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FINAL WORK PLAN FINAL CHARACTERIZATION AND REMOVAL ACTION IN SUPPORT OF RCRA FACILITY INVESTIGATION OF OFFSITE WEAPONS STORAGE AREA NAS FORT WORTH TX

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NAVAL AIR STATION FORT WORTH JRB CARSWELL FIELD TEXAS

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FINAL WORK PLAN

FINAL CHARACTERIZATION AND REMOVAL ACTION IN SUPPORT OF THE RCRA FACILITY INVESTIGATION (RFI) OF THE OFFSITE WEAPONS STORAGE AREA (WSA)

AT

NAVAL AIR STATION (NAS) FORT WORTH JOINT RESERVE BASE (JRB) CARSWELL FIELD, TEXAS

FINAL WORK PLAN

FINAL CHARACTERIZATION AND REMOVAL ACTION IN SUPPORT OF THE RCRA FACILITY INVESTIGATION (RFI) OF THE OFFSITE WEAPONS STORAGE AREA (WSA)

AT

NAVAL AIR STATION (NAS) FORT WORTH JOINT RESERVE BASE (JRB) CARSWELL FIELD, TEXAS

Contract No. F41624-95-D-8002
Delivery Order 0009

October 1998

Prepared for:

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This Work Plan provides a summary of existing information, presents an overview of project organization, and describes the methods to be used to complete the Final Characterization and Removal Action of the Offsite Weapons Storage Area at Naval Air Station Fort Worth, Joint Reserve Base, Carswell Field, Texas.

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PREFACE

A Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) of the Off-Site Weapons Storage Area (WSA) at Naval Air Station (NAS) Fort Worth, Joint Reserve Base, Carswell Field, Texas (identified as Project No. 96-8117) will be conducted to determine whether hazardous constituents have been released into the environment.

This Work Plan (WP) was prepared by The Environmental Company, Inc. (TEC) under contract No. F41624-95-D-8002, Delivery Order 0009. This WP is a project scoping document for Project No. 96-8117.

This WP provides a summary of existing information, presents an overview of project organization, and describes the methods to be utilized in completing the RFI.

This WP was written under the direction of Mr. Bob Duffner, P.E., TEC Project Manager.

The Contracting Officer's Representative for this project is Mr. Charles Rice, Air Force Center for Environmental Excellence (AFCEE), Environmental Restoration Branch (ERB), Brooks Air Force Base (AFB), Texas.

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NOTICE

This report has been prepared for the United States Air Force (USAF) by The Environmental Company, Inc. (TEC) for the purpose of aiding in the implementation of a final remedial action plan under the Air Force Installation Restoration Program (IRP).

Although the area of study is being investigated in accordance with IRP guidance, the area has not been identified as an IRP site. NAS Fort Worth (formerly Carswell Air Force Base) is undergoing property disposal/reuse pursuant to the Defense Base Closure and Realignment Act of 1990 and Round II of the Base Closure Commission deliberations. The area of study is being considered for property disposal or reuse and the Air Force Base Conversion Agency (AFBCA) desires to investigate the area to confirm or deny the presence of contamination.

As the report relates to actual or possible releases of potentially hazardous substances, its release prior to a USAF final decision on remedial action may be in the public's interest. The limited objectives of this report and the ongoing nature of the IRP, along with the evolving knowledge of site conditions and chemical effects on the environment and health, must be considered when evaluating this report since subsequent facts may become known that may make this report premature or inaccurate.

Acceptance of this report in performance of the contract under which it is prepared does not mean that the Air Force adopts the conclusions, recommendations, or other views expressed herein, which are those of the contractor only and do not necessarily reflect the official position of the USAF.

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LIST OF ACRONYMS AND ABBREVIATIONS

AFBCA	Air Force Base Conversion Agency
ARARs	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
COPC	Chemical of Potential Concern
CULs	Cleanup Levels
DNT	Dinitrotoluene
EOD	Explosive Ordnance Disposal
EPCs	Exposure Point Concentrations
FSP	Field Sampling Plan
HSP	Health and Safety Plan
IDW	Investigation Derived Waste
JRB	Joint Reserve Base
LPST	Leaking PetroleumStorage Tank Program
mg/kg	milligrams per kilogram
NAS	Naval Air Station
ND	Non-Detectable
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RRSN	Risk Reduction Standard Number
SAP	Sampling and Analysis Plan
SOW	Statement of Work
SPLP	Synthetic Precipitation Leachate Procedure
SVOC	Semivolatile Organic Contaminant
SWMU	Solid Waste Management Unit
TAC	Texas Administrative Code
TCLP	Toxicity Characteristic Leachate Procedure
TEC	The Environmental Company, Inc.
TEqC	Toxic Equivalency Concentration
TNRCC	Texas Natural Resources Conservation Commission
TPH	Total Petroleum Hydrocarbons
UST	Underground Storage Tank
VOC	Volatile Organic Compound

LIST OF ACRONYMS AND ABBREVIATIONS
(continued)

WP	Work Plan
WSA	Weapons Storage Area

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1.0 INTRODUCTION

This Work Plan (WP) was prepared by The Environmental Company, Inc. (TEC) under Contract No. F41624-95-D-8002, Delivery Order 0009. This WP describes the final field activities in support of the RCRA site closure of the Offsite Weapons Storage Area (WSA) at Naval Air Station Fort Worth Joint Reserve Base Carswell Field, Texas under Texas Natural Resources Conservation Commission (TNRCC) Risk Reduction Standard Number 2 (RRSN2) and the Leaking Petroleum Storage Tank Program (LPST) regulations (TNRCC 1993, 1994). These activities were initially discussed in *The Offsite Weapons Storage Area Final Characterization, Removal Action, and Site Closure* letter dated July 2, 1998 (Appendix A). In the letter, TEC identified areas or individual sample locations requiring additional action because contaminant concentrations exceeded site soil cleanup levels. The objective of the final field effort described in this WP is to address these areas and locations in a cost-effective and timely manner and obtain site closure. To achieve this goal, the final field effort will be performed following a two-phased approach consisting of the following:

- A focused final field characterization effort consisting of:
  - verifying previously reported results by resampling at previous locations and depths;
  - further determining the extent of contamination as needed; and
  - determining association of PAHs with potential roadway run-off.
- A location-specific action to reduce soil concentrations to site cleanup levels.

This WP was prepared in accordance with the procedures and requirements documented in the *Draft Work Plan and Draft Sampling and Analysis Plan (Draft Field Sampling Plan, and Quality Assurance Project Plan)* for the RCRA Facility Investigation (RFI) of the Offsite WSA (TEC 1996a, b). It was prepared in part to fulfill requirements outlined in a directive (February 16, 1995) issued by the TNRCC to the Air Force Base Conversion Agency (AFBCA) that summarized Solid Waste Management Units (SWMUs) requiring RFIs, including the Offsite WSA Waste Accumulation Area adjacent to Building 8503 (SWMU 59). In addition, other areas at the Offsite WSA have been investigated for the purposes of initiating disposal/reuse of the property.

The final field characterization and removal action described in this WP will complete the process established in the *Draft Work Plan* (TEC 1996a) of achieving the overall project goal of characterizing environmental conditions at the Offsite WSA in support of SWMU 59 closure and the disposal/reuse of the property.

The site environmental setting, history of site environmental activities, conceptual site model, and project applicable or relevant and appropriate requirements (ARARs) upon which the RCRA investigation of the Offsite WSA has been based are described in the *Draft Work Plan* (TEC 1996a).

1.1 SUMMARY OF PREVIOUS SITE ACTIVITIES AND REPORTS

This section describes the activities performed and documentation prepared to date by TEC under Contract No. F41624-95-D-8002. These activities and reports, in chronological order, include:

- Draft planning documents (December 1996)
- Initial field investigation effort (August 1997)
- *Draft RCRA Facilities Investigation Report* (January 1998)
- Field investigation effort (February 1998)
- *Addendum to the Draft RCRA Facilities Investigation Report* (May 1998)
- *Supplemental Field Sampling* letter and effort (May 1998)
- *Offsite WSA Final Characterization, Removal Action, and Site Closure* letter (July 1998)

A brief description of each activity and report is provided below.

Draft Planning Documents (December 1996)

TEC prepared a draft work plan, draft sampling and analysis plan (SAP) [which includes the draft field sampling plan (FSP) and quality assurance project plan (QAPP)], and health and safety plan (HSP) in December 1996 in support of the RFI field investigation efforts performed at the Offsite WSA (TEC 1996a, b, c). These documents constitute the scoping documents required by the Statement of Work (SOW) for this contract and delivery order. The 1996 *Draft Work Plan* provides the overall objectives, procedures, and requirements for the RFI investigation of the Offsite WSA. It summarizes the conceptual site model, project objectives, facility investigation tasks, and reporting requirements. The FSP presents the requirements and procedures for conducting field operations and investigations. The FSP was prepared to ensure that data quality objectives specified for this project are met, field sampling protocols are documented and reviewed in a consistent manner, and collected data are scientifically valid and defensible. The QAPP presents the policies, organization, functions, and Quality Assurance/Quality Control (QA/QC) requirements designed to achieve the data quality goals described in the SAP. The QAPP establishes the analytical protocols and documentation requirements to ensure that data are collected, reviewed, and analyzed in a consistent manner. The HSP establishes a site health and safety program that identifies, evaluates, controls, and reduces health and safety hazards for all field activities associated with this contract.

All work performed under this final field effort WP will adhere to the project-specific procedures and requirements set forth in the above draft planning documents.

Initial Field Investigation Effort (August 1997)

The initial field investigation activities consisted of soil, sediment, and groundwater sampling and facilities surveys completed at eight potential source areas, including:

- outdoor materiel storage and maintenance areas (A-1, A-2);
- unpaved perimeter of the Waste Accumulation Area and Bldg. 8503 (A-3);
- disturbed surface area southwest of the Control Fence (A-5);
- Explosive Ordnance Disposal (EOD) Range;
- bunker floor drain outlets;
- removed Underground Storage Tank (UST) locations;
- vehicle fueling area (A-4); and

- areas beneath transformers.

In addition to these potential source areas, samples were collected from on site drainageways and the Paluxy Aquifer groundwater to directly characterize potential contaminant migration pathways. Samples were also collected to determine site-specific background soil and groundwater conditions. Subsurface soil samples were collected and logged continuously. A total of 422 soil, sediment, groundwater, and quality control samples were collected and analyzed for inorganics, volatile organic compounds (VOCs), semivolatiles (SVOCs), pesticides/polychlorinated biphenyls (PCBs), explosives, total petroleum hydrocarbons (TPH), and polycyclic aromatic hydrocarbons (PAHs).

Draft RCRA Facilities Investigation Report (January 1998)

This draft report (TEC 1998a) presents the activities and results of the initial field investigation and facilities survey effort conducted in August 1997. Analytical results for samples collected were presented in the report and compared to background levels and RRSN2/LPST cleanup levels. Exceedances of cleanup levels were identified in five of the nine investigation areas.

The report demonstrated that contamination is generally limited to the upper horizon of soil (0 to 0.5 feet below ground surface [bgs]) and does not appear to have migrated vertically. Inorganic and semivolatile compounds are most prevalent in surface samples and typically decrease to either background levels or below detection limits after 0.5 feet bgs. Semivolatiles detected in subsurface soil at the former UST locations are likely the result of direct tank leaks below the surface rather than vertical migration. Both drainageway sediment and Paluxy Aquifer groundwater sampling support the conclusion that contamination is not migrating either vertically or off site. Detects in drainageway samples are confined to the adjacent source areas or to upgradient most samples within the drainageway. Inorganics in the groundwater were either below background or not attributable to the site. Organic compounds were not detected in groundwater.

Field Investigation Effort (February 1998)

Investigation activities performed in February 1998 consisted of collecting environmental samples that could not be obtained during the initial field investigation due to weather constraints. Samples were collected from drainageway surface water and seep surface water and sediment to directly measure potential contaminant migration pathways. Background surface water samples were collected from an off site drainageway that was not impacted by site-related contamination. Drainageway and seep samples were tested for the same set of analytes described in the Draft WP.

Soil samples were also collected from four locations previously sampled during the initial field investigation to verify the presence of relatively high contaminant concentrations at those locations.

Addendum to the Draft RCRA Facilities Investigation Report (May 1998)

An addendum report was prepared in May 1998 (TEC, 1998b) to present the results of the February 1998 investigation completed at the WSA, the results of the synthetic precipitation leachate procedure (SPLP) performed on archived soil samples, and the final soil cleanup levels (CULs) modified according to the SPLP results. The Addendum

concluded that detected chemical concentrations in both surface water and seep sediment samples were either below background levels or below risk-based screening criteria. Therefore, no cleanup levels were developed for these media and no further action is required.

Soil verification samples collected as part of the supplemental investigation effort indicated that either considerable variability exists in the vicinity of the locations where relatively high concentrations were originally reported or the concentrations, as reported in the Draft RFI report, do not truly represent conditions at those locations. These results are used in this WP to identify the need for additional sampling at sample locations A3-006, DW3-001, and DW4-001.

The SPLP was performed on several soil samples collected during the August 1997 field activities to develop site-specific soil cleanup levels for the soil to groundwater cross-media pathways, as allowed for in TAC Chapter 335, Subchapter S (TNRCC 1993c). The SPLP results were used to significantly modify the soil cleanup levels for inorganics originally developed in the Draft RFI report.

Supplemental Field Sampling Letter and Field Effort (May 1998)

The supplemental field sampling letter (TEC, 1998c) describes field sampling activities proposed for:

- a previously unidentified leach field located south of the WSA; and
- 11 surface water locations previously sampled during the February 1998 investigation effort.

Subsurface soil samples were collected at three locations, one inside the leach field area and two on the downgradient perimeter of the leach field. Drainageway and seep surface water samples were collected from 3 previously sampled locations and analyzed for explosives only. Two of these samples represented background locations. Surface water samples were not collected at all proposed locations due to the lack of water. One sediment sample was collected from each of the four seep locations. This effort was undertaken because the explosives results for the original data were rejected during data validation.

Offsite Weapons Storage Area Final Characterization, Removal Action, and Site Closure letter (July 1998)

The purpose of this letter report (TEC, 1998d) was to initiate final characterization and corrective action activities by presenting the final soil cleanup levels and proposing the actions necessary for site closure of the Offsite WSA. The letter provides the:

- final site soil cleanup levels;
- approach for selecting the soil cleanup levels;
- review of the SPLP results pertinent to developing cleanup levels;
- cleanup levels comparison to determine whether site concentrations pose a threat to human health or the environment and to identify areas needing further characterization or action; and
- investigation status and proposed actions of site study areas.

The final RRSN2 soil cleanup levels for the Offsite Weapons Storage Area are provided in Table 1-1. Four of the cleanup levels (for arsenic, mercury, copper and benzo(a)pyrene) have been modified from those originally presented in the Draft RFI report and Closure letter because of modifications made to RRSN2 medium-specific concentrations in TNRCC (1998).

The contents of the letter pertinent to the final characterization effort are further described in Section 2.0 of this WP.

1.2 PROJECT ORGANIZATION AND RESPONSIBILITIES

TEC has assembled a team of highly qualified professionals to both manage and execute the tasks required for the successful completion of this characterization and corrective action effort. The *Draft Work Plan* (TEC 1996a) provides a project organizational chart and a point-of-contact listing that identifies key project personnel.

Table 1-1. Proposed Final RRSN2 Soil Cleanup Levels for the Offsite Weapons Storage Area Samples

COPC	Proposed RRSN2 Soil Cleanup Level[a] (mg/kg)	Cleanup Level Basis
Metals		
Antimony	4.5	Background $UTL_{95,95}$
Arsenic	20 (10.5)	SPLP
Copper	130	RRSN2 Groundwater Protection
Iron	48,700 (49,100)	SPLP
Mercury	0.11	RRSN2 Groundwater Protection
Nickel	27.5 (207)	SPLP
Thallium	1.3	Background $UTL_{95,95}$
Semivolatiles (UST Sites)		
Benzo(a)anthracene	0.88	RRSN2 Res. Ingestion/Inhalation
Benzo(a)pyrene	0.088	RRSN2 Res. Ingestion/Inhalation
Benzo(b)fluoranthene	0.88	RRSN2 Res. Ingestion/Inhalation
Chrysene	7.2	RRSN2 Res. Ingestion/Inhalation
Dibenzo(a,h)anthracene	0.088	RRSN2 Res. Ingestion/Inhalation
Indeno(1,2,3-c,d)pyrene	0.88	RRSN2 Res. Ingestion/Inhalation
Semivolatiles (non-UST Sites)		
Benzo(a)anthracene	0.012	RRSN2 Groundwater Protection
Benzo(a)pyrene	0.0200	RRSN2 Groundwater Protection
Benzo(b)fluoranthene	0.012	RRSN2 Groundwater Protection
Chrysene	1.2	RRSN2 Groundwater Protection
Dibenzo(a,h)anthracene	0.0012	RRSN2 Groundwater Protection
Indeno(1,2,3-c,d)pyrene	0.012	RRSN2 Groundwater Protection
Explosives		
2,4-Dinitrotoluene	0.012	RRSN2 Groundwater Protection
2,6-Dinitrotoluene	0.012	RRSN2 Groundwater Protection

COPC - chemical of potential concern

NA - not available

Res. - residential

RRSN2 - Risk Reduction Standard Number 2

SPLP - Synthetic Precipitation Leachate Procedure

UTL - upper tolerance limit

[a] Value in parentheses is the proposed cleanup level for Drainageway 9 if based on the SPLP results.

