HSWA HAFB 6/M/00-01

DEPARTMENT OF THE AIR FORCE

HEADQUARTERS 49TH FIGHTER WING (ACC)
HOLLOMAN AIR FORCE BASE, NEW MEXICO

11 JAN 2001

MEMORANDUM FOR NEW MEXICO ENVIRONMENT DEPARTMENT
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FROM: 49 CES/CEV
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SUBJECT: Final Phase II Remedial Investigation (RI) Report for SS-61

1. Enclosed is the Final Phase II Remedial Investigation (RI) Report for SS-61. This site is being investigated under the Environmental Restoration Program (ERP).

2. If you have any questions, please contact Mr. Court Fesmire or Mr. Jose Gallegos at (505) 572-5395.

HOWARD E. MOFFITT
Deputy Base Civil Engineer

Enclosure
Report for SS-61

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

Holloman Air Force Base,
New Mexico

December 2000

49 CES/CEV
Holloman Air Force Base,
New Mexico

Project Number: KWRD20007002

PHASE II REMEDIAL INVESTIGATION REPORT FOR SS-61—SPILL SITE 61

HOLLOMAN AIR FORCE BASE, NEW MEXICO

Prepared for:

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Holloman Air Force Base, NM
and
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Under Contract No. DACW45-94-D-0003
Delivery Order No. 27, Work Authorization Directive 7

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

December 2000

Project Number: KWRD20007002

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LIST OF ACRONYMS

µg	micrograms
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
1,2-DCA	1,2-dichloroethane
AFB	Air Force Base
ARAR	applicable or relevant and appropriate requirement
AST	aboveground storage tank
atm-m^3/mol	atmosphere-cubic meter per mole
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
DPT	direct push technology
EMI	electromagnetic induction
EPA	United States Environmental Protection Agency
ERP	Environmental Restoration Program
ESA	ecological sloping assessment
Foster Wheeler	Foster Wheeler Environmental Corporation
ft	foot/feet
GPS	global positioning system
HHRA	human health risk assessment
IRP	Installation Restoration Program
K_H	Henry's Law Constant
K_{oc}	organic carbon partition coefficient
K_{ow}	octanol-water partition coefficient
LNAPL	light nonaqueous phase liquid
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mm Hg	millimeters of mercury

LIST OF ACRONYMS (Concluded)

msl	mean sea level
MW	monitoring well
NCP	National Contingency Plan
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
PID	photoionization detector
POL	petroleum, oil, and lubricants
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RI	remedial investigation
SI	site investigation
SLERA	screening level ecological risk assessment
SS-61	Spill Site 61
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TCE	trichloroethene
TDS	total dissolved solids
TERC	Total Environmental Restoration Contract
TNT	2,4,6-trinitrotoluene
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
USACE	United States Army Corps of Engineers
UST	underground storage tank
VOC	volatile organic compound
WQCC	New Mexico Water Quality Control Commission

EXECUTIVE SUMMARY

A Phase II remedial investigation (RI) was conducted at Spill Site 61 (SS-61) at Holloman Air Force Base (AFB), near Alamogordo, New Mexico. The Phase II RI was conducted as part of the Installation Restoration Program (IRP) at the Base. The results of the Phase I and Phase II RIs supported characterization of the northern and southern portions of SS-61, respectively. The northern part of SS-61, investigated during the Phase I RI in 1999, once included two above-ground storage tanks (ASTs), underground piping, and an apparent fuel dispensing area on the north side of DeZonia Drive where a concrete pad and piping remain. The area investigated during the Phase II RI is the southern portion of the site, which includes two aircraft hangars, additional contaminant sources that were suspected based on the results of the Phase I RI.

The Phase II RI field investigation was performed March through June 2000. The Phase II RI was conducted to locate the source and assess the extent of potential upgradient contamination in soil and groundwater south of the area investigated during the Phase I RI. Soil and groundwater samples were analyzed for petroleum hydrocarbons and volatile organic compounds (VOCs). Prior to the RI, contamination was detected in the upgradient monitoring well at Solid Waste Management Unit (SWMU) 104. Since the source of the upgradient contamination was expected to be to the southeast of the well and to the east of Building 1001, Area of Concern-1001 (AOC-1001) was identified. Phase I and Phase II Resource Conservation and Recovery Act Facility Investigations (RFIs) were conducted at AOC-1001 during 1996 and 1997. During the RFI at AOC-1001, soil vapor, soil, and groundwater sampling was conducted across an area of groundwater contamination to the east and southeast of SWMU 104. As a result of the RFI, SS-61 was designated an IRP site and therefore required further investigation.

VOCs were detected in soil and groundwater during the Phase I RI. Most of the detections in soil occurred immediately above the water table, indicating contaminant migration in groundwater rather than vadose zone contamination. Soil contamination was also detected above the water table in a borehole drilled to the northwest of the concrete pad. Groundwater contaminants included high levels of benzene, toluene, ethylbenzene, and total xylenes (BTEX) in the vicinity of the concrete pad. Lower levels of BTEX and solvents were detected south of DeZonia Drive in the vicinity of the two hangars (Buildings 1079 and 1080).

During the Phase II RI, detailed mapping of the site and geophysical data collection were conducted south of DeZonia Drive to identify potential sources of the upgradient groundwater contamination. These activities located the underground piping south of DeZonia Drive that was also identified during the Phase I RI. Phase II RI soil and groundwater samples were collected in the following areas to confirm potential contaminant sources:

- In the vicinity of the two hangars, Buildings 1079 and 1080
- In outlying areas of the two hangars to determine extent of groundwater contamination
- In an area southeast of Building 1080 where suspected fuel spills occurred during past operations
- In a stormwater overflow basin north of Building 1079, directly south of the concrete pad

Groundwater samples collected during the Phase I RI confirmed that past releases in the vicinity of the concrete pad account for the elevated concentrations of groundwater contaminants in a plume that extends to the north toward SWMU 104. However, soil sampling showed that currently no source of groundwater contamination exists above the water table in this area. Groundwater sampling conducted during the Phase II RI south of DeZonia Drive indicates the presence of cross-gradient and upgradient groundwater contamination attributable to multiple sources in the vicinity of Building 1079. As in the northern part of the site, there is no current source of groundwater contamination above the water table in the southern area of SS-61.

