AP - 45

STAGE 1 & 2 WORKPLANS

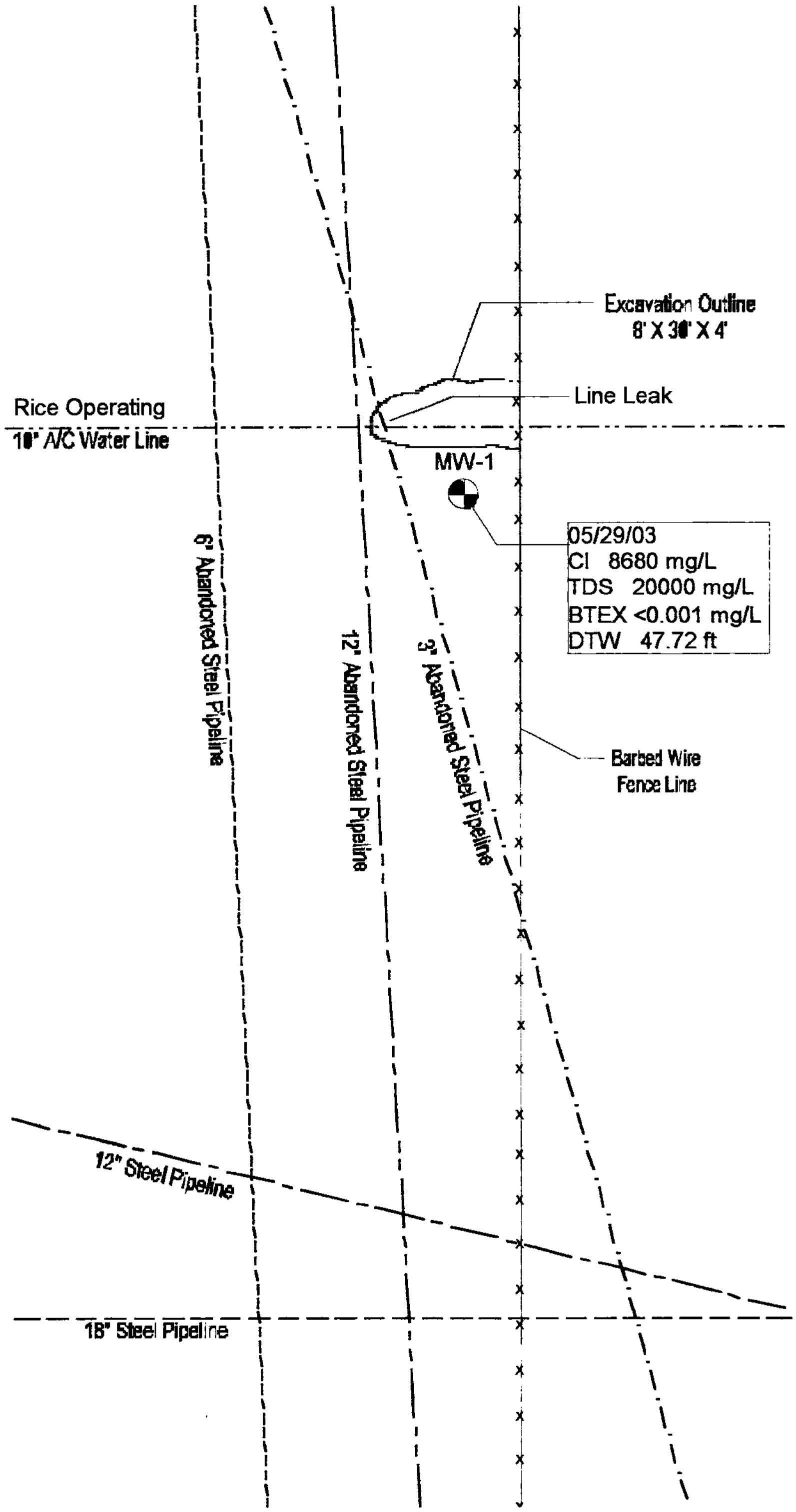
DATE:
July 31, 2003

Work Plan for EME P-6 Line Leak Site
T20S, R37E, Section 6, Unit Letter P
Lea County, New Mexico

JULY 31, 2003

Prepared For:

Rice Operating Company
122 West Taylor
Hobbs, New Mexico 88240



Prepared By:

TRIDENT
ENVIRONMENTAL

Trident Environmental
P O Box 7624
Midland, Texas 79708

TRIDENT ENVIRONMENTAL

July 31, 2003

Mr. Wayne Price
Environmental Bureau - New Mexico Oil Conservation Division
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

RE: Work Plan for EME P-6 Line Leak Site
T20S, R37E, SEC 6, Unit Letter P
Lea County, New Mexico

Dear Mr. Price:

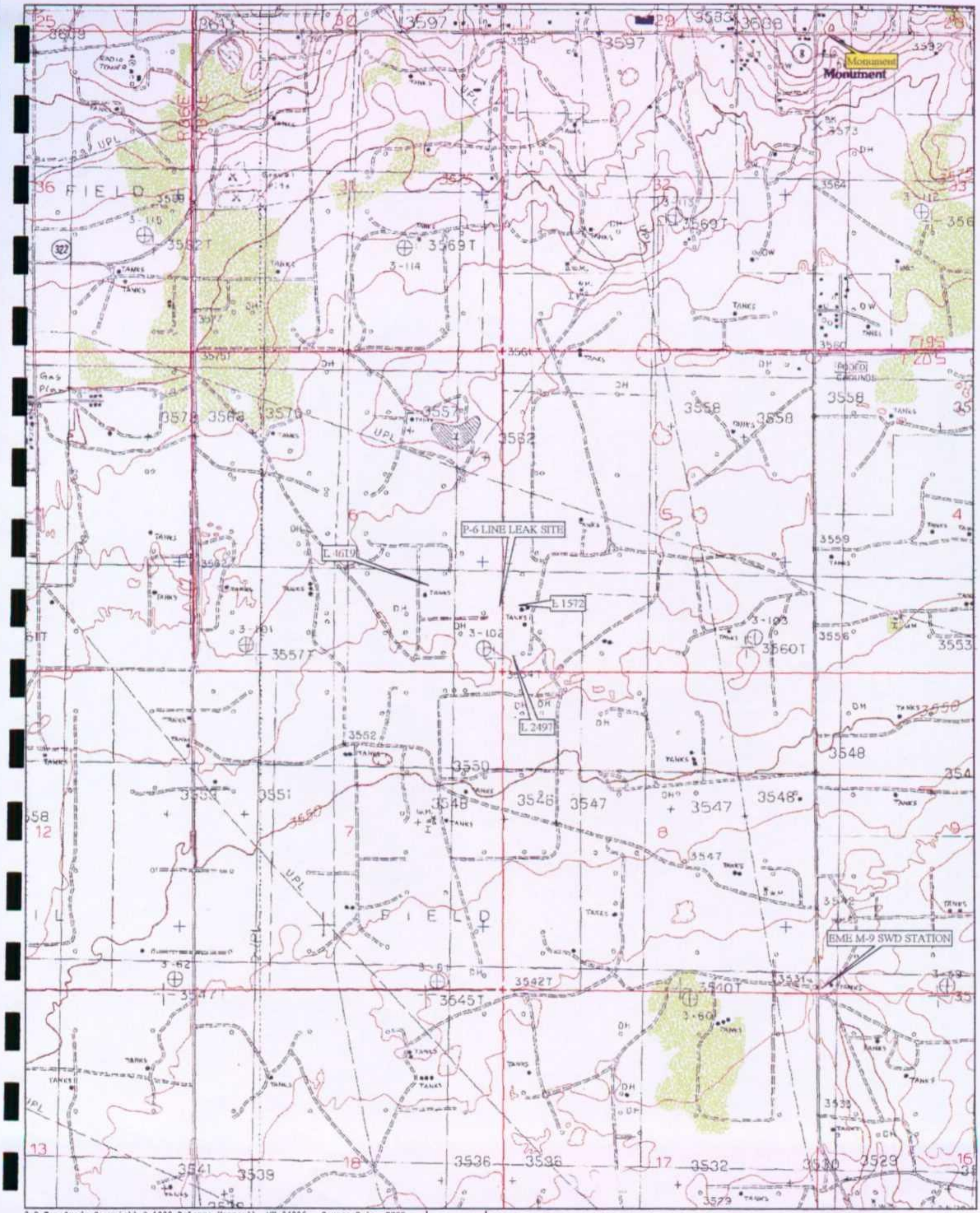
Trident Environmental has been retained by Rice Operating Company (ROC) to develop and submit this work plan for further actions regarding the hydrocarbon-impacted soil and chloride and total dissolved solids (TDS) -impacted groundwater at the EME P-6 line leak site. The actions described below are recommended.

Site Background

This project has been ongoing since the initial leak was discovered on November 29, 2000. So far work has included replacement of a 20-foot section of the 10-inch broken pipeline, preliminary site assessment sampling (field testing of chlorides and TPH in soil samples), installation and sampling of one groundwater monitoring well (MW-1), and notification to the New Mexico Oil Conservation Division (NMOCD) of all critical junctures related to the project (C-141 forms, Notification of Groundwater Impact, Disclosure Reports, etc). Copies of the field test results and initial C-141 form are included in Attachment A. The site location is identified on the following USGS topographic map.

Preliminary Soil Sampling Results

On November 14, 2001, and April 29, 2003, evaluation and delineation of the hydrocarbons at the EME P-6 Line Leak site was performed using the "MEGA" TPH method (QP-03 in Attachment B) to determine field total hydrocarbon concentrations. In addition, chloride concentrations in soil samples were measured using the titration method (QP-01 in Attachment B). A summary of "MEGA" TPH and chloride concentrations in soil is provided in Table 1. Although there has been no benzene detected in groundwater, field-testing indicates there is hydrocarbon impact (20,060 ppm with "MEGA" TPH analyzer) at depth (11 feet) in the vadose zone. However, based on field-testing results and lab analysis the hydrocarbon impact decreases quickly below that point (166 ppm at 30 feet below ground surface). "MEGA" TPH values ranged from a minimum of 67 to a maximum of 23,510 ppm. The higher "MEGA" TPH concentrations were found immediately below the line leak and at the surface within a 25-foot radius. Away from the source area the concentrations decreased dramatically within the upper two feet of soil.



Source Data: USGS 1000 ft Scale: 1 : 25,000 Detail: 13-0 Datum: WGS84

Table 1

Summary of "MEGA" TPH and Chloride Concentrations in Soil

Sample ID	Sample Location	Sampling Date	Sample Depth (Ft bgs)	"MEGA" TPH (ppm)	Chloride (ppm)
A	2 ft southeast of line leak source	11-14-01	5	4,380	525
			10	11,000	275
			15	879	600
			20	122	400
			25	441	500
			30	166	275
B	4 ft east of line leak source	04-29-03	3	23,510	200
			5	11,950	500
			7	9,900	950
			9	18,560	700
			11	20,060	500
			13	7,550	750
			15	6,270	750
C	23 ft west of line leak source	04-29-03	0	88	50
D	38 ft east of line leak source	04-29-03	0	67	50
			2	74	50
E	18.5 ft south of line leak source	04-29-03	0	964	100
			2	67	100
F	18 ft north of line leak source	04-29-03	0	3710	200
			2	67	200
G	25 ft north of line leak source	04-29-03	0	88	50

Potential Receptors

No residence or manned facilities are located within one mile of the site. Other oil and gas operations are present crossing the site area including two old abandoned pipelines (3" and 12" steel) and one 4" steel pipeline. The owners and operators of these lines are unknown. Based on database information obtained from the New Mexico State Engineer Office website and the USGS Monument SW topographic map, water wells identified within a 1,000 foot radius of the site are listed in Table 2 below. Locations of these wells and the site are included on the included topographic map. Based on the permit date and owner names, it is apparent that the permitted wells were constructed for industrial use (temporary water supply wells for oil well drilling). During a field survey conducted on January 24, 2003, none of these wells could be located; therefore it is most likely that they no longer exist.

Table 2

Water Wells Identified Within 1,000 feet of the EME P-6 Site

File No.	Permit Date	Owner	Distance from site	Well Use
L1572	09/15/1952	Exploration Drilling Co.	~500 ft E	Oil field supply well
L2497	03/08/1954	Amerada Petroleum Co.	~1,000 ft SE	Oil field supply well
L4619	03/29/1961	Gulf Oil Co.	~1,000 ft NW	Oil field supply well

Risk-Based Assessment

Trident performed a quantitative risk assessment to establish remediation action levels based on general knowledge of the chemistry of the hydrocarbons historically transported in the P-6 line relative to the worst-case parameters assumed in the establishment of the general NMOCD default target levels, particularly with respect to the receptor pathways of concern. The primary pathway of concern at this site is the protection of the groundwater due to leaching of the remaining hydrocarbons in the soil. There are no domestic water wells near the site. Inhalation of volatilized hydrocarbons by potential surface receptors was not considered because the remediation plans for the impacted soil will eliminate the hydrocarbon inhalation pathway risk.

While the MEGA-TPH sampling assessment conducted in November 2001 was useful in assessing the extent of the hydrocarbon-impacted soil, it cannot be used to interpret potential risks to human health and the environment. Therefore, soil samples recovered in April 2003 from the location and depth of the greatest subsurface MEGA-TPH concentration observed (20,060 ppm) at 11 feet below the surface, approximately 8 feet below the pipeline leak, were sent to the laboratory for analysis of benzene, toluene, ethylbenzene, total xylenes (BTEX) using EPA Method 8021B, gas and diesel range organics (GRO/DRO) using EPA Method 8015M, and total petroleum hydrocarbon (TPH) fractions using Texas Method 1006. An additional sample was taken at 15 feet below the surface (6,270 ppm MEGA-TPH) to determine the relative changes in the hydrocarbon concentrations with depth. The BTEX analysis was conducted so that the concentration of benzene in the soil could be used to assess the carcinogenic risk and the TPH fraction analysis was conducted to assess the non-carcinogenic risks. GRO/DRO was used as a screening tool to determine the need for the more expensive TPH fraction analysis and comparison with "MEGA" TPH values. A summary of the laboratory analytical results for the two soil samples is provided in the table below.

Table 3

**Summary of BTEX, GRO, DRO,
Aliphatic, and Aromatic Concentrations in mg/kg**

Analysis	Analytical Method	Compounds	Sample Depth	
			11' bgs	15' bgs
BTEX	8021B	Benzene	0.212	0.044
		Toluene	0.633	0.133
		Ethylbenzene	3.62	0.578
		Toluene	4.42	1.43
TPH	8015M	GRO	654	142
		DRO	1940	579
Aliphatics	TX1006	>C7-C8	24.3	12.7
		>C8-C10	196	15.3
		>C10-C12	390	51.1
		>C12-C16	822	153
		>C16-C21	469	92.8
		>C21-C35	582	74.9
Aromatics	TX1006	>C7-C8	34.1	38.4
		>C8-C10	44.6	54.2
		>C10-C12	7.55	<10.0
		>C12-C16	42.2	14.1
		>C16-C21	63.5	13.1
		>C21-C35	44.7	14.5

The potential future impact to the groundwater from the remaining hydrocarbon-impacted soil was predicted by modeling the vertical migration (fate and transport) of the soil contaminants using the VLEACH™ one-dimensional finite difference vadose zone-leaching model. A more in depth documentation of the risk assessment results for hydrocarbon compounds are presented in Attachment C. A summary table of the VLEACH modeling results for constituents of concern is provided below. It indicates that none of the predicted leachate concentrations exceed the calculated leachate Risk-Based Screening Levels (RBSLs).

Table 4
VLEACH Modeling Results for Constituents of Concern

Compound	Time Required for Maximum Leachate Concentration to Occur	Max. Leachate Concentration (mg/L)	Leachate RBSLs (mg/L)
Non-Carcinogen			
Aromatic $EC_{>7-8}$	60 years	4.31	590
Aromatic $EC_{>8-10}$	80 years	0.852	120
Aromatic $EC_{>10-12}$	0 years	0.099	120
Aromatic $EC_{>12-16}$	0 years	0.070	120
Carcinogen			
Benzene	30 years	0.035	0.291

Based on the modeling results presented herein it is apparent that the remaining hydrocarbons in the soil at the P-6 Line Leak site should not present a human health risk for current or future commercial receptors who may ingest the groundwater.