[b] Soil concentration corresponding to DW9 leachate is below background.

2.0 FINAL CHARACTERIZATION TASKS

This section summarizes the investigation status and additional sampling requirements for final characterization and closure of the Offsite WSA site.

2.1 INVESTIGATION STATUS AND PROPOSED CHARACTERIZATION

Comparison of site concentrations with the CULs and further comparison with the final modified CULs in Table 1-1 in the July 1998 *Offsite Weapons Storage Area (WSA) Final Characterization, Removal Action, and Site Closure* letter (TEC 1998d) forms the basis for determining whether areas need further characterization and/or removal actions. The complete comparison is provided in Tables 4 through 8 in Appendix A. The results of this comparison are graphically depicted in Figures 3 and 4, Appendix A and are outlined below. The results of this comparison have deviated somewhat because of modifications in the CULs (Section 1.0). These differences are reflected in the discussion below.

Areas in which characterization data currently available are sufficient to satisfy site closure requirements under RRSN2 and LPST (USTs only) and no further action is warranted include:

- Outdoor Materiel Storage/Maintenance Area A-1, except A1-019 and A1-028;
- Outdoor Materiel Storage/Maintenance Area A-2;
- Vehicle Fueling Area A-4;
- Disturbed Surface Area A-5;
- EOD, except EOD-006 and EOD-009;
- Bunker Floor Drains, except BD-002 and BD-005;
- Former USTs near Bldgs. 8503 and 8514;
- Electronic Transformers (all);
- Drainageways 2 and 5 through 9; and
- Drainageway sample locations DW3-002, DW3-003, and DW4-002.

Either no chemicals of potential concern (COPCs) were identified in these areas or site concentrations were below RRSN2 or LPST target cleanup levels. Exceedances of CULs occur in samples collected from the following areas or individual sample locations:

- Sample locations A1-019 and A1-028;
- Building 8503 and SWMU 59 Area A-3;
- Sample locations EOD-006 and EOD-009;
- USTs near Bldgs. 8500, 8505, and 8507;
- Bunker Floor Drains BD-002 and BD-005;
- Drainageway 1; and
- Sample locations DW3-001 and DW4-001.

A summary of the CULs comparison which identifies only those areas and/or locations where contaminant concentrations exceed CULs is presented in Table 2-1.

Contamination above CULs at these areas and/or locations can be organized into the following four categories:

1) **PAH detects with known sources.**
Areas in which PAHs were detected and are attributed to a known source include former UST sites near Buildings 8500, 8505 and 8507, as well as the Drainageway 3 sample location (DW3-001) adjacent to the UST associated with Building 8505.

2) **PAH detects with no known sources.**
PAH detections with no known sources appear along roadway and parking areas. PAHs are suspected to be associated with run-off impacted by vehicle related contaminants. These locations include Area A-3, Drainageway 1, sample location A1-019, and sample location DW4-001.

3) **Isolated high-level detects of inorganic compounds with no known sources.**
Isolated high-level detects of inorganic compounds with no known sources have been identified at several individual sample locations in A-1, A-3, Bunkers 8531 and 8535, and the EOD. These detects were generally found to be outliers in the data sets used to calculate exposure point concentrations (EPCs) or are single detects in a data set of non-detects. Compounds detected include nickel, mercury, copper, iron, antimony, and thallium.

The presence of elevated iron levels in these locations is likely attributable to iron-containing metal objects that were stored on the ground surface throughout the area. Because the cleanup level for iron is based on background rather than health and the compound is associated with low toxicity, no further action is recommended and no remedial action with respect to iron is proposed at these locations.

4) **Isolated detects of dinitrotoluenes with a known source.**
Dinitrotoluene compounds (2,4- and 2,6-dinitrotoluene) were detected in one sample collected outside and east of the main EOD area. These compounds were not detected in other samples and the detects appear to be isolated. The EOD pit is assumed to be the source.

Each of these categories is discussed in more detail in Appendix A.

Contaminant migration pathways documented in Section 4.0 of the draft RFI report (TEC 1998a) demonstrated that contamination, when present, was generally within the top portion of the soil horizon and was limited in the subsurface samples (0.5 feet to refusal). Figure 3 in Appendix A depicts this pattern for Area A3 and DW1 where PAHs detected above CULs were reported for a majority of surface soil samples (0.0 - 0.5 feet bgs), while contamination levels decreased or were below the detection limit in subsurface samples (0.5 feet bgs to refusal). Therefore, with a few exceptions the final investigation will focus on determining the horizontal extent of contamination and will assume the vertical contaminant pattern documented in the draft RFI report (TEC, 1998a).

Table 2-1. RRSN2 Soil Cleanup Level Exceedances at Specific Investigation Areas and Locations

Area	COPC	RRSN2 Human Health CUL (mg/kg)	EPC[a] (mg/kg) Surface Soil	EPC[a] (mg/kg) Subsurface Soil
Area A-1	**Metals**			
	Nickel @ A1-028[b]	27.5	514	BB
	Semivolatiles			
	Benzo(a)pyrene @ A1-019	0.0012	0.086[c]	ND
	Benzo(a)anthracene @ A1-019	0.0012	0.091[c]	ND
Area A-3	**Metals**			
	Antimony @ A3-019-02[b]	4.5	BB	1,300
	Antimony @ A3-019-03[b]	4.5	BB	5
	Antimony @ A3-020-02[b]	4.5	BB	13.7
	Mercury @ A3-006[b]	0.11	10.9[d]	BB
	Semivolatiles			
	Benzo(a)anthracene (area EPC)	0.012	1.7	< CUL
	Benzo(a)pyrene (area EPC)	0.02	1.5	< CUL
	Benzo(b)fluoranthene (area EPC)	0.012	2	< CUL
	Chrysene (area EPC)	1.2	1.7	< CUL
	Indeno(1,2,3-c,d)pyrene (area EPC)	0.012	0.9	< CUL
	Benzo(a)anthracene (at A3-002)	0.012	NA	0.069
	Benzo(a)pyrene (at A3-002)	0.02	NA	0.062
	Benzo(b)fluoranthene (at A3-002)	0.012	NA	0.12
	Benzo(a)anthracene (at A3-013)	0.012	NA	0.49
	Benzo(a)pyrene (at A3-013)	0.02	NA	0.42
	Benzo(b)fluoranthene (at A3-013)	0.012	NA	0.52
	Indeno(1,2,3-c,d)pyrene (at A3-013)	0.012	NA	0.19
EOD Range Area	**Metals**			
	Thallium (at EOD-009)	1.3	ND	4.1[c]
	Explosives			
	2,4-Dinitrotoluene (at EOD-006)	0.012	ND	26[c]
	2,6-Dinitrotoluene (at EOD-006)	0.012	ND	1.9[c]

Table 2-1. (continued)

Area	COPC	RRSN2 Human Health CUL (mg/kg)	EPC[a] (mg/kg) Surface Soil	EPC[a] (mg/kg) Subsurface Soil
Bunker Drains				
	Bunker 8531			
	Mercury at BD-002[b]	0.11	0.2	ND
	Bunker 8535			
	Copper at BD-005[b]	130	BD	166
UST Areas	**UST-8500**			
	Benzo(a)anthracene (area EPC)	0.88	NT	1.1
	Benzo(a)pyrene (area EPC)	0.088	NT	1.6
	Benzo(b)fluoranthene (area EPC)	0.88	NT	0.99
	Dibenzo(a,h)anthracene (area EPC)	0.088	NT	0.15
	UST-8505			
	Benzo(a)pyrene (area EPC)	0.088	NT	1.8
	UST-8507			
	Benzo(a)pyrene (area EPC)	0.088	NT	0.16
Drainageways	**DW1**			
	Benzo(a)anthracene (area EPC)	0.012	0.44	< CUL
	Benzo(a)pyrene (area EPC)	0.02	0.3	< CUL
	Benzo(b)fluoranthene (area EPC)	0.012	0.55	< CUL
	Indeno(1,2,3-c,d)pyrene (area EPC)	0.012	0.27	< CUL
	Benza(a)anthracene @DW1-001	0.012	NA	0.14
	Benzo(a)pyrene @ DW1-001	0.02	NA	0.11
	Benzo(a)flouranthene @ DW-001	0.012	NA	0.22
	Indo(1,2,3 - c,d)pyrene @ DW1-001	0.012	NA	0.24
	DW3			
	Benzo(a)anthracene (at DW3-001)	0.012	2	NT
	Benzo(a)pyrene (at DW3-001)	0.02	1.4	NT
	Benzo(b)fluoranthene (at DW3-001)	0.012	2	NT
	Chrysene (at DW3-001)	1.2	2.1	NT
	Indeno(1,2,3-c,d)pyrene (at DW3-001)	0.012	0.83	NT

Table 2-1. (continued)

Area	COPC	RRSN2 Human Health CUL (mg/kg)	EPC[a] (mg/kg) Surface Soil	EPC[a] (mg/kg) Subsurface Soil
	DW4			
	Benzo(a)anthracene (at DW4-001)	0.012	1.4	NT
	Benzo(a)pyrene (at DW4-001)	0.02	1.3	NT
	Benzo(b)fluoranthene (at DW4-001)	0.012	1.8	NT
	Chrysene (at DW4-001)	1.2	1.4	NT
	Dibenzo(a,h)anthracene (at DW4-001)	0.0012	0.074	NT
	Indeno(1,2,3-c,d)pyrene (at DW4-001)	0.012	0.52	NT

BB - below background

NA - Individual contaminant levels not considered since location results included in area EPC deternination.

ND - not detected.

NT - not tested.

[a]EPCs compiled in Appendix P of the Draft RFI Report for the Offsite Weapons Storage Area.

[b]Location of outlier concentration.

[c]Exceedance represents one sample location (shown next to COPC name), where the only detected concentration was reported.

[d]Exceedance represents the highest of two detects. The other detected concentration is 0.1 mg/kg, which is below the CUL.

Surface soils will be collected at all sample locations to determine horizontal extent. However, subsurface soil samples will also be collected to determine vertical extent at the following sites:

- locations A3-002 and A3-013;
- the EOD sample locations;
- DW3-001and DW4-001; and
- the former UST locations.

Subsurface samples will also be collected at sample locations A3-019 and A3-020 to verify reported results from the September 1997 sampling event.

Subsurface soil samples will be collected 10 feet in each direction from the original sample location at the EOD sites to determine the vertical extent of contamination.

Sample DW3-001 was located at the outfall pipe draining the interior of Bldg. 8505, which is assumed to be the source of contamination. During the August 1997 investigation, samples were limited to surface soil; therefore, subsurface soil samples will be collected at this location to determine extent of contamination.

PAHs detected near DW4-001 are suspected to be due to roadway run-off. Surface and subsurface sampling will be conducted at DW4 to verify this assumption. During the August 1997 investigation, samples were limited to surface soil, therefore, subsurface soil samples will be collected at this location to determine the vertical extent of contamination. If sample analysis indicates contamination is not due to roadway run-off, optional samples may be collected.

Subsurface contaminants detected at the former USTs are related to the depth of the former USTs and not vertical migration. The USTs extended down to the limestone bedrock, which hinders vertical migration. In this case, because the source of contamination is well understood, soil associated with the USTs will be removed based on results provided in Section 3.0 of the Draft RFI Report (TEC 1998a).

Following the focused characterization on the areas and locations described in Section 2.2 of this WP a limited removal action will be performed. The action will include removing soil from the locations and areas where final field characterization results indicate contaminant concentrations above cleanup levels. A discussion of removal actions is provided in Section 3.0.

Existing data and data collected as part of the final field characterization effort will be used to demonstrate that RRSN2 CULs (Table 1-1) have been attained. Following the removal action, limited "cleanup confirmation" sampling is proposed. TEC expects that, in general, the degree of characterization prior to the removal action will be sufficient to document site closure under RRSN2 and LPST regulations.

In addition to characterizing areas with contaminant concentrations above the CUL, the leach field area will be defined with respect to background levels.

2.2 FIELD SAMPLING REQUIREMENTS

This section summarizes the sampling activities that will be conducted at each location and area with CUL exceedances listed in Section 2.1 of this WP. A summary of sample

locations and numbers of surface, subsurface and optional samples to be collected at each site is provided in Table 2-2. Table 2-3 provides a summary of the number of verification and extent samples to be collected at each site, as well as the analyses to be performed. Optional samples are not included on Table 2-3.

Surface and subsurface soil samples will be collected, handled, prepared, and shipped in accordance with procedures specified in the Draft FSP (TEC, 1996b). Decontamination procedures and disposal of investigation derived waste (IDW) will be performed as described in Sections 5.12 and 5.13 of the Draft FSP (TEC 1996b).

2.2.1 Sample Locations A1-019 and A1-028

Investigation Area

The area between Building 8503 and Munitions Storage Bunkers 8531, 8533, and 8535 (Area A-1) was reportedly used to temporarily store munitions components. Maintenance activities such as sanding, painting, and general cleaning may also have been performed in this area. Initial characterization of this area was completed in August 1997 and sample results showed that exceedances of PAH and nickel cleanup levels occurred in surface soil at sample locations A1-019 and A1-028, respectively. These compounds are either not detected or below cleanup levels in subsurface soil samples from these locations. Therefore, this final field characterization will focus on the surface soil at these two individual sample locations.

Task Objective

The objectives of the additional sampling are to

- verify PAH contamination at sample location A1-019;
- determine if contamination at A1-019 is due to roadway run-off;
- verify nickel contamination at sample location A1-028; and
- determine extent of contamination at A1-028.

Task Scope and Rationale

A total of ten surface soil samples will be collected from locations near A1-019 and A1-28 shown on Figures 2-1 and 2-2. No subsurface soil samples will be collected.

In the vicinity of location A1-019, five samples will be collected to determine extent and to indicate if the source of the PAH contamination associated with roadway run-off. These samples will be analyzed for PAHs by Method SW8270 with quick turnaround from the laboratory. If results indicate PAH contamination is consistently adjacent to the road and concentrations decrease with distance from the road, it will be assumed that the source of contamination is roadway run-off. Samples near A1-19 will be collected as follows.

- One verification sample will be collected at the original sample location, A1-019, to verify PAH contamination.
- Two samples will be collected 20 feet north and south of the original sample.
- Two samples will be collected 10 feet east of A1-019 off of the original location.

Table 2-2. Sample Locations and Numbers

Sample Locations	Number of Samples[1]					
	Surface	Subsurface	Optional Surface	Optional Subsurface	Quality Control	Total
A1-019	5	0	4	0		9
A1-028	5	0	4	0	1	10
Building 8503 SWMU Area A3 Drainageway 1	17	7	7	0	3	34
EOD-006	5	5	0	4		14
EOD-009	4	4	0	3	1	12
BD-002	2	0				
BD-005	2	2				
DW3-001	2	4	2	4		12
DW4-001	5	5	3	6	2	21
LeachField		2				2
Total	47	29	20	17	7	114

[1]Estimated number of optional samples are presented for planning purposes only. The actual number of optional samples to be collected will be determined following receipt of quick turnaround results from the proposed surface and subsurface samples.

Table 2-3. Sample Analysis Summary

	Number of Analyses											
	Per Sample Depth			Per Analysis[1]								
Area or Location	Surface Sample (0.0 to 0.5 ft bgs)	Subsurface Sample (0.5 to 2.5 ft bgs)	Subsurface Sample (> than 2.5 ft bgs)	PAHs (SW8270)	Explosive Residue (SW8330)	Antimony (SW6010A)	Nickel (SW6010A)	Thallium (SW6010A)	Mercury (SW7470A / SW7471A)	Cadmium (SW6010A)	Copper (SW6010A)	Total Samples
A1-019												
Verification	1			1								1
Extent	4			4								4
A1-028												
Verification	1						1					1
Extent	4						4					4
Area A3 & DW1												
Edge of Pad	8	2		10								10
Top of Hills	4			4								4
DW1	4	1		5								5
A3-006	1								1			1
A3-019			2[a]			2						2
A3-020			2[a]			2						2
EOD-006												
Verification	1	1			2							2
Extent	4	4			8							8
EOD-009												
Verification	1	1						2				2
Extent	3	3						6				6
BD-002												
Verification	1								1			1
Extent	1								1			1
BD-005												
Verification	1	1									2	2
Extent	1	1									2	2
DW3-001												
Verification	1	1	1	3								3
Extent	1	1	1	3								3
Leach Field			2	2		2				2		2
DW4-001												
Verification	1	1		2								2
Extent	4	4		8								8
Total	47	21	8	42	10	6	5	8	3	2	4	76

[1]Since optional samples are for planning purposes only, they are not included on this table.

