to create the calibration curve. For best performance, ALWAYS use all 5 calibrators included with your Sitelab kits.

• Enter "5" then press "ENT".

Note: If you choose to perform a quick, 1-point calibration, be sure to use the highest calibration standard.

4. Start with Highest Std

• You must analyze the highest concentrated standard first, each time you start a new calibration.

• The UVF-3100 displays the "Hi Std Conc." from the previous or current calibration.

• Press "1" if value is OK (if you are re-calibrating to the same analysis). Otherwise, press "9" to change it.

5. Changing the Hi Std?

• After pressing "9", enter the new Hi Std concentration (printed on the Calibrator) and then press "ENT."

• Press "1" to OK and accept the new concentration value you just entered. Examples:

VPH or GRO use:	10 ppm
TPH-Oil use:	15 ppm
TPH-EDRO use:	5 ppm
EPH or PAHs use:	1.5 ppm

6. Pour Hi Std into Cuvette

• Open the lid and pull out the cuvette holder.

• Remove the cap on the Hi Std calibrator and pour into the cuvette about ¾ full.

• Carefully place cuvette into the cuvette holder. Be sure to avoid spills. Use tissue wipes to clean the outside glass from any liquids/fingerprints, if necessary.

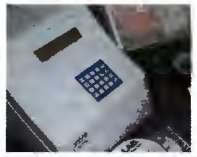
7. Insert Hi Std, Press <*>

• Lower the cuvette holder back into the optical filter cylinder until snug.

• Be sure the handle's arrow shaped handle is aiming at the silver dot located to the left of the lid.

• Next, close the lid and press the asterisk key <*>.

Continue to Step 8 ➡



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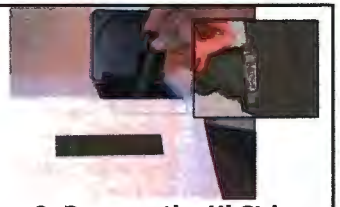
8. Sensitivity Set Value?

After you press the <*> key, do not open the lid. The analyzer adjusts it's sensitivity based on the concentration of the high standard. Once the sens factor is "set," the analyzer measures the Hi Std for several seconds. When finished, it will prompt you to enter the next standard.

Refer to the Calibration Kit Certificate or see Step 15 below for Sensitivity Set values to expect during calibration.



9. Remove the Hi Std

- Open the lid, pull out the cuvette holder and carefully remove cuvette. Pour the Hi Std back into it's test tube. Do not discard (calibrators are reusable)
- Rinse the cuvette several times with solvent so that the next calibrator you use, which will be lower in concentration, will not get cross-contaminated.

10. Calibrators 2 thru 5?

- After completing the Hi Std, analyzing standards 2, 3, 4 and 5 can be done in any random order you choose.
- To save time, use your lowest calibrator as the #2 Std and then go up. This avoids having to rinse the cuvette each time, as the calibrators increase in concentration and thus will not cross-contaminate each other.

11. Analyze #2 Std

- Fill the cuvette ¾ full with the lowest calibration standard and place into UVF-3100 as before.
- Press "9" to change the value. Type in the new value printed on the tube, press "ENT" and then "1" to OK.
- If you forget to change the value, an error may occur and you will need to start all over.

12. Second Std - Continued

- Insert the #2 Std into the analyzer, close the lid and press the <*> key as before.
- When the analyzer is finished and calls for the #3 Std, it is now safe to open the lid. Remove the 2nd calibrator and pour back into it's test tube.
- Invert cuvette onto tissues to drain any excess liquid.

13. Remaining Calibrators

- Analyze the 3rd, 4th and 5th calibrators the same way as the #2 Std.
- Be sure to change and enter the correct concentration for the calibrator each time.
- After testing #5 Std, the analyzer will prompt you to insert a Blank, where clean methanol solvent is used to 'zero' the instrument.

14. Analyze the Blank

- Rinse the cuvette with solvent and invert onto tissue wipes to drain any excess liquid left over from the #5 calibrator.
- Fill cuvette ¾ full with a clean dose of solvent and place into analyzer as before.
- Press "ENT" then the "0" key after value stabilizes. During GRO or VPH calibrations, the methanol will yield a positive value – do not be alarmed.

15. Calibration Complete!

When finished, the HOME screen appears and is now ready for sample analysis. The curve is electronically stored in memory. If connected to a computer, press "ENT" then "D" to send calibration data to Test Report.

Diagnostic Check

Press the "8" key to view the calibration sensitivity value.

Optimum Sensitivity Ranges for UVF-3100
Sens% for GRO, VPH, BTEX: 30-40
Sens% for PAHs, EPH, EDRO, TPH: 15-20

Quality Controls to Perform...

Calibration Checks:

- Recalibrating the analyzer each time you use it is not necessary as long as you are performing the same analysis.
- Periodically check the curve by analyzing one or two Calibrators as if they were samples to see how linear the curve is and whether or not the analyzer has suffered from drift.
- To test, fill the cuvette ¾ full with a Calibrator, place into the analyzer and wait for reading to stabilize. Do not press "ENT" for Setup/Cal.
- Calibration checks should read within 10 to 20% from their true concentration. If not, a new calibration may be required.

Methanol Blank Checks:

- Periodically analyze your methanol solvent. This is especially important before you begin extracting and testing samples. Blanks ensure the solvent used during operations is clean without interferences.
- When ever you purchase or use a new bottle of methanol, always test it first.
- To test, fill cuvette with a clean dose of solvent and place into the analyzer for analysis. Do not press the zero key.
- Readings should be at or close to zero ppm (+ or -). If not, then recalibrating the analyzer may be necessary.

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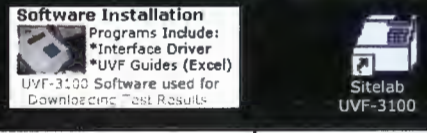
Software Features...

- Recording test results is fast, easy and improves quality control.
- Download and view the analyzer's linear 5-point calibration curve.
- Sample readings and dilutions are automatically calculated and recorded.

System Requirements...

- UVF-3100 Analyzer
- Sitelab Software CD
- RS-232 Serial Cable (standard)
- USB to Serial Adapter (optional/sold separately)
- Microsoft Windows® Operating Systems: XP, 2000, 98 or 95.
- Microsoft Excel
- Serial or USB Port

1. Install Software Programs



- Insert the Sitelab CD-ROM into your computer's compact disk drive. Wait a few moments for the auto start feature to activate your Internet Explorer browser.
- Scroll down and click "Software Installation Program," to begin the installation wizard.

- Next, choose "Run this program from its current location," and then click "Yes" in the Security Warning screen.
- Be sure to choose the Desktop Shortcut icon for easy access.
- After the installation is finished, your desktop reappears. Remove the CD from computer.

A Sitelab folder was created in your Program Files, which contains important programs to be used; a list of UVF-Guide Excel files and one Sitelab.EXE file which serves as the Interface Driver. If, during use, an error occurs or no data is received, check the Sitelab folder for these files.

2. Connect to Analyzer

Standard Cable Connection to Serial Port:

- Use the RS-232 cable supplied with your UVF-3100 and connect it to the male outlet of your computer's serial port.
- Connect the other end of the cable to the female outlet on the back of the UVF-3100.

No Serial Port?

Use Sitelab's USB to Serial Adapter:

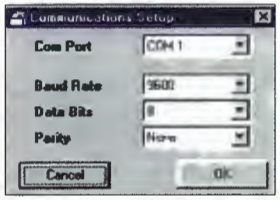
- Compatible with new computers that only have Universal Serial Bus (USB) ports.
- Sold Separately, Product No. 3100USB
- Includes Sitelab CD, USB cable, USB driver CD and installation instructions.

3. Check/Modify the Communication Settings...

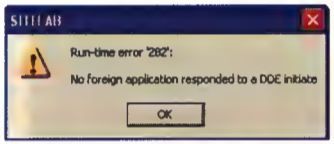
About the Sitelab Interface Driver...

The Interface Driver is a program which receives all the raw data coming from the instrument. Computers with different operating systems are configured differently from one another. As such, after installing the Sitelab software, check the Communication Settings on your computer to make sure the data will be received correctly:

- Open the Interface Driver by clicking on the icon. Go to "Com Setup" found in the Interface Driver's Options Menu and click "Communications Setup."
- Parity must be set to None, Baud Rate set to 9600 and Data Bits set to 8. Adjust these settings if necessary.
- Up to 9 Com Port options are listed. Switch/change the Com Port, if necessary, to accommodate the serial cable or USB connected to your computer.

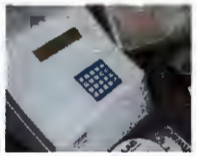


- The Driver's white window box will display the raw data received from the UVF-3100.
- Click here to keep the Interface Driver open, but out of view (minimize).
- Be sure to close the Interface Driver prior to opening a new UVF Guide.



Run Time Errors?

- If you experience a Run Time Error when sending data from the analyzer, the Interface Driver is on, but the UVF-Guide test report program you are using was either closed or you are trying to send the data to an Excel file that has a different name.
- If a Run Time Error occurs, close out the Interface Driver and any Excel files. Start over by clicking onto the Sitelab icon on your desktop.



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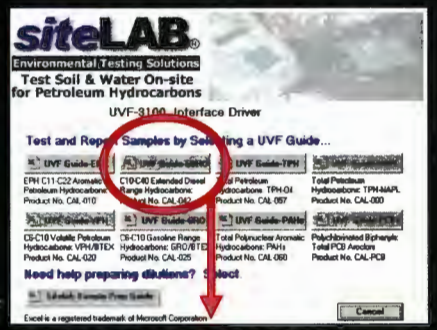
Open the Interface Driver and choose a UVF Guide to record your test results..

Sitelab UVF-3100

When you open the Interface Driver, a menu screen first appears (right).

The different UVF Guides contain spreadsheets where calibration and sample results are received and recorded.



Select the UVF Guide which matches the test you are performing

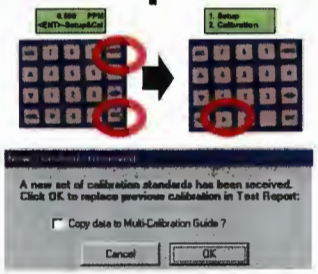
- Sitelab's UVF Guides are formatted in Microsoft Excel®, which automatically starts up after you make your selection. The "Test Report" worksheet will open by default.
- The UVF Guides are "Read Only" files, which serve as templates. When it comes time to save your Test Report, you will be asked to save the UVF Guide under a new file name.
- Once you save the UVF Guide under a new name, you can no longer send data to that file as the Interface Driver only delivers data to the Read Only files.
- To begin sending data again, you must close out the Interface Driver and Excel and start over.

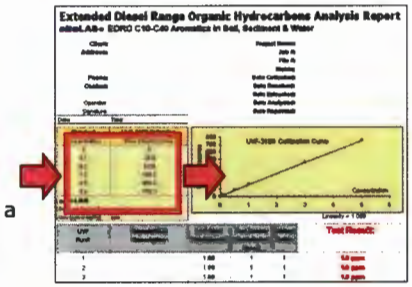
Send Calibration Curve to Test Report...

- Sending a new or current calibration curve from the UVF-3100 to the Test Report can be performed at any time as long as the software is running and the cable is connected.
- Starting from the HOME screen, press "ENT" so that the "1.Setup 2.Calibration" screen is displayed and then press the "D" key.

Your computer will then indicate "New Standards Received." Click OK if you want to replace the example calibration curve in the Test Report with the actual calibration data from the instrument.

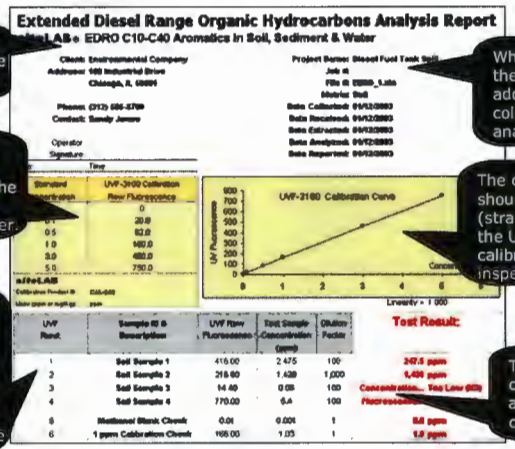
- Press the "H/HOME" key to return to the HOME screen. Do not press "2" unless you want to re-calibrate. Once you click OK, the instrument's concentration and fluorescence response values for all 5 Calibrators and the Blank will be placed into the Test Report and a linear curve will be generated for visual observations.





Note: Refer to the Manual's Software Section, available on the Sitelab CD-ROM, for instructions in using the "Multi-Calibration Guide" feature.

Saving & Editing your Test Report...



Be sure the analysis you performed matches the title and calibration kit applied.

When finished, enter the project name, address, sample collection date, analysis date, etc.

Replace the example calibration curve, which opens by default, with the actual calibration data directly from the analyzer.

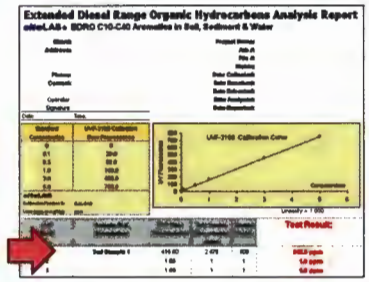
The calibration curve should have a linear slope (straight line). Confirm the UVF-3100 is properly calibrated by visually inspecting the curve.

Each report can record up to 20 sample results, including any calibration checks or other quality control tests performed. If all 20 rows are used up, save the UVF Guide and open a new one to continue.

The Test Report will display if a sample is above or below the calibration range.

Send Sample Data to Test Report...

- Send sample results from the UVF-3100 to the computer by pressing the "D" key from the HOME screen at any time. Be sure the sample is inside the instrument with the lid closed before doing so.
- Your computer will then indicate "New Sample Received" and ask you to enter the sample ID and dilution factor – Important!
- Once you name the sample and type in the appropriate dilution being tested, press enter. The sample's data is placed into the Test Report and the final result is calculated (on the right hand side in **red**). Then, continue to the next sample. If you make a mistake, click onto the worksheet and manually enter the information.



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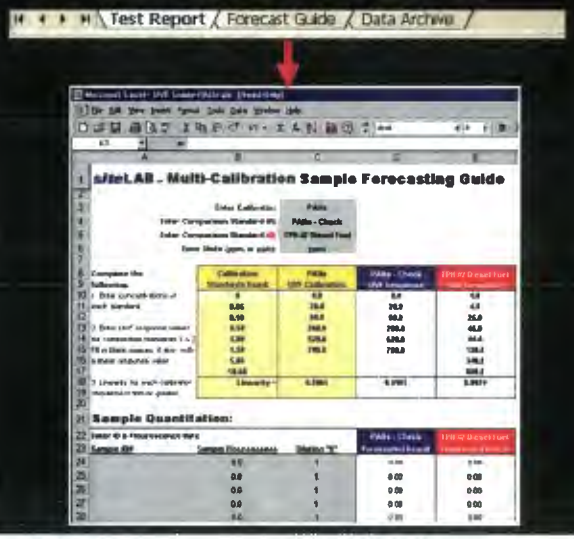
Using the Multi-Calibration Sample Forecasting Guide?

This time saving feature allows you to report test results simultaneously to two different calibration curves, without having to re-calibrate the instrument, even though the UVF-3100 generates results to only one curve at a time. Since both sets of calibration standards are linear to one another, the computer will generate the exact same result as if you re-calibrated the instrument and then re-analyzed the sample to the other calibration curve. Note: the same optics must be used when using this application: Slot A or B, but not both! This excludes a GRO and DRO combination.