Line Replacement, Excavation, Soil Sampling and Reseeding Procedures

Excavation, lining, backfilling, and reseeding with native vegetation, as described herein, is proposed as an engineering control for site remediation based on the following reasons:

- To eliminate potential exposure to vapors from future commercial or residential receptors (surface inhalation pathway)
- To provide an protective barrier eliminating the potential for infiltration of precipitation and the migration of residual hydrocarbons and chlorides through the vadose zone.
- To capture and retain the limited amount of precipitation within the root zone for use by native vegetation.

Prior to excavation work, an approximate 1375-foot section of the 10-inch pipeline that links the P-6 junction box with other facilities will be replaced with 10-inch poly line as a safety precaution for excavating around the existing pipeline. The excavation contractor will be responsible for contacting the New Mexico One Call for all line location requests. During excavation operations, subsurface soil samples will be collected and field screened with a "MEGA" TPH analyzer and/or organic vapor analyzer (OVM). All soil sampling, headspace analysis, and laboratory analysis will be performed in accordance with NMOCD *"Guidelines for Remediation of Leaks, Spills, and Releases"* (August 13, 1993).

It is proposed that using conventional backhoe equipment, the excavation shall not exceed 12 feet below ground surface (bgs). Although the risk assessment supports that removal of hydrocarbon-impacted soil is not necessary, soil with GRO/DRO levels above 10,000 mg/kg shall be hauled to an NMOCD-approved facility. Upon completion of excavation activities, closure samples will be collected in accordance with the procedures explained in QP-06, QP-07, and QP-08 (Attachment B). Soil samples submitted to the laboratory shall be analyzed for gas and diesel range organics (GRO and DRO) using EPA Method 8015 to determine TPH concentrations. Samples with headspace readings or GRO levels above 100 ppm will also be analyzed for BTEX using EPA Method 8021B.

A minimum 10-12 inch thick clay liner, compacted to meet or exceed 95 percent of a Proctor Test (ASTM-D-698) with a permeability less than or equal to 10^{-7} cm/sec, will be installed three to five feet below ground surface. The clay liner will be sloped to the southeast and shall extend laterally to insure sufficient deflection of any potential infiltrating water originating from the surface. The backfill (above and below the clay liner) will be composed of blended or remediated soil and will support vegetation. The surface will be contoured and shall be reseeded with native vegetation to eliminate any ponding of precipitation and promote evapotranspiration, thereby minimizing natural infiltration. Vegetation will be monitored for growth.

Upon completion of the above-referenced activities, a C-141 form will be submitted to the NMOCD. The C-141 form will include the following elements:

- Excavation, lining, backfilling, and reseeding procedures;
- Sample methods, laboratory analytical reports, and a summary of analytical results;
- Site map showing the excavated area, sample locations, and pertinent structures;
- Cross-sectional drawing illustrating the extent of excavation, and placement of backfill, clay liner, and topsoil;
- Headspace readings (OVM) and/or "MEGA" TPH Analyzer results (sample screening);
- Volume of excavated soil in cubic yards;
- Manifests (load tickets) of disposed soil
- Photographs of work related activities.

Installation of Groundwater Monitoring Wells

The soil boring and backhoe excavation data listed in Table 1 indicate relatively low concentrations of chlorides in the subsurface soil below the line leak source area with levels of 200 ppm at 3 feet bgs, increasing to 950 ppm at 7 feet bgs, and then steadily decreasing to 275 ppm at 30 feet bgs. This suggests that the residual chlorides in the vadose zone no longer pose a threat to leaching into the groundwater because the bulk of the chloride mass appears to have already passed through to groundwater and the vadose zone is no longer under saturated conditions.

ROC installed one monitoring well (MW-1) directly within the former source area on January 9, 2002 and has sampled it on a quarterly basis for major ions (chloride, sulfate, bicarbonate, carbonate, calcium, magnesium, sodium, potassium), total dissolved solids (TDS), and benzene, toluene, ethylbenzene, and xylenes (BTEX). A summary of pertinent analytical results is listed in Table 5.

Table 5

Summary of Groundwater Analytical Results for MW-1

Date Sampled	Depth to Groundwater (feet)	Chloride (mg/L)	TDS (mg/L)	BTEX (mg/L)
01/10/02	48.00	10,700	20,248	< 0.006
05/14/02	48.60	8,060	18,200	< 0.001
08/15/02	47.80	9,570	16,900	< 0.001
11/06/02	47.77	9,040	17,400	< 0.001
02/27/03	47.79	8,860	15,000	< 0.001
05/29/03	47.72	8,680	20,000	< 0.001

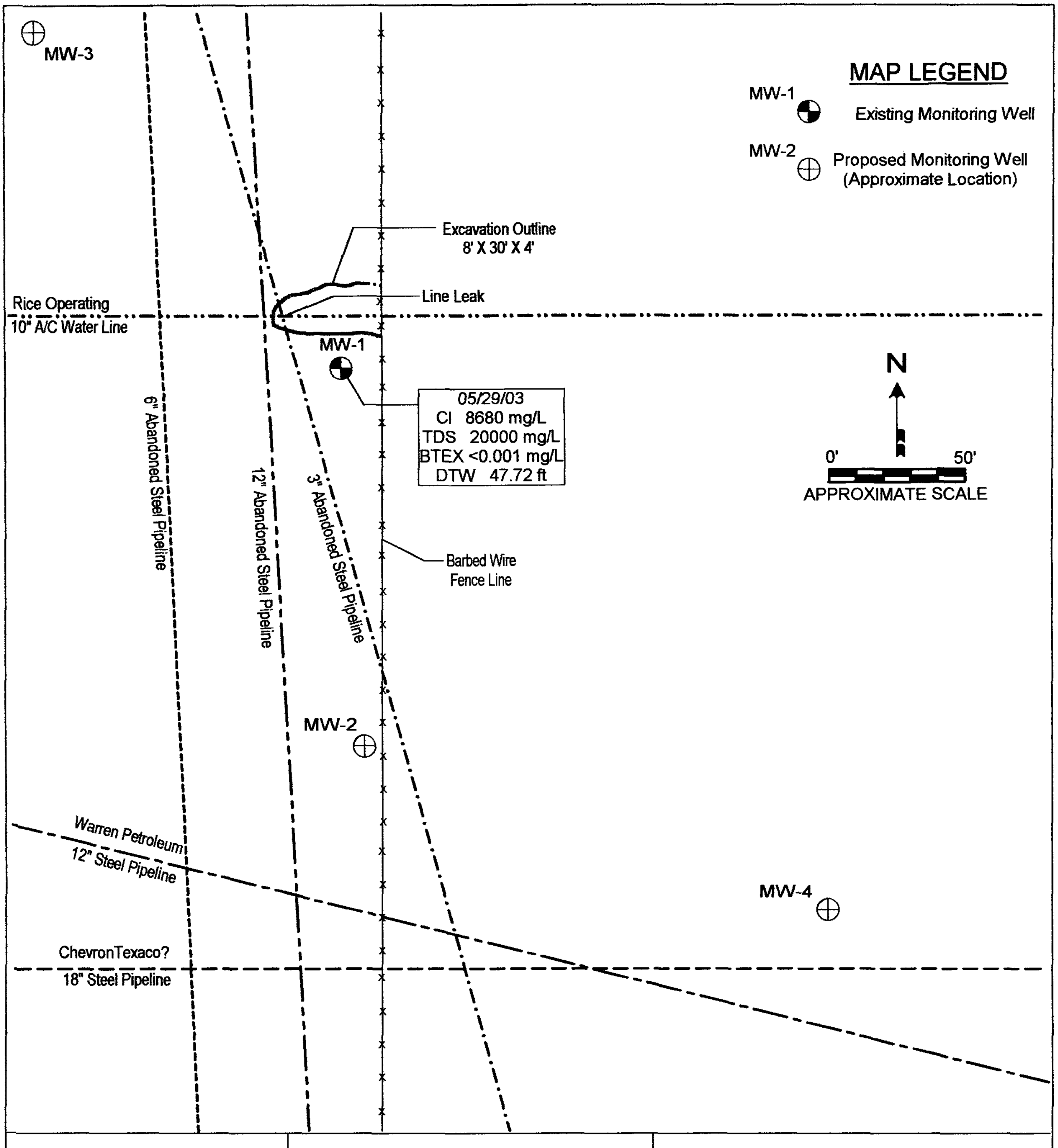
Although the most recent concentrations of chloride (8,680 mg/L) and TDS (20,000 mg/L) are above the New Mexico Water Quality Control Commission (WQCC) standards of 250 mg/L and 1,000 mg/L, respectfully, the excavation and clay liner work explained above will minimize the threat of future migration of chlorides in the subsurface soil and groundwater. Therefore, Trident recommends the installation of additional monitoring wells to delineate the horizontal extent of the chloride/TDS plume and determine the magnitude and direction of the groundwater gradient. The likely direction of groundwater flow is to the southeast, therefore Trident recommends the installation of the additional monitoring wells listed below.

- MW-2 approximately 200 feet south of MW-1 in the presumed down gradient direction.
- MW-3 approximately 150 feet northwest of MW-1in the presumed up gradient direction
- MW-4 approximately 200 feet down gradient from MW2 *only if* MW2 indicates groundwater is impacted with greater than 250 mg/l chlorides or 1,000 mg/l TDS

A site map with the proposed well locations is shown on the following page. During drilling operations, soil samples will be collected periodically (five feet intervals) and field tested for chloride using the titration method (Attachment C). Samples in the vadose zone and capillary fringe will also be submitted to the lab for analysis of gravimetric moisture content. Monitoring wells will be constructed of 2-inch diameter Schedule 40 PVC casing and screen (Attachment B). The wells will be completed with at least 5 feet of the well screen above the surface of the water table and at least 10 feet below the water table.

Monitoring Well Sampling Procedures

Prior to sampling, the monitoring will be gauged for depth to groundwater using an electronic water level indicator. Immediately prior to collecting groundwater samples, each monitoring well will be purged of a minimum of three well casing volumes of water using a new, clean, decontaminated disposable bailer.
Water samples will be collected with the disposable bailer and transferred into appropriately preserved containers for analysis of major ions, TDS, and BTEX. Chain-of-custody (COC) forms documenting sample identification numbers, collection times, and delivery times to the laboratories will be completed for each set of samples. The water samples will be placed in an ice-filled cooler immediately after collection and transported to Environmental Lab of Texas in Odessa, Texas, or other approved laboratory, for analysis of the aforementioned constituents. Purging and water sampling procedures are described in further detail in Attachment C (QP-04 and QP-05).



TRIDENT
ENVIRONMENTAL

Site: EME P-6 Line Leak

Date: May 29, 2003

Author: GJV Checked By: DTL

File: Projects/Rice/EME/P6/P6SiteMap

EME P-6 SITE MAP

PROPOSED MONITORING WELL LOCATIONS

Fate and Transport Modeling of Chlorides/TDS in Groundwater

The data obtained from the on site monitoring wells with other site specific information will be input into a fate and transport model such as WinTran (Version 1.3) to determine if the chloride/TDS plume will eventually attenuate by dispersion and dilution to levels below WQCC standards within a reasonable length of time and without risk to the human health and the environment.

Reporting Requirements

Depth to water measurements and groundwater samples will be obtained on a quarterly frequency for one year beginning immediately after the installation of the proposed new monitoring wells and annually thereafter. An annual groundwater investigation and monitoring report describing the monitoring well construction, sampling procedures, analytical results, modeling results, and conclusions of the investigation will be submitted to the New Mexico Oil Conservation Division (NMOCD). The following elements will be included in the annual report:

- A lithologic description and well completion diagram of the subsurface soils encountered, conditions observed, and construction details of each monitoring well.
- Groundwater elevation data and chloride and TDS concentrations for each monitoring event will be summarized in tabular format.
- Groundwater elevation map depicting the water table elevations and direction of groundwater flow for each sampling event.
- Chloride and TDS concentration maps for each sampling event.
- Maps displaying the modeled fate and transport of the chloride/TDS plume with respect to time.
- Identification of potential receptors
- Recommended further actions.

The proposed activities will be performed in accordance with NMOCD *"Guidelines for Remediation of Leaks, Spills, and Releases"* (August 13, 1993). Notice will be provided to the NMOCD at least one week prior to each sampling event. We appreciate the opportunity to work with you on this project. Please feel free to call me at 432-682-0808, or Carolyn Haynes or Kristin Farris at 505-393-9174, if you have any questions.

Sincerely,

Gilbert J. Van Deventer, REM, NMCS
Project Manager

cc: Carolyn Haynes, ROC (Hobbs, NM)

ATTACHMENTS

ATTACHMENT A

INITIAL C-141 FORM

AND

PRELIMINARY SITE ASSESSMENT DATA

EME P-6

District I
P.O. Box 1980, Hobbs, NM 88241-1980
District II
811 South First, Artesia, NM 88210
District III
1000 Rio Brazos, Aztec, NM 87410
District IV
2040 South Pacheco, Santa Fe, NM 87505

State of New Mexico
Energy, Minerals & Natural Resources Department
OIL CONSERVATION DIVISION
2040 South Pacheco
Santa Fe, NM 87505
OPERATOR'S MONTHLY REPORT

Form C-141
Originated 2/13/97

Submit 2 copies to
Appropriate District
Office in accordance
with Rule 116 on
back side of form

Release Notification and Corrective Action

OPERATOR

☒ Initial Report ☐ Final Report

Name Rice Operating Company	Contact James Sturgill
Address 122 West Taylor Hobbs, NM 88240	Telephone No. 505-393-9174
Facility Name EME SWD SYSTEM	Facility Type SWD Disposal Line

Surface Owner	Mineral Owner	Lease No.
JIMMY COOPER		

LOCATION OF RELEASE

Unit Letter	Section	Township	Range	Feet from the	North/South line	Feet from the	East/West Line	County
P	6	20S	37E					LEA

NATURE OF RELEASE

Type of Release PRODUCTION WATER	Volume of Release 20 BBLS	Volume Recovered 15 BBLS
Source of Release CRACK IN 10 A/C PIPE	Date and Hour of Occurrence 4: 00 PM 11-29-00	Date and Hour of Discovery 11-29-00 4:00 PM

Was Immediate Notice Given? ☐ Yes No X Not Required	If YES, To Whom?
By Whom? James Sturgill	Date and Hour
Was a Watercourse Reached? ☐ Yes X No	If YES, Volume Impacting the Watercourse. N/A

If a Watercourse was Impacted, Describe Fully. (Attach Additional Sheets If Necessary)