[a] See text for specific depth intervals

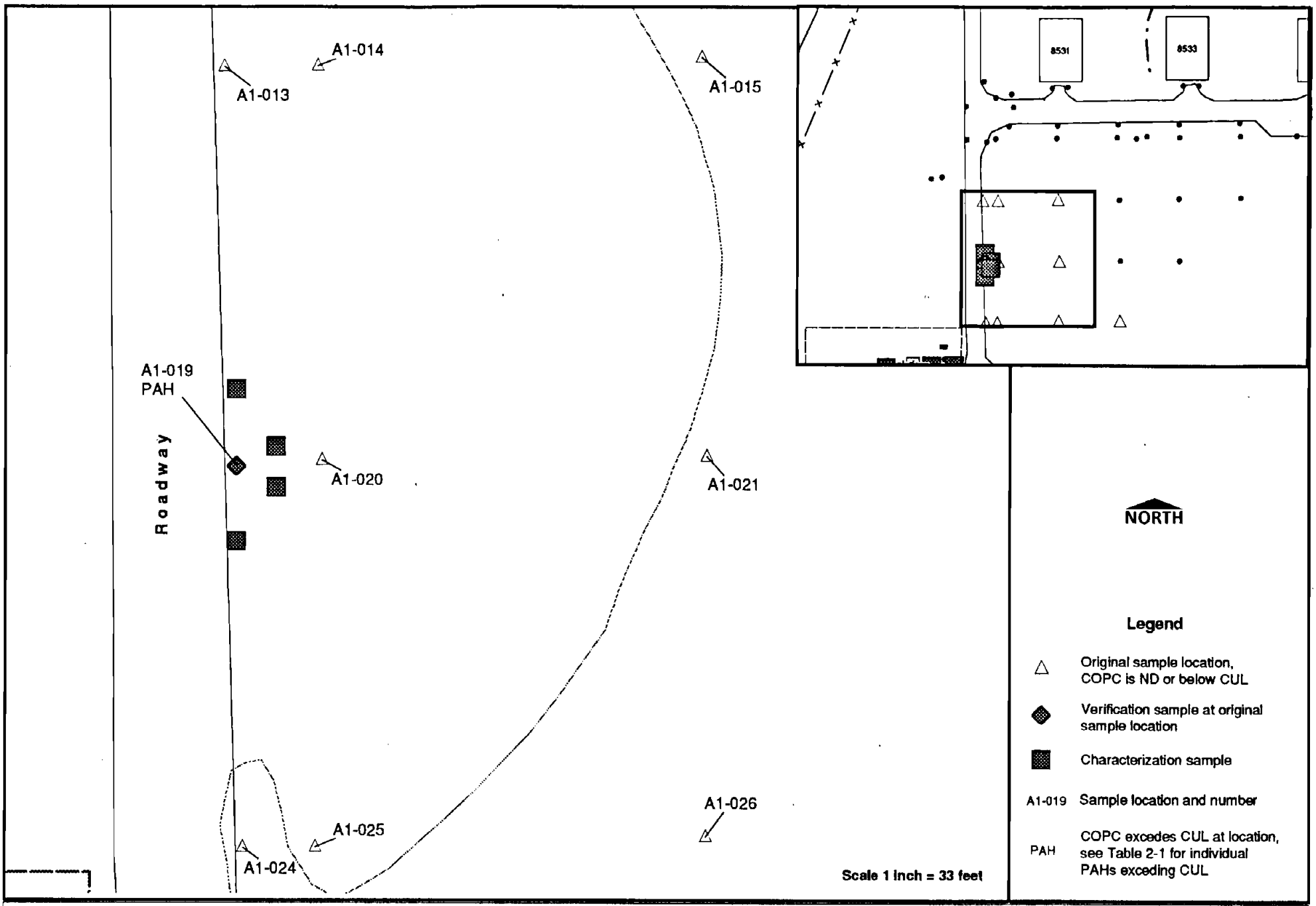

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Figure 2-1 -- A1-019 Sample Location Map

Date: August 1998
Project Manager: B. Duffner
Prepared By: D. Bedarf
Project No: P-3109

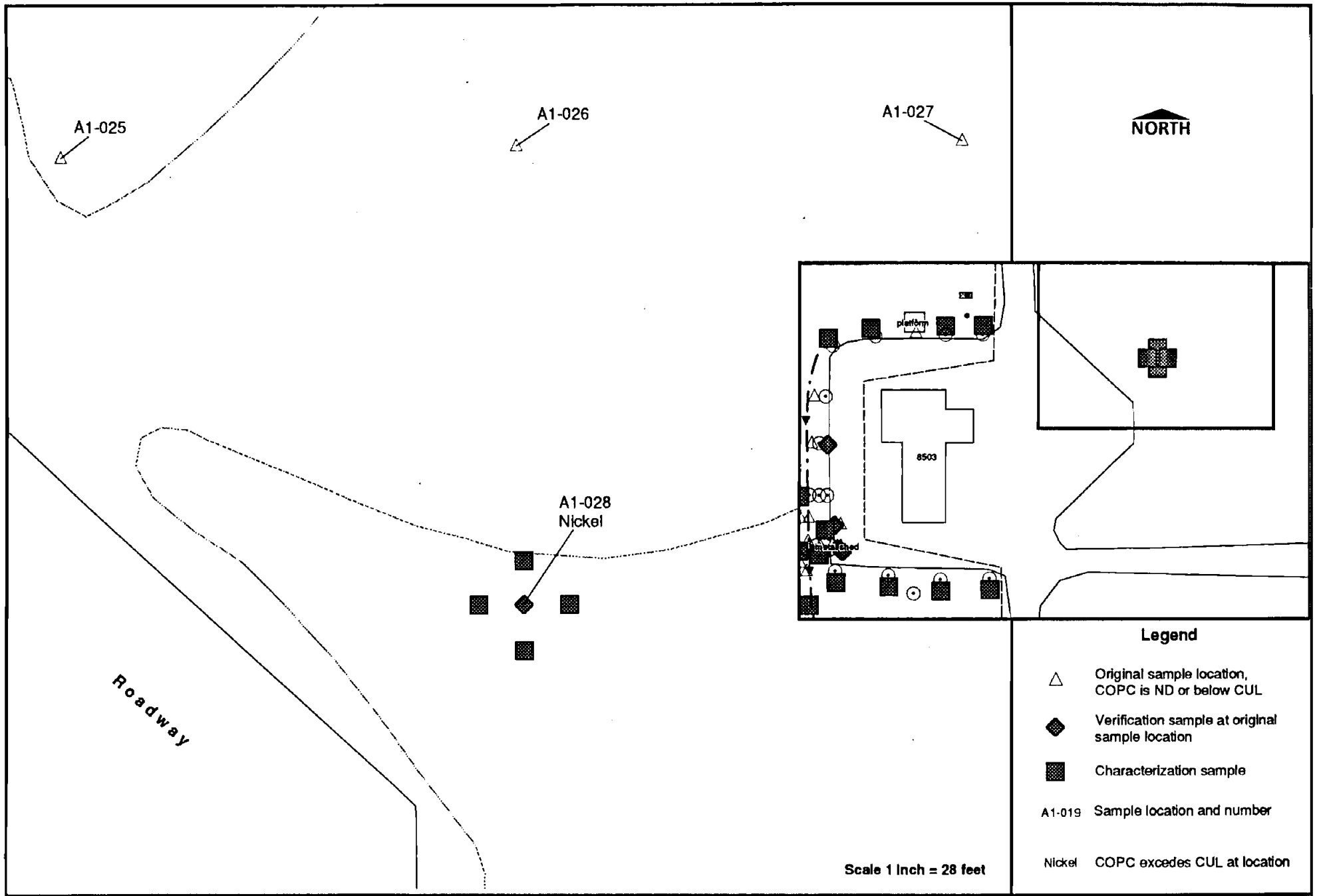

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Figure 2-2 -- A1-028 Sample Location Map

Date: August 1998
Project Manager: B. Duffner
Prepared By: D. Bedarf
Project No: P-3109

Verification and extent determination samples will also be collected in association with the nickel contamination indicated at location A1-028 (Figure 2-2). These samples will be analyzed with quick turnaround from the laboratory. Samples collected from the area around A1-028 will be analyzed for nickel only (Method SW6010A). Samples will be collected near A1-28 as follows.

- One verification surface sample will be collected at the original sample location, A1-028, to verify the nickel contamination.
- Four surface samples will be collected 10 feet to the north, south, east and west of the original sample.

If results of the characterization samples indicate nickel contamination, optional samples may be collected to further determine the area of contamination.

2.2.2 Area A-3 and Drainageway 1

Investigation Area

Building 8503 was the primary maintenance and inspection facility. The entire building is surrounded by a concrete surface. The Waste Accumulation Area (SWMU 59, Area A-3) is located directly west of the southern end of Building 8503, along the edge of the concrete surface. Drainageway 1 (DW1) drains Building 8503 and runs along the west side of the building, draining to the south.

Surface and subsurface soil sample locations in Area A3 are located in close proximity to soil sample locations in DW1. Surface soil samples from both A3 and DW1 showed PAH concentrations above CULs. Because of the close proximity of these areas and the similar types and levels of contaminants, areas A3 and DW1 will be characterized as one unit in this WP.

Mercury and antimony also exceeded CULs in subsurface soil samples collected at three locations in A-3. Samples collected in August 1997 showed high levels of mercury at sample location A3-006. A verification sample collected in February 1998 contradicted the August results by indicating mercury at this location was below the CUL. Antimony CULs were exceeded at sample locations A3-019 and A3-020 for subsurface soils.

Task Objective

Several individual sample locations in A-3 have detects of inorganic compounds and PAH concentrations above CULs. In addition, PAHs not attributable to known sources were detected above CULs in samples collected from DW1. The PAHs were located in surface soil along the roadway and parking areas associated with Building 8503 and may be associated with roadway run-off. The objectives of the final characterization are to

- determine if PAH contamination is related to roadway run-off;
- determine extent of PAH contamination if not related to roadway run-off;
- verify mercury contamination at sample location A3-006; and
- verify antimony contamination at sample locations A3-019 and A3-020.

Task Scope and Rationale

Thirteen characterization samples and five verification samples will be collected in the A-3/DW1 area. The majority of the characterization samples will be collected around the edge of the roadway and drainage ditch to determine if PAH contamination is related to roadway run-off. PAHs will be analyzed be Method 8270 with quick turnaround from the laboratory as described in Section 2.2.1 of this WP. Samples locations are shown on Figure 2-3.

- Eight surface samples will be collected for PAHs 15 feet from the northern and southern edge of the concrete pad (10 feet from the original sample locations). Subsurface samples (0.5 to 2.5 ft bgs) will also be collected at two of the locations adjacent to A3-002 and A3-013.
- Four surface samples will be collected for PAHs at locations 30 feet from the edge of the pavement on top of the west hill and north hill. Two locations will be on the west hill and two locations will be on the north hill.
- Four surface samples will be collected for PAHs at locations within the drainageway DW1. Three will be within the ditch, one will be five feet downgradient from DW1-009. A subsurface sample will also be collected at the location closest to DW1-001.

Additional samples will be collected to verify the previously reported inorganic results. Mercury and antimony will be analyzed with quick turnaround from the laboratory as described in Section 2.2.1 of this WP.

One verification sample collected from A3-006 in February 1998 yielded a mercury concentration of 0.079 mg/kg contradicting the original reported mercury concentration of 10.9 mg/kg. Additional verification of the mercury levels will be performed as follows.

- One surface sample will be collected at for mercury (Method SW7470A/SW7471A) A3-006 location to confirm the absence of mercury above CULs.

If analysis reveals mercury contamination above CULs, optional samples may be collected to further define the extent of contamination.

Original subsurface soil samples collected from 1 to 7 feet below ground surface (bgs) at sample locations A3-019 and A3-020 contained unusually high levels of antimony. There are no known sources of antimony in the area and the samples were collected below a thick concrete pad. Antimony was not identified anywhere on site at the concentrations reported for these samples. During drilling operations, concrete particulates may have been carried into the borehole, potentially attributing to the antimony contamination. Therefore, a section of the concrete pad will be removed at four location , two near A3-19 and two near A3-20. Two verification samples will be collected at each of these locations and analyzed for antimony (Method SW6010A)as follows.

- Two verification samples will be collected at locations within 5 feet of A3-019 at intervals of 1 to 3 feet bgs and 5 to 7 feet bgs intervals.
- Two verification samples will be collected at locations within 5 feet A3-020 at intervals of 3 to 5 feet bgs and 5 to 7 feet bgs.

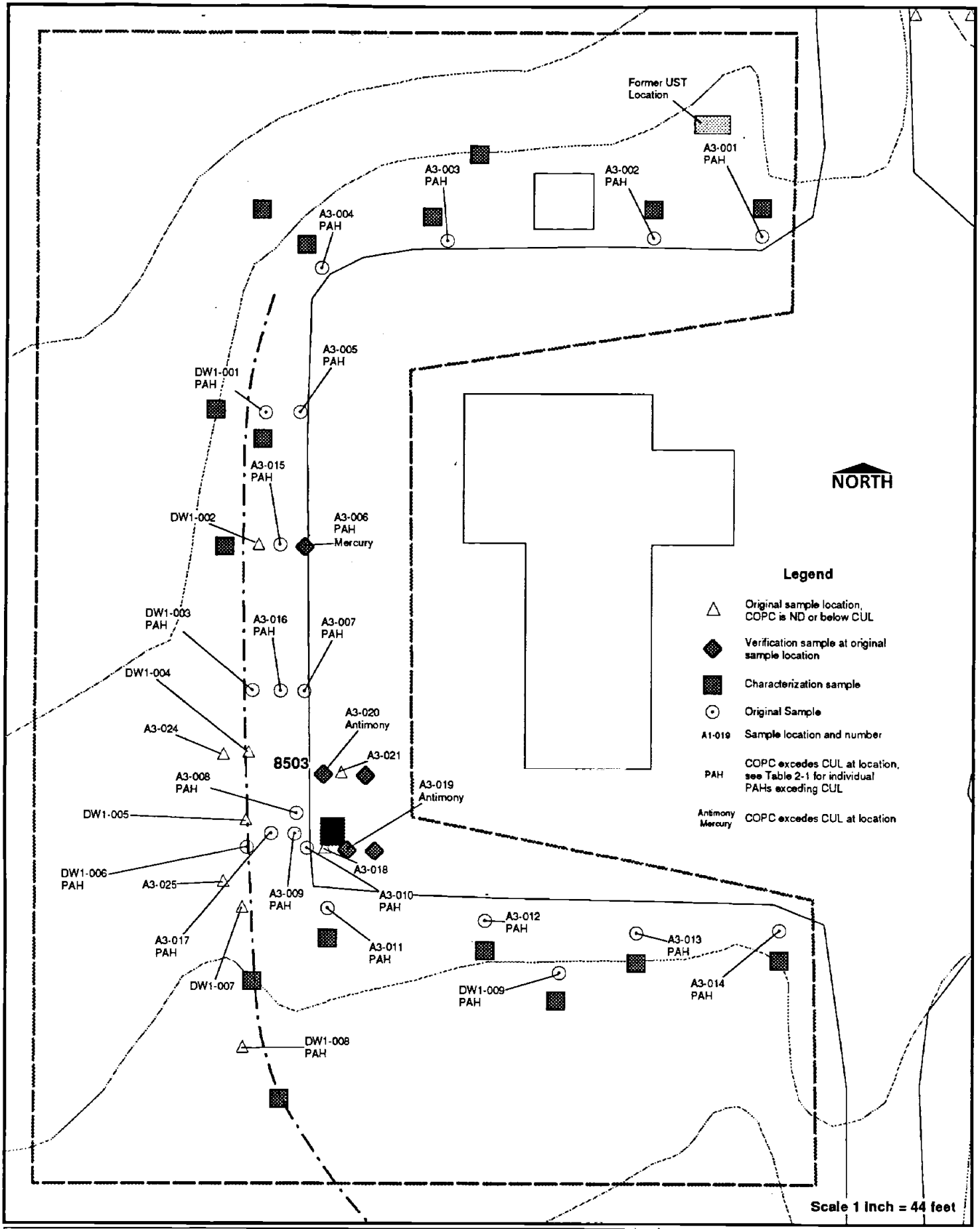

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Figure 2-3 – Area A-3, Drainageway 1 Sample Location Map

Date: August 1998
Project Manager B. Duffner
Prepared By: D. Bedarf
Project No: P-3109

As indicated the suspected source of antimony is the concrete pad and final characterization is not expected to reveal antimony contamination. However, if analysis reveals antimony contamination above CULs, optional samples may be collected to further define the extent of contamination.

2.2.3 Sample Locations EOD-006 and EOD-009

Investigation Area

The EOD range was located directly to the west of the site on a flat area of approximately 40,000 square feet (see Figure 2-4). Warning signs mark the perimeter of the former range. Surface and subsurface soil samples were collected where ordnance related debris or burial pits were located. Dinitrotoluene compounds were detected from a burial pit location (EOD-006) outside and east of the main EOD area at the depth of refusal. Thallium was detected at a location (EOD-009) south of the protective bunker and outside of the main EOD area, also at the depth of refusal.

Task Objective

The task objectives are to collect samples to

- verify dinitrotoluene concentrations at EOD-006;
- determine the horizontal and vertical extent of dinitrotoluene contamination;
- verify thallium concentrations at EOD-009; and
- determine the horizontal and vertical extent of thallium concentration.

Task Scope and Rationale

A total of ten soil samples will be collected in the vicinity of EOD-006 area as follows:

- Surface and subsurface soil will be collected from original sample location EOD-006 to verify dinitrotoluene concentrations extent (see Figure 2-4). All soil samples will be analyzed for dinitrotoluenes only (Method SW8330) with quick turnaround from the laboratory.
- A total of eight samples will be collected from four locations 10 feet to the north, south, east and of EOD-006. Surface (0.0 and 0.5 feet bgs) and subsurface (0.5 to 2.5 ft bgs) soil samples will be collected at the four locations.

If analysis of the characterization samples indicates concentrations above CULs, optional samples may be collected as needed to further define the extent of contamination. It is currently assumed that four optional extent samples may be collected.

