KANSAS
DEPARTMENT OF HEALTH
AND ENVIRONMENT
Division of Environment

Kathleen Sebelius, Governor
Roderick L. Bremby, Secretary

www.kdheks.gov

December 19, 2007

Mr. Michael Mailloux
Chevron Environmental Management Company
6001 Bollinger Canyon Road
San Ramon, California 94583

RE: ***Replacement Pages for the Remedial Investigation Report – Final Revision 0***
Former Unocal Chemical Distribution Facility, Wichita, Kansas

Dear Mr. Mailloux:

The Kansas Department of Health and Environment (KDHE) acknowledges receipt of the above-referenced submittal. KDHE has completed its review and approves the replacement pages without comment. The replacement pages will be inserted into our copies of Remedial Investigation Report - *Final Revision 0* and will be included in the administrative record file. Should you have any questions regarding this letter, please contact me by phone at 785-0926-0255 or email at ccarey@kdhe.state.ks.us.

Sincerely,

Christopher C. Carey
Environmental Scientist and Project Manager
Site Remediation Unit
Remedial Section
Bureau of Environmental Remediation

c: Mr. Derek Peacock, URS
Ms. E. Jean Underwood → Unocal File - C2-087-00431 (1.0)

URS

December 14, 2007

Mr. Christopher C. Carey
Post-Remediation Unit/Remedial Section
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Topeka, KS 66612-1367

Re: **Replacement Pages for the Final Revision 0 Remedial Investigation Report**
Former Unocal Chemical Distribution Facility
2100 East 37th Street North
Wichita, Kansas 67219

Dear Mr. Carey:

URS Corporation has prepared replacement pages for those portions of the document that were updated on the basis of your comments to the subject report. These comments were received by Chevron and URS on December 10, 2007 via electronic mail and then discussed over the telephone.

The replacement pages include:

- Page vi - List of Figures;
- Page 4-19;
- Page 5-16 through 5-21;
- Page 6-3;
- Figure 4-24;
- Figure 4-25; and
- Appendix D (4 plates).

These pages can simply be replaced into your copy of the document. Please review these materials, and if they are to your satisfaction, then we will send the electronic versions of the Remedial Investigation and Additional Delineation Reports.

Respectfully submitted,

Derek R. Peacock, PE
Project Manager, URS Corporation

cc: Mr. Mike Mailloux, Chevron (2 copies)
Ms. Eve Barron, Chevron (1 copy)
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Final Revision 0

Remedial Investigation Report

Former Unocal Chemical Distribution Facility
Wichita, Sedgwick County, Kansas

November 21, 2007

Prepared for:

Chevron Environmental Management Company (EMC)
6001 Bollinger Canyon Road
San Ramon, CA 94583

Prepared by:
URS Corporation
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Table of Contents

Section	Title	Page
	Executive Summary	ES-1
1.0	Introduction	1-1
	1.1 Site Background	1-1
	1.2 Purpose	1-1
	1.3 Report Organization	1-2
2.0	History and Environmental Setting	2-1
	2.1 Site History	2-1
	2.2 Site Environmental Setting	2-3
	2.2.1 Physiography and Topography	2-3
	2.2.2 Demography and Land Use	2-3
	2.2.3 Climate and Meteorology	2-3
	2.2.4 Soil	2-4
	2.2.5 Regional Geology	2-4
	2.2.6 Site Geology	2-5
	2.2.7 Regional Hydrogeology	2-6
	2.2.8 Site Hydrogeology	2-6
	2.2.9 Surface Water Hydrology	2-7
	2.2.10 Ecology	2-7
	2.2.11 Intended Land Use	2-8
3.0	Site Investigations	3-1
	3.1 Preliminary Site Characterization – Woodward-Clyde Consultants, June 1990	3-1
	3.2 Phase II Site Characterization – Woodward-Clyde Consultants, November 1991	3-2
	3.3 Phase I Remedial Investigation – Maude Environmental, Inc., November 1993	3-3
	3.4 Phase II Remedial Investigation Addendum Activities – Delta Environmental Consultants, Inc., September 1995	3-5
	3.5 Quarterly Groundwater Monitoring Reports 1995 – Delta Environmental Consultants, Inc., June, August, December, and January 1995	3-5
	3.6 Phase II Remedial Investigation – Smith Environmental Technologies Corporation, December 1996	3-6
	3.7 Comprehensive Remedial Investigation Report – Woodward-Clyde Consultants, June 1996	3-9
	3.8 Semi-Annual Groundwater Monitoring Results 1996 – Woodward-Clyde Consultants, December 1996	3-10
	3.9 DNAPL Site Evaluation – Woodward-Clyde Consultants, January 1997	3-10
	3.10 Semi-Annual Groundwater Monitoring Results 1997 – Harding Lawson Associates, July 1997 and January 1998	3-11
	3.11 Phase III Investigation Technical Memorandum – Harding Lawson Associates, April 1998	3-11

Table of Contents

Section	Title	Page
3.12	Semi-Annual Groundwater Monitoring Reports 1998 – Harding Lawson Associates, July 1998 and January 1999	3-12
3.13	Semi-Annual Groundwater Monitoring Reports 1999 – Harding Lawson Associates, May 1999 and January 2000	3-12
3.14	Semi-Annual Groundwater Monitoring Report 2000 – Harding Lawson Associates, June 2000	3-13
3.15	Enhanced Bioremediation Pilot Test Results – Harding ESE, Inc., May 2001	3-13
3.16	Semi-Annual Groundwater Monitoring Reports 2001 – Harding ESE Inc., July 2001 and Terracon, December 2001	3-15
3.17	Direct-Push Sampling Results for Further Source Delineation – Harding ESE, Inc., September 2001	3-15
3.18	Source Area Soil Removal Closure Report – Terracon, March 2002	3-16
3.19	Annual Groundwater Monitoring Report 2002 – Terracon, September 2002	3-17
3.20	On-Site Soil Characterization Report – URS, May 2003	3-17
3.21	Annual Groundwater Monitoring Report 2003 – URS, May 2004	3-17
3.22	Annual Groundwater Monitoring Report 2004 – URS, April 2005	3-18
3.23	Annual Groundwater Monitoring 2005	3-18
3.24	Annual Groundwater Monitoring 2006	3-19
3.25	USD's First Semiannual 2006 Groundwater Sampling Results - June 2006	3-19
3.26	Pilot Test Injection - December 2006	3-19
3.27	Membrane Interface Probe Investigation - September 2007	3-19
3.28	Additional Investigation Activities to Complete the RI Delineation – November 2007	3-20
4.0	Nature And Extent Of Contamination	4-1
4.1	Data Usability	4-1
4.2	Source Area Investigation	4-1
4.2.1	Primary Source Areas	4-2
4.2.2	Removal of Potential Primary and Secondary Source Areas	4-3
4.3	Screening Levels	4-4
4.4	Nature of Soil Contamination	4-4
4.5	Nature of Groundwater Contamination	4-8
4.5.1	Chlorinated VOCs and Other Solvents	4-9
4.5.2	Petroleum Hydrocarbons	4-14
4.5.3	Results Summary	4-17
4.6	Extent of Soil Contamination	4-17
4.7	Horizontal Extent of Groundwater Contamination	4-17
4.8	Vertical Extent of Groundwater Contamination	4-18
5.0	Contaminant Fate and Transport	5-1
5.1	Contaminant Persistence	5-1
5.2	Fate Mechanisms	5-3
5.3	Potential Routes of Migration	5-4

Table of Contents

Section	Title	Page
	5.3.1 Soil Routes of Migration	5-5
	5.3.2 Groundwater Routes of Migration	5-6
5.4	Site-Specific Soil Contaminant Migration	5-9
5.5	Site-Specific Groundwater Contaminant Migration	5-9
5.6	Groundwater to Surface Water (former Coleman Seep)	5-11
5.7	Natural Attenuation of Groundwater	5-12
	5.7.1 Primary Lines of Evidence	5-14
	5.7.2 Secondary Lines of Evidence	5-17
	5.7.3 Natural Attenuation Summary	5-19
5.8	Expanded Enhanced Reductive Dechlorination Pilot Test	5-20
6.0	Conclusions and Recommendations	6-1
6.1	Conceptual Site Model	6-1
	6.1.1 Overview and History	6-1
	6.1.2 Site Geology and Hydrogeology	6-2
	6.1.3 Nature and Extent of Contamination	6-2
	6.1.4 Contaminant Fate and Transport	6-3
6.2	Remedial Investigation Conclusions	6-4
7.0	References	7-1

Appendices

Appendix A: Unocal Consent Order
Appendix B: Unocal Groundwater Trend Plots
Appendix C: Unocal Historical Data (CD)
Appendix D: COC Results for 2006 Annual Monitoring Event with Historical and Supplemental Data

List of Tables

Table	Title	Page
3-1	List of Activities and Reports Issued for Former Unocal Chemical Distribution Facility	3-22
3-2	A Comparison of the Unocal and USD Results for the May 2006 Sampling Event	3-23
4-1	Former ASTs Capacities and Contents at the Former Unocal Chemical Distribution Facility	4-20
4-2	KDHE Tier 2 Risk-Based Residential Screening Values for Soil to Groundwater	4-21
4-3	KDHE Residential Screening Values for Groundwater	4-23
4-4	Concentrations of Detected Chemicals in Shallow Soil Samples	4-24
4-6	Concentrations of Detected Chemicals in Very Deep Soil Samples	4-34
4-7	COPC Concentrations in Shallow Soil Samples	4-35
4-8	COPC Concentrations in Deep Soil Samples	4-40
4-9	Well Construction Data, Former Unocal Chemical Distribution Facility Wichita, Kansas	4-45
4-10	Concentrations of Detected Chemicals in Groundwater for 2005 Event	4-48
4-11	Concentrations of Detected Chemicals in Groundwater for 2006 Event	4-54
5-1	Estimated Physical and Chemical Properties of Analytes that Exceed KDHE Screening Criteria - Former Unocal Chemical Distribution Facility	5-22
5-2	Former Unocal Chemical Distribution Plant Summary of Half-Life Values for Analytes that Exceed KDHE Screening Criteria	5-23
5-3	Natural Attenuation Parameter Results, Former Unocal Chemical Distribution Facility, Wichita, Kansas November 2004	5-24
5-4	Natural Attenuation Parameter Results, Former Unocal Chemical Distribution Facility, Wichita, Kansas 2005 Sampling Event	5-25
5-5	Summary of Results from Mann-Kendall Test	5-28
5-6	Natural Attenuation Parameters and Their Function	5-41

List of Figures

Figure	Title	Page
1-1	Site Location Map	1-3
2-1	Vicinity Map	2-9
2-2	Site Map with Primary Source Areas	2-10
2-3	IRM Groundwater Recovery System and Areas of Excavation	2-11
2-4	Historical Aerial Photographs	2-12
2-5	Surface Topography	2-13
2-6	Soil Survey Map	2-14
2-7	Geologic Cross Section A-A'	2-15
2-8	Geologic Cross Section B-B'	2-16
2-9	Geologic Cross Section C-C'	2-17
2-10	Top of Weathered Bedrock	2-18
2-11	2005 Groundwater Elevations (January 2006)	2-19
2-12	2006 Groundwater Elevations Under Pumping Conditions (May 2006)	2-20
2-13	2006 Groundwater Elevations Under Non-Pumping Conditions (June 2006)	2-21
3-1	Sample Location Map	3-24
4-1	Initial Soil Sample Results Above KDHE Screening Values	4-59
4-2	Shallow Soil Sample Results Above KDHE screening Values (2-5' bgs)	4-60
4-3	Deep Soil Sample Results Above KDHE Screening Values (5-10' bgs)	4-61
4-4	Very Deep Soil Sample Results Above KDHE Screening Values (>10' bgs)	4-62
4-5	Final Soil Sample Results Above KDHE Screening Values	4-63
4-6	2005 Groundwater Monitoring Locations (January-March 2006)	4-64
4-7	VOC Contaminants in Groundwater Above KDHE Screening Values During 2005 Event	4-65
4-8	Petroleum Hydrocarbon Contaminants in Groundwater Above KDHE Screening Values During 2005 Event	4-66
4-9	2006 Groundwater Monitoring Locations (June 2006)	4-67
4-10	VOC Contaminants in Groundwater Above KDHE Screening Levels During 2006 Event	4-68
4-11	Petroleum Hydrocarbon Contaminants in Groundwater Above KDHE Screening Levels During 2006 Event	4-69
4-12	PCE Concentrations in Groundwater (2005)	4-70
4-13	PCE Concentrations in Groundwater (2006)	4-71
4-14	TCE Concentrations in Groundwater (2005)	4-72
4-15	TCE Concentrations in Groundwater (2006)	4-73
4-16	*cis*-1,2-DCE Concentrations in Groundwater (2005)	4-74
4-17	*cis*-1,2-DCE Concentrations in Groundwater (2006)	4-75
4-18	Vinyl Chloride Concentrations in Groundwater (2005)	4-76
4-19	Vinyl Chloride Concentrations in Groundwater (2006)	4-77
4-20	Chlorinated Ethane Concentrations in Groundwater (2005)	4-78
4-21	Chlorinated Ethane Concentrations in Groundwater (2006)	4-79
4-22	Petroleum Hydrocarbon Concentrations in Groundwater (2005)	4-80
4-23	Petroleum Hydrocarbon Concentrations in Groundwater (2006)	4-81
4-24	Vertical Delineation Results for Chlorinated Ethenes	4-82
4-25	Vertical Delineation Results for Petroleum Hydrocarbons	4-83

List of Abbreviations and Acronyms

µg/L	micrograms per liter
°C	degrees Celsius
°F	degrees Fahrenheit
%	percent
AMSL	above mean sea level
AST	aboveground storage tank
atm-m^3/mole	atmospheres-cubic meter per mole
bgl	below ground level
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylene
CA	chloroethane
Canonie	Canonie Environmental
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cis-1,2-DCE	*cis*-1,2-dichloroethene
cm/sec	centimeters per second
Coleman	Coleman North East
COC	chemical of concern
COPC	constituent of potential concern
CSM	conceptual site model
DAF	dilution attenuation factor
DCA	dichloroethane
DCE	dichloroethene
DEC	Delta Environmental Consultants, Inc.
DNAPL	dense non-aqueous phase liquid
DO	dissolved oxygen
DOT	Department of Transportation
DP	direct-push
DPT	direct-push technology
ECD	electron capture detector
EPA	United States Environmental Protection Agency
f_{oc}	organic carbon fraction
FS	feasibility study
ft	feet
ft^2/day	square feet per day
ft^3/s	cubic feet per second
FID	flame ionization detector
GC	gas chromatograph
g/mole	grams per mole
gpm	gallons per minute
gw	groundwater
H^+	hydrogen ion
Harding	Harding ESE, Inc.
HLA	Harding Lawson Associates

List of Abbreviations and Acronyms)

HPDE	high-density polyethylene
HRC®	Hydrogen Release Compound
IRM	Interim Remedial Measure
k	first-order reaction rate coefficient
K_d	soil-water partition coefficient
K_{oc}	organic carbon partition coefficient
KDHE	Kansas Department of Health and Environment
KDWP	Kansas Department of Wildlife and Parks
L/kg	liters per kilogram
LNAPL	light non-aqueous phase liquid
LOE	line of evidence
MCL	maximum contaminant level
MEI	Maude Environmental, Inc.
MEK	2-Butanone
MIBK	4-methyl-2-pentanone
MTBE	methyl tert-butyl ether
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MNA	monitored natural attenuation
mph	miles per hour
MS/cm	milli siemens per centimeter
MW	monitoring well
NA	not analyzed
NAPL	non-aqueous phase liquid
ND	non-detect
NM	not measured
NOAA	National Oceanic & Atmospheric Administration
f_{oc}	organic carbon fraction
OH^-	hydroxide ion
ORP	oxidation-reduction potential
P or PZ	piezometer
PCE	tetrachloroethene
PID	photo ionization detector
POTW	Publicly Owned Treatment Works
ppb	parts per billion
QA	quality assurance
QC	quality control
R	recovery well
RI	Remedial Investigation
RSK	Risk-Based Standards
s	soil
SB	soil boring
Smith	Smith Environmental Technologies Corporation
SVE	soil vapor extraction

List of Abbreviations and Acronyms

SVOC	semivolatile organic compound
TCA	trichlorethane
TCE	trichloroethene
TMB	trimethylbenzene
TOC	total organic carbon
TW	test well
Unocal	Union Oil Company of California
URS	URS Corporation
USD	Unified School District
USDA	United States Department of Agriculture
USGS	U.S. Geological Survey
VOC	volatile organic compound
WCC	Woodward Clyde Consultants

EXECUTIVE SUMMARY

This Remedial Investigation (RI) report documents all investigative activities performed to define the nature and extent of environmental contamination associated with historical activities conducted at the former Union Oil Company of California (Unocal) Chemicals Distribution Facility (referred to as the Site). Known and unknown releases occurred from the Site, resulting in the contamination of unsaturated soil, saturated soil, groundwater, and at one time, surface water via the "Coleman Seep." The Site activities were initiated in 1989 after a tetrachloroethene (PCE) spill was reported, prompting a series of RIs and remediation activities.

Operations at the facility ceased in 1992. The chemical infrastructure (tanks, piping, rail cars, etc.) and the structures associated with the facility were razed prior to 2003. Currently, the Site has no permanent structures, is relatively flat, and is partially vegetated. The Site's subsurface is comprised primarily of silty clay with interbedded sands and gravel, atop shale that acts as the lower confining unit. The groundwater flow direction of the area is mostly southwest, toward the Little Arkansas River.

After decommissioning the soil vapor extraction (SVE) system that was initially installed, remediation activities continued. In 1994, a groundwater extraction system was installed. Groundwater was extracted from the Site and the Coleman North East (Coleman) property and treated via air stripping and Publicly Owned Treatment Works (POTW) discharge. The seep area was regraded, eliminating the potential for surface water exfiltration.

A pilot test was performed in 1999 to evaluate the effectiveness of the enhancement of reductive dechlorination. A series of excavations occurred in 2001, resulting in the removal of a significant portion of the unsaturated soil contaminant mass and, thus, the major sources of further contamination to the groundwater system. The extraction system was operated until August 30, 2006 and a second pilot test was initiated on the Coleman property in December 2006.

The nature and extent of the soil contamination at the Site is based on historical soil information collected over the last 15 years. After eliminating the non-qualified data, many of the initial soil exceedances were omitted from further evaluation because they were excavated in 2002 or were collected from the saturated zone. A screening-level risk assessment of these constituents of potential concern (COPCs) determined that only PCE and vinyl chloride remain as migration from soil to groundwater pathway COPCs for both residential and non-residential land use settings.

The nature and extent of the groundwater contamination at the Site is based on the groundwater data from the most recent *comprehensive* groundwater sampling event conducted January through March 2006 (i.e., also referred to as the 2005 groundwater sampling event). For this evaluation, data was evaluated in light of the refined spatial understanding that was developed in a comprehensive direct push technology (DPT) study performed in 1999 through 2001. This spatial understanding was the basis for developing the "plumelet" concept that is presented in this report. The plumelet concept identifies areas of the Site that are contaminated with various combinations of chemical constituents.

The analytes that most consistently and significantly exceed the residential groundwater criteria throughout the groundwater monitoring network are PCE, trichloroethene (TCE), *cis*-1,2-dichloroethene (*cis*-1,2-DCE), vinyl chloride, and 1,2,4-trimethylbenzene (TMB). A screening-level risk assessment determined that 1,1-dichloroethane (DCA), 1,1-DCE, 1,2,4-TMB, 1,3,5-TMB, benzene, isopropylbenzene, naphthalene, PCE, TCE, vinyl chloride, and *cis*-1,2-DCE remain as groundwater COPCs for the residential land use setting, while 1,1-DCE, 1,2,4-TMB, 1,3,5-TMB, benzene, isopropylbenzene, naphthalene, PCE, TCE, vinyl chloride, and *cis*-1,2-DCE remain as groundwater COPCs for the non-residential land use setting.

The contaminant fate and transport at the Site was explained using the plumelet concept originating from the comprehensive DPT investigation. Historically the plumelets (Plumelets A-F) remained segregated as they traveled in a mostly linear fashion down-gradient. At this time, the contaminant plumelets appear to have reached stability and, owing to removal and interim actions, contaminant concentrations continue to decrease. In areas where petroleum hydrocarbon constituents and solvents coexist, enhanced biodegradation has occurred, as evidenced by the presence of degradation products of chlorinated solvents (*cis*-1,2-DCE and vinyl chloride). For the remainder of the chlorinated solvent plume, reductive dechlorination appears to be limited by the availability of electron donor material. Providing donor material, as done in the 1999 Pilot Test, has been shown to enhance reductive dechlorination, lowering PCE and TCE concentrations to below regulatory standards for residential use. For example, dechlorination has been measured in groundwater over time on those portions of the Coleman property where benzene, toluene, ethylbenzene, and xylene (BTEX) and chlorinated solvents are mixed. Therefore, the addition of donor material on the Coleman site should result in a decline in contaminant concentrations in that area over time.

1.0 Introduction

This Remedial Investigation (RI) report documents the investigation activities used to define the nature and extent of environmental contamination associated with historical activities conducted at the former Union Oil Company of California (Unocal) Chemicals Distribution Facility located in Wichita, Sedgwick County, Kansas.

1.1 Site Background

The former Unocal Chemical Distribution Facility (hereafter referred to as the Site) is located at 2100 E. 37th Street in Wichita, Kansas, and lies approximately 1.3 miles north of the city of Wichita. The 2.4-acre site location is shown on Figure 1-1. The Kansas Department of Health and Environment (KDHE) and Unocal signed a Consent Order on March 23, 1992, that outlined provisions for an RI and feasibility study (FS) to be conducted at the Site and for interim remedial actions to be implemented, as needed (Case Number 91-E-206). This consent order required Unocal to implement "response action(s) to prevent a continuing release or threat of release of hazardous substances and remove the pollution or hazard." The Consent Order is presented in Appendix A.

On February 2, 2005, URS Corporation (URS) submitted the ***Unocal Final Remedial Investigation Report, Former Chemical Distribution Facility, Wichita, Kansas*** (URS, February 2005a) to KDHE on behalf of Unocal. This revision of that report addresses KDHE comments on the February 2005 submittal and was prepared in general accordance with the United States Environmental Protection Agency (EPA) ***Guidance for Conducting Remedial Investigations and Feasibility Studies under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)*** (EPA, October 1988). This RI report deviates slightly from the traditional CERCLA outline in that, to characterize the Site, it synthesizes multiple previous investigative efforts performed by different consulting firms to characterize the Site.

1.2 Purpose

The purpose of the RI report is to document the field activities and the interpretation of investigative data to adequately characterize the Site. The characterization includes a description of site physical properties, the nature and extent of contamination, and the screening level evaluation to support the development and evaluation of potential remedial alternatives. This RI has achieved the primary objectives outlined in the Consent Order and described below:

1) Sources of contamination have been adequately characterized to evaluate risk and support the determination of appropriate remediation goals.

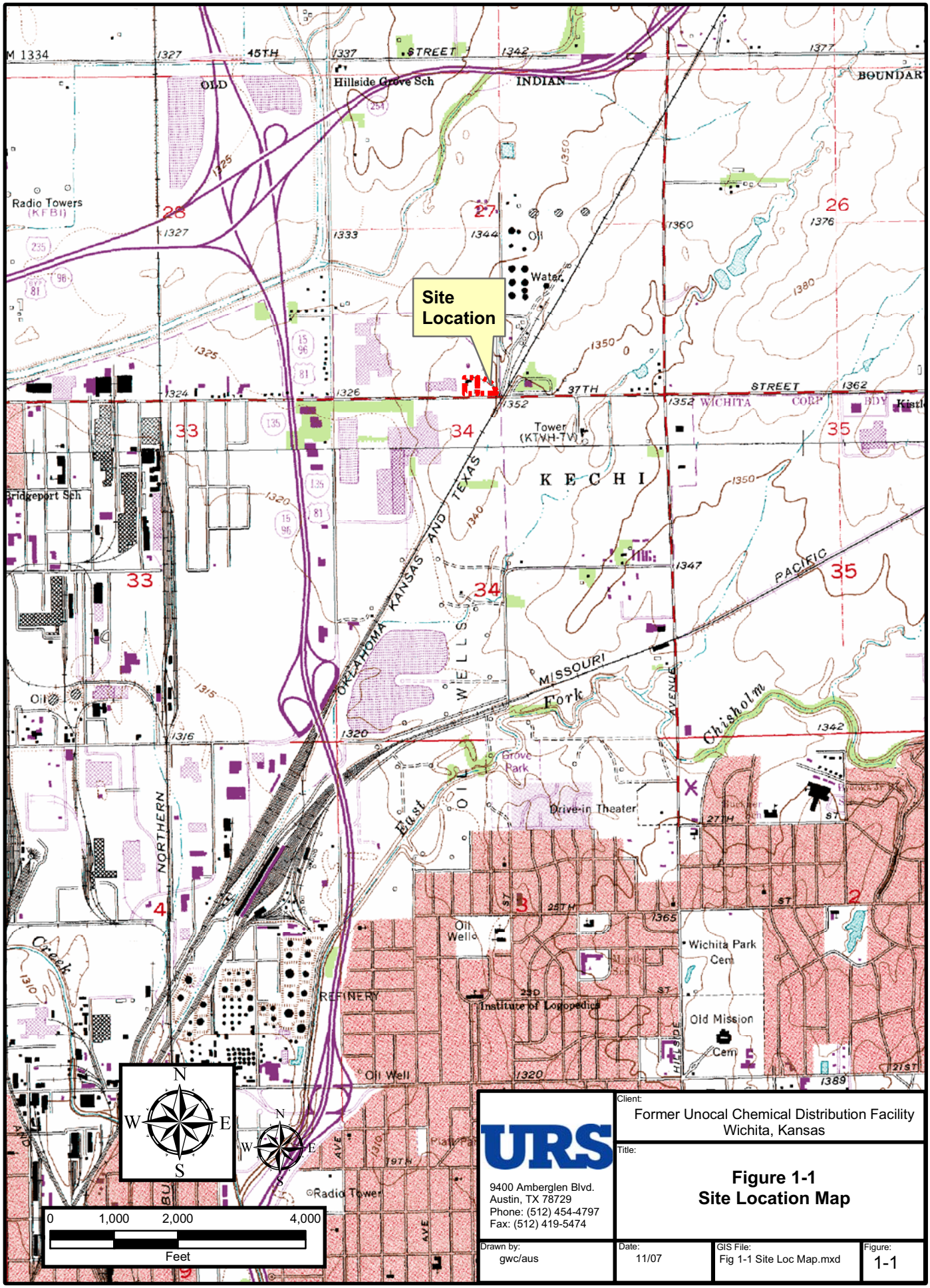
2) The nature of contamination and the horizontal and vertical extent have been defined to support development and evaluation of effective remedial alternatives.
3) The physical environmental setting has been characterized to support the understanding of contaminant fate and transport mechanisms at the Site and includes information on the regional and local geology, hydrogeology, and hydrology.
4) The chemical and physical properties of contaminants, their mobility and persistence in the environment, and their fate and transport mechanisms have been considered.
5) Interim Remedial Measures (IRMs) have been implemented appropriately in source areas and other areas of contamination.

1.3 Report Organization

This report summarizes the historical and recent RI activities and data used to definitively characterize the Site. Historical investigative activity reports have been submitted to the KDHE. The analytical data from the historical investigations have been tabulated and are included in this RI report; however, hard copies of the historical laboratory reports are not included for resubmission. These data have been provided in the various reports referenced throughout this document and can be provided upon request.

This report is organized into the following sections:

Executive Summary
Section 1.0 - Introduction
Section 2.0 - History and Environmental Setting
Section 3.0 - Summary of Site Investigations
Section 4.0 - Nature and Extent of Contamination
Section 5.0 - Contaminant Fate and Transport
Section 6.0 - Conclusions and Recommendations
Section 7.0 - References



Q:\Unocal-Wichita\Drawings\RI_Report\Fig 1-1 Site Loc Map.mxd - 11/8/2007 @ 4:24:10 PM

URS

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Wichita, Kansas

Title:
Figure 1-1
Site Location Map

Drawn by:	Date:	GIS File:	Figure:
gwc/aus	11/07	Fig 1-1 Site Loc Map.mxd	1-1

2.0 History and Environmental Setting

The Site is located at 2100 E. 37th Street in Wichita, Sedgwick County, Kansas, in the southwest quarter of Section 27, Township 26 South, Range 1 East (Figure 1-1). Other than the remediation system treatment trailer, no structures currently exist on the Site property - former facility structures have been razed, including an aboveground chemical storage tank farm and a warehouse building. The treatment system consists of a decommissioned air stripping system and associated underground piping. The groundcover of the western half of the Site consists primarily of gravel, and the eastern half of the Site is covered with grassy vegetation. A chain-link fence secures the Site. Figure 2-1 depicts the location and orientation of the Site and its geographic relationship to other properties in the immediate area.

2.1 Site History

The Site was originally constructed on agricultural land in 1953, operating until 1992 as a chemical storage and distribution facility. Operations at the facility involved the handling of organic solvents; specifically, receiving bulk shipments of containerized (55-gallon drum) liquid chemicals, storage of the bulk chemicals in aboveground storage tanks (ASTs), blending of bulk chemicals for customers, and packaging and transporting of bulk and containerized liquid chemicals to customers via truck. Bulk liquids were received by railcar and truck. Containerized liquids were received by truck. In addition, chemicals were stored in 55-gallon drums in the warehouse and drum storage area, in 500-gallon Department of Transportation (DOT) certified containers, and temporarily in railcars. The types of chemicals handled at the facility included aromatic and aliphatic hydrocarbons, chlorinated hydrocarbons, petrochemicals, ketones, alcohols, and glycol ethers. Hazardous wastes generated at the facility include line flushing wastes and drip pan contents for which the composition is a mixture of the chemicals listed above. Figure 2-2 presents the Site map with the primary source areas.

The only reported release at the facility occurred on November 3, 1989, when approximately 150 gallons of tetrachloroethene (PCE) were released in the AST farm area of the Site (Figure 2-2). Spills prior to 1989 (which is when spill reporting was required by law) may have occurred, but information regarding the location and size of the spills are unknown. However, it can be deduced that if prior spills occurred they would involve the chemicals handled at the facility (listed above). Further discussion of the primary and secondary source areas is provided in Section 4.2.

In an immediate response to the 1989 spill, Unocal installed a soil vapor extraction (SVE) system to remove residual PCE from the unsaturated zone soils. This SVE system consisted of vertical

wells installed in 1989. The SVE system was operated as installed until 1994 when new horizontal wells were installed to replace the former vertical wells. For the new system, a total of six horizontal vapor extraction wells was installed to depths ranging from approximately 7-9.5 feet (ft).

Initially, the vapor collected from the vertical SVE system was treated with activated carbon. Subsequent air quality sampling and modeling indicated that vapor phase treatment was not necessary, so the use of the activated carbon was discontinued. The horizontal SVE system was decommissioned in the late 1990s.

The 1989 spill prompted a series of RIs beginning with a preliminary reconnaissance assessment conducted in 1990. These investigations are detailed in Section 3.0. The purpose of the investigations was to determine potential environmental effects associated with the 1989 release (and any other unknown releases) and to characterize the Site for remediation evaluation in accordance with the KDHE consent order.

The combined investigative efforts identified an affected soil and groundwater plume on and down-gradient from the Site. In 1994, an IRM groundwater recovery system was installed to hydraulically control the migration of the contaminated groundwater with concurrent treatment of captured groundwater. The IRM system is shown on Figure 2-3. The IRM treatment system was installed on the southwest portion of the Site and began operating in January 1995. The IRM was shut down in August 2006.

In 2001, a series of excavations was performed in order to remove soil in the unsaturated zone that was impacted by volatile organic compounds (VOCs). Excavation was performed in three areas on the Site, as shown on Figure 2-3. One excavation was the area extending from the Site entrance to the northwestern warehouse (referred to as the Gate Excavation Area), another excavation is the area north of the bioremediation pilot test (referred to as the Pit Area Excavation), and the last is a portion of the former AST farm (referred to as Excavation Area #1). Impacted soils often extended to groundwater; however, excavation was terminated at the saturated zone. The excavation activities are discussed further in the ***Source Area Soil Removal Closure Report*** (Terracon, 2002a).

As mentioned above, the former facility structures, including the aboveground chemical storage tank farm and a warehouse building, have been razed; only the IRM treatment trailer currently exists on the Site property. A suite of historical aerial photographs for the Site, ranging from

1997 to 2003, is presented on Figure 2-4 and depicts the various changes occurring on the Site over time. Further discussion of the historical aerial photographs is provided in Section 4.2.

2.2 Site Environmental Setting

The Site is located in an industrial area, and the adjacent properties either currently support or have historically supported industrial activities (Figure 2-1). The Rock Island Railroad spur extends along the northern and eastern site boundary, and 37th Street forms the southern site boundary. The adjacent property to the north is owned by the Wichita Unified School District (USD) No. 259 and serves as a maintenance and equipment storage facility. The property northeast of the Site is operated by ConocoPhillips Pipe Line Company and serves as a fuel storage and distribution center. The area east of the Site is primarily commercial, and a radio station office is located approximately 500 ft east of the Site. The Coleman North East (Coleman) facility is located south of the Site across 37th Street and is operated by Coleman Company Inc. The Coleman facility manufactures recreational and camping equipment. Pinsker Steel, Inc. operated a structural steel fabrication and distribution facility immediately west of the Site, but that property is now occupied by Hillman Painting. The nearest residences are approximately 1/2 mile west of the Site.

2.2.1 Physiography and Topography

The Site is located in the Arkansas River Lowlands Physiographic Province. Surface topography at the Site is relatively flat, with a ground surface elevation of approximately 1,350 ft above mean sea level (AMSL). The ground surface has a slight downward grade to the southwest and west. The grade steepens on the adjacent Coleman property south and southwest of the Site and then levels out in the area approaching the Coleman warehouse. The ground surface also generally slopes to the west toward the Little Arkansas River, located approximately 2.5 miles to the west. Figure 2-5 presents the topography of the Site vicinity.

2.2.2 Demography and Land Use

The City of Wichita, Kansas, has a population of approximately 344,000 (US Census, 2000) and is the largest city in both population and areal extent in Sedgwick County. The Site and the areas to the north, west, and south are currently zoned as general industrial. Properties east of the Site are currently zoned as light industrial.

2.2.3 Climate and Meteorology

Wichita has a typical continental climate characterized by large daily and annual variations in temperature. The average winter (January) temperature is 29.6 degrees Fahrenheit (°F) and the average summer (July) temperature is 81.4°F. Most of the precipitation generally occurs

between the months of April and September. The average precipitation received at Wichita is 29.33 inches (National Oceanic & Atmospheric Administration [NOAA], 2006). The prevailing wind direction is to the south (NOAA, 2006). The average surface wind speed is approximately 12.3 miles per hour (mph) (NOAA, 2006).

2.2.4 Soil

Topsoil underlying the Site consists of a mixture of Blanket Silt Loam and Farnum Loam (Soil Conservation Service, 1979). These soils have been characterized as being well drained with slow percolation rates. Immediately below the topsoil lies a heterogeneous layer of silty clays, sandy clays, and discontinuous sand units. Sand units within the overburden are thin and discontinuous. Figure 2-6 presents the Site soil survey map.

2.2.5 Regional Geology

The regional geology of Sedgwick County consists of Precambrian igneous and metamorphic basement complex overlain by Paleozoic bedrock, which consists of approximately 4,000 to 4,500 ft of Cambrian, Ordovician, Mississippian, Pennsylvanian, and Permian aged limestone, dolomite, shale, and sandstone (Lane and Miller, 1965).

There is no rock record of the Mesozoic Era in Sedgwick County and Paleozoic bedrock in the region is unconformably overlain by Cenozoic sediment. The close of the Mesozoic Era is associated with a long period of erosion by streams in the region, which flowed eastward from the Rocky Mountains across Kansas. The period of erosion created a north-south-trending depressional area in the easily eroded Permian shale. The ancestral Arkansas River was the master stream in the area, and erosion predominated over deposition until the Pliocene Epoch. Pliocene sediments filled the depressional feature in the eroded Permian shale and formed a nearly continuous alluvial plain that extended from eastern Sedgwick County westward over all of western Kansas. Unconsolidated deposits of clay, silt, sand, and gravel equivalent to a part of the Pliocene Ogallala Formation unconformably overlie Permian rocks in the basal portion of the Arkansas River valley fill.

A minor uplift in the Rocky Mountain area marked the end of the Pliocene Epoch, and gradual climatic cooling in North America resulted in the formation of great continental ice sheets and mountain glaciers that distinguish the Pleistocene Epoch. The climatic changes accompanying the advance and retreat of the ice sheets affected areas beyond the ice fronts, causing changes in stream regimen and major drainage changes in some areas. Deposits representing at least four major depositional cycles of the Pleistocene Series are present in Sedgwick County. The continental glaciations and the interglacial periods that followed are the Nebraskan/Aftonian,

Kansan/Yarmouthian, Illinoisan/Sangamon, and Wisconsinan/recent alluvial deposition. During these sequences, a period of downcutting in stream valleys was followed by deposition of coarse alluvium that graded into finer material as the ice retreated and the climate became warmer and dryer. Erosional sequences during these periods reworked deposits from the previous periods. Sediments associated with Wisconsinan and Recent deposition along the Arkansas River underlie a broad, extremely flat surface adjacent to the river plain.

2.2.6 Site Geology

The Site is located within the Arkansas River Lowlands Physiographic Province. At the Site, the Wellington Formation (Permian age) is unconformably overlain by Wisconsinan and recent alluvium deposits (Quaternary age). The Wellington Formation consists of calcareous gray and blue shale containing several thin beds of impure limestone and thin beds of gypsum and anhydrite. The shale in the upper portion of the formation is weathered and is more permeable than the lower unweathered portion. The weathered portion of the Wellington Formation at the Site is approximately 16 ft thick. The overlying Wisconsinan and recent alluvium deposits consist of unconsolidated clay, sand, silt, and gravel. The thickness of the Wisconsinan and recent alluvium deposits are approximately 10-15 ft thick at the Site and range from 10-27 ft in thickness under the western portion of Coleman property.

Geologic logs from the Site and adjacent properties are consistent with the regional geology described in Section 2.2.5. Cross sections were created to depict the subsurface geology at the Site and Site vicinity. Cross sections A-A', B-B', and C-C' are presented on Figures 2-7, 2-8, and 2-9, respectively. Approximately half of the Site ground cover consists of gravel. In regions of the Site where natural ground surface is exposed, the predominate native surface soil to a depth of 2 ft below ground level (bgl) is silty clay, dark reddish-black to brown in the upper horizon, which grades sharply to an orange brown silty clay of the Wisconsinan and recent alluvium. The Wisconsinan and recent alluvium deposits are approximately 10-15 ft thick at the Site. Silt, sand, and gravel lenses of varying thickness are present in this unit. The Wisconsinan and recent alluvium and Wellington contact is abrupt and identified by stiff, dark bluish-black, blocky, weathered shale.

Figure 2-10 shows the top of the weathered Wellington Shale. As shown in the figure, the Site is located on the highest elevation of weathered shale (approximately 1345 ft AMSL). The weathered shale steeply slopes downward on the southeastern corner and eastern boundary of the Site, while it slopes gradually downward beyond the western boundary. The weathered shale on the Coleman property slopes southward, but much more gradually than on the Site. The weathered shale potentially acts as a vertical confining layer and may play a role in contaminant

migration (discussed further in Section 5.0). The weathered Wellington shale is up to 16 ft thick and gently grades to the unweathered Wellington shale. Minor sand and gypsum lenses are present in the Wellington shale.

Cross sections A-A' and B-B' depict the margins of the IRM system (see Figures 2-7 and 2-8). In both cross sections, the Wisconsinan and recent alluvium deposits increase in thickness to the south. This is because the Site is located within the transition zone of the Wellington Upland physiographic area and the Arkansas River Alluvial Valley. The sediments of the Arkansas River Alluvial Valley increase in thickness to the south and southwest. The top of the weathered Wellington shale slopes to the south and southwest. As depicted on cross section B-B' an isolated bedrock high occurs east of the Coleman building in the vicinity of Extraction Wells R-3, R-4, R-5, and R-6. Cross section C-C' (see Figure 2-9) initiates along the northern Site boundary and traverses southwest to the Coleman facility buildings. As in the other cross sections, the top of the weathered shale slopes from the northeast to the south and southwest. As noted in geologic cross sections A-A' through C-C', thin, discontinuous sand layers are observed in several locations within the Wisconsinan and recent alluvium deposits.

2.2.7 Regional Hydrogeology

The regional hydrostratigraphic unit can generally be correlated by topography, geologic age, lithology, and surface water hydrology. The Arkansas River Valley groundwater movement is, in general, toward the Little Arkansas River and toward the Arkansas River below the confluence of the two rivers. Stratified and lenticular deposits of different permeability characterize the valley fill yielding slightly different pressure gradients and groundwater flow direction in isolated locations, but the regional groundwater flow gradient is to the Arkansas River. The Arkansas River Valley contains the majority of the usable groundwater in the region. The quantity of groundwater in storage in the valley is about 6.1 million acre-ft if an assumed specific yield of 20 percent (%) for the sediments is correct. The yields of wells in the Arkansas River Valley range from a few gallons per minute (gpm) for small domestic and livestock wells to approximately 1,500 gpm for large municipal and industrial wells.

2.2.8 Site Hydrogeology

Figure 2-11 is a potentiometric surface contour map interpreted from a synoptic water-level survey conducted in site vicinity monitoring and recovery wells during February 2006. The monitoring and recovery wells are installed in the Wisconsinan and recent alluvium deposits and the upper weathered portion of Wellington Formation and have screens ranging from 4-59.8 ft bgl. Based on U.S. Geological Survey (USGS) topographic maps for the Site vicinity, the groundwater flow direction is assumed to be southwest, toward the Little Arkansas River.

Groundwater flow in the upland area (i.e., from the Site to the Coleman area) is to the south-southwest with a slight westerly trend as it transitions out of the upland area into the alluvial sand. Data generated during the Phase I RI and groundwater elevations measured during the Phase II RI concluded that groundwater flow was generally to the south-southwest. Data from the 2006 groundwater monitoring event, presented in Figures 2-12 and 2-13, confirmed that the groundwater flow is primarily to the south-southwest. Additionally, the 2006 groundwater monitoring event included groundwater elevation information for the USD and Hillman (Pinsker) properties, which showed a westerly component to groundwater flow that had previously not been identified.

2.2.9 Surface Water Hydrology

The Site lies within the Little Arkansas River Watershed (KDHE, October 2004). Surface water in the Site vicinity consists of the Arkansas River, the Little Arkansas River, small intermittent and low-discharge perennial tributaries of the rivers, drainage ditches, and manmade ponds. The Little Arkansas River is approximately 2.5 miles west of the Site, and the median annual flow of the river is 80.43 cubic feet per second (ft^3/s) (USGS, 2006). The Arkansas River is approximately 3.75 miles west of the Site and has a median annual flow of 362 ft^3/s (USGS, 2006). The confluence of the Arkansas and Little Arkansas Rivers is approximately 4.5 miles southwest of the Site. The Chisholm Creek, Middle Fork Chisholm Creek, and East Fork Chisholm Creek are tributaries of the Arkansas River and have median annual flows of less than 5 ft^3/s (USGS, 2006).

One pond is in proximity to the Site. A retention pond is located 1,754 ft southwest of the Site on the Coleman property between Hydraulic Avenue and the Coleman facility warehouse and shipping buildings. The retention pond is approximately 6.7 acres in size.

Regional surface water drainage is south to southwest to the tributaries of the Little Arkansas River. Surface drainage on the eastern portion of the Site is generally toward the center of the Site where the water accumulates and percolates into the ground. Drainage on the western portion of the Site is toward the south where overland flow intersects a drainage ditch that flows to the west along 37th Street.

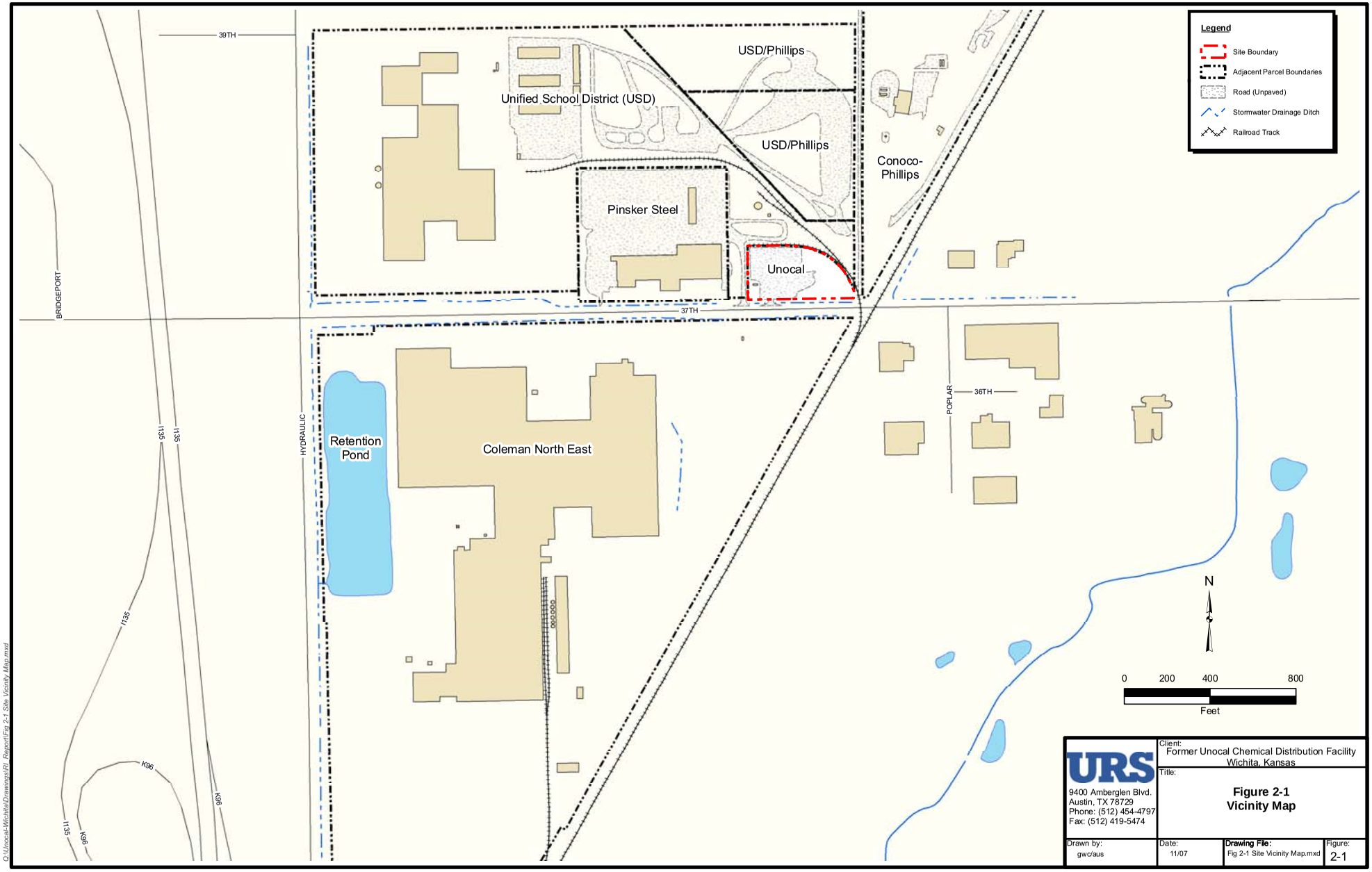
2.2.10 Ecology

The Site property consists primarily of relatively flat land with grass cover. The Site and surrounding properties are primarily commercial/industrial land use. The surrounding properties are primarily paved with very little to no grassy areas. The grassy area on the Site is mowed and maintained. The nearest water body is a pond located on the neighboring Coleman property

approximately 1,754 ft southwest of site. Although no specific fauna has been identified at the Site, anticipated species may include assorted small mammals, reptiles, birds, and insects. The State of Kansas currently has approximately 61 threatened or endangered species of animals (Kansas Department of Wildlife and Parks [KDWP], 2005). Approximately 40 of these species are fish, invertebrates, amphibians, or birds that reside in or near rivers or other water bodies. No threatened or endangered species have been identified at the Site or observed at the Site during site visits. No biotic sampling was conducted at the Site.

2.2.11 Intended Land Use

The current general land use for the Site and the area surrounding the Site is commercial/industrial. The land use of the Site is anticipated to remain commercial/industrial. The land use of the entities surrounding the Site are also anticipated to remain commercial/industrial.



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Phone: (512) 454-4797
Fax: (512) 419-5474

Client: Former Unocal Chemical Distribution Facility Wichita, Kansas

Title: **Figure 2-1 Vicinity Map**

Drawn by:	Date:	Drawing File:	Figure:
gwc/aus	11/07	Fig 2-1 Site Vicinity Map.mxd	2-1

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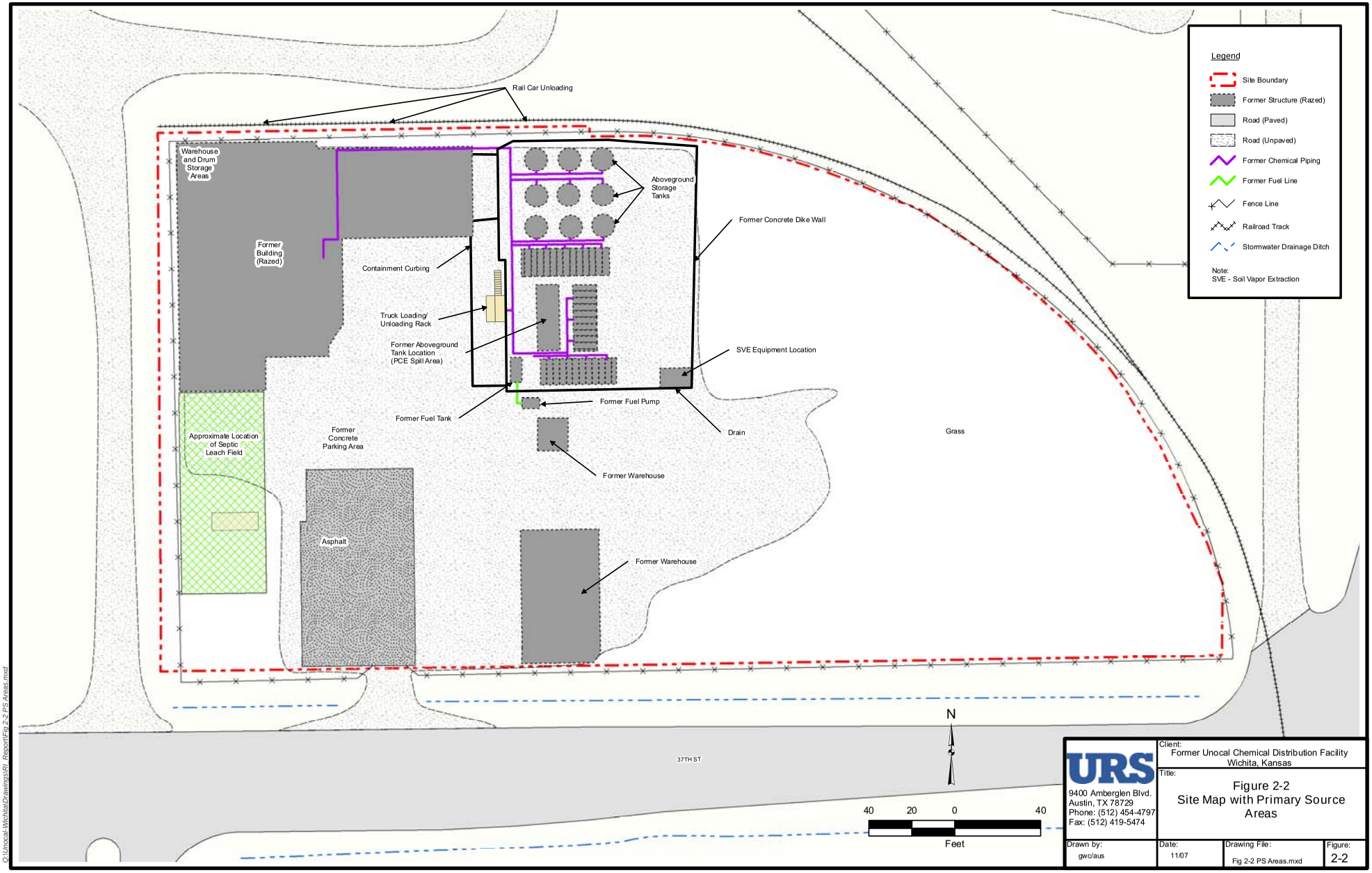

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Title: Figure 2-2 Site Map with Primary Source Areas

Drawn by:	Date:	Drawing File:	Figure:
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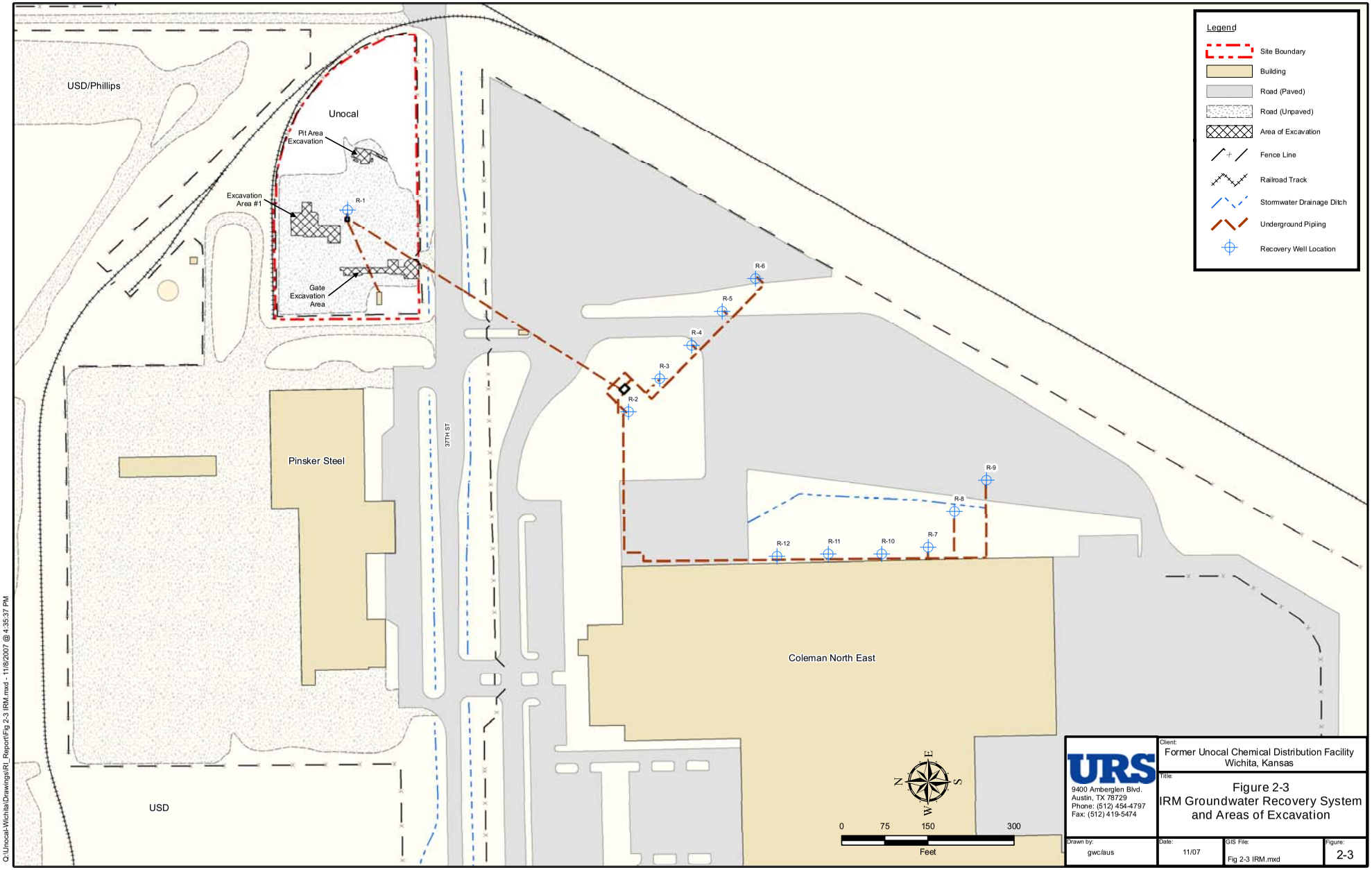
Q:\Unocal-Wichita\Drawings\RI Report\Fig 2-2 PS Areas.mxd



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Title: Figure 2-3 IRM Groundwater Recovery System and Areas of Excavation

Drawn by:	Date:	GIS File:	Figure:
gwc/aus	11/07	Fig 2-3 IRM.mxd	2-3

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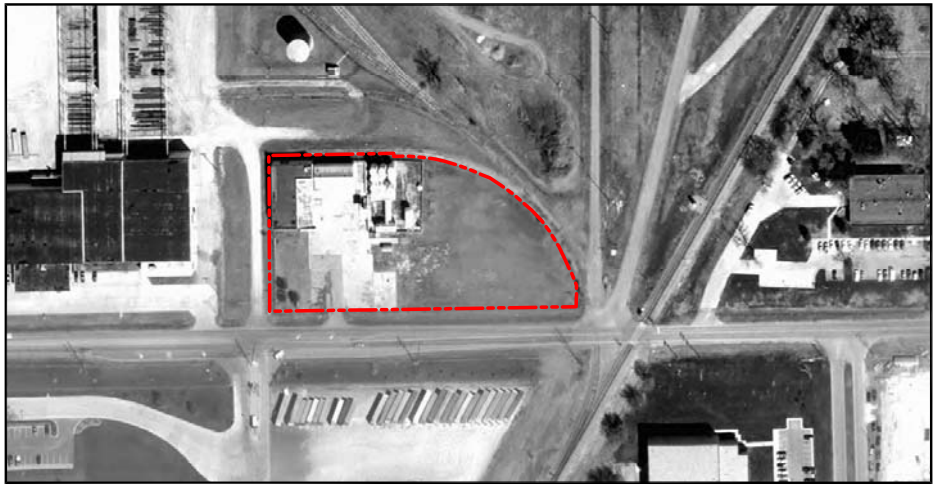

1997

2000

2003

Legend

Site Boundary

Note:
Aerials for 1970, 1981, and 1990 were also provided; however, due to the poor quality of the photographs, they were not included in this figure.

N

100 0 200

Feet

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Title: **Figure 2-4 Historical Aerial Photographs**

Drawn by:	Date:	Drawing File:	Figure:
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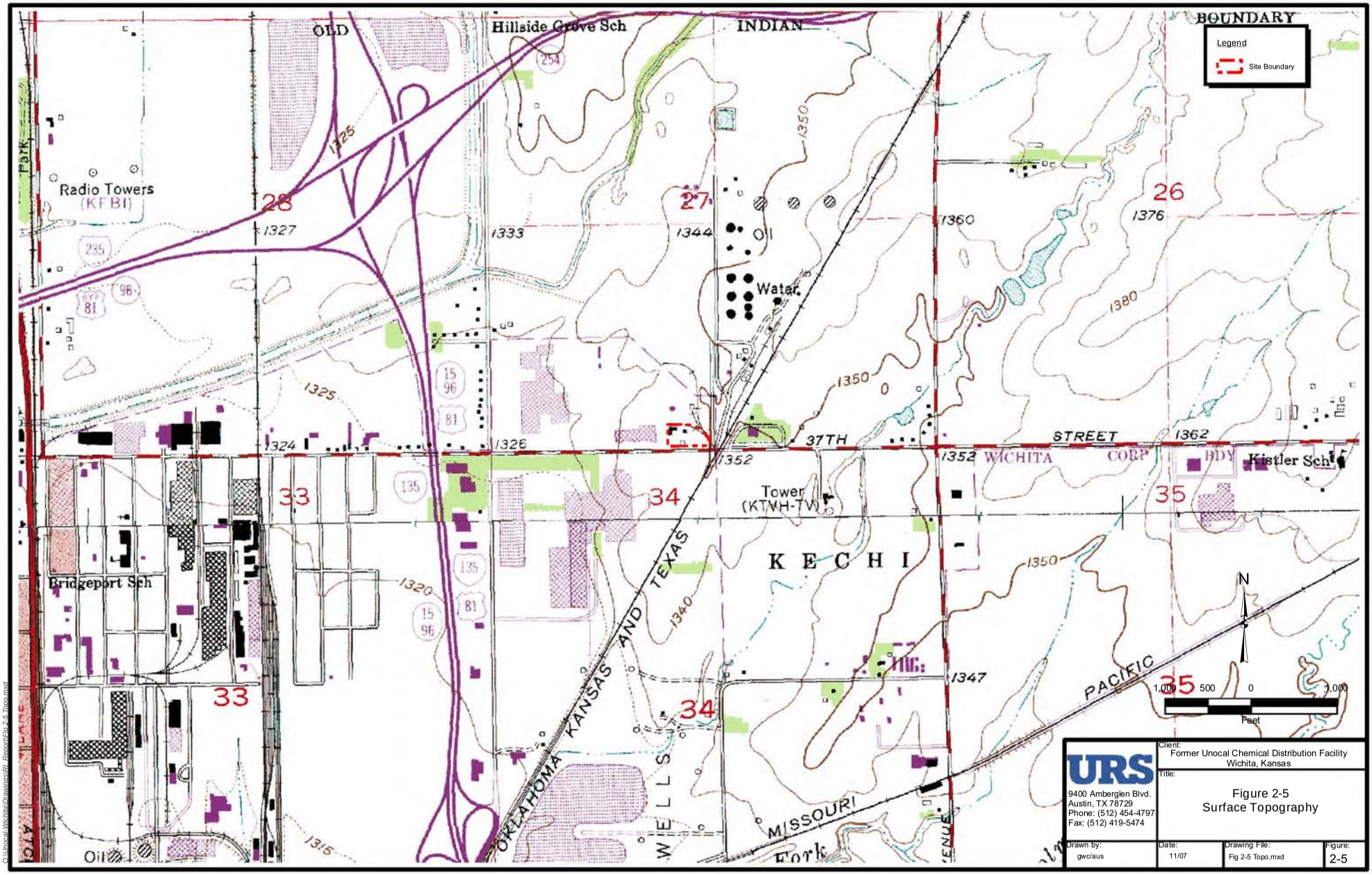
File: Q:\Unocal-Wichita\Drawings\RL Report\Fig 2-4 HAP.dwg Layout: Fig 2-4 Plotted: Nov 08, 2007 - 5:02pm



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Title: Figure 2-5 Surface Topography

Drawn by:	Date:	Drawing File:	Figure:
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O:\Unocal\Wichita\Drawings\RI_Report\Fig 2-5 Topo.mxd

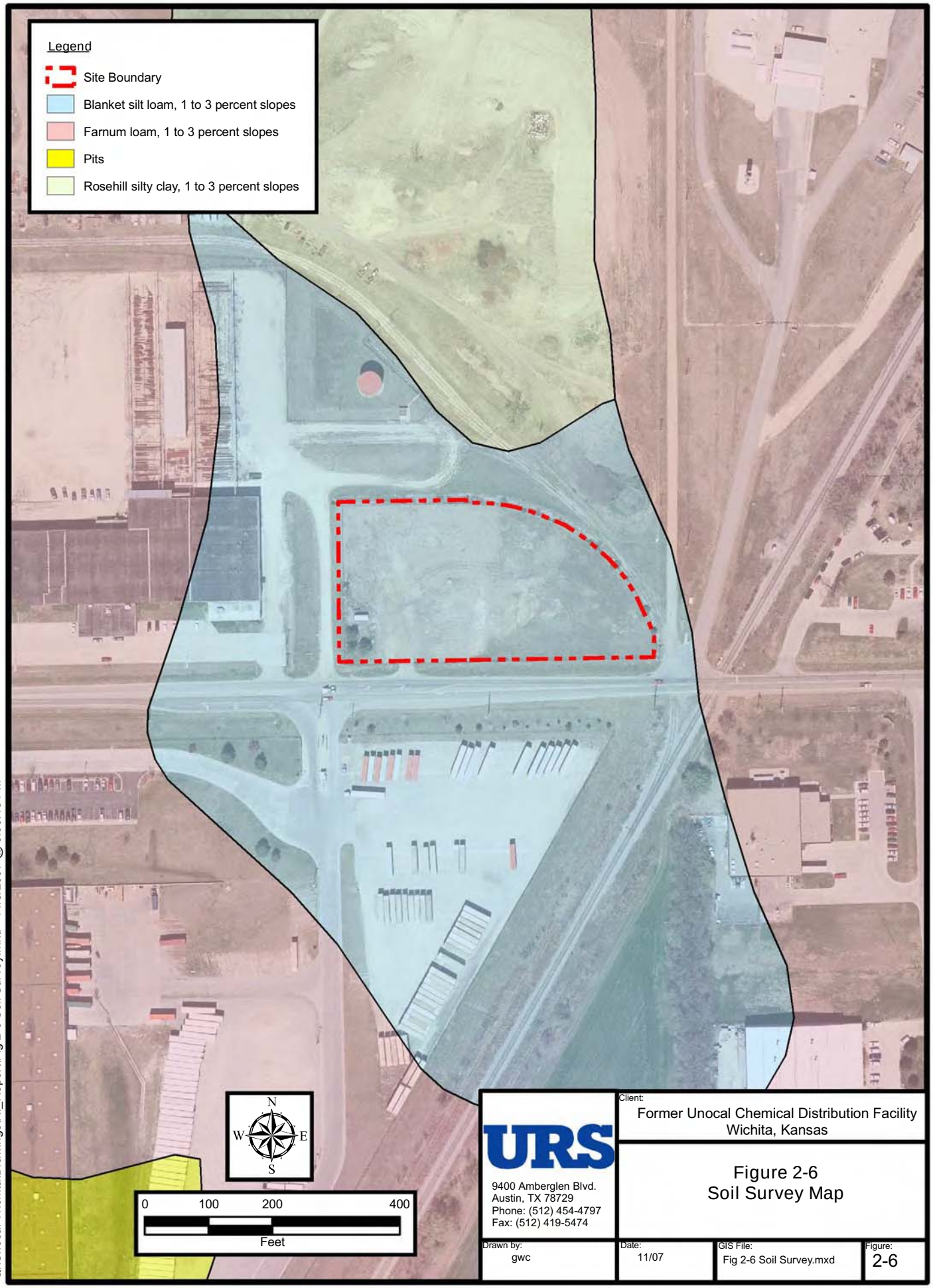

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Figure 2-6
Soil Survey Map

Drawn by:	Date:	GIS File:	Figure:
gwc	11/07	Fig 2-6 Soil Survey.mxd	2-6

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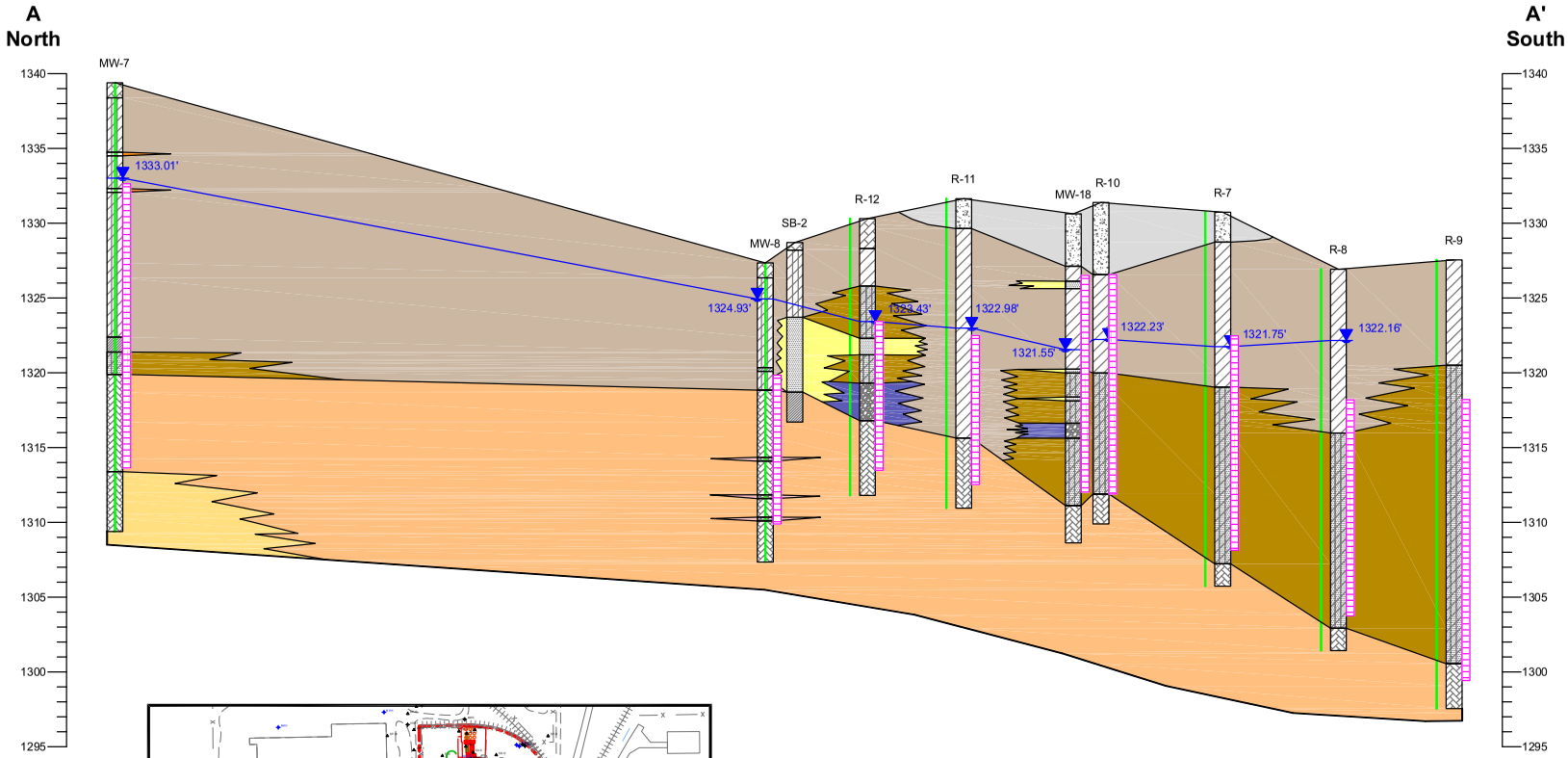

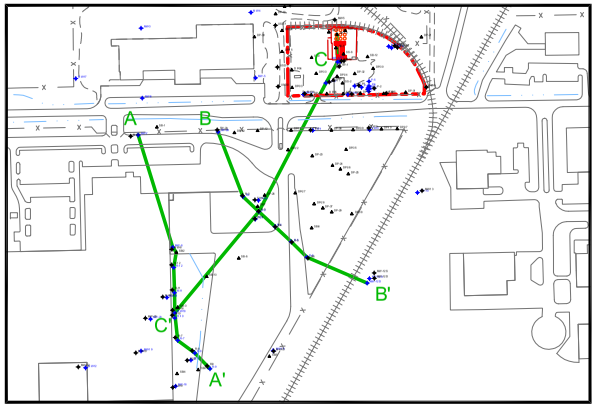

Legend

Lithostratigraphic Units

- Clay
- Sand
- Gravelly Sand
- Fill
- Shale Weathered
- Shale Unweathered
- Silty Clay with Varying Sand - Saturated
- Silt
- Gypsum Saturated

Soil Types

- Clay
- Oragnic Clay
- Fat Clay
- Sand
- Silt
- Fill
- Shale
- Gravelly Sand
- Groundwater Elevation (ft MSL) — 1332.55'
- Screened Interval

40 0 80

Horizontal Scale in Feet
Vertical Exaggeration = 10X

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Figure 2-7
Geologic Cross Section
A-A'

Drawn by:	Date:	Drawing File:	Figure:
gwc	11/07	Xsections.dwg	2-7

File: Q:\Unocal-Wichita\Drawings\RI_Report\Xsections.dwg Layout: Fig 2-7 Plotted: Nov 08, 2007 - 5:04pm

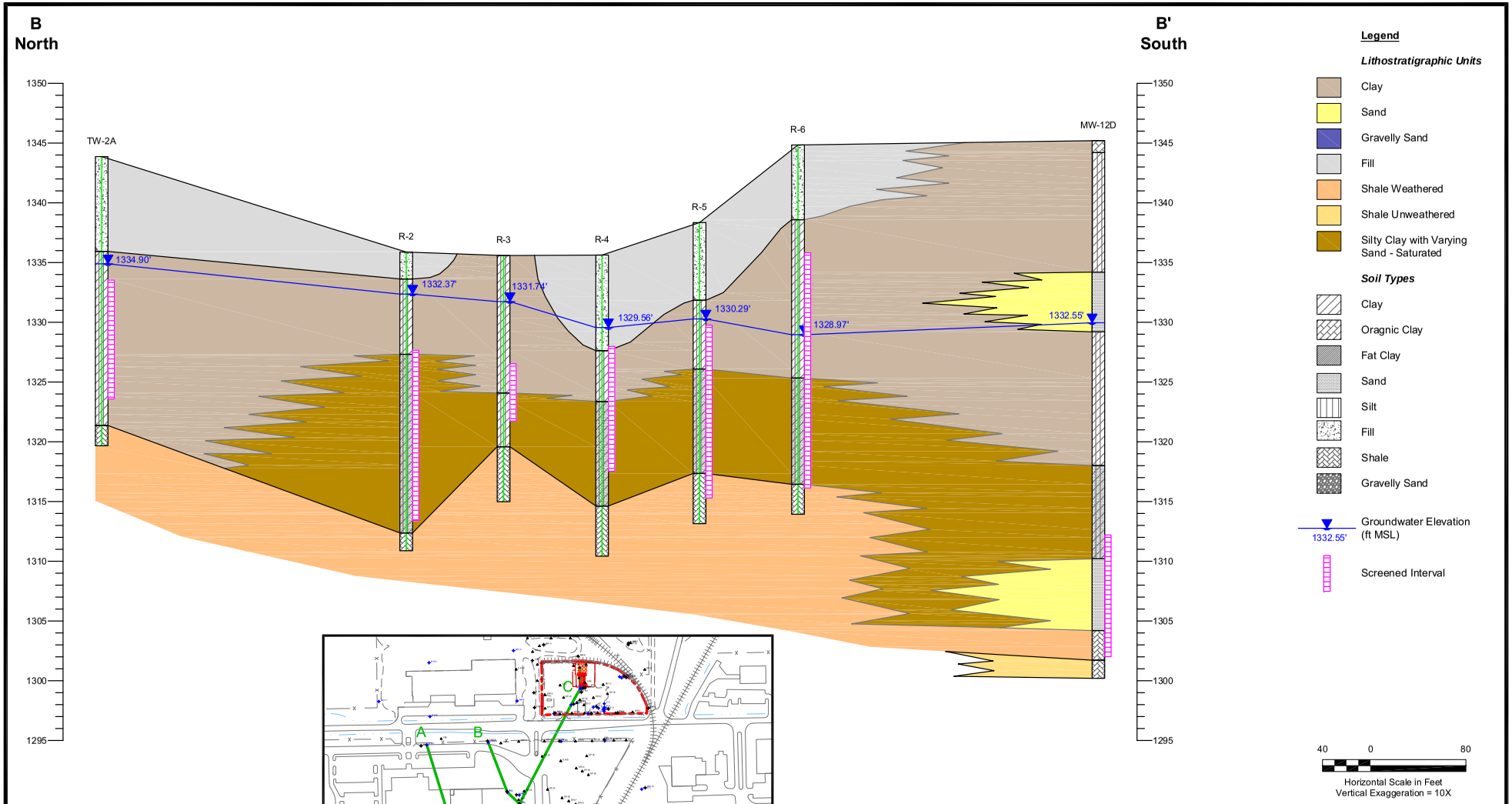

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Figure 2-8
Geologic Cross Section
B-B'

Drawn by:	Date:	Drawing File:	Figure:
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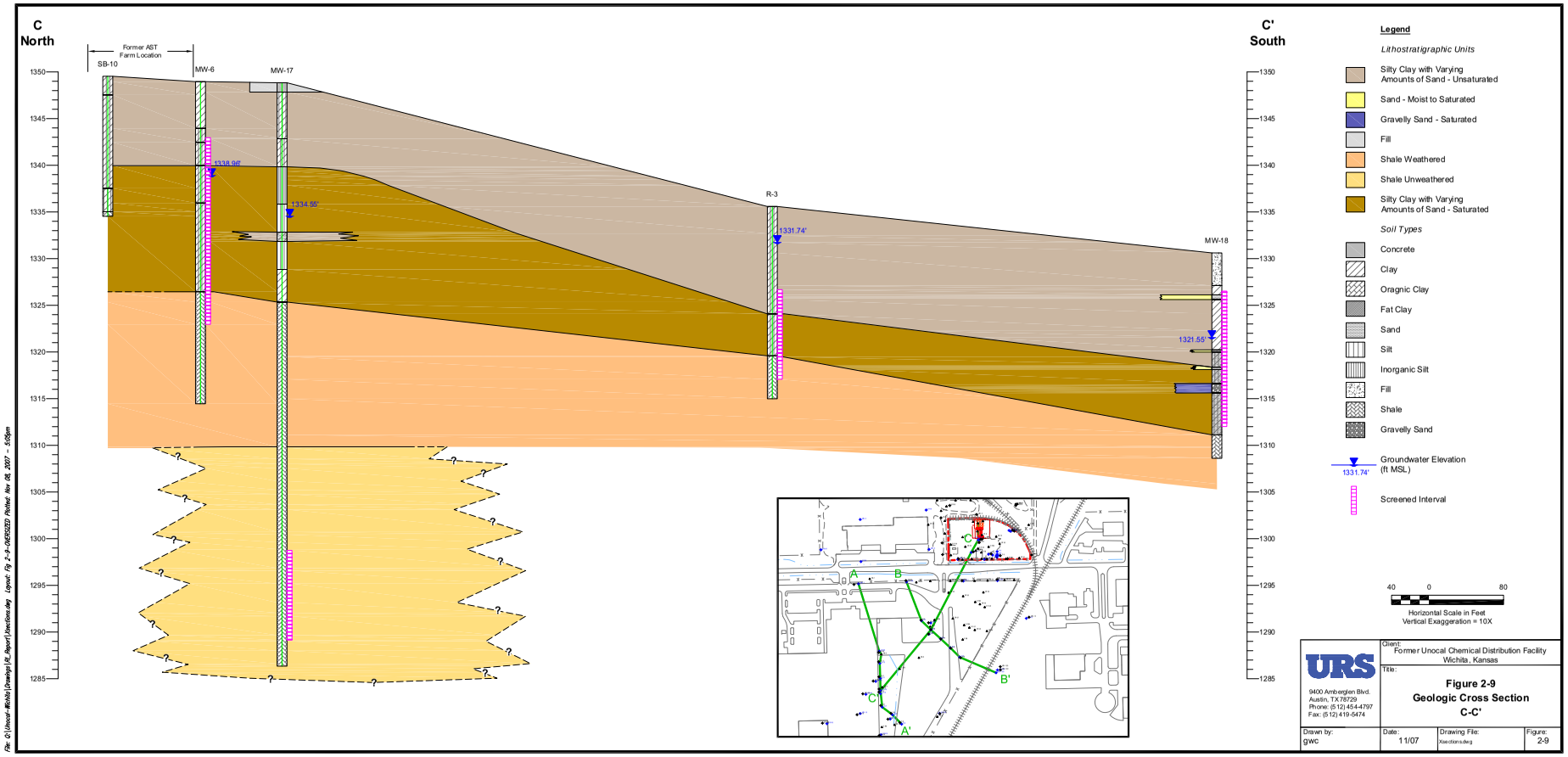
File: Q:\Unocal-Wichita\Drawings\RI_Report\Xsections.dwg Layout: Fig 2-8 Plotted: Nov 08, 2007 - 5:04pm



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Title:

Figure 2-9
Geologic Cross Section
C-C'

Drawn by:	Date:	Drawing File:	Figure:
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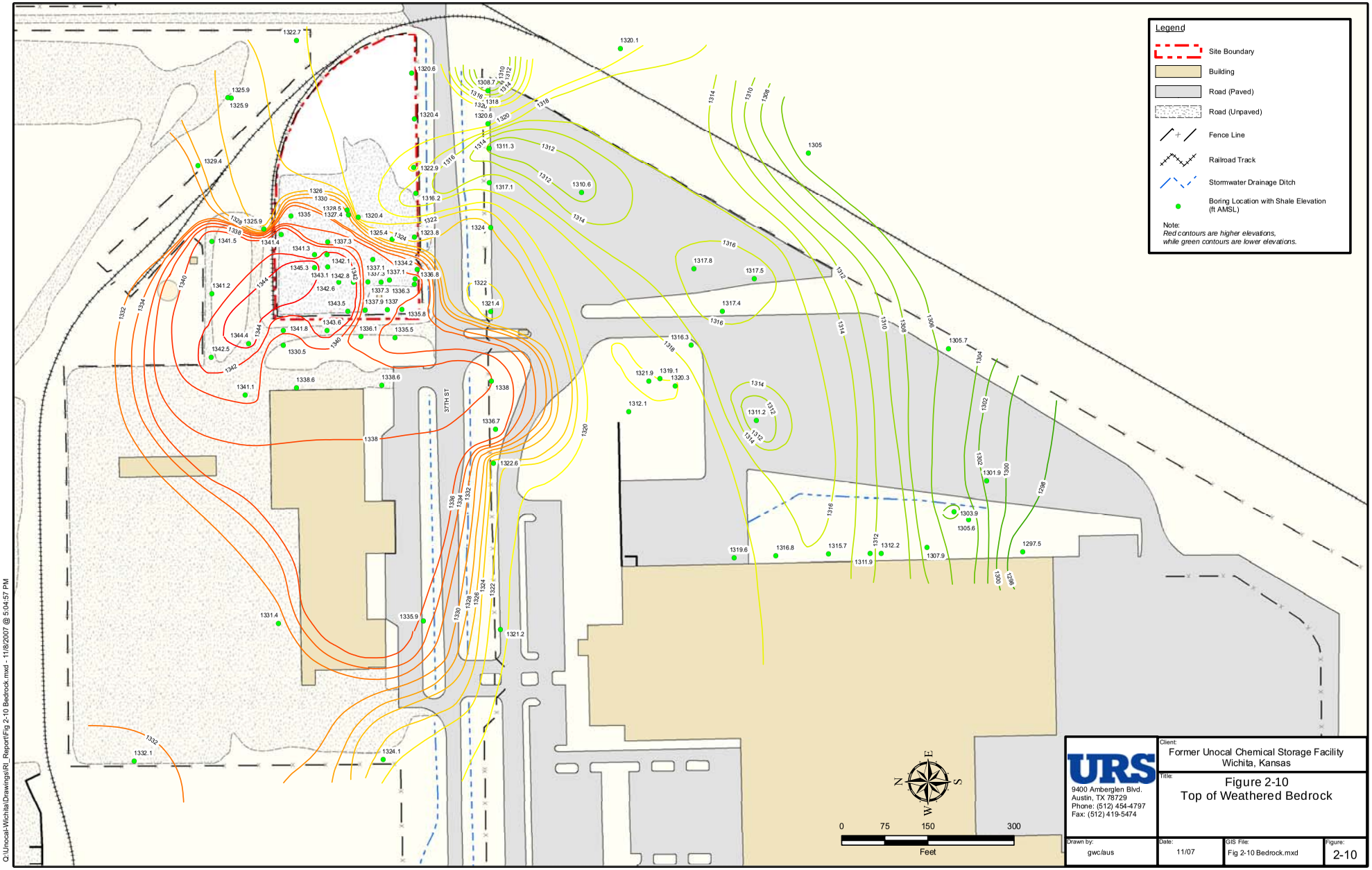

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Title: Figure 2-10 Top of Weathered Bedrock

Drawn by:	Date:	GIS File:	Figure:
gwc/aus	11/07	Fig 2-10 Bedrock.mxd	2-10

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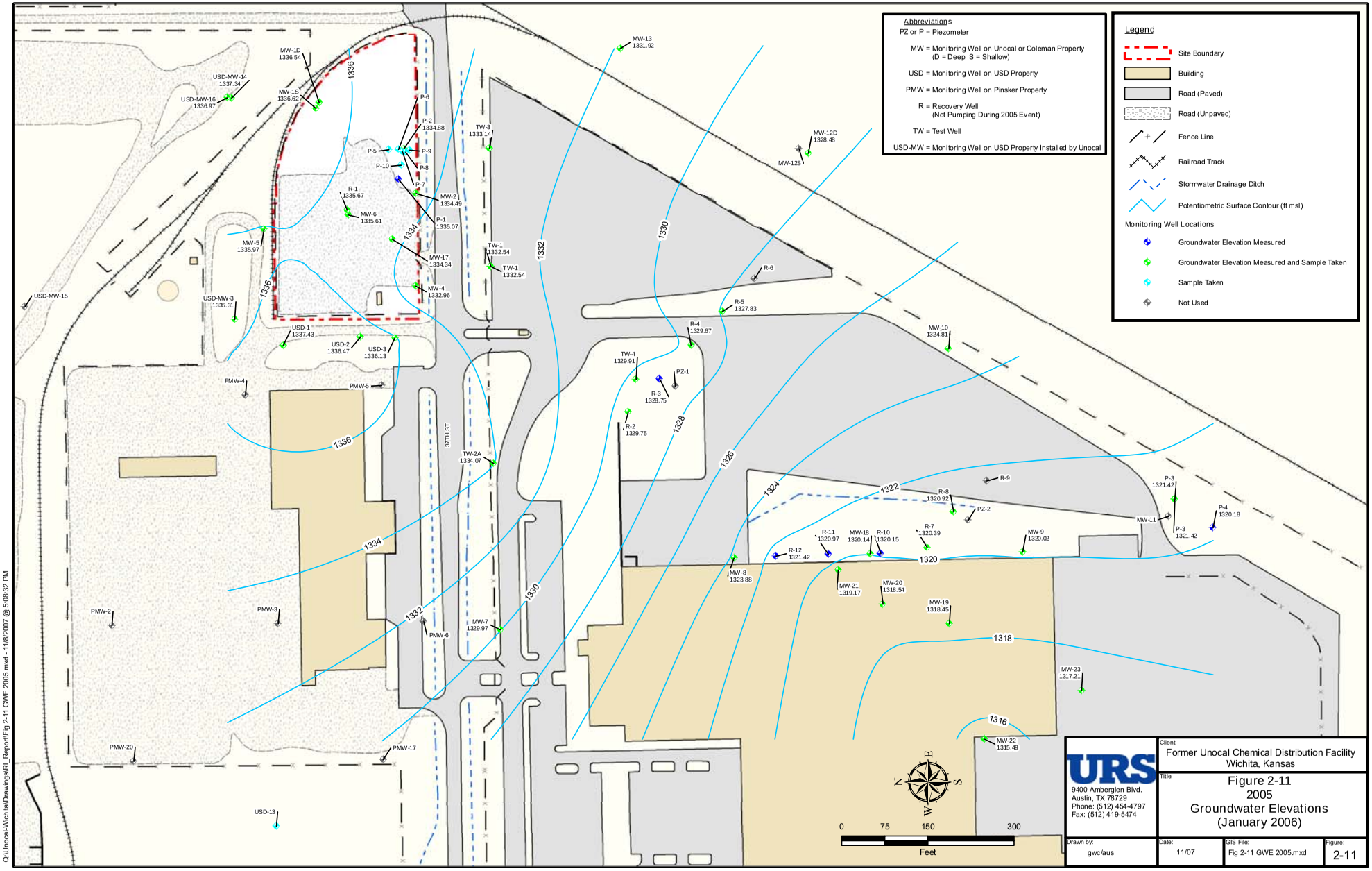
Abbreviations
PZ or P = Piezometer
MW = Monitoring Well on Unocal or Coleman Property (D = Deep, S = Shallow)
USD = Monitoring Well on USD Property
PMW = Monitoring Well on Pinsker Property
R = Recovery Well (Not Pumping During 2005 Event)
TW = Test Well
USD-MW = Monitoring Well on USD Property Installed by Unocal
Legend
Site Boundary
Building
Road (Paved)
Road (Unpaved)
Fence Line
Railroad Track
Stormwater Drainage Ditch
Potentiometric Surface Contour (ft msl)
Monitoring Well Locations
Groundwater Elevation Measured
Groundwater Elevation Measured and Sample Taken
Sample Taken
Not Used
MW-1D 1336.54
USD-MW-14 1337.34
USD-MW-16 1336.97
MW-1S 1336.62
P-6
P-2 1334.88
P-5
P-9
P-10
P-8
P-7
R-1 1335.67
MW-6 1335.61
MW-2 1334.49
P-1 1335.07
MW-5 1335.97
MW-17 1334.34
MW-4 1332.96
USD-MW-15
USD-MW-3 1335.31
USD-1 1337.43
USD-2 1336.47
USD-3 1336.13
PMW-4
PMW-5
PMW-2
PMW-3
PMW-6
PMW-20
PMW-17
USD-13
TW-3 1333.14
TW-1 1332.54
TW-1 1332.54
TW-2A 1334.07
MW-7 1329.97
37TH ST
MW-13 1331.92
MW-12D 1328.48
MW-12S
R-6
R-5 1327.83
R-4 1329.67
MW-10 1324.81
TW-4 1329.91
PZ-1
R-3 1328.75
R-2 1329.75
R-9
R-8 1320.92
PZ-2
P-3 1321.42
P-4 1320.18
MW-11
P-3 1321.42
R-11 1320.97
MW-18 1320.14
R-10 1320.15
R-7 1320.39
MW-9 1320.02
R-12 1321.42
MW-8 1323.88
MW-21 1319.17
MW-20 1318.54
MW-19 1318.45
MW-23 1317.21
MW-22 1315.49
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1330
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Phone: (512) 454-4797
Fax: (512) 419-5474
Client:
Former Unocal Chemical Distribution Facility
Wichita, Kansas
Title:
Figure 2-11
2005
Groundwater Elevations
(January 2006)
Drawn by:
gwc/aus
Date:
11/07
GIS File:
Fig 2-11 GWE 2005.mxd
Figure:
2-11
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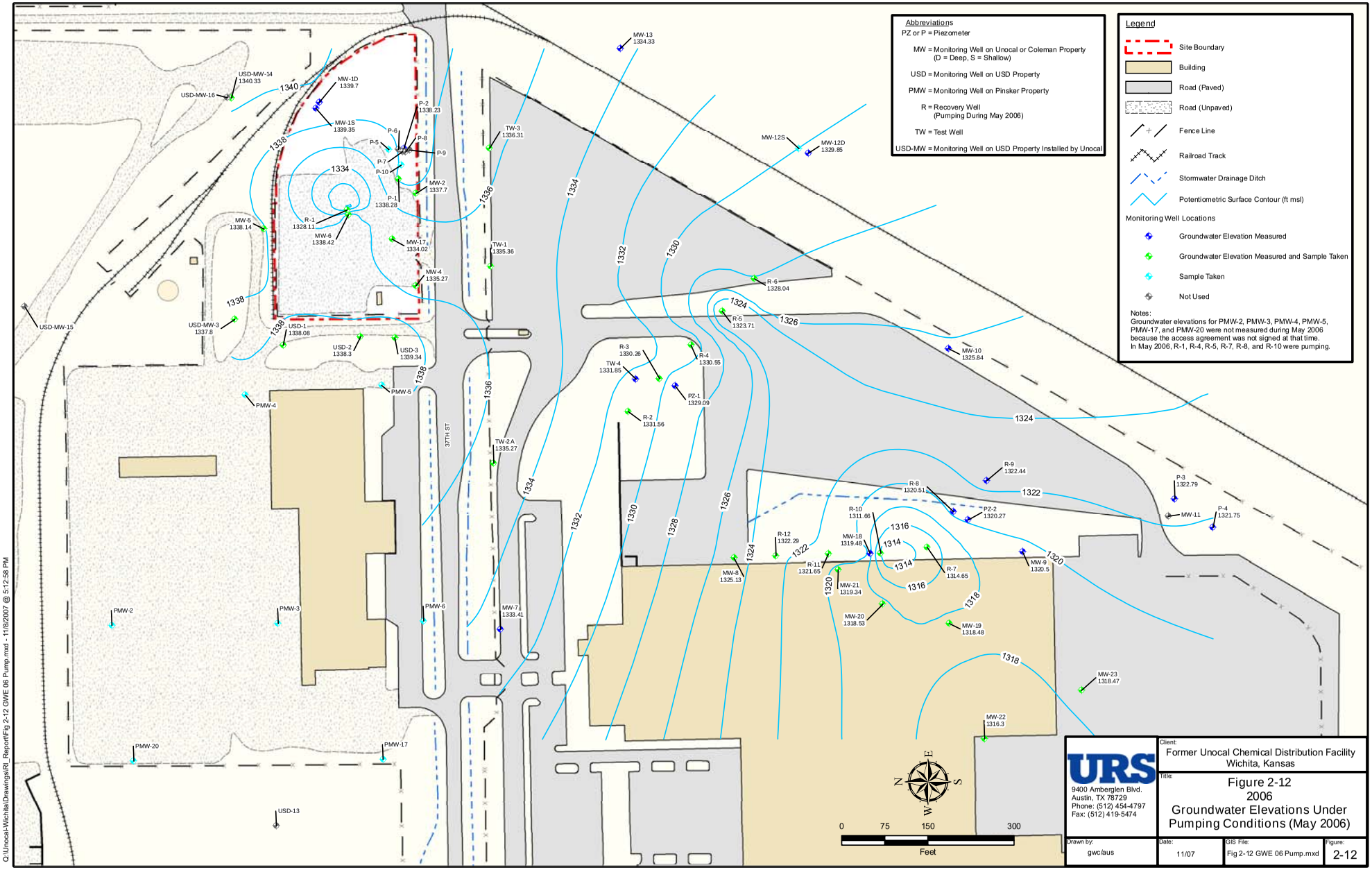
Abbreviations
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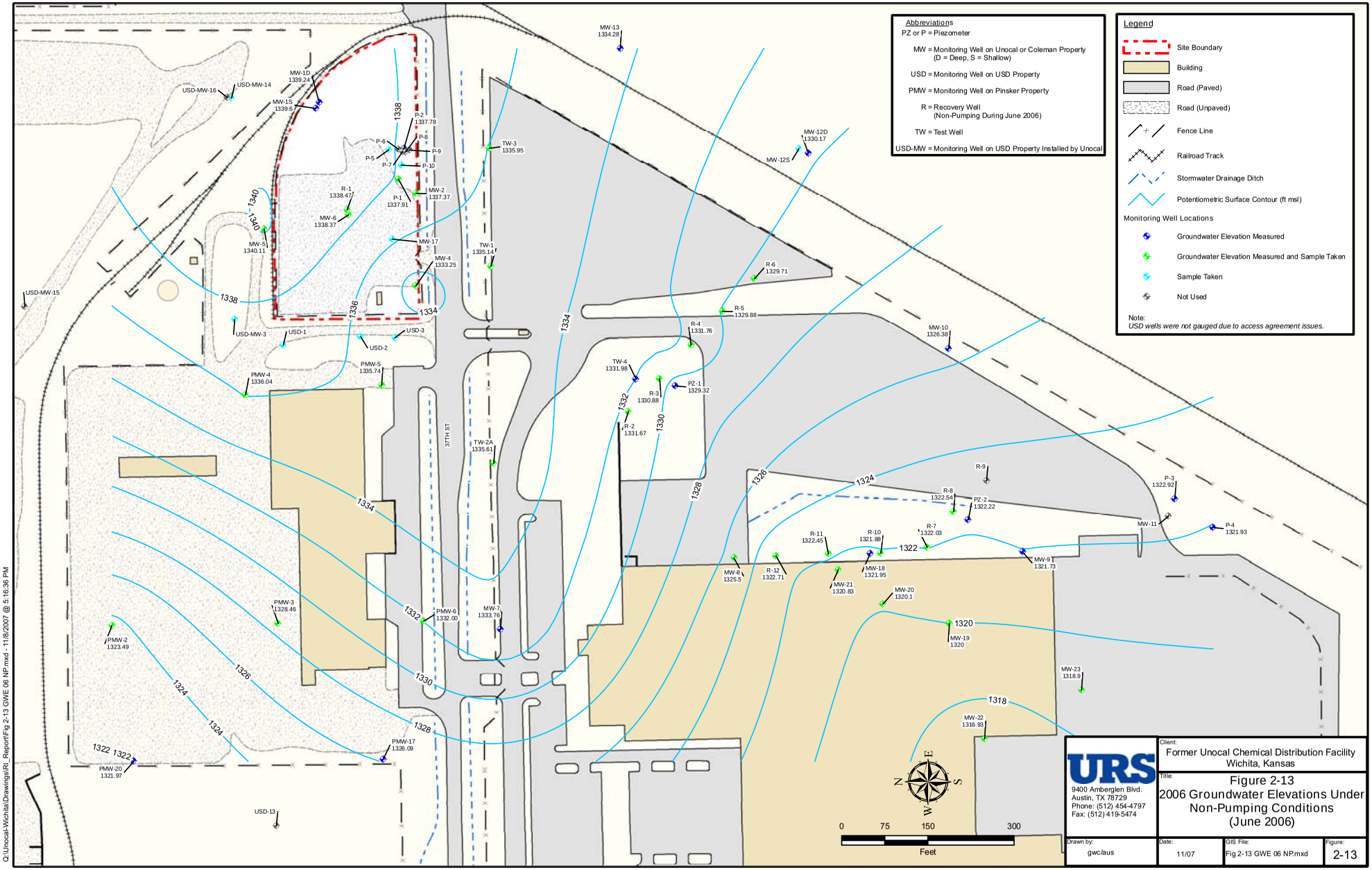
R = Recovery Well (Pumping During May 2006)
TW = Test Well
USD-MW = Monitoring Well on USD Property Installed by Unocal
Legend
Site Boundary
Building
Road (Paved)
Road (Unpaved)
Fence Line
Railroad Track
Stormwater Drainage Ditch
Potentiometric Surface Contour (ft msl)
Monitoring Well Locations
Groundwater Elevation Measured
Groundwater Elevation Measured and Sample Taken
Sample Taken
Not Used
Notes:
Groundwater elevations for PMW-2, PMW-3, PMW-4, PMW-5, PMW-17, and PMW-20 were not measured during May 2006 because the access agreement was not signed at that time.
In May 2006, R-1, R-4, R-5, R-7, R-8, and R-10 were pumping.
37TH ST
0 75 150 300
Feet
URS
9400 Amberglen Blvd.
Austin, TX 78729
Phone: (512) 454-4797
Fax: (512) 419-5474
Client: Former Unocal Chemical Distribution Facility Wichita, Kansas
Title: Figure 2-12 2006 Groundwater Elevations Under Pumping Conditions (May 2006)
Drawn by: gwc/aus
Date: 11/07
GIS File: Fig 2-12 GWE 06 Pump.mxd
Figure: 2-12
Q:\Unocal-Wichita\Drawings\RI_Report\Fig 2-12 GWE 06 Pump.mxd - 11/8/2007 @ 5:12:58 PM



URS
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Austin, TX 78729
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Fax: (512) 419-5474

Client: Former Unocal Chemical Distribution Facility Wichita, Kansas

Title: Figure 2-13
2006 Groundwater Elevations Under Non-Pumping Conditions (June 2006)

Drawn by:	Date:	GIS File:	Figure:
gwc/aus	11/07	Fig 2-13 GWE 06 NP.mxd	2-13

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3.0 Site Investigations

This site has been subject to numerous studies and field activities by multiple environmental consultants since 1989 as listed in Table 3-1. Sample and well locations associated with the historical field activities are presented in Figure 3-1. The following subsections summarize these historical field activities.

3.1 Preliminary Site Characterization – Woodward-Clyde Consultants, June 1990

Following the November 3, 1989 PCE release and the installation and operation of the SVE on November 22, 1989, Woodward Clyde Consultants (WCC) conducted a Preliminary Site Characterization Field Investigation. The purpose of the WCC 1990 investigation was to evaluate the extent of VOCs in soil and groundwater beneath the Site and characterize the Site lithology and geohydrology. Investigative activities included a soil gas survey, head space analyses of groundwater, laboratory analyses of groundwater, the installation of soil borings, and the collection of depth-to-groundwater data.

As part of the delineation activities, 12 soil gas samples were collected on the Site and analyzed for PCE, toluene, and total xylenes. Six of these soil gas survey locations were also used to collect groundwater samples for head space analyses. Head space samples were analyzed for toluene, total xylenes, PCE, and trichloroethene (TCE). Fifteen additional test holes were later installed to collect groundwater samples for head space analyses. In addition to the head space analyses, seven groundwater samples were sent to a laboratory for analysis.

Two soil borings were advanced as part of this investigation to characterize the Site lithology. Unconsolidated alluvial sediments consisting of silty clay with varying amounts of coarse grained sand were logged to depths ranging from approximately 10-13 ft below ground surface (bgs). The unconsolidated alluvial deposits were underlain by shale of the Wellington Formation. The upper 5 ft of shale was logged as weathered. Groundwater was encountered above the unconsolidated sediment, and weathered shale contact and depth to groundwater data indicated the groundwater gradient was south/southwest. WCC reported literature indicating that the shale bedrock was approximately 80-150 ft thick underlying the general site vicinity.

The concentrations of the detected compounds in soil gas were low compared to those detected in head space analysis of groundwater; therefore, the field investigation focused on an assessment of the extent of VOCs in groundwater. The highest concentrations of toluene and total xylenes in groundwater samples were reported inside the AST farm in the north central

portion of the Site. The highest concentrations of PCE and TCE in groundwater samples were reported west and southwest (down-gradient) of the AST farm.

During this investigation, the lateral extent of VOCs in the groundwater was limited to the Site as no samples were collected off-site. Based on the measured groundwater flow direction (south-southwest) and the elevated VOC concentrations detected at the southern property line, WCC determined that there was a potential for off-site migration to the south-southwest.

3.2 Phase II Site Characterization – Woodward-Clyde Consultants, November 1991

WCC conducted a Phase II Site Characterization in July and August 1991 to further investigate the horizontal and vertical extent of impacted groundwater previously identified beneath the Site, assess the extent of any off-site contamination, and provide preliminary corrective action alternatives. As part of the Phase II Site Characterization, WCC installed 35 test borings and conducted head space analyses on groundwater samples collected from the test borings. WCC installed 11 boreholes to depths ranging from 25-40 ft bgl to further characterize geologic and hydrogeologic conditions on-site and in the Site vicinity. WCC installed five test off-site monitoring wells (TW-01, TW-02, TW-03, TW-04, and TW-07), four test on-site monitoring wells (TW-05, TW-06, TW-08, and TW-09), and five permanent on-site monitoring wells (MW-01S, MW-01D, MW-02, MW-03, and MW-04).

Seven of the test monitoring wells, both on and off-site, (TW-01, TW-02, TW-03, TW-04, TW-06, TW-07, and TW-09) and three of the permanent monitoring wells (MW-01D, MW-02, and MW-03) were completed from the 11 soil borings. WCC collected groundwater samples from all test and permanent monitoring wells for chemical analysis. In addition, WCC collected soil samples from selected cored boreholes for chemical analyses; conducted slug withdrawal tests on MW-01S, MW-02, MW-03, and MW-04; and measured water level elevations in the test borings, test monitoring wells, and permanent monitoring wells.

The analytical data obtained by WCC showed that the VOC concentrations in soil samples increased with depth and the higher concentrations were reported in soil samples collected below the water table indicating horizontal migration of contamination.

Groundwater elevation data and the analytical results of groundwater samples indicated that impacted groundwater was migrating down-gradient (south-southwest) and off-site, onto the Coleman property. The groundwater VOC plume initiated in the AST farm in the north central

portion of the Site and extended approximately 750 ft south-southwest under the Coleman property.

3.3 Phase I Remedial Investigation – Maude Environmental, Inc., November 1993

Following the March 23, 1992 RI and FS consent order, Maude Environmental, Inc. (MEI) conducted a Phase I RI. The objectives of the Phase I RI were to further evaluate the nature and extent of off-site subsurface contamination resulting from historical operations at the Site and provide design recommendations for future remedial actions. Investigative activities included soil sampling, groundwater head space analysis, groundwater monitoring well installation and groundwater sampling, aquifer testing, and SVE system performance testing.

Fourteen test borings (TB-01 through TB-14) were drilled on the Coleman and Hillman (Pinsker Steel) properties, and groundwater samples were collected for head space analysis. The groundwater samples were analyzed in the field for benzene, toluene, ethylbenzene, and xylene (BTEX), 1,1-dichloroethene (DCE), 1-1-dichloroethane (DCA), *cis*-1,2-dichloroethene (*cis*-1,2-DCE), 1,1,1-trichlorethane (TCA), TCE, and PCE by a gas chromatograph (GC). The highest concentrations were reported in the head space sample collected at TB-3, approximately 360 ft south of the Site on the Coleman property. The head space sampling efforts defined the groundwater plume as extending approximately 800 ft southwest of the Site.

After approximating the groundwater plume, ten permanent monitoring wells (MW-05 through MW-11, MW-12S, MW-12D, and MW-13) were installed by MEI. During well installation activities, nine soil samples were collected from the vadose zone of the pilot boreholes installed for MW-5 through MW-13 and analyzed for EPA Method 8240. In addition to soil samples collected from the monitoring well borings, eight shallow hand borings (SS-01 through SS-08) were advanced to depths ranging from 0.5-2.1 ft and analyzed by EPA Methods 8010, 8015, and 8020. The shallow hand borings were installed near suspected source areas on-site and in the vicinity. Analytical data for soil samples reported ethylbenzene, xylenes, methyl isobutyl ketone, and toluene as the predominant VOCs with the highest concentrations in surface and shallow subsurface soils in the AST farm vicinity.

During the Phase I RI, MEI collected groundwater samples from MW-1S, MW-1D, MW-2 through MW-11, MW-12S, MW-12D, MW-13, TW-1 through TW-4, and MW-100 through MW-102. Groundwater samples were analyzed using EPA Methods 8010, 8015, and 8020. Analytical data for groundwater samples reported 1,1-DCA, 1,1-DCE, TCE, 1,1,1-TCA, PCE, vinyl chloride, methyl ethyl ketone, methyl isobutyl ketone, acetone, ethylbenzene, toluene, and

xylenes as the predominant VOCs with the highest concentrations at MW-6, south of the AST farm area, TW-1 approximately 200 ft south of the Site on the Coleman property, and TW-4, approximately 400 ft southwest of the Site. MEI prepared groundwater isoconcentration maps for the analytical well data and approximated the maximum terminus of the groundwater plume 500 ft southwest of the Site.

Aquifer tests were conducted at MW-2 and MW-11 to estimate the hydraulic properties of the shallow unconsolidated water-bearing unit for use in groundwater flow/contaminant transport and to assist remedial design activities. The initial step in the aquifer tests was a step drawdown test, which was used to select a pumping rate to be used during the aquifer pumping test. Two proximity piezometers (PZs) were installed at MW-2 and MW-11 to observe the pumping stress and associated drawdown in the unconsolidated material; water elevations in vicinity monitoring wells were also gauged during the tests. The calculated hydraulic conductivity at MW-2 ranged from 2.4-5.0 ft/day, the values calculated for the vicinity PZ ranged from 4.1-7.4 ft/day, and the calculated storage coefficient value ranged from 0.002-0.004. The calculated hydraulic conductivity at MW-11 ranged from 6.7-9.9 ft/day, the values calculated for the vicinity PZ ranged from 7.7-14 ft/day, and the calculated storage coefficient ranged from 0.006-0.014.

SVE performance tests were conducted to evaluate the effectiveness of the SVE system installed in November 1989. Performance tests included effluent vapor sampling from the SVE wellheads for select VOCs, short-term pilot tests to evaluate the effective radius of influence, and soil samples analyzed for moisture content, dry bulk density, soil particle density, total organic carbon (TOC), total porosity, and VOCs by EPA Methods 8010, 8015, and 8020. The performance tests supported that the SVE system was effectively venting the area impacted by the only known PCE spill. However, some soil and site characteristics had reportedly decreased the efficiency of the existing SVE system. The most important was the relatively high amount of moisture in the pore spaces. The SVE system was turned off, pending changes to the system, during the Phase II RI (discussed in Section 3.6).

MEI prepared a Phase II RI workplan (discussed in Section 3.6), but the fieldwork was executed by Canonie Environmental (Canonie). MEI also designed the IRM groundwater extraction and treatment system described in the ***Design Report-Interim Remedial Measure Investigation Workplan*** (MEI, June 1994a). The objectives of the IRM were to reduce source area and plume concentrations of VOCs in groundwater and control migration of the groundwater VOC plume.

3.4 Phase II Remedial Investigation Addendum Activities – Delta Environmental Consultants, Inc., September 1995

The Phase II RI Addendum was performed by Delta Environmental Consultants, Inc. (DEC) (DEC, September 1995c). This effort was conducted between the Phase II RI field activities and the issuance of the ***Final Report Phase II RI*** (Smith Environmental Technologies Corporation [Smith], February 1996). The Phase II RI Addendum activities included drilling 7 soil borings, completing 5 of the 7 soil borings as permanent groundwater monitoring wells (MW-19 through MW-23) to an approximate depth of 25 ft bgs, collection of geotechnical data from 2 of the 7 borings, collection of soil and groundwater samples from the newly installed wells and collecting water levels in 41 existing wells (29 monitoring wells and 12 recovery wells).

Three of the DEC Phase II RI Addendum monitoring wells (MW-19, MW-20, and MW-21) were installed inside the Coleman building. The wells were positioned in a line and at an angle down-gradient of extraction wells R-08 through R-12 while the other two monitoring wells, MW-22 and MW-23, were installed further down-gradient, outside the Coleman building. Based on the analytical results obtained, DEC demonstrated that while affected media did exist under the Coleman facility, the VOC concentration in the groundwater rapidly decreased down-gradient from the second series of extraction wells (along a line defined by wells MW-19 through MW-23), which are located within, and adjacent to the Coleman building.

3.5 Quarterly Groundwater Monitoring Reports 1995 – Delta Environmental Consultants, Inc., June, August, December, and January 1995

Quarterly groundwater sampling activities were conducted at select site and vicinity monitoring wells during 1995 to monitor the groundwater plume and the effectiveness of the IRM system. Groundwater samples were collected quarterly from 25 monitoring wells (MW-1S, MW-2 through MW-5, MW-7 through MW-11, MW-12S, MW-13 through MW-15, MW-17, R-1, R-2, R-4, R-6 through R-9, R-11, TW-2A, and TW-3). Groundwater samples were only collected for the last three quarters for MW-19 through MW-23. Only semi-annual groundwater samples were collected from five monitoring wells (R-3, R-5, R-10, R-12, and TW-1) and annual groundwater samples collected from three monitoring wells (MW-1D, MW-12D, and MW-16). All groundwater samples were analyzed for VOCs and are reported in ***1st Quarter 1995 Groundwater Monitoring Report*** (DEC, June 1995a), ***2nd Quarter 1995 Groundwater Monitoring Report*** (DEC, August 1995b), ***3rd Quarter 1995 Groundwater Monitoring Report*** (DEC, December 1995d), and ***4th Quarter 1995 Groundwater Monitoring Report*** (DEC, January 1996).

3.6 Phase II Remedial Investigation – Smith Environmental Technologies Corporation, December 1996

The ***Phase II RI Workplan*** (MEI, 1994b) was executed by Canonie, which later became Smith. Canonie submitted the ***Draft Report Phase II RI*** in December 1994; the ***Final Report Phase II RI*** was submitted in February 1996 by Smith. The goal of the Phase II RI was to further refine the vertical and horizontal extent of contamination on the Site and adjacent properties, and to provide final design parameters for the planned IRM that was subsequently designed to control the plume migration and to recover and treat contaminated groundwater. Phase II investigative activities included down-gradient groundwater sampling, groundwater screening, soil sampling, monitoring well and PZ installation, additional groundwater sampling, extraction well installation, aquifer testing, air sparging pilot test, SVE pilot test, and bioassessment.

Down-gradient Groundwater Sampling and Groundwater Screening

Prior to initiating the Phase II RI drilling activities, samples were collected from four down-gradient monitoring wells (MW-08, MW-09, MW-10, and MW-11) to determine if the groundwater plume identified during the MEI Phase I RI had migrated beyond these wells. Groundwater samples were analyzed for VOCs by EPA Method 8240 and semivolatile organic compounds (SVOCs) by EPA Method 8270. Analytical results indicated that the groundwater plume had not migrated beyond these wells. As part of the Phase II RI, 12 borings (SL-01 through SL-12) were drilled, and groundwater screening samples were collected and analyzed for VOCs by EPA Method 8240. Analytical results of the groundwater screening samples supported delineation of the plume, and data were used to optimize the location of recovery wells. Analytical results indicated that the groundwater VOC plume extended 800 ft southwest of the Site. Groundwater screening samples SL-7 through SL-9, collected along the eastern side of the Coleman building, reported several VOC exceedances. No additional groundwater screening locations were installed west of the building.

Soil Investigation

Fourteen soil borings (SB-01 through SB-14) were drilled or hand augured to further characterize VOC concentrations in the soil and evaluate biotreatability in areas of known groundwater and soil contamination. The highest VOC concentrations in soil were reported in on-site soil boring SB-9, approximately 75 ft southwest of the AST farm area. Soil samples were collected from several depth intervals at SB-9 to evaluate the vertical extent of VOC impacts. VOCs at SB-9 were present in the unconsolidated deposits (16-16.5 ft bgl) and the weathered bedrock (31-31.5 ft bgl), but were not detected in the unweathered shale bedrock (45 ft bgl).

Groundwater Investigation

Based on the results of groundwater samples collected during the Phase I RI, five new monitoring wells (MW-14 through MW-18) and two PZs (PZ-01 and PZ-02) were installed. Three of the monitoring wells were installed up-gradient of the Site (MW-14 through MW-16), one on-site (MW-17), and another down-gradient of the Site on the Coleman property (MW-18). Both PZs were installed on the Coleman property. Monitoring wells MW-16 and MW-17 were installed in the bedrock to monitor water quality and water levels in the unweathered shale.

During the Phase II RI, an IRM system was installed. As part of the IRM, 12 groundwater extraction wells were installed to control potential VOC migration within the water bearing zone and to recover VOC impacted groundwater. Groundwater extraction well R-1 was installed on the Site, while R-2 through R-12 were installed on Coleman property.

Groundwater samples were collected from a total of 36 monitoring/extraction wells (MW-1S, MW-1D, MW-2 through MW-11, MW-12S, MW-12D, MW-13 through MW-18, R-1 through R-12, TW-1, TW-2S, TW-3, and TW-4) from August to October 2004 and analyzed for VOCs by EPA Method 8240 and SVOCs by EPA Method 8270. The highest detections of VOCs were reported in groundwater samples collected from MW-6 and R-1, located immediately south and down-gradient of the AST farm area, TW-1 approximately 200 ft south of the Site on the Coleman property, and TW-4 and R-3, approximately 400 ft southwest of the Site. The most frequently detected VOCs were TCE, PCE, *cis*-1,2-DCE, 1,1-DCA, vinyl chloride, and 1,1-DCE. TCE was detected in 18 monitoring wells and 10 extraction wells ranging in concentrations from 1.1-20,000 parts per billion (ppb). PCE was detected in 17 wells and 10 extraction wells ranging in concentrations from 1-24,000 ppb.

Based on groundwater non-detect analytical results for MW-16 and MW-17, screened in the bedrock water-bearing unit, the investigators concluded that bedrock appears to act as a barrier to vertical VOC migration. Both MW-16 and MW-17 are located in areas where groundwater contamination was recorded in the overlying alluvium water-bearing unit.

The extent of the groundwater contamination plume was not defined during the Phase II RI and analytical groundwater and soil results indicated that VOC contamination could potentially extend under the Coleman building. Analytes were also detected up-gradient of the Site. Toluene, ethylbenzene, and xylene were detected in up-gradient MW-14.

During the Phase II RI, groundwater samples were also analyzed for SVOCs. Analytical results indicated that SVOC detections were limited to the areas with the highest VOC concentrations and that no SVOC exceeded its maximum contaminant level (MCL).

Aquifer Tests

Aquifer tests were conducted on the shallow alluvial water-bearing unit to further estimate the hydraulic properties of the unit for use in groundwater flow and contaminant fate and transport modeling and to support future remedial design activities. A slug test was conducted on up-gradient well MW-14. The test measured the rising water level in the well after the instantaneous removal of a known volume of water. The hydraulic conductivity calculated for the MW-14 slug test was 2.23E-02 centimeters per second (cm/sec) with a transmissivity of 132 square feet per day (ft^2/day), and the storage coefficient at 5.23E-03.

Slug tests were also to be performed on the two bedrock monitoring wells MW-16 and MW-17. However, recharge after development and sampling of the bedrock monitoring wells was extremely slow, and the static water level was never defined as water levels were observed to still be rising during field activities. To approximate hydraulic conductivity of the bedrock shale monitoring wells, the wells were bailed dry and water levels were measured for MW-16 for five days and for MW-17 for nine days. Hydraulic conductivity values of the bedrock shale ranged from 3.3E-07-6.7E-07 cm/sec.

Aquifer pumping tests were conducted on the shallow unconsolidated water-bearing unit at extraction wells R-3 and R-8 while the water levels in vicinity monitoring wells and PZs were monitored. The hydraulic conductivity calculated during the R-3 pumping test ranged from 7.39E-05-1.81E-03 cm/sec, the transmissivity ranged from 2.2-552 ft^2/day, and the storage coefficient ranged from 1.85E-03-9.87E-03. The hydraulic conductivity calculated during the R-8 pumping test ranged from 3.47E-03-8.49E-03 cm/sec, the transmissivity ranged from 185-577 ft^2/day, and the storage coefficient ranged from 1.23E-03-3.78E-03.