N/A

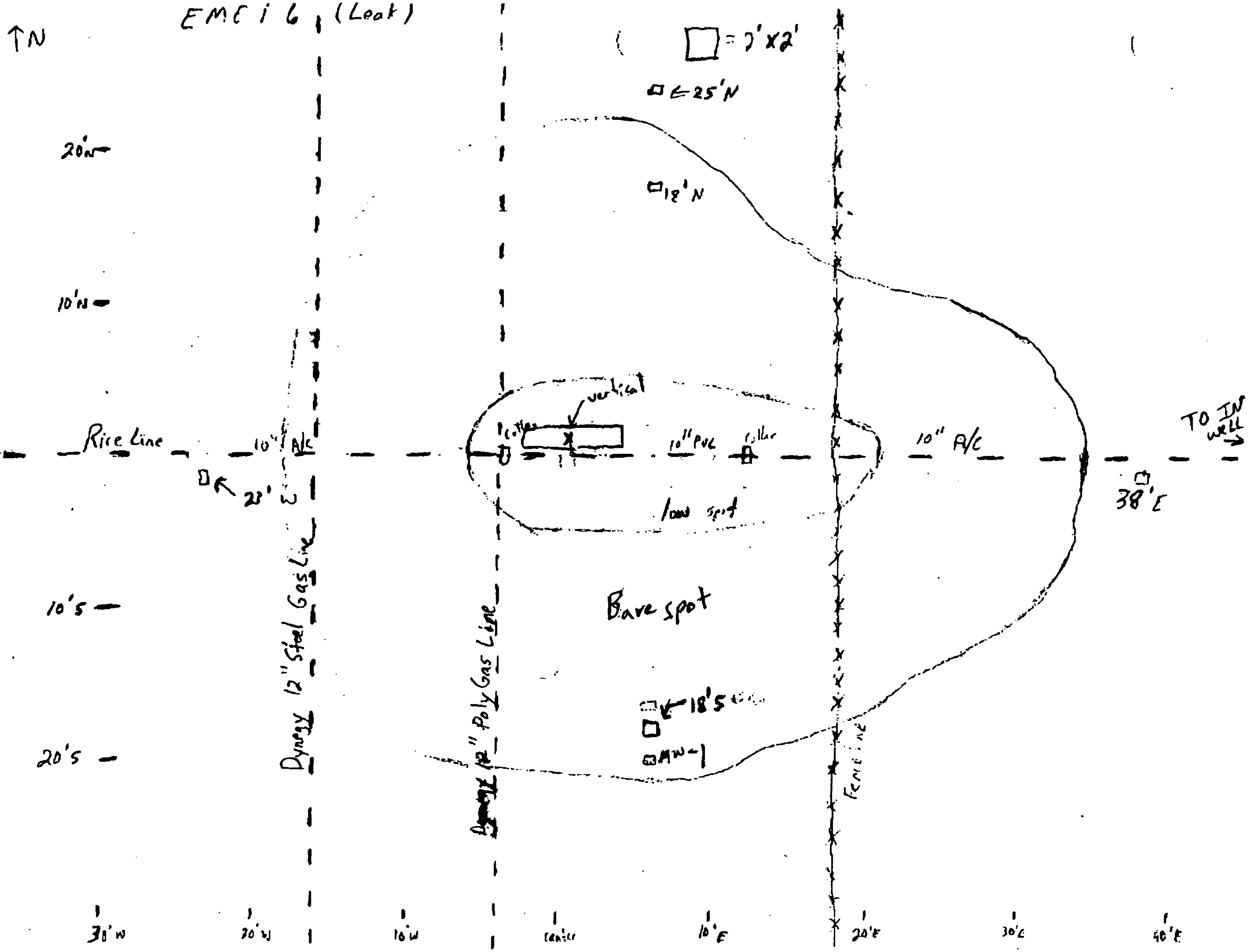
Describe Cause of Problem and Remedial Action Taken. (Attach Additional Sheets If Necessary)
HOLE IN 10" A/C PIPE, REPLACED WITH TWENTY FEET OF 10" PVC.

Describe Area Affected and Cleanup Action Taken. (Attach Additional Sheets If Necessary)
ONE HUNDRED TWENTY SQUARE FEET ON THE EAST SIDE OF FENCE IN U M SEC. 7-T20S-R37E. MOVED . PICKED UP PRODUCTION WATER , AND ALLOW TO DRY

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to NMOCD rules and regulations all operators are required to report and /or file certain release notifications and perform corrective actions for releases which may endanger public health or the environment. The acceptance of a C-141 report by the NMOCD marked as "Final Report" does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to ground water, human health or the environment. In addition, NMOCD acceptance of a C-141 report does not relieve the operator of responsibility for compliance with any other federal, state, or local laws and /or regulations.

Signature: James Sturgill Printed Name: James Sturgill	OIL CONSERVATION DIVISION Approved by District Supervisor:	
Title: Environmental Technician	Approval Date:	Expiration Date:
Date: November 29, 2000 Phone: 505-393-9174	Conditions of Approval:	Attached ☐

EMC i 6 (Leak)


↑N
□ = 2'x2'
□ ← 25'N
□ 18'N
20'N
10'N
10'S
20'S
Rice Line
10" A/C
□ ↖ 23' W
Dynegy 12" Steel Gas Line
Dynegy 12" Poly Gas Line
collar
vertical
10" PVC
collar
low spot
10" A/C
TO IN well →
□ 38'E
Bare spot
□ ← 18'S
□ MW-1
Fence line
30'W
20'W
10'W
center
10'E
20'E
30'E
40'E

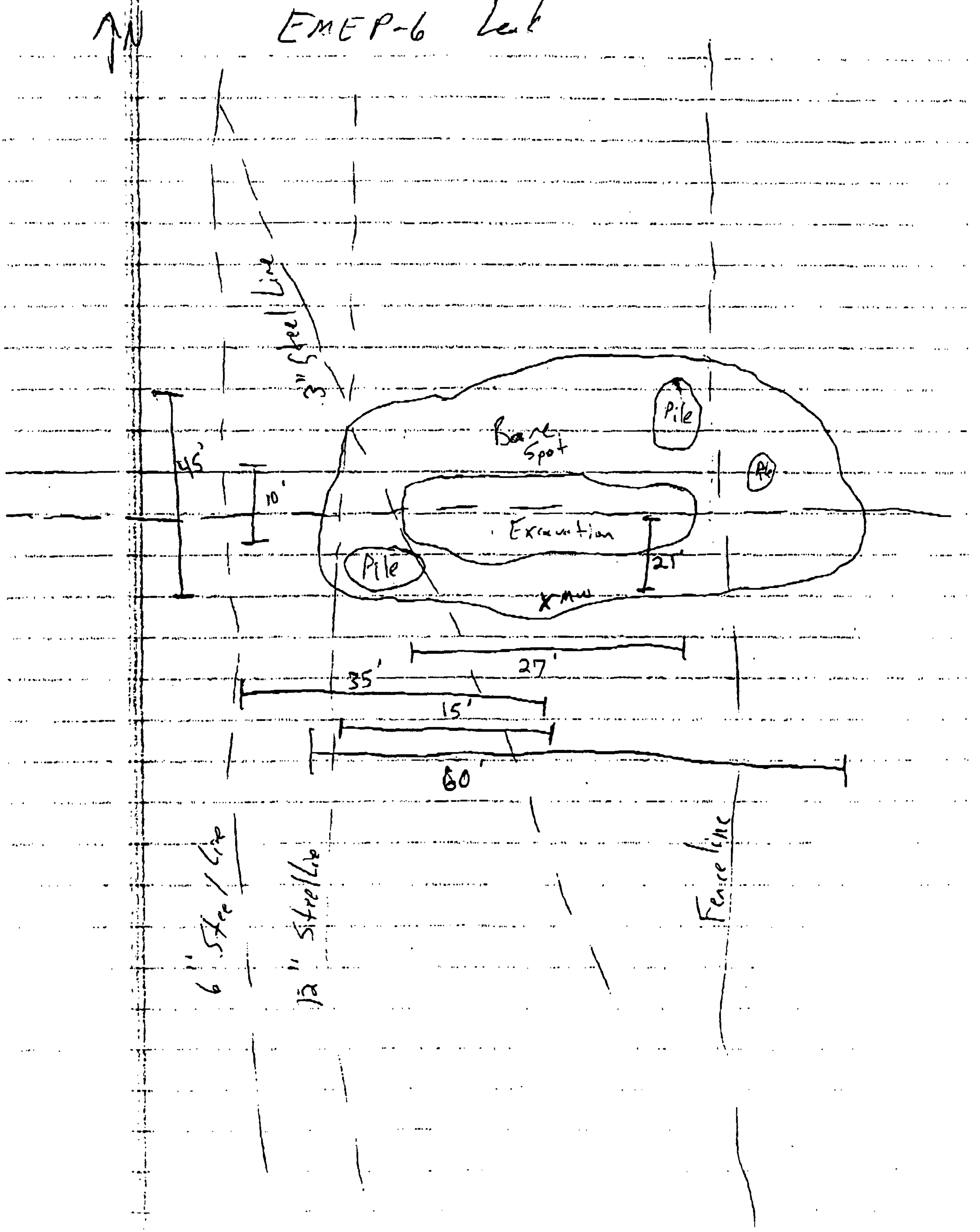
EME P-6 (Leak)

4-29-03
Logan Anderson
RE Env.

	below Pipe	TPH		Chloride
vert @ 3'	—	23,510 ppm		200 ppm
@ 5'	2'	11,950 ppm		500 ppm
@ 7	4'	9,900 ppm		950 ppm
@ 9'	6'	18,560 ppm		700 ppm
@ 11	8'	20,060 ppm	LAB 8015M TX1006	500 ppm
@ 13'	10'	7,550 ppm	LAB 8015M	750 ppm
@ 15'	12'	6,270 ppm		750 ppm
23' W @ surf.		88 ppm		50 ppm
38' E @ surf.		67 ppm		50 ppm
@ 2'		74 ppm		50 ppm
18' S @ surf.		964 ppm		100 ppm
@ 2'		67 ppm		100 ppm
18' NE surf.		3,710 ppm		200 ppm
@ 2'		67 ppm		200 ppm
25' N @ surf.		81 ppm		50 ppm

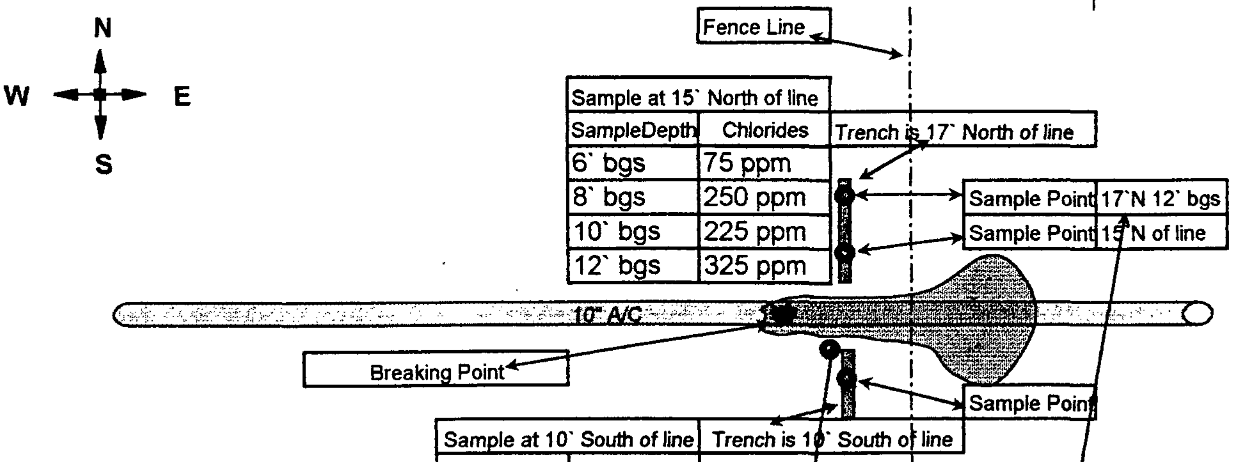
	GRO	DRO
@ 8'	508	1507
@ 11	112	455

EMEP-6 Leak


N
3" Steel Line
45'
10'
Bare Spot
Pile
Pile
Pile
Excavation
21'
X MW
27'
35'
15'
60'
6" Steel Line
12" Steel Line
Fence line

Sampled 11-14-01

P-6



Sample at 15` North of line	
SampleDepth	Chlorides
6` bgs	75 ppm
8` bgs	250 ppm
10` bgs	225 ppm
12` bgs	325 ppm

Sample at 10` South of line	
SampleDepth	Chloride
6` bgs	175 ppm
8` bgs	275 ppm
10` bgs	250 ppm
12` bgs	225 ppm

Sample at 17` North of line	
SampleDepth	Chlorides
12` bgs	25 ppm

	Field Bore Results		
	Depth	TPH	Chlorides
	5` bgs	4380 ppm	525 ppm
	10` bgs	11000 ppm	275 ppm
	15` bgs	879 ppm	600 ppm
	20` bgs	122 ppm	400 ppm
	25` bgs	441 ppm	500 ppm
	30` bgs	166 ppm	275 ppm
Lab Analysis	30` bgs	166 ppm	337 ppm

SWD E.M.E. System
P-6 Site Ground Water Depth 30` BGS
T20S/R37E SE 1/4 SE 1/4 Sec 6
Date of discharge 11/29/00

The landowners for the above referenced site are.
~~Jimmy Cooper~~ on the West side of the fence line.
James Dell Barber on the East side of the fence line.

O.P. Sims ←

@ 7-11' black clay on North side
looks like old sustained leak
sandy clay 7-11' may have stopped
the majority of TPH

Remove impacted soil to 15', install compacted
clay layer and back fill w/ clean soil.
Install MW to determine if impact to gw.

P-6

R.E. ENVIRONMENTAL SERVICES INC.

P.O. BOX 13418 ODESSA TX. 79768-3418 (915) 550-8522

Bill To: Rice Operating, Inc.
Attn: Donnie Anderson
Address: 122 W. Taylor
City, State, Zip: Hobbs, NM 88240

Receiving Date:
Analysis Date: 11/16/01
Sample Type: Soil
Sampling Date: 11/14/01
Location: P-6, E-12, N-33, I-1-A, I-1-C
Location #:
Sample Condition:

LOCATION		TPH In Soil	TPH In Water	Chloride In Soil	Chloride In Water	PH In Soil	PH In Water
P-6	5' BGS	4,380ppm					
	10' BGS	11,000ppm					
	15' BGS	879ppm					
	20' BGS	122ppm					
	25' BGS	441ppm					
I-1-A & I-1-C	5' BGS	185ppm					
EME E-12	10' BGS	29ppm					
N-33	15' BGS	18ppm					
	25' BGS	15ppm					
	35' BGS	15ppm					
	40' BGS	14ppm					

Relinquished By:
Date: November 27, 2001
Received By: Derek Robinson
Time:
Company Name & Address: R.E. Environmental Services, Inc.
P.O. Box 13418 Odessa, TX 79768-3418

	Chloride
5'	525ppm
10'	275ppm
15'	600ppm
20'	400ppm
25'	500ppm
30'	275ppm

11/30/01

N Trench 12' North of Pipe

6'	75 ppm
8'	250 ppm
10'	225 ppm
12'	325 ppm

11/29/01

S Trench 10' South of Pipe

6'	175ppm
8'	275ppm
10'	250ppm
12'	225ppm

N Trench 11/30/01 21' North of Pipe

12'	25 ppm

P-6

Atkins Engineering Associates, Inc.
2904 W. 2nd St., Roswell, NM 88202-3156

LOG OF BORING Rice ~~B~~ P-6

(Page 1 of 1)