A total of eight soil samples will be collected in the vicinity of EOD-009 as follows:

- Surface and subsurface soil will be collected from original sample location EOD-009 to verify thallium concentrations (Figure 2-4). All soil samples will be analyzed for thallium only (Method SW6010A) with quick turnaround from the laboratory.
- A total of six samples will be collected from three locations 10 feet to the south, east and of west EOD-009. Surface (0.0 and 0.5 feet bgs) and subsurface (0.5 and 2 feet bgs (refusal). Soil samples will be collected at the four locations.

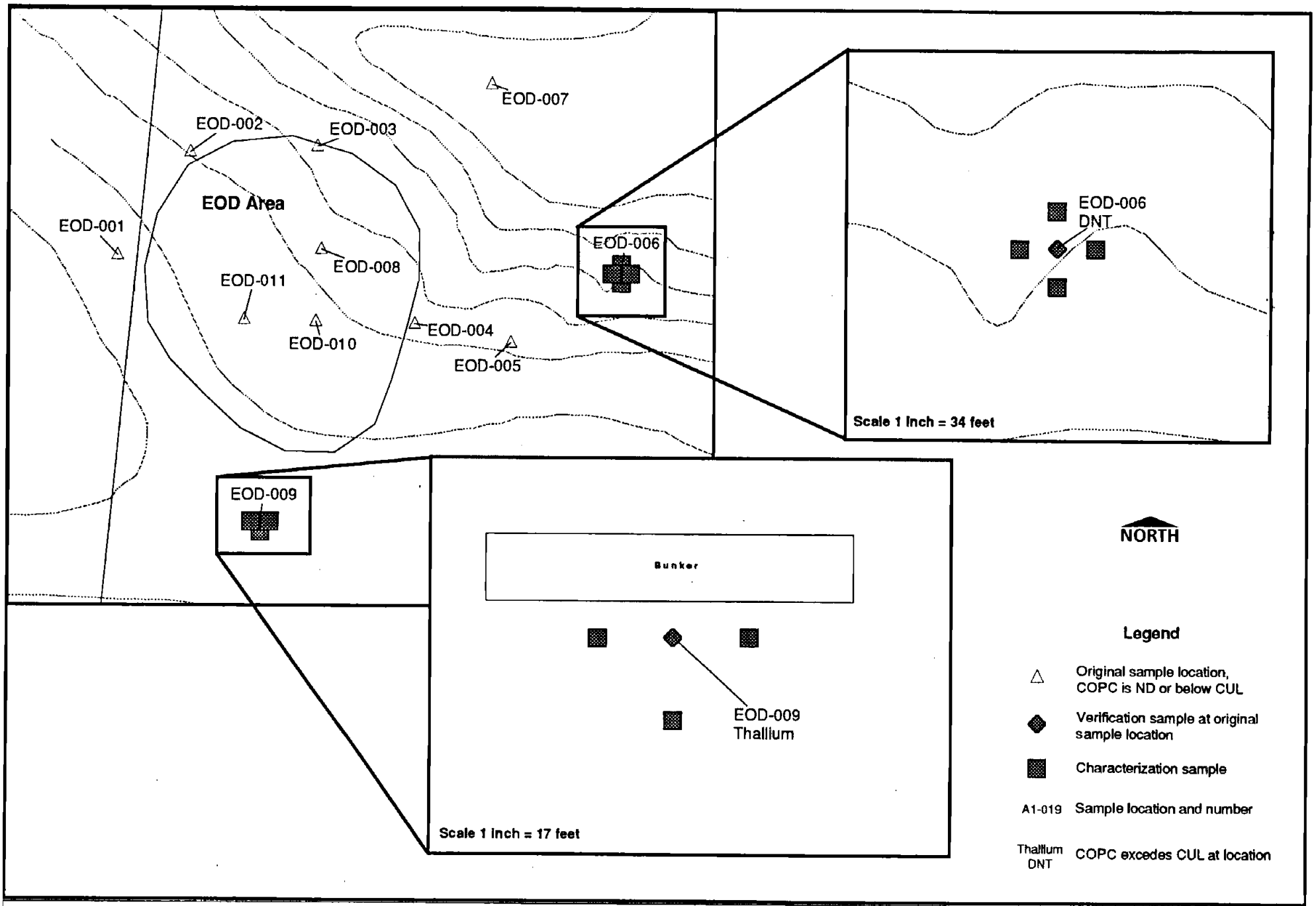

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Figure 2-4 -- Explosive Ordnance Disposal Range Sample Location Map

Date: August 1998
Project Manager: B. Duffner
Prepared By: D. Bedarf
Project No: P-3109

If analysis of the characterization samples indicates concentrations above CULs, optional samples may be collected as needed to further define the extent of contamination. The locations of these optional samples will be determined based on the results of the final characterization samples. As noted in Table 2-2, it is assumed that three optional samples may be collected.

2.2.4 Sample Locations BD-002 and BD-005

Investigation Area

Each bunker contains two drains along the foot of the structure which discharge directly to the ground surface along the front wall. Initial characterization samples were collected as close to the wall as possible. Two sample locations, Bunker 8531 (BD-002) and Bunker 8535 (BD-005) contained concentrations of mercury and copper above the CUL. The elevated mercury at location BD-002 was in the surface (0.0 to 0.5 feet bgs) sample. The elevated copper in BD-005 was in the upper subsurface sample (0.5 to 2.5 feet bgs).

Task Objective

The task objective is to confirm the presence of these contaminants above CULs and if present above these levels to determine the extent.

Task Scope and Rationale

A total of six samples will be collected at bunker drain locations BD-002 and BD-005.

- Two surface (0.0 to 0.5 feet bgs) soil samples will be collected at BD-002, one at the original location and one approximately three feet off the wall. Both samples will be analyzed for mercury.

- Four soil samples will be collected at BD-005 at two locations. One surface (0.0 to 0.5 feet bgs) and one upper subsurface (0.5 to 2.5 feet bgs) soil sample will be collected at each location. One location will be at the BD-005 to verify the results. The second location will be approximately three feet off the wall to demonstrate extent.

2.2.5 Sample Locations DW3-001 and DW4-001

Investigation Area

Surface water run-off provides one of the two contaminant transport pathways identified in the conceptual site model. A number of drainageways transport surface water off site. Drainageway 3 (DW3) drains the area around Building 8505 and 8507. A pipe connected to a floor drain in Bldg. 8505 directly discharges to the head of DW3. Sample location DW3-001 was biased to identify potential contamination associated with this pipe and surface soil sample results from the August 1997 field investigation showed elevated levels of PAHs at this location.

Drainageway 4 (DW4) collects surface water run-off generated from the southeast portion of the Offsite WSA. Surface soil samples from the August 1997 field

investigation showed PAH contamination at sample location DW4-001. The source of the elevated PAH levels is assumed to be associated with roadway run-off.

Task Objective

The task objectives are

- to verify the PAH concentration at sample location DW3-001;
- to determine the horizontal and vertical extent of contamination at DW3-001;
- to determine if PAH contamination at DW4-001 is related to roadway run-off; and
- to determine the horizontal and vertical extent of contamination at DW4-001 if the source is not roadway run-off.

Task Scope and Rationale

A total of six surface soil and subsurface soil samples will be collected from two locations in the DW3 drainage ditch (Figure 2-5). These samples will be analyzed with quick turnaround from the laboratory. If sample analysis indicates concentrations above CULs optional samples may be collected. Samples to be collected from DW3 are as follows.

- One surface (0.0 to 0.5 feet bgs) and two subsurface (0.5 to 2.5 feet bgs and 2.5 to 5 feet bgs) verification samples will be collected at the original sample location, DW3-001.
- One (0.0 to 0.5 feet bgs) and two subsurface (0.5 to 2.5 feet bgs and 2.5 to 5 feet bgs) soil samples will be collected 5 feet further east in the ditch to determine the extent of the contamination.

Samples will be collected near DW4-001 to determine extent and to indicate if the source of the PAH contamination associated with roadway run-off (Figure 2-6). Samples will be analyzed for PAHs by Method SW8270 with quick turnaround from the laboratory. If results indicate PAH contamination is consistently adjacent to the road and concentrations decrease with distance from the road, it will be assumed that the source of contamination is roadway run-off. Samples near DW4-001 will be collected as follows.

- One surface (0.0 to 0.5 feet bgs) and one subsurface (0.5 to 2.5 feet bgs) samples will be collected at the original sample location, DW4-001, to verify PAH contamination.
- Surface (0.0 to 0.5 feet bgs) and subsurface (0.5 to 2.5 feet bgs) samples will be collected at two locations 20 feet north and south and east of the original sample.
- Surface (0.0 to 0.5 feet bgs) and subsurface (0.5 to 2.5 feet bgs) samples will be collected at two locations 10 feet off the edge of the pavement centered off of the original location.

If sample results are not consistent with a roadway source, optional samples may be collected to determine the horizontal and vertical extent of contamination.

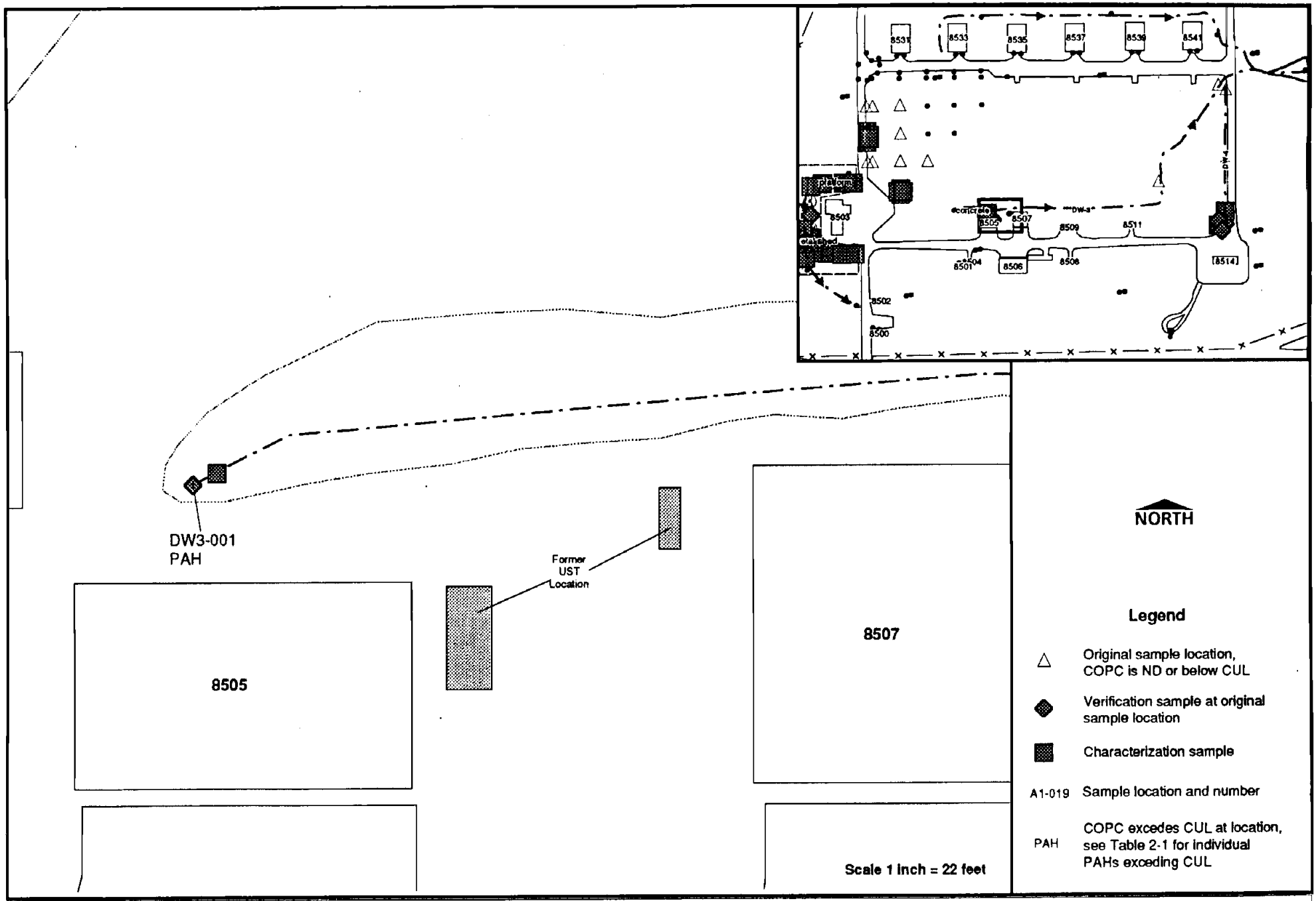

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Figure 2-5 -- Drainageway 3 Sample Location Map

Date: August 1998
Project Manager: B. Duffner
Prepared By: D. Bedarf
Project No: P-3109

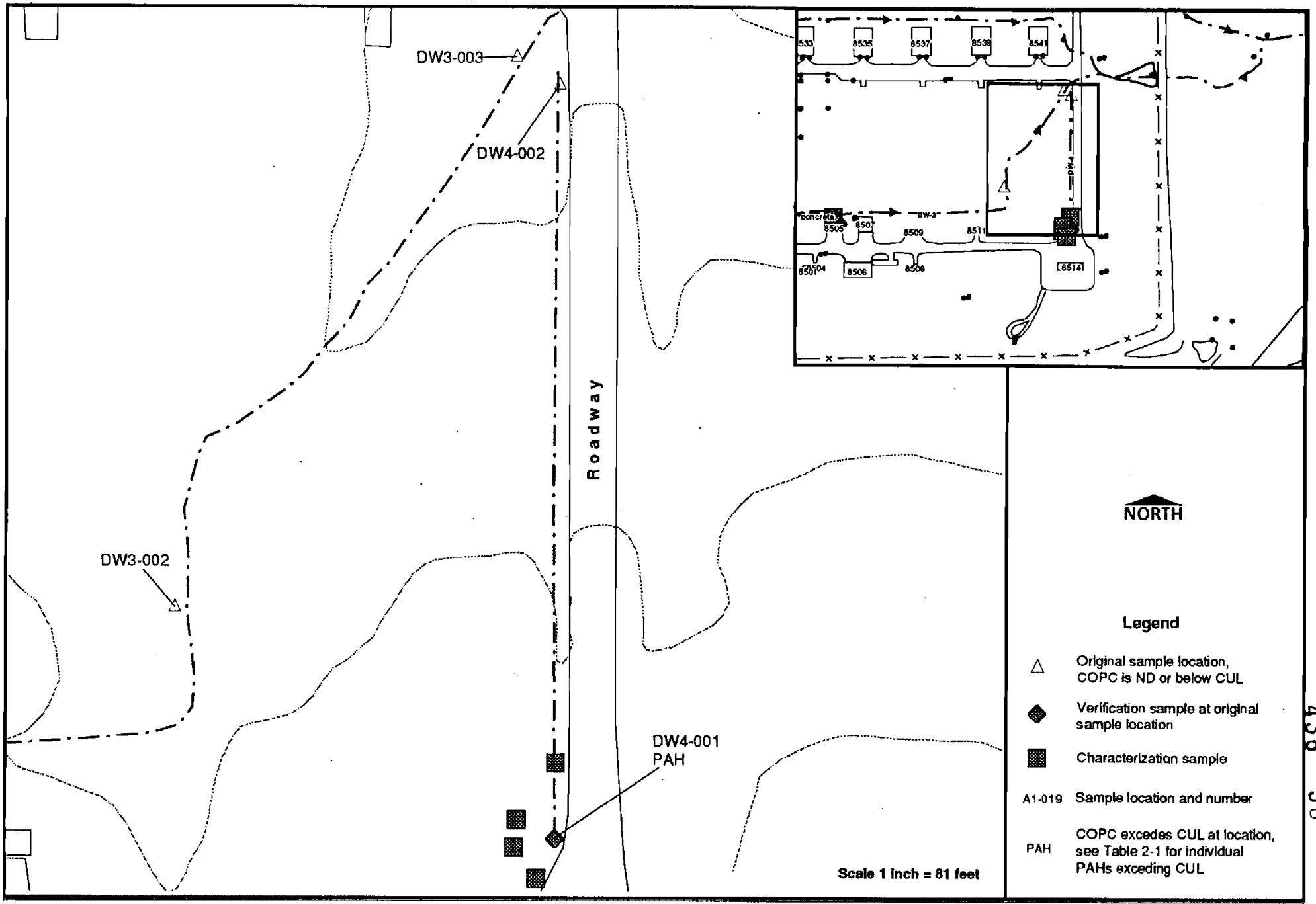

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Figure 2-6 -- Drainageway 4 Sample Location Map

Date: August 1998
Project Manager: B. Duffner
Prepared By: D. Bedart
Project No: P-3109

2.2.6 Underground Storage Tanks

The WSA contained five USTs, all of which have been removed previously. These tanks provided fuel in support of emergency power generation, heating, and vehicle fueling. Each tank was associated with a building. The former UST areas in which LPST CULs were exceeded are located near Buildings 8500, 8505, and 8507.

Former USTs ranged in capacity from 750 gallons to 5,000 gallons. The maximum area occupied by these tanks was 18 feet by 8 feet. The USTs were situated on the bedrock at a maximum depth of eight feet. In general, the data collected from the initial field investigation indicates that contamination is limited with respect to both extent and degree. Therefore, further characterization of extent will not be completed prior to the soil removal action described in Section 3.0. Since further characterization of extent will not be completed prior to removal, verification samples will be collected from the excavation walls after the soil is removed. If the excavation does not extend to refusal, additional floor verification samples will also be collected.

2.2.7 Leach Field

Investigation Area

Three locations had previously been sampled to characterized the leach field. One location was within the retaining wall and two were directly outside and downgradient from the. Antimony, cadmium, napthalene and 2-methlynapthalene were detected outside the wall at concentrations above background and below the CULs.

