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*Nellis AFB Site 44*

***Two-Phase Extraction (TPE)  
Pilot-Scale Test Technology  
Evaluation Report***

*FINAL*

*Nellis Air Force Base  
Las Vegas, Nevada*

*November 1995*



**TWO-  
PHASE**

*Prepared for:*

*U.S. Army Corps of Engineers  
Omaha District*

*AQMO1-04-0618*

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17 November 1995

U.S. Army Corps of Engineers, Omaha District  
ATTN: CEMRO-ED-EB (Robert Zaruba)  
215 North 17th Street  
Omaha, Nebraska 68102-4978

SUBJECT: Contract No. DACA45-93-D-0027, Delivery Order No. 27, Mod No. 2; Final  
Nellis AFB Two-Phase Pilot Test Technology Evaluation Report for Site 44

Dear Mr. Zaruba:

Enclosed you will find two copies of the Final Nellis AFB Two-Phase Pilot Test Technology Evaluation Report for Site 44 and associated response to comments table. The only comments received were from Omaha Corps of Engineers (COE) staff. Nellis AFB staff (Mr. John Roe and Mr. Jim Pedrick) were contacted and indicated that they would not be providing any comments.

If you have any questions regarding the report, please call me at (916) 857-7281 or Mike Thompson at (916) 857-7410.

Sincerely,



FRANCIS E. SLAVICH, PE  
Project Manager

c: Margaret Calvert, ACC/ESVW (2)  
Jim Pedrick, Nellis AFB (3)  
Mike Thompson, Radian  
Suzanne Felice, Radian  
Jeff Lawrence, Radian  
Bill Buchans, Radian  
James Machin, Radian  
Project File

NELLIS AFB TWO-PHASE PILOT TEST  
TECHNOLOGY EVALUATION REPORT  
FOR SITE 44

at

Nellis Air Force Base, Nevada

FINAL

Prepared for:

U.S. Army Corps of Engineers  
Omaha District  
ATTN: CEMRO-ED-EB  
215 North 17th Street  
Omaha, Nebraska 68102

Prepared by:

Radian Corporation  
10389 Old Placerville Road  
Sacramento, California 95827



November 1995

# TABLE OF CONTENTS

	<u>Page</u>
<b>1.0 INTRODUCTION .....</b>	<b>1-1</b>
1.1 Purpose/Objectives .....	1-1
1.2 Site Background.....	1-1
1.2.1 Subsurface Features .....	1-2
1.2.2 Nature and Extent of Contamination .....	1-2
<b>2.0 TWO-PHASE EXTRACTION TEST METHODOLOGY .....</b>	<b>2-1</b>
2.1 Test Procedures.....	2-1
2.2 Piezometer Installation .....	2-1
2.2.1 Test Equipment.....	2-1
2.3 Sampling and Analytical Methodologies.....	2-6
2.3.1 Sampling Methodology.....	2-6
2.3.2 Analytical Methodology .....	2-6
2.4 Residuals Management.....	2-6
<b>3.0 TEST RESULTS AND CONCLUSIONS.....</b>	<b>3-1</b>
3.1 System Operation.....	3-1
3.2 Radii of Influence and Production Rates .....	3-1
3.3 VOC Recovery.....	3-4
3.3.1 Extraction Results.....	3-4
3.3.2 Comparison with Typical Pump and Treat Technology .....	3-7
3.4 Conclusions.....	3-8
3.4.1 Overall Conclusions.....	3-8
<b>4.0 NELLIS AFB REMEDIAL ACTION ENHANCEMENT.....</b>	<b>4-1</b>
<b>5.0 REFERENCES .....</b>	<b>5-1</b>

Appendix A:	WELL AND DRILLING LOGS
Appendix B:	FIELD DATA SHEETS
Appendix C:	DATA QUALITY SUMMARY WITH ANALYTICAL DATA
Appendix D:	AM 4.02 METHODOLOGY
Appendix E:	11 RCRA TESTS
Appendix F:	SUPPORTING CALCULATIONS FOR PUMP AND TREAT DATA

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## LIST OF FIGURES

1-1	Nellis AFB Location Map.....	1-3
1-2	Concentrations of TCE in Groundwater Above the MCL.....	1-4
1-3	Site 44 Water Level Contour Map.....	1-5
2-1	Piezometer and Vapor Probe Construction Cross-Section .....	2-2
2-2	Combined Vapor and Liquid Piezometer Plan View.....	2-3
2-3	Two-Phase Extraction Apparatus Schematic.....	2-4
2-4	Two-Phase Wellhead Assembly and Extraction Well.....	2-5
3-1	Drawdown vs Distance Over Time.....	3-3
3-2	Vacuum Influence vs. Distance Over Time .....	3-5

## LIST OF TABLES

2-1	Summary of Wells and Monitoring Point Characteristics .....	2-1
2-2	Analytical Sampling Field Data Sheet.....	2-7
3-1	Two-Phase Extraction Technology Selection Criteria.....	3-2
3-2	Summary of TPE Pilot Study Results.....	3-1
3-3	Summary of Water Data .....	3-6
3-4	Summary of Vapor Data .....	3-7

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## ACRONYMS

ACC	Air Combat Command
AFB	Air Force Base
BGS	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfm	Cubic Foot (feet) Per Minute
cm/sec	Centimeter(s) Per Second
DCA	Dichloroethane
DCE	Dichloroethylene
DNAPL	Dense Non-Aqueous-Phase Liquid
ESVE	Enhanced Soil Vapor Extraction
GAC	Granulated Activated Carbon
gpm	Gallon(s) Per Minute
HQ	Headquarters
IRA	Interim Removal Action
LNAPL	Light Non-Aqueous-Phase Liquid
MCL	Maximum Contaminant Level
MW	Monitoring Well
PCE	Tetrachloroethylene
PID	Photo Ionization Detector
ppbv	Parts Per Billion by Volume
ppmv	Parts Per Million by Volume
PREECA	Presumptive Remedy Engineering Evaluation/Cost Analysis
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
scfm	Standard Cubic Foot (Feet) Per Minute
SVE	Soil Vapor Extraction
TCE	Trichloroethylene
TPE	Two-Phase Extraction Technology
VOA	Void of Air
VOC	Volatile Organic Compound
µg/L	Microgram(s) Per Liter

## 1.0 INTRODUCTION

In August 1995, Nellis Air Force Base (AFB) and Radian Corporation (Radian) completed a five-day pilot treatability test at Site 44 using the Two-Phase Extraction (TPE) technology. This report provides a summary of the methodology used during the test, the test results, and base-specific recommendations.

### 1.1 Purpose/Objectives

On 5 May 1995, Headquarters (HQ) Air Combat Command (ACC) published the *United States Air Force Presumptive Remedy Engineering Evaluation/Cost Analysis (PREECA)* (Radian, 1995) as a standardized decision framework specifying the criteria and associated decision logic necessary for implementing a non-time-critical removal action. This decision framework, developed by Radian in conjunction with the U.S. Army Corps of Engineers and the U.S. Air Force, combines the standard Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) non-time-critical removal action process with the concept of presumptive remedies and a "plug-in" logic approach. The result is a "generic" remedy selection document for all Air Force installations that facilitates early and substantial risk reduction. **The PREECA applies only to a closely defined subset of conditions** that the Air Force has found to be common to contaminated sites, and that pose sufficient risk to justify non-time-critical removal actions; this methodology was not intended to be used at sites where the need for cleanup actions is not readily apparent. The PREECA focuses on remedies that can satisfy the majority of these common contamination situations, namely, in situ bioventing, soil vapor extraction (SVE), groundwater pump-and-treat for containment, and capping. **However, the PREECA is intended to be updated as new, successful remedies are established.** The Air Force is currently gathering extensive cost and performance data at a number of contaminated sites for intrinsic groundwater remediation, bioslurping, and two-phase extraction. As part of this effort, HQ ACC has contracted with

Radian through the Omaha District Corps of Engineers to evaluate the TPE technology for inclusion in the Air Force PREECA. Under this contract, Radian, in conjunction with the Air Force, developed an initial remedy profile for TPE as an expansion of the original PREECA effort.

This report presents the results of the TPE pilot test conducted at Site 44, Nellis AFB in August 1995. It evaluates the test results in light of the overall goal of providing additional data to support the validity of the initial TPE remedy profile, and demonstrates that TPE is an effective remedial technology. In addition, it presents data related to the site specific objectives which were to:

- Demonstrate the contaminant removal effectiveness of the TPE technology at Site 44;
- Determine the feasibility of installing a full-scale TPE system at Nellis;
- Collect sufficient engineering data to facilitate the design, installation, and operation of a full-scale TPE; and
- Assist in the prevention of contaminant migration, thereby minimizing the threat of exposure to human health and the environment.

TPE was selected for testing at Site 44 because the site has relatively high concentrations of chlorinated hydrocarbons, primarily trichloroethylene (TCE). The site also has low soil permeabilities that would typically limit the effectiveness of conventional pump and treat systems in capturing groundwater contaminant plumes. The TPE technology is designed to enhance control of groundwater plumes in low-to moderate-permeability formations, as well as to remove contaminants from the saturated zone.

### 1.2 Site Background

Nellis AFB occupies approximately 11,193 acres (including Areas II and III) northeast of

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Las Vegas, Nevada (Figure 1-1). Site 44 is shown on Figure 1-2 and generally occupies an area approximately 900 by 1,200 feet along the flight line between the Flightline Fire Station and the Aerospace Ground Equipment area.

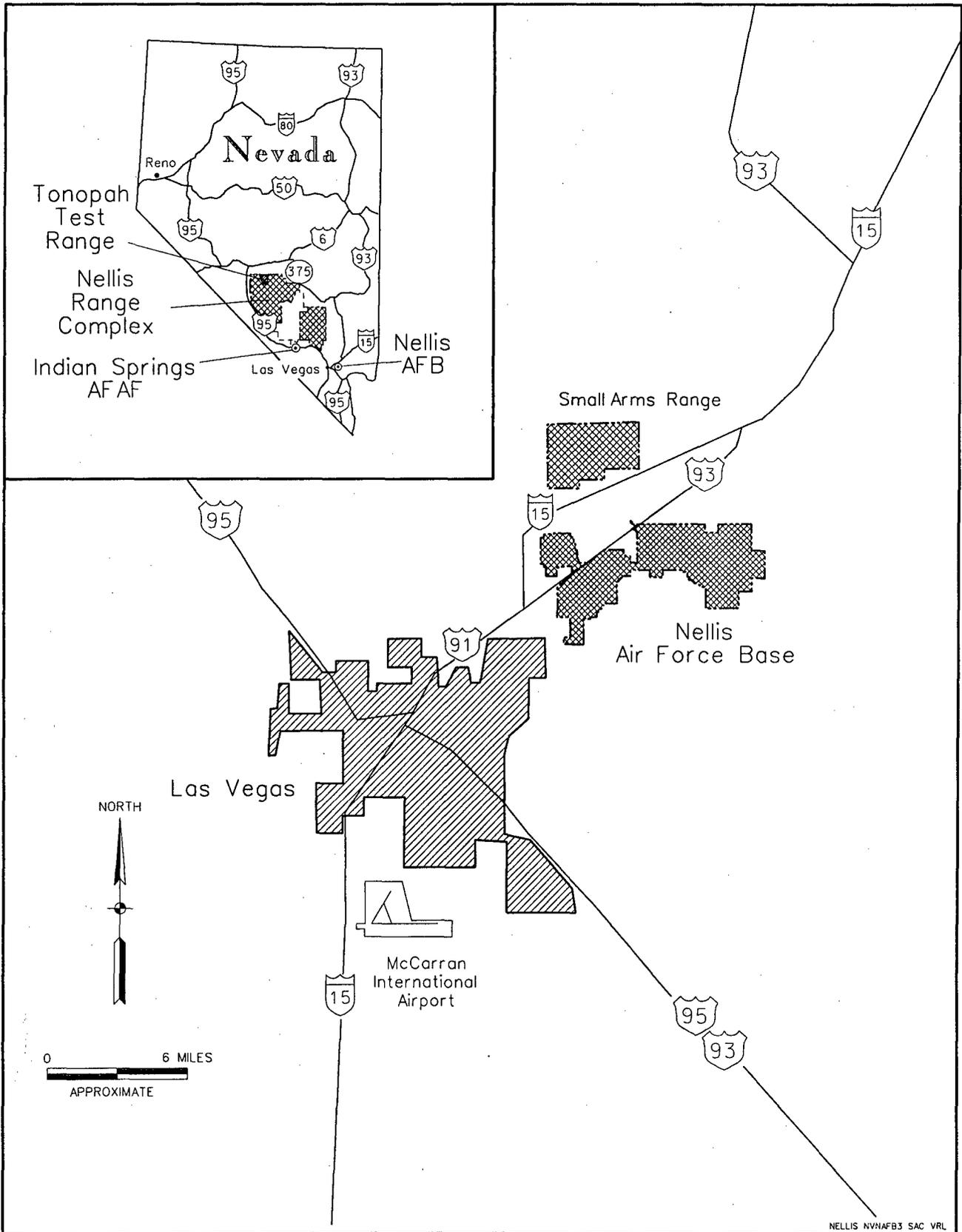
tions above the Maximum Contaminant Level (MCL). Lesser concentrations of 1,1-DCA and perchloroethene (PCE) were identified at concentrations below the MCLs.

### **1.2.1 Subsurface Features**

The soils underlying Site 44 consist primarily of clay to silty clay with lenses of caliche, silt and sand. The water bearing zone impacted by the TCE plume lies approximately 40 to 65 feet below the ground surface. Groundwater levels measured in March 1995 are shown in Figure 1-3 (Dames & Moore, 1995). The water level contours indicate a groundwater flow direction to the southeast.

### **1.2.2 Nature and Extent of Contamination**

A Remedial Investigation (RI) conducted at Site 44 (Engineering Science, 1994b) identified a plume of TCE-contaminated groundwater as shown on Figure 1-2. The RI also identified a second plume (not shown), southwest of the TCE plume, that contains elevated levels of benzene, toluene, ethylbenzene, and xylenes (BTEX). Another, smaller acetone plume was also identified in the area of the BTEX plume. The TCE plume is believed to be the result of various maintenance activities, primarily in Building 270 (Aircraft Inspection Hangar), but also possibly from Building 271 (Aircraft Washracks) and Building 277 (Fire Department). TCE was reportedly used in Building 270 from 1960 to 1985 and is believed to have reached the vadose zone and groundwater as the result of previous waste disposal activities. Sewer and drain lines that were used for disposal are suspected of leaking TCE as well (Engineering Science, 1994b). The data collected from previous investigations at Site 44 have been used to characterize the subsurface features and the nature and relative extent of contamination at the site. Groundwater contamination has resulted from the previous operations and is migrating to the southeast. The primary contaminant of interest is TCE but 1,2-dichloroethane (1,2-DCA) and 1,2-dichloroethene (1,2-DCE) were identified at concentra-



**Figure 1-1. Nellis AFB Location Map**



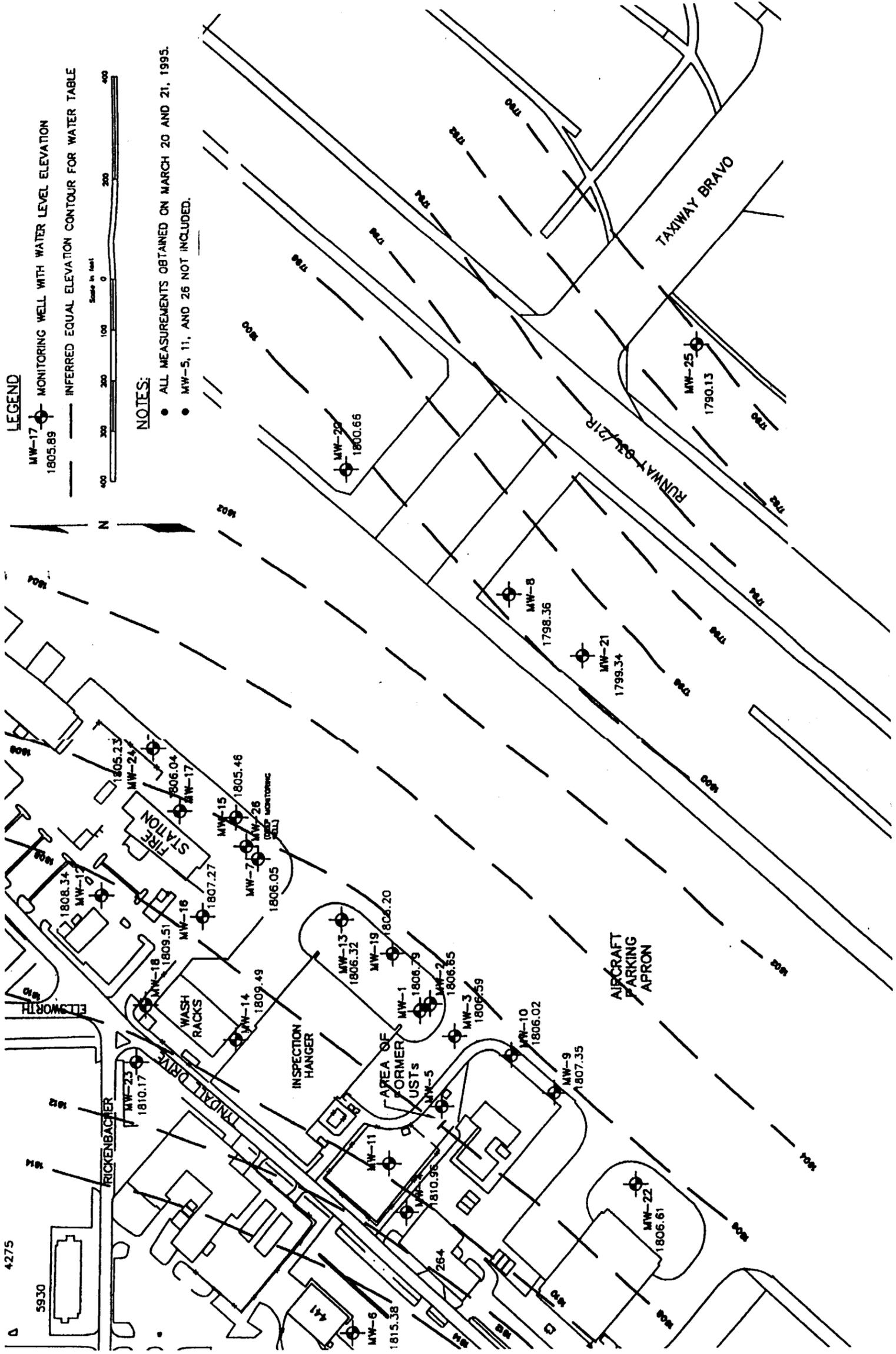


Figure 1-3.  
Site 44 Water Level Contour Map

## 2.0 TWO-PHASE EXTRACTION TEST METHODOLOGY

The following information on the technical approach and the sampling and analytical methodologies is a summary of the *Nellis AFB Site 44 2-Phase™ Vacuum Extraction Pilot-Scale Test Work Plan* (Work Plan) (Radian Corporation, 1995).

### 2.1 Test Procedures

The pilot-scale test of the TPE technology consisted of a five-day test conducted on monitoring well (MW) -7 at Site 44. The test was conducted from 7 to 11 August 1995. The primary VOCs of interest included TCE and other trace quantities of chlorinated and non-chlorinated VOCs (refer to Appendix C for complete analytical results). All activities (equipment monitoring, sample collection, sample control, and sample analysis) were conducted in accordance with the procedures and protocols described in the quality assurance/quality control portions of the 1994 Dames and Moore, Site 44 Sampling and Analysis Plan (SAP). Modifications to the SAP are contained in Appendix A of the Work Plan.

### 2.2 Piezometer Installation

An array of three combined groundwater and vapor piezometers was installed near the extraction well to assess the performance of the TPE system. The groundwater and vapor

piezometers were installed using a hollow-stem auger drilling rig in accordance with the well construction portions of the SAP.

Groundwater piezometers penetrate the saturated zone and are screened below the static water table between 40 to 60 BGS. Vapor piezometers were installed with each groundwater piezometer and screened from approximately 15 feet BGS to 10 feet above the groundwater table. Combined groundwater and vapor piezometer construction cross-sections are shown in Figure 2-1. A plan view of the site showing the combined vapor and liquid piezometers is provided in Figure 2-2. Table 2-1 provides a summary of the well and monitoring point characteristics. Details of the installation of the piezometers is provided in Appendix A.

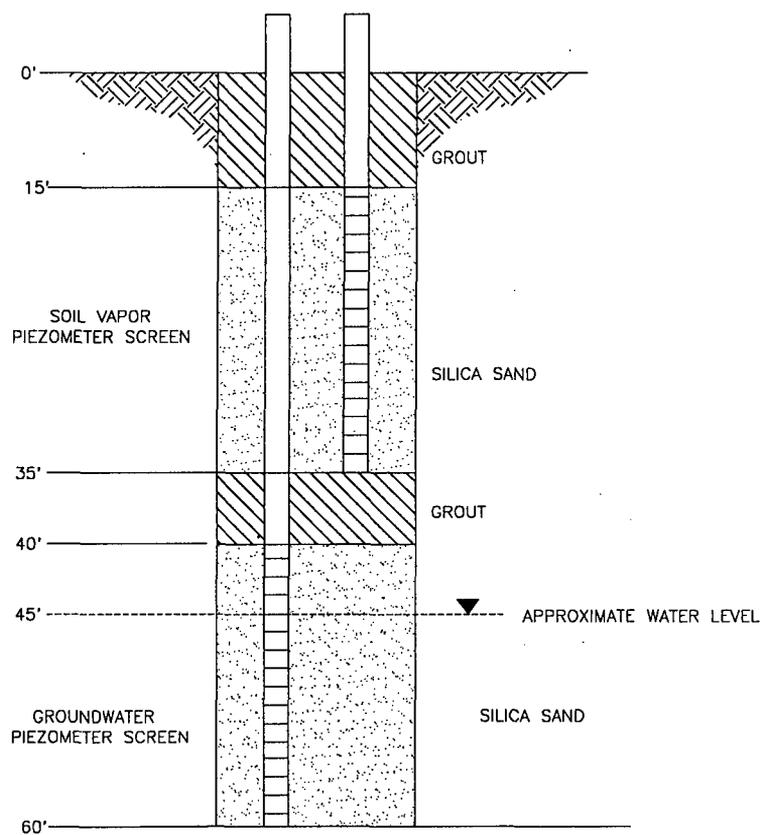
#### 2.2.1 Test Equipment

The test was conducted using a trailer-mounted, 25-horsepower, high-vacuum extraction unit. A schematic illustration of the TPE unit is provided in Figure 2-3. Extracted groundwater from the formation was treated using aqueous-phase granulated activated carbon (GAC) before discharge to a portable tank for temporary storage; extracted vapor was treated using vapor-phase GAC prior to discharge to the atmosphere. A general schematic of a TPE well is shown in Figure 2-4. Procedures followed during the operation of the TPE system are summarized in the Work Plan.