Rice Operating Co.
122 West Taylor
Hobbs, New Mexico 88240

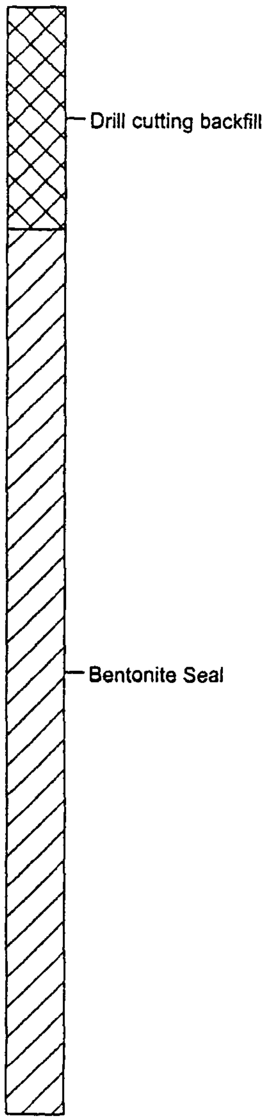
Contact: Donnie Anderson

Job#: RICEENV.JAL.01

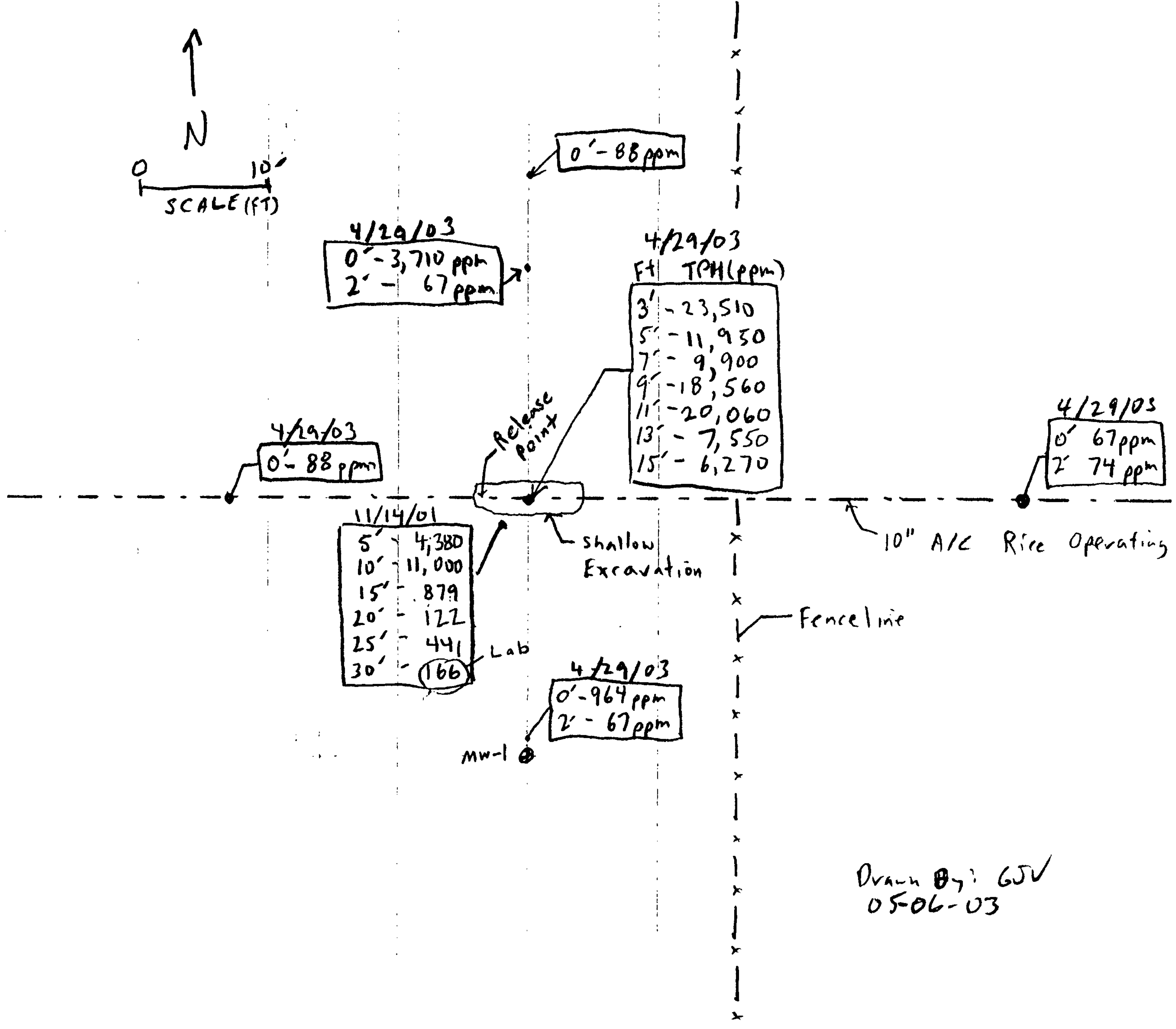
Date	: 11-14-01	Site Location	: Monument, NM
Drill Start	:	Auger Type	: Air drill
Drill End	:	Logged By	: Mort Bates
Boring Location	: Edge of pit		

Depth in Feet	GRAPHIC	USCS	Samples [illegible]	DESCRIPTION	TPH Lab
0	░	SP		Poorly graded sand, reddish tan, loose, damp	
5	░		525		4380
10	▨	CL	275	Sandy clay, tan, loose, damp	11,000
15	░	SP	600	Poorly graded sand, tan, loose, dry	879
20	░		480		122
25	░		500		241
30	▦		275	Caliche, tan, hard, dry	Lab 86
35			Lab 337	Total depth 30'	

Well: B-6



11-20-2001 C:\MTECH46\RICEJAL\b-6.bor


N
0
10'
SCALE (FT)
0'-88ppm
4/29/03
0'-3,710 ppm
2' - 67 ppm
4/29/03
Ft TPH (ppm)
3' - 23,510
5' - 11,950
7' - 9,900
9' - 18,560
11' - 20,060
13' - 7,550
15' - 6,270
4/29/03
0'- 88 ppm
Release point
4/29/03
0' 67ppm
2' 74 ppm
11/14/01
5' - 4,380
10' - 11,000
15' - 879
20' - 122
25' - 441
30' - 166
Lab
Shallow Excavation
10" A/C Rice Operating
Fenceline
4/29/03
0'-964 ppm
2' - 67 ppm
MW-1
Drawn By: GJV
05-06-03

ANALYTICAL REPORT

Prepared for:

Kristin Farris
Rice Operating
122 W. Taylor
Hobbs, NM 88240

Project: P-6 Leak
PO#: 510
Order#: G0306380
Report Date: 05/06/2003

Certificates
US EPA Laboratory Code TX00158

ENVIRONMENTAL LAB OF TEXAS

SAMPLE WORK LIST

Rice Operating
122 W. Taylor
Hobbs, NM 88240
505-397-1471

Order#: G0306380
Project:
Project Name: P-6 Leak
Location: EME

The samples listed below were submitted to Environmental Lab of Texas and were received under chain of custody. Environmental Lab of Texas makes no representation or certification as to the method of sample collection, sample identification, or transportation/handling procedures used prior to the receipt of samples by Environmental Lab of Texas, unless otherwise noted.

Lab ID:	Sample :	Matrix:	Date / Time Collected	Date / Time Received	Container	Preservative
0306380-01	8' Below Pipe	SOIL	4/29/03	4/29/03 19:50	4 oz glass	Ice

Lab Testing: **Rejected:** No **Temp:** 4 C

1006 TNRCC, Aliphatics
1006 TNRCC, Aromatics
8015M
8021B/5030 BTEX

Lab ID:	Sample :	Matrix:	Date / Time Collected	Date / Time Received	Container	Preservative
0306380-02	12' Below Pipe	SOIL	4/29/03	4/29/03 19:50	4 oz glass	Ice

Lab Testing: **Rejected:** No **Temp:** 4 C

1006 TNRCC, Aliphatics
1006 TNRCC, Aromatics
8015M
8021B/5030 BTEX

ENVIRONMENTAL LAB OF TEXAS
ANALYTICAL REPORT

Kristin Farris
Rice Operating
122 W. Taylor
Hobbs, NM 88240

Order#: G0306380
Project:
Project Name: P-6 Leak
Location: EME

Lab ID: 0306380-01
Sample ID: ~~8' Below Pipe~~

11' bgs

1006 TNRCC, Aliphatics

Method Blank	Date Prepared	Date Analyzed	Sample Amount	Dilution Factor	Analyst	Method
		5/5/03	1	1	WL	1006

Parameter	Result mg/kg	RL
>C6-C8	24.3	25.0
>C8-C10	196	25.0
>C10-C12	390	25.0
>C12-C16	822	25.0
>C16-C21	469	25.0
>C21-C35	582	25.0

1006 TNRCC, Aromatics

Method Blank	Date Prepared	Date Analyzed	Sample Amount	Dilution Factor	Analyst	Method
		5/5/03	1	1	WL	1006

Parameter	Result mg/kg	RL
>C7-C8	34.1	25.0
>C8-C10	44.6	25.0
>C10-C12	7.55	25.0
>C12-C16	42.2	25.0
>C16-C21	63.5	25.0
>C21-C35	44.7	25.0

DL = Diluted out N/A = Not Applicable RL = Reporting Limit

ENVIRONMENTAL LAB OF TEXAS

ANALYTICAL REPORT

Kristin Farris
Rice Operating
122 W. Taylor
Hobbs, NM 88240

Order#: G0306380
Project:
Project Name: P-6 Leak
Location: EME

Lab ID: 0306380-01
Sample ID: ~~8' Below Pipe~~
11' bgs

8015M

Method Blank	Date Prepared	Date Analyzed	Sample Amount	Dilution Factor	Analyst	Method
		4/30/03	1	5	WL	8015M

Parameter	Result mg/kg	RL
GRO, C6-C12	654	50.0
DRO, >C12-C35	1940	50.0
TOTAL, C6-C35	2594	50.0

Surrogates	% Recovered	QC Limits (%)	
1-Chlorooctane	23%	70	130
1-Chlorooctadecane	20%	70	130

Lab ID: 0306380-02
Sample ID: ~~12' Below Pipe~~
15' bgs

8015M

Method Blank	Date Prepared	Date Analyzed	Sample Amount	Dilution Factor	Analyst	Method
		4/30/03	1	1	WL	8015M

Parameter	Result mg/kg	RL
GRO, C6-C12	142	10.0
DRO, >C12-C35	579	10.0
TOTAL, C6-C35	721	10.0

Surrogates	% Recovered	QC Limits (%)	
1-Chlorooctane	106%	70	130
1-Chlorooctadecane	92%	70	130

Approval: Raland K Tuttle 5-06-03
Raland K. Tuttle, Lab Director, QA Officer Date
Celey D. Keene, Org. Tech. Director
Jeanne McMurrey, Inorg. Tech. Director
Sandra Biezugbe, Lab Tech.
Sara Molina, Lab Tech.

DL = Diluted out N/A = Not Applicable RL = Reporting Limit

ENVIRONMENTAL LAB OF TEXAS

ANALYTICAL REPORT

Kristin Farris
Rice Operating
122 W. Taylor
Hobbs, NM 88240

Order#: G0306380
Project:
Project Name: P-6 Leak
Location: EME

Lab ID: 0306380-01
Sample ID: ~~8' Below Pipe~~
11' bgs

8021B/5030 BTEX

Method Blank	Date Prepared	Date Analyzed	Sample Amount	Dilution Factor	Analyst	Method
0005460-02		5/7/03 13:22	1	25	CK	8021B

Parameter	Result mg/kg	RL
Benzene	**0.212**	0.025
Toluene	**0.633**	0.025
Ethylbenzene	**3.62**	0.025
p/m-Xylene	**3.98**	0.025
o-Xylene	**0.438**	0.025

Surrogates	% Recovered	QC Limits (%)	
aaa-Toluene	229%	80	120
Bromofluorobenzene	128%	80	120

Lab ID: 0306380-02
Sample ID: ~~12' Below Pipe~~
15' bgs

1006 TNRCC, Aliphatics

Method Blank	Date Prepared	Date Analyzed	Sample Amount	Dilution Factor	Analyst	Method
		5/7/03	1	1	CK	1006

Parameter	Result mg/kg	RL
>C6-C8	**12.7**	10.0
>C8-C10	**15.3**	10.0
>C10-C12	**51.1**	10.0
>C12-C16	**153**	10.0
>C16-C21	**92.8**	10.0
>C21-C35	**74.9**	10.0

DL = Diluted out N/A = Not Applicable RL = Reporting Limit

ENVIRONMENTAL LAB OF TEXAS

ANALYTICAL REPORT

Kristin Farris		**Order#:**	**G0306380**
Rice Operating		**Project:**	
122 W. Taylor		**Project Name:**	**P-6 Leak**
Hobbs, NM 88240		**Location:**	**EME**

Lab ID: 0306380-02

Sample ID: ~~12" Below Pipe~~ 15' bgs

1006 TNRCC, Aromatics

Method Blank	Date Prepared	Date Analyzed	Sample Amount	Dilution Factor	Analyst	Method
		5/7/03	1	1	CK	1006

Parameter	Result mg/kg	RL
>C7-C8	**38.4**	10.0
>C8-C10	**54.2**	10.0
>C10-C12	**<10.0**	10.0
>C12-C16	**14.1**	10.0
>C16-C21	**13.1**	10.0
>C21-C35	**14.5**	10.0

8021B/5030 BTEX

Method Blank	Date Prepared	Date Analyzed	Sample Amount	Dilution Factor	Analyst	Method
0005460-02		5/7/03 13:43	1	25	CK	8021B

Parameter	Result mg/kg	RL
Benzene	**0.044**	0.025
Toluene	**0.133**	0.025
Ethylbenzene	**0.578**	0.025
p/m-Xylene	**1.23**	0.025
o-Xylene	**0.196**	0.025

Surrogates	% Recovered	QC Limits (%)	
aaa-Toluene	113%	80	120
Bromofluorobenzene	118%	80	120

Approval: Raland K Tuttle 5-8-03

Raland K. Tuttle, Lab Director, QA Officer — Date
Celey D. Keene, Org. Tech. Director
Jeanne McMurrey, Inorg. Tech. Director
Sandra Biezugbe, Lab Tech.
Sara Molino, Lab Tech.

DL = Diluted out N/A = Not Applicable RL = Reporting Limit

ENVIRONMENTAL LAB OF TEXAS

QUALITY CONTROL REPORT

8021B/5030 BTEX

Order#: G0306380

BLANK SOIL	LAB-ID #	Sample Concentr.	Spike Concentr.	QC Test Result	Pct (%) Recovery	RPD
Benzene-mg/kg	0005460-02			<0.025		
Toluene-mg/kg	0005460-02			<0.025		
Ethylbenzene-mg/kg	0005460-02			<0.025		
p/m-Xylene-mg/kg	0005460-02			<0.025		
o-Xylene-mg/kg	0005460-02			<0.025		

MS SOIL	LAB-ID #	Sample Concentr.	Spike Concentr.	QC Test Result	Pct (%) Recovery	RPD
Benzene-mg/kg	0306423-02	0	0.1	0.094	94.%	
Toluene-mg/kg	0306423-02	0	0.1	0.090	90.%	
Ethylbenzene-mg/kg	0306423-02	0	0.1	0.087	87.%	
p/m-Xylene-mg/kg	0306423-02	0	0.2	0.183	91.5%	
o-Xylene-mg/kg	0306423-02	0	0.1	0.090	90.%	

MSD SOIL	LAB-ID #	Sample Concentr.	Spike Concentr.	QC Test Result	Pct (%) Recovery	RPD
Benzene-mg/kg	0306423-02	0	0.1	0.105	105.%	11.1%
Toluene-mg/kg	0306423-02	0	0.1	0.103	103.%	13.5%
Ethylbenzene-mg/kg	0306423-02	0	0.1	0.102	102.%	15.9%
p/m-Xylene-mg/kg	0306423-02	0	0.2	0.211	105.5%	14.2%
o-Xylene-mg/kg	0306423-02	0	0.1	0.101	101.%	11.5%

SRM SOIL	LAB-ID #	Sample Concentr.	Spike Concentr.	QC Test Result	Pct (%) Recovery	RPD
Benzene-mg/kg	0005460-05		0.1	0.094	94.%	
Toluene-mg/kg	0005460-05		0.1	0.096	96 %	
Ethylbenzene-mg/kg	0005460-05		0.1	0.095	95.%	
p/m-Xylene-mg/kg	0005460-05		0.2	0.197	98.5%	
o-Xylene-mg/kg	0005460-05		0.1	0.090	90.%	

ENVIRONMENTAL LAB OF TEXAS

QUALITY CONTROL REPORT

8015M

Order#: G0306380

BLANK SOIL	LAB-ID #	Sample Concentr.	Spike Concentr.	QC Test Result	Pct (%) Recovery	RPD
TOTAL, C6-C35-mg/kg	0005388-02			<10.0		

MS SOIL	LAB-ID #	Sample Concentr.	Spike Concentr.	QC Test Result	Pct (%) Recovery	RPD
TOTAL, C6-C35-mg/kg	0306383-01	0	952	1023	107.5%	

MSD SOIL	LAB-ID #	Sample Concentr.	Spike Concentr.	QC Test Result	Pct (%) Recovery	RPD
TOTAL, C6-C35-mg/kg	0306383-01	0	952	983	103.3%	4.%

SRM SOIL	LAB-ID #	Sample Concentr.	Spike Concentr.	QC Test Result	Pct (%) Recovery	RPD
TOTAL, C6-C35-mg/kg	0005388-05		1000	790	79.%	

CASE NARRATIVE
ENVIRONMENTAL LAB OF TEXAS

Prepared for:

Rice Operating
122 W. Taylor
Hobbs, NM 88240

Order#: G0306380

Project: P-6 Leak

The following samples were received as indicated below and on the attached Chain of Custody record. All analyses were performed within the holding time and with acceptable quality control results unless otherwise noted.