Soil and Groundwater Remedial Alternatives Pilot Testing

Two pilot-scale tests, the air sparging and ongoing SVE test, were conducted during the Phase II RI field activities to collect additional data to evaluate source area remedial alternatives. The air sparging pilot test was conducted to evaluate the applicability of this technology for site remediation. In certain applications, air sparging has the potential to accelerate remediation of VOCs in groundwater. The purpose of the pilot tests was to evaluate the air injection flow rates and injection pressures. Because the results of the air sparge pilot test showed a decrease in

VOCs, investigators concluded that air sparging was a potential technology to remediate VOC impacted groundwater.

The SVE pilot test was conducted in accordance with the ***Phase II RI Workplan*** (MEI, 1994b) and involved the installation of horizontal SVE wells beneath the AST and truck loading areas on-site. An air sample was collected from the exhaust sample port and analyzed for VOCs by EPA Method 8240. The detected compounds were similar to the compounds detected in groundwater. However, numerous shutdowns occurred owing to the relatively high amount of rainfall causing excessive pore space moisture to be drawn into the system. Because of water in the system, full-time monitoring of the system would have been required to keep it operational.

Bench-scale studies on four groundwater and soil samples were conducted to determine the feasibility of using bioremediation in conjunction with SVE to remediate contaminated soil and groundwater at the Site. The bioassessment was conducted to characterize the physical, chemical, and biological parameters and identify any parameters that could be toxic to the indigenous micro-organism or could possibly limit the rate or extent of biodegradation. The parameters tested include nutrient analysis, microbial enumeration, and general mineral analyses. Results indicate that the soil and groundwater samples contained a number of indigenous microorganisms that could degrade VOCs. In addition, no compounds inherently toxic to the indigenous microorganisms were found.

The ***Final Report Phase II RI*** (Smith, February 1996) recommended further investigation of the extent of contamination to define the down-gradient edge of the plume. The report also recommended that a plan for groundwater monitoring during operation of the IRM treatment system be developed and that additional soil and groundwater remedial alternative testing be conducted (continued biotreatability assessment and additional air sparging pilot testing).

3.7 Comprehensive Remedial Investigation Report – Woodward-Clyde Consultants, June 1996

Following the 150-gallon PCE spill in the north center portion of the Site in 1989, a series of five site investigations were completed between 1990 and 1995 (outlined above). The ***Comprehensive RI Report*** (WCC, June 1996b) is an interpretive compilation of the five site investigations. The objectives of the report were to better locate and assess source areas, assess IRM system performance, stability, and control of the groundwater plume (based on dissolved-phase trends analyses), and conduct a screening level exposure assessment. The ***Comprehensive RI Report*** (WCC, June 1996b) also included the results of the 1995 quarterly groundwater monitoring event. The groundwater monitoring plan included the collection of quarterly

groundwater samples from a total of 30 monitoring and recovery wells - 5 wells were sampled semi-annually, and 3 wells were sampled once. Groundwater samples were tested for VOCs by EPA Method 8240.

The ***Comprehensive RI Report*** (WCC, June 1996b) concluded the AST area at the Site contributed to contamination of soil and groundwater, producing a groundwater contamination plume or plumes. The report suggested a minimum of two sources originating from the Coleman property that contributed to the groundwater contamination plume(s). One potential source area on the Coleman property was in the vicinity of extraction well R-4, located approximately 425 ft east of the Coleman building, and another potential source was extraction well R-10, located along the middle of the eastern side of the Coleman building. It was reported that the plume was effectively being controlled by the IRM system installed and operated by Unocal and that the IRM system was capturing affected groundwater emanating from source areas on the Coleman property.

3.8 Semi-Annual Groundwater Monitoring Results 1996 – Woodward-Clyde Consultants, December 1996

Semi-annual groundwater sampling activities were conducted at select site and vicinity monitoring wells during 1996 to monitor the groundwater plume and the effectiveness of the IRM system. Groundwater samples were collected semi-annually from 35 monitoring wells (MW-1S, MW-2 through MW-5, MW-7 through MW-11, MW-12S, MW-13 through MW-15, MW-17, MW-19 through MW-23, R-1 through R-12, TW-1, TW-2A, and TW-3). Groundwater samples were collected from MW-1D, MW-12D, and MW-16 during the second semi-annual sampling event only. All groundwater samples were analyzed for VOCs and are reported in ***Semi-Annual Groundwater Monitoring Results, 1996 – 1st Event*** (WCC, 1996a) and ***Semi-Annual Groundwater Monitoring Results, 1996 – 2nd Event*** (WCC, 1996d).

3.9 DNAPL Site Evaluation – Woodward-Clyde Consultants, January 1997

A dense non-aqueous phase liquid (DNAPL) evaluation was conducted at the Site to assess whether DNAPL existed and, if present, the extent of any DNAPL discovered. A conceptual site model (CSM) of the source area was developed to ascertain existence, distribution, and persistence with the associated dissolved and vapor phase correlation.

Site data were used to assess past impacts and potential short and long-term effects. The CSM did not support migration of DNAPL off the Site. However, due to discontinuous sand layers, vapor pathways, and dispersion mechanisms, investigators concluded that the dissolved phase

(i.e., affected groundwater) had migrated off-site to the south and potentially to the north. Furthermore, models indicated that suspended pools/lenses of PCE potentially existed below the AST farm area in the saturated zone, that DNAPL may have existed near the source areas on the surface of the bedrock, and that trapped and/or immobile DNAPL may have existed in weathered bedrock.

The DNAPL evaluation indicated that the 1989 release would not have been of sufficient volume to account for the extent and distribution of PCE or TCE directly up-gradient of the source area. It is possible that earlier releases may have occurred in the more northern parts of the AST area or that a separate source existed to the north of the Site.

3.10 Semi-Annual Groundwater Monitoring Results 1997 – Harding Lawson Associates, July 1997 and January 1998

Semi-annual groundwater sampling activities were conducted at select site and vicinity monitoring wells during 1997 to monitor the groundwater plume and the effectiveness of the IRM system. Groundwater samples were collected semi-annually from 35 monitoring wells (MW-1S, MW-2 through MW-5, MW-7 through MW-11, MW-12S, MW-13 through MW-15, MW-17, MW-19 through MW-23, R-1 through R-12, TW-1, TW-2A, and TW-3). An additional sampling round was collected at MW-2, R-4, and TW-1. Groundwater samples were collected from MW-1D, MW-12D, and MW-16 during the second semi-annual sampling event only. All groundwater samples were analyzed for VOCs and are reported in ***Semi-Annual Groundwater Monitoring Report, 1997 – First Event*** (Harding Lawson Associates [HLA], July 1997) and ***Semi-Annual Groundwater Monitoring Report, 1997 – Second Event*** (HLA, January 1998a).

3.11 Phase III Investigation Technical Memorandum – Harding Lawson Associates, April 1998

In April of 1998, HLA prepared a Phase III Technical Memorandum presenting information collected during a direct-push (DP) sampling effort (HLA, April 1998b). Historical data were also incorporated in the memorandum to evaluate site conditions over time.

The Phase III data included hydrogeologic and water quality results obtained during the DP sampling of 39 locations (DP-01 through DP-39) conducted between November 2 and December 12, 1997. A total of 39 soil, 66 groundwater, and 50 quality assurance (QA)/quality control (QC) samples were collected during Phase III. Semi-annual groundwater monitoring results obtained during the final 1997 event (September 24-October 2, 1997) were also reported in the Phase III Technical Memorandum.

The Phase III Technical Memorandum identified several subset areas within the ongoing investigation area that contained distinctive mixtures of VOCs in groundwater. Some of these areas contained aromatic compounds (such as BTEX), PCE and associated degradation products (TCE, *cis*-1,2-DCE, and vinyl chloride), and TCA and DCA compounds. Other areas were found to only contain aromatic compounds BTEX. These discoveries lead to the development of the "plumelet" concept, where individual, chemically distinct releases were observed to have propagated separately and linearly down-gradient, though their degradation byproducts may have commingled within and down-gradient of the original source areas.

3.12 Semi-Annual Groundwater Monitoring Reports 1998 – Harding Lawson Associates, July 1998 and January 1999

Semi-annual groundwater sampling activities were conducted at select site and vicinity monitoring wells during 1998 to monitor the groundwater plume and the effectiveness of the IRM system. Groundwater samples were collected semi-annually from 35 monitoring wells (MW-1S, MW-2 through MW-5, MW-7 through MW-11, MW-12S, MW-13 through MW-15, MW-17, MW-19 through MW-23, R-1 through R-12, TW-1, TW-2A, and TW-3). Groundwater samples were collected from MW-1D, MW-12D, and MW-16 during the second semi-annual sampling event only. All groundwater samples were analyzed for VOCs and are reported in ***Semi-Annual Groundwater Monitoring Report, 1998 – First Event*** (HLA, July 1998c) and ***Semi-Annual Groundwater Monitoring Report, 1998 – Second Event*** (HLA, January 1999a).

3.13 Semi-Annual Groundwater Monitoring Reports 1999 – Harding Lawson Associates, May 1999 and January 2000

Groundwater sampling activities were conducted at select site and vicinity monitoring wells during 1999 to monitor the groundwater plume and the effectiveness of the IRM system. Quarterly groundwater samples were collected from 5 monitoring wells (MW-3, MW-8, MW-13 through MW-15), 3 groundwater sampling rounds were collected from 1 monitoring well (R-3), semi-annual groundwater samples were collected at 25 monitoring wells (MW-1S, MW-4, MW-5, MW-7, MW-9 through MW-11, MW-17 through MW-22, R-1, R-2, R-4 through R-11, TW-1, and TW-3), and annual groundwater samples were collected at 4 monitoring wells (MW-1D, MW-12D, MW-16, and MW-23). All groundwater samples were analyzed for VOCs and are reported in ***Semi-Annual Groundwater Monitoring Report, 1999 – First Event*** (HLA, May 1999b) and ***Semi-Annual Groundwater Monitoring Report, 1999 – Second Event*** (HLA, January 2000a).

3.14 Semi-Annual Groundwater Monitoring Report 2000 – Harding Lawson Associates, June 2000

Groundwater sampling activities were conducted at select site and vicinity monitoring wells during 2000 to monitor the groundwater plume and the effectiveness of the IRM system. In 2000, groundwater samples were collected once from 29 monitoring wells (MW-1S, MW-3 through MW-5, MW-7, MW-8, MW-11, MW-14, MW-15, MW-17 through MW-22, R-1 through R-11, TW-1, TW-2A, and TW-3). A second round was collected from MW-11. All groundwater samples were analyzed for VOCs and are reported in ***Semi-Annual Groundwater Monitoring Report, 2000 – First Event*** (HLA, June 2000b).

3.15 Enhanced Bioremediation Pilot Test Results – Harding ESE, Inc., May 2001

Harding ESE, Inc. (Harding), formerly HLA, was contracted by Unocal to perform an enhanced bioremediation pilot test (Harding, May 2001a). The objective of the pilot test was to evaluate the efficacy of injecting Hydrogen Release Compound (HRC®) to enhance the naturally occurring, in situ bio-attenuation of VOCs at the Site. HRC® is a polylactate ester that breaks down into volatile acids: acetic, butyric, lactic, propionic, and pyruvic. The analytes of primary interest for this pilot test were PCE, TCE, *cis*-1,2-DCE, and vinyl chloride. The test was conducted in an area free of ethanes and fuel constituents. Concentrations of the volatile acids, chlorinated ethenes and the degradation products ethene and ethane were monitored to assess the dechlorination process.

A site assessment was initially conducted to identify the optimal area for the pilot test on the Site. The physical criteria for the optimal pilot test location included the following: concentrations of PCE and TCE greater than approximately 100 micrograms per liter (µg/L), concentrations of PCE and TCE greater than the concentrations of the degradation daughter products *cis*-1,2-DCE and vinyl chloride, concentrations of BTEX in groundwater less than approximately 1,000 µg/L, down-gradient from the PCE/TCE source area, and on the Site.

During the Site assessment, soil and/or groundwater samples were collected from 38 DP locations (DP-41, DP-42, DP-44 through DP-73, DP-90 through DP-93, DP-95, and DP-96) in the eastern portion of the Site from September 20-September 29, 1999. Soil and groundwater samples were analyzed for VOCs in the field with a modified EPA Method 8021. Split soil and groundwater samples were collected from two locations and sent to a fixed laboratory for QC checks on the mobile laboratory. The split samples were analyzed for VOCs by EPA Method 8021B. Additionally, three soil samples were submitted to a fixed laboratory for TOC analysis using modified EPA Method 415.1. An attempt was made to collect soil vapor samples to assess

the applicability of this technology in the delineation of VOCs in the Site unsaturated soil. Due to mechanical problems, no evaluation of the applicability of soil vapor for source delineation could be made.

The only area sampled that met the criteria for the optimal pilot test location was the area south of DP-45, approximately 85 ft southeast of the AST area. It was determined that this area would serve as the location for the pilot test. The bioremediation pilot test design consisted of nine injection locations and seven groundwater monitoring PZs (P-02 and P-05 through P-10). On September 28 and 29, 1999, approximately 120 gallons of HRC® were injected into the saturated zone. Groundwater samples were collected from the pilot test PZs monthly from October 1999-January 2000, in March and May 2000, and then on a four-month schedule. Groundwater monitoring for the pilot study was concluded in September 2000. Field parameters were collected during groundwater sampling activities (pH, conductivity, temperature, dissolved oxygen [DO], total iron, ferrous iron, and oxidation-reduction potential [ORP]), and groundwater samples were analyzed for VOCs, inorganic parameters (alkalinity, chloride, DO, carbon, manganese, nitrate, nitrite, sulfate, and sulfide), and volatile acids (acetic, butyric, lactic, propionic, and pyruvic).

During the pilot test, PCE and TCE concentrations fluctuated in the up-gradient and cross-gradient directions but decreased in the mid- and down-gradient PZs. During the final sampling event, the furthest down-gradient PZs had no detectable concentrations of PCE. The concentrations of *cis*-1,2-DCE, vinyl chloride, and ethene also fluctuated in the mid- and down-gradient PZs during the pilot test. A temporary rise in the concentrations of *cis*-1,2-DCE, vinyl chloride, and ethene was observed in association with the decrease in concentration of PCE and TCE in the down-gradient wells. The concentrations of the chemicals proceeded to stabilize or decrease by the end of the pilot test. Prior to injection, no volatile acids were detected at their respective detection limits. Within 30 days of injections, volatile acids were found in down-gradient PZs, and by the final sampling round, concentrations of the volatile acids were increasing in the majority of down-gradient PZs. ORP values measured in down-gradient PZs indicated a reducing environment.

The enhanced bioremediation pilot test indicated that HRC® injected into the aquifer definitely contributed to a decrease in the concentrations of PCE and TCE in that area. Analyte concentrations varied from one sampling event to another based on various field conditions, such as the depth to groundwater. Coincidentally, the sampling in this area was resumed in 2006 for the subject analyses; the latest data indicate that the injection continues to affect the pilot test

area, as constituent concentrations have remained below the KDHE Risk-Based Standards (RSK) criteria.

3.16 Semi-Annual Groundwater Monitoring Reports 2001 – Harding ESE Inc., July 2001 and Terracon, December 2001

Groundwater sampling activities were conducted at select site and vicinity monitoring wells during 2001 to monitor the groundwater plume and the effectiveness of the IRM system. Semi-annual groundwater samples were collected from 26 monitoring wells (MW-1S, MW-1D, MW-3 through MW-5, MW-7, MW-12S, MW-13 through MW-15, MW-17, MW-19, MW-20, MW-22, R-1 through R-8, R-10, R-11, TW-2A, and TW-3). Annual groundwater samples were collected from five monitoring wells (MW-8, MW-11, MW-21, R-9, and TW-1). All groundwater samples were analyzed for VOCs, and the results are reported in ***2001 – Semi-Annual Groundwater Monitoring Report*** (Harding, July 2001b) and ***2001 Second Semi-Annual Groundwater Monitoring Report*** (Terracon, December 2001).

3.17 Direct-Push Sampling Results for Further Source Delineation – Harding ESE, Inc., September 2001

Additional source delineation activities were conducted to assess the lateral extent of VOCs in unsaturated soil and groundwater at the Site. Investigative activities were conducted from December 11-December 18, 2000. During the additional delineation activities, soil and/or groundwater samples were collected and analyzed from a total of 54 DP locations (DP-101 through DP-142 and DP-144 through DP-155) in the southwestern portion of the Site and areas in the tank farm vicinity. In August 2001, soil confirmation samples were collected from nine DP locations (DP-121A, DP-124A, DP-137A, DP-140A, DP-142A, DP-144A, DP-145A, DP-147A, and DP-149A) adjacent to select December 2000 borings.

The objective was to delineate VOCs in unsaturated soil; therefore, the target sampling depth was 3-5 ft bgl. Additional soil sample depth intervals were collected at seven borings based on field evidence (staining and odor). The initial soil samples collected in December 2000 were analyzed for VOCs in a mobile laboratory by modified EPA Method 3810/8021B. During the December 2000 sampling event, five borings were revisited and soil samples were collected and analyzed by EPA Method 5030/8021B to qualify previous analytical results. The August 2001 soil confirmation samples were analyzed for VOCs in a fixed laboratory by modified EPA Method 8260B.

Groundwater samples were collected or attempted at 38 of the DP boring locations during the December 2000 investigation. Only 15 of the 38 borings produced groundwater in sufficient

quantities to sample. Groundwater samples were collected from various depths in the borings and ranged from 14-22 ft bgl. Groundwater samples were analyzed by the mobile laboratory for modified EPA Method 3810/8021B, and six duplicates were analyzed by the mobile laboratory for modified EPA Method 5030/8021B to qualify the results.

Soil Sample Results

Analytical results for December 2000 soil samples collected in the unsaturated interval were screened against KDHE Tier 2 risk-based maximum allowable concentration for non-residential soil pathways. Nine analytes exceeded screening criteria (1,1-DCA, 1,1-DCE, 1,2-DCA, *cis*-1,2-DCE, PCE, TCE, vinyl chloride, 1,1,1-TCA, and benzene). Analytical results from confirmation soil samples collected during August 2001 report 12 analytes exceeding KDHE Tier 2 maximum allowable concentrations.

Groundwater Sample Results

The groundwater analytical results of the investigation were reported as similar to historical investigations. The highest concentrations of PCE, TCE, *cis*-1,2-DCE, and vinyl chloride were reported in and west of the AST area.

3.18 Source Area Soil Removal Closure Report – Terracon, March 2002

The analytical data from the ***Direct-Push Sampling Results for Further Source Delineation*** (Harding, March 2002) confirmed that VOC concentrations in the vadose zone exceeded Tier 2, RSK criteria. On October 30, 2001, source area soil removal activities were initiated at the Site. The source area soil removal activities included excavation, removal, and disposal of soils affected by VOCs. Excavation activities were conducted using a backhoe and trackhoe. Contaminated soils often extended to groundwater; however, excavation was terminated at the saturated zone. Source area removal activities were performed at three areas on Site: one area extending from the Site entrance to the northwestern warehouse (referred to as the Gate Excavation Area); another area north of the bioremediation pilot test (referred to as the Pit Area Excavation), and a portion of the former AST farm (referred to as Excavation Area #1). Confirmation soil samples were collected from site excavations to determine if VOC concentrations were below the KDHE RSK screening criteria. Once confirmation soil samples were reported below the KDHE RSK screening criteria, excavation activities were terminated and the excavations were backfilled with clean imported soil after obtaining KDHE approval (Terracon, 2002a). The excavation activities are discussed further in the ***Source Area Soil Removal Closure Report*** (Terracon, 2002a).

3.19 Annual Groundwater Monitoring Report 2002 – Terracon, September 2002

Groundwater sampling activities were conducted at select site and vicinity monitoring wells during 2002 to monitor the groundwater plume and the effectiveness of the IRM system. Annual groundwater samples were collected from 29 monitoring wells (MW-1S, MW-1D, MW-3 through MW-5, MW-7, MW-8, MW-12S, MW-13 through MW-15, MW-17, MW-19, MW-20, MW-22, R-1 through R-9, R-10, R-11, TW-2A, TW-3, and TW-4). Semi-annual groundwater samples were collected from USD-1, USD-2, and USD-3. All groundwater samples were analyzed for VOCs and results are reported in ***2002 Annual Groundwater Monitoring Report*** (Terracon, September 2002b).

3.20 On-Site Soil Characterization Report – URS, May 2003

On-site soil characterization activities were conducted in April 2003 to assess potential soil contamination above the water table in the area of the former railcar unloading area and the former chemical mixing and warehouse building. Only soils from above the water table were evaluated in order to determine if the unsaturated zone was acting as a source of groundwater contamination at these locations. Fourteen DP soil borings (DP-156 to DP-169) were advanced to an approximate depth of 8 to 10 ft bgs, where shale was encountered. For each boring, one sample was collected at approximately 4 ft bgs and one sample was collected at approximately 7 ft bgs. An exception was at boring DP-161 where only one sample was collected at the 4 foot level. All soil samples were analyzed for VOCs by EPA Method 8260B. Concentrations of VOCs were detected in two of the fourteen borings installed: DP-158 and DP-162. Both of these borings were located in the former loading dock area.

3.21 Annual Groundwater Monitoring Report 2003 – URS, May 2004

Groundwater sampling activities were conducted at select site and vicinity monitoring wells during 2003 to monitor the groundwater plume and the effectiveness of the IRM system. Groundwater levels were measured in 26 monitoring wells and 12 recovery well PZs. The groundwater gauging event was conducted during non-pumping of the IRM system as the system was shut down on October 6, 2003, for system modifications.

Groundwater samples were collected during three separate sampling events. The first groundwater sampling event was conducted on November 6 and 7, 2003, and consisted of collecting samples from 12 monitoring wells (MW-1S, MW-1D, MW-7, MW-8, MW-12S, MW-13, MW-17, MW-19, MW-20, MW-22, TW-2A, and TW-3). The second groundwater sampling event was conducted on December 15, 2003, and consisted of collecting samples from 12 recovery well PZs (R-1 through R-12). These samples were collected approximately one

week before the groundwater recovery system was reactivated. The third groundwater sampling event was conducted on December 23, 2003, and consisted of collecting samples from 10 recovery well PZs (R-2 through R-8 and R-10 through R-12). These samples were collected after the system had been reactivated. All groundwater samples were analyzed for VOCs by EPA Method 8260b, and the results are reported in ***2003 Annual Groundwater Monitoring Report*** (URS, May 2004).

3.22 Annual Groundwater Monitoring Report 2004 – URS, April 2005

Groundwater sampling activities were conducted at select site and vicinity monitoring wells during 2004 to monitor the groundwater plume and the effectiveness of the IRM system. Groundwater levels were measured in 22 monitoring wells and 12 recovery well PZs. The groundwater gauging event was conducted during pumping of the IRM system.

The annual groundwater sampling event was conducted from November 3-5, 2004, and groundwater samples were collected from 28 wells (P-2, P-5 through P-10, MW-1S, MW-1D, MW-4, MW-12S, MW-12D, MW-13, MW-17, MW-19, MW-20, MW-22, R-1 through R-7, R-10, R-11, TW-2A, and TW-3). All groundwater samples were analyzed for VOCs by EPA Method 8260b, and the results were reported in the ***Draft 2004 Annual Groundwater Monitoring Report*** (URS, 2005b) and the ***Final 2004 Annual Groundwater Monitoring Report*** (URS, 2007a).

3.23 Annual Groundwater Monitoring 2005

The annual 2005 groundwater monitoring event was initiated on January 26, 2006, and was concluded March 13, 2006. The groundwater sampling activities were conducted at select site and vicinity monitoring wells to monitor the groundwater plume and the effectiveness of the IRM system. The IRM system was shut off (non-pumping) from January 22-February 10, 2006, to allow for a potentiometric surface evaluation unaffected by groundwater extraction. Groundwater levels were measured in site and vicinity wells in January 2006 during the non-pumping period. During the annual event, groundwater samples were collected from 43 monitoring wells (P-1 through P-3, P-5 through P-10, MW-1D, MW-1S, MW-2 through MW-10, MW-12D, MW-13, MW-14, MW-16, MW-17, MW-19 through MW-23, USD-1, USD-2, USD-2, USD-3, R-1, R-2, R-4, R-5, R-7, R-8, TW-1, TW-2A, and TW-3). All groundwater samples were collected during the non-pumping period with the exception of those collected from P-6 through P-9 on March 13, 2006. All groundwater samples were analyzed for VOCs by EPA Method 8260b. Groundwater analytical results for this sampling event were used in the RI determination of nature and extent and the screening level evaluation. Groundwater sample results are reported in the ***2005 Annual Groundwater Monitoring Report*** (URS, 2007b).

3.24 Annual Groundwater Monitoring 2006

The annual 2006 groundwater monitoring event was initiated on May 22, 2006. Two comprehensive synoptic water level surveys were conducted in conjunction with the 2006 groundwater monitoring event. The first synoptic water level survey was conducted on May 22, 2006, while the IRM system was pumping, and the second synoptic water level survey was conducted on June 5, 2006, while the IRM system was shut down. The synoptic water surveys were used to produce the potentiometric surface figures, Figure 2-12 and 2-13. Groundwater sample results are reported in a ***2006 Annual Groundwater Monitoring Report*** (URS, 2007c). This Revised Draft Final RI Report does include the 2006 groundwater results in order to supplement the comprehensive results from the 2005 groundwater monitoring event.

3.25 USD's First Semiannual 2006 Groundwater Sampling Results - June 2006

USD initiated their first Semiannual Groundwater Monitoring Event for 2006 on May 22, 2006. This effort was performed in conjunction with the Annual 2006 Groundwater Monitoring Event at the former Unocal site. Samples for the following monitoring wells were split between URS and USD's consultants: MW-5, USD-1, USD-2, USD-3, USD-MW-3, and USD-MW-14. All groundwater samples were analyzed for VOCs by EPA Method 8260B. The results for the USD and URS samples were within the same order of magnitude, as shown in Table 3-2.

3.26 Pilot Test Injection - December 2006

The ***Enhanced Reductive Dechlorination Pilot Test Implementation Workplan*** (URS, 2006) was approved by the KDHE in October 2006. This workplan proposed replacing the groundwater pump and treatment system with an *in situ* reactive treatment comprised of two subsurface substrate barriers: one of HRC® and the other of CAP-18ME TM. These substrate barriers were injected into the subsurface in December 2006. Monitoring of the workplan-specified wells commenced in January 2007 and will continue until December 2007. The pilot test is discussed further in Section 5.8.

3.27 Membrane Interface Probe Investigation - September 2007

A membrane interface probe (MIP) investigation was performed on the former Unocal property in July 2007 in order to define saturated source zones. Additionally, groundwater samples were collected on the Coleman property due to a request from KDHE upon review of the ***Revised Draft Final Remedial Investigation Report*** (URS, 2007e). The initial purpose of this field event was to conduct a targeted screening investigation, using MIP, in the area surrounding P-5 (i.e., the "P-5 area"), owing to high concentrations of chemicals of concern (COCs) (i.e., chlorinated

solvents) in that area. This effort was modified after a meeting with KDHE on May 18, 2007; the modification consisted of an additional MIP investigation along the fence-line along the western boundary of the former Unocal property.

Thirty MIP points were driven to the Wellington shale and seven groundwater grabs were collected as part of this investigation. With the MIP, vapor samples were collected through a membrane after heating and transported to an aboveground instrument via a nitrogen carrier gas. At each MIP point, samples were collected continuously as the probe was advanced into the subsurface; samples were analyzed by three detectors: an electron capture detector (ECD), a Photo Ionization Detector (PID), and a Flame Ionization Detector (FID). Temperature, conductivity, and the speed of probe advancement were also measured.

Seven groundwater grab samples were collected at various locations in order to roughly correlate the ECD, PID, and FID readings with analytical concentrations of the COCs (primarily chlorinated solvents). The results of the MIP investigation and the analytical results of the groundwater grabs were reported in the letter to KDHE on September 28, 2007 (URS, 2007f).

3.28 Additional Investigation Activities to Complete the RI Delineation – November 2007

Based on comments from KDHE regarding the delineation data presented in the RI, additional investigation activities were performed in December 2006, July 2007, and October 2007 at the former Unocal site and the surrounding properties. The objective of the investigation was to complete the delineation of the historical groundwater plumelets described in the RI Report on the basis of comments received from KDHE on July 10, 2007. A letter Workplan was submitted to KDHE on August 31, 2007 outlining the scope of the investigation as follows:

1) On the USD property, collect groundwater grab samples surrounding MW-5 to delineate the extent of groundwater contamination related to Historical Plumelet D;
2) On the Pinsker property, collect groundwater grab samples at selected locations on the property, including the collection of a sample from monitoring well USD-13, to determine if groundwater contamination detected in PMW-5 and PMW-6 is related to groundwater contamination in Historical Plumelet F;
3) On the Coleman property, collect groundwater grab and vertical delineation samples along and south of Transect 2 to delineate the extent of groundwater contamination related to Historical Plumelet F; and

4) Also on the Coleman property, collect groundwater grab samples along Transect 1 to "re-baseline" the groundwater condition in the area south of TW-3.

A total of 29 groundwater grab samples were collected. Owing to the lack of groundwater in the area between Unocal and the former Pinsker site, groundwater samples could not be collected within 24 hours at those locations. Soil borings were performed during the second and third events to evaluate the presence of groundwater and determine the depth to shale on the properties adjacent to Unocal.

The 29 groundwater grab samples were analyzed by Lancaster Laboratories, the same fixed-base laboratory that is used for the most recent annual events and for the pilot test performance monitoring. All of the groundwater grab samples were analyzed for VOCs by EPA Method SW8260B. The results of the additional investigation activities were reported in the letter to KDHE on November 2, 2007 (URS, 2007g).

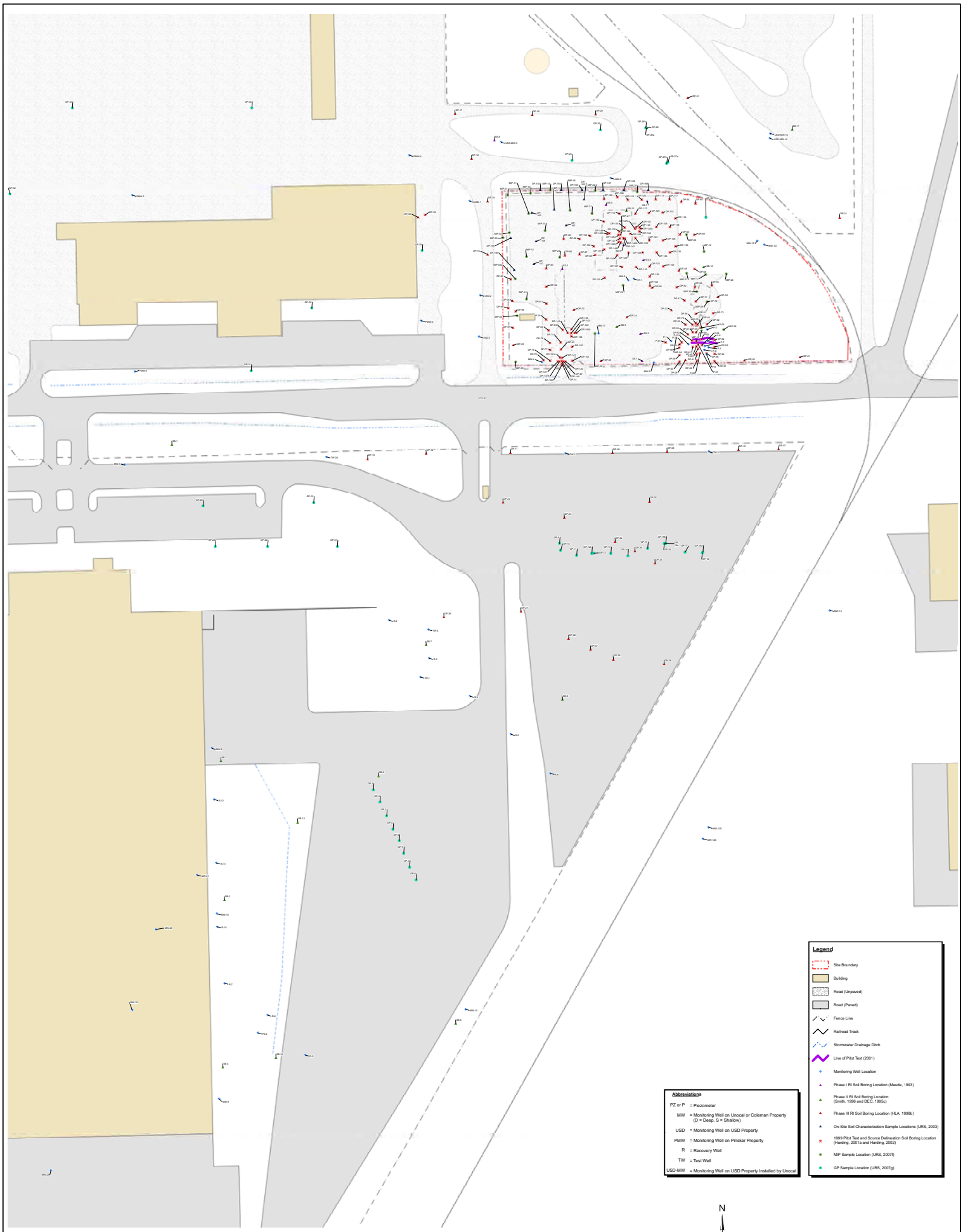
Table 3-1. List of Activities and Reports Issued for Former Unocal Chemical Distribution Facility

Date	Report	Issuing Consultant
June 1990	Preliminary Site Characterization -Field Investigation Report	Woodward-Clyde Consultants
November 1991	Phase II Site Characterization	Woodward-Clyde Consultants
August 1992	Phase I Remedial Investigation Workplan - Final	Maude Environmental Inc.
November 1993	Phase I Remedial Investigation and Report	Maude Environmental Inc.
June 1994	Phase II Remedial Investigation Workplan	Maude Environmental Inc.
December 1994	Phase II Remedial Investigation Activities and Draft Report	Canonie Environmental (Smith)
September 1995	Phase II Remedial Investigation Addendum Activities	Delta Environmental Consultants Inc.
June, August, and December 1995 and January 1996	Quarterly Groundwater Monitoring Reports-1995	Delta Environmental Consultants Inc.
December 1995	Phase II Remedial Investigation	Smith Environmental Technologies Corp.
February 1996	Phase II Remedial Investigation - Final Report	Smith Environmental Technologies Corp.
June 1996	Comprehensive Remedial Investigation Report	Woodward-Clyde Consultants
December 1996	Semi-Annual Groundwater Monitoring Results-1996	Woodward-Clyde Consultants
January 1997	DNAPL Site Evaluation	Woodward-Clyde Consultants
July 1997 and January 1998	Semi-Annual Groundwater Monitoring Results-1997	Harding Lawson Associates
April 1998	Phase III Investigation, Technical Memorandum	Harding Lawson Associates
July 1998 and January 1999	Semi-Annual Groundwater Monitoring Reports-1998	Harding Lawson Associates
May 1999 and January 2000	Semi-Annual Groundwater Monitoring Reports-1999	Harding Lawson Associates
June 2000	Semi-Annual Groundwater Monitoring Reports-2000	Harding Lawson Associates
May 2001	Enhanced Bioremediation Pilot Test Results	Harding ESE, Inc.
July and December 2001	Semi-Annual Groundwater Monitoring Reports-2001	Harding ESE, Inc.
September 2001	Direct-Push Sampling Results for Further Source Delineation	Harding ESE, Inc.
March 2002	Source Area Soil Removal Closure Report	Terracon
September 2002	Annual Groundwater Monitoring Report-2002	Terracon
May 2003	On-Site Soil Characterization Report	URS
May 2004	Annual Groundwater Monitoring Report-2003	URS
April 2005	Annual Groundwater Monitoring Report-2004	URS
June 2006	USD's First Semi-Annual 2006 Groundwater Sampling Results	USD/Golder Associates
October 2006	Enhanced Reductive Dechlorination Pilot Test	URS
February 2007	Annual Groundwater Monitoring Report-2005	URS
February 2007	Annual Groundwater Monitoring Report-2006	URS
September 2007	Membrane Interface Probe (MIP) Investigation	URS
November 2007	Additional Investigation Activities to Complete the RI Delineation	URS

Table 3-2. A Comparison of the Unocal and USD Results for the May 2006 Sampling Event

Location	Results	PCE µg/L	TCE µg/L	*cis*-1,2-DCE µg/L	VC µg/L
MW-5	Unocal	42	140	640	190
	USD	52.5	164	911	190
USD-1	Unocal	48	1.2	<1	<1
	USD	54.8	1.24	ND	ND
USD-2	Unocal	83	370	230	<1
	USD	104	412	258	ND
USD-3	Unocal	31	190	570	0.2 J
	USD	32.9	197	568	ND
USD-MW-3	Unocal	15	0.2 J	<1	<1
	USD	13.3	0.580	ND	ND
USD-MW-14	Unocal	<1	<1	<1	<1
	USD	ND	ND	ND	ND

J - The analyte was positively identified, the quantitation is an estimation.
ND - Non-detect.



URS
9400 Amberglen Blvd.
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Fax: (512) 419-5474

Client: Former Unocal Chemical Distribution Facility Wichita, Kansas

Title: Figure 3-1 Sample Location Map

Drawn by: gacloa | Date: 11/07 | Drawing File: Fig 3-1 Sample Locs OVERSIZED.cmd | Figure: 3-1

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4.0 Nature And Extent Of Contamination

The groundwater data from the most recent *comprehensive* groundwater sampling event conducted January through March 2006 (i.e., also referred to as the 2005 groundwater sampling data) were used as the basis for groundwater nature and extent determination of the Site. The 2005 event was designed to collect a comprehensive set of groundwater data (samples were collected from most of groundwater monitoring wells), with an emphasis on the collection of data to evaluate natural attenuation. Groundwater samples collected during this event were analyzed by an off-site laboratory for EPA Method 8260B. Groundwater data from the 2006 groundwater sampling event conducted May through June 2006 were used to supplement the 2005 event data.

A variety of soil data were used to generate a soil data set. All individual data sets were evaluated for usability, as described below. Analytical results for soil samples that were subsequently excavated were excluded from the comprehensive soil data set for data screening and reduction. This process is further discussed in Section 4.3.

4.1 Data Usability

Over the past 15 years, soil and groundwater monitoring well samples were analyzed by a qualified off-site laboratory or an on-site mobile laboratory GC, depending on the objectives of the particular study. Soil and groundwater samples collected at the Site over the past 15 years have been analyzed by one or a combination of the following EPA Methods: 8240, 8015, 8010, 8020, 8240, 8021A, 8021M, 8021B, 8021M, 3810/8021B, 5030, 5035, 8260, or 8260B. All of the data generated from these analytical methods were used to evaluate nature and extent in this report except for EPA Methods 8015, 8010, and 8020; the analytical results generated through these methods are of unknown or insufficient quality and, therefore, have been excluded from evaluation. Results from several investigations included those generated by an on-site mobile laboratory - the quality of these data were reviewed to determine whether field calibration was performed properly and if fixed-based laboratory duplicates were analyzed as part of the QC program. Some of the field-generated laboratory data was used in the evaluation of nature and extent for soil and groundwater. All data that were used to meet acceptance criteria.

4.2 Source Area Investigation

The *primary* sources of soil contamination at the Site are those related to the historical storage and transfer of chemicals, as shown in Figure 2-2, (Organic solvents were managed at the facility and included bulk shipments of liquid chemicals, storage of bulk shipments in ASTs, custom blending of chemicals to customer's specifications, and distribution of these chemicals to customers in drummed and/or bulk shipments). It is likely that there were multiple releases throughout the

operation of the facility rather than a single release at one point in time. Critical evaluation of the groundwater DP and field GC-analyzed results from the various assessments suggest that there are several individual plumes that may be commingling. Aerial photographs of the facility in 1997, 2000, and 2003 are shown in Figure 2-4. The *secondary* sources are the residual zones of contamination in unsaturated and saturated site soil that continue to impact deeper soil intervals and groundwater. As discussed in Section 4.2.2, some of these secondary sources have been removed.

4.2.1 Primary Source Areas

One of the primary source areas is the historical AST farm where bulk liquid chemicals were stored. Liquid chemicals were stored in nine vertical tanks and 20 horizontal tanks in the AST area. The horizontal tanks were compartments within larger tanks and each stored a different chemical. The types of chemicals handled at the facility included aromatic and aliphatic hydrocarbons, chlorinated hydrocarbons, petrochemicals, ketones, alcohols, and glycol ethers. Table 4-1 lists the contents and capacities of these tanks in 1988. Hazardous wastes generated at the facility include those generated by the flushing of transfer lines and drip pan wastes (for which the composition was a mixture of the chemicals listed above).

The base of the AST area consisted of gravel on top of natural soil with no underlying manmade (e.g., concrete or high-density polyethylene [HPDE]) or natural (e.g., clay) layers. A concrete containment wall surrounded the AST farm. The only recorded release occurred in November 1989 when approximately 150 gallons of PCE was accidentally discharge onto the ground in the tank farm area. In response to the spill, Unocal installed a temporary SVE system to remove PCE from the unsaturated zone soils. Operation of the SVE system was discontinued in July 1993 after the Phase I RI because of its decreased efficiency due to soil and site characteristics.

A second potential primary source area is the former fuel pump that was located outside of the southwestern tank farm containment wall and south of the truck loading and unloading dock. The pump was used to refuel trucks transporting bulk chemicals. The fuel pump was connected to a fuel tank inside the bermed tank farm via an aboveground transfer pipe.

A third potential primary source area is near the former truck loading and unloading rack. The chemical piping was plumbed such that one rack was used to transport chemicals to and from the trucks. This rack was located within the contaminant curbing surrounding the AST farm area.

A fourth potential primary source area is the drain along the southeastern AST farm berm wall. Surface water runoff potentially could have come into contact with contaminated surface soil in the tank farm area and drained from the area as impacted surface water runoff.

Other potential primary source areas include the warehouse storage buildings, which were historically used to store 55-gallon chemical drums and perform custom blending. One of the warehouses was located in the northwest corner of the Site, another south of the AST farm and the fuel pump, and another along the southern fence boundary east of the Site entrance. In 1984, a fire destroyed the warehouse along the southern fence line.

One mode of transporting chemicals to and from the facility was by railcar; railcars were also occasionally used as a temporary means of chemical storage. Since chemicals were transferred at the railcar loading/unloading area, this area is also a potential primary source area. The railcar loading/unloading area is located along the northern site boundary, north of the former AST farm. The chemical piping was plumbed such that the same pipe was used to transport chemicals to and from the railcars.

The final potential primary source area is the septic leach field located south of the warehouse in the northwestern corner of the Site. Floor drains could have transferred material to the septic leach field.

All of the potential primary source areas are depicted on Figure 2-2. The distribution of these potential source areas, along with the nature and timing of any releases, likely contributed to the segregated plumes (plumelets) that were observed in the Phase III study (discussed in Section 3.11).

4.2.2 Removal of Potential Primary and Secondary Source Areas

Facility operations ceased in 1992 and subsequent removal and demolition activities were performed to remove the warehouses, ASTs, 55-gallon drums, 500-gallon DOT containers, and the railcars, which were likely the main primary sources at the Site. By 2003, the Site was cleared of all structures. The analytical data from the ***Direct-Push Sampling Results for Further Source Delineation*** (Harding, March 2002) confirmed that soil VOC concentrations in the vadose zone exceeded Tier 2 RSK criteria. On October 30, 2001 source area soil removal activities were initiated at the Site. The source area soil removal activities included excavation, removal, and disposal of VOC contaminated soils. Excavation activities were conducted using a backhoe and trackhoe. Impacted soils often extended to groundwater; however, excavation was terminated at the saturated zone.

Source area removal activities excavated three areas on the Site. One excavation was the area extending from the Site entrance to the northwestern warehouse (referred to as the Gate Excavation Area). A second excavation is the area north of the bioremediation pilot test (referred to as the Pit Area Excavation). The last is a portion of the former AST farm (referred to as Excavation Area #1). The three excavated areas are shown in Figure 2-2. Confirmation soil samples were collected from site excavations to determine if VOC concentrations were below the KDHE RSK screening criteria. Once confirmation soil samples were reported below the KDHE RSK screening criteria and after obtaining KDHE approval, excavation activities were terminated and the excavations were backfilled with clean imported soil (Terracon, 2002a). The excavation activities are discussed further in the ***Source Area Soil Removal Closure Report*** (Terracon, 2002a). Figure 2-4 shows the aerial photograph of the Site in 2003 after excavation activities were completed.

4.3 Screening Levels

The KDHE Tier 2 Risk-Based Summary Table presents two types of soil screening levels. The "soil exposure pathway" screening levels address direct contact exposure routes (ingestion, dermal contact, and inhalation of particulates or vapors) for both residential and non-residential land use settings. The "soil to groundwater protection pathway" screening levels address whether a constituent is likely to leach from soil to groundwater and are derived using a dilution attenuation factor (DAF) of 20 for both residential and non-residential land use settings. The KDHE Tier 2 risk-based residential screening values used for soil to groundwater are presented in Table 4-2.

KDHE provides residential and non-residential groundwater screening levels that address direct contact exposure routes (ingestion, dermal contact, and inhalation of vapors). The Tier 2 groundwater screening levels are derived with the assumption that the aquifer is a source of potable water (KDHE, June 2007). For those contaminants that have a promulgated federal Safe Drinking Water Act MCL, the Tier 2 groundwater value for both residential and non-residential land use settings is the chemical-specific MCL. The KDHE manual states that if the groundwater is used as a drinking water source, then the screening level defaults to residential land use, irrespective of actual land use (KDHE, June 2007). The KDHE residential screening values used for groundwater are presented in Table 4-3.

4.4 Nature of Soil Contamination

Soil data have been collected at the Site over the past 15 years during multiple environmental investigations. These investigations were conducted to evaluate VOCs in soil and to characterize the Site for applicability and efficacy of treatment alternatives. For this report, historical soil data

were compiled in a central database to allow a comprehensive evaluation of the Site vadose zone. The historical soil database is presented on the CD in Appendix C. Some of the soil data were flagged and then not evaluated as part of the soil data set for the following reasons:

- If the soil sample location was off-site (i.e., on Coleman facility);
- If the soil sample location was removed during excavation activities;
- If the soil sample was collected below the groundwater table (a review of potentiometric data determined 15 ft bgl to be a conservative estimate to the groundwater table for the initial data screen); or,
- If the analytical method was determined to be deficient.

The flagged data were not used for the determination of the nature and extent of the soil contamination at the Site. The unflagged data were then screened against the KDHE residential "soil to groundwater migration" screening levels, presented in Table 4-2. These levels are referred to hereafter as "residential soil screening values."

Because the soil data set is a compilation of samples collected over 15 years by various environmental contractors under a number of investigative workplans, the soil sampling intervals vary from boring to boring, as do the laboratory methods for analysis. To assist in the vertical assessment of contamination, soil samples were categorized into the following strata; shallow subsurface soil (2-5 ft bgl), deep subsurface (5-10 ft bgl), and very deep subsurface (>10 ft bgl). All surface soil (0-2 ft bgl) sample locations were either removed during excavation activities and backfilled with clean borrow source soil or analyzed by a deficient analytical method; therefore, these locations were flagged and were not included in the evaluation.

The screening results for the soil samples are presented in Tables 4-4 through 4-6 by depth of strata: shallow subsurface, deep subsurface, and very deep subsurface, respectively. Only the chemicals with detected concentrations are presented, and the detected concentrations are shown in bold. The results exceeding the residential soil screening values are highlighted in Tables 4-4 through 4-6, and the initial cumulative exceedances are displayed on Figure 4-1. Figures 4-2 through 4-4 show the results exceeding residential soil screening values by depth of strata: shallow subsurface, deep subsurface, and very deep subsurface, respectively.

The analytes detected at concentrations that exceed the residential soil screening values are acetone, PCE, TCE, and vinyl chloride. The detection limits for 1,1-DCE, 4-methyl-2-pentanone (MIBK), and benzene in the shallow subsurface soil sample collected from the MW-6 soil boring exceed residential soil screening values. However, because concentrations for these chemicals

were not detected, these analytes were omitted from further evaluation. The following discussion of the nature and extent of contaminates in soil is divided into subgroups by analyte.

Acetone

Acetone exceeded the residential soil screening value (1.1 milligrams per kilogram [mg/kg]) in a single shallow subsurface soil sample collected at the MW-6 soil boring near the AST storage area (1.5 mg/kg). While this concentration does not exceed the KDHE non-residential screening value (3.8 mg/kg), acetone is evaluated further.

PCE

PCE exceeded the residential soil screening value in soil samples collected from the deep and very deep subsurface intervals at three locations (DP-62, DP-67, and DP-70), in the deep subsurface soil sample collected at DP-51, and the very deep subsurface soil samples collected at DP-61 and DP-66. A total of 10 soil samples exceed the residential soil screening value for PCE. All of the PCE exceedances are located in the south central portion of the Site, as shown on Figure 4-1. The boring logs for these sample locations were examined to further refine the depth of saturated soil, and it was determined that eight of the 10 soil samples were collected from the saturated soil (i.e., the boring logs described the soil as saturated and indicated that the elevation is below the potentiometric surface in the area at that time), thereby excluding them from the evaluation of nature and extent in the vadose zone. DP-51 and DP-70 are the remaining sampling locations with PCE exceedances. PCE concentrations in deep subsurface vadose soil collected at DP-51 and DP-70 were reported at 0.243 mg/kg and 0.535 mg/kg, respectively, which both exceed the PCE residential soil screening value of 0.18 mg/kg.

PCE exceeded the KDHE residential screening value in the shallow subsurface soil sample collected from the MW-6 soil boring. At this location PCE exceeded the screening criteria by default as the laboratory detection limit exceeded the residential soil screening value. However, because a concentration for this chemical was not detected, this occurrence is simply noted. Further discussion of PCE in MW-6 was omitted.

TCE

TCE exceeded the residential soil screening value in soil samples collected from the very deep soil sample interval at DP-66 and DP-70. Upon reviewing the boring logs for these locations, it was determined that these samples were collected from saturated soil and, therefore, were excluded from the evaluation of nature and extent in the vadose zone.

TCE exceeded the residential soil screening value in the shallow subsurface soil sample collected from the MW-6 soil boring. At this location TCE exceeded the screening criteria by default as the laboratory detection limit exceeded the residential soil screening value. However, because a concentration for this chemical was not detected, the occurrence is simply noted. Further discussion of TCE in MW-6 was omitted.

Vinyl Chloride

Vinyl chloride exceeded the residential soil screening value (0.02 mg/kg) in shallow subsurface soil samples collected at DP-76, DP-77, and DP-85 (0.023 mg/kg, 0.026 mg/kg, and 0.03 mg/kg, respectively). While the horizontal extent of these three sample locations is not bound in all directions, the results are only slightly above the residential soil screening value.

Vinyl chloride also exceeded the residential soil screening value (0.02 mg/kg) in very deep subsurface soil samples collected at DP-62, DP-66, DP-67, DP-70, and DP-82. Upon reviewing the boring logs for the very deep subsurface soil sample locations, it was determined that these samples were collected from saturated soil and, therefore, were excluded from the evaluation of nature and extent in the vadose zone.

Summary

In summary, soil data has been generated by a variety of studies, contractors, and methods over time. Some of this data were flagged and not evaluated as part of the soil data set for several reasons. These include whether the soil sample was collected below the groundwater table based on a review of potentiometric data that determined 15 ft bgl to be a conservative estimate for the groundwater table. The remaining unflagged data set was then screened against the KDHE residential soil to groundwater migration criteria.

Upon further review of the unflagged data set, many initial soil exceedances were omitted from further evaluation because either they were non-detect or they were determined not to be in the vadose zone through a review of their boring logs. Six soil samples remained that contain chemicals exceeding the residential soil screening values. The remaining soil constituents of potential concern (COPCs) are acetone in the shallow zone for MW-6, PCE in the deep zone for soil borings DP-51 and DP-70, and vinyl chloride in the shallow zone for soil borings DP-76, DP-77, and DP-85. No COPCs were determined to exist in the very deep zone that were not below the water table. Figure 4-5 presents the final soil sample results, and Tables 4-7 and 4-8 present the COPC concentrations for all of the soil borings for the shallow and deep zones, respectively.

4.5 Nature of Groundwater Contamination

Groundwater samples have been collected at the Site over time to evaluate VOCs in groundwater, monitor the groundwater contaminant plume, and evaluate the performance of interim measures. The current groundwater monitoring network consists of a combination of PZs, monitoring wells, and recovery wells totaling 65 locations. Completion data for all the wells is presented in Table 4-9. The frequency of monitoring and the number of wells have varied over the years as wells have been installed; monitoring events have been conducted quarterly, semi-annually, and annually. The groundwater monitoring data has been compiled in a central database, presented in Appendix C in the attached CD, to allow the reader of this report access to the historical groundwater data. Table 4-3 lists the residential KDHE groundwater screening levels. These values are the same as the Tier 2 residential groundwater screening values. The residential KDHE groundwater screening levels are referred to hereafter as "residential groundwater screening levels."

While a large volume of historical groundwater data exists for the Site, this report will focus on the 2005 groundwater monitoring results (conducted January to March of 2006) and the 2006 groundwater monitoring results (conducted May through June of 2006) to characterize the current site conditions and to determine the nature and extent of contamination currently present at the Site. The historical data predating the 2005 groundwater sampling event were used to evaluate analytical trends in groundwater (detailed in Section 4.5). Tables 4-10 and 4-11 present the screened results of the 2005 and 2006 groundwater monitoring events, respectively. Only the constituents with detected concentrations are presented, and the detected concentrations are shown in bold. The results exceeding the residential groundwater screening levels are highlighted.

Figure 4-6 shows the wells used to characterize groundwater during the 2005 event. Figure 4-7 shows the distribution of VOC contaminants that exceeded the residential groundwater screening levels for the 2005 groundwater monitoring event, while Figure 4-8 shows the distribution of the petroleum hydrocarbon contaminants that exceeded the residential groundwater screening levels for that event.

Figure 4-9 shows the wells sampled during the June 2006 event. Figure 4-10 shows the distribution of VOC contaminants that exceeded the residential groundwater screening levels for the 2006 groundwater monitoring event, while Figure 4-11 shows the distribution of the petroleum hydrocarbon contaminants that exceeded the residential groundwater screening levels for the 2006 event.

Contaminant plume maps were generated for PCE and TCE for the 2005, and 2006 annual monitoring events and are presented as Figures 4-12 through 4-19.

For the 2005 event, samples were collected from 45 wells. The following 18 VOCs were detected above the residential groundwater screening levels during that event and are discussed below: PCE; TCE; *cis*-1,2-DCE; *trans*-1,2-DCE; vinyl chloride; 1,1,1-TCA; 1,1-DCA; 1,2-DCA; 1,1-DCE; chloroethane (CA); 1,2,4-trimethylbenzene (TMB); 1,3,5-TMB, MIBK, isopropylbenzene; BTEX; and naphthalene. These same VOCs were also detected above the residential groundwater screening levels during the 2006 Annual Monitoring event except for *trans*-1,2-DCE and with the addition of methylene chloride and acetone being detected during the 2006 event.

The detection limits for some of the analytes for the 2005 event were above the residential groundwater screening levels. This occurred in samples that had to be diluted owing to high concentrations of COPCs (for example, in source wells such as MW-6, P-02, and P-05). In one other case (TW-3), the detection limit only slightly exceeded the screening values. Similar occurrences happened for the 2006 event. The detection limit exceedances for the 2005 event are shaded in Table 4-10; however, because concentrations for the chemicals were not detected, these results were considered non-detects for further discussion.

The results indicate that there are two primary groups of organic constituents present in groundwater above residential groundwater screening levels at the Site: 1) chlorinated VOCs (primarily chlorinated ethenes and ethanes) and other solvents; and 2) petroleum hydrocarbons. The following discussion on the nature of the groundwater contaminants is divided into the aforementioned subgroups.

4.5.1 Chlorinated VOCs and Other Solvents

The chlorinated VOCs group includes PCE, TCE, *cis*-1,2-DCE, *trans*-1,2-DCE, vinyl chloride, 1,1,1-TCA, 1,1-DCA, 1,1-DCE, 1,2-DCA, and CA. The following known primary product and degradation products are provided below:

- PCE to TCE to *cis*-1,2-DCE (or *trans*-1,2-DCE) to vinyl chloride;
- 1,1,1-TCA to 1,1-DCE or 1,1-DCA to CA (1,1-DCE can also degrade to vinyl chloride).

Figure 4-7 shows the distribution of chlorinated VOCs that exceed the residential groundwater screening levels for the 2005 groundwater monitoring event, while Figure 4-10 shows the

distribution of chlorinated VOCs that exceed the residential groundwater screening levels for the 2006 groundwater monitoring event. Isoconcentration maps for the primary VOCs, including PCE, TCE *cis*-1,2-DCE, and vinyl chloride (see Figures 4-12 through 4-19), are presented in Section 4.7.

PCE

PCE was detected in groundwater samples obtained from 19 monitor wells and 5 recovery wells during the 2005 Annual Monitoring Event (see Figure 4-12). PCE concentrations detected in the monitor wells were generally lower than PCE concentrations detected in November 2004, but higher than the PCE concentrations reported for the 2006 event, therefore, showing a decrease in PCE concentration over time. PCE concentrations detected in the monitor wells ranged from 0.37 J µg/L at MW-1S to 37,000 µg/L at P-05. P-05 is located north of the previous pilot test site on the Site. PCE concentrations detected in the recovery wells ranged from 1.5 J µg/L at R-2 to 660 µg /L at R-5. PCE concentrations exceeded the residential groundwater screening level of 5 µg/L in groundwater samples obtained from 13 monitor wells and 3 recovery wells.

PCE was detected in 19 of the 29 monitor wells sampled and 9 of the 10 recovery wells sampled during the 2006 Annual Monitoring Event (see Figure 4-13). PCE concentrations detected in the monitor wells ranged from 0.2 J µg/L at PMW-2 to 14,000 µg/L at P-05. PCE concentrations detected in the recovery wells ranged from 0.2 J µg/L at R-11 to 720 µg/L at R-5. PCE concentrations exceeded the residential groundwater screening level of 5 µg/L in groundwater samples obtained from 11 monitor wells and 6 recovery wells.

TCE

TCE was detected in groundwater samples obtained from 22 monitor wells and 5 recovery wells during the 2005 Annual Monitoring Event (see Figure 4-14). TCE concentrations detected in monitor wells ranged from 0.33 J µg/L (P-07) to 9900 µg/L (P-05), while concentrations detected in recovery wells ranged from 0.89 J µg/L (R-7) to 240 µg/L (R-5). TCE concentrations detected in monitoring wells in the 2005 monitoring event were generally lower than concentrations detected in November 2004, but were higher than the concentration reported for the 2006 event, thereby, showing a decrease in TCE concentration over time. TCE concentrations exceeded the TCE residential groundwater screening level of 5 µg/L in 14 monitor wells and 3 recovery wells.

TCE was detected in 17 of the 29 monitor wells sampled and 10 of the 10 recovery wells sampled during the 2006 Annual Monitoring Event (see Figure 4-15). TCE concentrations detected in monitor wells ranged from 0.2 J µg/L (P-01 and MW-3) to 4300 µg/L (P-05). TCE concentrations

exceeded the TCE residential groundwater screening level of 5 µg/L in 12 monitor wells and 8 recovery wells.

***cis*-1,2-DCE**

cis-1,2-DCE was detected in groundwater samples obtained from 26 monitor wells and 5 recovery wells during the 2005 Annual Monitoring Event (see Figure 4-16). *cis*-1,2-DCE concentrations detected in the monitor wells ranged from 0.38 J µg/L at P-01 to 31,000 µg/L at MW-6. MW-6 is located up-gradient of the former tank farm area. *cis*-1,2-DCE concentrations detected in the recovery wells ranged from 0.91 J µg/L at R-7 to 10,000 µg/L at R-1. *cis*-1,2-DCE concentrations exceeded the residential groundwater screening level of 70 µg/L in 11 monitor wells and 3 recovery wells.

cis-1,2-DCE was detected in 16 of the 29 monitor wells sampled and 10 of the 10 recovery wells sampled during the 2006 Annual Monitoring Event (see Figure 4-17). *cis*-1,2-DCE concentrations detected in the monitor wells ranged from 0.3 J µg/L at MW-19 to 7,000 µg/L at MW-6. *cis*-1,2-DCE concentrations detected in the recovery wells ranged from 13 µg/L at R-7 to 1,200 µg/L at R-1. *cis*-1,2-DCE concentrations exceeded the residential groundwater screening level of 70 µg/L in 9 monitor wells and 4 recovery wells.

***trans*-1,2-DCE**

trans-1,2-DCE was detected in a groundwater sample obtained from 1 monitor well (P-02) during the 2005 Annual Monitoring Event. The groundwater sample collected at P-2 in the south central portion of the Site had a *trans*-1,2-DCE result of 260 µg/L. This concentration exceeded the residential groundwater screening level of 100 µg/L.

trans-1,2-DCE was detected in 14 of the 29 monitor wells sampled and 10 of the 10 recovery wells sampled during the 2006 Annual Monitoring Event. *trans*-1,2-DCE concentrations detected in the monitor wells ranged from 0.2 J µg/L at TW-3 to 21 µg/L at USD-3. *trans*-1,2-DCE concentrations detected in the recovery wells ranged from 0.2 J µg/L at R-6, R-7, and R-10 to 11 µg/L at R-1. *trans*-1,2-DCE concentrations exceeded the residential groundwater screening level of 100 µg/L in none of the monitor wells and recovery wells.

Vinyl Chloride

Vinyl chloride was detected in 19 monitor wells and 4 recovery wells during the 2005 Annual Monitoring Event (see Figure 4-18). The detected concentrations of vinyl chloride ranged from 0.52 J µg/L (MW-1S) to 1200 µg/L (MW-6) for the monitor wells and 1.5 J µg/L (R-2) to 490 µg/L (R-1) for the recovery wells. Vinyl chloride concentrations exceeded the residential groundwater screening level of 2-µg/L in 12 monitor wells and 2 recovery wells.

Vinyl chloride was detected in 9 of the 29 monitor wells and 8 of the 10 recovery wells during the 2006 Annual Monitoring Event (see Figure 4-19). The detected concentrations of vinyl chloride ranged from 0.2 J µg/L (USD-3) to 430 µg/L (MW-6) for the monitor wells and 0.2 J µg/L (R-2) to 73 µg/L (R-11) for the recovery wells. Vinyl chloride concentrations exceeded the residential groundwater screening level of 2 µg/L in 6 monitor wells and 4 recovery wells.

1,1,1-TCA

1,1,1-TCA was detected in 6 monitor wells and 2 recovery wells during the 2005 Annual Monitoring Event. The detected concentrations of 1,1,1-TCA ranged from 0.22 J µg/L (P-07) to 480 µg/L (MW-6) for the monitor wells and 3.1 J µg/L (R-5) to 400 µg/L (R-1) for the recovery wells. 1,1,1-TCA concentrations exceeded the residential groundwater screening level of 200 µg/L in 2 monitoring wells and 1 recovery well.

1,1,1-TCA was detected in 3 of the 29 monitor wells and 4 of the 10 recovery wells during the 2006 Annual Monitoring Event. The detected concentrations of 1,1,1-TCA ranged from 5.7 µg/L (TW-3) to 230 µg/L (MW-6) for the monitor wells and 0.2 J µg/L (R-10) to 100 µg/L (R-1) for the recovery wells. 1,1,1-TCA concentrations exceeded the residential groundwater screening level of 200 µg/L in 1 monitoring well (MW-6), while none of the recovery wells exceeded this value.

1,1-DCA

1,1-DCA was detected in 18 monitor wells and 4 recovery wells during the 2005 Annual Monitoring Event. Detected concentrations ranged from 0.37 J µg/L (MW-17) to 270 µg/L (MW-06) for the monitor wells and 1.5 J µg/L (R-2) to 82 µg/L (R-1) for the recovery wells. None of the groundwater samples obtained from the monitor wells and the recovery wells contained 1,1-DCA concentrations that exceeded the 1,1-DCA residential groundwater screening level of 340 µg/L.

1,1-DCA was detected in 13 of the 29 monitor wells and 10 of the 10 recovery wells during the 2006 Annual Monitoring Event. Detected concentrations ranged from 0.5 µg/L (PMW-6) to

98 μg/L (MW-06) for the monitor wells and 1.5 μg/L (R-7) to 250 μg/L (R-11) for the recovery wells. None of the groundwater samples obtained from the monitor wells and the recovery wells contained 1,1-DCA concentrations that exceeded the 1,1-DCA residential groundwater screening level of 340 μg/L.

1,1-DCE

1,1-DCE was detected in groundwater samples obtained from 12 monitor wells and 3 recovery wells during the 2005 Annual Monitoring Event. Detected 1,1-DCE concentrations ranged from 0.52 J μg/L (P-07) to 830 μg/L (MW-6) for the monitor wells and 0.46 J μg/L (R-4) to 350 μg/L (R-1) for the recovery wells. Groundwater samples obtained from 5 of the monitor wells and 2 of the recovery wells contained 1,1-DCE concentrations that exceeded the 1,1-DCE residential groundwater screening level of 7 μg/L.

1,1-DCE was detected in groundwater samples obtained from 12 of the 29 monitor wells and 10 of the 10 recovery wells during the 2006 Annual Monitoring Event. Detected 1,1-DCE concentrations ranged from 0.2 J μg/L (PMW-3 and PMW-6) to 220 μg/L (MW-6) for the monitor wells and 0.2 J μg/L (R-2 and R-3) to 52 μg/L (R-1) for the recovery wells. Groundwater samples obtained from 2 of the monitor wells and 2 of the recovery wells contained 1,1-DCE concentrations that exceeded the 1,1-DCE residential groundwater screening level of 7 μg/L.

1,2-DCA

1,2-DCA was detected in groundwater samples obtained from 7 monitor wells and 1 recovery well during the 2005 Annual Monitoring Event. Detected 1,2-DCA concentrations ranged from 0.52 JH μg/L (MW-04) to 8.6 J μg/L (TW-4) for the monitor wells, and the detected 1,2-DCA concentration was 0.77 J μg/L (R-5) for the recovery well. The detected 1,2-DCA concentration in the recovery well was below the 1,2-DCA residential groundwater screening level; however, 2 monitor wells (TW-1 and TW-4) exceeded the 1,2-DCA residential groundwater screening level of 5 μg/L.

1,2-DCA was detected in groundwater samples obtained from 11 of the 29 monitor wells and 6 of the 10 recovery wells during the 2006 Annual Monitoring Event. Detected 1,2-DCA concentrations ranged from 0.1 J μg/L (P-01) to 11 J μg/L (TW-1) for the monitor wells, and from 0.1 J μg/L (R-6) to 4.3 μg/L (R-11) for the recovery wells. The detected 1,2-DCA concentrations in the recovery wells were below the 1,2-DCA residential groundwater screening level of 5 μg/L; however, 1 monitor well (TW-1) exceeded the 1,2-DCA residential groundwater screening level.

CA

CA was detected in groundwater samples obtained from 6 monitor wells and was not detected in any recovery wells during the 2005 Annual Monitoring Event. Detected CA concentrations ranged from 0.89 J μg/L (MW-20) to 190 μg/L (TW-1) for the monitor wells. The detected CA concentrations in 2 of the monitor wells (TW-1 and TW-4) exceeded the CA residential groundwater screening level of 48 μg/L.

CA was detected in groundwater samples obtained from 3 of the 29 monitor wells and 2 of the 10 recovery wells during the 2006 Annual Monitoring Event. Detected CA concentrations ranged from 0.5 J μg/L (MW-20) to 110 μg/L (TW-1) for the monitor wells and were reported as 4.5 μg/L and 0.2 J μg/L for recovery wells R-3 and R-4, respectively. The detected CA concentration in 1 of the monitor wells (TW-1) exceeded the CA residential groundwater screening level of 48 μg/L, while the detected CA concentrations in the recovery wells did not exceed the screening level.

MIBK

MIBK was detected in groundwater samples obtained from 2 monitor wells and 1 recovery well during the 2005 Annual Monitoring Event. Detected MIBK concentrations ranged from 0.22 J μg/L (P-06) to 0.72 μg/L (TW-4) for the monitor wells, and the detected MIBK concentration was 9.9 J μg/L (R-1) for the recovery well. The detected MIBK concentrations in both the monitor wells and the recovery well did not exceed the MIBK residential groundwater screening level of 70 μg/L.

MIBK was detected in groundwater samples obtained from 1 of the 29 monitor wells and none of the 10 recovery wells during the 2006 Annual Monitoring Event. The detected MIBK concentration was 18 J μg/L at MW-6. This detected MIBK concentration did not exceed the MIBK residential groundwater screening level of 70 μg/L.

4.5.2 Petroleum Hydrocarbons

The petroleum hydrocarbons include 1,2,4-TMB, 1,3,5-TMB, isopropylbenzene, BTEX, and naphthalene, which are components of fuels and refined petroleum products. Figures 4-8 and 4-11 show the distributions of the analytes in the petroleum hydrocarbons group that exceed the residential groundwater screening levels for the 2005 and 2006 annual groundwater monitoring events, respectively. Generalized petroleum hydrocarbon exceedance zone maps for 2005 and 2006, Figures 4-22 and 4-23, are presented in Section 4.7.

1,2,4-TMB

1,2,4-TMB was detected in groundwater samples obtained from 11 monitor wells and 1 recovery well during the 2005 Annual Monitoring Event. Detected 1,2,4-TMB concentrations ranged from 0.2 J µg/L (P-07) to 770 µg/L (TW-1 and TW-4) for the monitor wells, and the detected 1,2,4-TMB concentration was 19 J µg/L (R-1) for the recovery well. The detected 1,2,4-TMB concentrations in 6 monitor wells and the recovery well exceeded the 1,2,4-TMB residential groundwater screening level of 5 µg/L.

1,2,4-TMB was detected in groundwater samples obtained from 4 of the 29 monitor wells and none of the 10 recovery wells during the 2006 Annual Monitoring Event. Detected 1,2,4-TMB concentrations ranged from 12 µg/L (MW-5) to 670 µg/L (TW-1) for the monitor wells. The detected 1,2,4-TMB concentrations in all 4 monitor wells exceeded the 1,2,4-TMB residential groundwater screening level of 5 µg/L.

1,3,5-TMB

1,3,5-TMB was detected in groundwater samples obtained from 7 monitor wells and 1 recovery well during the 2005 Annual Monitoring Event. Detected 1,3,5-TMB concentrations ranged from 0.21 J µg/L (MW-02) to 210 µg/L (TW-1) for the monitor wells, and the detected 1,3,5-TMB concentration was 3.3 J µg/L (R-1) for the recovery well. The detected 1,3,5-TMB concentrations in 3 monitor wells exceeded the 1,3,5-TMB residential groundwater screening level of 5 µg/L, but the detected concentration in the recovery well did not exceed that level.

1,3,5-TMB was detected in groundwater samples obtained from 4 of the 29 monitor wells and none of the 10 recovery wells during the 2006 Annual Monitoring Event. Detected 1,3,5-TMB concentrations ranged from 2.3 J µg/L (MW-5) to 170 µg/L (TW-1) for the monitor wells. The detected 1,3,5-TMB concentrations in 2 monitor wells exceeded the 1,3,5-TMB residential groundwater screening level of 5 µg/L. Both of these wells (MW-6 and TW-1) had exceedances for this analyte in 2005.

Isopropylbenzene

Isopropylbenzene was detected in groundwater samples obtained from 9 monitor wells and 2 recovery wells during the 2005 Annual Monitoring Event. Detected isopropylbenzene concentrations ranged from 0.42 J µg/L (P-07) to 65 µg/L (TW-4) for the monitor wells and 0.19 J µg/L (R-4) to 2.4 µg/L (R-1) for the recovery wells. None of the groundwater samples obtained from the monitor wells and the recovery wells contained isopropylbenzene

concentrations that exceeded the isopropylbenzene residential groundwater screening level of 224 µg/L.

Isopropylbenzene was detected in groundwater samples obtained from 5 of the 29 monitor wells and 2 of the 10 recovery wells during the 2006 Annual Monitoring Event. Detected isopropylbenzene concentrations ranged from 3.3 J µg/L (MW-5) to 46 µg/L (MW-6) for the monitor wells, and were reported as 0.6 µg/L (R-4) to 0.1 J µg/L (R-11) for the recovery wells. None of the groundwater samples obtained from the monitor wells and the recovery wells contained isopropylbenzene concentrations that exceeded the isopropylbenzene residential groundwater screening level of 224 µg/L.

BTEX

BTEX constituents were detected in groundwater samples obtained from 17 monitor wells and 2 recovery wells during the 2005 Annual Monitoring Event. Benzene concentrations detected in MW-06, TW-1, and TW-4 exceeded the benzene residential groundwater screening level of 5 µg/L. The exceedance results range from 47 J to 140 JL µg/L with the highest concentration reported in Coleman property well TW-1. Ethylbenzene concentrations detected in MW-06 and TW-1 exceed the ethylbenzene residential groundwater screening level of 700 µg/L. Groundwater samples collected from MW-6 on the Site reported an ethylbenzene concentration of 6,500 µg/L and TW-1 on the Coleman property reported the ethylbenzene concentration of 2,700 µg/L. Detected concentrations of toluene and xylenes (o, m&p, and total) did not exceed their respective residential groundwater screening levels.

BTEX constituents were detected in groundwater samples obtained from 11 of the 29 monitor wells and 4 of the 10 recovery wells during the 2006 Annual Monitoring Event. Benzene concentrations detected in monitor wells MW-5, MW-6, and TW-1 and recovery wells R-1 and R-3 exceeded the benzene residential groundwater screening level of 5 µg/L, while ethylbenzene concentrations detected in MW-6 and TW-1 exceed the ethylbenzene residential groundwater screening level of 700 µg/L. Toluene and total xylenes concentrations detected in MW-6 exceeded their respective residential groundwater screening levels of 1,000 µg/L and 10,000 µg/L, respectively.

Naphthalene

Naphthalene was detected in 16 of the 39 monitor wells and 5 of the 6 recovery wells during the 2005 Annual Monitoring Event. Detected naphthalene concentrations ranged from 0.35 JB µg/L (MW-17) to 770 µg/L (MW-06) for the monitor wells and 0.35 JB µg/L (R-2 and R-7) to 28 µg/L

(R-1). Groundwater samples obtained from 6 of the monitor wells and 1 of the recovery wells contained naphthalene concentrations that exceeded the naphthalene residential groundwater screening level of 3 µg/L.

Naphthalene was detected in groundwater samples in 4 of the 29 monitor wells and none of the 10 recovery wells during the 2006 Annual Monitoring Event. Detected naphthalene concentrations ranged from 2.6 J µg/L (MW-5) to 910 µg/L (TW-1) for the monitor wells. Groundwater samples obtained from 3 of the monitor wells (MW-6, MW-14, and TW-1) contained naphthalene concentrations that exceeded the naphthalene residential groundwater screening level of 3 µg/L. These wells also had exceedances of naphthalene during the 2005 sampling event.

4.5.3 Results Summary

The analytes that most consistently and significantly exceeded their respective residential groundwater criteria throughout the groundwater monitoring network are PCE, TCE, *cis*-1,2-DCE, and vinyl chloride. These analytes exceeded the residential groundwater criteria in over 20% of the groundwater samples collected during the 2005 sampling event. Groundwater isoconcentration maps for PCE, TCE, *cis*-1,2-DCE, and vinyl chloride were generated for the 2005 and 2006 sampling events and are presented in Section 4.7. Additionally, the extent of petroleum hydrocarbon contamination is presented as generalized petroleum hydrocarbon exceedance zone maps for 2005 and 2006, Figures 4-22 and 4-23, in Section 4.7.

4.6 Extent of Soil Contamination

Several potential primary unsaturated soil source areas have been removed through excavation. Additionally, saturated soil contamination was removed (to 20 ft bgs) at the Gate Excavation Area. Figures 4-2 through 4-4 show the results exceeding KDHE residential soil screening values by depth of strata; these few remaining exceedances are not of sufficient quantity and/or concentration to be considered residual sources in the unsaturated zone. Since the excavations were terminated at the saturated zone, however, submerged sources of contamination may persist as free phase droplets dispersed within and sorbed to the aquifer matrix. The potential for this occurrence is discussed further in Section 5.0.

4.7 Horizontal Extent of Groundwater Contamination

Historical groundwater data indicates migration of certain COPCs down-gradient of the Site. Isoconcentration maps for the primary VOCs (PCE, TCE, *cis*-1,2-DCE, and vinyl chloride) for 2005 and 2006 are presented in Figures 4-12 through 4-19. The plates contained in Appendix D show the PCE, TCE, *cis*-1,2-DCE, and vinyl chloride plumelets along with the analytical results from historic direct-push technology (DPT) results (Phase III delineation), the 2006 annual event,

and the recent delineation sampling. Additionally, exceedance maps for the chlorinated ethanes for 2005 and 2006 are presented in Figures 4-20 and 4-21. Petroleum exceedance maps for 2005 and 2006 were generated to depict the general area of petroleum hydrocarbon and solvent contamination, and are presented in Figures 4-22 and 4-23.

Overall, groundwater contamination appears to have migrated laterally within the groundwater system in a south-southwesterly direction, as demonstrated by the contaminant plumelets. The distribution of the potential primary source areas and the varying nature of potential releases resulted in the distribution of contaminants that are present today. The current extent of groundwater contamination is also a result of the production and subsequent migration of the various degradation products, as well as the interactive nature of chlorinated solvent and petroleum hydrocarbons degradation. The fate and transport of the groundwater plumelets are discussed further in Section 5.0.

4.8 Vertical Extent of Groundwater Contamination

Vertical delineation at the Site was evaluated by examining the concentrations of COCs at various depths. The site lithology is comprised of a layer of silty clay with varying sand on top of a layer of weathered shale. As the depth increases, the shale varies from deeply weathered to moderately weathered to unweathered shale. The top of the unweathered shale is considered the confining layer for the COCs.

Sample collection for vertical delineation was primarily conducted during the Phase III field effort in November and December of 1997. During that effort, groundwater samples were collected at varying intervals from fourteen DPT locations (DP-01, DP-02, DP-05, DP-06, DP-07, DP-08, DP-09, DP-10, DP-15, DP-18, DP-21, DP-25, DP-29, and DP-31). The analytical results of these samples were reported in the Phase III Technical Memorandum (HLA, April 1998b).

Additionally, groundwater samples were collected from location DP-62 in September 1999 at two different intervals (11 to 13 ft bgs and 14 to 16 ft bgs). The analytical results of these samples were reported in the Enhanced Bioremediation Pilot Test Results (Harding, May 2001a).

Two pairs of monitoring wells are located on the Site: USD-MW-14/16 and MW-1S/1D. The 2005 groundwater sampling event was the most recent event during which samples were collected from both USD-MW-14 and USD-MW-16; the 2006 groundwater monitoring event was the most recent event during which samples were collected from MW-1S and MW-1D. The analytical results for these wells were presented in their respective annual groundwater monitoring reports.

During the latest field efforts in July 2007 and October 2007, vertical profile sampling was performed at four different locations to complete the vertical delineation at the Site. In July 2007, two groundwater grab samples were collected next to P-05 at depth intervals of 22 to 26 ft bgs and 28 to 31 ft bgs. This information was coupled with the P-05 results obtained from the 2007 Groundwater Annual Monitoring Event (depth interval of 5 to 15 ft bgs) to determine a profile at P-05. In October 2007, groundwater samples were collected at multiple depths for GP-16 and GP-27. Additionally, a groundwater sample was collected at GP-12a at a depth interval of 30 to 35 ft bgs. This information was coupled with the GP-12 results obtained from July 2007 (depth interval of 12 to 22 ft bgs) to determine the profile at that location.

The results of the vertical delineation are presented in Figures 4-24 and 4-25. From the results presented in these figures, the following conclusions were drawn:

- Most contamination (both chlorinated ethenes and petroleum hydrocarbons) was observed in the groundwater bearing unit in the alluvium.
- Chlorinated ethenes were also identified in the weathered shale layer, decreasing in concentration with depth. For example, higher concentrations of COCs were observed in the deepest DP-06 sample (25.5 - 28.5 ft bgs), which is the top of the weathered shale layer, while much lower concentrations of COCs were observed in the deepest DP-09 sample (39 - 42 ft bgs), which is the bottom of the weathered shale layer. This decrease in concentration may be due to decreasing fractures in the less weathered shale. As the size and the number of fractures decrease, the capillary pressure of the water in the unweathered shale overcomes the downward force of the contaminant migration, confining the COCs to the weathered shale layer and above.
- Petroleum hydrocarbons were only detected in the weathered shale layer in the DP-15 sample (17 - 26 ft bgs). In the DP-05 sample, concentrations increased with depth, but did not reach the weathered shale. The increased hydrocarbon concentrations in the 24.5 - 25.75 ft sample for DP-05 correlated with similar increasing concentrations for chlorinated ethenes.
- In cases where the groundwater sample was collected from very deep within the Weatherford shale layer (e.g., USD-MW-16 and MW-17), the results have shown non-detect values for both the chlorinated ethenes and petroleum hydrocarbons. Based on these results, the unweathered shale layer is considered the confining layer for all of the COCs.

Table 4-1. Former ASTs Capacities and Contents at the Former Unocal Chemical Distribution Facility

Tank	Size (gallons)	Contents	Tank Status
AST 1	15,000	Toluene	Removed
AST 2	15,000	Methyl Ethyl Ketone	Removed prior to 2003
AST 3	15,000	140 Solvent	Removed prior to 2003
AST 4	12,000	Regular Mineral Spirits	Removed prior to 2003
AST 5	12,000	Super High Flash Naphtha	Removed prior to 2003
AST 6	12,000	Methanol	Removed prior to 2003
AST 7	12,000	Regular Mineral Spirits	Removed prior to 2003
AST 8	12,000	Special Naptholite	Removed prior to 2003
AST 9	25,000	Xylene	Removed prior to 2003
AST 10	8,300	Acetone	Removed prior to 2003
AST 11	6,200	Lactol Spirits	Removed prior to 2003
AST 12	6,200	Lactol Spirits	Removed prior to 2003
AST 13	6,200	1,1,1-Trichloroethane	Removed prior to 2003
AST 14	5,400	1,1,1-Trichloroethane	Removed prior to 2003
AST 15	5,800	Odorless Insecticide Base	Removed prior to 2003
AST 16	5,800	Isopropyl Alcohol 99%	Removed prior to 2003
AST 17	5,800	Napthol Spirits	Removed between 9/89 and 10/91
AST 18	5,800	Methyl Isobutyl Ketone	Removed between 9/89 and 10/91
AST 19	5,800	Isopropanol	Removed between 9/89 and 10/91
AST 20	5,800	Methanol	Removed between 9/89 and 10/91
AST 21	6,500	Perchlorethylene	Removed prior to 2003
AST 22	6,500	Solvent PM	Removed prior to 2003
AST 23	6,500	PM Acetate	Removed prior to 2003
AST 24	6,500	HAD-E	Removed prior to 2003
AST 25	6,500	n-Butanol	Removed between 8/88 and 9/89
AST 26	6,500	PM Acetate	Removed between 8/88 and 9/89
AST 27	6,500	Solvent PM	Removed between 8/88 and 9/89
AST 28	6,500	Trich III	Removed between 8/88 and 9/89
AST 29	6,500	Solvent G	Removed between 8/88 and 9/89

AST - Aboveground storage tank.

Table 4-2. KDHE Tier 2 Risk-Based Residential Screening Values for Soil to Groundwater

Analyte	KDHE Screening Value[1]
Methods 5030/5035/8021B/8021M	
1,1,1-Trichloroethane	5.5
1,1,2-Trichloroethane	0.07
1,1-Dichloroethane	3.7
1,1-Dichloroethene	0.12
1,2,4-Trimethylbenzene	0.78
1,2-Dichloroethane	0.04
1,3,5-Trimethylbenzene	0.77
2-Butanone (MEK)	3.6
4-Methyl-2-pentanone (MIBK)	0.41
Benzene	0.08
Carbon tetrachloride	0.20
Chlorobenzene	4.8
Chloroethane (Ethyl chloride)	0.457
Ethylbenzene	55
Isopropylbenzene (Cumene)	37.7
Methylene chloride (Dichloromethane)	0.03
Naphthalene	1.05
Styrene	16
Tetrachloroethene	0.18
Toluene	40
Trichloroethene	0.2
Vinyl chloride (Chloroethene)	0.02
Xylenes (total)	700 S
cis-1,2-Dichloroethene	11.9
m&p-Xylene	700 S
n-Butylbenzene	11.9
o-Xylene	700 S
trans-1,2-Dichloroethene	1.5
Methods 8240/8260/8260B	
1,1,1-Trichloroethane	5.5
1,1,2-Trichloroethane	0.07
1,1-Dichloroethane	3.7
1,1-Dichloroethene	0.12
1,2,4-Trimethylbenzene	0.78
1,2-Dichlorobenzene	77
1,2-Dichloroethane	0.04
1,2-Dichloroethene	0.8

All units are presented in mg/kg.
[1] Tier 2 Residential RSK Levels for Soil to Groundwater Pathway (KDHE, June 2007).
S - Soil saturation.

Table 4-2. KDHE Tier 2 Risk-Based Residential Screening Values for Soil to Groundwater (Continued)

Analyte	KDHE Screening Value[1]
Methods 8240/8260/8260B (Continued)	
1,3,5-Trimethylbenzene	0.77
2-Butanone (MEK)	3.6
2-Chlorotoluene (o-Chlorotoluene)	4.36
4-Isopropyltoluene (Cymene)	--
4-Methyl-2-pentanone (MIBK)	0.41
Acetone (2-Propanone)	1.1
Benzene	0.08
Carbon disulfide	0.14
Carbon tetrachloride	0.20
Chlorobenzene	4.8
Chloroethane (Ethyl chloride)	0.457
Chloroform	0.96
Ethylbenzene	55
Isopropylbenzene (Cumene)	37.7
Methylcyclohexane	163
Methylene chloride (Dichloromethane)	0.03
Naphthalene	1.05
Styrene	16
Tetrachloroethene	0.18
Toluene	40
Tribromomethane (Bromoform)	1.72
Trichloroethene	0.2
Trichlorofluoromethane	15.9
Vinyl acetate	0.78
Vinyl chloride (Chloroethene)	0.02
Xylenes (total)	700 S
cis-1,2-Dichloroethene	0.8
m&p-Xylene	700 S
n-Butylbenzene	11.9
n-Propylbenzene	11.3
o-Xylene	700 S
trans-1,2-Dichloroethene	1.5

All units are presented in mg/kg.
[1] Tier 2 Residential RSK Levels for Soil to Groundwater Pathway (KDHE, June 2007).
S - Soil saturation.

Table 4-3. KDHE Residential Screening Values for Groundwater

Analyte	Residential KDHE Screening Value[1]
1,1,1-Trichloroethane	200
1,1,2-Trichloroethane	5
1,1-Dichloroethane	340
1,1-Dichloroethene	7
1,2,4-Trimethylbenzene	5
1,2-Dichlorobenzene	600
1,2-Dichloroethane	5
1,3,5-Trimethylbenzene	5
2-Butanone (MEK)	820
4-Methyl-2-pentanone (MIBK)	70
Acetone (2-Propanone)	260
Benzene	5
Carbon disulfide	9
Carbon tetrachloride	5
Chlorobenzene	100
Chloroethane (Ethyl chloride)	48
Chloroform	80
Ethylbenzene	700
Isopropylbenzene (Cumene)	224
Methyl tert-butyl ether (MTBE)	20
Methylene chloride (Dichloromethane)	5
Naphthalene	3
Styrene	100
Tetrachloroethene	5
Toluene	1000
Tribromomethane (Bromoform)	80
Trichloroethene	5
Trichlorofluoromethane	767
Vinyl acetate	149
Vinyl chloride (Chloroethene)	2
Xylenes (total)	10000
cis-1,2-Dichloroethene	70
m&p-Xylene	10000
n-Butylbenzene	21
o-Xylene	10000
trans-1,2-Dichloroethene	100

All units are presented in µg/L.
[1] Tier 2 residential RSK levels for the Groundwater Pathway (KDHE, June 2007).

Table 4-4. Concentrations of Detected Chemicals in Shallow Soil Samples

	Well ID No.	DP-041	DP-046	DP-053	DP-075	DP-076	DP-077	DP-078	DP-079
		shallow	shallow	shallow	shallow	shallow	shallow	shallow	shallow
Analyte	KDHE Screening Value[1,2]	3.5-4 ft	3-3.5 ft	3-3.5 ft	3-4 ft	3-3.5 ft	3-3.5 ft	2.5-3 ft	3-3.5 ft
Methods 5030/5035/8021B/8021M									
1,1-Dichloroethane	3.7	ND (0.002)	ND (0.003)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.003)	ND (0.002)
1,1-Dichloroethene	0.12	**0.003**	ND (0.003)	ND (0.002)	ND (0.0025)	**0.009**	ND (0.002)	ND (0.0025)	ND (0.002)
2-Butanone (MEK)	3.6	NA	NA	NA	NA	NA	NA	NA	NA
4-Methyl-2-pentanone (MIBK)	0.41	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	55	ND (0.002)	ND (0.003)	ND (0.002)	0.008	ND (0.002)	ND (0.002)	ND (0.0025)	ND (0.002)
Styrene	16	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	0.18	ND (0.002)	ND (0.003)	**0.067**	ND (0.0025)	ND (0.002)	ND (0.002)	ND (0.0025)	ND (0.002)
Toluene	40	ND (0.002)	ND (0.003)	ND (0.002)	**0.188**	ND (0.002)	ND (0.002)	ND (0.0025)	ND (0.002)
Vinyl chloride (Chloroethene)	0.02	ND (0.002)	**0.011**	ND (0.002)	ND (0.0025)	**0.023**	**0.026**	ND (0.0025)	ND (0.002)
Xylenes (total)	700	ND (0.002)	ND (0.0033)	ND (0.002)	**0.227**	ND (0.002)	ND (0.002)	ND (0.0025)	ND (0.002)
cis-1,2-Dichloroethene	0.8	ND (0.002)	ND (0.003)	ND (0.002)	ND (0.0025)	ND (0.002)	ND (0.002)	ND (0.0025)	ND (0.002)
m&p-Xylene	700 S	ND (0.002)	ND (0.0033)	ND (0.002)	**0.171**	ND (0.002)	ND (0.002)	ND (0.0025)	ND (0.002)
o-Xylene	700 S	ND (0.002)	ND (0.0033)	ND (0.002)	**0.056**	ND (0.002)	ND (0.002)	ND (0.0025)	ND (0.002)
trans-1,2-Dichloroethene	1.5	ND (0.002)	ND (0.003)	ND (0.002)	ND (0.0025)	ND (0.002)	ND (0.002)	**0.003**	ND (0.002)
Methods 8240/8260/8260B									
1,1-Dichloroethane	3.7	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	0.12	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethene	0.8	NA	NA	NA	NA	NA	NA	NA	NA
4-Methyl-2-pentanone (MIBK)	0.41	NA	NA	NA	NA	NA	NA	NA	NA
Acetone (2-Propanone)	1.1	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	0.08	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	0.18	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	0.2	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.8	NA	NA	NA	NA	NA	NA	NA	NA

Bold values were detected.
Shaded values are above the KDHE screening value.
[1] KDHE Tier 2 residential RSK levels for Soil to Groundwater Pathway screening value (KDHE, June 2007).
[2] All units are presented in mg/kg.
NA - Not analyzed.
ND - Non-detect.
S - Soil saturation.

Table 4-4. Concentrations of Detected Chemicals in Shallow Soil Samples (Continued)

	Well ID No.	DP-080	DP-081	DP-082	DP-083	DP-084	DP-085	DP-086	DP-087
		shallow	shallow	shallow	shallow	shallow	shallow	shallow	shallow
Analyte	KDHE Screening Value [1,2]	3-3.5 ft	3-3.5 ft	2-2.5 ft	4-4.5 ft	3-3.5 ft	3-3.5 ft	3-3.5 ft	4-4.5 ft
Methods 5030/5035/8021B/8021M									
1,1-Dichloroethane	3.7	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	**0.019**	**0.02**	**0.003**	ND (0.002)
1,1-Dichloroethene	0.12	ND (0.002)	**0.003**	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	**0.003**	ND (0.002)
2-Butanone (MEK)	3.6	NA	NA	NA	NA	NA	NA	NA	NA
4-Methyl-2-pentanone (MIBK)	0.41	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	55	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)
Styrene	16	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	0.18	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	**0.002**	ND (0.002)	ND (0.002)
Toluene	40	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)
Vinyl chloride (Chloroethene)	0.02	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	**0.007**	**0.03**	**0.007**	ND (0.002)
Xylenes (total)	700	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	**0.00834**	ND (0.002)	ND (0.002)
cis-1,2-Dichloroethene	0.8	ND (0.002)	**0.004**	ND (0.002)	ND (0.002)	**0.012**	**0.005**	**0.005**	ND (0.002)
m&p-Xylene	700 S	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	**0.00834**	ND (0.002)	ND (0.002)
o-Xylene	700 S	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)
trans-1,2-Dichloroethene	1.5	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)
Methods 8240/8260/8260B									
1,1-Dichloroethane	3.7	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	0.12	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethene	0.8	NA	NA	NA	NA	NA	NA	NA	NA
4-Methyl-2-pentanone (MIBK)	0.41	NA	NA	NA	NA	NA	NA	NA	NA
Acetone (2-Propanone)	1.1	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	0.08	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	0.18	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	0.2	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.8	NA	NA	NA	NA	NA	NA	NA	NA

Bold values were detected.
Shaded values are above the KDHE screening value.
[1] KDHE Tier 2 residential RSK levels for Soil to Groundwater Pathway screening value (KDHE, June 2007).
[2] All units are presented in mg/kg.
NA - Not analyzed.
ND - Non-detect.
S - Soil saturation.

Table 4-4. Concentrations of Detected Chemicals in Shallow Soil Samples (Continued)

	Well ID No.	DP-088	DP-097	DP-099	DP-100	DP-128	DP-140A	DP-156	DP157
		shallow	shallow	shallow	shallow	shallow	shallow	shallow	shallow
Analyte	KDHE Screening Value[1,2]	3-3.5 ft	3-3.5 ft	3-3.5 ft	3-3.5 ft	3-4 ft	3 ft	4 ft	4 ft
Methods 5030/5035/8021B/8021M									
1,1-Dichloroethane	3.7	**0.026**	ND (0.001)	ND (0.001)	ND (0.001)	NA	NA	NA	NA
1,1-Dichloroethene	0.12	**0.003**	ND (0.001)	ND (0.001)	ND (0.001)	NA	NA	NA	NA
2-Butanone (MEK)	3.6	NA	ND (0.001)	ND (0.001)	**0.017**	NA	NA	NA	NA
4-Methyl-2-pentanone (MIBK)	0.41	NA	ND (0.001)	ND (0.001)	**0.004**	NA	NA	NA	NA
Ethylbenzene	55	ND (0.002)	ND (0.001)	ND (0.001)	**0.004**	NA	NA	NA	NA
Styrene	16	NA	ND (0.001)	ND (0.001)	**0.002**	NA	NA	NA	NA
Tetrachloroethene	0.18	ND (0.002)	ND (0.001)	ND (0.001)	ND (0.001)	NA	NA	NA	NA
Toluene	40	ND (0.002)	ND (0.001)	ND (0.001)	ND (0.001)	NA	NA	NA	NA
Vinyl chloride (Chloroethene)	0.02	ND (0.002)	ND (0.001)	ND (0.001)	ND (0.001)	NA	NA	NA	NA
Xylenes (total)	700	ND (0.002)	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.8	**0.031**	ND (0.001)	ND (0.001)	ND (0.001)	NA	NA	NA	NA
m&p-Xylene	700 S	ND (0.002)	NA	NA	NA	NA	NA	NA	NA
o-Xylene	700 S	ND (0.002)	NA	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	1.5	ND (0.002)	ND (0.001)	ND (0.001)	ND (0.001)	NA	NA	NA	NA
Methods 8240/8260/8260B									
1,1-Dichloroethane	3.7	NA	NA	NA	NA	ND (0.005)	**0.008**	ND (0.005)	ND (0.005)
1,1-Dichloroethene	0.12	NA	NA	NA	NA	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
1,2-Dichloroethene	0.8	NA	NA	NA	NA	ND (0.005)	**0.007**	ND (0.005)	ND (0.005)
4-Methyl-2-pentanone (MIBK)	0.41	NA	NA	NA	NA	ND (0.01)	ND (0.01)	ND (0.010)	ND (0.010)
Acetone (2-Propanone)	1.1	NA	NA	NA	NA	ND (0.1)	ND (0.1)	ND (0.100)	ND (0.100)
Benzene	0.08	NA	NA	NA	NA	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Tetrachloroethene	0.18	NA	NA	NA	NA	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Trichloroethene	0.2	NA	NA	NA	NA	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
cis-1,2-Dichloroethene	0.8	NA	NA	NA	NA	ND (0.005)	**0.007**	ND (0.005)	ND (0.005)

Bold values were detected.
Shaded values are above the KDHE screening value.
[1] KDHE Tier 2 residential RSK levels for Soil to Groundwater Pathway screening value (KDHE, June 2007).
[2] All units are presented in mg/kg.
NA - Not analyzed.
ND - Non-detect.
S - Soil saturation.

Table 4-4. Concentrations of Detected Chemicals in Shallow Soil Samples (Continued)

	Well ID No.	DP-158	DP-159	DP-160	DP-161	DP-162	DP-163	DP-164	DP-165
		shallow	shallow	shallow	shallow	shallow	shallow	shallow	shallow
Analyte	KDHE Screening Value[1,2]	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft
Methods 5030/5035/8021B/8021M									
1,1-Dichloroethane	3.7	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	0.12	NA	NA	NA	NA	NA	NA	NA	NA
2-Butanone (MEK)	3.6	NA	NA	NA	NA	NA	NA	NA	NA
4-Methyl-2-pentanone (MIBK)	0.41	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	55	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	16	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	0.18	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	40	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl chloride (Chloroethene)	0.02	NA	NA	NA	NA	NA	NA	NA	NA
Xylenes (total)	700	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.8	NA	NA	NA	NA	NA	NA	NA	NA
m&p-Xylene	700 S	NA	NA	NA	NA	NA	NA	NA	NA
o-Xylene	700 S	NA	NA	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	1.5	NA	NA	NA	NA	NA	NA	NA	NA
Methods 8240/8260/8260B									
1,1-Dichloroethane	3.7	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
1,1-Dichloroethene	0.12	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
1,2-Dichloroethene	0.8	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	**0.028**	ND (0.005)	ND (0.005)	ND (0.005)
4-Methyl-2-pentanone (MIBK)	0.41	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)
Acetone (2-Propanone)	1.1	ND (0.100)	ND (0.100)	ND (0.100)	ND (0.100)	ND (0.100)	ND (0.100)	ND (0.100)	ND (0.100)
Benzene	0.08	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Tetrachloroethene	0.18	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Trichloroethene	0.2	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
cis-1,2-Dichloroethene	0.8	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	**0.028**	ND (0.005)	ND (0.005)	ND (0.005)

Bold values were detected.
Shaded values are above the KDHE screening value.
[1] KDHE Tier 2 residential RSK levels for Soil to Groundwater Pathway screening value (KDHE, June 2007).
[2] All units are presented in mg/kg.
NA - Not analyzed.
ND - Non-detect.
S - Soil saturation.

Table 4-4. Concentrations of Detected Chemicals in Shallow Soil Samples (Continued)

	Well ID No.	DP-166	DP-167	DP-168	DP-169	MW-06	MW-11
		shallow	shallow	shallow	shallow	shallow	shallow
Analyte	KDHE Screening Value[1,2]	4 ft	4 ft	4 ft	4 ft	3-5 ft	3-5 ft
Methods 5030/5035/8021B/8021M							
1,1-Dichloroethane	3.7	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	0.12	NA	NA	NA	NA	NA	NA
2-Butanone (MEK)	3.6	NA	NA	NA	NA	NA	NA
4-Methyl-2-pentanone (MIBK)	0.41	NA	NA	NA	NA	NA	NA
Ethylbenzene	55	NA	NA	NA	NA	NA	NA
Styrene	16	NA	NA	NA	NA	NA	NA
Tetrachloroethene	0.18	NA	NA	NA	NA	NA	NA
Toluene	40	NA	NA	NA	NA	NA	NA
Vinyl chloride (Chloroethene)	0.02	NA	NA	NA	NA	NA	NA
Xylenes (total)	700	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.8	NA	NA	NA	NA	NA	NA
m&p-Xylene	700 S	NA	NA	NA	NA	NA	NA
o-Xylene	700 S	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	1.5	NA	NA	NA	NA	NA	NA
Methods 8240/8260/8260B							
1,1-Dichloroethane	3.7	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.625)	ND (0.005)
1,1-Dichloroethene	0.12	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.625)	ND (0.005)
1,2-Dichloroethene	0.8	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.625)	ND (0.005)
4-Methyl-2-pentanone (MIBK)	0.41	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (1.25)	ND (0.01)
Acetone (2-Propanone)	1.1	ND (0.100)	ND (0.100)	ND (0.100)	ND (0.100)	**1.5**	**0.067**
Benzene	0.08	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.625)	ND (0.005)
Tetrachloroethene	0.18	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.625)	ND (0.005)
Trichloroethene	0.2	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.625)	ND (0.005)
cis-1,2-Dichloroethene	0.8	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	NA	NA

Bold values were detected.
Shaded values are above the KDHE screening value.
[1] KDHE Tier 2 residential RSK levels for Soil to Groundwater Pathway screening value (KDHE, June 2007).
[2] All units are presented in mg/kg.
NA - Not analyzed.
ND - Non-detect.
S - Soil saturation.

Table 4-5. Concentrations of Detected Chemicals in Deep Soil Samples

	Well ID No.	DP-042	DP-044	DP-049	DP-050	DP-051	DP-052	DP-061	DP-061
		deep	deep	deep	deep	deep	deep	deep	deep
Analyte	KDHE Screening Value[1,2]	5-5.5 ft	5-5.5 ft	5-5.5 ft	5-5.5 ft	5-5.5 ft	5-5.5 ft	5-5.5 ft	9-9.5 ft
Methods 5030/5035/8021B/8021M									
1,1-Dichloroethene	0.12	**0.003**	ND (0.002)	ND (0.004)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	**0.005**
1,2,4-Trimethylbenzene	0.78	NA	NA	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	0.77	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	0.08	ND (0.002)	ND (0.002)	ND (0.004)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)
Chlorobenzene	4.8	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	55	ND (0.002)	ND (0.002)	ND (0.004)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)
Isopropylbenzene (Cumene)	37.7	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	1.05	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	0.18	**0.017**	**0.014**	**0.111**	**0.056**	**0.243**	**0.07**	**0.066**	**0.094**
Toluene	40	ND (0.002)	ND (0.002)	ND (0.004)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)
Trichloroethene	0.2	ND (0.002)	ND (0.002)	ND (0.004)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)
Vinyl chloride (Chloroethene)	0.02	ND (0.002)	ND (0.002)	ND (0.004)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)
Xylenes (total)	700 S	ND (0.002)	ND (0.002)	ND (0.004)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)
cis-1,2-Dichloroethene	0.8	ND (0.002)	ND (0.002)	ND (0.004)	ND (0.002)	**0.004**	ND (0.002)	ND (0.002)	**0.003**
m&p-Xylene	700 S	ND (0.002)	ND (0.002)	ND (0.004)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)
n-Butylbenzene	11.9	NA	NA	NA	NA	NA	NA	NA	NA
o-Xylene	700 S	ND (0.002)	ND (0.002)	ND (0.004)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)
Methods 8240/8260/8260B									
1,1-Dichloroethane	3.7	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethene	0.8	NA	NA	NA	NA	NA	NA	NA	NA
2-Butanone (MEK)	3.6	NA	NA	NA	NA	NA	NA	NA	NA
Acetone (2-Propanone)	1.1	NA	NA	NA	NA	NA	NA	NA	NA
Methylene chloride (Dichloromethane)	0.03	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	0.18	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	40	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.8	NA	NA	NA	NA	NA	NA	NA	NA

Bold values were detected.
Shaded values are above the KDHE screening value.
[1] KDHE Tier 2 residential RSK levels for Soil to Groundwater Pathway screening value (KDHE, June 2007).
[2] All units are presented in mg/kg.
NA - Not analyzed.
ND - Non-detect.
S - Soil saturation.

Table 4-5. Concentrations of Detected Chemicals in Deep Soil Samples (Continued)

Analyte	Well ID No. / KDHE Screening Value[1,2]	DP-062 deep 5-5.5 ft	DP-062 deep 9-9.5 ft	DP-066 deep 5-5.5 ft	DP-066 deep 9-9.5 ft	DP-067 deep 5-5.5 ft	DP-067 deep 9-9.5 ft	DP-070 deep 5-5.5 ft	DP-070 deep 9-9.5 ft
Methods 5030/5035/8021B/8021M									
1,1-Dichloroethene	0.12	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.007)	ND (0.01)
1,2,4-Trimethylbenzene	0.78	NA	NA	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	0.77	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	0.08	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.007)	ND (0.01)
Chlorobenzene	4.8	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	55	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.007)	ND (0.01)
Isopropylbenzene (Cumene)	37.7	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	1.05	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	0.18	**0.014**	**0.252**	**0.045**	**0.103**	**0.139**	**1.08**	**0.535**	**0.44**
Toluene	40	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.007)	ND (0.01)
Trichloroethene	0.2	ND (0.002)	**0.008**	ND (0.002)	ND (0.002)	ND (0.002)	**0.037**	ND (0.007)	ND (0.01)
Vinyl chloride (Chloroethene)	0.02	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.007)	ND (0.01)
Xylenes (total)	700 S	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.0066)	ND (0.01)
cis-1,2-Dichloroethene	0.8	ND (0.002)	**0.005**	ND (0.002)	ND (0.002)	ND (0.002)	**0.028**	ND (0.007)	**0.018**
m&p-Xylene	700 S	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.0066)	ND (0.01)
n-Butylbenzene	11.9	NA	NA	NA	NA	NA	NA	NA	NA
o-Xylene	700 S	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.0066)	ND (0.01)
Methods 8240/8260/8260B									
1,1-Dichloroethane	3.7	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethene	0.8	NA	NA	NA	NA	NA	NA	NA	NA
2-Butanone (MEK)	3.6	NA	NA	NA	NA	NA	NA	NA	NA
Acetone (2-Propanone)	1.1	NA	NA	NA	NA	NA	NA	NA	NA
Methylene chloride (Dichloromethane)	0.03	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	0.18	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	40	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.8	NA	NA	NA	NA	NA	NA	NA	NA

Bold values were detected.
Shaded values are above the KDHE screening value.
[1] KDHE Tier 2 residential RSK levels for Soil to Groundwater Pathway screening value (KDHE, June 2007).
[2] All units are presented in mg/kg.
NA - Not analyzed.
ND - Non-detect.
S - Soil saturation.

Table 4-5. Concentrations of Detected Chemicals in Deep Soil Samples (Continued)

	Well ID No.	DP-096	DP-125	DP-140A	DP-140A	DP-156	DP-157	DP-158	DP-159
		deep	deep	deep	deep	deep	deep	deep	deep
Analyte	KDHE Screening Value[1,2]	5-6 ft	6-6.5 ft	6 ft	9 ft	7 ft	7 ft	7 ft	7 ft
Methods 5030/5035/8021B/8021M									
1,1-Dichloroethene	0.12	ND (0.003)	**0.002**	NA	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	0.78	NA	**0.001 J**	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	0.77	NA	**0.001 J**	NA	NA	NA	NA	NA	NA
Benzene	0.08	ND (0.003)	**0.001 J**	NA	NA	NA	NA	NA	NA
Chlorobenzene	4.8	NA	**0.001 J**	NA	NA	NA	NA	NA	NA
Ethylbenzene	55	ND (0.003)	**0.0014**	NA	NA	NA	NA	NA	NA
Isopropylbenzene (Cumene)	37.7	NA	**0.001 J**	NA	NA	NA	NA	NA	NA
Naphthalene	1.05	NA	**0.001 J**	NA	NA	NA	NA	NA	NA
Tetrachloroethene	0.18	ND (0.003)	**0.001 J**	NA	NA	NA	NA	NA	NA
Toluene	40	ND (0.003)	**0.0026**	NA	NA	NA	NA	NA	NA
Trichloroethene	0.2	ND (0.003)	**0.001 J**	NA	NA	NA	NA	NA	NA
Vinyl chloride (Chloroethene)	0.02	**0.008**	**0.0038**	NA	NA	NA	NA	NA	NA
Xylenes (total)	700 S	ND (0.0025)	**0.012**	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.8	ND (0.003)	**0.001 J**	NA	NA	NA	NA	NA	NA
m&p-Xylene	700 S	ND (0.0025)	**0.0086**	NA	NA	NA	NA	NA	NA
n-Butylbenzene	11.9	NA	**0.0013**	NA	NA	NA	NA	NA	NA
o-Xylene	700 S	ND (0.0025)	**0.0033**	NA	NA	NA	NA	NA	NA
Methods 8240/8260/8260B									
1,1-Dichloroethane	3.7	NA	NA	**0.007**	**0.007**	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
1,2-Dichloroethene	0.8	NA	NA	**0.014**	**0.006**	ND (0.005)	ND (0.005)	**0.021**	ND (0.020)
2-Butanone (MEK)	3.6	NA	NA	NA	NA	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.100)
Acetone (2-Propanone)	1.1	NA	NA	ND (0.1)	ND (0.1)	ND (0.100)	ND (0.100)	ND (0.100)	ND (0.005)
Methylene chloride (Dichloromethane)	0.03	NA	NA	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Tetrachloroethene	0.18	NA	NA	NA	NA	ND (0.005)	ND (0.005)	**0.014**	ND (0.005)
Toluene	40	NA	NA	NA	NA	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
cis-1,2-Dichloroethene	0.8	NA	NA	**0.014**	**0.006**	ND (0.005)	ND (0.005)	**0.021**	ND (0.005)

Bold values were detected.
Shaded values are above the KDHE screening value.
[1] KDHE Tier 2 residential RSK levels for Soil to Groundwater Pathway screening value (KDHE, June 2007).
[2] All units are presented in mg/kg.
NA - Not analyzed.
ND - Non-detect.
S - Soil saturation.

Table 4-5. Concentrations of Detected Chemicals in Deep Soil Samples (Continued)

	Well ID No.	DP-160	DP-162	DP-163	DP-164	DP-165	DP-166	DP-167	DP-168
		deep	deep	deep	deep	deep	deep	deep	deep
Analyte	KDHE Screening Value[1,2]	7 ft	7 ft	7 ft	7 ft	7 ft	7 ft	7 ft	7 ft
Methods 5030/5035/8021B/8021M									
1,1-Dichloroethene	0.12	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	0.78	NA	NA	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	0.77	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	0.08	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzene	4.8	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	55	NA	NA	NA	NA	NA	NA	NA	NA
Isopropylbenzene (Cumene)	37.7	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	1.05	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	0.18	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	40	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	0.2	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl chloride (Chloroethene)	0.02	NA	NA	NA	NA	NA	NA	NA	NA
Xylenes (total)	700 S	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.8	NA	NA	NA	NA	NA	NA	NA	NA
m&p-Xylene	700 S	NA	NA	NA	NA	NA	NA	NA	NA
n-Butylbenzene	11.9	NA	NA	NA	NA	NA	NA	NA	NA
o-Xylene	700 S	NA	NA	NA	NA	NA	NA	NA	NA
Methods 8240/8260/8260B									
1,1-Dichloroethane	3.7	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
1,2-Dichloroethene	0.8	ND (0.005)	**0.130**	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
2-Butanone (MEK)	3.6	ND (0.020)	**0.020**	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)
Acetone (2-Propanone)	1.1	ND (0.100)	**0.250**	ND (0.100)	ND (0.100)	ND (0.100)	ND (0.100)	ND (0.100)	ND (0.100)
Methylene chloride (Dichloromethane)	0.03	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Tetrachloroethane	0.18	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Toluene	40	ND (0.005)	**0.008**	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
cis-1,2-Dichloroethene	0.8	ND (0.005)	**0.130**	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)

Bold values were detected.
Shaded values are above the KDHE screening value.
[1] KDHE Tier 2 residential RSK levels for Soil to Groundwater Pathway screening value (KDHE, June 2007).
[2] All units are presented in mg/kg.
NA - Not analyzed.
ND - Non-detect.
S - Soil saturation.

Table 4-5. Concentrations of Detected Chemicals in Deep Soil Samples (Continued)

	Well ID No.	DP-169	SB-12
		deep	deep
Analyte	KDHE Screening Value[1,2]	7 ft	6-6.5 ft
Methods 5030/5035/8021B/8021M			
1,1-Dichloroethene	0.12	NA	NA
1,2,4-Trimethylbenzene	0.85	NA	NA
1,3,5-Trimethylbenzene	0.77	NA	NA
Benzene	0.08	NA	NA
Chlorobenzene	4.8	NA	NA
Ethylbenzene	55	NA	NA
Isopropylbenzene (Cumene)	37.7	NA	NA
Naphthalene	1.05	NA	NA
Tetrachloroethene	0.18	NA	NA
Toluene	40	NA	NA
Trichloroethene	0.2	NA	NA
Vinyl chloride (Chloroethene)	0.02	NA	NA
Xylenes (total)	700 S	NA	NA
cis-1,2-Dichloroethene	0.8	NA	NA
m&p-Xylene	700 S	NA	NA
n-Butylbenzene	11.9	NA	NA
o-Xylene	700 S	NA	NA
Methods 8240/8260/8260B			
1,1-Dichloroethane	3.7	ND (0.005)	ND (0.005)
1,2-Dichloroethene	0.8	ND (0.005)	NA
2-Butanone (MEK)	3.6	ND (0.020)	NA
Acetone (2-Propanone)	1.1	ND (0.100)	**0.0083 JB**
Methylene chloride (Dichloromethane)	0.03	ND (0.005)	**0.017**
Tetrachloroethane	0.18	ND (0.005)	NA
Toluene	40	ND (0.005)	NA
cis-1,2-Dichloroethene	0.8	ND (0.005)	ND (0.005)

Bold values were detected.
Shaded values are above the KDHE screening value.
[1] KDHE Tier 2 residential RSK levels for Soil to Groundwater Pathway screening value (KDHE, June 2007).
[2] All units are presented in mg/kg.
NA - Not analyzed.
ND - Non-detect.
SB - Soil boring.
S - Soil saturation.

Table 4-6. Concentrations of Detected Chemicals in Very Deep Soil Samples

	Well ID No.	DP-061	DP-062	DP-066	DP-067	DP-070	DP-082	DP-088	DP-140A
		very deep	very deep	very deep	very deep	very deep	very deep	very deep	very deep
Analyte	KDHE Screening Value[1,2]	13-13.5 ft	14.5-15 ft	14.5-15 ft	14.5-15 ft	14.5-15 ft	11-11.5 ft	11-12 ft	12 ft
Methods 5030/5035/8021B/8021M									
1,1,1-Trichloroethane	5.5	ND (0.002)	ND (0.002)	**0.006**	ND (0.01)	ND (0.01)	ND (0.002)	ND (0.002)	NA
1,1-Dichloroethane	3.7	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.01)	ND (0.01)	**0.01**	**0.009**	NA
1,1-Dichloroethene	0.12	ND (0.002)	ND (0.002)	**0.004**	ND (0.01)	ND (0.01)	ND (0.002)	**0.002**	NA
1,2-Dichloroethane	0.04	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.01)	ND (0.01)	**0.0256**	ND (0.002)	NA
Benzene	0.08	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.01)	ND (0.01)	**0.009**	ND (0.002)	NA
Ethylbenzene	55	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.01)	ND (0.01)	**0.045**	ND (0.002)	NA
Tetrachloroethene	0.18	**1.027**	**1.131**	**2.086**	**1.05**	**6.309**	ND (0.002)	ND (0.002)	NA
Toluene	40	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.01)	ND (0.01)	**0.882**	ND (0.002)	NA
Trichloroethene	0.2	**0.08**	**0.116**	**0.45**	**0.016**	**0.51**	ND (0.002)	ND (0.002)	NA
Vinyl chloride (Chloroethene)	0.02	**0.014**	**0.025**	**0.028**	**0.032**	**0.053**	**0.567**	**0.02**	NA
Xylenes (total)	700 S	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.01)	ND (0.01)	**0.197**	ND (0.002)	NA
cis-1,2-Dichloroethene	0.8	**0.056**	**0.082**	**0.298**	**0.031**	**0.299**	**0.624**	**0.317**	NA
m&p-Xylene	700 S	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.01)	ND (0.01)	**0.14**	ND (0.002)	NA
o-Xylene	700 S	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.01)	ND (0.01)	**0.0574**	ND (0.002)	NA
trans-1,2-Dichloroethene	1.5	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.01)	ND (0.01)	ND (0.002)	ND (0.002)	NA
No detected values with Methods 8240/8260/8260B for DP-140A. NA for all other samples.									

Bold values were detected.
Shaded values are above the KDHE screening value.
[1] KDHE Tier 2 residential RSK levels for Soil to Groundwater Pathway screening value (KDHE, June 2007).
[2] All units are presented in mg/kg.
NA - Not analyzed.
ND - Non-detect.
S - Soil saturation.