**Table 2-1. Summary of Wells and Monitoring Point Characteristics**

Well/ Piezometer ID	Used to Monitor	Total Depth (Feet BGS)	Screened Interval (Feet BGS)	Approximate Distance from MW-7 (Test Well)
Vapor PZC-1	Induced Vacuum	35	15-35	10
Vapor PZC-2	Induced Vacuum	35	15-35	25
Vapor PZC-3	Induced Vacuum	35	15-35	50
GW PZC-1	Water Level	62	40-60	10
GW PZC-2	Water Level	61	40-60	25
GW PZC-3	Water Level	66	40-60	50
MW-7	Extraction Well	60	30-60	—
MW-15	Water Level	54	39-54	90

COMBINED GROUNDWATER AND VAPOR PIEZOMETER CONSTRUCTION



BOREHOLE DIAMETER: 12"-14"  
 PIPE: 1" (VAPOR ) AND 2" (GROUNDWATER) SCHEDULE 40 PVC  
 SCREEN: 10 SLOT  
 NTS

PROJECT: NELLUS\FG4\NEZ.DWG SAC ETB

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Figure 2-1. Piezometer and Vapor Probe Construction Cross-Section

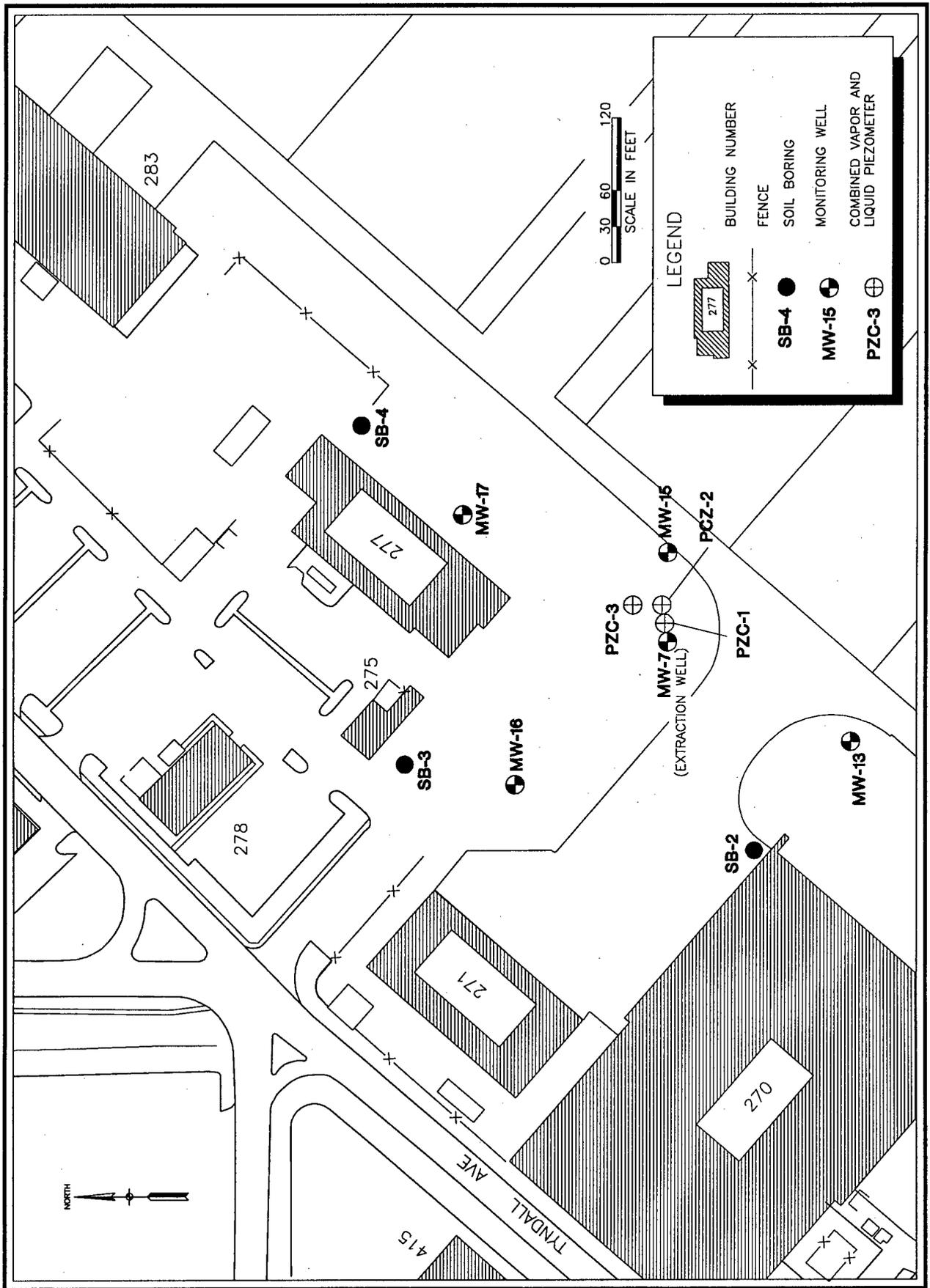
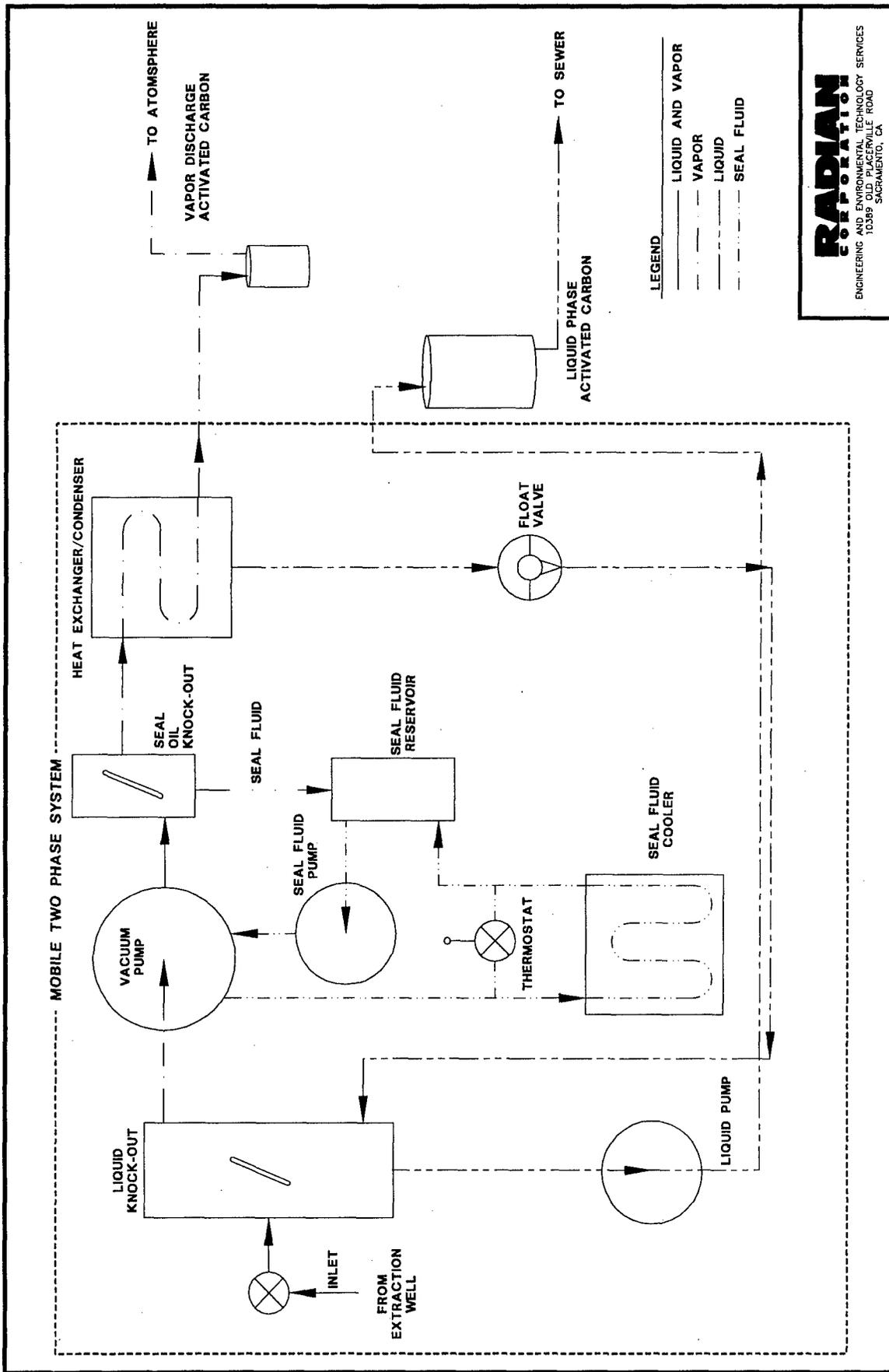


Figure 2-2. Combined Vapor and Liquid Piezometer Plan View

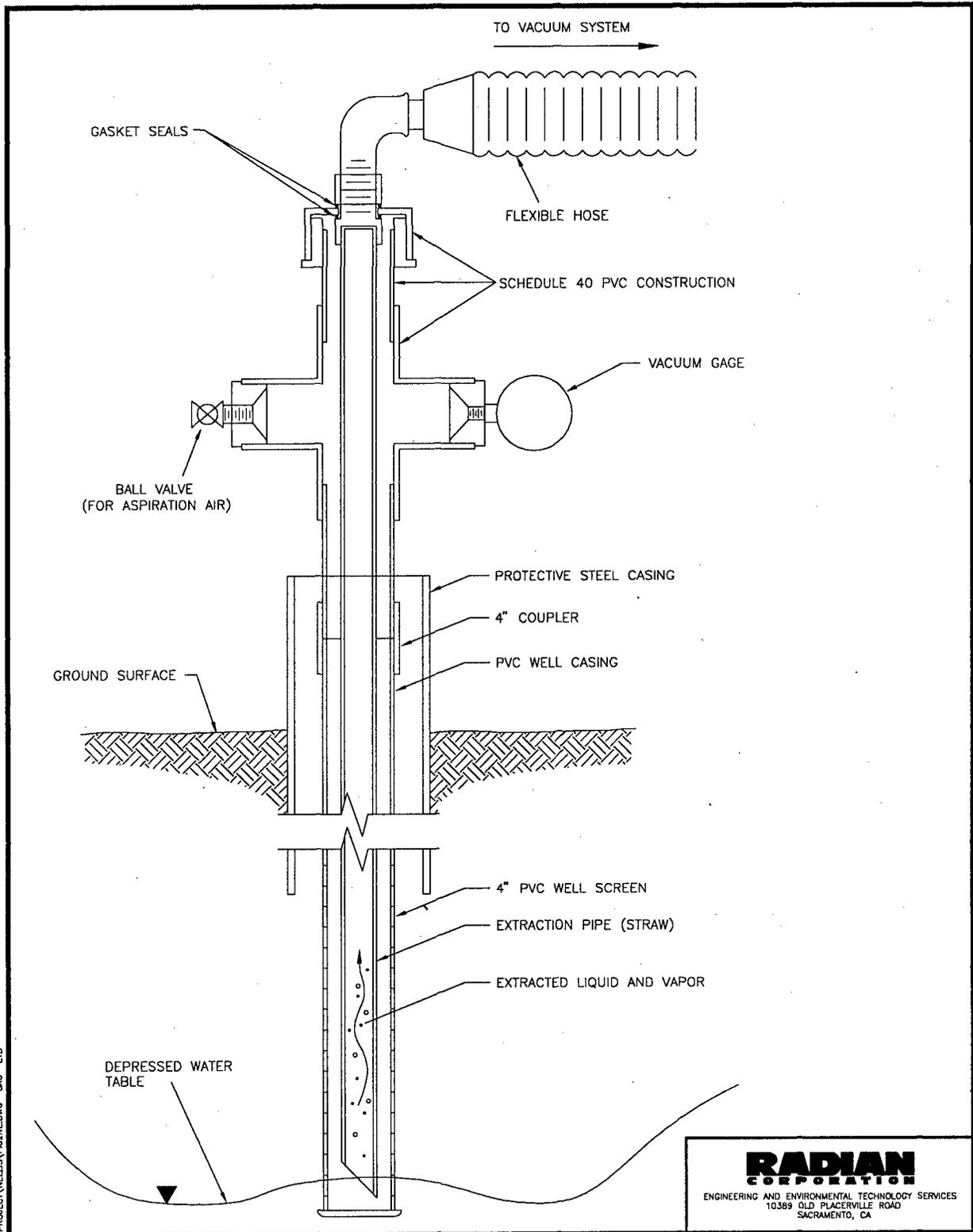


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PROJECT: NELLIS/1031NE.DWG SAC ETB

Figure 2-3. Two-Phase Extraction Apparatus Schematic



PROJECT: NELLIS FIRE/DMG SAC ETB

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Figure 2-4. Two-Phase Wellhead Assembly and Extraction Well

## **2.3 Sampling and Analytical Methodologies**

All sampling and analytical procedures (except where noted) were conducted in accordance with procedures and protocols described in the SAP. The sampling frequency for soil, vapor, and water samples collected during the study are summarized on Table 2-2.

### **2.3.1 Sampling Methodology**

System parameters and extracted vapor and liquid conditions were measured using vacuum and temperature gauges included on the TPE trailer. Groundwater drawdown in the observation wells was measured using a water level meter, and induced vacuum was measured using Magnehelic® gauges. Data collected during the test were recorded on field data sheets (Appendix B).

Baseline groundwater samples were collected from MW-7 prior to TPE testing in 40-milliliter void of air (VOA) vials using a dedicated teflon bailer. Prior to collecting the baseline samples, three well volumes of water were purged from the well. Following the test, post-test groundwater samples were collected using the dedicated bailer.

During the operation of the system, extracted groundwater samples were collected directly from the air/water separator on the TPE trailer in VOA vials. All VOA vials were iced and stored in a dedicated cooler until shipped to Radian's analytical laboratory in Austin, Texas.

All vapor samples were collected using disposable syringes and evacuated vials provided by Microseeps Inc. The samples were stored at ambient conditions until shipped to the Microseeps laboratory for analysis.

Quality control samples were also collected during sample collection activities. Duplicate water and vapor samples were collected at a 10% frequency by the methods previously described. Trip blanks accompanied the VOA vials throughout shipping and handling.

One carbon sample was collected from the vapor phase GAC and one from the aqueous phase GAC for profiling purposes. These samples were analyzed by Weststates Carbon Laboratory.

Base personnel collected composite soil samples of drill cuttings for profiling purposes to determine waste characteristics for disposal. These samples were analyzed by a Nellis AFB selected laboratory.

### **2.3.2 Analytical Methodology**

Extracted groundwater samples were analyzed for VOCs by EPA Method SW8260. Soil vapor samples were analyzed for VOCs by Microseeps Analytical Method AM 4.02. Carbon samples were analyzed by the 11 Resource Conservation and Recovery Act (RCRA) test. Treated groundwater samples were analyzed to determine if the water was within the discharge limits for the sanitary sewer.

Results of the analytical data are provided in Appendix C. The AM 4.02 methodology is provided in Appendix D. The list of methods included in the 11 RCRA test along with the results are provided in Appendix E.

## **2.4 Residuals Management**

The following residuals were generated during the TPE activities:

- One drum of aqueous-phase GAC and one drum vapor-phase GAC;
- Drill cuttings from piezometer and vapor probe installation;
- Purged water from sampling and well development activities; and
- Extracted groundwater from the TPE activities.

The GAC drums are scheduled for disposal following profiling activities. The carbon will be shipped as hazardous waste to a permitted carbon regeneration facility for disposal. This shipment will be manifested by Nellis AFB.

Table 2-2. Analytical Sampling Field Data Sheet

Schedule		Extracted Liquid	Extracted Vapor	Liquid Duplicate	Liquid Trip Blank	Vapor Duplicate	Ground-water	Soil Vapor	Soil Cuttings	Liquid Phase Carbon Effluent	Vapor Phase Carbon Effluent	Vapor Phase Carbon	Liquid Phase Carbon	Vapor Phase Carbon	PID
Day	Hour	SW-8260	AM4.02	SW-8260	SW-8260	AM4.02	SW-8260	AM4.02	SW-8260	SW-8260	AM4.02	11 RCRA Test	11 RCRA Test	11 RCRA Test	
0	before						X	X	X						
1	0.25	X	X												X
1	2	X	X												
1	4	X	X												
1	8	X	X	X											
2	24	X	X		X	X									X
2	28	X	X												
2	32	X	X							X	X				X
3	48	X	X												X
3	56	X	X	X	X	X									X
4	76	X	X												X
5	104	X	X												X
5	after						X	X				X	X		

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The drill cuttings were placed in a roll-off bin for temporary storage at the site. Following analysis and profiling, Nellis AFB managed the manifesting and disposal of all soils generated during testing activities. The soils were eventually sent to Las Vegas Paving for incineration.

Purged water from sampling and well development activities was temporarily stored in a 600-gallon, trailer-mounted tank. The purged water was then transferred to the existing water treatment plant for treatment. The treatment plant is located at Site 28 at Nellis AFB.

All water extracted during the TPE study was treated using aqueous-phase GAC and then temporarily stored in a 20,000-gallon tank. Following approval of the wastewater analytical results (presented in Appendix C) by the base environmental staff, the wastewater was discharged to the sanitary sewer.

### 3.0 TEST RESULTS AND CONCLUSIONS

To add a new technology to the PREECA process as a presumptive remedy, the conditions under which the technology can be applied must be determined. The range of site conditions where the technology has been shown to be successful is referred to as the Remedy Profile. Radian has prepared an initial TPE Remedy Profile based on the results of previous TPE tests done at sites across the country. As more information becomes available, the new data are used to update and refine the technology's Remedy Profile.

The data available for Site 44 prior to the test indicated that it was a good TPE candidate site with relatively high VOC concentrations and low permeability. The test was successful at significantly improving the groundwater extraction rate and the VOC mass removal rate over conventional extraction methods such as pump and treat. However, the vapor flow rate observed during the test was higher than expected given the available information on the vadose zone soil types. The relatively high flow rate (87 to 97 scfm) puts the site at the bounds of the current remedy profile.

The TPE test at Site 44 was successful in providing additional verification of the initial draft Remedy Profile. Table 3-1 presents an initial TPE Remedy Profile. In addition, it compares the Nellis Site 44 data to the TPE profile. The "cases" described in the Remedy Profile relate to the relative concentration of contaminants and the permeability of the saturated and vadose zones to site conditions where the technology is applicable.

The test met all of the test objectives related to verifying and expanding the draft Remedy Profile. It also met all of the site-specific objectives related to obtaining site-specific design information (vapor radius of influence, expected flow rates, expected concentrations, etc.) with the exception of determining the exact groundwater radius of influence. While this value has been estimated, the fluctuations in the water table make the values uncertain.

### 3.1 System Operation

Physical and analytical data were analyzed to determine the following:

- Baseline TCE and total VOC concentrations in groundwater;
- The major VOC constituents in the vapor and water streams;
- Average groundwater and soil vapor extraction rates;
- Average TCE and total VOC extraction rates and total pounds removed;
- The relationship between distance and groundwater drawdown and induced vacuum, including radii of influence.

Table 3-2 summarizes the results achieved using the TPE system at MW-7 and provides a comparison with conventional pump and treat (P&T) applications.

**Table 3-2. Summary of TPE Pilot Study Results**

System Parameter	TPE at MW-7	TPE vs. P&T
Groundwater Extraction Rate	1.7 gpm	2-3 times
Soil Vapor Extraction Rate	87-97 scfm	NA
Avg. VOC Removal Rate	0.39 lbs/day	> 30 times
Avg. TCE Removal Rate	0.33 lbs/day	> 30 times
Radius of Influence <sup>a</sup> (Groundwater)	>85 feet	unknown
Radius of Influence (Vapor) <sup>a</sup>	>50 feet (estimated to be 100 ft by extrapolation)	NA

<sup>a</sup>Radius of influence results were based on limited data as discussed in Section 3.2.

scfm = standard cubic foot (feet) per minute  
lb/day = pound(s) per day  
gpm = gallons per minute  
NA = not applicable

The supporting calculation for the pump and treat data is provided as Appendix F. The data calculation for the TPE system parameters are provided in Appendix B.

### 3.2 Radii of Influence and Production Rates

Groundwater drawdown versus the distance from the extraction well over time is presented in Figure 3-1. The groundwater level readings

**Table 3-1. Two-Phase Extraction Technology Selection Criteria**

<b>Criteria Parameter</b>	<b>PREECA Remedy Profile Guideline</b>	<b>Nellis AFB, Site 44</b>
Contaminant	Halogenated VOCs <sup>a</sup>	Halogenated VOCs: primarily trichloroethylene (TCE)
Contaminant Location	Saturated zone or both the saturated and vadose zones	Saturated and vadose zone
Contaminant Concentration	Significantly greater than MCLs	Significantly greater than MCLs for TCE
Depth of Contamination	< 150 BGS	< 65 feet BGS
Henry's Law Constant of Majority of Contaminants	> 0.01 at 20°C (dimensionless)	0.37 at 20°C for TCE
Vapor Pressure of Contaminant	> 1.0 mm Hg at 20°C	58 mm Hg at 20°C
Hydraulic Conductivity (Saturated Zone)	< 1 x 10 <sup>-4</sup> cm/sec (silts and clays with minimal interlayered sands and gravels)	2.8 x 10 <sup>-5</sup> cm/sec (clays, silts, and caliche)
Groundwater Production	< 15 gpm (for 4-inch well casing)	< 1 gpm groundwater only for 4-inch well casing
Average Air Permeability of Vadose Zone and Distribution of Contaminants	<p><b>Groundwater Only:</b></p> <p>Case 1:</p> <p>No contamination present in vadose zone. Air permeability in vadose zone is not a determining factor. High concentrations (significantly higher than MCLs) of contaminants in saturated zone.</p> <p><b>Vadose Zone and Groundwater Contamination:</b></p> <p>Case 2:</p> <p>Low to moderate concentrations of contaminants in vadose zone. Low or high air permeability in vadose zone. High concentrations of contaminants in saturated zone.</p> <p>Case 3:</p> <p>Low or high air permeability in vadose zone. High concentrations of contaminants in vadose zone and saturated zone.</p> <p>Case 4:</p> <p>High concentrations of contaminants in vadose zone. Low air permeability in vadose zone. Low to moderate concentrations of contaminant in saturated zone.</p>	<p>Case 2:</p> <p>Low to moderate concentrations of VOC compounds in vadose zone and high concentrations of VOC compounds in saturated zone; and</p> <p>Low to moderate air permeability in both the vadose zone and the saturated zone (clays and silt).</p>

<sup>a</sup> TPH and/or BTEX can be included for sites where expedited action is required.