The contaminants detected in the Phase I and Phase II RIs were compared to New Mexico Environment Department (NMED) approved soil action levels for petroleum hydrocarbons and benzene at Holloman AFB. The action levels for petroleum hydrocarbon and benzene concentrations in soil are 1,000 milligrams per kilogram (mg/kg) and 25 mg/kg, respectively. In the Tularosa Basin, where Holloman AFB is located, groundwater is nonpotable because it contains naturally high levels of dissolved solids; therefore, water quality concentration-based action levels do not apply to areas of historic releases at the Base. However, remediation is required if free-phase product is present on the water table. Petroleum hydrocarbon soil sample concentrations detected in the northern and southern portions of the site were below the 1,000

mg/kg action level. No existing sources of groundwater contamination were identified and no floating product was observed at the water table at any of the groundwater sampling locations. Benzene and other VOCs were also evaluated as part of the human health and screening-level ecological risk assessments.

Based on the comparison of maximum detected contaminant concentrations to NMED-approved action levels, along with the results of the risk assessments conducted during both phases of the RI, no further action is recommended at SS-61. No significant risk to human health or ecological receptors was found in the northern and southern portions of the site. In addition, no existing sources of contamination were identified in soil that would cause release of contamination or further degradation of groundwater. Therefore, no action is needed to protect human health or the environment at SS-61.

1.0 INTRODUCTION

This report presents the results of the Foster Wheeler Environmental Corporation (Foster Wheeler) Phase II Remedial Investigation (RI) of Spill Site 61 (SS-61) at Holloman Air Force Base (AFB), New Mexico (Figure 1-1). The purpose of the RI, was to determine the source, nature, and extent of contamination observed during the Phase I RI and previous investigations in the vicinity of SS-61. The RI was conducted under the Department of Defense Installation Restoration Program (IRP) in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Contingency Plan (NCP).

Contamination was first detected during the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) that was conducted at nearby Solid Waste Management Unit (SWMU) 104, the Former Army Landfill. The RFI was prepared for SWMU 104 under the RCRA Corrective Action Program requirements of the Holloman AFB RCRA Part B Permit for a Hazardous Waste Facility (Radian, 1995). This SWMU is also known as IRP Site LF-29. The RI was performed for the U.S. Army Corps of Engineers (USACE), Omaha District, under Total Environmental Restoration Contract (TERC) Number DACW-45-94-D0003 and under the oversight of the New Mexico Environment Department (NMED) and Region VI of the U. S. Environmental Protection Agency (EPA). The RI field activities were conducted in accordance with an addendum (Foster Wheeler, 2000) to previously prepared work plans (Foster Wheeler, 1999a; Foster Wheeler and Groundwater Technology Government Services Incorporated [GTI], 1996, 1997a), as described in Section 2.0.

SS-61 includes potentially contaminated soil and groundwater in an industrial area north of two aircraft hangars at Holloman AFB (Figure 1-2). As investigated during the Phase I RI, the northern portion of SS-61 includes a concrete pad believed to have been used for fuel dispensing. Underground piping once connected this pad to one or both of two aboveground storage tanks (ASTs) that have been removed. Previous investigations, as described in Section 1.3 of this report, indicated that fuel was released to soil and groundwater in this area. This portion of SS-61 also includes a debris pile adjacent to the concrete pad.

The area investigated during the Phase II RI is the southern portion of the site where there are two aircraft hangars and additional contaminant sources were suspected based on the results of the Phase I RI. A detailed description of the site is provided in Section 1.2. Information on the

southern portion of SS-61 is limited because this part of the site has been used by the U.S. Army for aircraft maintenance and storage for the White Sands Missile Range. Despite the lack of detailed information about the operations, the Phase II RI was designed to provide sufficient data to adequately characterize the source, nature, and extent of contamination in this area. The Phase II RI consisted of:

- Conducting personal interviews
- Searching records available on base
- Mapping site cultural features
- Surveying the area using geophysics to locate the underground piping and other potential sources

Soil and groundwater sampling was conducted throughout the southern area in the suspected source areas and at upgradient and downgradient locations. The Phase II data are combined in this report with the summary information from previous investigations for site characterization.

1.1 PURPOSE

The purpose of this report is to present the results of the Phase II RI and previous investigations of SS-61 and the surrounding area. These results were used to complete the following assessments:

- Soil and groundwater sampling results, along with information on site features, were used to assess the nature and extent of contamination in the northern part of the site and to confirm the existence of upgradient sources to the south.
- Fuel constituent concentrations in soil and groundwater were compared to action levels established by the NMED for petroleum-contaminated sites at Holloman AFB (NMED, 1995).
- Concentrations of other site contaminants were compared to human health medium-specific screening levels (HHSLs) developed by EPA Region VI (EPA, 1999).
- A site conceptual model and screening-level risk assessment were provided to document the potential exposure pathways and risks to human and ecological receptors at the site.

The conclusions of the assessments listed above were then used to support recommendations for the closure of this site.