Table 4-7. COPC Concentrations in Shallow Soil Samples

	Well ID No.	DP-041	DP-046	DP-053	DP-075	DP-076	DP-077	DP-078	DP-079
		shallow	shallow	shallow	shallow	shallow	shallow	shallow	shallow
Analyte	KDHE Screening Value[1,2]	3.5-4 ft	3-3.5 ft	3-3.5 ft	3-4 ft	3-3.5 ft	3-3.5 ft	2.5-3 ft	3-3.5 ft
Methods 5030/5035/8021B/8021M									
Tetrachloroethene	0.18	ND (0.002)	ND (0.003)	**0.067**	ND (0.0025)	ND (0.002)	ND (0.002)	ND (0.0025)	ND (0.002)
Vinyl chloride (Chloroethene)	0.02	ND (0.002)	**0.011**	ND (0.002)	ND (0.0025)	**0.023**	**0.026**	ND (0.0025)	ND (0.002)
Methods 8240/8260/8260B									
Acetone (2-Propanone)	1.1	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	0.18	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.8	NA	NA	NA	NA	NA	NA	NA	NA

Bold values were detected.
Shaded values are above the KDHE screening value.
[1] KDHE Tier 2 residential RSK levels for Soil to Groundwater Pathway screening value (KDHE, June 2007).
[2] All units are presented in mg/kg.
NA - Not analyzed.
ND - Non-detect.

Table 4-7. COPC Concentrations in Shallow Soil Samples (Continued)

	Well ID No.	DP-080	DP-081	DP-082	DP-083	DP-084	DP-085	DP-086	DP-087
		shallow	shallow	shallow	shallow	shallow	shallow	shallow	shallow
Analyte	KDHE Screening Value[1,2]	3-3.5 ft	3-3.5 ft	2-2.5 ft	4-4.5 ft	3-3.5 ft	3-3.5 ft	3-3.5 ft	4-4.5 ft
Methods 5030/5035/8021B/8021M									
Tetrachloroethene	0.18	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	**0.002**	ND (0.002)	ND (0.002)
Vinyl chloride (Chloroethene)	0.02	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	**0.007**	**0.03**	**0.007**	ND (0.002)
Methods 8240/8260/8260B									
Acetone (2-Propanone)	1.1	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	0.18	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.8	NA	NA	NA	NA	NA	NA	NA	NA

Bold values were detected.
Shaded values are above the KDHE screening value.
[1] KDHE Tier 2 residential RSK levels for Soil to Groundwater Pathway screening value (KDHE, June 2007).
[2] All units are presented in mg/kg.
NA - Not analyzed.
ND - Non-detect.

Table 4-7. COPC Concentrations in Shallow Soil Samples (Continued)

	Well ID No.	DP-088	DP-097	DP-099	DP-100	DP-128	DP-140A	DP-156	DP-157
		shallow	shallow	shallow	shallow	shallow	shallow	shallow	shallow
Analyte	KDHE Screening Value[1,2]	3-3.5 ft	3-3.5 ft	3-3.5 ft	3-3.5 ft	3-4 ft	3 ft	4 ft	4 ft
Methods 5030/5035/8021B/8021M									
Tetrachloroethene	0.18	ND (0.002)	ND (0.001)	ND (0.001)	ND (0.001)	NA	NA	NA	NA
Vinyl chloride (Chloroethene)	0.02	ND (0.002)	ND (0.001)	ND (0.001)	ND (0.001)	NA	NA	NA	NA
Methods 8240/8260/8260B									
Acetone (2-Propanone)	1.1	NA	NA	NA	NA	ND (0.1)	ND (0.1)	ND (0.100)	ND (0.100)
Tetrachloroethene	0.18	NA	NA	NA	NA	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
cis-1,2-Dichloroethene	0.8	NA	NA	NA	NA	ND (0.005)	0.007	ND (0.005)	ND (0.005)

Bold values were detected.
Shaded values are above the KDHE screening value.
[1] KDHE Tier 2 residential RSK levels for Soil to Groundwater Pathway screening value (KDHE, June 2007).
[2] All units are presented in mg/kg.
NA - Not analyzed.
ND - Non-detect.

Table 4-7. COPC Concentrations in Shallow Soil Samples (Continued)

	Well ID No.	DP-158	DP-159	DP-160	DP-161	DP-162	DP-163	DP-164	DP-165
		shallow	shallow	shallow	shallow	shallow	shallow	shallow	shallow
Analyte	KDHE Screening Value[1,2]	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft	4 ft
Methods 5030/5035/8021B/8021M									
Tetrachloroethene	0.18	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl chloride (Chloroethene)	0.02	NA	NA	NA	NA	NA	NA	NA	NA
Methods 8240/8260/8260B									
Acetone (2-Propanone)	1.1	ND (0.100)	ND (0.100)	ND (0.100)	ND (0.100)	ND (0.100)	ND (0.100)	ND (0.100)	ND (0.100)
Tetrachloroethene	0.18	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
cis-1,2-Dichloroethene	0.8	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	**0.028**	ND (0.005)	ND (0.005)	ND (0.005)

Bold values were detected.
Shaded values are above the KDHE screening value.
[1] KDHE Tier 2 residential RSK levels for Soil to Groundwater Pathway screening value (KDHE, June 2007).
[2] All units are presented in mg/kg.
NA - Not analyzed.
ND - Non-detect.

Table 4-7. COPC Concentrations in Shallow Soil Samples (Continued)

	Well ID No.	DP-166	DP-167	DP-168	DP-169	MW-06	MW-11
		shallow	shallow	shallow	shallow	shallow	shallow
Analyte	KDHE Screening Value[1,2]	4 ft	4 ft	4 ft	4 ft	3-5 ft	3-5 ft
Methods 5030/5035/8021B/8021M							
Tetrachloroethene	0.18	NA	NA	NA	NA	NA	NA
Vinyl chloride (Chloroethene)	0.02	NA	NA	NA	NA	NA	NA
Methods 8240/8260/8260B							
Acetone (2-Propanone)	1.1	ND (0.100)	ND (0.100)	ND (0.100)	ND (0.100)	**1.5**	**0.067**
Tetrachloroethene	0.18	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.625)	ND (0.005)
cis-1,2-Dichloroethene	0.8	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	NA	NA

Bold values were detected.
Shaded values are above the KDHE screening value.
[1] KDHE Tier 2 residential RSK levels for Soil to Groundwater Pathway screening value (KDHE, June 2007).
[2] All units are presented in mg/kg.
NA - Not analyzed.
ND - Non-detect.

Table 4-8. COPC Concentrations in Deep Soil Samples

	Well ID No.	DP-042	DP-044	DP-049	DP-050	DP-051	DP-052	DP-061	DP-061
		deep	deep	deep	deep	deep	deep	deep	deep
Analyte	KDHE Screening Value[1,2]	5-5.5 ft	5-5.5 ft	5-5.5 ft	5-5.5 ft	5-5.5 ft	5-5.5 ft	5-5.5 ft	9-9.5 ft
Methods 5030/5035/8021B/8021M									
Tetrachloroethene	0.18	**0.017**	**0.014**	**0.111**	**0.056**	**0.243**	**0.07**	**0.066**	**0.094**
Vinyl chloride (Chloroethene)	0.02	ND (0.002)	ND (0.002)	ND (0.004)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)
Methods 8240/8260/8260B									
Acetone (2-Propanone)	1.1	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	0.18	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl chloride (Chloroethene)	0.02	NA	NA	NA	NA	NA	NA	NA	NA

Bold values were detected.
Shaded values are above the KDHE screening value.
[1] KDHE Tier 2 residential RSK levels for Soil to Groundwater Pathway screening value (KDHE, June 2007).
[2] All units are presented in mg/kg.
[3] Saturated soil was encountered at this depth for the sample. Therefore, the sample was not included in determining the COPCs for the vadose zone.
NA - Not analyzed.
ND - Non-detect.

Table 4-8. COPC Concentrations in Deep Soil Samples (Continued)

	Well ID No.	DP-062	DP-062	DP-066	DP-066	DP-067	DP-067	DP-070	DP-070
		deep	deep	deep	deep	deep	deep	deep	deep
Analyte	KDHE Screening Value[1,2]	5-5.5 ft	9-9.5 ft[3]	5-5.5 ft	9-9.5 ft	5-5.5 ft	9-9.5 ft[3]	5-5.5 ft	9-9.5 ft[3]
Methods 5030/5035/8021B/8021M									
Tetrachloroethene	0.18	**0.014**	**0.252**	**0.045**	**0.103**	**0.139**	**1.08**	**0.535**	**0.44**
Vinyl chloride (Chloroethene)	0.02	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.007)	ND (0.01)
Methods 8240/8260/8260B									
Acetone (2-Propanone)	1.1	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	0.18	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl chloride (Chloroethene)	0.02	NA	NA	NA	NA	NA	NA	NA	NA

Bold values were detected.
Shaded values are above the KDHE screening value.
[1] KDHE Tier 2 residential RSK levels for Soil to Groundwater Pathway screening value (KDHE, June 2007).
[2] All units are presented in mg/kg.
[3] Saturated soil was encountered at this depth for the sample. Therefore, the sample was not included in determining the COPCs for the vadose zone.
NA - Not analyzed.
ND - Non-detect.

Table 4-8. COPC Concentrations in Deep Soil Samples (Continued)

	Well ID No.	DP-096	DP-125	DP-140A	DP-140A	DP-156	DP-157	DP-158	DP-159
		deep	deep	deep	deep	deep	deep	deep	deep
Analyte	KDHE Screening Value[1,2]	5-6 ft	5-5.5 ft	6 ft	9 ft	7 ft	7 ft	7 ft	7 ft
Methods 5030/5035/8021B/8021M									
Tetrachloroethene	0.18	ND (0.003)	**0.001 J**	NA	NA	NA	NA	NA	NA
Vinyl chloride (Chloroethene)	0.02	**0.008**	**0.0038**	NA	NA	NA	NA	NA	NA
Methods 8240/8260/8260B									
Acetone (2-Propanone)	1.1	NA	NA	ND (0.1)	ND (0.1)	ND (0.100)	ND (0.100)	ND (0.100)	ND (0.100)
Tetrachloroethene	0.18	NA	NA	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	**0.014**	ND (0.005)
Vinyl chloride (Chloroethene)	0.02	NA	NA	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)

Bold values were detected.
Shaded values are above the KDHE screening value.
[1] KDHE Tier 2 residential RSK levels for Soil to Groundwater Pathway screening value (KDHE, June 2007).
[2] All units are presented in mg/kg.
[3] Saturated soil was encountered at this depth for the sample. Therefore, the sample was not included in determining the COPCs for the vadose zone.
NA - Not analyzed.
ND - Non-detect.

Table 4-8. COPC Concentrations in Deep Soil Samples

	Well ID No.	DP-160	DP-162	DP-163	DP-164	DP=165	DP-166	DP-167	DP-169
		deep	deep	deep	deep	deep	deep	deep	deep
Analyte	KDHE Screening Value[1,2]	7 ft	7 ft	7 ft	7 ft	7 ft	7 ft	7 ft	7 ft
Methods 5030/5035/8021B/8021M									
Tetrachloroethene	0.18	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl chloride (Chloroethene)	0.02	NA	NA	NA	NA	NA	NA	NA	NA
Methods 8240/8260/8260B									
Acetone (2-Propanone)	1.1	ND (0.100)	**0.250**	ND (0.100)	ND (0.100)	ND (0.100)	ND (0.100)	ND (0.100)	ND (0.100)
Tetrachloroethene	0.18	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Vinyl chloride (Chloroethene)	0.02	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)

Bold values were detected.
Shaded values are above the KDHE screening value.
[1] KDHE Tier 2 residential RSK levels for Soil to Groundwater Pathway screening value (KDHE, June 2007).
[2] All units are presented in mg/kg.
[3] Saturated soil was encountered at this depth for the sample. Therefore, the sample was not included in determining the COPCs for the vadose zone.
NA - Not analyzed.
ND - Non-detect.

Table 4-8. COPC Concentrations in Deep Soil Samples (Continued)

	Well ID No.	SB-12
		deep
Analyte	KDHE Screening Value[1,2]	6-6.5 ft
Methods 5030/5035/8021B/8021M		
Tetrachloroethene	0.18	NA
Vinyl chloride (Chloroethene)	0.02	NA
Methods 8240/8260/8260B		
Acetone (2-Propanone)	1.1	0.0083 JB
Tetrachloroethene	0.18	ND (0.005)
Vinyl chloride (Chloroethene)	0.02	ND (0.01)

Bold values were detected.
Shaded values are above the KDHE screening value.
[1] KDHE Tier 2 residential RSK levels for Soil to Groundwater Pathway screening value (KDHE, June 2007).
[2] All units are presented in mg/kg.
[3] Saturated soil was encountered at this depth for the sample. Therefore, the sample was not included in determining the COPCs for the vadose zone.
NA - Not analyzed.
ND - Non-detect.
SB - Soil boring.

Table 4-9. Well Construction Data, Former Unocal Chemical Distribution Facility Wichita, Kansas

Monitoring Well Number	Owner	Installation Date	Well Diameter (inches)	Northing	Easting	Surface Elevation (ft AMSL)	Top of Casing Elevation (ft AMSL)	Total Depth (ft BGS)	Screen Length (ft)	Top of Screen (ft BGS)	Bottom of Screen (ft BGS)
MW-1D	Unocal	08/05/91	2	1710017.087	1656677.466	1348.66	1348.37	30.1	4.6	24.5	29.1
MW-1S	Unocal	08/05/91	2	1710022.442	1656667.220	1348.65	1348.25	20.8	4.6	15.0	19.6
MW-2	Unocal	08/05/91	2	1709848.240	1656519.213	1349.20	1348.86	24.3	4.6	18.0	22.6
MW-4	Unocal	08/05/91	2	1709848.751	1656358.378	1348.74	1350.38	20.2	4.7	14.5	19.2
MW-5	USD	10/30/92	4	1710112.681	1656457.426	1348.86	1348.72	27.4	20.0	4.8	24.8
MW-6	Unocal	10/30/92	4	1709966.352	1656482.093	1349.90	1349.58	34.7	20.0	6.0	26.0
MW-7	Coleman	10/28/92	2	1709701.259	1655760.399	1340.67	1339.92	29.0	20.0	6.9	26.9
MW-8	Coleman	10/28/92	2	1709295.091	1655885.179	1328.07	1327.91	19.6	10.0	7.6	17.6
MW-9	Coleman	10/28/92	2	1708792.462	1655895.548	1331.42	1331.36	35.5	20.0	12.9	32.9
MW-10	Coleman	10/31/92	2	1708920.954	1656249.074	1338.66	1338.43	40.0	20.0	14.6	34.6
MW-11	Coleman	10/29/92	2	1708538.662	1655957.461	NA	NA	28.0	20.0	5.8	25.8
MW-12D	Coleman	11/01/92	2	1709165.489	1656589.397	1345.96	1348.32	45.0	10.0	33.0	43.0
MW-12S	Coleman	11/03/92	2	1709181.852	1656597.368	1346.04	1348.46	22.0	10.0	9.0	19.0
MW-13	Coleman	11/03/92	2	1709493.012	1656771.402	1346.08	1347.77	29.5	20.0	8.0	28.0
MW-17	Unocal	08/26/94	2	1709889.980	1656439.696	1348.85	1349.18	62.5	9.6	50.1	59.7
MW-18	Coleman	08/24/94	2	1709057.888	1655892.521	1331.55	1331.10	21.4	14.6	4.1	18.6
MW-19	Coleman	06/29/95	2	1708919.953	1655770.932	1332.21	1331.85	35.0	25.0	6.3	31.3
MW-20	Coleman	06/30/95	2	1709035.537	1655804.904	1332.24	1331.89	24.5	15.0	6.7	21.7
MW-21	Coleman	06/29/95	2	1709113.556	1655864.018	1332.23	1332.01	22.1	10.0	10.3	20.3
MW-22	Coleman	06/28/95	2	1708858.863	1655570.074	1328.14	1327.78	25.0	15.0	8.7	23.7
MW-23	Coleman	06/28/95	2	1708690.059	1655654.459	1327.79	1327.38	25.0	15.0	7.4	22.4
P-1	Unocal	10/30/92	2	1709878.849	1656543.735	1348.58	1348.19	23.2	15.0	8.0	23.0
P-2	Unocal	10/30/92	2	1709869.571	1656597.403	1348.65	1348.18	23.2	15.0	8.0	23.0
P-3	Coleman	11/04/92	2	1708527.600	1655987.209	1327.53	1327.28	26.0	20.0	6.0	26.0
P-4	Coleman	11/04/92	2	1708460.994	1655937.734	1326.45	1326.13	26.3	20.0	6.0	26.0
P-5	Unocal	NA	NA	1709895.465	1656595.560	1348.73	1349.69	15.5	10	5	15
P-6	Unocal	NA	NA	1709878.660	1656596.041	1348.72	1349.47	15.5	10	5	15
P-7	Unocal	NA	NA	1709871.977	1656591.961	1348.59	1349.44	15.5	10	5	15

A* - Drawdown tube.
AMSL - Above mean sea level.
BGS - Below ground surface.
NA - Not available.
USD - Unified School District.

Table 4-9. Well Construction Data, Former Unocal Chemical Distribution Facility Wichita, Kansas (Continued)

Monitoring Well Number	Owner	Installation Date	Well Diameter (inches)	Northing	Easting	Surface Elevation (ft AMSL)	Top of Casing Elevation (ft AMSL)	Total Depth (ft BGS)	Screen Length (ft)	Top of Screen (ft BGS)	Bottom of Screen (ft BGS)
P-8	Unocal	NA	NA	1709866.424	1656591.415	1348.38	1349.42	15.5	10	5	15
P-9	Unocal	NA	NA	1709859.691	1656594.708	1348.68	1349.60	15.5	10	5	15
P-10	Unocal	NA	NA	1709874.343	1656568.520	1348.69	1349.62	15.5	10	5	15
PMW-2	Hillman	11/13/00	2	1710377.788	1655767.382	1344.04	1343.63	23.0	10.0	13.0	23.0
PMW-3	Hillman	11/14/00	2	1710088.355	1655770.932	1345.12	NA	24.0	10.0	14.0	24.0
PMW-4	Hillman	11/12/00	2	1710145.289	1656168.344	1344.93	1344.47	23.0	10.0	13.0	23.0
PMW-5	Hillman	11/10/00	2	1709908.287	1656185.298	1345.06	1344.46	23.0	10.0	13.0	23.0
PMW-6	Hillman	11/13/00	2	1709835.070	1655775.008	1341.44	1341.20	19.5	10.0	9.5	19.5
PMW-17	Hillman	11/14/00	2	1709905.819	1655534.205	1341.59	1341.25	23.0	10.0	13.0	23.0
PMW-20	Hillman	11/14/00	2	1710339.433	1655531.409	1342.75	1342.31	23.0	10.0	13.0	23.0
PZ-1	Coleman	09/23/94	2	1709397.242	1656184.315	1334.25	1333.78	19.4	14.7	4.0	18.7
PZ-2	Coleman	09/23/94	2	1708887.017	1655951.232	1329.14	1328.59	24.9	19.8	4.6	24.4
R-1	Unocal	09/20/94	5	1709968.263	1656490.532	1349.51	1350.78	24.7	14.6	8.0	22.6
R-1A*	Unocal	09/20/94	1	1709968.263	1656490.532	1349.51	1350.78	22.5	15.0	7.5	22.5
R-2	Coleman	09/27/94	5	1709478.685	1656139.470	1335.58	1336.42	24.7	14.6	8.0	22.6
R-2A*	Coleman	09/27/94	1	1709478.685	1656139.470	1335.58	1336.42	22.7	15.0	7.7	22.7
R-3	Coleman	09/22/94	5	1709424.233	1656196.807	1335.05	1336.12	20.6	9.6	8.9	18.5
R-3A*	Coleman	09/22/94	1	1709424.233	1656196.807	1335.05	1336.12	18.6	10.0	8.6	18.6
R-10	Coleman	09/12/94	5	1709039.360	1655892.808	1331.67	1331.83	21.5	14.6	4.9	19.5
R-10A*	Coleman	09/12/94	1	1709039.360	1655892.808	1331.67	1331.83	21.5	15.0	6.5	21.5
R-11	Coleman	09/14/94	5	1709130.820	1655891.703	1331.71	1331.72	20.7	9.6	9.1	18.7
R-11A*	Coleman	09/14/94	1	1709130.820	1655891.703	1331.71	1331.72	19.1	10.0	9.1	19.1
R-12	Coleman	09/13/94	5	1709221.721	1655888.676	1330.29	1330.85	18.5	9.6	6.9	16.5
R-12A*	Coleman	09/13/94	1	1709221.721	1655888.676	1330.29	1330.85	16.9	10.0	6.9	16.9
R-4	Coleman	09/21/94	5	1709369.816	1656255.388	1337.31	1336.18	25.2	15.5	7.6	23.1
R-4A*	Coleman	09/21/94	1	1709369.816	1656255.388	1337.31	1336.18	23.3	15.0	8.3	23.3
R-5	Coleman	09/15/94	5	1709315.217	1656314.012	1338.44	1338.90	25.2	14.6	8.5	23.1
R-5A*	Coleman	09/15/94	1	1709315.217	1656314.012	1338.44	1338.90	23.5	15.0	8.5	23.5

A* - Drawdown tube.
AMSL - Above mean sea level.
BGS - Below ground surface.
NA - Not available.
USD - Unified School District.

Table 4-9. Well Construction Data, Former Unocal Chemical Distribution Facility Wichita, Kansas (Continued)

Monitoring Well Number	Owner	Installation Date	Well Diameter (inches)	Northing	Easting	Surface Elevation (ft AMSL)	Top of Casing Elevation (ft AMSL)	Total Depth (ft BGS)	Screen Length (ft)	Top of Screen (ft BGS)	Bottom of Screen (ft BGS)
R-6	Coleman	09/14/94	5	1709259.223	1656370.848	1345.95	1345.36	30.9	19.6	9.3	28.9
R-6A*	Coleman	09/14/94	1	1709259.223	1656370.848	1345.95	1345.36	29.0	20.0	9.0	29.0
R-7	Coleman	09/11/94	5	1708958.403	1655903.321	1331.45	1331.24	25.0	14.6	8.2	22.8
R-7A*	Coleman	09/11/94	1	1708958.403	1655903.321	1331.45	1331.24	25.0	15.0	10.0	25.0
R-8	Coleman	09/11/94	5	1708912.572	1655965.238	1327.86	1327.45	25.5	14.6	8.8	23.4
R-8A*	Coleman	09/11/94	1	1708912.572	1655965.238	1327.86	1327.45	25.5	15.0	10.5	25.5
R-9	Coleman	09/10/94	5	1708855.344	1656019.245	1328.90	1328.07	30.5	19.6	8.9	28.5
R-9A*	Coleman	09/10/94	1	1708855.344	1656019.245	1328.90	1328.07	30.5	20.0	10.5	30.5
TW-1	Coleman	08/05/91	2	1709718.115	1656392.332	1347.86	1347.51	27.4	4.3	21.9	26.2
TW-2A	Coleman	09/30/94	2	1709712.982	1656049.514	1345.12	1344.41	24.2	9.6	10.3	19.9
TW-3	Coleman	08/05/91	2	1709720.392	1656597.802	1348.27	1347.77	21.4	4.2	15.3	19.5
TW-4	Coleman	08/05/91	2	1709465.186	1656195.738	1336.73	1336.52	17.8	4.2	12.3	16.5
USD-1	USD	02/26/02	2	1710079.509	1656254.943	1346.01	1345.65	21.0	15.0	6.0	21.0
USD-2	USD	02/26/02	2	1709944.791	1656269.947	1347.16	1346.60	20.7	15.0	6.0	21.0
USD-3	USD	02/07/02	2	1709885.196	1656268.142	1347.51	1347.06	21.0	15.0	6.0	21.0
USD-13	USD	NA	NA	1710091.434	1655418.588	1331.24	1331.07	NA	NA	NA	NA
USD-MW-3	USD	08/05/91	2	1710163.996	1656299.959	1346.40	1346.07	21.4	4.6	15.0	19.6
USD-MW-14	USD	09/07/94	2	1710169.544	1656685.236	1350.36	1350.02	27.8	13.8	11.3	25.1
USD-MW-15	USD	09/07/94	2	1710529.317	1656322.018	NA	NA	22.8	15.0	5.0	20.0
USD-MW-16	USD	09/08/94	2	1710176.563	1656686.025	1350.35	1350.03	62.7	9.6	50.3	59.8

A* - Drawdown tube.
AMSL - Above mean sea level.
BGS - Below ground surface.
NA - Not available.
USD - Unified School District.

Table 4-10. Concentrations of Detected Chemicals in Groundwater for 2005 Event

	Well ID No.	MW-01D	MW-01S	MW-02	MW-03	MW-04	MW-05	MW-06	MW-07
Analyte	Residential KDHE Screening Value[1]	01/26/2006	01/26/2006	02/08/2006	02/01/2006	02/01/2006	02/09/2006	02/06/2006	02/06/2006
1,1,1-Trichloroethane	200	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.86)	**480**	ND (0.21)
1,1,2-Trichloroethane	5	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.83)	ND (12)	ND (0.23)
1,1-Dichloroethane	340	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	**0.75 J**	**1**	**270**	ND (0.26)
1,1-Dichloroethene	7	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.33)	**3**	**830**	ND (0.33)
1,2,4-Trimethylbenzene	5	ND (0.18)	ND (0.18)	**0.93 J**	ND (0.18)	ND (0.18)	ND (0.39)	**740**	ND (0.18)
1,2-Dichlorobenzene	600	ND (0.24)	**1.2 J**	ND (0.24)	ND (0.24)	ND (0.24)	ND (0.49)	ND (12)	ND (0.24)
1,2-Dichloroethane	5	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	**0.52 JH**	ND (0.43)	ND (13)	ND (0.26)
1,3,5-Trimethylbenzene	5	ND (0.17)	ND (0.17)	**0.21 J**	ND (0.17)	ND (0.17)	ND (0.44)	**170 J**	ND (0.17)
2-Butanone (MEK)	820	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (2.6)	ND (12)	ND (0.25)
4-Methyl-2-pentanone (MIBK)	70	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.44)	ND (9.8)	ND (0.2)
Acetone (2-Propanone)	260	**1.6 JB**	ND (0.73)	ND (0.73)	ND (0.73)	ND (0.73)	ND (8)	ND (36)	ND (0.73)
Benzene	5	ND (0.22)	ND (0.22)	ND (0.22)	ND (0.22)	ND (0.22)	**2**	**47 J**	ND (0.22)
Carbon disulfide	9	ND (0.22)	ND (0.22)	ND (0.22)	ND (0.22)	ND (0.22)	ND (0.62)	ND (11)	ND (0.22)
Carbon tetrachloride	5	ND (0.19)	ND (0.19)	ND (0.19)	**0.64 J**	ND (0.19)	ND (1.1)	ND (9.6)	ND (0.19)
Chlorobenzene	100	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.42)	ND (9.6)	ND (0.19)
Chloroethane (Ethyl chloride)	48	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.96)	ND (10)	ND (0.2)
Chloroform	80	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.74)	ND (13)	ND (0.26)
Ethylbenzene	700	ND (0.17)	ND (0.17)	**2.3 J**	ND (0.17)	ND (0.17)	**3**	**6500**	ND (0.17)
Isopropylbenzene (Cumene)	224	ND (0.19)	**0.9 J**	**5.5**	ND (0.19)	ND (0.19)	ND (0.47)	**63 J**	ND (0.19)
Methyl tert-butyl ether (MTBE)	20	ND (0.23)	ND (0.23)	**1.1 J**	ND (0.23)	ND (0.23)	ND (0.62)	ND (11)	ND (0.23)
Methylene chloride (Dichloromethane)	5	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.58)	ND (25)	ND (0.5)
Naphthalene	3	ND (0.19)	ND (0.19)	**1.0 J**	ND (0.19)	ND (0.19)	ND (0.36)	**770**	ND (0.19)
Styrene	100	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.44)	**13 J**	ND (0.18)
Tetrachloroethene	5	ND (0.28)	**0.37 J**	ND (0.28)	**14**	**3.8 J**	**66**	**340**	ND (0.28)
Toluene	1000	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.53)	**790**	ND (0.23)
Tribromomethane (Bromoform)	80	ND (0.24)	ND (0.24)	ND (0.24)	ND (0.24)	ND (0.24)	ND (0.6)	ND (12)	ND (0.24)
Trichloroethene	5	ND (0.24)	ND (0.24)	**2.0 J**	ND (0.24)	**5.6**	**190**	**27 J**	**0.44 JB**
Trichlorofluoromethane	767	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.9)	ND (8.8)	ND (0.18)
Vinyl chloride (Chloroethene)	2	ND (0.3)	**0.52 J**	**3.4 J**	ND (0.3)	ND (0.3)	**190**	**1200**	ND (0.3)
Xylenes (total)	10000	ND (0.18)	ND (0.18)	**3.76 J**	ND (0.18)	ND (0.18)	**2.0 J**	**10000**	ND (0.18)
cis-1,2-Dichloroethene	70	ND (0.29)	**2.1 J**	**20**	ND (0.29)	**44**	**800**	**31000**	**6.7**
m&p-Xylene	10000	ND (0.38)	ND (0.38)	**3.5 J**	ND (0.38)	ND (0.38)	**2.0 J**	**6900**	ND (0.38)
n-Butylbenzene	21	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.38)	**50 J**	ND (0.2)
o-Xylene	10000	ND (0.18)	ND (0.18)	**0.26 J**	ND (0.18)	ND (0.18)	ND (0.42)	**3100**	ND (0.18)
trans-1,2-Dichloroethene	100	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.15)	**0.36 J**	**3**	**52 J**	ND (0.15)

[1] KDHE Tier 2 RSK residential screening values for groundwater (KDHE, June 2007).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
H - Result may be biased high.
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.
ND - Non-detect.
Bold values were detected.
Shaded values are above the KDHE screening values.
All units are presented in µg/L.

Table 4-10. Concentrations of Detected Chemicals in Groundwater for 2005 Event (Continued)

	Well ID No.	MW-08	MW-09	MW-10	MW-12D	MW-13	MW-13(USD)	MW-14	MW-16
Analyte	Residential KDHE Screening Value[1]	02/03/2006	02/06/2006	01/27/2006	01/27/2006	01/27/2006	02/01/2006	01/31/2006	01/31/2006
1,1,1-Trichloroethane	200	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.86)	ND (0.86)
1,1,2-Trichloroethane	5	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.83)	ND (0.83)
1,1-Dichloroethane	340	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	**0.98 J**	ND (0.34)	ND (0.34)
1,1-Dichloroethene	7	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.95)	ND (0.95)
1,2,4-Trimethylbenzene	5	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	**65**	ND (0.39)
1,2-Dichlorobenzene	600	ND (0.24)	ND (0.24)	ND (0.24)	ND (0.24)	ND (0.24)	ND (0.24)	ND (0.49)	ND (0.49)
1,2-Dichloroethane	5	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.43)	ND (0.43)
1,3,5-Trimethylbenzene	5	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	**3**	ND (0.44)
2-Butanone (MEK)	820	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (2.6)	ND (2.6)
4-Methyl-2-pentanone (MIBK)	7	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.44)	ND (0.44)
Acetone (2-Propanone)	26	ND (0.73)	**1.4 JHB**	ND (0.73)	**0.74 JB**	ND (0.73)	ND (0.73)	ND (8)	ND (8)
Benzene	5	ND (0.22)	ND (0.22)	ND (0.22)	ND (0.22)	ND (0.22)	ND (0.22)	ND (0.44)	ND (0.44)
Carbon disulfide	0.9	ND (0.22)	ND (0.22)	ND (0.22)	ND (0.22)	ND (0.22)	ND (0.22)	ND (0.62)	ND (0.62)
Carbon tetrachloride	5	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (1.1)	ND (1.1)
Chlorobenzene	100	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	**0.31 J**	ND (0.42)	ND (0.42)
Chloroethane (Ethyl chloride)	20	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.96)	ND (0.96)
Chloroform	80	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.74)	ND (0.74)
Ethylbenzene	700	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	**2**	ND (0.31)
Isopropylbenzene (Cumene)	2	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	**10**	ND (0.47)
Methyl tert-butyl ether (MTBE)	20	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.62)	ND (0.62)
Methylene chloride (Dichloromethane)	5	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.58)	ND (0.58)
Naphthalene	10	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	**5**	ND (0.36)
Styrene	100	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.44)	ND (0.44)
Tetrachloroethene	5	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)	ND (0.28)	**1.1 J**	ND (0.67)	ND (0.67)
Toluene	1000	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.53)	ND (0.53)
Tribromomethane (Bromoform)	80	ND (0.24)	ND (0.24)	ND (0.24)	ND (0.24)	ND (0.24)	ND (0.24)	ND (0.6)	ND (0.6)
Trichloroethene	5	ND (0.24)	ND (0.24)	ND (0.24)	ND (0.24)	**1.4 J**	**6.9**	ND (0.98)	ND (0.98)
Trichlorofluoromethane	5	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.9)	ND (0.9)
Vinyl chloride (Chloroethene)	2	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.71)	ND (0.71)
Xylenes (total)	10000	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	**6**	ND (0.42)
cis-1,2-Dichloroethene	70	ND (0.29)	ND (0.29)	ND (0.29)	ND (0.29)	**1.9 J**	**66**	ND (0.8)	ND (0.8)
m&p-Xylene	10000	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	**6**	ND (1.2)
n-Butylbenzene	21	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	**2**	ND (0.38)
o-Xylene	10000	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.42)	ND (0.42)
trans-1,2-Dichloroethene	100	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.15)	ND (0.97)	ND (0.97)

[1] KDHE Tier 2 RSK residential screening values for groundwater (KDHE, June 2007).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
H - Result may be biased high.
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.
ND - Non-detect.
Bold values were detected.
Shaded values are above the KDHE screening values.
All units are presented in µg/L.

Table 4-10. Concentrations of Detected Chemicals in Groundwater for 2005 Event (Continued)

	Well ID No.	MW-17	MW-18	MW-19	MW-20	MW-21	MW-22	MW-23	P-01
Analyte	Residential KDHE Screening Value[1]	02/09/2006	02/03/2006	02/02/2006	02/02/2006	02/03/2006	02/02/2006	02/02/2006	02/08/2006
1,1,1-Trichloroethane	200	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)
1,1,2-Trichloroethane	5	ND (0.23)	**0.39 J**	ND (0.23)	**0.8 J**	**0.27 J**	ND (0.23)	ND (0.23)	ND (0.23)
1,1-Dichloroethane	340	**0.37 J**	**84**	ND (0.26)	**84**	**180**	ND (0.26)	ND (0.26)	ND (0.26)
1,1-Dichloroethene	7	ND (0.33)	**7.4**	ND (0.33)	**8.1**	**3.5 J**	ND (0.33)	ND (0.33)	ND (0.33)
1,2,4-Trimethylbenzene	5	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	**1.5 J**
1,2-Dichlorobenzene	600	ND (0.24)	**0.98 J**	ND (0.24)	ND (0.24)	**1.2 J**	ND (0.24)	ND (0.24)	ND (0.24)
1,2-Dichloroethane	5	ND (0.26)	**1.7 J**	ND (0.26)	**2.1 J**	**2.7 J**	ND (0.26)	ND (0.26)	ND (0.26)
1,3,5-Trimethylbenzene	0.5	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	**0.32 J**
2-Butanone (MEK)	820	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)
4-Methyl-2-pentanone (MIBK)	70	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
Acetone (2-Propanone)	260	ND (0.73)	**1.1 JB**	**1.6 JB**	ND (0.73)	**1.3 JB**	ND (0.73)	ND (0.73)	**1.6 JB**
Benzene	5	ND (0.22)	**0.27 J**	ND (0.22)	ND (0.22)	**0.5 J**	ND (0.22)	ND (0.22)	ND (0.22)
Carbon disulfide	9	ND (0.22)	ND (0.22)	ND (0.22)	ND (0.22)	ND (0.22)	ND (0.22)	ND (0.22)	ND (0.22)
Carbon tetrachloride	5	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)
Chlorobenzene	100	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)
Chloroethane (Ethyl chloride)	48	ND (0.2)	ND (0.2)	ND (0.2)	**0.89 J**	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
Chloroform	80	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)
Ethylbenzene	700	**0.19 J**	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	**2.0 J**
Isopropylbenzene (Cumene)	224	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)
Methyl tert-butyl ether (MTBE)	20	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)
Methylene chloride (Dichloromethane)	5	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
Naphthalene	3	**0.35 JB**	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	**1.3 J**
Styrene	100	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)
Tetrachloroethene	5	ND (0.28)	**200**	**1.3 J**	**310**	**28**	ND (0.28)	ND (0.28)	ND (0.28)
Toluene	1000	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)
Tribromomethane (Bromoform)	80	ND (0.24)	ND (0.24)	ND (0.24)	ND (0.24)	ND (0.24)	ND (0.24)	ND (0.24)	ND (0.24)
Trichloroethene	5	ND (0.24)	**270**	**0.52 J**	**190**	**75**	ND (0.24)	ND (0.24)	ND (0.24)
Trichlorofluoromethane	767	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)
Vinyl chloride (Chloroethene)	2	ND (0.3)	**1.5 J**	ND (0.3)	ND (0.3)	**29 J**	ND (0.3)	ND (0.3)	ND (0.3)
Xylenes (total)	10000	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	**5.71**
cis-1,2-Dichloroethene	70	ND (0.29)	**440**	**0.42 J**	**260**	**220**	ND (0.29)	ND (0.29)	**0.38 J**
m&p-Xylene	10000	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	**5.3**
n-Butylbenzene	21	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
o-Xylene	10000	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	**0.41 J**
trans-1,2-Dichloroethene	100	ND (0.15)	**1.3 J**	ND (0.15)	**5.6**	**5.3**	ND (0.15)	ND (0.15)	ND (0.15)

[1] KDHE Tier 2 RSK residential screening values for groundwater (KDHE, June 2007).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
H - Result may be biased high.
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.
ND - Non-detect.
Bold values were detected.
Shaded values are above the KDHE screening values.
All units are presented in µg/L.

Table 4-10. Concentrations of Detected Chemicals in Groundwater for 2005 Event (Continued)

	Well ID No.	P-02	P-03	P-05	P-06	P-07	P-08	P-09	P-10
Analyte	Residential KDHE Screening Value[1]	01/26/2006	02/06/2006	02/08/2006	03/13/2006	03/13/2006	03/13/2006	03/13/2006	02/08/2006
1,1,1-Trichloroethane	200	**76**	ND (0.21)	**210 J**	**0.27 J**	**0.22 J**	ND (0.21)	ND (0.21)	**2.7 J**
1,1,2-Trichloroethane	5	ND (2.3)	ND (0.23)	ND (12)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)
1,1-Dichloroethane	340	**7.6 J**	ND (0.26)	ND (13)	**5.8**	**5.5**	**6.4**	**3.1**	**0.44 J**
1,1-Dichloroethene	7	**41 J**	ND (0.33)	**29 J**	ND (0.33)	**0.52 J**	ND (0.33)	ND (0.33)	**1.1 J**
1,2,4-Trimethylbenzene	5	ND (1.8)	ND (0.18)	**24 J**	**0.54 J**	**0.2 J**	ND (0.18)	ND (0.18)	ND (0.18)
1,2-Dichlorobenzene	600	ND (2.4)	ND (0.24)	ND (12)	**1.0 J**	**0.56 J**	**0.73 J**	**0.33 J**	ND (0.24)
1,2-Dichloroethane	5	ND (2.6)	ND (0.26)	ND (13)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)
1,3,5-Trimethylbenzene	5	ND (1.7)	ND (0.17)	ND (8.6)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)
2-Butanone (MEK)	820	ND (2.5)	ND (0.25)	ND (12)	**0.78 J**	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)
4-Methyl-2-pentanone (MIBK)	70	ND (2)	ND (0.2)	ND (9.8)	**0.22 J**	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
Acetone (2-Propanone)	260	ND (7.3)	ND (0.73)	ND (36)	**0.75 J**	**0.77 J**	ND (0.73)	**2.8 J**	ND (0.73)
Benzene	5	ND (2.2)	ND (0.22)	ND (11)	ND (0.22)	ND (0.22)	ND (0.22)	ND (0.22)	ND (0.22)
Carbon disulfide	9	ND (2.2)	ND (0.22)	ND (11)	**0.29 J**	**0.6 J**	**0.32 J**	**0.34 J**	ND (0.22)
Carbon tetrachloride	5	ND (1.9)	ND (0.19)	ND (9.6)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)
Chlorobenzene	100	ND (1.9)	ND (0.19)	ND (9.6)	ND (0.19)	ND (0.19)	**0.85 J**	**0.33 J**	ND (0.19)
Chloroethane (Ethyl chloride)	48	ND (2)	ND (0.2)	ND (10)	**1.9 J**	ND (0.2)	**1.5 J**	**1.7 J**	ND (0.2)
Chloroform	80	ND (2.7)	ND (0.26)	ND (13)	ND (0.26)	ND (0.26)	ND (0.26)	**0.41 J**	ND (0.26)
Ethylbenzene	700	ND (1.7)	ND (0.17)	ND (8.4)	**0.34 J**	**0.36 J**	**0.35 J**	ND (0.17)	ND (0.17)
Isopropylbenzene (Cumene)	224	ND (1.9)	ND (0.19)	ND (9.3)	**0.62 J**	**0.42 J**	**0.53 J**	ND (0.19)	ND (0.19)
Methyl tert-butyl ether (MTBE)	20	ND (2.3)	ND (0.23)	ND (11)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)
Methylene chloride (Dichloromethane)	5	ND (5)	ND (0.5)	ND (25)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
Naphthalene	3	**3.9 J**	ND (0.19)	**81 JB**	**1.7 JB**	**0.39 JB**	**0.37 JB**	**0.7 JB**	**1.9 JB**
Styrene	100	ND (1.8)	ND (0.18)	ND (8.8)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)
Tetrachloroethene	5	**20 J**	ND (0.28)	**37000**	**3.1**	ND (0.28)	ND (0.28)	ND (0.28)	**630**
Toluene	1000	ND (2.3)	ND (0.23)	ND (11)	**0.5 J**	**0.25 J**	**0.3 J**	ND (0.23)	ND (0.23)
Tribromomethane (Bromoform)	80	ND (2.4)	ND (0.24)	ND (12)	**0.38 J**	ND (0.24)	ND (0.24)	ND (0.24)	ND (0.24)
Trichloroethene	5	**1600**	ND (0.24)	**9900**	**2.4**	**0.33 J**	ND (0.24)	ND (0.24)	**220**
Trichlorofluoromethane	767	ND (1.8)	ND (0.18)	ND (8.8)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)
Vinyl chloride (Chloroethene)	2	**710 J**	ND (0.3)	**170 J**	**4.4**	ND (0.3)	**20**	**0.66 J**	**3.2 J**
Xylenes (total)	10000	ND (1.8)	ND (0.18)	ND (9)	**0.25 J**	ND (0.18)	**0.23 J**	ND (0.18)	ND (0.18)
cis-1,2-Dichloroethene	70	**8800**	ND (0.29)	**5000**	**9.6**	**510**	**11**	**1.4**	**150**
m&p-Xylene	10000	ND (3.8)	ND (0.38)	ND (19)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)
n-Butylbenzene	21	ND (2)	ND (0.2)	ND (10)	**0.37 J**	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
o-Xylene	10000	ND (1.8)	ND (0.18)	ND (9)	**0.25 J**	ND (0.18)	**0.23 J**	ND (0.18)	ND (0.18)
trans-1,2-Dichloroethene	100	**260**	ND (0.15)	**70 J**	**55**	**57**	**59**	**20**	**1.1 J**

[1] KDHE Tier 2 RSK residential screening values for groundwater (KDHE, June 2007).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
H - Result may be biased high.
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.

ND - Non-detect.
Bold values were detected.
Shaded values are above the KDHE screening values.
All units are presented in µg/L.

Table 4-10. Concentrations of Detected Chemicals in Groundwater for 2005 Event (Continued)

	Well ID No.	R-1	R-2	R-4	R-5	R-7	R-8	TW-1	TW-2A
Analyte	Residential KDHE Screening Value[1,2]	02/09/2006	02/09/2006	02/09/2006	02/09/2006	02/09/2006	02/09/2006	02/07/2006	02/07/2006
1,1,1-Trichloroethane	200	**400**	ND (0.21)	ND (0.21)	**3.1 J**	ND (0.21)	ND (0.21)	ND (1)	ND (0.21)
1,1,2-Trichloroethane	5	**1.7 J**	ND (0.23)	ND (0.23)	**0.49 J**	ND (0.23)	ND (0.23)	ND (1.2)	ND (0.23)
1,1-Dichloroethane	340	**82**	**1.5 J**	**30**	**17**	ND (0.26)	ND (0.26)	**57**	ND (0.26)
1,1-Dichloroethene	7	**350**	ND (0.33)	**0.46 J**	**15**	ND (0.33)	ND (0.33)	ND (1.6)	**0.55 J**
1,2,4-Trimethylbenzene	5	**19 J**	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	**770**	ND (0.18)
1,2-Dichlorobenzene	600	ND (1.2)	ND (0.24)	ND (0.24)	**0.68 J**	ND (0.24)	ND (0.24)	**2.1 J**	ND (0.24)
1,2-Dichloroethane	5	ND (1.3)	ND (0.26)	ND (0.26)	**0.77 J**	ND (0.26)	ND (0.26)	**8.6 J**	ND (0.26)
1,3,5-Trimethylbenzene	5	**3.3 J**	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	**210**	ND (0.17)
2-Butanone (MEK)	820	ND (1.2)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)	ND (1.2)	ND (0.25)
4-Methyl-2-pentanone (MIBK)	70	**9.9 J**	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.98)	ND (0.2)
Acetone (2-Propanone)	260	ND (3.6)	**1.6 JB**	**2.3 JB**	ND (0.73)	ND (0.73)	ND (0.73)	ND (3.6)	**1.5 JB**
Benzene	5	**4.4 J**	ND (0.22)	**1.1 J**	ND (0.22)	ND (0.22)	ND (0.22)	**140 JL**	ND (0.22) UJL
Carbon disulfide	9	ND (1.1)	ND (0.22)	**0.5 J**	ND (0.22)	ND (0.22)	ND (0.22)	ND (1.1)	ND (0.22)
Carbon tetrachloride	5	ND (0.96)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.96)	ND (0.19)
Chlorobenzene	100	ND (0.97)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.19)	ND (0.97)	ND (0.19)
Chloroethane (Ethyl chloride)	48	ND (1)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	**190**	ND (0.2)
Chloroform	80	ND (1.3)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (1.3)	ND (0.26)
Ethylbenzene	700	**240**	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	**2700**	ND (0.17)
Isopropylbenzene (Cumene)	224	**2.4 J**	ND (0.19)	**0.19 J**	ND (0.19)	ND (0.19)	ND (0.19)	**63 JL**	ND (0.19) UJL
Methyl tert-butyl ether (MTBE)	20	ND (1.1)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (1.1)	ND (0.23)
Methylene chloride (Dichloromethane)	5	ND (2.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (2.5)	ND (0.5)
Naphthalene	3	**28**	**0.35 JB**	**0.37 JB**	ND (0.19)	**0.35 JB**	**0.38 JB**	**690**	ND (0.19)
Styrene	100	**29**	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.88)	ND (0.18)
Tetrachloroethene	5	**6.8 J**	**1.5 J**	**6.9**	**660**	**4.0 J**	ND (0.28)	ND (1.4)	**1.7 J**
Toluene	1000	**430**	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)	**160**	**0.35 JB**
Tribromomethane (Bromoform)	80	ND (1.2)	ND (0.24)	ND (0.24)	ND (0.24)	ND (0.24)	ND (0.24)	ND (1.2)	ND (0.24)
Trichloroethene	5	**27**	**2.2 J**	**13**	**240**	**0.89 J**	ND (0.24)	ND (1.2)	**30**
Trichlorofluoromethane	767	ND (0.88)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.88)	ND (0.18)
Vinyl chloride (Chloroethene)	2	**490 J**	**1.5 J**	**30**	**1.2 J**	ND (0.3)	ND (0.3)	**7.4 JL**	ND (0.3) UJL
Xylenes (total)	10000	**370**	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	**7640**	ND (0.18)
cis-1,2-Dichloroethene	70	**10000**	**14**	**79**	**440**	**0.91 J**	ND (0.29)	**2.2 J**	**26**
m&p-Xylene	10000	**210**	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	ND (0.38)	**7200**	ND (0.38)
n-Butylbenzene	21	**1.8 J**	ND (0.2)	**0.23 J**	ND (0.2)	ND (0.2)	ND (0.2)	**21 JH**	ND (0.2)
o-Xylene	10000	**160**	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	**440**	ND (0.18)
trans-1,2-Dichloroethene	100	**19 J**	**0.17 J**	**0.63 J**	**2.0 J**	ND (0.15)	ND (0.15)	**9.7 J**	**0.18 J**

[1] KDHE Tier 2 RSK residential screening values for groundwater (KDHE, June 2007).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
H - Result may be biased high.
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.
ND - Non-detect.
Bold values were detected.
Shaded values are above the KDHE screening values.
All units are presented in µg/L.

Table 4-10. Concentrations of Detected Chemicals in Groundwater for 2005 Event (Continued)

	Well ID No.	TW-3	TW-4	USD-1	USD-2	USD-3
Analyte	Residential KDHE Screening Value[1,2]	02/07/2006	02/07/2006	02/01/2006	02/01/2006	02/01/2006
1,1,1-Trichloroethane	200	ND (1)	ND (0.21)	ND (0.21)	ND (0.21)	ND (0.21)
1,1,2-Trichloroethane	5	ND (1.2)	ND (0.23)	ND (0.23)	**0.45 J**	**0.7 J**
1,1-Dichloroethane	340	**13 J**	**130**	ND (0.26)	ND (0.26)	**4.2 J**
1,1-Dichloroethene	7	ND (1.6)	ND (0.33)	ND (0.33)	**3.1 J**	**5.3**
1,2,4-Trimethylbenzene	5	**1.4 J**	**770**	ND (0.18)	ND (0.18)	ND (0.18)
1,2-Dichlorobenzene	600	ND (1.2)	**10**	ND (0.24)	ND (0.24)	ND (0.24)
1,2-Dichloroethane	5	ND (1.3)	**5.6**	ND (0.26)	ND (0.26)	**1.4 JH**
1,3,5-Trimethylbenzene	5	ND (0.86)	**190**	ND (0.17)	ND (0.17)	ND (0.17)
2-Butanone (MEK)	820	ND (1.2)	ND (0.25)	ND (0.25)	ND (0.25)	ND (0.25)
4-Methyl-2-pentanone (MIBK)	70	ND (0.98)	**0.72 J**	ND (0.2)	ND (0.2)	ND (0.2)
Acetone (2-Propanone)	260	ND (3.6)	ND (0.73)	ND (0.73)	ND (0.73)	**0.75 JB**
Benzene	5	ND (1.1)	**76 JL**	ND (0.22)	**0.27 JB**	ND (0.22)
Carbon disulfide	9	ND (1.1)	ND (0.22)	ND (0.22)	ND (0.22)	ND (0.22)
Carbon tetrachloride	5	ND (0.96)	ND (0.19)	**1.6 J**	**0.63 J**	ND (0.19)
Chlorobenzene	100	ND (0.97)	**0.21 J**	ND (0.19)	ND (0.19)	ND (0.19)
Chloroethane (Ethyl chloride)	48	ND (1)	**95**	ND (0.2)	ND (0.2)	ND (0.2)
Chloroform	80	ND (1.3)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)
Ethylbenzene	700	**5.1 J**	**170**	ND (0.17)	ND (0.17)	ND (0.17)
Isopropylbenzene (Cumene)	224	ND (0.93)	**65 JL**	ND (0.19)	ND (0.19)	ND (0.19)
Methyl tert-butyl ether (MTBE)	20	ND (1.1)	ND (0.23)	ND (0.23)	ND (0.23)	ND (0.23)
Methylene chloride (Dichloromethane)	5	ND (2.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
Naphthalene	3	**1.7 JB**	**310**	ND (0.19)	ND (0.19)	ND (0.19)
Styrene	100	ND (0.88)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)
Tetrachloroethene	5	**27**	ND (0.28)	**68**	**86**	**70**
Toluene	1000	ND (1.1)	**7.2**	ND (0.23)	ND (0.23)	ND (0.23)
Tribromomethane (Bromoform)	80	ND (1.2)	ND (0.24)	ND (0.24)	ND (0.24)	ND (0.24)
Trichloroethene	5	**6.3 J**	**0.44 J**	**1.3 J**	**620**	**500**
Trichlorofluoromethane	767	ND (0.88)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)
Vinyl chloride (Chloroethene)	2	**51**	**36 JL**	ND (0.3)	ND (0.3)	ND (0.3)
Xylenes (total)	10000	**13 J**	**102**	ND (0.18)	ND (0.18)	ND (0.18)
cis-1,2-Dichloroethene	70	**44**	**7.9**	ND (0.29)	**330**	**600**
m&p-Xylene	10000	**13 J**	**94**	ND (0.38)	ND (0.38)	ND (0.38)
n-Butylbenzene	21	ND (1)	**20 JH**	ND (0.2)	ND (0.2)	ND (0.2)
o-Xylene	10000	ND (0.9)	**8**	ND (0.18)	ND (0.18)	ND (0.18)
trans-1,2-Dichloroethene	100	ND (0.77)	**2.0 J**	ND (0.15)	**3.7 J**	**12**

[1] KDHE Tier 2 RSK residential screening values for groundwater (KDHE, June 2007).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
H - Result may be biased high.
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.
ND - Non-detect.
Bold values were detected.
Shaded values are above the KDHE screening values.
All units are presented in µg/L.

Table 4-11. Concentrations of Detected Chemicals in Groundwater for 2006 Event

	Well ID No.	MW-2	MW-3	MW-4	MW-5	MW-6	MW-8	MW-12S	MW-14
Analyte	**Residential KDHE Screening Value[1]**	**6/1/2006**	**5/23/2006**	**6/1/2006**	**5/23/2006**	**6/1/2006**	**5/24/2006**	**5/31/2006**	**5/23/06**
1,1,1-Trichloroethane	200	ND (0.1) J	ND (0.1)	ND (0.4)	ND (1)	**230**	ND (0.1)	ND (0.1)	ND (0.1)
1,1,2-Trichloroethane	5	ND (0.1) J	ND (0.1)	ND (0.4)	ND (1)	ND (1)	ND (0.1)	ND (0.1)	ND (0.1)
1,1-Dichloroethane	340	ND (0.1) J	ND (0.1)	**1 J**	**3.4 J**	**98**	ND (0.1)	ND (0.1)	ND (0.1)
1,1-Dichloroethene	7	ND (0.1) J	ND (0.1)	ND (0.4)	**2.1 J**	**220**	ND (0.1)	ND (0.1)	ND (0.1)
1,2,4-Trimethylbenzene	5	ND (0.1) J	ND (0.1)	ND (0.4)	**12**	**480**	ND (0.1)	ND (0.1)	**58**
1,2-Dichloroethane	5	ND (0.1) J	ND (0.1)	**0.9 J**	ND (1)	ND (1)	ND (0.1)	ND (0.1)	ND (0.1)
1,3,5-Trimethylbenzene	5	ND (0.1) J	ND (0.1)	ND (0.4)	**2.3 J**	**120**	ND (0.1)	ND (0.1)	**4.5**
2-Butanone (MEK)	820	ND (1) J	ND (1)	ND (4)	ND (10)	ND (10)	ND (1)	ND (1)	ND (1)
4-Methyl-2-pentanone (MIBK)	70	ND (1) J	ND (1)	ND (4)	ND (10)	**18 J**	ND (1)	ND (1)	ND (1)
Acetone (2-Propanone)	260	**18 JL**	ND (3)	ND (12)	ND (30)	ND (30)	ND (3)	ND (3)	**49**
Benzene	5	ND (0.1) J	ND (0.1)	ND (0.4)	**2.8 J**	**22**	ND (0.1)	ND (0.1)	ND (0.1)
Carbon disulfide	9	**0.2 JL**	ND (0.1)	ND (0.4)	ND (1)	ND (1)	ND (0.1)	ND (0.1)	ND (0.1)
Carbon tetrachloride	5	ND (0.1) J	**0.9**	ND (0.4)	ND (1)	ND (1)	ND (0.1)	ND (0.1)	ND (0.1)
Chlorobenzene	100	ND (0.1) J	ND (0.1)	ND (0.4)	ND (1)	ND (1)	ND (0.1)	ND (0.1)	ND (0.1)
Chloroethane (Ethyl chloride)	48	ND (0.1) J	ND (0.1)	ND (0.4)	ND (1)	ND (1)	ND (0.1)	ND (0.1)	**0.8**
Chloroform	80	ND (0.1) J	ND (0.1)	ND (0.4)	ND (1)	ND (1)	ND (0.1)	ND (0.1)	**0.9**
Ethylbenzene	700	**1.9 JL**	ND (0.1)	ND (0.4)	**350**	**5200**	ND (0.1)	ND (0.1)	**2.6**
Isopropylbenzene (Cumene)	224	**8.2 JL**	ND (0.1)	ND (0.4)	**3.3 J**	**46**	ND (0.1)	ND (0.1)	**14**
Methyl tert-butyl ether (MTBE)	20	**1.2 JL**	ND (0.1)	ND (0.4)	ND (1)	ND (1)	ND (0.1)	ND (0.1)	**2.1**
Methylene chloride (Dichloromethane)	5	ND (0.2) J	ND (0.2)	ND (0.8)	ND (2)	ND (2)	ND (0.2)	**0.3 J**	ND (0.2)
Naphthalene	3	ND (0.1) J	ND (0.1)	ND (0.4)	**2.6 J**	**710**	ND (0.1)	ND (0.1)	**10**
Styrene	100	ND (0.1) J	ND (0.1)	ND (0.4)	ND (1)	ND (1)	ND (0.1)	ND (0.1)	ND (0.1)
Tetrachloroethene	5	ND (0.1) J	**15**	**4.2**	**42**	**7.3**	ND (0.1)	ND (0.1)	ND (0.1)
Toluene	1000	ND (0.1) J	ND (0.1)	ND (0.4)	**290**	**1800**	ND (0.1)	ND (0.1)	**6**
Trichloroethene	5	ND (0.1) J	**0.2 J**	**5.5**	**140**	**3.8 J**	ND (0.1)	ND (0.1)	ND (0.1)
Trichlorofluoromethane	767	ND (0.1) J	ND (0.1)	ND (0.4)	ND (1)	ND (1)	ND (0.1)	ND (0.1)	ND (0.1)
Vinyl acetate	149	ND (0.2) J	ND (0.2)	ND (0.8)	ND (2)	ND (2)	ND (0.2)	ND (0.2)	ND (0.2)
Vinyl chloride (Chloroethene)	2	**0.6 JL**	ND (0.1)	ND (0.4)	**130**	**430**	ND (0.1)	ND (0.1)	ND (0.1)
Xylenes (total)	10000	**0.4 JL**	ND (0.1)	ND (0.4)	**1400**	**14000**	ND (0.1)	ND (0.1)	**10**
cis-1,2-Dichloroethene	70	**3 JL**	ND (0.1)	**50**	**640**	**7000**	ND (0.1)	ND (0.1)	ND (0.1)
n-Butylbenzene	21	**3.5 JL**	ND (0.1)	ND (0.4)	ND (1)	**0.017**	ND (0.1)	ND (0.1)	**2.6**
trans-1,2-Dichloroethene	100	ND (0.1) J	ND (0.1)	**1 J**	**5.9**	**8.3**	ND (0.1)	ND (0.1)	ND (0.1)

[1] KDHE Tier 2 RSK residential screening values for groundwater (KDHE, June 2007).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
H - Result may be biased high.
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.
ND - Non-detect.
Bold values were detected.
Shaded values are above the KDHE screening values.
All units are presented in µg/L.

Table 4-11. Concentrations of Detected Chemicals in Groundwater for 2006 Event (Continued)

	Well ID No.	MW-17	MW-17(USD)	MW-19	MW-20	MW-20(USD)	MW-21	MW-22	MW-23
Analyte	**Residential KDHE Screening Value[1]**	**6/1/06**	**6/6/2006**	**5/30/2006**	**5/30/2006**	**6/7/2006**	**5/31/2006**	**5/24/2006**	**5/24/2006**
1,1,1-Trichloroethane	200	ND (0.4)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)
1,1,2-Trichloroethane	5	ND (0.4)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)
1,1-Dichloroethane	340	ND (0.4)	ND (0.1)	ND (0.1)	**49**	ND (0.1)	**130**	ND (0.1)	ND (0.1)
1,1-Dichloroethene	7	ND (0.4)	ND (0.1)	ND (0.1)	**4.7**	ND (0.1)	**1.8 J**	ND (0.1)	ND (0.1)
1,2,4-Trimethylbenzene	5	ND (0.4)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)
1,2-Dichloroethane	5	ND (0.4)	ND (0.1)	ND (0.1)	**1.5 J**	ND (0.1)	**2 J**	ND (0.1)	ND (0.1)
1,3,5-Trimethylbenzene	5	ND (0.4)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)
2-Butanone (MEK)	820	ND (4)	ND (1)	ND (1)	ND (5)	ND (1)	ND (5)	ND (1)	ND (1)
4-Methyl-2-pentanone (MIBK)	70	ND (4)	ND (1)	ND (1)	ND (5)	ND (1)	ND (5)	ND (1)	ND (1)
Acetone (2-Propanone)	260	ND (12)	ND (3)	ND (3)	ND (15)	ND (3)	ND (15)	ND (3)	ND (3)
Benzene	5	**0.8 J**	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)
Carbon disulfide	9	ND (0.4)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)
Carbon tetrachloride	5	ND (0.4)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)
Chlorobenzene	100	ND (0.4)	ND (0.1)	ND (0.1)	ND (0.5)	**0.1 J**	ND (0.5)	ND (0.1)	ND (0.1)
Chloroethane (Ethyl chloride)	48	ND (0.4)	ND (0.1)	ND (0.1)	**0.5 J**	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)
Chloroform	80	ND (0.4)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)
Ethylbenzene	700	ND (0.4)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)
Isopropylbenzene (Cumene)	224	ND (0.4)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)
Methyl tert-butyl ether (MTBE)	20	ND (0.4)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)
Methylene chloride (Dichloromethane)	5	ND (0.8)	ND (0.2)	**0.3 J**	**1.2 J**	ND (0.2)	**1.1 J**	ND (0.2)	ND (0.2)
Naphthalene	3	ND (0.4)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)
Styrene	100	ND (0.4)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)
Tetrachloroethene	5	ND (0.4)	ND (0.1)	**1.1**	**180**	ND (0.1)	**15**	ND (0.1)	ND (0.1)
Toluene	1000	ND (0.4)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)
Trichloroethene	5	ND (0.4)	ND (0.1)	**0.4 J**	**120**	ND (0.1)	**38**	ND (0.1)	ND (0.1)
Trichlorofluoromethane	767	ND (0.4)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)
Vinyl acetate	149	ND (0.8)	ND (0.2)	ND (0.2)	ND (1)	ND (0.2)	ND (1)	ND (0.2)	ND (0.2)
Vinyl chloride (Chloroethene)	2	ND (0.4)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	**21**	ND (0.1)	ND (0.1)
Xylenes (total)	10000	ND (0.4)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)
cis-1,2-Dichloroethene	70	ND (0.4)	ND (0.1)	**0.3 J**	**160**	ND (0.1)	**160**	ND (0.1)	ND (0.1)
n-Butylbenzene	21	ND (0.4)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)
trans-1,2-Dichloroethene	100	ND (0.4)	ND (0.1)	ND (0.1)	**1.3 J**	ND (0.1)	**0.6 J**	ND (0.1)	ND (0.1)

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H - Result may be biased high.
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.

ND - Non-detect.
Bold values were detected.
Shaded values are above the KDHE screening values.
All units are presented in µg/L.

Table 4-11. Concentrations of Detected Chemicals in Groundwater for 2006 Event (Continued)

	Well ID No.	P-01	P-05	PMW-2	PMW-3	PMW-4	PMW-5	PMW-6	R-1
Analyte	**Residential KDHE Screening Value[1]**	**6/1/2006**	**5/24/2006**	**6/7/2006**	**6/7/2006**	**6/6/2006**	**6/6/2006**	**6/6/2006**	**5/31/2006**
1,1,1-Trichloroethane	200	ND (0.1)	**200**	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.2)	ND (0.1)	**100**
1,1,2-Trichloroethane	5	ND (0.1)	ND (10)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.2)	ND (0.1)	ND (2)
1,1-Dichloroethane	340	ND (0.1)	ND (10)	ND (0.1)	**1.4**	ND (0.1)	**7**	**0.5**	**21**
1,1-Dichloroethene	7	ND (0.1)	**30 J**	ND (0.1)	**0.2 J**	ND (0.1)	**0.9 J**	**0.2 J**	**52**
1,2,4-Trimethylbenzene	5	ND (0.1)	ND (10)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.2)	ND (0.1)	ND (2)
1,2-Dichloroethane	5	**0.1 J**	ND (10)	ND (0.1)	**0.2 J**	ND (0.1)	**0.9 J**	**0.1 J**	ND (2)
1,3,5-Trimethylbenzene	5	ND (0.1)	ND (10)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.2)	ND (0.1)	ND (2)
2-Butanone (MEK)	820	ND (1)	ND (100)	ND (1)	ND (1)	ND (1)	ND (2)	ND (1)	ND (20)
4-Methyl-2-pentanone (MIBK)	70	ND (1)	ND (100)	ND (1)	ND (1)	ND (1)	ND (2)	ND (1)	ND (20)
Acetone (2-Propanone)	260	ND (3)	ND (300)	ND (3)	ND (3)	ND (3)	ND (6)	ND (3)	ND (60)
Benzene	5	ND (0.1)	ND (10)	ND (0.1)	**0.1 J**	ND (0.1)	ND (0.2)	**0.1 J**	**4.1 J**
Carbon disulfide	9	ND (0.1)	ND (10)	ND (0.1)	**0.3 J**	ND (0.1)	ND (0.2)	ND (0.1)	ND (2)
Carbon tetrachloride	5	ND (0.1)	ND (10)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.2)	ND (0.1)	ND (2)
Chlorobenzene	100	ND (0.1)	ND (10)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.2)	ND (0.1)	ND (2)
Chloroethane (Ethyl chloride)	48	ND (0.1)	ND (10)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.2)	ND (0.1)	ND (2)
Chloroform	80	ND (0.1)	ND (10)	ND (0.1)	ND (0.1)	ND (0.1)	**0.3 J**	ND (0.1)	ND (2)
Ethylbenzene	700	ND (0.1)	ND (10)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.2)	ND (0.1)	**3.8 J**
Isopropylbenzene (Cumene)	224	ND (0.1)	ND (10)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.2)	ND (0.1)	ND (2)
Methyl tert-butyl ether (MTBE)	20	**0.1 J**	ND (10)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.2)	ND (0.1)	ND (2)
Methylene chloride (Dichloromethane)	5	ND (0.2)	ND (20)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.4)	ND (0.2)	**7.9 J**
Naphthalene	3	ND (0.1)	ND (10)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.2)	ND (0.1)	ND (2)
Styrene	100	ND (0.1)	ND (10)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.2)	ND (0.1)	ND (2)
Tetrachloroethene	5	**0.3 J**	**14000**	**0.2 J**	**0.6**	**0.5 J**	**3.2**	**0.7**	**3.9 J**
Toluene	1000	ND (0.1)	ND (10)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.2)	ND (0.1)	**69**
Trichloroethene	5	**0.2 J**	**4300**	ND (0.1)	**5.2**	ND (0.1)	**13**	**12**	**11**
Trichlorofluoromethane	767	ND (0.1)	ND (10)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.2)	ND (0.1)	ND (2)
Vinyl acetate	149	ND (0.2)	ND (20)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.4)	ND (0.2)	ND (4)
Vinyl chloride (Chloroethene)	2	ND (0.1)	**36 J**	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.2)	ND (0.1)	**63**
Xylenes (total)	10000	ND (0.1)	ND (10)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.2)	ND (0.1)	**180**
cis-1,2-Dichloroethene	70	**0.6**	**2200**	ND (0.1)	**73**	ND (0.1)	**300**	**10**	**1200**
n-Butylbenzene	21	ND (0.1)	ND (10)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.2)	ND (0.1)	ND (2)
trans-1,2-Dichloroethene	100	ND (0.1)	**13 J**	ND (0.1)	**0.3 J**	ND (0.1)	**1.8**	**0.6**	**11**

[1] KDHE Tier 2 RSK residential screening values for groundwater (KDHE, June 2007).
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H - Result may be biased high.
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.
ND - Non-detect.
Bold values were detected.
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All units are presented in µg/L.

Table 4-11. Concentrations of Detected Chemicals in Groundwater for 2006 Event (Continued)

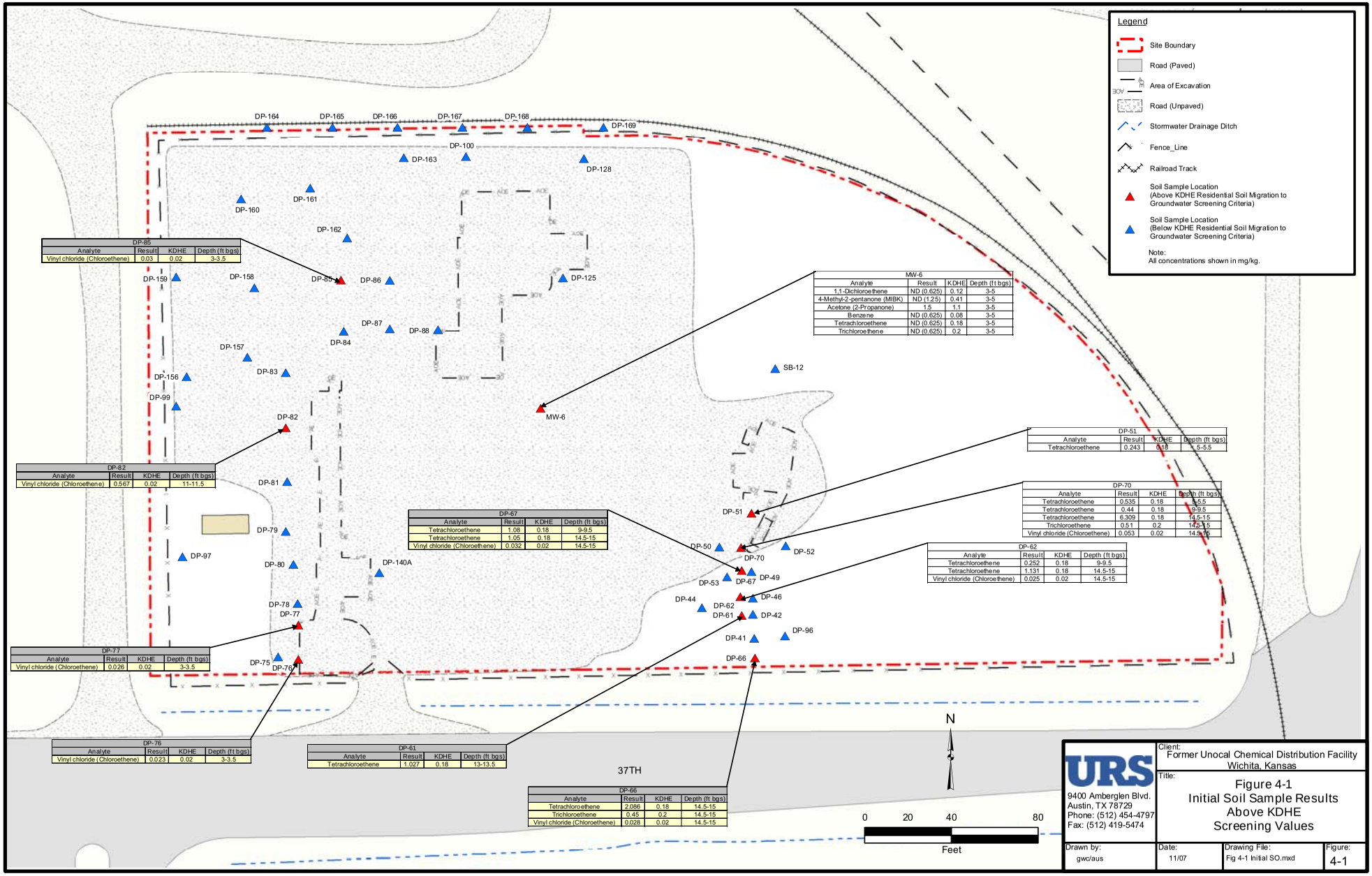
	Well ID No.	R-2	R-3	R-4	R-5	R-6	R-7	R-10	R-11
Analyte	**Residential KDHE Screening Value[1]**	**5/25/2006**	**5/25/2006**	**5/25/2006**	**5/26/2006**	**5/26/2006**	**5/25/2006**	**5/25/2006**	**5/25/2006**
1,1,1-Trichloroethane	200	ND (0.1)	ND (0.1)	ND (0.1)	**3.9**	**0.8**	ND (0.1)	**0.2 J**	ND (0.1)
1,1,2-Trichloroethane	5	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	**0.2 J**	ND (0.1)	ND (0.1)	ND (0.1)
1,1-Dichloroethane	340	**4.7**	**24**	**41**	**13**	**2**	**1.5**	**2.8**	**250**
1,1-Dichloroethene	7	**0.2 J**	**0.2 J**	**0.3 J**	**11**	**1.1**	**0.3 J**	**0.4 J**	**2.8**
1,2,4-Trimethylbenzene	5	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
1,2-Dichloroethane	5	**0.2 J**	**0.7**	ND (0.1)	**0.7 J**	**0.1 J**	ND (0.1)	ND (0.1)	**4.3**
1,3,5-Trimethylbenzene	5	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
2-Butanone (MEK)	820	ND (1)	ND (1)	ND (1)	ND (5)	ND (1)	ND (1)	ND (1)	ND (1)
4-Methyl-2-pentanone (MIBK)	70	ND (1)	ND (1)	ND (1)	ND (5)	ND (1)	ND (1)	ND (1)	ND (1)
Acetone (2-Propanone)	260	ND (3)	**3.6 J**	**6.9**	ND (15)	ND (3)	ND (3)	ND (3)	**5.1**
Benzene	5	ND (0.1)	**4**	**1.7**	ND (0.5)	ND (0.1)	ND (0.1)	ND (0.1)	**1.2**
Carbon disulfide	9	ND (0.1)	**0.1 J**	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Carbon tetrachloride	5	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Chlorobenzene	100	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)	ND (0.1)	**0.2 J**
Chloroethane (Ethyl chloride)	48	ND (0.1)	**4.5**	**0.2 J**	ND (0.5)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Chloroform	80	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)	ND (0.1)	**0.3 J**
Ethylbenzene	700	ND (0.1)	**0.1 J**	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Isopropylbenzene (Cumene)	224	ND (0.1)	**1.4**	**0.6**	ND (0.5)	ND (0.1)	ND (0.1)	ND (0.1)	**0.1 J**
Methyl tert-butyl ether (MTBE)	20	ND (0.1)	ND (0.1)	**0.2 J**	ND (0.5)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Methylene chloride (Dichloromethane)	5	**0.4 JB**	**0.6 B**	**0.6 B**	ND (1)	**0.4 JB**	**0.4 JB**	**0.4 JB**	ND (0.2)
Naphthalene	3	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Styrene	100	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Tetrachloroethene	5	**0.2**	ND (0.1)	**12**	**720**	**90**	**17**	**58**	**0.2 J**
Toluene	1000	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Trichloroethene	5	**7.7**	**0.3 J**	**5.8**	**330**	**29**	**95**	**25**	**0.7**
Trichlorofluoromethane	767	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Vinyl acetate	149	ND (0.2)	ND (0.2)	ND (0.2)	ND (1)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
Vinyl chloride (Chloroethene)	2	**1.1**	**10**	**24**	**0.7 J**	**0.2 J**	ND (0.1)	ND (0.1)	**73**
Xylenes (total)	10000	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
cis-1,2-Dichloroethene	70	**68**	**43**	**46**	**480**	**36**	**13**	**20**	**310**
n-Butylbenzene	21	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
trans-1,2-Dichloroethene	100	**1.1**	**1.4**	**2.7**	**2.3 J**	**0.2 J**	**0.2 J**	**0.2 J**	**4.6**

[1] KDHE Tier 2 RSK residential screening values for groundwater (KDHE, June 2007).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
H - Result may be biased high.
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.
ND - Non-detect.
Bold values were detected.
Shaded values are above the KDHE screening values.
All units are presented in µg/L.

Table 4-11. Concentrations of Detected Chemicals in Groundwater for 2006 Event (Continued)

	Well ID No.	R-12	TW-1	TW-2A	TW-3	USD-1	USD-2	USD-3
Analyte	**Residential KDHE Screening Value[1]**	**5/25/2006**	**5/31/2006**	**5/25/2006**	**5/31/2006**	**5/23/2006**	**5/23/2006**	**5/23/2006**
1,1,1-Trichloroethane	200	ND (0.2)	ND (5)	ND (0.1)	**5.7**	ND (0.1)	ND (0.5)	ND (0.1)
1,1,2-Trichloroethane	5	ND (0.2)	ND (5)	**0.3 J**	ND (0.1)	ND (0.1)	ND (0.5)	**0.3 J**
1,1-Dichloroethane	340	**110**	**32**	**0.5 J**	**17**	ND (0.1)	**1.4 J**	**6.9**
1,1-Dichloroethene	7	**0.6 J**	ND (5)	**1.8**	**2.5**	ND (0.1)	**4.5**	**2.6**
1,2,4-Trimethylbenzene	5	ND (0.2)	**670**	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)
1,2-Dichloroethane	5	**1.2**	**11 J**	**0.6**	**0.5 J**	ND (0.1)	ND (0.5)	**1.6**
1,3,5-Trimethylbenzene	5	ND (0.2)	**170**	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)
2-Butanone (MEK)	820	ND (2)	ND (50)	ND (1)	ND (1)	ND (1)	ND (5)	ND (1)
4-Methyl-2-pentanone (MIBK)	70	ND (2)	ND (50)	ND (1)	ND (1)	ND (1)	ND (5)	ND (1)
Acetone (2-Propanone)	260	ND (6)	ND (150)	ND (3)	ND (3)	ND (3)	ND (15)	ND (3)
Benzene	5	ND (0.2)	**99**	**0.1 J**	**0.4 J**	ND (0.1)	ND (0.5)	**0.1 J**
Carbon disulfide	9	ND (0.2)	ND (5)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)
Carbon tetrachloride	5	ND (0.2)	ND (5)	ND (0.1)	ND (0.1)	**1.7**	**0.5 J**	ND (0.1)
Chlorobenzene	100	ND (0.2)	ND (5)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)
Chloroethane (Ethyl chloride)	48	ND (0.2)	**110**	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)
Chloroform	80	ND (0.2)	ND (5)	ND (0.1)	ND (0.1)	**0.3 J**	ND (0.5)	**0.2 J**
Ethylbenzene	700	ND (0.2)	**1800**	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)
Isopropylbenzene (Cumene)	224	ND (0.2)	**35**	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)
Methyl tert-butyl ether (MTBE)	20	ND (0.2)	ND (5)	ND (0.1)	**0.1 J**	ND (0.1)	ND (0.5)	ND (0.1)
Methylene chloride (Dichloromethane)	5	**0.5 JB**	ND (10)	**0.4 JB**	**0.2 J**	ND (0.2)	ND (1)	ND (0.2)
Naphthalene	3	ND (0.2)	**910**	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)
Styrene	100	ND (0.2)	ND (5)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)
Tetrachloroethene	5	**31**	ND (5)	**7.3**	**20**	**48**	**83**	**31**
Toluene	1000	ND (0.2)	**20 J**	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)
Trichloroethene	5	**47**	ND (5)	**92**	**5.5**	**1.2**	**370**	**190**
Trichlorofluoromethane	767	ND (0.2)	ND (5)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)
Vinyl acetate	149	ND (0.4)	ND (10)	ND (0.2)	ND (0.2)	ND (0.2)	ND (1)	ND (0.2)
Vinyl chloride (Chloroethene)	2	**0.9 J**	**9 J**	**0.3 J**	**59**	ND (0.1)	ND (0.5)	**0.2 J**
Xylenes (total)	10000	ND (0.2)	**5100**	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)
cis-1,2-Dichloroethene	70	**290**	ND (5)	**47**	**50**	ND (0.1)	**230**	**570**
n-Butylbenzene	21	ND (0.2)	**9 J**	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.5)	ND (0.1)
trans-1,2-Dichloroethene	100	**2**	**6.8 J**	**3.1**	**0.2 J**	ND (0.1)	**3.9**	**21**

[1] KDHE Tier 2 RSK residential screening values for groundwater (KDHE, June 2007).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
H - Result may be biased high.
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.
ND - Non-detect.
Bold values were detected.
Shaded values are above the KDHE screening values.
All units are presented in µg/L.



DP-85			
Analyte	Result	KDHE	Depth (ft bgs)
Vinyl chloride (Chloroethene)	0.03	0.02	3-3.5

MW-6			
Analyte	Result	KDHE	Depth (ft bgs)
1,1-Dichloroethene	ND (0.625)	0.12	3-5
4-Methyl-2-pentanone (MIBK)	ND (1.25)	0.41	3-5
Acetone (2-Propanone)	1.5	1.1	3-5
Benzene	ND (0.625)	0.08	3-5
Tetrachloroethene	ND (0.625)	0.18	3-5
Trichloroethene	ND (0.625)	0.2	3-5

DP-51			
Analyte	Result	KDHE	Depth (ft bgs)
Tetrachloroethene	0.243	0.18	5-5.5

DP-82			
Analyte	Result	KDHE	Depth (ft bgs)
Vinyl chloride (Chloroethene)	0.567	0.02	11-11.5

DP-70			
Analyte	Result	KDHE	Depth (ft bgs)
Tetrachloroethene	0.535	0.18	5-5.5
Tetrachloroethene	0.44	0.18	9-9.5
Tetrachloroethene	6.309	0.18	14.5-15
Trichloroethene	0.51	0.2	14.5-15
Vinyl chloride (Chloroethene)	0.053	0.02	14.5-15

DP-67			
Analyte	Result	KDHE	Depth (ft bgs)
Tetrachloroethene	1.08	0.18	9-9.5
Tetrachloroethene	1.05	0.18	14.5-15
Vinyl chloride (Chloroethene)	0.032	0.02	14.5-15

DP-62			
Analyte	Result	KDHE	Depth (ft bgs)
Tetrachloroethene	0.252	0.18	9-9.5
Tetrachloroethene	1.131	0.18	14.5-15
Vinyl chloride (Chloroethene)	0.025	0.02	14.5-15

DP-77			
Analyte	Result	KDHE	Depth (ft bgs)
Vinyl chloride (Chloroethene)	0.026	0.02	3-3.5

DP-76			
Analyte	Result	KDHE	Depth (ft bgs)
Vinyl chloride (Chloroethene)	0.023	0.02	3-3.5

DP-61			
Analyte	Result	KDHE	Depth (ft bgs)
Tetrachloroethene	1.027	0.18	13-13.5

DP-66			
Analyte	Result	KDHE	Depth (ft bgs)
Tetrachloroethene	2.086	0.18	14.5-15
Trichloroethene	0.45	0.2	14.5-15
Vinyl chloride (Chloroethene)	0.028	0.02	14.5-15

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Title: Figure 4-1 Initial Soil Sample Results Above KDHE Screening Values

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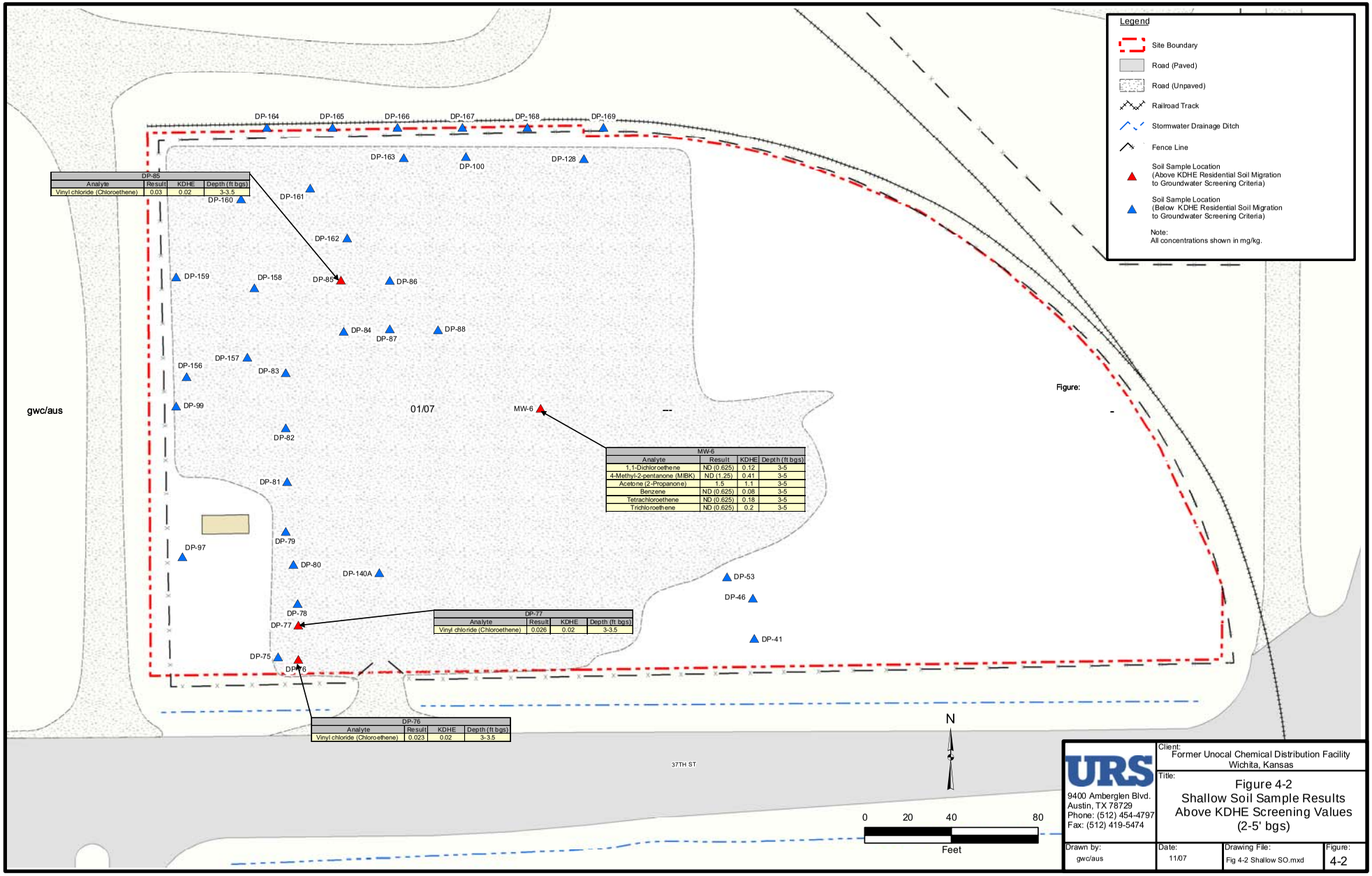

DP-85			
Analyte	Result	KDHE	Depth (ft bgs)
Vinyl chloride (Chloroethene)	0.03	0.02	3-3.5

MW-6			
Analyte	Result	KDHE	Depth (ft bgs)
1,1-Dichloroethene	ND (0.625)	0.12	3-5
4-Methyl-2-pentanone (MIBK)	ND (1.25)	0.41	3-5
Acetone (2-Propanone)	1.5	1.1	3-5
Benzene	ND (0.625)	0.08	3-5
Tetrachloroethene	ND (0.625)	0.18	3-5
Trichloroethene	ND (0.625)	0.2	3-5

DP-77			
Analyte	Result	KDHE	Depth (ft bgs)
Vinyl chloride (Chloroethene)	0.026	0.02	3-3.5

DP-76			
Analyte	Result	KDHE	Depth (ft bgs)
Vinyl chloride (Chloroethene)	0.023	0.02	3-3.5

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Title: Figure 4-2 Shallow Soil Sample Results Above KDHE Screening Values (2-5' bgs)

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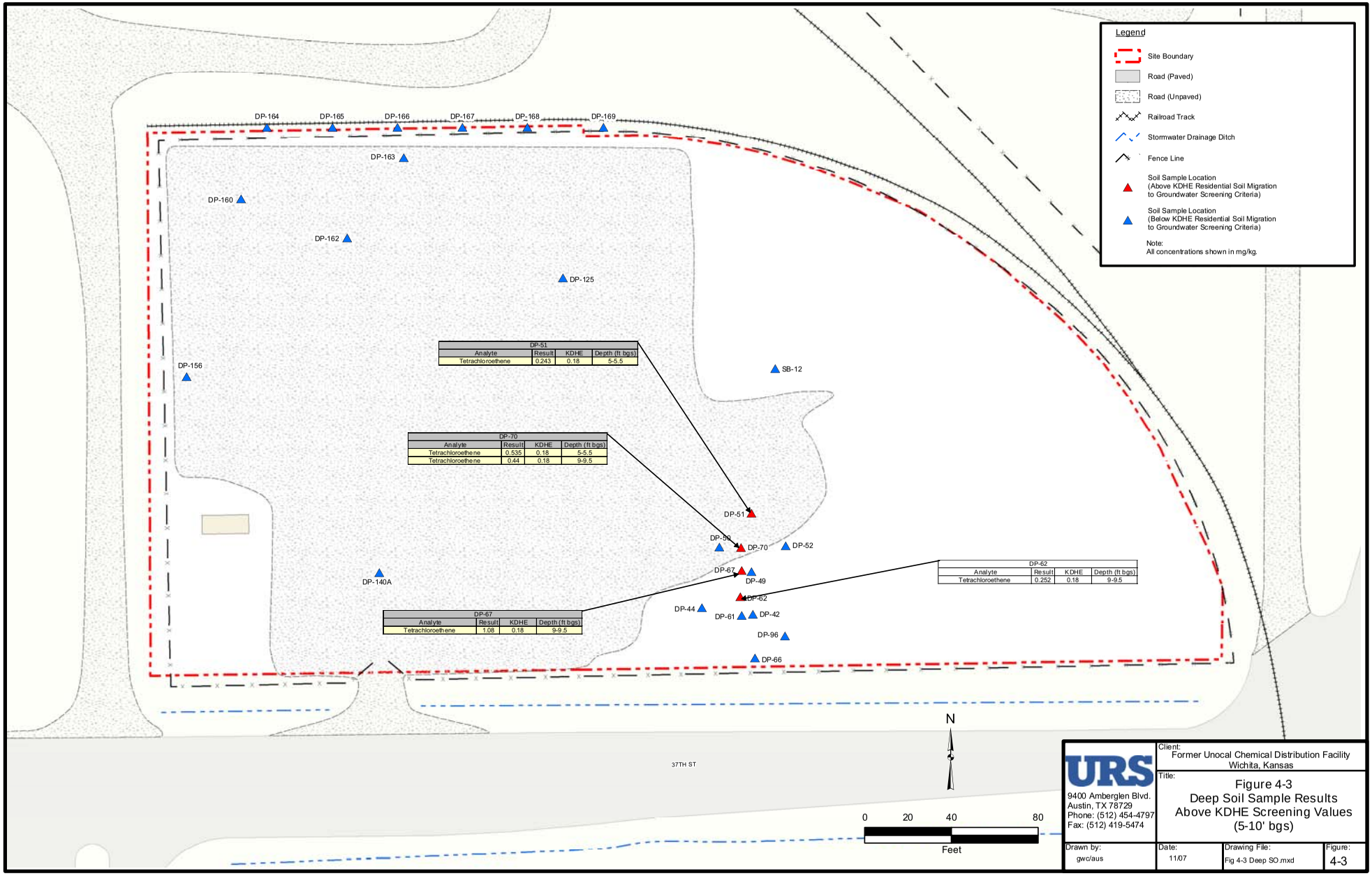

DP-51			
Analyte	Result	KDHE	Depth (ft bgs)
Tetrachloroethene	0.243	0.18	5-5.5

DP-70			
Analyte	Result	KDHE	Depth (ft bgs)
Tetrachloroethene	0.535	0.18	5-5.5
Tetrachloroethene	0.44	0.18	9-9.5

DP-67			
Analyte	Result	KDHE	Depth (ft bgs)
Tetrachloroethene	1.08	0.18	9-9.5

DP-62			
Analyte	Result	KDHE	Depth (ft bgs)
Tetrachloroethene	0.252	0.18	9-9.5

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Title: Figure 4-3 Deep Soil Sample Results Above KDHE Screening Values (5-10' bgs)

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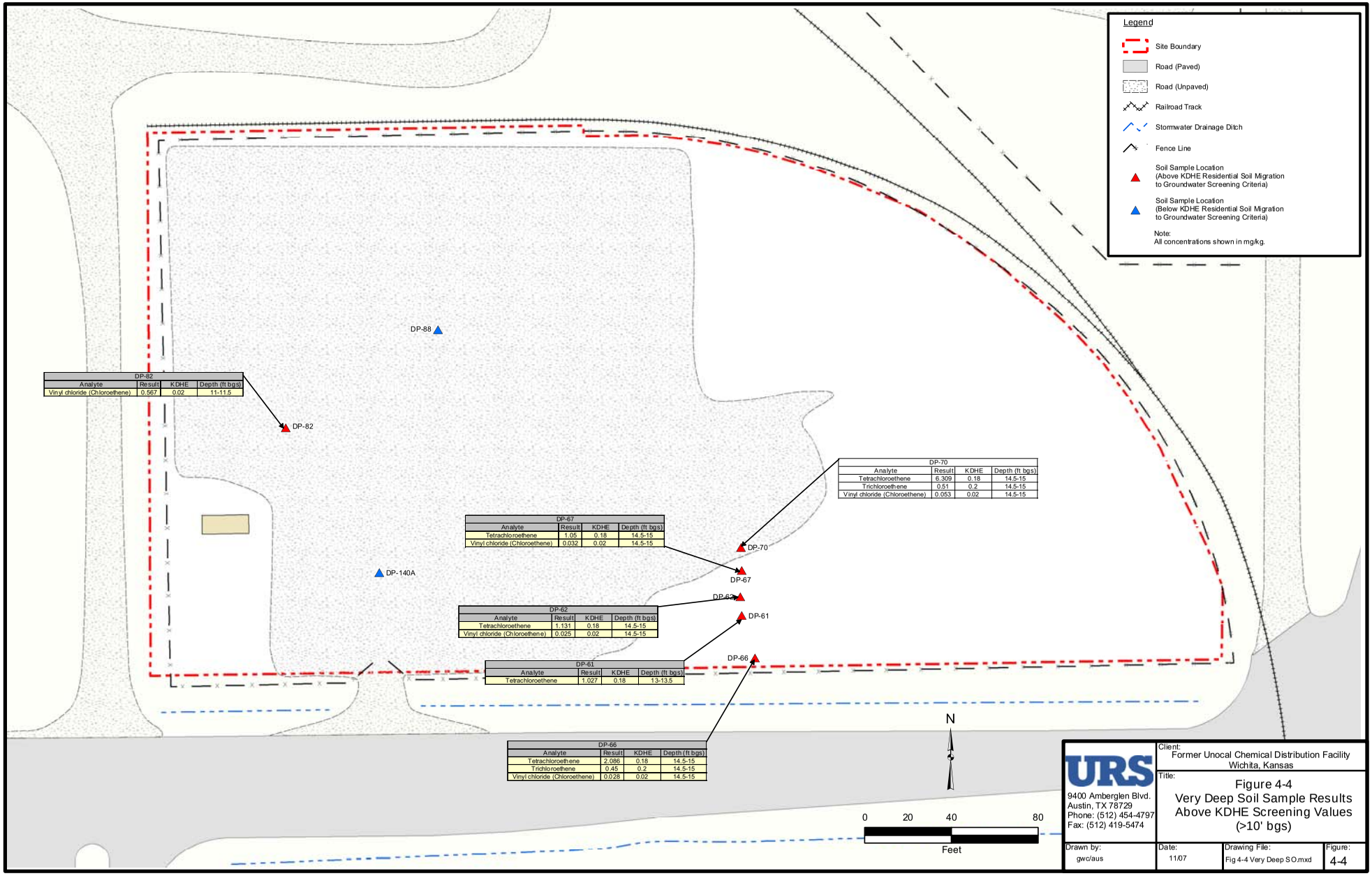

DP-82			
Analyte	Result	KDHE	Depth (ft bgs)
Vinyl chloride (Chloroethene)	0.567	0.02	11-11.5

DP-70			
Analyte	Result	KDHE	Depth (ft bgs)
Tetrachloroethene	6.309	0.18	14.5-15
Trichloroethene	0.51	0.2	14.5-15
Vinyl chloride (Chloroethene)	0.053	0.02	14.5-15

DP-67			
Analyte	Result	KDHE	Depth (ft bgs)
Tetrachloroethene	1.05	0.18	14.5-15
Vinyl chloride (Chloroethene)	0.032	0.02	14.5-15

DP-62			
Analyte	Result	KDHE	Depth (ft bgs)
Tetrachloroethene	1.131	0.18	14.5-15
Vinyl chloride (Chloroethene)	0.025	0.02	14.5-15

DP-61			
Analyte	Result	KDHE	Depth (ft bgs)
Tetrachloroethene	1.027	0.18	13-13.5

DP-66			
Analyte	Result	KDHE	Depth (ft bgs)
Tetrachloroethene	2.086	0.18	14.5-15
Trichloroethene	0.45	0.2	14.5-15
Vinyl chloride (Chloroethene)	0.028	0.02	14.5-15

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Title: Figure 4-4 Very Deep Soil Sample Results Above KDHE Screening Values (>10' bgs)

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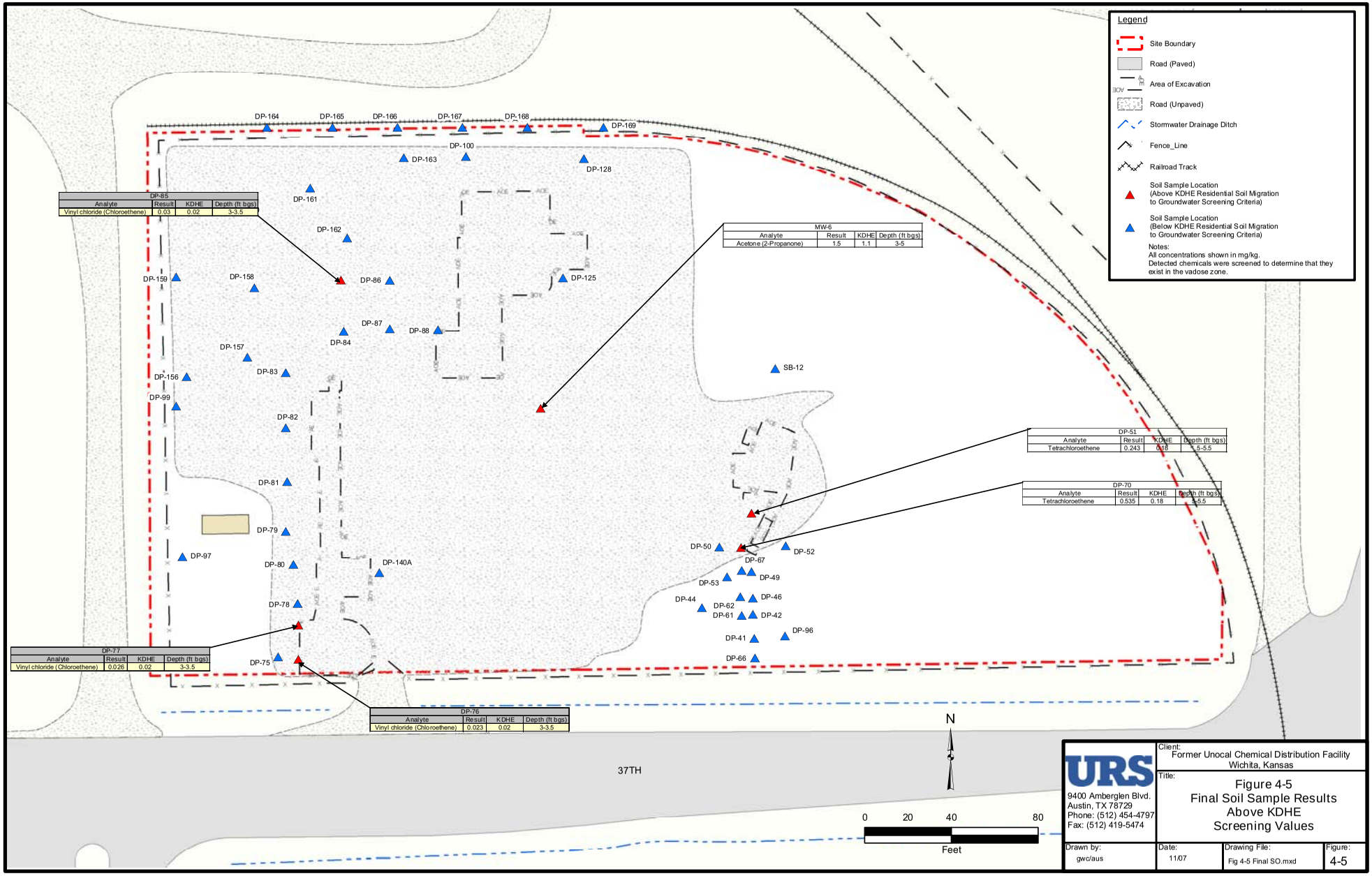

DP-85			
Analyte	Result	KDHE	Depth (ft bgs)
Vinyl chloride (Chloroethene)	0.03	0.02	3-3.5

MW-6			
Analyte	Result	KDHE	Depth (ft bgs)
Acetone (2-Propanone)	1.5	1.1	3-5

DP-51			
Analyte	Result	KDHE	Depth (ft bgs)
Tetrachloroethene	0.243	0.18	5-5.5

DP-70			
Analyte	Result	KDHE	Depth (ft bgs)
Tetrachloroethene	0.535	0.18	5-5.5

DP-77			
Analyte	Result	KDHE	Depth (ft bgs)
Vinyl chloride (Chloroethene)	0.026	0.02	3-3.5

DP-76			
Analyte	Result	KDHE	Depth (ft bgs)
Vinyl chloride (Chloroethene)	0.023	0.02	3-3.5

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Title: Figure 4-5 Final Soil Sample Results Above KDHE Screening Values

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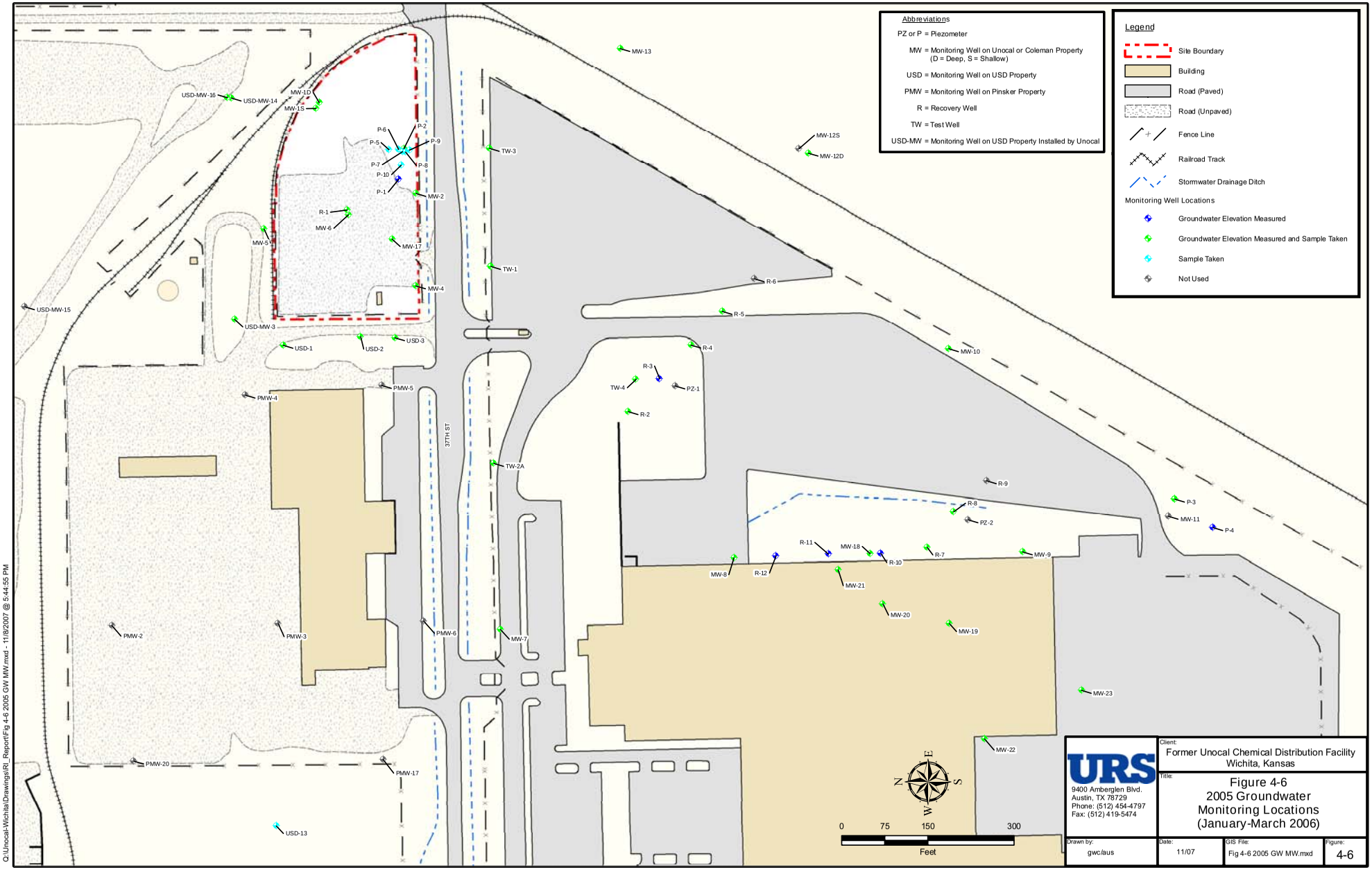

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Title: Figure 4-6 2005 Groundwater Monitoring Locations (January-March 2006)

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gwc/aus	11/07	Fig 4-6 2005 GW MW.mxd	4-6

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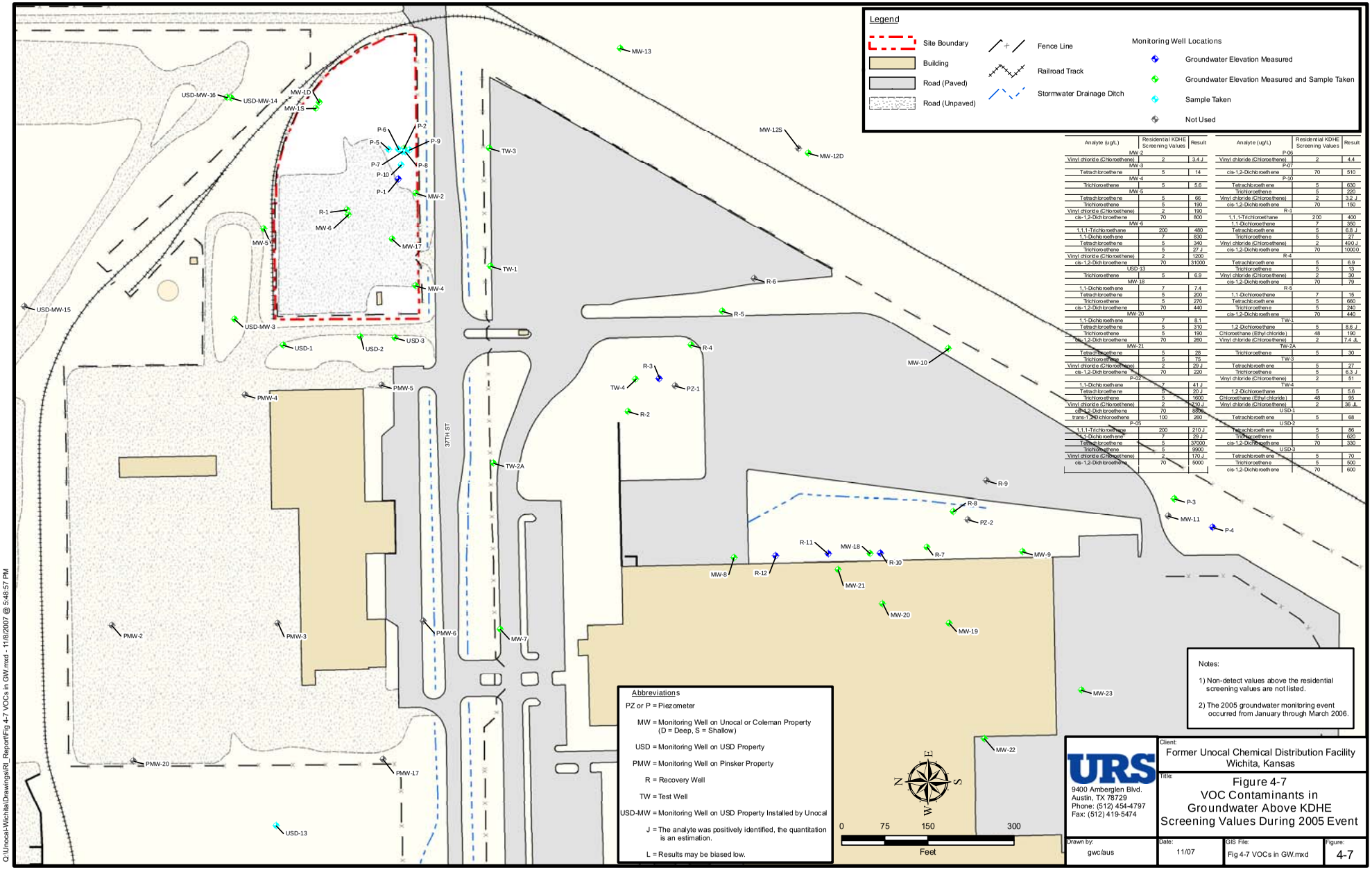

Analyte (ug/L)	Residential KDHE Screening Values	Result
MW-2		
Vinyl chloride (Chloroethene)	2	3.4 J
MW-3		
Tetrachloroethene	5	14
MW-4		
Trichloroethene	5	5.6
MW-5		
Tetrachloroethene	5	66
Trichloroethene	5	190
Vinyl chloride (Chloroethene)	2	190
cis-1,2-Dichloroethene	70	800
MW-6		
1,1,1-Trichloroethane	200	480
1,1-Dichloroethene	7	830
Tetrachloroethene	5	340
Trichloroethene	5	27 J
Vinyl chloride (Chloroethene)	2	1200
cis-1,2-Dichloroethene	70	31000
USD-13		
Trichloroethene	5	6.9
MW-18		
1,1-Dichloroethene	7	7.4
Tetrachloroethene	5	200
Trichloroethene	5	270
cis-1,2-Dichloroethene	70	440
MW-20		
1,1-Dichloroethene	7	8.1
Tetrachloroethene	5	310
Trichloroethene	5	190
cis-1,2-Dichloroethene	70	260
MW-21		
Tetrachloroethene	5	28
Trichloroethene	5	75
Vinyl chloride (Chloroethene)	2	29 J
cis-1,2-Dichloroethene	70	220
P-02		
1,1-Dichloroethene	7	41 J
Tetrachloroethene	5	20 J
Trichloroethene	5	1600
Vinyl chloride (Chloroethene)	2	210 J
cis-1,2-Dichloroethene	70	8000
trans-1,2-Dichloroethene	100	260
P-05		
1,1,1-Trichloroethane	200	210 J
1,1-Dichloroethene	7	29 J
Tetrachloroethene	5	37000
Trichloroethene	5	9900
Vinyl chloride (Chloroethene)	2	170 J
cis-1,2-Dichloroethene	70	5000

Analyte (ug/L)	Residential KDHE Screening Values	Result
P-06		
Vinyl chloride (Chloroethene)	2	4.4
P-07		
cis-1,2-Dichloroethene	70	510
P-10		
Tetrachloroethene	5	630
Trichloroethene	5	220
Vinyl chloride (Chloroethene)	2	3.2 J
cis-1,2-Dichloroethene	70	150
R-1		
1,1,1-Trichloroethane	200	400
1,1-Dichloroethene	7	350
Tetrachloroethene	5	6.8 J
Trichloroethene	5	27
Vinyl chloride (Chloroethene)	2	490 J
cis-1,2-Dichloroethene	70	10000
R-4		
Tetrachloroethene	5	6.9
Trichloroethene	5	13
Vinyl chloride (Chloroethene)	2	30
cis-1,2-Dichloroethene	70	79
R-5		
1,1-Dichloroethene	7	15
Tetrachloroethene	5	660
Trichloroethene	5	240
cis-1,2-Dichloroethene	70	440
TW-1		
1,2-Dichloroethane	5	8.6 J
Chloroethane (Ethyl chloride)	48	190
Vinyl chloride (Chloroethene)	2	7.4 JL
TW-2A		
Trichloroethene	5	30
TW-3		
Tetrachloroethene	5	27
Trichloroethene	5	6.3 J
Vinyl chloride (Chloroethene)	2	51
TW-4		
1,2-Dichloroethane	5	5.6
Chloroethane (Ethyl chloride)	48	95
Vinyl chloride (Chloroethene)	2	36 JL
USD-1		
Tetrachloroethene	5	68
USD-2		
Tetrachloroethene	5	86
Trichloroethene	5	620
cis-1,2-Dichloroethene	70	330
USD-3		
Tetrachloroethene	5	70
Trichloroethene	5	500
cis-1,2-Dichloroethene	70	600

Abbreviations

PZ or P = Piezometer

MW = Monitoring Well on Unocal or Coleman Property (D = Deep, S = Shallow)

USD = Monitoring Well on USD Property

PMW = Monitoring Well on Pinsker Property

R = Recovery Well

TW = Test Well

USD-MW = Monitoring Well on USD Property Installed by Unocal

J = The analyte was positively identified, the quantitation is an estimation.

L = Results may be biased low.

Notes:

1) Non-detect values above the residential screening values are not listed.

2) The 2005 groundwater monitoring event occurred from January through March 2006.

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Title: Figure 4-7 VOC Contaminants in Groundwater Above KDHE Screening Values During 2005 Event

Drawn by:	Date:	GIS File:	Figure:
gwc/aus	11/07	Fig 4-7 VOCs in GW.mxd	4-7

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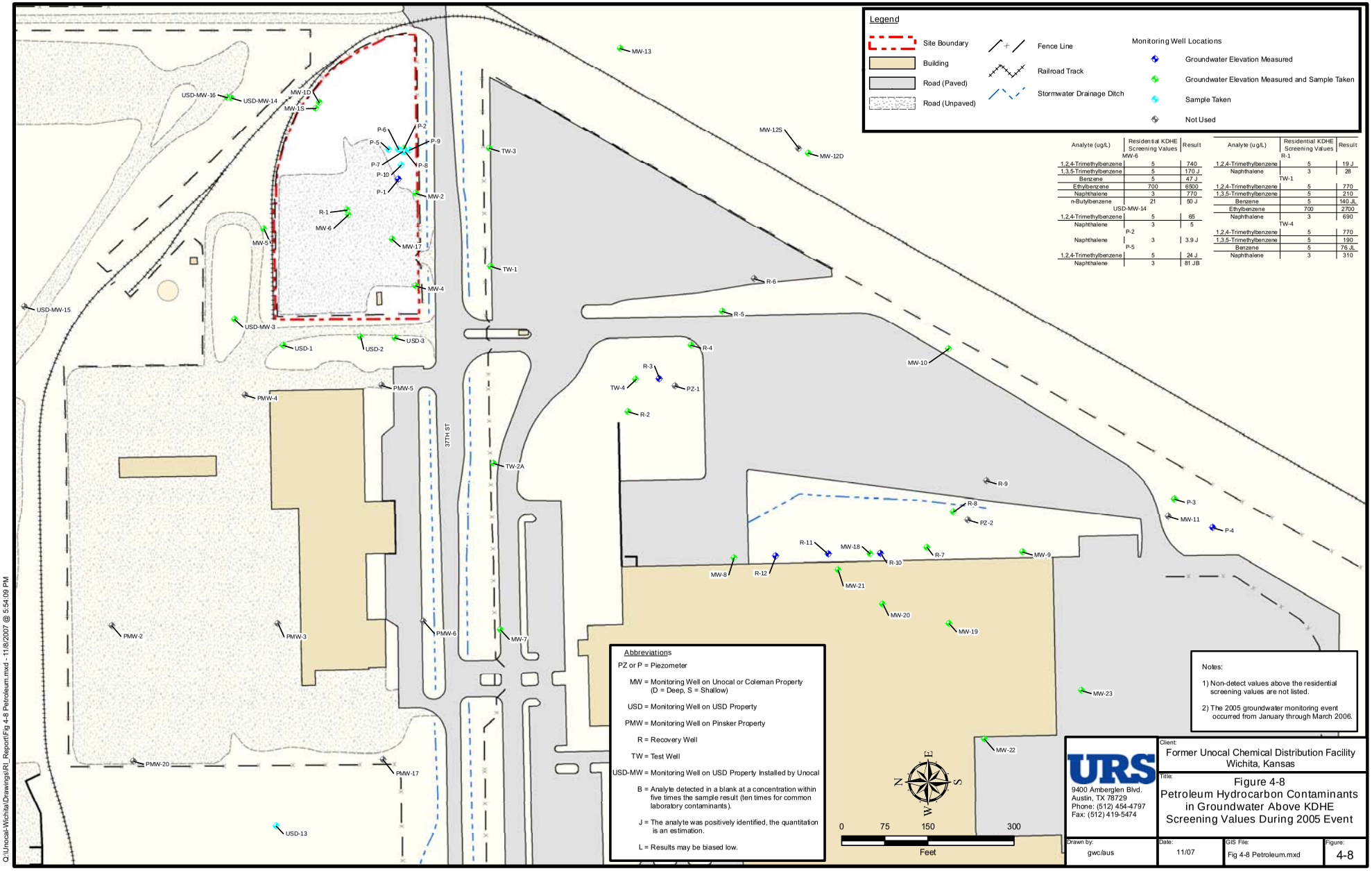

Analyte (ug/L)	Residential KDHE Screening Values	Result
MW-6		
1,2,4-Trimethylbenzene	5	740
1,3,5-Trimethylbenzene	5	170 J
Benzene	5	47 J
Ethylbenzene	700	6500
Naphthalene	3	770
n-Butylbenzene	21	50 J
USD-MW-14		
1,2,4-Trimethylbenzene	5	65
Naphthalene	3	5
P-2		
Naphthalene	3	3.9 J
P-5		
1,2,4-Trimethylbenzene	5	24 J
Naphthalene	3	81 JB

Analyte (ug/L)	Residential KDHE Screening Values	Result
R-1		
1,2,4-Trimethylbenzene	5	19 J
Naphthalene	3	28
TW-1		
1,2,4-Trimethylbenzene	5	770
1,3,5-Trimethylbenzene	5	210
Benzene	5	140 JL
Ethylbenzene	700	2700
Naphthalene	3	690
TW-4		
1,2,4-Trimethylbenzene	5	770
1,3,5-Trimethylbenzene	5	190
Benzene	5	76 JL
Naphthalene	3	310

Abbreviations

PZ or P = Piezometer

MW = Monitoring Well on Unocal or Coleman Property (D = Deep, S = Shallow)

USD = Monitoring Well on USD Property

PMW = Monitoring Well on Pinsker Property

R = Recovery Well

TW = Test Well

USD-MW = Monitoring Well on USD Property Installed by Unocal

B = Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).