SAMPLE ID	LAB ID	MATRIX	Date Collected	Date Received
8' Below Pipe	0306380-01	SOIL	04/29/2003	04/29/2003
12' Below Pipe	0306380-02	SOIL	04/29/2003	04/29/2003

Surrogate recoveries on 8015M TPH are outside of control limits due to dilution (G0306380-01).

The enclosed results of analyses are representative of the samples as received by the laboratory. Environmental Lab of Texas makes no representations or certifications as to the methods of sample collection, sample identification, or transportation handling procedures used prior to our receipt of samples. To the best of my knowledge, the information contained in this report is accurate and complete.

Approved By: Raland K Juo Date: 5-06-03
Environmental Lab of Texas I, Ltd.

Environmental Lab of Texas, Inc.

12600 West I-20 East
Odessa, Texas 79763

Phone: 915-563-1800
Fax: 915-563-1713

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

Project Manager: Kristin Farris
Company Name: RICE Operating
Company Address: 122 W. Taylor
City/State/Zip: Hobbs, NM 88240
Telephone No: (505)393-9174 631-5075
Fax No: (505)397-1471
Sampler Signature: Kristin Farris

Project Name: P-6 leak
Project #:
Project Loc: EME
PO #: 510

LAB # (lab use only) 630380	FIELD CODE	Date Sampled	Time Sampled	No. of Containers	Preservative: Ice	HNO3	HCl	NaOH	H2SO4	None	Other (Specify)	Matrix: Water	Sludge	Soil	Other (specify)	Analyze For: TDS / CL / SAR / EC	TPH 418.1	TCLP / TOTAL: TPH TX 1005 1006	TPH 8015M GRO/DRO	Metals: As Ag Ba Cd Cr Pb Hg Se	Volatiles	Semivolatiles	BTEX 8021B/5030	RUSH TAT (Pre-Schedule)	Standard TAT
01	8' below pipe	042903	—	1	X									X				X	X				X		
02	12' below pipe	042903	—	1	X									X				X	X				X		

Special Instructions: Fax Results to Trident Environmental (915) 682-0727

Relinquished by:	Date	Time	Received by:	Date	Time
K. Farris	042903	16:30			
Relinquished by:	Date	Time	Received at ELOT:	Date	Time
	4/29/03	19:40		4-29-03	1950

Sample Containers Intact? Y N
Temperature Upon Receipt:
Laboratory Comments:
* See attached fax for request 5/6/3

ATTACHMENT B

PROCEDURE FOR CONDUCTING FIELD TPH ANALYSIS (QP-01)

PROCEDURE FOR OBTAINING SOIL SAMPLES FOR TRANSPORTATIOJN TO A LABORATORY (QP-02)

SAMPLING AND TESTING PROTOCOL FOR CHLORIDE TITRATION (QP-03)

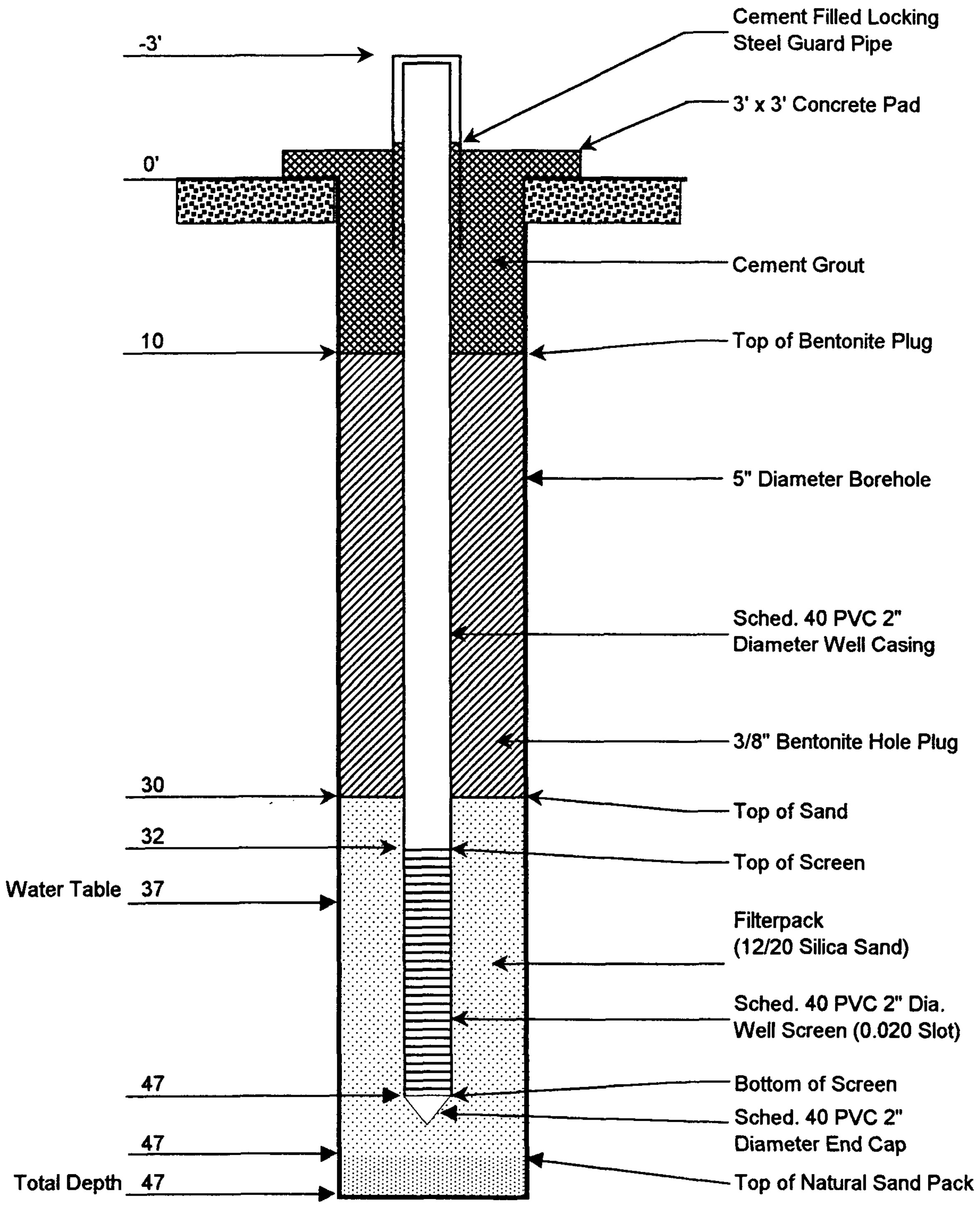
PROCEDURE FOR DEVELOPING CASED WATER MONITORING WELLS (QP-04)

PROCEDURE FOR OBTAINING WATER SAMPLES (CASED WELLS) (QP-05)

COMPOSITE SAMPLING OF EXCAVATION SIDEWALLS AND BOTTOMS (QP-06)

MONITORING WELL CONSTRUCTION DIAGRAM

MONITORING WELL CONSTRUCTION DIAGRAM



TRIDENT ENVIRONMENTAL	SITE: EME P-6 LINE LEAK			**Monitoring Well Construction Diagram**
	DATE: 03/27/03		REV. NO.: 1	
	AUTHOR: GJV		DRAWN BY: GJV	
	CK'D BY: DTL		FILE: Well Bore Diagram	

Rice Operating Company

Quality Procedure

Procedure for Conducting Field TPH Analysis

1.0 Purpose

To define the procedure to be used in conducting total percentage hydrocarbon testing in accordance with EPA Method 418.1 (modified) using the "MEGA" TPH Analyzer.

2.0 Scope

This procedure is to be used for field testing and on site remediation information.

3.0 Procedure

3.1 The G.A.C. "MEGA" TPH analyzer is an instrument that measures concentrations of aliphatic hydrocarbons by means of infra-red spectrometry. It is manufactured to specifications and can accurately measure concentrations from two parts per million through 100,000 parts per million. The unit is factory calibrated however minor calibration adjustments may be made in the field. Quality Procedure 25 defines the field calibration methods to be employed.

3.2 Prior to taking the machine into the field, insert a 500 ppm and 5,000 ppm calibration standard into the sample port of the machine. Zero out the Range dial until the instrument records the exact standard reading.

3.3 Once in the field, insert a large and small cuvette filled with clean Freon 113 into the sample port of the machine. Use the range dial to zero in the reading. If the machine does not zero, do not attempt to adjust the span dial. Immediately implement Quality Procedure 25.

3.4 Place a 100 g weight standard on the field scale to insure accuracy. Zero out the scale as necessary.

3.5 Tare a clean 100 ml sample vial with the Teflon cap removed. Add 10 g (+/-.01g), of sample soil into the vial taking care to remove rocks or vegetable matter from the sample to be tested. If the sample is wet, add up to 5 g silica gel or anhydrous sodium sulfate to the sample after weighing.

3.6 Dispense 10 ml Freon 113 into the sample vial.

3.7 Cap the vial and shake for five minutes.

3.8 Carefully decant the liquid contents of the vial into a filter/desiccant cartridge and affix the cartridge cap. Recap the sample vial and set aside.

3.9 Insert the metal tip of the pressure syringe into the cap opening and slowly pressurize. **WARNING: APPLY ONLY ENOUGH PRESSURE ON THE SYRINGE TO EFFECT FLOW THROUGH THE FILTERS. TOO MUCH PRESSURE MAY CAUSE THE CAP TO SEPARATE FROM THE BODY OF THE CARTRIDGE.** Once flow is established through the cartridge, direct the flow into the 5 cm cuvette until the cuvette is full. Reverse the pressure on the syringe and remove the syringe tip form the cartridge cap. Set the cartridge aside in vertical position.

3.10 The cuvette has two clear and two frosted sides. Hold the cuvette by the frosted sides and carefully insert into the sample port of the machine. Read the right hand digital read-out of the instrument. If the reading is less than 1,000 ppm, the results shall be recorded in the field Soil Analysis Report. If the result is higher than 1,000 ppm, continue with the dilution procedure.

4.0 Dilution Procedure

4.1 When initial readings are greater than 1,000 ppm using the 5 cm cuvette, pour the contents of the 5 cm cuvette into a 1 cm cuvette. Insert the 1 cm cuvette into the metal holder and place into the test port of the instrument.

4.2 Read the left hand read-out of the machine. If the results are less than 10,000 ppm, record the results into the field Soil Analysis Reports. If greater than 10,000 ppm, continue the dilution process. **Concentrations >10,000 ppm are to be used for field screen purposes only.**

4.3 Pour the contents of the small cuvette into a graduated glass pipette. Add 10 ml pure Freon 113 into the pipette. Shake the contents and pour into the 1cm. cuvette. Repeat step 4.2 adding two zeros to the end of the displayed number. If the reported result is greater than 100,000 ppm, the accuracy of further readings through additional dilutions is extremely questionable. **Do not use for reporting purposes.**

4.4 **Pour all sample Freon into the recycling container.**

5.0 Split Samples

5.1 Each tenth test sample shall be a split sample. Decant approximately one half of the extraction solvent through a filter cartridge and insert into the instrument to obtain a concentration reading. Clean and rinse the cuvette and decant the remainder of the fluid to obtain a second concentration reading from the same sample. If the second reading varies by more than 1% from the original, it will be necessary to completely recalibrate the instrument.

Rice Operating Company

Quality Procedure

Procedure for Obtaining Soil Samples for Transportation to a Laboratory

1.0 Purpose

This procedure outlines the methods to be employed when obtaining soil samples to be taken to a laboratory for analysis.

2.0 Scope

This procedure is to be used when collecting soil samples intended for ultimate transfer to a testing laboratory.

3.0 Preliminary

3.1 Obtain sterile sampling containers from the testing laboratory designated to conduct analyses of the soil. The shipment should include a Certificate of Compliance from the manufacturer of the collection bottle or vial and a Serial Number for the lot of containers. Retain this Certificate for future documentation purposes.

3.2 If collecting TPH, BTEX, RCRA 8 metals, cation /anions or O&G, the sample jar may be a clear 4 oz. container with Teflon lid. If collecting PAH's, use an amber 4 oz. container.

4.0 Chain of Custody

4.1 Prepare a Sample Plan. The plan will list the number, location and designation of each planned sample and the individual tests to be performed on the sample. The sampler will check the list against the available inventory of appropriate sample collection bottles to insure against shortage.

4.2 Transfer the data to the Laboratory Chain of Custody Form. Complete all sections of the form except those that relate to the time of delivery of the samples to the laboratory.

4.3 Pre-label the sample collection jars. Include all requested information except time of collection. (Use a fine point Sharpie to insure that the ink remains on the label.) Affix the labels to the jars.

5.0 Sampling Procedure

5.1. Do not touch the soil with your bare hands. Use new latex gloves with each sample to help minimize any cross-contamination.

5.2. Go to the sampling point with the sample container. If not analyzing for ions or metals, use a trowel to obtain the soil.

5.3. Pack the soil tightly into the container leaving the top slightly domed. Screw the lid down tightly. Enter the time of collection onto the sample collection jar label.

5.4. Place the sample directly on ice for transport to the laboratory if required.

5.5. Complete the Chain of Custody form to include the collection times for each sample. Deliver all samples to the laboratory.

6.0 Documentation

6.1 The testing laboratory shall provide the following minimum information:

- a. Project and sample name.
- b. Signed copy of the original Chain of Custody Form including the time the sample was received by the lab.
- c. Results of the requested analyses
- d. Test Methods employed
- e. Quality Control methods and results

Rice Operating Company

QUALITY PROCEDURE

Sampling and Testing Protocol
Chloride Titration Using .282 Normal
Silver Nitrate Solution

1.0 Purpose

This procedure is to be used to determine the concentration of chloride in soil.

2.0 Scope

This procedure is to be used as the standard field measurement for soil chloride concentrations.

3.0 Sample Collection and Preparation

3.1 Collect at least 80 grams of soil from the sample collection point. Take care to insure that the sample is representative of the general background to include visible concentrations of hydrocarbons and soil types. If necessary, prepare a composite sample for soils obtained at several points in the sample area. Take care to insure that no loose vegetation, rocks or liquids are included in the sample(s).

3.2 The soil sample(s) shall be immediately inserted into a one-quart or larger polyethylene freezer bag. Care should be taken to insure that no cross-contamination occurs between the soil sample and the collection tools or sample processing equipment.

3.3 The sealed sample bag should be massaged to break up any clods.

4.0 Sample Preparation

4.1 Tare a clean glass vial having a minimum 40 ml capacity. Add at least 10 grams of the soil sample and record the weight.

4.2 Add at least 10 grams of reverse osmosis water to the soil sample and shake for 20 seconds.

4.3 Allow the sample to set for a period of 5 minutes or until the separation of soil and water.

4.4 Carefully pour the free liquid extract from the sample through a paper filter into a clean plastic cup if necessary.

5.0 Titration Procedure

5.1 Using a graduated pipette, remove 10 ml extract and dispense into a clean plastic cup.

5.2 Add 2-3 drops potassium chromate (K_2CrO_4) to mixture.

5.3 If the sample contains any sulfides (hydrogen or iron sulfides are common to oilfield soil samples) add 2-3 drops of hydrogen peroxide (H_2O_2) to mixture.

5.4 Using a 1 ml pipette, carefully add .282 normal silver nitrate (one drop at a time) to the sample while constantly agitating it. Stop adding silver nitrate when the solution begins to change from yellow to red. Be consistent with endpoint recognition.

5.5 Record the ml of silver nitrate used.

6.0 Calculation

To obtain the chloride concentration, insert measured data into the following formula:

$$\frac{.282 \text{ X } 35{,}450 \text{ X ml } AgNO_3}{\text{ml water extract}} \quad \text{X} \quad \frac{\text{grams of water in mixture}}{\text{grams of soil in mixture}}$$

Using Step 5.0, determine the chloride concentration of the RO water used to mix with the soil sample. Record this concentration and subtract it from the formula results to find the net chloride in the soil sample.

Record all results on the delineation form.

Rice Operating Company

Quality Procedure

Procedure for Developing Cased Water Monitoring Wells

1.0 Purpose

This procedure outlines the methods to be employed to develop cased monitoring wells.