Task Objective

The objective of the sampling effort will be to define the leach field area subsurface soils with respect to background concentrations

Task Scope and Rationale

Two locations will be established outside of the leach field wall. The locations will be on the downgradient side of the structure. One subsurface soil sample will be collected at each location directly above refusal. Samples will be analyzed for semivolatiles, antimony, and cadmium. Refusal is anticipated to be at a depth of approximately 5 feet.

3.0 SOIL REMOVAL AND DISPOSAL

3.1 OBJECTIVE

The objective of the soil removal and disposal action is to remove soil exceeding site CULs, so that the site may be closed under TNRCC RRSN2 and LPST regulations.

3.2 METHODS

This section summarizes the areas identified for removal action and describes the expected horizontal and vertical extent of excavation at these areas.

3.2.1 Identification of Removal Areas

The areas designated for soil removal action were initially described in the July 1998 letter (TEC, 1998d) based on CUL exceedances and location of known contaminant sources. The letter, provided in Appendix A, describes graphically and in tabular format four WSA areas in which contaminant characterization has been completed and removal actions are proposed. Six additional sites are pending action upon further characterization. Table 9 in Appendix A summarizes the investigation status and proposed actions at the WSA, which were determined from the following field investigations and their associated reports:

- Initial Investigation (August/September 1997);
- February 1998 drainageway and verification sampling; and
- May 1998 leach field and drainageway sampling.

These activities are described in Section 1.0 of this WP. In addition, Appendix A (Figures 3 and 4) provides detailed maps depicting the CUL exceedances, investigation status, and proposed actions at the WSA.

Areas in which removal actions are currently proposed include

- former UST located near Building 8500;
- former UST located near Building 8505;
- former UST located near Building 8507; and
- sample location EOD-006.

Areas where removal actions may be conducted following final characterization are described in Section 2.0 of this WP and include

- sample location A1-028;
- sample location A3-006;
- sample locations A3-019 and A3-020;
- sample location EOD-009;
- sample locations BD-002 and BD-005; and
- the drainageway at DW3-001.

Limited removal actions will be performed at these locations where final field characterization results indicate contaminant concentrations above CULs. As discussed in Section 2.0, the removal actions will exclude removal of soils with:

- iron concentrations greater than CULs; and
- PAH concentrations greater than CULs that are attributable to roadway run-off.

Areas where PAH contamination is suspected to be due to roadway run-off and not point sources include Area A-3, Drainageway 1, sample location A1-019, and sample location DW4-001. As discussed in Section 2.0, the final characterization samples from these areas will be used to confirm this assumption. This characterization is not expected to reveal contamination extending significantly beyond the sides of the roadways and at this time removal activities are not planned for these areas. However, if final characterization indicates PAH contamination is not due to roadway run-off optional samples may be collected to determine extent of contamination and removal activities will be conducted.

3.2.2 Extent of Removal

3.2.2.1 General Removal Actions

The horizontal and vertical extent of the removal actions will be generally defined by sample locations with concentrations exceeding CULs. Horizontally, the excavation area will be defined by the mid-point between a location with sample results below CULs and a location with samples above CULs. Subsurface samples were collected continuously to the point of refusal during the August 1997 field investigation. Unless further defined by the investigation effort described in this WP, the August 1997 field investigation results will be used to define the vertical extent of contamination for the purpose of the removal actions. Vertical extent of excavation will be based on the lowest depth of the sample interval in which CULs are exceeded. For example, the nickel soil concentration is above the CUL at sample location A1-028 from 0.0 to 0.5 feet bgs. However, below 0.5 feet bgs soil concentrations do not exceed CULs. Therefore, if a removal action were to be conducted at A1-028, soil would be excavated only to a depth of 0.5 feet bgs. Based on this delineation approach, the area to be excavated will be surveyed on site prior to any removal activities.

Subsurface soil samples will be collected at two locations for verification of past results. With a few exceptions, subsurface sampling to determine extent will not occur. Exceptions include:

- sample location A3-002 and A3-013;
- sample locations EOD-006 and EOD-009; and
- drainageway locations DW3-001 and DW4-001.

An investigation conducted by the Air Force in 1993 (USAF 1993b Draft RFI Report) revealed small arms, actuators, and starter cartridges in two burial pits located within the EOD Range. Several biased samples (including EOD-006) were collected within these burial pits during the August 1997 field investigation. The source of dinitrotoluene contamination at EOD-006 is assumed to be one of these burial pits. However, the extent of contamination is not well known. Therefore, surface and subsurface soil samples will be collected at this location to define the horizontal and vertical extent of contamination prior to the proposed removal action.

Sample location EOD-009 was also a biased sample located south of the protective bunker at the EOD range. The source of the high levels of thallium detected is unknown.

Therefore surface and subsurface soil samples will be collected at this location to define the horizontal and vertical extent of contamination.

With the exception of DW1, the drainageway sampling investigation conducted in August 1997 only collected surface soil samples. Therefore in order to define the horizontal and vertical extent of contamination at DW3 and DW4, surface and subsurface samples will be collected at these locations.

Cleanup verification samples will be collected in order to demonstrate that excavation and removal of soils from the site has resulted in attainment of CULs. Soil samples will be collected in accordance with under TAC 335.553 (TNRCC 1996). Cleanup verification samples will be collected at a rate of approximately 1 sample per 400 square feet.

3.2.2.2 UST Removal Actions

No additional characterization will be performed prior to removal of soil associated with the former USTs because contamination is well-defined. Excavation will be based on the known dimensions of the removed tanks, photoionization detector field screening, and visual observations.

Subsurface soil samples were collected to the point of refusal during the August 1997 field investigation. Concentrations exceeding CULs were only detected in the deepest samples collected at all UST sites. Surface soil in the vicinity of the UST contaminated areas will be removed and stockpiled separately. Potentially contaminated subsurface soil will be excavated to refusal. Refusal depth at the UST sites near Bldgs. 8500, 8505, and 8507 is approximately 1.0 feet, 8.0 feet, and 6.0 feet bgs respectively. Both surface and potentially contaminated subsurface soil will be characterized separately as described below in Section 3.2.3. Soil determined to be contaminant free will be backfilled into the excavation.

As noted in Section 2.2.5, verification soil samples will be collected from the walls of the excavations following the removal action. Verification samples from the floor of the excavations will only be collected if excavations do not extend to refusal as planned.

Table 3-1 summarizes the approximate horizontal dimension of contamination of each area identified in Section 3.2.1, if known, and the sample depth intervals with soil concentrations greater than CULs.

3.2.3 Soil Removal and Management of Waste

Soil excavated from the WSA will be stored on site while waste characterization proceeds. Waste management will involve the following components:

- segregation of soil;
- waste type determination;
- storage of waste; and
- transportation, and disposal.

Table 3-1. Summary of Extent of Proposed and Pending Removal Actions

Location (COPC)	Horizontal Extent of Removal Action	Vertical Extent of Removal Action: Depth Intervals Sampled [a] (feet bgs)	Vertical Extent of Removal Action: CULs Exceeded in Interval Samples?
UST at Bldg. 8500 (PAHs)	Approx. 10' x 6' [b]	0.5 - 1.0	Y
		5.0 - 7.0	Y
UST at Bldg. 8505 (PAHs)	Approx. 18' x 8' [b]	0.5 - 2.0	Y
		6.0 - 8.0	Y
UST at Bldg. 8507 (PAHs)	Approx. 10.6' x 4' [b]	2.0 - 4.0	Y
		4.0 - 6.0	Y
EOD-006 (dinitrotoluenes)	Unknown	0.0 - 0.5	ND
		0.5 - 2.5	Y
EOD-009 (thallium) [c]	Unknown	0.0 - 0.5	ND
		0.5 - 2.0	Y
A1-019 (PAHs)	Unknown	0.0 - 0.5	Y
		0.5 - 1.5	ND
A1-028 (nickel) [c]	Unknown	0.0 - 0.5	Y
		0.5 - 2.5	ND
		2.5 - 4.5	ND
A3-006 (mercury) [c]	Unknown	0.0 - 0.5	Y
		0.5 - 2.5	ND

Table 3-1. (continued)

Location (COPC)	Horizontal Extent of Removal Action	Vertical Extent of Removal Action: Depth Intervals Sampled [a] (feet bgs)	Vertical Extent of Removal Action: CULs Exceeded in Interval Samples?
A3-020 (antimony) [c]	Unknown	3.1 - 5.1	Y
		5.1 - 7.1	ND
Area A3 (PAHs) [d]	Unknown	0.0 - 0.5	Y
		0.5 - Refusal	ND [e]
DW1 (PAHs) [d]	Unknown	0.0 - 0.5	Y
		0.5 - Refusal	ND [f]
BD-002 (Mercury)	Unknown	0.0 - 0.5	Y
		0.5 - 2.5	ND
BD-005 (Copper)	Unknown	0.0 - 0.5	ND
		0.5 - 2.5	Y
DW3-001 (PAHs) [c]	Unknown	0.0 - 0.5	Y
DW4-001 (PAHs) [c]	Unknown	0.0 - 0.5	Y

[a]The lowest depth represents refusal, except for DW3-001, where only surface samples (0.0 - 0.5 feet bgs) were collected.

[b]Based on dimension of former UST

[c]Removal action pending results of final characterization.

[d]Area wide contamination based on determination of exposure point concentrations.

[e]Only two samples (A3-013-02, 0.5 - 2.5 feet bgs and A3-002, 0.5 to 2.5 feet bgs) were detected above CULs.

[f]Only one sample (DW1-001-02, 0.5 - 2.5 feet bgs) was detected above CULs.

ND - not detected

At the time of excavation, waste will be segregated by environmental contaminant and concentration level. Soil from areas or zones distant from or above contaminated sources will be segregated. The approximate quantity of soil waste will be inventoried at the end of each field day. Information on soil waste will be recorded on container labels and on a Waste Inventory Tracking Form (Appendix B). This information will include the following:

- Date generated;
- Location of origin (e.g., surficial soil within a 5 foot radius of DW3-001);
- Container number;
- TEC field personnel and phone numbers;
- IDW media (i.e., soil);
- Constituents of concern; and
- Carswell AFB contact name and phone number.

Samples collected for waste determination will be collected in the following manner. At least one sample will be collected from each batch of soil with similar contaminant types and levels (similar waste types). A minimum of one composite sample will be collected from each 100 cubic yards of soil. Each composite sample will consist of individual subsamples, each representing a maximum of approximately 20 cubic yards (e.g., a minimum of 5 subsamples will be composited into one sample to characterize approximately 100 cubic yards of soil).

Waste characterization samples will be submitted for Toxicity Characteristic Leachate Procedure (TCLP) analyses. Individual analysis will be based on contaminants shown to be present from previous field investigations (i.e., semivolatiles, metals, PAHs, etc.). TPH analyses will also be performed on soil excavated from the former UST areas.

Analyses of IDW samples collected thus far have indicated that the contaminated soil at the Offsite WSA is not considered a hazardous waste under TAC Chapter 335, Subchapter R (TNRCC 1996). However, the actual waste classification of the removed soil will be determined. Although this soil is not believed to be hazardous, it will be stored as a potential hazardous waste. In accordance with Chapter 335 Subchapter C (TNRCC 1993a), waste will be stored for no longer than 90 days and will be placed in lined covered containers.

Soil removal will be completed using a backhoe or excavator, whichever is determined to be most appropriate, and placed in lined covered transport containers for temporary storage. Transport containers will be in good condition and will be lined with materials that will not react with the stored waste, such that the integrity of the container is not impaired, as required by TAC Chapter 335 Subchapter E (TNRCC 1993b). Plastic sheeting will be placed over the containers at the end of each field day and anchored to prevent infiltration of rainwater into the soil piles. Soil from these storage piles will be characterized as either hazardous or non-hazardous waste. The soil will remain on site in the secured Offsite WSA until characterization is completed in support of its off site disposal. Soil determined to have no contamination above CULs will be backfilled on site. Soil with contaminant levels above CULs will be disposed off-site at a permitted facility in accordance with TAC 335 Subchapter A.

3.2.4 Restoration

Following excavation and backfilling activities, sites will be regraded and seeded with a native grass mixture. The removal sites will be planted with native vegetation adapted to the hydrologic regime in those areas. Seed mixtures, shown in Table 3-2, were determined by comparing the soil mapping units with recommendations from the USDA Natural Resource Conservation Service (NRCS) and the Tarrant County Soil Survey. Seed catalogs were also consulted to verify that the seeds chosen were commercially available.

To ensure establishment, the removal sites will be hydroseeded at approximately 60 lbs./acre with the species mix presented in Table 3-2. Planting will occur in the early spring to take advantage of the spring rains.

Table 3-2. Species for Hydroseeding and Planting In the Removal Areas

Common Name	Scientific Name	Planting Method	Percent Mixture
Little bluestem	Schizachyrium scoparium	Hydroseeding	45%
Big bluestem	Andropogon gerardi	Hydroseeding	12.50%
Indiangrass	Sorghastrum nutans	Hydroseeding	12.50%
Sideoats grama	Bouteloua curtipendula	Hydroseeding	15%
Vine-mesquite	Panicium obtusum	Hydroseeding	15%

4.0 REFERENCES

1981. (June). *Soil Survey of Tarrant County, Texas.* United States Department of Agriculture Soil Conservation Service in cooperation with Texas Agricultural Experiment Station.

TEC. 1996a (December). *Draft Work Plan, RCRA Facility Investigation (RFI) of the Offsite Weapons Storage Area (WSA), Naval Air Station (NAS) Fort Worth, Joint Reserve Base (JRB), Carswell Field, Texas.* Contract No. F41624-95-D-8002, Delivery Order 0009. The Environmental Company, Charlottesville, VA.

TEC. 1996b (December). *Draft Sampling and Analysis Plan (Field Sampling Plan, Quality Assurance Project Plan) RCRA Facility Investigation (RFI) of the Offsite Weapons Storage Area, Naval Air Station (NAS) Fort Worth, Joint Reserve Base (JRB), Fort Worth, Texas.* Contract No. F41624-95-D-8002, Delivery Order 0009. The Environmental Company, Charlottesville, VA.

TEC. 1996c (December). *Draft Health and Safety Plan, RCRA Facility Investigation (RFI) of the Offsite Weapons Storage Area (WSA), Naval Air Station (NAS) Fort Worth, Joint Reserve Base (JRB), Carswell Field, Texas.* Contract No. F41624-95-D-8002, Delivery Order 0009. The Environmental Company, Charlottesville, VA.

TEC. 1998a (January). *Draft Report, RCRA Facility Investigation (RFI) of the Offsite Weapons Storage Area (WSA), Naval Air Station (NAS) Fort Worth, Joint Reserve Base (JRB), Carswell Field, Texas.* Contract No. F41624-95-D-8002, Delivery Order 0009. The Environmental Company, Charlottesville, VA.

TEC. 1998b (May). *Addendum to the Draft Report, RCRA Facility Investigation (RFI) of the Offsite Weapons Storage Area (WSA), Naval Air Station (NAS) Fort Worth, Joint Reserve Base (JRB), Carswell Field, Texas.* Contract No. F41624-95-D-8002, Delivery Order 0009. The Environmental Company, Charlottesville, VA.

TEC. 1998c (May). *Draft Supplemental Field Investigation at the Offsite Weapons Storage Area NAS Fort Worth, Joint Reserve Base, Carswell Field, Texas.* The Environmental Company, Charlottesville, VA.

TEC. 1998d (July). *Offsite Weapons Storage Area Final Characterization, Removal Action, and Site Closure NAS Fort Worth, Joint Reserve Base, Carswell Field, Texas.* The Environmental Company, Charlottesville, VA.

TNRCC. 1993a (December). *Subchapter C: Standards Applicable to Generators of Hazardous Waste, Texas Natural Resource Conservation Commission, Chapter 335 - Industrial Solid Waste and Municipal Hazardous Waste.* Texas Natural Resource Conservation Commission, Austin, TX.

TNRCC. 1993b (December). *Subchapter E: Interim Standards for Owners and Operators of Hazardous Storage, Processing or Disposal Facilities, Texas Natural Resource Conservation Commission, Chapter 335 - Industrial Solid Waste and Municipal Hazardous Waste.* Texas Natural Resource Conservation Commission, Austin, TX.

TNRCC. 1993c (December). *Subchapter S: Risk Reduction Standards, Texas Natural Resource Conservation Commission, Chapter 335 - Industrial Solid Waste and Municipal Hazardous Waste.* Texas Natural Resource Conservation Commission, Austin, TX.

TNRCC. 1994 (January). *Leaking Storage Tank Program, Risk-Based Corrective Action for Leaking Storage Tank Sites.* Texas Natural Resource Conservation Commission, Austin, TX.

TNRCC. 1996 (March). *Subchapter R: Waste Classification, Texas Natural Resource Conservation Commission, Chapter 335 - Industrial Solid Waste and Municipal Hazardous Waste.* Texas Natural Resource Conservation Commission, Austin, TX.

USAF. 1993 (March). Excess Range Survey of Carswell AFB.

APPENDIX A

THE OFFSITE WEAPONS STORAGE AREA FINAL CHARACTERIZATION, REMOVAL ACTION AND SITE CLOSURE LETTER, DATED JULY 2, 1998

The Environmental Company, Inc.