1.2 SITE DESCRIPTION AND BACKGROUND

SS-61 is located in the central part of Holloman AFB at the edge of an industrial area (Figure 1-2). The northern part of the site, which was the focus of the Phase I RI, is approximately 300 feet (ft) north of two aircraft hangars. The primary focus of the Phase II RI is the southern part of SS-61, which consists of potentially impacted soil and groundwater in the vicinity of the following two features:

- The two hangars where fuel and waste fluids may have been previously disposed
- The underground piping, which connected one or both of the former ASTs in the northern part of the site that traverses the site from north to south toward the aircraft tarmac

The Phase II RI investigation area is bounded on the north and south by DeZonia Drive and the aircraft tarmac, respectively. The east and west boundaries of the site extend just past the two hangars, Buildings 1079 and 1080. Samples were collected outside of the investigation area to delineate contaminated groundwater potentially migrating from the hangar areas.

Most of the investigated area is relatively flat and paved in asphalt, concrete, or coarse gravel. Sparse vegetation is present along with some brush in areas originally designated as landscaping. The eastern hangar, Building 1080, is the newer of the two structures. Infrequent activity was observed in the area of Building 1080, and there was no indication of external sumps or fuel spills that could have leached to groundwater in the past. The western hangar, Building 1079, is an older structure that dates back to the 1940s as observed in an aerial photograph from 1942 (Appendix C). In the vicinity of Building 1079, an underground concrete sump was observed outside of the northwest entrance of the hangar. Site personnel indicated that they did not dispose of anything in the sump as it currently appears dry and unused. A shallow surface depression, approximately 3 ft deep, is in the parking lot north of Building 1079 and measures approximately 100 x 70 ft. According to base Civil Engineering personnel (St. John, 2000), the area was used as a surface overflow basin used as a stormwater collection basin.

Contamination at SS-61 was first detected during Phase II of the Table 1 RFI of SWMU 104 in 1994 (Foster Wheeler and Radian Corporation [Radian], 1997). This landfill, located north of Building 1001 and northwest of SS-61, was used for disposal of waste munitions. During Phase II of the Table 1 RFI, monitoring well MW-29-05 was installed and sampled upgradient from the landfill. Groundwater contamination detected in MW-29-05 included benzene, 1,2-

dichloroethane (1,2-DCA), 2,4,6-trinitrotoluene (TNT), and 1,3,5-trinitrobenzene. Water levels measured in the SWMU 104 wells indicated a hydraulic gradient for groundwater flow to the north-northwest. Therefore, the source of the contamination was believed to be to the south-southeast of the landfill. Based on these results, a recommendation for No Further Action status was requested for SWMU 104. The area southeast of the landfill was designated Area of Concern (AOC)-1001. An investigation of AOC-1001 was conducted to assess the nature and extent of the groundwater contamination detected in MW-29-05 and to locate the source of this contamination.

Two investigations were conducted at AOC-1001 prior to the RI of SS-61, one in 1996 and one in 1997, to delineate the contamination and locate its source (Foster Wheeler and GTI, 1997b). These investigations detected soil contamination and the highest groundwater contaminant concentrations in the vicinity of the concrete pad. Groundwater samples were collected from 24 direct push technology (DPT) locations and 11 monitoring wells in the vicinity of AOC-1001 and SWMU 104. The resulting data outlined a groundwater contaminant plume extending to the north of the concrete pad area. Groundwater monitoring results suggest that this plume also extends to the east (crossgradient) and south-southeast (upgradient) from the concrete pad.

SS-61 was added as an IRP site upon completion of a CERCLA site investigation (SI) and RFI in 1996 and 1997 (Foster Wheeler and GTI, 1997b). At that time, it was concluded that an additional RI was required to determine the nature and extent of soil and groundwater contamination, develop a site conceptual model, and collect information in support of screening-level human health and ecological risk assessments. Field activities for the RI were conducted from March through April 1999.

The six other SWMUs are located within the vicinity of SS-61 and are listed below:

- SWMU 36—Oil-water separator at Building 1001
- SWMU 37— Oil-water separator at Building 1080
- SWMU 38— Oil-water separator at Building 1080A
- SWMU 126—Waste oil tank at Building 1001
- SWMU 164—Pond at Building 1080

- SWMU 212 (IRP Site SD-28)—Former North Area washrack

These Table 2 and 3 SWMUs are listed in the Base's RCRA Permit and were investigated under during the RFI or the IRP, and are not believed to be the sources of the contamination observed at SS-61. These six SWMUs have been proposed to the NMED for No Further Action status as part of the modification to the Base's RCRA Permit.

1.3 SUMMARY OF SITE INVESTIGATIONS

Three separate investigations have taken place at SS-61 prior to the Phase II RI. These three programs include the following investigations and they are discussed in the two subsections below.

- Phase I RFI in 1996 (Foster Wheeler and GTI, 1997b)
- Phase II RFI in 1997 (Foster Wheeler and GTI, 1997b)
- Phase I RI in 1999 (Foster Wheeler, 1999b)

1.3.1 Phase I and Phase II RFI

Following the RFI of SWMU 104, SS-61 was formerly designated AOC-1001, and Phases I and II of an RFI were conducted in 1996 and 1997. The RFI objective was to determine the source and extent of soil and groundwater contamination southeast of SWMU 104. The results of the Phase I and Phase II investigations were presented in the RFI report for AOC-1001 (Foster Wheeler and GTI, 1997b) and are summarized in Section 2.0 of this report.

The scope of the Phase I RFI of AOC-1001 included the following field activities:

- A passive soil vapor survey was conducted that included 49 sample points spread over a grid with 50-ft spacing. The intent of the soil vapor survey was to identify target areas for soil and groundwater collection.
- Based on the results of the soil vapor survey, 10 soil borings were sampled and DPT soil and groundwater samples were collected for chemical analysis.