2.0 Scope

This procedure shall be used for developed, cased water monitoring wells. It is not to be used for standing water samples such as ponds or streams.

3.0 Sample Collection and Preparation

3.1 Prior to development, the static water level and height of the water column within the well casing will be measured with the use of an electric D.C. probe or a steel engineer's tape and water sensitive paste.

3.2 All measurements will be recorded within a field log notebook.

3.3 All equipment used to measure the static water level will be decontaminated after each use by means of Liquinox, a phosphate free laboratory detergent, and water to reduce the possibility of cross-contamination. The volume of water in each well casing will be calculated.

4.0 Purging

4.1 Wells will be purged by using a 2" decontaminated submersible pump or dedicated one liter Teflon bailer. Wells should be purged until the pH and conductivity are stabilized and the turbidity has been reduced to the greatest extent possible.

4.2 If a submersible is used the pump will be decontaminated prior to use by scrubbing the outside surface of tubing and wiring with a Liquinox water mixture, pumping a Liquinox-water mixture through the pump, and a final flush with fresh water.

5.0 Water Disposal

5.1 All purge and decontamination water will be temporarily stored within a portable tank to be later disposed of in an appropriate manner.

6.0 Records

6.1 Rice Operating Company will record the amount of water removed from the well during development procedures. The purge volume will be reported to the appropriate regulatory authority when filing the closure report.

Rice Operating Company

Quality Procedure

Procedure for Obtaining Water Samples (Cased Wells) Using One Liter Bailer

1.0 Purpose

This procedure outlines the methods to be employed in obtaining water samples from cased monitoring wells.

2.0 Scope

This procedure shall be used for developed, cased water monitoring wells. It is not to be used for standing water samples such as ponds or streams.

3.0 Preliminary

3.1 Obtain sterile sampling containers from the testing laboratory designated to conduct analyses of the water. The shipment should include a Certificate of Compliance from the manufacturer of the collection bottle or vial and a Serial Number for the lot of containers. Retain this Certificate for future documentation purposes.

3.2 The following table shall be used to select the appropriate sampling container, preservative method and holding times for the various elements and compounds to be analyzed.

Compound to be Analyzed	Sample Container Size	Sample Container Description	Cap Requirements	Preservative	Maximum Hold Time
BTEX	40 ml	VOA Container	Teflon Lined	HCI	7 days
TPH	1 liter	clear glass	Teflon Lined	HCI	28 days
PAH	1 liter	amber glass	Teflon Lined	Ice	7 days
Cation/Anion	1 liter	clear glass	Teflon Lined	None	48 Hrs
Metals	1 liter	HD polyethylene	Any Plastic	Ice/HNO_3	28 Days
TDS	300 ml	clear glass	Any Plastic	Ice	7 Days

4.0 Chain of Custody

4.1 Prepare a Sample Plan. The plan will list the well identification and the individual tests to be performed at that location. The sampler will check the list against the available inventory of appropriate sample collection bottles to insure against shortage.

4.2 Transfer the data to the Laboratory Chain of Custody Form. Complete all sections of the form except those that relate to the time of delivery of the samples to the laboratory.

4.3 Pre-label the sample collection jars. Include all requested information except time of collection. (Use a fine point Sharpie to insure that the ink remains on the label). Affix the labels to the jars.

5.0 Bailing Procedure

5.1 Identify the well from the sites schematics. Place pre-labeled jar(s) next to the well. Remove the plastic cap from the well bore by first lifting the metal lever and then unscrewing the entire assembly.

5.2 Using a dedicated one liter Teflon bailer, purge a minimum of three well volumes. Place the water in storage container for transport to a ROC disposal facility.

5.3 Take care to insure that the bailing device and string do not become cross-contaminated. A clean pair of rubber gloves should be used when handling either the retrieval string or bailer. The retrieval string should not be allowed to come into contact with the ground.

6.0 Sampling Procedure

6.1 Once the well has been bailed in accordance with 5.2 of this procedure, a sample may be decanted into the appropriate sample collection jar directly from the bailer. The collection jar should be filled to the brim. Once the jar is sealed, turn the jar over to detect any bubbles that may be present. Add additional water to remove all bubbles from the sample container.

6.2 Note the time of collection on the sample jar with a fine Sharpie.

6.3 Place the sample directly on ice for transport to the laboratory. The preceding table shows the maximum hold times between collection and testing for the various analyses.

6.4 Complete the Chain of Custody form to include the collection times for each sample. Deliver all samples to the laboratory.

7.0 Documentation

7.1 The testing laboratory shall provide the following minimum information:

A. Project and sample name.
B. Signed copy of the original Chain of Custody Form including the time the sample was received by the lab.
C. Results of the requested analyses
D. Test Methods employed
E. Quality Control methods and results

Calculation for Determining the Minimum Bailing Volume for Monitor Wells

Formula $V= (\pi r^2 h)$

2" well [V/231=gal] X 3 = Purge Volume

V=Volume
π=pi
r=inside radius of the well bore
h=maximum height of well bore in water table

Example:

π	r^2	h(in)	V(cu.in)	V(gal)	X 3 Volumes	Actual
3.1416	1	180	565.488	2.448	7.34 gal	>10 gal

Rice Operating Company

Quality Procedure
Composite Sampling of Excavation Sidewalls and Bottoms

1.0 Purpose

This procedure outlines the methods to be employed when obtaining final composite soil samples.

2.0 Scope

This procedure is to be used in conjunction with ***Quality Procedure – 02: Soil Samples for Transportation to a Laboratory*** and will be inserted at subparagraph 5.2 of Section 5.0: Sampling Procedure.

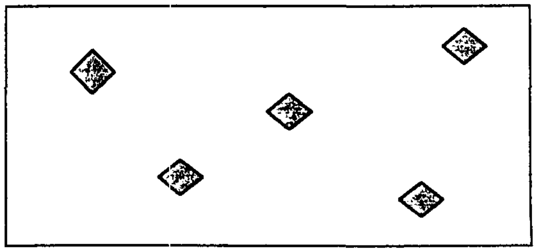
3.0 Sampling Procedure

Follow ***Quality Procedure – 02: Soil Samples for Transportation to a Laboratory*** for all Sections and subparagraphs until subparagraph 5.2 of Section 5.0: Sampling Procedure. Instead of 5.2 instructions, perform the composite sample collection procedure as follows:

3.1 Go to the excavation with a clean large blending bowl or new plastic baggie. If not analyzing for ions or metals, use a trowel to obtain the soil. If the excavation is deeper than 6' BGS, do not enter the pit, but use a backhoe to assist in procurement of the sample. (If a backhoe is used, the backhoe will obtain an amount of soil from each composite point, bring the purchase to the surface staging area where a sample-portion of soil will be extracted from the backhoe purchase. The remainder of the backhoe purchase will be staged on the surface with other staged soils.)

3.2 Sidewall samples

3.2.1 On each sidewall, procure a 5oz sample from each of five distinct points on the sidewall with distinct points resembling the "W" pattern:



3.2.2 Thoroughly blend these five samples in the blending bowl.
3.2.3 Pour blended sample into sifter and sift into labeled baggie.
3.2.4 Repeat steps 3.2.1 through 3.2.4 for each remaining sidewall, using a clean blending bowl for each sidewall.
3.2.5 From each labeled baggie, procure a 5 oz portion and pour into a baggie labeled "Sidewall Composite". Blend this soil mixture completely.
3.2.6 Obtain proper laboratory sample container for "Sidewall Composite" and continue with subparagraph 5.3 of QP – 02.

3.3 Bottom Sample
3.3.1 From bottom of excavation, procure a 5oz sample from each of five distinct points with distinct points resembling the "W" pattern as illustrated above.
3.3.2 Thoroughly blend these five samples in a clean blending bowl.
3.2.3 Pour blended sample into sifter and sift into baggie labeled "Bottom Composite".
3.2.6 Obtain proper laboratory sample container for "Bottom Composite" and continue with subparagraph 5.3 of QP – 02.

Rice Operating Company

QUALITY PROCEDURE
Sampling and Testing Protocol for VOC in Soil

1.0 Purpose

This procedure is to be used to determine the concentrations of Volatile Organic Compounds in soils.

2.0 Scope

This procedure is to be used as the standard field measurement for soil VOC concentrations. It is not to be used as a substitute for full spectrographic speciation of organic compounds.

3.0 Procedure

3.1 Sample Collection and Preparation

3.1.1 Collect at least 500 g. of soil from the sample collection point. Take care to insure that the sample is representative of the general background to include visible concentrations of hydrocarbons and soil types. If necessary, prepare a composite sample of soils obtained at several points in the sample area. Take care to insure that no loose vegetation, rocks or liquids are included in the sample(s).

3.1.2 The soil sample(s) shall be immediately inserted into a one-quart or larger polyethylene freezer bag and sealed. When sealed, the bag should contain a nearly equal space between the soil sample and trapped air. Record the sample name and the time that the sample was collected on the Field Analytical Report Form.

3.1.3 The sealed samples shall be allowed to set for a minimum of five minutes at a temperature of between 10-15 Celsius, (59-77 ^{0}F). The sample temperatures may be adjusted by cooling the sample in ice, or by heating the sample within a generally controlled environment such as the inside of a vehicle. The samples should not be placed directly on heated surfaces or placed in direct heat sources such as lamps or heater vents.

3.1.4 The sealed sample bag should be massaged to break up any clods, and to provide the soil sample with as much exposed surface area as practically possible.

3.2 Sampling Procedure

3.2.1 The instrument to be used in conducting VOC concentration testing shall be an Environmental Instruments 13471 OVM / Datalogger or a similar PID-type instrument. (Device will be identified on VOC Field Test Report Form.) Prior to use, the instrument shall be zeroed-out in accordance with the appropriate maintenance and calibration procedure outlined in the instrument operation manual. The PID device will be calibrated each day it's used.

3.2.2 Carefully open one end of the collection bag and insert the probe tip into the bag taking care that the probe tip not touch the soil sample or the sidewalls of the bag.

3.2.3 Set the instrument to retain the highest result reading value. Record the reading onto the Field Test Report Form.

3.2.4 If the instrument provides a reading exceeding 100 ppm, proceed to conduct BTEX Speciation in accordance with **QP-02 and QP-06. If the reading is 100 ppm or less, NMOCD BTEX guideline has been met and no further testing for BTEX is necessary. File the Field Test Report Form in the project file.**

4.0 Clean-up

After testing, the soil samples shall be returned to the sampling location, and the bags collected for off-site disposal. **IN NO CASE SHALL THE SAME BAG BE USED TWICE. EACH SAMPLE CONTAINER MUST BE DISCARDED AFTER EACH USE.**

Rice Operating Company

Quality Procedure
Composite Sampling of Excavation Sidewalls and Bottoms For BTEX Analysis

1.0 Purpose

This procedure outlines the methods to be employed when obtaining final composite soil samples for BTEX analysis.

2.0 Scope

This procedure is to be used when collecting soil samples intended for ultimate transfer to a testing laboratory for BTEX analysis. This procedure is to be used only when the PID field-test results for OVM exceeds 100 ppm.

3.0 Preliminary

3.1 Obtain sterile, clear, 2 oz. glass containers with Teflon lid from a laboratory supply company or the testing laboratory designated to conduct analyses of the soil.

3.2 The container shipment should include a Certificate of Compliance from the manufacturer of the collection bottle or vial and a Serial Number for the lot of containers. Retain this Certificate for future documentation purposes.

4.0 Chain of Custody

4.1 Prepare a Sample Plan. The plan will list the number, location and designation of each planned sample and the individual tests to be performed on the sample. The sampler will check the list against the available inventory of appropriate sample collection bottles to insure against shortage.

4.2 Transfer the data to the Laboratory Chain of Custody Form. Complete all sections of the form except those that relate to the time of delivery of the samples to the laboratory.

4.3 Pre-label the sample collection jars. Include all requested information except time of collection. (Use a fine point Sharpie to insure that the ink remains on the label.) Affix the labels to the jars.

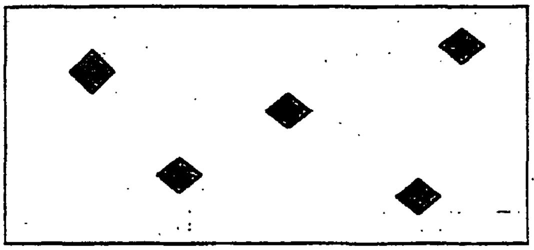
5.0 Sampling Procedure

5.1.Do not touch the soil with your bare hands. Use new latex gloves with each sample to help minimize any cross-contamination.

5.2.If safe and within OSHA regulations, go to the sampling point with the sample container. If not analyzing for ions or metals, use a trowel to obtain the soil. If the excavation is deeper than 6' BGS, do not enter the pit, but use a backhoe to assist in procurement of the sample. (If a backhoe is used, the backhoe will obtain an amount of soil from each composite point, bring the purchase to the surface staging area where a sample-portion of soil will be extracted from the backhoe purchase. The remainder of the backhoe purchase will be staged on the surface with other staged soils.)

5.3.Sidewall Samples

5.3.1.On each sidewall, procure a 2oz sample from each of five distinct points on the sidewall with distinct points resembling the "W" pattern:



5.4.Pack the soil tightly into the container leaving the top slightly domed. Screw the lid down tightly. Enter the time of collection onto the sample collection jar label. Repeat for each sampling point.

5.5.Place the samples directly on ice for transport to the laboratory if required.

5.6.Complete the Chain of Custody form to include the collection times for each sample. Deliver all samples to the laboratory.

6.0 Documentation

6.1 The testing laboratory shall provide the following minimum information:

a. Project and sample name.
b. Signed copy of the original Chain of Custody Form including the time the sample was received by the lab.
c. Results of the requested analyses
d. Test Methods employed
e. Quality Control methods and results

ATTACHMENT C

RISK ASSESSMENT RESULTS

FOR HYDROCARBON COMPOUNDS

Risk Assessment of Hydrocarbon Compounds

Rice Operating Company' desire for the New Mexico Oil Conservation Division (OCD) to consider their use of a quantitative risk assessment to establish remediation action levels is based on their general knowledge of the chemistry of the hydrocarbons historically transported in the P-6 line relative to the worst-case parameters assumed in the establishment of the general OCD default target levels, particularly with respect to the receptor pathway of concern.

Receptor Pathway of Concern

The primary pathway of concern at this site is the protection of the groundwater due to leaching of the remaining hydrocarbons in the soil. Although there are no domestic water wells near the site, a conservative assumption has been made that a commercial worker could ingest the underlying groundwater. Inhalation of volatilized hydrocarbons by potential surface receptors was not considered because the remediation plans for the chloride-impacted soil will also eliminate the hydrocarbon inhalation pathway risk.

Chemicals of Concern

On November 14, 2001, and April 29, 2003, evaluation and delineation of the hydrocarbons at the EME P-6 Line Leak site were performed using the "Mega-TPH" equipment to determine field total hydrocarbon concentrations. These values range from approximately 75 to 23,510 ppm, with the maximum concentrations found immediately below the line leak and at the surface within a 25-foot radius. Away from the source area the concentrations decrease dramatically within the upper two feet of soil. While the Mega-TPH assessment was useful in assessing the extent of the hydrocarbon-impacted soil, it cannot be used to interpret potential risks to human health and the environment. Therefore, soil samples recovered from the location and depth of the greatest subsurface Mega-TPH concentration observed (20,060 ppm) at 11 feet below the surface, approximately 8 feet below the pipeline leak, were sent to the laboratory for analysis of benzene, toluene, ethylbenzene, total xylenes (BTEX) using EPA Method 8021B, gas and diesel range organics (GRO/DRO) using EPA Method 8015M, and total petroleum hydrocarbon (TPH) fractions using Texas Method 1006. An additional sample was taken at 15 feet below the surface (6,270 ppm Mega-TPH) to determine the relative changes in the hydrocarbon concentrations with depth. A summary of the laboratory analytical results for the soil samples is provided in the following tables.