436 51

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July 2, 1998

Charles A. Rice
HQ AFCEE/ERB
3207 North Road, Bldg 532
Brooks AFB, TX 78235-5363

RE: Offsite Weapons Storage Area Final Characterization, Removal Action, and Site Closure

Dear Mr. Rice:

In preparation for final characterization and site closure of the Offsite Weapons Storage Area (WSA), The Environmental Company, Inc. (TEC) prepared the enclosed materials that present the proposed soil cleanup levels and actions for the site. The materials include tables and figures that describe the following:

- proposed site soil cleanup levels;
- approach for selecting the soil cleanup levels;
- synthetic precipitation leachate procedure (SPLP) results pertinent to developing cleanup levels;
- cleanup levels and exposure point concentrations (EPCs) comparison; and
- investigation status and proposed actions of site study areas.

Proposed soil cleanup levels and the SPLP results were previously submitted in TEC's May 1998 *Addendum to the Draft RCRA Facilities Investigation Report* as part of the *Response to Review Comments* on the draft RFI report. This letter transmits the final proposed cleanup levels that are slightly different than those reported in the Addendum. Specifically, cleanup levels for arsenic and cadmium are higher than originally proposed and cleanup levels for Drainageway 9 based on the SPLP results were developed separately due to significant differences in soil characteristics compared to the other study areas (gravel versus silty clay). In addition to these materials, TEC prepared a comparison of the final proposed cleanup levels with EPCs derived separately for the two soil horizons sampled in response to the U.S. EPA's draft RFI report comment regarding site-specificity of EPCs (i.e., surface soil 0-0.5 feet below ground surface [bgs] and subsurface soil > 0.5 feet bgs). TEC also prepared figures showing cleanup level exceedances and the investigation status and proposed actions of the study areas based on the results of the cleanup level comparison. The remaining contents of this letter discuss the enclosed materials in detail.

Proposed Cleanup Levels

Table 1 presents all of the concentrations that were considered for use as soil cleanup levels at the site. These include Risk Reduction Standard Number 2 (RRSN2) and Leaking Storage Tank Program (LSTP) target concentrations for soil ingestion/inhalation and groundwater protection; site background levels; and soil concentrations corresponding to SPLP results. Table 2 summarizes the proposed cleanup levels selected from the values provided in Table 1. The logic in selecting the proposed cleanup levels is illustrated in Figure 1. Initially, the lower of the two risk-based concentrations shown in Table 1 was selected as the cleanup level. If this value was below the background, the background was identified as the cleanup level. Because the cleanup levels for the majority of the inorganic chemicals of potential concern (COPCs) defaulted to background levels, the SPLP was performed on several soil samples to develop more site-specific cleanup levels for the soil to groundwater migration pathway. The most appropriate soil concentration resulting from this procedure was selected as the cleanup level if it was above the background or risk-based level.

SPLP Results

Originally presented in the addendum to the draft RFI report, Table 3 summarizes the SPLP results of several soil samples collected during the RFI field effort. The data in this table supports the use of the highest soil concentration corresponding to a leachate level below the residential groundwater RRSN2 as the cleanup level for the majority of the COPCs. Leachate concentrations for antimony, thallium, and the polycyclic aromatic hydrocarbons (PAHs) were above respective RRSN2 values. Therefore, SPLP results were not used to develop cleanup levels for these compounds.

The majority of the leachate concentrations reported for the other COPCs are below respective RRSN2 groundwater standards and are strongly correlated with the soil concentrations. However, some deviation in this pattern occurs with the lead leachate results. Specifically, two data points in the upper mid-range of the soil concentration distribution correspond to leachate concentrations that slightly exceed the RRSN2. These results are for samples collected from BD-005 and DW4-001. The three highest soil concentrations, the mid-range concentrations, and all of the lower levels coincide with leachate levels that are below the RRSN2 groundwater concentrations. This pattern is depicted in Figure 2 with a graph of soil lead concentrations versus leachate results. The reason for the two anomalous results are unclear.

Cleanup Level Comparison

EPCs are compared to the cleanup levels in Tables 4 through 8. Because the final proposed cleanup levels for several of the inorganic compounds are higher than those developed in the draft RFI report, the results of the comparison are significantly different from those presented in the draft report. Figure 3 presents COPCs with EPCs above cleanup levels on a site map with study area boundaries and sample locations. Based on these results, Table 9 summarizes and Figure 4 graphically presents the contaminant characterization status and proposed action of each area.

Concentrations of the carcinogenic PAHs [i.e., benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-c,d)pyrene] are presented individually and as benzo(a)pyrene toxic equivalents in

Tables 4 through 8. These toxic equivalency concentrations (TCs) are conveniently provided in these tables for use in presenting cleanup level exceedances on Figure 3 (including all PAH names would have made the figure too cluttered). The TC approach is a way to collectively represent the concentrations of the carcinogenic PAHs relative to benzo(a)pyrene. It does not change the results of the cleanup level comparison. To generate a TC, a reported concentration of each carcinogenic PAH is multiplied by its toxic equivalency factor (TEFs), which reflects a compound's carcinogenic potency relative to benzo(a)pyrene. Alternatively, the TEF can be incorporated into the cleanup level for a particular PAH, as was done for the individual PAHs listed in Tables 4 through 8. The TCs of all detected carcinogenic PAHs are summed to produce a total benzo(a)pyrene TC. The PAH TEFs are as follows:

- Benzo(a)pyrene 1.0
- Benzo(a)anthracene 0.1
- Benzo(b)fluoranthene 0.1
- Chrysene 0.001
- Dibenzo(a,h)anthracene 1.0
- Indeno(1,2,3-c,d)pyrene .0.1

Areas in which characterization is complete and no further action is warranted include:

- Outdoor Materiel Storage/Maintenance Area A-1, except A1-019 and A1-028;
- Outdoor Materiel Storage/Maintenance Area A-2;
- Vehicle Fueling Area A-4;
- Disturbed Surface Area A-5;
- EOD, except EOD-006 and EOD-009;
- Bunker Floor Drains (all);
- Former Underground Storage Tanks (USTs) near Bldgs. 8503 and 8514;
- Electrical Transformers (all);
- Drainageways 2 and 5 through 9; and
- Drainageway sample locations DW3-002, DW3-003, and DW4-002.

There were either no COPCs identified in these areas or EPCs were below RRSN2 or LSTP target cleanup levels. One exception is iron detected above the cleanup level in samples collected from three bunker drains (BD-010, BD-012, BD-019) and one Area A-3 location (A3-011). The presence of elevated iron in these locations is likely attributable to iron-containing metal objects that were stored on the ground surface throughout the area. Because the cleanup level for iron is based on background rather than health and the compound is associated with low toxicity, we recommend doing no further action. Therefore, no remedial action with respect to iron is proposed at these locations. The areas listed above are shown in green on Figure 4 and comprise the bulk of the site.

Exceedances of cleanup levels occur in samples collected from the following areas or individual sample locations:

- Sample locations A1-019 and A1-028;

- Building 8503 and SWMU 59 Area A-3;
- Sample locations EOD-006 and EOD-009;
- USTs near Bldgs. 8500, 8505, and 8507;
- Drainageway 1; and
- Sample locations DW3-001 and DW4-001.

Contamination above cleanup levels at these locations can be organized into four categories: 1) PAH detects with known sources; 2) PAH detects with no known sources; 3) isolated high level detects of inorganic compounds with no known sources; and 4) isolated detects of dinitrotoluenes with a known source. We recommend a two-phased approach to address these areas in a cost-effective and timely manner and to close the site under RRSN2. Briefly, we propose the following:

- A focused final field characterization effort consisting of:
  - -verifying previously reported results by resampling at previous locations and depths;
  - -determining horizontal extent of contamination; and
  - -determining association of PAHs with potential roadway runoff.
- A location-specific action to reduce soil concentrations to site cleanup levels.

Each of the categories of contamination outlined above is discussed below in the context of the phased approach.

Investigation Status and Proposed Actions

PAHs With Known Sources. This first category includes a very limited number of locations where PAHs have been detected and can be attributable to a known source. These areas include the sites of former USTs located near Bldgs. 8500, 8505, and 8507 and the Drainageway 3 sample location adjacent to the UST associated with Bldg. 8505. Because the contamination is from known sources and the extent of contamination is expected to be well defined, we recommend collecting additional field samples to delineate the extent of contamination at each of these locations and performing location-specific removal actions to reduce soil concentrations to site cleanup levels.

PAHs With Unknown Sources. The most prevalent compounds detected above cleanup levels in site soil at various locations are PAHs that are not attributable to known point sources. The locations include Area A-3, Drainageway 1, sample location A1-019, and sample location DW4-001. Because the detects appear to be ubiquitous in nature and are along the roadway and parking areas associated with these locations, we suspect that the PAHs may be due to runoff from vehicles. To confirm this suspicion, we propose to perform additional sampling to verify the detects and determine the extent of contamination. We previously collected a verification sample at DW4-001 during the supplemental investigation effort completed in February 1998. The results indicated levels of PAHs similar to those detected during the August 1997 field sampling effort. If elevated PAH detects in all of these areas are limited to the borders of the roadways and parking areas, it is likely that the contamination is due to vehicle runoff and we recommend doing no further action at these locations.

Isolated High Level Detects of Inorganic Compounds. Several individual sample locations in A-1, A-3, and the EOD have unusually high single detects of inorganic compounds that have no known associated sources. These detects were either found to be outliers in the data sets used to calculate EPCs in the RFI risk evaluation or are single detects in a data set of nondetects. They are generally one to three orders of magnitude higher than surrounding detects and in all cases, the area-wide EPCs of the compounds calculated without the outliers are below cleanup levels. The compounds include nickel detected at A1-028 (surface), mercury detected at A3-006 (surface), iron detected at A3-011 (surface), antimony detected at A3-019 and A3-020 (subsurface), and thallium detected at EOD-009 (subsurface). Analyses of samples collected below the depth of the nickel and iron outliers yielded concentrations below background levels. Mercury was not detected in samples collected below the outlier detection. It was detected in only one other sample in Area A-3 at a concentration of 0.1 mg/kg. Thallium was not detected in any samples other than EOD-009.

Antimony is particularly unusual because there are three concentrations considered outliers at the locations noted above, all of which were reported in subsurface samples (1 to 7 feet bgs) collected below the thick concrete pad surrounding Bldg. 8503. The highest level, which is about three orders of magnitude greater than other detected concentrations, was reported in the A3-019 sample collected from the 1 to 3 foot bgs interval. The lowest of the three outlier concentrations was reported for the sample collected from the deepest interval (5 to 7 feet bgs). There are no obvious sources of antimony in the vicinity and the samples were collected from soil that is assumed to have been under pavement since 1956 (construction date of the Offsite WSA). One possible source may be the dust created from drilling through the concrete pad during sample collection (assuming that the concrete contains antimony).

We recommend collecting additional samples at locations A1-028, A3-006, A3-019, A3-020, and EOD-009 to verify whether the inorganic outliers are real and to delineate the extent of contamination. The need for verification sampling was demonstrated in the analytical results obtained from the February 1998 supplemental investigation effort (TEC, 1998). A sample collected from A3-006 to verify the elevated mercury detect revealed that either the original reported concentration of 10.9 mg/kg was in error or the soil containing this concentration was removed during the supplemental sampling because analysis of the verification sample yielded a concentration of 0.079 mg/kg. This concentration is well below the proposed cleanup level. Determination of appropriate actions at these locations should be made after results are verified and extent of contamination is established.

As discussed above, the presence of elevated iron at A3-011 is likely attributable to iron-containing metal objects that were stored on the ground surface throughout the area. Because the cleanup level for iron is based on background rather than health and the compound is associated with low toxicity, we recommend doing no further action. Therefore, no remedial action with respect to iron is proposed at this location.

Isolated Detects of Dinitrotoluene. Dinitrotoluene compounds (2,4- and 2,6-) were detected in a subsurface soil sample (0.5 to 2.5 feet bgs) collected from a location outside and east of the main EOD area. These compounds were detected in no other surface or subsurface samples. Because the EOD area can be assumed to be the source of the

dinitrotoluenes and the detects appear to be isolated, we recommend collecting one sample to verify that the detects are real and concurrently collect additional samples to delineate the extent of contamination. Following this characterization, a location-specific removal action can be performed, if necessary, to reduce soil concentrations to site cleanup levels.

Summary

The final field characterization effort will be focused on verifying previously reported results by resampling at previous locations and depths. The effort will be based on the contaminant migration pathways documented in the draft RFI report (TEC 1998). The evaluation presented in Section 4.0 of the draft report demonstrated that, in general, the contamination, when present, was limited to the top portion of the soil horizon and not migrating vertically to subsurface soils. This pattern is depicted in Figure 3 for Area A-3 and DW-1, where PAHs detected above cleanup levels were reported for the majority of surface soil samples but virtually no detects were reported for the subsurface samples.

Contaminant distributions associated with the USTs display a different pattern than the other areas because detects were reported for surface and subsurface. The vertical distribution of these detects, however, are most likely related to the depth of the USTs and extent of excavation and fill placement during tank removal. The depth of the USTs extended down to the limestone, which hinders further contaminant migration.

Therefore, with a few exceptions, we will focus on determining the horizontal extent during the additional characterization and we will assume the vertical contaminant pattern documented in the draft RFI report. The exceptions include the outliers detected in the two EOD samples and the PAHs detected in DW3-001 and DW4-001. The EOD contaminants were detected in the deepest samples collected at EOD-006 and EOD-009 and the drainageway sampling was limited to the surface soil during the RFI investigation. Therefore, in these cases, samples will be collected to determine the vertical extent of the contaminants.

Following the focused characterization on the areas and locations as described above, we recommend performing a limited removal action. The action will include removing soil from the locations and areas where final field characterization results indicate contaminant concentrations above cleanup levels. The action will exclude removal of soils with:

- iron concentrations greater than cleanup levels; and
- PAHs associated with roadway runoff.

In addition, we propose to utilize the existing data to demonstrate cleanup with respect to depth. Following the removal action, no additional "cleanup verification" sampling is proposed. We expect that the degree of characterization prior to the removal action will be sufficient to document site closure under RRSN2.

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If you have any questions regarding the enclosed materials, please call me at (425) 557-7899.

Sincerely,

THE ENVIRONMENTAL COMPANY, INC.

Bob Duffner, P.E.

Dawn M. Nelson

cc: Alvin Brown (AFBCA) (one copy)

Table 1. Values Considered for Use as RRSN2 Soil Cleanup Levels for The Offsite Weapons Storage Area

COPC	RRSN2 Residential Ing./Inhal[a] (mg/kg)	RRSN2 Residential GW Protection[a] (mg/kg)	Background $UTL_{95,95}$[b] (mg/kg)	SPLP Results[c] (mg/kg)	SPLP Results for Drainageway 9[d] (mg/kg)
Metals					
Antimony	110	0.6	4.5	NA[f]	NA[f]
Arsenic	20[e]	5	11.8	24.6	10.5
Cadmium	137	0.5	1.2	9.7	BB
Chromium	391	1.0	49	185	37.1
Iron	NA	NA	33,008	7,120	49,100
Lead	500	1.5	26	200	106
Manganese	162	5,280	1,140	661	744
Mercury	82.3	0.2	0.051	NA	NA
Nickel	1,560	10	21.9	27.5	207
Selenium	1,370	5	1.1	5	ND
Thallium	59.2	0.29	1.3	NA[f]	NA[f]
Semivolatiles (UST sites)					
Benzo(a)anthracene	0.877	4.9	--	NA[f]	NA[f]
Benzo(a)pyrene	0.0877	1.3	--	NA[f]	NA[f]
Benzo(b)fluoranthene	0.877	15	--	NA[f]	NA[f]
Chrysene	7.2	7.2	--	NA[f]	NA[f]
Dibenzo(a,h)anthracene	0.0877	4.7	--	NA[f]	NA[f]
Indeno(1,2,3-c,d)pyrene	0.877	43	--	NA[f]	NA[f]
Semivolatiles (non-UST sites)					
Benzo(a)anthracene	0.875	0.012	--	NA[f]	NA[f]
Benzo(a)pyrene	0.0875	0.0012	--	NA[f]	NA[f]
Benzo(b)fluoranthene	0.875	0.012	--	NA[f]	NA[f]
Chrysene	87.5	1.2	--	NA[f]	NA[f]
Dibenzo(a,h)anthracene	0.0875	0.0012	--	NA[f]	NA[f]
Indeno(1,2,3-c,d)pyrene	0.875	0.012	--	NA[f]	NA[f]

Table 1. Values Considered for Use as RRSN2 Soil Cleanup Levels for The Offsite Weapons Storage Area (continued)

COPC	RRSN2 Residential Ing./Inhal[a] (mg/kg)	RRSN2 Residential GW Protection[a] (mg/kg)	Background $UTL_{95,95}$[b] (mg/kg)	SPLP Results[c] (mg/kg)	SPLP Results for Drainageway 9[d] (mg/kg)
Volatiles					
Trichloroethene	2.4	0.5	--	NA	NA
Explosives					
2,4-Dinitrotoluene	0.63	0.0124	--	NA	NA
2,6-Dinitrotoluene	0.63	0.0124	--	NA	NA
Pesticides					
β-Hexachlorocyclohexane	3.56	0.0473	--	NA	NA

-- - not applicable

BB - below background

COPC - chemical of potential concern

GW - groundwater

Ing. - ingestion

Inhal. - inhalation

NA - not available

ND - not detected

RRSN2 - Risk Reduction Standard Number 2

SPLP - Synthetic Precipitation Leachate Procedure.

UTL - upper tolerance limit

[a] Source: TNRCC Chapter 335, Subchapter S; Risk Reduction Standards (TNRCC 1993); LSTP risk-based corrective action guidance followed for UST cleanup levels (TNRCC 1994).