The Phase II RFI focused on the area south of the bermed areas and east of Building 1001 and SWMU 104. Because benzene and 1,2-DCA were identified in groundwater during the Phase I RFI, the Phase II RFI consisted of:

- Collection of 17 soil and 23 groundwater samples (including field duplicates) followed by analysis using onsite mobile and offsite laboratories

- Installation and sampling of four monitoring wells in critical areas identified through DPT sampling to better define groundwater quality and flow direction
- Installation of four piezometers and measurement of groundwater levels to better characterize groundwater elevation and flow direction across the site

In December 1997, the area previously referred to as AOC-1001 was designated as IRP Site SS-61. At this time, an SI was conducted and it was determined that an RI would be needed to complete the site investigation.

Soil sampling conducted during the SI and the 1996 and 1997 investigations detected benzene, toluene, ethylbenzene, and xylenes (BTEX), as well as 1,2-DCA, tetryl, and TNT. Most detections of these compounds were in samples collected directly above the water table (depths greater than 15 ft below ground surface [bgs]) where groundwater contamination is interpreted to have entered the capillary fringe. Benzene, ethylbenzene, and xylenes were detected in only one sample collected from unsaturated vadose zone soil above the capillary fringe. These detections occurred in a soil sample collected north of the concrete pad at a depth of 11 to 12 ft bgs. Tetryl and TNT were detected in one sample collected west of the AST area at a depth of 15 to 18 ft bgs. Groundwater contaminants included BTEX, 1,2-DCA, and trichloroethene (TCE). The results of these previous investigations indicated possible soil contamination in the area of the concrete pad and a broad groundwater contaminant plume extending to the north from SS-61, as well as crossgradient to the east and possibly upgradient to the south-southeast.

1.3.2 Phase I RI

In March and April 1999, the Phase I RI was conducted to complete the characterization of the site and to refine the assessment of the source and extent of soil and groundwater contamination in this area to the southeast of SWMU 104. Contamination was detected in the upgradient well at SWMU 104 in 1994.

The results of the following field activities are summarized in this report (Foster Wheeler, 1999b):

- Collection of soil and groundwater samples at 12 locations using a DPT rig. The sampling locations were distributed:
  - — Near the pipeline identified along the east edge of the site near the southern berm and north of Building 1072
  - — In the vicinity of the concrete pad

  - — Near Building 1001
  - — South of the concrete pad
  - — Upgradient of SS-61 near the hangars (Buildings 1079 and 1080)
- Collection of surface soil and sediment samples in the vicinity of the concrete pad and within the northern bermed area, as well as at a location where the buried pipeline extends above the ground surface at the former southern AST, to support the evaluation of human health and ecological risk at the site
- Installation and sampling of two monitoring wells southeast of the concrete pad to evaluate water quality upgradient of SS-61
- Sampling of eight existing wells in the area associated with SS-61 and SWMU 104 to help define the source of shallow groundwater contamination in the area
- Excavation of a test pit at the north side of the western concrete vault to determine if a subsurface release has occurred

In March and April 1999, the Phase I RI field sampling was conducted. The objective was conducted to locate the source and assess the extent of fuel contamination in soil and groundwater to the southeast of solid waste management unit (SWMU) 104 (LF-29). Contamination was detected in the upgradient monitoring well at SWMU 104 in 1994.

Detailed mapping of the site and geophysical data collection were conducted during the Phase I RI to identify potential sources of this groundwater contamination. These activities located the underground piping that connected the former ASTs to the concrete pad. Phase I RI samples were collected at the following locations to confirm the contaminant source:

- In the area of the two former ASTs to the northeast of the site
- Along the pipeline that once connected the former ASTs to a concrete pad in the southwest part of the site
- Under and around the concrete pad where AST-related underground piping emerges
- Near a debris pile that lies to the north of the concrete pad
- In the southeastern portion of the parking area outside Building 1001, where motor vehicle maintenance is conducted
- Upgradient of SS-61 in an area surrounding two hangars

Groundwater samples collected during the RI confirmed that past releases in the vicinity of the concrete pad account for the elevated concentrations of groundwater contaminants in a plume that extends to the north toward SWMU 104. However, soil sampling showed that there is no

continuing source of groundwater contamination above the water table in this area. Groundwater sampling conducted to the south and southeast of the pad indicates that there is also crossgradient and upgradient groundwater contamination attributable to one or more other sources that have not yet been characterized.

All total recoverable petroleum hydrocarbon (TRPH) soil sample concentrations in the northern part of the site were below the 1,000-milligrams per kilograms (mg/kg)-action level. No continuing source of groundwater contamination was indicated by soil sample results and no free product was observed at the water table at any of the groundwater sampling locations. Of the soil samples collected above the capillary fringe zone affected by groundwater contamination, only one contained a benzene concentration above the Holloman AFB screening level of 25 mg/kg. This benzene concentration and other individual soil and groundwater analytes were evaluated in a human-health risk assessment (HHRA) and screening-level ecological risk assessment. The risk assessments concluded that no unacceptable risk is posed to either human or ecological receptors. Therefore, no remediation is required to protect human health and the environment in the northern part of SS-61.

As a result of the Phase I RI, an additional investigation was recommended to the south of the AST system and concrete pad area investigated to date. The Phase II RI was recommended to locate and characterize upgradient sources of the observed groundwater contamination. Groundwater sampling at three locations in the southern part of SS-61 indicated these sources may be located in the vicinity of the hangars, Buildings 1079 and 1080.