Sample Depth (Ft bgs)	Mega TPH (ppm)	GRO (mg/kg)	DRO (mg/kg)	B (mg/kg)	T (mg/kg)	E (mg/kg)	X (mg/kg)
3	23,510	NA	NA	NA	NA	NA	NA
5	11,950	NA	NA	NA	NA	NA	NA
7	9,900	NA	NA	NA	NA	NA	NA
9	18,560	NA	NA	NA	NA	NA	NA
11	20,060	654	1940	0.212	0.633	3.62	4.42
13	7,550	NA	NA	NA	NA	NA	NA
15	6,270	142	579	0.044	0.133	0.578	1.43

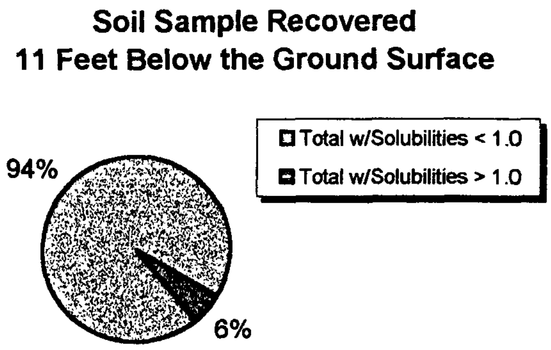
TX1006	Range	Sample Depth	
		11' bgs	15' bgs
Aliphatics	>C7-C8	24.3	12.7
	>C8-C10	196	15.3
	>C10-C12	390	51.1
	>C12-C16	822	153
	>C16-C21	469	92.8
	>C21-C35	582	74.9
Aromatics	>C7-C8	34.1	38.4
	>C8-C10	44.6	54.2
	>C10-C12	7.55	<10.0
	>C12-C16	42.2	14.1
	>C16-C21	63.5	13.1
	>C21-C35	44.7	14.5

The BTEX analysis was conducted so that the concentration of benzene in the soil could be used to assess the carcinogenic risk and the TPH fraction analysis was conducted to assess the non-carcinogenic risks. GRO/DRO was used as a screening tool to determine the need for the more expensive TPH fraction analysis.

The method of evaluating health risk using TPH fractions is based on work conducted by the Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG) in 1993. The TPHCWC was formed to address the difficulty in quantifying risk assessment parameters associated with unrefined hydrocarbon mixtures. It was guided by a steering committee consisting of representatives from industry, government, and academia. Some of the active participants among the more than 400 involved, include the Gas Research Institute, the Petroleum Environmental Research Forum, several major petroleum companies including Chevron, Exxon, and Shell, the American Petroleum Institute, the Association of American Railroads, several state governments agencies, the U.S. Environmental Protection Agency, the Department of Defense, and many consulting firms.

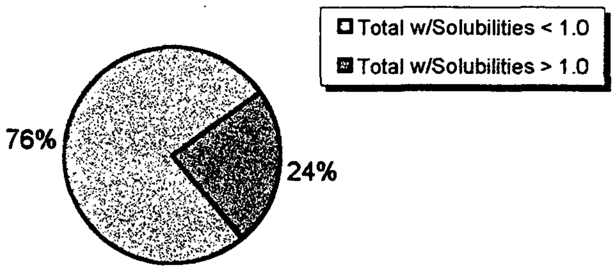
The Working Group has published several documents that describe the development of a method to delineate TPH into equivalent carbon number fractions based on similar fate and transport characteristics. Once the carbon number fractions were identified, physical-chemical properties and non-carcinogen toxicity values were determined based on a statistical averaging of the compounds represented by each group.

Because the risk assessment is focused on the potential leaching of hydrocarbons from the remaining impacted soil to the underlying groundwater, the aqueous solubility of the chemicals of concern is very important. As a summary, the following pie charts were prepared to demonstrate the relative concentrations of the low soluble hydrocarbons with the high soluble hydrocarbons in the impacted soil at the P-6 site.


Soil Sample Recovered 11 Feet Below the Ground Surface

Low soluble chemicals (TPH fractions) are defined as having an aqueous solubility of less than 1.0 mg/L. They include the aliphatics range with equivalent carbon (EC) numbers from greater than 8 to 35 and the aromatics range with EC numbers greater than 16 to 35. In the soil sample recovered from highest concentration area (11 feet below the surface) the low solubility chemicals represent approximately 94% of the total hydrocarbon impact. The migration of these chemicals will require an extremely long period of time since less than 1 mg/L of chemical can be carried by the leachate. As a result, the concentration of these chemicals delivered to the groundwater will likely be dispersed immediately upon contact with the aquifer and therefore not present a threat to the potential receptor.

**Soil Sample Recovered
15 Feet Below the Ground Surface**



The soil sample recovered from 15 feet below the surface (4 feet below the highest concentration area) demonstrates the relatively immobile character of the low solubility chemicals. The total petroleum hydrocarbon concentrations have decreased from 2,721 mg/kg at 11 feet BGS to 544 mg/kg at 15 feet BGS. However the percentage of low solubility hydrocarbons has decreased from 94% to 76%. This suggests that the migration of the low solubility hydrocarbons is controlled primarily by gravity in response to the fate and transport character of the soil while the high solubility hydrocarbons are also being transported by leaching.

Exposure Pathway Analysis: Ingestion of Groundwater by a Commercial Worker

The potential future impact to the groundwater from the remaining hydrocarbon-impacted soil was predicted by modeling the vertical migration (fate and transport) of the soil contaminants using the VLEACH™ one-dimensional finite difference vadose zone-leaching model. The model describes the movement of an organic contaminant within and between three different phases: (1) as a solute dissolved in water, (2) as a gas in the vapor phase, and (3) as an adsorbed compound in the solid phase. Equilibration between the phases occurs according to the distribution coefficients defined by the user. In particular, VLEACH simulates vertical transport by advection in the liquid phase and by gaseous diffusion in the vapor phase.

The exposure point is defined as the intersection of the vertically migrating leachate (solute dissolved in water) and the horizontally flowing groundwater beneath the impacted area. Risk-Based Screening Levels (RBSLs) of, first the groundwater, then the leachate at the groundwater depth were calculated for comparison to the leachate concentrations predicted by the model according to the following method:

Determination of Groundwater RBSLs

Rather than calculate an RBSL for the ingestion of benzene in the groundwater by a commercial worker, the New Mexico human health standard (Section 20.6.2.3103 NMAC) of 0.01 mg/L was used.

Groundwater ingestion RBSLs were calculated for each of the TPH fractions using the physical/chemical and toxicity parameters established by the TPHCWG as follows:

Fraction-Specific Physical-Chemical and Toxicology Properties

Total Petroleum Hydrocarbon Fractions		Boiling Point (°C)	Equiv. Carbon No.	Molecular Weight (g/mole)	Aqueous Solubility (mg/L)	Vapor Pressure (atm)	Henry's Law Constant (cm^3/cm^3)	log K_{oc} (L/kg)	Koc (unitless)	Diffusivity in Air (cm^2/s)	Diffusivity in Water (cm^2/s)	RfD_o Oral (mg/kg/day)	RfC_i Inhalation (mg/m^3)
ALIPHATICS	EC: >6-8	96	7.0	100	5.4E+00	6.3E-02	5.0E+01	3.6	3.98E+03	1.0E-01	1.0E-05	5.0	18.4
	EC: >8-10	150	9.0	130	4.3E-01	6.3E-03	8.0E+01	4.5	3.16E+04	1.0E-01	1.0E-05	0.1	1.0
	EC: >10-12	200	11.0	160	3.4E-02	6.3E-04	1.2E+02	5.4	2.51E+05	1.0E-01	1.0E-05		
	EC: >12-16	260	14.0	200	7.6E-04	4.8E-05	5.2E+02	6.7	5.01E+06	1.0E-01	1.0E-05		
	EC: >16-35	320	19.0	270	2.5E-06	1.1E-06	4.9E+03	8.8	6.31E+08	1.0E-01	1.0E-05	2.0	not volatile
AROMATICS	EC: >7-8	110	7.6	92	1.3E+02	3.8E-02	2.7E-01	2.4	2.51E+02	1.0E-01	1.0E-05	0.2	0.4
	EC: >8-10	150	9.0	120	6.5E+01	6.3E-03	4.8E-01	3.2	1.58E+03	1.0E-01	1.0E-05	0.04	0.2
	EC: >10-12	200	11.0	130	2.5E+01	6.3E-04	1.4E-01	3.4	2.51E+03	1.0E-01	1.0E-05		
	EC: >12-16	260	14.0	150	5.8E+00	4.8E-05	5.3E-02	3.7	5.01E+03	1.0E-01	1.0E-05		
	EC: >16-21	320	19.0	190	6.5E-01	1.1E-06	1.3E-02	4.2	1.58E+04	1.0E-01	1.0E-05	0.03	not volatile
	EC: >21-35	340	28.0	240	6.6E-03	4.4E-10	6.7E-04	5.1	1.26E+05	1.0E-01	1.0E-05		

- Information taken from the TPH Criteria Working Group Series Volume 3 and 4

/Projects/Rice Engineering/EME P-6/GW Ingestion Tables

Default exposure parameters and default fate and transport parameters used in the determination of RBSLs were provided by the American Society for Testing and Materials (ASTM) standard (E 1739 - 95) as follows:

ASTM Default Exposure Parameters

Parameter			Default Exposure Case		
			Commercial	Residential	
Symbol	Description	Units	Worker	Adult	Child
C_s	Soil Concentration	mg/kg	Measured Soil Concentration		
EF	Exposure Frequency	days/years	250	350	
ED	Exposure Duration	years	25	30	
IR_{soil}	Soil Ingestion Rate	mg/day	50	100	
IR_{air}	Outdoor Air Ingestion Rate	m^3/day	20	20	
IR_w	Water Ingestion Rate	L/day	1.0	2.0	
RAF_o	Oral Relative Absorption Factor	unitless	1.0		
RAF_d	Dermal Relative Absorption Factor	unitless	0.5		
SA	Total Skin Surface Area	cm^2	3,160		
M	Soil to Skin Adherence Factor	mg/cm^2	1.0		
BW	Body Weight	kg	70		15
AT_n	Averaging Time (non-carcinogen)	years	25	30	

/Projects/Rice Engineering/EME P-6/GW Ingestion Tables

All of the above parameters were applied to the following ASTM formula:

$$RBSL_{gw}(mg/L) = \frac{THQ \times RfD_o \times BW \times AT_n \times 365\,days/year}{IR_w \times EF \times ED}$$

The results of $RBSL_{gw}$ calculations are provided below. They indicate that the only TPH fractions with groundwater RBSLs lower than the aqueous solubility are the Aromatics that range from EC_7 to EC_{16}. The remaining TPH fractions (Aliphatics EC_6 to EC_{35} and Aromatics EC_{16} to EC_{35}) were not further evaluated because their low solubility prevents the achievement of a concentration capable of presenting a human health risk via a leach-driven pathway.

Chemicals of Concern		THQ	RfD_o	BW	AT_n	IR_w	EF	ED	$RBSL_{gw}$ (mg/L)
ALIPHATICS	EC: >6-8	1.0	5.0	70	25	1.0	250	25	5.1E+02
	EC: >8-10	1.0	0.1	70	25	1.0	250	25	1.0E+01
	EC: >10-12	1.0	0.1	70	25	1.0	250	25	1.0E+01
	EC: >12-16	1.0	0.1	70	25	1.0	250	25	1.0E+01
	EC: >16-35	1.0	2.0	70	25	1.0	250	25	2.0E+02
AROMATICS	EC: >7-8	1.0	0.2	70	25	1.0	250	25	**2.0E+01**
	EC: >8-10	1.0	0.04	70	25	1.0	250	25	**4.1E+00**
	EC: >10-12	1.0	0.04	70	25	1.0	250	25	**4.1E+00**
	EC: >12-16	1.0	0.04	70	25	1.0	250	25	**4.1E+00**
	EC: >16-21	1.0	0.03	70	25	1.0	250	25	3.1E+00
	EC: >21-35	1.0	0.03	70	25	1.0	250	25	3.1E+00

*** Bold values indicate RBSL<Solubility**

ASTM Default Fate and Transport Parameters

Parameter			Defalut Values	
Symbol	Description	Units	Resid.	Comm.
P_e	Particulate Emmission Rate	g/cm^2-sec	6.90E-14	
W	Width of Contaminated Area (Parallel to Wind or Gradient Direction)	cm	1,500	
U_{air}	Wind Speed Above Ground Surface in Ambient Mixing Zone	cm/sec	225	
$Delta_{air}$	Ambient Air Mixing Zone Height	cm	200	
$Delta_{gw}$	Groundwater Mixing Zone Thickness	cm	200	
Rho_s	Soil Bulk Density	g/cm^3	1.7	
d	Lower Depth of Surface Soil	cm	100	
Tau	Averaging Time for Vapor Flux	sec	7.88E+08	
$Theta_{ws}$	Volumetric Water Content in Vadose Zone Soils	L-wtr/L-soil	0.12	
$Theta_{as}$	Volumetric Air Content in Vadose Zone Soils	L-air/L-soil	0.26	
$Theta_T$	Total Soil Porosity	L/L-soil	0.38	
k_s	Soil Water Sorption Coefficient	L-wtr/g-soil	$f_{oc} \times k_{oc}$	
f_{oc}	Fraction of Organic Carbon in the Soil	g-carb/g-soil	0.01	

/Projects/Rice Engineering/EME P-6/GW Ingestion Tables

Determination of Leachate RBSLs

Actual contaminant concentrations in the groundwater in a leach-driven pathway is a function of the concentration and recharge rate of the leachate, relative to the volume and flow rate of available clean (un-impacted) groundwater in the aquifer. Therefore an RBSL concentration of the leachate at the groundwater interface depth was determined by applying the calculated groundwater RBSLs and published (or measured) information about the aquifer quality to the following formula:

$$RBSL_{Leachate}(mg/L)=\left(\frac{\left(\frac{k\times i}{\theta_T}\right)\times T_{aq}\times W\times 365(day/year)}{A\times R}\right)\times RBSL_{gw}(mg/L)$$

where as:

A is the area of the release source (2,000 ft^2 measured from site data)
R is the recharge at the release source (0.90 ft/year or total average precipitation)
k is the estimated aquifer conductivity (33 ft/day from Southern Lea County Report No. 6 aquifer transmissivity data)
i is the groundwater gradient (measured - 0.005 feet/foot from Southern Lea County Report No. 6 Map)
T_{aq} is the aquifer mixing zone thickness (ASTM default is 6.6 ft, although if the water is produced from a domestic well the mixing zone could be much greater)
W is the width of the source area parallel to the gradient (50 ft from site data)

The results of the leachate RBSL calculation for benzene and the TPH fractions ($RBSL_{GW}$ concentrations less than the constituent solubility) are provided below.

Chemicals of Concern		Area (ft^2)	ReChg (ft/yr)	k (ft/dy)	i (ft/ft)	Theta (Total)	T_{aq} (ft)	W (ft)	$RBSL_{Leachate}$ (mg/L)
ALIPHATICS	EC: >6-8	2,000	0.90	33	0.005	0.38	6.6	50	NA
	EC: >8-10	2,000	0.90	33	0.005	0.38	6.6	50	NA
	EC: >10-12	2,000	0.90	33	0.005	0.38	6.6	50	NA
	EC: >12-16	2,000	0.90	33	0.005	0.38	6.6	50	NA
	EC: >16-35	2,000	0.90	33	0.005	0.38	6.6	50	NA
AROMATICS	EC: >7-8	2,000	0.90	33	0.005	0.38	6.6	50	**5.9E+02**
	EC: >8-10	2,000	0.90	33	0.005	0.38	6.6	50	**1.2E+02**
	EC: >10-12	2,000	0.90	33	0.005	0.38	6.6	50	**1.2E+02**
	EC: >12-16	2,000	0.90	33	0.005	0.38	6.6	50	**1.2E+02**
	EC: >16-21	2,000	0.90	33	0.005	0.38	6.6	50	NA
	EC: >21-35	2,000	0.90	33	0.005	0.38	6.6	50	NA
***Benzene**		2,000	0.90	33	0.005	0.38	6.6	50	**2.91E-01**

NA - $RBSL_{Leachate}$ is not applicable because $RBSL_{gw}$ is greater than compound solubility

*Benzene $RBSL_{GW}$: **0.01** mg/L

/Projects/Rice Engineering/EME P-6/GW Ingestion Tables

Prediction of Leachate Concentrations at the Groundwater Depth

The hydrocarbon concentration profile used as a starting point for the VLEACH model at the P-6 Line Leak was taken from the soil samples recovered at 11 and 15 feet below the surface. The following conservative assumptions has been made concerning the initial conditions:

- Only the top 3 feet of soil have been removed by excavation and replaced with clean backfill
- The hydrocarbon concentrations from 3 to 15 feet are represented by the 11-foot soil sample
- The hydrocarbon concentrations from 15 to 30 feet are represented by the 15-foot soil sample, although it is unlikely that the concentrations observed at 15 feet extend to that depth
- The hydrocarbon concentrations from 30 to 45 feet (groundwater depth) are assumed to be approximately 1/4 of the concentration of the overlying soil.
- All of the average annual precipitation is available for recharge to the aquifer (no run-off)
- A compacted clay liner, which will greatly reduce the recharge rate, is not taken into consideration in the model

Concentrations are listed in micrograms per kilogram (µg/kg) in order to be compatible with the VLEACH model input units.