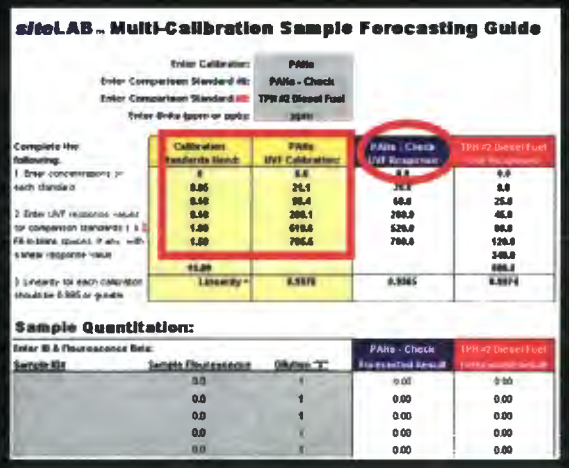
Typical applications include: testing TPH and EDRO together, weathered diesel and fresh diesel together and total PAHs and fuel oils together (as illustrated here). This is also helpful if a petroleum site has mixed types of contamination and you are unsure as to which Calibration Kit should be used to report results, especially if confirmatory lab analysis is performed. The "Forecast Guide" worksheet can be found at the bottom of your screen in each UVF Guide program.



STEP 1: Send Calibration to Forecast Guide

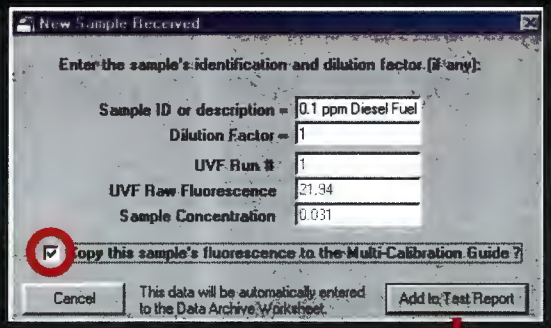
Before you begin analyzing samples, replace the example calibration curve (in yellow blocks) in the UVF Forecast Guide, by checking the box (circled in red below) each time you send a calibration curve from the instrument to the computer as before. Then press OK.

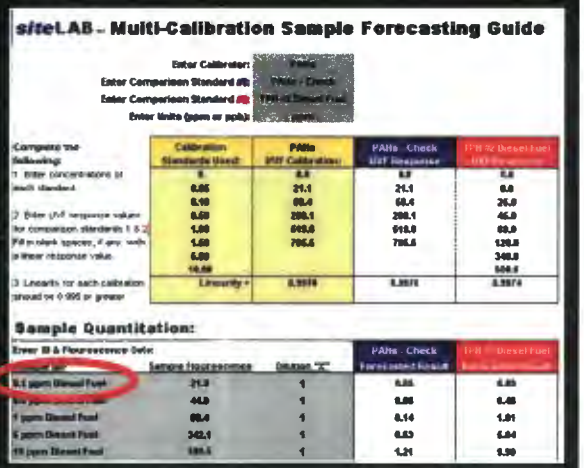
In this example, the blue column is used for Quality Control so that both the computer and UVF-3100 display the same reading. Manually type in the same UVF response values from the UVF's calibration (in yellow).

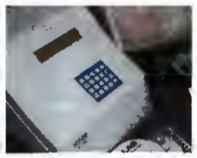


STEP 2: Analyze 2nd Calibrators for Forecast Guide

Using a different Sitelab Calibration Kit, analyze each of the five Calibrators one at a time as if they were samples. Download the results into the Forecast Guide by checking the box (circled in red below).







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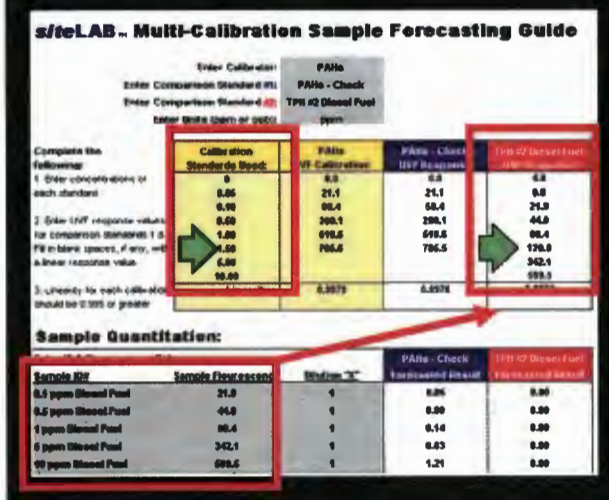
STEP 3: Transfer 2nd Calibration Data to Red Column:

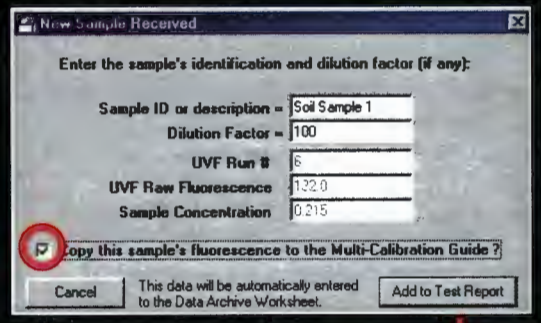
- Manually type the fluorescence response values generated by each of the new Calibrators by replacing the "dummy" UVF responses in the upper right red block.
- Be sure to match these five new fluorescence responses to their respective concentrations displayed in the upper left yellow block.

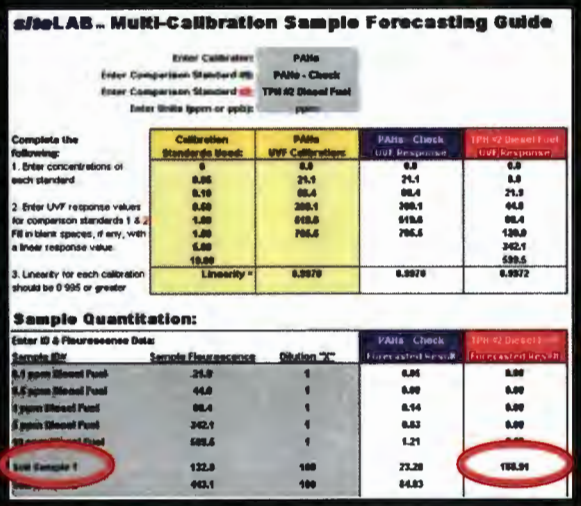
Important! Some of the 2nd set of Calibrators may not be available at the same concentrations as the 1st set. In this case, type in a number which provides the best "linear fit." In this example, the #2 Diesel Fuel Calibration Kit does not contain a 1.5 ppm Calibrator, where as the PAH kit does. Thus, a "120" UVF response value was placed into the space provided by multiplying the Diesel's 1 ppm fluorescence response by 1.5 (green)



STEP 4: Test & Send Sample Data to Multi-Calibration Guide:

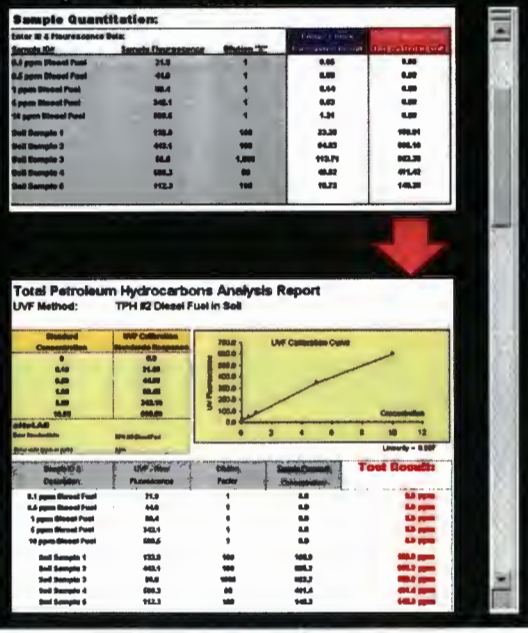
Now that your calibrators are complete, analyze your samples and download the results by checking the box (circled in red) as before. The blue and red columns will display the new concentrations for each curve.





Create a Test Report to the New Calibration Curve:

- Test Reports reflecting the calibration curves you applied and the sample results generated in both the blue and red columns can be found by scrolling down the worksheet.
- Within these Test Reports, be sure to manually type in the concentrations of the calibrators applied, including the fluorescence response values so that the calibration curve can be graphed and visually inspected.
- Since the Sitelab UVF Guides are "Read Only" files, each time you open this program you must manually re-enter the fluorescence response and concentration values in the upper yellow, blue, and red blocks as before. Re-analyzing these new standards each time, however, is not necessary, unless the UVF-3100 itself is re-calibrated to something else.
- To view the UVF-3100's calibration and sample results, click back to the Test Report worksheet at the bottom of your screen.



Troubleshooting Instructions

for Sitelab UVF•3100 Petroleum Hydrocarbon Applications

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Questions and answers to common problems you may be experiencing...

Software Installation:

Problem: My CD doesn't run when I put it into my computer.

Solution: The CD's auto start feature isn't working. Go into My Computer and manually open the "SitelabInstall.EXE" file.

Problem: Files are missing. Only the SitelabInstall file was downloaded. No other files were installed, including the Excel UVF Guide files.

Solution: In the first "File Download" screen, click "Run this program from its current location." Do not choose "Save this program to disk."

Problem: No data is received when using the USB Serial Adapter.

Solution: Open the Interface Driver and go to the Com Setup feature under the options menu. Change the Com Port setting and re-try.
Use the "HyperTerminal" feature on your computer as an alternative method to receive data. See the instructions included with your Sitelab USB Serial Adapter for details.

Computer Connection:

Problem: Cable is connected from UVF-3100 to computer. But when I press "D" nothing happens, no data is sent.

Solution: Interface Driver and UVF Guide Programs must both be open.

Problem: I get a "Run Time Error" when pressing D.

Solution: The Interface Driver program crashed, as the UVF Guide program was either closed or saved under a new name. Close down both programs and start over again.

Problem: When I press "D" to send data, the computer displays very strange or scrambled data.

Solution: Go to Com Setup in the About menu found in your Interface Driver. Set Parity to "None."

Problem: Pressing "D" on the analyzer's keypad isn't sending calibration data.

Solution: From the HOME screen, press "ENT" to go to the "1.Setup 2.Calibration" screen. Now press D. Press "H" to return to the HOME screen.

UVF-3100 Calibration:

Problem: I get a "Bad Cal" error during or after the calibration process.

Solution: Press "ESC" and then "1" to Abort. Start calibration over again. Be sure you type in the correct concentrations for all 5 Calibrators, including the Max Range value. Check if the correct optical filters (Slot A, B, etc.) are aligned properly next to silver dot to the left of the lid.

Problem: I get "Error5: Blk reads > Std#" message when calibrating.

Solution: The solvent you are using for the Blank fluoresces higher than one of the calibration standards. Be sure the methanol you are using is clean and the glass cuvette is thoroughly rinsed after testing the calibrators. If you try and recalibrate the analyzer and the Blank still creates an error, you may need to prepare new calibrators using your solvent and the Reference Standard supplied with your calibration kit. Refer to the product certificate for preparation instructions. By making new calibrators using your solvent, any methanol interferences will be zeroed out the next time you calibrate.

Refer to the Quality Controls listed in the Calibration Instructions page for additional information.

UVF-3100 Sample Analysis:

Problem: Sample has no reading, or a negative reading, when inside the chamber.

Solution: Check the alignment of the cuvette holder. Be sure the arrow shaped handle points to the silver dot to the left of the lid. The lid must also be closed when reading samples.

Problem: Sample readings drift slowly over time and do not settle.

Solution: Confirm the analyzer is properly calibrated by testing one or two of the calibration standards as if they were samples. If the calibrator concentrations are off and/or the readings drift, recalibrate the analyzer. Before doing so, however, visually inspect the curve by downloading the calibration data to a computer using the software. Be sure you are using the correct optical filters and that the optical filter cylinder is aligned properly. In addition, confirm the UV lamp is on by sliding out the optical filter cylinder. A blue light should be visible from down inside the chamber.

Refer to the Quality Controls listed in the Sample Testing Instructions page for additional information.

siteLAB®
Environmental Testing Solutions
Test Soil & Water On-site for Petroleum Hydrocarbons

Quick Reference Guide

for Sitelab UVF•3100 Petroleum Hydrocarbon Applications

Online @site-lab.com For Technical Support Call:
Toll Free 877-SITELAB or Dial (USA) 978-363-2299

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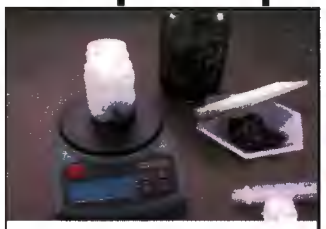
UVF-3100 Standard Operating Procedures Version 6.0

Sample Preparation & Analysis...



Testing Soil?

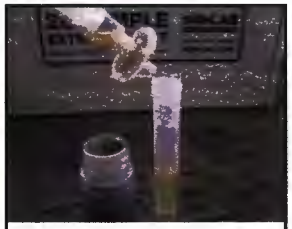
Using the digital scale and spatulas, weigh 5 grams of soil into an extraction jar (within +/- 0.1 gram)

Testing Water?

Using a plastic test tube, measure out 10 mL of water sample and add to extraction jar.

2. Add Solvent

Add Methanol to solvent dispenser bottle. Using a test tube, dispense solvent to the 10 mL line. Empty into the extraction jar. This creates a 2X Extract Dilution. Shake soil jars by hand for several minutes. Shake water jars for ten to twenty seconds.



3. Filter Extract

Let soil extract jars settle for a few minutes before removing lid. Suck up 2 to 4 mL of extract from the jar's surface using a syringe. Attach/screw a filter to the syringe and dispense contents into test tube. Label extract tube with sample ID and 2X Dilution – keep track!

4. Dilute Extract

Adjust the setting on the Sitelab pipette, attach a tip and use a 2nd test tube to prepare a larger dilution for analysis - in order for the sample to be detected within the analyzer's calibration range.

Recommended Dilutions:
Extract Volume + Solvent = DIL
"100"uL into 5 mL = 100X (start)
"020"uL into 10 mL = 1,000X

5. Add to Cuvette

Pour the dilution made in Step 4 into the glass cuvette. Cuvette needs to be about ¾ full. Use tissue wipes to clean outside glass to remove fingerprints and liquids. Next, carefully slide cuvette into the black cuvette holder. Be sure not to spill sample.

6. Test Sample

Lower into analyzer and close the lid. Be sure the cuvette holder's arrow shaped handle points to silver dot (to left of chamber). Wait a few seconds for concentration to stabilize. Multiply the reading by the dilution tested. Avoid readings below detection limit.

Products Used...

Sitelab test procedures listed here require the following...

UVF-3100 Analyzer & Tools:
Product No. UVF-3100A

- Optic Emission Filters
- Scale & Spatulas
- Adjustable Pipette
- Solvent Dispenser
- Tissues & Markers
- Software & Manual

20 Sample Extraction Kits:
Product No. EXTR010-20

- 40 Test Tubes
- 20 Sitelab® Filters
- 20 Jars
- 20 Syringes
- 20 Pipette Tips

WARNING! Product uses flammable alcohols – Methanol, HPLC grade. Dispose solvent waste properly.

Calibrate Instrument...

1. Calibration Kit

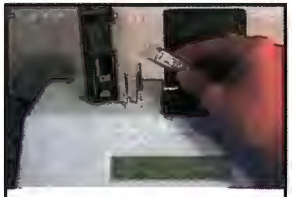
Choose a certified Sitelab Calibration Kit for your application:

Cal Kit & Emission Optics	
GRO/BTEX	Slot B
Total PAHs/EPH	Slot A
TPH-EDRO Range	Slot A
TPH-Oil Range	Slot A
Target PAHs	Slot D

Or ask about custom kits available

2. Setup Analyzer

Turn on. Allow to warm up or press "H" to bypass Rotate filter cylinder so that correct Emission Optics are aligned next to silver dot (to left). Press "ENT" then "2" and enter the proper Maximum Range setting (see cal kit certificate for details).



3. Calibrate

Always start using the highest calibrator first. Pour calibrator into cuvette and lower into analyzer. Be sure to enter and/or change the correct concentration. Pour calibrator back into test tube when finished. Test remaining calibrators

Quality Controls...