1.4 DOCUMENT ORGANIZATION

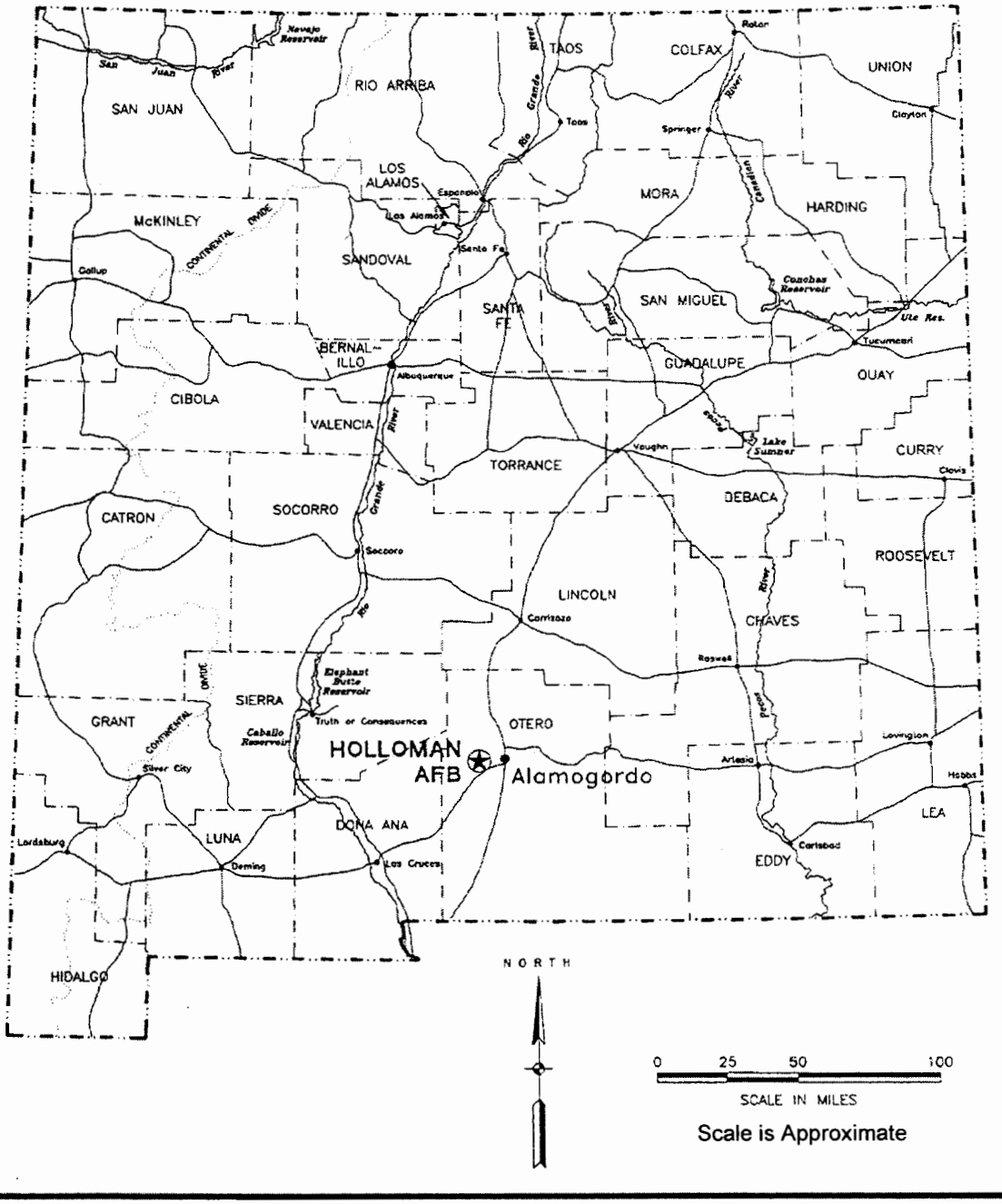
This report presents information gathered as a result of the 2000 Phase II RI field activities and the previous investigations to support recommendations for SS-61. The remainder of this report is organized into the following sections:

- Section 2.0 — Remedial Investigation Field Program
- Section 3.0 — Physical Setting
- Section 4.0 — Applicable or Relevant and Appropriate Requirements
- Section 5.0 — Nature and Extent of Contamination

- Section 6.0 — Contaminant Fate and Transport
- Section 7.0 — Screening-Level Risk Assessment
- Section 8.0 — Summary and Conclusions
- Section 9.0 — References

Figures and tables are found at the end of each section.

Appendix A provides supporting information necessary to evaluate the chemical analytical data. It is presented in the form of the Data Quality Control Summary Report and accompanying laboratory data. Appendix B presents field borehole logs, well construction diagrams, and well development information. Historical aerial photographs of the site and survey information for the six new monitoring wells are provided in Appendices C and D, respectively. Appendix E provides the checklist for Ecological Assessment/Sampling completed for the ecological scoping assessment (ESA) site visit.