[b] Source: draft RFI report for the Offsite WSA (TEC,1998).

[c] Soil concentration associated with SPLP result that is below residential groundwater RRSN2.

[d] Soil concentration associated with DW9 leachate concentration that is below residential groundwater RRSN2. Because of soil characteristic differences at DW9 (gravel versus silty clay), cleanup levels based on SPLP results were determined separately for this area.

[e] TNRCC interim remediation cleanup level for soil ingestion (TNRCC 1995).

[f] All SPLP leachate concentrations were above the residential groundwater RRSN2; therefore, corresponding soil concentrations were not considered as potential cleanup levels.

Table 2. Proposed RRSN2 Soil Cleanup Levels for The Offsite Weapons Storage Area

COPC	Proposed RRSN2 Soil Cleanup Level[a] (mg/kg)	Cleanup Level Basis
Metals		
Antimony	4.5	Background $UTL_{95,95}$
Arsenic	24.6 (10.5)	SPLP
Cadmium	9.7[b]	SPLP
Chromium	185 (371)	SPLP
Iron	33,008 (49,100)	Background $UTL_{95,95}$ (SPLP)
Lead	200 (106)	SPLP
Manganese	1,140	Background $UTL_{95,95}$
Mercury	0.2	RRSN2 Groundwater Protection
Nickel	27.5 (207)	SPLP
Selenium	5	RRSN2 Groundwater Protection & SPLP
Thallium	1.3	Background $UTL_{95,95}$
Semivolatiles (UST Sites)		
Benzo(a)anthracene	0.88	RRSN2 Res. Ingestion/Inhalation
Benzo(a)pyrene	0.088	RRSN2 Res. Ingestion/Inhalation
Benzo(b)fluoranthene	0.88	RRSN2 Res. Ingestion/Inhalation
Chrysene	7.2	RRSN2 Res. Ingestion/Inhalation
Dibenzo(a,h)anthracene	0.088	RRSN2 Res. Ingestion/Inhalation
Indeno(1,2,3-c,d)pyrene	0.88	RRSN2 Res. Ingestion/Inhalation
Semivolatiles (non-UST Sites)		
Benzo(a)anthracene	0.012	RRSN2 Groundwater Protection
Benzo(a)pyrene	0.0012	RRSN2 Groundwater Protection
Benzo(b)fluoranthene	0.012	RRSN2 Groundwater Protection
Chrysene	1.2	RRSN2 Groundwater Protection
Dibenzo(a,h)anthracene	0.0012	RRSN2 Groundwater Protection
Indeno(1,2,3-c,d)pyrene	0.012	RRSN2 Groundwater Protection
Volatiles		
Trichloroethene	0.5	RRSN2 Groundwater Protection
Explosives		
2,4-Dinitrotoluene	0.012	RRSN2 Groundwater Protection
2,6-Dinitrotoluene	0.012	RRSN2 Groundwater Protection
Pesticides		
β-Hexachlorocyclohexane	0.047	RRSN2 Groundwater Protection

COPC - chemical of potential concern

NA - not available

Res. - residential

RRSN2 - Risk Reduction Standard Number 2

SPLP - Synthetic Precipitation Leachate Procedure

UTL - upper tolerance limit

[a] Value in parentheses is the proposed cleanup level for Drainageway 9 if based on the SPLP results.

[b] Soil concentration corresponding to DW9 leachate is below background.

Table 3. Summary of SPLP Results for Human Health Chemicals of Potential Concern

	Antimony		Arsenic		Cadmium		Chromium	
Sample Location	SPLP Conc. (mg/L)	Corresponding Soil (mg/kg)	SPLP Conc. (mg/L)	Corresponding Soil (mg/kg)	SPLP Conc. (mg/L)	Corresponding Soil (mg/kg)	SPLP Conc. (mg/L)	Corresponding Soil (mg/kg)
RRSN2 GWC (mg/L):	0.006		0.05		0.005		0.1	
BD-004-01	0.0075 U	0.82 U	0.007 U	5	0.0007 U	9.70	0.0065	11
BD-005-01	0.0075 U	0.82 U	0.007 U	4.4	0.0007	0.67	0.0071	16.8
BD-005-02	0.014 U	0.90 U	0.007 U	4	0.0007 U	0.88	0.0035 U	39
BD-010-01	0.0075 U	0.80 U	0.007 U	7.2	0.0007 U	3.55	0.0061	28.15
BD-012-01	0.0075 U	0.81 U	0.007 U	7.3	0.0007 U	0.071 U	0.0270	33.2
DW1-001-01	0.0075 U	1.20 U	0.0085 U	24.6	0.0007 U	0.71	0.0061	18.1
DW1-004-01	0.0075 U	0.85 U	0.007 U	9.9	0.0007 U	2.60	0.0320	185
DW4-001-01	0.0075 U	1.30	0.007 U	4.3	0.0007 U	1.40	0.0035 U	15.1
DW9-002-01[b]	0.048 U	2.50	0.007 U	10.5	0.0007 U	0.71	0.0035 U	371
EOD-009-02	0.0075 U	2.20	0.007 U	7.6	0.0007 U	0.33	0.0049 F	5.7
A3-002-20	0.01 U	1.00 U	0.007 U	6.8	0.0007 U	0.089 U	0.0040 F	28.1
A3-006-20	0.0075 U	0.98 F	0.007 U	16	0.0007 U	0.082 U	0.0067	19.5
DW1-003-20	0.0075 U	1.30 U	0.007 U	6.5	0.0007 U	0.11	0.0035 U	24.1
DW4-001-20	0.0075 U	1.00 U	0.007 U	3.3	0.0007 U	0.09 U	0.0035 U	14.6

Note: Boxed values are highest soil concentrations in which corresponding SPLP concentrations are below RRSN2 for residential groundwater. Shaded SPLP concentrations are below RRSN2 GWC.

F - Compound was positively detected below the PQL

GWC - groundwater concentration

NA - Not Analyzed

ND - Not Detected above the Method Detection Limit

RRSN2 - Risk Reduction Standard Number 2

SPLP - synthetic precipitation leachate procedure

U - Compound was analyzed for, but detected below the method detection limit

[a] Value represents a Federal drinking water guideline, not a standard (HSDB 1998). No RRSN2 values are available for iron.

[b] Because of differences in soil characteristics at DW9-002, the results for this sample were not used as soil cleanup level for areas other than DW9.

Table 3. Summary of SPLP Results for Human Health Chemicals of Potential Concern (continued)

	Iron		Lead		Manganese		Mercury	
Sample Location	SPLP Conc. (mg/L)	Corresponding Soil (mg/kg)	SPLP Conc. (mg/L)	Corresponding Soil (mg/kg)	SPLP Conc. (mg/L)	Corresponding Soil (mg/kg)	SPLP Conc. (mg/L)	Corresponding Soil (mg/kg)
RRSN2 GWC (mg/L):	0.3[a]		0.015		162		0.002	
BD-004-01	2	9,430	0.0038 F	23.10	0.026	304	NA	-
BD-005-01	1.3	8,130	0.021	49.50	0.022	246	NA	-
BD-005-02	1.2	9,310	0.0033 U	200.00	0.0075	319	NA	-
BD-010-01	0.71	45,050	0.0068	54.25	0.028	513	NA	-
BD-012-01	4	48,700	0.015	45.30	0.044	555	NA	-
DW1-001-01	3.2	8,710	0.0034 F	15.80	0.012	359	NA	-
DW1-004-01	1.2	15,700	0.0033 U	22.70	0.011	278	NA	-
DW4-001-01	0.21	7,120	0.016	71.60	0.01	661	NA	-
DW9-002-01[b]	0.26	49,100	0.0033 U	106.00	0.004 F	744	NA	-
EOD-009-02	1.9	3,740	0.0035 U	5.10	0.015	166	NA	-
A3-002-20	1.9	11,200	0.008 F	36.10	0.014	193	0.00024 U	0.051 U
A3-006-20	3.1	7,180	0.0045 F	45.60	0.014	138	0.00024 U	0.079
DW1-003-20	1.1	9,050	0.0085	33.20	0.0097	196	0.00024 U	0.064 U
DW4-001-20	0.77	7,890	0.0075	91.00	0.0088	222	0.00024 U	0.051 U

Note: Boxed values are highest soil concentrations in which corresponding SPLP concentrations are below RRSN2 for residential groundwater. Shaded SPLP concentrations are below RRSN2 GWC.

F - Compound was positively detected below the PQL

GWC - groundwater concentration

NA - Not Analyzed

ND - Not Detected above the Method Detection Limit

RRSN2 - risk reduction standard number 2

U - Compound was analyzed for, but detected below the method detection limit

[a] Value represents a Federal drinking water guideline, not a standard (HSDB 1998). No RRSN2 values are available for iron.

[b] Because of differences in soil characteristics at DW9-002, the results for this sample were not used as soil cleanup level for areas other than DW9.

Table 3. Summary of SPLP Results for Human Health Chemicals of Potential Concern (continued)

	Nickel		Selenium		Thallium		Benzo(a)anthracene	
Sample Location	SPLP Conc. (mg/L)	Corresponding Soil (mg/kg)	SPLP Conc. (mg/L)	Corresponding Soil (mg/kg)	SPLP Conc. (mg/L)	Corresponding Soil (mg/kg)	SPLP Conc. (mg/L)	Corresponding Soil (mg/kg)
RRSN2 GWC (mg/L):	0.1		0.05		0.002		0.00012	
BD-004-01	0.005 U	9	0.01 U	0.67 U	0.0085 U	ND	NA	--
BD-005-01	0.005 U	7.9	0.01 U	0.66 U	0.0085 U	ND	NA	--
BD-005-02	0.005 U	6.4	0.01 U	0.89	0.0085 U	ND	NA	--
BD-010-01	0.005 U	22.95	0.01 U	0.65 U	0.0085 U	ND	NA	--
BD-012-01	0.005 U	27.5	0.01 U	0.66 U	0.0085 U	ND	NA	--
DW1-001-01	0.005 U	8.5	0.01 U	0.94 U	0.0085 U	ND	NA	--
DW1-004-01	0.005 U	10.5	0.01 U	0.69 U	0.0085 U	ND	NA	--
DW4-001-01	0.005 U	10.7	0.01 U	0.75 U	0.0085 U	ND	NA	--
DW9-002-01[b]	0.005 U	207	0.01 U	0.75 U	0.0085 U	ND	NA	--
EOD-009-02	0.005 U	5	0.01 U	5	0.0085 U	4.1	NA	--
A3-002-20	0.0098	8.4	0.01 U	0.83 U	0.0085 U	1.1 U	0.018 U	2.1
A3-006-20	0.005 U	7	0.01 U	0.76 U	0.0085 U	1	NA	--
DW1-003-20	0.005 U	6.9	0.01 U	0.1 U	0.0085 U	1.3 U	0.023 U	3.7
DW4-001-20	0.005 U	6.5	0.01 U	0.84 U	0.0085 U	1.1 U	0.02 U	1.2

Note: Boxed values are highest soil concentrations in which corresponding SPLP concentrations are below RRSN2 for residential groundwater. Shaded SPLP concentrations are below RRSN2 GWC.

F - Compound was positively detected below the POL

GWC - groundwater concentration

NA - Not Analyzed

ND - Not Detected above the Method Detection Limit

RRSN2 - risk reduction standard number 2

U - Compound was analyzed for, but detected below the method detection limit

[a] Value represents a Federal drinking water guideline, not a standard (HSDB 1998). No RRSN2 values are available for iron.

[b] Because of differences in soil characteristics at DW9-002, the results for this sample were not used as soil cleanup level for areas other than DW9.

Table 3. Summary of SPLP Results for Human Health Chemicals of Potential Concern (continued)

	Benzo(a)pyrene		Benzo(b)fluoranthene		Chrysene		Dibenzo(a,h)anthracene	
Sample Location	SPLP Conc. (mg/L)	Corresponding Soil (mg/kg)	SPLP Conc. (mg/L)	Corresponding Soil (mg/kg)	SPLP Conc. (mg/L)	Corresponding Soil (mg/kg)	SPLP Conc. (mg/L)	Corresponding Soil (mg/kg)
RRSN2 GWC (mg/L):	0.000012		0.00012		0.012		0.000012	
BD-004-01	NA	--	NA	--	NA	--	NA	--
BD-005-01	NA	--	NA	--	NA	--	NA	--
BD-005-02	NA	--	NA	--	NA	--	NA	--
BD-010-01	NA	--	NA	--	NA	--	NA	--
BD-012-01	NA	--	NA	--	NA	--	NA	--
DW1-001-01	NA	--	NA	--	NA	--	NA	--
DW1-004-01	NA	--	NA	--	NA	--	NA	--
DW4-001-01	NA	--	NA	--	NA	--	NA	--
DW9-002-01[b]	NA	--	NA	--	NA	--	NA	--
EOD-009-02	NA	--	NA	--	NA	--	NA	--
A3-002-20	0.018 U	2	0.033 U	2.8	0.019 U	2.3	0.02 U	0.4 U
A3-006-20	NA	--	NA	--	NA	--	NA	--
DW1-003-20	0.023 U	3.1	0.043 U	4.3	0.024 U	3.7	0.026 U	0.53 U
DW4-001-20	0.02 U	1.3	0.038 U	1.9	0.024 U	1.5	0.022 U	0.19 U

Note: Boxed values are highest soil concentrations in which corresponding SPLP concentrations are below RRSN2 for residential groundwater. Shaded SPLP concentrations are below RRSN2 GWC.

F - Compound was positively detected below the PQL

GWC - groundwater concentration

NA - Not Analyzed

ND - Not Detected above the Method Detection Limit

RRSN2 - risk reduction standard number 2

U - Compound was analyzed for, but detected below the method detection limit

[a] Value represents a Federal drinking water guideline, not a standard (HSDB 1998). No RRSN2 values are available for iron.

[b] Because of differences in soil characteristics at DW9-002, the results for this sample were not used as soil cleanup level for areas other than DW9.

Table 3. Summary of SPLP Results for Human Health Chemicals of Potential Concern (continued)

Indeno(1,2,3-c,d)pyrene

Sample Location	SPLP Conc. (mg/L)	Corresponding Soil (mg/kg)
RRSN2 GWC (mg/L):	0.00012	
BD-004-01	NA	--
BD-005-01	NA	--
BD-005-02	NA	--
BD-010-01	NA	--
BD-012-01	NA	--
DW1-001-01	NA	--
DW1-004-01	NA	--
DW4-001-01	NA	--
DW9-002-01[b]	NA	--
EOD-009-02	NA	--
A3-002-20	0.036 U	1.7
A3-006-20	NA	--
DW1-003-20	0.046 U	2.7
DW4-001-20	0.04 U	0.91

Note: Boxed values are highest soil concentrations in which corresponding SPLP concentrations are below RRSN2 for residential groundwater. Shaded SPLP concentrations are below RRSN2 GWC.

F - Compound was positively detected below the PQL

GWC - groundwater concentration

NA - Not Analyzed

ND - Not Detected above the Method Detection Limit

RRSN2 - risk reduction standard number 2

U - Compound was analyzed for, but detected below the method detection limit

[a] Value represents a Federal drinking water guideline, not a standard (HSDB 1998). No RRSN2 values are available for iron.

[b] Because of differences in soil characteristics at DW9-002, the results for this sample were not used as soil cleanup level for areas other than DW9.

Table 4. RRSN2 Soil Cleanup Level Comparison for Areas A-1, A-2, A-3, and A-5

Area	COPC	RRSN2 Human Health CUL (mg/kg)	EPC[a] (mg/kg) Surface Soil	EPC[a] (mg/kg) Subsurface Soil
Area A-1	**Metals**			
	Antimony	4.5	NC	2
	Cadmium	9.7	NC	1.3
	Chromium	185	NC	8.3
	Lead	200	12.4	NC
	Nickel	27.5	5.5	NC
	Nickel @ A1-028[b]	27.5	514	NC
	Semivolatiles			
	Benzo(a)pyrene (A1-019)	0.0012	0.086[c]	NC
Area A-2	Antimony	4.5	NC	0.94
	Arsenic	24.6	5	NC
	Lead	200	24	NC
Area A-3	**Metals**			
	Antimony	4.5	NC	1.8
	Antimony @ A3-019-02[b]	4.5	NC	1,300
	Antimony @ A3-019-03[b]	4.5	NC	5
	Antimony @ A3-020-02[b]	4.5	NC	13.7
	Arsenic	24.6	8.6	NC
	Cadmium	9.7	2.5	0.41
	Chromium	185	29	10.2
	Iron	33,008	11,208	NC
	Iron @ A3-011[b]	33,008	65,200	NC
	Lead	200	58	7.2
	Mercury @A3-006[b]	0.2	10.9[d]	NC
	Semivolatiles			
	Benzo(a)anthracene	0.012	1.7	0.49
	Benzo(a)pyrene	0.0012	1.5	0.42
	Benzo(b)fluoranthene	0.012	2	0.52
	Chrysene	1.2	1.7	0.48
	Indeno(1,2,3-c,d)pyrene	0.012	0.9	0.19
	Benzo(a)pyrene TEC	0.0012	1.96	0.54
	Volatiles			
	Trichloroethene	0.50	NT	0.056
	Pesticides			

Table 4. RRSN2 Soil Cleanup Level Comparison for Areas A-1, A-2, A-3, and A-5 (continued)

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Area	COPC	RRSN2 Human Health CUL (mg/kg)	EPC[a] (mg/kg) Surface Soil	EPC[a] (mg/kg) Subsurface Soil
	β-Hexachlorocyclohexane	0.046	0.018	NC
Area A-5	Antimony	4.5	NC	2.5
	Cadmium	9.7	NC	0.75

Box denotes exceedance of RRSN2 human health CUL.