4. Clean Cuvette

Rinse with solvent into a waste jar between samples or calibrators. Place upside down onto tissue wipes to drain. Fill with clean methanol and analyze when prompted at end of each calibration. Wait for value to stabilize before pressing zero.

5. Check Curve

Periodically check the calibration curve for drift and linearity by testing one or two standards as if they were samples, including the methanol (as blank). To view curve and report test results, download data using Sitelab UVF3100 software

APPENDIX F

NMED TPH SCREENING GUIDELINES

NOVEMBER 2005

NEW MEXICO ENVIRONMENT DEPARTMENT TPH SCREENING GUIDELINES
November 2005

In some instances, it may be practical to assess areas of soil contamination that are the result of releases of petroleum products such as jet fuel and diesel, using total petroleum hydrocarbon (TPH) analyses. TPH results may be used to delineate the extent of petroleum-related contamination at these sites and ascertain if the residual level of petroleum products in soil represents an unacceptable risk to future users of the site. Petroleum hydrocarbons represent complex mixtures of compounds, some of which are regulated constituents and some compounds that are not regulated. In addition, the amount and types of the constituent compounds in a petroleum hydrocarbon release differ widely depending on what type of product was spilled and how the spill has weathered. This variability makes it difficult to determine the toxicity of weathered petroleum products in soil solely from TPH results; however, these results can be used to approximate risk in some cases, depending upon the nature of the petroleum product, the release scenario, how well the site has been characterized, and anticipated potential future land uses. In some cases, site clean up cannot be based solely on results of TPH sampling. The New Mexico Environment Department (NMED) will make these determinations on a case by case basis. If NMED determines that additional data are necessary, these TPH guidelines must be used in conjunction with the screening guidelines for individual petroleum-related contaminants in Table 3 and other contaminants, as applicable.

The screening levels for each petroleum carbon range from the Massachusetts Department of Environmental Protection (MADEP) Volatile Petroleum Hydrocarbons/Extractable Petroleum Hydrocarbons (VPH/EPH) approach and the percent composition table below were used to generate screening levels corresponding to total TPH. Except for waste oil, the information in the compositional assumptions table was obtained from the Massachusetts Department of Environmental Protection guidance document *Implementation of the MADEP VPH/EPH Approach* (October 31, 2002). TPH toxicity was based only on the weighted sum of the toxicity of the hydrocarbon fractions listed in Table 1.

Table 1. TPH Compositional Assumptions in Soil

Petroleum Product	C11-C22 Aromatics	C9-C18 Aliphatics	C19-C36 Aliphatics
Diesel #2/ new crankcase oil	60%	40%	0%
#3 and #6 Fuel Oil	70%	30%	0%
Kerosene and jet fuel	30%	70%	0%
Mineral oil dielectric fluid	20%	40%	40%
Unknown oil[a]	100%	0%	0%
Waste Oil[b]	0%	0%	100%

[a] Sites with oil from unknown sources must be tested for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals, and polychlorinated biphenyls (PCBs) to determine if other potentially toxic constituents are present. The TPH guidelines in Table 2 are not designed to be protective of exposure to these constituents therefore they must be tested for, and compared to, their individual NMED soil screening guidelines.

[b] Compositional assumption for waste oil developed by NMED is based on review of chromatographs of several types of waste oil. Sites with waste oil must be tested for VOCs, SVOCs, metals, and PCBs to determine if other potentially toxic constituents are present. The TPH guidelines in Table 2 are not designed to be protective of exposure to these constituents therefore they must be tested for, and compared to, their individual NMED soil screening guidelines.

A TPH screening guideline was calculated for each of the types of petroleum product based on the assumed composition from Table 1 for petroleum products and the direct soil standards incorporating ceiling concentrations given in the MADEP VPH/EPH Excel spreadsheet for each of the carbon fractions. Groundwater concentrations are based on the weighted sum of the noncarcinogenic toxicity of the petroleum fractions.

Method 1 from the MADEP VPH/EPH document was applied, which represents generic cleanup standards for soil and groundwater. Method 1 applies if contamination exists in only soil and groundwater. The MADEP VPH/EPH further divides groundwater into standards. Standard GW-1 applies when groundwater may be used for drinking water purposes. GW-1 standards are based upon ingestion and use of groundwater as a potable water supply. The TPH screening guidelines for sites with potable groundwater are presented in Table 2a.

Table 2a. TPH Screening Guidelines for Potable Groundwater (GW-1)

TPH			Concentration in Groundwater (mg/L)
Petroleum Product	**Residential Direct Exposure (mg/kg)**	**Industrial Direct Exposure (mg/kg)**	
Diesel #2/crankcase oil	520	1120	1.72
#3 and #6 Fuel Oil	440	890	1.34
Kerosene and jet fuel	760	1810	2.86
Mineral oil dielectric fluid	1440	3040	3.64
Unknown oil [a]	200	200	0.2
Waste Oil [b]	2500	5000	Petroleum-Related Contaminants
Gasoline	Not applicable	Not applicable	Petroleum-Related Contaminants

[a] Sites with oil from unknown sources must be tested for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals, and polychlorinated biphenyls (PCBs) to determine if other potentially toxic constituents are present. The TPH guidelines in Table 2 are not designed to be protective of exposure to these constituents therefore they must be tested for, and compared to, their individual NMED soil screening guidelines.

[b] Compositional assumption for waste oil developed by NMED is based on review of chromatographs of several types of waste oil. Sites with waste oil must be tested for VOCs, SVOCs, metals, and PCBs to determine if other potentially toxic constituents are present. The TPH guidelines in Table 2 are not designed to be protective of exposure to these constituents therefore they must be tested for, and compared to, their individual NMED soil screening guidelines.

The second standard is GW-2, which is applicable for sites where the depth to groundwater is less than 15 feet from the ground surface <u>and</u> within 30 feet of an occupied structure. The structure may be either residential or industrial. GW-2 standards are based upon "inhalation exposures that could occur to occupants of the building impacted by volatile compounds, which partition from the groundwater" (MADEP 2001). The GW-2 screening guidelines ONLY apply for the evaluation of inhalation exposures. If potential ingestion or contact with contaminated soil and/or

groundwater could occur, then the screening guidelines provided in Table 2.a should be applied. Table 2.b lists the TPH screening guidelines for the inhalation scenario.

Table 2b. TPH Screening Guidelines – Vapor Migration and Inhalation of Groundwater (GW-2)

TPH			Concentration in Groundwater (mg/L)
Petroleum Product	**Residential Direct Exposure (mg/kg)**	**Industrial Direct Exposure (mg/kg)**	
Diesel #2/crankcase oil	880	2200	30.4
#3 and #6 Fuel Oil	860	2150	35.3
Kerosene and jet fuel	940	2350	15.7
Mineral oil dielectric fluid	1560	3400	10.4
Unknown oil [a]	800	2000	50.0
Waste Oil [b]	2500	5000	Petroleum-Related Contaminants
Gasoline	Not applicable	Not applicable	Petroleum-Related Contaminants

[a] Sites with oil from unknown sources must be tested for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals, and polychlorinated biphenyls (PCBs) to determine if other potentially toxic constituents are present. The TPH guidelines in Table 2 are not designed to be protective of exposure to these constituents therefore they must be tested for, and compared to, their individual NMED soil screening guidelines.

[b] Compositional assumption for waste oil developed by NMED is based on review of chromatographs of several types of waste oil. Sites with waste oil must be tested for VOCs, SVOCs, metals, and PCBs to determine if other potentially toxic constituents are present. The TPH guidelines in Table 2 are not designed to be protective of exposure to these constituents therefore they must be tested for, and compared to, their individual NMED soil screening guidelines.

Mineral oil based hydraulic fluids can be evaluated for petroleum fraction toxicity using the screening guidelines from Tables 2a and 2b specified for waste oil, because this type of hydraulic fluid is composed of approximately the same range of carbon fractions as waste oil. However, these hydraulic fluids often contain proprietary additives that may be significantly more toxic than the oil itself; these additives must be considered on a site- and product-specific basis (see ATSDR hydraulic fluids profile reference). **Use of alternate screening guideline values requires prior written approval from the New Mexico Environment Department.** TPH screening guidelines in Tables 2a and 2b must be used in conjunction with the screening levels for petroleum-related contaminants given in Table 3 because the TPH screening levels are NOT designed to be protective of exposure to these individual petroleum-related contaminants. Table 3 petroleum-related contaminants screening levels are based on the New Mexico Environment Department soil screening levels (SSLs) released in February 2004.

The list of petroleum-related contaminants does not include polyaromatic hydrocarbons (PAHs) with individual screening levels that would exceed the total TPH screening levels (acenaphthene, anthracene, flouranthene, flourene, and pyrene). In addition, these TPH screening guidelines are based solely on human health, not ecological risk considerations, protection of surface water, or

potential indoor air impacts from soil vapors. Potential soil vapor impacts to structures or utilities are not addressed by these guidelines. Site-specific investigations for potential soil vapor impacts to structures or utilities must be done to assure that screenings are consistently protective of human health, welfare or use of the property. NMED believes that use of these screening guidelines will allow more efficient screenings of petroleum release sites at sites while protecting human health and the environment. Copies of the references cited below are available on the MADEP website at http://www.state.ma.us/dep/bwsc/vph_eph.htm and the NMED website at http://www.nmenv.state.nm.us/HWB/guidance.html.

Table 3. Petroleum-Related Contaminants Screening Guidelines

Petroleum-Related Contaminants	Values for Direct Exposure to Soil		NMED DAF[a] 20 GW protection (mg/kg in soil)	NMED DAF[b] 1 GW protection (mg/kg in soil)
	NMED residential SSL (mg/kg)	NMED Industrial SSL (mg/kg)		
Benzene	2.70E+01	7.36E+01	2.83E-02	1.41E-03
Toluene	2.48E+02	2.48E+02	6.80E+00	3.40E-01
Ethyl benzene	1.06E+04	2.54E+04	1.05E+01	5.25E-01
Xylene[c]	1.32E+02	1.32E+02	1.01E+01	5.07E-01
Naphthalene	7.19E+01	9.83E+01	3.93E-01	1.97E-02
2-methyl naphthalene	1.00E+03[d]	2.50E+03[d]	---[d]	---[d]
Benzo(a)anthracene	6.21E+00	2.34E+01	1.10E+00	5.49E-02
Benzo(b)fluoranthene	6.21E+00	2.34E+01	3.40E+00	1.7E-01
Benzo(k)fluoranthene	6.21E+01	2.34E+02	3.40E+01	1.70E+00
Benzo(a)pyrene	6.21E-01	2.34E+00	6.12E+00	3.06E-01
Chrysene	6.21E+02	2.34E+03	1.10E+02	5.49E+00
Dibenz(a,h) anthracene	6.21E-01	2.34E+00	1.05E+00	5.24E-02
Indeno(1,2,3-c,d) pyrene	6.21E+00	2.34E+01	9.58E+00	4.79E-01

[a] DAF – Dilution Attenuation Factor
[b] For contaminated soil in contact with groundwater
[c] Based upon total xylenes
[d] No NMED value available, value taken from MADEP 2002

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1997. Toxicological Profile for Hydraulic fluids.

Massachusetts Department of Environmental Protection, Bureau of Waste Site Cleanup and Office of Research and Standards. 1994. "Background Documentation for the Development of the MCP Numerical Standards."

Massachusetts Department of Environmental Protection, Bureau of Waste Site Cleanup and Office of Research and Standards. 2002. "Characterizing Risks Posed by Petroleum Contaminated Sites: Implementation of the MADEP VPH/EPH Approach," Policy, October 31, 2002.

Massachusetts Department of Environmental Protection, Bureau of Waste Site Cleanup and Office of Research and Standards. 2003. "Updated Petroleum Hydrocarbon Fraction Toxicity Values for the VPH/EPH/APH Methodology." November 2003.

New Mexico Environment Department, Hazardous Waste Bureau and Groundwater Quality Bureau Voluntary Remediation Program. 2004. "Technical Background Document for Development of Soil Screening Levels." February 2004. Revision 2.0.

APPENDIX G

ASTM STANDARD D2922 *TEST METHODS FOR DENSITY OF SOIL AND SOIL-AGGREGATE IN PLACE BY NUCLEAR METHODS (SHALLOW DEPTH)*

Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)[1]

This standard is issued under the fixed designation D 2922; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

These test methods have been approved for use by agencies of the Department of Defense. Consult the DoD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

[ε1] NOTE—Table 1 was corrected editorially in December 1997.

1. Scope

1.1 These test methods cover the determination of the total or wet density of soil and soil-rock mixtures by the attenuation of gamma radiation where the source and detector(s) remain on the surface (Backscatter Method) or the source or detector is placed at a known depth up to 300 mm (12 in.) while the detector(s) or source remains on the surface (Direct Transmission Method).

1.2 The density in mass per unit volume of the material under test is determined by comparing the detected rate of gamma radiation with previously established calibration data.

1.3 The values tested in SI units are to be regarded as the standard. The inch-pound equivalents may be approximate.

1.4 It is common practice in the engineering profession to c[illegible]rently use pounds to represent both a unit of mass (lb[illegible]) and a unit of force (lbf). This implicitly combines two separate systems of units; that is, the absolute system and the gravitational system. It is scientifically undesirable to combine the use of two separate sets of inch-pound units within a single standard. This standard has been written using the gravitational system of units when dealing with the inch-pound system. In this system the pound (lbf) represents a unit of force (weight). However, the use of balances or scales recording pounds of mass (lbm), or the recording of density in lbm/ft^3 should not be regarded as nonconformance with this standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* For specific Hazard statements, see Section 6.

2. Referenced Documents

2.1 *ASTM Standards:*

D 698 Test Method for Moisture-Density Relations of Soil and Soil-Aggregate Mixtures Using 5.5-lb (2.49-kg) Rammer and 12-in. (305-mm) Drop[2]

D 1557 Test Method for Moisture-Density Relations of Soil and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop[2]

D 3216 Test Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures[2]

D 3017 Test Method for Water Content of Soil and Rock In-Place by Nuclear Methods (Shallow Depth)[2]

D4253 Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table[2]

D4643 Test Method for Determination of Water Content by the Microwave Oven Method[2]

D 4718 Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles[2]

D4944 Test Method for Field Determination of Water (Moisture) Content of Soil by the Calcium Carbide Gas Pressure Tester Method[3]

D4959 Test Method for Determination of Water (Moisture) Content by Direct Heating Method[3]

3. Significance and Use

3.1 The test methods described are useful as rapid, nondestructive techniques for the in-place determination of density of soil and rock.

3.2 The test methods are suitable for quality control and acceptance testing for construction and for research and development applications.

3.3 The nondestructive nature of the tests allow repetitive measurements to be made at a single test location.

4. Interferences

4.1 The chemical composition of the sample may affect the measurement, and adjustments may be necessary.

4.2 The test methods exhibit spatial bias in that the instrument is more sensitive to the density of the material in close proximity to the surface (Backscatter Method only).

NOTE 1—The nuclear gauge density measurements are somewhat biased to the surface layers of the soil being tested. This bias has *largely*

[1] These test methods are under the jurisdiction of ASTM Committee D-18 on Soil and Rock and are the direct responsibility of Subcommittee D18.08 on Special and Construction Control Tests.

Current edition approved Oct. 10, 1996. Published February 1997. Originally published as D 2922 – 71. Last previous edition D 2922 – 91.

[2] *Annual Book of ASTM Standards*, Vol 04.08.

[3] *Annual Book of ASTM Standards*, Vol 04.09.

been corrected out of the direct transmission method and any remaining bias is insignificant. The backscatter method is still more sensitive to the material within the first several inches from the surface.

4.3 Oversize rocks or large voids in the source-detector path may cause higher or lower density determination. Where lack of uniformity in the soil due to layering, rock or voids is suspected, the test volume site should be dug up and visually examined to determine if the test material is representative of the full material in general and if rock correction (see 9.6) is required.