SS-61 REMEDIAL INVESTIGATION REPORT

Holloman Air Force Base, New Mexico

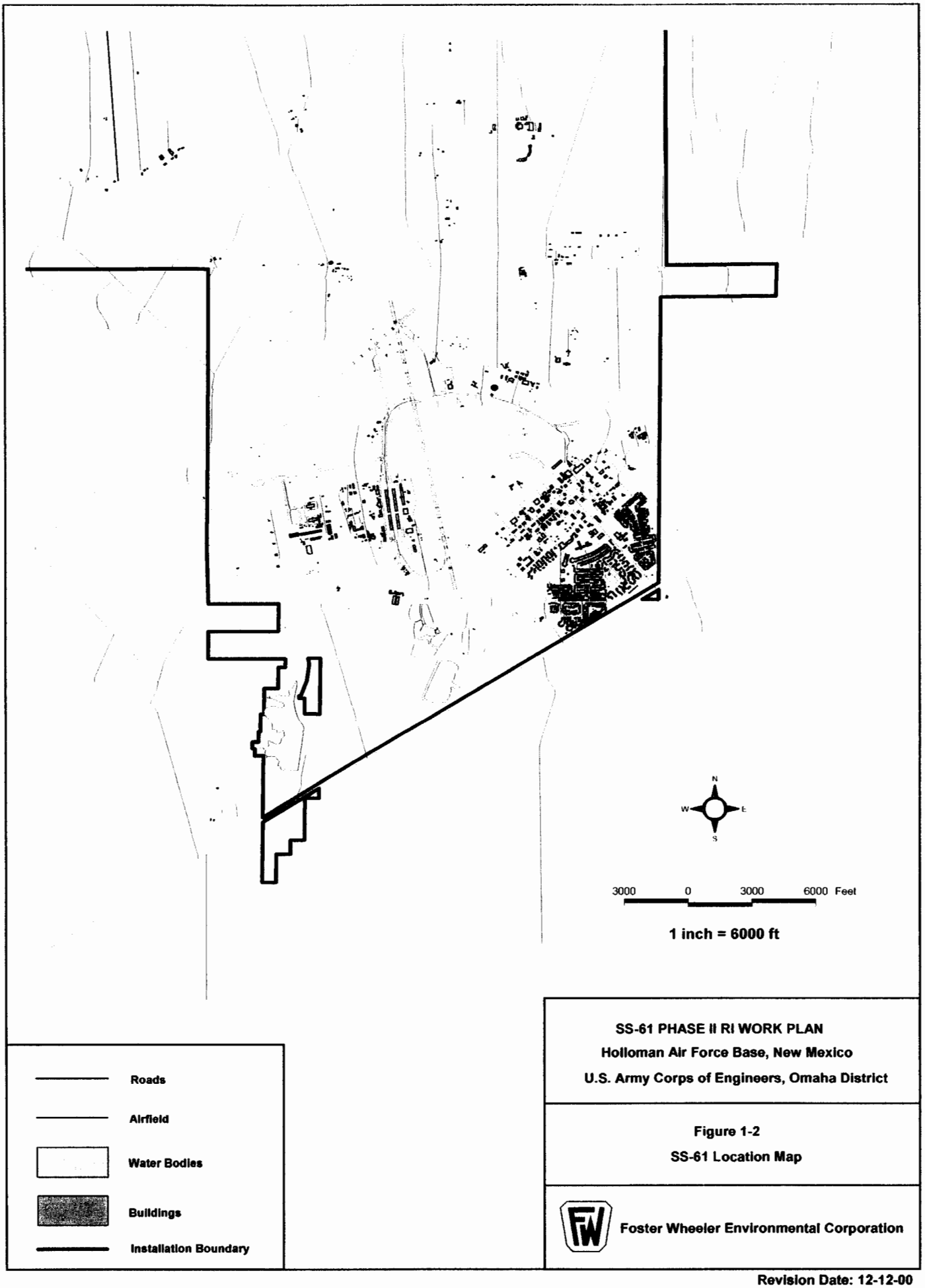
U.S. Army Corps of Engineers, Omaha District

Figure 1-1

Location of Holloman Air Force Base

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Revision Date: 12-12-00



SS-61 PHASE II RI WORK PLAN
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

Revision Date: 12-12-00

2.0 REMEDIAL INVESTIGATION FIELD PROGRAM

This section explains the objectives and technical approach of each field activity that was conducted. The results of previous investigations are summarized in Table 2-1 and in Section 5.0 of this report.

The Phase II RI field activities were conducted in the following sequence:

1. 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 such as fuel and solvent storage and supply systems, drains, sewers, and sumps used for waste collection.
2. Conducted geophysical electromagnetic survey immediately north and east of Building 1079 to delineate an extension of the underground pipeline that extends from the former ASTs northeast of Buildings 1079 and 1080.
3. Performed initial DPT soil and groundwater sampling at 10 locations with a 48-hour turnaround time for chemical analytical results. Potential source locations were then selected for characterization.
4. Selected remaining 10 DPT soil and groundwater sampling locations to complete the characterization of areas upgradient and crossgradient of Buildings 1079 and 1080.
5. Installed six groundwater monitoring wells in the vicinity of Buildings 1079 and 1080 and the underground pipeline. Two of the six wells were located upgradient of suspected sources at the hangars.
6. Collected groundwater samples from the 6 new monitoring wells and 10 existing monitoring wells.

With this approach, information obtained from steps 1 and 2 was used to select subsequent sampling locations (steps 3 and 4) to define and isolate the probable source of the groundwater and soil contamination in the area. The investigative steps and related activities are described in more detail in the following sections.

2.1 GEOPHYSICAL SURVEY

The objective of the Phase II geophysical investigation at SS-61 was to detect, locate, and map the underground pipeline that extends south from the former ASTs located northeast of the concrete pad at SS-61. The survey focused on the area south of Building 1072. Electromagnetic induction (EMI) was the best-suited geophysical method for this type of characterization, and

therefore, was selected. EMI instruments are sensitive to both ferrous and nonferrous metals and are able to detect a buried 55-gallon drum or a 10-inch pipe to depths approaching 10 ft.

2.1.1 Methodology

Lateral changes in ground conductivity can also be detected using EMI techniques. Conductivity contrasts in the earth can be caused by natural phenomena such as lithologic changes or by man-made phenomena such as disturbed ground, buried materials, or contaminants in the soil or groundwater.

EMI instrumentation operates on one of two principles, commonly referred to as time-domain EMI (EM61) or frequency-domain EMI (GEM 3, EM38, and EM31). The time-domain EMI system used during the Phase II RI employs a coil that generates a pulsed (i.e., time-based) primary magnetic field in the earth, which induces eddy currents in conductive media. The decay of these eddy currents produces a secondary magnetic field measured by the same coil. If the secondary field is measured at a relatively long time after the start of the decay, the current induced in the relatively nonconductive ground will fully dissipate, while the current in the conductive media (usually metallic objects) continues to produce a secondary magnetic field. The measured response is reported in units of millivolts.