J = The analyte was positively identified, the quantitation is an estimation.

L = Results may be biased low.

Notes:

1) Non-detect values above the residential screening values are not listed.

2) The 2005 groundwater monitoring event occurred from January through March 2006.

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Title: Figure 4-8 Petroleum Hydrocarbon Contaminants in Groundwater Above KDHE Screening Values During 2005 Event

Drawn by:	Date:	GIS File:	Figure:
gwc/aus	11/07	Fig 4-8 Petroleum.mxd	4-8

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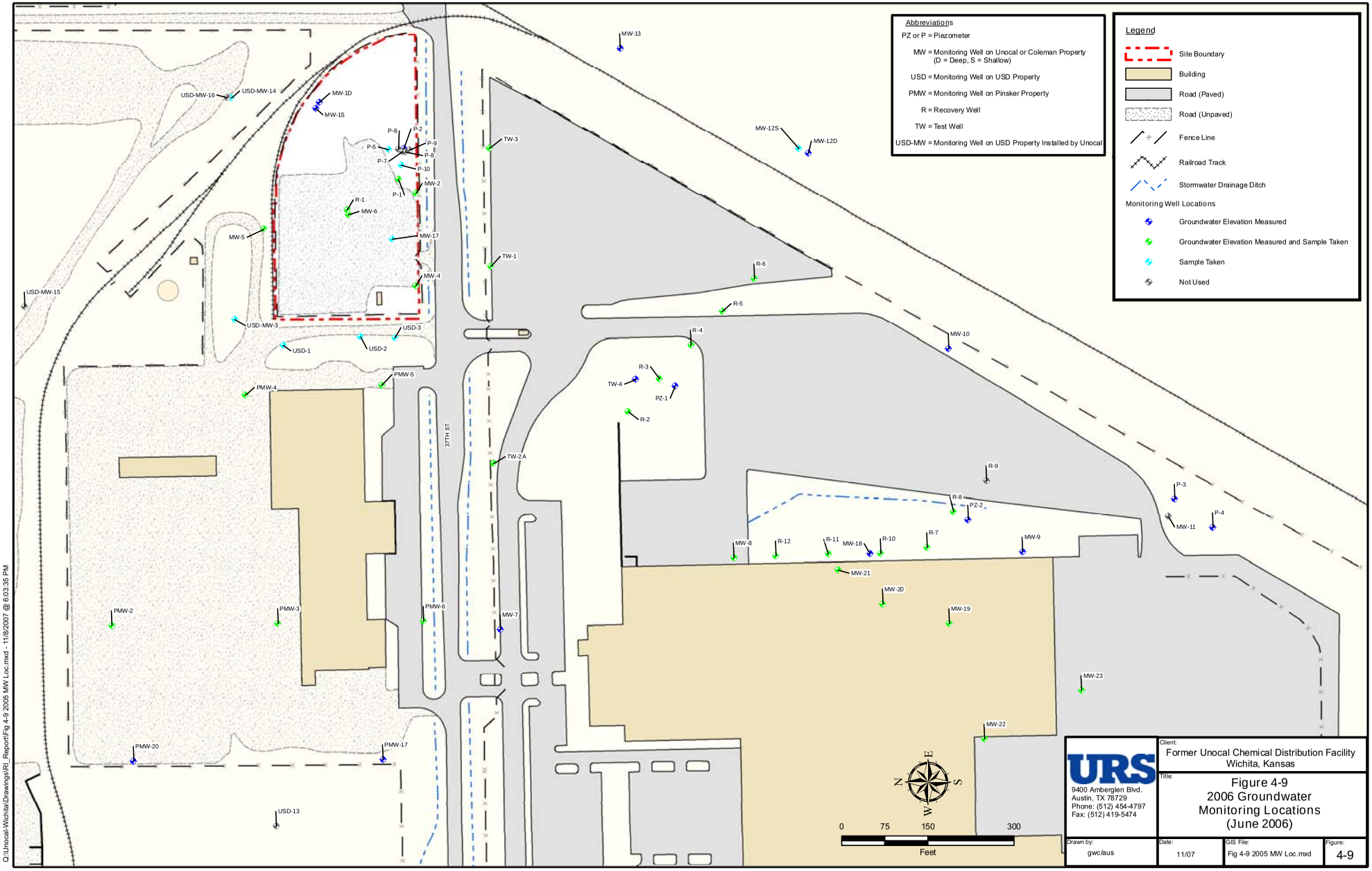

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Title: Figure 4-9 2006 Groundwater Monitoring Locations (June 2006)

Drawn by:	Date:	GIS File:	Figure:
gwc/aus	11/07	Fig 4-9 2005 MW Loc.mxd	4-9

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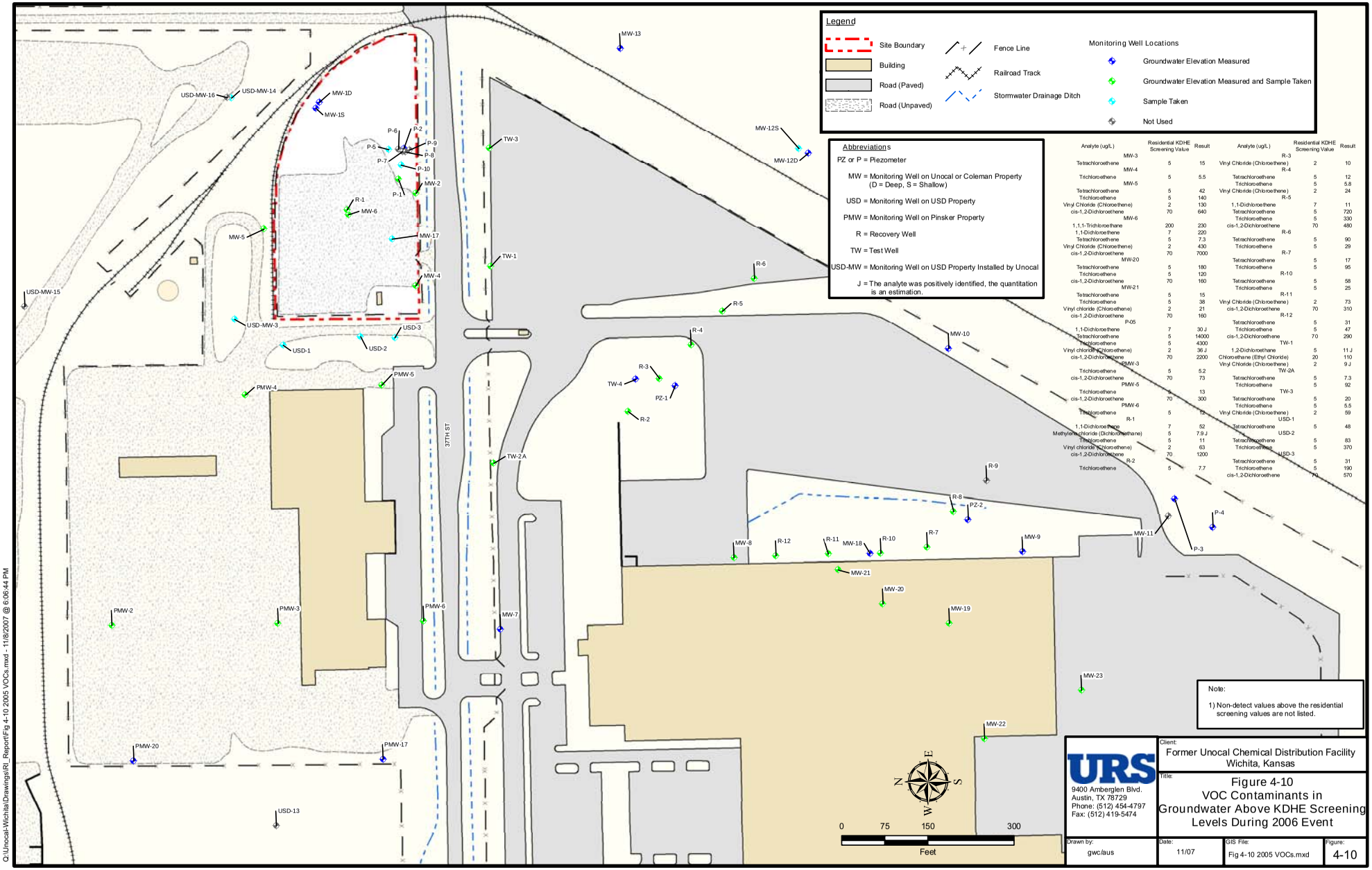

Analyte (ug/L)	Residential KDHE Screening Value	Result
MW-3		
Tetrachloroethene	5	15
MW-4		
Trichloroethene	5	5.5
MW-5		
Tetrachloroethene	5	42
Trichloroethene	5	140
Vinyl Chloride (Chloroethene)	2	130
cis-1,2-Dichloroethene	70	640
MW-6		
1,1,1-Trichloroethane	200	230
1,1-Dichloroethene	7	220
Tetrachloroethene	5	7.3
Vinyl Chloride (Chloroethene)	2	430
cis-1,2-Dichloroethene	70	7000
MW-20		
Tetrachloroethene	5	180
Trichloroethene	5	120
cis-1,2-Dichloroethene	70	160
MW-21		
Tetrachloroethene	5	15
Trichloroethene	5	38
Vinyl chloride (Chloroethene)	2	21
cis-1,2-Dichloroethene	70	160
P-05		
1,1-Dichloroethene	7	30 J
Tetrachloroethene	5	14000
Trichloroethene	5	4300
Vinyl chloride (Chloroethene)	2	36 J
cis-1,2-Dichloroethene	70	2200
PMW-3		
Trichloroethene	5	5.2
cis-1,2-Dichloroethene	70	73
PMW-5		
Trichloroethene	5	13
cis-1,2-Dichloroethene	70	300
PMW-6		
Trichloroethene	5	12
R-1		
1,1-Dichloroethene	7	52
Methylene chloride (Dichloromethane)	5	7.9 J
Trichloroethene	5	11
Vinyl chloride (Chloroethene)	2	63
cis-1,2-Dichloroethene	70	1200
R-2		
Trichloroethene	5	7.7

Analyte (ug/L)	Residential KDHE Screening Value	Result
R-3		
Vinyl Chloride (Chloroethene)	2	10
R-4		
Tetrachloroethene	5	12
Trichloroethene	5	5.8
Vinyl Chloride (Chloroethene)	2	24
R-5		
Tetrachloroethene	7	11
1,1-Dichloroethene	5	720
Trichloroethene	5	330
cis-1,2-Dichloroethene	70	480
R-6		
Tetrachloroethene	5	90
Trichloroethene	5	29
R-7		
Tetrachloroethene	5	17
Trichloroethene	5	95
R-10		
Tetrachloroethene	5	58
Trichloroethene	5	25
R-11		
Vinyl Chloride (Chloroethene)	2	73
cis-1,2-Dichloroethene	70	310
R-12		
Tetrachloroethene	5	31
Trichloroethene	5	47
cis-1,2-Dichloroethene	70	290
TW-1		
1,2-Dichloroethane	5	11 J
Chloroethane (Ethyl Chloride)	20	110
Vinyl Chloride (Chloroethene)	2	9 J
TW-2A		
Tetrachloroethene	5	7.3
Trichloroethene	5	92
TW-3		
Tetrachloroethene	5	20
Trichloroethene	5	5.5
Vinyl Chloride (Chloroethene)	2	59
USD-1		
Tetrachloroethene	5	48
USD-2		
Tetrachloroethene	5	83
Trichloroethene	5	370
USD-3		
Tetrachloroethene	5	31
Trichloroethene	5	190
cis-1,2-Dichloroethene	70	570

Note:

1) Non-detect values above the residential screening values are not listed.

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Title: Figure 4-10 VOC Contaminants in Groundwater Above KDHE Screening Levels During 2006 Event

Drawn by:	Date:	GIS File:	Figure:
gwc/aus	11/07	Fig 4-10 2005 VOCs.mxd	4-10

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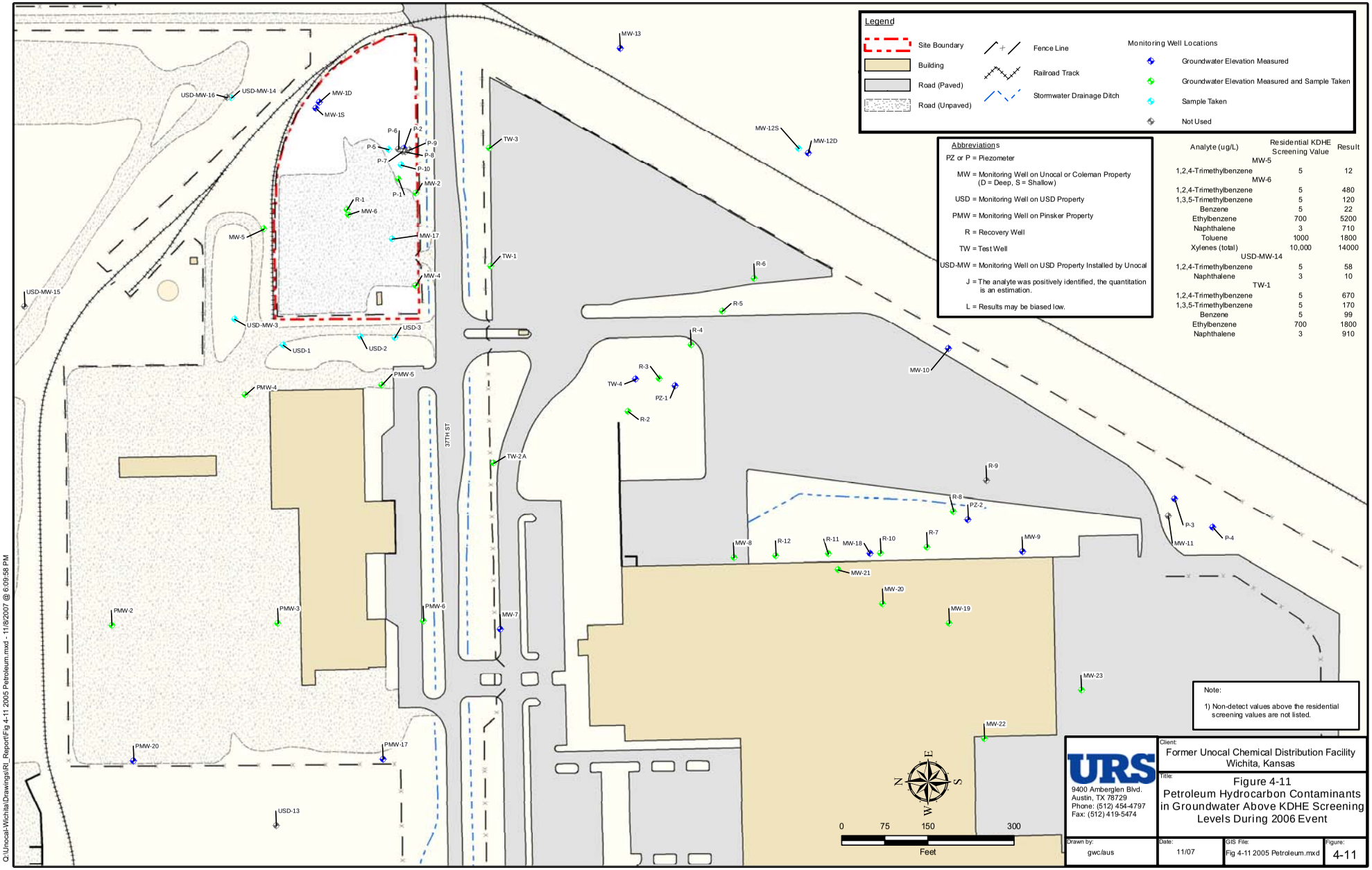
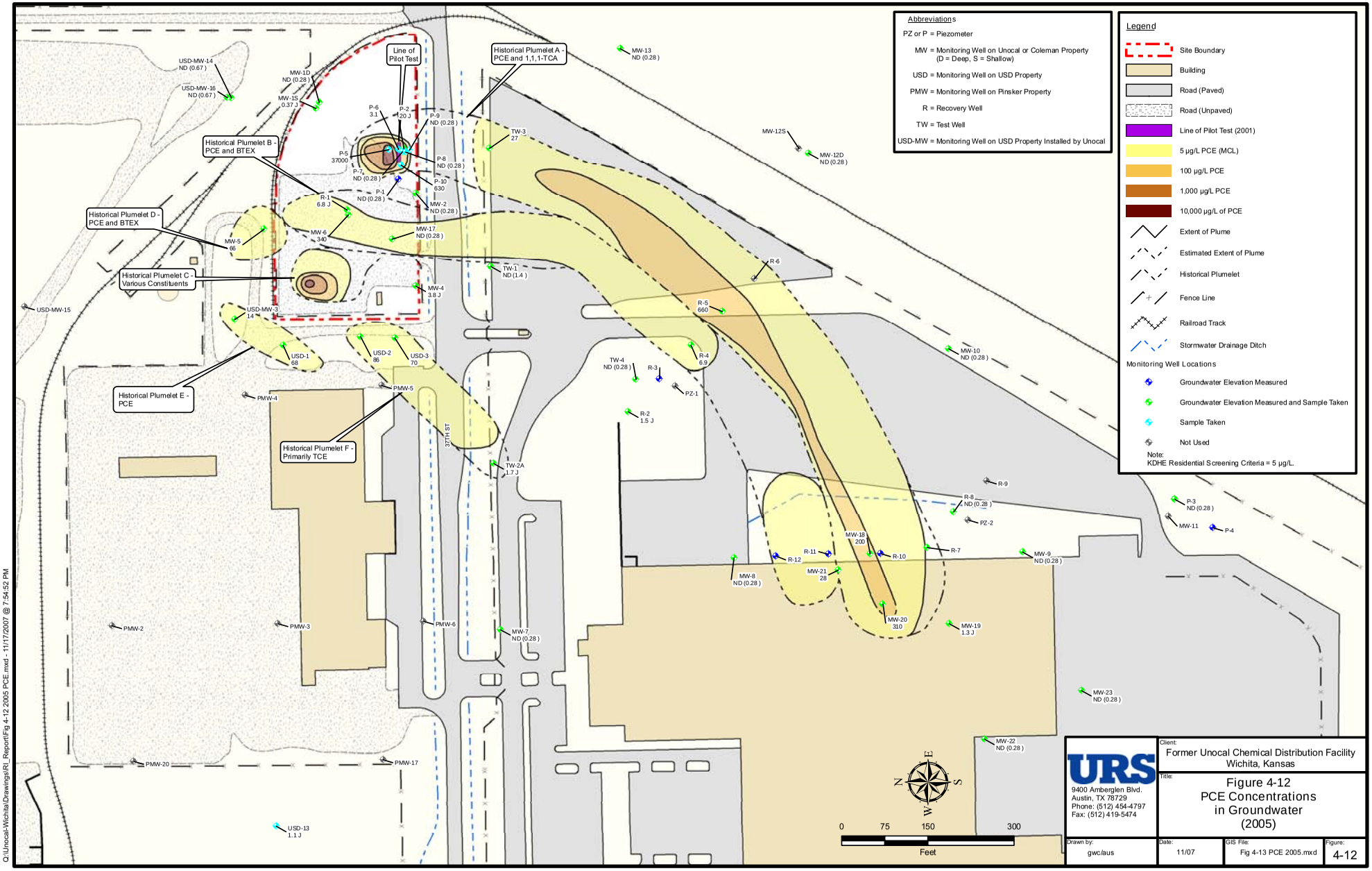


Analyte (ug/L)	Residential KDHE Screening Value	Result
MW-5		
1,2,4-Trimethylbenzene	5	12
MW-6		
1,2,4-Trimethylbenzene	5	480
1,3,5-Trimethylbenzene	5	120
Benzene	5	22
Ethylbenzene	700	5200
Naphthalene	3	710
Toluene	1000	1800
Xylenes (total)	10,000	14000
USD-MW-14		
1,2,4-Trimethylbenzene	5	58
Naphthalene	3	10
TW-1		
1,2,4-Trimethylbenzene	5	670
1,3,5-Trimethylbenzene	5	170
Benzene	5	99
Ethylbenzene	700	1800
Naphthalene	3	910



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Title: Figure 4-12 PCE Concentrations in Groundwater (2005)

Drawn by:	Date:	GIS File:	Figure:
gwc/aus	11/07	Fig 4-13 PCE 2005.mxd	4-12

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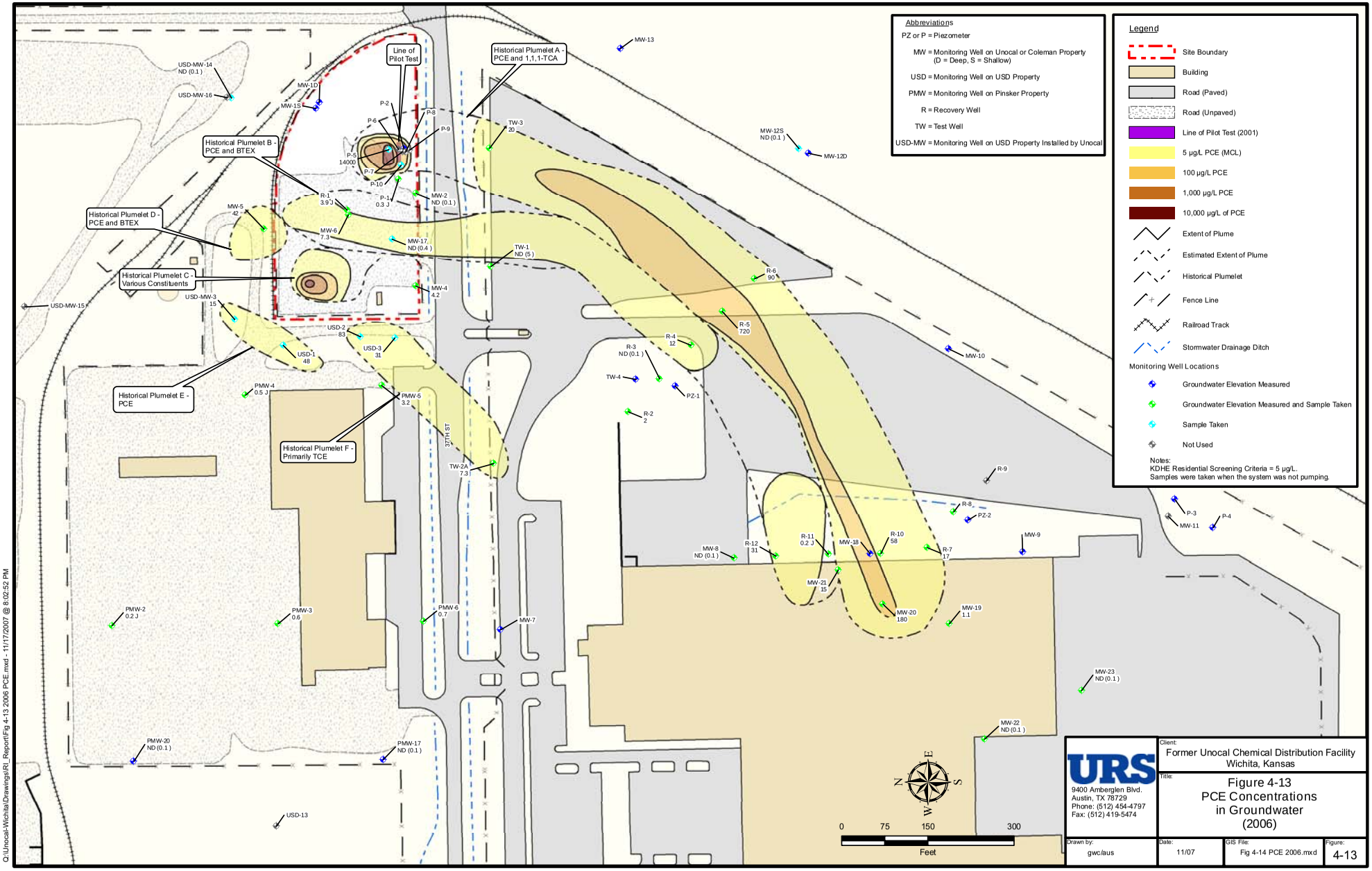
Abbreviations
PZ or P = Piezometer
MW = Monitoring Well on Unocal or Coleman Property (D = Deep, S = Shallow)
USD = Monitoring Well on USD Property
PMW = Monitoring Well on Pinsker Property
R = Recovery Well
TW = Test Well
USD-MW = Monitoring Well on USD Property Installed by Unocal
Legend
Site Boundary
Building
Road (Paved)
Road (Unpaved)
Line of Pilot Test (2001)
5 µg/L PCE (MCL)
100 µg/L PCE
1,000 µg/L PCE
10,000 µg/L of PCE
Extent of Plume
Estimated Extent of Plume
Historical Plumelet
Fence Line
Railroad Track
Stormwater Drainage Ditch
Monitoring Well Locations
Groundwater Elevation Measured
Groundwater Elevation Measured and Sample Taken
Sample Taken
Not Used
Notes:
KDHE Residential Screening Criteria = 5 µg/L.
Samples were taken when the system was not pumping.
Line of Pilot Test
Historical Plumelet A - PCE and 1,1,1-TCA
Historical Plumelet B - PCE and BTEX
Historical Plumelet C - Various Constituents
Historical Plumelet D - PCE and BTEX
Historical Plumelet E - PCE
Historical Plumelet F - Primarily TCE
37TH ST
MW-13
USD-MW-14 ND (0.1)
USD-MW-16
MW-1D
MW-1S
P-2
P-6
P-8
P-9
P-5 14000
P-7
P-10
P-1 0.3 J
R-1 3.9 J
MW-2 ND (0.1)
TW-3 20
MW-12S ND (0.1)
MW-12D
MW-5 42
MW-6 7.3
MW-17 ND (0.4)
TW-1 ND (5)
MW-4 4.2
USD-MW-15
USD-MW-3 15
USD-2 83
USD-1 48
USD-3 31
R-6 90
R-5 720
R-4 12
R-3 ND (0.1)
TW-4
PZ-1
R-2 2
MW-10
PMW-4 0.5 J
PMW-5 3.2
TW-2A 7.3
R-9
R-8
PZ-2
P-3
MW-11
P-4
MW-9
R-10 58
R-7 17
MW-18
R-11 0.2 J
R-12 31
MW-8 ND (0.1)
MW-21 15
MW-20 180
MW-19 1.1
PMW-2 0.2 J
PMW-3 0.6
PMW-6 0.7
MW-7
MW-23 ND (0.1)
MW-22 ND (0.1)
PMW-20 ND (0.1)
PMW-17 ND (0.1)
USD-13
N
E
S
W
0 75 150 300
Feet
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Title:
Figure 4-13
PCE Concentrations
in Groundwater
(2006)
Drawn by:
gwc/aus
Date:
11/07
GIS File:
Fig 4-14 PCE 2006.mxd
Figure:
4-13
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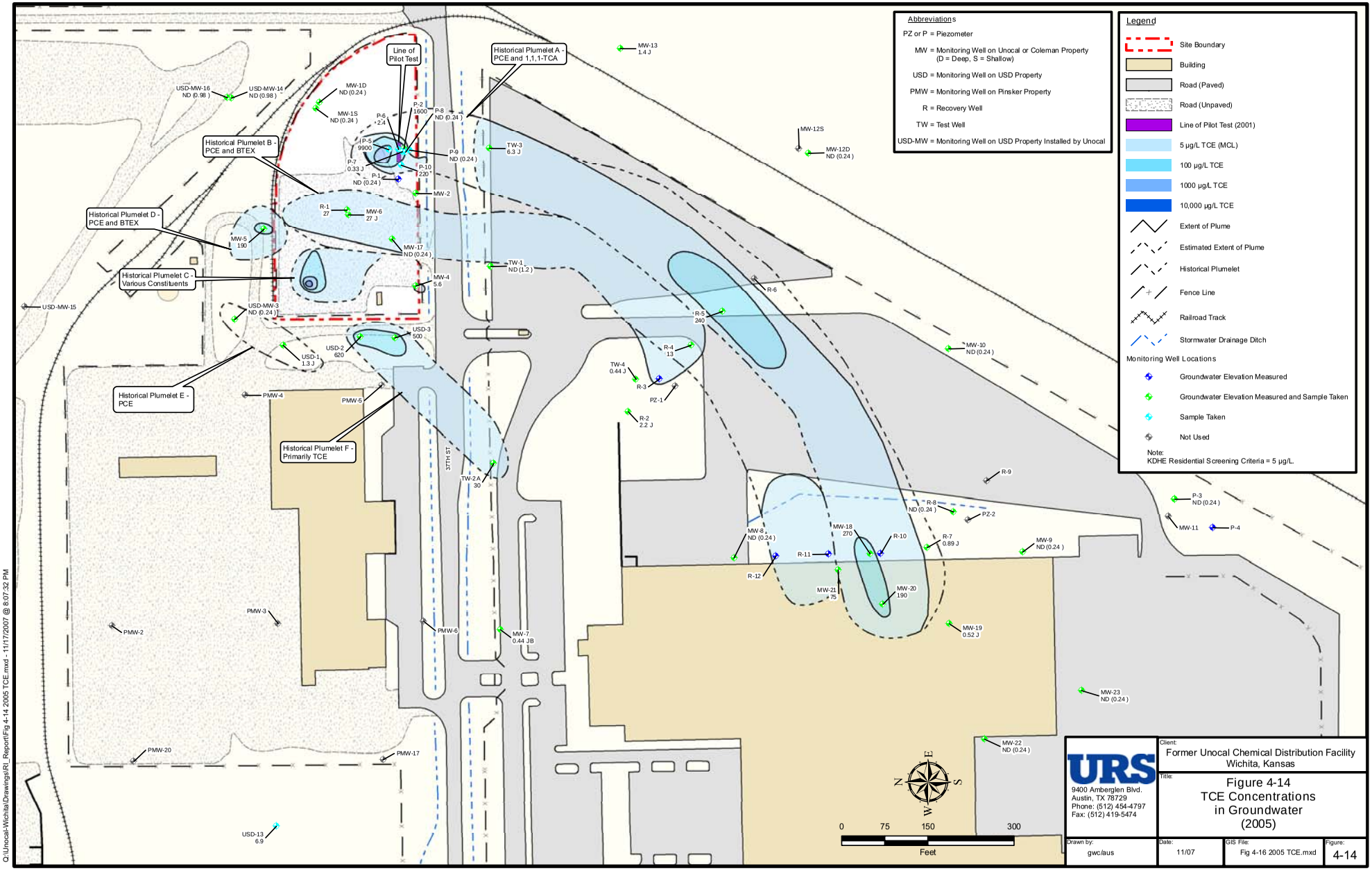

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Title: Figure 4-14 TCE Concentrations in Groundwater (2005)

Drawn by:	Date:	GIS File:	Figure:
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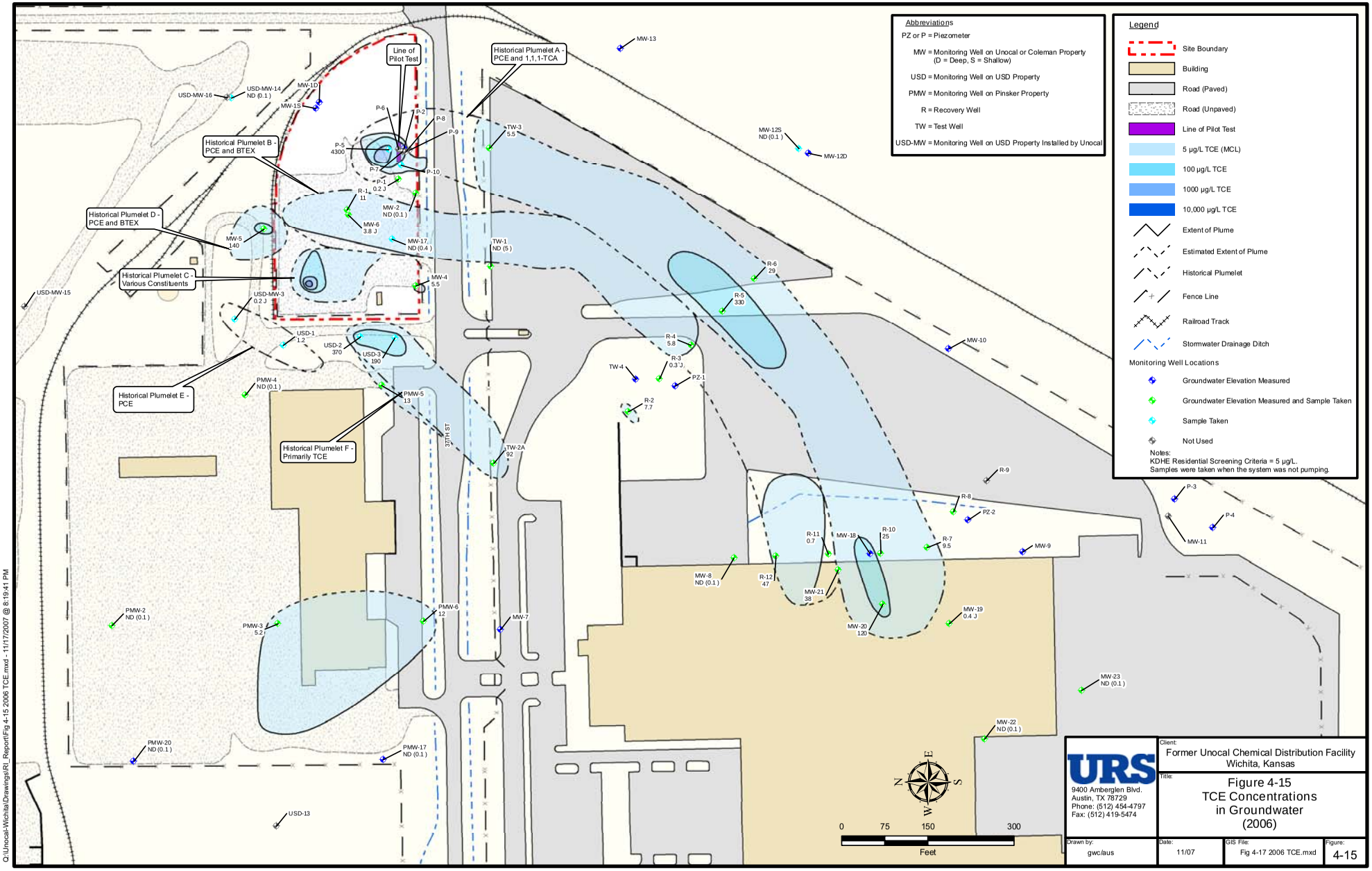

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Title: Figure 4-15 TCE Concentrations in Groundwater (2006)

Drawn by:	Date:	GIS File:	Figure:
gwc/aus	11/07	Fig 4-17 2006 TCE.mxd	4-15

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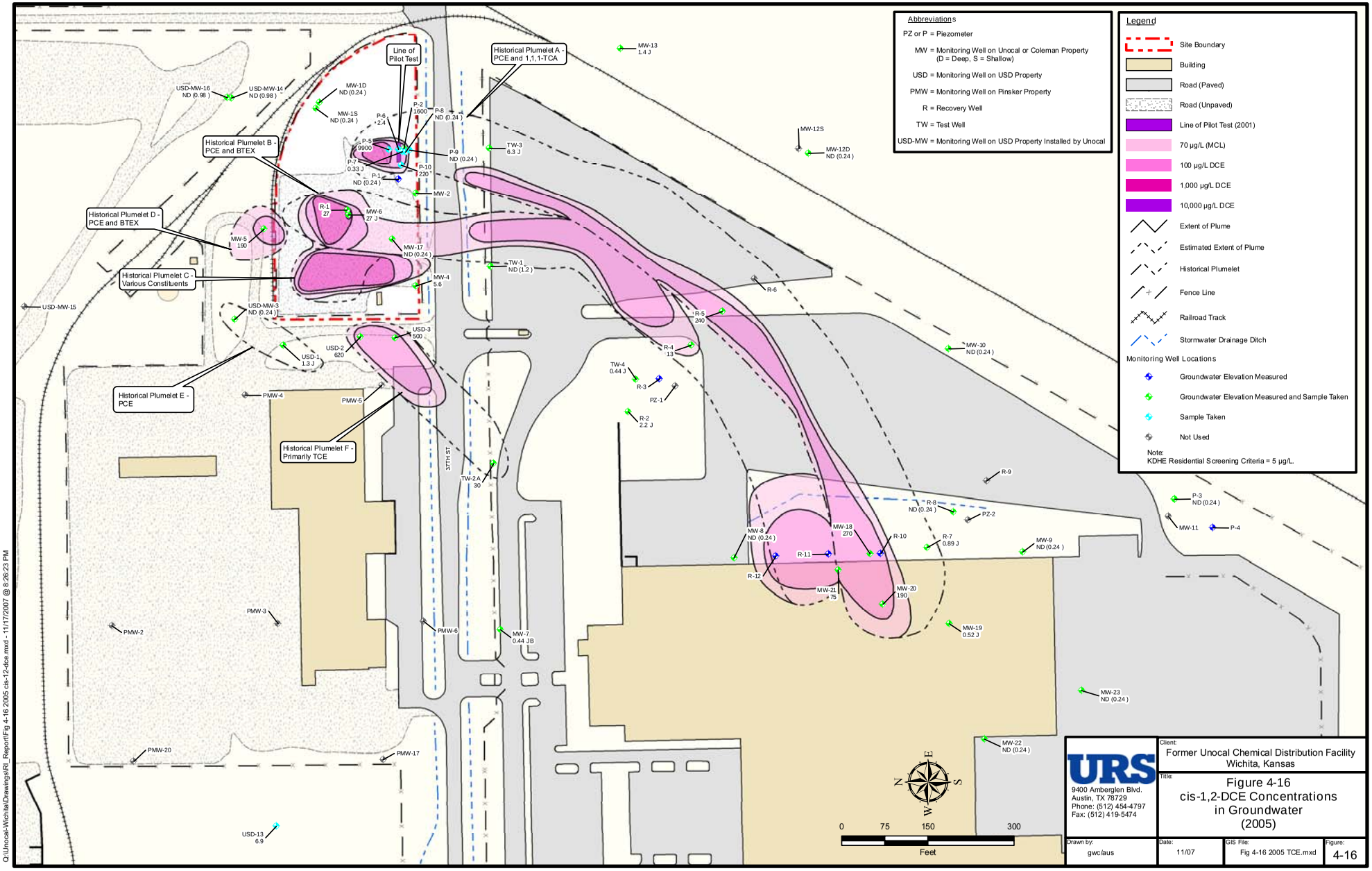

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Title: Figure 4-16 cis-1,2-DCE Concentrations in Groundwater (2005)

Drawn by:	Date:	GIS File:	Figure:
gwc/aus	11/07	Fig 4-16 2005 TCE.mxd	4-16

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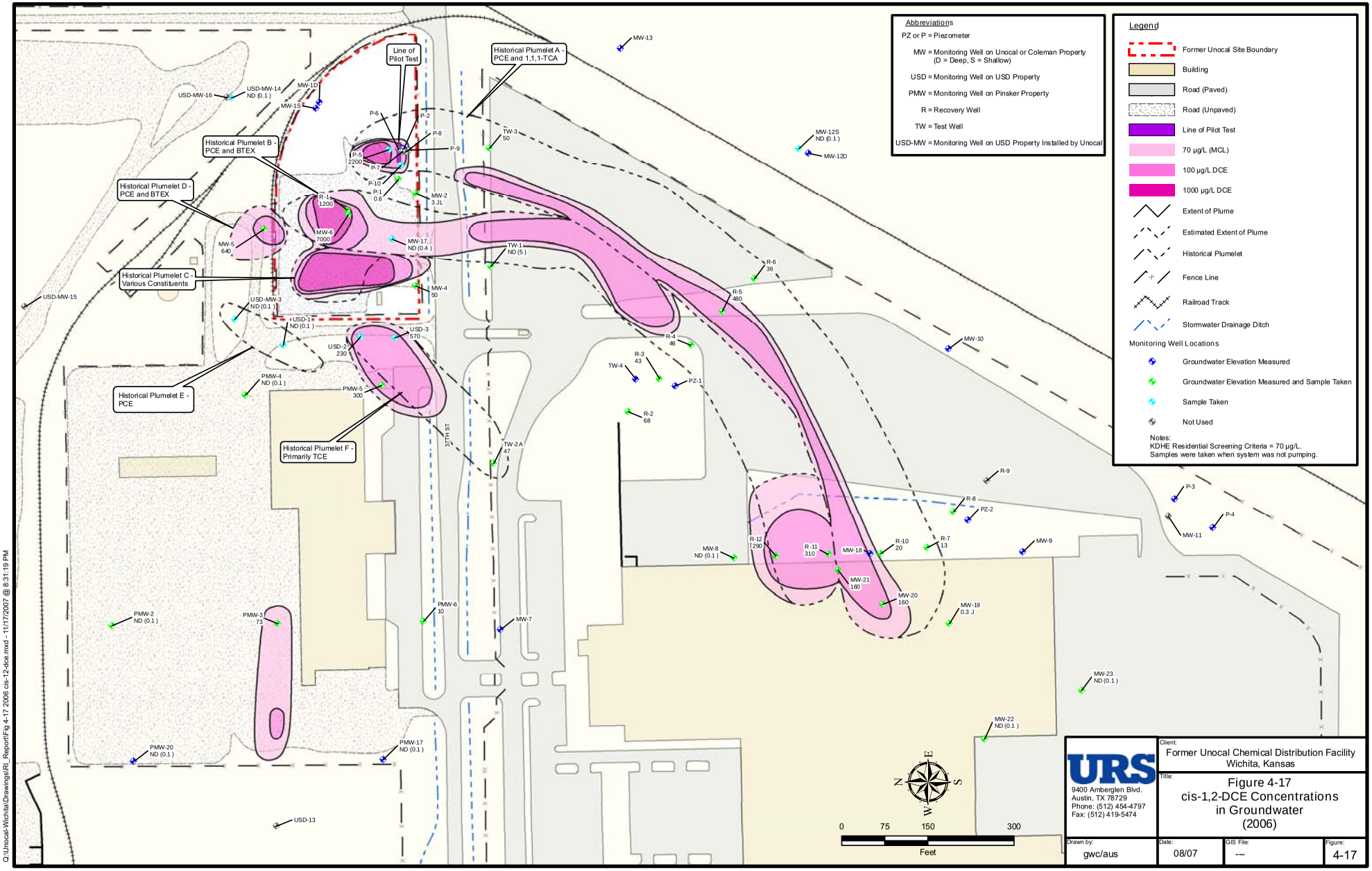

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Title: Figure 4-17 cis-1,2-DCE Concentrations in Groundwater (2006)

Drawn by:	Date:	GIS File:	Figure:
gwc/aus	08/07	---	4-17

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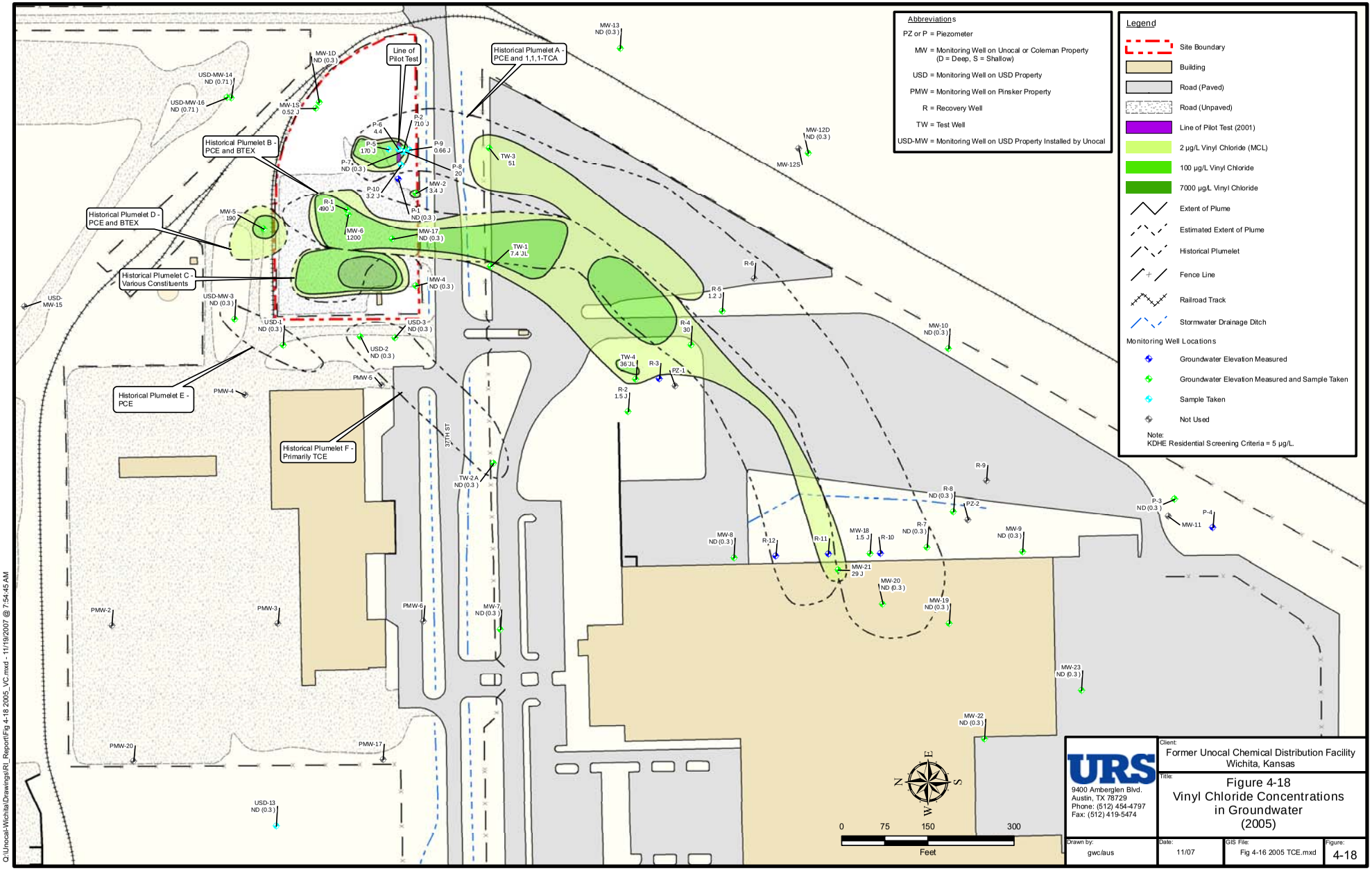

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Title: Figure 4-18 Vinyl Chloride Concentrations in Groundwater (2005)

Drawn by:	Date:	GIS File:	Figure:
gwc/aus	11/07	Fig 4-16 2005 TCE.mxd	4-18

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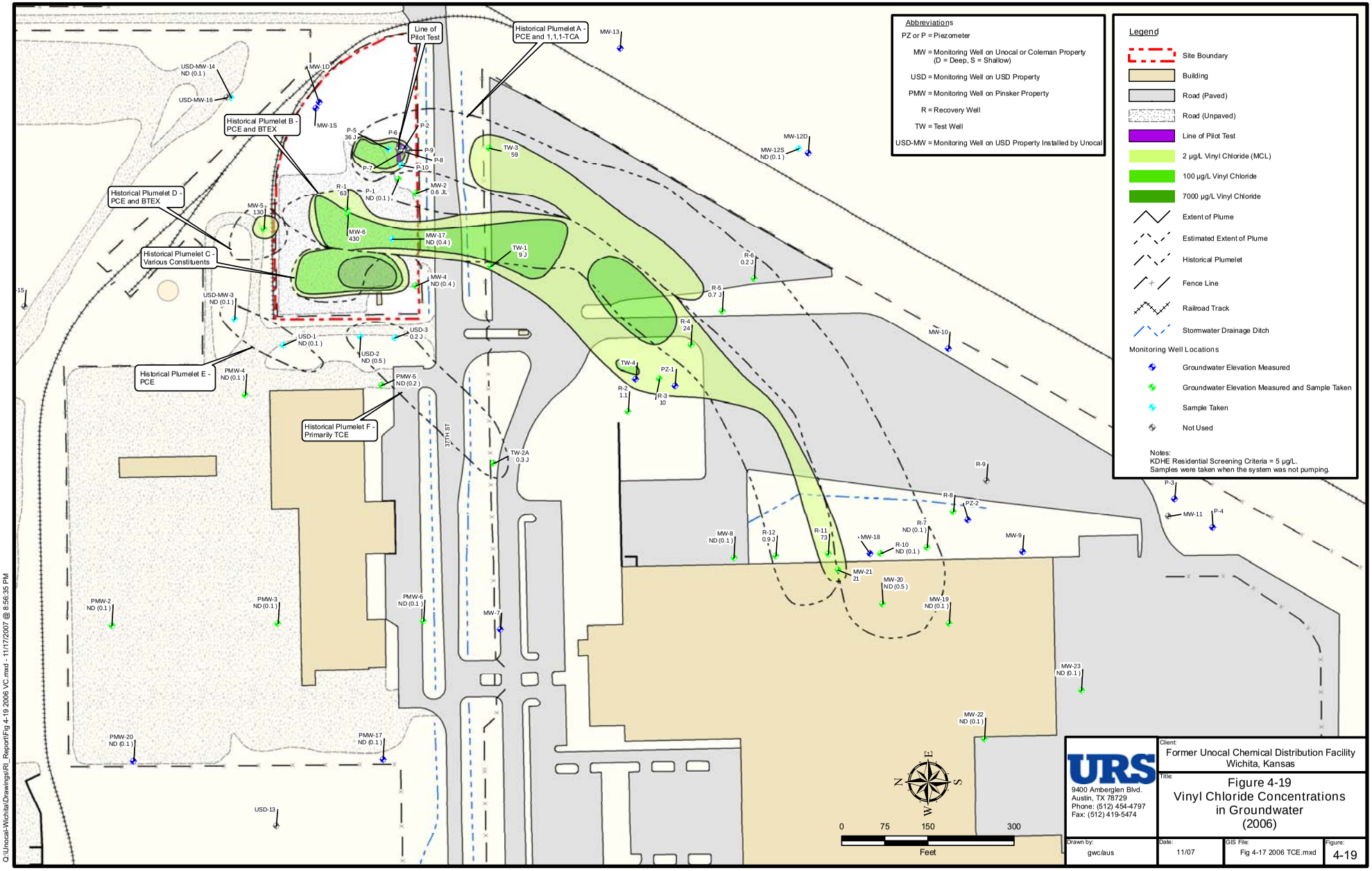

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Title: Figure 4-19 Vinyl Chloride Concentrations in Groundwater (2006)

Drawn by:	Date:	GIS File:	Figure:
gwc/aus	11/07	Fig 4-17 2006 TCE.mxd	4-19

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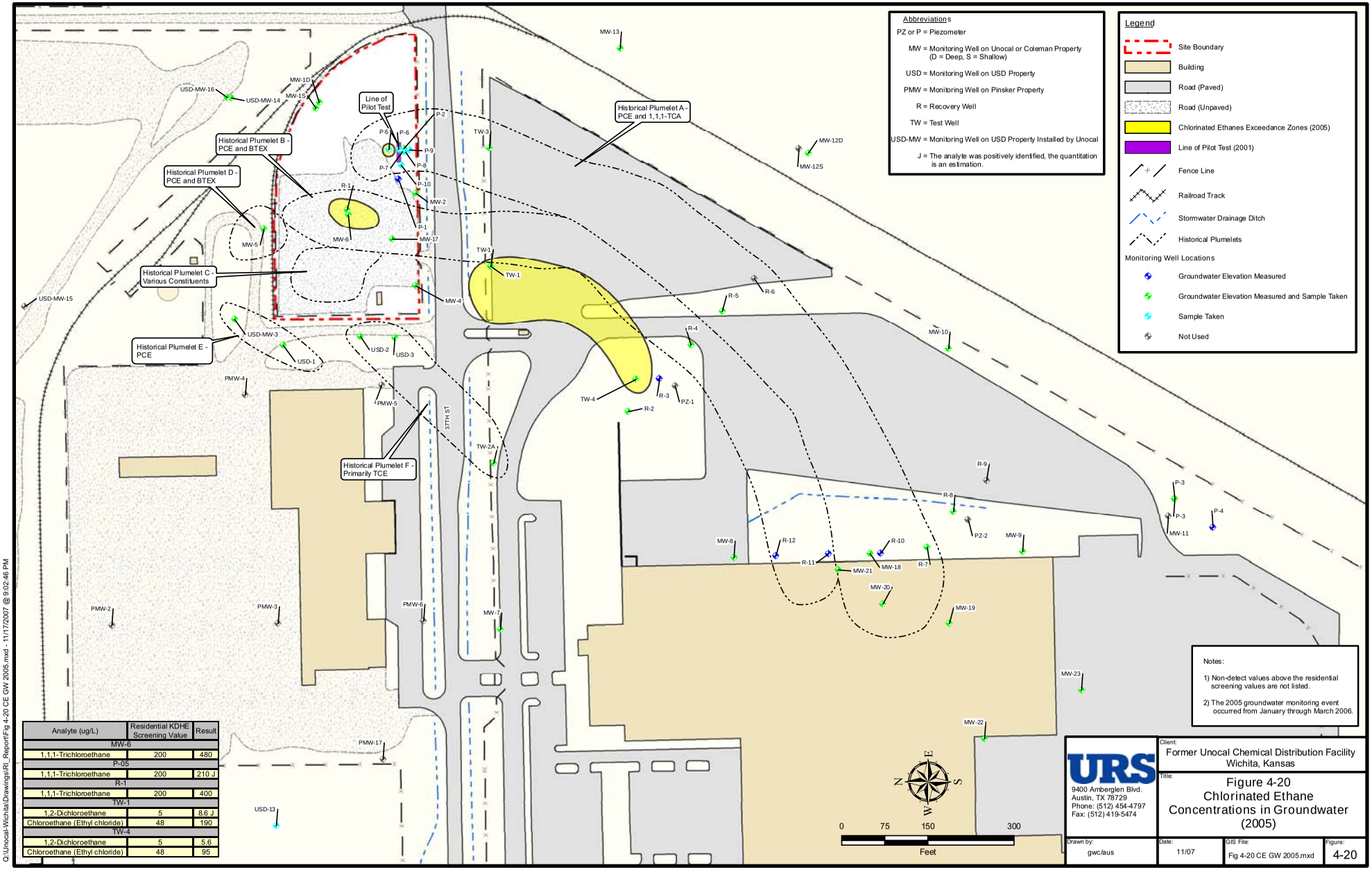

Analyte (ug/L)	Residential KDHE Screening Value	Result
MW-6		
1,1,1-Trichloroethane	200	480
P-05		
1,1,1-Trichloroethane	200	210 J
R-1		
1,1,1-Trichloroethane	200	400
TW-1		
1,2-Dichloroethane	5	8.6 J
Chloroethane (Ethyl chloride)	48	190
TW-4		
1,2-Dichloroethane	5	5.6
Chloroethane (Ethyl chloride)	48	95

Notes:

1) Non-detect values above the residential screening values are not listed.

2) The 2005 groundwater monitoring event occurred from January through March 2006.

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Title: Figure 4-20 Chlorinated Ethane Concentrations in Groundwater (2005)

Drawn by: gwc/aus | Date: 11/07 | GIS File: Fig 4-20 CE GW 2005.mxd | Figure: 4-20

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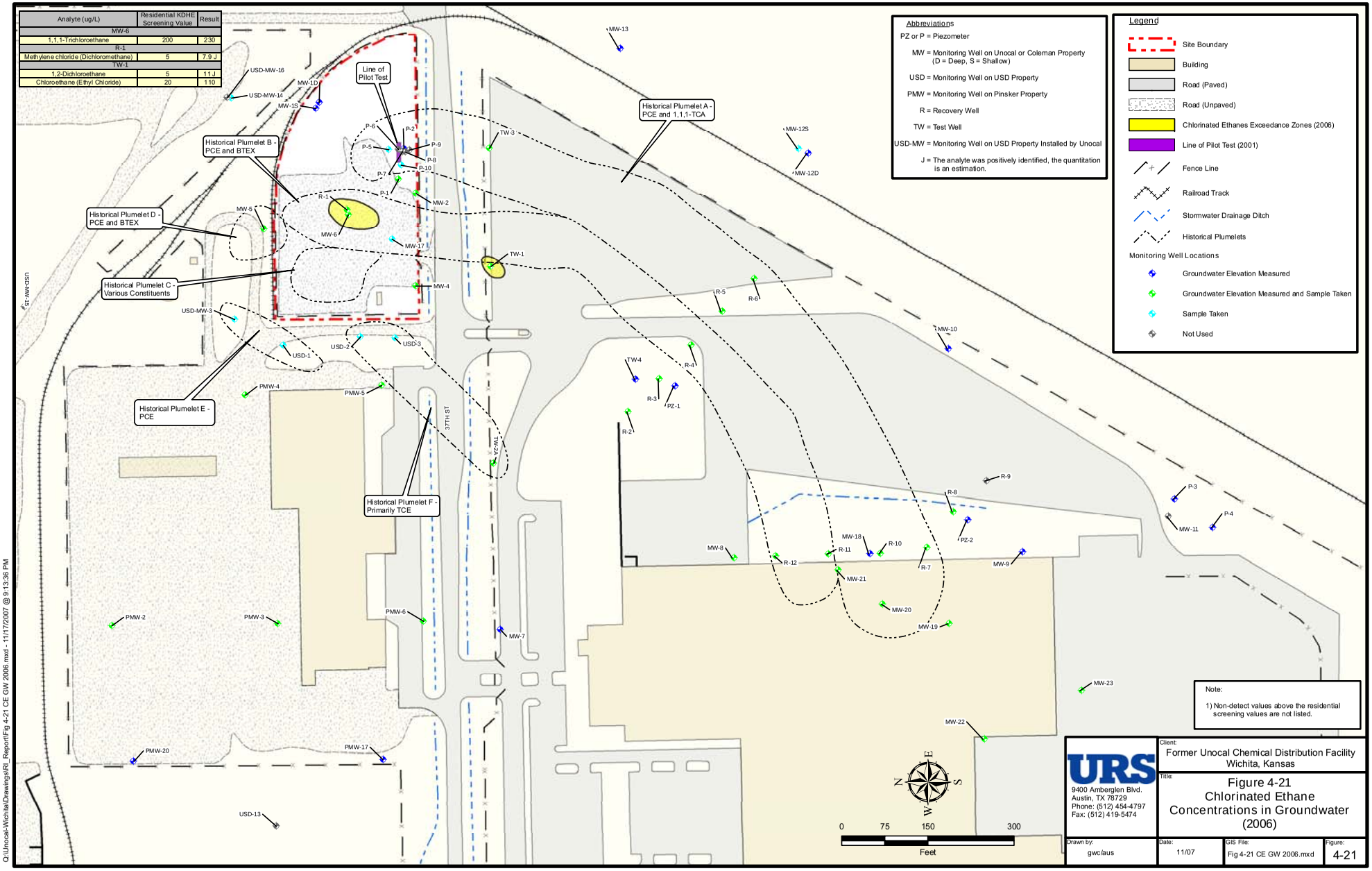
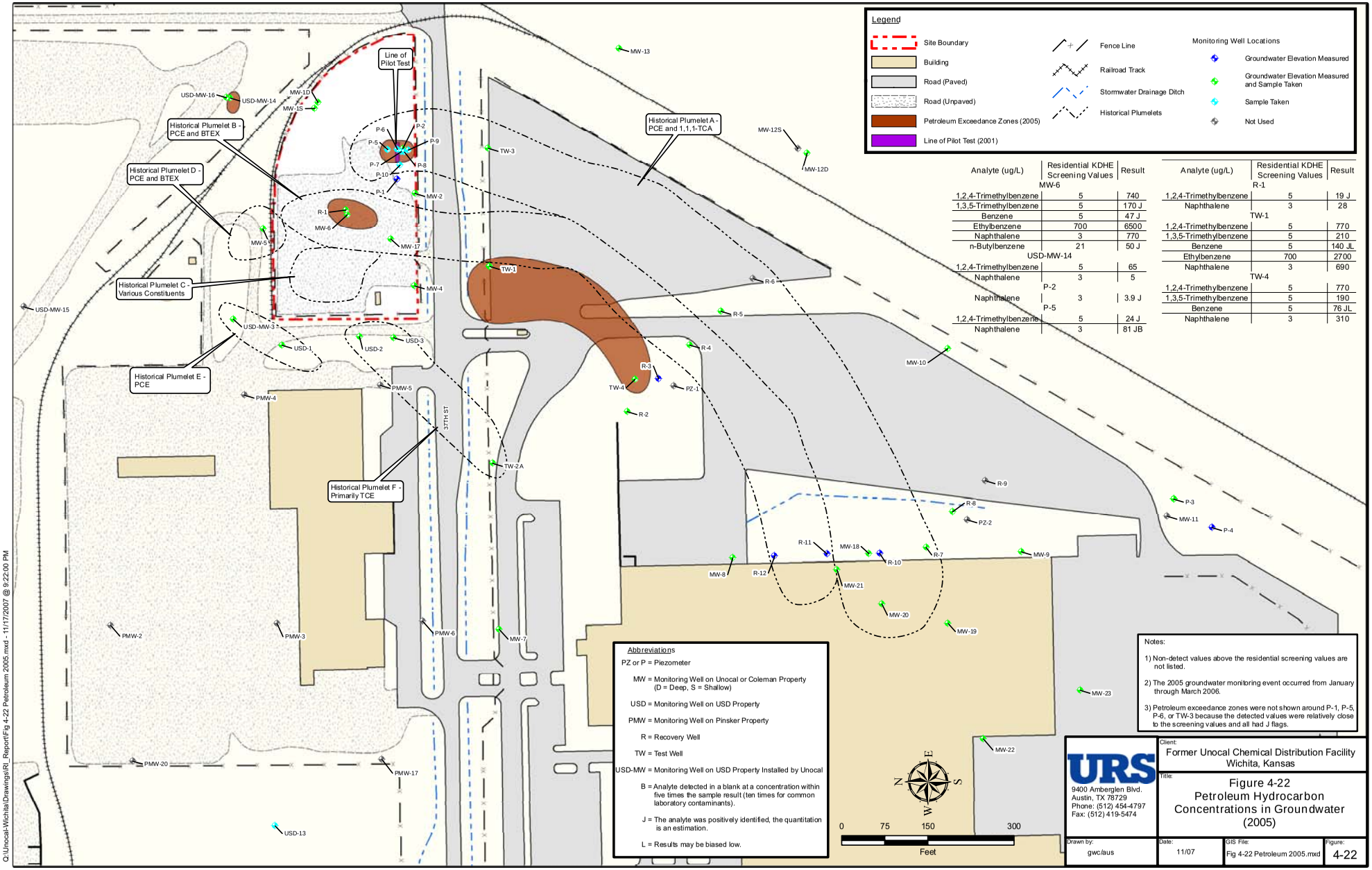


Analyte (ug/L)	Residential KDHE Screening Value	Result
MW-6		
1,1,1-Trichloroethane	200	230
R-1		
Methylene chloride (Dichloromethane)	5	7.9 J
TW-1		
1,2-Dichloroethane	5	11 J
Chloroethane (Ethyl Chloride)	20	110



Analyte (ug/L)	Residential KDHE Screening Values	Result
MW-6		
1,2,4-Trimethylbenzene	5	740
1,3,5-Trimethylbenzene	5	170 J
Benzene	5	47 J
Ethylbenzene	700	6500
Naphthalene	3	770
n-Butylbenzene	21	50 J
USD-MW-14		
1,2,4-Trimethylbenzene	5	65
Naphthalene	3	5
P-2		
Naphthalene	3	3.9 J
P-5		
1,2,4-Trimethylbenzene	5	24 J
Naphthalene	3	81 JB

Analyte (ug/L)	Residential KDHE Screening Values	Result
R-1		
1,2,4-Trimethylbenzene	5	19 J
Naphthalene	3	28
TW-1		
1,2,4-Trimethylbenzene	5	770
1,3,5-Trimethylbenzene	5	210
Benzene	5	140 JL
Ethylbenzene	700	2700
Naphthalene	3	690
TW-4		
1,2,4-Trimethylbenzene	5	770
1,3,5-Trimethylbenzene	5	190
Benzene	5	76 JL
Naphthalene	3	310

Abbreviations

PZ or P = Piezometer

MW = Monitoring Well on Unocal or Coleman Property (D = Deep, S = Shallow)

USD = Monitoring Well on USD Property

PMW = Monitoring Well on Pinsker Property

R = Recovery Well

TW = Test Well

USD-MW = Monitoring Well on USD Property Installed by Unocal

B = Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).

J = The analyte was positively identified, the quantitation is an estimation.

L = Results may be biased low.

Notes:

1) Non-detect values above the residential screening values are not listed.

2) The 2005 groundwater monitoring event occurred from January through March 2006.

3) Petroleum exceedance zones were not shown around P-1, P-5, P-6, or TW-3 because the detected values were relatively close to the screening values and all had J flags.

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Title: Figure 4-22 Petroleum Hydrocarbon Concentrations in Groundwater (2005)

Drawn by:	Date:	GIS File:	Figure:
gwc/aus	11/07	Fig 4-22 Petroleum 2005.mxd	4-22

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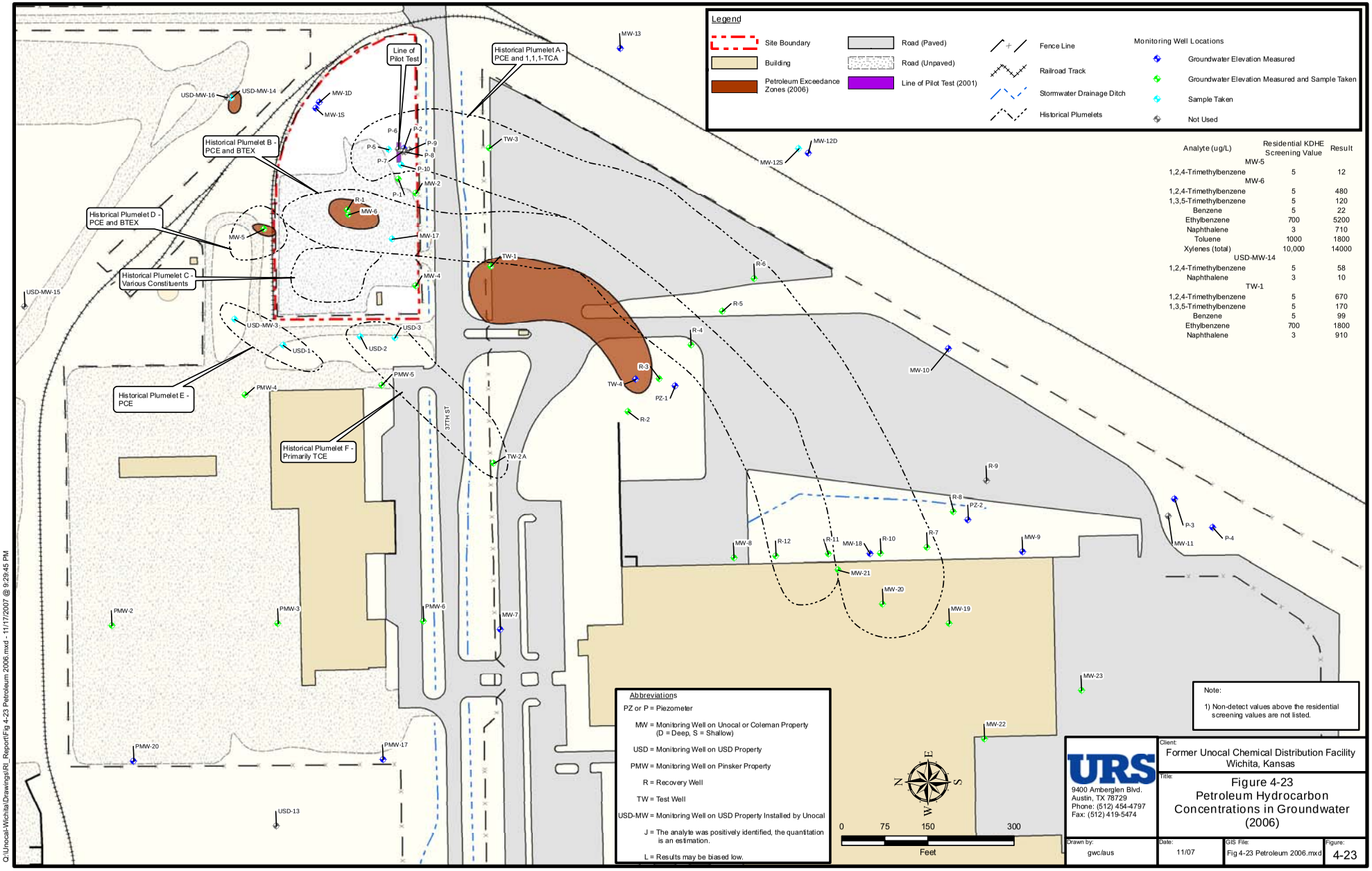

Analyte (ug/L)	Residential KDHE Screening Value	Result
MW-5		
1,2,4-Trimethylbenzene	5	12
MW-6		
1,2,4-Trimethylbenzene	5	480
1,3,5-Trimethylbenzene	5	120
Benzene	5	22
Ethylbenzene	700	5200
Naphthalene	3	710
Toluene	1000	1800
Xylenes (total)	10,000	14000
USD-MW-14		
1,2,4-Trimethylbenzene	5	58
Naphthalene	3	10
TW-1		
1,2,4-Trimethylbenzene	5	670
1,3,5-Trimethylbenzene	5	170
Benzene	5	99
Ethylbenzene	700	1800
Naphthalene	3	910

Abbreviations

PZ or P = Piezometer

MW = Monitoring Well on Unocal or Coleman Property (D = Deep, S = Shallow)

USD = Monitoring Well on USD Property

PMW = Monitoring Well on Pinsker Property

R = Recovery Well

TW = Test Well

USD-MW = Monitoring Well on USD Property Installed by Unocal

J = The analyte was positively identified, the quantitation is an estimation.

L = Results may be biased low.

Note:

1) Non-detect values above the residential screening values are not listed.

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Title: Figure 4-23 Petroleum Hydrocarbon Concentrations in Groundwater (2006)

Drawn by: gwc/aus | Date: 11/07 | GIS File: Fig 4-23 Petroleum 2006.mxd | Figure: 4-23

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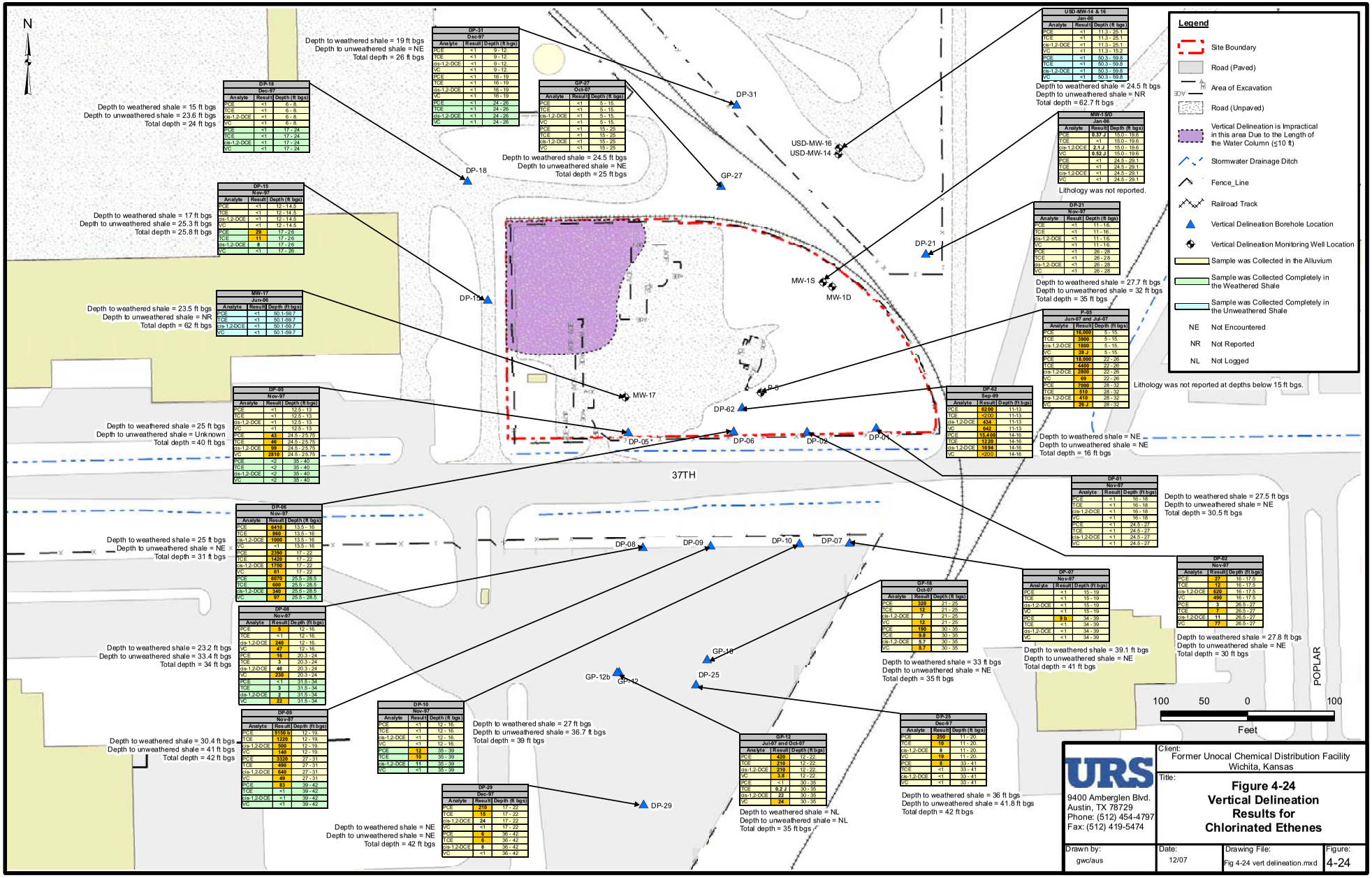

DP-18 Dec-97		
Analyte	Result	Depth (ft bgs)
PCE	<1	6 - 8.
TCE	<1	6 - 8.
cis-1,2-DCE	<1	6 - 8.
VC	<1	6 - 8
PCE	<1	17 - 24
TCE	<1	17 - 24
cis-1,2-DCE	<1	17 - 24
VC	<1	17 - 24

DP-31 Dec-97		
Analyte	Result	Depth (ft bgs)
PCE	<1	9 - 12.
TCE	<1	9 - 12.
cis-1,2-DCE	<1	9 - 12.
VC	<1	9 - 12.
PCE	<1	16 - 19
TCE	<1	16 - 19
cis-1,2-DCE	<1	16 - 19
VC	<1	16 - 19
PCE	<1	24 - 26
TCE	<1	24 - 26
cis-1,2-DCE	<1	24 - 26
VC	<1	24 - 26

GP-27 Oct-07		
Analyte	Result	Depth (ft bgs)
PCE	<1	5 - 15.
TCE	<1	5 - 15.
cis-1,2-DCE	<1	5 - 15.
VC	<1	5 - 15.
PCE	<1	15 - 25
TCE	<1	15 - 25
cis-1,2-DCE	<1	15 - 25
VC	<1	15 - 25

USD-MW-14 & 16 Jan-06		
Analyte	Result	Depth (ft bgs)
PCE	<1	11.3 - 25.1
TCE	<1	11.3 - 25.1
cis-1,2-DCE	<1	11.3 - 25.1
VC	<1	11.3 - 15.2
PCE	<1	50.3 - 59.8
TCE	<1	50.3 - 59.8
cis-1,2-DCE	<1	50.3 - 59.8
VC	<1	50.3 - 59.8

MW-13/D Jan-06		
Analyte	Result	Depth (ft bgs)
PCE	0.37 J	15.0 - 19.6
TCE	<1	15.0 - 19.6
cis-1,2-DCE	2.1 J	15.0 - 19.6
VC	0.52 J	15.0 - 19.6
PCE	<1	24.5 - 29.1
TCE	<1	24.5 - 29.1
cis-1,2-DCE	<1	24.5 - 29.1
VC	<1	24.5 - 29.1

DP-21 Nov-97		
Analyte	Result	Depth (ft bgs)
PCE	<1	11 - 16.
TCE	<1	11 - 16.
cis-1,2-DCE	<1	11 - 16.
VC	<1	11 - 16.
PCE	<1	26 - 28
TCE	<1	26 - 28
cis-1,2-DCE	<1	26 - 28
VC	<1	26 - 28

DP-15 Nov-97		
Analyte	Result	Depth (ft bgs)
PCE	<1	12 - 14.5
TCE	<1	12 - 14.5
cis-1,2-DCE	<1	12 - 14.5
VC	<1	12 - 14.5
PCE	29	17 - 26
TCE	11	17 - 26
cis-1,2-DCE	8	17 - 26
VC	<1	17 - 26

MW-17 Jun-06		
Analyte	Result	Depth (ft bgs)
PCE	<1	50.1-59.7
TCE	<1	50.1-59.7
cis-1,2-DCE	<1	50.1-59.7
VC	<1	50.1-59.7

P-05 Jun-07 and Jul-07		
Analyte	Result	Depth (ft bgs)
PCE	16,000	5 - 15.
TCE	3900	5 - 15.
cis-1,2-DCE	1600	5 - 15.
VC	28 J	5 - 15.
PCE	18,000	22 - 26
TCE	4400	22 - 26
cis-1,2-DCE	2800	22 - 26
VC	69	22 - 26
PCE	7000	28 - 32
TCE	510	28 - 32
cis-1,2-DCE	410	28 - 32
VC	26 J	28 - 32

DP-05 Nov-97		
Analyte	Result	Depth (ft bgs)
PCE	<1	12.5 - 13
TCE	<1	12.5 - 13
cis-1,2-DCE	<1	12.5 - 13
VC	<1	12.5 - 13
PCE	43	24.5 - 25.75
TCE	46	24.5 - 25.75
cis-1,2-DCE	99	24.5 - 25.75
VC	2810	24.5 - 25.75
PCE	<2	35 - 40
TCE	<2	35 - 40
cis-1,2-DCE	<2	35 - 40
VC	<2	35 - 40

DP-02 Sep-09		
Analyte	Result	Depth (ft bgs)
PCE	62.00	11-13
TCE	<200	11-13
cis-1,2-DCE	434	11-13
VC	642	11-13
PCE	15,400	14-16
TCE	12.00	14-16
cis-1,2-DCE	10.94	14-16
VC	<200	14-16

DP-01 Nov-97		
Analyte	Result	Depth (ft bgs)
PCE	<1	16 - 18
TCE	<1	16 - 18
cis-1,2-DCE	<1	16 - 18
VC	<1	16 - 18
PCE	<1	24.5 - 27
TCE	<1	24.5 - 27
cis-1,2-DCE	<1	24.5 - 27
VC	<1	24.5 - 27

DP-06 Nov-97		
Analyte	Result	Depth (ft bgs)
PCE	6410	13.5 - 16
TCE	800	13.5 - 16
cis-1,2-DCE	1900	13.5 - 16
VC	<1	13.5 - 16
PCE	2300	17 - 22
TCE	1420	17 - 22
cis-1,2-DCE	1750	17 - 22
VC	61	17 - 22
PCE	6070	25.5 - 28.5
TCE	600	25.5 - 28.5
cis-1,2-DCE	340	25.5 - 28.5
VC	97	25.5 - 28.5

DP-08 Nov-97		
Analyte	Result	Depth (ft bgs)
PCE	5	12 - 16.
TCE	<1	12 - 16.
cis-1,2-DCE	240	12 - 16.
VC	47	12 - 16.
PCE	16	20.3 - 24
TCE	3	20.3 - 24
cis-1,2-DCE	46	20.3 - 24
VC	230	20.3 - 24
PCE	<1	31.5 - 34
TCE	3	31.5 - 34
cis-1,2-DCE	2	31.5 - 34
VC	22	31.5 - 34

DP-09 Nov-97		
Analyte	Result	Depth (ft bgs)
PCE	5150 b	12 - 19.
TCE	1220	12 - 19.
cis-1,2-DCE	500	12 - 19.
VC	140	12 - 19.
PCE	3320	27 - 31
TCE	490	27 - 31
cis-1,2-DCE	640	27 - 31
VC	49	27 - 31
PCE	53	39 - 42
TCE	<1	39 - 42
cis-1,2-DCE	<1	39 - 42
VC	<1	39 - 42

DP-10 Nov-97		
Analyte	Result	Depth (ft bgs)
PCE	<1	12 - 16
TCE	<1	12 - 16.
cis-1,2-DCE	<1	12 - 16.
VC	<1	12 - 16.
PCE	12	35 - 39
TCE	10	35 - 39
cis-1,2-DCE	11	35 - 39
VC	<1	35 - 39

DP-29 Dec-97		
Analyte	Result	Depth (ft bgs)
PCE	210	17 - 22
TCE	15	17 - 22
cis-1,2-DCE	24	17 - 22
VC	<1	17 - 22
PCE	6	36 - 42
TCE	6	36 - 42
cis-1,2-DCE	8	36 - 42
VC	<1	36 - 42

GP-16 Oct-07		
Analyte	Result	Depth (ft bgs)
PCE	320	21 - 25
TCE	12	21 - 25
cis-1,2-DCE	7	21 - 25
VC	12	21 - 25
PCE	190	30 - 35
TCE	9.8	30 - 35
cis-1,2-DCE	5.7	30 - 35
VC	8.7	30 - 35

GP-12 Jul-07 and Oct-07		
Analyte	Result	Depth (ft bgs)
PCE	420	12 - 22
TCE	210	12 - 22
cis-1,2-DCE	210	12 - 22
VC	3.8	12 - 22
PCE	<1	30 - 35
TCE	0.2 J	30 - 35
cis-1,2-DCE	22	30 - 35
VC	24	30 - 35

DP-25 Dec-07		
Analyte	Result	Depth (ft bgs)
PCE	250	11 - 20.
TCE	10	11 - 20.
cis-1,2-DCE	8	11 - 20.
VC	18	11 - 20.
PCE	8	33 - 41
TCE	<1	33 - 41
cis-1,2-DCE	<1	33 - 41
VC	<1	33 - 41

DP-07 Nov-07		
Analyte	Result	Depth (ft bgs)
PCE	<1	15 - 19
TCE	<1	15 - 19
cis-1,2-DCE	<1	15 - 19
VC	<1	15 - 19
PCE	9 b	34 - 39
TCE	<1	34 - 39
cis-1,2-DCE	<1	34 - 39
VC	<1	34 - 39

DP-02 Nov-97		
Analyte	Result	Depth (ft bgs)
PCE	27	16 - 17.5
TCE	12	16 - 17.5
cis-1,2-DCE	520	16 - 17.5
VC	490	16 - 17.5
PCE	3	26.5 - 27
TCE	7	26.5 - 27
cis-1,2-DCE	11	26.5 - 27
VC	77	26.5 - 27

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Title: **Figure 4-24 Vertical Delineation Results for Chlorinated Ethenes**

Drawn by:	Date:	Drawing File:	Figure:
gwc/aus	12/07	Fig 4-24 vert delineation.mxd	4-24

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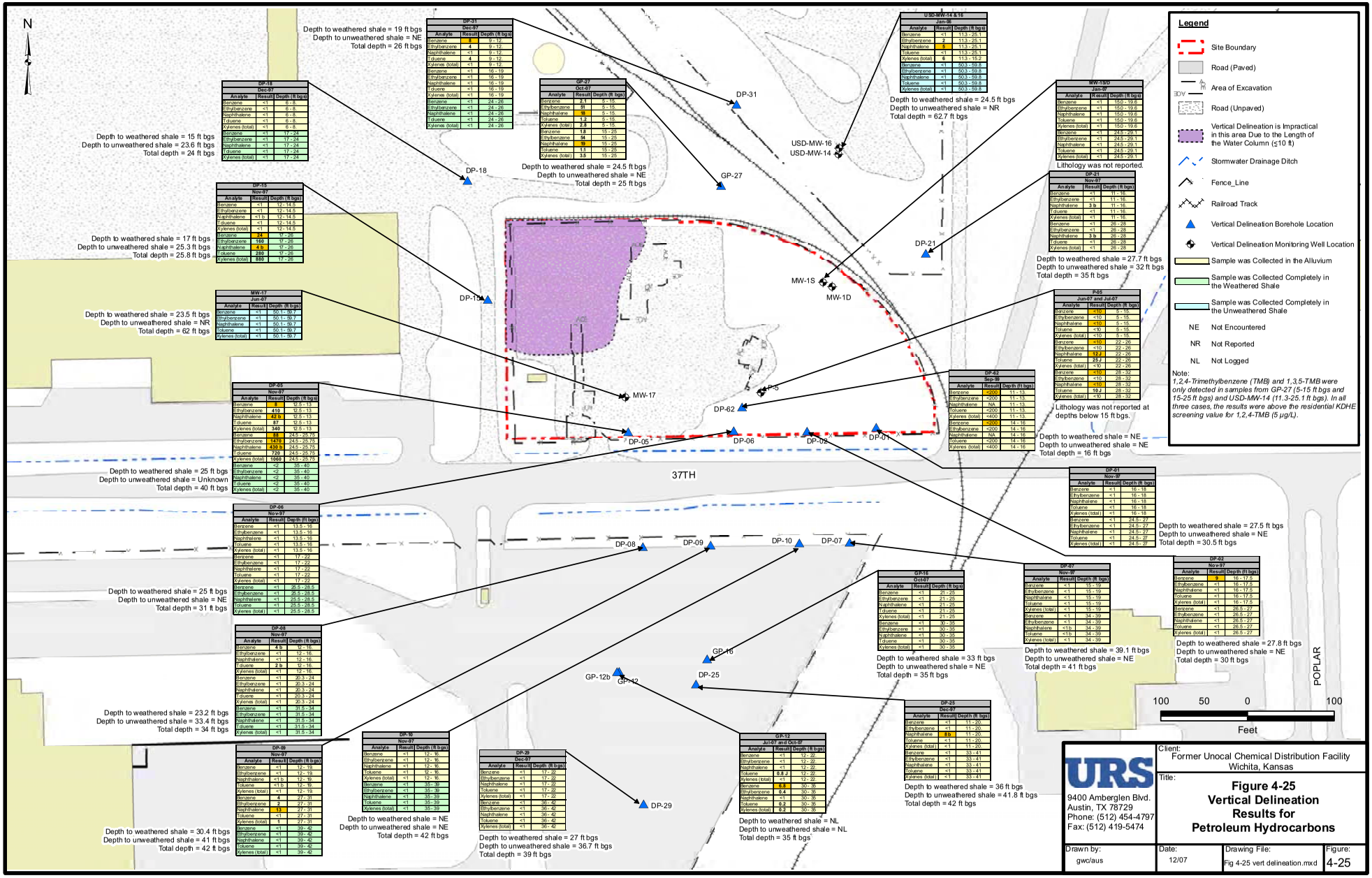

DP-31
Dec-97

Analyte	Result	Depth (ft bgs)
Benzene	5	9 - 12
Ethylbenzene	4	9 - 12
Naphthalene	<1	9 - 12
Toluene	4	9 - 12
Xylenes (total)	<1	9 - 12
Benzene	<1	16 - 19
Ethylbenzene	<1	16 - 19
Naphthalene	<1	16 - 19
Toluene	<1	16 - 19
Xylenes (total)	<1	16 - 19
Benzene	<1	24 - 26
Ethylbenzene	<1	24 - 26
Naphthalene	<1	24 - 26
Toluene	<1	24 - 26
Xylenes (total)	<1	24 - 26

USD-MW-14 & 16
Jan-98

Analyte	Result	Depth (ft bgs)
Benzene	<1	11.3 - 25.1
Ethylbenzene	2	11.3 - 25.1
Naphthalene	5	11.3 - 25.1
Toluene	<1	11.3 - 25.1
Xylenes (total)	6	11.3 - 15.2
Benzene	<1	50.3 - 59.8
Ethylbenzene	<1	50.3 - 59.8
Naphthalene	<1	50.3 - 59.8
Toluene	<1	50.3 - 59.8
Xylenes (total)	<1	50.3 - 59.8

DP-18
Dec-97

Analyte	Result	Depth (ft bgs)
Benzene	<1	6 - 8
Ethylbenzene	<1	6 - 8
Naphthalene	<1	6 - 8
Toluene	<1	6 - 8
Xylenes (total)	<1	6 - 8
Benzene	<1	17 - 24
Ethylbenzene	<1	17 - 24
Naphthalene	<1	17 - 24
Toluene	<1	17 - 24
Xylenes (total)	<1	17 - 24

GP-27
Oct-07

Analyte	Result	Depth (ft bgs)
Benzene	2.1	5 - 15
Ethylbenzene	51	5 - 15
Naphthalene	18	5 - 15
Toluene	1.2	5 - 15
Xylenes (total)	2.8	5 - 15
Benzene	1.8	15 - 25
Ethylbenzene	54	15 - 25
Naphthalene	19	15 - 25
Toluene	1.1	15 - 25
Xylenes (total)	3.5	15 - 25

MW-15/D
Jan-97

Analyte	Result	Depth (ft bgs)
Benzene	<1	15.0 - 19.6
Ethylbenzene	<1	15.0 - 19.6
Naphthalene	<1	15.0 - 19.6
Toluene	<1	15.0 - 19.6
Xylenes (total)	<1	15.0 - 19.6
Benzene	<1	24.5 - 29.1
Ethylbenzene	<1	24.5 - 29.1
Naphthalene	<1	24.5 - 29.1
Toluene	<1	24.5 - 29.1
Xylenes (total)	<1	24.5 - 29.1

DP-21
Nov-97

Analyte	Result	Depth (ft bgs)
Benzene	<1	11 - 16
Ethylbenzene	<1	11 - 16
Naphthalene	3 b	11 - 16
Toluene	<1	11 - 16
Xylenes (total)	<1	11 - 16
Benzene	<1	26 - 28
Ethylbenzene	<1	26 - 28
Naphthalene	3 b	26 - 28
Toluene	<1	26 - 28
Xylenes (total)	<1	26 - 28

DP-15
Nov-97

Analyte	Result	Depth (ft bgs)
Benzene	<1	12 - 14.5
Ethylbenzene	<1	12 - 14.5
Naphthalene	<1 b	12 - 14.5
Toluene	<1	12 - 14.5
Xylenes (total)	<1	12 - 14.5
Benzene	24	17 - 26
Ethylbenzene	160	17 - 26
Naphthalene	4 b	17 - 26
Toluene	280	17 - 26
Xylenes (total)	880	17 - 26

MW-17
Jun-07

Analyte	Result	Depth (ft bgs)
Benzene	<1	50.1 - 59.7
Ethylbenzene	<1	50.1 - 59.7
Naphthalene	<1	50.1 - 59.7
Toluene	<1	50.1 - 59.7
Xylenes (total)	<1	50.1 - 59.7

P-05
Jun-07 and Jul-07

Analyte	Result	Depth (ft bgs)
Benzene	<10	5 - 15
Ethylbenzene	<10	5 - 15
Naphthalene	<10	5 - 15
Toluene	<10	5 - 15
Xylenes (total)	<10	5 - 15
Benzene	<10	22 - 26
Ethylbenzene	<10	22 - 26
Naphthalene	12 J	22 - 26
Toluene	25 J	22 - 26
Xylenes (total)	<10	22 - 26
Benzene	<10	28 - 32
Ethylbenzene	<10	28 - 32
Naphthalene	<10	28 - 32
Toluene	10 J	28 - 32
Xylenes (total)	<10	28 - 32

DP-62
Sep-99

Analyte	Result	Depth (ft bgs)
Benzene	<200	11 - 13
Ethylbenzene	<200	11 - 13
Naphthalene	NA	11 - 13
Toluene	<200	11 - 13
Xylenes (total)	<400	11 - 13
Benzene	<200	14 - 16
Ethylbenzene	<200	14 - 16
Naphthalene	NA	14 - 16
Toluene	<200	14 - 16
Xylenes (total)	<400	14 - 16

DP-05
Nov-97

Analyte	Result	Depth (ft bgs)
Benzene	8	12.5 - 13
Ethylbenzene	410	12.5 - 13
Naphthalene	42 b	12.5 - 13
Toluene	87	12.5 - 13
Xylenes (total)	340	12.5 - 13
Benzene	85	24.5 - 25.75
Ethylbenzene	1470	24.5 - 25.75
Naphthalene	430 b	24.5 - 25.75
Toluene	720	24.5 - 25.75
Xylenes (total)	1060	24.5 - 25.75
Benzene	<2	35 - 40
Ethylbenzene	<2	35 - 40
Naphthalene	<2	35 - 40
Toluene	<2	35 - 40
Xylenes (total)	<2	35 - 40

DP-01
Nov-97

Analyte	Result	Depth (ft bgs)
Benzene	<1	16 - 18
Ethylbenzene	<1	16 - 18
Naphthalene	<1	16 - 18
Toluene	<1	16 - 18
Xylenes (total)	<1	16 - 18
Benzene	<1	24.5 - 27
Ethylbenzene	<1	24.5 - 27
Naphthalene	<1	24.5 - 27
Toluene	<1	24.5 - 27
Xylenes (total)	<1	24.5 - 27

DP-06
Nov-97

Analyte	Result	Depth (ft bgs)
Benzene	<1	13.5 - 16
Ethylbenzene	<1	13.5 - 16
Naphthalene	<1	13.5 - 16
Toluene	<1	13.5 - 16
Xylenes (total)	<1	13.5 - 16
Benzene	<1	17 - 22
Ethylbenzene	<1	17 - 22
Naphthalene	<1	17 - 22
Toluene	<1	17 - 22
Xylenes (total)	<1	17 - 22
Benzene	<1	25.5 - 28.5
Ethylbenzene	<1	25.5 - 28.5
Naphthalene	<1	25.5 - 28.5
Toluene	<1	25.5 - 28.5
Xylenes (total)	<1	25.5 - 28.5

GP-16
Oct-07

Analyte	Result	Depth (ft bgs)
Benzene	<1	21 - 25
Ethylbenzene	<1	21 - 25
Naphthalene	<1	21 - 25
Toluene	<1	21 - 25
Xylenes (total)	<1	21 - 25
Benzene	<1	30 - 35
Ethylbenzene	<1	30 - 35
Naphthalene	<1	30 - 35
Toluene	<1	30 - 35
Xylenes (total)	<1	30 - 35

DP-07
Nov-97

Analyte	Result	Depth (ft bgs)
Benzene	<1	15 - 19
Ethylbenzene	<1	15 - 19
Naphthalene	<1	15 - 19
Toluene	<1	15 - 19
Xylenes (total)	<1	15 - 19
Benzene	<1	34 - 39
Ethylbenzene	<1	34 - 39
Naphthalene	<1 b	34 - 39
Toluene	<1 b	34 - 39
Xylenes (total)	<1	34 - 39

DP-02
Nov-97

Analyte	Result	Depth (ft bgs)
Benzene	3	16 - 17.5
Ethylbenzene	<1	16 - 17.5
Naphthalene	<1	16 - 17.5
Toluene	<1	16 - 17.5
Xylenes (total)	<1	16 - 17.5
Benzene	<1	26.5 - 27
Ethylbenzene	<1	26.5 - 27
Naphthalene	<1	26.5 - 27
Toluene	<1	26.5 - 27
Xylenes (total)	<1	26.5 - 27

DP-08
Nov-97

Analyte	Result	Depth (ft bgs)
Benzene	4 b	12 - 16
Ethylbenzene	<1	12 - 16
Naphthalene	<1	12 - 16
Toluene	2 b	12 - 16
Xylenes (total)	<1	12 - 16
Benzene	<1	20.3 - 24
Ethylbenzene	<1	20.3 - 24
Naphthalene	<1	20.3 - 24
Toluene	<1	20.3 - 24
Xylenes (total)	<1	20.3 - 24
Benzene	<1	31.5 - 34
Ethylbenzene	<1	31.5 - 34
Naphthalene	<1	31.5 - 34
Toluene	<1	31.5 - 34
Xylenes (total)	<1	31.5 - 34

DP-25
Dec-97

Analyte	Result	Depth (ft bgs)
Benzene	<1	11 - 20
Ethylbenzene	<1	11 - 20
Naphthalene	8 b	11 - 20
Toluene	<1	11 - 20
Xylenes (total)	<1	11 - 20
Benzene	<1	33 - 41
Ethylbenzene	<1	33 - 41
Naphthalene	<1	33 - 41
Toluene	<1	33 - 41
Xylenes (total)	<1	33 - 41

DP-09
Nov-97

Analyte	Result	Depth (ft bgs)
Benzene	<1	12 - 19
Ethylbenzene	<1	12 - 19
Naphthalene	<1 b	12 - 19
Toluene	<1 b	12 - 19
Xylenes (total)	<1	12 - 19
Benzene	4	27 - 31
Ethylbenzene	2	27 - 31
Naphthalene	13	27 - 31
Toluene	<1	27 - 31
Xylenes (total)	1	27 - 31
Benzene	<1	39 - 42
Ethylbenzene	<1	39 - 42
Naphthalene	<1	39 - 42
Toluene	<1	39 - 42
Xylenes (total)	<1	39 - 42

DP-10
Nov-97

Analyte	Result	Depth (ft bgs)
Benzene	<1	12 - 16
Ethylbenzene	<1	12 - 16
Naphthalene	<1	12 - 16
Toluene	<1	12 - 16
Xylenes (total)	<1	12 - 16
Benzene	<1	35 - 39
Ethylbenzene	<1	35 - 39
Naphthalene	<1	35 - 39
Toluene	<1	35 - 39
Xylenes (total)	<1	35 - 39

DP-29
Dec-97

Analyte	Result	Depth (ft bgs)
Benzene	<1	17 - 22
Ethylbenzene	<1	17 - 22
Naphthalene	<1	17 - 22
Toluene	<1	17 - 22
Xylenes (total)	<1	17 - 22
Benzene	<1	36 - 42
Ethylbenzene	<1	36 - 42
Naphthalene	<1	36 - 42
Toluene	<1	36 - 42
Xylenes (total)	<1	36 - 42

GP-12
Jul-07 and Oct-07

Analyte	Result	Depth (ft bgs)
Benzene	<1	12 - 22
Ethylbenzene	<1	12 - 22
Naphthalene	<1	12 - 22
Toluene	0.8 J	12 - 22
Xylenes (total)	<1	12 - 22
Benzene	6.8	30 - 35
Ethylbenzene	0.4	30 - 35
Naphthalene	<1	30 - 35
Toluene	0.2	30 - 35
Xylenes (total)	0.2	30 - 35

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Client: Former Unocal Chemical Distribution Facility Wichita, Kansas

Title: **Figure 4-25 Vertical Delineation Results for Petroleum Hydrocarbons**

Drawn by:	Date:	Drawing File:	Figure:
gwc/aus	12/07	Fig 4-25 vert delineation.mxd	4-25

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5.0 Contaminant Fate and Transport

This section will build on the previous discussion regarding the nature and extent of the COPCs and the trends for the identified COPCs. Within the following contaminant fate and transport discussion, each key concept is evaluated and discussed in light of the actual COPCs and environmental conditions at the Site.

Fate and transport analysis is used below to identify potential routes and relative rates of contaminant migration or degradation in the Site-specific environment of the Site. Estimates of contaminant mobility, persistence, and potential to impact air, soil, surface water, and/or groundwater were evaluated on the basis of the physical, chemical, and biological properties of both the contaminants and the soil and/or groundwater environment in which they occur. Table 5-1 presents estimates of the physical and chemical properties for the COPCs at the Site, as determined in Section 4.0. These characteristics can significantly affect the potential of analytes to migrate from soil to groundwater.

5.1 Contaminant Persistence

This section identifies the processes, physical, chemical, and biological, in nature that affect the persistence of the COPCs in the subsurface. Persistence is a measure of how long a chemical will exist in an environment before it migrates, dilutes, degrades, or transforms into another chemical via biotic or abiotic processes. Factors that can affect chemical persistence include:

- the quantity and concentration of chemical present;
- driving forces for migration such as gravity or a hydraulic gradient;
- the chemical's solubility and vapor pressure;
- the types and quantities of microorganisms present;
- the availability of nutrients; and
- ORP and presence of natural or anthropogenic electron acceptors and donors.

Because many factors affect chemical persistence, it is often difficult to predict the stability of a specific chemical at a given site. However, a qualitative evaluation of chemical persistence can be made on the basis of published results of chemical properties and biodegradation rates developed for laboratory and/or field studies conducted at other locations. This qualitative evaluation can be compared with the empirical data that has been collected over time in order to develop a CSM (discussed in Section 6.0).

The time frame for the degradation of organic compounds is often expressed in terms of a half-life (i.e., the time it takes for the compound to degrade to half of the initial concentration, assuming that its degradation can be described as a first-order reaction). Half-life values reported in the literature can be derived from laboratory studies conducted under controlled conditions, or they can be extrapolated from field measurements. Half-life values (and the related first-order reaction rate coefficient [k]) vary widely depending on the environmental factors affecting the chemical (for example, half-lives for benzene reported in the literature vary over four orders of magnitude, from 0.3 day to 9.5 years). Table 5-2 presents the half-life values for analytes that exceed KDHE screening criteria. Because of this variation, these published values provide little benefit in the Site evaluation. Instead, since this site has been monitored since the early nineties, contaminant trends over time provide a better basis for predicting future contaminant migration, degradation, and behavior.

The following general statements regarding the persistence of select analytes that exceed KDHE screening values at the Site are important:

- PCE readily evaporates from near-surface soil or surface water. Its solubility is approximately 200 milligrams per liter (mg/L) at 25 degrees Celsius (ºC). Once PCE has entered a groundwater system, it tends to persist in the groundwater environment owing to its tendency to adsorb to the aquifer matrix.

- TCE is a moderately volatile compound that is also more soluble than PCE. Its solubility is approximately 1,100 mg/L at 25ºC. Once TCE has entered the groundwater system, it also tends to persist in the groundwater environment, depending on environmental conditions.

- The occurrence of *cis*-1,2-DCE, *trans*-1,2-DCE, 1,1-DCE, and vinyl chloride (and TCE in some locations) at the Site indicate that dechlorination has occurred; however, the relatively high levels of PCE in groundwater suggest degradation is occurring at a slow rate in some areas.

- Vinyl chloride is highly volatile in soil and readily dissolves in water. Based upon its relatively high water solubility (around 2,800 mg/L) and its low soil-water partition coefficient (K_d), vinyl chloride is expected to be mobile in soil and leach to groundwater readily. Vinyl chloride does not undergo significant adsorption or hydrolysis.

- The occurrence of 1,1-DCA, 1,1-DCE, CA, and vinyl chloride at the Site indicate subsurface conditions are amenable for abiotic degradation of 1,1,1-TCA.

- The presence of fuel constituents (electron donors) and chlorinated hydrocarbons (electron acceptors) in the same area can facilitate degradation of both chemicals via microbially-mediated redox reactions.

- Benzene can degrade biologically in aerobic or anaerobic conditions, but aerobic biodegradation is typically faster. Its half-life is often longer than that of the other BTEX compounds, but this may be an artifact of their biodegradation pathway.

- Ethylbenzene tends to be first converted to benzene, thus temporarily adding to the benzene pool and giving the impression that benzene is degrading more slowly. Ethylbenzene has similar volatility and biodegradability as benzene.

- Naphthalene is less volatile than benzene, its biodegradation is markedly slower, and it is less soluble and, therefore, less likely to leach. Its rate of biodegradation can be promoted by the presence of other hydrocarbons.

5.2 Fate Mechanisms

The fate of organic COPCs is a function of volatilization, abiotic chemical reactions (such as hydrolysis), and biological degradation. The relationship between the chlorinated constituents and the fuel constituents at this site greatly influences the fate of both in the various areas of the Site.

Volatilization

Volatilization of organic compounds into the soil gas and the atmosphere from groundwater or surface water is governed by Henry's Law Constants. Chemicals with Henry's Law Constants greater than 4.1×10^{-4} atmospheres-cubic meter per mole (atm-m^3/mole) and molecular weights less than 200 grams per mole (g/mole) tend to volatilize readily from soil or groundwater (CDM Federal Programs Corporation, 1999). Based on these criteria, all of the analytes listed in Table 5-1 have potential for volatilization. The net effect of volatilization is the reduction in concentration levels within each medium (soil and groundwater) with time and ultimately transport to the atmosphere, where complete degradation through photolysis and photo-oxidation generally occurs rapidly.

Abiological Chemical Degradation

Abiological chemical degradation includes any transformation reaction that involving organic compounds that is not mediated by microorganisms. Hydrolysis, photolysis, and oxidation are potential abiological degradation mechanisms. Due to the limited penetration of light and weak oxidizing conditions in the Site's subsurface, photolysis and chemical oxidation are not expected to be significant in the subsurface media. Hydrolysis is an abiological chemical degradation reaction where an organic molecule reacts with water or a component ion of water, such as hydrogen ion ($H^{+)}$ or hydroxide ion (OH^-). Many organics that do not biodegrade will be transformed by hydrolysis.

Biological Degradation

Transformation processes that are catalyzed by microbial activity are referred to as biodegradation reactions, a component of natural attenuation. Biodegradation requires a microbial population sufficiently adapted to use the chemicals of interest as an energy source. Biodegradation reactions also require both an electron donor and an acceptor for the reaction to occur. Aerobic biodegradation uses oxygen as an electron acceptor. Petroleum-related hydrocarbons and lightly-halogenated hydrocarbons can be susceptible to aerobic biodegradation. This process, however, may be limited by the availability of oxygen in the subsurface media.

In oxygen-limited environments, alternative electron acceptors, such as nitrate, ferric iron, manganese (IV), sulfate, carbon dioxide, and even highly-halogenated hydrocarbons, such as PCE, can be used. Reactions of this type are known as anaerobic biodegradation. Reductive dechlorination reactions occur anaerobically where chlorinated hydrocarbons act as the electron acceptors and react with hydrogen that acts as the electron donor. Under reductive dechlorination conditions, PCE can degrade to TCE, then to *cis*-1,2-DCE, to vinyl chloride, and ultimately to ethene (sometimes further to ethane).

Biological degradation is dominant at locations at this site where petroleum hydrocarbons and chlorinated solvents coexist or have coexisted in the past. Site-specific biological degradation of petroleum hydrocarbons and chlorinated solvents are explained further in the natural attenuation discussion later in this section.

5.3 Potential Routes of Migration

Potential soil contaminant migration routes can include airborne transport as vapor or fugitive dust emissions, surface water runoff, and soil-to-groundwater migration. Potential groundwater contaminant migration routes are dependent on the form of the contaminant (either free phase or

solute) and can include gravity flow, advection, dispersion, diffusion, and discharge of shallow groundwater to surface water. Potential routes of migration are evaluated in the subsections that follow.

5.3.1 Soil Routes of Migration

Soil contamination is limited to the Site only. Any soil samples that were previously collected off-site (i.e., on the Coleman facility) are not part of this evaluation.

Airborne Transport as Vapor or Fugitive Dust

Volatilization of the COPCs from the soil, as discussed in Section 5.2, can result in vapors that facilitate airborne transport of the contaminant. This migration route is not considered to be a viable mode of transportation at the Site because most soil contamination has been excavated and the reported exceedances occur at depths greater than 3 ft. Fugitive dust emissions from surface soils can be caused by wind or mechanical disturbances in barren (non-vegetated) areas. This is not considered to be a significant mode of transportation at the Site because most areas are covered by gravel pavement or vegetation.

Surface Water Runoff

The Site is virtually flat, but elevated relative to the surrounding area; surface water runoff drains to the unlined ditches to the south and east of the Site. If surface soil contamination were present, there could be a potential for migration of site contamination to these ditches through surface water runoff. However, the contaminants present at the Site are highly volatile and would readily evaporate from near-surface soil. This migration route is not anticipated to be a viable mode of transportation at the Site because the ground surface has been regraded and the reported exceedances occur at depths greater than 3 ft.

Soil-to-Groundwater Migration

Primary factors that affect the migration of contaminants from soil to groundwater are the physical/chemical properties of the contaminants (e.g., solubility, density, viscosity, organic carbon partition coefficient [K_{oc}], and K_d), and the physical/chemical properties of the environment (e.g., soil type, permeability, porosity, particle size distribution, organic carbon content, pH, ORP, and rainfall percolation rate). Due to the numerous factors that interact to affect the rate of contaminant migration in soil, it is often difficult to predict contaminant movement.

The potential mobility of organic compounds is best represented by the K_d. Compounds have the potential to adsorb strongly to organic materials within soils, and K_d can be estimated as the

product of the K_{oc} and the organic carbon fraction (f_{oc}) of the soil as represented by the following formula.

$$K_d = K_{oc} \times f_{oc}$$

The organic matter of blanket silt loam (1 to 3% slopes) ranges from 0.0-0.3% according to the United States Department of Agriculture's (USDA's) Natural Resource Conservation Service (USDA, 2006). This range is equivalent to f_{oc} values between approximately 0.0 and 0.002. Table 5-1 shows K_{oc} and K_d values for the organics that exceed KDHE screening criteria (calculated using the upper limit f_{oc} = 0.002 based on the average total organic carbon concentrations found in background soil). Lower f_{oc} values are associated with greater contaminant mobility; because the upper limit was used, the calculated K_d values are conservatively high. A K_d greater than 100 liters per kilogram (L/kg) indicates strong adsorption to soil and low mobility, while a K_d less than 100 L/kg indicates preferential partitioning into the aqueous phase and a greater potential for migration (Ryan, 1986). The low estimated K_d values for some soil COPCs (i.e., acetone and vinyl chloride) in Table 5-1 reveal why these analytes have migrated to groundwater.

5.3.2 Groundwater Routes of Migration

Contaminants have the potential to enter and move through the groundwater system in two forms; either as a liquid in its original form (also known as "free-phase"), or as a solute that has been dissolved in groundwater. The solubility of the chemical is the determining factor for which form will occur. Constituents with high solubilities are usually relatively mobile once in contact with aqueous media. At sites where the chemicals are in sufficient quantity to exceed solubility capacity, there can be a separate free-phase or non-aqueous phase liquid (NAPL). Free-phase products were not observed during the either the 2005 or 2006 groundwater sampling events; however, constituent concentrations determined from the 2005 and 2006 events indicate the possible presence of free-phase 1,2,4-TMB, ethylbenzene, naphthalene, and PCE (EPA, 1992). Therefore, the following discussion of contaminant transport in the groundwater system presents the behavior in both the free-phase and solute phases.

Non-Aqueous Phase Liquid

According to the "1% of solubility" rule of thumb (EPA, 1992), 1,2,4-TMB, ethylbenzene, and naphthalene may be present as free-phase light non-aqueous phase liquid (LNAPL), and PCE may be present as free-phase DNAPL. The maximum 1,2,4-TMB concentration detected during the 2005 groundwater monitoring event (770 µg/L) is 1.4% of the theoretical water solubility (57,000 µg/L). The maximum ethylbenzene concentration detected during the 2005 groundwater monitoring event (6,500 µg/L) is 3.8% of the water solubility (169,000 µg/L). The maximum

naphthalene concentration detected during the 2005 groundwater monitoring event (770 μg/L) is 2.4% of the water solubility (31,000 μg/L). The maximum PCE concentration detected during the 2005 groundwater monitoring event (37,000 μg/L) is 18.5% of the water solubility (200,000 μg/L).

The 2006 groundwater monitoring event had similar results for these constituents with the maximum detected 1,2,4-TMB concentration of 670 μg/L (1.2% solubility), the maximum detected ethylbenzene concentration of 5200 (3.1% solubility), the maximum detected naphthalene concentration of 910 (2.9% solubility), and the maximum detected PCE concentration of 14,000 (7.0% solubility). Although groundwater concentrations of the referenced analytes indicate LNAPL and/or DNAPL may be present at the Site, no NAPL was observed during either the January to March 2006 groundwater monitoring event or the May to June 2006 monitoring event.

The variables that govern LNAPL and DNAPL transport are:

- LNAPL and DNAPL characteristics (density, viscosity, vapor pressure, volatility, interfacial tension, and wettability;
- Subsurface media characteristics (capillary force, pore size/initial moisture content, lower confining layer gradient, and groundwater flow velocity; and
- Saturation dependent parameters (residual saturation and relative permeability) (EPA, March 1991).

LNAPL is lighter and typically less viscous than water, and tends to persist in a "smear zone" near the potentiometric surface; DNAPL is denser and typically less viscous than water, and migrates via gravity and soil capillary forces. In low permeability clays, like those found in portions of the Site, high capillary forces would hinder DNAPL migration. The potential for higher residual saturation percentage is also higher in low permeability clays. Floating LNAPL tends to accumulate and spread out laterally atop the potentiometric surface; conversely, when a sinking DNAPL encounters a low permeability layer, it tends to accumulate and spread out laterally via zones of high permeability such as fractures or porous layers. The transport of DNAPL is also dependent on the slope of a low permeability layer (such as the lower confining layer), rather than on the groundwater flow gradient. As a result, the lateral direction of DNAPL movement may be different than the direction of groundwater flow (EPA, March 1991).

LNAPL and DNAPL typically slowly partition to the solute phase (EPA, March 1991). Continued partitioning to the solute phase in the unsaturated zone beneath the Site is a viable mode of migration since the Site is unpaved and rainwater infiltration would entrain constituents that remain present in the unsaturated zone.

Dissolved Phase Contamination

There are four primary mechanical processes that govern the transport of solutes through a groundwater system – advection, dispersion, adsorption, and diffusion. Advection is the dominant process by which solutes are transported with the movement of flowing water. The average rate of solute movement due to advection is generally equal to the linear velocity of the groundwater within the system (Freeze and Cherry, 1979). The velocity and direction of groundwater movement, and, therefore, the transport of solutes by advection is controlled by the hydraulic characteristics of the aquifer, including the geometry of the saturated zone, its hydrostatic pressure, and the transmissivity, storativity, and porosity of the aquifer materials. The long and linear plumelets at the Site indicate that advection was the primary transport mechanism for dissolved phase constituents in groundwater.

As a solute travels along an advective flow path through the groundwater system, it is also affected by hydrodynamic dispersion. The process of dispersion is the tendency for a solute to spread out along a flow path as a result of mechanical mixing as the water takes varying flow paths through the aquifer substrate. The degree of solute dispersion is dependent on the porosity and the physical characteristics of the aquifer materials as well as the groundwater velocity. Dispersion occurs predominantly longitudinally (parallel) to the direction of flow but can also occur to a lesser extent in a transverse (perpendicular) direction to groundwater flow.

Adsorption to the soil matrix can reduce the concentration of dissolved contaminants moving through the ground water. As an organic solute migrates through the saturated soil, it continually sorbs and desorbs from the aquifer matrix. This has the effect of retarding the solute velocity relative to groundwater velocity. The retardation factor (R) is the ratio of the groundwater seepage velocity to the rate that organic chemicals migrate in the groundwater. This retardation can be quantified using the following equation:

$R = 1 + (\text{soil bulk density} \times K_d)/\text{effective porosity}$ where: $K_d = f_{oc} \times K_{oc}$

The higher the compound's K_{oc} and K_d, the more it will be retarded. For example, if degradation is minimal, PCE will migrate more slowly than TCE, *cis*-1,2-DCE, or vinyl chloride in a given groundwater system, owing to its higher K_{oc}.

The fourth process acting on a solute within the groundwater system is diffusion, or the tendency of individual molecules to move and expand as a function of thermal-kinetic energy and concentration gradients. The process of diffusion in solute transport only becomes relatively significant in stagnant water or waters with very low velocities (Domenico and Schwartz, 1990); such conditions exist in some of the clay material at the Site.

5.4 Site-Specific Soil Contaminant Migration

For soil, the potential primary source areas have been removed through excavation, resulting in few areas of residual soil contamination. The few remaining soil exceedances in the unsaturated zone do not present significant migration potential, as the overall contaminant mass in soil is low relative to the contaminant mass that potentially remains below the groundwater table.

5.5 Site-Specific Groundwater Contaminant Migration

Contaminants that were released on the former Unocal site have entered the groundwater system and have migrated in the down-gradient direction. Several factors affected the degree and direction of migration that resulted in the various plumelets that exist today: the chemical composition of the various releases; the groundwater hydraulics; and the mass of contaminants released at certain location; and, the solubility of the parent and daughter compounds. Isoconcentration maps for the primary VOCs (PCE, TCE, *cis*-1,2-DCE, and vinyl chloride) for 2005 and 2006 were generated and are presented in Section 4.0 as Figures 4-12 through 4-19.