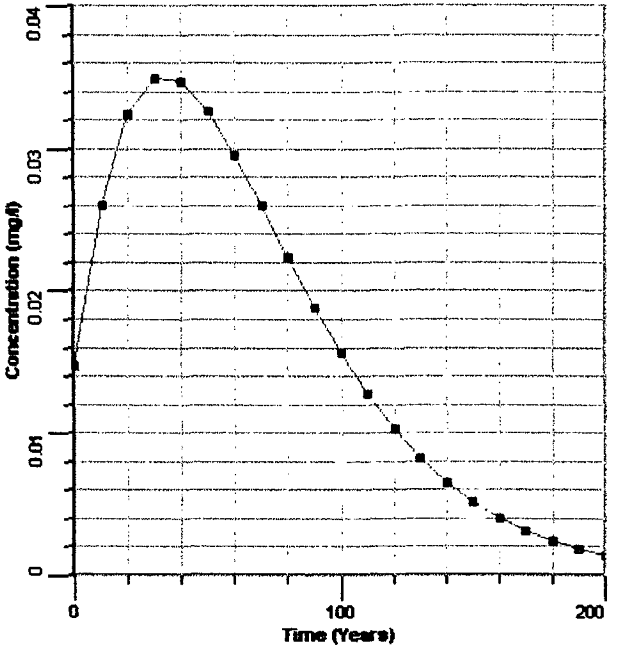
Initial Soil Concentrations used in the Leach Model

Depth Interval	Carcinogen Benzene (µg/kg)	Aromatic TPH Fractions (Non-Carcinogen)			
		$EC_{>7-8}$ (µg/kg)	$EC_{>8-10}$ (µg/kg)	$EC_{>10-12}$ (µg/kg)	$EC_{>12-16}$ (µg/kg)
0 – 3 Ft	10	1,000	1,000	1,000	1,000
3 – 15 Ft	212	34,100	44,600	7,550	42,200
15 – 30 Ft	44	38,400	54,200	10,000	14,100
30 – 45 Ft	11	9,600	13,550	2,500	3,525

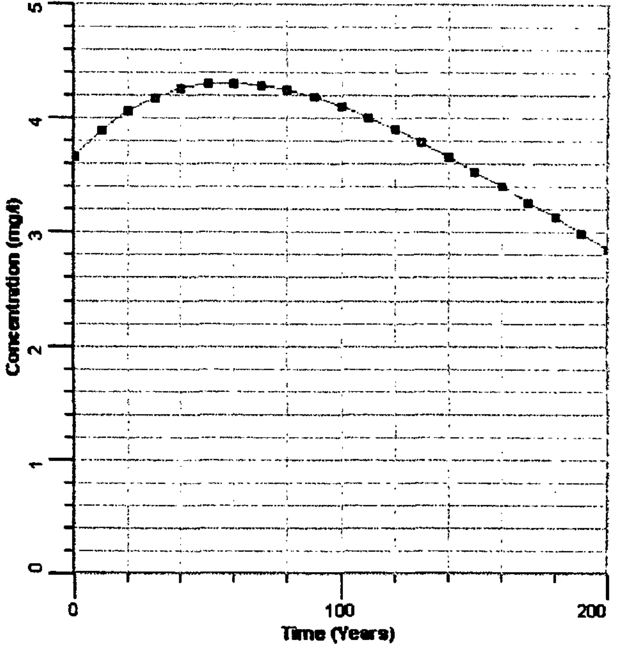
The output from VLEACH modeling program is a calculated contaminant concentration in weight per volume of the gas in the pore space, the leachate in the pore space, and the contaminant sorbed to the soil for each depth and time interval specified. The evaluation of the P-6 Line Leak site was conducted to estimate the maximum potential contaminant concentration in the leachate for comparison to the calculated leachate RBSLs.

A listing of the VLEACH input parameters (raw data) is provided in Appendix A. Graphs representing the leachate concentrations at the groundwater depth over the simulation time period for each modeled contaminant are provided as follows:

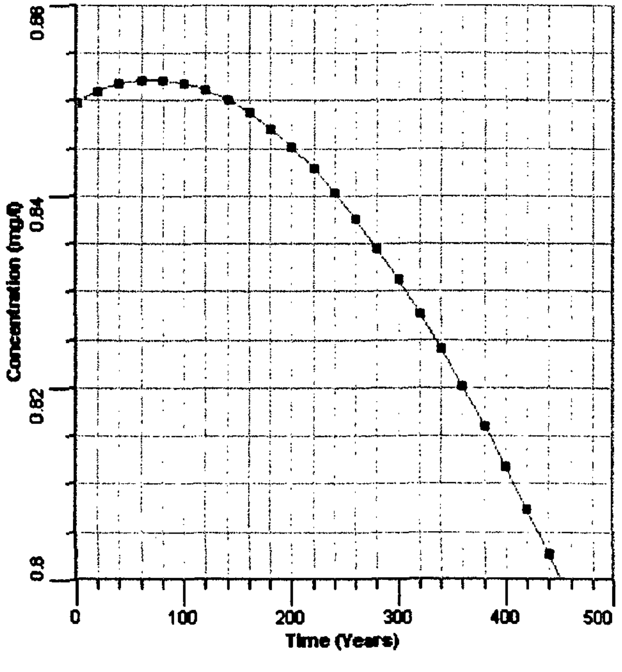
Concentration of Benzene in Leachate
at the Groundwater Depth



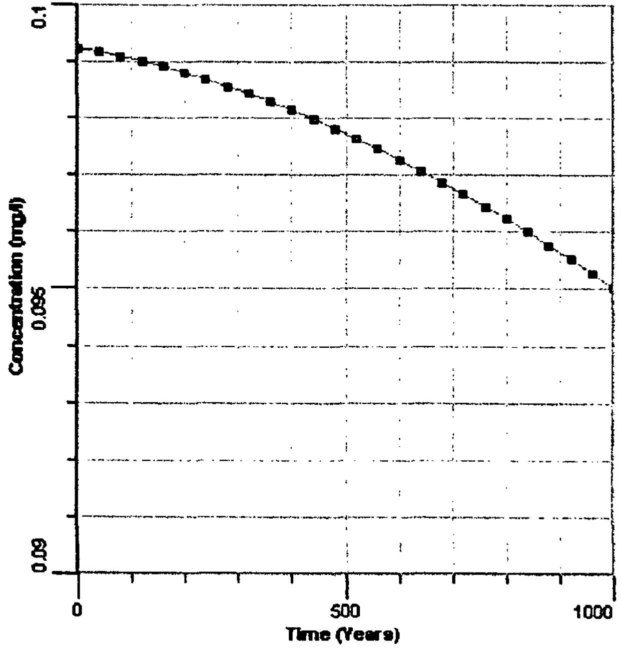
Concentration of Aromatics (EC >7-8) in Leachate
at the Groundwater Depth

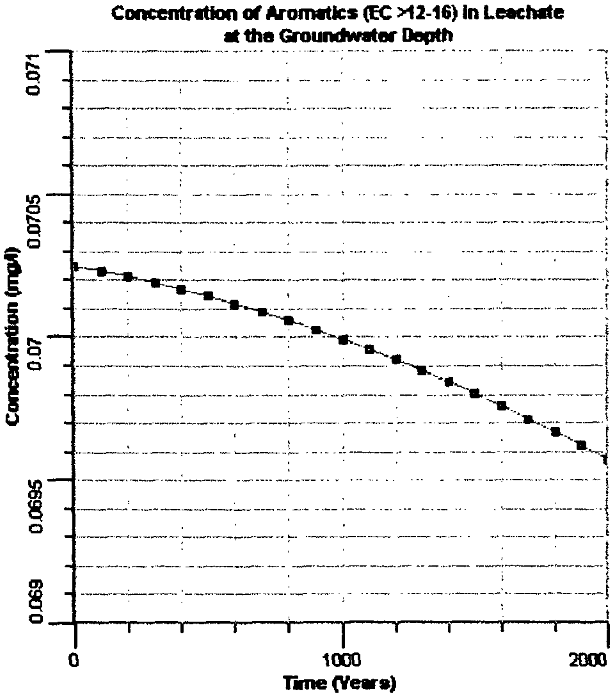


Concentration of Aromatics (EC >8-10) in Leachate
at the Groundwater Depth



Concentration of Aromatics (EC >10-12) in Leachate
at the Groundwater Depth





The graph of the benzene concentration in the leachate at the groundwater depth indicates that a maximum level of 0.035 mg/L will occur in approximately 20 to 50 years from the present. Similar graphs are depicted for the aromatic EC $_{>7-8}$ and EC $_{>8-10}$ compounds although the maximum peak concentrations occur over a much longer period of time. The graphs for the aromatic EC $_{>10-12}$ and EC $_{>12-16}$ compounds indicate that the maximum concentrations, which are very low, occur at present and decrease slowly over a very long period of time.

It should be noted that none of the predicted leachate concentration graphs reflect changes due to biodegradation, therefore the data should be considered extremely conservative in that respect.

A summary table of the modeling results is provided below. It indicates that none of the predicted leachate concentrations exceed the calculated leachate RBSLs.

VLEACH Modeling Results

Compound	**Time Required for Maximum Leachate Concentration to Occur**	**Max. Leachate Concentration (mg/L)**	**Leachate RBSLs (mg/L)**
Non-Carcinogen			
Aromatic EC$_{>7-8}$	60 years	4.31	590
Aromatic EC$_{>8-10}$	80 years	0.852	120
Aromatic EC$_{>10-12}$	0 years	0.099	120
Aromatic EC$_{>12-16}$	0 years	0.070	120
Carcinogen			
Benzene	30 years	0.035	0.291

In light of the information provided, it is the opinion of Trident Environmental and Rice Operating Company that the remaining hydrocarbons in the soil at the P-6 Line Leak site do not present a human health risk for current or future commercial receptors who may ingest the groundwater.

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VLEACH INPUT PARAMETERS
EME P-6 Line Leak Site

GLOBAL SETTINGS

Profile Structure

Layer	Top (ft)	Bottom (ft)	Thickness (ft)
ASTM Default Sand	3595	3550	45

[VLEACH] Soil Parameters

Parameter	Value	Units
Bulk Density	1.7	(g/cu.cm)
Effective Porosity	0.38	(vol/vol)
Water Content	0.12	(vol/vol)
Fraction Organic Content	0.01	(part of unit)

Benzene (ASTM Default)

[VLEACH] Case Settings

Parameter	Value	Units
Simulation Timestep	5	(years)
Simulation Length	200	(years)
Cell Number	9	(-)
Recharge Rate	10.5	(in/year)
Concentration in Recharge Water	0.0	(mg/l)
Upper Boundary for Vapor	0.0	(mg/l)
Lower Boundary for Vapor	0.0	(mg/l)
Output Timestep	10	(years)

[VLEACH] Initial Conditions

#	Start Depth	End Depth	Initial Contaminant Concentration (µg/kg)
1	**0**	**3**	10
2	**3**	**15**	212
3	**15**	**30**	44
4	**30**	**45**	11

VLEACH] Chemical Parameters

Parameter	Value	Units
Water Solubility	1780	(mg/l)
Organic Carbon Partition Coefficient	64.56	(ml/g)
Henry Law Constant	0.221	(-)
Free Air Diffusion Coefficient	0.665	(m2/day)

Aromatics ($EC_{>7-8}$)

[VLEACH] Case Settings

Parameter	Value	Units
Simulation Timestep	5	(years)
Simulation Length	200	(years)
Cell Number	9	(-)
Recharge Rate	10.5	(in/year)
Concentration in Recharge Water	0.0	(mg/l)
Upper Boundary for Vapor	0.0	(mg/l)
Lower Boundary for Vapor	0.0	(mg/l)
Output Timestep	10	(years)

[VLEACH] Initial Conditions

#	Start Depth	End Depth	Initial Contaminant Concentration (µg/kg)
1	0	3	1,000
2	3	15	34,100
3	15	30	38,400
4	30	45	9,600

[VLEACH] Chemical Parameters

Parameter	Value	Units
Water Solubility	130	(mg/l)
Organic Carbon Partition Coefficient	251	(ml/g)
Henry Law Constant	0.27	(-)
Free Air Diffusion Coefficient	0.1	(cm2/sec)

Aromatics ($EC_{>8-10}$)

[VLEACH] Case Settings

Parameter	Value	Units
Simulation Timestep	10	(years)
Simulation Length	500	(years)
Cell Number	9	(-)
Recharge Rate	10.5	(in/year)
Concentration in Recharge Water	0.0	(mg/l)
Upper Boundary for Vapor	0.0	(mg/l)
Lower Boundary for Vapor	0.0	(mg/l)
Output Timestep	20	(years)

[VLEACH] Initial Conditions

#	Start Depth	End Depth	Initial Contaminant Concentration (µg/kg)
1	0	3	1,000
2	3	15	44,600
3	15	30	54,200
4	30	45	13,500

[VLEACH] Chemical Parameters

Parameter	Value	Units
Water Solubility	65	(mg/l)
Organic Carbon Partition Coefficient	1580	(ml/g)
Henry Law Constant	0.48	(-)
Free Air Diffusion Coefficient	0.1	(cm2/sec)

Aromatics ($EC_{>10\text{-}12}$)

[VLEACH] Case Settings

Parameter	Value	Units
Simulation Timestep	20	(years)
Simulation Length	1000	(years)
Cell Number	9	(-)
Recharge Rate	10.5	(in/year)
Concentration in Recharge Water	0.0	(mg/l)
Upper Boundary for Vapor	0.0	(mg/l)
Lower Boundary for Vapor	0.0	(mg/l)
Output Timestep	40	(years)

[VLEACH] Initial Conditions

#	Start Depth	End Depth	Initial Contaminant Concentration (µg/kg)
1	**0**	**3**	1,000
2	**3**	**15**	7,550
3	**15**	**30**	10,000
4	**30**	**45**	2,500

[VLEACH] Chemical Parameters

Parameter	Value	Units
Water Solubility	25	(mg/l)
Organic Carbon Partition Coefficient	2510	(ml/g)
Henry Law Constant	0.14	(-)
Free Air Diffusion Coefficient	0.1	(cm2/sec)

Aromatics ($EC_{>12\text{-}16}$)

[VLEACH] Case Settings

Parameter	Value	Units
Simulation Timestep	50	(years)
Simulation Length	2000	(years)
Cell Number	9	(-)
Recharge Rate	10.5	(in/year)
Concentration in Recharge Water	0.0	(mg/l)
Upper Boundary for Vapor	0.0	(mg/l)
Lower Boundary for Vapor	0.0	(mg/l)
Output Timestep	100	(years)

[VLEACH] Initial Conditions

#	Start Depth	End Depth	Initial Contaminant Concentration (µg/kg)
1	0	3	1,000
2	3	15	42,200
3	15	30	14,100
4	30	45	3,525

[VLEACH] Chemical Parameters

Parameter	Value	Units
Water Solubility	5.8	(mg/l)
Organic Carbon Partition Coefficient	5010	(ml/g)
Henry Law Constant	0.053	(-)
Free Air Diffusion Coefficient	0.1	(cm2/sec)