4.4 The sample volume is approximately 0.0028 m^3 (0.10 ft^3) for the Backscatter Method and 0.0057 m^3 (0.20 ft^3) for the Direct Transmission Method when the test depth is 15 cm (6 in.). The actual sample volume is indeterminate and varies with the apparatus and the density of the material. In general, the higher the density the smaller the volume.

5. Apparatus

5.1 *Nuclear Gage*—An electronic counting instrument, capable of being seated on the surface of the material under test, and which contains:

5.1.1 A sealed source of high energy gamma radiation such as cesium or radium.

5.1.2 *Gamma* Detector-Any type of gamma detector such as a Geiger-Mueller tube(s).

5.2 *Reference Standard-A* block of material used for checking instrument operation and to establish conditions for a reproducible reference count rate.

5.3 *Site Preparation* Device-A plate, straightedge, or other suitable leveling tool which may be used for planning the test site to the required smoothness, and in the Direct Transmission Method, guiding the drive pin to prepare a perpendicular hole.

5.4 *Drive Pin-A* pin of slightly larger diameter than the rod in the Direct Transmission Instrument, used to prepare a hole in the material under test for inserting the rod.

5.5 *Drive Pin Extractor-A* tool that may be used to remove the drive pin in a vertical direction so that the pin will not distort the hole in the extraction process.

5.5.1 A slide hammer, with a drive pin attached, may also be used both to prepare a hole in the material to be tested and to extract the pin without distortion to the hole.

6. Hazards

6.1 This equipment utilizes radioactive materials that may be hazardous to the health of the users unless proper precautions are taken. Users of this equipment must become familiar with applicable safety procedures and government regulations.

6.2 Effective user instructions together with routine safety procedures, such as source leak tests, recording and evaluation of film badge data, etc., are a recommended part of the operation and storage of this instrument.

7. Calibration

7.1 Calibration of the instrument will be in accordance with Annex A I.

8. Standardization and Reference Check

8.1 Nuclear gages are subject to long-term aging of the radioactive source, detectors, and electronic systems, which may change the relationship between count rate and material density. To offset this aging, the gage may be calibrated as the ratio of the measured count rate to a count rate made on a reference standard or to an air-gap count (for the backscatter air-gap technique, see 9.5.1.3). The reference count rate should be of the same order of magnitude as the measured count rate over the useful density range of the instrument.

8.2 Standardization of the gage shall be performed at the start of each day's work, and a permanent record of these data shall be retained. Perform the standardization with the gage located at least 8 m (25 ft) away from other sources of radioactive material, and clear of large masses or other items which may affect the reference count rate.

8.2.1 If recommended by the instrument manufacturer to provide more stable and consistent results: (*1*) turn on the gauge prior to use to allow it to stabilize, (2) leave the power on during the use of the gage for that day.

8.2.2 Using the reference standard, take at least four repetitive readings at the normal measurement period and determine the mean. If available on the gage, one measurement period of four or more times the normal period is acceptable. This constitutes one standardization check.

8.2.3 If the value obtained above is within the limits stated below, the gage is considered to be in satisfactory condition, and the value may be used to determine the count ratios for the day of use. If the value is outside these limits, allow additional time for the gage to stabilize, make sure the area is clear of sources of interference, and then conduct another standardization check. If the second standardization check is within the limits, the gage may be used, but if it also fails the test, the gage shall be adjusted or repaired as recommended by the manufacturer. The limits are as follows:

$$|N_s - N_o| \leq 2.0 \sqrt{N_o/F} \quad (1)$$

where:

N_s = value of current standardization count,

N_o = average of the past four values of N_s taken for prior usage, and

F = value of prescale. [The prescale value (F) is a divisor which reduces the actual value for the purpose of display. The manufactor will supply this value if other than 1.0.] Some instruments may have provisions to compute and display these values.

8.2.3.1 If the instrument standardization has not been checked within the previous three months, perform at least four new standardization checks, and use the mean as the value for N_o.

8.3 Use the value of N_s to determine the count ratios for the current day's use of the instrument. If for any reason the measured density becomes suspect during the day's use, perform another standardization check.

9. Procedure for Field Use

9.1 Standardize the gage. (See Section 8.)

9.2 Select a test location. If the gage will be closer than 250 mm (10 in.) to any vertical mass that might influence the result, such as in a trench or alongside a pipe, follow the manufacturer's correction procedure.

9.3 Remove all loose and disturbed material. Remove

additional material as necessary to reach the material that represents a valid sample of the zone or stratum to be tested. Surface drying and spatial bias should be considered in determining the depth of material to be removed.

9.4 Plane or scrape a smooth horizontal surface so as to obtain maximum contact between the gage and the material being tested. The placement of the gage on the surface of the material to be tested is always important, but is especially critical to the successful determination of density when using the *backscatter* method. The optimum condition in all cases, is total contact between the bottom surface of the gauge and the surface of the material being tested. To correct for surface irregularities, use of native fines or fine sand as a filler may be necessary. The depth of the filler should not exceed approximately 3 mm (1/8 in.) and the total area filled should not exceed 10 % of the bottom area of the instrument. The maximum depth of any void beneath the gage that can be tolerated without filling shall not exceed approximately 3 mm (1/8 in.). Several trial seatings may be required to achieve these conditions.

9.5 Proceed with the test in the following manner:

9.5.1 Backscatter Procedure:

9.5.1.1 Seat the gage firmly on the prepared test site.

9.5.1.3 Keep all other radioactive sources away from the gauge to avoid affecting the measurement so as not to affect the readings.

9.5.1.3 Secure and record one or more readings for the normal measurement period in the backscatter position.

NOTE 2—When using the backscatter air-gap procedure, follow the instrument manufacturers instructions regarding apparatus set up. Take the same number of readings for the normal measurement period in the air-gap position as in the standard backscatter position. Determine the air-gap ratio by dividing counts per minute obtained in the air-gap position by counts per minute obtained in standard backscatter position.

9.5.1.4 Determine the ratio of the reading to the standard count or to the air gap count. From this count ratio and the appropriate calibration and adjustment data, determine the in-place wet density.

9.5.2 *Direct Transmission Procedure:*

9.5.2.1 Make a hole perpendicular to the prepared surface using the guide and the hole-forming device 5.4, or by drilling if necessary. The hole shall be of such depth and alignment that insertion of the probe will not cause the gage to tilt from the plane of the prepared area. The depth of the hole must be deeper than the depth to which the probe will be placed. The guide shall be the same size as the base of the gauge, with the hole in the same location on the guide as the probe on the gauge. The corners of the guide are marked by scoring the surface of the soil. The guide plate is then removed and any necessary repairs are made to the prepared surface.

9.5.2.2 Proceed with testing in the following manner:

9.5.2.3 Set the gage on the soil surface, carefully aligning it with the marks on the soil so that the probe will be directly over the pre-formed hole.

9.5.2.4 Insert the probe in the hole.

9.5.2.5 Seat the gage firmly by rotating it about the probe with a back and forth motion.

9.5.2.6 Pull gently on the gage in the direction that will bring the side of the probe against the side of the hole that is closest to the detector (or source) location in the gauge housing.

9.5.2.7 Keep all other radioactive sources away from the gage to avoid affecting the measurement.

9.5.2.8 Secure and record one or more readings for the normal measurement period.

9.5.2.9 Determine the ratio of the reading to the standard count. From this count ratio and the appropriate calibration and adjustment data, determine the in-place wet density.

NOTE 3—Some instruments have built-in provisions to compute the ratio, wet density, and to enter an adjustment bias. Additionally some instruments may have provisions to measure and compute moisture content, and dry density.

9.6 If the volume tested as defined in 4.4 has excess oversize material with respect to the limitations in the appropriate Test Methods D 698, D 1557 or D 4253, then a correction for wet density (unit weight) and water content must be applied. This correction will be done in accordance with Practice D 4718. This test method requires sampling from the actual test volume.

9.6.1 If samples of the measure material are to be taken for purposes of correlation with other test methods or rock correction, the volume measured can be approximated by a 200 mm (8 in.) diameter cylinder located directly under the center line of the radioactive source and detector(s). The height of the cylinder to be excavated will be the depth setting of the source rod when using the Direct Transmission method or approximately 75 mm (3 in.) when using the Backscatter Method.

9.6.2 An alternative to the correction for oversize particles, that can be used with mass density methods or minimal oversize situations, involves multiple tests. Tests may be taken at adjacent locations and the results averaged to get a representative value. Comparisons need to be made to evaluate whether the presence of a single large rock or void in the soil is producing unrepresentative values of density. Whenever values obtained are questionable, the test volume site should be dug up and visually examined.

10. Calculation of Results

10.1 The in-place wet density is determined as outlined in 9.5. If dry density is required, the in-place water content shall be determined using either gravimetric samples and laboratory determination of water content (Test Methods D 2216, D 4643, D 4959, D 4944), or an instrument which determines water content by neutron thermalization (Test Method D 3017).

10.1.1 If the water content is determined by nuclear methods, Test Method D 3017, subtract the kg/m^3 (lbf/ft^3) of moisture from the kg/m^3 (lbf/ft^3) of wet density, and obtain dry density in kg/m^3 (lbf/ft^3).

10.1.2 If the water content is determined by other methods, and is in the form of percent, proceed as follows:

$$\rho_d = \frac{100\rho_m}{100 + w} \quad (2)$$

where:

ρ_d = dry density in kg/m^3 (lbf/ft^3),
ρ_m = wet density in kg/m^3 (lbf/ft^3), and
W = water as a percent of the dry mass.

11. Report

11.1 Report the following information:

11.1.1 Standardization and adjustment data for the date of the tests.

11.1.2 Make, model and serial number of the test instrument.

11.1.3 Name of the operator(s).

11.1.4 Test site identification.

11.1.5 Visual description of material tested.

11.1.6 Test mode (backscatter or direct transmission) and test depth (if applicable).

11.1.7 Wet and dry densities in kg/m^3 or unit weights in lb/ft^3.

11.1.8 Water content in percent of dry mass or dry unit weight.

12. Precision and Bias

12.1 *Precision:*

12.1.1 Precision-Criteria for judging the acceptability of wet density test results obtained by this test method are given in Table 1. The figure in column three represents the standard deviations that have been found to be appropriate for the materials tested in column one. The figures given in column four are the limits that should not be exceeded by the difference between the results of two properly conducted tests. The figures given are based upon an interlaboratory study in which five test sites containing soils, with wet densities as shown in column two were tested by eight different devices and operators. The wet density of each test site was determined three times by each device.[4]

12.1.2 An instrument count precision of 8 kg/m^3 (0.5 lbf/ft^3) for the Backscatter Method and 4 kg/m^3 (0.25 lbf/ft^3) Direct Transmission Method are typical on a material of approximately 2000 kg/m^3 (125 lbf/ft^3) density, with a measurement time of one minute.

[4] The data used to establish this precision statement is contained in a Research Report available from ASTM Headquarters. Request RR:D 18- 1004.

TABLE 1 Results of Statistical Analysis

Precision and Soil Type	Average kg/m^3 (lb/ft^3)	Standard Deviation, kg/m^3 (lb/ft^3)	Acceptable Range of Two Results kg/m^3 (lb/ft^3)
Single Operator Precision:			
Direct Transmission:			
CL	1637 (114.7)	5.4 (0.34)	15.1 (0.94)
SP	1937 (120.9)	4.3 (0.27)	11.9 (0.74)
ML	2064 (130.1)	7.4 (0.46)	20.5 (1.28)
Backscatter:			
ML	1996 (124.6)	19.4 (1.21)	54.3 (3.39)
Multilaboratory Precision:			
Direct Transmission:			
a	1637 (114.7)	10.6 (0.66)	29.8 (1.66)
SP	1937 (120.9)	10.9 (0.66)	30.6 (1.91)
ML	2084 (130.1)	12.3 (0.77)	34.4 (2.15)
Backscatter:			
ML	1996 (124.6)	36.1 (2.36)	107 (6.67)

12.1.2.1 Instrument count precision is defined as the change in density that occurs corresponding to a one standard deviation change in the count due to the random decay of the radioactive source. The density of the material and the time period of the count must be stated. It may be determined from a series of 20 or more counts taken without moving the instrument, or alternately from the calibration data using the assumption that σ is equal to the $\sqrt{\text{count}}$ at that density. The count must be the true instrument count corrected for any pre-scaling (see 8.2.3).

$$P = \frac{\sigma}{S} \tag{3}$$

where:

P = instrument precision in density (kg/m^3 or lbf/ft^3)

σ = one standard deviation of the count

S = the slope of the calibration curve at the defined density value.

12.2 *Bias:*

12.2.1 There is no accepted reference value for this test method, therefore, bias cannot be determined.

13. Keywords

13.1 density; field density; nuclear methods

ANNEX

(Mandatory Information)

A1. CALIBRATION

A1.1 Verify or reestablish calibration curves, tables, or equation coefficients at least once every 12 to 18 months and after all major repairs which may affect the instrument geometry.

A1.2 The instrument shall be calibrated in such a way as to produce a calibration response within ± 16 kg/m^3 (± 1.0 lbf/ft^3) on blocks of materials (standards) of established densities. (This calibration may be done by the manufacturer, the user, or an independent vendor.) Nuclear instrument response is influenced by the chemical composition of measured material. This response must be taken into account in establishing the assigned standard block density. The densities of materials used to establish or verify the calibration should extend through a range representative of the density of the materials to be tested. The density of these material standards shall be determined to an accuracy of ± 0.2 %.

A1.3 Sufficient data shall be taken on each density standard to ensure an instrument count precision of at least one-half the instrument count precision required for field use. The data may be presented in the form of a graph, table equation coefficients, or stored in the gauge, to allow covering the count rate data to material density.

A1.4 The method and test procedures used in establishing

the calibration count rate data shall be the same as those used for obtaining the field count rate data.

A1 .5 The material type, actual density and assigned dard block density of each calibration standard used to establish or verify the instrument calibration shall be stated as part of the calibration data.

A1 .6 The standards shall be of sufficient size to not change the count rate if enlarged in any dimension. Minimum surface dimensions of approximately 6 10 mm long by 430 mm wide (24 by 17 in.) have proven satisfactory. For the Backscatter Method a minimum depth of 230 mm (9 in.) is adequate; for the Direct Transmission Method the depth shall be at least 50 mm (2 in.) deeper than the deepest rod depth. A larger surface area may be required for the Backscatter Air-Gap technique. Minimum surface dimensions may be reduced slightly if the standards are adjacent to a dense material.

A1 .7 The most successful standards that have been established for accurate calibration have been made of aluminum, magnesium, aluminum/magnesium, granite and limestone. These standards have been used in combination with each other and with historical curve information to produce accurate and reliable calibration.

A1 .7.1 Standards of soil, rock, and concrete that have the characteristics of reproducible uniformity are difficult to prepare. These standards may be of use for some special calibration or field calibration where local site material chemistry or background situation require special adaptation.

The American Society for Testing and Materials takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

APPENDIX H

UFGS SECTION 02770A
CONCRETE SIDEWALKS AND CURBS AND GUTTERS

MARCH 2004

UNIFIED FACILITIES GUIDE SPECIFICATIONS

Latest change indicated by CHG tags
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SECTION 02770A

CONCRETE SIDEWALKS AND CURBS AND GUTTERS
03/04

****
NOTE: This guide specification covers the requirements for concrete sidewalks and curbs and gutters.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

This guide specification includes tailoring options for sidewalks, and curbs and gutters. Selection or deselection of a tailoring option will include or exclude that option in the section, but editing the resulting section to fit the project is still required.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.
****

PART 1 GENERAL

****
AND=GUTTERS> s/public.html> AND=GUTTERS> s/public.html>NOTE: This specification may be adjusted to cover separate curbs and gutters or combination curbs and gutters. This guide specification will not be used for integral or

monolithic curbs of concrete pavement or for curbs and gutters for bridges.

****

1.1 REFERENCES

****

NOTE: Issue (date) of references included in project specifications need not be more current than provided by the latest guide specification.