The Phase III Technical Memorandum (HLA, April 1998b) identified several areas within the Site and the Coleman investigation area that contained distinct mixtures of VOCs in groundwater. In some areas, fuel constituents were mixed with chlorinated compounds and their degradation products. In other areas, only chlorinated compounds were found. Chlorinated ethanes were absent in some areas and present in others. This discovery led to the development of the "plumelet" concept, where individual and chemically distinct releases and their degradation byproducts have migrated, co-mingling down-gradient of the original source areas.

The plumelet concept was developed from the refined spatial data set that was generated from the DPT investigations during that time. Using DPT for sample collection and an on-site GC with appropriate QC, the refined spatial data set revealed that these plumelets traveled more or less in a linear fashion in the down-gradient direction, with advection being the dominant transport mechanism. The plumelet concept was further refined by the ***Results of the MIP Investigation*** (URS, 2007f) and the ***Results of Additional Investigation Activities to Complete the RI Delineation*** (URS, 2007g).

The plumelet concept involves the existence of six different plumes (Plumelets A through F) based on a combination of the current and historical data, including the 2006 monitoring well data, recent MIP and delineation sampling results, and the Phase III DPT sample results. Below is a description of each of the plumelets:

- **Plumelet A** initiates from the center of the Site's southern boundary of the eastern parcel and extends onto Coleman's property. The source of this plume was near the Pit Area Excavation and was confirmed as part of the MIP investigation. This plume historically contained PCE, its degradation products (TCE, *cis*-1,2-DCE, and vinyl chloride), and 1,1,1-TCA. BTEX has not been historically found in significant quantities in this plume. The ratios of PCE and 1,1,1-TCA to their degradation products are higher than in other plumelets.

- **Plumelet B** initiates from the center of the Site's western parcel and extends onto Coleman's property. The source of this plume was thought to be the Tank Farm. This plume historically contained PCE, its degradation products (TCE, *cis*-1,2-DCE, and vinyl chloride), and BTEX. The ratio of PCE to its degradation products is lower than in Plumelet A. 1,1,1-TCA has not been found historically in significant quantities in this plume.

- **Plumelet C** initiates from the northeast area of the Site and extends into Plumelet B on the Coleman property. The source of this plume was thought to be an underground piping terminus under the former warehouse building. On the basis of a 2007 DPT sample collected from the location of MIP 15, this plumelet contains 1,1,1-TCA and associated degradation products; PCE, TCE, and all of the associated degradation products; acetone; BTEX; TMB; 2-Butanone (MEK); MIBK; methylene chloride; and styrene.

- **Plumelet D** is confined to the area north from the center of the northern site boundary (near MW-5). This plume historically contained PCE and TCE.

- **Plumelet E** is confined to the area northwest of the northwest corner of the Site. The MIP investigation did not indicate a clear source of contamination present along the western boundary of the Site. This plume historically contained mostly PCE. TCE has not been found historically in significant quantities in this plume.

- **Plumelet F** is confined to the area west-southwest of the western site boundary. The MIP investigation did not indicate a clear source of contamination present along the western boundary of the Site. This plume historically contained TCE with lower concentrations of PCE.

For this report, Chevron began with the above understanding of the plumelets in order to develop the current contamination plume maps. Although the current well network is rather extensive (65 locations), it still does not provide the spatial understanding previously gained from the DPT surveys, MIP investigation, and additional delineation sampling. Currently, the contamination plumes reveal that the former plumelets have migrated, co-mingled, and sometimes degraded. In cases where chlorinated solvents were in proximity with fuel constituents (Plumelets B and C), concentrations have declined drastically (i.e., recovery wells R-2 and R-3). In cases where PCE and 1,1,1-TCA were the primary constituents and BTEX was not present (Plumelet A), degradation was less pronounced. Down-gradient from the recovery wells R-2 through R-6, dispersion and diffusion may have contributed to the point where the primary contaminants and their degradation products have co-mingled.

Owing to the remedial actions that have been conducted (soil excavation at the Site and the operation of the groundwater extraction system), continued migration does not seem to be an issue. A review of the contaminant trends, presented in Section 4.0, reveals that in nearly all cases, each of the COPCs are continuing to decline in concentration throughout the plume. The groundwater extraction system was turned off in August 2006. In December 2006, injections of CAP-18-ME™ and HRC® were performed (URS, 2007d). It is expected that the injected substrates will contribute to enhanced biodegradation in the areas where fuel constituents are not present.

As of the 2006 groundwater monitoring event, the plumelets can be characterized as stable, or even receding. Dissolution from residual sources in the saturated zone on the Site continue to provide contaminant mass to groundwater, yet natural attenuation forces have surpassed that rate and the contaminant plumes are no longer expanding.

5.6 Groundwater to Surface Water (former Coleman Seep)

In August 1993, an apparent groundwater seep was observed on the Coleman property in the vicinity of monitoring wells TW-4 and R-2. At that time, a flow of less than one gpm was observed at the surface. According to the ***Draft Phase II Remedial Investigation (RI)*** (Canonie, 1994), samples were collected from the seep water and concentrations of VOCs similar to those detected in the nearby monitoring wells were detected. Unocal submitted a report to KDHE

summarizing the results of the seep sampling, and a workplan was submitted and approved by KDHE to control the surface water flow in the seep area (MEI, 1993).

Since 1994, the groundwater has stopped flowing in to the seep. The current groundwater extraction system was thought to have lowered the groundwater table, thereby eliminating the seep and reducing the contaminants found in that area. However, the relationship between the former seep and the operation of the treatment system was unclear. On several occasions, the system has been shut down for maintenance, and the seep did not appear. Additionally, R-2 and R-3 were not operating for several months in 2005 due to pump failure, and the seep did not appear. Additionally, during construction of the extraction system, grading of the former seep area occurred and has further reduced the potential for seepage.

The historic sample results collected at the seep can be most closely related to concentrations detected in recovery well R-2. Concentrations have declined substantially in this area. Coincidentally, it was thought that the intrusion of historic BTEX into this area provided a carbon source to facilitate both reductive dechlorination and the degradation of fuel constituents.

5.7 Natural Attenuation of Groundwater

The purpose of evaluating monitored natural attenuation (MNA) at the Site was to provide a baseline for the potential development of a natural reductive dechlorination MNA alternative in the forthcoming FS. Additionally, MNA is frequently used in conjunction with "active" remedies or as the final step in a treatment train approach. For example, an active remedy designed for source control or hot spot decontamination can be used in conjunction with MNA along the periphery of a plume. MNA can also be used as a last phase of remediation after an active remedy is discontinued. Therefore, the data presented below can actually be used in the development of all remedies; this discussion does not imply that an MNA remedy would be the sole and final remedy, as the final decision will be concluded in the FS. The data obtained to date and presented here will allow MNA to be considered as a potential final remedy in a FS or as a component of a final remedy.

Biological Degradation of Petroleum Hydrocarbons

In almost all shallow subsurface environments petroleum hydrocarbons can serve as electron donors in microbial metabolism. When petroleum hydrocarbons are utilized as the primary electron donor for microbial metabolism, they typically are completely degraded or detoxified (Bouwer, 1992). Common electron acceptors include oxygen, nitrate, ferric iron, sulfate, and carbon dioxide. The metabolic by-products typically produced from the biodegradation of petroleum hydrocarbons are carbon dioxide, water, nitrogen gas, ferrous iron, hydrogen sulfide,

and methane (Wiedemeier, 1999). As the trend plots illustrate (Appendix B) concentration of the primary hydrocarbon constituents have decreased over time.

The biodegradation of petroleum hydrocarbons is limited primarily by electron acceptor availability, and generally will proceed until all of the contaminants biochemically accessible to the microbes are oxidized. Aerobic respiration is the first reaction to occur in an aerobic environment that contains microorganisms capable of aerobic respiration (Bouwer, 1992). Once the available DO is depleted and anaerobic conditions dominate the interior regions of the dissolved hydrocarbon plume, microorganisms utilize other electron acceptors in the following order of preference: nitrate, manganese (IV), ferric iron, sulfate, and carbon dioxide. In most subsurface environments both aerobic and anaerobic degradation of petroleum hydrocarbons can occur, often simultaneously in different parts of the plume (Wiedemeier, 1999).

Fermentation is a very important degradation reaction for petroleum hydrocarbons. During fermentation, the compound being biodegraded serves as both the electron donor and the electron acceptor. This reaction supplies other organisms in the consortia with dissolved hydrogen. Dissolved hydrogen is an excellent electron donor that can assist in the in situ biodegradation of chlorinated solvents (Wiedemeier, 1999). The dissolved hydrogen generated from the fermentation of petroleum hydrocarbons supports the reductive dechlorination (degradation) of chlorinated solvents at this site.

Biological Degradation of Chlorinated Solvents

The key factor governing the dechlorination of chlorinated compounds is halorespiration (Gossett and Zinder, 1996). During halorespiration chlorinated solvents are used as electron acceptors (hydrogen is the electron donor) and reduced via reductive dechlorination. Based on the reaction kinetics and field data analysis, halorespiration probably accounts for the majority of chlorinated solvent biodegradation at many of the Sites where biodegradation is significantly attenuating the plume (Wiedemeier, 1999).

Chlorinated solvents in groundwater have been documented to persist in aquifer environments in excess of 30 years (Deutsch, 1997). The rate of degradation for breakdown products varies and is dependent on a wide range of factors including the reaction kinetics, redox potential of the groundwater system, pH, temperature, and the presence of bacteria that carry on these biological processes.

There is evidence at the Site that the fermentation of petroleum hydrocarbons produced dissolved hydrogen, which was used in the reductive dechlorination (halorespiration) of chlorinated

compounds. This evidence lies in observations of petroleum hydrocarbon concentrations in groundwater declining over time and the breakdown products of PCE increasing and then declining when these two constituent classes are commingled. Several of the analytes exceeding KDHE screening values are the intermediary chlorinated compounds (or degradation products), indicating that the primary chlorinated solvents and fuel constituents have been in residence in the groundwater system for an extended period of time and that conditions within the Site are favorable for degradation. PCE and TCE degradation follows a pathway that includes the intermediary compounds TCE, 1,1-DCE, *cis*-1,2-DCE, and vinyl chloride. 1,1,1-TCA degradation follows pathways that produce compounds 1,1-DCA, 1,1-DCE, CA, and vinyl chloride.

A comprehensive MNA demonstration was performed using three lines of evidence (LOEs):

Primary LOEs—Relies on use of historical groundwater data that demonstrate a clear trend of stable or decreasing COPC concentrations over time and with distance away from the source at appropriate monitoring points.

Secondary LOEs—Uses geochemical indicators to document certain geochemical signatures in the groundwater that demonstrate the type of natural attenuation processes occurring at a site. These indicators were evaluated in the comprehensive 2005 event. A subset of the wells was evaluated in 2004. Tables 5-3 and 5-4 present the natural attenuation parameter results for the 2004 and 2005 groundwater sampling events, respectively.

Other LOEs—Most often consists of predictive modeling studies and other lab or field studies that may be used to predict contaminant migration and natural attenuation processes occurring at a site. Owing to the complex nature of the various sources, resultant plumes, and their various contaminant signatures, other LOEs were not used as part of this evaluation.

Primary and secondary LOEs are evaluated in the subsections below.

5.7.1 Primary Lines of Evidence

Primary LOEs that were evaluated consist of the following:

- Individual contaminant trends over time;

- The distribution of primary contaminants, such as PCE and TCE, in relation to reductive products *cis*-1,2-DCE and vinyl chloride;
- The distribution of primary contaminants such as 1,1,1-TCA to reductive products DCA, CA, 1,1-DCE, and vinyl chloride;
- The distribution of fuel constituents and their relation to the above; and
- The spatial distribution of all of these contaminants over time.

Individual Contaminant Trends over Time

A statistical trend analysis for each well in the groundwater monitoring network was plotted for analytes that were analyzed in five or more separate events. Additionally, a Mann-Kendall test was performed for each of these plots to determine the type of trend (i.e., upward, downward or no trend). However, due to the volume of information produced, this report will only discuss statistical trend analysis plots and Mann-Kendall results for analytes in each well that were detected in 5 or more separate events. The statistical trend analysis plots are provided in Appendix B, and Table 5-5 presents a summary of the Mann-Kendall results.

Overall, most of the analytes, whether on the Site or Coleman property, appear to have a downward trend based on the Mann-Kendall results. The only upward trend identified was for CA in monitoring well TW-1. Since CA is a daughter product of 1,1,1-TCA degradation, this result likely indicates that bioremediation has occurred and in that region 1,1-DCA and 1,1,1-TCA have been degraded.

Historical results show the highest concentrations of analytes in on-site wells, primarily R-1 located in the former AST farm area. The PZ wells on the Site, which also had high VOC concentrations, have not been sampled 5 or more times and, therefore, were not included in the trend analysis. For recovery well R-1, the Mann-Kendall test reports downward trends for the chlorinated solvents of interest (i.e., PCE, TCE, *cis*-1,2 DCE, and vinyl chloride); however, the *cis*-1,2 DCE and vinyl chloride plots show large deviations over time possibly due to the biodegradation of PCE and TCE. Additionally, 1,2,4-TMB was reported to have a downward trend for R-1. The trend plot analysis shows that 1,2,4-TMB concentrations have decreased from approximately 72 µg/L in 2002 to approximately 20 µg/L in 2006. The KDHE residential groundwater screening level for 1,2,4-TMB is 5.0g/L.

The Mann-Kendall tests for analytes in wells along the northern plume boundary (i.e., up-gradient monitoring wells MW-1S, MW-3, MW-5, and MW-14) generally show a downward trend over time for the VOC COPCs. The trend analysis plots for analytes along the northern

plume boundary generally show a decreasing trend over time with the exception of vinyl chloride, which demonstrated a sharp increase in concentrations from 1991 to 1996 in MW-1S that then fell drastically in 1997 and have since stabilized. PCE concentrations at MW-3 and concentrations of all of the primary VOCs at MW-5 have decreased over time but are still above their respective MCLs. The trend analysis plots also revealed decreasing concentrations of petroleum hydrocarbon products over time at MW-14.

The wells along the eastern and southern plume boundaries (i.e., MW-10, MW-11, MW-12S, MW-12D, and MW-13) did not have 5 total detected values for any analyte. The wells along the western plume boundary did not have enough historical information to conduct a trend analysis.

Distribution of Contaminants over Time

The first line of evidence for reductive dechlorination was the mere presence of reductive constituents TCE, *cis*-1,2-DCE, DCA, CA, vinyl chloride, and 1,1-DCE. Many of the chlorinated ethene and ethane degradation products occur mostly in the source zones where the primary contaminants are or were present with BTEX (Plumelet B). Illustrations of the most recent chlorinated ethene and ethane plumelet positions were presented in Section 4.0. Not all of the COPCs were illustrated; the focus for these diagrams was the primary contaminants. The plates contained in Appendix D show the PCE and TCE plumelets along with the analytical results for other chlorinated COPCs.

Historically in Plumelet B on the Coleman property, petroleum hydrocarbons were present during the comprehensive DPT investigation performed in 1997. At that time, TCE, *cis*-1,2-DCE, and vinyl chloride and 1,1-DCA were present in higher concentrations than historically in Plumelet A (both on the Site and on the Coleman property). During the recent comprehensive round of sampling (2005 event), most of the petroleum hydrocarbon and chlorinated solvent contamination has since degraded in Plumelet B on the Coleman property. PCE and 1,1,1-TCA were not detected in this area. Since BTEX was only present in significant quantities in monitoring wells TW-1 and TW-4 during the 2005 groundwater monitoring event, it is unclear if continued biodegration of chlorinated solvents in Plumelet B will continue.

Two historic DPT locations (DP-11 and DP-22) exhibited elevated concentrations of PCE, TCE, *cis* 1,2-DCE, and vinyl chloride at the time that they were collected. Additional sampling was performed in 2007 to the east of these locations; detections in the 2007 concentrations were below screening levels for all constituents other than vinyl chloride (although the vinyl chloride exceedances were much lower than was observed in DP-11 and DP-22). It appears that currently, either the concentrations in the entire area have declined since 1999 or that DP-11 and DP-22 are

in a separate exceedance area. Data from TW-1 and MW-4 was reviewed to determine if this area is connected to either Plumelets B or C, but that does not appear to be the case. Therefore, the area around DP-11 and DP-22 was outlined on Appendix D plates to indicate the lack of confirming data in recent sampling events.

Historically in Plumelet A, little degradation has occurred on the Site (i.e., in the area surrounding P-5); however, a pilot test conducted in 1999 enabled degradation of COPCs down-gradient from that area. All of the PCE and most of the TCE was degraded down-gradient in the pilot test area where HRC® was injected. Residual concentrations of *cis*-1,2-DCA and 1,1-DCA remain in Plumelet A on the Coleman property, albeit at relatively low concentrations. In Plumelet A, fuel constituents were not detected during the 1997 event; lower ratios of the chlorinated ethene and ethane degradation products were found relative to PCE and 1,1,1-TCA. As of the 2006 groundwater monitoring event, PCE persisted on the Site and on the Coleman property and was present at concentrations higher than the degradation products.

In the R-1/MW-6 area (Plumelet C), concentrations of all constituents have declined by a combination of natural attenuation via biodegradation and because of the excavations that were performed up-gradient from that area (i.e., Excavation Area #1) in 2002.

5.7.2 Secondary Lines of Evidence

Microorganisms obtain energy for growth by transferring electrons from electron donors (e.g., fuel hydrocarbons or native organic carbon) to an electron acceptor. For hydrocarbons, the presence of electron acceptors facilitates the biodegradation of fuel constituents and metabolic products result from these reactions. The previous section discussed the distribution of BTEX constituents in relation to chlorinated solvents. This section focuses on electron acceptors other than chlorinated solvents as an indicator of past biodegradation. Table 5-6 presents the parameters that are typically evaluated for chlorinated solvent contaminated sites.

For reductive dechlorination to occur, some form of carbon source (humus, natural organic matter, BTEX, etc.) must be present in the aquifer. For this site, it appears that a lack of sufficient native carbon source has limited chlorinated solvent reduction in areas where BTEX was not present.

During the 2005 comprehensive groundwater sampling event, natural attenuation parameters were collected from 23 monitoring and recovery wells. In addition to “in plume” samples, samples from background (up-gradient and side-gradient) wells were also tested to determine whether electron acceptors and carbon sources were present in non-contaminated groundwater

and used as a baseline for comparison to concentrations within the contaminant plume. Products of reductive dechlorination were also analyzed.

In order for reductive dechlorination to occur, a carbon source must be present within the aquifer matrix. Potential carbon sources at environmental sites include natural organic carbon, fuel hydrocarbons, and other sources such as landfill leachate. As discussed in Section 5.3.1, the natural fraction of organic carbon in soil at the Site is relatively low. However, in many portions of the Site, fuel hydrocarbons are present. It is in these areas where reductive dechlorination has occurred. Another location where reductive dechlorination has occurred, but not in the presence of fuel constituents, is at the former pilot test location.

The potential for continued natural attenuation was evaluated by analyzing the data presented in Tables 5-3 and 5-4. A brief discussion for each of the redox reactions and metabolic byproducts follows.

Dissolved Oxygen and REDOX Potential

DO results ranged in concentration from zero to 7.86 mg/L. During the field sampling program, extra care was taken to collect meaningful DO data. DO appears to be reduced in several areas:

- Area 1 - down-gradient from the pilot test location (monitoring well P-2);
- Area 2 - on the Coleman property (from TW-1 through TW-4 to MW-21);
- Area 3 - on the shallow portion of the aquifer northeast of the Site, toward the ConocoPhillips facility (USD-MW-14 and MW-1S); and
- Area 4 - north of the Site, corresponding to Plumelet E (USD-MW-3).

Except for the last occurrence, a rationale exists for lower concentrations of DO in each area. The HRC® injected at the former pilot test location (Area 1) appears to remain effective as of the 2005 groundwater monitoring event); the elevated PCE up-gradient from the area (P-5) was dechlorinated as contaminated groundwater flowed through the test area. On the Coleman property, Area 2, depressed DO was found in the Plumelet B area where BTEX was detected or has been detected. Up-gradient from the Site in the northeasterly direction (Area 3), DO was not detected in the shallow well USD-MW-14. This well also exhibits slight concentrations of acetone, butylbenzene, CA, ethylbenzene, isopropylbenzene, methyl tert-butyl ether (MTBE), naphthalene, trichlorofluoromethane, TMBs, and xylenes during the 2005 groundwater monitoring event.

In Areas 1-3 mentioned above, the redox potential of the groundwater was also less than zero milli siemens per centimeter (MS/cm). The redox potential was most strongly reduced in Area 1, down-gradient from the 2001 pilot test, and Area 3, where fuel constituents were detected up-gradient from the Site (USD-MW-14). It was unclear why USD-MW-3 (Area 4) would have nearly zero DO; the redox potential for this well was not particularly low.

Nitrate concentrations ranged from non-detect to 4.4 mg/L. Nitrate was also not detected in Areas 1-3, but was detected in Area 4 at 0.94 mg/L, a concentration relatively close to the side-gradient concentrations along the southeast side of the Coleman property. In the area down-gradient from the contaminant plumes, nitrate was detected at the highest concentrations.

Ferrous iron, a product of the reduction of ferric iron, was only detected in Areas 1-3 as described above. The highest concentration of ferrous iron was detected in Area 3 at 3.5 mg/L. Ferrous iron is typically generated in petroleum hydrocarbon plumes under reducing conditions when ferric iron is present. In Area 4, there was no ferrous iron detected.

Sulfate concentrations ranged from 0.72 mg/L to 2300 mg/L. The range of sulfate concentrations was biased high owing to three samples: MW-8 (2300 mg/L), MW-9 (1000 mg/L), and MW-13 (970 mg/L). The presence of sulfate at these concentrations may inhibit further dechlorination. Again, Areas 1-3 exhibited lower sulfate concentrations relative to the rest of the Site. Sulfate at Area 4 was closer to the side and down-gradient concentrations.

Dissolved gases (ethene, ethane, and methane) were also analyzed for each of the wells from which natural attenuation parameters were measured. Ethene was detected at location P-2 (0.25 mg/L), south of where the pilot test occurred. Both ethene and ethane were detected in locations TW-1 and TW-4, where chlorinated ethenes, ethanes, and fuel constituents were mixed. Ethane was not detected in the pilot test area, as the original contamination in that area consisted of PCE. Interestingly, ethane and ethene were not detected in Area 3, northeast of the Site; this indicates that contaminants in that area may be from another up-gradient source.

Methane is presented as another reductive daughter product when carbon dioxide is used as an electron acceptor. Methane was detected at ten locations, eight of which were from wells that exhibited lower (negative) redox potential and where fuel contamination was present. Methane was also was detected at two locations where the redox potential was positive (TW-3 and MW-18); it is unclear why methane is present in these two wells.

5.7.3 Natural Attenuation Summary

Overall, natural attenuation (via biodegradation and other processes) at the Site has reduced concentrations of both chlorinated solvents and fuel constituents when they coexist. There is a clear line of reducing conditions present in a straight line from northeast to southwest through the following wells: MW-14, MW-1S, P-1, MW-2, TW-1, TW-4, and MW-21. In each of these wells, the following conditions exist:

- Limited DO in several of the locations;
- Little or no nitrate in all of the locations;
- Detected ferrous iron in all but one location;
- Decreased sulfate in all but one location;
- Detected ethene and ethane in several of the locations, but not northeast and in the northeast portion of the Site; and
- Methane in all locations.

These conditions are generally the opposite of what was observed at the remainder of the Site. Biodegradation of chlorinated solvents is limited in areas where fuel constituents are not or have not been present. On the basis of the success of the pilot test implemented in 2001, an expanded pilot test was initiated in December 2006.

5.8 Expanded Enhanced Reductive Dechlorination Pilot Test

In the summer of 2006, Chevron "replaced" the groundwater pump and treatment system with *in situ* reactive treatment comprised of an injected Regenesis product — HRC® and an injected DBI Remediation Product — CAP-18-ME™. The basis for this decision was three-fold:

- The extraction system had approached the end of its useful life;
- Enhanced reductive dechlorination has been demonstrated at this site; and,
- Discharge options had expired.

Therefore, the 1999-2006 HRC® injection pilot test was extended. The goal of the pilot test was to lower chlorinated solvent concentrations to below KDHE RSK residential values via enhanced and natural attenuation. Additionally, a side-by-side comparison of HRC® and CAP-18-ME™ was desired. This expanded pilot test was to occur over a larger area scale than the nine location injection area that was performed in the down-gradient from P-5 (on the Site).

The proposed pilot test was discussed verbally with Coleman and the KDHE; from those conversations, an **Enhanced Reductive Dechlorination Pilot Test Implementation Workplan**

was produced in October 2006. The Implementation Plan was approved by KDHE via letter on December 8, 2006. In December 2006, injections of CAP-18-ME™ and HRC® were performed (URS, 2007d).

HRC® is a proprietary polylactate ester that is manufactured as a viscous gel by Regenesis. CAP-18-ME™ is a proprietary vegetable oil product made by DBI Remediation. Both substrates are used to accelerate the in situ biodegradation rates of chlorinated hydrocarbons, such as PCE and TCE, via anaerobic reductive dechlorination processes. CAP-18-ME™ is less mobile and thus acts more like a "biobarrier" treatment zone. A detailed description of the HRC® product and the CAP-18-ME™ product and their use at the Site was presented in the workplan (URS, 2006).

The HRC® and CAP-18-ME™ were injected into the subsurface via DPT from the lower confining unit to above the estimated potentiometric surface forming two treatment walls on the Coleman site. DPT has been used previously on both the Site and the Coleman site for soil and groundwater sampling and at the Site for the HRC® injection during the bioremediation pilot test. The treatment walls are located up-gradient and parallel to each of the two lines of extraction wells (Interceptor A and Interceptor B). The extraction wells and adjacent monitoring wells are being used to monitor the effectiveness of the pilot test.

Additionally, the monitoring plan discussed in the **Enhanced Reductive Dechlorination Pilot Test Implementation Workplan** is currently being implemented; the first monitoring event occurred in January 2007. Pilot test monitoring will continue through December 2007, with reporting to follow.

Table 5-1. Estimated Physical and Chemical Properties of Analytes that Exceed KDHE Screening Criteria - Former Unocal Chemical Distribution Facility

COPC	Media	Molecular Weight (g/mole)	Henry's Law Constant (Unitless)	Water Solubility at 25ºC (mg/L)	Organic Carbon Partition Coefficient K_{oc} (L/kg)	Soil-Water Partition Coefficient K_d (L/kg)
(a) VOCs						
1,1,1-Trichloroethane	gw	1.33E+02	7.05E-01	1.33E+03	1.10E+02	2.20E-01
1,1-Dichloroethane	gw	9.90E+01	2.30E-01	5.06E+03	3.16E+01	6.32E-02
1,1-Dichloroethene	gw	9.70E+01	1.07E+00	2.25E+03	5.89E+01	1.18E-01
1,2,4-Trimethylbenzene	gw	1.20E+02	2.34E-01	5.70E+01	3.72E+03	7.44E+00
1,2-Dichloroethane	gw	9.90E+01	4.01E-02	8.52E+03	1.74E+01	3.48E-02
1,3,5-Trimethylbenzene	gw	1.20E+02	3.16E-01	4.82E+01	8.19E+02	1.64E+00
4-Methyl-2-pentanone	gw	1.00E+02	5.74E-03	1.90E+04	1.34E+02	2.68E-01
Acetone	gw, s	5.80E+01	1.59E-03	1.00E+06	5.75E-01	1.15E-03
Benzene	gw	7.81E+01	2.28E-01	1.75E+03	5.89E+01	1.18E-01
Chloroethane	gw	6.50E+01	4.51E-01	5.70E+03	1.47E+01	2.94E-02
Ethylbenzene	gw	1.06E+02	3.23E-01	1.69E+02	3.63E+02	7.26E-01
Isopropylbenzene	gw	1.20E+02	4.72E-01	6.10E+01	2.20E+02	4.40E-01
Naphthalene	gw	1.28E+02	1.98E-02	3.10E+01	1.19E+03	2.38E+00
PCE	gw, s	1.66E+02	7.54E-01	2.00E+02	2.69E+02	5.38E-01
TCE	gw	1.31E+02	4.22E-01	1.10E+03	1.82E+01	3.64E-02
Vinyl chloride	gw, s	6.30E+01	1.11E+00	2.76E+03	1.86E+01	3.72E-02
cis-1,2-Dichloroethene	gw	9.70E+01	1.67E-01	3.50E+03	3.55E+01	7.10E-02
n-Butylbenzene	gw	1.34E+02	5.37E-01	1.38E+01	2.83E+03	5.66E+00
trans-1,2-Dichloroethene	gw	9.70E+01	3.85E-01	6.30E+03	5.25E+01	1.05E-01

°C - Degrees Celsius.
g/mole - Grams per mole.
gw - Groundwater.
L/kg - Liters per kilogram.
mg/kg - Milligrams per kilogram.
s - Soil.

Note: For organics, K_d was calculated as follows: $K_d = K_{oc} * f_{oc}$, calculated with $f_{oc} = 0.002$ for soil.

Table 5-2. Former Unocal Chemical Distribution Plant Summary of Half-Life Values for Analytes that Exceed KDHE Screening Criteria

COPC	Media	Half-Life (low) (days)	Half-Life (high) (days)	Reference
VOCs				
1,1,1-Trichloroethane	Groundwater	63	165	Aronson and Howard, 1997
1,1-Dichloroethane	Groundwater	32	616	Howard et al., 1991
1,1-Dichloroethene	Groundwater	NA	NA	--
1,2,4-Trimethylbenzene	Groundwater	7	112	Howard et al., 1991
1,2-Dichloroethane	Groundwater	63	165	Aronson and Howard, 1997
1,3,5-Trimethylbenzene	Groundwater	NA	178	Aronson and Howard, 1997
4-Methyl-2-pentanone	Groundwater	NA	NA	--
Acetone	Soil	1	28	Howard et al., 1991
Benzene	Groundwater	58	9.5 years	Aronson et al., 1999; Rifai et al., 1995
Chloroethane	Groundwater	7	112	Howard et al., 1991
Ethylbenzene	Groundwater	87	462	Aronson and Howard, 1997; Rifai et al., 1995
Isopropylbenzene	Groundwater	NA	171	Corrarelli et al., 2005
Naphthalene	Groundwater	20	258	Howard et al., 1991
PCE	Soil, Groundwater	98	4.5 years	Howard et al., 1991
TCE	Soil, Groundwater	277	4950	Aronson and Howard, 1997
Vinyl chloride	Soil, Groundwater	95	2100	Aronson and Howard, 1997
cis-1,2-Dichloroethene	Groundwater	NA	NA	--
n-Butylbenzene	Groundwater	NA	NA	--
trans-1,2-Dichloroethene	Groundwater	95	2100	Aronson and Howard, 1997

NA - Not available.

Table 5-3. Natural Attenuation Parameter Results, Former Unocal Chemical Distribution Facility, Wichita, Kansas November 2004

Analysis	EPA Method	MW-1S 11/3/2004	MW-13 11/4/2004	MW-17 11/3/2004	MW-20 11/5/2004	MW-22 11/5/2004	TW-2A 11/5/2004	TW-3 11/4/2004
pH	Field Test	7.23	7.29	8.73	7.39	NA	NA	NA
DO	Field Test	0	0.1	0	2.09	NA	NA	NA
ORP	Field Test	-125	136	-76	50.5	NA	NA	NA
Alkalinity, Total	E310.1	606	453	125	455	328	315	237
Chloride, Total	E325.2	72.2	23.6	71.9	60.9	96.3	65.7	47.9
Metals, Total	6010B	1.79	0.00782	0.334	0.00857	< 0.005	0.197	0.073
Nitrate Nitrogen, Total	E353.2	< 0.5	0.913	1.07	1.42	3.52	< 0.5	1.8
Sulfate, Total	E375.4	2920	142	2390	133	133	358	68
Sulfide, Total	E376.2	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total Organic Carbon	SW9060	11.9	4.11	2.33	5.72	4.41	5.95	6.72
Ferrous Iron	--	4.0	0	0	0	0	0	0

Note: All values in mg/L (milligrams per liter).
Ferrous iron was analyzed in the field using an Iron Hach Kit.
DO - Dissolved oxygen.
EPA - Environmental Protection Agency.
MW -Monitoring well on Unocal or Coleman property (S-shallow).
NA - Not available.
ORP - Oxidation reduction potential.
TW - Test well.

Table 5-4. Natural Attenuation Parameter Results, Former Unocal Chemical Distribution Facility, Wichita, Kansas 2005 Sampling Event

Analysis	EPA Method	MW-1D 1/26/2006	MW-1S 1/26/2006	MW-2 2/8/2006	MW-8 2/3/2006	MW-9 2/6/2006	MW-10 1/27/2006	MW-12D 1/27/2006	MW-13 1/27/2006	MW-13-USD 2/1/2006
pH	Field Test	6.74	6.73	7.4	6.66	7.95	7.03	7.16	6.63	7.1
DO	Field Test	2.43	0	1.11	1.5	3.79	3.05	3.05	0.01	2.53
ORP	Field Test	11	-70	-53	59	188	90	90	53	152
Alkalinity, Total	E310.1	585	541	588	223	336	422	382	202	513
Chloride, Total	E300.0	36	36	24	150	1600	40	12	47	78
Nitrate Nitrogen, Total	E300.0	0.025 J	ND	0.018 J	ND	1.4	1.1	0.54	0.94	0.078 J
Sulfate, Total	E300.0	190	200	2.8	2300	1000	96	120	120	970
Ethane	RSK175	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0025)
Ethylene	RSK175	ND (0.0032)	ND (0.0032)	ND (0.0032)	ND (0.0032)	ND (0.0032)	ND (0.0032)	ND (0.0032)	ND (0.0032)	ND (0.0032)
Methane	RSK175	ND (0.0012)	0.18	0.11	ND (0.0012)	ND (0.0012)	ND (0.0012)	ND (0.0012)	ND (0.0012)	ND (0.0012)
Ferrous Iron	--	0.5	2.0	2.25	0.5	0.0	0.0	0.0	0.0	0.0

Note: Values for alkalinity, chloride, nitrate nitrogen, sulfate and ferrous iron are in mg/L (milligrams per liter).
Ferrous iron was analyzed in the field using an Iron Hach Kit.
Metals, sulfide (total) and total organic carbon (TOC) were not measured.
MW3 through MW7, MW16, MW17, P05, P10, and USD1 through USD3 were not able to sustain water during testing.
DO - Dissolved oxygen.
EPA - Environmental Protection Agency.
J - The analyte was positively identified, the quantitation is an estimation.
MW - Monitoring well on Unocal or Coleman property (D-deep, S-shallow).
ND - Non-detect.
NM - Not measured.
ORP - Oxidation reduction potential.
P or PZ - Piezometer.
R - Recovery well.
TW - Test well.
USD - Monitoring well on USD property.

Table 5-4. Natural Attenuation Parameter Results, Former Unocal Chemical Distribution Facility, Wichita, Kansas 2005 Sampling Event (Continued)

Analysis	EPA Method	MW-14 1/31/2006	MW-18 2/3/2006	MW-19 2/2/2006	MW-20 2/2/2006	MW-21 2/3/2006	MW-22 2/2/2006	MW-23 2/2/2006	P-01 2/8/2006	P-2 1/26/2006
pH	Field Test	6.8	6.23	6.87	6.8	6.73	6.91	6.78	7.46	6.63
DO	Field Test	0	2.15	3.19	1.64	0.54	6.28	7.86	3.36	0
ORP	Field Test	-125	209	68	79	-52	250	245	-19	-134
Alkalinity, Total	E310.1	728	517	372	417	399	332	352	653	615
Chloride, Total	E300.0	30	68	82	79	89	51	33	31	35
Nitrate Nitrogen, Total	E300.0	ND	0.029 J	1.4	0.72	0.14 J	2.3	4.4	ND	ND
Sulfate, Total	E300.0	1.5	64	120	110	61	120	120	56	45
Ethane	RSK175	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.0025)	ND (0.025)
Ethylene	RSK175	ND (0.0032)	ND (0.0032)	ND (0.0032)	ND (0.0032)	ND (0.0032)	ND (0.0032)	ND (0.0032)	ND (0.0032)	0.25
Methane	RSK175	0.74	0.011	ND (0.0012)	ND (0.0012)	0.039	ND (0.0012)	ND (0.0012)	0.0043	1
Ferrous Iron	--	3.5	0.0	0.0	0.0	0.5	0.0	0.0	1.2	2.0

Note: Values for alkalinity, chloride, nitrate nitrogen, sulfate and ferrous iron are in mg/L (milligrams per liter).
Ferrous iron was analyzed in the field using an Iron Hach Kit.
Metals, sulfide (total) and total organic carbon (TOC) were not measured.
MW3 through MW7, MW16, MW17, P05, P10, and USD1 through USD3 were not able to sustain water during testing.
DO - Dissolved oxygen.
EPA - Environmental Protection Agency.
J - The analyte was positively identified, the quantitation is an estimation.
MW - Monitoring well on Unocal or Coleman property (D-deep, S-shallow).
ND - Non-detect.
NM - Not measured.
ORP - Oxidation reduction potential.
P or PZ - Piezometer.
R - Recovery well.
TW - Test well.
USD - Monitoring well on USD property.

Table 5-4. Natural Attenuation Parameter Results, Former Unocal Chemical Distribution Facility, Wichita, Kansas 2005 Sampling Event (Continued)

Analysis	EPA Method	P-03 2/6/2006	TW-1 2/7/2006	TW-2A 2/7/2006	TW-3 2/7/2006	TW-4 2/7/2006
pH	Field Test	7.95	6.7	8.04	6.92	6.72
DO	Field Test	4.72	3.83	4.49	5.22	0.28
ORP	Field Test	318	-54	275	99	-78
Alkalinity, Total	E310.1	378	578	303	322	586
Chloride, Total	E300.0	44	89	70	19	92
Nitrate Nitrogen, Total	E300.0	2.7	ND	0.090 J	0.048 J	ND
Sulfate, Total	E300.0	150	0.72	320	130	2.7
Ethane	RSK175	ND (0.0025)	0.17	ND (0.0025)	ND (0.0025)	0.39
Ethylene	RSK175	ND (0.0032)	0.31	ND (0.0032)	ND (0.0032)	0.21
Methane	RSK175	ND (0.0012)	2.9	ND (0.0012)	0.025	7.3
Ferrous Iron	--	0.0	NM	NM	0.0	2.5

Note: Values for alkalinity, chloride, nitrate nitrogen, sulfate and ferrous iron are in mg/L (milligrams per liter).
Ferrous iron was analyzed in the field using an Iron Hach Kit.
Metals, sulfide (total) and total organic carbon (TOC) were not measured.
MW3 through MW7, MW16, MW17, P05, P10, and USD1 through USD3 were not able to sustain water during testing.
DO - Dissolved oxygen.
EPA - Environmental Protection Agency.
J - The analyte was positively identified, the quantitation is an estimation.
MW - Monitoring well on Unocal or Coleman property (D-deep, S-shallow).
NM - Not measured.
ORP - Oxidation reduction potential.
P or PZ - Piezometer.
R - Recovery well.
TW - Test well.
USD - Monitoring well on USD property.

Table 5-5. Summary of Results from Mann-Kendall Test

Well	Analyte	Units	Number of Detected Results	Number of Samples	p-value for Mann-Kendall Test	Conclusion of Mann-Kendall Test
MW1D	1,1-Dichloroethane	µg/L	1	14	0.0045749671	Downward
MW1D	1,2,4-Trimethylbenzene	µg/L	1	9	0.154	Undetermined
MW1D	1,2-Dichloroethane	µg/L	1	14	0.0014471639	Downward
MW1D	2-Butanone (MEK)	µg/L	1	14	0.0063929101	Downward
MW1D	Acetone (2-Propanone)	µg/L	2	14	0.1283725604	Undetermined
MW1D	Carbon disulfide	µg/L	1	12	0.2042141207	Undetermined
MW1D	Carbon tetrachloride	µg/L	1	13	0.0117677071	Downward
MW1D	Ethylbenzene	µg/L	3	14	0.0221292257	Downward
MW1D	Isopropylbenzene (Cumene)	µg/L	1	9	0.11	Undetermined
MW1D	Tetrachloroethene	µg/L	1	14	0.0162149072	Downward
MW1D	Toluene	µg/L	1	14	0.0014471639	Downward
MW1D	Xylenes (total)	µg/L	3	14	0.0046166631	Downward
MW1D	cis-1,2-Dichloroethene	µg/L	1	12	0.0103158912	Downward
MW1S	1,1,1-Trichloroethane	µg/L	1	22	0.0107142878	Downward
MW1S	1,1-Dichloroethane	µg/L	7	22	0.00015596	Downward
MW1S	1,1-Dichloroethene	µg/L	2	22	0.0015186878	Downward
MW1S	1,2,4-Trimethylbenzene	µg/L	2	13	0.0787280293	Undetermined
MW1S	1,3,5-Trimethylbenzene	µg/L	1	13	0.0237647598	Downward
MW1S	2-Butanone (MEK)	µg/L	2	21	0.0003200379	Downward
MW1S	Benzene	µg/L	3	22	0.0011371232	Downward
MW1S	Carbon disulfide	µg/L	1	18	0.0447146795	Downward
MW1S	Ethylbenzene	µg/L	14	22	0.0251831453	Downward
MW1S	Isopropylbenzene (Cumene)	µg/L	3	13	0.318739511	Undetermined
MW1S	Methylene chloride (Dichloromethane)	µg/L	1	20	0.000072208	Downward
MW1S	Naphthalene	µg/L	3	13	0.0404690995	Downward
MW1S	Styrene	µg/L	1	20	0.0000769622	Downward
MW1S	Tetrachloroethene	µg/L	8	22	0.0007922121	Downward
MW1S	Toluene	µg/L	8	22	0.0126181252	Downward
MW1S	Trichloroethene	µg/L	8	22	0.0000208611	Downward
MW1S	Vinyl chloride (Chloroethene)	µg/L	14	22	0.0002330163	Downward
MW1S	Xylenes (total)	µg/L	9	22	0.2009246504	Undetermined
MW1S	cis-1,2-Dichloroethene	µg/L	19	20	0.0169685424	Downward
MW1S	n-Butylbenzene	µg/L	1	13	0.0237647598	Downward
MW1S	trans-1,2-Dichloroethene	µg/L	1	20	0.0082433265	Downward
MW2	1,1-Dichloroethane	µg/L	1	17	0.0126127129	Downward
MW2	1,1-Dichloroethene	µg/L	2	17	0.0000957823	Downward
MW2	1,2,4-Trimethylbenzene	µg/L	2	6	0.0048	Downward
MW2	1,3,5-Trimethylbenzene	µg/L	1	6	0.0083	Downward
MW2	2-Butanone (MEK)	µg/L	1	16	0.0000225326	Downward
MW2	4-Methyl-2-pentanone (MIBK)	µg/L	1	16	0.0000225326	Downward
MW2	Acetone (2-Propanone)	µg/L	3	16	0.0005880851	Downward
MW2	Carbon disulfide	µg/L	3	13	0.0006428937	Downward
MW2	Ethylbenzene	µg/L	15	17	0.0000313407	Downward
MW2	Isopropylbenzene (Cumene)	µg/L	5	6	0.235	Undetermined
MW2	Methylene chloride (Dichloromethane)	µg/L	2	16	0.0000911378	Downward

Table 5-5. Summary of Results from Mann-Kendall Test (Continued)

Well	Analyte	Units	Number of Detected Results	Number of Samples	p-value for Mann-Kendall Test	Conclusion of Mann-Kendall Test
MW2	Naphthalene	µg/L	3	7	0.015	Downward
MW2	Styrene	µg/L	1	15	0.0086432009	Downward
MW2	Tetrachloroethene	µg/L	2	17	0.0009431118	Downward
MW2	Toluene	µg/L	3	17	0.000486079	Downward
MW2	Trichloroethene	µg/L	12	17	0.0002611788	Downward
MW2	Vinyl chloride (Chloroethene)	µg/L	12	17	0.0001162763	Downward
MW2	Xylenes (total)	µg/L	11	17	0.0056512902	Downward
MW2	cis-1,2-Dichloroethene	µg/L	14	15	0.0014927354	Downward
MW2	n-Butylbenzene	µg/L	3	6	0.43	Undetermined
MW3	1,2,4-Trimethylbenzene	µg/L	2	15	0.0001443558	Downward
MW3	1,2-Dichloroethane	µg/L	2	24	0.0004722309	Downward
MW3	1,3,5-Trimethylbenzene	µg/L	2	15	0.0001443558	Downward
MW3	Benzene	µg/L	3	24	0.0000236933	Downward
MW3	Carbon tetrachloride	µg/L	6	19	0.0483587008	Downward
MW3	Ethylbenzene	µg/L	2	24	0.0000115131	Downward
MW3	Isopropylbenzene (Cumene)	µg/L	2	15	0.0001086979	Downward
MW3	Methylene chloride (Dichloromethane)	µg/L	2	23	3.9971487E-6	Downward
MW3	Naphthalene	µg/L	2	15	0.0000260585	Downward
MW3	Tetrachloroethene	µg/L	24	24	0.0015007206	Downward
MW3	Toluene	µg/L	2	24	0.0000115131	Downward
MW3	Trichloroethene	µg/L	4	24	0.0144426376	Downward
MW3	Vinyl chloride (Chloroethene)	µg/L	2	24	0.1488737365	Undetermined
MW3	Xylenes (total)	µg/L	2	24	0.0000115131	Downward
MW3	cis-1,2-Dichloroethene	µg/L	2	22	0.0061520104	Downward
MW3	n-Butylbenzene	µg/L	3	15	0.0001147063	Downward
MW3	trans-1,2-Dichloroethene	µg/L	2	23	0.0009882892	Downward
MW4	1,1-Dichloroethane	µg/L	8	23	0.0069559429	Downward
MW4	1,1-Dichloroethene	µg/L	1	23	0.0001580594	Downward
MW4	1,2-Dichloroethane	µg/L	4	23	0.0347028085	Downward
MW4	Benzene	µg/L	1	23	0.0001358028	Downward
MW4	Methylene chloride (Dichloromethane)	µg/L	2	22	0.0000328198	Downward
MW4	Naphthalene	µg/L	1	14	0.0019961731	Downward
MW4	Tetrachloroethene	µg/L	7	23	0.3184707117	Undetermined
MW4	Trichloroethene	µg/L	12	23	0.3834088139	Undetermined
MW4	Vinyl chloride (Chloroethene)	µg/L	11	23	0.0000885296	Downward
MW4	Xylenes (total)	µg/L	1	23	0.0001358028	Downward
MW4	cis-1,2-Dichloroethene	µg/L	21	21	0.1595040151	Undetermined
MW4	trans-1,2-Dichloroethene	µg/L	5	22	0.0283780955	Downward
MW5	1,1,1-Trichloroethane	µg/L	1	21	0.0000226639	Downward
MW5	1,1-Dichloroethane	µg/L	4	21	0.0568227756	Undetermined
MW5	1,1-Dichloroethene	µg/L	18	21	0.0113226877	Downward
MW5	1,2,4-Trimethylbenzene	µg/L	7	13	0.2687405833	Undetermined
MW5	1,3,5-Trimethylbenzene	µg/L	3	13	0.0066459046	Downward
MW5	2-Butanone (MEK)	µg/L	3	20	0.0007147597	Downward
MW5	Benzene	µg/L	10	21	0.0150989869	Downward

Table 5-5. Summary of Results from Mann-Kendall Test (Continued)

Well	Analyte	Units	Number of Detected Results	Number of Samples	p-value for Mann-Kendall Test	Conclusion of Mann-Kendall Test
MW5	Carbon disulfide	µg/L	1	19	0.0069782059	Downward
MW5	Chloroethane (Ethyl chloride)	µg/L	7	21	0.0005035284	Downward
MW5	Ethylbenzene	µg/L	21	21	0.2932921064	Undetermined
MW5	Isopropylbenzene (Cumene)	µg/L	4	13	0.5	Undetermined
MW5	Methylene chloride (Dichloromethane)	µg/L	1	21	0.0001506632	Downward
MW5	Naphthalene	µg/L	4	13	0.1034044576	Undetermined
MW5	Tetrachloroethene	µg/L	21	21	0.0214315688	Downward
MW5	Toluene	µg/L	17	21	0.0868987807	Undetermined
MW5	Trichloroethene	µg/L	21	21	0.0512483041	Undetermined
MW5	Vinyl chloride (Chloroethene)	µg/L	21	21	0.0035991742	Downward
MW5	Xylenes (total)	µg/L	21	21	0.2342085993	Undetermined
MW5	cis-1,2-Dichloroethene	µg/L	20	20	0.0115343144	Downward
MW5	n-Butylbenzene	µg/L	1	13	0.0015751698	Downward
MW5	trans-1,2-Dichloroethene	µg/L	8	21	0.3794939753	Undetermined
MW6	1,1,1-Trichloroethane	µg/L	5	5	0.0083	Downward
MW6	1,1-Dichloroethane	µg/L	5	5	0.117	Undetermined
MW6	1,1-Dichloroethene	µg/L	5	5	0.408	Undetermined
MW6	2-Butanone (MEK)	µg/L	2	5	0.117	Undetermined
MW6	4-Methyl-2-pentanone (MIBK)	µg/L	2	5	0.242	Undetermined
MW6	Acetone (2-Propanone)	µg/L	2	5	0.117	Undetermined
MW6	Benzene	µg/L	4	5	0.592	Undetermined
MW6	Ethylbenzene	µg/L	4	5	0.408	Undetermined
MW6	Methylene chloride (Dichloromethane)	µg/L	2	5	0.117	Undetermined
MW6	Tetrachloroethene	µg/L	4	5	0.042	Downward
MW6	Toluene	µg/L	5	5	0.117	Undetermined
MW6	Trichloroethene	µg/L	4	5	0.117	Undetermined
MW6	Vinyl chloride (Chloroethene)	µg/L	5	5	0.117	Undetermined
MW6	Xylenes (total)	µg/L	5	5	0.117	Undetermined
MW6	trans-1,2-Dichloroethene	µg/L	3	5	0.408	Undetermined
MW7	1,2-Dichloroethane	µg/L	1	20	0.0296035715	Downward
MW7	Acetone (2-Propanone)	µg/L	1	19	0.0014538515	Downward
MW7	Chloroethane (Ethyl chloride)	µg/L	4	20	0.0116983238	Downward
MW7	Ethylbenzene	µg/L	1	20	0.0002990335	Downward
MW7	Trichloroethene	µg/L	2	20	0.0253791301	Downward
MW7	cis-1,2-Dichloroethene	µg/L	5	19	0.1483028434	Undetermined
MW8	1,2,4-Trimethylbenzene	µg/L	2	15	0.0001443558	Downward
MW8	1,2-Dichloroethane	µg/L	2	23	0.0009882892	Downward
MW8	1,3,5-Trimethylbenzene	µg/L	2	15	0.0001443558	Downward
MW8	Benzene	µg/L	2	23	0.0000193161	Downward
MW8	Ethylbenzene	µg/L	2	23	0.0000193161	Downward
MW8	Isopropylbenzene (Cumene)	µg/L	2	15	0.0001086979	Downward
MW8	Methylene chloride (Dichloromethane)	µg/L	3	23	3.5387485E-6	Downward
MW8	Naphthalene	µg/L	2	15	0.0000260585	Downward
MW8	Tetrachloroethene	µg/L	2	23	0.0042461767	Downward
MW8	Toluene	µg/L	2	23	0.0000193161	Downward

Table 5-5. Summary of Results from Mann-Kendall Test (Continued)

Well	Analyte	Units	Number of Detected Results	Number of Samples	p-value for Mann-Kendall Test	Conclusion of Mann-Kendall Test
MW8	Trichloroethene	µg/L	2	23	0.0134498557	Downward
MW8	Vinyl chloride (Chloroethene)	µg/L	2	23	0.4030129628	Undetermined
MW8	Xylenes (total)	µg/L	3	23	3.6416389E-7	Downward
MW8	cis-1,2-Dichloroethene	µg/L	2	22	0.0051792935	Downward
MW8	n-Butylbenzene	µg/L	2	15	0.0001086979	Downward
MW8	trans-1,2-Dichloroethene	µg/L	2	23	0.0134498557	Downward
MW9	Acetone (2-Propanone)	µg/L	1	14	0.0400462123	Downward
MW10	1,3,5-Trimethylbenzene	µg/L	1	7	0.0019	Downward
MW10	Chlorobenzene	µg/L	1	15	0.0143489651	Downward
MW10	Methylene chloride (Dichloromethane)	µg/L	1	16	0.0007512624	Downward
MW10	Naphthalene	µg/L	1	7	0.0008	Downward
MW11	1,2,4-Trimethylbenzene	µg/L	2	9	0.038	Downward
MW11	1,2-Dichloroethane	µg/L	2	17	0.2464807702	Undetermined
MW11	1,3,5-Trimethylbenzene	µg/L	2	9	0.038	Downward
MW11	Benzene	µg/L	2	17	0.0166179899	Downward
MW11	Carbon disulfide	µg/L	2	14	0.4483172495	Undetermined
MW11	Carbon tetrachloride	µg/L	2	14	0.1658395071	Undetermined
MW11	Ethylbenzene	µg/L	2	17	0.0166179899	Downward
MW11	Isopropylbenzene (Cumene)	µg/L	2	9	0.06	Undetermined
MW11	Methylene chloride (Dichloromethane)	µg/L	3	17	0.0029316591	Downward
MW11	Naphthalene	µg/L	2	9	0.017	Downward
MW11	Tetrachloroethene	µg/L	2	17	0.2464807702	Undetermined
MW11	Toluene	µg/L	2	17	0.0166179899	Downward
MW11	Trichloroethene	µg/L	2	17	0.2464807702	Undetermined
MW11	Vinyl chloride (Chloroethene)	µg/L	2	17	0.0616840633	Undetermined
MW11	Xylenes (total)	µg/L	2	17	0.0166179899	Downward
MW11	cis-1,2-Dichloroethene	µg/L	2	16	0.1052687986	Undetermined
MW11	n-Butylbenzene	µg/L	2	9	0.06	Undetermined
MW11	trans-1,2-Dichloroethene	µg/L	2	17	0.2464807702	Undetermined
MW12D	Acetone (2-Propanone)	µg/L	1	10	0.045	Downward
MW12D	Carbon disulfide	µg/L	1	9	0.0063	Downward
MW12D	Carbon tetrachloride	µg/L	1	10	0.03	Downward
MW12D	Methylene chloride (Dichloromethane)	µg/L	1	10	0.0064	Downward
MW12S	Acetone (2-Propanone)	µg/L	1	19	0.0334605592	Downward
MW12S	Methylene chloride (Dichloromethane)	µg/L	2	20	0.0001268943	Downward
MW13	1,2,4-Trimethylbenzene	µg/L	2	13	0.004724362	Downward
MW13	1,2-Dichloroethane	µg/L	2	22	0.0074515013	Downward
MW13	1,3,5-Trimethylbenzene	µg/L	2	13	0.004724362	Downward
MW13	Benzene	µg/L	2	22	0.0001605935	Downward
MW13	Ethylbenzene	µg/L	2	22	0.0001605935	Downward
MW13	Isopropylbenzene (Cumene)	µg/L	2	13	0.0029927948	Downward
MW13	Methylene chloride (Dichloromethane)	µg/L	3	22	0.0000864831	Downward
MW13	Naphthalene	µg/L	4	13	0.0215618555	Downward
MW13	Tetrachloroethene	µg/L	2	22	0.0068556039	Downward
MW13	Toluene	µg/L	2	22	0.0001605935	Downward

Table 5-5. Summary of Results from Mann-Kendall Test (Continued)

Well	Analyte	Units	Number of Detected Results	Number of Samples	p-value for Mann-Kendall Test	Conclusion of Mann-Kendall Test
MW13	Trichloroethene	µg/L	3	22	0.2177008734	Undetermined
MW13	Vinyl chloride (Chloroethene)	µg/L	2	22	0.1366238215	Undetermined
MW13	Xylenes (total)	µg/L	2	22	0.0001605935	Downward
MW13	cis-1,2-Dichloroethene	µg/L	3	21	0.1158873213	Undetermined
MW13	n-Butylbenzene	µg/L	2	13	0.0029927948	Downward
MW13	trans-1,2-Dichloroethene	µg/L	2	22	0.0074515013	Downward
MW14	1,2,4-Trimethylbenzene	µg/L	13	13	0.1223118026	Undetermined
MW14	1,2-Dichloroethane	µg/L	2	21	0.0008623385	Downward
MW14	1,3,5-Trimethylbenzene	µg/L	13	13	0.3557002424	Undetermined
MW14	Acetone (2-Propanone)	µg/L	1	18	0.0004243945	Downward
MW14	Benzene	µg/L	3	21	0.0000117118	Downward
MW14	Chloroethane (Ethyl chloride)	µg/L	1	19	0.0000306215	Downward
MW14	Ethylbenzene	µg/L	21	21	4.1372032E-6	Downward
MW14	Isopropylbenzene (Cumene)	µg/L	13	13	0.4751146706	Undetermined
MW14	Methylene chloride (Dichloromethane)	µg/L	2	21	8.7910679E-7	Downward
MW14	Naphthalene	µg/L	15	15	0.0035971985	Downward
MW14	Tetrachloroethene	µg/L	2	21	0.0008623385	Downward
MW14	Toluene	µg/L	4	21	0.0002164398	Downward
MW14	Trichloroethene	µg/L	2	21	0.0008623385	Downward
MW14	Vinyl chloride (Chloroethene)	µg/L	2	21	0.3382959534	Undetermined
MW14	Xylenes (total)	µg/L	21	21	1.2212658E-6	Downward
MW14	cis-1,2-Dichloroethene	µg/L	2	21	0.0008623385	Downward
MW14	n-Butylbenzene	µg/L	7	13	0.5	Undetermined
MW14	trans-1,2-Dichloroethene	µg/L	2	21	0.0008623385	Downward
MW15	1,2,4-Trimethylbenzene	µg/L	3	12	0.2916795071	Undetermined
MW15	1,2-Dichloroethane	µg/L	2	20	0.0034554147	Downward
MW15	1,3,5-Trimethylbenzene	µg/L	3	12	0.0041452706	Downward
MW15	Benzene	µg/L	2	20	0.0000222551	Downward
MW15	Chlorobenzene	µg/L	1	17	0.0003640203	Downward
MW15	Chloroethane (Ethyl chloride)	µg/L	1	18	0.0000906104	Downward
MW15	Ethylbenzene	µg/L	4	20	0.0042579014	Downward
MW15	Isopropylbenzene (Cumene)	µg/L	3	12	0.1760698685	Undetermined
MW15	Methylene chloride (Dichloromethane)	µg/L	3	20	0.0000548194	Downward
MW15	Naphthalene	µg/L	5	12	0.1785840278	Undetermined
MW15	Tetrachloroethene	µg/L	2	20	0.0034554147	Downward
MW15	Toluene	µg/L	3	20	0.0001709184	Downward
MW15	Trichloroethene	µg/L	3	20	0.0074979072	Downward
MW15	Vinyl chloride (Chloroethene)	µg/L	3	20	0.0347763634	Upward
MW15	Xylenes (total)	µg/L	3	20	0.0032461927	Downward
MW15	cis-1,2-Dichloroethene	µg/L	4	20	0.0856450514	Undetermined
MW15	n-Butylbenzene	µg/L	3	12	0.107377536	Undetermined
MW15	trans-1,2-Dichloroethene	µg/L	2	20	0.0034554147	Downward
MW16	Benzene	µg/L	1	7	0.035	Downward
MW16	Carbon disulfide	µg/L	1	7	0.068	Undetermined
MW16	Carbon tetrachloride	µg/L	1	7	0.191	Undetermined

Table 5-5. Summary of Results from Mann-Kendall Test (Continued)

Well	Analyte	Units	Number of Detected Results	Number of Samples	p-value for Mann-Kendall Test	Conclusion of Mann-Kendall Test
MW17	1,1-Dichloroethane	µg/L	1	22	0.0001666664	Downward
MW17	1,2,4-Trimethylbenzene	µg/L	1	14	0.001363785	Downward
MW17	2-Butanone (MEK)	µg/L	1	21	0.0000380729	Downward
MW17	Acetone (2-Propanone)	µg/L	1	21	0.0000918503	Downward
MW17	Benzene	µg/L	1	22	0.000031827	Downward
MW17	Carbon disulfide	µg/L	1	20	0.0287935171	Downward
MW17	Ethylbenzene	µg/L	2	22	4.5333269E-6	Downward
MW17	Methylene chloride (Dichloromethane)	µg/L	1	22	4.413705E-7	Downward
MW17	Naphthalene	µg/L	3	16	0.0018518405	Downward
MW17	Xylenes (total)	µg/L	1	22	0.0000650862	Downward
MW19	1,1,1-Trichloroethane	µg/L	1	21	1.2948871E-6	Downward
MW19	1,1-Dichloroethane	µg/L	1	20	0.000010901	Downward
MW19	Acetone (2-Propanone)	µg/L	1	18	0.0000153728	Downward
MW19	Benzene	µg/L	1	21	1.2948871E-6	Downward
MW19	Carbon disulfide	µg/L	1	17	0.03561691	Downward
MW19	Methylene chloride (Dichloromethane)	µg/L	1	19	0.0000104725	Downward
MW19	Tetrachloroethene	µg/L	21	21	0.0000466671	Downward
MW19	Trichloroethene	µg/L	14	21	0.0000540476	Downward
MW19	cis-1,2-Dichloroethene	µg/L	7	20	0.0002684322	Downward
MW20	1,1,1-Trichloroethane	µg/L	4	23	2.0674716E-7	Downward
MW20	1,1,2-Trichloroethane	µg/L	14	22	0.0000263704	Downward
MW20	1,1-Dichloroethane	µg/L	23	23	1.6785674E-8	Downward
MW20	1,1-Dichloroethene	µg/L	23	23	1.4299031E-6	Downward
MW20	1,2-Dichloroethane	µg/L	23	23	4.8308356E-9	Downward
MW20	Benzene	µg/L	3	22	1.1236495E-6	Downward
MW20	Chloroethane (Ethyl chloride)	µg/L	16	23	4.4498836E-8	Downward
MW20	Methylene chloride (Dichloromethane)	µg/L	1	21	0.0001640538	Downward
MW20	Tetrachloroethene	µg/L	23	23	2.1190575E-7	Downward
MW20	Toluene	µg/L	1	21	0.0000467991	Downward
MW20	Trichloroethene	µg/L	23	23	3.6492147E-6	Downward
MW20	Vinyl chloride (Chloroethene)	µg/L	11	23	1.1504094E-8	Downward
MW20	Xylenes (total)	µg/L	1	21	0.0000130204	Downward
MW20	cis-1,2-Dichloroethene	µg/L	22	22	2.842835E-8	Downward
MW20	trans-1,2-Dichloroethene	µg/L	10	22	0.0253683665	Downward
MW21	1,1,2-Trichloroethane	µg/L	2	17	0.0000531647	Downward
MW21	1,1-Dichloroethane	µg/L	19	19	0.0000583083	Downward
MW21	1,1-Dichloroethene	µg/L	19	19	3.7464937E-7	Downward
MW21	1,2-Dichloroethane	µg/L	18	19	0.0000153918	Downward
MW21	2-Butanone (MEK)	µg/L	1	16	0.004867867	Downward
MW21	Acetone (2-Propanone)	µg/L	1	16	0.0000350377	Downward
MW21	Benzene	µg/L	14	19	3.4534673E-6	Downward
MW21	Chloroethane (Ethyl chloride)	µg/L	5	18	0.0627532357	Undetermined
MW21	Methylene chloride (Dichloromethane)	µg/L	4	17	0.0015935148	Downward
MW21	Styrene	µg/L	1	17	0.0000389902	Downward
MW21	Tetrachloroethene	µg/L	19	19	4.2525474E-8	Downward

Table 5-5. Summary of Results from Mann-Kendall Test (Continued)

Well	Analyte	Units	Number of Detected Results	Number of Samples	p-value for Mann-Kendall Test	Conclusion of Mann-Kendall Test
MW21	Toluene	µg/L	1	17	0.0000119975	Downward
MW21	Trichloroethene	µg/L	19	19	3.6689446E-6	Downward
MW21	Vinyl chloride (Chloroethene)	µg/L	19	19	4.3764514E-6	Downward
MW21	cis-1,2-Dichloroethene	µg/L	18	18	1.8485333E-6	Downward
MW21	trans-1,2-Dichloroethene	µg/L	7	18	0.0047557009	Downward
MW22	Carbon disulfide	µg/L	1	17	0.0200724782	Downward
MW22	Carbon tetrachloride	µg/L	2	18	0.0000411121	Downward
MW22	Ethylbenzene	µg/L	2	21	6.316661E-7	Downward
MW22	Methylene chloride (Dichloromethane)	µg/L	1	19	0.0000104725	Downward
MW22	Naphthalene	µg/L	2	14	0.0020163648	Downward
MW22	Tetrachloroethene	µg/L	1	20	1.5826453E-6	Downward
MW22	Toluene	µg/L	2	21	6.316661E-7	Downward
MW22	Xylenes (total)	µg/L	3	21	9.7914106E-6	Downward
MW23	1,1-Dichloroethane	µg/L	1	14	0.0000628838	Downward
MW23	Tetrachloroethene	µg/L	1	14	0.0000386549	Downward
MW23	Trichloroethene	µg/L	1	14	0.0001182126	Downward
R1	1,1,1-Trichloroethane	µg/L	22	22	0.0000269321	Downward
R1	1,1,2-Trichloroethane	µg/L	4	22	0.0000287143	Downward
R1	1,1-Dichloroethane	µg/L	21	22	0.0003903293	Downward
R1	1,1-Dichloroethene	µg/L	20	22	0.0001884386	Downward
R1	1,2,4-Trimethylbenzene	µg/L	13	14	0.0068083341	Downward
R1	1,2-Dichloroethane	µg/L	3	22	0.0009709504	Downward
R1	1,3,5-Trimethylbenzene	µg/L	12	14	0.0035232281	Downward
R1	2-Butanone (MEK)	µg/L	14	21	1.5955537E-6	Downward
R1	4-Methyl-2-pentanone (MIBK)	µg/L	11	21	0.000152487	Downward
R1	Acetone (2-Propanone)	µg/L	11	21	0.0000292858	Downward
R1	Benzene	µg/L	18	22	0.0009458881	Downward
R1	Carbon disulfide	µg/L	1	20	0.1046943806	Undetermined
R1	Chloroethane (Ethyl chloride)	µg/L	2	22	0.0002944143	Downward
R1	Ethylbenzene	µg/L	21	22	2.74297E-6	Downward
R1	Isopropylbenzene (Cumene)	µg/L	13	14	0.0090227126	Downward
R1	Methylene chloride (Dichloromethane)	µg/L	19	22	0.0000129032	Downward
R1	Naphthalene	µg/L	15	16	0.0051397392	Downward
R1	Styrene	µg/L	16	22	0.0003208983	Downward
R1	Tetrachloroethene	µg/L	20	22	0.0000274284	Downward
R1	Toluene	µg/L	22	22	1.1933138E-7	Downward
R1	Trichloroethene	µg/L	21	22	0.0004342229	Downward
R1	Vinyl chloride (Chloroethene)	µg/L	21	22	0.002402732	Downward
R1	Xylenes (total)	µg/L	22	22	1.1845824E-7	Downward
R1	cis-1,2-Dichloroethene	µg/L	22	22	0.0010532293	Downward
R1	n-Butylbenzene	µg/L	6	14	0.3260852542	Undetermined
R1	trans-1,2-Dichloroethene	µg/L	7	22	0.015918197	Downward
R2	1,1,1-Trichloroethane	µg/L	1	25	0.0001278508	Downward
R2	1,1-Dichloroethane	µg/L	25	25	2.5659032E-7	Downward
R2	1,1-Dichloroethene	µg/L	10	25	4.73336E-6	Downward

Table 5-5. Summary of Results from Mann-Kendall Test (Continued)

Well	Analyte	Units	Number of Detected Results	Number of Samples	p-value for Mann-Kendall Test	Conclusion of Mann-Kendall Test
R2	1,2,4-Trimethylbenzene	µg/L	1	17	0.0005562748	Downward
R2	1,2-Dichloroethane	µg/L	11	25	2.5882889E-6	Downward
R2	1,3,5-Trimethylbenzene	µg/L	1	17	0.000289213	Downward
R2	Acetone (2-Propanone)	µg/L	2	25	5.6806817E-6	Downward
R2	Benzene	µg/L	5	25	4.7114083E-7	Downward
R2	Chloroethane (Ethyl chloride)	µg/L	3	25	1.5914563E-7	Downward
R2	Ethylbenzene	µg/L	3	25	5.8337539E-6	Downward
R2	Methylene chloride (Dichloromethane)	µg/L	1	25	2.7355945E-8	Downward
R2	Naphthalene	µg/L	3	17	0.001075171	Downward
R2	Tetrachloroethene	µg/L	24	25	0.0000208761	Downward
R2	Toluene	µg/L	3	25	9.3744313E-8	Downward
R2	Trichloroethene	µg/L	24	25	3.2418467E-6	Downward
R2	Vinyl chloride (Chloroethene)	µg/L	18	25	0.0020869377	Downward
R2	Xylenes (total)	µg/L	4	25	6.8358254E-6	Downward
R2	cis-1,2-Dichloroethene	µg/L	25	25	5.6173918E-6	Downward
R2	trans-1,2-Dichloroethene	µg/L	9	25	0.0004172367	Downward
R3	1,1-Dichloroethane	µg/L	21	21	1.0637666E-6	Downward
R3	1,1-Dichloroethene	µg/L	4	21	0.0000361684	Downward
R3	1,2,4-Trimethylbenzene	µg/L	11	16	0.0953844894	Undetermined
R3	1,2-Dichloroethane	µg/L	17	21	6.9541661E-7	Downward
R3	1,3,5-Trimethylbenzene	µg/L	11	16	0.0742119239	Undetermined
R3	2-Butanone (MEK)	µg/L	3	21	0.0031635605	Downward
R3	4-Methyl-2-pentanone (MIBK)	µg/L	2	21	0.0004693489	Downward
R3	Acetone (2-Propanone)	µg/L	3	21	1.3272287E-6	Downward
R3	Benzene	µg/L	20	21	0.0000326662	Downward
R3	Carbon disulfide	µg/L	1	20	0.0320057605	Downward
R3	Chloroethane (Ethyl chloride)	µg/L	18	21	0.0777236276	Undetermined
R3	Ethylbenzene	µg/L	19	21	0.0018487548	Downward
R3	Isopropylbenzene (Cumene)	µg/L	14	16	0.0518826022	Undetermined
R3	Methylene chloride (Dichloromethane)	µg/L	2	21	0.001746648	Downward
R3	Naphthalene	µg/L	13	17	0.0031936126	Downward
R3	Tetrachloroethene	µg/L	5	21	5.3042556E-6	Downward
R3	Toluene	µg/L	17	21	1.5970618E-9	Downward
R3	Trichloroethene	µg/L	8	21	0.0001453927	Downward
R3	Vinyl chloride (Chloroethene)	µg/L	20	21	1.0412669E-6	Downward
R3	Xylenes (total)	µg/L	17	21	9.0620054E-7	Downward
R3	cis-1,2-Dichloroethene	µg/L	21	21	0.0247307292	Downward
R3	n-Butylbenzene	µg/L	10	15	0.1071645768	Undetermined
R3	trans-1,2-Dichloroethene	µg/L	7	21	0.0001345145	Downward
R4	1,1,1-Trichloroethane	µg/L	10	24	0.0002652839	Downward
R4	1,1-Dichloroethane	µg/L	24	24	2.7281152E-9	Downward
R4	1,1-Dichloroethene	µg/L	19	24	0.0002406794	Downward
R4	1,2,4-Trimethylbenzene	µg/L	4	15	0.0010280984	Downward
R4	1,2-Dichloroethane	µg/L	5	24	2.0762387E-7	Downward
R4	1,3,5-Trimethylbenzene	µg/L	3	15	0.000390943	Downward

Table 5-5. Summary of Results from Mann-Kendall Test (Continued)

Well	Analyte	Units	Number of Detected Results	Number of Samples	p-value for Mann-Kendall Test	Conclusion of Mann-Kendall Test
R4	2-Butanone (MEK)	µg/L	1	24	0.0019803045	Downward
R4	Acetone (2-Propanone)	µg/L	4	24	0.0000623572	Downward
R4	Benzene	µg/L	22	24	5.3903356E-8	Downward
R4	Carbon disulfide	µg/L	1	23	0.0091006555	Downward
R4	Chloroethane (Ethyl chloride)	µg/L	10	24	0.0004016725	Downward
R4	Ethylbenzene	µg/L	16	24	0.000025181	Downward
R4	Isopropylbenzene (Cumene)	µg/L	6	15	0.013494345	Downward
R4	Methylene chloride (Dichloromethane)	µg/L	2	24	0.0001100261	Downward
R4	Naphthalene	µg/L	6	16	0.0047029475	Downward
R4	Tetrachloroethene	µg/L	24	24	0.0086104877	Downward
R4	Toluene	µg/L	10	24	4.6658033E-7	Downward
R4	Trichloroethene	µg/L	24	24	0.0185121768	Downward
R4	Vinyl chloride (Chloroethene)	µg/L	23	24	0.0000190427	Downward
R4	Xylenes (total)	µg/L	12	24	7.5064302E-6	Downward
R4	cis-1,2-Dichloroethene	µg/L	24	24	2.0656066E-8	Downward
R4	n-Butylbenzene	µg/L	2	15	0.0020393807	Downward
R4	trans-1,2-Dichloroethene	µg/L	9	24	0.0080358547	Downward
R5	1,1,1-Trichloroethane	µg/L	20	23	0.0007525841	Downward
R5	1,1,2-Trichloroethane	µg/L	4	23	5.0008879E-6	Downward
R5	1,1-Dichloroethane	µg/L	23	23	0.0000228397	Downward
R5	1,1-Dichloroethene	µg/L	23	23	0.0000495552	Downward
R5	1,2,4-Trimethylbenzene	µg/L	2	17	0.0018060356	Downward
R5	1,2-Dichloroethane	µg/L	12	23	6.8759407E-6	Downward
R5	1,3,5-Trimethylbenzene	µg/L	2	17	0.0008630608	Downward
R5	Benzene	µg/L	1	23	1.2521293E-6	Downward
R5	Chloroethane (Ethyl chloride)	µg/L	1	23	1.2521293E-6	Downward
R5	Ethylbenzene	µg/L	3	23	0.0000137509	Downward
R5	Methylene chloride (Dichloromethane)	µg/L	1	23	0.0001891713	Downward
R5	Naphthalene	µg/L	2	17	0.001430919	Downward
R5	Tetrachloroethene	µg/L	22	23	0.0041100901	Downward
R5	Trichloroethene	µg/L	23	23	0.5	Undetermined
R5	Vinyl chloride (Chloroethene)	µg/L	17	23	0.001137432	Downward
R5	Xylenes (total)	µg/L	2	23	0.0000633903	Downward
R5	cis-1,2-Dichloroethene	µg/L	23	23	0.1166970847	Undetermined
R5	n-Butylbenzene	µg/L	1	17	0.0005562748	Downward
R5	trans-1,2-Dichloroethene	µg/L	9	23	0.0250316543	Downward
R6	1,1,1-Trichloroethane	µg/L	4	22	0.0008585591	Downward
R6	1,1,2-Trichloroethane	µg/L	2	22	5.9071483E-6	Downward
R6	1,1-Dichloroethane	µg/L	14	22	0.00480156	Downward
R6	1,1-Dichloroethene	µg/L	7	22	0.005207335	Downward
R6	1,2,4-Trimethylbenzene	µg/L	2	14	0.0330115664	Downward
R6	1,2-Dichloroethane	µg/L	5	22	0.0000179843	Downward
R6	Benzene	µg/L	1	22	0.0000212178	Downward
R6	Ethylbenzene	µg/L	3	22	0.0034770341	Downward
R6	Methylene chloride (Dichloromethane)	µg/L	1	22	8.8853727E-7	Downward

Table 5-5. Summary of Results from Mann-Kendall Test (Continued)

Well	Analyte	Units	Number of Detected Results	Number of Samples	p-value for Mann-Kendall Test	Conclusion of Mann-Kendall Test
R6	Naphthalene	µg/L	3	14	0.0078569034	Downward
R6	Tetrachloroethene	µg/L	22	22	0.0070217057	Downward
R6	Trichloroethene	µg/L	20	22	0.0255847644	Downward
R6	Vinyl chloride (Chloroethene)	µg/L	7	22	0.0230775573	Downward
R6	Xylenes (total)	µg/L	3	22	0.0010958304	Downward
R6	cis-1,2-Dichloroethene	µg/L	19	22	0.1292981362	Undetermined
R6	trans-1,2-Dichloroethene	µg/L	4	22	0.0036344786	Downward
R7	1,1,1-Trichloroethane	µg/L	5	23	8.4637596E-7	Downward
R7	1,1-Dichloroethane	µg/L	21	23	0.0000211039	Downward
R7	1,1-Dichloroethene	µg/L	20	23	6.4045386E-7	Downward
R7	1,2-Dichloroethane	µg/L	8	23	1.262246E-6	Downward
R7	Carbon disulfide	µg/L	2	22	0.0124185469	Downward
R7	Chloroethane (Ethyl chloride)	µg/L	2	23	5.8366402E-6	Downward
R7	Ethylbenzene	µg/L	1	23	2.2274729E-6	Downward
R7	Methylene chloride (Dichloromethane)	µg/L	1	23	2.9667628E-7	Downward
R7	Naphthalene	µg/L	3	15	0.0004860105	Downward
R7	Tetrachloroethene	µg/L	23	23	1.6219621E-6	Downward
R7	Trichloroethene	µg/L	23	23	5.1189898E-6	Downward
R7	Vinyl chloride (Chloroethene)	µg/L	5	23	0.0028074398	Downward
R7	Xylenes (total)	µg/L	2	23	0.0000330073	Downward
R7	cis-1,2-Dichloroethene	µg/L	23	23	7.3099317E-6	Downward
R7	trans-1,2-Dichloroethene	µg/L	5	23	0.0004322742	Downward
R8	1,1-Dichloroethane	µg/L	4	20	0.0001271189	Downward
R8	Ethylbenzene	µg/L	1	20	0.0000600633	Downward
R8	Methylene chloride (Dichloromethane)	µg/L	1	20	0.000072208	Downward
R8	Naphthalene	µg/L	1	12	0.0124854982	Downward
R8	Tetrachloroethene	µg/L	14	20	0.0000138235	Downward
R8	Trichloroethene	µg/L	11	20	0.0000121719	Downward
R8	Xylenes (total)	µg/L	1	20	0.0009035426	Downward
R8	cis-1,2-Dichloroethene	µg/L	7	20	0.0010539073	Downward
R9	Tetrachloroethene	µg/L	1	16	0.0511606784	Undetermined
R10	1,1,1-Trichloroethane	µg/L	4	22	1.2955499E-7	Downward
R10	1,1,2-Trichloroethane	µg/L	2	22	1.1296965E-6	Downward
R10	1,1-Dichloroethane	µg/L	22	22	1.6237664E-6	Downward
R10	1,1-Dichloroethene	µg/L	21	22	2.377164E-6	Downward
R10	1,2-Dichloroethane	µg/L	17	22	1.2292995E-7	Downward
R10	Benzene	µg/L	6	22	2.8898611E-7	Downward
R10	Carbon disulfide	µg/L	1	20	0.0048783625	Downward
R10	Chloroethane (Ethyl chloride)	µg/L	14	22	0.0008630569	Downward
R10	Ethylbenzene	µg/L	1	22	1.5756936E-6	Downward
R10	Methylene chloride (Dichloromethane)	µg/L	2	22	7.4258312E-6	Downward
R10	Naphthalene	µg/L	1	18	0.0001317507	Downward
R10	Tetrachloroethene	µg/L	22	22	2.9721354E-7	Downward
R10	Toluene	µg/L	1	22	8.3663298E-7	Downward
R10	Trichloroethene	µg/L	22	22	0.0004736373	Downward

Table 5-5. Summary of Results from Mann-Kendall Test (Continued)

Well	Analyte	Units	Number of Detected Results	Number of Samples	p-value for Mann-Kendall Test	Conclusion of Mann-Kendall Test
R10	Vinyl chloride (Chloroethene)	µg/L	17	22	3.1570497E-7	Downward
R10	Xylenes (total)	µg/L	1	22	0.0000110556	Downward
R10	cis-1,2-Dichloroethene	µg/L	22	22	6.0526899E-7	Downward
R10	trans-1,2-Dichloroethene	µg/L	6	22	0.0000875154	Downward
R11	1,1,1-Trichloroethane	µg/L	1	22	1.4122509E-6	Downward
R11	1,1,2-Trichloroethane	µg/L	1	22	0.0000137377	Downward
R11	1,1-Dichloroethane	µg/L	22	22	0.0005100571	Downward
R11	1,1-Dichloroethene	µg/L	19	22	0.0000542353	Downward
R11	1,2-Dichloroethane	µg/L	18	22	0.001425307	Downward
R11	2-Butanone (MEK)	µg/L	1	21	0.0004525982	Downward
R11	Acetone (2-Propanone)	µg/L	1	21	4.2729088E-6	Downward
R11	Benzene	µg/L	11	22	0.0000724563	Downward
R11	Carbon tetrachloride	µg/L	1	20	0.000174559	Downward
R11	Chlorobenzene	µg/L	1	19	0.0000138091	Downward
R11	Chloroethane (Ethyl chloride)	µg/L	14	22	0.276424934	Undetermined
R11	Ethylbenzene	µg/L	1	22	0.0000601904	Downward
R11	Isopropylbenzene (Cumene)	µg/L	1	13	0.004724362	Downward
R11	Methylene chloride (Dichloromethane)	µg/L	1	22	5.5466733E-6	Downward
R11	Naphthalene	µg/L	1	14	0.0042702968	Downward
R11	Styrene	µg/L	1	22	0.0000770671	Downward
R11	Tetrachloroethene	µg/L	21	22	1.0632068E-6	Downward
R11	Toluene	µg/L	1	22	5.5466733E-6	Downward
R11	Trichloroethene	µg/L	22	22	0.0001864165	Downward
R11	Vinyl chloride (Chloroethene)	µg/L	17	22	0.0018195736	Downward
R11	cis-1,2-Dichloroethene	µg/L	21	22	0.0003448262	Downward
R11	trans-1,2-Dichloroethene	µg/L	8	22	0.0091791809	Downward
R12	1,1,1-Trichloroethane	µg/L	2	15	0.0000352641	Downward
R12	1,1,2-Trichloroethane	µg/L	1	15	0.0013194189	Downward
R12	1,1-Dichloroethane	µg/L	15	15	0.0001011645	Downward
R12	1,1-Dichloroethene	µg/L	10	15	0.0001374383	Downward
R12	1,2,4-Trimethylbenzene	µg/L	1	9	0.0091	Downward
R12	1,2-Dichloroethane	µg/L	12	15	0.0000975619	Downward
R12	Acetone (2-Propanone)	µg/L	1	14	0.0047268735	Downward
R12	Benzene	µg/L	3	15	0.0000238491	Downward
R12	Chloroethane (Ethyl chloride)	µg/L	1	15	0.0005350946	Downward
R12	Methylene chloride (Dichloromethane)	µg/L	3	15	0.0012479973	Downward
R12	Tetrachloroethene	µg/L	15	15	0.0010767467	Downward
R12	Trichloroethene	µg/L	14	15	0.0002469272	Downward
R12	Vinyl chloride (Chloroethene)	µg/L	11	15	0.0004375359	Downward
R12	Xylenes (total)	µg/L	1	15	0.0013194189	Downward
R12	cis-1,2-Dichloroethene	µg/L	15	15	0.0065610118	Downward
R12	trans-1,2-Dichloroethene	µg/L	7	15	0.0127038054	Downward
TW1	1,1,1-Trichloroethane	µg/L	1	19	0.0091960302	Downward
TW1	1,1-Dichloroethane	µg/L	19	19	0.0002301567	Downward
TW1	1,1-Dichloroethene	µg/L	4	19	0.0004371232	Downward

Table 5-5. Summary of Results from Mann-Kendall Test (Continued)

Well	Analyte	Units	Number of Detected Results	Number of Samples	p-value for Mann-Kendall Test	Conclusion of Mann-Kendall Test
TW1	1,2,4-Trimethylbenzene	µg/L	11	11	0.2181374644	Undetermined
TW1	1,2-Dichloroethane	µg/L	5	19	0.0589211286	Undetermined
TW1	1,3,5-Trimethylbenzene	µg/L	11	11	0.5	Undetermined
TW1	2-Butanone (MEK)	µg/L	2	18	0.0063769585	Downward
TW1	4-Methyl-2-pentanone (MIBK)	µg/L	1	19	0.006871357	Downward
TW1	Acetone (2-Propanone)	µg/L	2	18	0.0195298665	Downward
TW1	Benzene	µg/L	18	19	0.2005512864	Undetermined
TW1	Chloroethane (Ethyl chloride)	µg/L	9	17	0.0023182018	Upward
TW1	Ethylbenzene	µg/L	19	19	0.0001185827	Downward
TW1	Isopropylbenzene (Cumene)	µg/L	10	11	0.2410958305	Undetermined
TW1	Methylene chloride (Dichloromethane)	µg/L	1	18	0.0413404091	Downward
TW1	Naphthalene	µg/L	13	13	0.4756760655	Undetermined
TW1	Tetrachloroethene	µg/L	1	19	0.035257802	Downward
TW1	Toluene	µg/L	19	19	0.0000678813	Downward
TW1	Trichloroethene	µg/L	1	19	0.035257802	Downward
TW1	Vinyl chloride (Chloroethene)	µg/L	15	19	0.0007092616	Downward
TW1	Xylenes (total)	µg/L	19	19	0.001039424	Downward
TW1	cis-1,2-Dichloroethene	µg/L	10	17	0.0223447225	Downward
TW1	n-Butylbenzene	µg/L	7	11	0.2654579935	Undetermined
TW1	trans-1,2-Dichloroethene	µg/L	4	18	0.3433862356	Undetermined
TW2A	1,1,1-Trichloroethane	µg/L	1	22	0.0004372296	Downward
TW2A	1,1,2-Trichloroethane	µg/L	1	20	0.0000959517	Downward
TW2A	1,1-Dichloroethane	µg/L	3	22	0.0189046456	Downward
TW2A	1,1-Dichloroethene	µg/L	10	22	0.0257963972	Downward
TW2A	1,2,4-Trimethylbenzene	µg/L	1	13	0.0003529148	Downward
TW2A	1,2-Dichloroethane	µg/L	3	22	0.0101862153	Downward
TW2A	4-Methyl-2-pentanone (MIBK)	µg/L	1	21	0.0002000776	Downward
TW2A	Acetone (2-Propanone)	µg/L	1	21	0.0001900127	Downward
TW2A	Benzene	µg/L	2	22	0.0000641332	Downward
TW2A	Methylene chloride (Dichloromethane)	µg/L	1	21	0.0000142678	Downward
TW2A	Naphthalene	µg/L	2	13	0.0004914677	Downward
TW2A	Tetrachloroethene	µg/L	21	22	0.4886965989	Undetermined
TW2A	Toluene	µg/L	1	22	0.0000419424	Downward
TW2A	Trichloroethene	µg/L	22	22	0.5	Undetermined
TW2A	Vinyl chloride (Chloroethene)	µg/L	3	22	0.2249735234	Undetermined
TW2A	Xylenes (total)	µg/L	1	22	0.0007295609	Downward
TW2A	cis-1,2-Dichloroethene	µg/L	20	20	0.0850951896	Undetermined
TW2A	trans-1,2-Dichloroethene	µg/L	6	21	0.2418800648	Undetermined
TW3	1,1,1-Trichloroethane	µg/L	12	24	0.0000459225	Downward
TW3	1,1-Dichloroethane	µg/L	20	24	0.0709721613	Undetermined
TW3	1,1-Dichloroethene	µg/L	17	24	0.0003227386	Downward
TW3	1,2,4-Trimethylbenzene	µg/L	1	15	0.0045852807	Downward
TW3	1,2-Dichloroethane	µg/L	6	24	7.4791292E-6	Downward
TW3	Benzene	µg/L	4	24	0.0000255723	Downward
TW3	Ethylbenzene	µg/L	1	24	0.0010843656	Downward

Table 5-5. Summary of Results from Mann-Kendall Test (Continued)

Well	Analyte	Units	Number of Detected Results	Number of Samples	p-value for Mann-Kendall Test	Conclusion of Mann-Kendall Test
TW3	Methylene chloride (Dichloromethane)	µg/L	1	23	0.0000451544	Downward
TW3	Naphthalene	µg/L	4	15	0.0089152208	Downward
TW3	Tetrachloroethene	µg/L	24	24	0.0000359475	Downward
TW3	Toluene	µg/L	1	24	0.0004116469	Downward
TW3	Trichloroethene	µg/L	22	24	0.1907373479	Undetermined
TW3	Vinyl chloride (Chloroethene)	µg/L	23	24	0.0086104877	Downward
TW3	Xylenes (total)	µg/L	2	24	0.0029670338	Downward
TW3	cis-1,2-Dichloroethene	µg/L	22	22	0.0352264517	Downward
TW3	trans-1,2-Dichloroethene	µg/L	4	23	0.0516269843	Undetermined
USD1	Carbon tetrachloride	µg/L	5	5	0.5	Undetermined
USD1	Tetrachloroethene	µg/L	5	5	0.408	Undetermined
USD1	Trichloroethene	µg/L	5	5	0.242	Undetermined
USD1	cis-1,2-Dichloroethene	µg/L	1	5	0.18	Undetermined
USD2	1,1,2-Trichloroethane	µg/L	2	5	0.025	Downward
USD2	1,1-Dichloroethane	µg/L	4	5	0.5	Undetermined
USD2	1,1-Dichloroethene	µg/L	5	5	0.242	Undetermined
USD2	1,2-Dichloroethane	µg/L	1	5	0.18	Undetermined
USD2	Benzene	µg/L	1	5	0.042	Downward
USD2	Carbon tetrachloride	µg/L	2	5	0.325	Undetermined
USD2	Methylene chloride (Dichloromethane)	µg/L	1	5	0.325	Undetermined
USD2	Tetrachloroethene	µg/L	4	5	0.117	Undetermined
USD2	Trichloroethene	µg/L	5	5	0.042	Downward
USD2	cis-1,2-Dichloroethene	µg/L	5	5	0.117	Undetermined
USD2	trans-1,2-Dichloroethene	µg/L	4	5	0.592	Undetermined
USD3	1,1,2-Trichloroethane	µg/L	2	5	0.5	Undetermined
USD3	1,1-Dichloroethane	µg/L	4	5	0.408	Undetermined
USD3	1,1-Dichloroethene	µg/L	5	5	0.242	Undetermined
USD3	1,2-Dichloroethane	µg/L	4	5	0.242	Undetermined
USD3	Acetone (2-Propanone)	µg/L	1	5	0.5	Undetermined
USD3	Benzene	µg/L	1	5	0.325	Undetermined
USD3	Carbon tetrachloride	µg/L	1	5	0.18	Undetermined
USD3	Methylene chloride (Dichloromethane)	µg/L	1	5	0.5	Undetermined
USD3	Tetrachloroethene	µg/L	5	5	0.592	Undetermined
USD3	Trichloroethene	µg/L	5	5	0.242	Undetermined
USD3	Vinyl chloride (Chloroethene)	µg/L	1	5	0.325	Undetermined
USD3	cis-1,2-Dichloroethene	µg/L	5	5	0.042	Upward
USD3	trans-1,2-Dichloroethene	µg/L	5	5	0.592	Undetermined

Table 5-6. Natural Attenuation Parameters and Their Function

Analytes	Purpose of Analysis
Electron acceptors	
Dissolved Oxygen Nitrate Sulfate Carbon dioxide	Determine to what extent other electron acceptors compete for electrons with chlorinated solvents or are available for fuel constituents; provide evidence that the aquifer is poised at the appropriate redox potential for reductive dehalogenation of chlorinated solvents.
Metabolites and other indicators	
Ferrous Iron Hydrogen Sulfide Methane Alkalinity	Provide additional evidence for electron transfers that could impact reductive dehalogenation, and to determine the redox environment.
Electron donors	
Fraction organic carbon (background) BTEX Hydrogen	Determine if electron donors are limiting; determine if hydrogen concentration is compatible with reductive dehalogenation.
Parent and daughter compounds, dechlorination metabolites	
PCE, TCE, *cis*-1,2-DCE, VC, ethene, ethane, carbon tetrachloride, chloroform, dichloromethane, chloromethane	Provide direct evidence of the occurrence of reductive dehalogenation.
Other	
Nutrients, pH, redox potential	Verify that the environment is suitable for biodegradation, verify redox level.

6.0 Conclusions and Recommendations

This section presents the summary and conclusions based on all phases of study and analysis conducted at the Site. These include the development of COPCs and the determination of the nature and extent of contamination (Section 4.0) and the evaluation of fate and transport mechanisms, migration pathways and potential, and natural attenuation processes (Section 5.0).

6.1 Conceptual Site Model

The CSM summarizes the current understanding of the geology, hydrogeology, nature and extent of contamination, and current and future land uses of each site. Together, these individual components of the program illustrate the current understanding of the Site.

6.1.1 Overview and History

Known and unknown releases occurred from the Site, resulting in the contamination of unsaturated soil, saturated soil, groundwater, and at one time, surface water via the "Coleman Seep." On November 3, 1989, a PCE spill was reported (Section 2.0), prompting site investigation and remediation. An SVE system was installed and operated until the late 1990s in response to the spill and subsequent KDHE notification. The 1989 spill prompted a series of remedial investigations beginning with a preliminary reconnaissance assessment conducted in 1990. These investigations are detailed in Section 3.0.

Operations at the facility ceased in 1992. The chemical infrastructure (tanks, piping, rail cars, etc.) and the structures associated with the facility were razed prior to 2003. In 1994, a groundwater extraction system was installed. Groundwater was extracted from the Site and Coleman facility and treated via air stripping and Publicly Owned Treatment Works (POTW) discharge. The seep area was regraded, eliminating the potential for surface water exfiltration. The extraction system was operated until August 30, 2006.

On the Site, a pilot test was performed in 1999 to evaluate the effectiveness of enhancement of reductive dechlorination. A series of excavations occurred in 2001, resulting in the removal of a significant portion of the unsaturated soil contaminant mass and, thus, the source of further contamination to the groundwater system.

The current general land use for the Site and the area surrounding the Site is commercial/industrial. The land use of the Site is anticipated to remain commercial/industrial. The land use of the entities surrounding the Site are also anticipated to remain commercial/industrial.

6.1.2 Site Geology and Hydrogeology

Approximately half of the Site ground cover consists of gravel. In regions of the Site where natural ground surface is exposed, the predominant native surface soil to a depth of 2 ft bgl is silty clay, which grades sharply to an orange brown silty clay. Silt, sand, and gravel lenses of varying thickness comprise the Wisconsinan and recent alluvium deposits and are approximately 10-15 ft thick at the Site and from 10-27 ft in thickness under the western portion of the Coleman property. The lower confining unit (Wellington) contact is abrupt and identified by stiff, dark bluish-black, blocky, weathered shale. The shale in the upper portion of the formation is weathered and is more permeable than the lower unweathered portion.

The weathered portion of the Wellington Formation at the Site is approximately 16 ft thick and steeply slopes downward on the southeastern corner and eastern boundary of the Site, while it slopes gradually downward beyond the western boundary. The weathered shale on the Coleman property slopes southward, but much more gradually than on the Site. The weathered shale potentially acts as a vertical confining layer and may play a role in groundwater and contaminant migration. The weathered shale gently grades vertically to an unweathered condition.

Based on USGS topographic maps for the Site vicinity, the groundwater flow direction is assumed to be southwest, toward the Little Arkansas River. Groundwater flow in the upland area (i.e., from the Site to the Coleman area) is to the south-southwest with a slight westerly trend as it transitions out of the upland area into the alluvial sand. Data generated during the Phase I/II RI and confirmed during the 2006 groundwater monitoring concluded that groundwater flow was generally to the south-southwest. Additionally, the 2006 groundwater monitoring event included groundwater elevation information for the USD and Hillman (Pinsker) properties, which showed a westerly component to groundwater flow that had previously not been identified.

6.1.3 Nature and Extent of Contamination

Soil

The nature and extent of the groundwater contamination at the Site is based on historical soil information over the last 15 years. After eliminating the non-qualified data, many of the initial soil exceedances were omitted from further evaluation because they were excavated in 2002. Additionally, many of the samples were saturated with water, and it was determined that the samples were not collected from the vadose zone. The remaining soil COPCs were acetone in the shallow zone for MW-6, PCE in the deep zone for soil borings DP-51 and DP-70, and vinyl

the shallow zone for MW-6, PCE in the deep zone for soil borings DP-51 and DP-70, and vinyl chloride in the shallow zone for soil borings DP-76, DP-77, and DP-85.

Groundwater

The nature and extent of the groundwater contamination at the Site is based on the groundwater data from the most recent *comprehensive* groundwater sampling event conducted January through March 2006 (i.e., also referred to as the 2005 groundwater sampling event). For this evaluation, the current data was evaluated in light of the refined spatial understanding that was developed in the DPT study, using the plumelet concept. This evaluation was also supplemented with data from the 2006 groundwater sampling event. The analytes that most consistently and significantly exceed the residential groundwater criteria throughout the groundwater monitoring network are PCE, TCE, *cis*-1,2-DCE, vinyl chloride, and 1,2,4-TMB. These analytes exceed the residential groundwater criteria in over 20% of the groundwater samples collected during the January to March 2006 sampling event.

6.1.4 Contaminant Fate and Transport

It is assumed that several releases occurred other than the reported spill. These releases were presumably of various compositions and they could have been continuing, periodic, or one-time releases in separate locations. The nature of these releases would result in contaminant plumes that vary by composition. A comprehensive DPT investigation in 1997 illustrated these differences, and the plumelet concept was developed. Although NAPL has not been observed during environmental investigation, the assumed releases may have formed LNAPL or DNAPL depending on their composition. NAPL would have traveled by gravity through the unsaturated zone, and once enough was present, to the saturated zone. The dissolved phase contaminant plumes then formed and spread, and in 1994 presumably emanated from a surface water seep on the Coleman property.

The processes described in Section 5.0 governed the fate and transport of constituents released to the environment. Historically, the plumelets remained segregated as they traveled in a mostly linear fashion down-gradient. Since the time that the sources were discontinued, the plumelets have approached an equilibrium state. At this time the reduction in concentration resulting from the various natural attenuation processes are in balance or are exceeding the rate of source area dissolution into groundwater. The presence of degradation products of chlorinated solvents (*cis*-1,2-DCE and vinyl chloride) indicates that natural attenuation had occurred from the time of the initial sampling efforts until today.

The removal of secondary sources contributed to altering the balance such that natural attenuation could overtake the rate of dissolution to the groundwater. Owing to the effects of the groundwater extraction system, pilot test, and the excavation of contaminated soil present at the Site, groundwater concentrations of all constituents have declined over the last decade.

Natural attenuation processes are accountable for considerable decreases in both fuel and chlorinated solvent constituents along in portions of the plume. The contaminant plume can be characterized by decreasing concentrations of chlorinated solvents and reductive by-products that occur over a relatively widespread area, mixed with residual concentrations of fuel constituents. Historically, reductive dechlorination has occurred in all portions of the various plumelets, but it appears most pronounced in the areas where petroleum hydrocarbons and solvents were mixed.

6.2 Remedial Investigation Conclusions

It appears that the contaminant plumes have reached stability and, owing to removal and interim actions, concentrations continue to decrease. In areas where fuel constituents and solvents coexist, enhanced biodegradation has occurred. For the remainder of the chlorinated solvent plume, reductive dechlorination appears to be limited by the availability of electron donor material. Providing donor material has been shown to enhance reductive dechlorination, lowering PCE and TCE concentrations to below regulatory standards for residential use.

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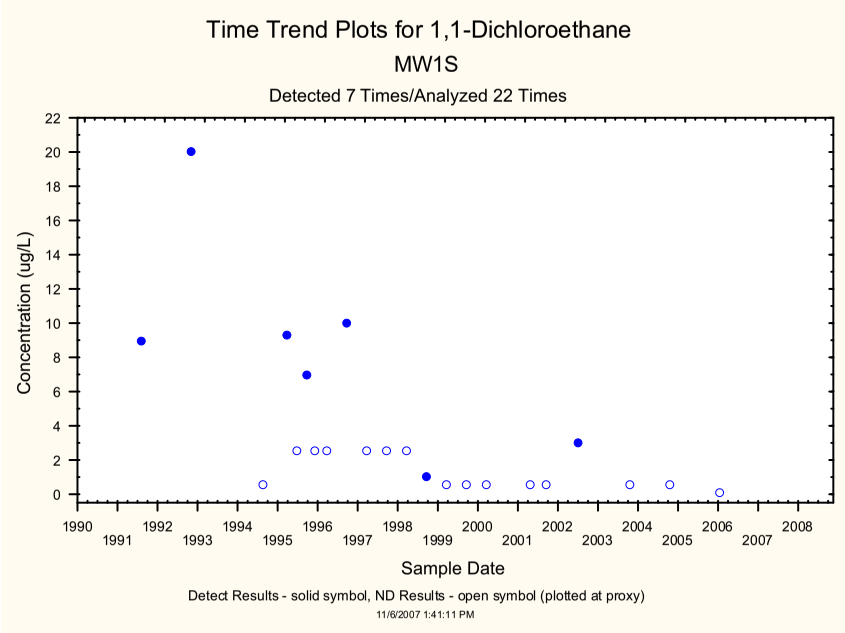
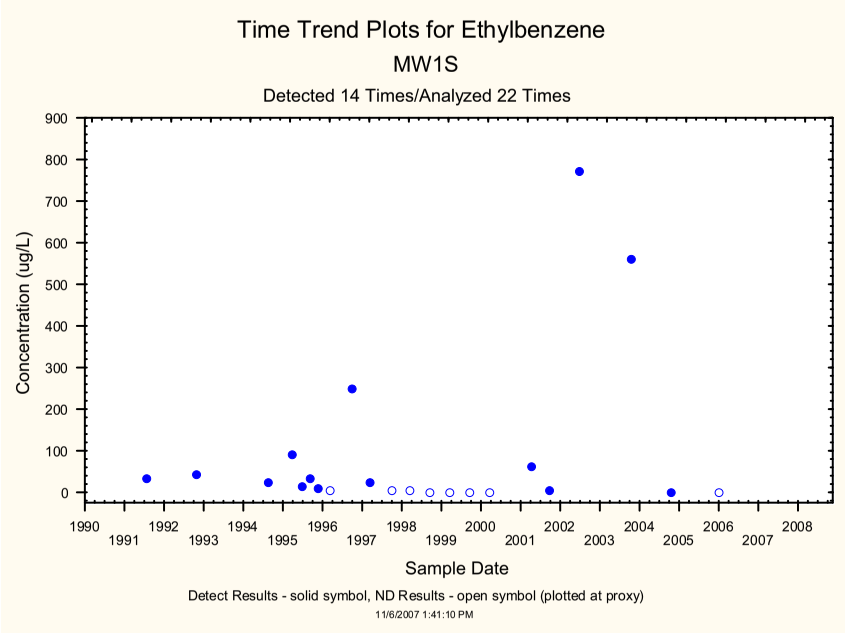
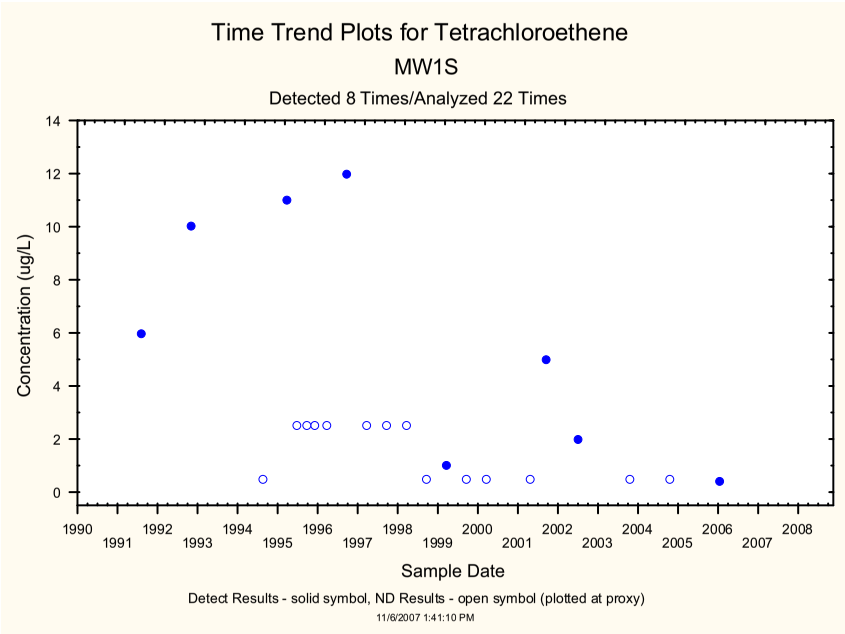
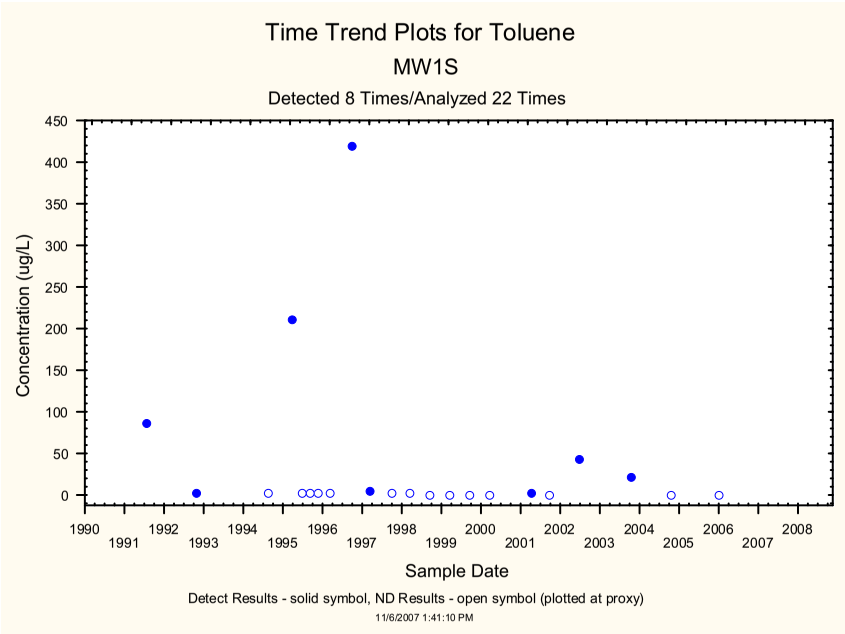
APPENDIX B

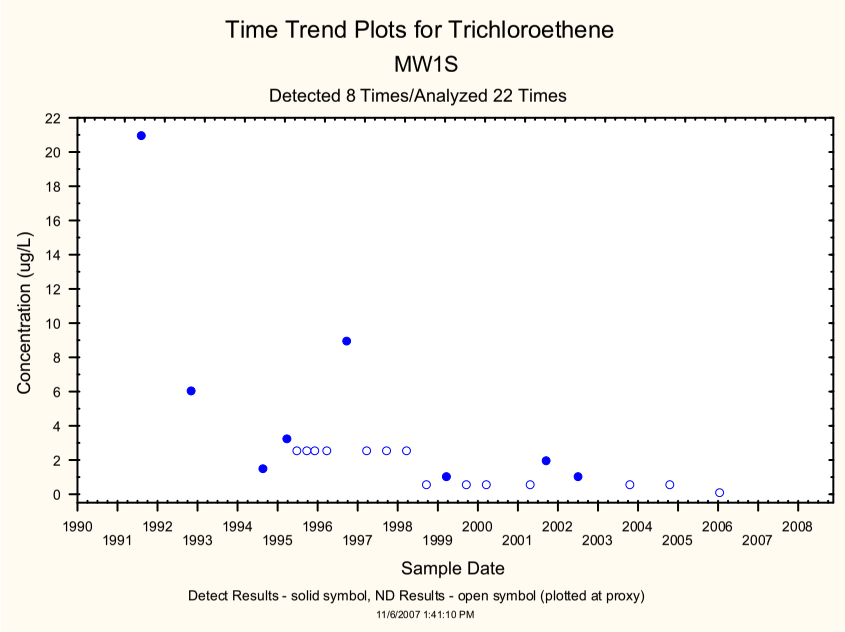
Unocal Groundwater Trend Plots

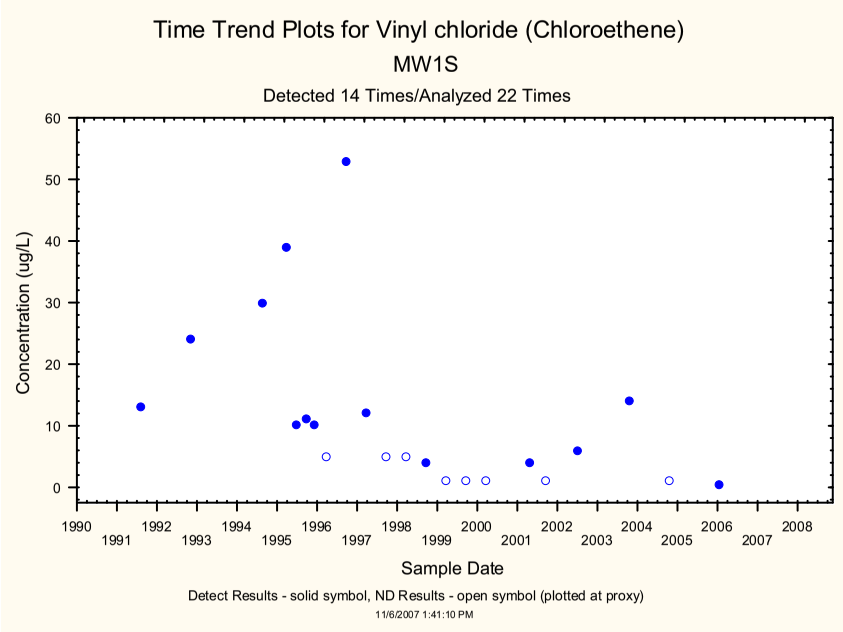

Time Trend Plots for 1,1-Dichloroethane
MW1S
Detected 7 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:11 PM

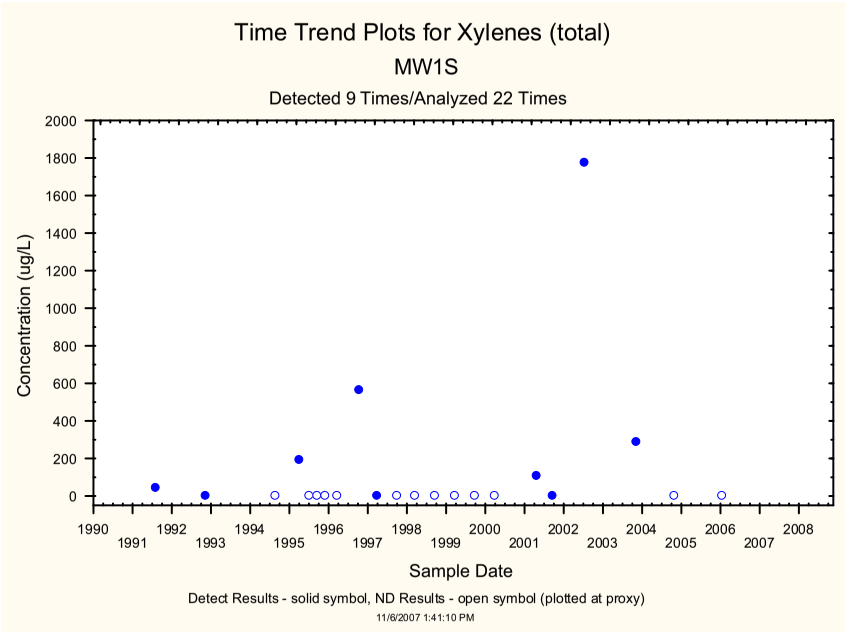

Time Trend Plots for Ethylbenzene
MW1S
Detected 14 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:10 PM

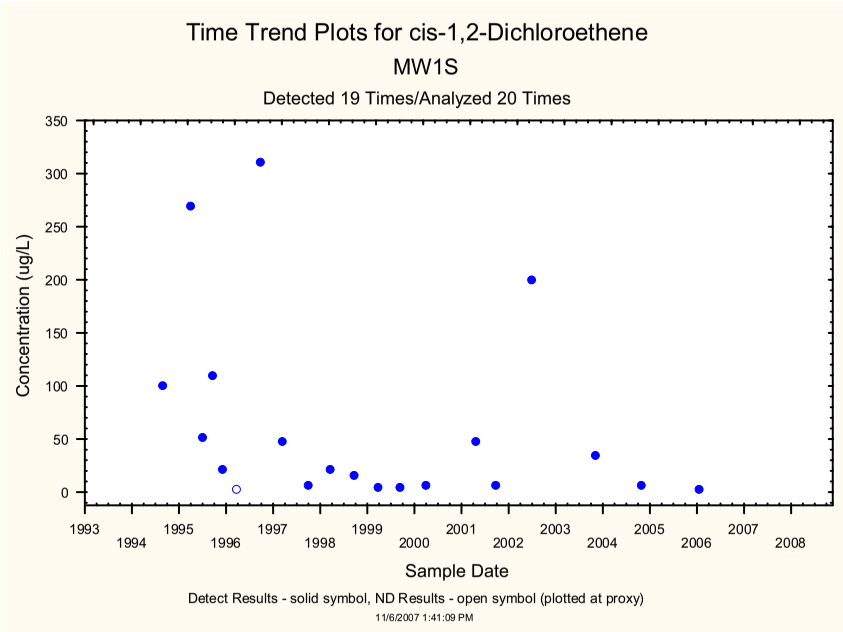

Time Trend Plots for Tetrachloroethene
MW1S
Detected 8 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:10 PM

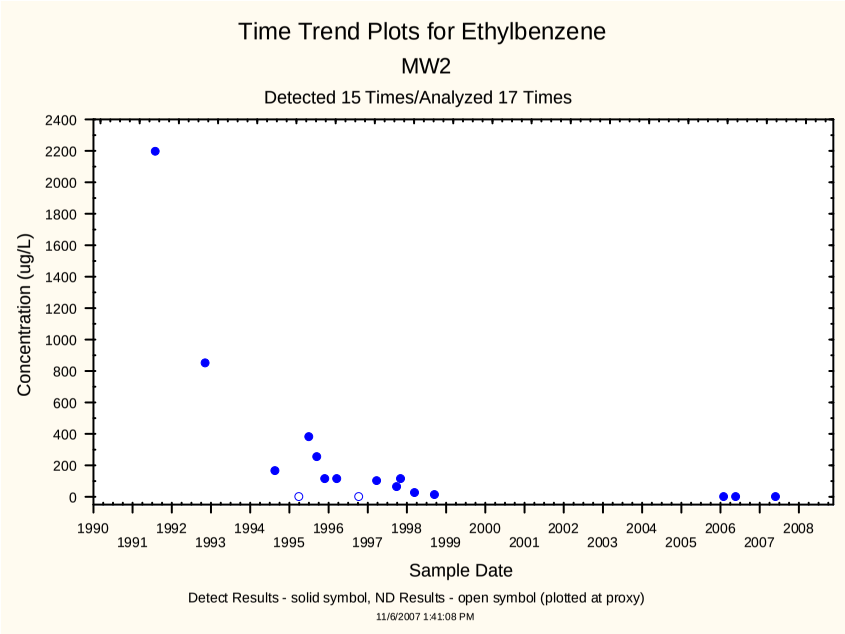

Time Trend Plots for Toluene
MW1S
Detected 8 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:10 PM

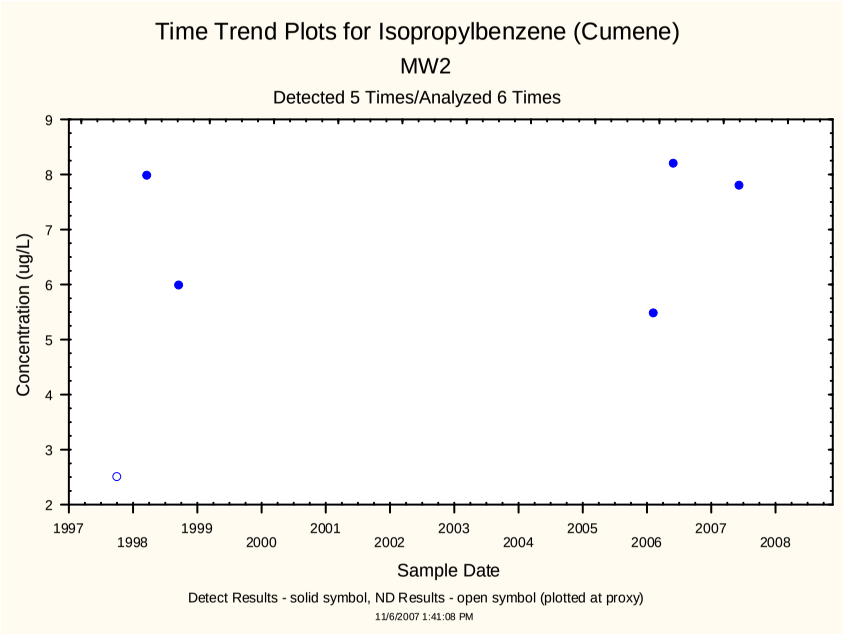

Time Trend Plots for Trichloroethene
MW1S
Detected 8 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:10 PM