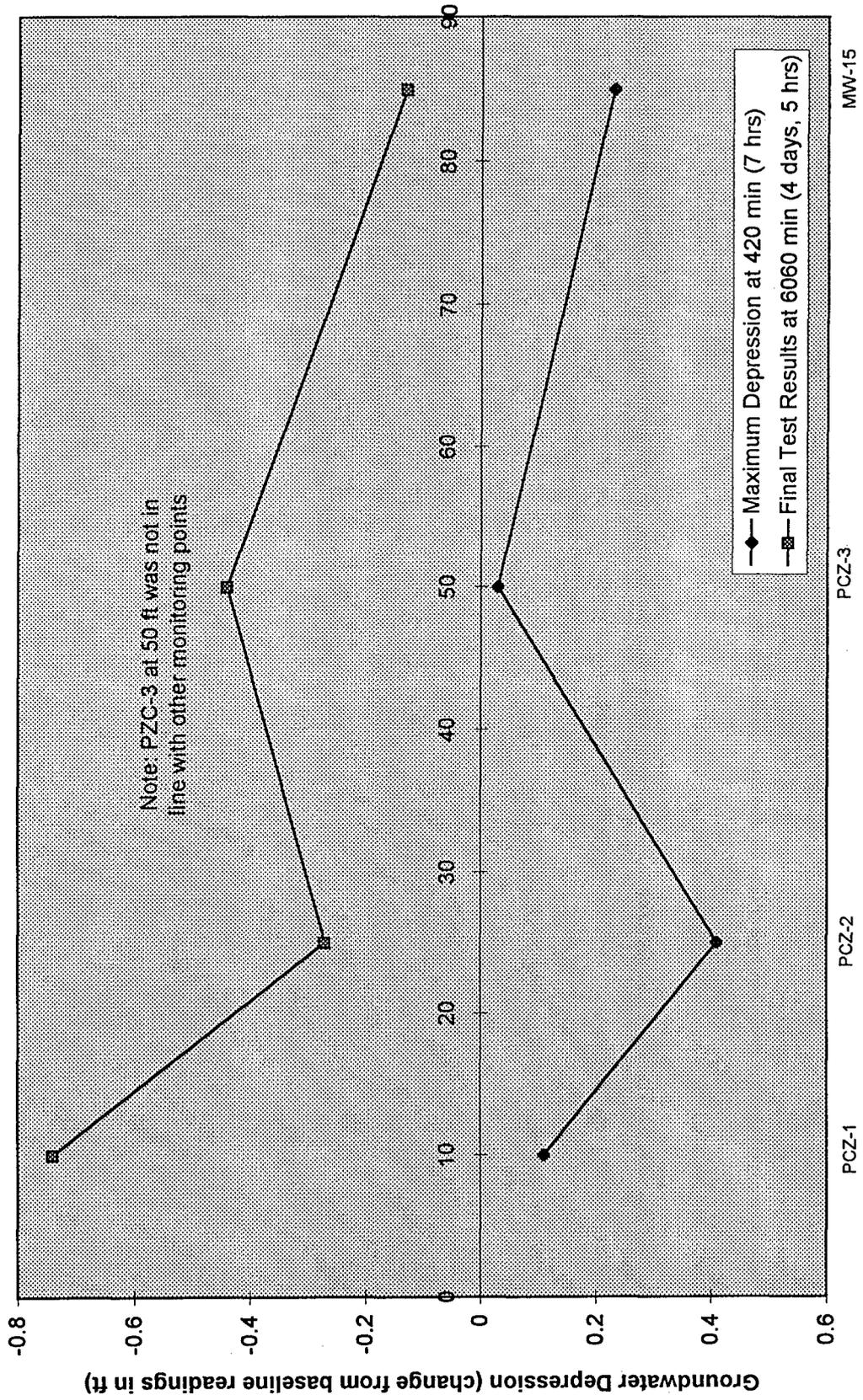


Figure 3-1 Groundwater Drawdown vs. Distance

taken during the test indicate that the aquifer had not reached steady state at the conclusion of the test. During the first day of operation, the data indicated a reduction in the water table at all four monitoring points. Approximately midday on the second day of testing, the water levels began to increase as the water table rebounded from the initial depression and continued to increase gradually during the remainder of the test. The radius of influence for groundwater, based on the first day of operation, is greater than 85 feet. As shown in Figure 3-1, a drawdown of about 0.2 foot was obtained at MW-15, which is approximately 85 feet from the extraction well. Groundwater levels at all piezometers increased slowly through the end of the test on MW-7. By the end of the test, the water levels showed a net rise over the baseline readings in all monitoring points.

The increase in soil vacuum caused by the TPE unit would tend to cause a rise in the static groundwater level. This does not completely explain the resulting groundwater level results, as the observed rise in the water table was greater than would be expected by a vacuum influence of less than 1 inch of water column. Data obtained during the test indicates that there may have been an outside influence on the water table that was either responsible for a drawdown of the baseline water level readings or recharge to the area. The aquifer is not a source of potable water and is not connected to an aquifer that is currently being pumped by a supply well.

Soil vacuum readings were measured at all three monitoring points indicating a vapor radius of influence greater than 50 feet. No vacuum readings could be collected at MW-15. Figure 3-2 presents the vacuum readings versus distance over time from the extraction well. This figure is used to estimate the approximate vapor radius of influence at the site. The radius of influence for vapor is estimated to be significantly greater than the hydraulic radius, in the range of 80 to 100 feet based on extrapolation of the data.

The groundwater flow rate was measured using a totalizing flow water meter. After an initial surge resulting from evacuating the well, flow

slowly decreased to a steady state rate of approximately 1.6 to 1.7 gpm. An average flow of 1.7 gpm was obtained for the 100-hour test.

The vapor flow rate was measured by rotometers on the TPE unit. The flow rate for MW-7 quickly stabilized at a relatively high rate of between 85 and 95 scfm during the entire test. This indicates that the unsaturated zone of the formation have a higher permeability than initially expected.

### 3.3 VOC Recovery

Tables 3-3 and 3-4 summarize the analytical results for the VOCs detected in the samples collected during the study. TCE, PCE, and other minor amounts of chlorinated organics were the primary contaminants found at the Site (see Appendix C for the analytical laboratory results). Results of sampling at MW-7 included:

- The baseline concentration (before the test) of TCE in groundwater at MW-7 was 1,760 µg/L;
- The post-test concentration of TCE in groundwater at MW-7 was 647 µg/L;
- The concentration of TCE in water samples taken from the TPE air/water separator averaged 58.5 µg/L; and
- The total VOC concentration in extracted vapor ranged from 6,167 to 9,431 parts per billion by volume (ppbv).

#### 3.3.1 Extraction Results

Results of the MW-7 test included:

- Approximately 1.6 lb of total VOC compounds were extracted from MW-7 in 100 hours of testing (approximately 0.39 lb/day). The majority of the compounds were extracted in the vapor phase.
- Average groundwater extraction rate was 1.7 gpm.

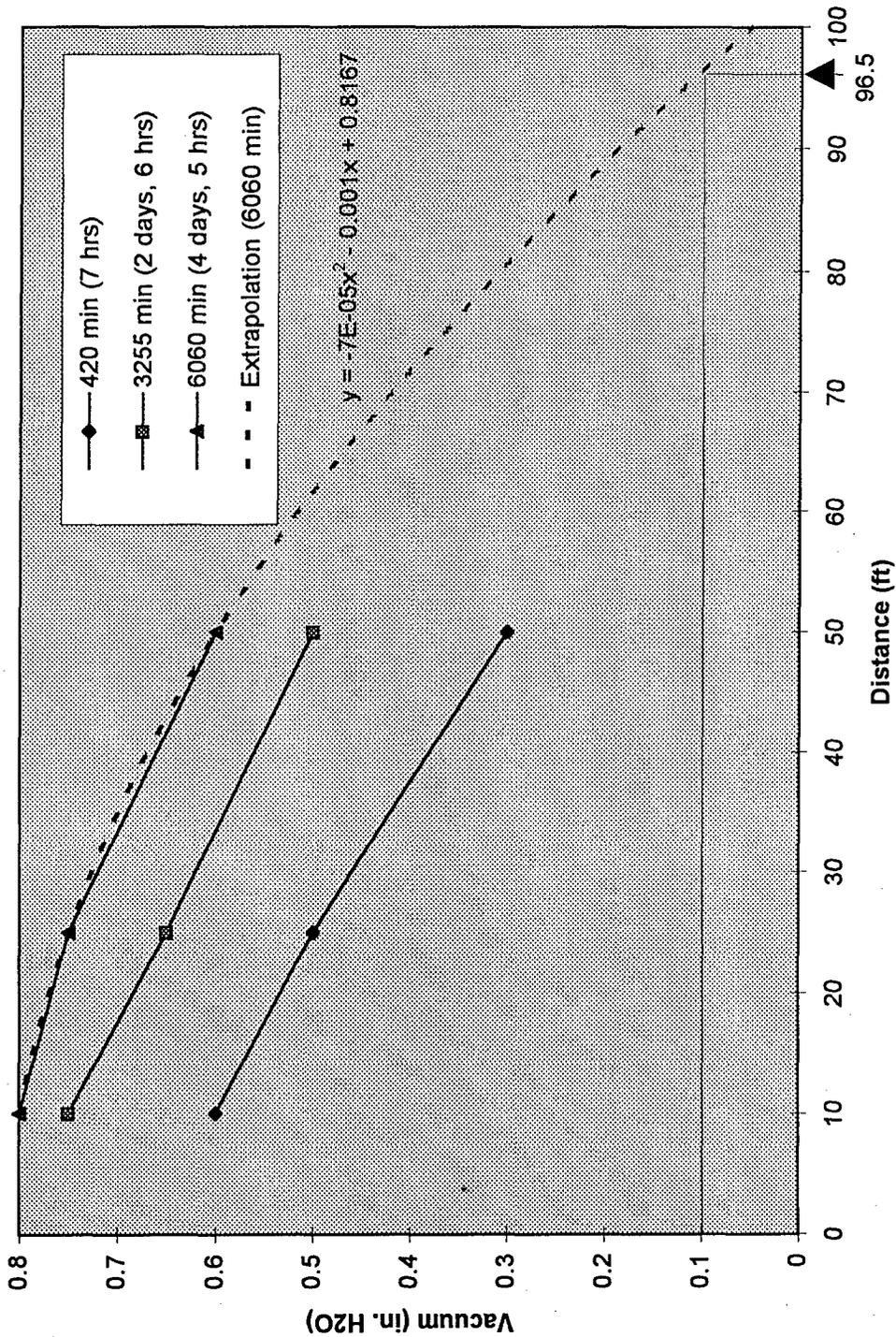


Figure 3-2 Formation Vacuum vs. Distance over Time

**Table 3-3. Summary of Water Data  
Concentration in Micrograms per Liter (µg/L)**

Date/Time Collected Contaminant <sup>a</sup>	Groundwater		Sample ID <sup>b</sup>										Groundwater												
	Pre-Test 001	Post-Test GW2	Extracted Groundwater										Post-Test GW2	0											
			8-7/1330 UW 1	8-7/1600 UW 2	8-8/0930 UW 3	8-8/1200 UW 4	8-8/1530 UW 5	8-9/0700 UW 6	8-9/1540 UW 7	8-10/1230 UW 8	8-11/1400 UW 9														
Benzene	0.238	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Bromodichloromethane	0.171	0.0876	0.106	0.106	0.101	0.0817	0.0817	0.0847	0.0847	0.0919	0.0919	0	0	0	0	0	0.981	0.167	0	0	0	0	0	0	
Chlorobenzene	0.144	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Chloroform	0.506	1.15	1.31	1.07	1.42	1.07	1.3	1.3	1.11	1.11	1.17	1.17	1.21	1.35	0.361	0	0	0	0	0	0	0	0	0	0
1,3-Dichlorobenzene	0.38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1,1-Dichloroethane	1.19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1,1,1-Dichloroethene	0.331	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
cis-1,2-Dichloroethene	60.9	0.951	0.98	0.678	0.898	0.678	0.814	0.814	0.673	0.673	0.696	0.696	0.617	0.59	38.8	0	0	0	0	0	0	0	0	0	0
trans-1,2-Dichloroethene	0.257	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2-Hexanone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tetrachloroethene	12.6	3.49	4.27	5.08	6.41	5.08	6.19	6.19	5.9	5.9	6.48	6.48	5.64	7.41	13.2	0	0	0	0	0	0	0	0	0	0
Toluene	0.153	0	0.216	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichloroethene	1760	50.9	53.2	51.5	64.1	51.5	61.4	61.4	57.1	57.1	63.5	63.5	55.6	69.5	647	0	0	0	0	0	0	0	0	0	0
Trichlorofluoromethane	0.886	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1,1,2-Trichlorofluoroethane	2.21	0	0.442	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

<sup>a</sup>Only analytes with confirmed hits above detection limits are reported.

<sup>b</sup>Only last three digits of sample number are shown. The actual extracted groundwater samples were labeled as "UW" for untreated water instead of as "VW" as reported by the laboratory. The correct sample numbers are provided.

Note: All influent samples were taken from the knockout pot prior to carbon treatment.

*should be < Reporting Limit*

**Table 3-4. Summary of Vapor Data  
Concentrations in Parts per Billion by Volume (ppbv)**

Sample ID <sup>b</sup>	Date/Time Collected	Extracted Vapor Concentration <sup>a</sup>				
		Chloroform	Decane	Hexane	PCE	TCE
SV1 (Pre-test) <sup>c</sup>	8-7/0830	43	0	130	210	4,400
UV1	8-7/1330	47	0	280	340	5,500
UV2	8-7/1600	53	0	610	470	6,600
UV3	8-8/0930	48	0	710	450	5,200
UV4	8-8/1200	50	0	180	500	5,500
UV5	8-8/1530	52	440	190	610	6,300
UV6	8-9/0715	58	0	0	810	7,700
UV7	8-9/1600	57	0	90	780	7,500
UV8	8-10/1230	61	240	410	820	7,900
UV9	8-11/1430	63	170	260	820	7,700
SV2 (Post-test) <sup>c</sup>	8-11/1600	54	90	80	610	5,700

<sup>a</sup>Results below the method detection limit are shown as "0" ppb. Only analytes with confirmed hits above detection limits are reported.

<sup>b</sup>Only last three digits of sample number is shown on table (UV = untreated vapor, SV = soil vapor).

<sup>c</sup>Samples taken of extracted soil gas with the straw above the water table.

*These results demonstrate that main mass removal mechanism is SVE*

- Average vapor extraction rate from the formation was 93 scfm. This flow rate is relatively high and would be considered to be on the upper edge of the remedy profile.

for more than 10 to 15 minutes without dewatering the well. The flow rate identified during the Groundwater Quarterly Monitoring Report indicated a flowrate of 0.79 gpm at MW-7. The TPE system was able to continuously extract 1.7 gpm, doubling the hourly extraction rate.

*Inconclusive* → The TPE extraction system transferred over 90% of the VOCs in the groundwater to the vapor phase, resulting in water phase concentrations that required only minimal polishing prior to discharge. *Based on 1 initial sample*

**Increased Contaminant Removal Rate.** The contaminant mass removal rate (0.39 lb/day of VOCs) was increased 30 times when contrasted with a conventional pump and treat system that would operate at this site. A conventional pump and treat system for this site would be expected to operate at 0.8 gpm with an average groundwater TCE removal rate of 0.011 lb/day. The increase in mass removal rates occurs as a result of pulling air through the recently dewatered saturated zone and stripping dissolved contaminants from the soil particles. In addition, contaminated soil vapors are often simultaneously extracted from the vadose zone, reducing the potential for transfer of additional contaminants from the vadose zone into the groundwater.

*Removal of soil gas is more prominent mass removal mechanism*

**3.3.2 Comparison with Typical Pump and Treat Technology** *should compare with SVE*

Two-phase extraction demonstrated a number of advantages over a typical pump and treat systems if used at Site 44. A number of these advantages are discussed below.

**Increased Water Extraction Rate.** The increased down-well vacuum increases the pressure gradient within the water bearing zone. This results in a significant increase in water extraction rates in low permeability formations. The well development logs indicate that a pumping rate of 1 gpm could not be sustained

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***In Situ* Air Stripping.** The TPE system extracts the groundwater as dispersed droplets. This, combined with highly turbulent vacuum conditions, results in significant transfer of the volatile components from the liquid to the gas phase. Stripping rates greater than 90% were observed during the TPE study at the site. This results in more cost-effective treatment of the extracted contaminants.

### **3.4 Conclusions**

The pilot test on MW-7 demonstrated the effectiveness of the TPE technology for removing VOCs from the saturated zone. Up to 0.39 lbs/day of VOCs were removed from the subsurface during the study. This contaminant removal rate indicates that TPE is an effective technology for contaminant removal at Site 44.

#### **3.4.1 Overall Conclusions**

The test demonstrated the TPE system's effectiveness at remediating the site. This provides additional verification of the existing remedy profile for TPE because the site conditions are within the bounds of the current TPE profile.

The TPE process resulted in significantly increased subsurface contaminant mass removal rates. The pilot test data should provide significant information to evaluate the cost and technical feasibility of installing a full-scale system at the site. For use as a source or "hot-spot" remediation technology, the groundwater radius of influence data are adequate to design and install a full-scale system. Due to the fact that the water table did not reach steady-state during the test, making accurate estimation of the groundwater radius of influence uncertain, phased implementation may be required for complete plume and contaminant control. The time required to reach steady-state cannot be determined since the exact cause of the increase in groundwater levels was not identified. Additional review of the most recent groundwater monitoring data should be conducted to verify that the water level fluctuations occur as a result of influences other

than the TPE system. If this cannot be determined, a longer pilot test may be required to obtain better groundwater radius of influence data.

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#### **4.0 NELLIS AFB REMEDIAL ACTION ENHANCEMENT**

Nellis AFB is currently in the process of evaluating a number of technologies for remediating the soil and groundwater contamination at Site 44. The data from this TPE pilot test will be used to evaluate TPE versus other technologies to identify the most cost-effective solution. The results of the test indicate that TPE would be an effective remedial solution for the site.

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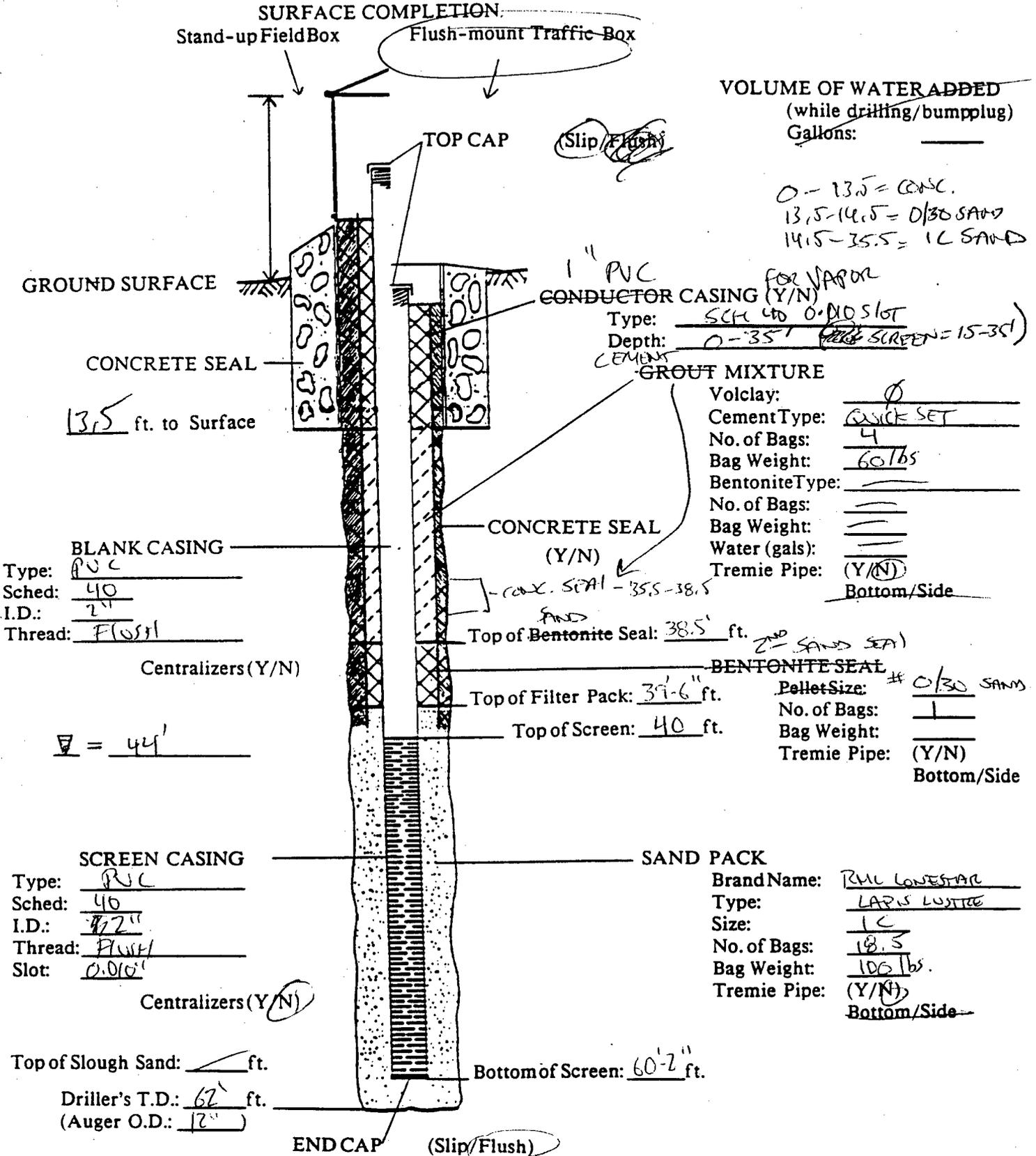
## 5.0 REFERENCES

- Dames & Moore, 1994. *Sampling and Analysis Plan Site 44*. Las Vegas, NV. 09 August.
- Dames & Moore, 1995. *Quarterly Groundwater Monitoring Report, March 1995, Site 44, Nellis AFB*. Las Vegas, NV. June.
- Engineering Science, 1994a. *Feasibility Study of Site 44 at Nellis AFB, Las Vegas, Nevada*. Houston, TX. July.
- Engineering Science, 1994b. *Remedial Investigation of Site 44 at Nellis AFB, Las Vegas, Nevada, Final Edition*. Houston, TX. May.
- Radian Corporation, 1995. *Nellis AFB, Site 44 2-Phase™ Vacuum Extraction Pilot-Scale Test Work Plan*. Final. Nellis AFB, Sacramento, CA. June.
- Radian Corporation, 1995. *United States Air Force Presumptive Remedy Engineering Evaluation/Cost Analysis (PREECA)*. Final. Sacramento, CA. 5 May.