****

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(1991; R 2000) Burlap Cloth Made from Jute or Kenaf

ASTM INTERNATIONAL (ASTM)

ASTM A 185	(2002) Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A 615/A 615M	(2003a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 143/C 143M	(2003) Slump of Hydraulic Cement Concrete
ASTM C 171	(2003) Sheet Materials for Curing Concrete
ASTM C 172	(1999) Sampling Freshly Mixed Concrete
ASTM C 173	(1994ael) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 231	(2003) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 309	(2003) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2003a) Making and Curing Concrete Test Specimens in the Field
ASTM C 920	(2002) Elastomeric Joint Sealants
ASTM D 1751	(1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

ASTM D 1752	(1984; R 1996e1) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 5893	(1996) Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements

1.2 MEASUREMENT FOR PAYMENT

****

NOTE: The MEASUREMENT FOR PAYMENT and BASIS FOR PAYMENT paragraphs will be deleted if the work covered by this section of the specifications is included in one lump-sum contract price for the entire work covered by the invitation for bids.

****

1.2.1 Sidewalks

The quantities of sidewalks to be paid for will be the number of square meters yards of each depth of sidewalk constructed as indicated.

AND=GUTTERS> s/public.html> AND=GUTTERS> s/public.html>1.2.2 Curbs and Gutters

The quantities of curbs and gutters to be paid for will be the number of linear meters feet of each cross section constructed as indicated, measured along the face of the curb at the gutter line.

1.3 BASIS FOR PAYMENT

1.3.1 Sidewalks

Payment of the quantities of sidewalks measured as specified will be at the contract unit price per square meter yard of the thickness specified.

AND=GUTTERS> s/public.html> AND=GUTTERS> s/public.html>1.3.2 Curbs and Gutters

Payment of the quantities of curbs and gutters measured as specified will be at the contract unit price per linear meter foot of each cross section.

1.4 SUBMITTALS

****

NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

A "G" following a submittal item indicates that the

submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

****

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Concrete

Copies of certified delivery tickets for all concrete used in the construction.

SD-06 Test Reports

Field Quality Control

Copies of all test reports within 24 hours of completion of the test.

1.5 WEATHER LIMITATIONS

1.5.1 Placing During Cold Weather

Concrete placement shall not take place when the air temperature reaches 5 degrees C 40 degrees F and is falling, or is already below that point.

Placement may begin when the air temperature reaches 2 degrees C 35 degrees F and is rising, or is already above 5 degrees C 40 degrees F. Provisions shall be made to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 2 degrees C 35 degrees F, placement and protection shall be approved in writing. Approval will be contingent upon full conformance with the following provisions. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. [Mixing water and aggregates] [Mixing water] [Aggregates] shall be heated as necessary to result in the temperature of the in-place concrete being between 10 and 30 degrees C 50 and 85 degrees F. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 10 degrees C 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

1.5.2 Placing During Warm Weather

The temperature of the concrete as placed shall not exceed 30 degrees C 85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. The placing temperature shall not exceed 35 degrees C 95 degrees F at any time.

1.6 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.6.1 General Requirements

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Contracting Officer shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

AND=GUTTERS> s/public.html> AND=GUTTERS> s/public.html>1.6.2 Slip Form Equipment

Slip form paver or curb forming machine, will be approved based on trial use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in 1 pass.

PART 2 PRODUCTS

2.1 CONCRETE

Concrete shall conform to the applicable requirements of [Section 03300A CAST-IN-PLACE STRUCTURAL CONCRETE] [Section 02753A CONCRETE PAVEMENT FOR AIRFIELDS AND OTHER HEAVY-DUTY PAVEMENTS] [Section 02754A CONCRETE

PAVEMENTS FOR SMALL PROJECT] except as otherwise specified. Concrete shall have a minimum compressive strength of 24 MPa 3500 psi at 28 days. Maximum size of aggregate shall be 37.5 mm 1-1/2 inches.

2.1.1 Air Content

****

NOTE: The air content specified is for concrete that will be subjected to freezing weather and the possible action of deicing chemicals. In climates where freezing is not a factor but where air entrainment is used in local commercial practice to improve the workability and placeability of concrete, concrete having air content percent of 4.5 plus or minus 1.5 percent may be specified as Contractor's option to non air-entrained concrete.

****

Mixtures shall have air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

2.1.2 Slump

****

NOTE: The desired slump will be inserted. Suggested limits are 75 mm (3 inches) plus or minus 25 mm (1 inch) for hand placed concrete or 25 mm (1 inch) plus or minus 10 mm (1/2 inch) for slipformed concrete.

****

The concrete slump shall be 50 mm plus or minus 25 mm 2 inches plus or minus 1 inch where determined in accordance with ASTM C 143/C 143M.

2.1.3 Reinforcement Steel

****

NOTE: Reinforcement steel normally will not be required for curb and gutter construction. Where conditions exist that make it advantageous to use reinforcement steel, the reinforcing steel details will be indicated, and the following paragraphs will be included in the contract specification.

****

Reinforcement bars shall conform to ASTM A 615/A 615M. Wire mesh reinforcement shall conform to ASTM A 185.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Impervious sheet materials shall conform to ASTM C 171, type optional, except that polyethylene film, if used, shall be white opaque.

2.2.2 Burlap

Burlap shall conform to AASHTO M 182.

2.2.3 White Pigmented Membrane-Forming Curing Compound

White pigmented membrane-forming curing compound shall conform to ASTM C 309, Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Concrete protection materials shall be a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

AND=GUTTERS> s/public.html> AND=GUTTERS> s/public.html>2.4.1 Contraction Joint Filler for Curb and Gutter

Contraction joint filler for curb and gutter shall consist of hard-pressed fiberboard.

2.4.2 Expansion Joint Filler, Premolded

****

NOTE: Either type of joint sealer may be specified if determined necessary by the Contracting Officer and the inapplicable publication removed. Joint sealing material may be omitted where sealing of expansion joints is not deemed essential or advisable.

****

Expansion joint filler, premolded, shall conform to ASTM D 1751 or ASTM D 1752, 13 mm 1/2 inch thick, unless otherwise indicated.

2.5 JOINT SEALANTS

Joint sealant, cold-applied shall conform to ASTM C 920 or ASTM D 5893.

2.6 FORM WORK

Form work shall be designed and constructed to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete. Wood forms shall be surfaced plank, 50 mm 2 inches nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of

3 m 10 feet. Radius bends may be formed with 19 mm 3/4 inch boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of 3 m 10 feet with a minimum of 3 welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.1 Sidewalk Forms

Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk.

AND=GUTTERS> s/public.html> AND=GUTTERS> s/public.html>2.6.2 Curb and Gutter Forms

Curb and gutter outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Rigid forms shall be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 3 m 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 38 mm 1-1/2 inch benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface, provided the results are approved.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

****

NOTE: On most projects, major grading operations involving excavation and construction of embankments will be performed and paid for under other sections of the specifications and, therefore, are not included in this guide specification. Where such work, including the construction of any required subbase, must be done under this section, paragraphs FORM SETTING, SIDEWALK CONCRETE PLACEMENT AND FINISHING, and CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING will be revised to cover necessary additional requirements. The subgrade will be indicated as extending at least 600 mm (2 feet) in width back of curb, gutter, entrance, and combination curb and gutters.

****

The subgrade shall be constructed to the specified grade and cross section prior to concrete placement. Subgrade shall be placed and compacted [as directed] [in conformance with Section [_____]].

3.1.1 Sidewalk Subgrade

The subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

AND=GUTTERS> s/public.html> AND=GUTTERS> s/public.html>3.1.2 Curb and Gutter Subgrade

The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb and gutter. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Subgrade

The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected to produce a subgrade free from frost when the concrete is deposited.

3.2 FORM SETTING

Forms shall be set to the indicated alignment, grade and dimensions. Forms shall be held rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 1.2 m 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Clamps, spreaders, and braces shall be used where required to ensure rigidity in the forms. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly and satisfactorily repaired. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1 Sidewalks

Forms for sidewalks shall be set with the upper edge true to line and grade with an allowable tolerance of 3 mm 1/8 inch in any 3 m 10 foot long section. After forms are set, grade and alignment shall be checked with a 3 m 10 foot straightedge. Forms shall have a transverse slope [as indicated] [of 20 mm per meter 1/4 inch per foot] with the low side adjacent to the roadway. Side forms shall not be removed for 12 hours after finishing has been completed.

AND=GUTTERS> s/public.html> AND=GUTTERS> s/public.html>3.2.2 Curbs and Gutters

The forms of the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished, as specified for concrete finishing. Gutter forms shall not be

removed while the concrete is sufficiently plastic to slump in any direction.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Concrete shall be placed in the forms in one layer. When consolidated and finished, the sidewalks shall be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a strike off.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished with a wood float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished with an edger having a radius of 3 mm 1/8 inch. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

3.3.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 8 mm 5/16 inch from the testing edge of a 3 m 10-foot straightedge. Permissible deficiency in section thickness will be up to 6 mm 1/4 inch.

AND=GUTTERS> s/public.html> AND=GUTTERS> s/public.html>3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb and Gutter

Concrete shall be placed to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators. Curve shaped gutters shall be finished with a standard curb "mule".

3.4.2 Curb and Gutter Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

3.4.3 Concrete Finishing

Exposed surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of 13 mm 1/2 inch. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The front curb surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float.

3.4.4 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

3.4.5 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 6 mm 1/4 inch from the testing edge of a 3 m 10-foot straightedge. Permissible deficiency in section thickness will be up to 6 mm 1/4 inch.

3.5 SIDEWALK JOINTS

Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 1.5 m 5 feet on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 3 m 10 feet or more in width. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated. Expansion joints are not required between sidewalks and curb that abut the sidewalk longitudinally.

3.5.1 Sidewalk Contraction Joints

The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a 3 mm 1/8 inch blade to the depth indicated. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

3.5.2 Sidewalk Expansion Joints

****

NOTE: For projects which do not reference Section 02760A FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS, the last paragraph will replace the reference to Section 02760A.

****

Expansion joints shall be formed with 13 mm 1/2 inch joint filler strips. Joint filler in expansion joints surrounding structures and features within the sidewalk may consist of preformed filler material conforming to ASTM D 1752 or building paper. Joint filler shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 3 mm 1/8 inch, and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be cleaned and filled with cold-applied joint sealant. Joint sealant shall be gray or stone in color. [Joints shall be sealed as specified in Section 02760A FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS.] [The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 10 degrees C 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.]

3.5.3 Reinforcement Steel Placement

****

NOTE: Reinforcement steel normally will not be required for curb and gutter construction. Where conditions exist that make it advantageous to use reinforcement steel, the reinforcing steel details will be indicated, and the following paragraphs will be included in the contract specification.

****

Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

AND=GUTTERS> s/public.html> AND=GUTTERS> s/public.html>3.6 CURB AND GUTTER JOINTS

Curb and gutter joints shall be constructed at right angles to the line of curb and gutter.

3.6.1 Contraction Joints

Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that

monolithic sections between curb returns will not be less than 1.5 m 5 feet nor greater than 4.5 m 15 feet in length. Contraction joints shall be constructed by means of 3 mm 1/8 inch thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

3.6.2 Expansion Joints

****

NOTE: For projects which do not reference Section 02760A FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS, the last paragraph will replace the reference to Section 02760A.

****

Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement, and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least 13 mm 1/2 inch in width shall be provided at intervals not less than 10 meters (30 feet) nor greater than 35 meters (120 feet). Expansion joints shall be provided in nonreinforced concrete gutter at locations indicated. Expansion joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. [Joints shall be sealed as specified in Section 02760A FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS.] [Expansion joints and the top 25 mm 1 inch depth of curb and gutter contraction-joints shall be sealed with joint sealant. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 10 degrees C 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.]

3.7 CURING AND PROTECTION

****

NOTE: Only the methods of curing appropriate to local weather conditions and construction practices will be retained, but Contractor's option of at least 2 curing methods will be retained to promote competition in bidding.

****

3.7.1 General Requirements

Concrete shall be protected against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation.

Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

3.7.1.1 Mat Method

The entire exposed surface shall be covered with 2 or more layers of burlap. Mats shall overlap each other at least 150 mm 6 inches. The mat shall be thoroughly wetted with water prior to placing on concrete surface and shall be kept continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

3.7.1.2 Impervious Sheeting Method

The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 300 mm 12 inches when a continuous sheet is not used. The curing medium shall not be less than 450 mm 18-inches wider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

3.7.1.3 Membrane Curing Method

A uniform coating of white-pigmented membrane-curing compound shall be applied to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Formed surfaces shall be coated immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water and the curing compound applied as soon as the free water disappears. Curing compound shall be applied in two coats by hand-operated pressure sprayers at a coverage of approximately 5 square meters/L 200 square feet per gallon for the total of both coats. The second coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, an additional coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be resprayed. Necessary precautions shall be taken to insure that the concrete is properly cured at sawed joints, and that no curing compound enters the joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed before the concrete in the region of the joint is

resprayed with curing compound. The method used for sealing the joint groove shall prevent loss of moisture from the joint during the entire specified curing period. Approved standby facilities for curing concrete pavement shall be provided at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane.

3.7.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.7.3 Protection

Completed concrete shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

3.7.4 Protective Coating

****

NOTE: Concrete may require protection against the action of urea, sodium chloride, and calcium chloride used for de-icing purposes. Protection against these chemicals is not required for concrete of the specified air content that will be in place for a cumulative time of 6 weeks at a continuous minimum temperature of 5 degrees C (40 degrees F), excluding the curing time. Concrete which is to receive protective coating should be moist cured to eliminate the need for removing a curing membrane prior to application of the protective coating. ACI Committee Report 515 provides a detailed discussion of protective coating for concrete. The following paragraphs will be inserted if protective coating is required.

****

Protective coating, of linseed oil mixture, shall be applied to the exposed-to-view concrete surface after the curing period, if concrete will be exposed to de-icing chemicals within 6 weeks after placement. Concrete to receive a protective coating shall be moist cured.

3.7.4.1 Application

Curing and backfilling operation shall be completed prior to applying two coats of protective coating. Concrete shall be surface dry and clean before each application. Coverage shall be by spray application at not more than 11 square meters/L 50 square yards per gallon for first application and not more than 15.5 square meters/L 70 square yards per gallon for second application, except that the number of applications and coverage for each application for commercially prepared mixture shall be in accordance with the manufacturer's instructions. Coated surfaces shall be protected from vehicular and pedestrian traffic until dry.

3.7.4.2 Precautions

Protective coating shall not be heated by direct application of flame or electrical heaters and shall be protected from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Material shall not be applied at ambient or material temperatures lower than 10 degrees C 50 degrees F.

3.8 FIELD QUALITY CONTROL

3.8.1 General Requirements

The Contractor shall perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, the Contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.

3.8.2 Concrete Testing

3.8.2.1 Strength Testing

The Contractor shall provide molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 190 cubic meters 250 cubic yards of concrete. The samples for strength tests shall be taken in accordance with ASTM C 172. Cylinders for acceptance shall be molded in conformance with ASTM C 31/C 31M by an approved testing laboratory. Each strength test result shall be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 4 MPa 500 psi.

3.8.2.2 Air Content

Air content shall be determined in accordance with ASTM C 173 or ASTM C 231. ASTM C 231 shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each

shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.8.2.3 Slump Test

Two slump tests shall be made on randomly selected batches of each class of concrete for every 190 cubic meters 250 cubic yards, or fraction thereof, of concrete placed during each shift. Additional tests shall be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

3.8.3 Thickness Evaluation

The anticipated thickness of the concrete shall be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

3.8.4 Surface Evaluation

The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

3.9 SURFACE DEFICIENCIES AND CORRECTIONS

3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 6 mm 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 6 mm 1/4 inch. Pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Government

and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

-- End of Section --

APPENDIX I

ACCUTEST LABORATORIES USACE LABORATORY VALIDATION APPROVAL US DEPARTMENT OF ARMY

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
12565 WEST CENTER ROAD
OMAHA NE 68144-3869

REPLY TO
ATTENTION OF

July 9, 2004

Hazardous, Toxic and Radioactive Waste
Center of Expertise

Svetlana Izosimova
Accutest Laboratories Southeast, Inc.
4405 Vineland Road, Suite C-15
Orlando, FL 32811

Dear Ms Izosimova:

This correspondence addresses the recent evaluation of Accutest Laboratories Southeast, Inc. of Orlando, FL by the U.S. Army Corps of Engineers (USACE) for chemical analysis in support of the USACE Hazardous, Toxic and Radioactive Waste Program.