COPC - chemical of potential concern

CUL - cleanup level

EPC - exposure point concentration

NC - not a chemical of concern at specified soil horizon

NT - not tested

TEC - toxic equivalency concentration

RRSN2 - Risk Reduction Standard Number 2

[a] EPCs compiled in Appendix P of the Draft RFI report for the Offsite Weapons Storage Area.

[b] Location of outlier concentration.

[c] Exceedance represents one sample location (shown next to COPC name), where the only detected concentration was reported.

[d] Exceedance represents the highest of two detects. The other detected concentration is 0.1 mg/kg, which is below the CUL.

Table 5. RRSN2 Soil Cleanup Level Comparison for EOD Range Area

COPC	RRSN2 Human Health CUL (mg/kg)	EPC[a] (mg/kg) Surface Soil	EPC[a] (mg/kg) Subsurface Soil
Metals			
Antimony	4.5	BB	2.2
Arsenic	24.6	4.6	NC
Arsenic @ EOD-004[b]	24.6	10.6	NC
Cadmium	9.7	BB	0.31
Selenium (EOD-009)	5	ND	5
Thallium (EOD-009)	1.3	ND	4.1[c]
Explosives			
2,4-Dinitrotoluene (EOD-006)	0.012	ND	26[c]
2,6-Dinitrotoluene (EOD-006)	0.012	ND	1.9[c]

Box denotes exceedance of RRSN2 human health CUL.

BB - below background $UTL_{95,95}$

COPC - chemical of potential concern

CUL - cleanup level

EPC - exposure point concentration

NC - not a chemical of concern at specified soil horizon

ND - not detected

RRSN2 - risk reduction standard number 2

[a] EPCs compiled in Appendix P of the Draft RFI report for the Offsite Weapons Storage Area.

[b] Location of outlier concentration.

[c] Exceedance represents one sample location (shown next to COPC name), where the only detected concentration was reported.

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Table 6. RRSN2 Soil Cleanup Level Comparison for Bunker Drains

Bunker Number (Sample Location)[a]	COPC	RRSN2 Human Health CUL (mg/kg)	EPC[b] (mg/kg) Surface Soil	EPC[b] (mg/kg) Subsurface Soil
8531 (BD-001)	Antimony	--	BB	BB
	Arsenic	--	BB	BB
	Cadmium	--	BB	BB
	Chromium	--	NC	BB
	Iron	--	BB	BB
	Lead	200	47.4	BB
	Manganese	--	BB	BB
	Nickel	--	BB	BB
8531 (BD-002)	Antimony	--	ND	ND
	Arsenic	--	BB	BB
	Cadmium	9.7	8	BB
	Chromium	--	NC	BB
	Iron	--	BB	BB
	Lead	200	30.8	BB
	Manganese	--	BB	BB
	Nickel	--	BB	BB
8533 (BD-003 & BD-004)	Antimony	--	ND	ND
	Arsenic	24.6	10	12
	Cadmium	9.7	9.7	BB
	Chromium	185	NC	15.4
	Iron	33,008	BB	24,500
	Lead	200	99.8	BB
	Manganese	--	BB	BB
	Nickel	27.5	BB	23.5
8535 (BD-005 & BD-006)	Antimony	--	ND	ND
	Arsenic	--	BB	BB
	Cadmium	9.7	BB	0.88
	Chromium	185	NC	39
	Iron	--	BB	BB
	Lead	200	49.5	200
	Manganese	--	BB	BB
	Nickel	--	BB	BB
8537 (BD-007 & BD-008)	Antimony	--	ND	ND
	Arsenic	--	BB	BB
	Cadmium	9.7	1.8	2.2
	Chromium	185	NC	25.3
	Iron	--	BB	BB
	Lead	200	65.9	49.8
	Manganese	--	BB	BB
	Nickel	--	BB	BB

Table 6. RRSN2 Soil Cleanup Level Comparison for Bunker Drains (continued)

Bunker Number (Sample Location)[a]	COPC	RRSN2 Human Health CUL (mg/kg)	EPC[b] (mg/kg) Surface Soil	EPC[b] (mg/kg) Subsurface Soil
8539 (BD-009)	Antimony	--	ND	ND
	Arsenic	--	BB	BB
	Cadmium	--	BB	BB
	Chromium	--	NC	BB
	Iron	--	BB	BB
	Lead	200	44	BB
	Manganese	--	BB	BB
	Nickel	--	BB	BB
8539 (BD-010)	Antimony	--	ND	ND
	Arsenic	24.6	7.2	BB
	Cadmium	9.7	3.6	BB
	Chromium	--	NC	BB
	Iron	33,008	45,050	BB
	Lead	200	54.3	BB
	Manganese	1,140	513	BB
	Nickel	27.5	23	BB
8541 (BD-011)	Antimony	--	ND	ND
	Arsenic	--	BB	BB
	Cadmium	9.7	BB	0.79
	Chromium	185	NC	16.1
	Iron	--	BB	BB
	Lead	200	60.5	28.3
	Manganese	--	BB	BB
	Nickel	--	BB	BB
8541 (BD-012)	Antimony	--	ND	ND
	Arsenic	--	BB	BB
	Cadmium	9.7	BB	2.4
	Chromium	185	BB	33.2
	Iron	33,008	48,700	BB
	Lead	200	45.3	71.2
	Manganese	--	BB	BB
	Nickel	27.5	27.5	BB
8552 (BD-013)	Antimony	--	ND	ND
	Arsenic	--	BB	BB
	Cadmium	9.7	2.5	1.1
	Chromium	185	NC	15.2
	Iron	--	BB	BB
	Lead	200	69.4	45.3
	Manganese	--	BB	BB
	Nickel	--	BB	BB

Table 6. RRSN2 Soil Cleanup Level Comparison for Bunker Drains (continued)

Bunker Number (Sample Location)[a]	COPC	RRSN2 Human Health CUL (mg/kg)	EPC[b] (mg/kg) Surface Soil	EPC[b] (mg/kg) Subsurface Soil
8552 (BD-014)	Antimony	--	ND	ND
	Arsenic	--	BB	BB
	Cadmium	9.7	4.5	1.4
	Chromium	--	NC	BB
	Iron	--	BB	BB
	Lead	200	62.3	21.2
	Manganese	--	BB	BB
	Nickel	--	BB	BB
8554 (BD-021)	Antimony	--	BB	BB
	Arsenic	--	BB	BB
	Cadmium	9.7	1.3	0.7
	Chromium	--	NC	BB
	Iron	--	BB	BB
	Lead	200	79.5	BB
	Manganese	--	BB	BB
	Nickel	--	BB	BB
8554 (BD-022)	Antimony	--	ND	ND
	Arsenic	--	BB	BB
	Cadmium	9.7	BB	0.75
	Chromium	--	NC	BB
	Iron	--	BB	BB
	Lead	200	32.2	BB
	Manganese	--	BB	BB
	Nickel	--	BB	BB
8556 (BD-019)	Antimony	--	ND	ND
	Arsenic	--	BB	BB
	Cadmium	9.7	3.7	0.79
	Chromium	185	NC	15.8
	Iron	33,008	37,500	BB
	Lead	200	43	BB
	Manganese	--	BB	BB
	Nickel	27.5	22.2	BB
8556 (BD-020)	Antimony	--	ND	BB
	Arsenic	--	BB	BB
	Cadmium	9.7	BB	0.79
	Chromium	--	NC	BB
	Iron	--	BB	BB
	Lead	200	63.5	35.4
	Manganese	--	BB	BB
	Nickel	--	BB	BB

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Table 6. RRSN2 Soil Cleanup Level Comparison for Bunker Drains (continued)

Bunker Number (Sample Location)[a]	COPC	RRSN2 Human Health CUL (mg/kg)	EPC[b] (mg/kg) Surface Soil	EPC[b] (mg/kg) Subsurface Soil
8558 (BD-017 & BD-018)	Antimony	4.5	ND	2
	Arsenic	--	BB	BB
	Cadmium	9.7	1.5	1.5
	Chromium	--	NC	BB
	Iron	--	BB	BB
	Lead	200	68.3	23.6
	Manganese	--	BB	BB
	Nickel	--	BB	BB
8560 (BD-015)	Antimony	--	BB	BB
	Arsenic	--	BB	BB
	Cadmium	9.7	BB	0.61
	Chromium	--	NC	BB
	Iron	--	BB	BB
	Lead	200	80	BB
	Manganese	--	BB	BB
	Nickel	--	BB	BB
8560 (BD-016)	Antimony	--	ND	ND
	Arsenic	--	BB	BB
	Cadmium	9.7	3.5	0.6
	Chromium	--	NC	BB
	Iron	--	BB	BB
	Lead	200	43.9	BB
	Manganese	--	BB	BB
	Nickel	--	BB	BB

Box denotes exceedance of RRSN2 human health CUL.

-- not applicable

BB - below background $UTL_{95,95}$

COPC - chemical of potential concern

CUL - cleanup level

EPC - exposure point concentration

NC - not a chemical of concern at specified soil horizon

ND - not detected

RRSN2 - Risk Reduction Standard Number 2

[a] Data sets with less than six samples are presented by sample location.

[b] EPCs compiled in Appendix P of the Draft RFI report for the Offsite Weapons Storage Area.

Table 7. RRSN2 Soil Cleanup Level Comparison for UST Areas

UST Name	COPC	RRSN2 Human Health CUL (mg/kg)	EPC[a] (mg/kg) Surface Soil	EPC[a] (mg/kg) Subsurface Soil
UST-8500	Benz(a)anthracene	0.88	NT	1.1
	Benzo(a)pyrene	0.088	NT	1.6
	Benzo(b)fluoranthene	0.88	NT	0.99
	Dibenzo(a,h)anthracene	0.088	NT	0.15
	Indeno(1,2,3-c,d)pyrene	0.88	NT	0.78
	Benzo(a)pyrene TEC	0.088	NT	1.96
UST-8503	Benz(a)anthracene	0.88	NT	0.012
	Benzo(a)pyrene	0.088	NT	0.042
	Benzo(b)fluoranthene	0.88	NT	0.013
	Dibenzo(a,h)anthracene	--	NT	ND
	Indeno(1,2,3-c,d)pyrene	--	NT	ND
UST-8505	Benz(a)anthracene	0.88	NT	0.81
	Benzo(a)pyrene	0.088	NT	1.8
	Benzo(b)fluoranthene	0.88	NT	0.76
	Dibenzo(a,h)anthracene	0.088	NT	0.02
	Indeno(1,2,3-c,d)pyrene	0.88	NT	0.6
UST-8507	Benz(a)anthracene	0.88	NT	0.046
	Benzo(a)pyrene	0.088	NT	0.16
	Benzo(b)fluoranthene	0.88	NT	0.061
	Dibenzo(a,h)anthracene	--	NT	ND
	Indeno(1,2,3-c,d)pyrene	0.88	NT	0.042
UST-8514	Benz(a)anthracene	--	NT	ND
	Benzo(a)pyrene	0.088	NT	0.025
	Benzo(b)fluoranthene	--	NT	ND
	Dibenzo(a,h)anthracene	--	NT	ND
	Indeno(1,2,3-c,d)pyrene	--	NT	ND

Box denotes exceedance of RRSN2 human health CUL.

COPC - chemical of potential concern

CUL - cleanup level

EPC - exposure point concentration

ND - not detected

NT - not tested

RRSN2 - Risk Reduction Standard Number 2

TEC - toxic equivalency concentration

[a] EPCs compiled in Appendix P of the Draft RFI report for the Offsite Weapons Storage Area.

Table 8. RRSN2 Soil Cleanup Level Comparison for Drainageways

Drainageway[a]	COPC	RRSN2 Human Health CUL (mg/kg)	EPC[b] (mg/kg) Surface Soil	EPC[b] (mg/kg) Subsurface Soil
DW1	**Metals**			
	Antimony	4.5	BB	1.3
	Arsenic	24.6	13.3	BB
	Cadmium	9.7	2.6	0.42
	Chromium	185	40	18.5
	Chromium @ DW1-004[c]	185	185	NC
	Iron	33,008	BB	26,000
	Lead	200	26.7	9.9
	Lead @ DW1-009[c]	200	97.2	NC
	Manganese	--	BB	BB
	Nickel	--	BB	BB
	Semivolatiles			
	Benzo(a)anthracene	0.012	0.44	0.14
	Benzo(a)pyrene	0.0012	0.3	0.11
	Benzo(b)fluoranthene	0.012	0.55	0.22
	Chrysene	1.2	0.45	0.15
	Dibenzo(a,h)anthracene	--	ND	ND
	Indeno(1,2,3-c,d)pyrene	0.012	0.27	0.24
	Benzo(a)pyrene TEC	0.0012	0.43	0.17
	Volatiles			
	Trichloroethene	0.50	ND	0.071
	Pesticides			
	β-Hexachlorocyclohexane	0.046	0.032	ND
DW3	**Metals**			
	Antimony	--	BB	NT
	Arsenic	--	BB	NT
	Cadmium	--	BB	NT
	Chromium	--	BB	NT
	Iron	--	BB	NT
	Lead	--	BB	NT
	Manganese	--	BB	NT
	Nickel	--	BB	NT
	Semivolatiles			
	Benzo(a)anthracene	0.012	2	NT
	Benzo(a)pyrene	0.0012	1.4	NT
	Benzo(b)fluoranthene	0.012	2	NT
	Chrysene	1.2	2.1	NT
	Dibenzo(a,h)anthracene	--	ND	NT
	Indeno(1,2,3-c,d)pyrene	0.012	0.63	NT
	Benzo(a)pyrene TEC	0.0012	1.9	NT
	Volatiles			

Table 8. RRSN2 Soil Cleanup Level Comparison for Drainageways (continued)

Drainageway[a]	COPC	RRSN2 Human Health CUL (mg/kg)	EPC[b] (mg/kg) Surface Soil	EPC[b] (mg/kg) Subsurface Soil
	Volatiles			
	Trichloroethene	--	ND	NT
DW-9 (cont.)	**Pesticides**			
	β-Hexachlorocyclohexane	--	ND	NT

Box denotes exceedance of RRSN2 human health CUL.

-- - not applicable

BS - below background $UTL_{95,95}$

COPC - chemical of potential concern

CUL - cleanup level

EPC - exposure point concentration

NC - not a chemical of concern at specified soil horizon

ND - not detected

NT - not tested in subsurface soil samples

RRSN2 - Risk Reduction Standard Number 2

TEC - toxic equivalency concentration

[a] COPCs in samples collected from DW2 and DW5-DW8 were either below background $UTL_{95,95}$, not detected, or not tested (See Appendix P).

[b] EPCs compiled in Appendix P of the Draft RFI report for the Offsite Weapons Storage Area.

[c] Location of outlier concentration.

Table 8. RRSN2 Soil Cleanup Level Comparison for Drainageways (continued)

Drainageway[a]	COPC	RRSN2 Human Health CUL (mg/kg)	EPC[b] (mg/kg) Surface Soil	EPC[b] (mg/kg) Subsurface Soil
	Trichloroethene	--	ND	NT
DW3 (cont.)	**Pesticides**			
	β-Hexachlorocyclohexane	0.046	0.031	NT
DW4	**Metals**			
	Antimony	--	BB	NT
	Arsenic	--	BB	NT
	Cadmium	9.7	1.4	NT
	Chromium	--	BB	NT
	Iron	--	BB	NT
	Lead	200	71.6	NT
	Manganese	1,140	661	NT
	Nickel	--	BB	NT
	Semivolatiles			
	Benzo(a)anthracene	0.012	1.4	NT
	Benzo(a)pyrene	0.0012	1.3	NT
	Benzo(b)fluoranthene	0.012	1.8	NT
	Chrysene	1.2	1.4	NT
	Dibenzo(a,h)anthracene	0.0012	0.074	NT
	Indeno(1,2,3-c,d)pyrene	0.012	0.52	NT
	Benzo(a)pyrene TEC	0.0012	1.75	NT
	Volatiles			
	Trichloroethene	--	ND	NT
	Pesticides			
	β-Hexachlorocyclohexane	--	ND	NT
DW9	**Metals**			
	Antimony	--	BB	NT
	Arsenic	10.5	10.5	NT
	Cadmium	--	BB	NT
	Chromium	371	371	NT
	Iron	49,100	49,100	NT
	Lead	106	106	NT
	Manganese	1,140	744	NT
	Nickel	207	207	NT
	Semivolatiles			
	Benzo(a)anthracene	--	ND	NT
	Benzo(a)pyrene	--	ND	NT
	Benzo(b)fluoranthene	--	ND	NT
	Chrysene	--	ND	NT
	Dibenzo(a,h)anthracene	--	ND	NT
	Indeno(1,2,3-c,d)pyrene	--	ND	NT

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APPENDIX B

WASTE INVENTORY TRACKING FORM

WASTE INVENTORY TRACKING FORM

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LOCATION: _____

PROJECT NAME: _____

ACTIVITIES: _____

Date Waste Generated	Activity Generating Waste (borehole # / well #)	Description of Waste	Field Evidence of Contamination	Estimated Volume	Type of Container (storage ID#)	Location of Container	Waste Characterization	Comments

Note: Describe whether soil or water samples have been collected for waste characterization, include date, if known.

Signature: _____

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