**APPENDIX A**  
**Well and Drilling Logs**

Project Name: Nellis AFB 2-PHASE Piezometer Installation  
 Project No.: 612-001-31  
 Geologist: GS Mckelvey  
 Drilling Co.: WEST HAZMAT DRILLING

Well No.: PZC-1



VOLUME OF WATER ADDED  
 (while drilling/bumpplug)  
 Gallons: \_\_\_\_\_

0 - 13.5 = CONC.  
 13.5 - 14.5 = 0/30 SAND  
 14.5 - 35.5 = 1C SAND

Type: PVC  
 Sched: 40  
 I.D.: 2"  
 Thread: Flush

Centralizers (Y/N)

44'

Type: PVC  
 Sched: 40  
 I.D.: 2.2"  
 Thread: Flush  
 Slot: 0.010'

Centralizers (Y/N)

Top of Slough Sand: \_\_\_\_\_ ft.

Driller's T.D.: 62' ft.  
 (Auger O.D.: 12")

GROUT MIXTURE  
 Volclay: \_\_\_\_\_  
 Cement Type: QUICK SET  
 No. of Bags: 4  
 Bag Weight: 60 lbs  
 Bentonite Type: \_\_\_\_\_  
 No. of Bags: \_\_\_\_\_  
 Bag Weight: \_\_\_\_\_  
 Water (gals): \_\_\_\_\_  
 Tremie Pipe: (Y/N)  
 Bottom/Side

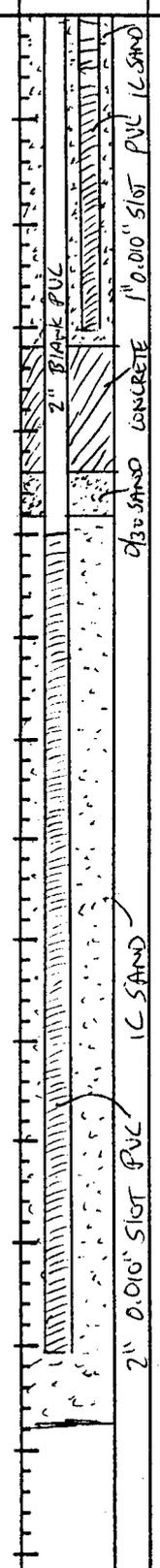
BENTONITE SEAL  
 Pellet Size: # 0/30 SANDS  
 No. of Bags: 1  
 Bag Weight: \_\_\_\_\_  
 Tremie Pipe: (Y/N)  
 Bottom/Side

SAND PACK  
 Brand Name: RMC LOWESTAR  
 Type: LARS LUSTEE  
 Size: 1C  
 No. of Bags: 18.5  
 Bag Weight: 100 lbs.  
 Tremie Pipe: (Y/N)  
 Bottom/Side

PROJECT: Nellis AFB 2-PHASE PERIMETER I-EST PROJECT NO: G12-001-31-36

BORING DESIGNATION: FZC-1 LOGGED BY: GS MCKELVEY DATE: 7-31-95

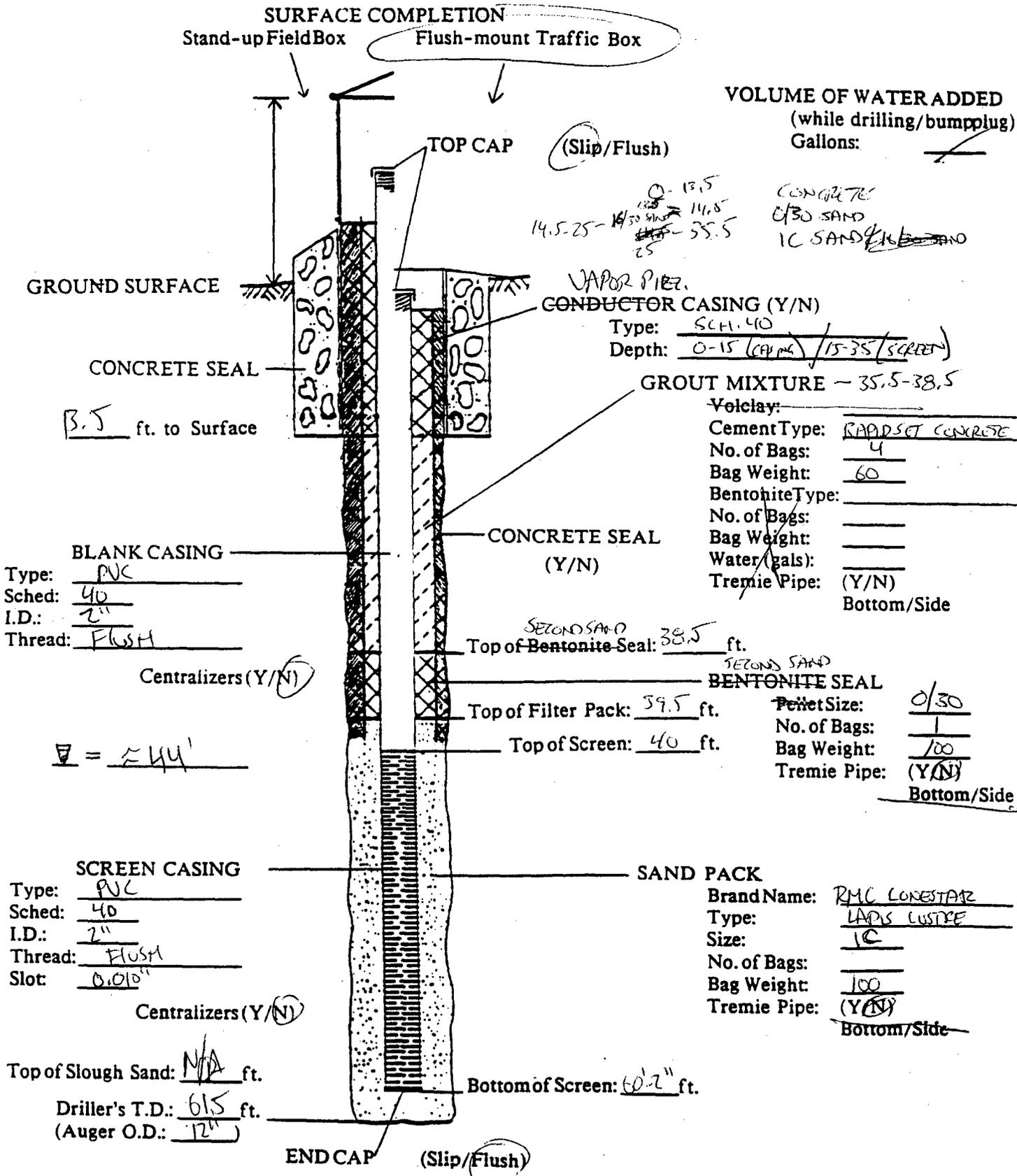
DEPTH	n	% REC.	SAMPLE NO.	TIME	SOIL DESCRIPTION (Group Name, Group Symbol, Color, ASTM Descriptions)	LITH	WELL CONST.	DRILLING AND SAMPLER NOTES/ OVM/FID/PID (BG/R)
27.5								
30					31' TOP OF CALICHE LAYER. SLOW DRILLING			
32.5								
35								
37.5					OUT OF CALICHE AT 37'			
40					40.5' TOP OF CALICHE LAYER.			
42.5					42.5' OUT OF CALICHE			
45					WET AT 44' SANDY LEAN CLAY (CL)			
47.5					SAND: 10%, SILT: 15%, CLAY: 75%. MAX = 6MM. SUB-ROUNDED. WET (NOT TO TOUCH) SOFT. HOMOGENEOUS. MOD PLASTILITY.			
50								
52.5								
55								
57.5								
60								
62.5								



DEPTHS IN FEET BGS      n = BLOWS/6 INCHES      BG/R = BACKGROUND/READING  
 FOR BLOW COUNT CONVERSION, x + y + z (CAL. MOD. SPLIT SPOON) = (y + z)/2 (SPT)

Project Name: KELLIS AFB 2-PHASE PIEZOMETER INST.  
 Project No.: 612-001-31  
 Geologist: GS MCKELVEY  
 Drilling Co.: WEST HAZMAT DRILLING CO.

Well No.: PZC-2



VOLUME OF WATER ADDED  
(while drilling/bumping)  
Gallons:       

0-13.5  
13.5-14.5  
14.5-15.5  
15.5-25  
25-35.5

CONCRETE  
0/30 SAND  
1C SAND/1/2 SAND

VAPOR PIEZ.  
CONDUCTOR CASING (Y/N)  
Type: SCH. 40  
Depth: 0-15 (CAP) / 15-35 (SCREEN)

GROUT MIXTURE - 35.5-38.5  
 Volclay: \_\_\_\_\_  
 Cement Type: RAPIDSET CONCRETE  
 No. of Bags: 4  
 Bag Weight: 60  
 Bentonite Type: \_\_\_\_\_  
 No. of Bags: \_\_\_\_\_  
 Bag Weight: \_\_\_\_\_  
 Water (gals): \_\_\_\_\_  
 Tremie Pipe: (Y/N) \_\_\_\_\_  
 Bottom/Side

SECOND SAND  
Top of Bentonite Seal: 38.5 ft.

SECOND SAND  
BENTONITE SEAL  
Pallet Size: 0/30  
No. of Bags: 1  
Bag Weight: 100  
Tremie Pipe: (Y/N) \_\_\_\_\_  
Bottom/Side

BLANK CASING  
Type: PVC  
Sched: 40  
I.D.: 2"  
Thread: FLUSH

Centralizers (Y/N)       

▽ = ≈ 44'

SCREEN CASING  
Type: PVC  
Sched: 40  
I.D.: 2"  
Thread: FLUSH  
Slot: 0.010"

Centralizers (Y/N)       

Top of Slough Sand: N/A ft.  
Driller's T.D.: 615 ft.  
(Auger O.D.: 12")

SAND PACK  
Brand Name: RMC LONESTAR  
Type: LAVIS LUSTREE  
Size: 1C  
No. of Bags: \_\_\_\_\_  
Bag Weight: 100  
Tremie Pipe: (Y/N) \_\_\_\_\_  
Bottom/Side

Bottom of Screen: 60.2" ft.

PROJECT: Nellis AFB 2PHASE PNEUMATIC INST. PROJECT NO: 612-CO1-31-36

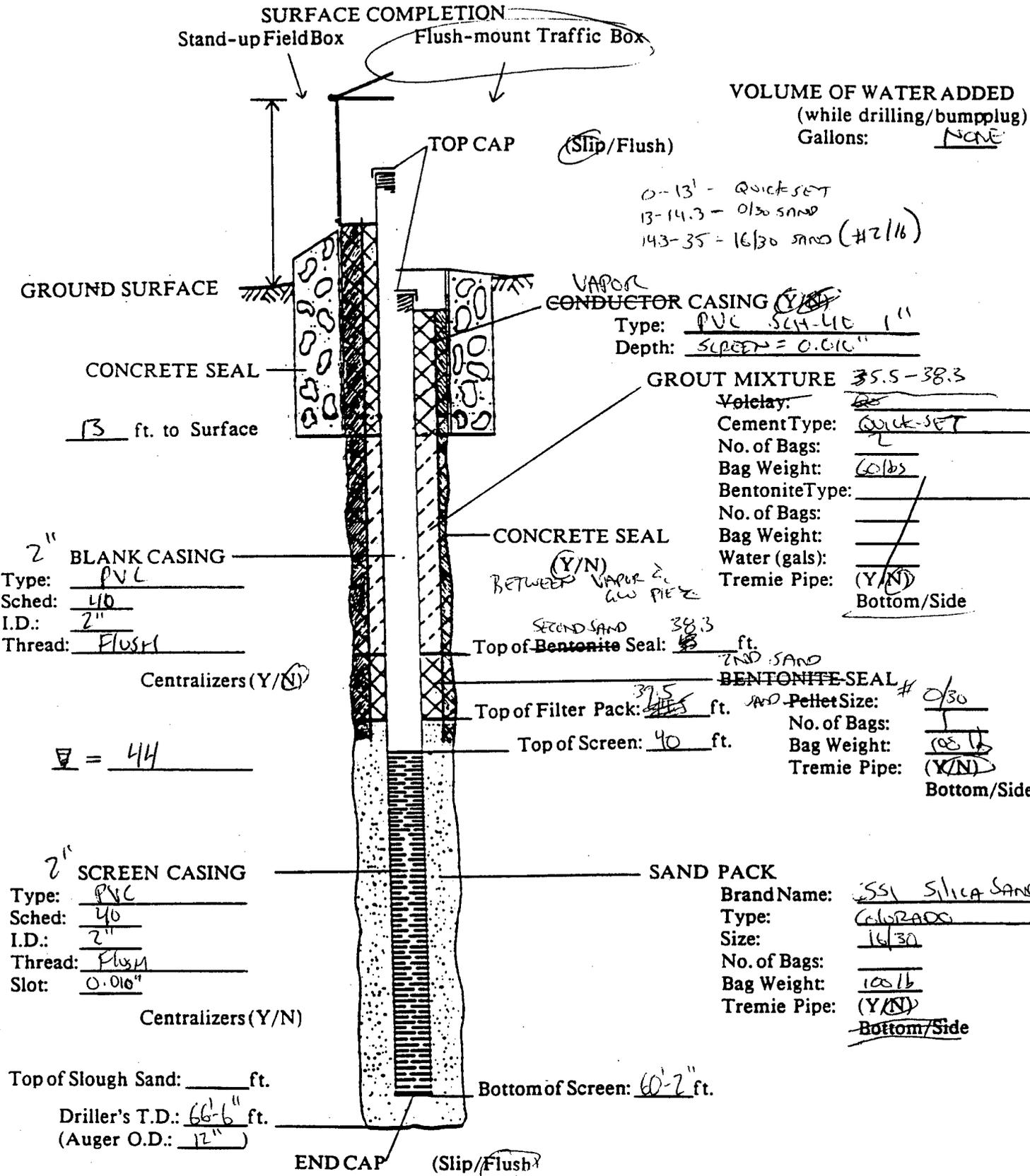
BORING DESIGNATION: PZC-2 LOGGED BY: GS MCKELVEY DATE: 7-31-95

DEPTH	n	% REC.	SAMPLE NO.	TIME	SOIL DESCRIPTION (Group Name, Group Symbol, Color, ASTM Descriptions)	LITH	WELL CONST.	DRILLING AND SAMPLER NOTES/ OVM/FID/PID (BG/R)
27.5		NA	N/A		SANDY LEAN CLAY (CL) LIGHT YELLOWISH BROWN (10YR, 6/4). <del>MAX=4mm</del> MAX=4MM D.I.A. DRY - FIRM. HOMOGENEOUS. MED. PLASTICITY.	CL	1" 0.010" PUG (L SAND)	
30.0						CL		2" BLANK PUG
32.5						CL	1" 0.010" PUG	
35.0					— CALICHE LAYER AT 3-36.5 FEET			
37.5					<del>TOP OF CALICHE LAYER AT 38'</del>			
40.0					— TOP OF CALICHE LAYER AT 40.5'			
42.5								
45.0					— OUT OF CALICHE @ 44'			
47.5					SANDY LEAN CLAY, SAME AS ABOVE	CL		
50.0								
52.5					— 51'-52' MED. HARD CALICHE LAYER.			
55.0					— TOP OF CALICHE LAYER AT <del>53'</del> 53'			
57.5					— BOTTOM AT 55'.			
60.0								
62.5					— TD=61'			
65.0					<del>CLAYE 67.5</del>			
67.5								

DEPTHS IN FEET BGS n = BLOWS/6 INCHES BG/R = BACKGROUND/READING  
 FOR BLOW COUNT CONVERSION, x + y + z (CAL. MOD. SPLIT SPOON) = (y + z)/2 (SPT)

Project Name: NELLIS AFB 2-PHASE PIEZOMETER INST.  
 Project No.: 612-001-31  
 Geologist: GS MCKENNEY  
 Drilling Co.: WEST HAZMAT DRILLING Co.

Well No.: PZC-3



VOLUME OF WATER ADDED  
 (while drilling/bumpplug)  
 Gallons: NONE

0-13' - QUICKSET  
 13-14.3 - 0/30 SAND  
 14.3-35 - 16/30 SAND (#2/16)

GROUT MIXTURE 35.5-38.3  
 Veolay: AS  
 Cement Type: QUICK-SET  
 No. of Bags: 2  
 Bag Weight: 60 lbs  
 Bentonite Type: 2  
 No. of Bags: 1  
 Bag Weight: 100 lb  
 Water (gals): 1  
 Tremie Pipe: (Y/N) Bottom/Side

Top of SECOND SAND 38.3 ft.  
 Top of BENTONITE SEAL 38.3 ft.  
 Top of FILTER PACK 39.5 ft.  
 Top of SCREEN 40 ft.  
 BENTONITE SEAL # 0/30  
 No. of Bags: 1  
 Bag Weight: 100 lb  
 Tremie Pipe: (Y/N) Bottom/Side

SAND PACK  
 Brand Name: 551 Silica Sand  
 Type: COLORADO  
 Size: 16/30  
 No. of Bags: 1  
 Bag Weight: 100 lb  
 Tremie Pipe: (Y/N) Bottom/Side

Top of Slough Sand: \_\_\_\_\_ ft.  
 Driller's T.D.: 66'-6" ft.  
 (Auger O.D.: 12")

PROJECT: NELLS APB 2-PHASE PEROMETER INST. PROJECT NO: 612-001-31

BORING DESIGNATION: <u>P2C-3</u>		LOGGED BY: <u>GS MCKELVEY</u>		DATE: <u>8-3-75</u>				
DEPTH	n	% REC.	SAMPLE NO.	TIME	SOIL DESCRIPTION (Group Name, Group Symbol, Color, ASTM Descriptions)	LITH	WELL CONST.	DRILLING AND SAMPLER NOTES/ OVM/FID/PID (BG/R)
27.5'			<u>MA</u>	<u>V/A</u>	<u>SANDY LEAN CLAY (CL) LIGHT YELLOWISH TALLOW (10yr, 6/4). MAX=8MA. DRY. HOMOGENEOUS, FIRM. MED. PLASTICITY</u>	<u>CL</u>	<u>2" BLANK GRIND 1" O.D. SLOT SCREEN</u>	
30.0'					<u>LESS CLAY, MORE SILT. MORE DENSE MATERIAL.</u>			<u>APPEAR TO BE COMING INTO HIGHER % OF CALICHE.</u>
32.5'					<u>MILD CALICHE LAYER AT 36-36.5'</u>		<u>CONCRETE</u>	<u>MOD. TOUCH DRILLING</u>
35.0'					<u>TOP OF CALICHE LAYER AT 37.5'</u>	<u>CL</u>	<u>0.085mm</u>	<u>VERY TOUGH DRILLING UP TO 2800 PSI FEED PRESSURE</u>
37.5'					<u>OUT OF LAYER AT 39'</u>			
40.0'					<u>TOP OF CALICHE LAYER</u>			
42.5'								
45.0'					<u>OUT OF CALICHE AT 44.5'</u>			
47.5'								
50.0'					<u>VERY WET</u>		<u>2" O.D. SLOT-SCREEN</u>	<u>COULD NOT knock plug OUT OF AUGER. PULLED AUGERS ON 8-2 P.M. 2' OF CALICHE PLUGGING LEAD AUGER. REMOVED AND RE-BORED HOLE TO SET CASINGS.</u>
52.5'								
55.0'								
57.5'								
60.0'								
62.5'								<u>DRILLERS lost COUNT WENT TO <del>62.5</del> 65' DEEPER THAN PLANNED.</u>
65.0'					<u>TD=66'</u>			

DEPTHS IN FEET BGS

n = BLOWS/6 INCHES

BG/R = BACKGROUND/READING

FOR BLOW COUNT CONVERSION, x + y + z (CAL. MOD. SPLIT SPOON) = (y + z)/2 (SPT)

**WELL DEVELOPMENT/SAMPLE DATA SHEET**

PROJECT: Nellis AFB 2-PHASE PIEZOMETER INJ. NUMBER: 612-001-31

WELL IDENTIFICATION: PZC-1 DATE: 8-2-95

PURPOSE: DEVELOP/SAMPLE BY: GSMckelvey WELL DEPTH: (60.16) FT (FROM T.O.C.)

PURGE EQUIPMENT: 2" BAILER / 2" SUB. PUMP -WATER LEVEL (b): (44.0) FT

SAMPLE EQUIPMENT: N/A WATER COL. (W): (15.64) FT

WELL DIAMETER (D): 12 inches PROD LEVEL (c): ( ) FT

CASING DIAMETER (d): 2 inches (PVC/ST. ST.) PROD THICKNESS (P): ( ) FT (b - c)

SCREEN: PVC/ST. ST. 2 inches TOTAL COLUMN (H): (15.64) FT (W+P)

A = (D<sup>2</sup> - d<sup>2</sup>)0.785 = 101.9 in<sup>2</sup>  
 VWA = .30(A)H/144 = 20.35 ft<sup>3</sup> VWC = d<sup>2</sup>(π)H/576 = .34 ft<sup>3</sup>

[VWA ( 20.35 ) + VWC ( .34 )] 7.48 = 29.3 gal = 1 WELL VOLUME/CASING VOLUME (C.V.)

[W.V./C.V. ( 29.3 ) gal] [ 3.5 ] = 146 gal = TOTAL PURGE VOLUME

[VWA = VOL. WATER: ANNULUS] [VWC = VOL. WATER: CASING] [DTW = DEPTH TO WATER]

TIME	DTW (Feet)	GALLONS	DISCHARGE RATE	TEMP. (°C)	Ph	EC (umhos)	WATER CHARACTERIZATION/OBSERVATIONS	IMHOFF CONE	DRAWDOWN (Feet)
1520	/	210	.75 gpm	N/A	N/A	N/A	NO SOLIDS. PALE BROWN	0.05	-
1525	/	221	1.2 gpm				NO SOLIDS. ALMOST CLEAR	0.05	-
1530	46.30	40	2.0 gpm				Clear. COLORLESS	0.00	1.8
1540	47.00	55	2.5 gpm				" "	0.00	2.50
1600	47.80	95	1.9 gpm				" "	0.00	3.38
1608	48.87	<del>110</del> 110	1.45 gpm				" "	0.00	4.37
1633	50.32	165	2.7 gpm				" "	0.00	5.82
1638	45.20	-	-				-	-	0.70

Pump off - RECHARGE (5 min)

START TIME: 1515 STOP TIME: 1633 # DRUMS FILLED: 3 1165 (gals.)