Your laboratory is now validated for the parameters listed below:

METHOD(1)	PARAMETERS	MATRIX(2)
300.0/9056	Anions(5)	Water(3)
5030B/8021B	Aromatic Volatile Organics	Water(3)
5030B/8021b	Aromatic Volatile Organics	Solids(3)
9010B/9014	Cyanide	Water(3)
9010B/9014	Cyanide	Solids(3)
8330A	Explosives6	Water
8330A	Explosives6	Solids
7196A	Hexavalent Chromium	Water(3)
1664	Oil and Grease	Water(3)
1664	Oil and Grease	Solids(3)
3510C/8081A	Organochlorine Pesticides	Water(3)
3550B/8081A	Organochlorine Pesticides	Solids(3)
3510C/8082	Polychlorinated Biphenyls	Water(3)
3550B/8082	Polychlorinated Biphenyls	Solids(3)
3510C/8270C	Semivolatile Organics	Water(3)
3550B/8270C	Semivolatile Organics	Solids(3)
3010A/6010B/7470A	TAL Metals(4)	Water(3)
3050B/6010B/7471A	TAL Metals(4)	Solids(3)

Printed on Recycled Paper

3510C/5030/Mod 8015	TPH - DRO/GRO	Water(3)
3550B/5030/Mod 8015	TPH - DRO/GRO	Solids(3)
5030B/5035/8260B	Volatile Organics	Water(3)
5030B/5035/8260B	Volatile Organics	Solids(3)

Remarks:

1) Sample preparation methods have been added to reflect program policy change.

2) 'Solids' includes soils, sediments, and solid waste.

3) The laboratory has successfully analyzed a Proficiency Testing (PT) sample for this method/matrix.

4) TAL Metals: Aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

5) Anions: Chloride, fluoride, sulfate, nitrate, nitrite, and ortho-phosphate.

6) Approval for this parameter is based on review of SOPs only.

Enclosed for your information is a copy of the Laboratory Inspection and Evaluation Report. Your laboratory has responded to the deficiencies as noted in the report. No further responses are necessary.

Based on the successful analysis of the National Environmental Laboratory Accreditation Conference Proficiency Testing samples for the appropriate fields of testing, the results of the laboratory inspection, and your Corrective Action Report, your laboratory will be validated for sample analysis by the methods listed above. The evaluation, which was conducted for your facility, is based substantially on ISO Guide 25 (General Requirements for the Competence of Testing Laboratories) and USACE Engineering Manual (EM) 200-1-3, Appendix I (Shell for Analytical Chemistry Requirements). The period of validation is 24 months and expires on July 9, 2006.

The USACE reserves the right to conduct additional laboratory inspections or to suspend validation status for any or all of the listed parameters if deemed necessary. It should be noted that your laboratory may not subcontract USACE analytical work to any other laboratory location without the approval of this office. This laboratory validation does not guarantee the delivery of any analytical samples from a USACE Contracting Officer Representative.

Any questions or comments can be directed to Richard Kissinger at (402) 697-2569. General questions regarding laboratory validation may be directed to the Laboratory Validation Coordinator at (402) 697-2574.

Sincerely,

Marcia C. Davies

Enclosure

Marcia C. Davies, Ph.D.
Director, USACE Hazardous,
Toxic and Radioactive Waste
Center of Expertise

APPENDIX J

NMED *TECHNICAL BACKGROUND DOCUMENT FOR DEVELOPMENT OF SOIL SCREENING LEVELS, REVISION 4.0*, APPENDIX A

JUNE 2006

Appendix A

State of New Mexico Soil Screening Levels

Table A-1 provides State of New Mexico Soil Screening Levels (SSLs), as developed by the New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB) and the Ground Water Quality Bureau Voluntary Remediation Program for 208 chemicals most commonly associated with environmental releases within the state. These NMED SSLs are derived using default exposure parameter values (as presented in Table A-2) and chemical- and State of New Mexico-specific physical parameters (as presented in Table B-1 of Appendix B). These default values are assumed to be appropriately conservative in the face of uncertainty and are likely to be protective for the majority of site conditions relevant to soil exposures within New Mexico.

However, the NMED SSLs are not necessarily protective of all known human exposure pathways, reasonable land uses or ecological threats. Thus, before applying NMED SSLs at a site, it is extremely important to compare the conceptual site model (CSM) with the assumptions upon which the NMED SSLs are predicated to ensure that the site conditions and exposure pathways match those used to develop the NMED SSLs. If this comparison indicates that the site at issue is more complex than the corresponding SSL scenarios, or that there are significant exposure pathways not accounted for by the NMED SSLs, then the NMED SSLs are insufficient for use in a defensible assessment of the site. A more detailed site-specific approach will be necessary to evaluate the additional pathways or site conditions.

Table A-1

Column 1:	The first column in Table A-1 presents the names of the chemicals for which NMED has developed SSLs.
Column 2:	The second column presents NMED SSLs predicated on residential soil exposures.
Column 3, 5, 7, and 10:	These columns present indicator categories for the NMED SSL residential, industrial, construction, and tap water basis, whether predicated on carcinogenic effects (ca), noncarcinogenic effects (nc), soil saturation limits (sat) or a non-risk based "max" determination. NMED SSLs predicated on a carcinogenic endpoint reflect age-adjusted child-to-adult exposures. NMED SSLs predicated on a noncarcinogenic endpoint reflect child-only exposures. Detected concentrations above the "sat" value may indicate the presence of nonaqueous phase liquid (NAPL). For certain inorganic and semivolatile organic compounds (SVOCs) that exhibit relatively low toxicity, a non risk-based maximum concentration of 10^5 mg/kg is given when the risk-based SSL exceeds that level. These are noted as "max" in the tables.
Columns 4 and 6:	The fourth and sixth columns present NMED SSLs analogous to Column 1, with the exception that these values correspond to Industrial/Occupational and Construction worker (adult-only) exposures, respectively.
Columns 5 and 7:	The fifth and seventh columns present endpoint bases analogous to Column 3

for the Industrial/Occupational and Construction worker receptor populations, respectively. Unlike the Residential population, noncarcinogenic endpoint notes for these receptor populations are predicated on adult-only exposures.

Column 8: The eighth column notes which chemicals are considered VOCs (for inhalation considerations). Those chemicals not considered VOCs are evaluated within the SSLs relative to inhalation of particulate emissions.

Column 9: Presents the tap water SSL for the residential scenario.

Columns 11 and 12: The ninth column presents NMED SSLs for the migration to groundwater pathway developed using a default dilution attenuation factor (DAF) of 1, which assumes no effective dilution or attenuation. These values can be considered at sites where little or no dilution or attenuation of soil leachate concentrations is expected (e.g., shallow water tables, karst topography). Column 10 presents NMED SSLs for the migration to groundwater pathway developed using a DAF of 20 to account for natural processes that reduce contaminant concentrations in the subsurface.

As noted above, separate NMED SSLs are presented for use in evaluating three discrete potential receptor populations: Residential, Industrial/Occupational, and Construction. Each NMED SSL considers incidental ingestion of soil, inhalation of volatiles (limited to those chemicals noted as volatile organic compounds [VOCs] within Table A-1) or particulate emissions from impacted soil, and dermal contact with soil.

Generally, if a contaminant is detected at a level in soil exceeding the most relevant NMED SSL, and the site-specific CSM is in general agreement with the underlying assumptions upon which the NMED SSLs are predicated, this result indicates the potential for adverse human health effects to occur. Conversely, if no contaminants are detected above the most relevant NMED SSL, this tends to indicate to the user that environmental conditions may not necessitate remedial action of the surface soil or the vadose zone.

A detection above an NMED SSL does not indicate that unacceptable exposures are, in fact, occurring. The NMED SSLs are predicated on relatively conservative exposure assumptions and an exceedance only tends to indicate the potential for adverse effects. The NMED SSLs do not account for additive exposures, whether for carcinogenic or noncarcinogenic endpoints. Section 5 of Part A addresses a methodology by which an environmental manager may determine whether further site-evaluation is warranted, however, this methodology does not replace the need for defensible risk assessment where indicated.

The NMED SSLs address a basic subset of exposures fundamental to the widest array of environmentally-impacted sites within the State of New Mexico. The NMED SSLs cannot address all relevant exposure pathways associated with all sites. The utility of the NMED SSLs depends heavily upon the understanding of site conditions as accurately reflected in the CSM and nature and extent of contamination determinations. Consideration of the NMED SSLs does not preclude the need for site-specific risk assessment in all instances.

Table A-1: NMED Soil Screening Levels

Chemical	Residential Soil (mg/kg)	End-point	Industrial/ Occupational Soil (mg/kg)	End-point	Construction Worker Soil (mg/kg)	End-point	VOC	Tap Water (ug/L)	End-point	DAF 1 (mg/kg)	DAF 20 (mg/kg)
Acenaphthene	3.73E+03	nc	3.35E+04	nc	1.41E+04	nc	x	3.65E+02	nc	2.75E+00	5.49E+01
Acetaldehyde	1.06E+02	nc	3.84E+02	nc	3.45E+02	nc	x	1.72E+01	ca		
Acetone	2.81E+04	nc	1.00E+05	max	9.85E+04	nc	x	5.48E+03	nc	9.55E-01	1.91E+01
Acrylonitrile	4.27E+00	ca	1.26E+01	ca	5.75E+01	nc	x	3.81E-01	ca	6.68E-05	1.34E-03
Acetophenone	1.48E+03	sat	1.48E+03	sat	1.48E+03	sat	x	6.08E+02	nc	1.48E-01	2.95E+00
Acrolein	2.06E-01	nc	7.52E-01	nc	6.75E-01	nc	x	4.16E-02	nc	8.55E-06	1.71E-04
Aldrin	2.84E-01	ca	1.12E+00	ca	6.99E+00	nc		3.87E-02	ca	1.42E-01	2.84E+00
Aluminum	7.78E+04	nc	1.00E+05	max	1.44E+04	nc		3.65E+04	nc	5.48E+04	1.10E+06
Anthracene	2.20E+04	nc	1.00E+05	max	8.60E+04	nc	x	1.83E+03	nc	8.11E+01	1.62E+03
Antimony	3.13E+01	nc	4.54E+02	nc	1.24E+02	nc		1.46E+01	nc	6.61E-01	1.32E+01
Arsenic	3.90E+00	ca	1.77E+01	ca	8.52E+01	nc		4.42E-01	ca	1.45E-02	2.90E-01
Barium	1.56E+04	nc	1.00E+05	max	6.02E+04	nc		7.30E+03	nc	3.01E+02	6.03E+03
Benzene	1.03E+01	ca	2.58E+01	ca	1.74E+02	nc	x	3.49E+00	ca	1.00E-03	2.01E-02
Benzidine	2.11E-02	ca	8.33E-02	ca	7.09E-01	ca		2.89E-03	ca	1.24E-05	2.47E-04
Benzo(a)anthracene	6.21E+00	ca	2.34E+01	ca	2.12E+02	ca		9.09E-01	ca	5.43E-01	1.09E+01
Benzo(a)pyrene	6.21E-01	ca	2.34E+00	ca	2.12E+01	ca		9.09E-02	ca	1.39E-01	2.78E+00
Benzo(b)fluoranthene	6.21E+00	ca	2.34E+01	ca	2.12E+02	ca		9.09E-01	ca	1.68E+00	3.35E+01
Benzo(k)fluoranthene	6.21E+01	ca	2.34E+02	ca	2.12E+03	ca		9.09E+00	ca	1.68E+01	3.35E+02
Beryllium	1.56E+02	nc	2.25E+03	nc	5.62E+01	nc		7.30E+01	nc	5.77E+01	1.15E+03
a-BHC (HCH)	9.02E-01	ca	3.99E+00	ca	3.00E+01	ca		1.05E-01	ca	2.13E-04	4.25E-03
b-BHC (HCH)	3.16E+00	ca	1.40E+01	ca	5.39E+01	nc		3.69E-01	ca	7.61E-04	1.52E-02
g-BHC	4.37E+00	ca	1.93E+01	ca	8.09E+01	nc		5.10E-01	ca	9.08E-04	1.82E-02
1,1-Biphenyl	3.08E+03	nc	2.73E+04	nc	1.17E+04	nc	x	3.04E+02	nc	3.61E+00	7.22E+01
Bis(2-chloroethyl) ether	2.44E+00	ca	7.45E+00	ca	1.05E+02	ca	x	9.65E-02	ca	2.77E-05	5.55E-04
Bis(2-chloroisopropyl) ether	3.87E+01	ca	1.19E+02	ca	4.53E+02	sat	x	2.71E+00	ca	7.21E-04	1.44E-02
Bis(2-ethylhexyl) phthalate	3.47E+02	ca	1.37E+03	ca	4.66E+03	nc		4.74E+01	ca	1.07E+03	2.15E+04
Bis(chloromethyl) ether	4.72E-03	ca	1.23E-02	ca	2.32E-01	ca	x	5.09E-04	ca	8.95E-08	1.79E-06
Boron	1.56E+04	nc	1.00E+05	max	3.09E+04	nc		7.30E+03	nc	2.40E+01	4.80E+02
Bromobenzene	3.70E+01	nc	1.37E+02	nc	1.21E+02	nc	x	2.06E+01	nc	1.07E-02	2.14E-01
Bromodichloromethane	1.44E+01	ca	3.72E+01	ca	7.17E+02	ca	x	1.78E+00	ca	5.90E-04	1.18E-02