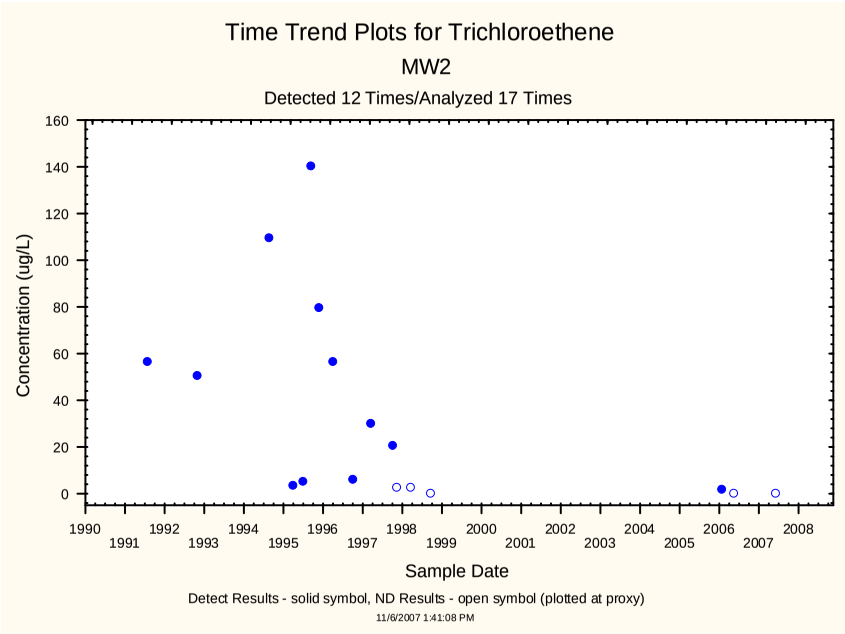

Time Trend Plots for Vinyl chloride (Chloroethene)
MW1S
Detected 14 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:10 PM

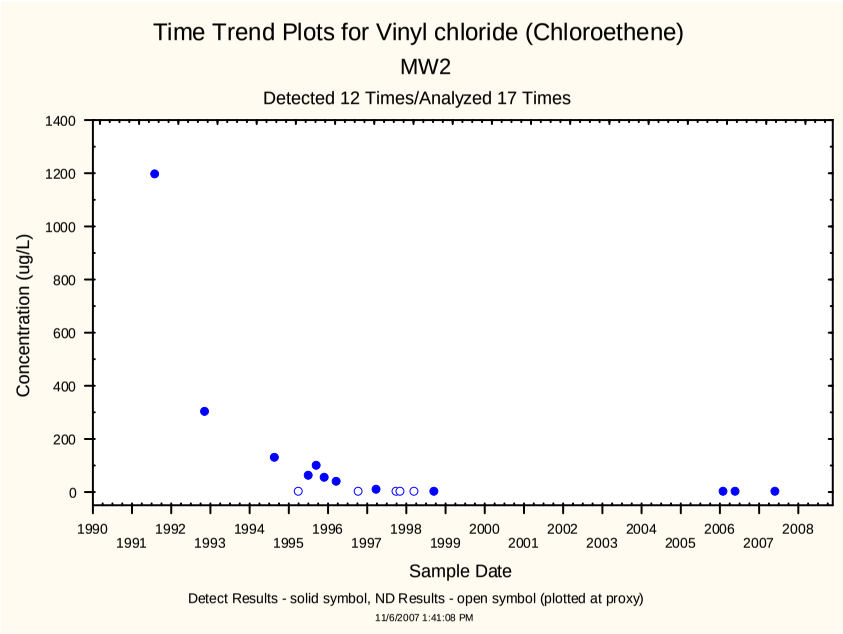

Time Trend Plots for Xylenes (total)
MW1S
Detected 9 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:10 PM

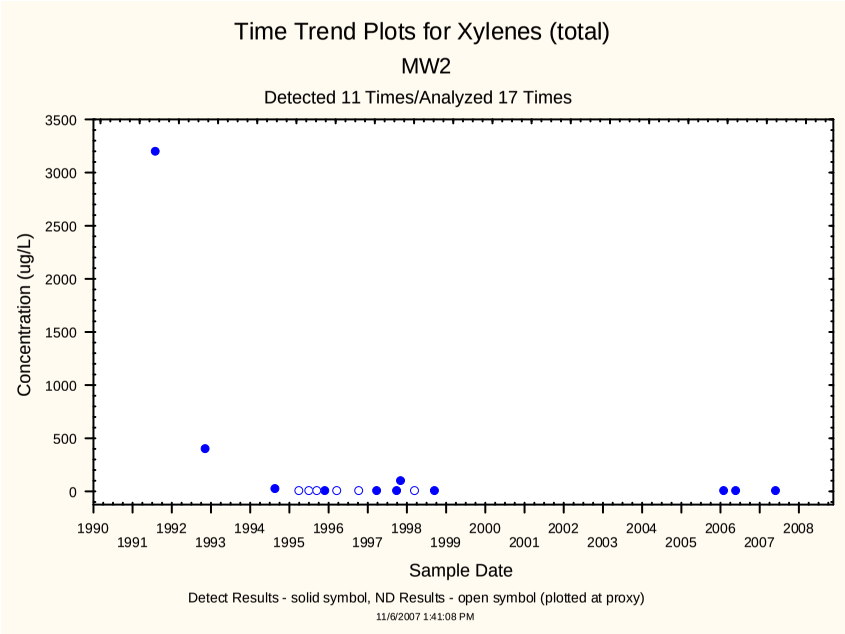

Time Trend Plots for cis-1,2-Dichloroethene
MW1S
Detected 19 Times/Analyzed 20 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:09 PM

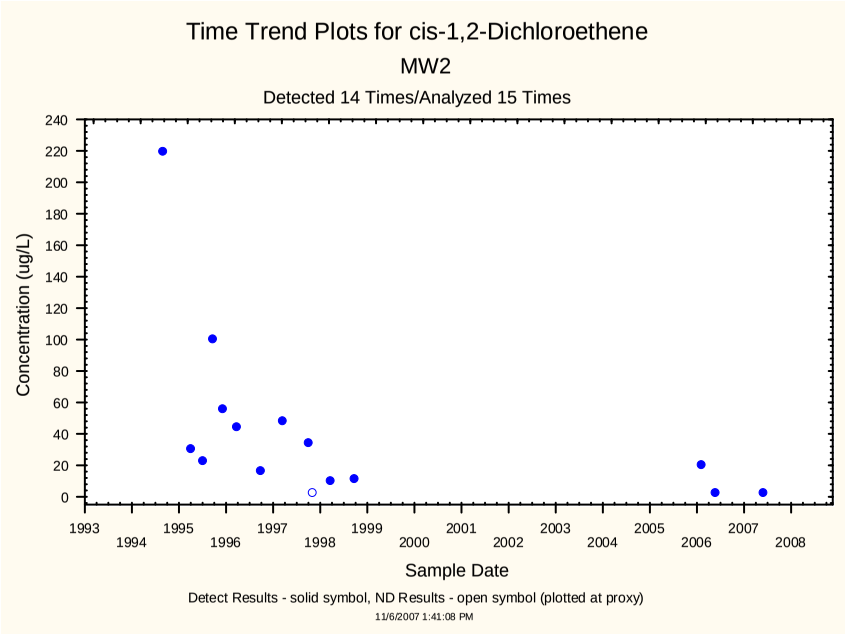

Time Trend Plots for Ethylbenzene
MW2
Detected 15 Times/Analyzed 17 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:08 PM

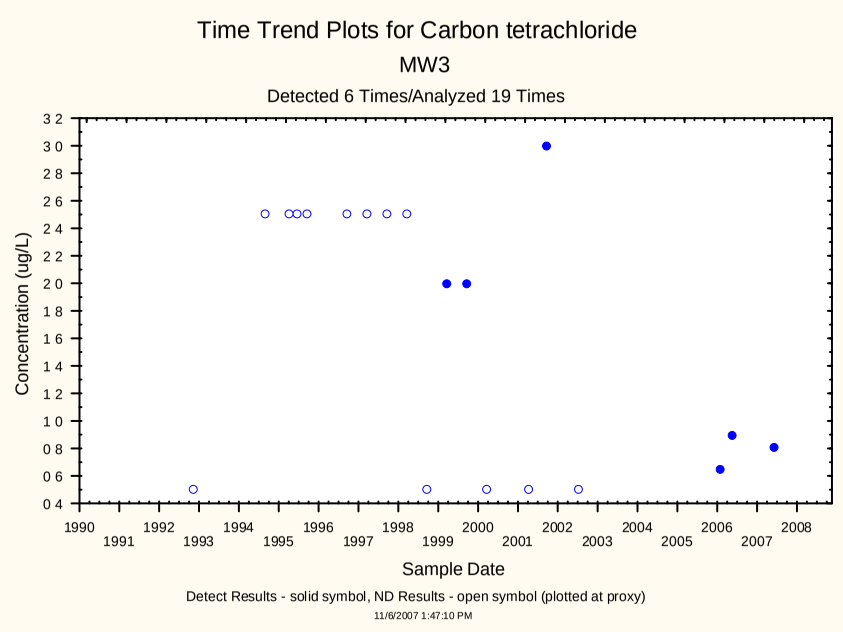

Time Trend Plots for Isopropylbenzene (Cumene)
MW2
Detected 5 Times/Analyzed 6 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:08 PM

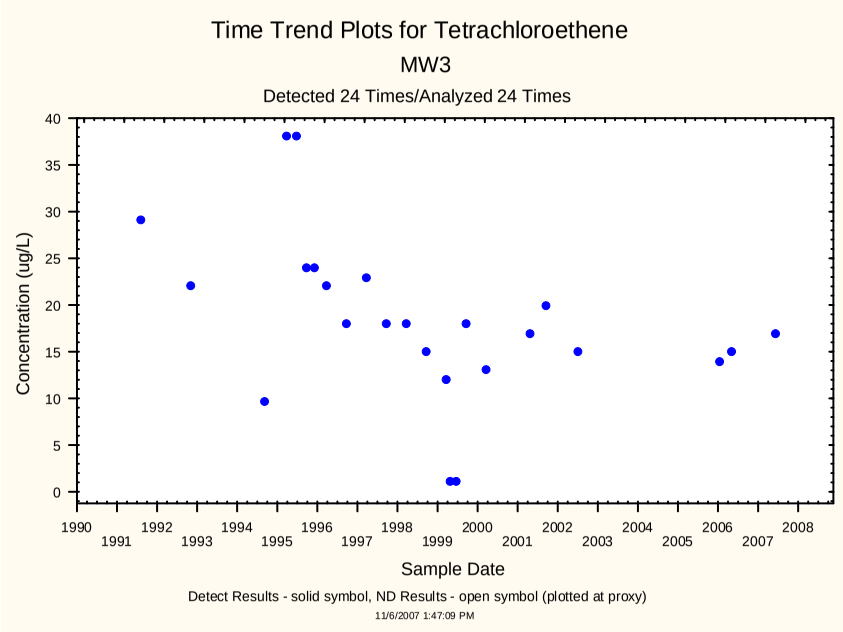

Time Trend Plots for Trichloroethene
MW2
Detected 12 Times/Analyzed 17 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:08 PM

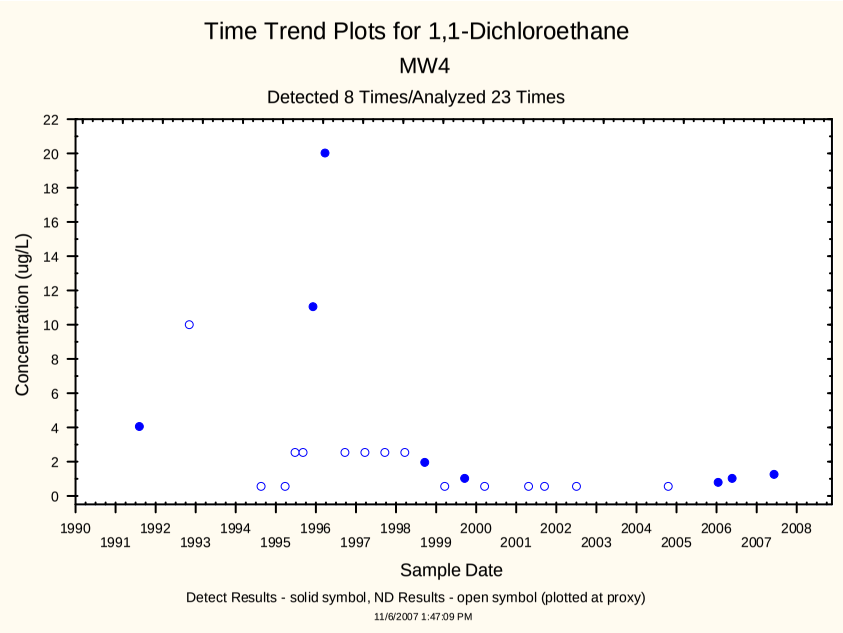

Time Trend Plots for Vinyl chloride (Chloroethene)
MW2
Detected 12 Times/Analyzed 17 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:08 PM

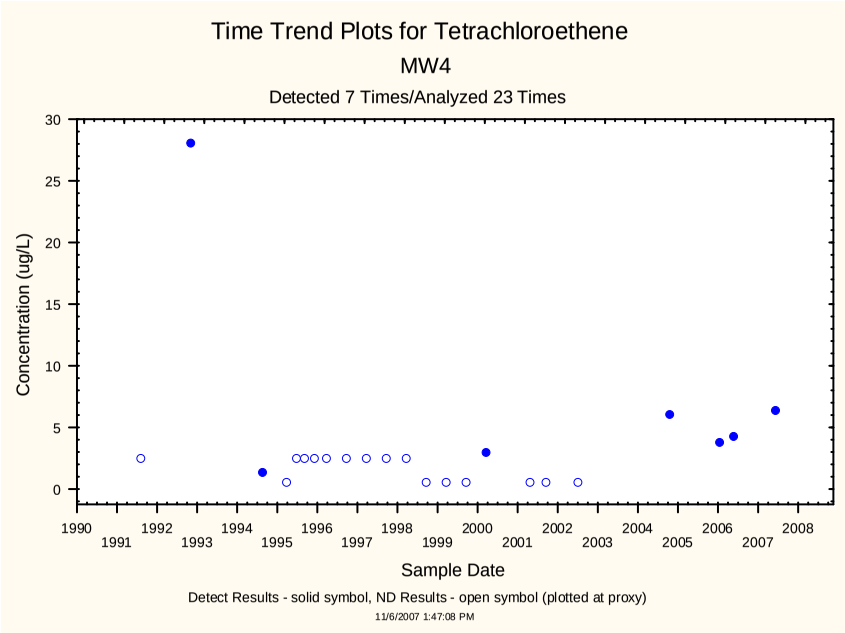

Time Trend Plots for Xylenes (total)
MW2
Detected 11 Times/Analyzed 17 Times
Concentration (ug/L)
3500
3000
2500
2000
1500
1000
500
0
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:08 PM

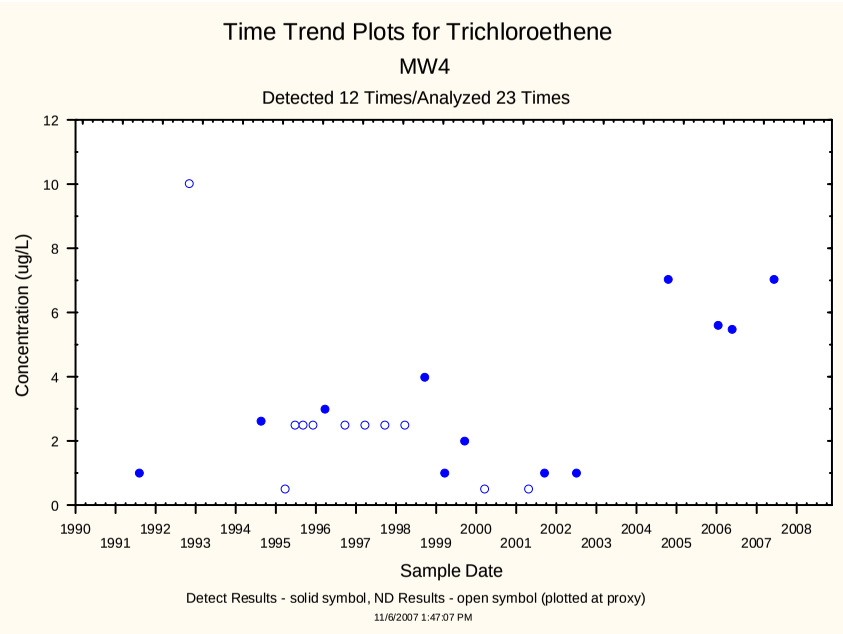

Time Trend Plots for cis-1,2-Dichloroethene
MW2
Detected 14 Times/Analyzed 15 Times
Concentration (ug/L)
240
220
200
180
160
140
120
100
80
60
40
20
0
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:08 PM

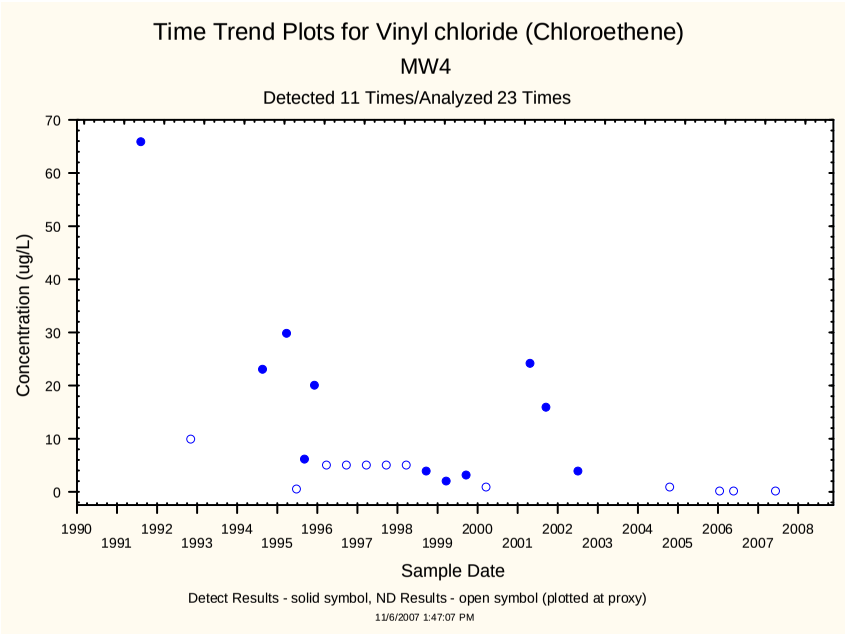

Time Trend Plots for Carbon tetrachloride
MW3
Detected 6 Times/Analyzed 19 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:10 PM

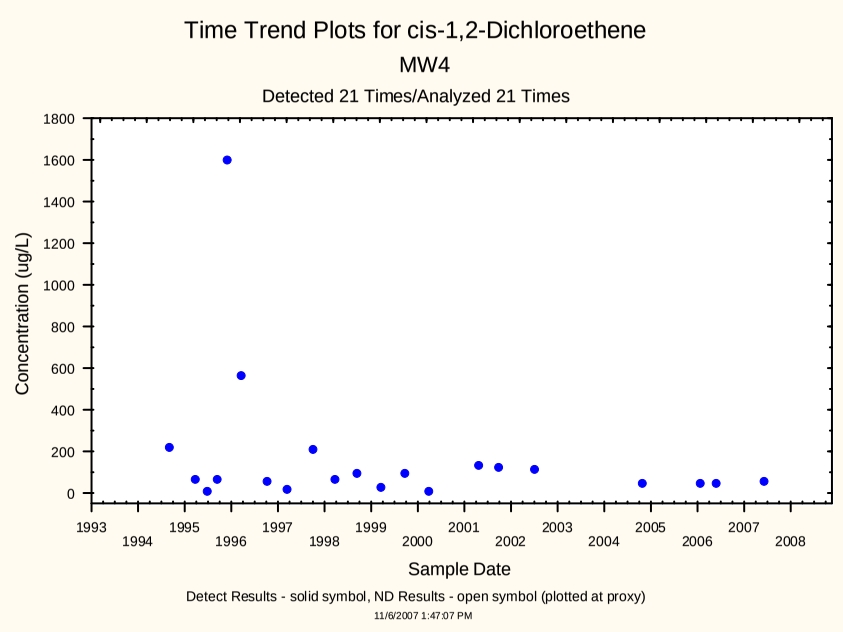

Time Trend Plots for Tetrachloroethene
MW3
Detected 24 Times/Analyzed 24 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:09 PM

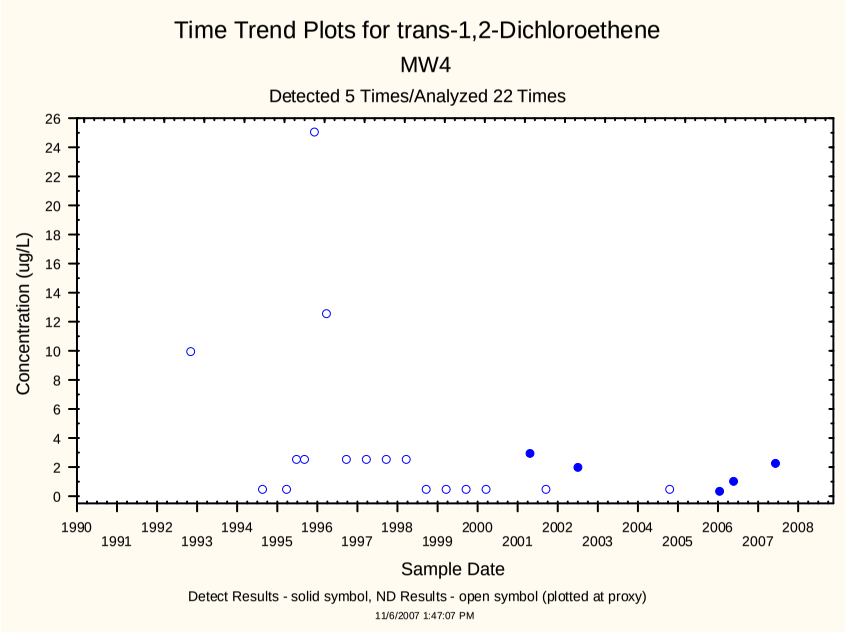

Time Trend Plots for 1,1-Dichloroethane
MW4
Detected 8 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:09 PM

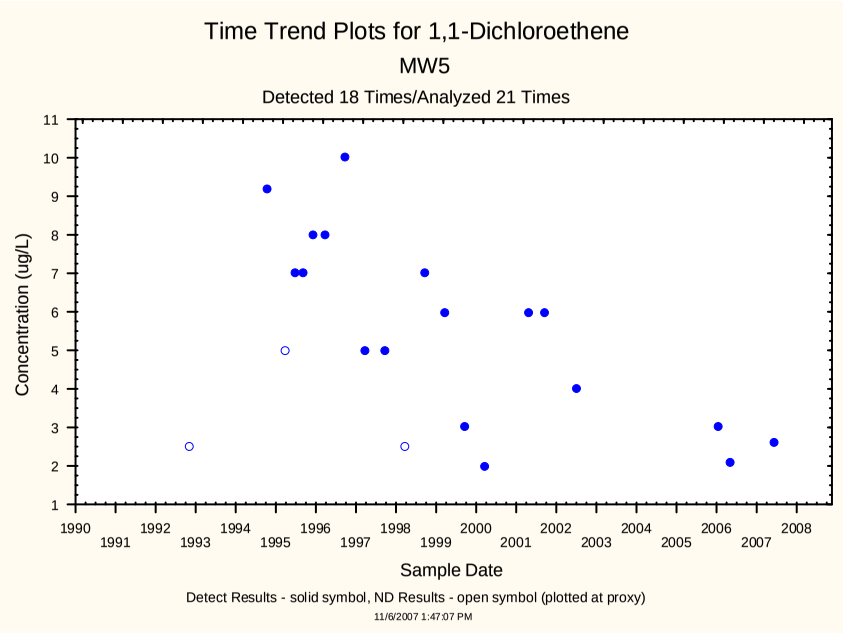

Time Trend Plots for Tetrachloroethene
MW4
Detected 7 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:08 PM

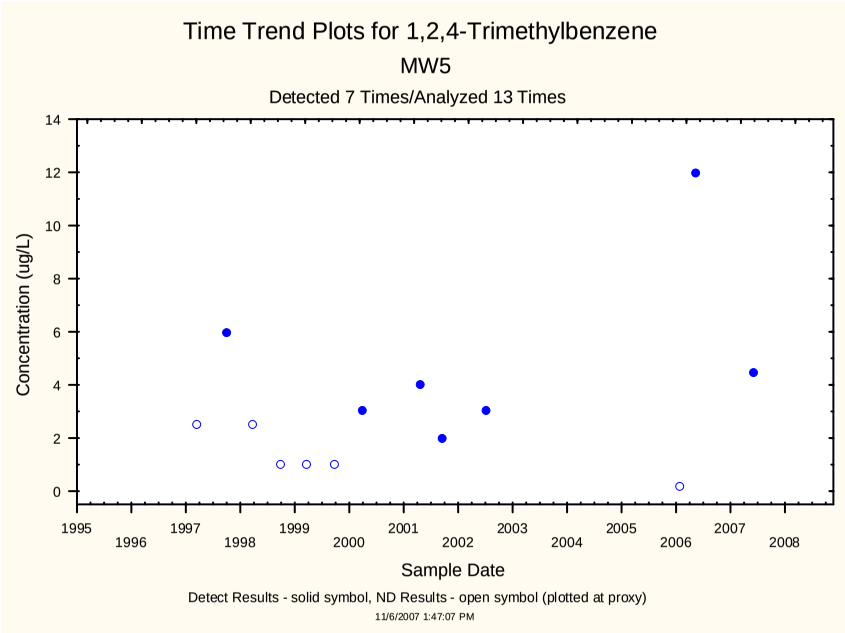

Time Trend Plots for Trichloroethene
MW4
Detected 12 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:07 PM

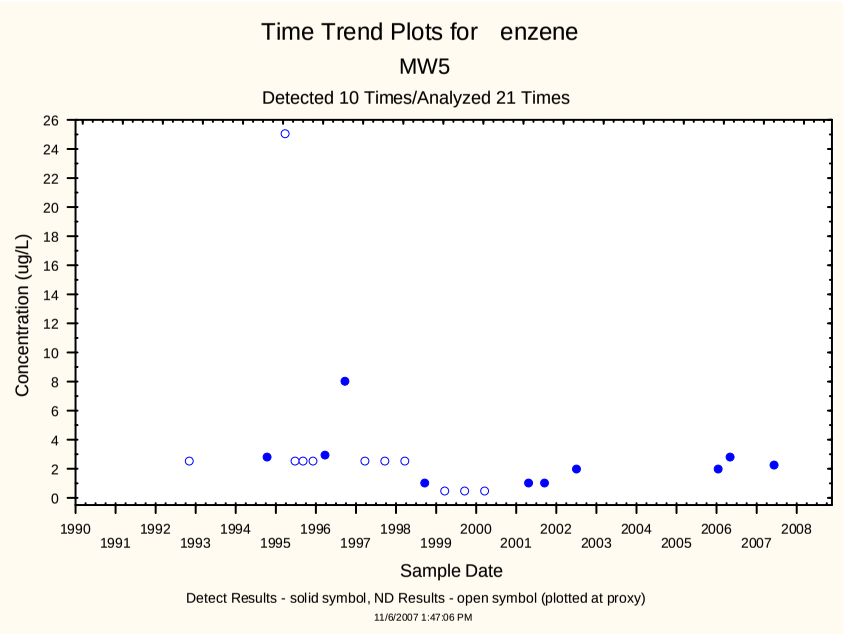

Time Trend Plots for Vinyl chloride (Chloroethene)
MW4
Detected 11 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:07 PM

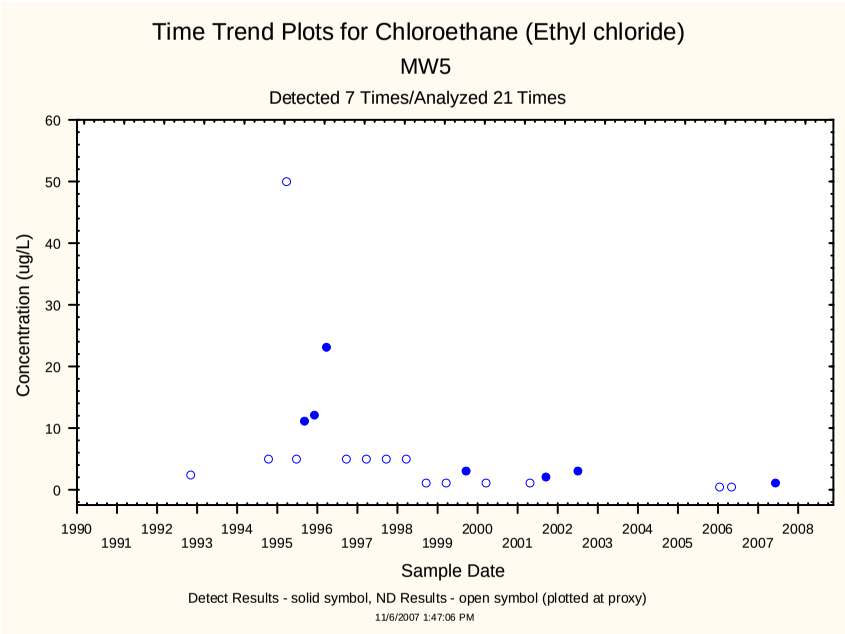

Time Trend Plots for cis-1,2-Dichloroethene
MW4
Detected 21 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:07 PM

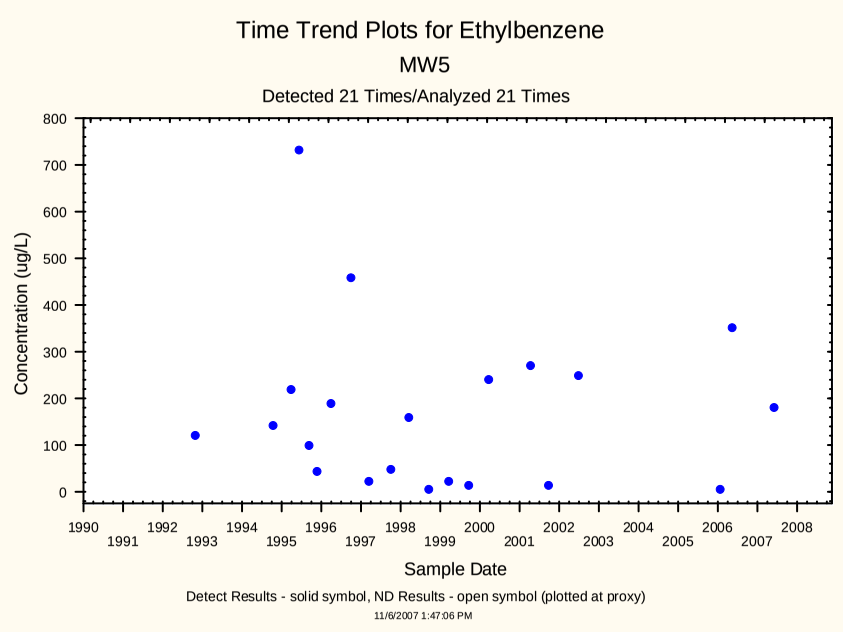

Time Trend Plots for trans-1,2-Dichloroethene
MW4
Detected 5 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:07 PM

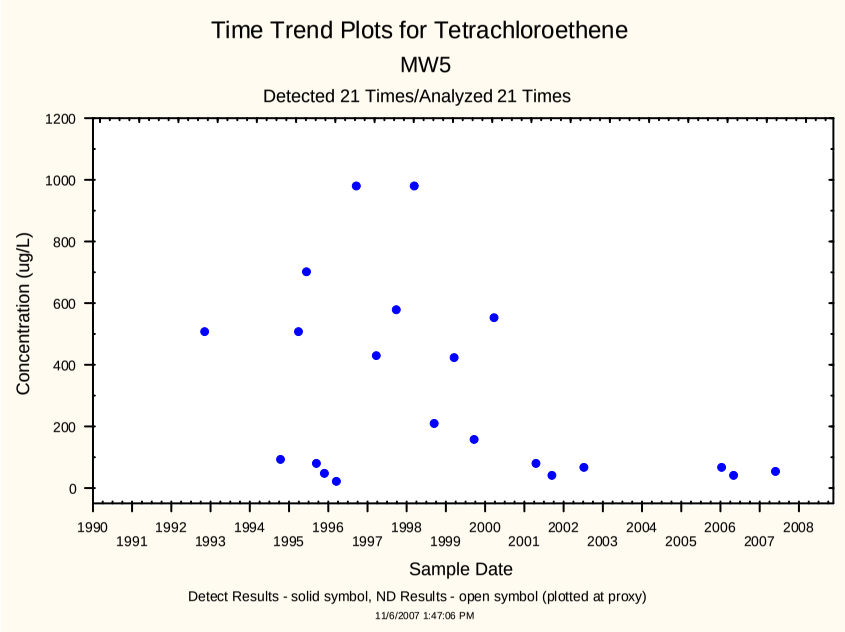

Time Trend Plots for 1,1-Dichloroethene
MW5
Detected 18 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:07 PM

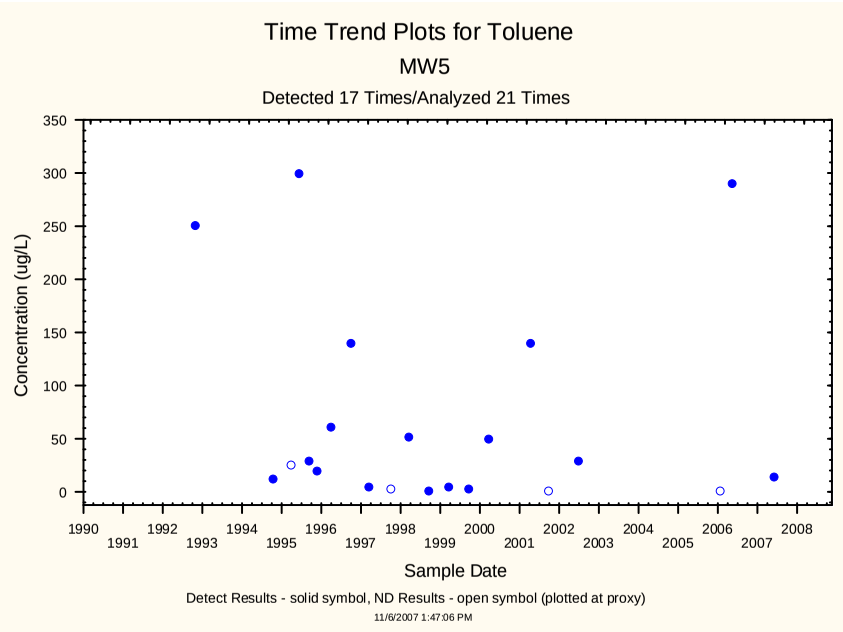

Time Trend Plots for 1,2,4-Trimethylbenzene
MW5
Detected 7 Times/Analyzed 13 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:07 PM

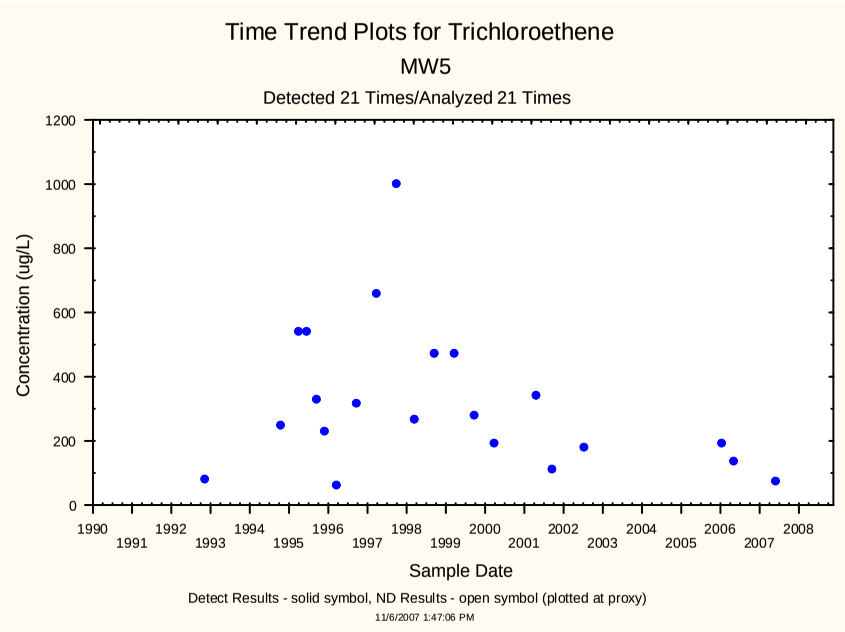

Time Trend Plots for enzene
MW5
Detected 10 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:06 PM

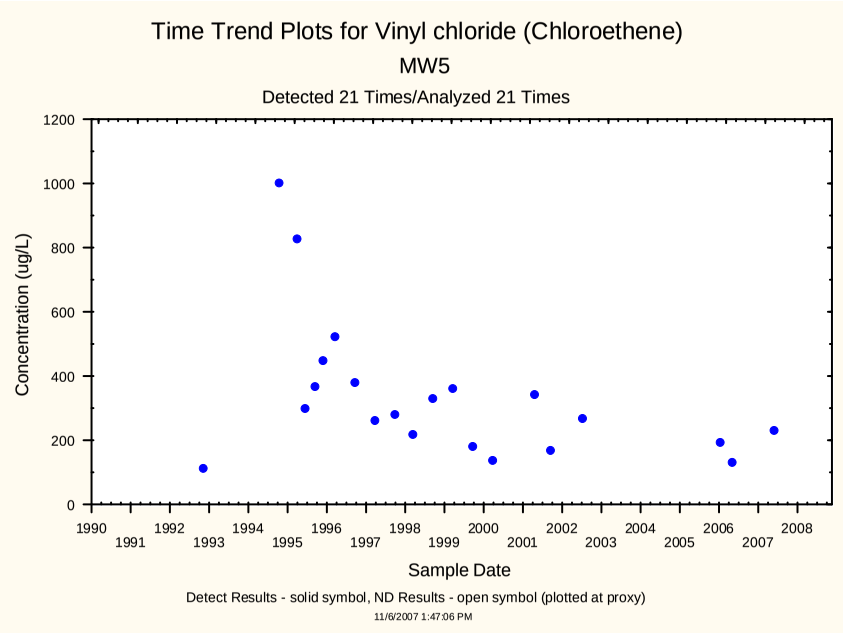

Time Trend Plots for Chloroethane (Ethyl chloride)
MW5
Detected 7 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:06 PM

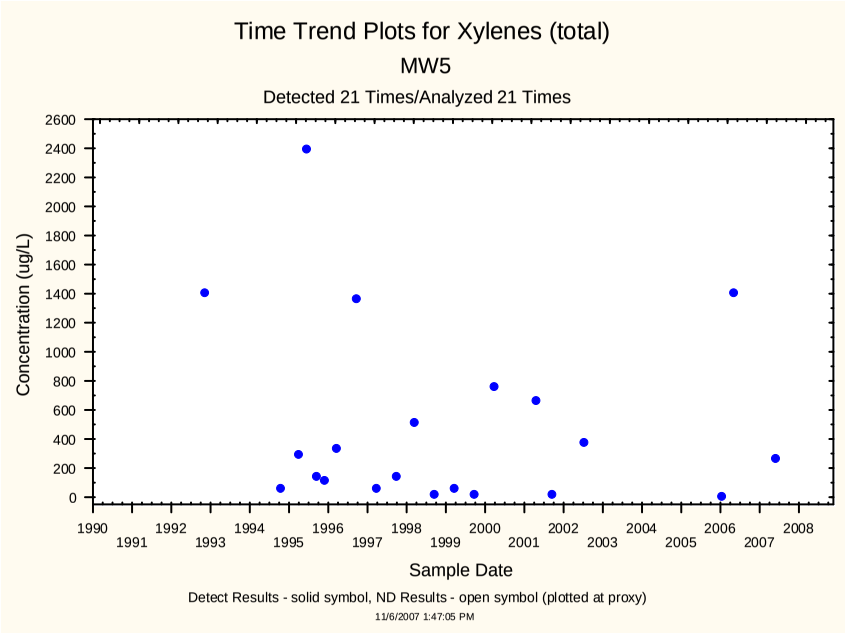

Time Trend Plots for Ethylbenzene
MW5
Detected 21 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:06 PM

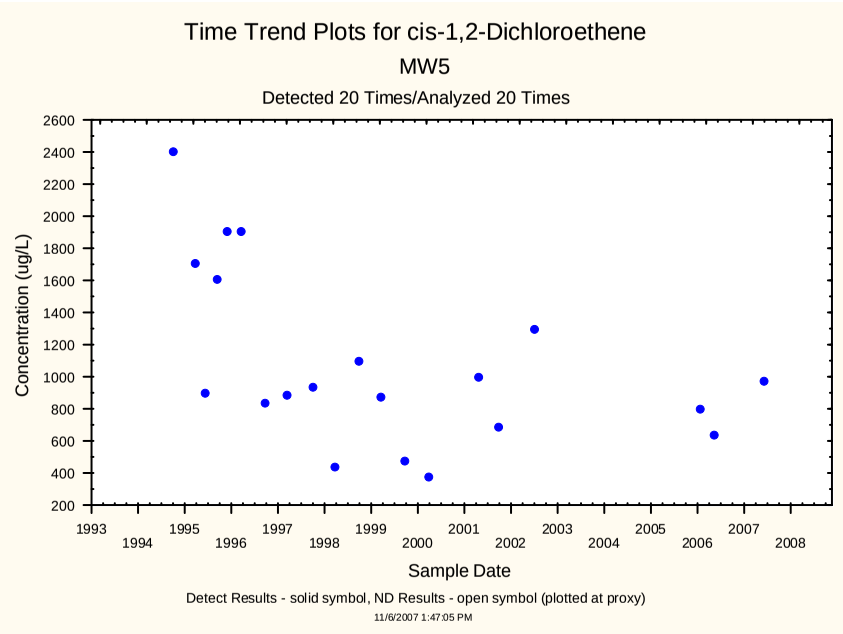

Time Trend Plots for Tetrachloroethene
MW5
Detected 21 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:06 PM

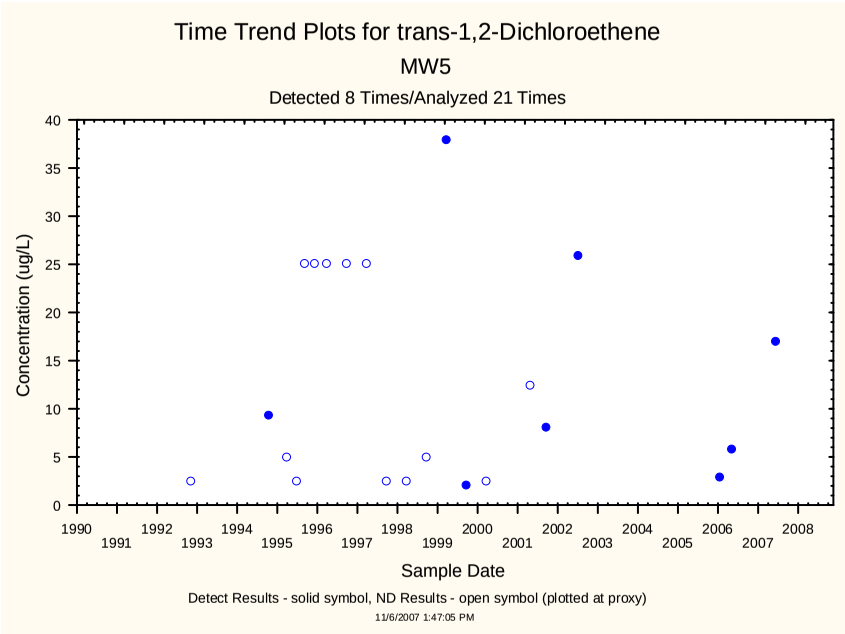

Time Trend Plots for Toluene
MW5
Detected 17 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:06 PM

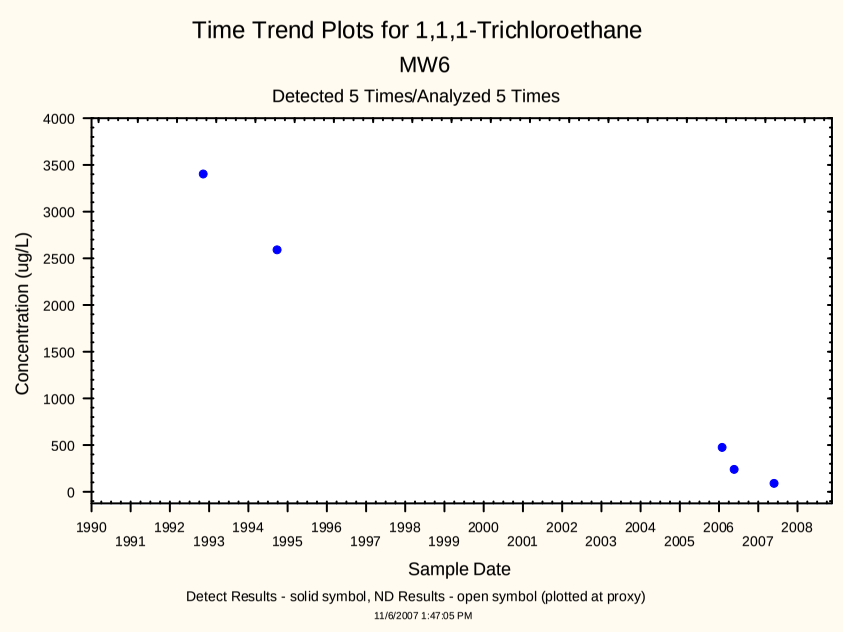

Time Trend Plots for Trichloroethene
MW5
Detected 21 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:06 PM

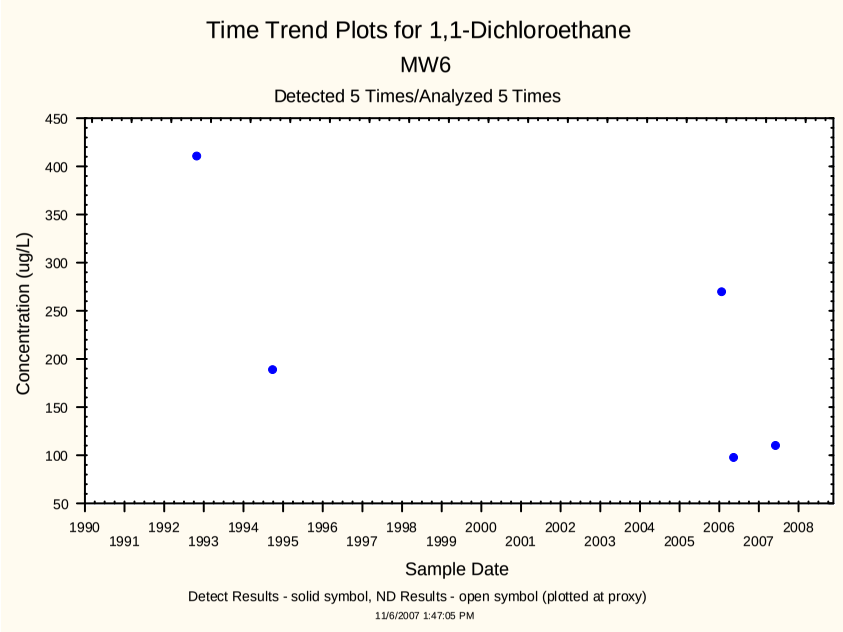

Time Trend Plots for Vinyl chloride (Chloroethene)
MW5
Detected 21 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:06 PM

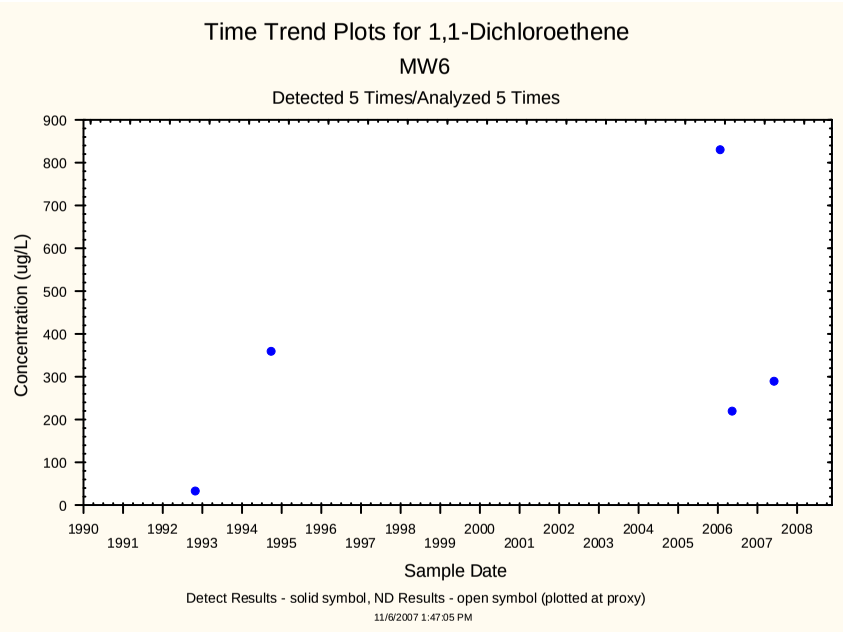

Time Trend Plots for Xylenes (total)
MW5
Detected 21 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:05 PM

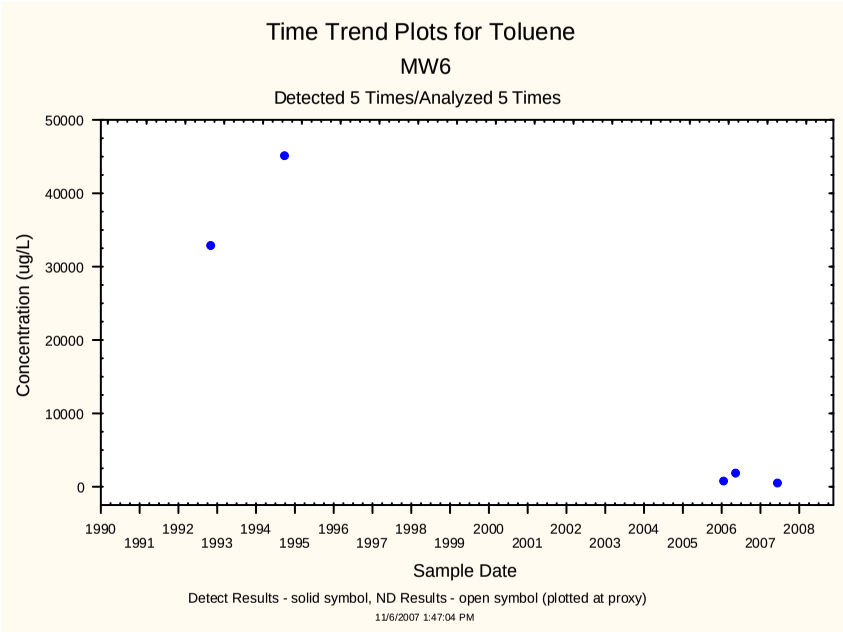

Time Trend Plots for cis-1,2-Dichloroethene
MW5
Detected 20 Times/Analyzed 20 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:05 PM

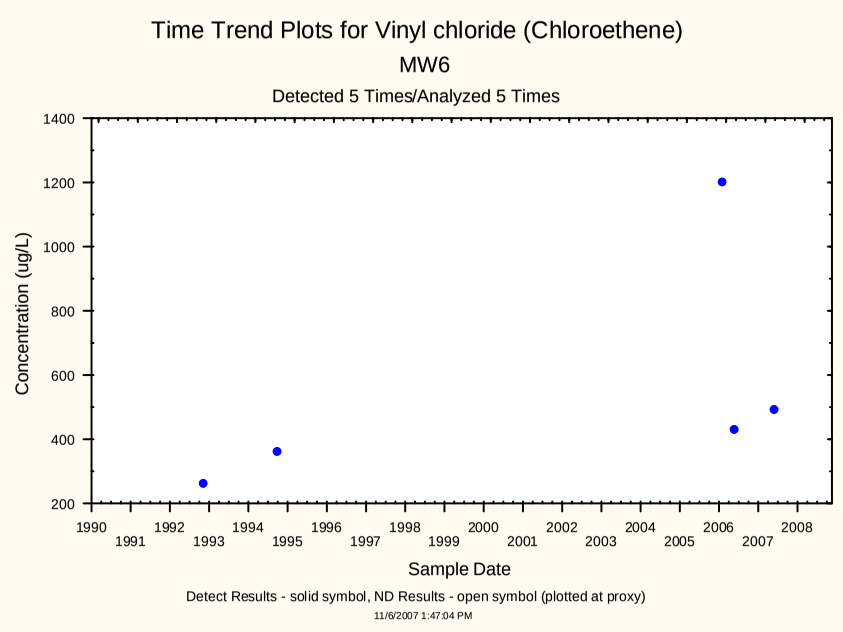

Time Trend Plots for trans-1,2-Dichloroethene
MW5
Detected 8 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:05 PM

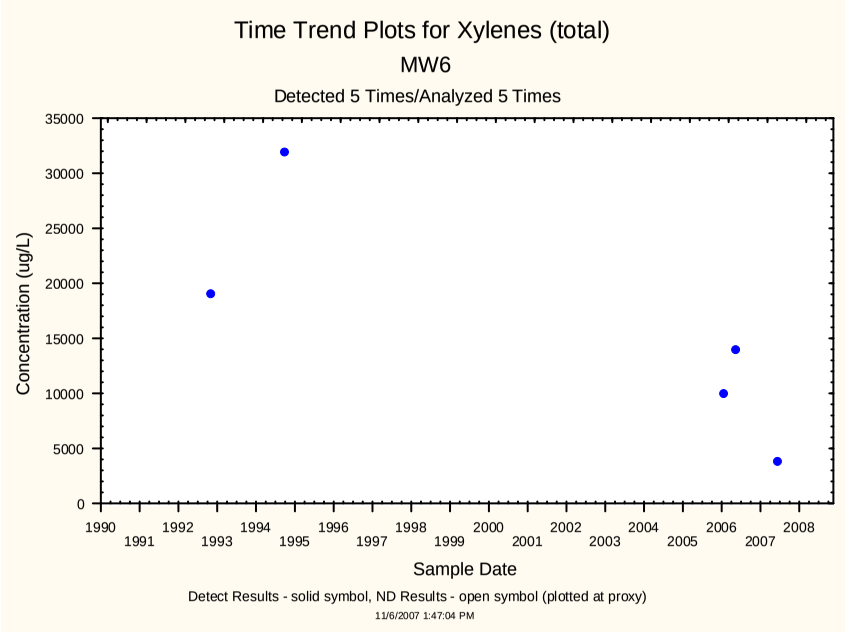

Time Trend Plots for 1,1,1-Trichloroethane
MW6
Detected 5 Times/Analyzed 5 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:05 PM

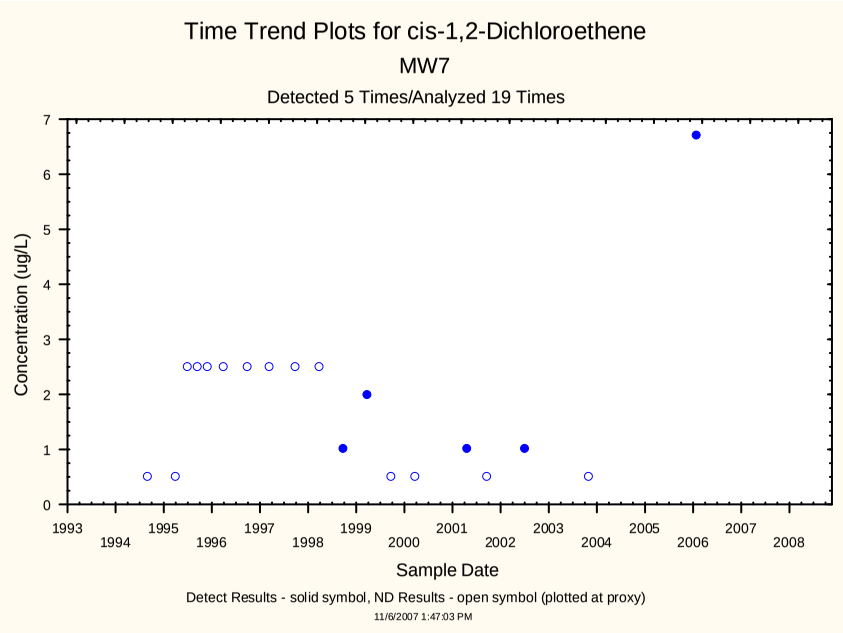

Time Trend Plots for 1,1-Dichloroethane
MW6
Detected 5 Times/Analyzed 5 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:05 PM

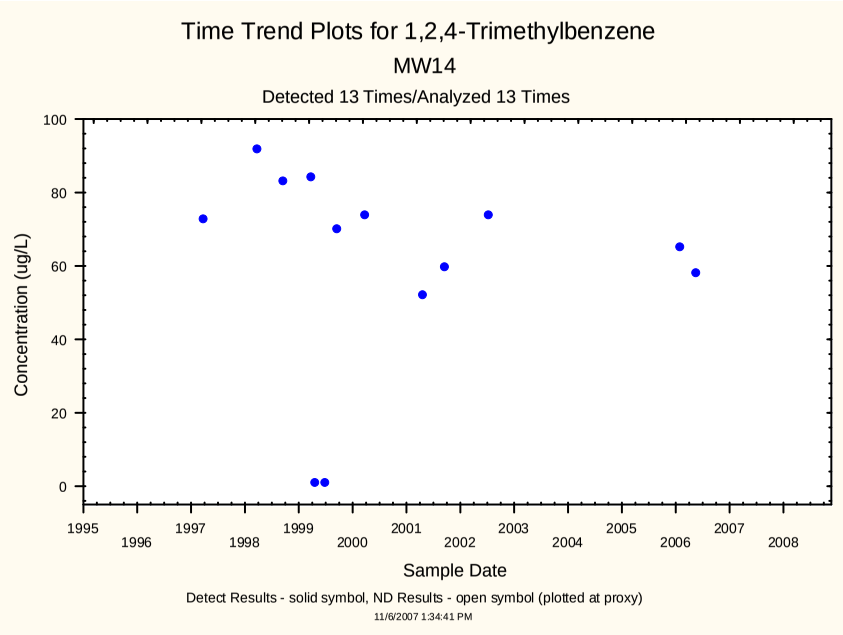

Time Trend Plots for 1,1-Dichloroethene
MW6
Detected 5 Times/Analyzed 5 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:05 PM

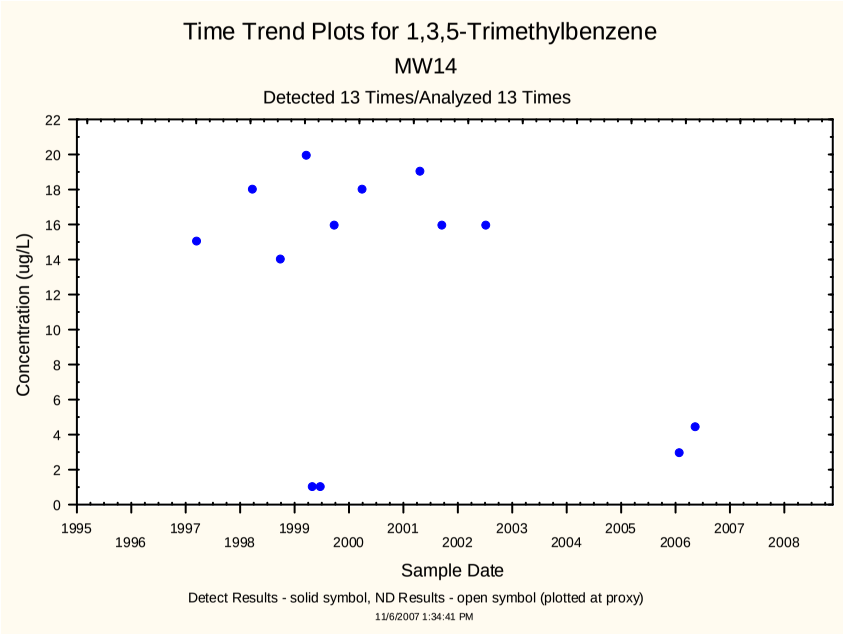

Time Trend Plots for Toluene
MW6
Detected 5 Times/Analyzed 5 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:04 PM

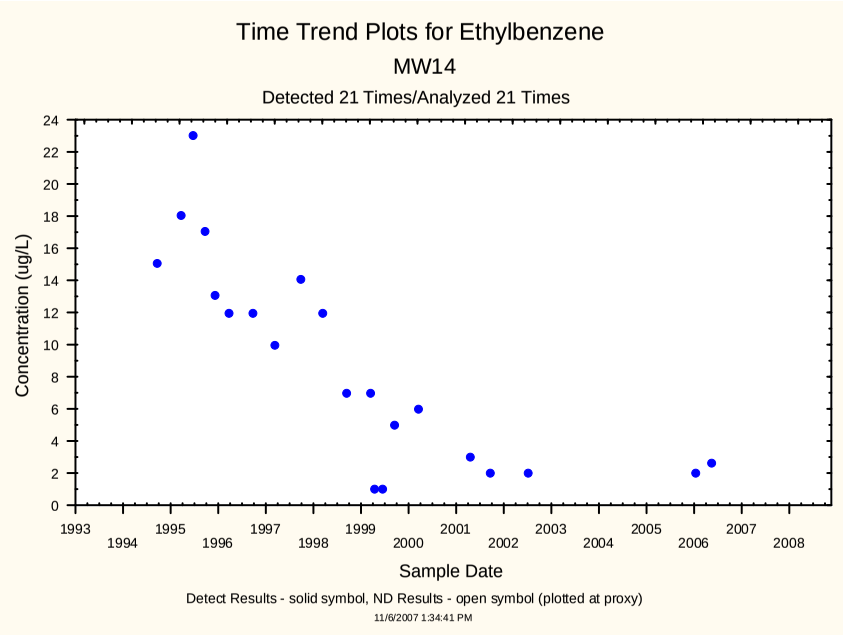

Time Trend Plots for Vinyl chloride (Chloroethene)
MW6
Detected 5 Times/Analyzed 5 Times
Concentration (ug/L)
1400
1200
1000
800
600
400
200
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:04 PM

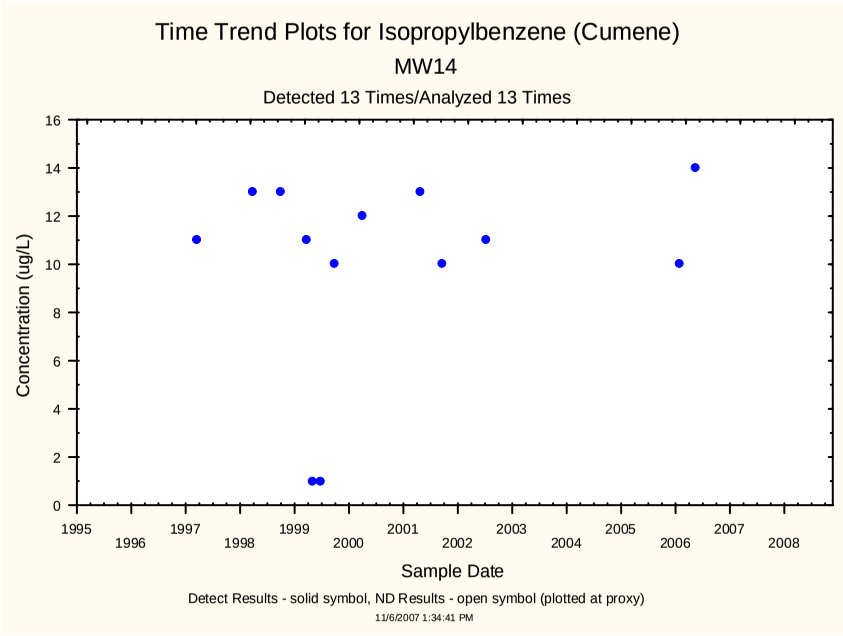

Time Trend Plots for Xylenes (total)
MW6
Detected 5 Times/Analyzed 5 Times
Concentration (ug/L)
35000
30000
25000
20000
15000
10000
5000
0
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:04 PM

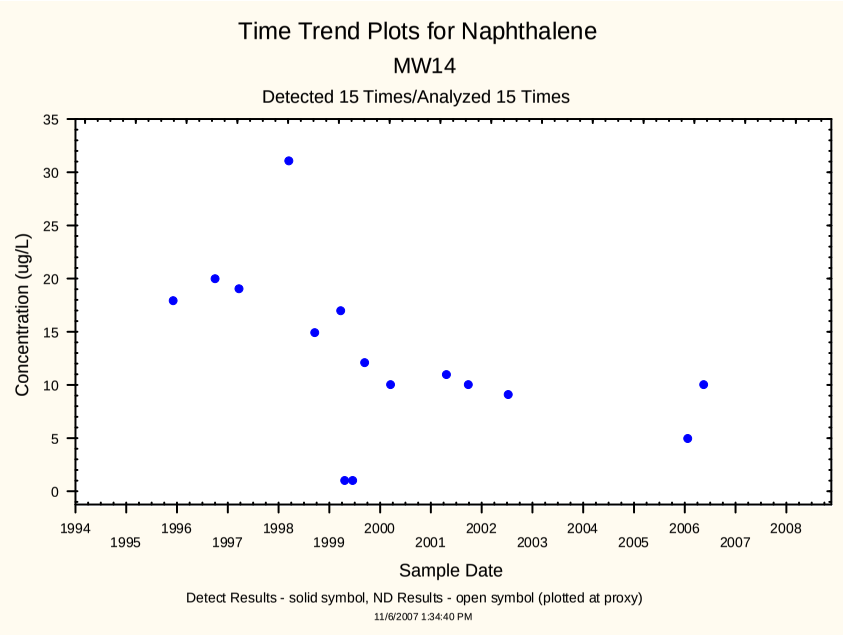

Time Trend Plots for cis-1,2-Dichloroethene
MW7
Detected 5 Times/Analyzed 19 Times
Concentration (ug/L)
0
1
2
3
4
5
6
7
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:47:03 PM

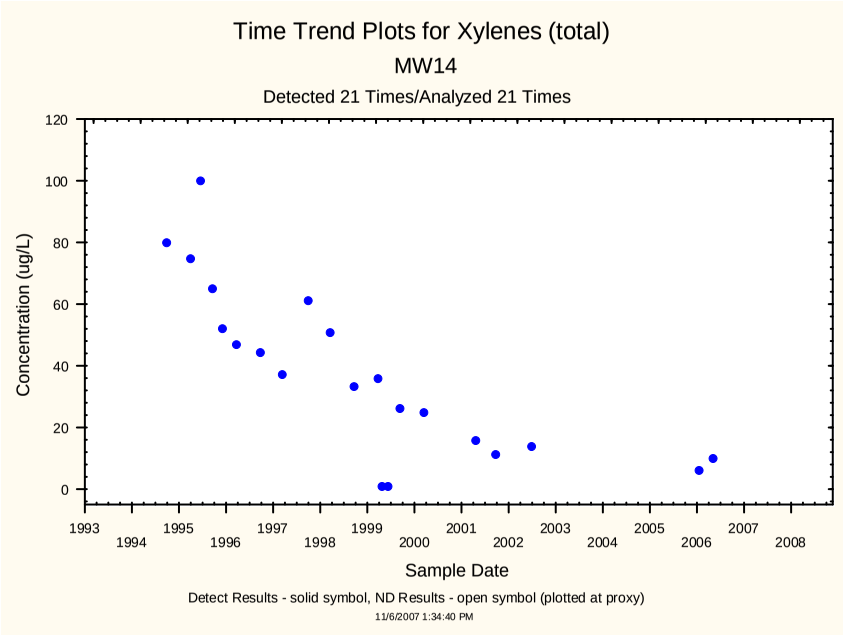

Time Trend Plots for 1,2,4-Trimethylbenzene
MW14
Detected 13 Times/Analyzed 13 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:34:41 PM

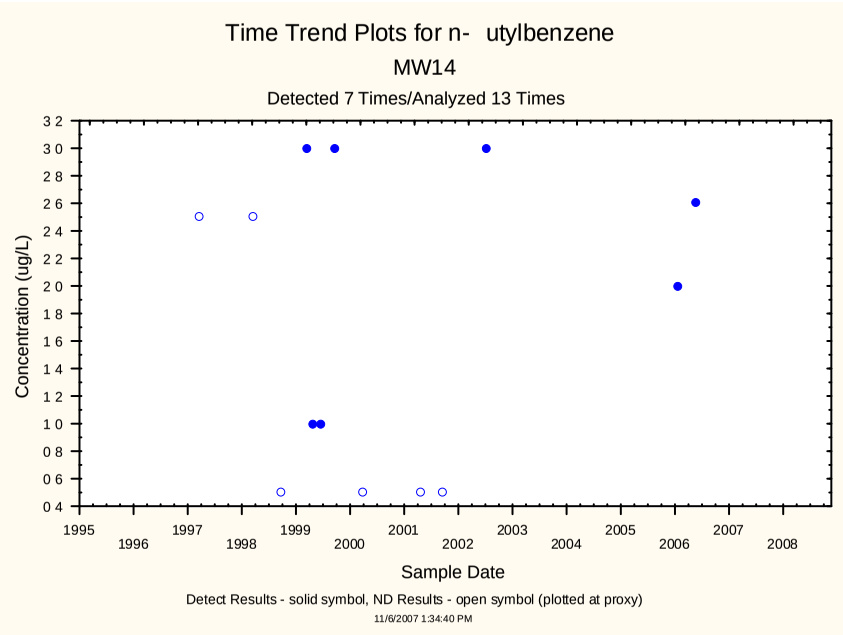

Time Trend Plots for 1,3,5-Trimethylbenzene
MW14
Detected 13 Times/Analyzed 13 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:34:41 PM

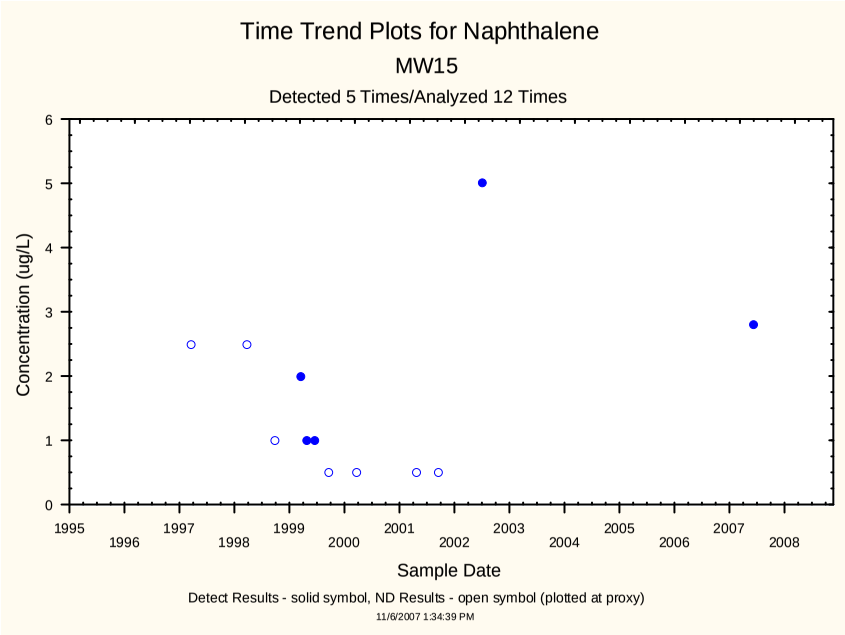

Time Trend Plots for Ethylbenzene
MW14
Detected 21 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:34:41 PM

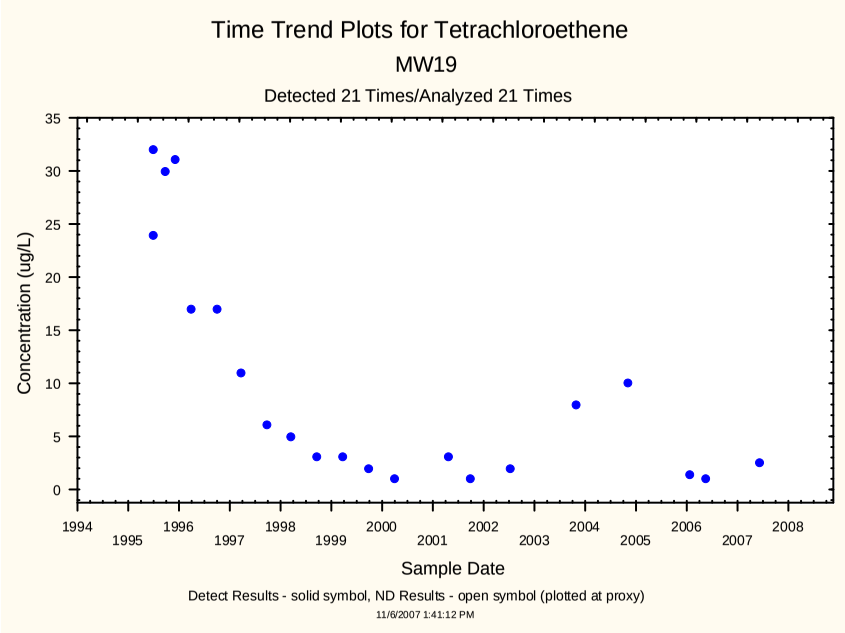

Time Trend Plots for Isopropylbenzene (Cumene)
MW14
Detected 13 Times/Analyzed 13 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:34:41 PM

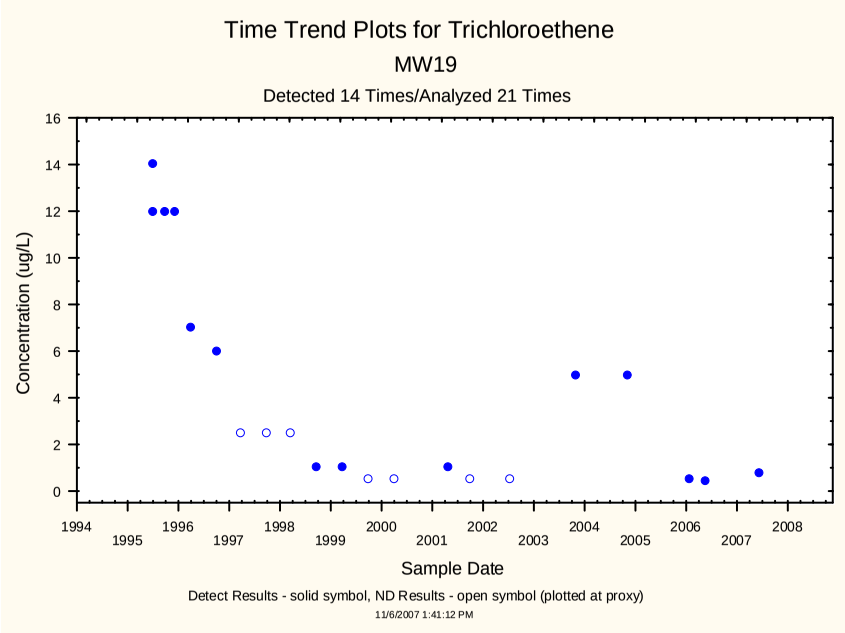

Time Trend Plots for Naphthalene
MW14
Detected 15 Times/Analyzed 15 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:34:40 PM

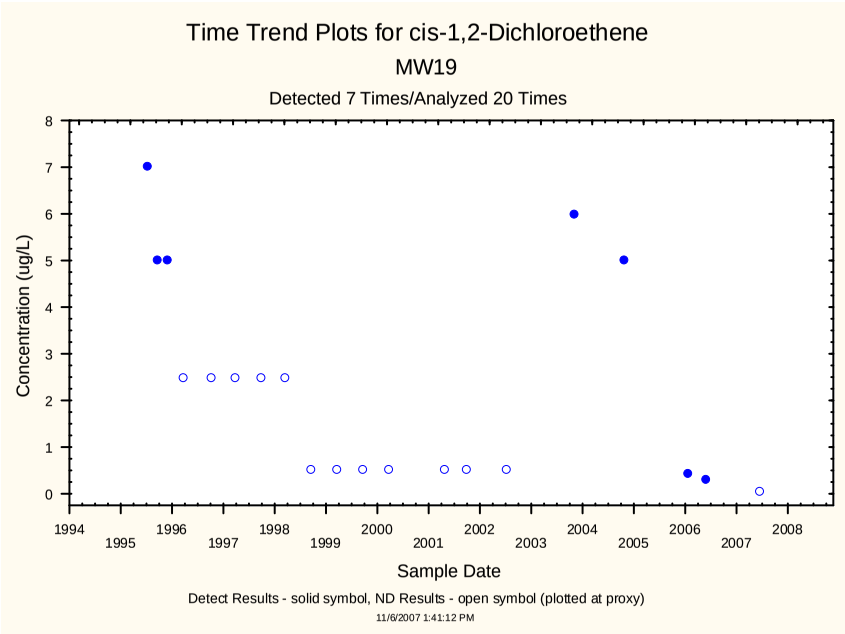

Time Trend Plots for Xylenes (total)
MW14
Detected 21 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:34:40 PM

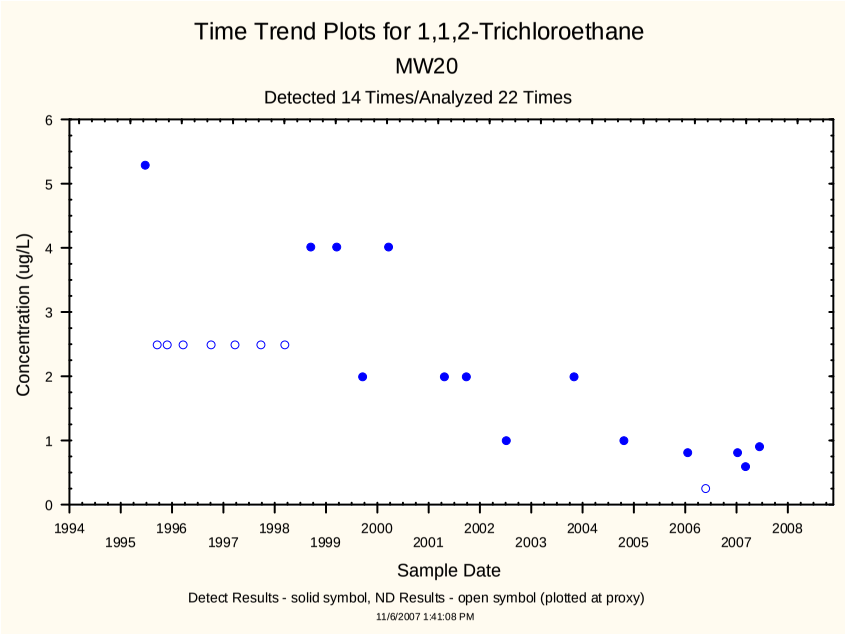

Time Trend Plots for n- utylbenzene
MW14
Detected 7 Times/Analyzed 13 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:34:40 PM

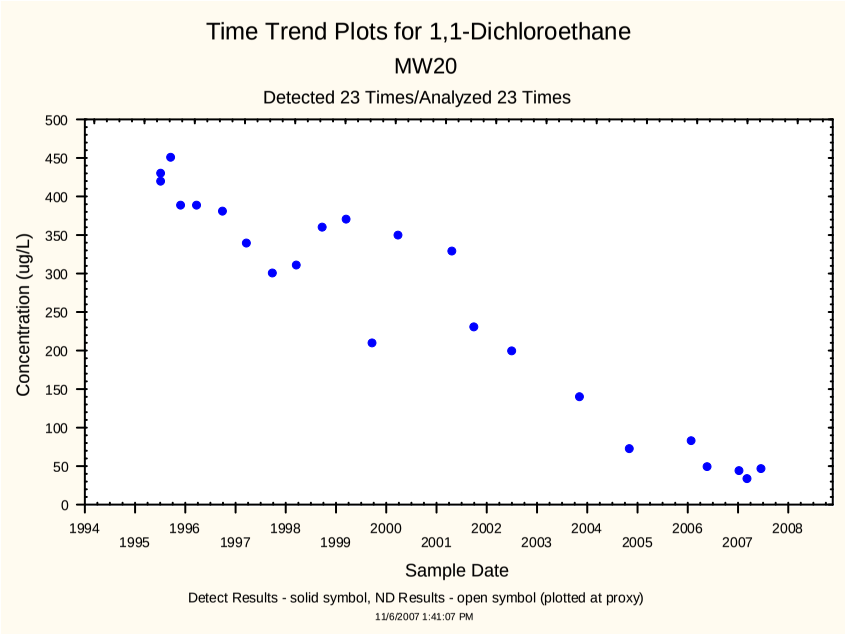

Time Trend Plots for Naphthalene
MW15
Detected 5 Times/Analyzed 12 Times
Concentration (ug/L)
0
1
2
3
4
5
6
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:34:39 PM

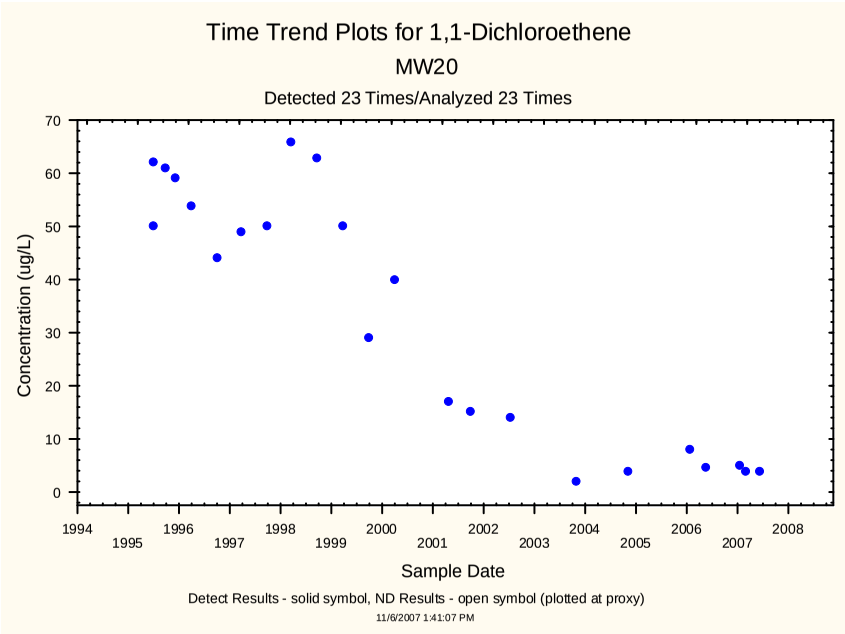

Time Trend Plots for Tetrachloroethene
MW19
Detected 21 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:12 PM

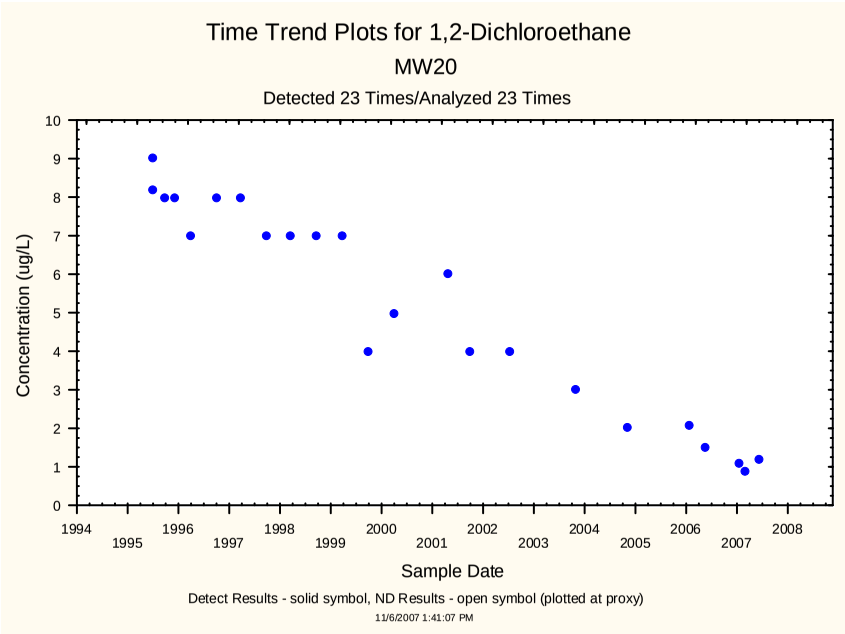

Time Trend Plots for Trichloroethene
MW19
Detected 14 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:12 PM

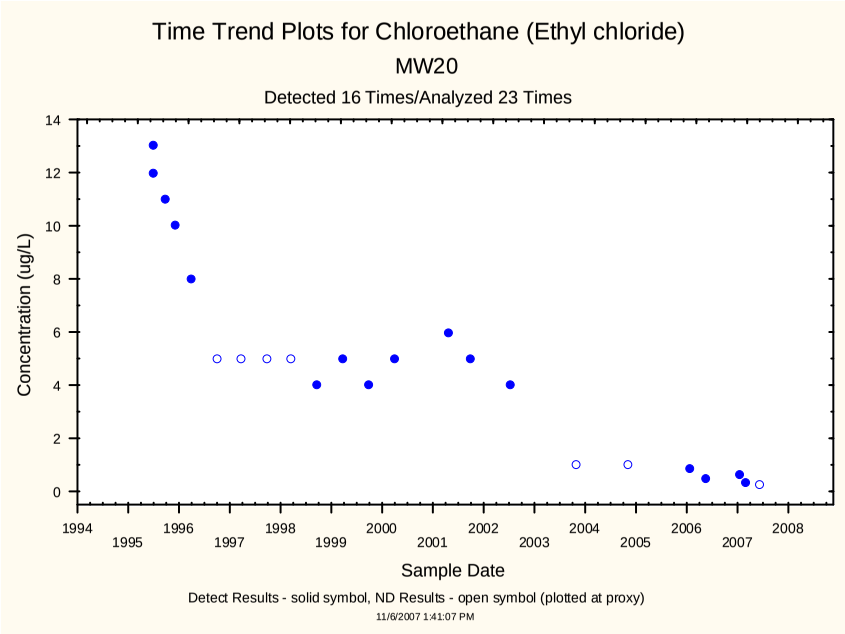

Time Trend Plots for cis-1,2-Dichloroethene
MW19
Detected 7 Times/Analyzed 20 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:12 PM

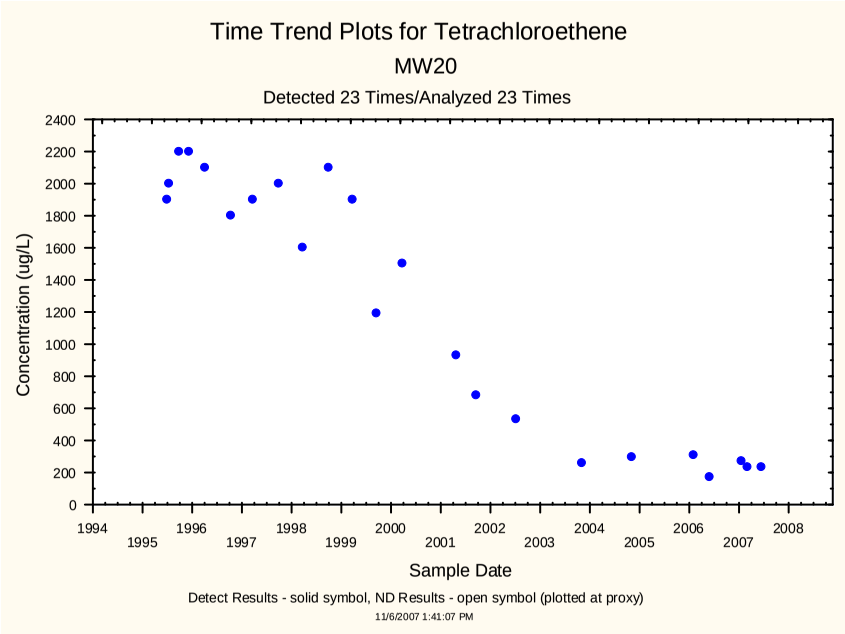

Time Trend Plots for 1,1,2-Trichloroethane
MW20
Detected 14 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:08 PM

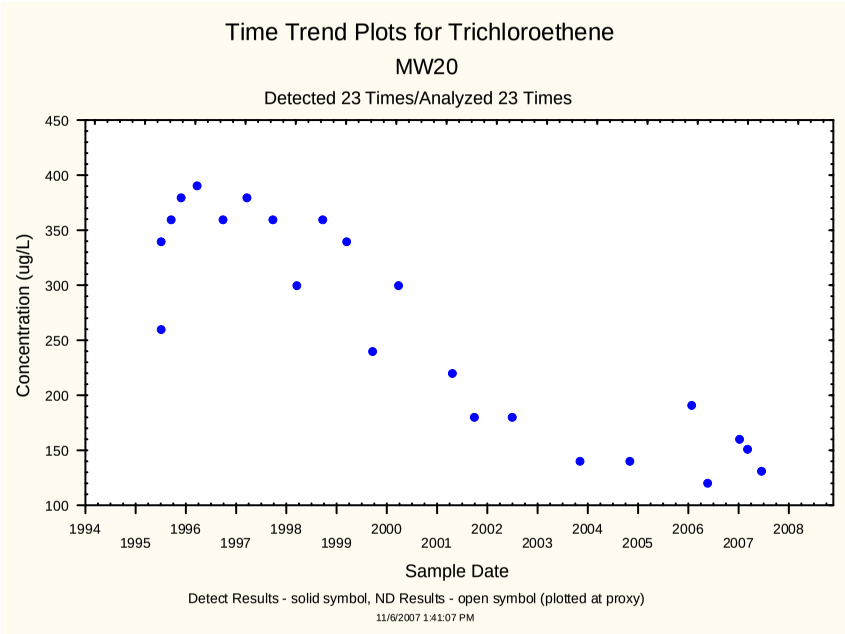

Time Trend Plots for 1,1-Dichloroethane
MW20
Detected 23 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:07 PM

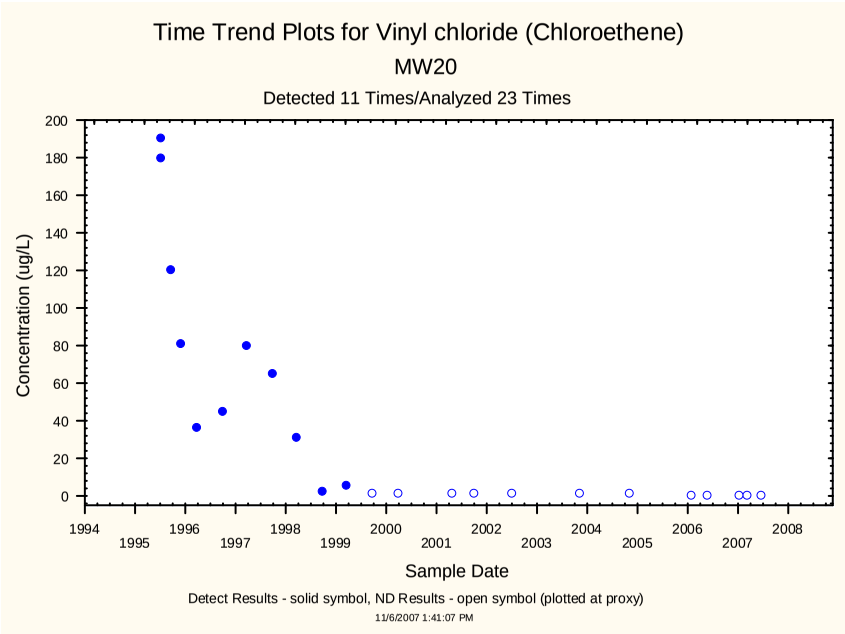

Time Trend Plots for 1,1-Dichloroethene
MW20
Detected 23 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:07 PM

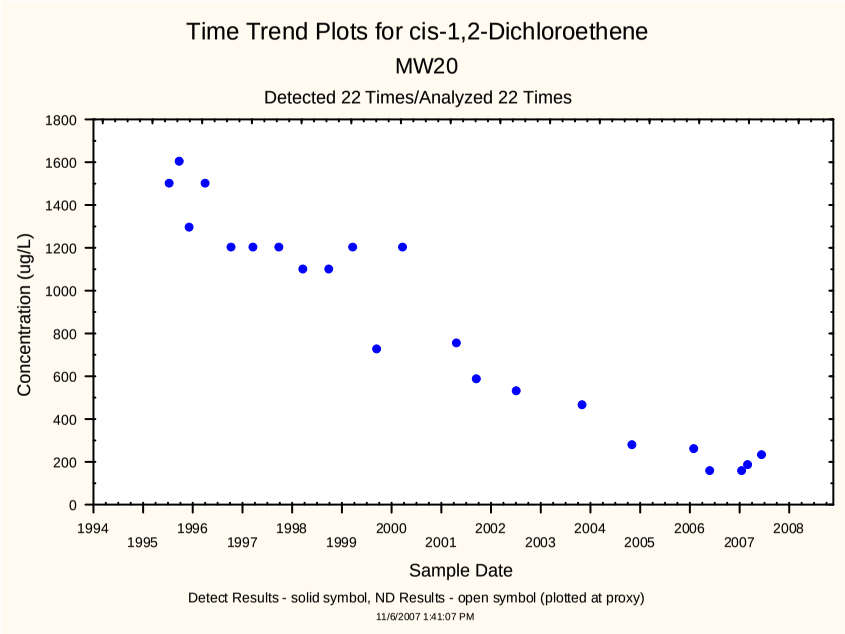

Time Trend Plots for 1,2-Dichloroethane
MW20
Detected 23 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:07 PM

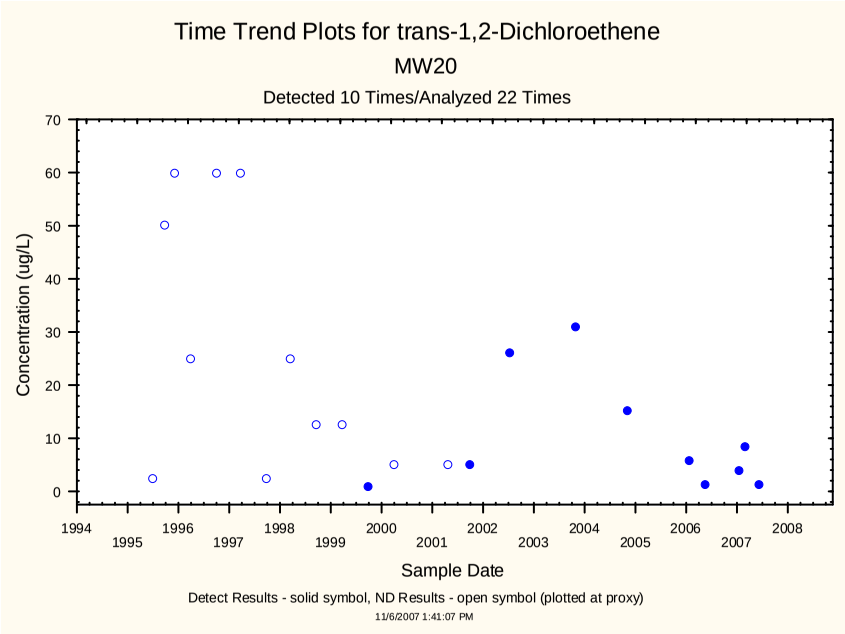

Time Trend Plots for Chloroethane (Ethyl chloride)
MW20
Detected 16 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:07 PM

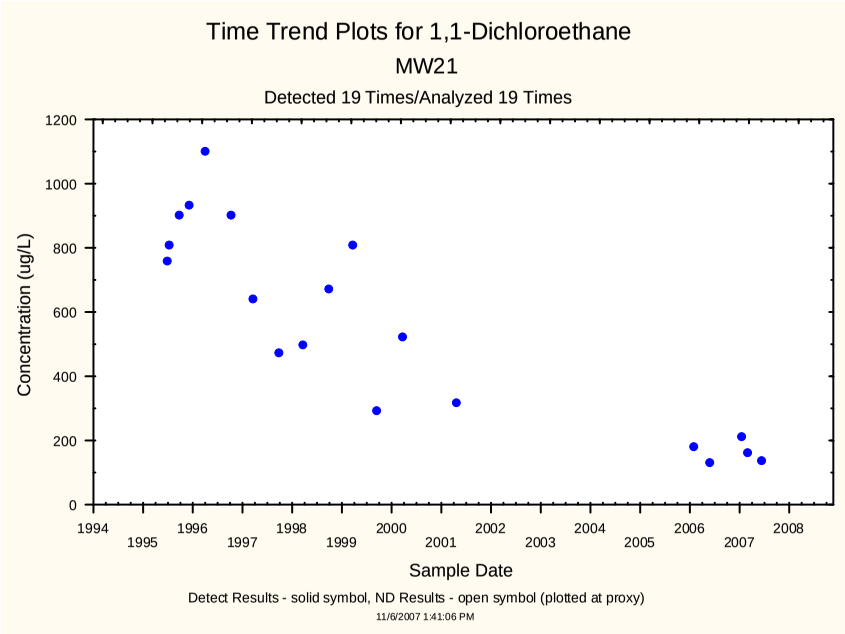

Time Trend Plots for Tetrachloroethene
MW20
Detected 23 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:07 PM

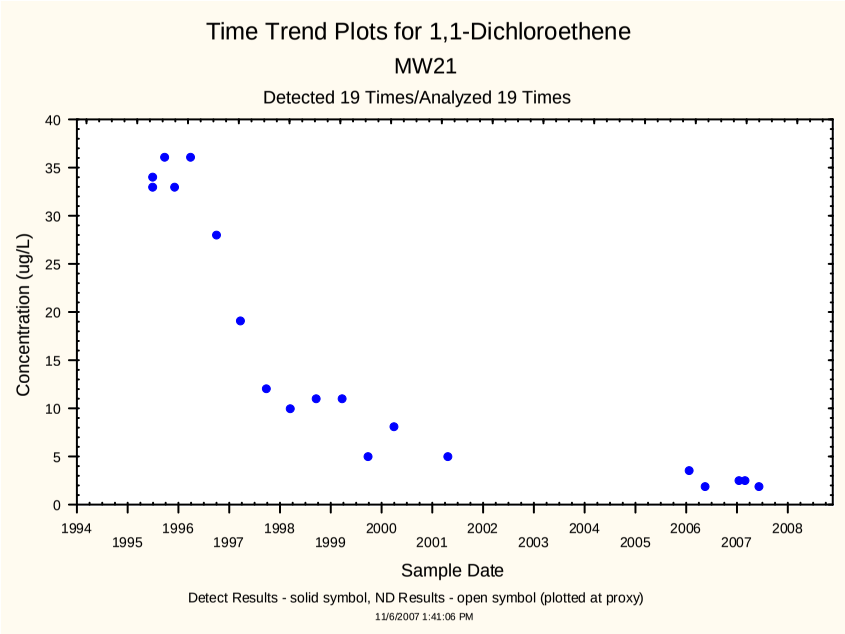

Time Trend Plots for Trichloroethene
MW20
Detected 23 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:07 PM

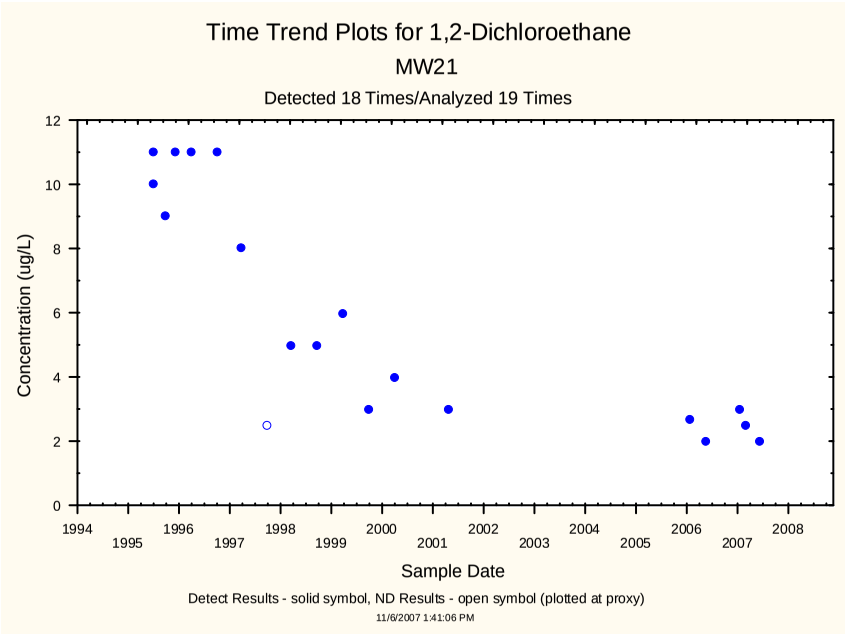

Time Trend Plots for Vinyl chloride (Chloroethene)
MW20
Detected 11 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:07 PM

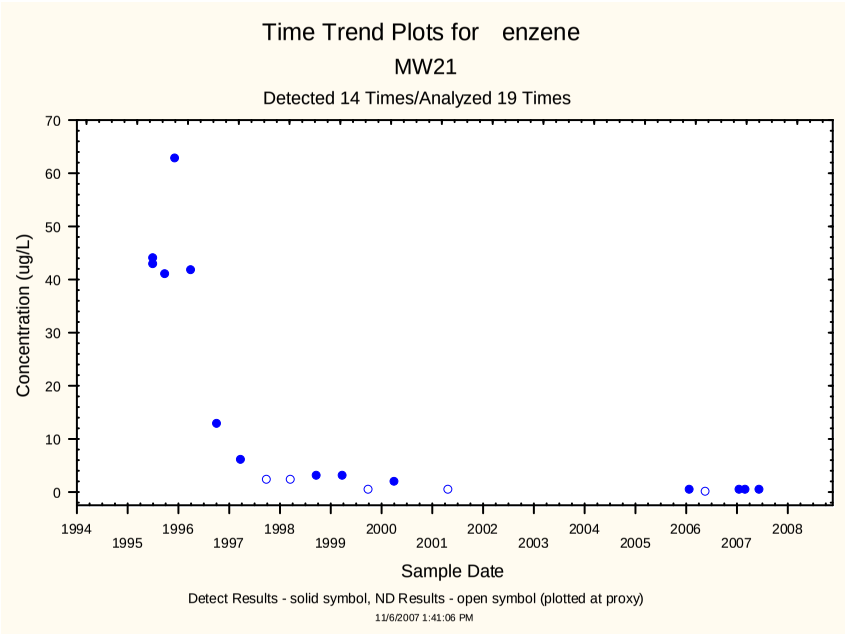

Time Trend Plots for cis-1,2-Dichloroethene
MW20
Detected 22 Times/Analyzed 22 Times
Concentration (ug/L)
0
200
400
600
800
1000
1200
1400
1600
1800
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:07 PM

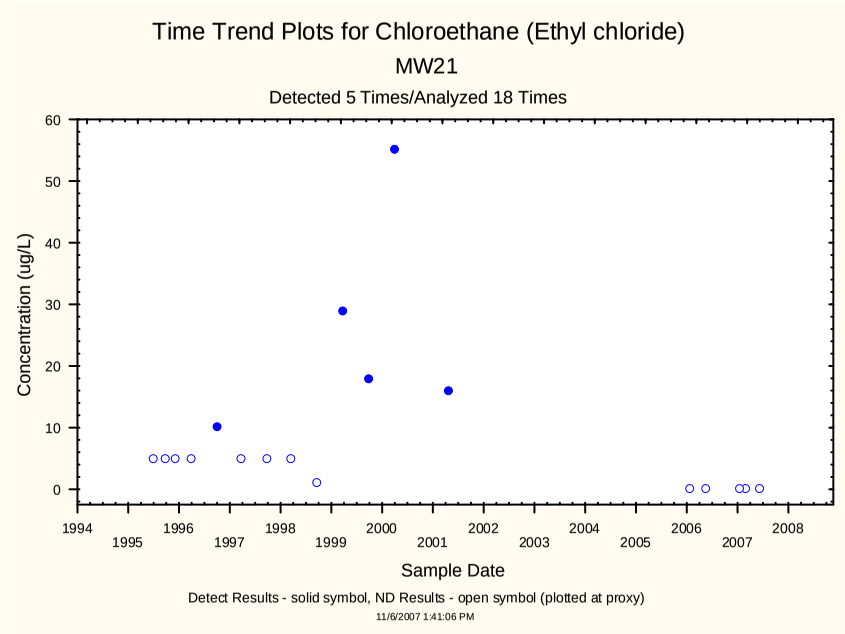

Time Trend Plots for trans-1,2-Dichloroethene
MW20
Detected 10 Times/Analyzed 22 Times
Concentration (ug/L)
0
10
20
30
40
50
60
70
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:07 PM

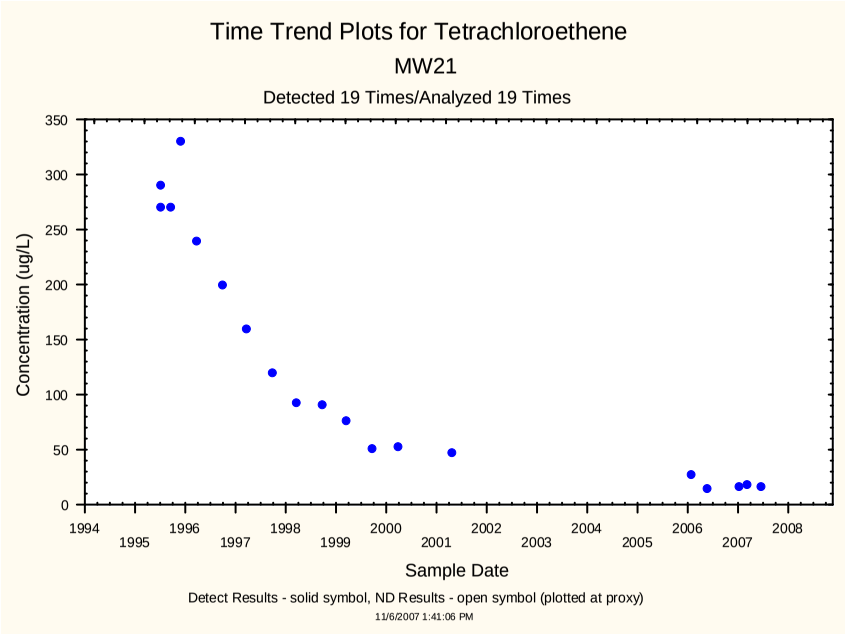

Time Trend Plots for 1,1-Dichloroethane
MW21
Detected 19 Times/Analyzed 19 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:06 PM

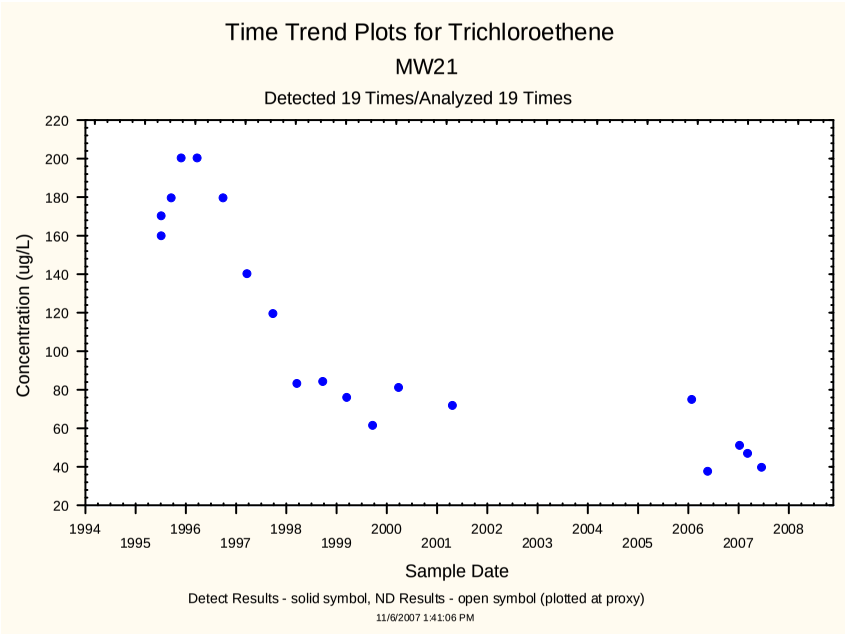

Time Trend Plots for 1,1-Dichloroethene
MW21
Detected 19 Times/Analyzed 19 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:06 PM

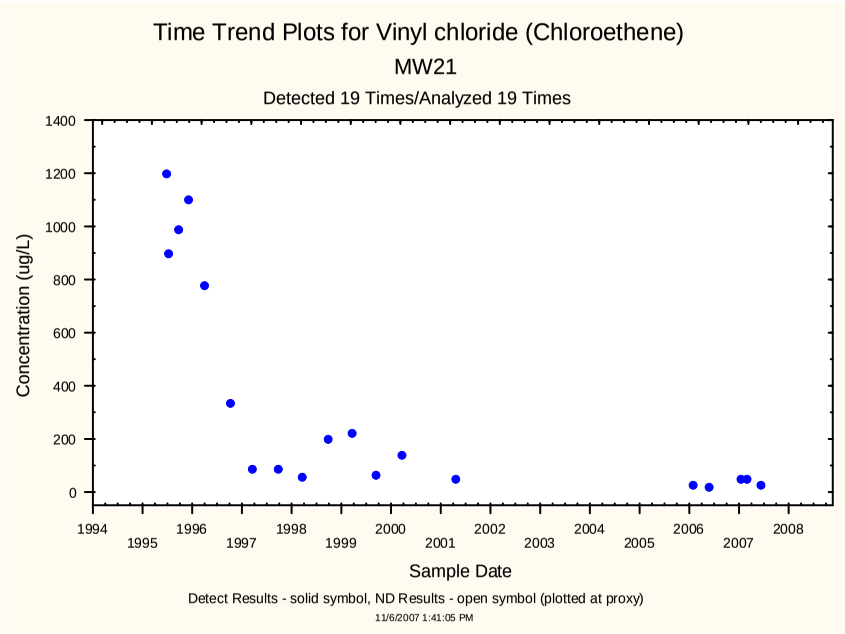

Time Trend Plots for 1,2-Dichloroethane
MW21
Detected 18 Times/Analyzed 19 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:06 PM

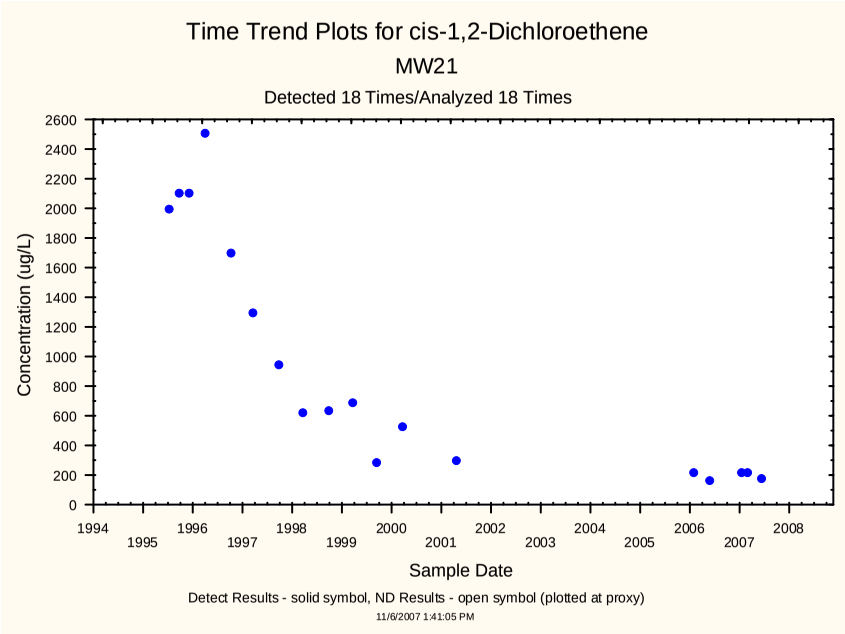

Time Trend Plots for enzene
MW21
Detected 14 Times/Analyzed 19 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:06 PM

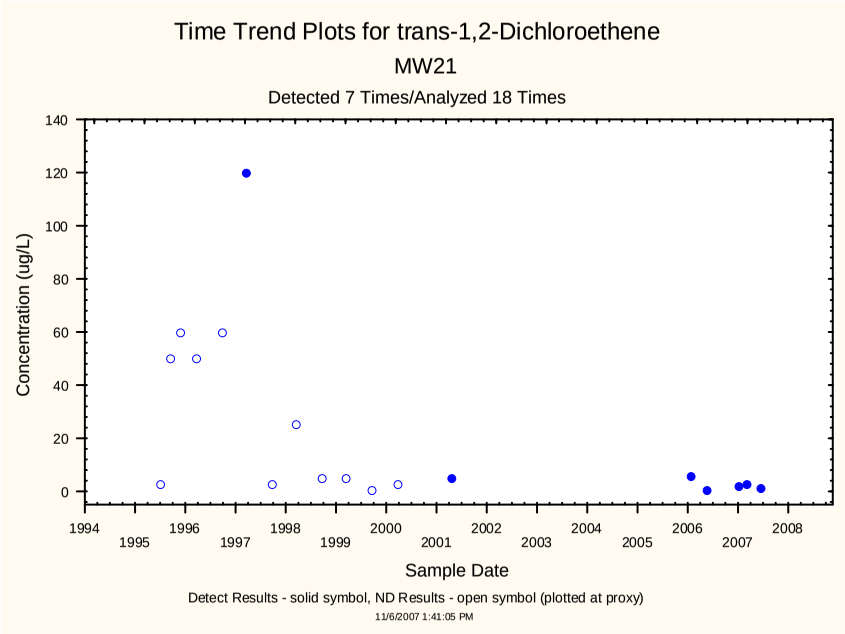

Time Trend Plots for Chloroethane (Ethyl chloride)
MW21
Detected 5 Times/Analyzed 18 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:06 PM

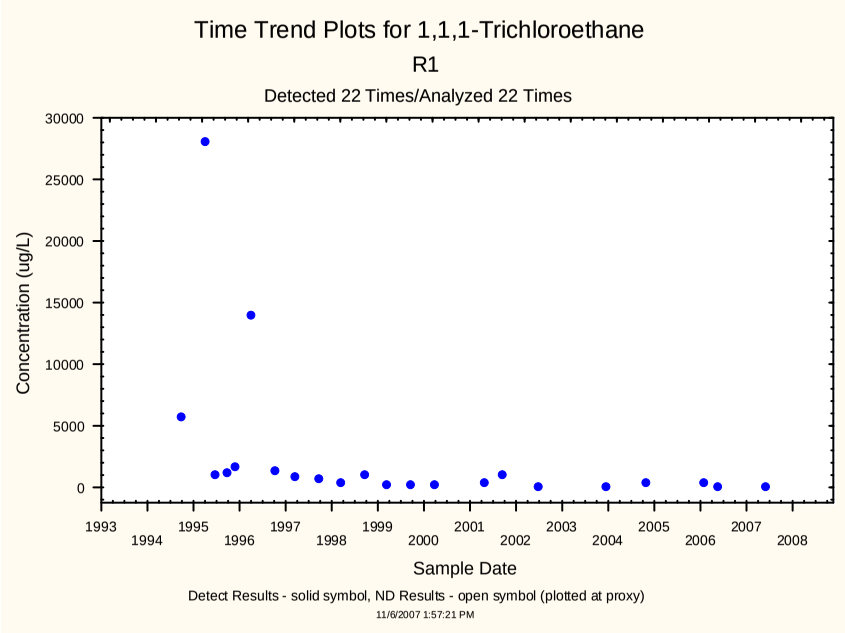

Time Trend Plots for Tetrachloroethene
MW21
Detected 19 Times/Analyzed 19 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:06 PM

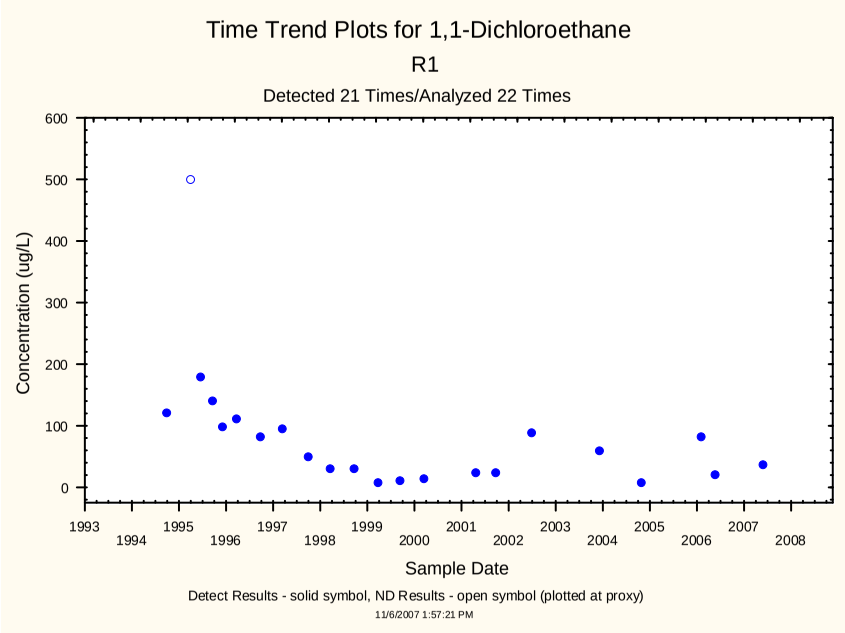

Time Trend Plots for Trichloroethene
MW21
Detected 19 Times/Analyzed 19 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:06 PM