2.1.2 Data Acquisition, Processing, and Interpretation

The geophysical survey area was approximately 400 x 450 ft. The EMI data were collected approximately every 0.5 ft (7 samples per second) along lines spaced 6 ft apart within the survey area. A Geonics EM61 time-domain electromagnetic instrument was used to collect EMI data at the site. Data were acquired using the procedures discussed in the work plan addendum (Foster Wheeler, 2000). Site cultural features were mapped to achieve a more complete understanding of the relationships between the observed site characteristics and the geophysical data. The location of the geophysical survey area is presented in Figure 2-1.

Data files for the survey areas were checked for proper geometry and recording interval with internally developed software in conjunction with Geonics software. Relative x and y location coordinates were assigned to each EMI data point. Data were then formatted for input into the Geosoft application for analysis and interpretation. The objective of the data analysis and

interpretation phase was to characterize the responses from the geophysical data in terms of their most probable sources (i.e., underground storage tank [UST], pipeline, debris trench or pit, etc.).

A color-coded map was generated showing the Channel 2 EMI response (Figure 2-1). Two channels were recorded by the EM61 instrument and both were used for the interpretation. However, for display purposes, the Channel 2 map was sufficient to present the geophysical data. Background values are colored green, and anomalies are colored blue, yellow, red, and pink, depending on the intensity (note color bar on figure). Many of the anomalies are surface features such as manhole covers, monitoring wells, buildings, dumpsters, fences, power/telephone poles, and miscellaneous metal debris.

The target of interest, the underground pipe running south from Building 1072, is denoted on the figure. This pipeline continues south of the survey area under the tarmac and was tracked using the EM61 in audio mode (data not recorded). It appears that the pipe may merge with another pipeline that extends south from the southeast corner of the hangar (Building 1079). This pipeline continues under the tarmac and terminates at a covered (metal) hole in the tarmac several hundred yards south of the hangar.

There are several other pipelines present in the survey area. Almost all of the geophysical anomalies are surface features or underground pipelines with the exception of one, located at approximately 300E 42N. There are three plausible causes for this shallow (less than 2 ft bgs) anomaly: either a reinforced concrete pad (long and narrow, underlying the asphalt), a UST (long and narrow, less than 6 ft by 20 ft), or an east-west trending pipe (with a vertical component). Unfortunately, because the target pipeline trended north-south, the data acquisition lines were oriented east-west and, therefore, the data do not resolve east-west trending features as well as north-south trending features. It is the Foster Wheeler geophysicist's opinion that the anomaly is most likely the piping, and may be attached/related to the target pipe that extends from under Building 1072.

2.2 DIRECT PUSH TECHNOLOGY SOIL AND GROUNDWATER SAMPLING

The Phase II RI was intended to define the source of soil and groundwater contamination detected during previous investigations in the vicinity of the two aircraft hangars (Buildings 1079

and 1080). The field investigation focused on the areas surrounding Buildings 1079 and 1080, and the underground pipeline. Based on the results of previous investigations along with the current results of the geophysical survey and personnel interviews, the field investigation focused on DPT collection of subsurface soil and groundwater samples from 20 separate locations. Sections 2.2.1 and 2.2.2 present detailed information on the DPT soil and groundwater sampling, respectively. Table 2-1 presents the location, summary of analytes detected, and field observations for each of the DPT locations sampled during the Phase II RI.

Initially, 10 DPT borings (DP38 through DP47) were drilled at predetermined locations around the perimeters of Buildings 1079 and 1080. Groundwater samples were collected from each of these borings and analyzed within 48 hours. Based on the analytical results along with additional field observations obtained during drilling, the locations of the remaining 10 DPT borings were selected. This approach allowed for a more precise attempt to delineate the source(s) of the groundwater contamination in the vicinity of Buildings 1079 and 1080.

2.2.1 Direct Push Technology Soil Sampling

A total of 32 subsurface soil samples were collected from the 20 DPT boring locations. Soil samples were analyzed offsite for volatile organic compounds (VOCs) using EPA SW-846 Methods 5035/8260B and TRPH using EPA Methods 9071/418.1. Figure 2-2 shows the location of the DPT borings.

Using the DPT drilling rig, subsurface soil cores were collected continuously from the ground surface to the water table at each borehole location. Soil within the core was used for lithologic description and subsequent sample collection. Sampling intervals were selected during drilling, and soil that exhibited odor, staining, or elevated photoionization detector (PID) readings was selected for chemical analysis. Soil samples were collected in 8-oz glass jars and immediately placed on ice. Field logs containing a description of the soil encountered in each boring are presented in Appendix B.

The initial 10 DPT borings were designated DP38 through DP47. Nine of these 10 boreholes were located around the perimeter of Building 1079 and the last borehole was located southeast of Building 1080. Soil staining, accompanied by a strong petroleum odor, was observed in soil

samples collected within the capillary fringe (immediately above the water table) in boreholes DP39, DP43, DP44, DP45, and DP46; the staining and strong odor continued into the water table. These five DPT borings were located around the immediate perimeter of Building 1079. Five additional DPT borings (DP38, DP40, DP41, DP42, and DP47) were drilled further away from the perimeter of Building 1079, although there was no visible soil staining in any of these.

Based on visual observations of the soil in the initial 10 DPT borings at Building 1079, the locations of 10 additional borings were selected to further delineate the source(s) of the soil contamination detected in the five DPT borings drilled around the perimeter of the building. The boring locations were based on the understanding of groundwater flow direction in the area surrounding Buildings 1079 and 1080. These additional DPT borings were located west and south of Buildings 1079 and 1080, which represent, the upgradient and crossgradient hydrologic locations.