Chemical	Residential Soil (mg/kg)	End-point	Industrial/ Occupational Soil (mg/kg)	End-point	Construction Worker Soil (mg/kg)	End-point	VOC	Tap Water (ug/L)	End-point	DAF 1 (mg/kg)	DAF 20 (mg/kg)
Bromomethane	8.51E+00	nc	3.28E+01	nc	2.82E+01	nc	x	8.66E+00	nc	1.87E-03	3.74E-02
1,3-Butadiene	9.93E-01	ca	2.38E+00	ca	4.59E+00	nc	x	1.26E+00	ca		
2-Butanone (MEK)	3.18E+04	nc	4.87E+04	sat	4.87E+04	sat	x	7.06E+03	nc	1.27E+00	2.55E+01
tert-Butyl methyl ether (MTBE)	3.88E+02	ca	9.84E+02	ca	1.96E+04	ca	x	6.14E+01	ca		
n-Butylbenzene	6.21E+01	sat	6.21E+01	sat	6.21E+01	sat	x	6.08E+01	nc	2.70E-01	5.40E+00
sec-Butylbenzene	6.06E+01	sat	6.06E+01	sat	6.06E+01	sat	x	6.08E+01	nc	2.17E-01	4.33E+00
tert-Butylbenzene	1.06E+02	sat	1.06E+02	sat	1.06E+02	sat	x	6.08E+01	nc	2.15E-01	4.30E+00
Cadmium	3.90E+01	nc	5.64E+02	nc	1.54E+02	nc		1.83E+01	nc	1.37E+00	2.75E+01
Carbon disulfide	4.60E+02	sat	4.60E+02	sat	4.60E+02	sat	x	1.04E+03	nc	3.95E-01	7.89E+00
Carbon tetrachloride	3.47E+00	ca	8.64E+00	ca	1.80E+02	ca	x	1.69E+00	ca	9.74E-04	1.95E-02
Chlordane	1.62E+01	ca	7.19E+01	ca	1.30E+02	nc		1.90E+00	ca	3.42E-01	6.83E+00
2-Chloroacetophenone	4.25E-02	nc	1.62E-01	nc	1.41E-01	nc	x	5.22E-02	nc	4.37E-05	8.75E-04
2-Chloro-1,3-butadiene	6.32E+00	nc	2.30E+01	nc	2.06E+01	nc	x	1.43E+01	nc	5.66E-03	1.13E-01
1-Chloro-1,1-difluoroethane	2.11E+02	sat	2.11E+02	sat	2.11E+02	sat	x	8.66E+04	nc	6.28E+01	1.26E+03
Chlorobenzene	1.94E+02	nc	2.45E+02	sat	2.45E+02	sat	x	1.06E+02	nc	5.50E-02	1.10E+00
1-Chlorobutane	1.22E+02	nc	2.99E+02	sat	2.99E+02	sat	x	2.43E+02	nc	9.63E-02	1.93E+00
Chlorodifluoromethane	2.11E+02	sat	2.11E+02	sat	2.11E+02	sat	x	9.75E+04	nc	7.07E+01	1.41E+03
Chloroethane	6.33E+01	ca	1.54E+02	ca	1.42E+03	sat	x	3.81E+01	ca	9.41E-03	1.88E-01
Chloroform	4.00E+00	ca	9.59E+00	ca	2.16E+02	ca	x	1.65E+00	ca	4.12E-04	8.25E-03
Chloromethane	2.18E+01	ca	5.34E+01	ca	2.84E+02	nc	x	1.49E+01	ca	5.02E-03	1.00E-01
b-Chloronaphthalene	3.99E+03	nc	2.78E+04	nc	1.47E+04	nc	x	4.87E+02	nc	1.25E+00	2.51E+01
o-Chloronitrobenzene	1.49E+00	nc	5.48E+00	nc	4.88E+00	nc	x	1.45E-01	nc	3.94E-05	7.88E-04
p-Chloronitrobenzene	1.05E+01	nc	4.23E+01	nc	3.51E+01	nc	x	1.20E+00	nc	3.25E-04	6.51E-03
2-Chlorophenol	1.66E+02	nc	8.85E+02	nc	5.86E+02	nc	x	3.04E+01	nc	2.36E-02	4.72E-01
2-Chloropropane	2.83E+02	nc	7.05E+02	sat	7.05E+02	sat	x	1.76E+02	nc	4.60E-02	9.19E-01
o-Chlorotoluene	2.02E+02	sat	2.02E+02	sat	2.02E+02	sat	x	1.22E+02	nc	5.22E-02	1.04E+00
Chromium III	1.00E+05	max	1.00E+05	max	1.00E+05	max		5.48E+04	nc	9.86E+07	1.97E+09
Chromium VI	2.34E+02	nc	3.40E+03	nc	2.61E+01	ca		1.10E+02	nc	2.10E+00	4.20E+01
Chrysene	6.15E+02	ca	2.31E+03	ca	2.12E+04	ca	x	2.91E+01	ca	1.74E+01	3.48E+02
Cobalt	1.52E+03	nc	2.05E+04	nc	6.10E+01	nc		7.30E+02	nc	3.31E+01	6.61E+02
Copper	3.13E+03	nc	4.54E+04	nc	1.24E+04	nc		1.46E+03	nc	5.15E+01	1.03E+03
Crotonaldehyde	7.01E-02	ca	1.70E-01	ca	3.73E+00	ca	x	5.82E-02	ca	1.49E-04	2.99E-03

Chemical	Residential Soil (mg/kg)	End-point	Industrial/ Occupational Soil (mg/kg)	End-point	Construction Worker Soil (mg/kg)	End-point	VOC	Tap Water (ug/L)	End-point	DAF 1 (mg/kg)	DAF 20 (mg/kg)
Cumene (isopropylbenzene)	2.71E+02	nc	3.89E+02	sat	3.89E+02	sat	x	6.78E+02	nc	4.10E+00	8.21E+01
Cyanide	1.22E+03	nc	1.37E+04	nc	4.76E+03	nc		7.30E+02	nc	7.35E+00	1.47E+02
Cyanogen	1.71E+03	sat	1.71E+03	sat	1.71E+03	sat	x	1.46E+03	nc	2.91E-01	5.82E+00
Cyanogen bromide	2.02E+03	sat	2.02E+03	sat	2.02E+03	sat	x	3.29E+03	nc	7.76E-01	1.55E+01
Cyanogen chloride	2.02E+03	sat	2.02E+03	sat	2.02E+03	sat	x	1.83E+03	nc	4.31E-01	8.62E+00
DDD	2.44E+01	ca	1.11E+02	ca	8.07E+02	ca		2.77E+00	ca	4.15E+00	8.30E+01
DDE	1.72E+01	ca	7.81E+01	ca	5.70E+02	ca		1.95E+00	ca	1.31E+01	2.62E+02
DDT	1.72E+01	ca	7.81E+01	ca	1.38E+02	nc		1.95E+00	ca	7.70E+00	1.54E+02
Dibenz(a,h)anthracene	6.21E-01	ca	2.34E+00	ca	2.12E+01	ca		9.09E-02	ca	5.18E-01	1.04E+01
Dibenzofuran	1.42E+02	nc	1.62E+03	nc	5.52E+02	nc	x	1.22E+01	nc	1.44E-01	2.87E+00
1,2-Dibromo-3-chloropropane	1.84E+00	nc	9.68E+00	nc	6.48E+00	nc	x	3.47E-01	nc	1.49E-04	2.98E-03
Dibromochloromethane	1.48E+01	ca	3.95E+01	ca	7.16E+02	ca	x	1.32E+00	ca	3.58E-04	7.16E-03
1,2-Dibromoethane	5.04E-01	ca	1.31E+00	ca	2.48E+01	ca	x	5.53E-02	ca	1.20E-05	2.40E-04
1,4-Dichloro-2-butene	1.22E-01	ca	3.23E-01	ca	5.97E+00	ca	x	1.19E-02	ca	2.93E-06	5.87E-05
1,2-Dichlorobenzene	3.74E+01	sat	3.74E+01	sat	3.74E+01	sat	x	4.96E+01	nc	1.19E-02	2.37E-01
1,3-Dichlorobenzene	3.26E+01	nc	3.74E+01	sat	3.74E+01	sat	x	1.83E+01	nc	4.36E-03	8.73E-02
1,4-Dichlorobenzene	3.95E+01	ca	1.03E+02	ca	1.96E+03	ca	x	4.95E+00	ca	5.49E-03	1.10E-01
3,3-Dichlorobenzidine	1.08E+01	ca	4.26E+01	ca	3.63E+02	ca		1.47E+00	ca	1.86E-03	3.71E-02
Dichlorodifluoromethane	1.61E+02	nc	2.11E+02	sat	2.11E+02	sat	x	3.95E+02	nc	2.86E-01	5.72E+00
1,1-Dichloroethane	1.40E+03	nc	1.42E+03	sat	1.42E+03	sat	x	1.22E+03	nc	3.39E-01	6.79E+00
1,2-Dichloroethane	6.04E+00	ca	1.52E+01	ca	6.42E+01	nc	x	1.22E+00	ca	2.85E-04	5.71E-03
cis-1,2-Dichloroethene	7.65E+01	nc	3.00E+02	nc	2.54E+02	nc	x	6.08E+01	nc	1.49E-02	2.99E-01
trans-1,2-Dichloroethene	1.12E+02	nc	4.29E+02	nc	3.70E+02	nc	x	1.22E+02	nc	3.33E-02	6.67E-01
1,1-Dichloroethene	2.06E+02	nc	7.77E+02	nc	6.78E+02	nc	x	3.39E+02	nc	1.34E-01	2.68E+00
2,4-Dichlorophenol	1.83E+02	nc	2.05E+03	nc	6.99E+02	nc		1.10E+02	nc	4.31E-02	8.63E-01
1,2-Dichloropropane	6.00E+00	ca	1.49E+01	ca	3.33E+01	nc	x	1.63E+00	ca	4.10E-04	8.19E-03
1,3-Dichloropropene	1.20E+01	ca	3.17E+01	ca	8.98E+01	nc	x	3.90E+00	ca	1.16E-03	2.31E-02
Dicyclopentadiene	2.21E+01	nc	8.26E+01	nc	7.28E+01	nc	x	1.39E+01	nc	1.50E-02	3.00E-01
Dieldrin	3.04E-01	ca	1.20E+00	ca	1.02E+01	ca		4.15E-02	ca	1.34E-03	2.68E-02
Diethyl phthalate	4.89E+04	nc	1.00E+05	max	1.00E+05	max		2.92E+04	nc	1.77E+01	3.54E+02
Dimethyl phthalate	1.00E+05	max	1.00E+05	max	1.00E+05	max		3.65E+05	nc	8.36E+01	1.67E+03
Di-n-butyl phthalate	6.11E+03	nc	6.84E+04	nc	2.33E+04	nc		3.65E+03	nc	1.86E+02	3.72E+03

Chemical	Residential Soil (mg/kg)	End-point	Industrial/ Occupational Soil (mg/kg)	End-point	Construction Worker Soil (mg/kg)	End-point	VOC	Tap Water (ug/L)	End-point	DAF 1 (mg/kg)	DAF 20 (mg/kg)
2,4-Dimethylphenol	1.22E+03	nc	1.37E+04	nc	4.66E+03	nc		7.30E+02	nc	3.55E-01	7.11E+00
4,6-Dinitro-o-cresol	6.11E+00	nc	6.84E+01	nc	2.33E+01	nc		3.65E+00	nc	3.93E-03	7.85E-02
2,4-Dinitrophenol	1.22E+02	nc	1.37E+03	nc	4.66E+02	nc		7.30E+01	nc	5.25E-02	1.05E+00
2,4-Dinitrotoluene	1.22E+02	nc	1.37E+03	nc	4.66E+02	nc		7.30E+01	nc	2.31E-02	4.62E-01
1,2-Diphenylhydrazine	6.08E+00	ca	2.39E+01	ca	2.04E+02	ca		8.30E-01	ca	4.48E-03	8.95E-02
Endosulfan	3.67E+02	nc	4.10E+03	nc	1.40E+03	nc		2.19E+02	nc	7.41E-01	1.48E+01
Endrin	1.83E+01	nc	2.05E+02	nc	6.99E+01	nc		1.10E+01	nc	2.04E-01	4.08E+00
Epichlorohydrin	1.66E+01	nc	6.56E+01	nc	5.54E+01	nc	x	2.03E+00	nc	3.62E-04	7.25E-03
Ethyl acetate	2.10E+04	sat	2.10E+04	sat	2.10E+04	sat	x	5.48E+03	nc	1.44E+00	2.87E+01
Ethyl acrylate	2.79E+00	ca	6.75E+00	ca	5.22E+01	sat	x	2.30E+00	ca	5.86E-03	1.17E-01
Ethyl chloride	6.33E+01	ca	1.54E+02	ca	1.42E+03	sat	x	3.81E+01	ca	9.41E-03	1.88E-01
Ethyl ether	1.94E+03	sat	1.94E+03	sat	1.94E+03	sat	x	1.22E+03	nc	2.37E-01	4.73E+00
Ethyl methacrylate	5.27E+01	sat	5.27E+01	sat	5.27E+01	sat	x	5.48E+02	nc	1.41E+00	2.81E+01
Ethylbenzene	1.28E+02	sat	1.28E+02	sat	1.28E+02	sat	x	1.34E+03	nc	1.01E+00	2.02E+01
Ethylene oxide	2.65E+00	ca	8.07E+00	ca	1.15E+02	ca	x	2.41E-01	ca	4.27E-05	8.54E-04
Fluoranthene	2.29E+03	nc	2.44E+04	nc	8.73E+03	nc		1.46E+03	nc	2.35E+02	4.69E+03
Fluorene	2.66E+03	nc	2.65E+04	nc	1.02E+04	nc	x	2.43E+02	nc	2.93E+00	5.85E+01
Fluoride	3.67E+03	nc	4.10E+04	nc	1.43E+04	nc		2.19E+03	nc	3.29E+02	6.58E+03
Furan	5.53E+00	nc	2.12E+01	nc	1.83E+01	nc	x	6.08E+00	nc	1.32E-03	2.63E-02
Heptachlor	1.08E+00	ca	4.26E+00	ca	3.63E+01	ca		1.47E-01	ca	3.12E-01	6.24E+00
Hexachlorobenzene	3.04E+00	ca	1.20E+01	ca	1.02E+02	ca		4.15E-01	ca	3.43E-02	6.86E-01
Hexachloro-1,3-butadiene	1.22E+01	nc	1.37E+02	nc	4.66E+01	nc		7.30E+00	nc	5.90E-01	1.18E+01
Hexachlorocyclopentadiene	3.66E+02	nc	4.10E+03	nc	4.31E+02	nc		2.19E+02	nc	6.58E+01	1.32E+03
Hexachloroethane	6.11E+01	nc	6.84E+02	nc	2.33E+02	nc		3.65E+01	nc	1.04E-01	2.09E+00
n-Hexane	3.80E+01	sat	3.80E+01	sat	3.80E+01	sat	x	4.16E+02	nc	8.64E-01	1.73E+01
HMX	3.06E+03	nc	3.42E+04	nc	1.17E+04	nc		1.83E+03	nc	5.39E+00	1.08E+02
Hydrogen cyanide	2.24E+01	nc	8.22E+01	nc	7.33E+01	nc	x	6.20E+00	nc	1.24E-03	2.47E-02
Indeno(1,2,3-c,d)pyrene	6.21E+00	ca	2.34E+01	ca	2.12E+02	ca		9.09E-01	ca	4.73E+00	9.46E+01
Iron	2.35E+04	nc	1.00E+05	max	9.29E+04	nc		1.10E+04	nc	2.77E+02	5.54E+03
Isobutanol	1.38E+04	nc	2.26E+04	sat	2.26E+04	sat	x	1.83E+03	nc	4.86E-01	9.72E+00
Isophorone	5.12E+03	ca	2.02E+04	ca	4.66E+04	nc		6.99E+02	ca	1.70E-01	3.40E+00
Lead	4.00E+02	IEUBK	8.00E+02	IEUBK	8.00E+02	IEUBK					