DRUM CONDITION/LOCATIONS: Moved to storage area against wall, adjacent to Bldg. # 275

TOTAL GALLONS EXTRACTED = 165 / 29.3 (W.V./C.V.) = 5.63 PURGE VOLUMES

SAMPLE NO. NONE COLLECTED METHOD N/A  
 SAMPLE NO. \_\_\_\_\_ METHOD \_\_\_\_\_  
 SAMPLE TIME: \_\_\_\_\_ WATER LEVEL: \_\_\_\_\_ (FEET)

PVC = Polyvinylchloride  
 St. St. = Stainless Steel



**WELL DEVELOPMENT/SAMPLE DATA SHEET**

PROJECT: Nellis AFB 2PHASE PERMUTATED INST. NUMBER: 612-001-31-36

WELL IDENTIFICATION: PZC-3 DATE: 8-2-95

PURPOSE: DEVELOP/SAMPLE BY: GS MUKELVEY WELL DEPTH: (59.02) FT From T.O.C.

PURGE EQUIPMENT: 2" BAILER / 2" SUB-PUMP -WATER LEVEL (b): (43.05) FT

SAMPLE EQUIPMENT: N/A WATER COL. (W): (15.97) FT

WELL DIAMETER (D): 12 inches PROD LEVEL (c): ( / ) FT

CASING DIAMETER (d): 2 inches (PVC/ST. ST.) PROD THICKNESS (P): ( / ) FT (b - c)

SCREEN: PVC/ST. ST. 2 inches TOTAL COLUMN (H): (15.97) FT (W+P)

A = (D<sup>2</sup> - d<sup>2</sup>)0.785 = 109.9 in<sup>2</sup> OVA: B/ RV

VWA = .30(A)H/144 = 3.66 ft<sup>3</sup> VWC = d<sup>2</sup>(π)H/576 = .35 ft<sup>3</sup> TIME

[VWA ( 3.66 ) + VWC ( .35 )] 7.48 = 30.00 gal = TOTAL WELL VOLUME/CASING VOLUME (C.V.)

[W.V.C.V. ( 30 ) gal] [ 3/5 ] = 150 gal = TOTAL PURGE VOLUME

[VWA = VOL. WATER: ANNULUS] [VWC = VOL. WATER: CASING] [DTW = DEPTH TO WATER]

TIME	DTW (Feet)	GALLONS	DISCHARGE RATE	TEMP. (°C)	Ph	EC (umhos)	WATER CHARACTERIZATION/OBSERVATIONS	IMHOFF CONE	DRAWDOWN (Feet)
1925	55.71	10 (40)	2 gpm	N/A	N/A	N/A	LI. BROWN TRANSPARENT	20.75	12.66
1944	58.00	65 (95)	2.9 gpm				COLORLESS - OPAQUE	0.00	14.95
2021	58.00	150	1.5 gpm				CRYSTAL CLEAR COLORLESS	0.00	14.95
2031	43.65								0.60

SDR  
RETRACT

START TIME: 1920 STOP TIME: 2021 # DRUMS FILLED: 2.5 / 150 (gals.)

DRUM CONDITION/LOCATIONS: Moved to STORAGE AREA AGAINST WALL, ADJACENT TO BLDG. # 275.

TOTAL GALLONS EXTRACTED = 150 / 830 (W.V.C.V.) = 5 PURGE VOLUMES

SAMPLE NO. NONE COLLECTED METHOD N/A

SAMPLE NO. \_\_\_\_\_ METHOD \_\_\_\_\_

SAMPLE NO. \_\_\_\_\_ METHOD \_\_\_\_\_

SAMPLE NO. \_\_\_\_\_ METHOD \_\_\_\_\_

SAMPLE TIME: \_\_\_\_\_ WATER LEVEL: \_\_\_\_\_ (FEET)

PVC = Polyvinylchloride  
St. St. = Stainless Steel

STARTED w/ 35 gallons BAILED INTO DRUM



**APPENDIX B**  
**Field Data Sheets**



SV Radius

Soil Vapor Radius of Influence - Data Sheet

Date: August 7 to 11, 1995  
 Site: Nellis Air Force Base, Site 44  
 Well Being Tested: MW- 7

Sampler(s): RADIAN

Date/Time	Elapsed Time (min)	Piezometer ID						Corresponding Barometric Pressure	Piezometer ID				
		P1		P2		P3			P1	P2	P3		
		Distance From Test Well							Distance From Test Well				
		10 E	25 E	50 ENE	10 E	25 E	50 ENE		10 E	25 E	50 ENE		
		Reading	Reading	Reading	Reading	Reading	Reading	Reading	Reading	Reading	Reading	Reading	Reading
8/7 0945	0	10	25	50	149	0	0	0	0	0	0	0	0
1130	105	0.6	0.6	0.5		0.575	0.575	0.575	0.575	0.575	0.575	0.475	0.475
1300	195	0.65	0.6	0.5		0.605	0.605	0.555	0.555	0.455	0.455	0.455	0.455
1645	420	0.6	0.5	0.3		0.49	0.49	0.39	0.39	0.19	0.19	0.19	0.19
8/8 0730	1305	0.7	0.65	0.5		0.71	0.71	0.66	0.66	0.51	0.51	0.51	0.51
1030	1485	0.75	0.7	0.55		0.775	0.775	0.725	0.725	0.575	0.575	0.575	0.575
1505	1760	0.7	0.65	0.55		0.635	0.635	0.585	0.585	0.485	0.485	0.485	0.485
8/9 0700	2715	0.8	0.7	0.6		0.75	0.75	0.65	0.65	0.55	0.55	0.55	0.55
1110	2965	0.7	0.65	0.5		0.66	0.66	0.61	0.61	0.46	0.46	0.46	0.46
1600	3255	0.75	0.65	0.5		0.57	0.57	0.47	0.47	0.32	0.32	0.32	0.32
8/10 0715	4170	0.8	0.7	0.65		0.665	0.665	0.565	0.565	0.515	0.515	0.515	0.515
1205	4460	0.8	0.71	0.65		0.7	0.7	0.61	0.61	0.55	0.55	0.55	0.55
1540	4675	0.8	0.71	0.62		0.655	0.655	0.565	0.565	0.475	0.475	0.475	0.475
8/11 0710	5605	0.85	0.8	0.6		0.82	0.82	0.77	0.77	0.57	0.57	0.57	0.57
1135	5870	0.75	0.75	0.65		0.755	0.755	0.755	0.755	0.655	0.655	0.655	0.655
1445	6060	0.8	0.75	0.6		0.765	0.765	0.715	0.715	0.565	0.565	0.565	0.565
1615	6150	0	0	0		-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05

Sheet 2 Soil Vapor Radius of Influence, Sheet 3 Groundwater Radius of Influence

GW Radius

Groundwater Radius of Influence - Data Sheet

Date: August 7 to 11, 1995  
 Site: Nellis AFB, Site 44  
 Well Being Tested: MW-7  
 Sampler(s): RADIAN

Date/Time	Elapsed Time (min)	Monitoring Well/Piezometer ID				Corresp. Barometric Pressure in Hg*	Monitoring Well/Piezometer ID						
		P1	P2	P3	MW-15		P1	P2	P3	MW-15			
		Distance From Test Well					Distance From Test Well						
		10 E	25 E	50 ENE	85 E	10 E	25 E	50 ENE	85 E				
		Water Level Reading (ft)				Water Level Drawdown (ft)							
	Distance (ft)	10	25	50	85	10	25	50	85				
8/7	0945	44.5	44.4	44.9	45.17	0	0	0	0				
	1130	44.55	44.76	44.82	45.32	0.05	0.36	-0.08	0.15				
	1300	44.56	44.8	44.86	45.35	0.06	0.4	-0.04	0.18				
	1645	44.61	44.81	44.93	45.4	0.11	0.41	0.03	0.23				
8/8	0730	44.47	44.75	44.92	45.4	-0.03	0.35	0.02	0.23				
	1030	44.4	44.7	44.91	46.2	-0.1	0.3	0.01	1.03				
	1505	44.34	44.6	44.81	45.3	-0.16	0.2	-0.09	0.13				
8/9	0700	44.23	44.5	44.72	45.25	-0.27	0.1	-0.18	0.08				
	1110	44.18	44.47	44.69	45.22	-0.32	0.07	-0.21	0.05				
	1600	44.1	44.4	44.62	45.16	-0.4	0	-0.28	-0.01				
8/10	0715	44.11	44.36	44.63	45.16	-0.39	-0.04	-0.27	-0.01				
	1205	44.07	44.36	44.61	45.15	-0.43	-0.04	-0.29	-0.02				
	1540	44.04	44.34	44.59	45.13	-0.46	-0.06	-0.31	-0.04				
8/11	0710	44.08	44.35	44.60	45.15	-0.42	-0.05	-0.3	-0.02				
	1135	44.02	44.30	44.57	45.11	-0.48	-0.1	-0.33	-0.06				
	1445	43.99	44.28	44.54	45.10	-0.51	-0.12	-0.36	-0.07				
	1615	43.76	44.13	44.46	45.04	-0.74	-0.27	-0.44	-0.13				

Barometric Pressure taken from the nearest hour provided by base meteorological data.

SV Data

SUMMARY OF SOIL VAPOR DATA

SUMMARY OF CONTAMINANT REMOVAL RATES

Sample ID	Date/Time	Elapsed Time	Conc. in PPBV			Total Flowrate (scfm)	Formation Flowrate (scfm)	Dilution Factor	TCE		Hexane		Decane		Chloroform		PCE		
			TCE	Hexane	Decane				Chloroform	PCE	Extraction Rate lb/min	Cum Total lbs	Extraction Rate lb/min	Cum Total lbs	Extraction Rate lb/min	Cum Total lbs	Extraction Rate lb/min	Cum Total lbs	Extraction Rate lb/min
Molecular Weight			131.4	86.18	142.28	119.39	185.85												
NEL071000SV1	0607/0830	0	4400	130	0	43	210	1.00	0.00012164	0	3.594E-06	0	0	1.1888E-06	0	5.8058E-06	0		
NEL071330UV1	0807/1630	225	5500	280	0	47	340	1.00	0.00016536	0.0372062	8.418E-06	0.001894	0	1.4131E-06	0.00031794	1.0222E-05	0.0023		
NEL071600UV2	0807/1600	375	6600	610	0	53	470	1.00	0.00021668	0.0658593	2.003E-05	0.004027	0	1.74E-06	0.00055443	1.543E-05	0.004224		
NEL080930UV3	0809/0930	1425	5200	710	0	48	450	1.00	0.00016173	0.2645257	2.208E-05	0.026135	0	1.4929E-06	0.00225171	1.3986E-05	0.019673		
NEL081200UV4	0808/1200	1575	5500	180	0	50	500	1.00	0.00017486	0.2897705	5.723E-06	0.02822	0	1.5897E-06	0.0024829	1.5897E-05	0.021815		
NEL081530UV5	0808/1530	1785	6300	190	0	52	610	1.00	0.00020683	0.3296488	6.236E-06	0.029476	1.4445E-05	1.7072E-06	0.00282907	2.0026E-05	0.025687		
NEL090715UV6	0809/0715	2730	7700	0	0	58	810	1.00	0.00024481	0.5492489	3.017E-06	0.032423	0	1.944E-06	0.00450701	2.5753E-05	0.047317		
NEL091600UV7	0809/1600	3255	7500	90	0	57	780	1.00	0.00025141	0.879507	1.346E-05	0.033215	0	1.9107E-06	0.00549264	2.6147E-05	0.060941		
NEL101230UV8	0810/1230	4485	7900	410	240	61	820	1.00	0.00025936	0.9876307	8.626E-06	0.043349	7.8793E-06	0.013188	0.00789936	2.6921E-05	0.083578		
NEL111430UV9	0811/1430	6045	7700	260	170	63	820	1.00	0.00025545	1.3891852	8.626E-06	0.060576	5.6398E-06	0.023733	0.01109169	2.7204E-05	0.135795		
NEL111600SV2	0811/1600	6135	5700	80	90	54	610	1.00	0.0001891	2.344E-10			2.9858E-06	1.7915E-06	2.0237E-05				
EFFLUENT DATA																			
MW269 - 0327/1630 - EV	0327/1630	90	18																
MW269 - 0328/1730 - EV	0328/1730	1590	ND																
MW269 - 0329/1740 - EV	0329/1740	3035	14																
MW269 - 0330/1715 - EV	0330/1715	4445	ND																
Average Removal Rate of TCE in lbs/min																0.00022981	Average Removal Rate of Total VOCs in lbs/min		0.000268
Est. Total LBS of VOC Removed from the Vapor Phase =																1.620381			

GW Data

SUMMARY OF GROUNDWATER DATA - 2Phase Extraction Pilot Study - MW-269 Travis AFB

Contaminant	Sample ID									
	NEL071330UW1	NEL071600UW2	NEL080930UW3	NEL081200UW4	NEL081530UW5	NEL090700UW6	NEL091540UW7	NEL101230UW8	NEL111400UW9	NEL111630GW2 (post test)
Acetone	0	0	0	0	0	0	0	0	0	0
Benzene	0.238	0	0	0	0	0	0	0	0	0
Bromodichloromethane	0.171	0.106	0.101	0.0817	0.0847	0.0919	0	0.0981	0.167	0
2-Butanone (MEK)	0	0	0	0	0	0	0	0	0	0
Chlorobenzene	0.144	0	0	0	0	0	0	0	0	0
Chloroform	0.506	1.31	1.42	1.07	1.3	1.11	1.17	1.21	1.35	0.361
Chloromethane	0	0	0	0	0	0	0	0	0	0
1,3-Dichlorobenzene	0.38	0	0	0	0	0	0	0	0	0
1,1-Dichloroethane	1.19	0	0	0	0	0	0	0	0	0
1,1-Dichloroethene	0.331	0	0	0	0	0	0	0	0	0
cis-1,2-Dichloroethene	60.9	0.951	0.988	0.678	0.814	0.673	0.696	0.617	0.59	36.8
trans-1,2-Dichloroethene	0.257	0	0	0	0	0	0	0	0	0
2-Hexanone	0	0	0	0	0	0	0	0	0	0
Tetrachloroethene	12.6	3.49	6.41	5.08	6.19	5.9	6.48	5.64	0.812	0
Toluene	0.153	0	0.216	0	0	0	0	0	7.41	13.2
Trichloroethene	1760	50.9	64.1	51.5	61.4	57.1	63.5	55.6	69.5	647
Trichlorofluoromethane	0.886	0	0	0	0	0	0	0	0	0
1,1,2-trichlorotrifluoroethane	2.21	0	0	0	0	0	0	0	0	0
Total ug/l	1839.966	56.5786	72.929	58.4097	69.7887	64.8749	71.846	63.1651	79.829	699.361
Startup	732.62 = Time	155928 = Water Meter Reading	1425	1575	1785	2730	3255	4485	6045	NA
Elapsed Time - Sample (min)	NA	733.95	739.05	756.76	762.15	777.17	786.16	806.26	832.72	NA
System Clock (hours)*	NA	79.8	385.8	1448.4	1771.8	2673	3212.4	4418.4	6006	NA
Elapsed Time - System (min)	NA	156726	156690	158795	159255	160698	161464	163466	166064	NA
Water Meter Reading (gal)	NA	2.481203	1.9751166	2.0011148	1.979426	1.8777514	1.723322	1.706047	1.687646	NA
Water Extraction Rate (gpm)	1.687646	Water Extraction Rate GPM * 3.785 L/GAL * 1E-6 g/gal * 1/454 Lb/g * Conc. in ug/L								
Ave. Extraction Rate (gpm)	1.05E-06	8.76E-07	1.069E-06	8.5E-07	9.612E-07	8.495E-07	9.12E-07	7.91E-07	9.78E-07	
Contaminant Removal Rate =	0.000237	0.0003663	0.0014912	0.001619	0.0018205	0.00262329	0.003102	0.004075	0.0056	
TCE Removal Rate in GW lbs/min	1.17E-06	9.966E-07	1.217E-06	9.64E-07	1.093E-06	9.6518E-07	1.03E-06	8.98E-07	1.12E-06	
TCE Removed from GW lbs	0.000263	0.0004128	0.0016904	0.001835	0.0020644	0.00297647	0.003518	0.004623	0.006376	
VOC Removal Rate in GW lbs/min										
VOC Removed from GW lbs										
% Stripping (Based on TCE)	89%	to	97%							

\* Elapsed Time = 0 at 9:45 = 732.62 on the system clock; @ T = 0, Water Meter = 155928

**APPENDIX C**

**Data Quality Summary with Analytical Data**

## QUALITY SUMMARY

This document summarizes results obtained from the quality assurance/quality control (QA/QC) activities performed for the Technology Evaluation Report prepared for the two-phase-extraction pilot study conducted at Site 44 on Nellis Air Force Base (AFB) in Los Vegas, NV.

The primary goals of the QA/QC activities were to:

- Ensure that data of known quality were obtained.
- Minimize transcription and reporting errors.
- Identify any data use limitations and communicate these to the data users.

These goals were accomplished by comparing three types of QC samples, blanks, spikes and duplicates, with the laboratory and method specifications for precision and accuracy and performing a complete review of analytical reports, chain of custody documentation and holding time compliance.

Groundwater, carbon effluent, soil and vapor samples were collected from the two-phase extraction system at Site 44 on Nellis AFB on August 3 and August 7 through August 11, 1995. All groundwater, carbon effluent, and soil samples were analyzed by Radian Analytical Services in Summit Park, TX. All vapor analyses were performed by MICROSEEPS at the University of Pittsburgh Applied Research Center in Pittsburgh, PA. All analyses were performed as requested. All holding time requirements were met. All chain of custody records were well documented and completed.

One systematic data quality issue was identified during this review. Low level acetone and 2-butanone contamination was identified in the SW8260 trip blank. As a result, four SW8260 results may not be used to document extraction efficiency at Site 44 at Nellis AFB.

Due to this contamination, the acetone results from samples NEL071500TW1, NEL081200VW4, and NEL111400UW9 and the 2-butanone result from sample NEL111400UW9 may not be used.

Table 1 lists the sample ID's and analyses performed for this project. One trip blank was analyzed in addition to the field samples listed in Table 1. Field samples with a "D" included in the sample name are field duplicate samples. Four field duplicate QC samples were collected and analyzed.

The assessment of the QC sample results associated with the volatiles analyses, EPA methods 8260, 8260A and MICROSEEPS and the analyses for total hydrocarbons, cyanide, pH, total dissolved solids, total suspended solids, and metals, EPA methods 418.1, 335.3, 150.1, 160.1, 160.2, and 200.7, respectively, follow Table 1. Copies of the analytical results are included at the end of this document.

**Table 1**  
**Sample Summary**

Sample Names	Dates Collected	Analyses Performed
NAFB-08-001	08/03/95	Volatiles using SW8260
NEL071330VW1	08/07/95	Volatiles using SW8260
NEL071500TW1	08/07/95	Volatiles using SW8260, Total Hydrocarbons using 418.1, Cyanide using 335.3, pH using 150.1, Total Dissolved Solids using 160.1, Total Suspended Solids using 160.2, and Metals using 200.7
NEL071600VW2	08/07/95	Volatiles using SW8260
NEL071600VWD	08/07/95	Volatiles using SW8260
NEL080930VW3	08/07/95	Volatiles using SW8260
NEL081200VW4	08/08/95	Volatiles using SW8260
NEL081530VW5	08/08/95	Volatiles using SW8260
NEL090700UW6	08/09/95	Volatiles using SW8260
NEL091540UW7	08/09/95	Volatiles using SW8260
NEL091540UWD2	08/09/95	Volatiles using SW8260
NEL101230VW8	08/10/95	Volatiles using SW8260
NEL111400UW9	08/11/95	Volatiles using SW8260
NEL111630GW2	08/11/95	Volatiles using SW8260
NEL081200S1	08/08/95	Volatiles using SW8260A and % moisture
NEL071000SV1	08/07/95	Volatiles using MICROSEEPS
NEL071330UV1	08/07/95	Volatiles using MICROSEEPS
NEL071600UV2	08/07/95	Volatiles using MICROSEEPS
NEL080930UV3	08/08/95	Volatiles using MICROSEEPS
NEL08930UVD	08/08/95	Volatiles using MICROSEEPS
NEL081200UV4	08/08/95	Volatiles using MICROSEEPS
NEL081530UV5	08/08/95	Volatiles using MICROSEEPS
NEL081530TV1	08/08/95	Volatiles using MICROSEEPS
NEL090715UV6	08/09/95	Volatiles using MICROSEEPS
NEL091600UV7	08/09/95	Volatiles using MICROSEEPS
NEL091600UVD2	08/09/95	Volatiles using MICROSEEPS
NEL101230UV8	08/10/95	Volatiles using MICROSEEPS
NEL111430UV9	08/11/95	Volatiles using MICROSEEPS
NEL111600SV2	08/11/95	Volatiles using MICROSEEPS

### **Volatiles using 8260, 8260A, and MICROSEEPS**

Acetone and 2-butanone (also known as methyl ethyl ketone {MEK}) were detected at 11.8 and 3.98 ug/L, respectively, in the one trip blank analyzed using EPA method SW8260. Any acetone and 2-butanone detected in the field samples within 5 times the trip blank concentrations must be qualified as not detected and attributed to blank contamination. As a result, the acetone results from samples NEL071500TW1, NEL081200VW4, and NEL111400UW9 and the 2-butanone result from sample NEL111400UW9 should be considered not detected. These results may not be used to evaluate two-phase extraction efficiency. Acetone and 2-butanone were not detected in the 8260A soil sample or in any of the MICROSEEPS vapor samples. These samples were not effected by the contamination.

Trichloroethene was quantitated outside the calibration range of the analytical instrument in groundwater sample NEL111400UW9 analyzed using EPA method SW8260. This result may be used to document two-phase extraction efficiency, but should be considered an estimated value.

Field duplicate results for methods SW8260 and MICROSEEPS indicate that overall precision of the sampling and analytical techniques were well within method and laboratory limits. However, the hexane results from the two MICROSEEPS field duplicate pairs indicate that vapor hexane results have increased variability. One field duplicate pair had one not detected result and the other had a relative percent difference (%RPD) of 146%. As a result, the hexane results from the MICROSEEPS analyses may be used to document two-phase extraction efficiency, but should be considered more variable than other sample results. The other SW8260 and MICROSEEPS field duplicate %RPDs ranged from 0% to 24%, indicating precision for the other analytes were well within method and laboratory limits.