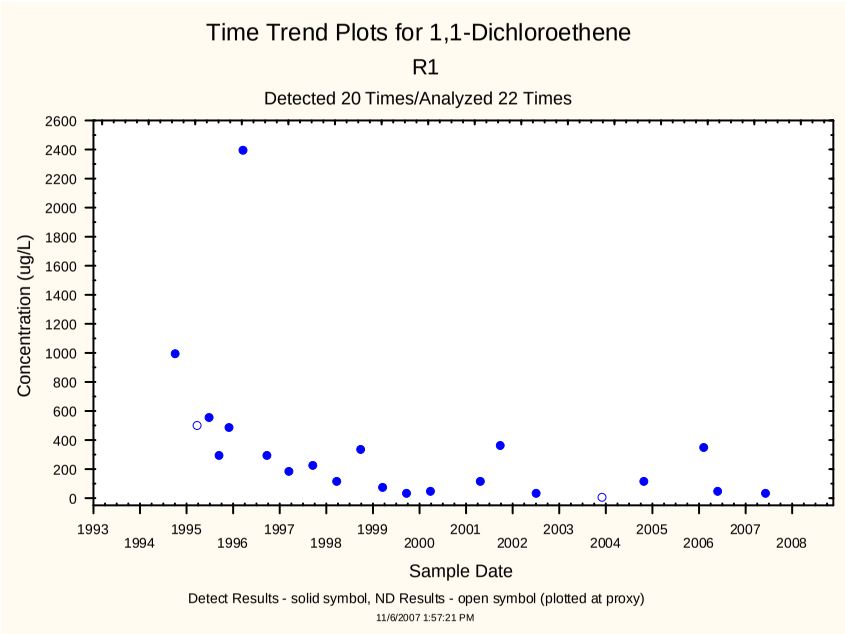

Time Trend Plots for Vinyl chloride (Chloroethene)
MW21
Detected 19 Times/Analyzed 19 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:05 PM

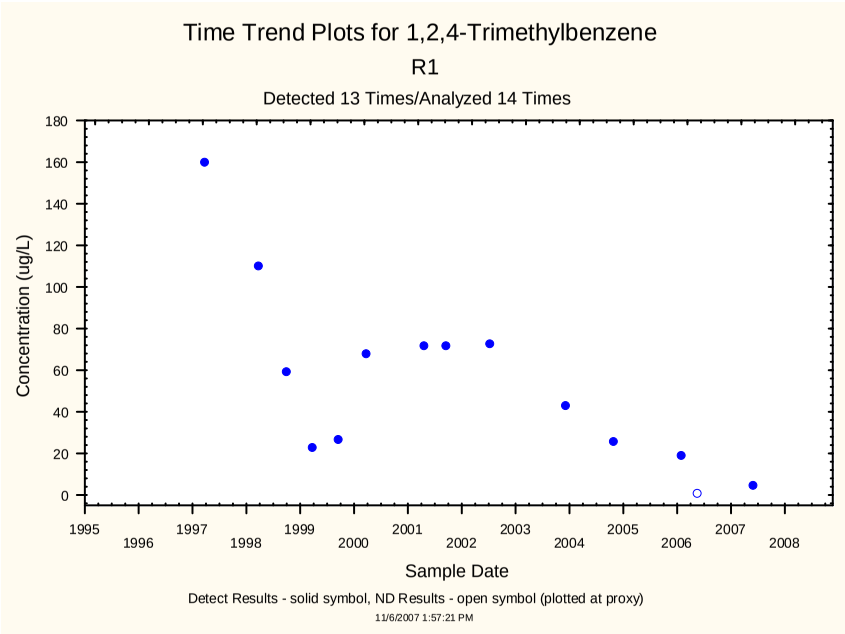

Time Trend Plots for cis-1,2-Dichloroethene
MW21
Detected 18 Times/Analyzed 18 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:05 PM

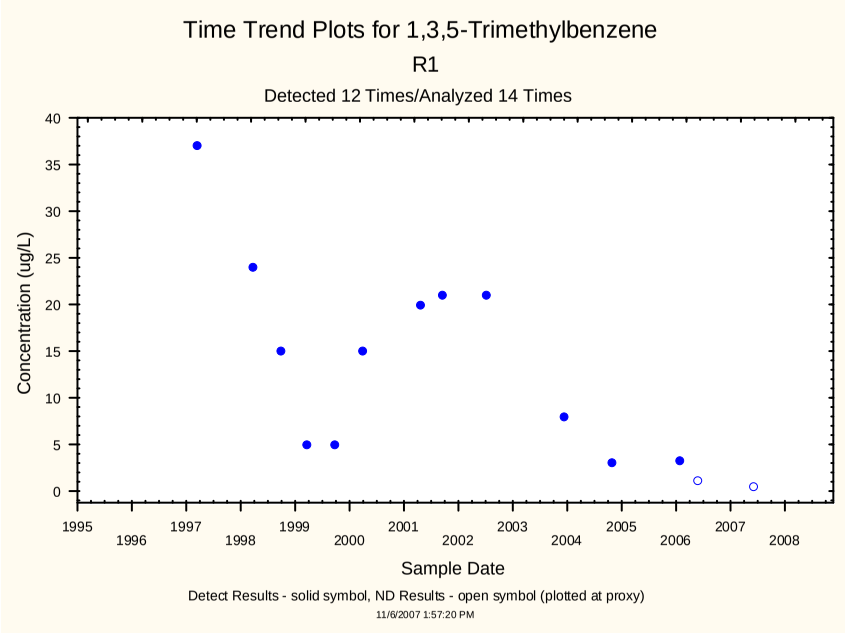

Time Trend Plots for trans-1,2-Dichloroethene
MW21
Detected 7 Times/Analyzed 18 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:41:05 PM

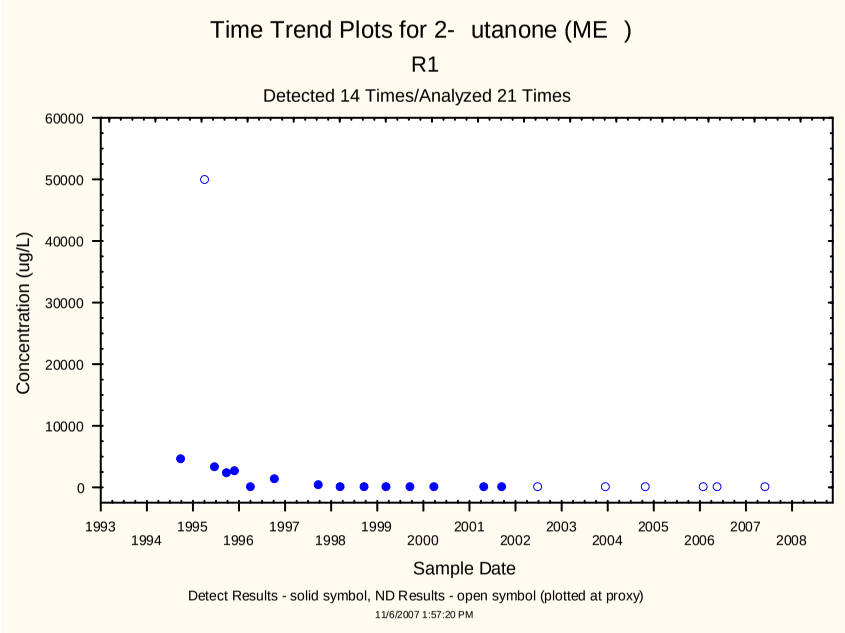

Time Trend Plots for 1,1,1-Trichloroethane
R1
Detected 22 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:21 PM

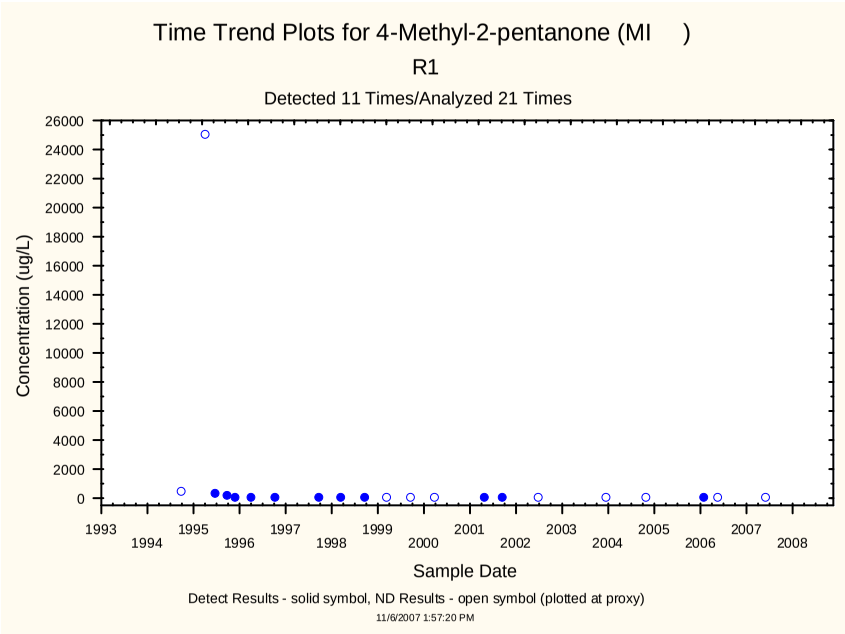

Time Trend Plots for 1,1-Dichloroethane
R1
Detected 21 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:21 PM

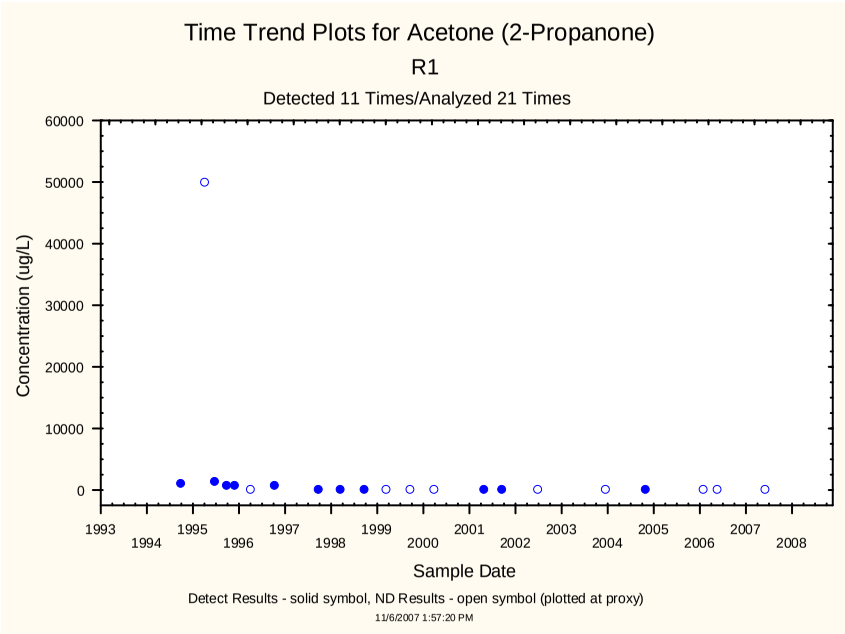

Time Trend Plots for 1,1-Dichloroethene
R1
Detected 20 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:21 PM

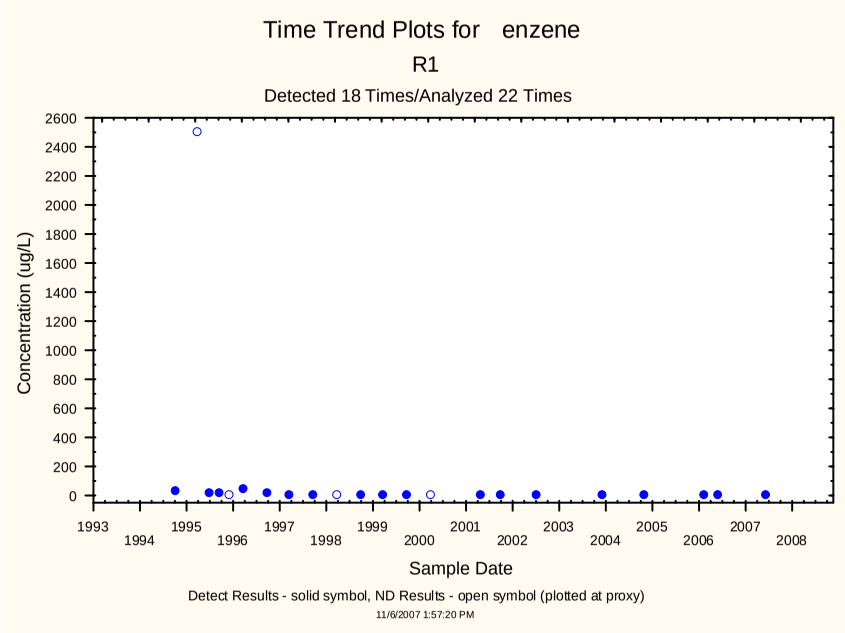

Time Trend Plots for 1,2,4-Trimethylbenzene
R1
Detected 13 Times/Analyzed 14 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:21 PM

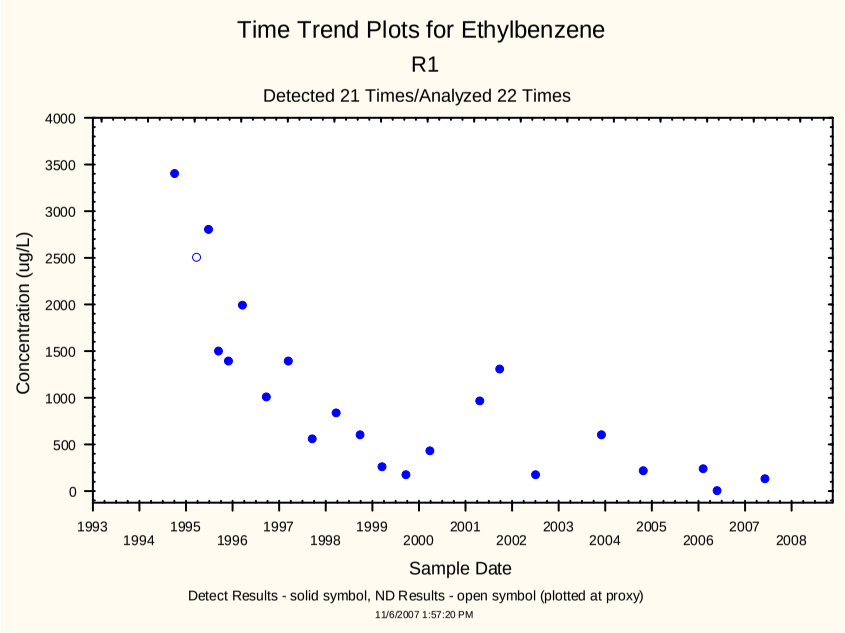

Time Trend Plots for 1,3,5-Trimethylbenzene
R1
Detected 12 Times/Analyzed 14 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:20 PM

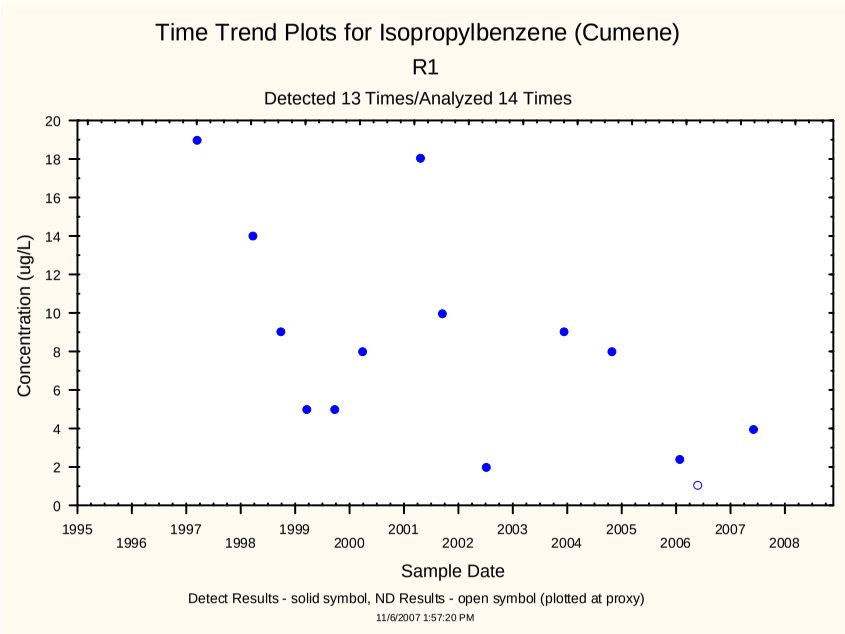

Time Trend Plots for 2- utanone (ME)
R1
Detected 14 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:20 PM

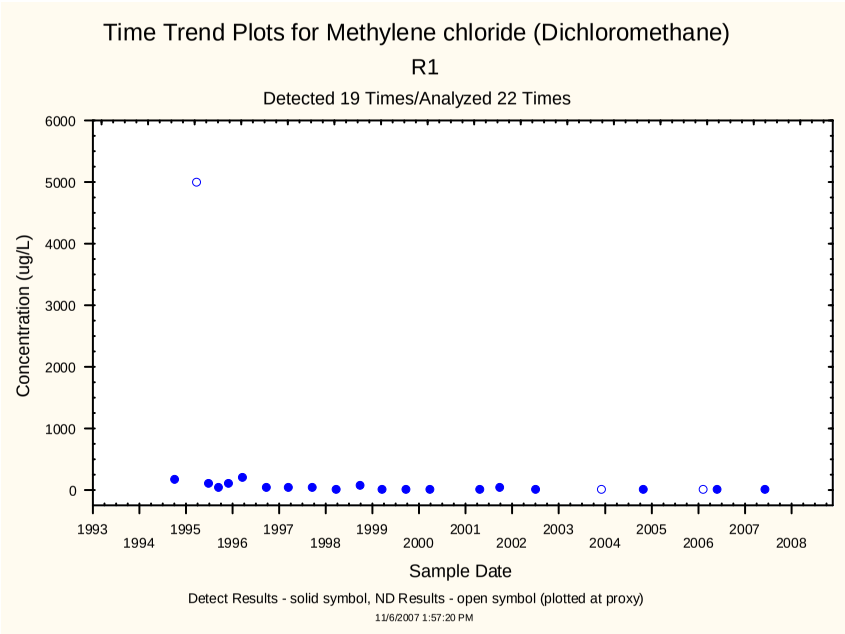

Time Trend Plots for 4-Methyl-2-pentanone (MI)
R1
Detected 11 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:20 PM

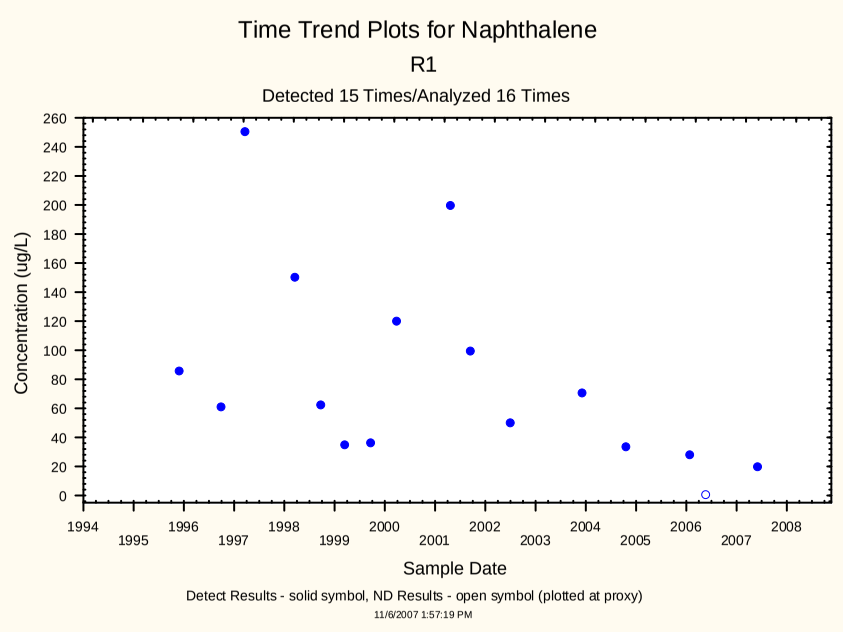

Time Trend Plots for Acetone (2-Propanone)
R1
Detected 11 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:20 PM

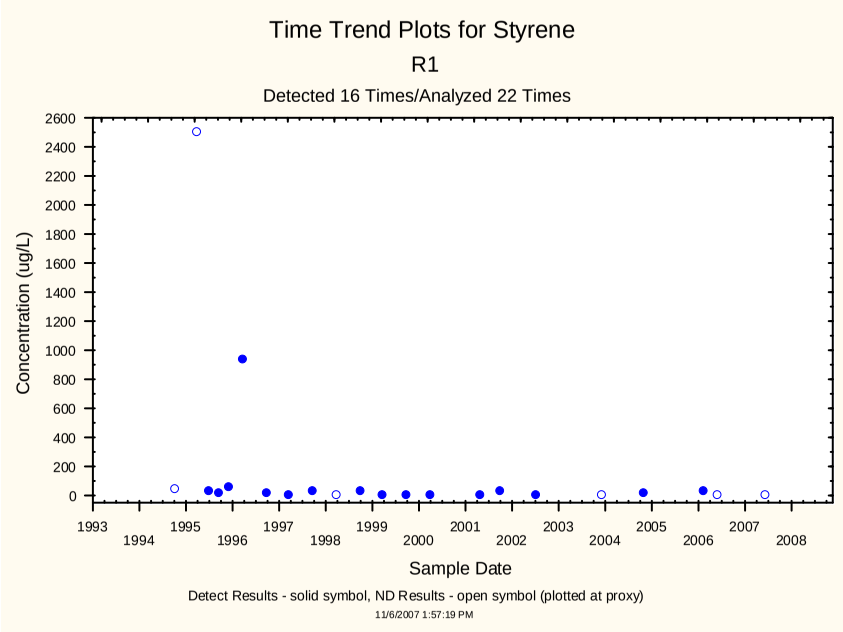

Time Trend Plots for enzene
R1
Detected 18 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:20 PM

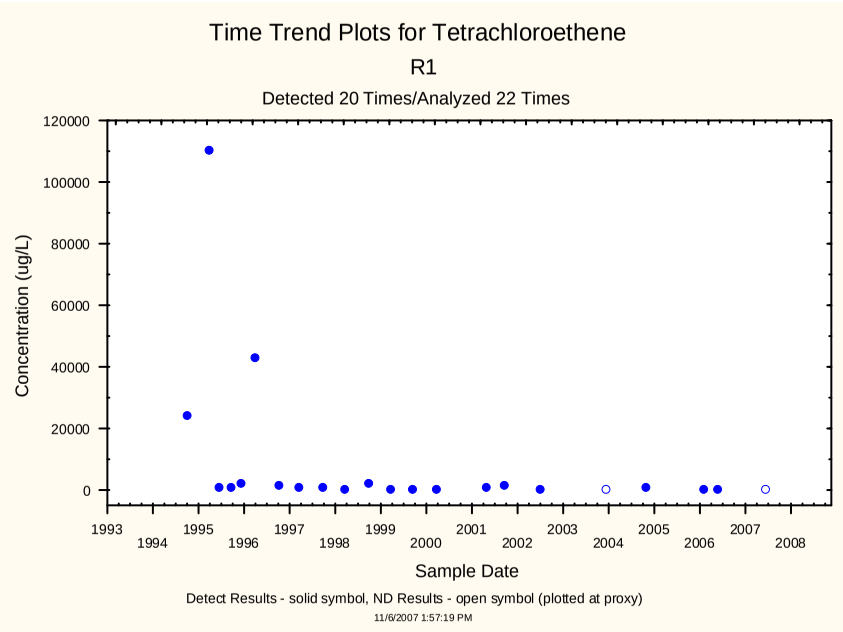

Time Trend Plots for Ethylbenzene
R1
Detected 21 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:20 PM

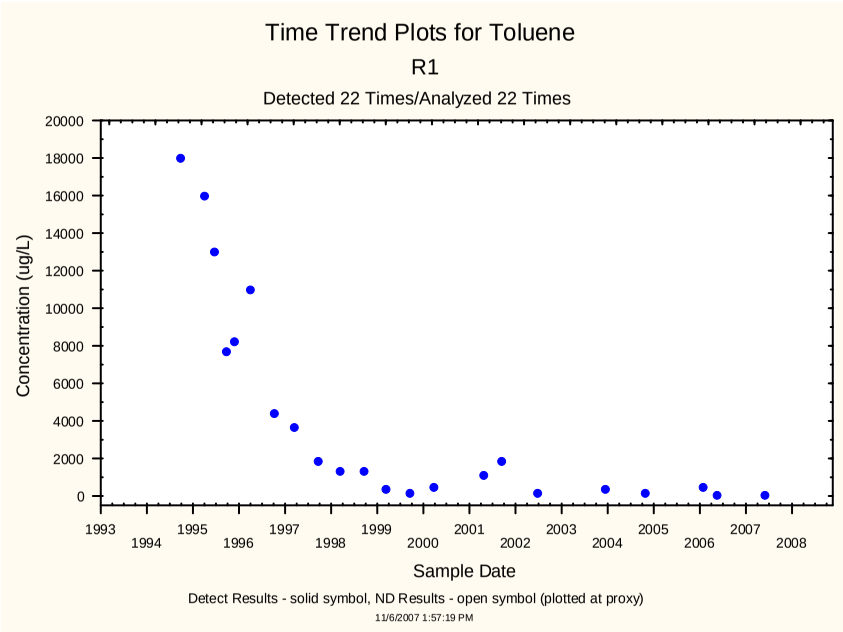

Time Trend Plots for Isopropylbenzene (Cumene)
R1
Detected 13 Times/Analyzed 14 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:20 PM

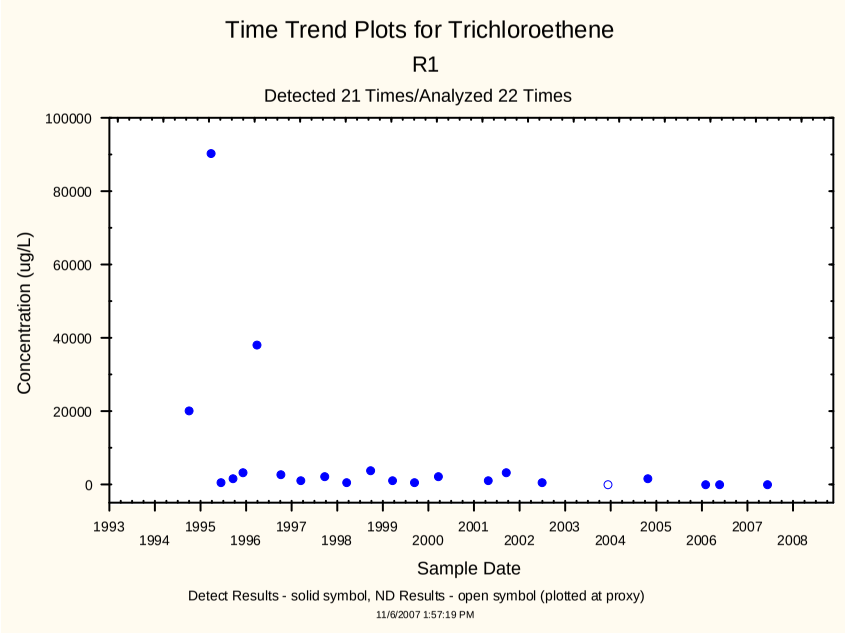

Time Trend Plots for Methylene chloride (Dichloromethane)
R1
Detected 19 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:20 PM

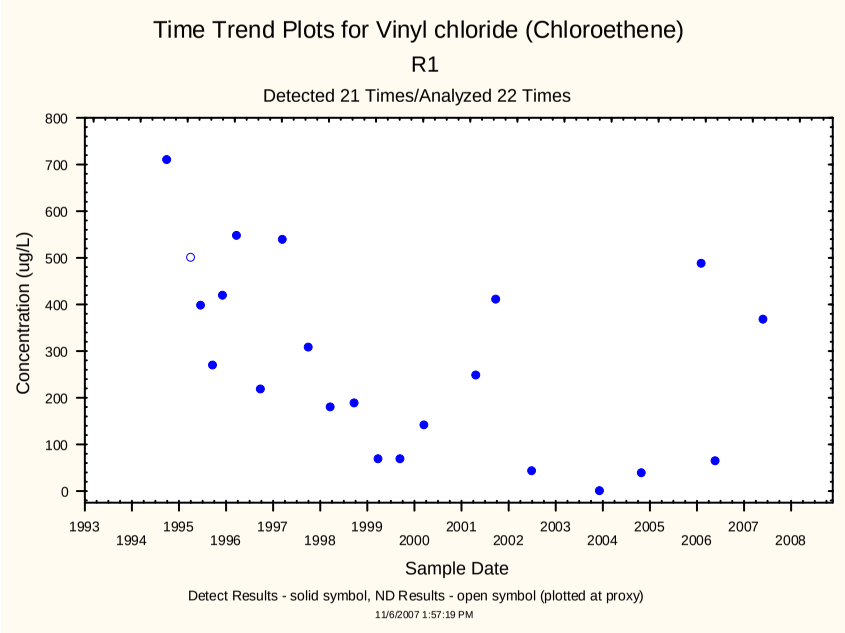

Time Trend Plots for Naphthalene
R1
Detected 15 Times/Analyzed 16 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:19 PM

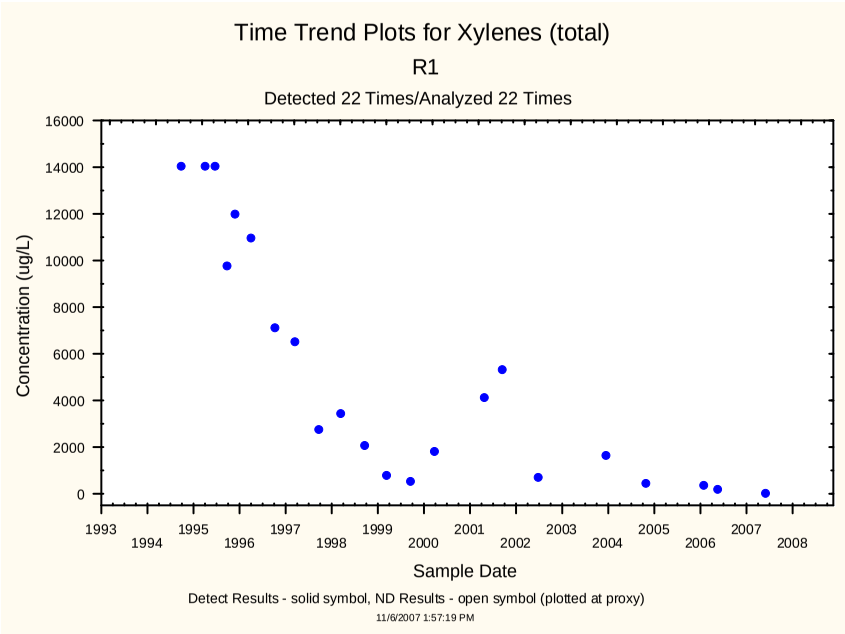

Time Trend Plots for Styrene
R1
Detected 16 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:19 PM

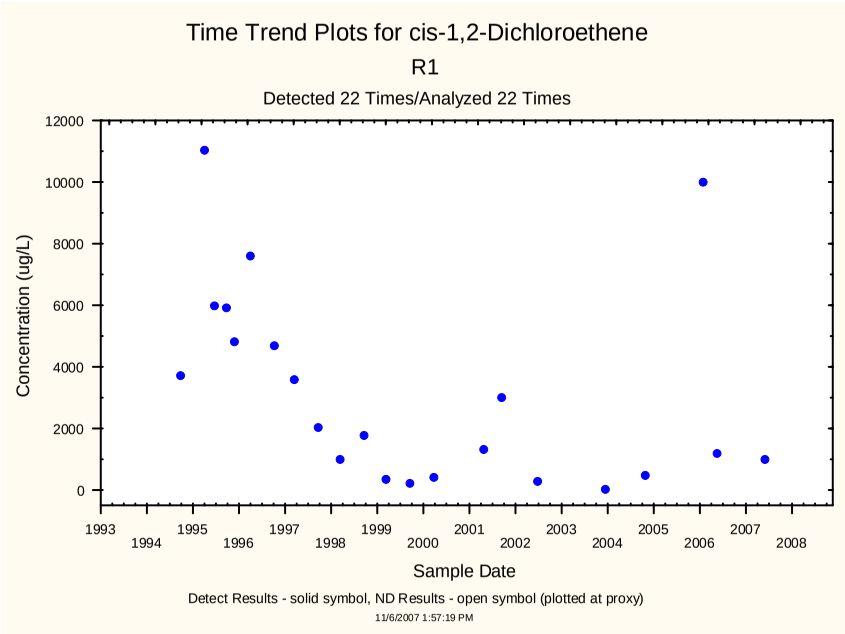

Time Trend Plots for Tetrachloroethene
R1
Detected 20 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:19 PM

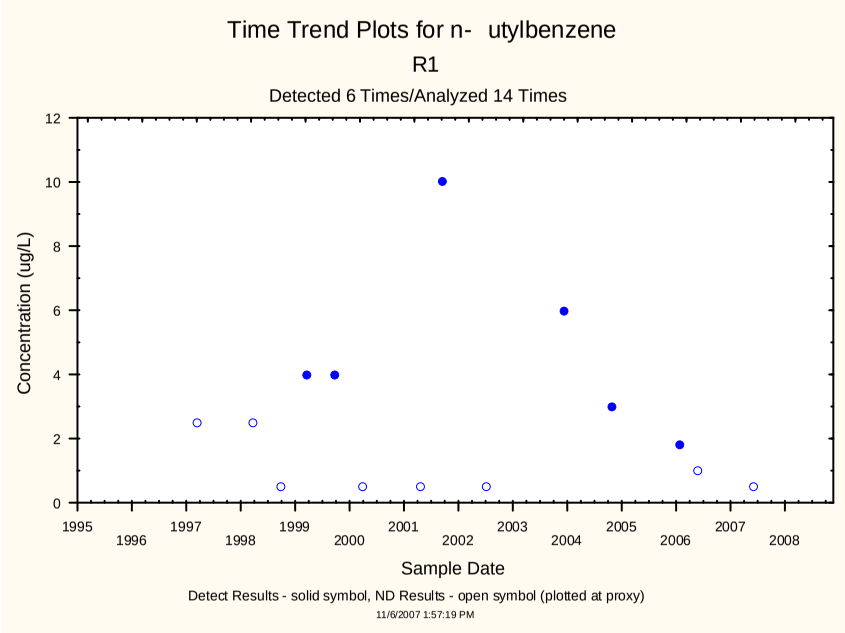

Time Trend Plots for Toluene
R1
Detected 22 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:19 PM

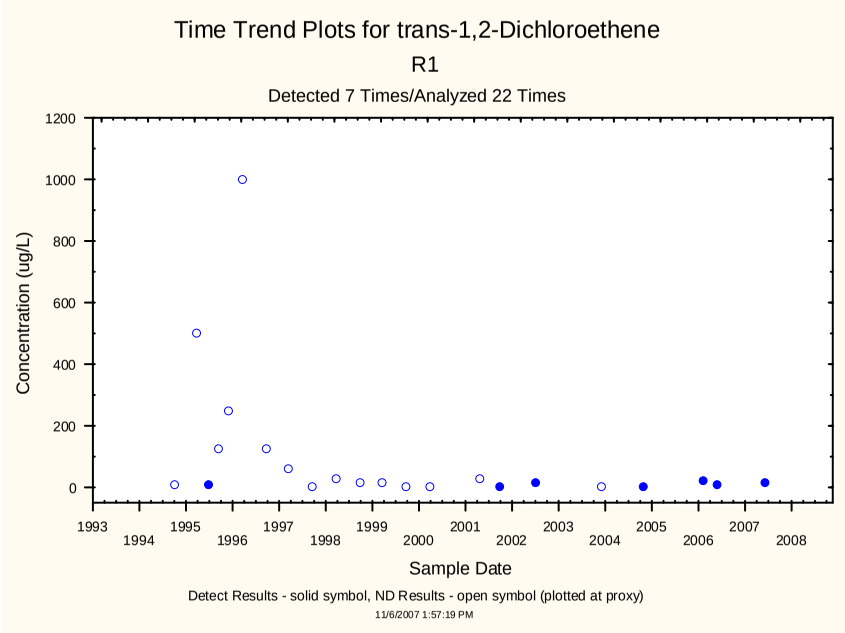

Time Trend Plots for Trichloroethene
R1
Detected 21 Times/Analyzed 22 Times
Concentration (ug/L)
100000
80000
60000
40000
20000
0
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:19 PM

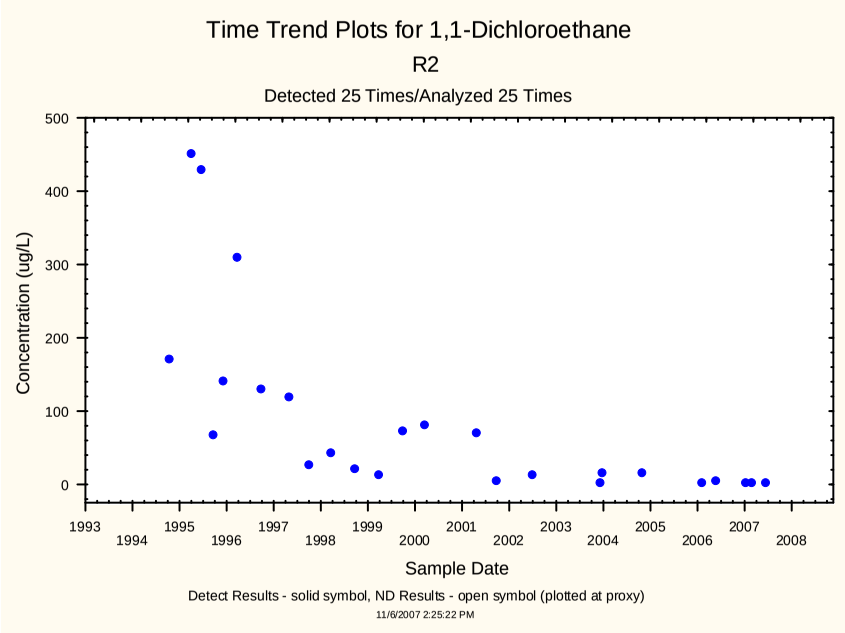

Time Trend Plots for Vinyl chloride (Chloroethene)
R1
Detected 21 Times/Analyzed 22 Times
Concentration (ug/L)
800
700
600
500
400
300
200
100
0
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:19 PM

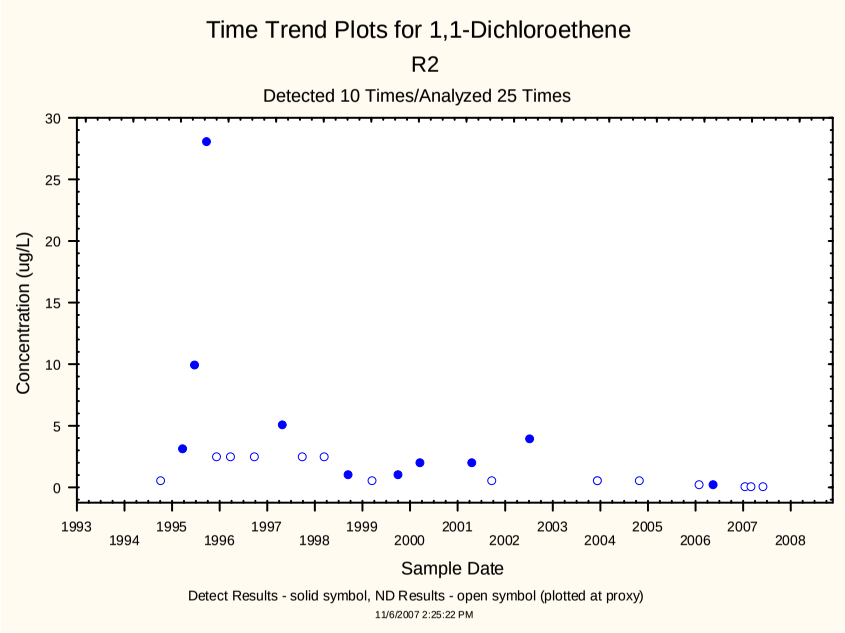

Time Trend Plots for Xylenes (total)
R1
Detected 22 Times/Analyzed 22 Times
Concentration (ug/L)
16000
14000
12000
10000
8000
6000
4000
2000
0
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:19 PM

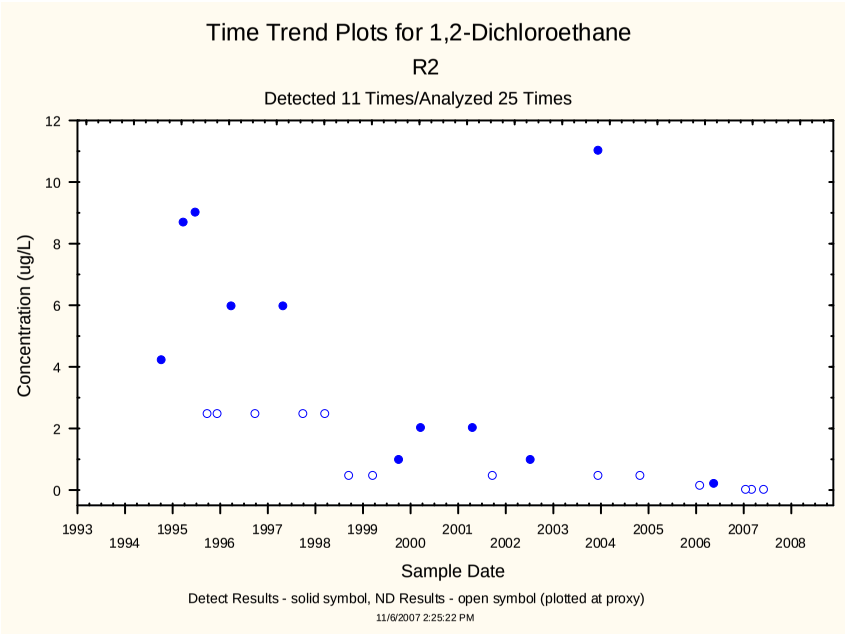

Time Trend Plots for cis-1,2-Dichloroethene
R1
Detected 22 Times/Analyzed 22 Times
Concentration (ug/L)
12000
10000
8000
6000
4000
2000
0
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:19 PM

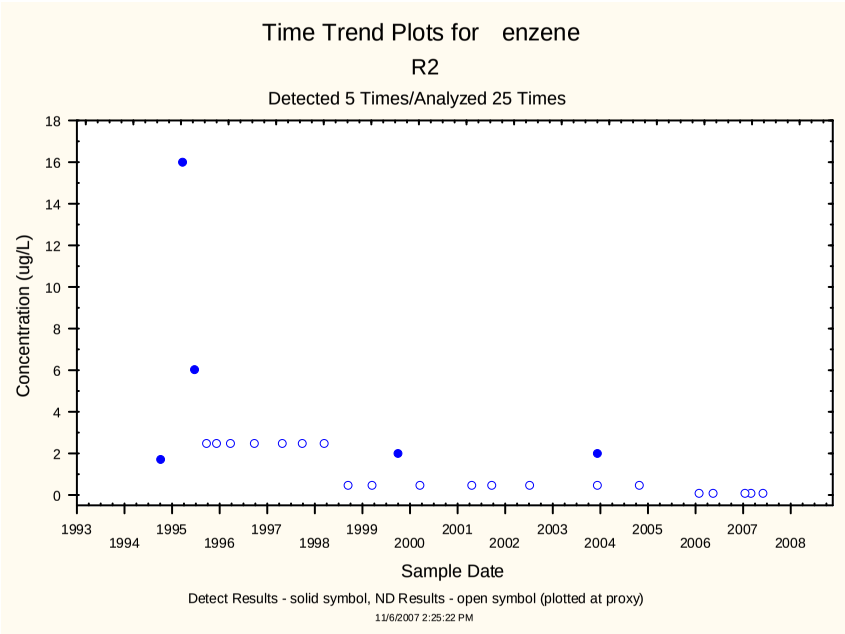

Time Trend Plots for n- utylbenzene
R1
Detected 6 Times/Analyzed 14 Times
Concentration (ug/L)
0
2
4
6
8
10
12
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:19 PM

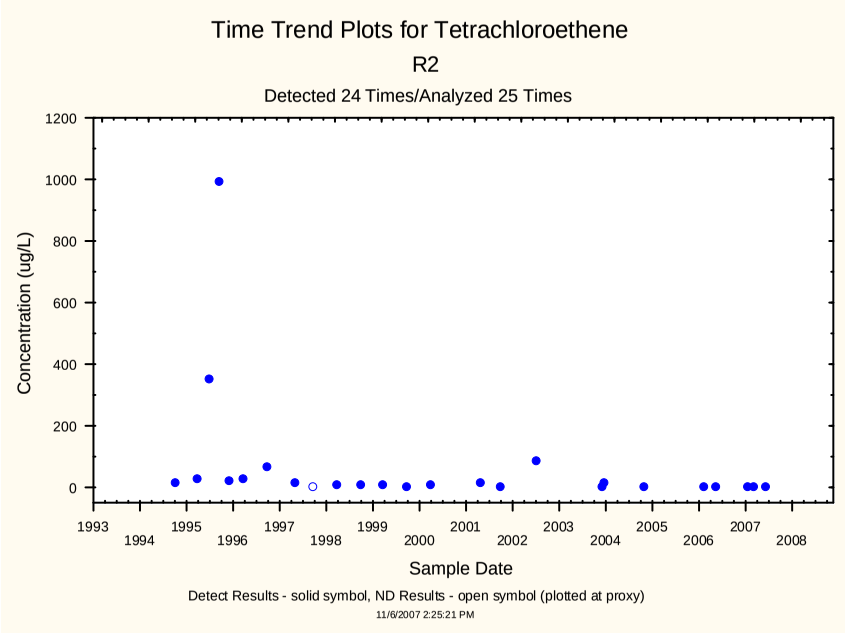

Time Trend Plots for trans-1,2-Dichloroethene
R1
Detected 7 Times/Analyzed 22 Times
Concentration (ug/L)
0
200
400
600
800
1000
1200
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:19 PM

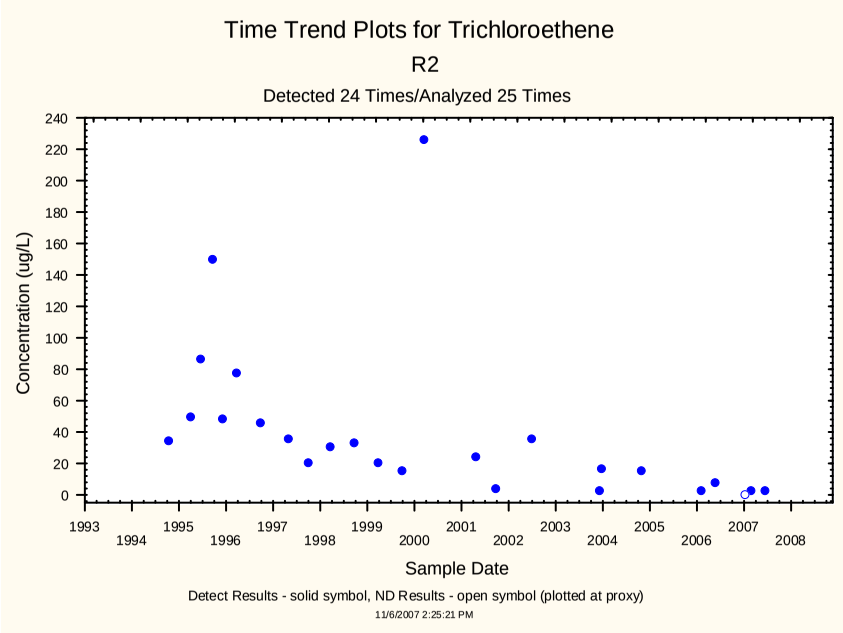

Time Trend Plots for 1,1-Dichloroethane
R2
Detected 25 Times/Analyzed 25 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:22 PM

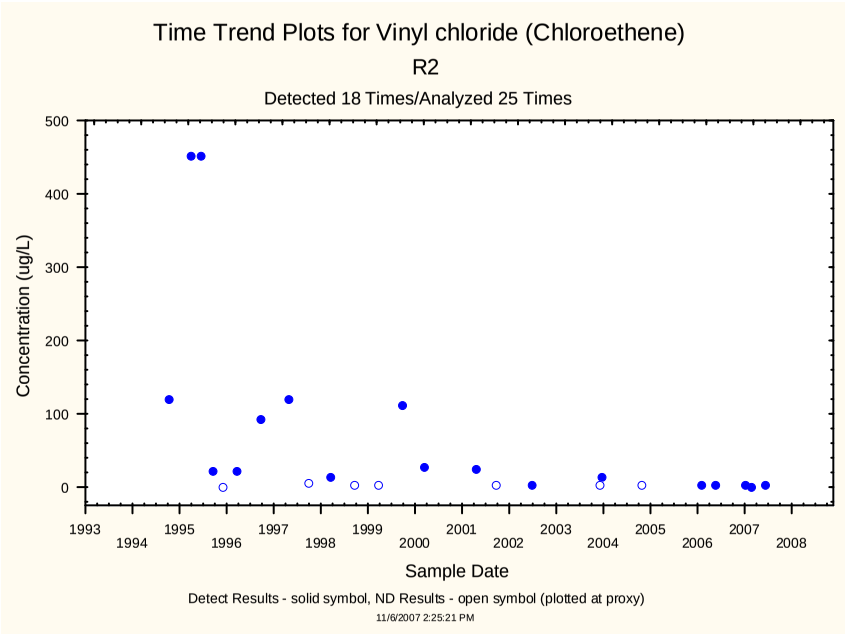

Time Trend Plots for 1,1-Dichloroethene
R2
Detected 10 Times/Analyzed 25 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:22 PM

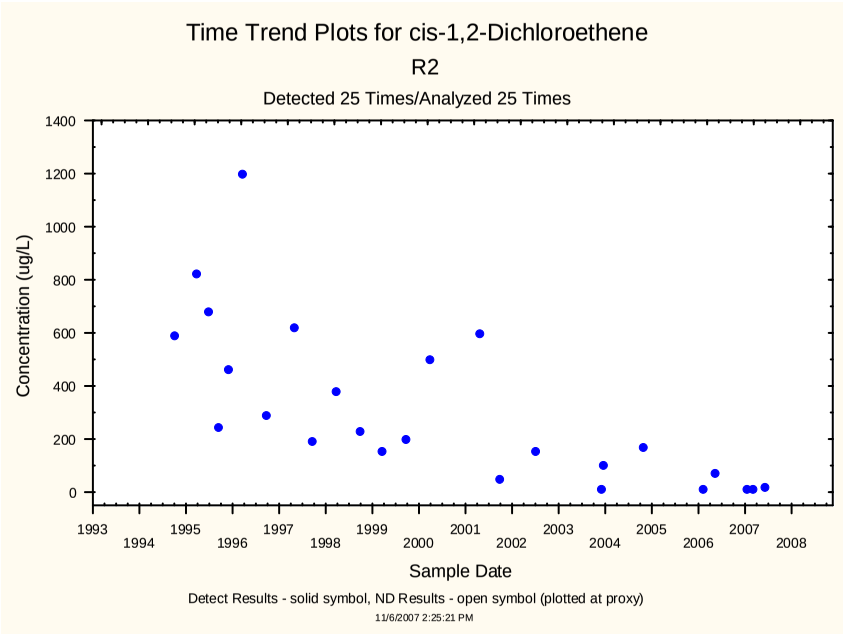

Time Trend Plots for 1,2-Dichloroethane
R2
Detected 11 Times/Analyzed 25 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:22 PM

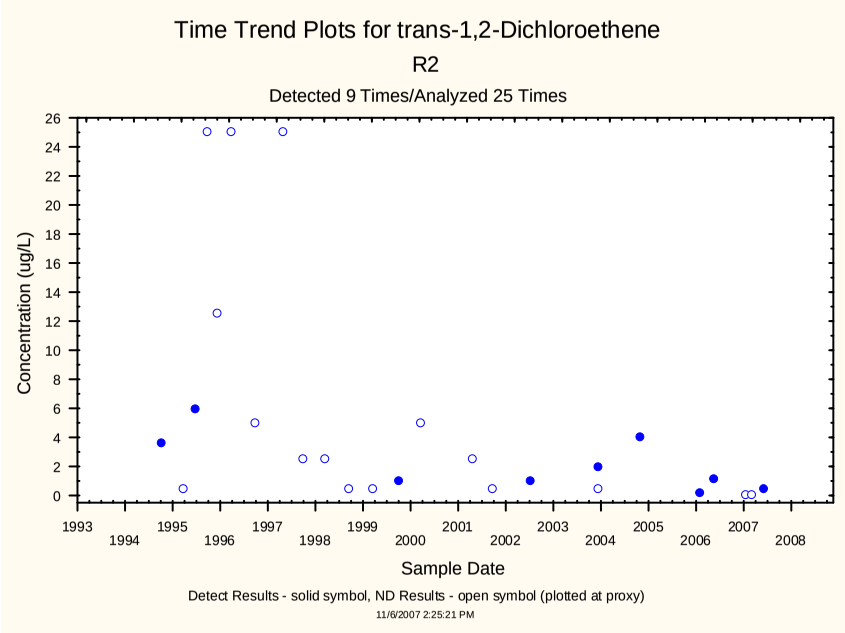

Time Trend Plots for enzene
R2
Detected 5 Times/Analyzed 25 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:22 PM

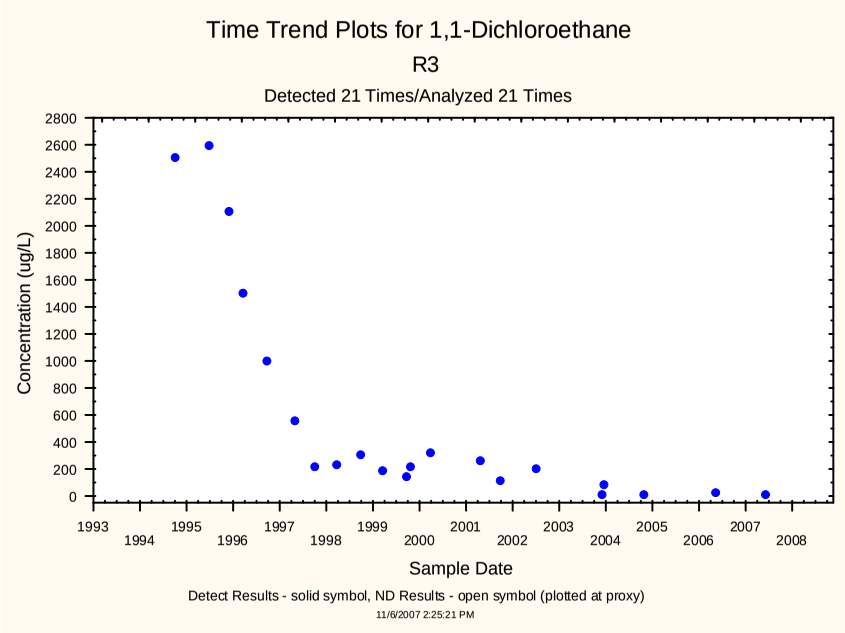

Time Trend Plots for Tetrachloroethene
R2
Detected 24 Times/Analyzed 25 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:21 PM

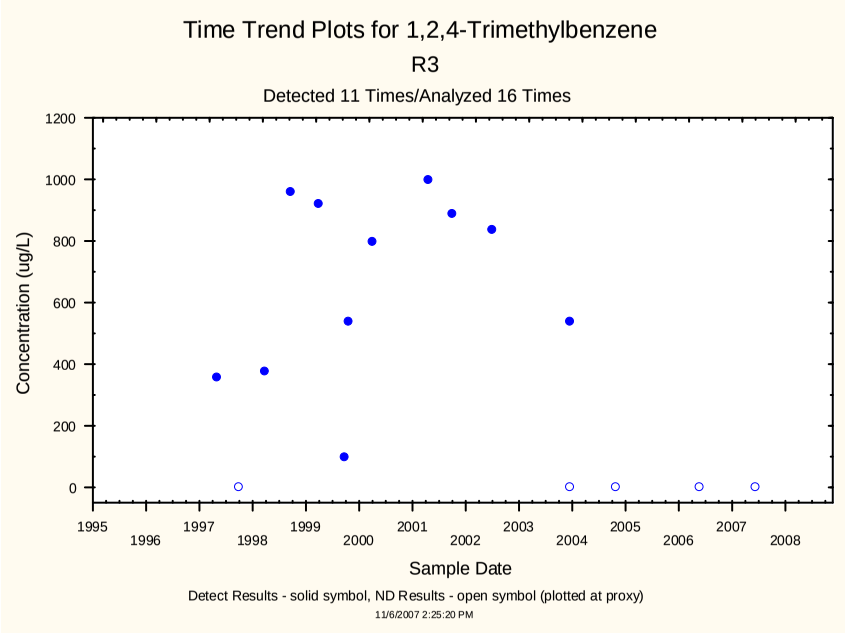

Time Trend Plots for Trichloroethene
R2
Detected 24 Times/Analyzed 25 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:21 PM

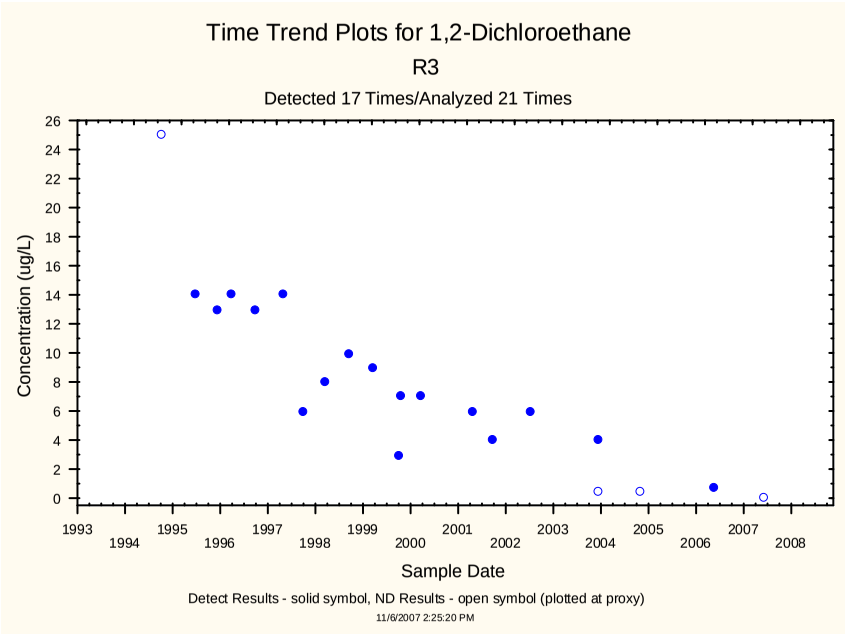

Time Trend Plots for Vinyl chloride (Chloroethene)
R2
Detected 18 Times/Analyzed 25 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:21 PM

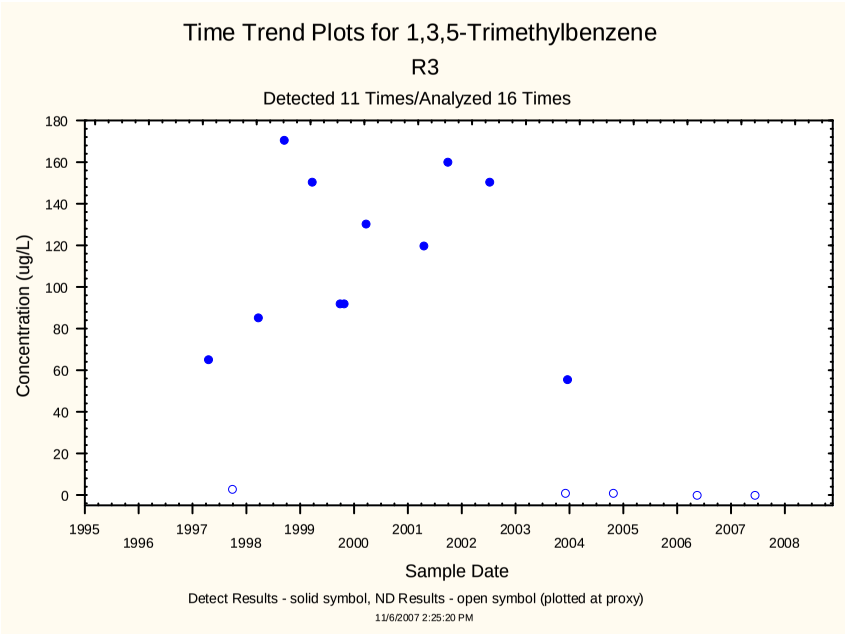

Time Trend Plots for cis-1,2-Dichloroethene
R2
Detected 25 Times/Analyzed 25 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:21 PM

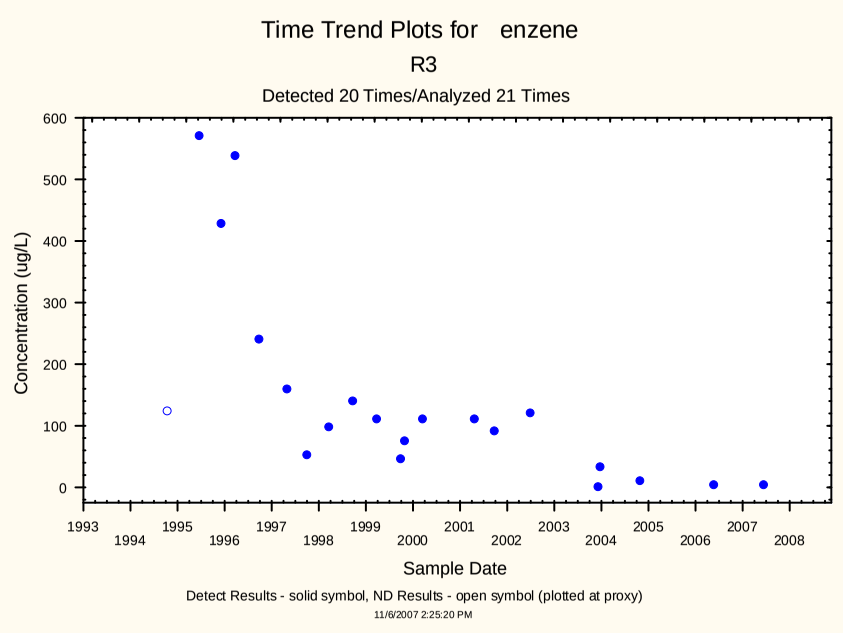

Time Trend Plots for trans-1,2-Dichloroethene
R2
Detected 9 Times/Analyzed 25 Times
Concentration (ug/L)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:21 PM


Time Trend Plots for 1,1-Dichloroethane
R3
Detected 21 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:21 PM


Time Trend Plots for 1,2,4-Trimethylbenzene
R3
Detected 11 Times/Analyzed 16 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:20 PM


Time Trend Plots for 1,2-Dichloroethane
R3
Detected 17 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:20 PM


Time Trend Plots for 1,3,5-Trimethylbenzene
R3
Detected 11 Times/Analyzed 16 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:20 PM


Time Trend Plots for enzene
R3
Detected 20 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
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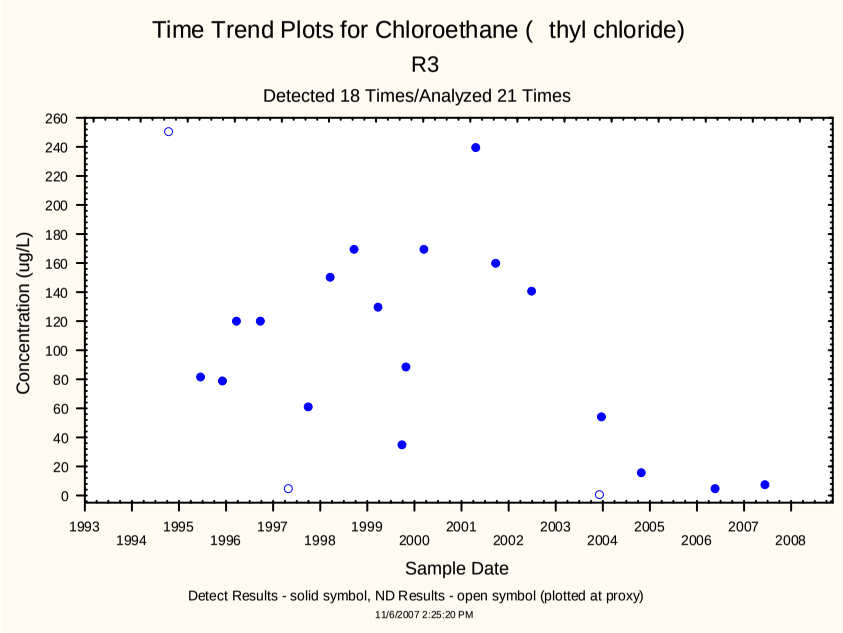
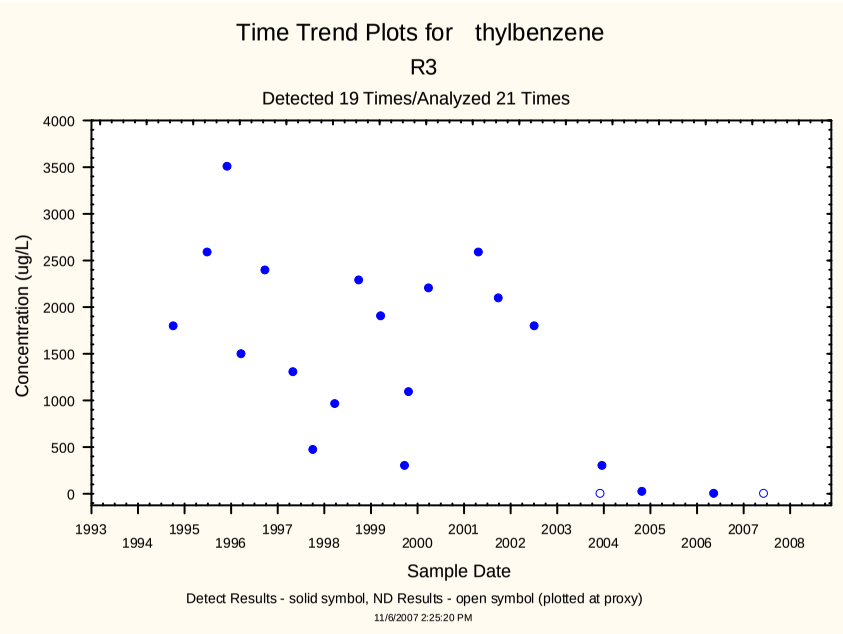
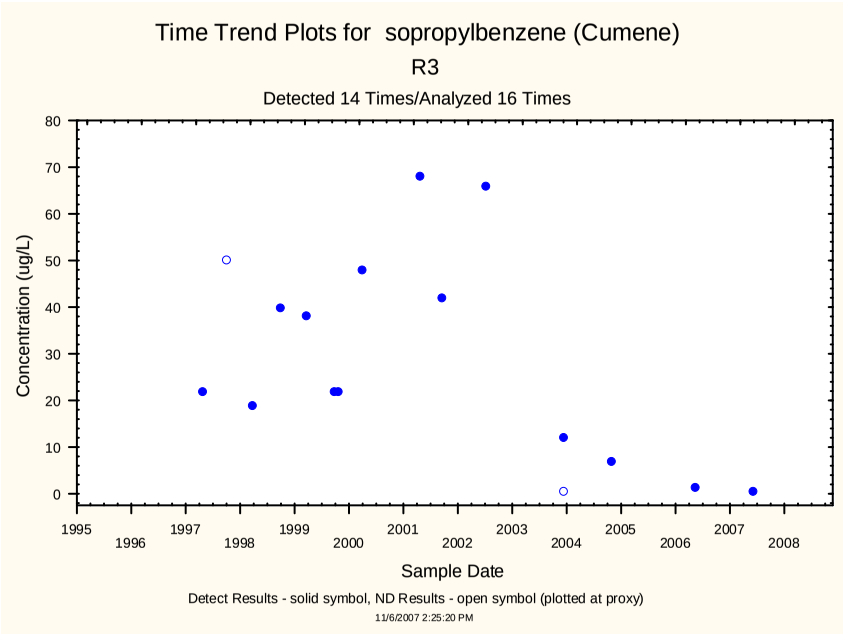
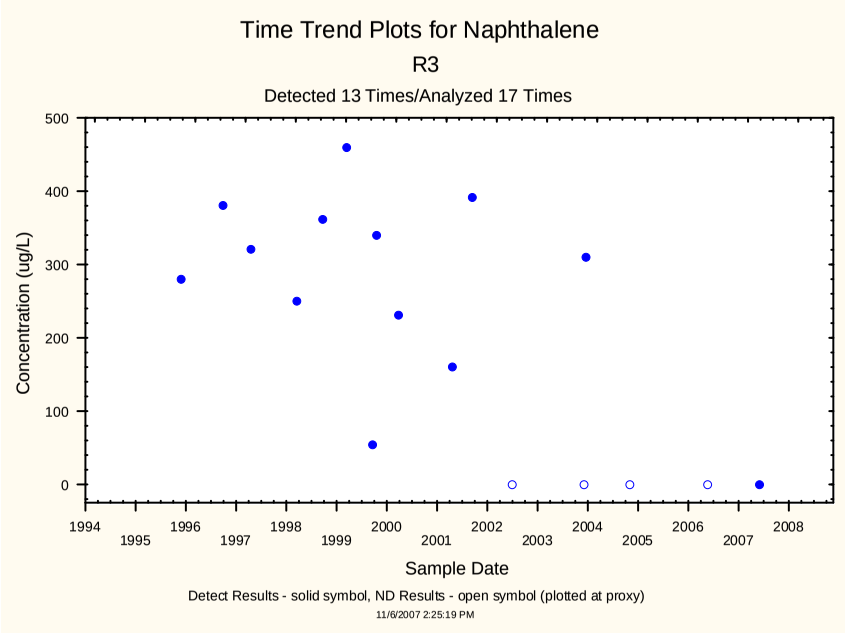
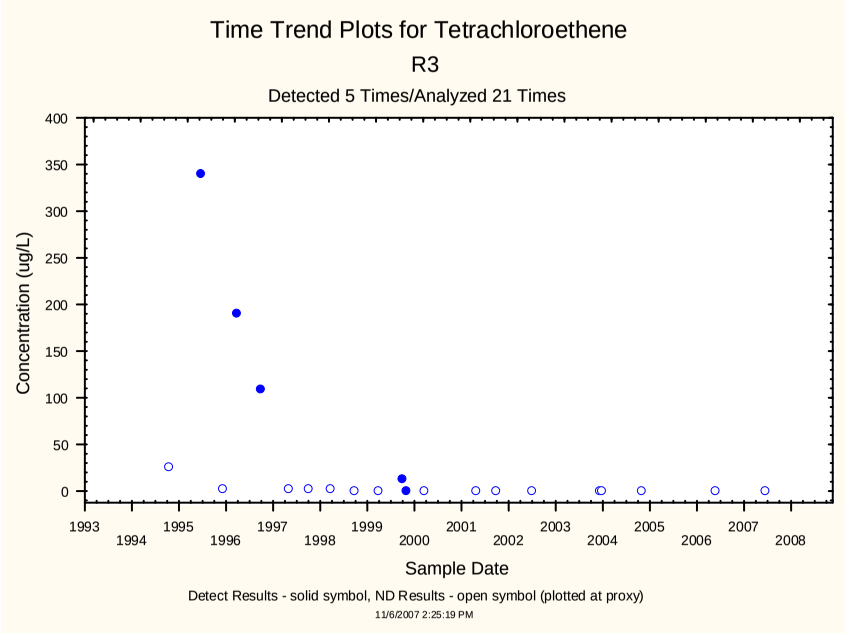
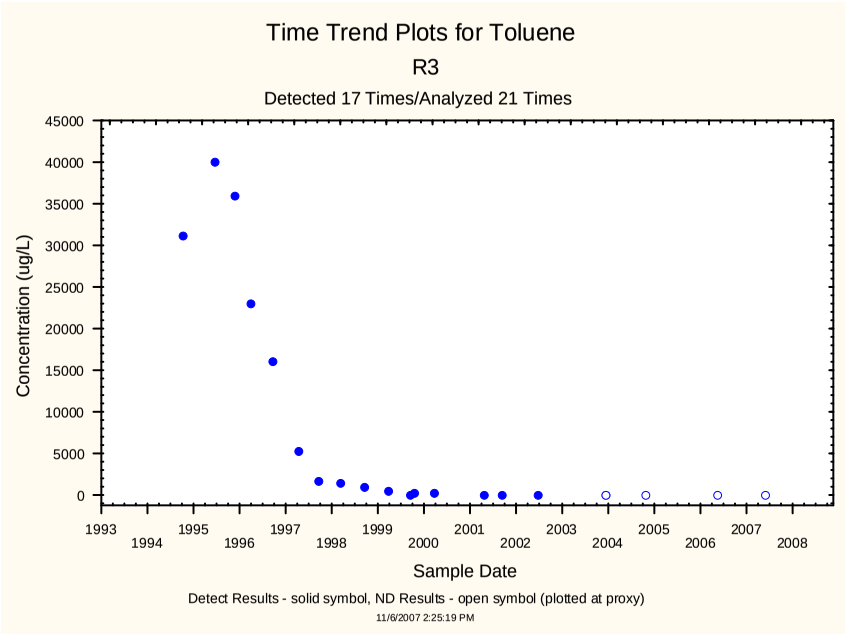

Time Trend Plots for Chloroethane (thyl chloride)
R3
Detected 18 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:20 PM

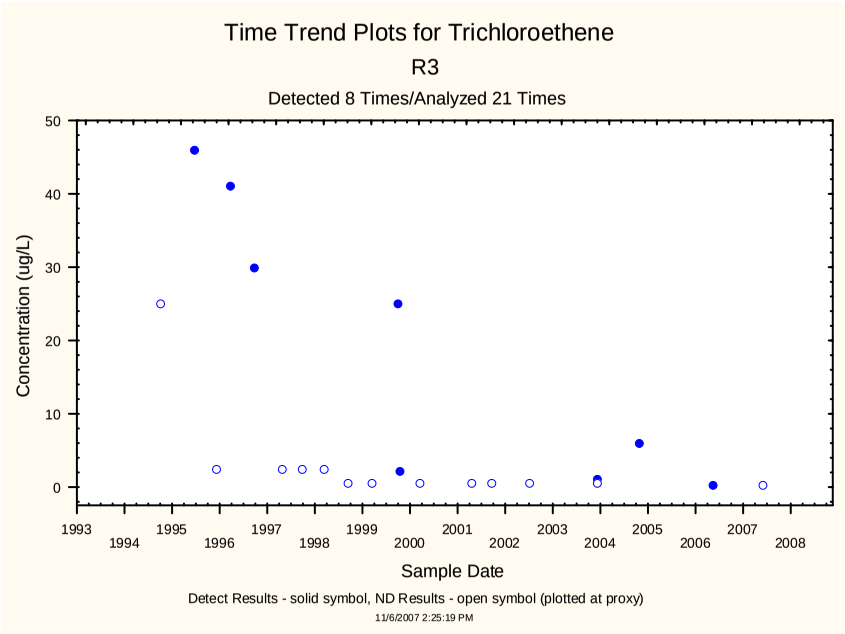

Time Trend Plots for thylbenzene
R3
Detected 19 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:20 PM

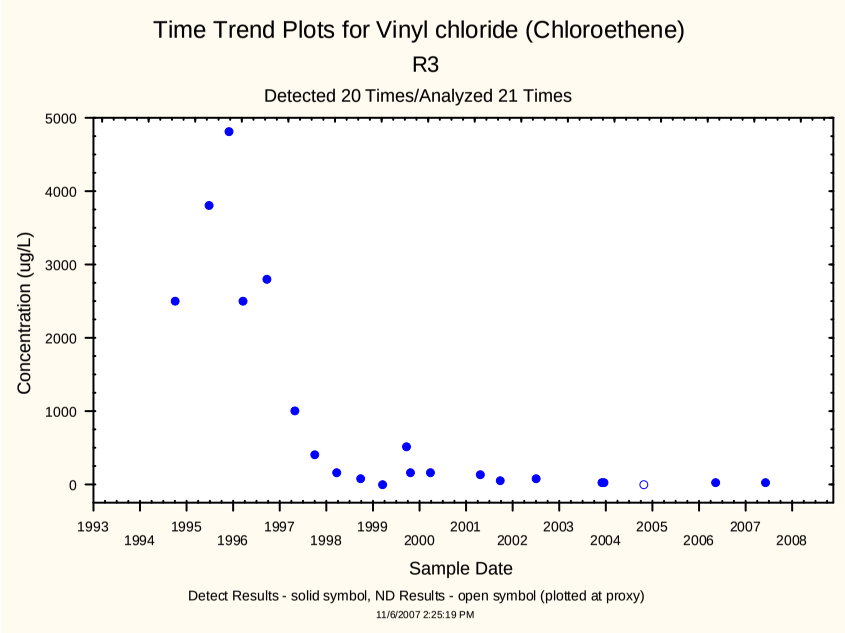

Time Trend Plots for sopropylbenzene (Cumene)
R3
Detected 14 Times/Analyzed 16 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:20 PM

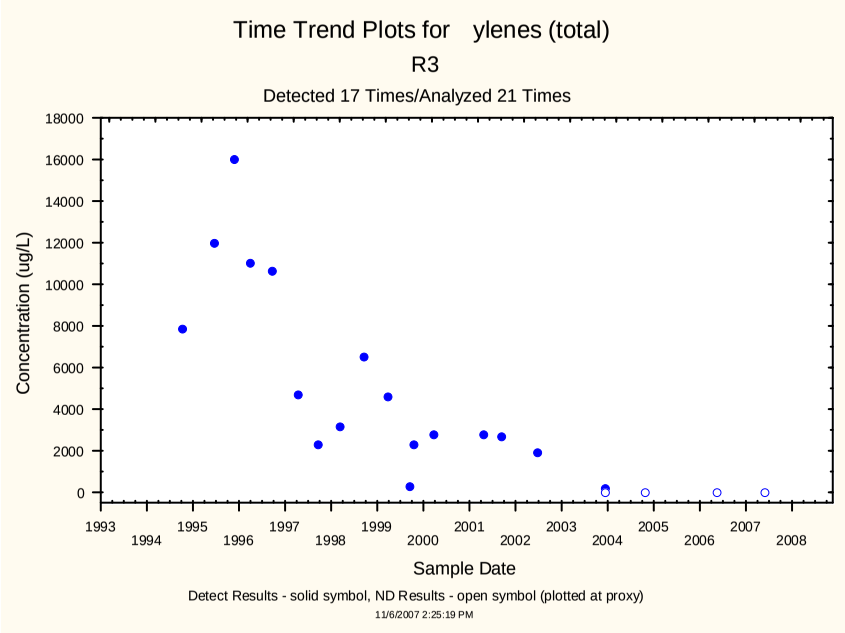

Time Trend Plots for Naphthalene
R3
Detected 13 Times/Analyzed 17 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:19 PM

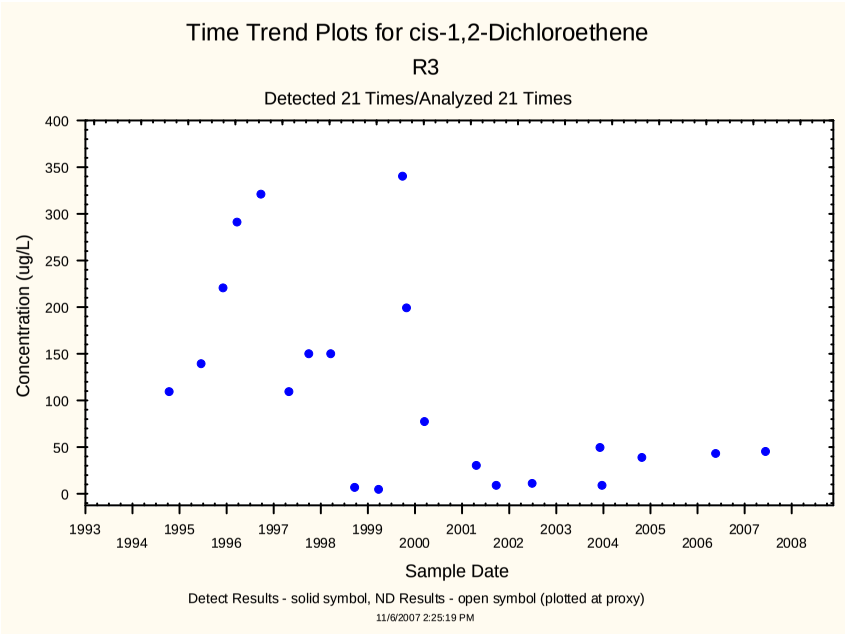

Time Trend Plots for Tetrachloroethene
R3
Detected 5 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:19 PM

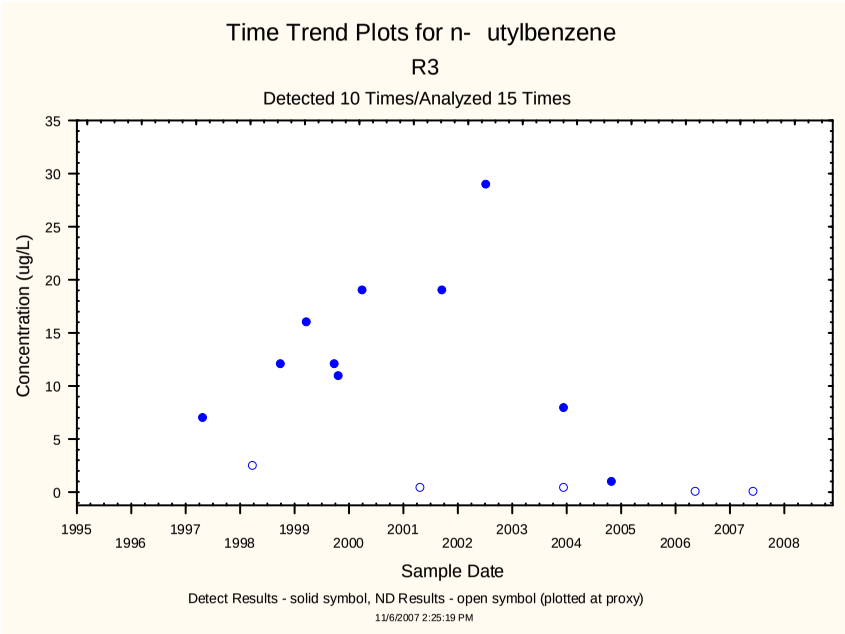

Time Trend Plots for Toluene
R3
Detected 17 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:19 PM

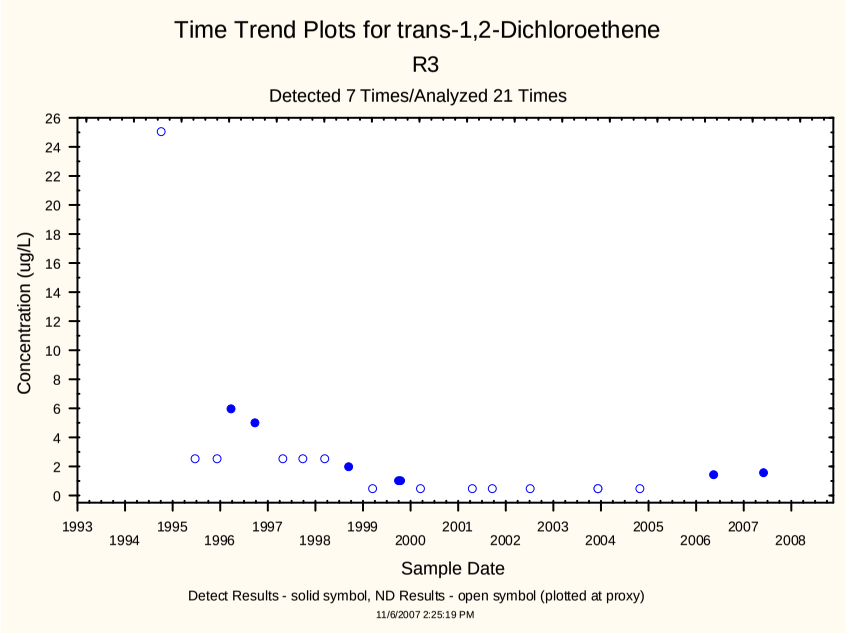

Time Trend Plots for Trichloroethene
R3
Detected 8 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:19 PM

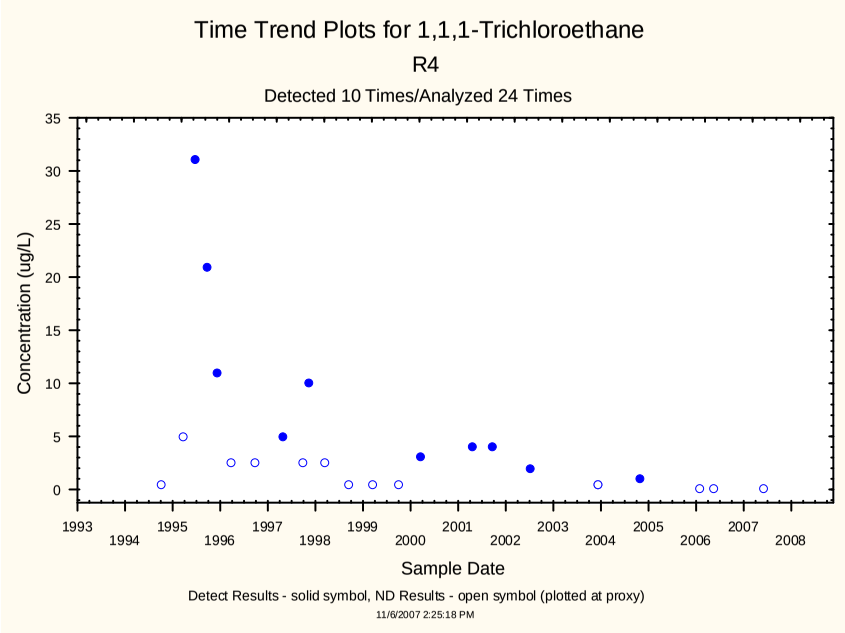

Time Trend Plots for Vinyl chloride (Chloroethene)
R3
Detected 20 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:19 PM

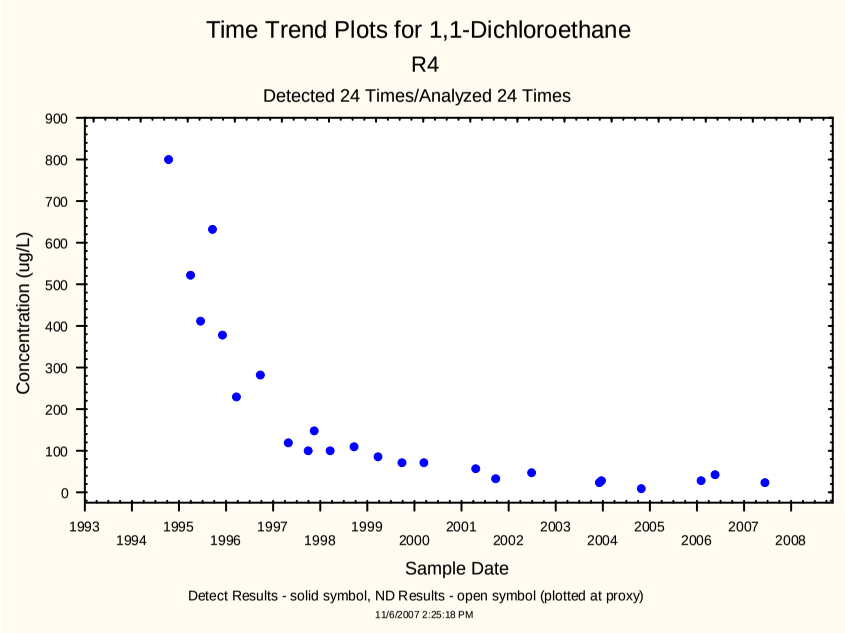

Time Trend Plots for ylenes (total)
R3
Detected 17 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:19 PM

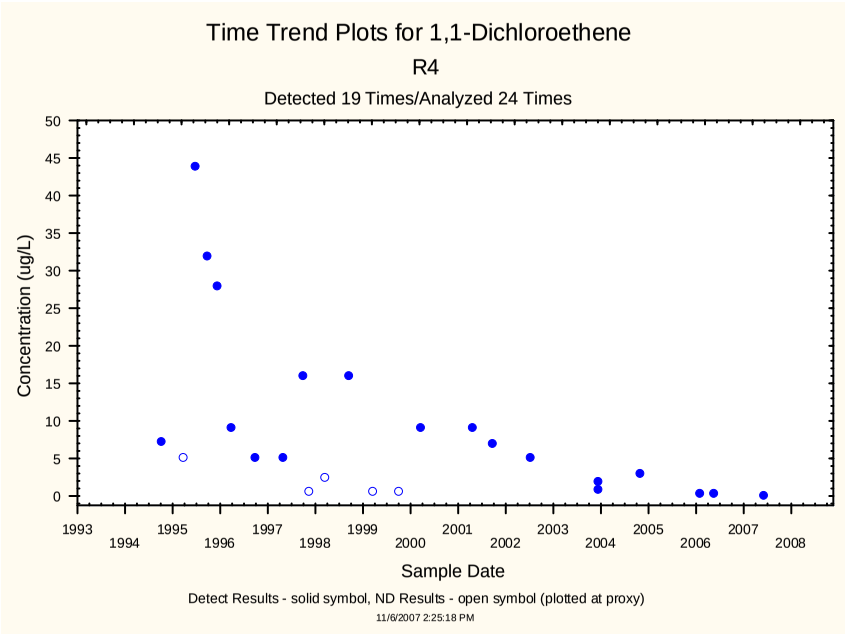

Time Trend Plots for cis-1,2-Dichloroethene
R3
Detected 21 Times/Analyzed 21 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:19 PM

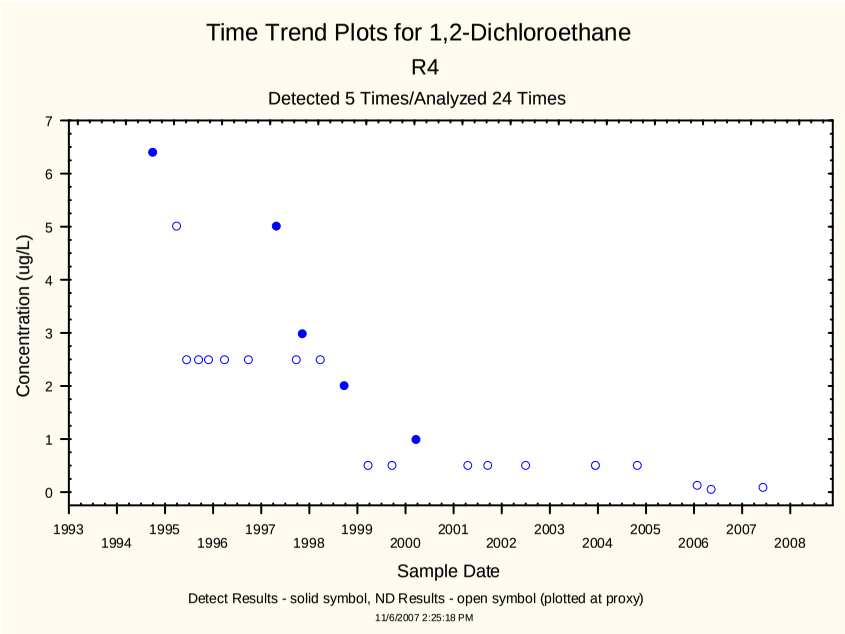

Time Trend Plots for n- utylbenzene
R3
Detected 10 Times/Analyzed 15 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:19 PM

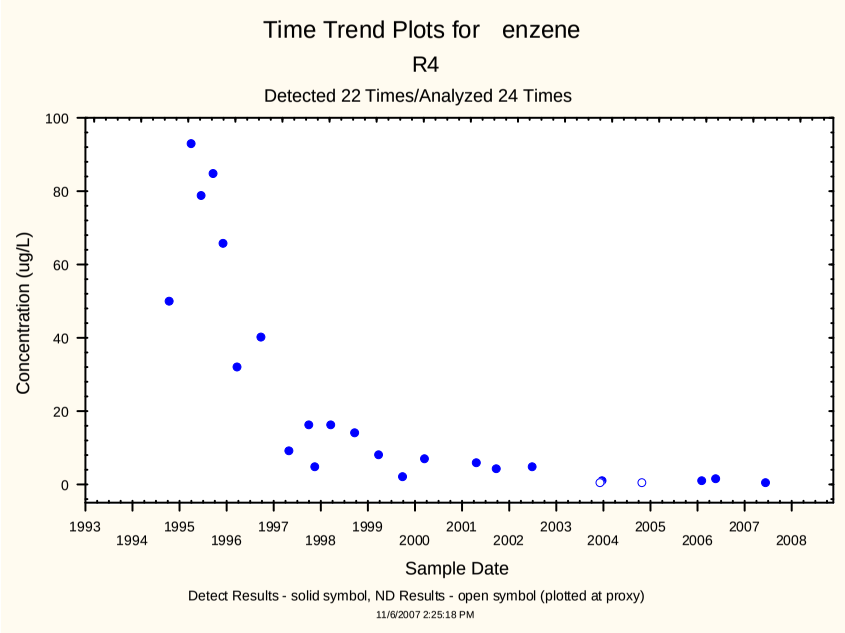

Time Trend Plots for trans-1,2-Dichloroethene
R3
Detected 7 Times/Analyzed 21 Times
Concentration (ug/L)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:19 PM

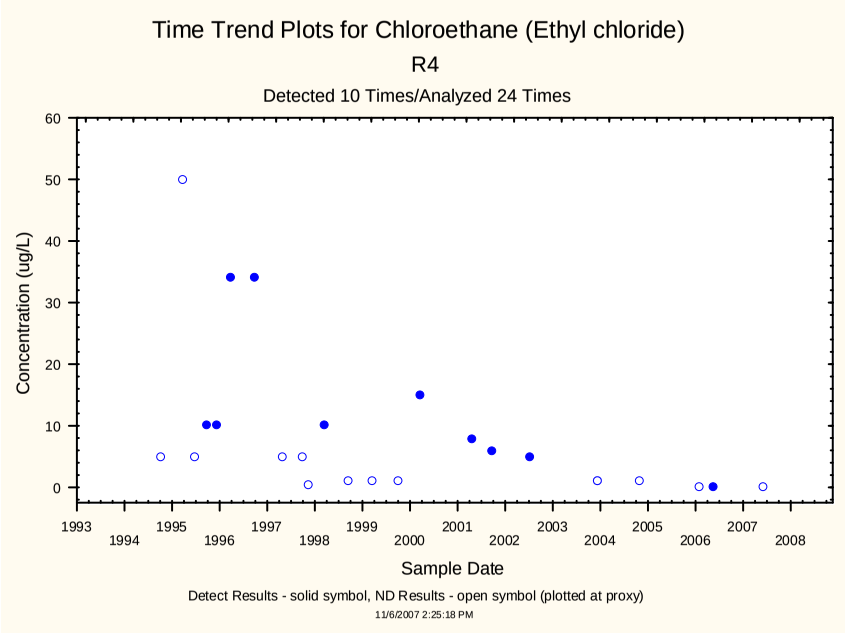

Time Trend Plots for 1,1,1-Trichloroethane
R4
Detected 10 Times/Analyzed 24 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:18 PM

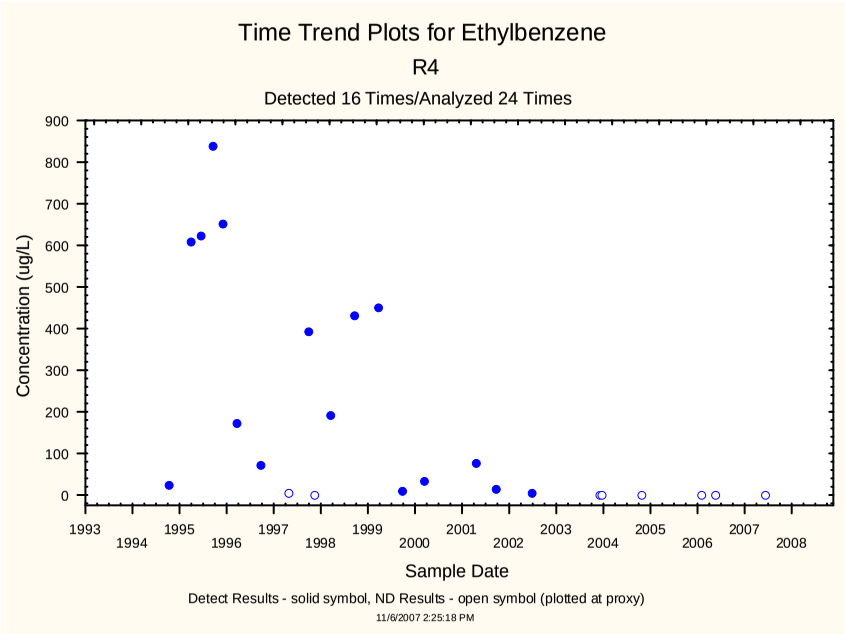

Time Trend Plots for 1,1-Dichloroethane
R4
Detected 24 Times/Analyzed 24 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:18 PM

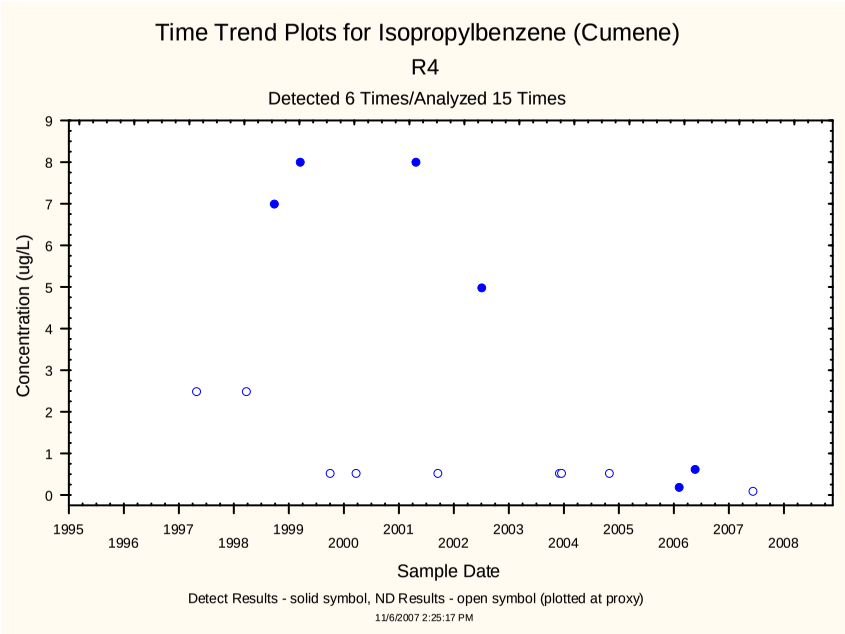

Time Trend Plots for 1,1-Dichloroethene
R4
Detected 19 Times/Analyzed 24 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:18 PM

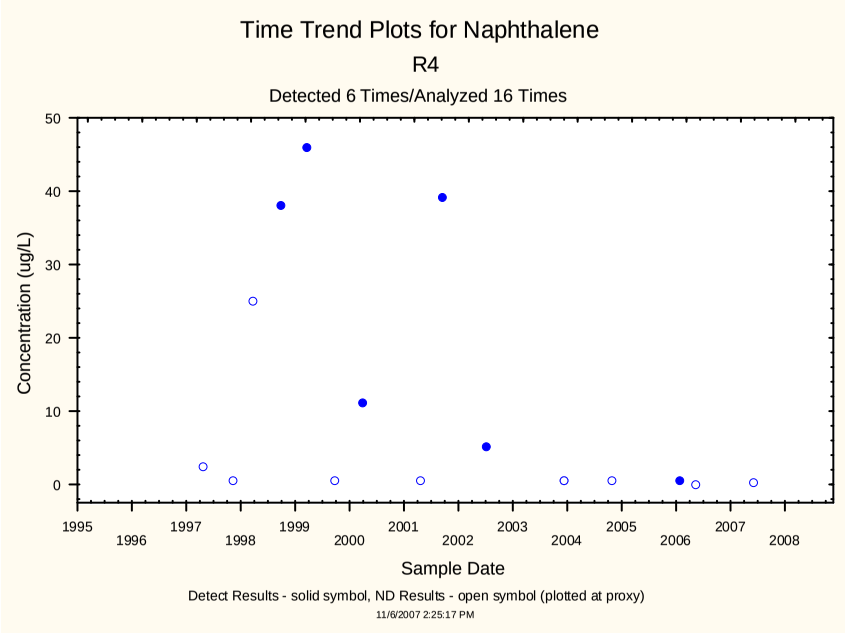

Time Trend Plots for 1,2-Dichloroethane
R4
Detected 5 Times/Analyzed 24 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:18 PM

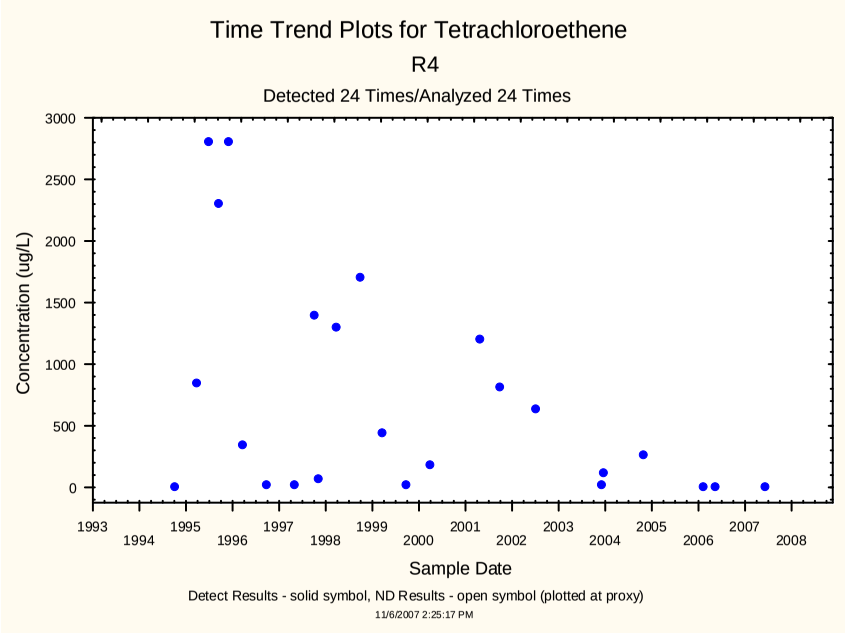

Time Trend Plots for enzene
R4
Detected 22 Times/Analyzed 24 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:18 PM

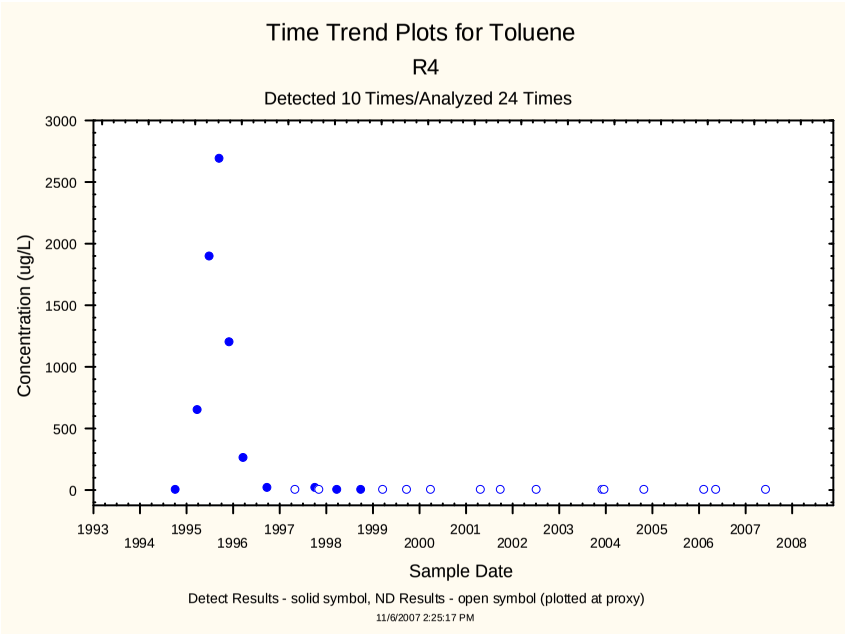

Time Trend Plots for Chloroethane (Ethyl chloride)
R4
Detected 10 Times/Analyzed 24 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:18 PM

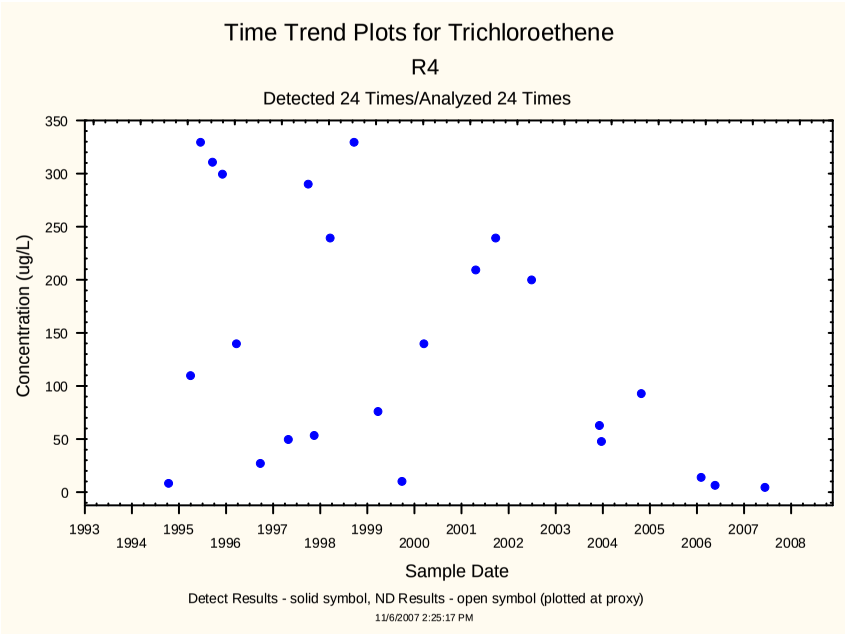

Time Trend Plots for Ethylbenzene
R4
Detected 16 Times/Analyzed 24 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:18 PM

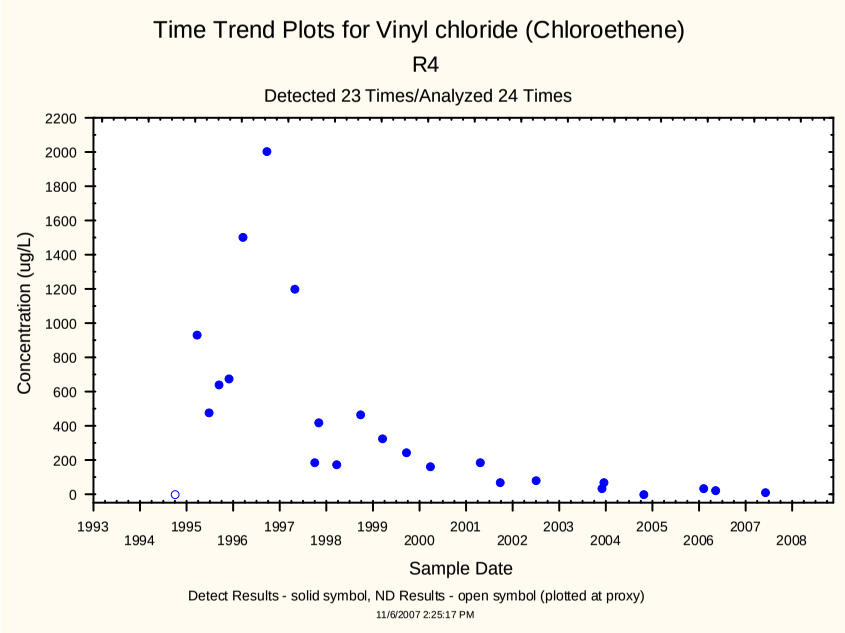

Time Trend Plots for Isopropylbenzene (Cumene)
R4
Detected 6 Times/Analyzed 15 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:17 PM

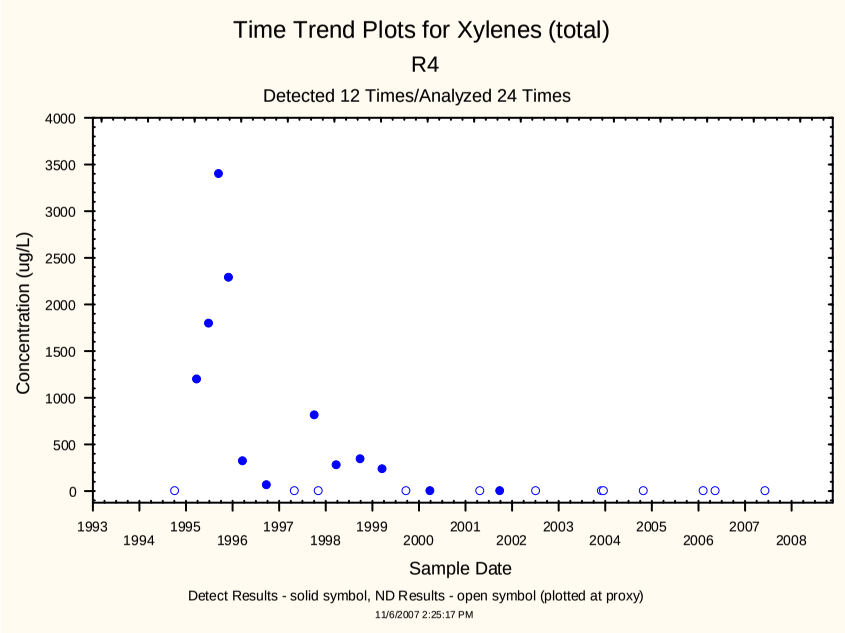

Time Trend Plots for Naphthalene
R4
Detected 6 Times/Analyzed 16 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:17 PM

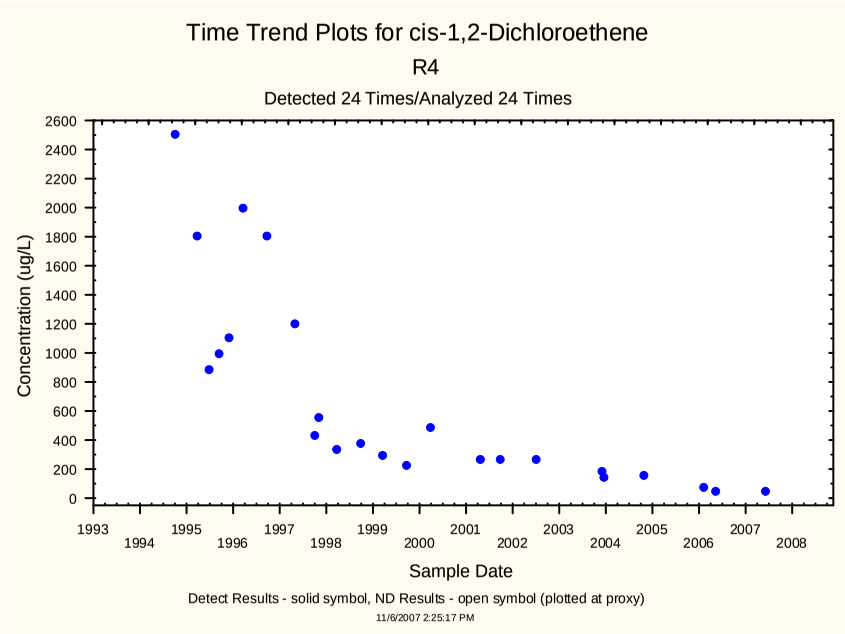

Time Trend Plots for Tetrachloroethene
R4
Detected 24 Times/Analyzed 24 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:17 PM

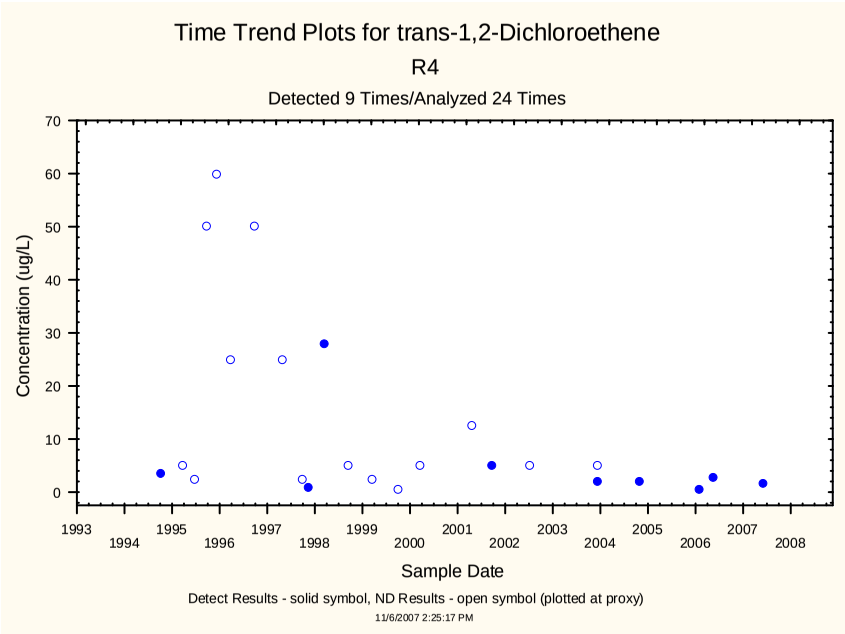

Time Trend Plots for Toluene
R4
Detected 10 Times/Analyzed 24 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:17 PM

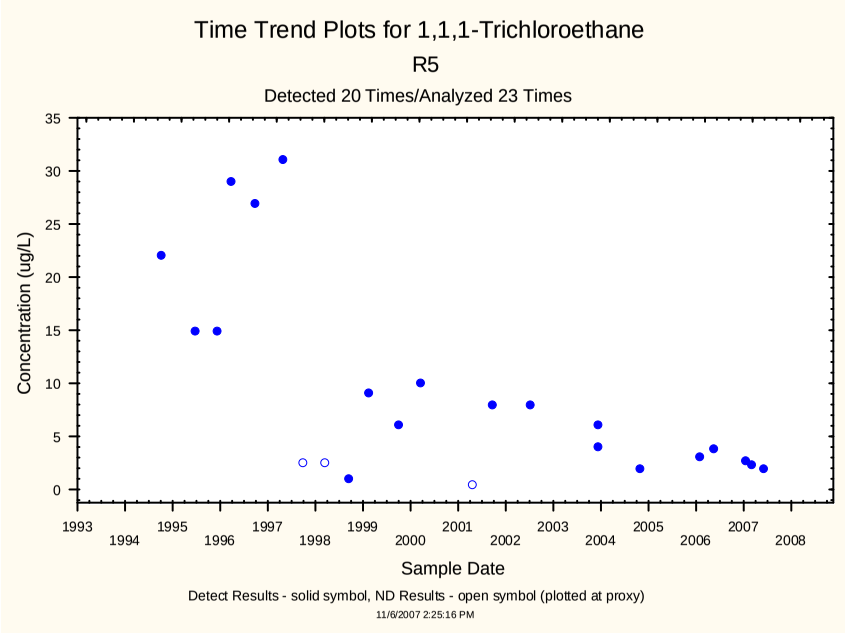

Time Trend Plots for Trichloroethene
R4
Detected 24 Times/Analyzed 24 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:17 PM

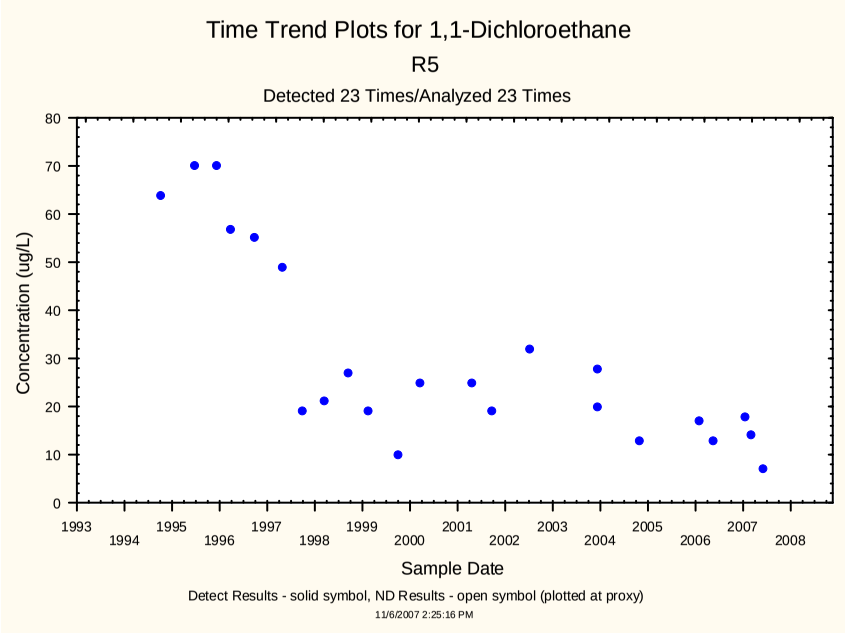

Time Trend Plots for Vinyl chloride (Chloroethene)
R4
Detected 23 Times/Analyzed 24 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:17 PM

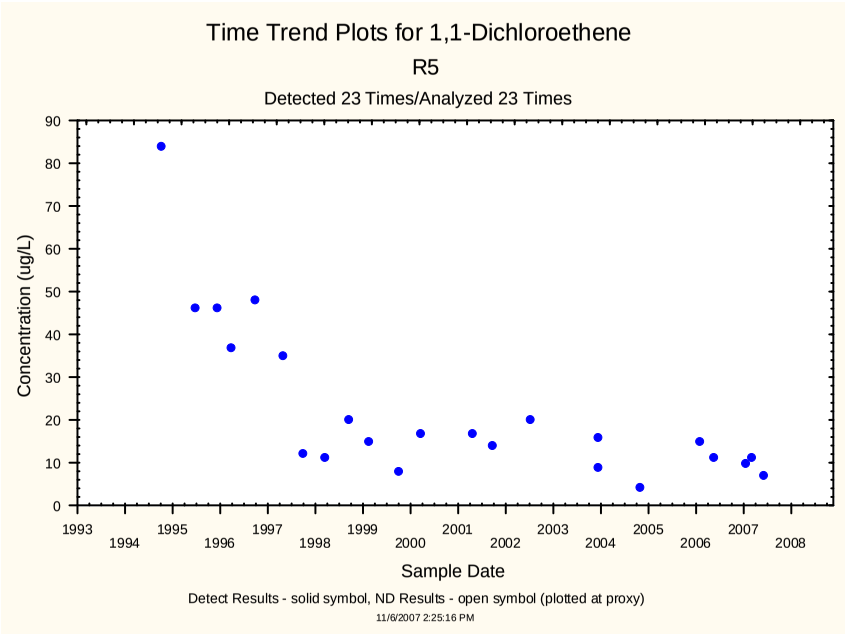

Time Trend Plots for Xylenes (total)
R4
Detected 12 Times/Analyzed 24 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:17 PM