Chemical	Residential Soil (mg/kg)	End-point	Industrial/ Occupational Soil (mg/kg)	End-point	Construction Worker Soil (mg/kg)	End-point	VOC	Tap Water (ug/L)	End-point	DAF 1 (mg/kg)	DAF 20 (mg/kg)
Lead (tetraethyl-)	6.11E-03	nc	6.84E-02	nc	2.38E-02	nc		3.65E-03	nc	6.33E-07	1.27E-05
Maleic hydrazide	1.61E+03	sat	1.61E+03	sat	1.61E+03	sat	x	3.04E+03	nc	8.12E-01	1.62E+01
Manganese	3.59E+03	nc	4.84E+04	nc	1.50E+02	nc		1.72E+03	nc	1.12E+02	2.24E+03
Mercury (elemental)	1.00E+05	max	1.00E+05	max	9.27E+02	nc				1.05E-01	2.09E-03
Mercury (methyl)	6.11E+00	nc	6.84E+01	nc	2.38E+01	nc		3.65E+00	nc	8.26E-04	1.65E-02
Methacrylonitrile	3.84E+00	nc	2.20E+01	nc	1.37E+01	nc	x	1.04E+00	nc	1.83E-04	3.65E-03
Methomyl	8.44E+01	nc	3.17E+02	nc	2.78E+02	nc	x	1.52E+02	nc	5.74E-02	1.15E+00
Methyl acetate	3.76E+04	nc	1.00E+05	max	1.00E+05	max	x	6.08E+03	nc	1.08E+00	2.15E+01
Methyl acrylate	9.28E+01	nc	1.57E+02	sat	1.57E+02	sat	x	1.83E+02	nc	4.64E-01	9.29E+00
Methyl isobutyl ketone	5.51E+03	nc	7.01E+03	sat	7.01E+03	sat	x	1.99E+03	nc	7.35E-01	1.47E+01
Methyl methacrylate	2.92E+03	sat	2.92E+03	sat	2.92E+03	sat	x	1.42E+03	nc	2.76E-01	5.52E+00
Methyl styrene (alpha)	2.17E+02	sat	2.17E+02	sat	2.17E+02	sat	x	4.26E+02	nc	3.08E-01	6.17E+00
Methyl styrene (mixture)	1.39E+02	nc	2.17E+02	sat	2.17E+02	sat	x	5.48E+01	nc	3.96E-02	7.93E-01
Methylcyclohexane	7.89E+01	sat	7.89E+01	sat	7.89E+01	sat	x	5.23E+03	nc	2.88E+01	5.77E+02
Methylene bromide	1.79E+02	nc	7.85E+02	nc	6.09E+02	nc	x	6.08E+01	nc	2.72E-02	5.44E-01
Methylene chloride	1.82E+02	ca	4.90E+02	ca	2.63E+03	sat	x	4.22E+01	ca	8.51E-03	1.70E-01
Molybdenum	3.91E+02	nc	5.68E+03	nc	1.55E+03	nc		1.83E+02	nc	3.70E+00	7.40E+01
Naphthalene	7.95E+01	nc	3.00E+02	nc	2.62E+02	nc	x	6.20E+00	nc	1.97E-02	3.94E-01
Nickel	1.56E+03	nc	2.27E+04	nc	6.19E+03	nc		7.30E+02	nc	4.77E+01	9.53E+02
Nitrate	1.00E+05	max	1.00E+05	max	1.00E+05	max		5.84E+04	nc	1.67E+01	3.35E+02
Nitrite	7.82E+03	nc	1.00E+05	max	3.10E+04	nc		3.65E+03	nc	7.63E-01	1.53E+01
Nitrobenzene	2.28E+01	nc	1.47E+02	nc	8.28E+01	nc	x	3.40E+00	nc	9.18E-04	1.84E-02
Nitroglycerin	3.47E+02	ca	1.37E+03	ca	1.17E+04	ca		4.74E+01	ca	2.80E-02	5.61E-01
N-Nitrosodiethylamine	3.24E-02	ca	1.28E-01	ca	1.09E+00	ca		4.42E-03	ca	8.73E-06	1.75E-04
N-Nitrosodimethylamine	9.54E-02	ca	3.76E-01	ca	1.86E+00	nc		1.30E-02	ca	1.17E-05	2.34E-04
N-Nitrosodi-n-butylamine	2.69E-01	ca	7.28E-01	ca	1.24E+01	ca	x	1.99E-02	ca	1.12E-05	2.24E-04
N-Nitrosodiphenylamine	9.93E+02	ca	3.91E+03	ca	4.66E+03	nc		1.35E+02	ca	2.86E-01	5.71E+00
N-Nitrosopyrrolidine	2.32E+00	ca	9.12E+00	ca	7.77E+01	ca		3.16E-01	ca	1.30E-04	2.60E-03
m-Nitrotoluene	5.69E+02	sat	5.69E+02	sat	5.69E+02	sat	x	1.22E+02	nc	3.30E-02	6.59E-01
o-Nitrotoluene	1.08E+01	ca	3.23E+01	ca	4.73E+02	ca	x	4.81E-01	ca	1.30E-04	2.61E-03
p-Nitrotoluene	1.46E+02	ca	4.37E+02	ca	1.55E+03	nc	x	6.51E+00	ca	1.76E-03	3.53E-02
Pentachlorobenzene	4.89E+01	nc	5.47E+02	nc	1.86E+02	nc		2.92E+01	nc	9.37E-02	1.87E+00

Chemical	Residential Soil (mg/kg)	End-point	Industrial/ Occupational Soil (mg/kg)	End-point	Construction Worker Soil (mg/kg)	End-point	VOC	Tap Water (ug/L)	End-point	DAF 1 (mg/kg)	DAF 20 (mg/kg)
Pentachlorophenol	2.98E+01	ca	1.00E+02	ca	1.02E+03	ca		5.53E+00	ca	5.87E-03	1.17E-01
Phenanthrene	1.83E+03	nc	2.05E+04	nc	6.99E+03	nc		1.10E+03	nc	2.32E+01	4.64E+02
Phenol	1.83E+04	nc	1.00E+05	max	6.99E+04	nc		1.10E+04	nc	2.37E+00	4.74E+01
Polychlorinatedbiphenyls											
Aroclor 1016	3.93E+00	nc	4.13E+01	nc	1.50E+01	nc		2.56E+00	nc	1.73E-01	3.45E+00
Aroclor 1221	1.12E+00	nc	8.26E+00	ca	4.28E+00	nc		3.32E-01	ca	2.24E-02	4.47E-01
Aroclor 1232	1.12E+00	nc	8.26E+00	ca	4.28E+00	nc		3.32E-01	ca	2.24E-02	4.47E-01
Aroclor 1242	1.12E+00	nc	8.26E+00	ca	4.28E+00	nc		3.32E-01	ca	2.24E-02	4.47E-01
Aroclor 1248	1.12E+00	nc	8.26E+00	ca	4.28E+00	nc		3.32E-01	ca	2.64E-01	5.28E+00
Aroclor 1254	1.12E+00	nc	8.26E+00	ca	4.28E+00	nc		3.32E-01	ca	2.64E-01	5.28E+00
Aroclor 1260	1.12E+00	nc	8.26E+00	ca	4.28E+00	nc		3.32E-01	ca	2.64E-01	5.28E+00
n-Propylbenzene	6.21E+01	sat	6.21E+01	sat	6.21E+01	sat	x	6.08E+01	nc	2.70E-01	5.40E+00
Propylene oxide	2.22E+01	ca	9.33E+01	ca	7.92E+02	nc	x	2.18E+00	ca	4.60E-04	9.20E-03
Pyrene	2.29E+03	nc	3.09E+04	nc	9.01E+03	nc	x	1.83E+02	nc	1.86E+01	3.73E+02
RDX	4.42E+01	ca	1.74E+02	ca	6.99E+02	nc		6.03E+00	ca	1.68E-03	3.36E-02
Selenium	3.91E+02	nc	5.68E+03	nc	1.55E+03	nc		1.83E+02	nc	9.52E-01	1.90E+01
Silver	3.91E+02	nc	5.68E+03	nc	1.55E+03	nc		1.83E+02	nc	1.57E+00	3.13E+01
Strontium	4.69E+04	nc	1.00E+05	max	1.00E+05	max		2.19E+04	nc	7.73E+02	1.55E+04
Styrene	1.00E+02	sat	1.00E+02	sat	1.00E+02	sat	x	1.62E+03	nc	5.23E-01	1.05E+01
1,2,4,5-Tetrachlorobenzene	1.83E+01	nc	2.05E+02	nc	6.99E+01	nc		1.10E+01	nc	2.14E-02	4.29E-01
1,1,1,2-Tetrachloroethane	4.32E+01	ca	1.14E+02	ca	2.11E+03	ca	x	4.27E+00	ca	1.25E-03	2.50E-02
1,1,2,2-Tetrachloroethane	5.55E+00	ca	1.46E+01	ca	2.71E+02	ca	x	5.46E-01	ca	1.60E-04	3.21E-03
Tetrachloroethene	1.25E+01	ca	3.16E+01	ca	1.34E+02	sat	x	4.32E+00	ca	2.87E-03	5.74E-02
Thallium	5.16E+00	nc	7.49E+01	nc	2.04E+01	nc		2.41E+00	nc	1.72E-01	3.43E+00
Toluene	2.52E+02	sat	2.52E+02	sat	2.52E+02	sat	x	2.27E+03	nc	1.08E+00	2.17E+01
Toxaphene	4.42E+00	ca	1.74E+01	ca	1.48E+02	ca		6.03E-01	ca	2.33E-01	4.65E+00
Tribromomethane	6.21E+02	ca	2.46E+03	ca	4.44E+03	nc		2.44E+01	ca	1.73E-01	3.47E+00
1,1,2-Trichloro-1,2,2-trifluoroethane	3.28E+03	sat	3.28E+03	sat	3.28E+03	sat	x	5.92E+04	nc	1.68E+02	3.36E+03
1,2,4-Trichlorobenzene	6.93E+01	nc	2.69E+02	nc	2.30E+02	nc	x	7.16E+00	nc	2.04E-02	4.08E-01
1,1,1-Trichloroethane	5.63E+02	sat	5.63E+02	sat	5.63E+02	sat	x	3.17E+03	nc	1.33E+00	2.65E+01
1,1,2-Trichloroethane	1.19E+01	ca	3.02E+01	ca	1.94E+02	nc	x	1.97E+00	ca	4.98E-04	9.95E-03
Trichloroethylene	6.38E-01	ca	1.56E+00	ca	3.36E+01	ca	x	2.77E-01	ca	1.00E-04	2.00E-03

Chemical	Residential Soil (mg/kg)	End-point	Industrial/ Occupational Soil (mg/kg)	End-point	Construction Worker Soil (mg/kg)	End-point	VOC	Tap Water (ug/L)	End-point	DAF 1 (mg/kg)	DAF 20 (mg/kg)
Trichlorofluoromethane	5.88E+02	nc	9.83E+02	sat	9.83E+02	sat	x	1.29E+03	nc	1.12E+00	2.23E+01
2,4,5-Trichlorophenol	6.11E+03	nc	6.84E+04	nc	2.33E+04	nc		3.65E+03	nc	7.13E+00	1.43E+02
2,4,6-Trichlorophenol	6.11E+00	nc	6.84E+01	nc	2.33E+01	nc		3.65E+00	nc	7.13E-03	1.43E-01
1,1,2-Trichloropropane	2.53E+01	nc	9.64E+01	nc	8.35E+01	nc	x	3.04E+01	nc	1.17E-02	2.35E-01
1,2,3-Trichloropropane	8.61E-02	ca	2.09E-01	ca	4.57E+00	ca	x	5.53E-02	ca	2.07E-05	4.14E-04
1,2,3-Trichloropropene	1.21E+00	nc	4.39E+00	nc	3.95E+00	nc	x	2.10E+00	nc	7.88E-04	1.58E-02
Triethylamine	4.90E+01	nc	2.33E+02	nc	1.69E+02	nc	x	1.21E+01	nc	2.14E-03	4.29E-02
1,2,4-Trimethylbenzene	5.80E+01	nc	2.13E+02	nc	1.90E+02	nc	x	1.23E+01	nc	7.09E-02	1.42E+00
1,3,5-Trimethylbenzene	2.48E+01	nc	6.92E+01	sat	6.92E+01	sat	x	1.23E+01	nc	1.77E-02	3.55E-01
2,4,6-Trinitrotoluene	3.06E+01	nc	3.42E+02	nc	1.17E+02	nc		1.83E+01	nc	5.34E-02	1.07E+00
Vanadium	7.82E+01	nc	1.14E+03	nc	3.10E+02	nc		3.65E+01	nc	3.65E+01	7.30E+02
Vinyl acetate	1.07E+03	nc	3.68E+03	sat	3.52E+03	nc	x	4.12E+02	nc	7.57E-02	1.51E+00
Vinyl bromide	2.85E+00	ca	6.84E+00	ca	1.93E+01	nc	x	1.18E+00	ca	4.71E-04	9.41E-03
Vinyl chloride (Child)	2.25E+00	ca					x	4.28E-01	ca	1.40E-04	2.80E-03
Vinyl chloride (adult)	4.37E+00	ca	1.40E+01	ca	1.82E+02	ca	x	8.33E-01	ca	2.72E-04	5.45E-03
m-Xylene	8.20E+01	sat	8.20E+01	sat	8.20E+01	sat	x	2.03E+02	nc	1.03E-01	2.06E+00
o-Xylene	9.95E+01	sat	9.95E+01	sat	9.95E+01	sat	x	7.30E+03	nc	4.07E+00	8.14E+01
Xylenes	8.20E+01	sat	8.20E+01	sat	8.20E+01	sat	x	2.03E+02	nc	1.03E-01	2.06E+00
Zinc	2.35E+04	nc	1.00E+05	max	9.29E+04	nc		1.10E+04	nc	6.82E+02	1.36E+04

Table A-2

Default Exposure Factors

Symbol	Definition (units)	Default	Reference
CSF_o	Cancer slope factor oral $(mg/kg\text{-}day)^{-1}$	Chem.-spec.	IRIS, HEAST, or NCEA
CSF_i	Cancer slope factor inhaled $(mg/kg\text{-}day)^{-1}$	Chem.-spec.	IRIS, HEAST, or NCEA
RfD_o	Reference dose oral (mg/kg-day)	Chem.-spec.	IRIS, HEAST, or NCEA
RfD_i	Reference dose inhaled (mg/kg-day)	Chem.-spec.	IRIS, HEAST, or NCEA
TR	Target cancer risk	1E-05	NMED-specific value
THQ	Target hazard quotient	1	US EPA, 1989
BW	Body weight (kg)		
	-- adult	70	US EPA, 1989
	-- child	15	US EPA, 1991
AT	Averaging time (days)		
	-- carcinogens	25550	US EPA, 1989
	-- noncarcinogens	ED*365	
SA	Exposed surface area for soil/dust (cm^2/day)		US EPA, 1989
	-- adult resident	5700	US EPA, 1996a
	-- adult worker	3300	US EPA, 1996a
	-- child	2800	US EPA, 1989
AF	Adherence factor, soils (mg/cm^2)		US EPA, 1989
	-- adult resident	0.07	US EPA, 1996a
	-- adult worker	0.2	US EPA, 1996a
	-- child resident	0.2	US EPA, 1989
	-- construction worker	0.3	NMED-specific value
ABS	Skin absorption defaults (unitless):		
	-- semi-volatile organics	0.1	US EPA, 1989
	-- volatile organics	na	US EPA, 2003a
	-- inorganics	na	US EPA, 2000s
IRA	Inhalation rate (m^3/day)		
	-- adult resident	20	US EPA, 1991
	-- adult worker	20	US EPA, 2001a
	-- child resident	10	Exposure Factors, (US EPA, 1997)
IRW	Drinking water ingestion rate (L/day)		
	-- adult	2	US EPA, 2004b
	-- child	1	US EPA, 2004b
IRS	Soil ingestion (mg/day)		
	-- adult resident	100	US EPA, 1991
	-- child resident	200	US EPA, 1991
	-- commercial/industrial worker	100	US EPA, 2001a
	construction worker	330	US EPA, 1991
EF	Exposure frequency (days/yr)		
	-- residential	350	US EPA, 1991
	-- commercial/industrial	225	US EPA, 2001a
	-- construction worker	250	NMED-specific value
ED	Exposure duration (years)		
	-- residential	30[a]	US EPA, 1991)
	-- child	6	(US EPA, 1991)
	-- commercial/industrial	25	(US EPA, 1999)
	-- construction worker	1	NMED-specific value
	Age-adjusted factors for carcinogens		
IFSadj	Ingestion factor, soils ([mg-yr]/[kg-day])	114	US EPA, 2001a
SFSadj	Dermal factor, soils ([mg-yr]/[kg-day])	361	US EPA, 2001a
InhFadj	Inhalation factor, air ([m^3-yr]/[kg-day])	11	By analogy to RAGS: Part B, (US EPA, 1991)
IFWadj	Ingestion factor, water ([L-yr]/[kg-day])	1.1	By analogy to RAGS: Part B, (US EPA, 1991)
PEF	Particulate emission factor (m^3/kg)	Chem.-spec.	US EPA, 2001a
VFs	Volatilization factor for soil (m^3/kg)	Chem.-spec.	US EPA, 2001a
VFw	Volatilization factor for water (L/m^3)	0.5	US EPA, 1991
Csat	Soil saturation concentration (mg/kg)	Chem.-spec.	US EPA, 2001a

[a]Exposure duration for lifetime residents is assumed to be 30 years total. For carcinogens, exposures are combined for children (6 years) and adults (24 years).

Chem.-spec.- Chemical-specific value
na - not applicable
RAGS – Risk Assessment Guidance for Superfund
IRIS – Integrated Risk Information System, USEPA, 2003b
HEAST – Health Effects Assessment Summary Tables, USEPA, 1997
NCEA – National Center for Environmental Assessment, Office of Research and Development (USEPA, 2003c)
NMED – New Mexico Environment Department