The percent recoveries (%Rs) for acetone from one laboratory control spike/laboratory control spike duplicate (LCS/LCSD) pair were 224% and 235%,

respectively. These recoveries exceed laboratory and method quality control (QC) criteria for LCS/LCSD recoveries. Acetone was not detected in any of the field samples analyzed in association with this LCS/LCSD and no sample data was impacted by the high LCS/LCSD recovery for acetone.

All other 8260, 8260A and MICROSEEPS data are valid and accuracy and precision are within the acceptance criteria of the laboratory and analytical method.

### **Total Hydrocarbons using 418.1**

No QA/QC problems were discovered for method 418.1. All data are valid and accuracy and precision are within laboratory and method acceptance criteria.

### **Cyanide using 335.3**

No QA/QC problems were discovered for method 335.3. All data are valid and accuracy and precision are within laboratory and method acceptance criteria.

### **Total Dissolved and Total Suspended Solids using 160.1 and 160.2**

No QA/QC problems were discovered for methods 160.1 and 160.2. All data are valid and accuracy and precision are within laboratory and method acceptance criteria.

### **Metals using 200.7**

No QA/QC problems were discovered for method 200.7. All data are valid and accuracy and precision are within laboratory and method acceptance criteria.

08/18/95 16:15:04

RESULTS SUMMARY

Work Order # 9508115  
Page 4

Method Volatile Organics SM8260  
Test Code 826SWANA

Project Sample ID:	NAFB-08-001	NAFB-08-001	NAFB-08-001	Conc.	DL	Conc.	DL	Conc.	DL
Lab ID:	9508115-01A	9508115-01B	9508115-01B	ND	0.641	ND	69.0	ND	69.0
File ID:	(F)810533	(F)814524	(F)814524	0.238	0.194	ND	3.66	ND	3.66
Date Collected:	08/03/95	08/03/95	08/03/95	0.171	0.0491	ND	1.39	ND	1.39
Date Prepared:				ND	0.0776	ND	4.08	ND	4.08
Date Analyzed:	08/11/95 11:46:00	08/11/95 03:32:00	08/15/95 03:32:00	ND	0.106	ND	1.50	ND	1.50
Dilution Factor:	1	30	30	ND	3.11	ND	38.7	ND	38.7
Matrix:	Water	Water	Water	ND	0.125	ND	5.70	ND	5.70
Units:	ug/L	ug/L	ug/L	ND	0.127	ND	3.93	ND	3.93
Report as:	received	received	received	0.144	0.101	ND	6.15	ND	6.15
Column:				ND	0.130	ND	2.69	ND	2.69
Analyte				5.06	0.0709	5.56	2.96	5.56	2.96
Acetone	ND	0.641	ND	ND	0.119	ND	2.68	ND	2.68
Benzene	0.238	0.194	ND	ND	0.0554	ND	2.61	ND	2.61
Bromodichloromethane	0.171	0.0491	ND	< DL	0.102	ND	5.46	ND	5.46
Bromoform	ND	0.0776	ND	0.380	0.110	< DL	6.84	< DL	6.84
Bromomethane	ND	0.106	ND	ND	0.116	ND	6.48	ND	6.48
2-Butanone (MEK)	ND	3.11	ND	1.19	0.0794	ND	1.94	ND	1.94
Carbon disulfide	ND	0.125	ND	ND	0.0454	ND	1.44	ND	1.44
Carbon tetrachloride	ND	0.127	ND	0.331	0.148	ND	6.36	ND	6.36
Chlorobenzene	0.144	0.101	ND	53.4	0.0485	ND	3.12	ND	3.12
Chloroethane	ND	0.130	ND						
Chloroform	5.06	0.0709	5.56						
Chloromethane	ND	0.119	ND						
Dibromochloromethane	ND	0.0554	ND						
1,2-Dichlorobenzene	< DL	0.102	ND						
1,3-Dichlorobenzene	0.380	0.110	< DL						
1,4-Dichlorobenzene	ND	0.116	ND						
1,1-Dichloroethane	1.19	0.0794	ND						
1,2-Dichloroethane	ND	0.0454	ND						
1,1-Dichloroethene	0.331	0.148	ND						
cis-1,2-Dichloroethene	53.4	0.0485	60.9						

Project Sample ID:	NAFB-08-001	NAFB-08-001	NAFB-08-001	Conc.	DL	Analyte
Lab ID:	9508115-01A	9508115-01B	9508115-01B	ND	6.36	trans-1,2-Dichloroethene
File ID:	F0810533	G0814524	G0814524	ND	1.32	1,2-Dichloropropane
Date Collected:	08/03/95	08/03/95	08/03/95	ND	3.48	cis-1,3-Dichloropropene
Date Prepared:				ND	2.17	trans-1,3-Dichloropropene
Date Analyzed:	08/11/95 11:46:00	08/15/95 03:32:00	08/15/95 03:32:00	ND	7.38	Ethylbenzene
Dilution Factor:	1	30	30	ND	10.4	2-Hexanone
Matrix:	Water	Water	Water	ND	9.48	4-Methyl-2-pentanone (MIBK)
Units:	ug/L	ug/L	ug/L	< DL	12.7	Methylene chloride
Report as:	received	received	received	ND	5.52	Styrene
Column:				ND	2.12	1,1,2,2-Tetrachloroethane
Analyte	Conc.	DL	Conc.	DL	Conc.	DL
	0.257	0.118	0.257	0.118	12.6	12.6
	ND	0.0763	ND	0.0763	0.153	0.153
	ND	0.0860	ND	0.0860	ND	ND
	ND	0.0988	ND	0.0988	0.330	0.330
	< DL	0.139	< DL	0.139	512 ER	512 ER
	ND	0.431	ND	0.431	0.886	0.886
	ND	0.130	ND	0.130	2.21	2.21
	< DL	0.426	< DL	0.426	ND	ND
	ND	0.0811	ND	0.0811	ND	ND
	ND	0.152	ND	0.152	ND	ND
	12.6	0.179	12.6	0.179	ND	ND
	0.153	0.0880	0.153	0.0880	ND	ND
	ND	0.0980	ND	0.0980	ND	ND
	0.330	0.0855	0.330	0.0855	1760	1760
	512 ER	0.100	512 ER	0.100	3.00	3.00
	0.886	0.172	0.886	0.172	< DL	< DL
	2.21	0.148	2.21	0.148	ND	ND
	ND	0.176	ND	0.176	ND	ND
	ND	0.159	ND	0.159	ND	ND
	< DL	0.248	< DL	0.248	ND	ND
					16.6	16.6

08/18/95 16:15:04

Method Volatile Organics SW8260  
Test Code 826SWANA

RESULTS SUMMARY (Cont'd)

Work Order # 9508115  
Page 6

Project Sample ID:	NAFB-08-001	NAFB-08-001	
Lab ID:	9508115-01A	9508115-01B	
File ID:	F0810533	G0814524	
Date Collected:	08/03/95	08/03/95	
Date Prepared:			
Date Analyzed:	08/11/95 11:46:00	08/15/95 03:32:00	
Dilution Factor:	1	30	
Matrix:	Water	Water	
Units:	ug/L	ug/L	
Report as:	received	received	
Column:			
Analyte	Conc. DL	Conc. DL	Conc. DL
o-Xylene	ND 0.107	ND 6.21	

Surrogate(s)	Recovery %	Recovery %	Recovery %
1,4-Bromofluorobenzene	93	100	
1,2-Dichloroethane-d4	114	90	
Toluene-d8	99	99	

RESULTS SUMMARY

Project Sample ID:	NELO71330W1	NELO71600W2	NELO71600WD	NEL080930W3
Lab ID:	9508187-01A	9508187-03A	9508187-04A	9508187-05A
File ID:	G0814544	G0814545	G0814546	G0814547
Date Collected:	08/07/95	08/07/95	08/07/95	08/08/95
Date Prepared:				
Date Analyzed:	08/15/95 13:41:00	08/15/95 14:07:00	08/15/95 14:32:00	08/15/95 14:56:00
Dilution Factor:	1	1	1	1
Matrix:	Water	Water	Water	Water
Units:	ug/L	ug/L	ug/L	ug/L
Report as:	received	received	received	received
Column:				
Analyte	Conc.	Conc.	Conc.	Conc.
	DL	DL	DL	DL
Acetone	< DL	< DL	< DL	ND
Benzene	ND	< DL	< DL	ND
Bromodichloromethane	0.0876	0.106	0.103	0.101
Bromoform	ND	ND	ND	ND
Bromomethane	ND	ND	ND	ND
2-Butanone(MEK)	ND	ND	ND	ND
Carbon disulfide	ND	ND	ND	ND
Carbon tetrachloride	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND
Chloroethane	ND	ND	ND	ND
Chloroform	1.15	1.31	1.04	1.42
Chloromethane	ND	ND	ND	ND
Dibromochloromethane	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	ND
1,3-Dichlorobenzene	ND	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND
1,1-Dichloroethene	ND	< DL	ND	ND
cis-1,2-Dichloroethene	0.951	0.980	0.768	0.898
	DL	DL	DL	DL
	2.30	2.30	2.30	2.30
	0.122	0.122	0.122	0.122
	0.0462	0.0462	0.0462	0.0462
	0.136	0.136	0.136	0.136
	0.0500	0.0500	0.0500	0.0500
	1.29	1.29	1.29	1.29
	0.190	0.190	0.190	0.190
	0.131	0.131	0.131	0.131
	0.205	0.205	0.205	0.205
	0.0898	0.0898	0.0898	0.0898
	0.0985	0.0985	0.0985	0.0985
	0.0893	0.0893	0.0893	0.0893
	0.0870	0.0870	0.0870	0.0870
	0.182	0.182	0.182	0.182
	0.228	0.228	0.228	0.228
	0.216	0.216	0.216	0.216
	0.0646	0.0646	0.0646	0.0646
	0.0481	0.0481	0.0481	0.0481
	0.212	0.212	0.212	0.212
	0.104	0.104	0.104	0.104

Project Sample ID:	NELO71330W1	NELO71600W2	NELO71600W4D	NELO80930W43
Lab ID:	9508187-01A	9508187-03A	9508187-04A	9508187-05A
File ID:	G0814544	G0814545	G0814546	G0814547
Date Collected:	08/07/95	08/07/95	08/07/95	08/08/95
Date Prepared:				
Date Analyzed:	08/15/95 13:41:00	08/15/95 14:07:00	08/15/95 14:32:00	08/15/95 14:56:00
Dilution Factor:	1	1	1	1
Matrix:	Water	Water	Water	Water
Units:	ug/L	ug/L	ug/L	ug/L
Report as:	received	received	received	received
Column:				
Analyte	Conc.	Conc.	Conc.	Conc.
	DL	DL	DL	DL
trans-1,2-Dichloroethene	ND	ND	ND	ND
1,2-Dichloropropane	ND	ND	ND	ND
cis-1,3-Dichloropropene	ND	ND	ND	ND
trans-1,3-Dichloropropene	ND	ND	ND	ND
Ethylbenzene	ND	< DL	< DL	ND
2-Hexanone	ND	ND	ND	ND
4-Methyl-2-pentanone (MIBK)	ND	ND	ND	ND
Methylene chloride	< DL	< DL	< DL	< DL
Styrene	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND
Tetrachloroethene	3.49	4.27	4.19	6.41
Toluene	< DL	0.216	< DL	< DL
1,1,1-Trichloroethane	ND	0.163	0.163	0.163
1,1,2-Trichloroethane	ND	0.120	0.120	0.120
Trichloroethene	ND	0.0678	0.0678	0.0678
Trichlorofluoromethane	50.9	0.197	0.197	64.1
1,1,2-Trichlorotrifluoroethane	ND	0.0999	0.0999	0.0999
Vinyl acetate	ND	0.332	0.332	0.332
Vinyl chloride	< DL	0.381	0.381	0.381
m&p-Xylene	ND	0.0697	0.0697	0.0697
	< DL	0.554	0.554	0.554

08/18/95 16:00:25

RESULTS SUMMARY (Cont'd)

Work Order # 9508187

Page 6

Method Volatile Organics SM8260

Test Code 826SWANA

Project Sample ID:	NELO71330W1	NELO71600W2	NELO71600WVD	NELO80930WV3
Lab ID:	9508187-01A	9508187-03A	9508187-04A	9508187-05A
File ID:	G0814544	G0814545	G0814546	G0814547
Date Collected:	08/07/95	08/07/95	08/07/95	08/08/95
Date Prepared:				
Date Analyzed:	08/15/95 13:41:00	08/15/95 14:07:00	08/15/95 14:32:00	08/15/95 14:56:00
Dilution Factor:	1	1	1	1
Matrix:	Water	Water	Water	Water
Units:	ug/L	ug/L	ug/L	ug/L
Report as:	received	received	received	received
Column:				
Analyte	Conc. DL	Conc. DL	Conc. DL	Conc. DL
o-Xylene	< DL 0.207	< DL 0.207	< DL 0.207	ND 0.207

Surrogate(s)	Recovery %	Recovery %	Recovery %
1,4-Bromofluorobenzene	99	95	100
1,2-Dichloroethane-d4	96	101	100
Toluene-d8	98	99	98

Method Volatile Organics Sw8260  
Test Code 826SWANA

Project Sample ID:	NEL081200VM4	NEL081530VM5	Conc.	DL	Conc.	DL
Lab ID:	9508187-07A	9508187-08A	< DL	2.30	< DL	2.30
File ID:	G0814548	G0814549	< DL	0.122	< DL	0.122
Date Collected:	08/08/95	08/08/95	0.0817	0.0462	0.0847	0.0462
Date Prepared:			ND	0.136	ND	0.136
Date Analyzed:	08/15/95 15:21:00	08/15/95 15:45:00	ND	0.0500	ND	0.0500
Dilution Factor:	1	1	ND	1.29	ND	1.29
Matrix:	Water	Water	ND	0.190	ND	0.190
Units:	ug/L	ug/L	ND	0.131	ND	0.131
Report as:	received	received	ND	0.205	ND	0.205
Column:			ND	0.0898	ND	0.0898
Analyte			1.07	0.0985	1.30	0.0985
Acetone	2.80	2.30	ND	0.0893	ND	0.0893
Benzene	< DL	0.122	ND	0.0870	ND	0.0870
Bromodichloromethane	0.0817	0.0462	ND	0.182	ND	0.182
Bromoform	ND	0.136	ND	0.228	ND	0.228
Bromomethane	ND	0.0500	ND	0.216	ND	0.216
2-Butanone(MEK)	ND	1.29	ND	0.0646	ND	0.0646
Carbon disulfide	ND	0.190	ND	0.0481	ND	0.0481
Carbon tetrachloride	ND	0.131	ND	0.212	ND	0.212
Chlorobenzene	ND	0.205	ND	0.104	ND	0.104
Chloroethane	ND	0.0898	ND		ND	
Chloroform	1.07	0.0985	ND		ND	
Chloromethane	ND	0.0893	ND		ND	
Dibromochloromethane	ND	0.0870	ND		ND	
1,2-Dichlorobenzene	ND	0.182	ND		ND	
1,3-Dichlorobenzene	ND	0.228	ND		ND	
1,4-Dichlorobenzene	ND	0.216	ND		ND	
1,1-Dichloroethane	ND	0.0646	ND		ND	
1,2-Dichloroethane	ND	0.0481	ND		ND	
1,1-Dichloroethene	ND	0.212	ND		ND	
cis-1,2-Dichloroethene	0.678	0.104	0.814		0.814	

Project Sample ID:	NEL081200W46	NEL081530W5		
Lab ID:	9508187-07A	9508187-08A		
File ID:	G0814548	G0814549		
Date Collected:	08/08/95	08/08/95		
Date Prepared:				
Date Analyzed:	08/15/95 15:21:00	08/15/95 15:45:00		
Dilution Factor:	1	1		
Matrix:	Water	Water		
Units:	ug/L	ug/L		
Report as:	received	received		
Column:				
Analyte	Conc.	Conc.	DL	DL
trans-1,2-Dichloroethene	ND	ND	0.212	0.212
1,2-Dichloropropane	ND	ND	0.0440	0.0440
cis-1,3-Dichloropropene	ND	ND	0.116	0.116
trans-1,3-Dichloropropene	ND	ND	0.0724	0.0724
Ethylbenzene	ND	ND	0.246	0.246
2-Hexanone	ND	ND	0.347	0.347
4-Methyl-2-pentanone(MIBK)	ND	ND	0.316	0.316
Methylene chloride	< DL	< DL	0.423	0.423
Styrene	ND	ND	0.184	0.184
1,1,2,2-Tetrachloroethane	ND	ND	0.0708	0.0708
Tetrachloroethene	5.08	6.19	0.420	0.420
Toluene	< DL	< DL	0.163	0.163
1,1,1-Trichloroethane	ND	ND	0.120	0.120
1,1,2-Trichloroethane	ND	ND	0.0678	0.0678
Trichloroethene	51.5	61.4	0.197	0.197
Trichlorofluoromethane	< DL	ND	0.0999	0.0999
1,1,2-Trichlorotrifluoroethane	ND	ND	0.332	0.332
Vinyl acetate	ND	ND	0.381	0.381
Vinyl chloride	ND	ND	0.0697	0.0697
m&p-Xylene	< DL	< DL	0.554	0.554

Method Volatile Organics SW8260  
Test Code 826SWANA

Project Sample ID:	NEL081200VM4	NEL081530VM5	
Lab ID:	9508187-07A	9508187-08A	
File ID:	G0814548	G0814549	
Date Collected:	08/08/95	08/08/95	
Date Prepared:			
Date Analyzed:	08/15/95 15:21:00	08/15/95 15:45:00	
Dilution Factor:	1	1	
Matrix:	Water	Water	
Units:	ug/L	ug/L	
Report as:	received	received	
Column:			
Analyte	Conc. DL	Conc. DL	Conc. DL
o-Xylene	ND 0.207	ND 0.207	

Surrogate(s)	Recovery %	Recovery %	Recovery %
1,4-Bromofluorobenzene	99	98	
1,2-Dichloroethane-d4	89	94	
Toluene-d8	98	98	

08/16/95 10:43:33

RESULTS SUMMARY

Work Order # 9508210  
Page 4

Method Volatile Organics SH8260  
Test Code 826SHANA

Project Sample ID:	NEL071500TW1	DL	Conc.	DL	Conc.	DL	Conc.	DL
Lab ID:	9508210-01A							
File ID:	F0810508							
Date Collected:	08/07/95							
Date Prepared:								
Date Analyzed:	08/10/95 16:33:00							
Dilution Factor:	1							
Matrix:	Water							
Units:	ug/L							
Report as:	received							
Column:								
Analyte	Conc.	DL	Conc.	DL	Conc.	DL	Conc.	DL
Acetone	2.15	0.641						
Benzene	0.223	0.194						
Bromodichloromethane	ND	0.0491						
Bromoform	ND	0.0776						
Bromomethane	ND	0.106						
2-Butanone(MEK)	< DL	3.11						
Carbon disulfide	ND	0.125						
Carbon tetrachloride	ND	0.127						
Chlorobenzene	ND	0.101						
Chloroethane	ND	0.130						
Chloroform	0.673	0.0709						
Chloromethane	ND	0.119						
Dibromochloromethane	ND	0.0554						
1,2-Dichlorobenzene	ND	0.102						
1,3-Dichlorobenzene	ND	0.110						
1,4-Dichlorobenzene	ND	0.116						
1,1-Dichloroethane	ND	0.0794						
1,2-Dichloroethane	ND	0.0454						
1,1-Dichloroethene	ND	0.148						
cis-1,2-Dichloroethene	ND	0.0485						



08/16/95 10:43:33

RESULTS SUMMARY (Cont'd)

Work Order # 9508210  
Page 6

Method Volatile Organics SW8260  
Test Code 826SMANA

Project Sample ID: Lab ID: File ID: Date Collected: Date Prepared: Date Analyzed: Dilution Factor: Matrix: Units: Report as: Column: Analyte	NEL071500TW1  9508210-01A F0810508 08/07/95  08/10/95 16:33:00 1 Water ug/L received  Conc. DL 0.112 0.107	Conc.	DL	Conc.	DL	Conc.	DL
o-Xylene							

Surrogate(s)	Recovery %	Recovery %	Recovery %
1,4-Bromofluorobenzene	87		
1,2-Dichloroethane-d4	102		
Toluene-d8	96		

RESULTS SUMMARY

Project Sample ID:	NELO90700UM6	NELO91540UM7	NELO91540UMD2	TRIP BLANK
Lab ID:	9508228-01A	9508228-03A	9508228-04A	9508228-02A
File ID:	G0821513	G0821514	G0821515	G0821512
Date Collected:	08/09/95	08/09/95	08/09/95	08/09/95
Date Prepared:				
Date Analyzed:	08/21/95 19:26:00	08/21/95 19:50:00	08/21/95 20:15:00	08/21/95 19:02:00
Dilution Factor:	1	1	1	1
Matrix:	Water	Water	Water	Water
Units:	ug/L	ug/L	ug/L	ug/L
Report as:	received	received	received	received
Column:				
Analyte	Conc.	DL	Conc.	DL
Acetone	ND	2.30	ND	11.8
Benzene	< DL	0.122	ND	ND
Bromodichloromethane	0.0919	0.0462	0.0824	ND
Bromoform	ND	0.136	ND	ND
Bromomethane	ND	0.0500	ND	ND
2-Butanone(MEK)	ND	1.29	ND	3.98
Carbon disulfide	ND	0.190	ND	ND
Carbon tetrachloride	ND	0.131	ND	ND
Chlorobenzene	ND	0.205	ND	ND
Chloroethane	ND	0.0898	ND	ND
Chloroform	1.11	0.0985	1.15	ND
Chloromethane	< DL	0.0893	0.0902	ND
Dibromochloromethane	ND	0.0870	ND	ND
1,2-Dichlorobenzene	ND	0.182	ND	ND
1,3-Dichlorobenzene	ND	0.228	ND	ND
1,4-Dichlorobenzene	ND	0.216	ND	ND
1,1-Dichloroethane	ND	0.0646	ND	ND
1,2-Dichloroethane	ND	0.0481	ND	ND
1,1-Dichloroethene	ND	0.212	ND	ND
cis-1,2-Dichloroethene	0.673	0.104	0.650	ND
				2.30
				0.122
				0.0462
				0.136
				0.0500
				1.29
				0.190
				0.131
				0.205
				0.0898
				0.0985
				0.0893
				0.0870
				0.182
				0.228
				0.216
				0.0646
				0.0481
				0.212
				0.104