2.2.2 Direct Push Technology Groundwater Sampling

All 20 DPT boreholes were converted to temporary well points by extending the DPT probe approximately 3 to 5 ft below the water table. The drill rods were then retracted from the borehole to the ground surface and a temporary well point was installed using slotted well screen (0.01-inch slot size) and blank casing. Each well consisted of 10 ft of well screen where the water table was located approximately in the middle of screen length. The wells were completed to ground surface using 1.5-inch-diameter Schedule 40 polyvinyl chloride (PVC). Each of the temporary DPT wells was sampled with a separate 1/2-inch-diameter disposable Teflon® bailer. Prior to collection of each groundwater sample, a single volume of the bailer was purged from the well point. After the sample was collected, the PVC material was removed from the borehole, which were abandoned by downhole hydration of bentonite chips. A total of 20 DPT groundwater samples, including 2 field duplicates, were collected and analyzed for VOCs using SW-846 Method 8260B and for total petroleum hydrocarbons (TPH) as JP-4 using EPA Method Modified 8015, which provides a determination of the source/type of petroleum hydrocarbons present in groundwater.

Groundwater samples were collected at the first 10 DPT locations (DP38 through DP47) and sent to the offsite laboratory for 48-hour turnaround of analytical results. The analytical results were

used to select the locations of the 10 additional DPT groundwater samples collected (DP48 through DP57). A rationale for the locations is provided in Table 2-1. The analytical results indicated that groundwater has been impacted in the vicinity of Building 1079. Elevated concentrations of VOCs and JP-4 were detected in groundwater samples collected from DPT well points DP39, DP43, DP44, DP45, and DP46. These five DPT well points were located around the immediate perimeter of Building 1079; and the groundwater samples produced a strong hydrocarbon odor. The five DPT wells were allowed to equilibrate for approximately 24 hours, after which water level and free-product measurements were performed. There was no oily sheen or free-phase product visible in these five DPT well points. Based on water levels collected in this area, these borings are located hydrologically downgradient of Buildings 1079 and 1080.

Analytical results for groundwater samples collected from DPT well points DP38, DP40, DP41, DP42, and DP47 indicate low to nondetectable levels of VOCs and TPH. These DPT well points are located further downgradient and crossgradient from Building 1079.

The location of the remaining 10 DPT well points (DP48 through DP57) focused on the area upgradient and crossgradient of Buildings 1079 and 1080 and attempted to provide optimum coverage for isolating the source and lateral extent of the groundwater contamination in this area. The analytical results for groundwater samples collected from these DPT wells were non-detectable for VOCs and TPH.

The groundwater analytical results from the 20 DPT wells that were sampled indicate the source of the contamination is isolated to the area surrounding Building 1079. No elevated concentrations of VOCs or TPH were detected in groundwater samples collected upgradient of Building 1079 on the aircraft taxiway.

2.3 SHALLOW SOIL SAMPLING

Nine shallow soil samples (1 to 2 ft bgs) were collected to determine where historical site activities have directly impacted soil and to support the risk assessment. The samples were collected at eight DPT locations (DP39, DP40, DP43, DP44, DP45, DP46, DP49, and DP50) where the results of drilling and visual observations indicated that activities may have impacted

soil. Shallow soil samples were analyzed for VOCs using SW-846 Methods 5035/8260B and for TRPH using SW-846 Methods 9071/418.1. Results are presented in Table 5-3.

2.4 MONITORING WELL INSTALLATION AND SAMPLING

Six new monitoring wells were installed and sampled to determine groundwater conditions upgradient (SS61-MW11) and south (SS61-MW07 through SS61-MW10 and SS61-MW12) of the previously investigated northern part of SS-61. The final locations of the wells were determined during the field program and were based on the results of the DPT groundwater samples. Figure 2-2 presents the locations of the monitoring wells and Table 2-1 gives a rationale for the well locations.

Soil samples for chemical or geotechnical analyses were not collected from the boreholes where the wells were installed. The depths of the six monitoring wells extended from 19.5 to 23.0 ft bgs, with screened intervals of 10 ft. Groundwater was encountered from approximately 14 to 16.5 ft bgs at each of the monitoring well locations. Well development began after the grout was allowed to set for at least 48 hours. Sampling took place at least 48 hours following development.

Groundwater samples were collected from the six new wells, six existing monitoring wells in the vicinity of SS-61, and four wells at SWMU 104 (LF-29) to assess the extent of contamination in groundwater and to provide a comparison of water quality between the previous investigation and the Phase II RI. Of the existing wells that were sampled, six were installed during the previous characterization of the site (SS61-MW01 through SS61-MW06) and four were associated with SWMU 104 to the northwest (MW-29-02, MW-29-03, MW-29-05, and MW-29-06). The offsite laboratory analyzed the samples for VOCs using SW-846 Method 8260B and TPH as JP-4 using SW-846 Method 8015.

2.5 LOCATION AND ELEVATION SURVEYING

Two phases of surveying took place during the RI field activities. During the first phase, trained site personnel operated a portable global positioning system (GPS) unit that was used to survey RI sample locations, geophysical survey area corners, and the position of important site cultural features. These data were used to create an accurate map for this RI Report. During the second

phase, the locations and elevations of the six new monitoring wells were surveyed by a licensed surveyor. All survey data obtained with the GPS unit and by the licensed surveyor are reported in New Mexico state planar coordinates and are based on the 1983 North American Datum used by the Holloman AFB geographic information system. The survey data have been entered into the Environmental Resource Program Information Management System for data storage and reporting.

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[3]	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)