Method Volatile Organics SW8260  
 Test Code 8265HANA

Project Sample ID:	NEL090700UW6	NEL091540UW7	NEL091540UMD2	TRIP BLANK
Lab ID:	9508228-01A	9508228-03A	9508228-04A	9508228-02A
File ID:	G0821513	G0821514	G0821515	G0821512
Date Collected:	08/09/95	08/09/95	08/09/95	08/09/95
Date Prepared:				
Date Analyzed:	08/21/95 19:26:00	08/21/95 19:50:00	08/21/95 20:15:00	08/21/95 19:02:00
Dilution Factor:	1	1	1	1
Matrix:	Water	Water	Water	Water
Units:	ug/L	ug/L	ug/L	ug/L
Report as:	received	received	received	received
Column:				
Analyte	Conc.	Conc.	Conc.	Conc.
	DL	DL	DL	DL
trans-1,2-Dichloroethene	ND	ND	ND	ND
1,2-Dichloropropane	ND	ND	ND	ND
cis-1,3-Dichloropropene	ND	ND	ND	ND
trans-1,3-Dichloropropene	ND	ND	ND	ND
Ethylbenzene	ND	ND	ND	ND
2-Hexanone	ND	ND	ND	ND
4-Methyl-2-pentanone (MIBK)	ND	ND	ND	ND
Methylene chloride	< DL	< DL	< DL	< DL
Styrene	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND
Tetrachloroethene	5.90	6.48	6.86	ND
Toluene	< DL	< DL	< DL	< DL
1,1,1-Trichloroethane	< DL	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND
Trichloroethene	57.1	63.5	66.0	ND
Trichlorofluoromethane	ND	ND	ND	ND
1,1,2-Trichlorotrifluoroethane	ND	ND	ND	ND
Vinyl acetate	ND	ND	ND	ND
Vinyl chloride	ND	ND	ND	ND
m&p-Xylene	ND	ND	ND	ND
	0.212	0.212	0.212	0.212
	0.0440	0.0440	0.0440	0.0440
	0.116	0.116	0.116	0.116
	0.0724	0.0724	0.0724	0.0724
	0.246	0.246	0.246	0.246
	0.347	0.347	0.347	0.347
	0.316	0.316	0.316	0.316
	0.423	0.423	0.423	0.423
	0.184	0.184	0.184	0.184
	0.0708	0.0708	0.0708	0.0708
	0.420	0.420	0.420	0.420
	0.163	0.163	0.163	0.163
	0.120	0.120	0.120	0.120
	0.0678	0.0678	0.0678	0.0678
	0.197	0.197	0.197	0.197
	0.0999	0.0999	0.0999	0.0999
	0.332	0.332	0.332	0.332
	0.381	0.381	0.381	0.381
	0.0697	0.0697	0.0697	0.0697
	0.554	0.554	0.554	0.554

08/28/95 12:03:10

RESULTS SUMMARY (Cont'd)

Work Order # 9508228  
Page 6

Method Volatile Organics SM8260  
Test Code 826SWANA

Project Sample ID:	NELO90700UM6	NELO91540UM7	NELO91540UMD2	TRIP BLANK
Lab ID:	9508228-01A	9508228-03A	9508228-04A	9508228-02A
File ID:	G0821513	G0821514	G0821515	G0821512
Date Collected:	08/09/95	08/09/95	08/09/95	08/09/95
Date Prepared:				
Date Analyzed:	08/21/95 19:26:00	08/21/95 19:50:00	08/21/95 20:15:00	08/21/95 19:02:00
Dilution Factor:	1	1	1	1
Matrix:	Water	Water	Water	Water
Units:	ug/L	ug/L	ug/L	ug/L
Report as:	received	received	received	received
Column:				
Analyte	Conc.	Conc.	Conc.	Conc.
	DL	DL	DL	DL
o-Xylene	ND	ND	ND	ND
	0.207	0.207	0.207	0.207

Surrogate(s)	Recovery %	Recovery %	Recovery %
1,4-Bromofluorobenzene	102	101	93
1,2-Dichloroethane-d4	78	87	95
Toluene-d8	99	99	97

Method Volatile Organics SW8260  
 Test Code 826SWAMA

Project Sample ID:	NEL111400UM9	NEL111630GW2	
Lab ID:	9508272-01A	9508272-02B	
File ID:	G0821517	G0821535	
Date Collected:	08/11/95	08/11/95	
Date Prepared:			
Date Analyzed:	08/21/95 21:04:00	08/22/95 04:16:00	
Dilution Factor:	1	30	
Matrix:	Water	Water	
Units:	ug/L	ug/L	
Report as:	received	received	
Column:			
Analyte	Conc.	Conc.	DL
Acetone	6.59	ND	69.0
Benzene	ND	ND	3.66
Bromodichloromethane	0.167	ND	1.39
Bromoform	ND	ND	4.08
Bromomethane	ND	ND	1.50
2-Butanone(MEK)	3.63	ND	38.7
Carbon disulfide	ND	ND	5.70
Carbon tetrachloride	ND	ND	3.93
Chlorobenzene	ND	ND	6.15
Chloroethane	ND	ND	2.69
Chloroform	1.35	3.61	2.96
Chloromethane	< DL	ND	2.68
Dibromochloromethane	ND	ND	2.61
1,2-Dichlorobenzene	ND	ND	5.46
1,3-Dichlorobenzene	ND	ND	6.84
1,4-Dichlorobenzene	ND	ND	6.48
1,1-Dichloroethane	ND	ND	1.94
1,2-Dichloroethane	ND	ND	1.44
1,1-Dichloroethene	ND	ND	6.36
cis-1,2-Dichloroethene	0.590	38.8	3.12

Method Volatile Organics SW8260  
Test Code 8265WANA

Project Sample ID:	NEL111400LW9	NEL111630GW2	Conc.	DL	Conc.	DL
Lab ID:	9508272-01A	9508272-02B	ND	0.212	ND	6.36
File ID:	G0821517	G0821535	ND	0.0440	ND	1.32
Date Collected:	08/11/95	08/11/95	ND	0.116	ND	3.48
Date Prepared:			ND	0.0724	ND	2.17
Date Analyzed:	08/21/95 21:04:00	08/22/95 04:16:00	ND	0.246	ND	7.38
Dilution Factor:	1	30	0.812	0.347	ND	10.4
Matrix:	Water	Water	ND	0.316	ND	9.48
Units:	ug/L	ug/L	< DL	0.423	< DL	12.7
Report as:	received	received	ND	0.184	ND	5.52
Column:			ND	0.0708	ND	2.12
Analyte			7.41	0.420	13.2	12.6
trans-1,2-Dichloroethene			< DL	0.163	< DL	4.89
1,2-Dichloropropane			ND	0.120	ND	3.60
cis-1,3-Dichloropropene			ND	0.0678	ND	2.03
trans-1,3-Dichloropropene			69.5 E	0.197	64.7	5.91
Ethylbenzene			ND	0.0999	ND	3.00
2-Hexanone			ND	0.332	< DL	9.96
4-Methyl-2-pentanone (MIBK)			ND	0.381	ND	11.4
Methylene chloride			ND	0.0697	ND	2.09
Styrene			ND	0.554	ND	16.6
1,1,2,2-Tetrachloroethane						
Tetrachloroethene						
Toluene						
1,1,1-Trichloroethane						
1,1,2-Trichloroethane						
Trichloroethene						
Trichlorofluoromethane						
1,1,2-Trichlorotrifluoroethane						
Vinyl acetate						
Vinyl chloride						
m&p-Xylene						

08/28/95 12:09:11

RESULTS SUMMARY (Cont'd)

Work Order # 9508272

Page 6

Method Volatile Organics SM8260

Test Code 826SWANA

Project Sample ID:	NEL111400U9	NEL111630GW2	
Lab ID:	9508272-01A	9508272-02B	
File ID:	G0821517	G0821535	
Date Collected:	08/11/95	08/11/95	
Date Prepared:			
Date Analyzed:	08/21/95 21:04:00	08/22/95 04:16:00	
Dilution Factor:	1	30	
Matrix:	Water	Water	
Units:	ug/L	ug/L	
Report as:	received	received	
Column:			
Analyte	Conc. DL	Conc. DL	Conc. DL
o-Xylene	ND 0.207	ND 6.21	

Surrogate(s)	Recovery %	Recovery %	Recovery %
1,4-Bromofluorobenzene	100	98	
1,2-Dichloroethane-d4	78	76	
Toluene-d8	98	98	

Method Volatile Organics SW8260  
Test Code 826SWANA

Project Sample ID: Lab ID: File ID: Date Collected: Date Prepared: Date Analyzed: Dilution Factor: Matrix: Units: Report as: Column: Analyte	NEL101230VV#8 9508249-01A G0814550 08/10/95 08/15/95 16:10:00 1 Water ug/L received	Conc.	DL	Conc.	DL
Acetone	< DL	2.30			
Benzene	< DL	0.122			
Bromodichloromethane	0.0981	0.0462			
Bromoform	ND	0.136			
Bromomethane	ND	0.0500			
2-Butanone(MEK)	ND	1.29			
Carbon disulfide	ND	0.190			
Carbon tetrachloride	ND	0.131			
Chlorobenzene	ND	0.205			
Chloroethane	ND	0.0898			
Chloroform	1.21	0.0985			
Chloromethane	ND	0.0893			
Dibromochloromethane	ND	0.0870			
1,2-Dichlorobenzene	ND	0.182			
1,3-Dichlorobenzene	ND	0.228			
1,4-Dichlorobenzene	ND	0.216			
1,1-Dichloroethane	ND	0.0646			
1,2-Dichloroethane	ND	0.0481			
1,1-Dichloroethene	ND	0.212			
cis-1,2-Dichloroethene	0.617	0.104			

Method Volatile Organics SM8260  
 Test Code 826SHANA

Project Sample ID:	NEL101230VAB	DL	Conc.	DL	Conc.	DL	Conc.	DL
Lab ID:	9508249-01A							
File ID:	G0814550							
Date Collected:	08/10/95							
Date Prepared:								
Date Analyzed:	08/15/95 16:10:00							
Dilution Factor:	1							
Matrix:	Water							
Units:	ug/L							
Report as:	received							
Column:								
Analyte		Conc.	DL	Conc.	DL	Conc.	DL	Conc.
trans-1,2-Dichloroethene		ND	0.212					
1,2-Dichloropropane		ND	0.0440					
cis-1,3-Dichloropropene		ND	0.116					
trans-1,3-Dichloropropene		ND	0.0724					
Ethylbenzene		ND	0.246					
2-Hexanone		ND	0.347					
4-Methyl-2-pentanone(MIBK)		ND	0.316					
Methylene chloride		< DL	0.423					
Styrene		ND	0.184					
1,1,2,2-Tetrachloroethane		ND	0.0708					
Tetrachloroethene		5.64	0.420					
Toluene		< DL	0.163					
1,1,1-Trichloroethane		ND	0.120					
1,1,2-Trichloroethane		ND	0.0678					
Trichloroethene		55.6	0.197					
Trichlorofluoromethane		ND	0.0999					
1,1,2-Trichlorotrifluoroethane		ND	0.332					
Vinyl acetate		ND	0.381					
Vinyl chloride		ND	0.0697					
m&p-Xylene		ND	0.554					

Method Volatile Organics SM8260  
 Test Code 826SWANA

Project Sample ID:	NEL101230WdB				
Lab ID:	9508249-01A				
File ID:	G0814550				
Date Collected:	08/10/95				
Date Prepared:					
Date Analyzed:	08/15/95 16:10:00				
Dilution Factor:	1				
Matrix:	Water				
Units:	ug/L				
Report as:	received				
Column:					
Analyte	Conc.	DL	Conc.	DL	Conc.
o-Xylene	ND	0.207			

Surrogate(s)	Recovery %	Recovery %	Recovery %
1,4-Bromofluorobenzene	100		
1,2-Dichloroethane-d4	95		
Toluene-d8	99		

08/21/95 14:27:42

Method Volatile Organics SW8260A  
 Test Code 826SSANA

RESULTS SUMMARY

Work Order # 9508204  
 Page 4

Project Sample ID: Lab ID: File ID: Date Collected: Date Prepared: Date Analyzed: Dilution Factor: Matrix: Units: Report as: Column: Analyte	NEL081200S1 9508204-01A F0815521 08/08/95 08/16/95 12:28:00 1 Solid ug/kg dry weight	Conc.	DL	Conc.	DL
Acetone	< DL	6.04			
Benzene	ND	1.08			
Bromodichloromethane	ND	0.978			
Bromoform	ND	0.784			
Bromomethane	ND	1.34			
2-Butanone(MEK)	ND	4.74			
Carbon disulfide	ND	0.943			
Carbon tetrachloride	ND	1.07			
Chlorobenzene	ND	0.969			
Chloroethane	ND	1.35			
Chloroform	ND	1.31			
Chloromethane	ND	1.18			
Dibromochloromethane	ND	1.00			
1,2-Dichlorobenzene	ND	0.569			
1,3-Dichlorobenzene	ND	0.736			
1,4-Dichlorobenzene	ND	0.974			
1,1-Dichloroethane	ND	1.35			
1,2-Dichloroethane	ND	0.976			
1,1-Dichloroethene	ND	0.945			
cis-1,2-Dichloroethene	ND	1.12			

Method Volatile Organics SW8260A  
Test Code 8Z6SSANA

Project Sample ID: Lab ID: File ID: Date Collected: Date Prepared: Date Analyzed: Dilution Factor: Matrix: Units: Report as: Column: Analyte	NEL081200S1 9508204-01A F0815521 08/08/95 08/16/95 12:28:00 1 Solid ug/kg dry weight	Conc.	DL	Conc.	DL
trans-1,2-Dichloroethene	ND	1.36			
1,2-Dichloropropane	ND	0.762			
cis-1,3-Dichloropropene	ND	0.802			
trans-1,3-Dichloropropene	ND	0.756			
Ethylbenzene	ND	0.818			
2-Hexanone	ND	3.25			
4-Methyl-2-pentanone(MIBK)	ND	2.88			
Methylene chloride	4.66	1.13			
Styrene	ND	1.09			
1,1,2,2-Tetrachloroethane	ND	1.42			
Tetrachloroethene	ND	1.29			
Toluene	ND	0.934			
1,1,1-Trichloroethane	ND	0.993			
1,1,2-Trichloroethane	ND	1.02			
Trichloroethene	ND	0.938			
Trichlorofluoromethane	ND	4.29			
1,1,2-Trichlorotrifluoroethane	ND	1.14			
Vinyl acetate	ND	1.09			
Vinyl chloride	ND	0.905			
m&p-Xylene	ND	1.93			

Method Volatile Organics SW8260A  
 Test Code 826SSANA

Project Sample ID: Lab ID: File ID: Date Collected: Date Prepared: Date Analyzed: Dilution Factor: Matrix: Units: Report as: Column: Analyte	NEL081200S1 9508204-01A F0815521 08/08/95 08/16/95 12:28:00 1 Solid ug/kg dry weight Conc. DL DL 0.876	Conc. DL DL DL	Conc. DL DL DL
o-Xylene	ND		

Surrogate(s)	Recovery %	Recovery %	Recovery %
1,4-Bromofluorobenzene	94		
1,2-Dichloroethane-d4	118		
Toluene-d8	99		

08/17/95 15:17:27

RESULTS SUMMARY

Work Order # 9508203

Page 4

Method Percent moisture, SH846

Test Code MSRSSA00

Project Sample ID:	Project Sample ID:	Project Sample ID:	Project Sample ID:
Lab ID: File ID: Date Collected: Date Prepared: Date Analyzed: Dilution Factor: Matrix: Units: Report as: Column: Analyte	NEL081200S1  9508203-01A MSRS081610-1 08/08/95  08/16/95 10:50 1 solid %	NEL081200S1  9508203-01A MSRS081610-2 08/08/95  08/16/95 10:50:00 1 Solid %	Conc.  DL  Conc.  DL  Conc.  DL
Percent moisture	23.6	23.0	

RESULTS SUMMARY

Method ICP analysis by EPA 200.7  
Test Code ICPEW5NA

<p>Project Sample ID: Lab ID: File ID: Date Collected: Date Prepared: Date Analyzed: Dilution Factor: Matrix: Units: Report as: Column: Analyte</p>	<p>NELO71500TW1 9508188-01A JA610811-20 08/07/95 08/10/95 08/11/95 1 Water mg/L received Conc. DL</p>	<p>Conc. DL</p>	<p>Conc. DL</p>	<p>Conc. DL</p>
<p>Arsenic Beryllium Cadmium Chromium Copper Lead Nickel Selenium Silver Zinc</p>	<p>&lt; DL 0.0468 &lt; DL 0.000510 &lt; DL 0.00386 &lt; DL 0.00524 &lt; DL 0.00916 0.0731 0.0216 &lt; DL 0.0141 0.152 0.0891 &lt; DL 0.00519 0.0131 0.00402</p>			

08/11/95 10:40:08

RESULTS SUMMARY

Work Order # 9508192

Page 4

Method pH,water

Test Code PH\_EWA00

Project Sample ID:	NELO71500TW1	NELO71500TW1	NELO71500TW1	Conc.	DL
Lab ID: File ID: Date Collected: Date Prepared: Date Analyzed: Dilution Factor: Matrix: Units: Report as: Column: Analyte	9508192-01A 9400809-6 08/07/95 08/09/95 12:00:00 1 Water pH units received	9508192-01A 9400809-7 08/07/95 08/09/95 12:00:00 1 Water pH units received	9508192-01A 9400809-7 08/07/95 08/09/95 12:00:00 1 Water pH units received	Conc.	DL
pH	8.12	8.13			

08/11/95 10:40:42

RESULTS SUMMARY

Work Order # 9508190

Page 4

Method Hydrocarbons, total E418.1

Test Code HC1EMA00

Project Sample ID:	Project Sample ID:	Project Sample ID:	Project Sample ID:
Lab ID: 9508190-01A File ID: PEIR0810-13 Date Collected: 08/07/95 Date Prepared: Date Analyzed: 08/10/95 12:00:00 Dilution Factor: 1 Matrix: Water Units: mg/L Report as: received Column: Analyte	NEL071500TW1 9508190-01A PEIR0810-14 08/07/95 08/10/95 12:00:00 1 Water mg/L received Conc. DL < DL 0.163	NEL071500TW1 9508190-01A PEIR0810-14 08/07/95 08/10/95 12:00:00 1 Water mg/L received Conc. DL < DL 0.163	Conc. DL Conc. DL
Hydrocarbons	< DL 0.163	< DL 0.163	

08/11/95 13:25:29

Work Order # 9508191

Page 4

RESULTS SUMMARY

Method Tot. dissolv. solid E160.1

Test Code IDSEMA00

Project Sample ID:  Lab ID: File ID: Date Collected: Date Prepared: Date Analyzed: Dilution Factor: Matrix: Units: Report as: Column: Analyte	NEL071500TW1  9508191-01A TDS0809-4 08/07/95  08/09/95 16:00:00 1 Water mg/L received  Conc. DL 1500 7.87	NEL071500TW1  9508191-01A TDS0809-5 08/07/95  08/09/95 16:00:00 1 Water mg/L received  Conc. DL 1530 7.87	Conc. DL Conc. DL
Total dissolved solids			

08/11/95 13:25:29

RESULTS SUMMARY

Work Order # 9508191

Page 13

Method ISS by EPA 160.2  
Test Code ISSEWA00

Project Sample ID:  Lab ID: File ID: Date Collected: Date Prepared: Date Analyzed: Dilution Factor: Matrix: Units: Report as: Column: Analyte	NEL071500TW1  9508191-01A TSS0809-4 08/07/95  08/09/95 12:00:00 1 Water mg/L received  Conc. DL	NEL071500TW1  9508191-01A TSS0809-5 08/07/95  08/09/95 12:00:00 1 Water mg/L received  Conc. DL	Conc. DL  Conc. DL
Total suspended solids	< DL	2.17	3.00 2.17

08/11/95 14:45:19

RESULTS SUMMARY

Work Order # 9508189

Page 4

Method Total cyanide by EPA 335.3

Test Code ICNEWA00

Project Sample ID: Lab ID: File ID: Date Collected: Date Prepared: Date Analyzed: Dilution Factor: Matrix: Units: Report as: Column: Analyte	NEL071500TW1 9508189-01A TRAC0811-17 08/07/95 08/11/95 07:47:00 1 Water mg/L received	NEL071500TW1 9508189-01A TRAC0811-18 08/07/95 08/11/95 07:47:00 1 Water mg/L received	Conc. DL Conc. DL Conc. DL < DL 0.00618 < DL 0.00618
Cyanide			

**APPENDIX D**  
**AM 4.02 Methodology**

ANALYTICAL METHOD AM4A.04

FIELD ANALYSIS OF VOLATILE ORGANIC COMPOUNDS IN SOIL GAS

1.0 Scope and Application

1.1 Method AM4A.04 is used to determine the concentration of volatile organic compounds in soil gas samples. Specifically, Method AM4A.04 may be used to detect the volatile organics including but not limited to the following compounds:

pentane	benzene
hexane	toluene
heptane	m & p-xylene
octane	o-xylene
nonane	ethyl benzene
decane	freon 113
chloromethane	bromomethane
vinyl chloride	chloroethane
1,1-dichloroethylene	fluorotrichloromethane
methylene chloride	1,2-dichloropropane
1,1-dichloroethane	bromodichloromethane
1,2-dichloroethane	cis 1,3-dichloropropylene
trans 1,2-dichloroethylene	trans 1,3-dichloropropylene
chloroform	1,1,2-trichloroethane
1,1,1-trichloroethane	chlorodibromomethane
carbon tetrachloride	chlorobenzene
trichloroethylene	bromoform
tetrachloroethylene	1,2-dichlorobenzene
1,1,2,2-tetrachloroethane	1,4-dichlorobenzene
1,3-dichlorobenzene	acetone
methyl t-butyl ether	2-butanone
undecane	dodecane
tridecane	tetradecane
pentadecane	hexadecane
heptadecane	octadecane

1.2 This method is recommended for use by, or under the supervision of, analysts experienced in the operation of a gas chromatograph and in the interpretation of a chromatogram.

AM4A.04

## 2.0 Summary of Method

The volatile organic compounds are analyzed using a Hewlett Packard Model 5890 Series II Gas Chromatograph in conjunction with a Hewlett Packard Model 7694 Automated Headspace Sampler. A Supelco, 105M x 0.53mm i.d. Vocol, wide bore capillary column is used in conjunction with an output splitter connected to an electron capture detector and a flame ionization detector. The detector output signals are interfaced directly to an IBM compatible microcomputer through an analog to digital converter. Data storage, processing, analysis and presentation are facilitated using a chromatography data system (Chrom Perfect, Justice Innovations).

## 3.0 Interferences

3.1 Contamination by carryover can occur whenever high-level and low-level samples are sequentially analyzed. While in the standby mode, the HP 7694 provides continuous flushing of the sample loop and sample valve between sample analyses. This flush flow should be maintained and the sample valve and loop should be kept heated.

3.2 The analyst should demonstrate the absence of carryover contamination by analysis of the contents of the sample loop when purged with pure nitrogen. This demonstration should be performed prior to the analysis of a sample set and when carryover contamination is suspected (after high samples). In the event that 'ghost peaks' (peaks similar to previous sample) appear when a pure nitrogen sample is analyzed measures should be taken to eliminate the carryover contamination.

3.3 Extra peaks in a chromatogram can be actual peaks from a previous run. Contamination from compounds eluting late in the chromatogram can occur when injection to injection time is too short. The HP 5890 Series II is equipped with a temperature programmable oven which can be utilized to minimize this interference.

3.4 The analyst should be certain that all peaks have eluted from the previous analysis prior to analyzing any sample or standard. This can be accomplished by elevating the oven temperature after an analysis until such time that a clean stable baseline is obtained. If samples or standard chromatograms contain suspected 'extra peaks' the sample should be reanalyzed after a clean baseline is established.

AM4A.04

#### 4.0 Materials and Equipment

4.1 Sample vials: 22 ml glass vials (Hewlett Packard #9301-0716 or equivalent). Vials should be free of interferences prior to use. This can be accomplished by washing and rinsing with hydrocarbon free water then heating to 100 degrees C for 1 hour followed by purging with pure nitrogen.

4.2 Septums: Teflon lined septums (Wheaton #224168 or equivalent) may be used provided vials are capped within two weeks prior to use. Other septums may be used provided they are gas tight and do not produce interferences.

4.3 Gas Chromatograph: The Hewlett Packard 5890 Series II Gas Chromatograph is equipped with a Supelco, 105M x 0.53mm i.d. Vocol, wide bore capillary column connected to an electron capture detector and flame ionization detector.

4.4 Headspace Sampler: A Hewlett Packard Model 7694 is used. The headspace sampler contains 44 slots for headspace vials. The Model 7694 contains a heated platen, a heated sample valve, a heated sample loop and a heated transfer line to facilitate transfer of the sample onto the column in the gas chromatograph.

4.5 Data Acquisition: Chrom Perfect Direct 4i, Justice Innovations, Mountain View, CA. The detector output signals are interfaced directly to an IBM compatible microcomputer through an analog to digital converter (Model DT2804, Data Translations). Data storage, processing, analysis and presentation are facilitated using the Chrom Perfect data system.

#### 5.0 Sample Preparation and Analysis

5.1 Sample vial preparation: All sample vials should meet specifications as noted in sections 4.1 and 4.2 above. Vials should be tightly capped and evacuated to a pressure of less than 100 millitorr. The vial septum should be punctured only with needles of 22 gauge or smaller.

5.2 The evacuated sample vials should be filled with sample or standard gas to a positive gauge pressure. Sample vials should be used (filled with sample) within two weeks of preparation.

5.3 The 22 cc sample vials are heated in the headspace sampling unit for a minimum of 45 minutes prior to injection to minimize component loss via adsorption to the walls of the vial.

AM4A.04

5.4 The headspace sampling unit is programmed to mechanically puncture the septum, transfer the sample to the heated sample loop, and mechanically inject the sample into the column flow stream via the heated transfer line.

## 6.0 Standards and Calibrations

6.1 Gas standards or liquid standards may be used to achieve calibrations. In some situations it may be necessary to use both types of standards. Certified commercial gas standards are most desirable, but may not always be available for all the compounds or for the concentration levels of the compounds of interest.

6.2 Commercial gas standards are introduced by filling a 22ml headspace vial with standard gas. The gas standards are placed in the vials and analyzed in the same manner as samples (as described in section 5.0). The concentrations are those certified by the manufacturer.

6.3 Liquid standard solutions are injected directly into a capped vial and allowed to vaporize. These standards are produced from high purity compounds as described in the Standard Preparation Methods. The liquid standard solutions are placed in vials that meet specifications described in sections 4.1 and 4.2. The vials used must be capped and be at atmospheric pressure when the liquid standard is injected. The vial is then analyzed in the same manner as a sample as described in section 5.3.

6.4 At the beginning of a project or sample set, standards of appropriate calibration ranges will be run at least three times or until the results agree with a percent standard deviation no greater than 10%.

6.5 Thereafter, at least one standard will be run for every 10 samples.

6.6 The instrument response (for any one subsequent standard in section 6.5 above) must not vary by more than 20%.

## 7.0 Quality Control

7.1 If the parameters set forth in section 6.6 are not met the analytical program will be terminated until the cause is determined and a solution is effected.

7.2 Before and during sample analysis, instrument blanks (sample loops filled with flush nitrogen) should be analyzed to assure the absence of interferences as described in section 3.0 above.

AM4A.04

7.3 Prior to the analysis of a sample set, multiple standards, at different concentration levels, should be analyzed to establish an initial calibration table. During sample analysis, standards should be run at a rate of 1 for each 10 samples.

7.4 Standards analyzed during the course of analyzing samples are compared to the calibration table as well as being used for peak identification. All chromatograms should be examined by an experienced analyst.

7.5 The soil gas sample vial is pressurized at the time of sampling. This pressure preserves sample integrity since any leakage is out of the vial and does not result in contamination or sample dilution.

7.6 The headspace sampling unit contains a heated platen as well as a heated sampling loop and transfer line. The latter two zones are continually flushed with nitrogen between sample analyses to minimize the chance of instrumental carry over. This nitrogen in the sample loop is injected periodically to check for instrument contamination.

7.7 Once the headspace vials are punctured in the headspace unit, the sample loop is allowed to equilibrate to atmospheric pressure just prior to injection (see section 8.2, vent time). This insures that an accurate, equal volume will be injected each time. Each vial is analyzed one time only.

7.8 Calibration records are generated and stored in the computer. All such records will be maintained in the laboratory during the course of the project.

## 8.0 Instrument Conditions

### 8.1 Gas Chromatograph:

Injection Temp. 220 deg. C.

Flame Ionization Detector Temp. 220 deg. C.

Electron Capture Detector Temp. 375 deg. C.

Oven Temp. Program:

Initial temp. 30 deg. C.

Hold 10 min.

Rate 4 deg. min. to 110 deg. C.

Hold .01 min.

Rate 20 deg. min. to 200 deg. C.

Hold 15 min.

Equilibration Time 1 min.

Initial E.C.D. Signal Range 5

Initial F.I.D. Signal Range 4

Carrier Flow Rates: (output of column split)

Head Space Sampler in 12 cc/min.

Make up gas to E.C.D. 76 cc/min.

AM4A.04

Make up gas to F.I.D. 34 cc/min.  
Total column 12 cc/min.  
Hydrogen Pressure 22 psig.  
Flame Air Pressure 30 psig.

8.2 Headspace Sampler:

Platen Temp. 75 deg. C.  
Valve/Loop Temp. 110 deg. C.  
Transfer Line 110 deg. C.  
Sample Equilibration time 45 min.  
Sampling interval 60 min (remote)  
Valve Timing:  
    Pressurize 0.0 min.  
    Vent/fill loop 0.25 min.  
    Loop equilibration 0.33 min.  
    Inject to G.C. 1.0 min.  
Carrier Flow 12 cc/min.

AM4A.04

**APPENDIX E**

**11 RCRA Tests**

**Analytical Report**

<b>Customer:</b>	Nellis Air Force Base	<b>Lab Number:</b>	5666A
<b>Address:</b>	10589 Old Placerville Road Sacramento, CA 95827	<b>Date Sampled:</b>	8/11/1995
<b>Contacts:</b>	Ms. Suzanne Felice & Mike Thepean	<b>Date Received:</b>	8/14/1995
<b>Sample Request:</b>	One sample received intact with CDC form for 11 RCRA tests.	<b>Date Reported:</b>	8/31/1995
<b>Project# :</b>	NEL11AC1	<b>Date Analyzed:</b>	8/14-8/31 1995
<b>Consulting Firm:</b>	Radian Corporation	<b>Sample Matrix:</b>	GAC

PARAMETER	DESCRIPTION	METHODS	RESULTS	RCRA LIMITS
Physical Description	Carbon is spent material; no foreign material present, liquid phase carbon, EG 401 5x30	Visual Inspection	Acceptable	*NA
Flash Point	Closed-cup Pensky Martens Flashpoint tester or a Setflash Closed Cup Tester (ASTM D-3278-78)	EPA 1010M	> 140 °F*	Must have a flashpoint >60 C (140 F)
pH	For corrosive identity; sample mixed with 1:1 DI water	EPA 9045	8.7 pH units	< or = to 2 or > or = to 12.5
Compatibility	Sample did not exhibit adverse reactions with water; in stable form.	IN-100S (internal)	compatible	*NA
Cyanide	Sample extracted by SW-846, Section 7.3 methodology	EPA 9010	< 10 mg/kg	250 mg RCRA/kg
Sulfide	Sample extracted by SW-846, Section 7.3 methodology	EPA 9030	< 10 mg/kg	500 mg H2S/kg
Lead	Sample extracted by EPA Method 3050 methodology	EPA 7420	< 5 mg/kg	5.0 mg/kg
Mercury	Sample extracted by EPA Method 7000, cold vapor technique	EPA 7671	< 0.2 mg/kg	0.2 mg/kg
Halogen Content	Sample extract from BTU combustate solution	EPA 9252	7259 mg/kg	*NA
Sulfur Content	Sample extract from BTU combustate solution	Parr Bomb	< 50 mg/kg	*NA
Heat of Combustion (BTU)	Parr Bomb Calorimeter	EPA 5080	5133 BTU/lb	*NA

\* Not Applicable; No defined RCRA Limits; For internal use only

\* Sample is not ignitable with an open flame.

Completed by:

Reviewed by:

*Margaret Jefferson*

Margaret Jefferson  
Analytical Chemist

James R. Graham, PhD  
Technical Director


**Wheelabrator Clean Air Systems Inc.**

 2130 Leo Avenue  
 Los Angeles, CA 90040  
 Tel. 213-722-7500  
 Fax. 213-722-8207

**A n a l y t i c a l   R e p o r t**

<b>Customer:</b>	Mallife Air Force Base	<b>Lab Number:</b>	56668
<b>Address:</b>	10209 Old Placerville Road Sacramento, CA 95837	<b>Date Sampled:</b>	8/11/1995
<b>Contact:</b>	Ms. Suzanne Felice & Mike Thompson	<b>Date Received:</b>	8/14/1995
<b>Sample Request:</b>	One sample received intact with CAC form for 11 RCRA tests.	<b>Date Reported:</b>	8/31/1995
<b>Project# :</b>	WGL11VC1	<b>Date Analyzed:</b>	8/14-8/31 1995
<b>Consulting Firm:</b>	Radian Corporation	<b>Sample Matrix:</b>	SAC

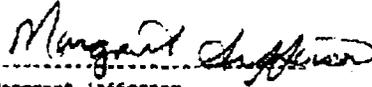
PARAMETER	DESCRIPTION	METHOD	RESULTS	RCRA LIMITS
Physical Description	Carbon is spent material; no foreign material present, vapor phase carbon, CC 601 6x8	Visual Inspection	Acceptable	*NA
Flash Point	Closed-cup Pensky Martens Flashpoint tester or a Setaflex Closed Cup Tester (ASTM D-3278-78)	EPA 1010H	> 140 F**	Must have a Flashpoint >60 C (140 F)
pH	For corrosive identity; sample mixed with 1:1 DI water	EPA 9045	9.7 pH units	< or = to 2 or > or = to 12.5
Compatibility	Sample did not exhibit adverse reactions with water; in stable form.	IM-1008 (internal)	compatible	*NA
Cyanide	Sample extracted by SW-846, Section 7.3 methodology	EPA 9010	< 10 mg/kg	250 mg KCN/kg
Sulfide	Sample extracted by SW-846, Section 7.3 methodology	EPA 9030	< 10 mg/kg	500 mg H <sub>2</sub> S/kg
Lead	Sample extracted by EPA Method 3050 methodology	EPA 7420	< 5 mg/kg	5.0 mg/kg
Mercury	Sample extracted by EPA Method 7000, cold vapor technique	EPA 7471	< 0.2 mg/kg	0.2 mg/kg
Halogen Content	Sample extract from BTU combustate solution	EPA 9252	3312 mg/kg	*NA
Sulfur Content	Sample extract from BTU combustate solution	Parr Bomb	< 50 mg/kg	*NA
Heat of Combustion (BTU)	Parr Bomb Calorimeter	EPA 5050	9908 BTU/Lb	*NA

\* Not Applicable; No defined RCRA Limits; For internal use only

\*\* sample is not ignitable with an open flame.

Completed by:

Reviewed by:

  
 Margaret Jefferson  
 Analytical Chemist

 James R. Graham, PhD  
 Technical Director

**APPENDIX F**

**Supporting Calculations for Pump and Treat Data**

SIGNATURE J. Thompson DATE 11-6-95 CHECKED JT DATE 11/7/95

PROJECT PRECCA - Nellis TPE JOB NO. 6012-001

SUBJECT Pump & Treat vs TPE SHEET 1 OF 1 SHEETS

Estimated P&Treat Extraction Rate

$$\text{Concentration (from pre/post test sampling)} = \frac{1760 \mu\text{g/l} + 647 \mu\text{g/l}}{2} = 1203.5 \mu\text{g/l TCE}$$

$$= \frac{(1830 + 692.4)}{2} = 1270 \mu\text{g/l VOCs}$$

Flow Rate (from Dames & Moore Quarterly GW Monitoring Report, Appendix A, Groundwater Sampling Information Sheet for MW-7:

$$\frac{30 \text{ gal}}{38 \text{ min}} = 0.79 \text{ gpm}$$

Extraction Rate (TCE)

$$\frac{1203 \mu\text{g TCE}}{\text{l}} \times \frac{1 \text{ gal}}{10^6 \mu\text{g}} \times \frac{16}{454 \text{ g}} \times \frac{3.785 \text{ l}}{\text{gal}} \times \frac{0.79 \text{ gal}}{\text{min}} \times \frac{1440 \text{ min}}{\text{day}} = 0.011 \text{ lb TCE/day}$$

P&T vs TPE  $\Rightarrow \frac{.33 \text{ lb/day}}{.011 \text{ lb/day}} = 30 \text{ times greater for TCE}$

Extraction Rate (Total VOCs)

$$\frac{1270 \mu\text{g VOC}}{\text{l}} \times \frac{1}{10^6} \times \frac{1}{454} \times 3.785 \times 0.79 \times 1440 = 0.012 \text{ lb VOC/day}$$

$$\frac{.39 \text{ lb/day VOC}}{.012 \text{ lb/day VOC}} = 32.5 \text{ times greater for VOCs}$$

**SPECIFIC COMMENTS TO THE DRAFT TWO-PHASE EXTRACTION PILOT-SCALE TEST  
TECHNOLOGY EVALUATION REPORT**

Section	Page	Paragraph	Reviewer	Comment	Response
1.2.2	1-2		Todd Wilson	Change Lesser levels to Lesser concentrations.	Document revised.
2.1	2-1		Todd Wilson	Define trace quantities, or delete.	The document has been modified to reference the exact concentration data provided in the Appendices.
2.3.1	2-6		Todd Wilson	Clarify that profiling is specifically to determine waste characteristics for disposal.	The document has been clarified.
2.3.2	2-6		Todd Wilson	Provide additional clarification as to the 11 RCRA test. Include a list of analyses required for this test.	A copy of the 11 RCRA tests Analytical Report provided by Wheelabrator Clean Air systems is provided in Appendix E. This lists the tests that are included.
2.3.2	2-6		Todd Wilson	The AM 4.02 methodology should be provided since this is not a standard, EPA, NIOSH, or other approved test method.	The AM 4.02 methodology is now provided as Appendix D.
Table 2-2			Todd Wilson	Groundwater and soil vapor data should be collected at some point after the pilot is complete. A new round of site quarterly groundwater data is to be collected in September/October. Preliminary results indicate that the groundwater concentrations have returned to approximately the same concentrations. Additional information will be available around the 1st of November.	We agree that continued comparison with quarterly monitoring data may provide additional information about the site (particularly related to groundwater levels). However, the data was not available at the time the report was provided and has not been incorporated.
2.4	2-8		Todd Wilson	Additional information should be provided based on the disposition of these soils.	Mr. Waldo Pulido of Nellis AFB indicated that the soils were disposed of via incineration at Las Vegas Paving. The report has been modified accordingly.

**SPECIFIC COMMENTS TO THE DRAFT TWO-PHASE EXTRACTION PILOT-SCALE TEST  
TECHNOLOGY EVALUATION REPORT (CONTINUED)**

Section	Page	Paragraph	Reviewer	Comment	Response
3.0	General		Todd Wilson	Provide information used to make comparisons between pump and treat and TPE. State if a pump test was conducted on MW-7, or if previous information was used to extrapolate the operating parameters for pump and treat.	Supporting information on the pump and treat values used are now provided as Appendix F. The pre- and post-test groundwater concentration data combined with previous groundwater flow rate data from the Quarterly Groundwater Monitoring Report were used for the comparison. The extraction rates shown in Table 3-2 have been revised to indicate that the TPE extraction rates were approximately 30 times greater than pump and treat. The revision resulted from an error in the original calculation.
Table 3-2			Todd Wilson	See comment on Section 3.0, General. Provide background in which average VOC and TCE removal rates were determined.	Contaminant removal rate information is currently provided in the "Summary of Contaminant Removal Rates" table provided in Appendix B.
3.2	3-4		Todd Wilson	The vapor component of the plume is expected to be minor. The actual source of the TCE plume has not been determined, and all soil borings and monitoring wells within the area have not been contaminated except at the groundwater interface.	Soil gas readings indicated that reasonably high soil vapor concentrations may be present at the site. Our pre- and post-test soil vapor samples indicated 4,400 ppbv and 5,700 ppbv of TCE. The soil gas survey reported in the Remedial Investigation of Site 44 (ES, May 1994) indicated concentrations of up to 9626 micrograms per liter of TCE in the soil gas.
3.3	3-4		Todd Wilson	See comment to Table 2-2.	Refer to previous response.

**SPECIFIC COMMENTS TO THE DRAFT TWO-PHASE EXTRACTION PILOT-SCALE TEST  
TECHNOLOGY EVALUATION REPORT (CONTINUED)**

Section	Page	Paragraph	Reviewer	Comment	Response
3.3.1	3-4		Todd Wilson	Provide an estimate on the time required to cleanup ST-44 as compared to pump and treat.	The estimated time to clean-up the site cannot be made because there is insufficient information available related to the mass of contaminants in the groundwater and detailed modeling of the water flow through the site. Additionally, the increase in mass removal rate resulting from in-situ air stripping of the VOCs from the dewatered zone cannot be quantified. TPE will range between 2 times (if only the increased water extraction rate is considered) to 30 times (assuming that all of the extracted mass would have to eventually be removed from the groundwater) faster than pump and treat at cleaning up the site. This would also be dependent on the design of the respective TPE and pump and treat systems used for the cleanup.
3.3	3-4		Todd Wilson	See comment to Table 2-2.	Refer to previous response.

**SPECIFIC COMMENTS TO THE DRAFT TWO-PHASE EXTRACTION PILOT-SCALE TEST  
TECHNOLOGY EVALUATION REPORT (CONTINUED)**

Section	Page	Paragraph	Reviewer	Comment	Response
3.4.1	3-8		Todd Wilson	Provide an estimate of time required to meet steady-state. State if all objectives of the study were met, or if a longer pilot study would be required to obtain better ROI information (vapor and groundwater), or other operating parameters.	<p>This pilot test is adequate for determining an approximate vapor ROI for the site.</p> <p>Since the exact cause of the groundwater fluctuations could not be identified, the exact duration needed to reach steady state cannot be determined. If the rate of change observed in the previous pilot testing remained constant, steady state would be achieved in a two week test.</p> <p>All test objectives were met with the exception of firm delineation of the groundwater ROI. The report has been modified to make this statement.</p>

**SPECIFIC COMMENTS TO THE DRAFT TWO-PHASE EXTRACTION PILOT-SCALE TEST  
TECHNOLOGY EVALUATION REPORT (CONTINUED)**

Section	Page	Paragraph	Reviewer	Comment	Response
4.0	4-1		Todd Wilson	<p>State what other types of sites this would be useful for, or where it has been used to effectively treat TCE plumes. It is this reader's assumption that BTEX would be treatable as well as chlorinated compounds. Provide general information such as minimum and maximum depth to water, etc. In this case, the groundwater is at approximately 80 feet. This is also the estimated vapor radius of influence. State if it is better for these to overlap, or if this does not matter. It is my guess that the more this exceeds the depth to the water table, the more enhancement of the remediation.</p>	<p>Despite data indicating low soil permeabilities, the vapor flow rates in the test were relatively high. TPE typically will be better relative to other, alternative technologies, when the formation is tighter and the vapor flow rates lower than those found during the test. The Remedy Profile Guideline provided in Table 3-1 is basically a summary of the site conditions where TPE is effective.</p> <p>BTEX compounds are treatable using the TPE technology. BTEX compounds are not included in the Remedy Profile Guidelines except where expedited action is required (See Table 3-1, footnote "a") because BTEX in the groundwater can often be remediated using intrinsic remediation if no receptors will be impacted before the groundwater plume attenuates.</p> <p>It is not important that the depth to the water table overlap the vapor radius of influence. However, if the water table is very shallow, short-circuiting may occur that reduces the vapor radius of influence.</p>
App. A			Todd Wilson	<p>State if headspace readings were collected. None are marked on the bore logs.</p>	<p>No headspace readings were collected.</p>

**SPECIFIC COMMENTS TO THE DRAFT TWO-PHASE EXTRACTION PILOT-SCALE TEST  
TECHNOLOGY EVALUATION REPORT (CONTINUED)**

Section	Page	Paragraph	Reviewer	Comment	Response
App. C			Todd Wilson	Clarify if the trip blank contamination led to the rejection of acetone and 2-butanone data. Based on the text, this appears to be the case. If the data isn't rejected, then the data may be used with some bias of the data.	Acetone results from NEL071500TW1, NEL081200VW4, and NEL111400UW9 and 2-butanone results from sample NEL111400UW9 have been rejected.
App. C		Table 1	Todd Wilson	Clarify the reasoning for analyzing both 8260 and 8260A.	The laboratory switched from 8260 to 8260A in June and July. The reporting software for the liquid samples had not been updated to reflect the analytical change. All samples were analyzed using 8260A.