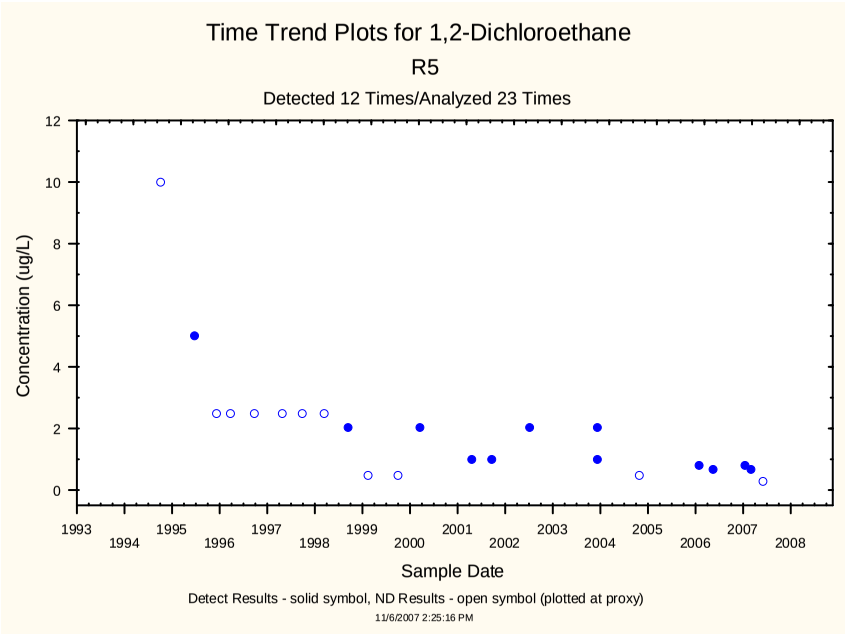

Time Trend Plots for cis-1,2-Dichloroethene
R4
Detected 24 Times/Analyzed 24 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:17 PM

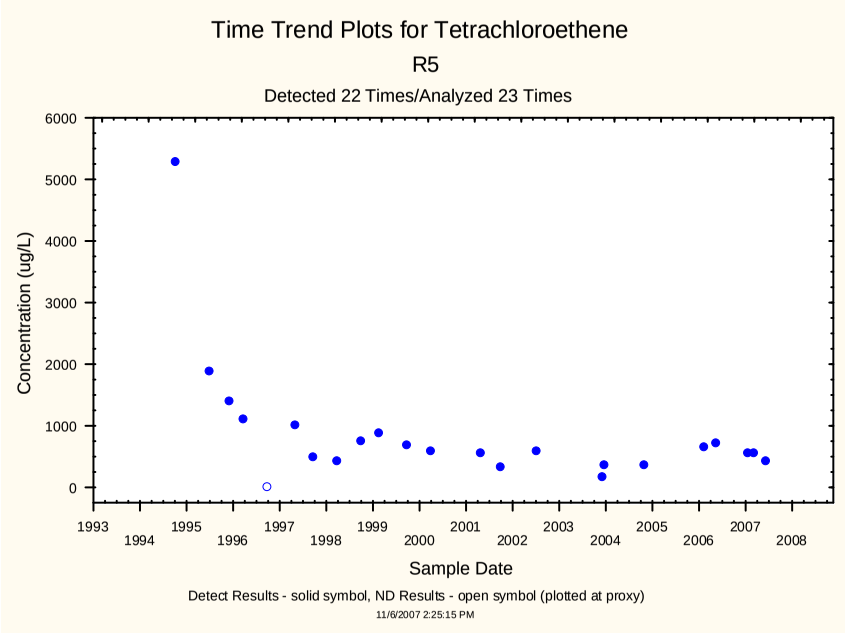

Time Trend Plots for trans-1,2-Dichloroethene
R4
Detected 9 Times/Analyzed 24 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:17 PM

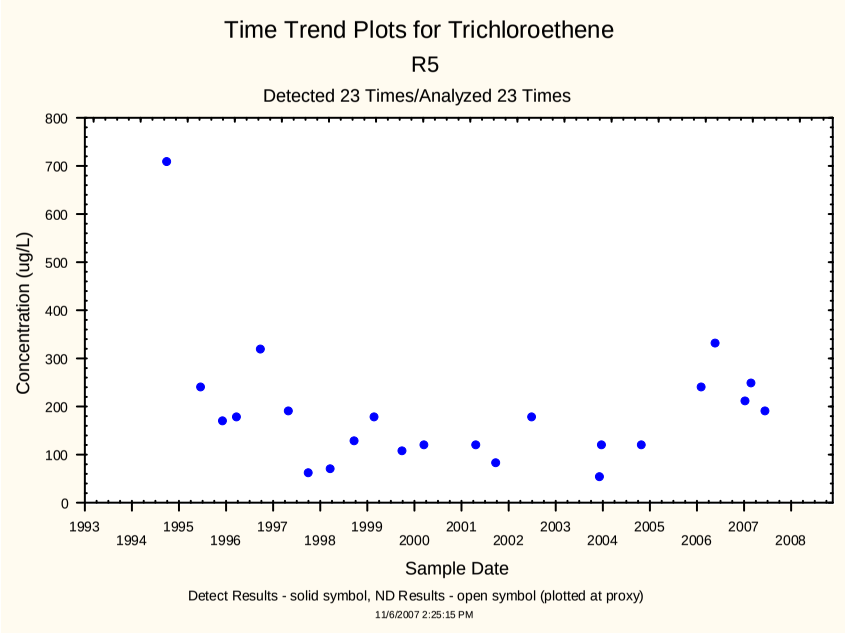

Time Trend Plots for 1,1,1-Trichloroethane
R5
Detected 20 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:16 PM

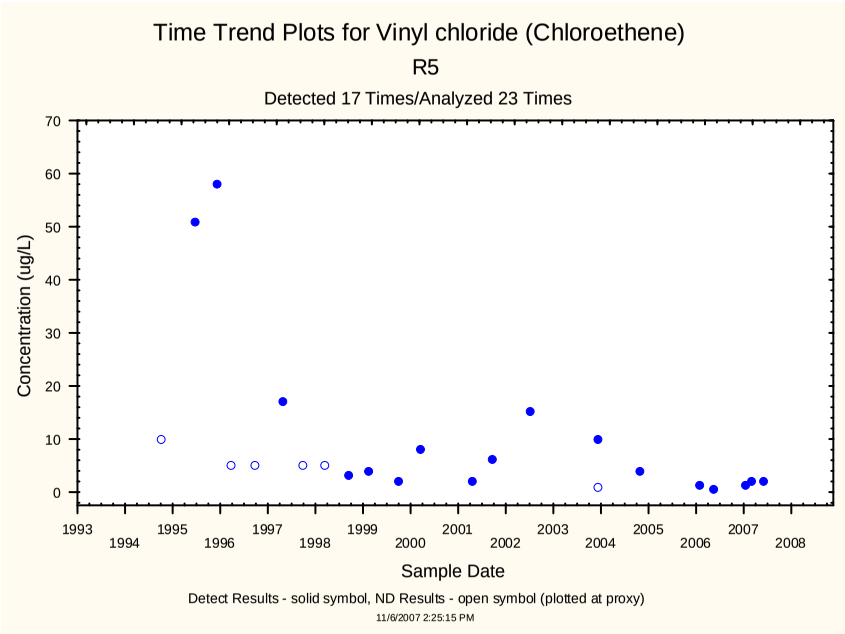

Time Trend Plots for 1,1-Dichloroethane
R5
Detected 23 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:16 PM

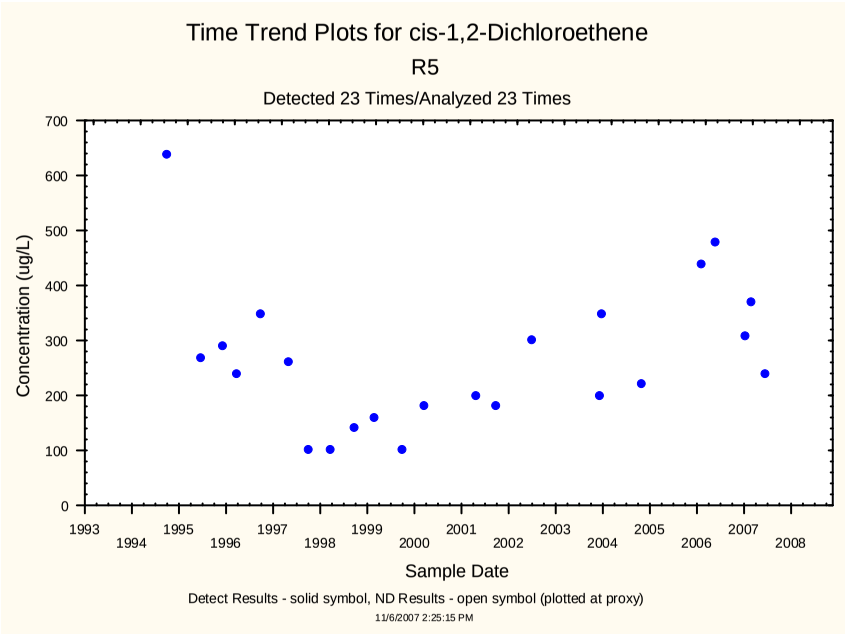

Time Trend Plots for 1,1-Dichloroethene
R5
Detected 23 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:16 PM

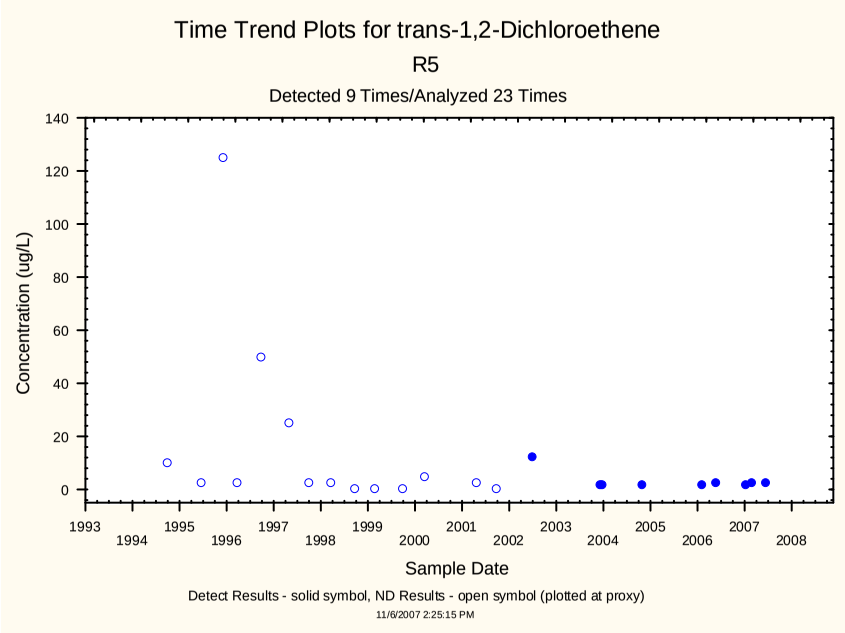

Time Trend Plots for 1,2-Dichloroethane
R5
Detected 12 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:16 PM

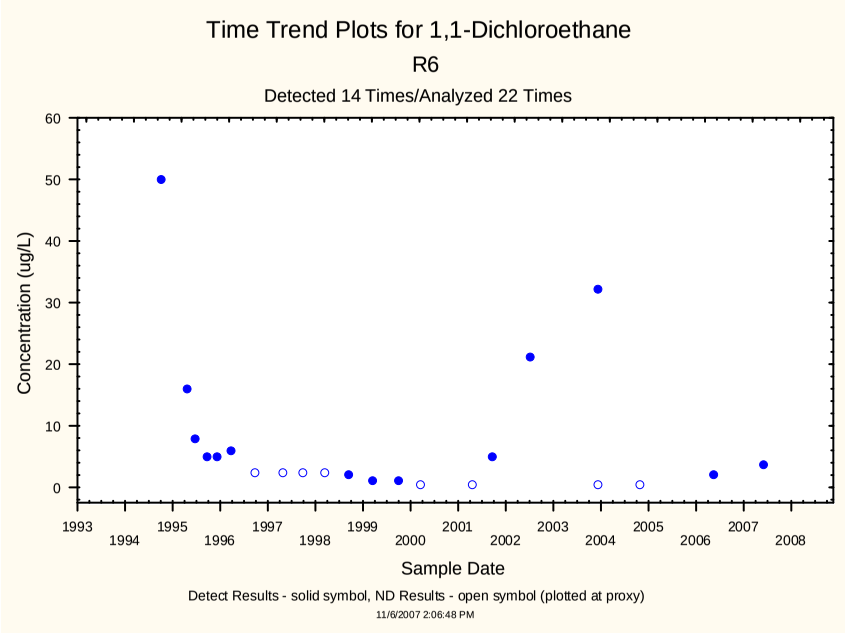

Time Trend Plots for Tetrachloroethene
R5
Detected 22 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:15 PM

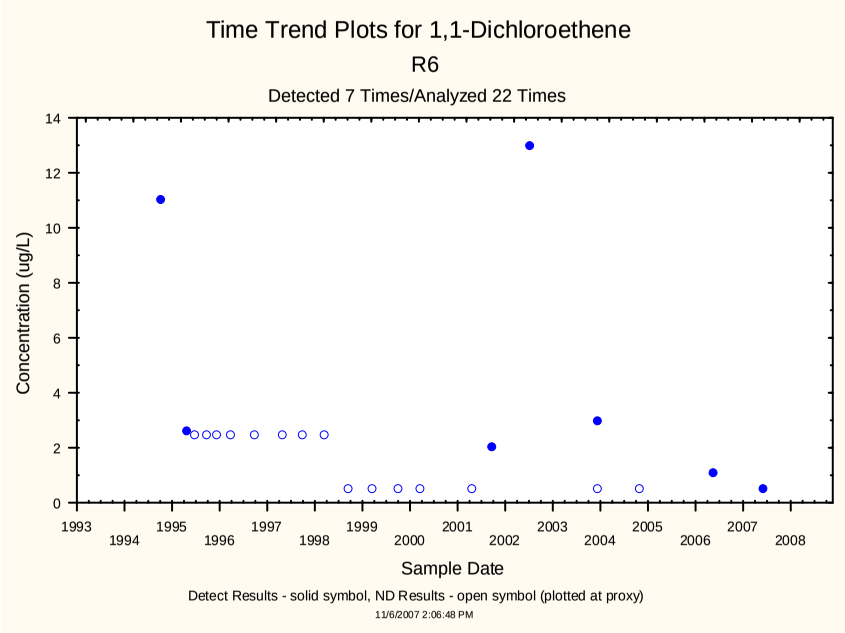

Time Trend Plots for Trichloroethene
R5
Detected 23 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:15 PM

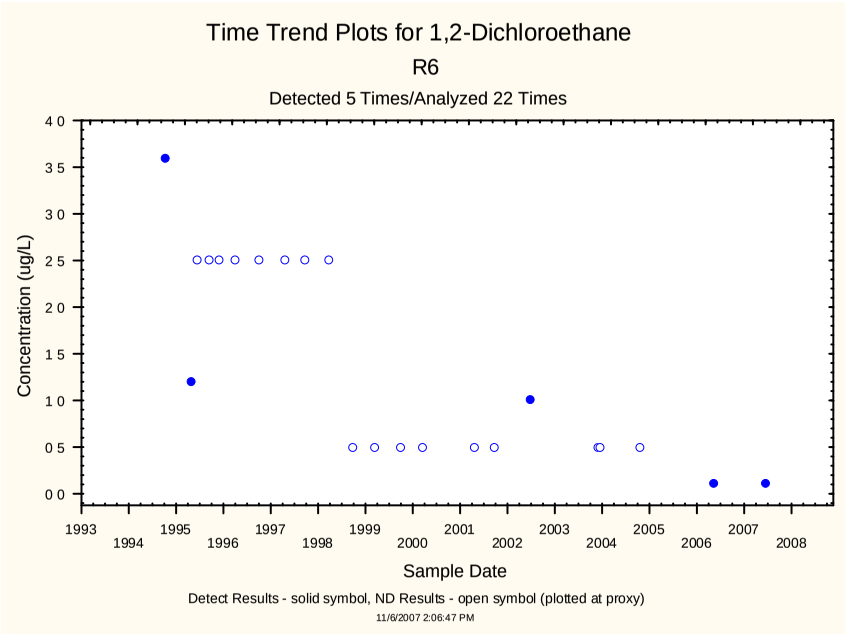

Time Trend Plots for Vinyl chloride (Chloroethene)
R5
Detected 17 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:15 PM

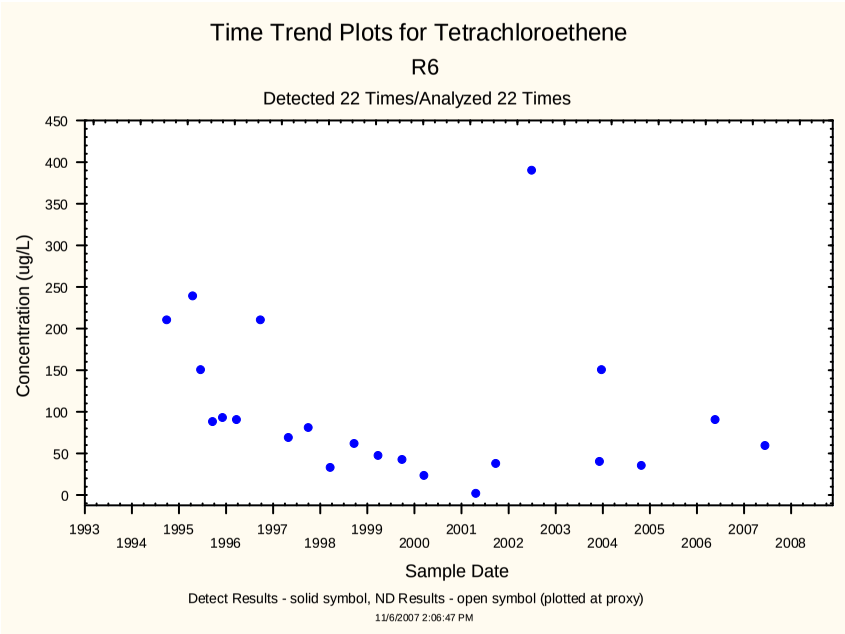

Time Trend Plots for cis-1,2-Dichloroethene
R5
Detected 23 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:15 PM

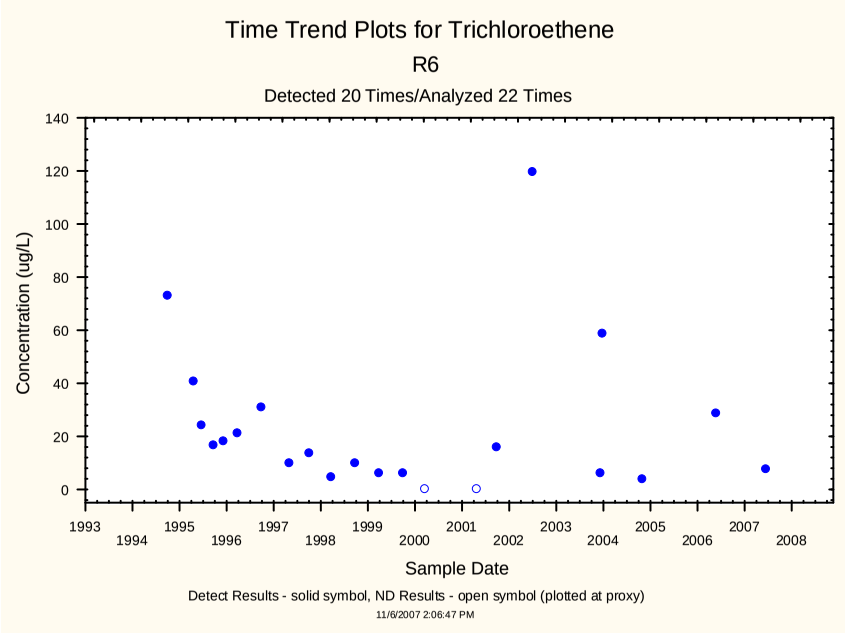

Time Trend Plots for trans-1,2-Dichloroethene
R5
Detected 9 Times/Analyzed 23 Times
Concentration (ug/L)
140
120
100
80
60
40
20
0
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:25:15 PM

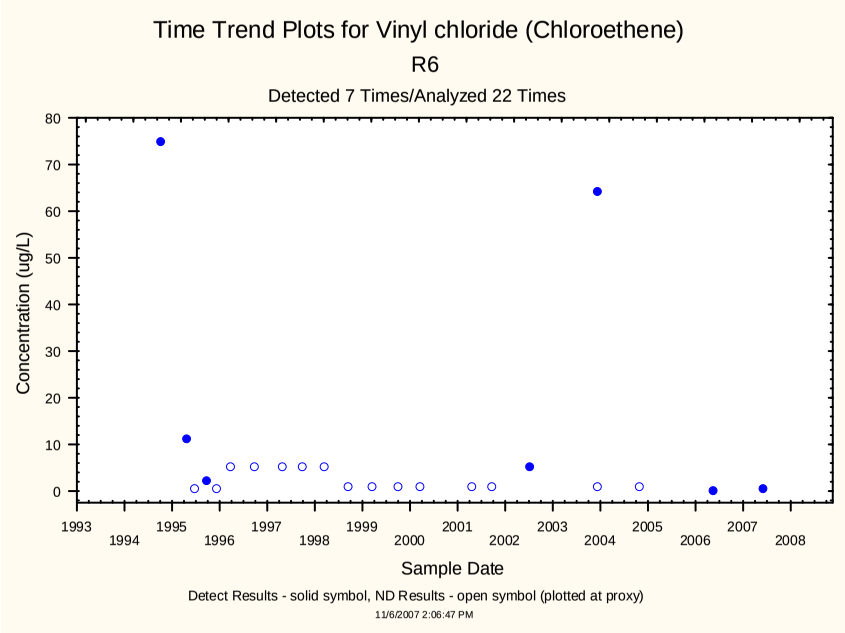

Time Trend Plots for 1,1-Dichloroethane
R6
Detected 14 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:48 PM

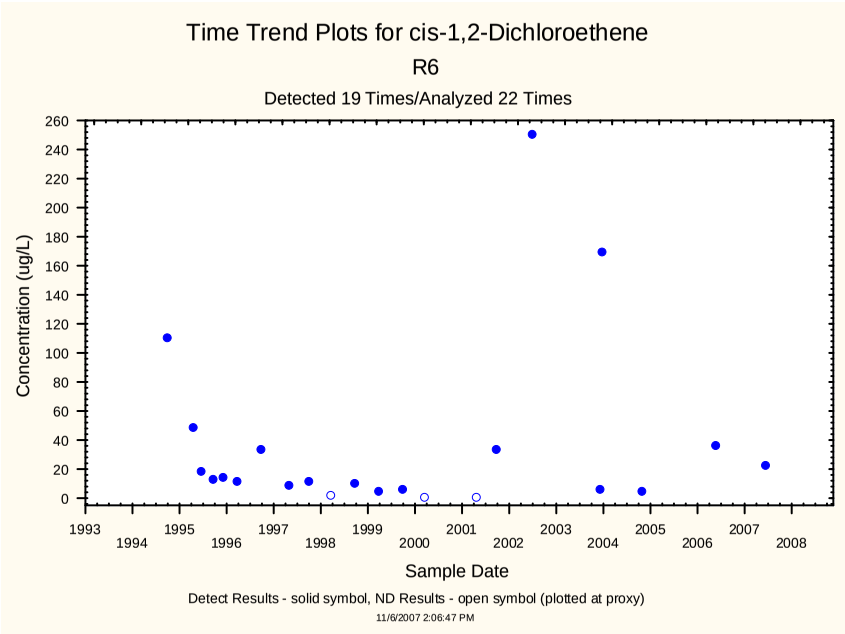

Time Trend Plots for 1,1-Dichloroethene
R6
Detected 7 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:48 PM

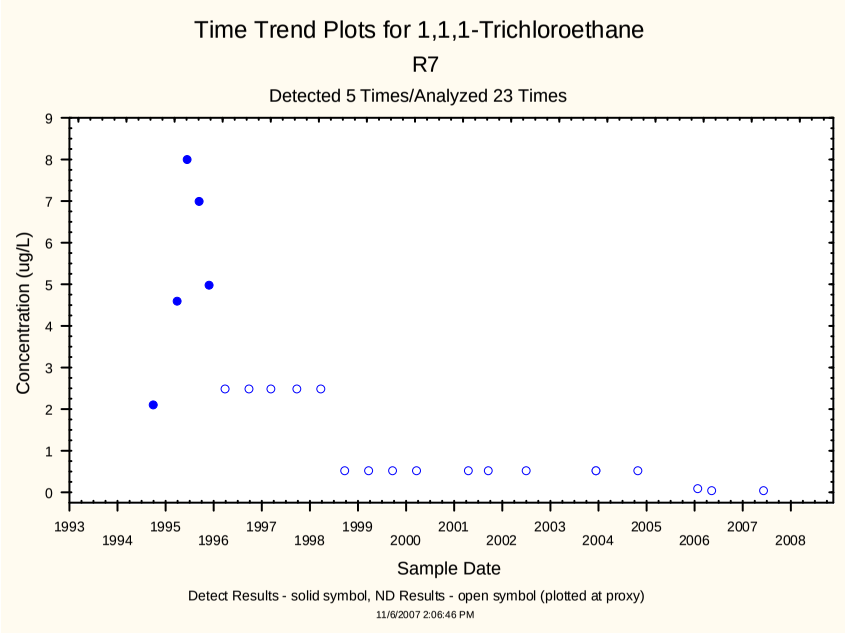

Time Trend Plots for 1,2-Dichloroethane
R6
Detected 5 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:47 PM

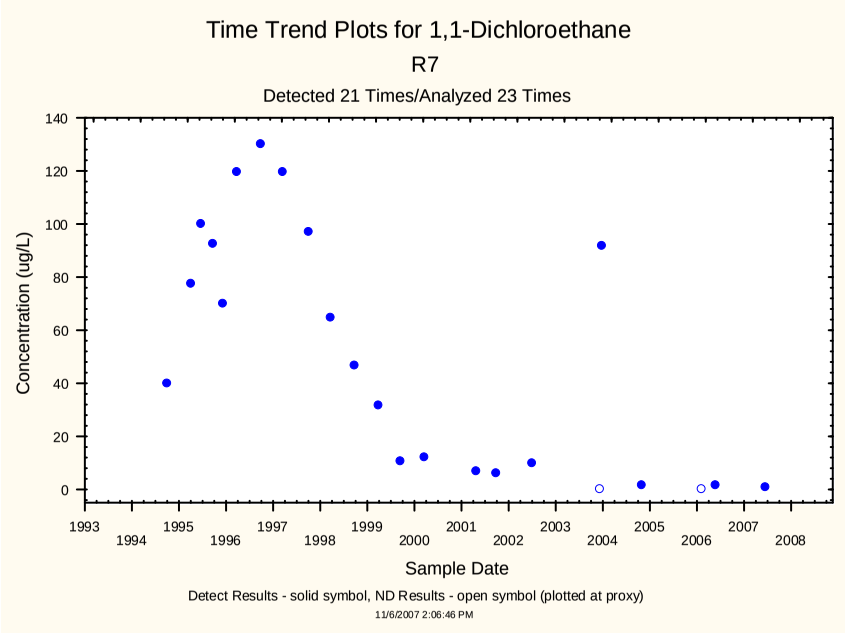

Time Trend Plots for Tetrachloroethene
R6
Detected 22 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:47 PM

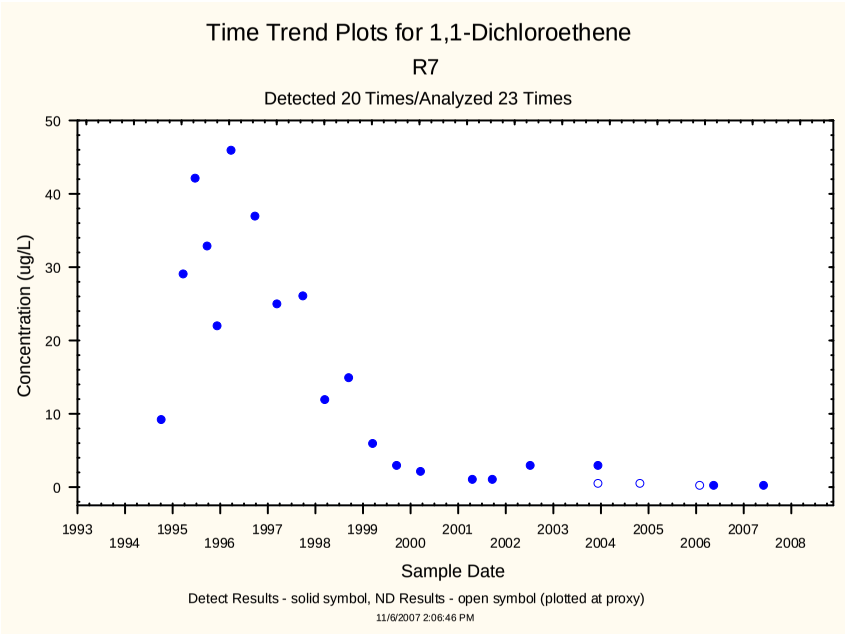

Time Trend Plots for Trichloroethene
R6
Detected 20 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:47 PM

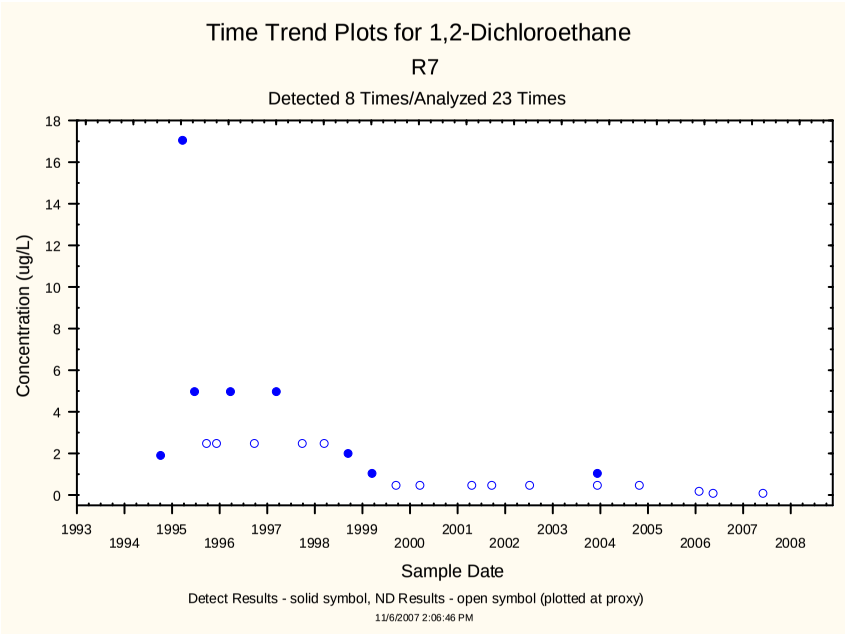

Time Trend Plots for Vinyl chloride (Chloroethene)
R6
Detected 7 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:47 PM

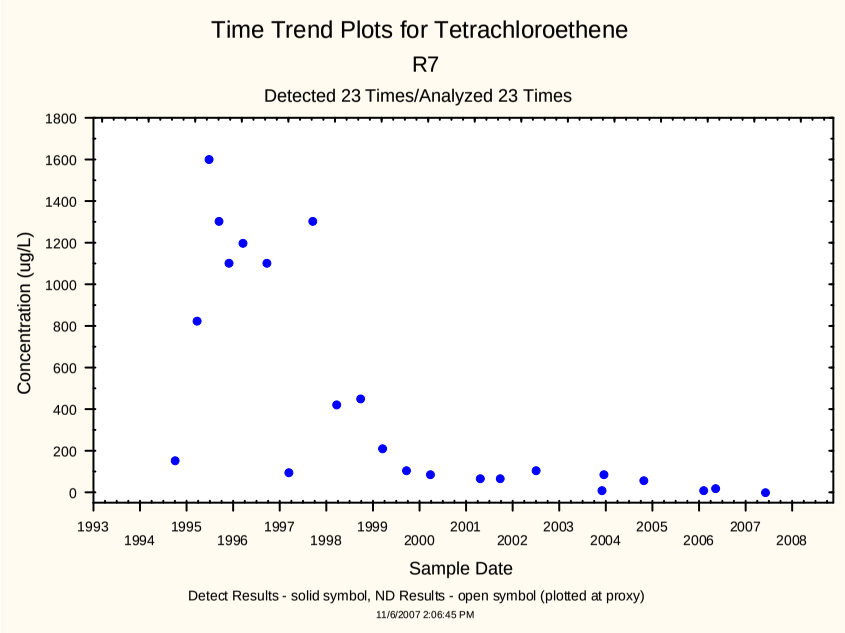

Time Trend Plots for cis-1,2-Dichloroethene
R6
Detected 19 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:47 PM

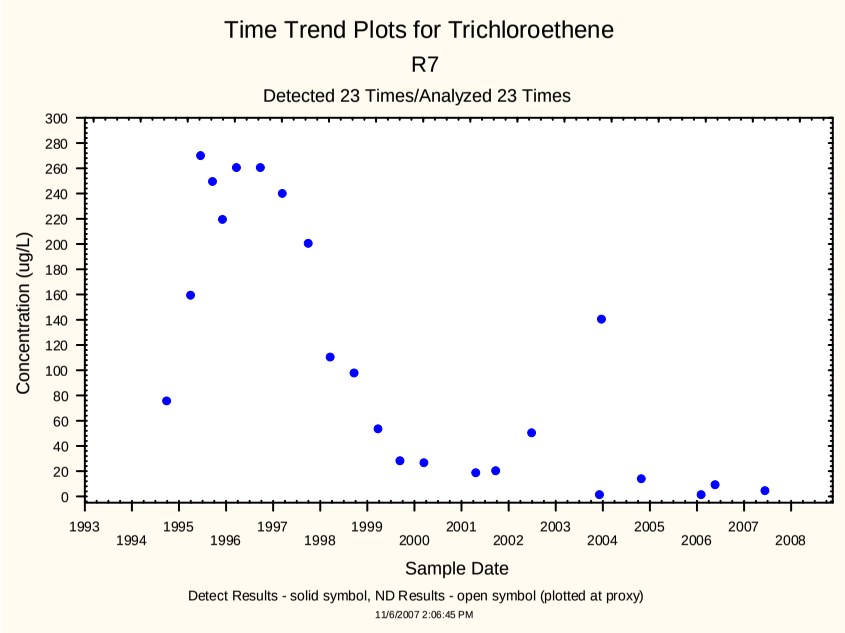

Time Trend Plots for 1,1,1-Trichloroethane
R7
Detected 5 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:46 PM

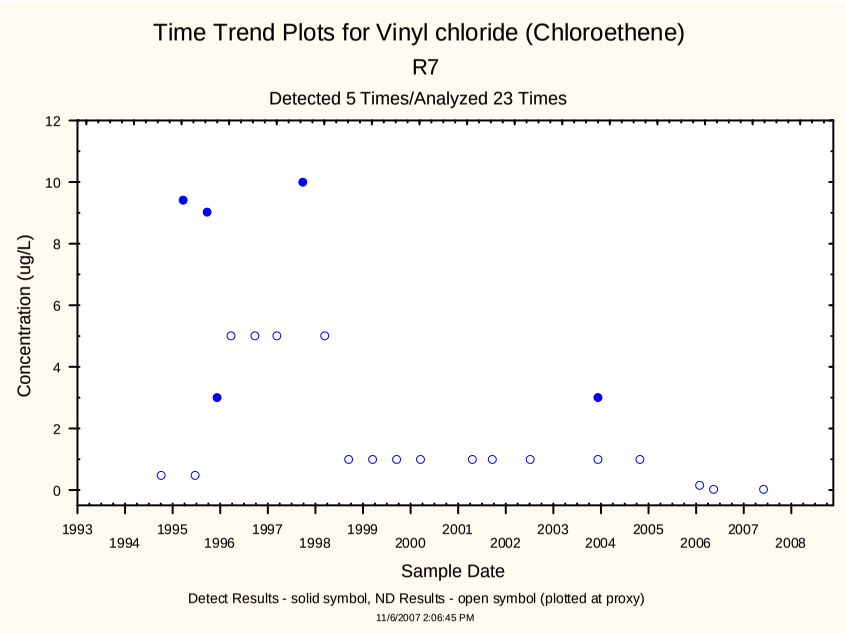

Time Trend Plots for 1,1-Dichloroethane
R7
Detected 21 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:46 PM

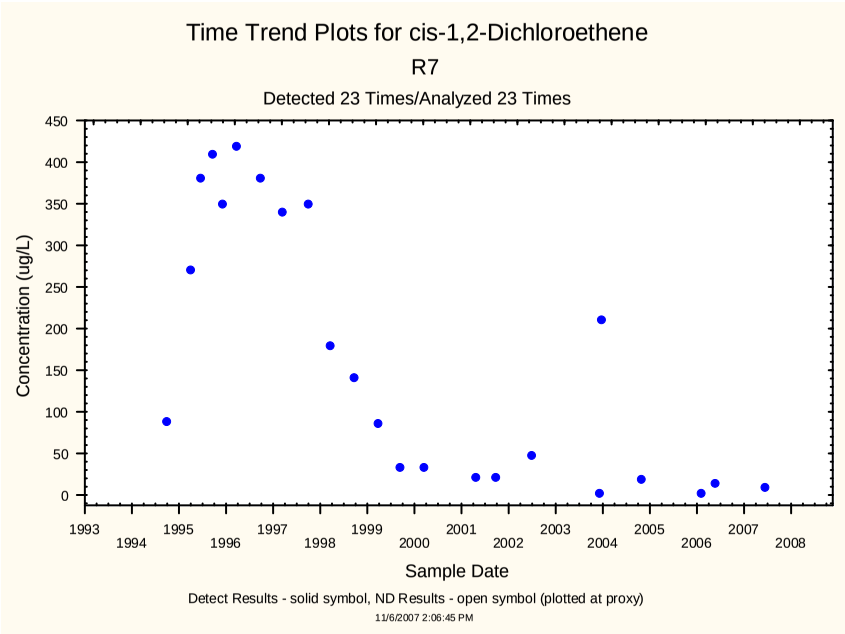

Time Trend Plots for 1,1-Dichloroethene
R7
Detected 20 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:46 PM

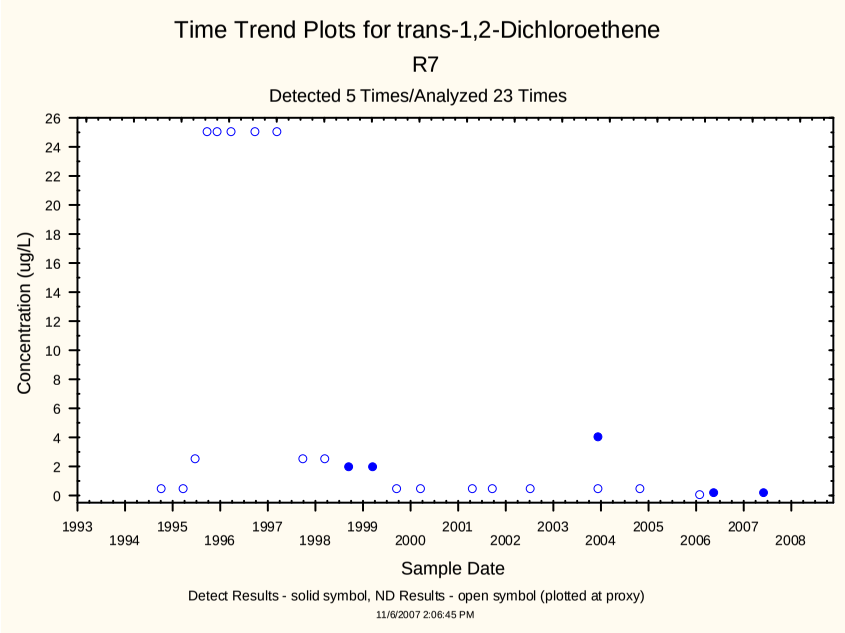

Time Trend Plots for 1,2-Dichloroethane
R7
Detected 8 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:46 PM

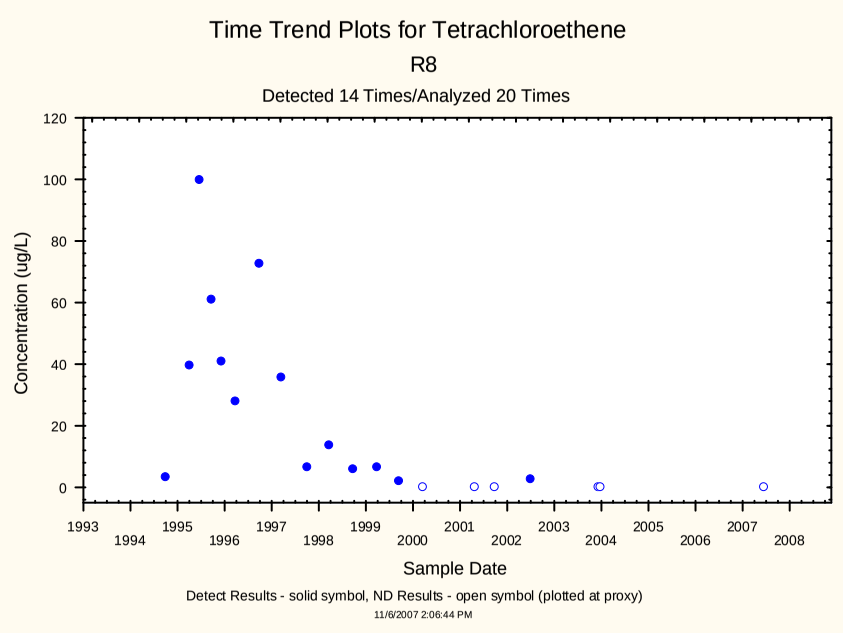

Time Trend Plots for Tetrachloroethene
R7
Detected 23 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:45 PM

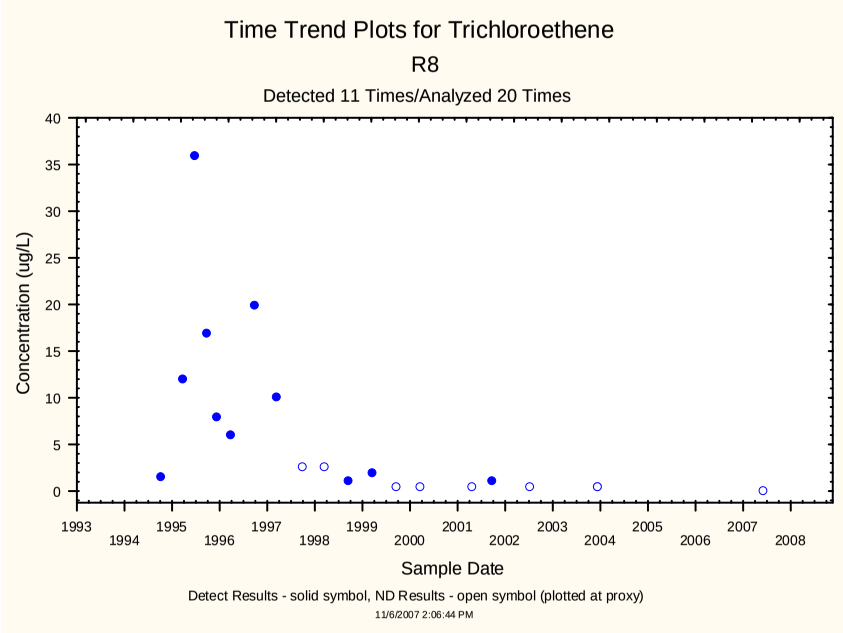

Time Trend Plots for Trichloroethene
R7
Detected 23 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:45 PM

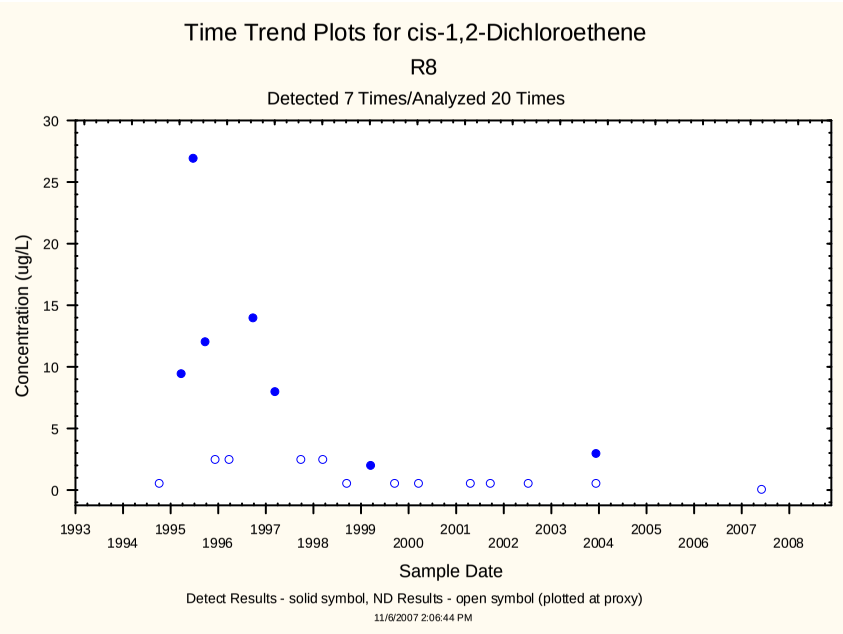

Time Trend Plots for Vinyl chloride (Chloroethene)
R7
Detected 5 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:45 PM

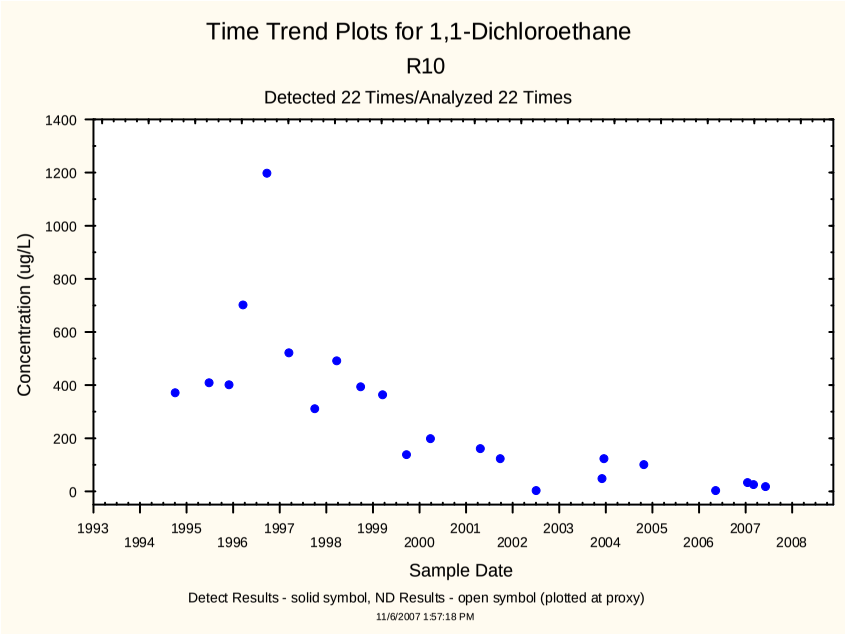

Time Trend Plots for cis-1,2-Dichloroethene
R7
Detected 23 Times/Analyzed 23 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:45 PM

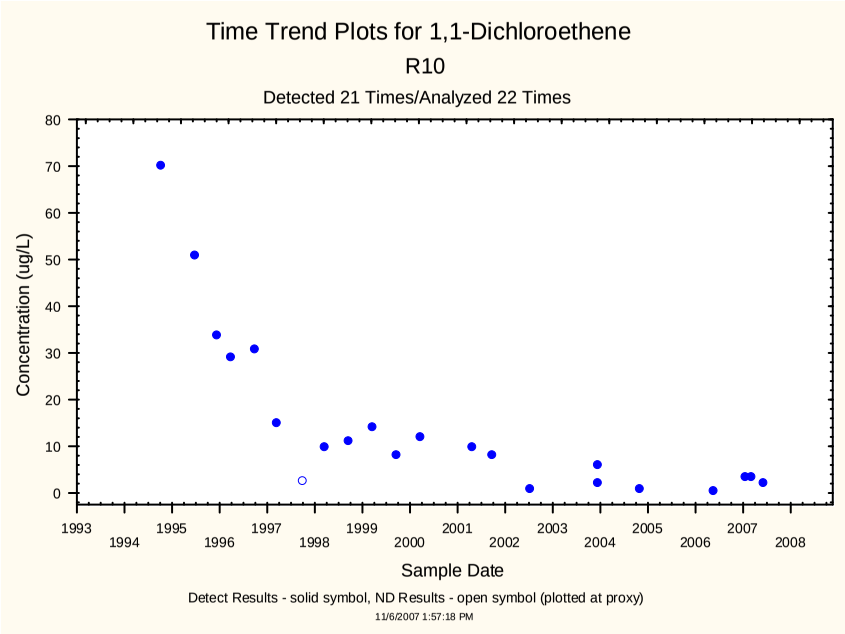

Time Trend Plots for trans-1,2-Dichloroethene
R7
Detected 5 Times/Analyzed 23 Times
Concentration (ug/L)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:45 PM

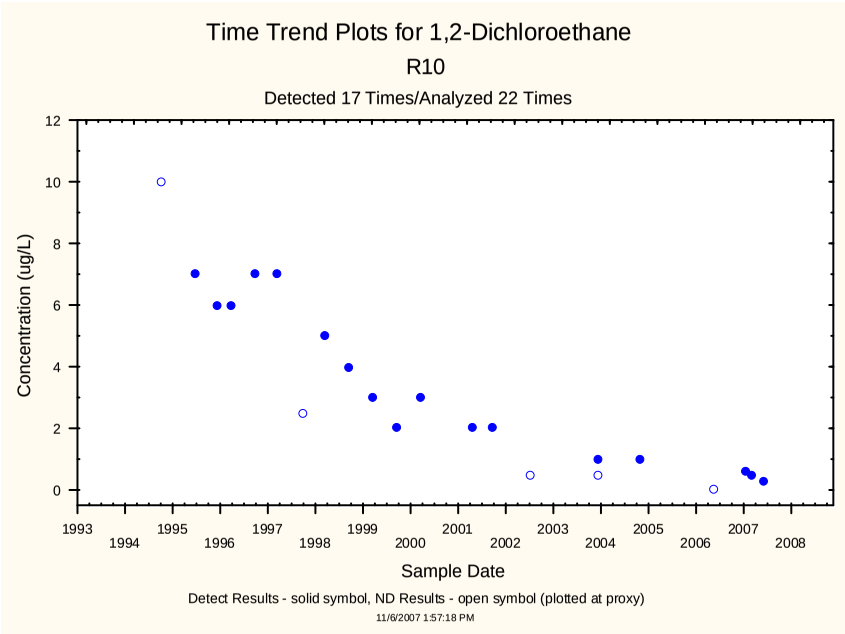

Time Trend Plots for Tetrachloroethene
R8
Detected 14 Times/Analyzed 20 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:44 PM

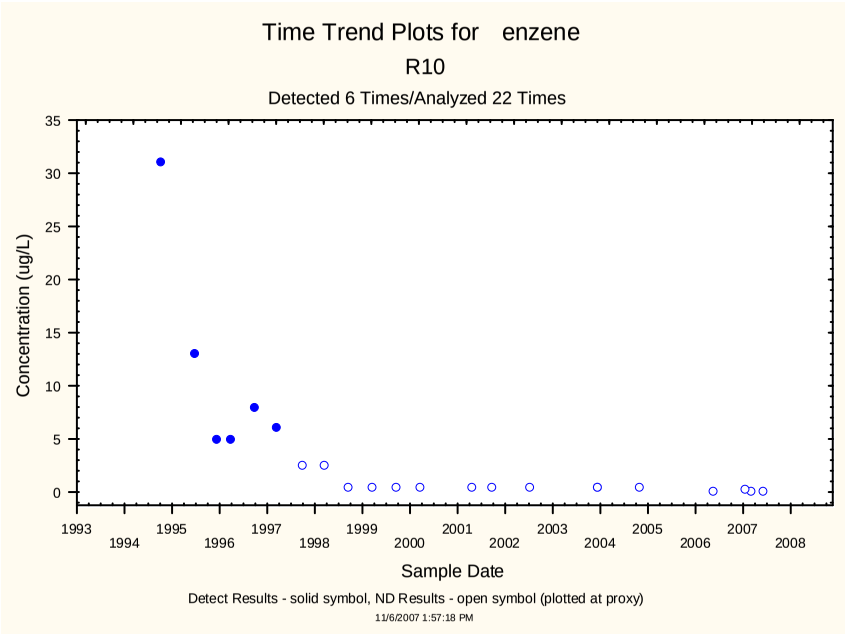

Time Trend Plots for Trichloroethene
R8
Detected 11 Times/Analyzed 20 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:44 PM

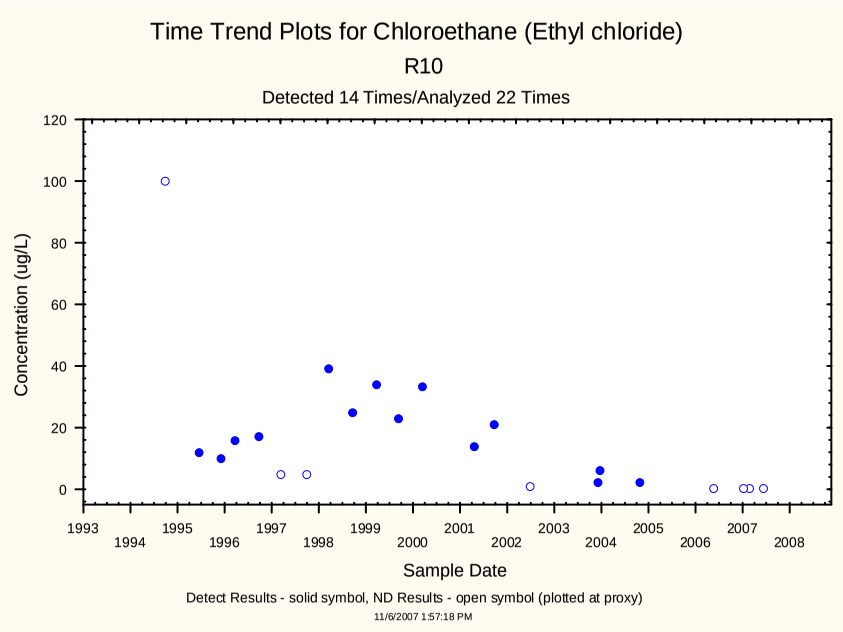

Time Trend Plots for cis-1,2-Dichloroethene
R8
Detected 7 Times/Analyzed 20 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:44 PM

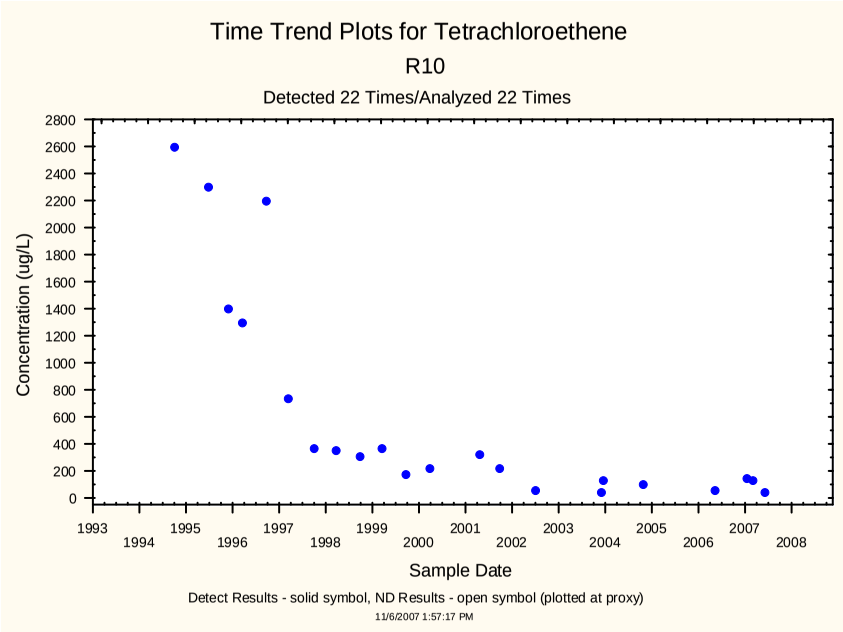

Time Trend Plots for 1,1-Dichloroethane
R10
Detected 22 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:18 PM

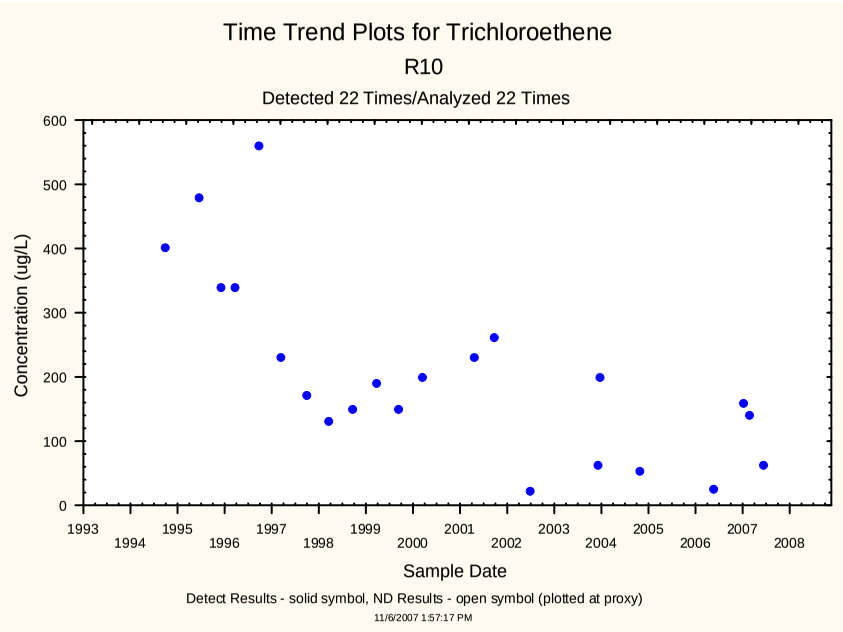

Time Trend Plots for 1,1-Dichloroethene
R10
Detected 21 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:18 PM

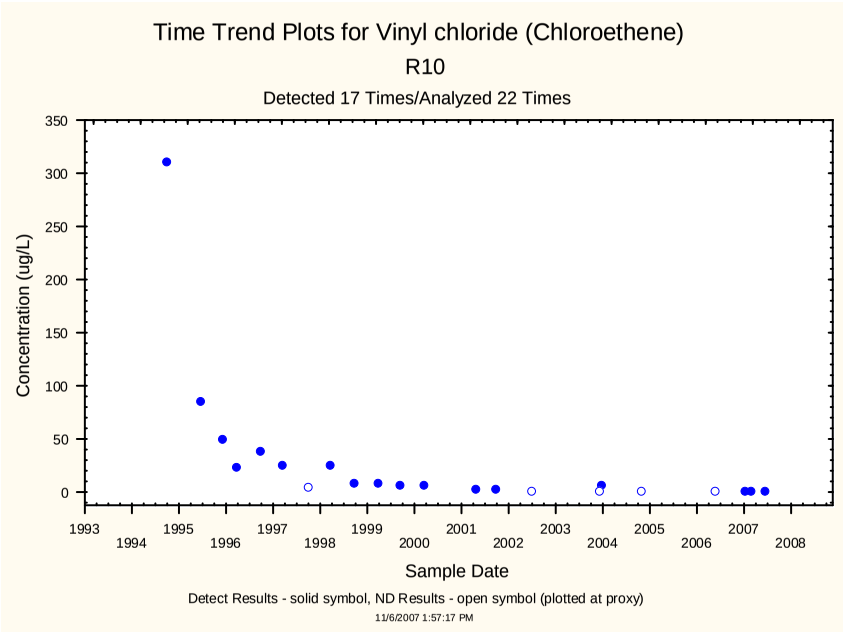

Time Trend Plots for 1,2-Dichloroethane
R10
Detected 17 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:18 PM

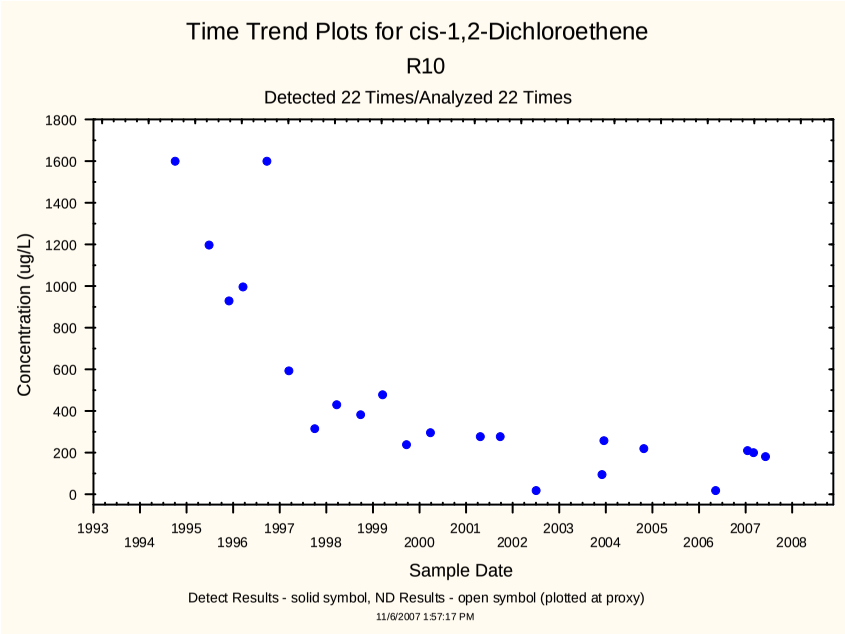

Time Trend Plots for enzene
R10
Detected 6 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:18 PM

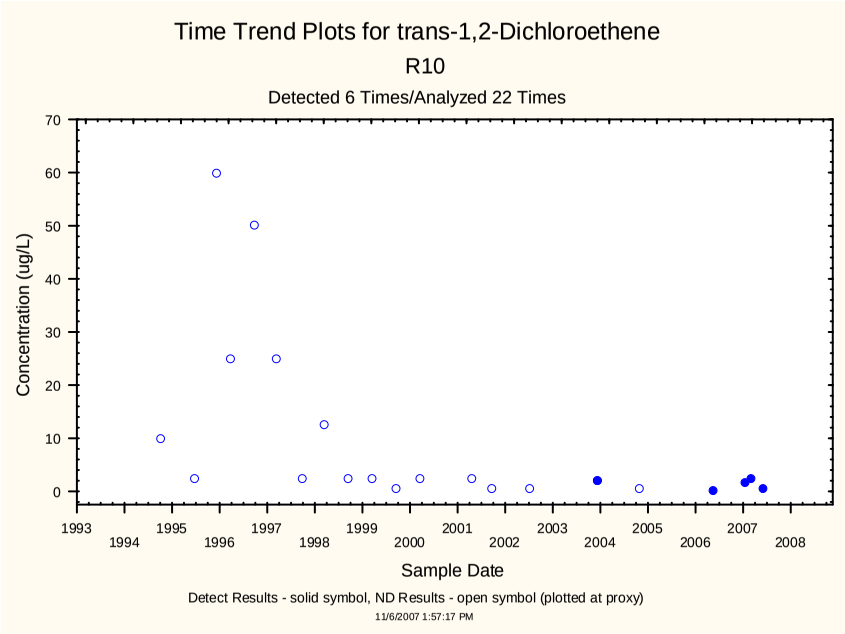

Time Trend Plots for Chloroethane (Ethyl chloride)
R10
Detected 14 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:18 PM

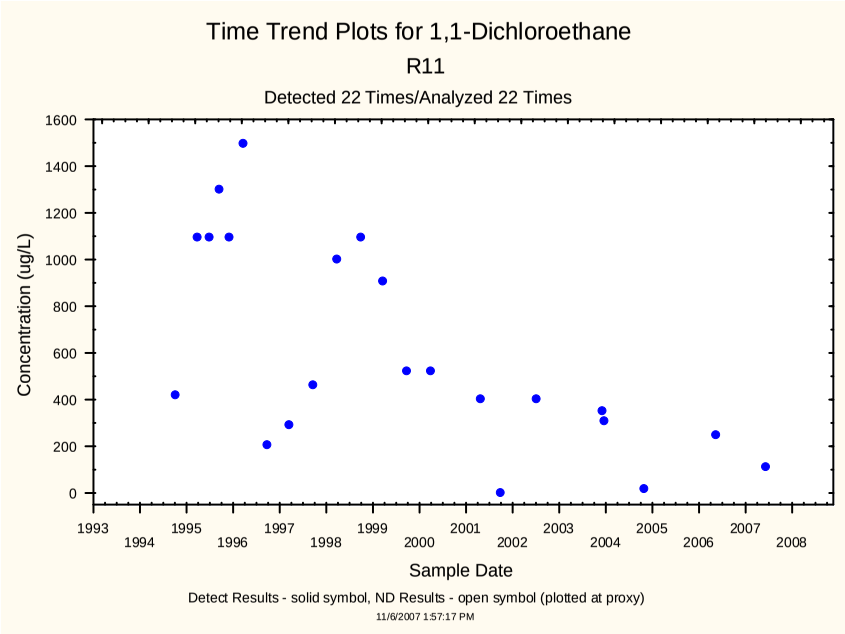

Time Trend Plots for Tetrachloroethene
R10
Detected 22 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:17 PM

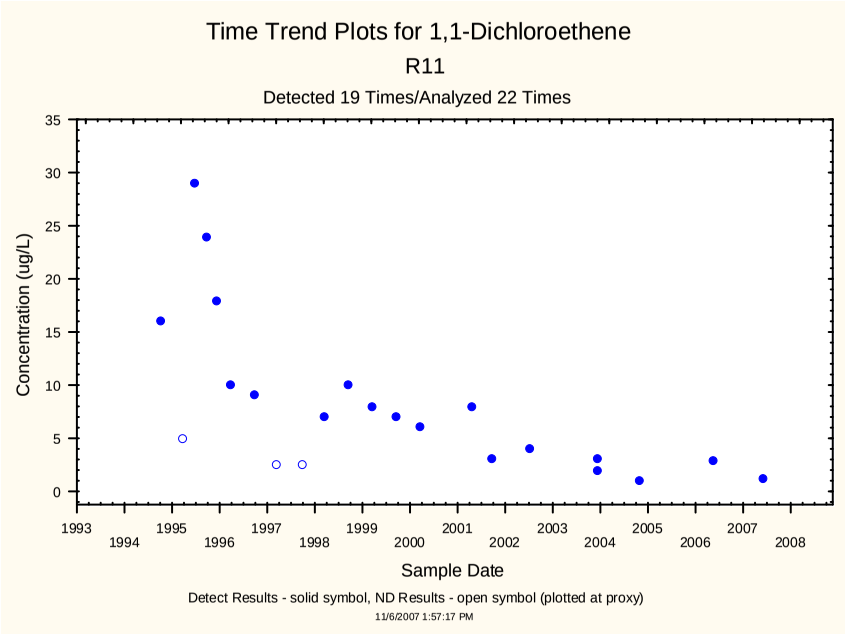

Time Trend Plots for Trichloroethene
R10
Detected 22 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:17 PM

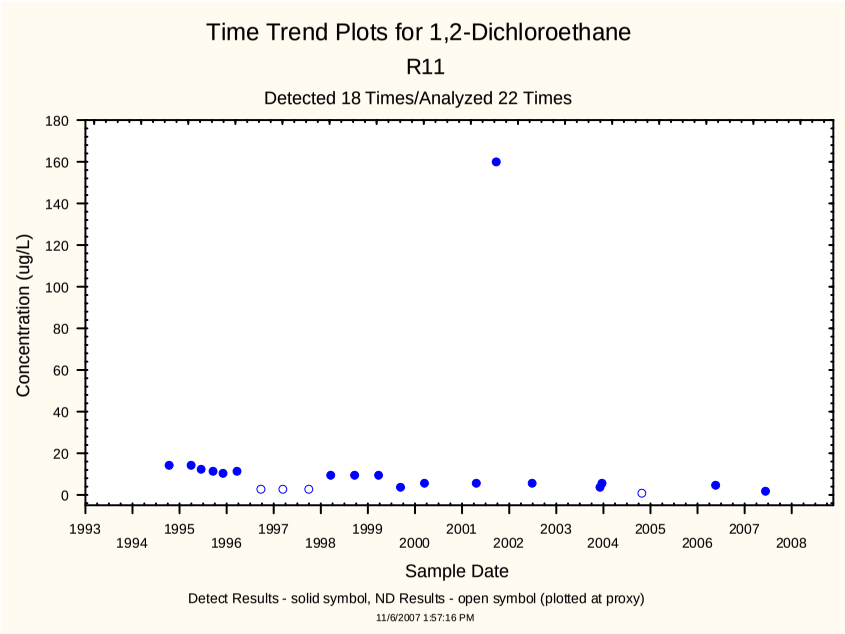

Time Trend Plots for Vinyl chloride (Chloroethene)
R10
Detected 17 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:17 PM

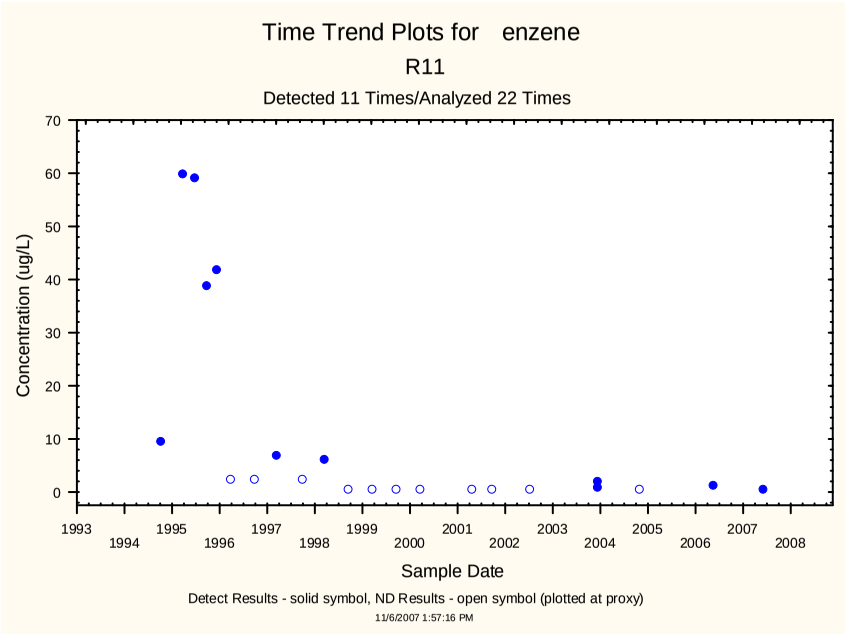

Time Trend Plots for cis-1,2-Dichloroethene
R10
Detected 22 Times/Analyzed 22 Times
Concentration (ug/L)
1800
1600
1400
1200
1000
800
600
400
200
0
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:17 PM

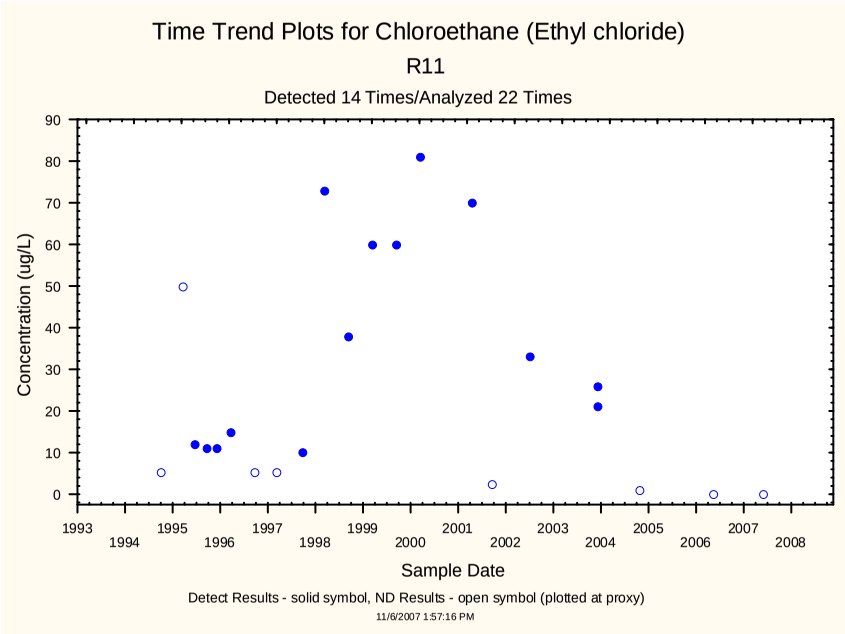

Time Trend Plots for trans-1,2-Dichloroethene
R10
Detected 6 Times/Analyzed 22 Times
Concentration (ug/L)
70
60
50
40
30
20
10
0
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:17 PM

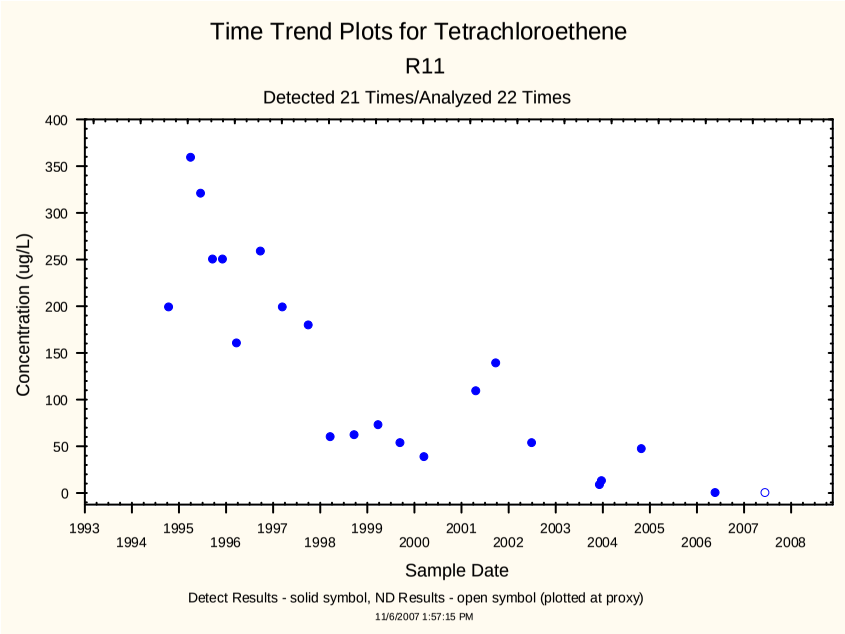

Time Trend Plots for 1,1-Dichloroethane
R11
Detected 22 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:17 PM

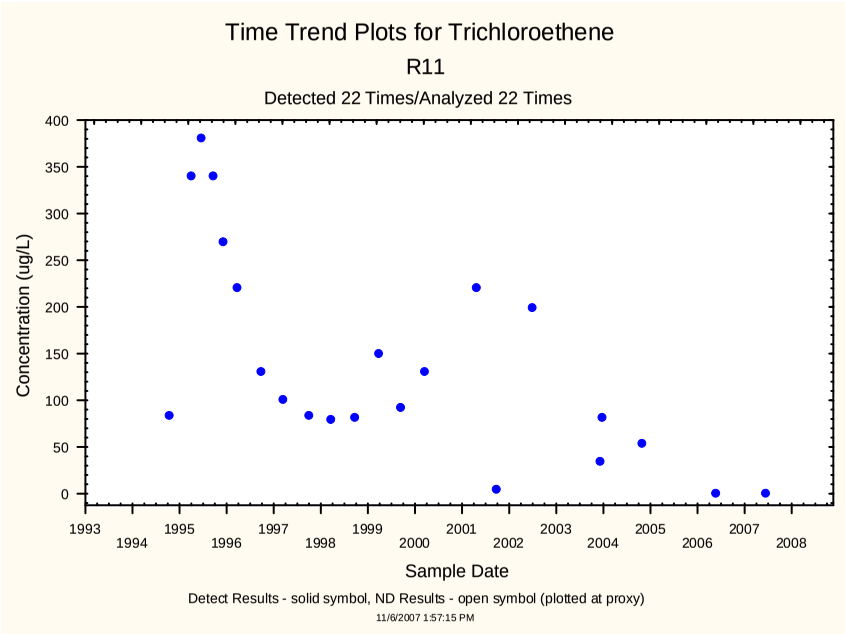

Time Trend Plots for 1,1-Dichloroethene
R11
Detected 19 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:17 PM

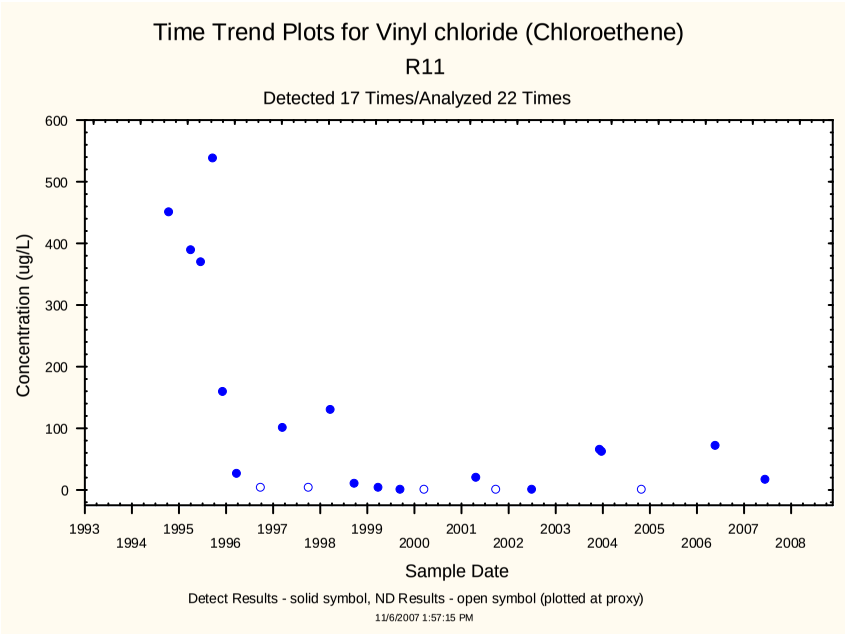

Time Trend Plots for 1,2-Dichloroethane
R11
Detected 18 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:16 PM

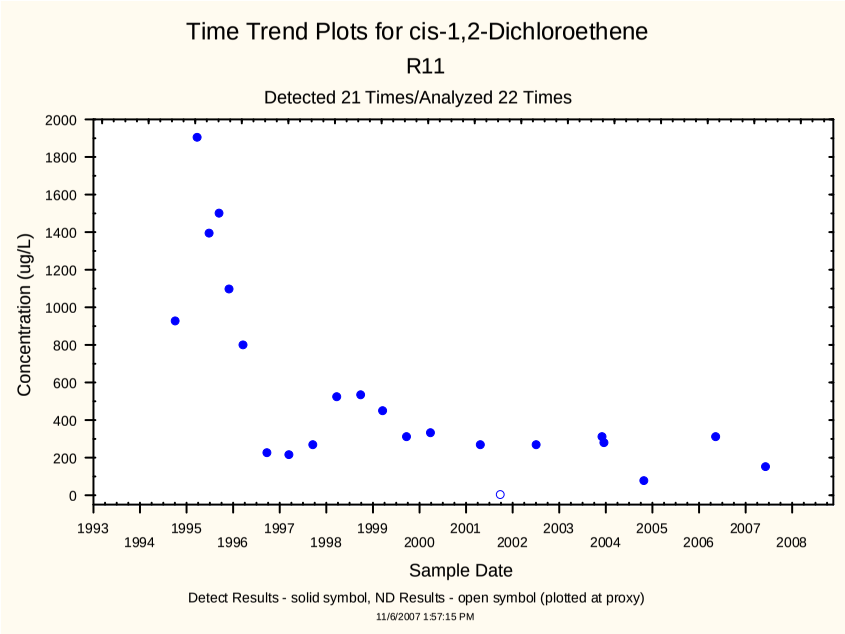

Time Trend Plots for enzene
R11
Detected 11 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:16 PM

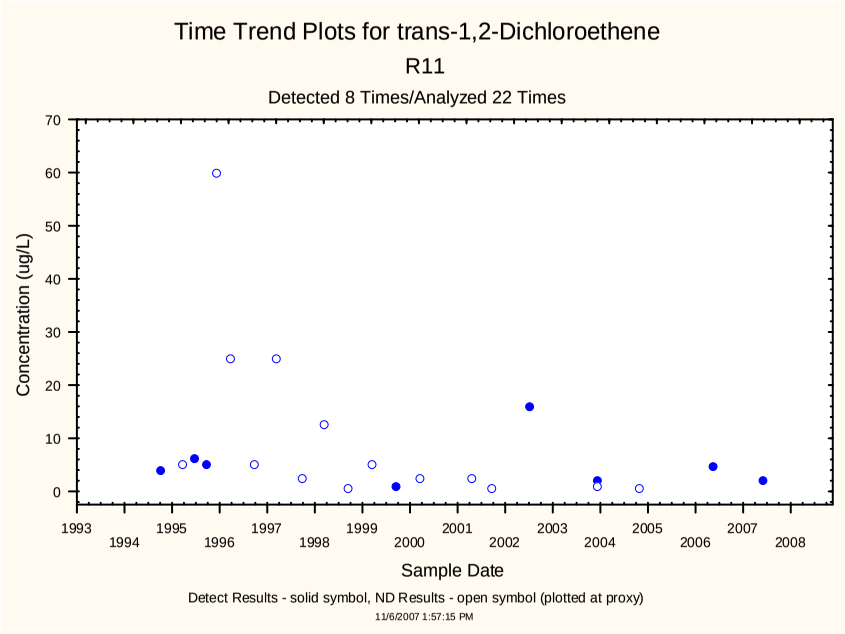

Time Trend Plots for Chloroethane (Ethyl chloride)
R11
Detected 14 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:16 PM

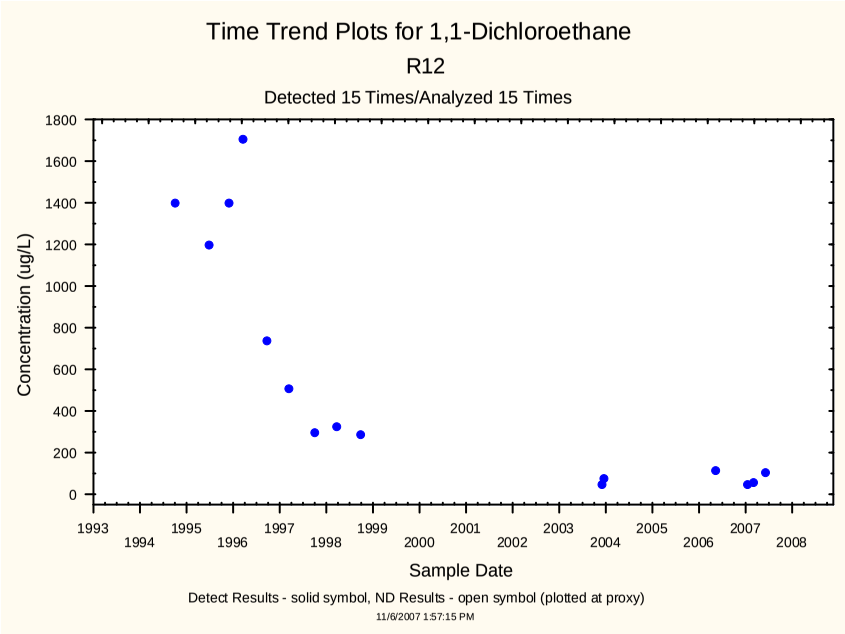

Time Trend Plots for Tetrachloroethene
R11
Detected 21 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:15 PM

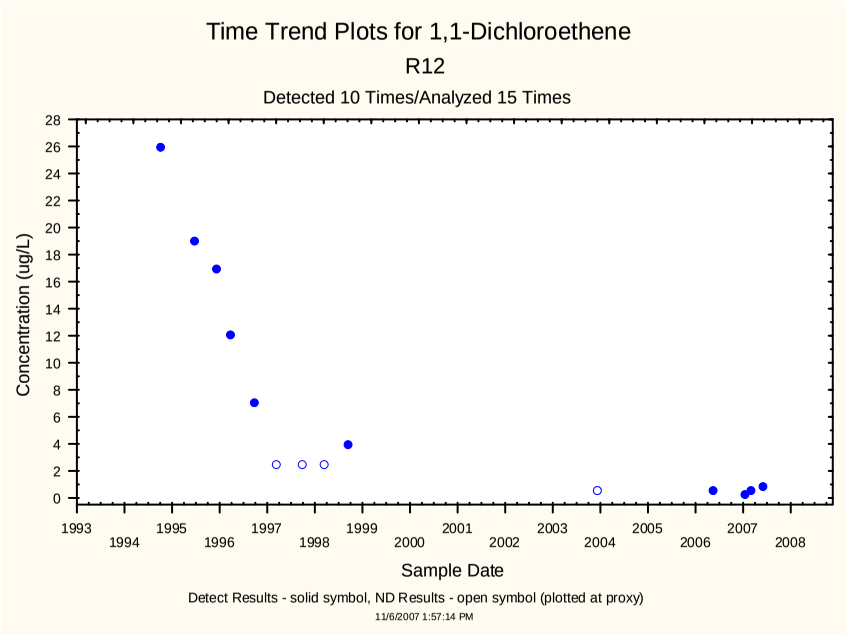

Time Trend Plots for Trichloroethene
R11
Detected 22 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:15 PM

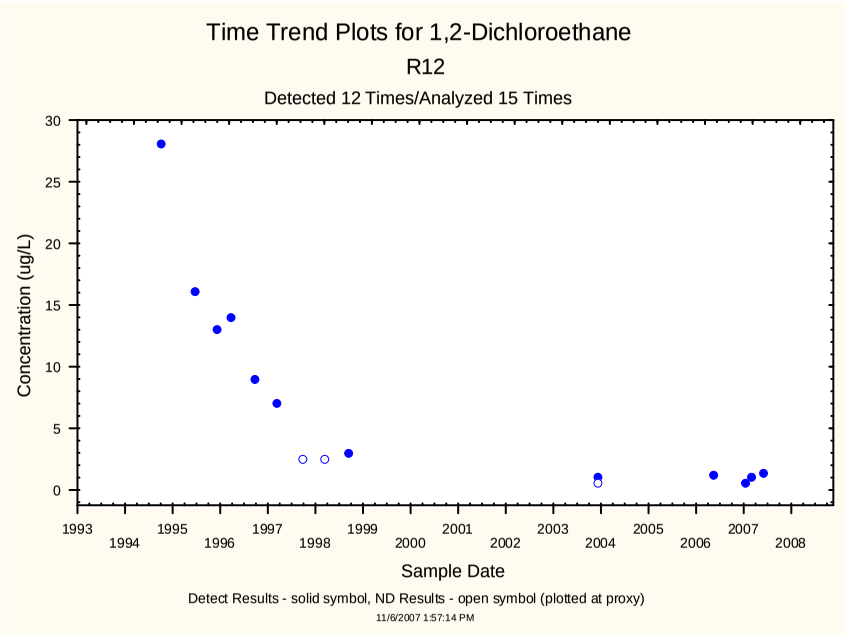

Time Trend Plots for Vinyl chloride (Chloroethene)
R11
Detected 17 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:15 PM

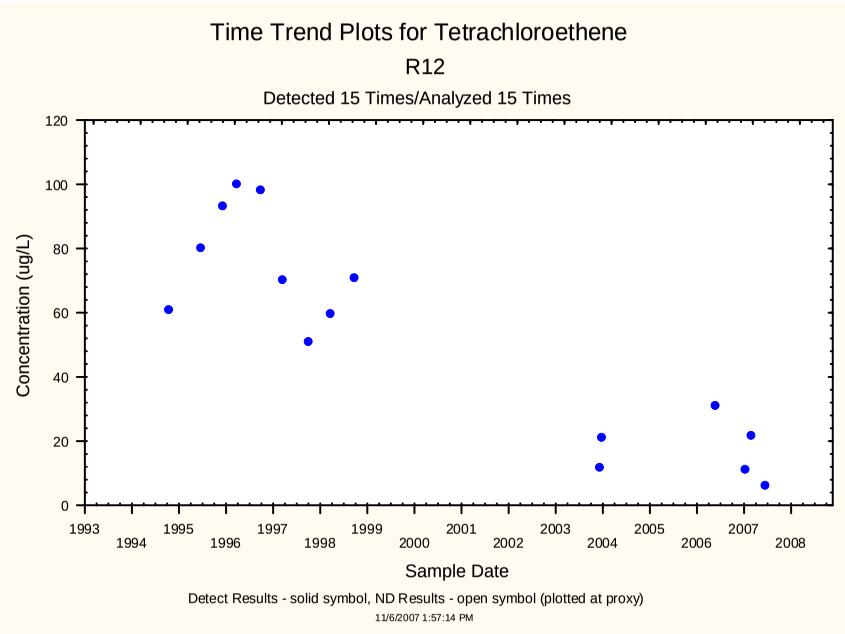

Time Trend Plots for cis-1,2-Dichloroethene
R11
Detected 21 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:15 PM

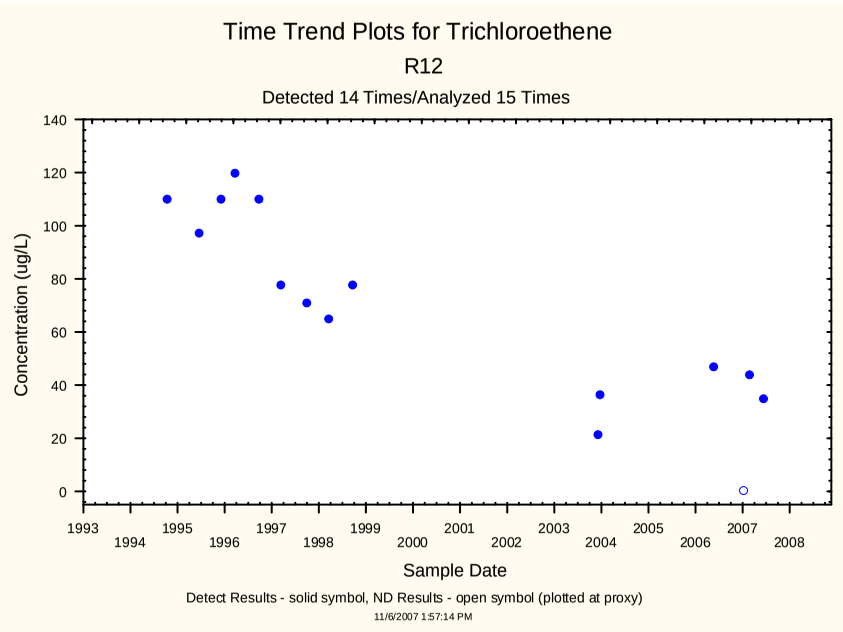

Time Trend Plots for trans-1,2-Dichloroethene
R11
Detected 8 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:15 PM

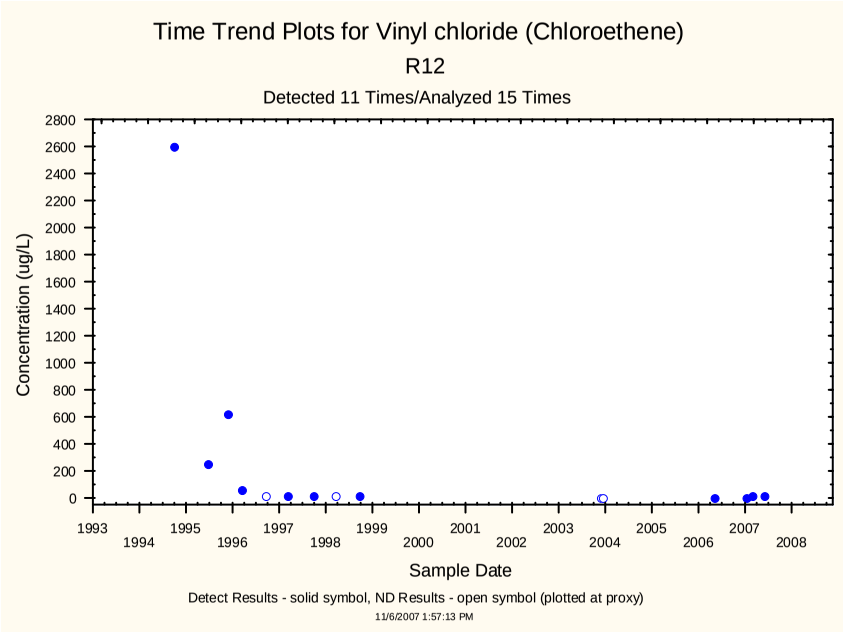

Time Trend Plots for 1,1-Dichloroethane
R12
Detected 15 Times/Analyzed 15 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:15 PM

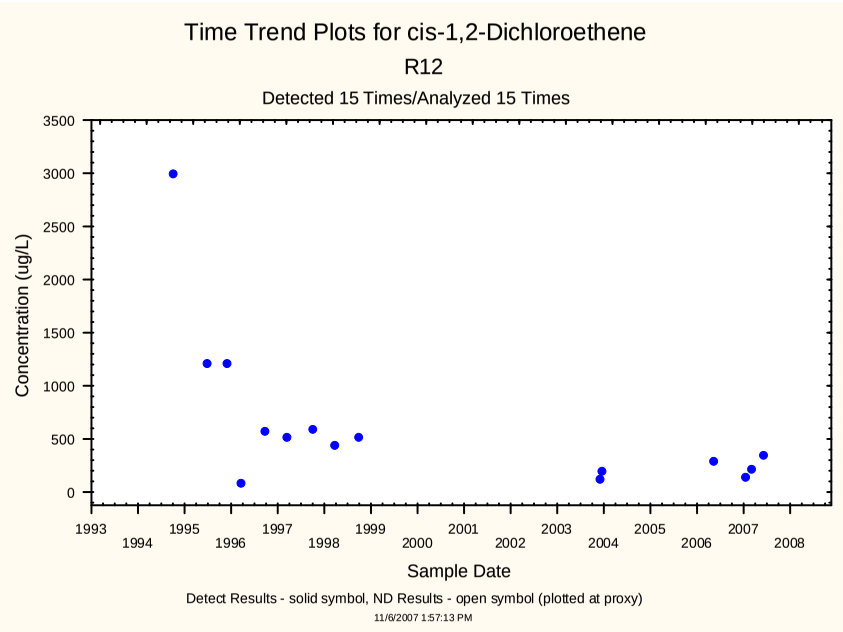

Time Trend Plots for 1,1-Dichloroethene
R12
Detected 10 Times/Analyzed 15 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:14 PM

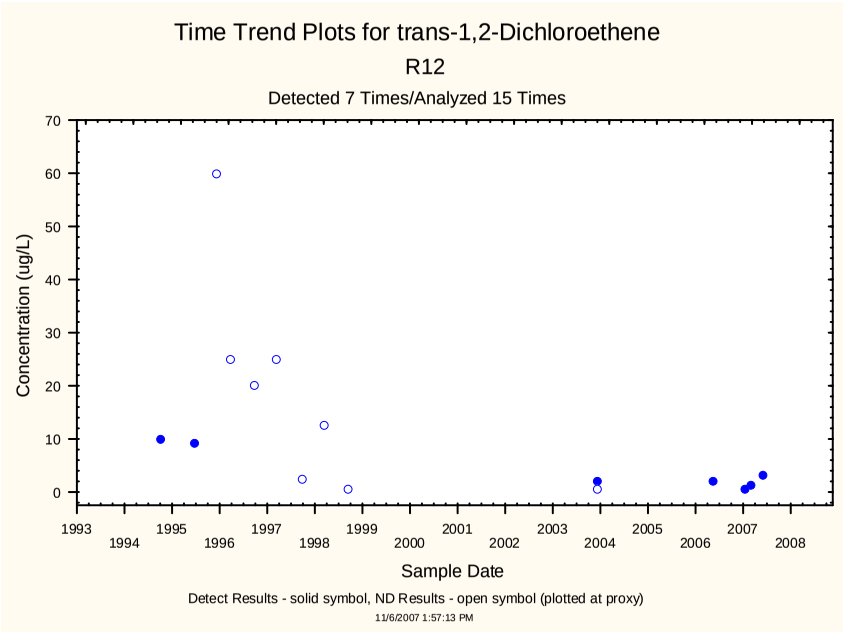

Time Trend Plots for 1,2-Dichloroethane
R12
Detected 12 Times/Analyzed 15 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:14 PM

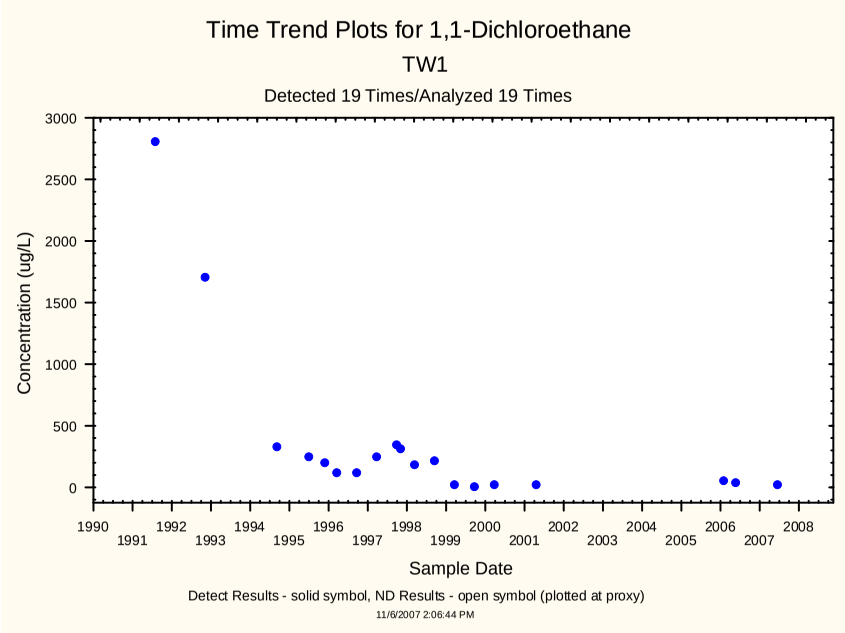

Time Trend Plots for Tetrachloroethene
R12
Detected 15 Times/Analyzed 15 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:14 PM

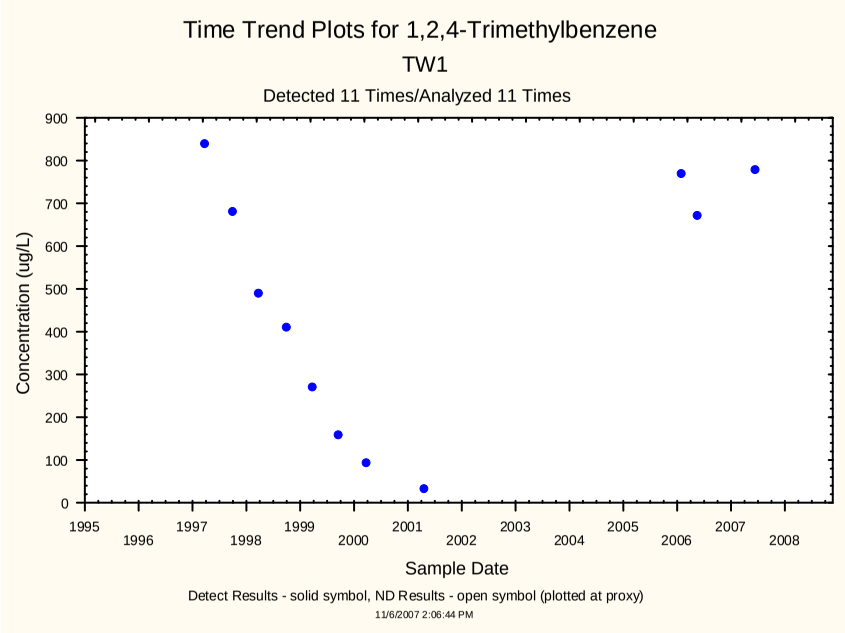

Time Trend Plots for Trichloroethene
R12
Detected 14 Times/Analyzed 15 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:14 PM

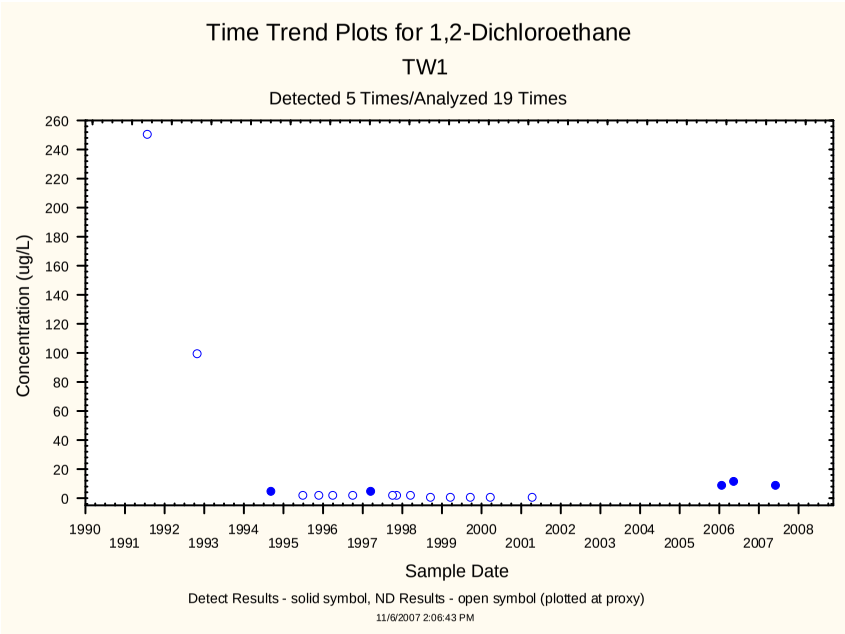

Time Trend Plots for Vinyl chloride (Chloroethene)
R12
Detected 11 Times/Analyzed 15 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:13 PM

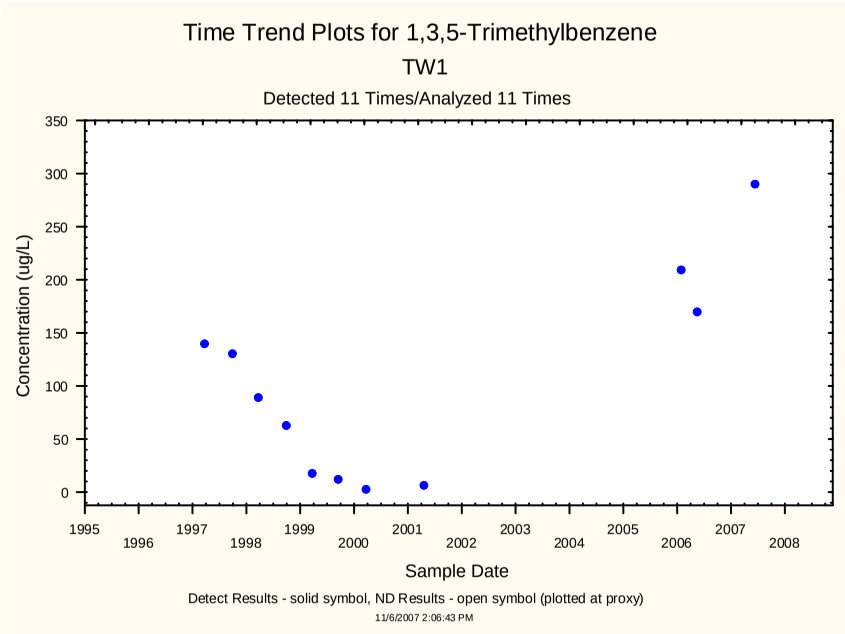

Time Trend Plots for cis-1,2-Dichloroethene
R12
Detected 15 Times/Analyzed 15 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:13 PM

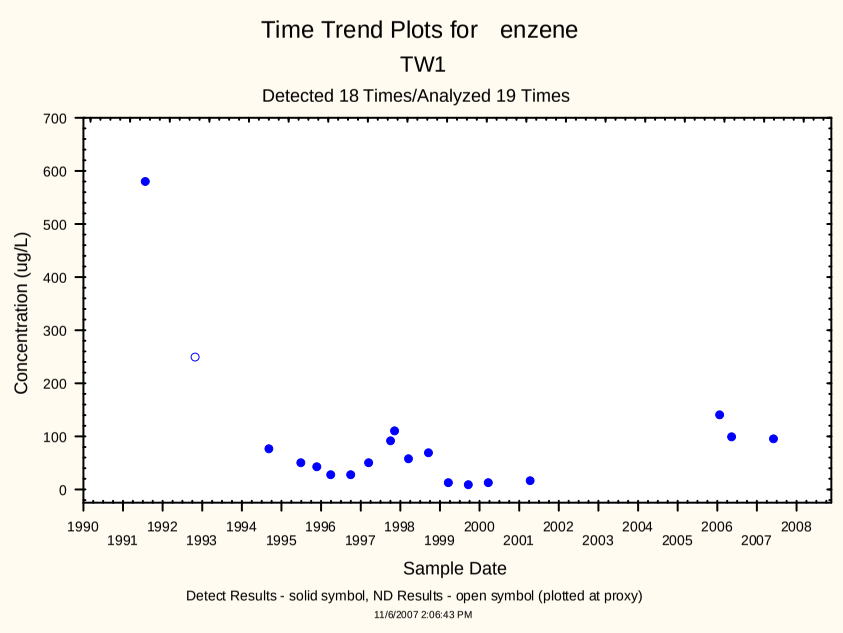

Time Trend Plots for trans-1,2-Dichloroethene
R12
Detected 7 Times/Analyzed 15 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 1:57:13 PM

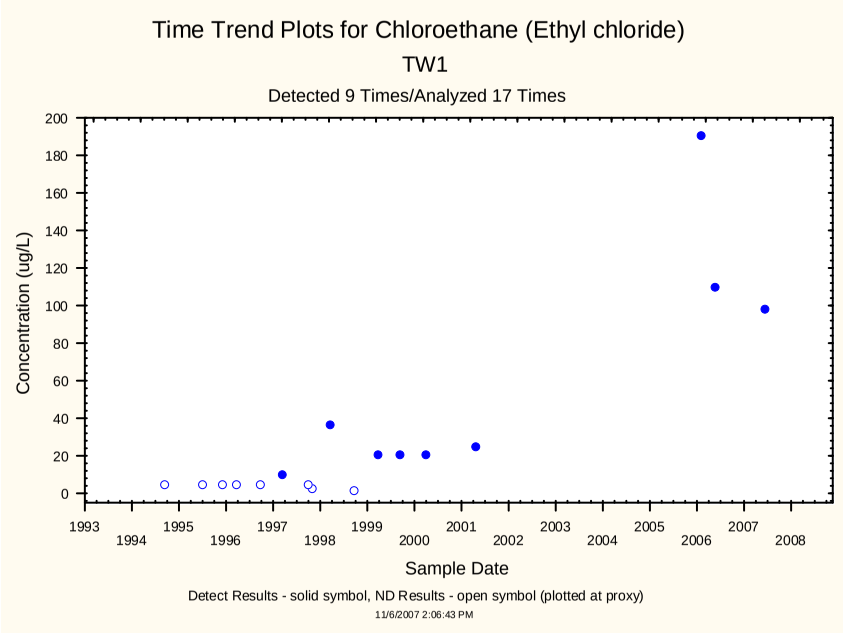

Time Trend Plots for 1,1-Dichloroethane
TW1
Detected 19 Times/Analyzed 19 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:44 PM

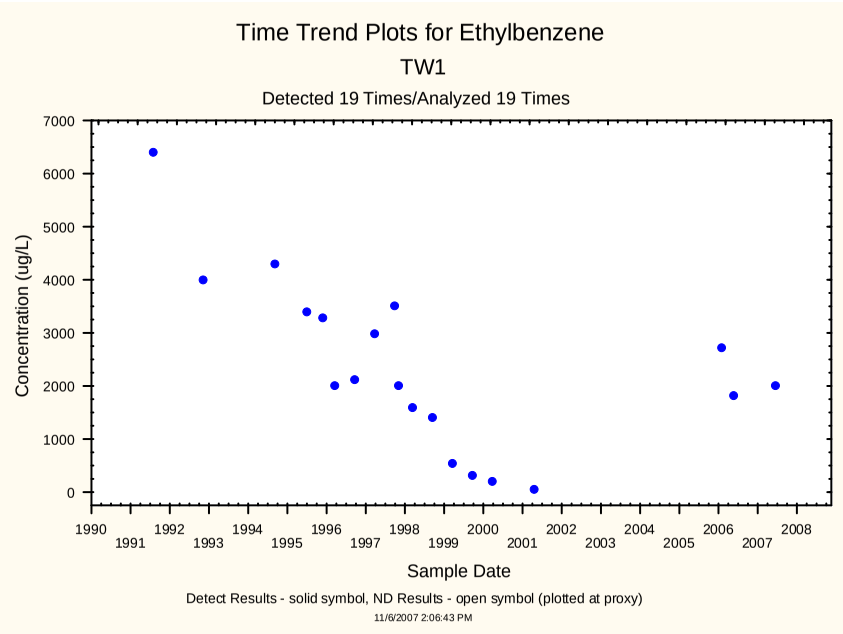

Time Trend Plots for 1,2,4-Trimethylbenzene
TW1
Detected 11 Times/Analyzed 11 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:44 PM

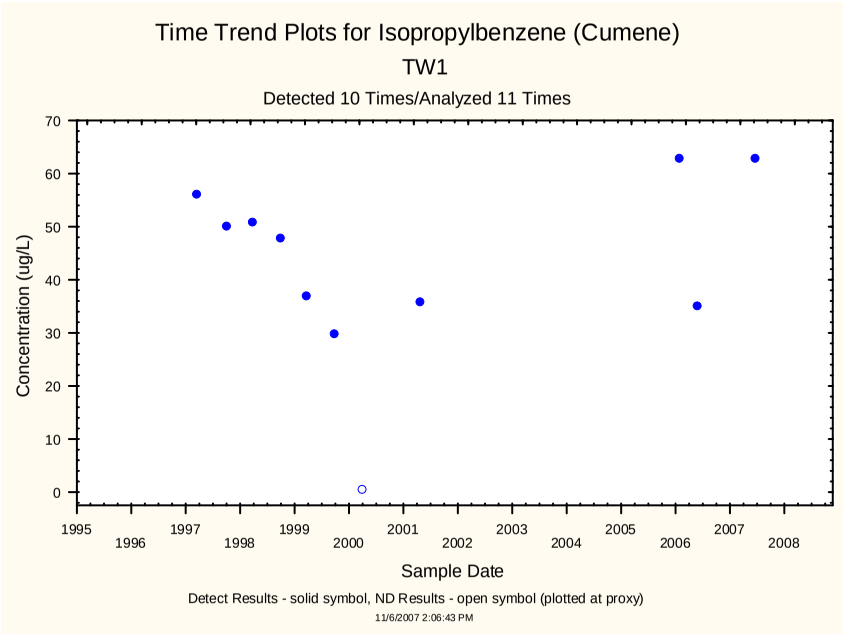

Time Trend Plots for 1,2-Dichloroethane
TW1
Detected 5 Times/Analyzed 19 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:43 PM

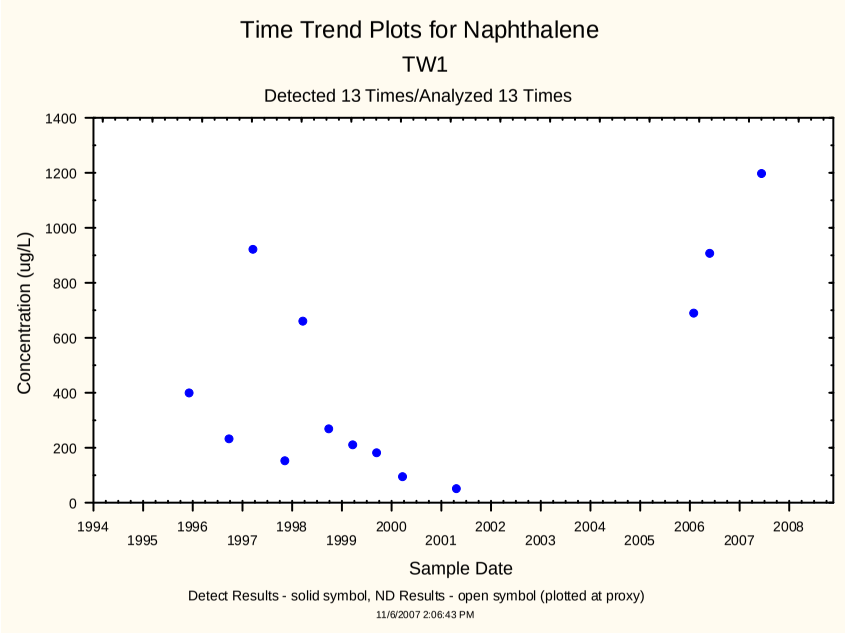

Time Trend Plots for 1,3,5-Trimethylbenzene
TW1
Detected 11 Times/Analyzed 11 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:43 PM

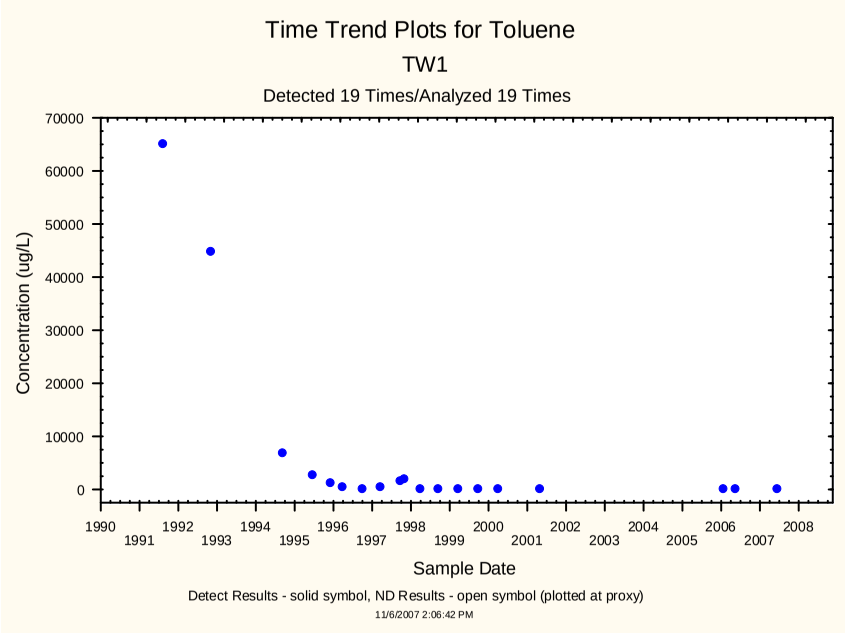

Time Trend Plots for enzene
TW1
Detected 18 Times/Analyzed 19 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:43 PM

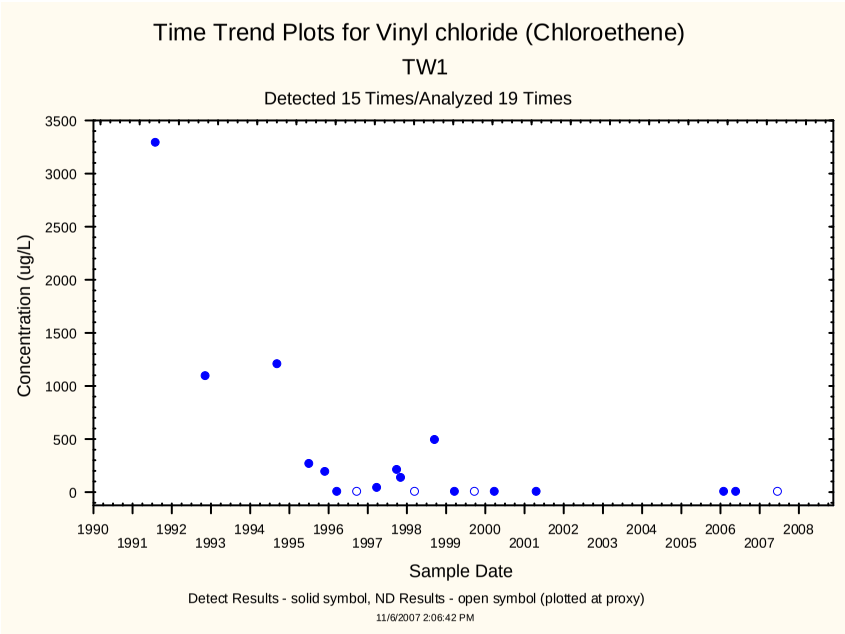

Time Trend Plots for Chloroethane (Ethyl chloride)
TW1
Detected 9 Times/Analyzed 17 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:43 PM

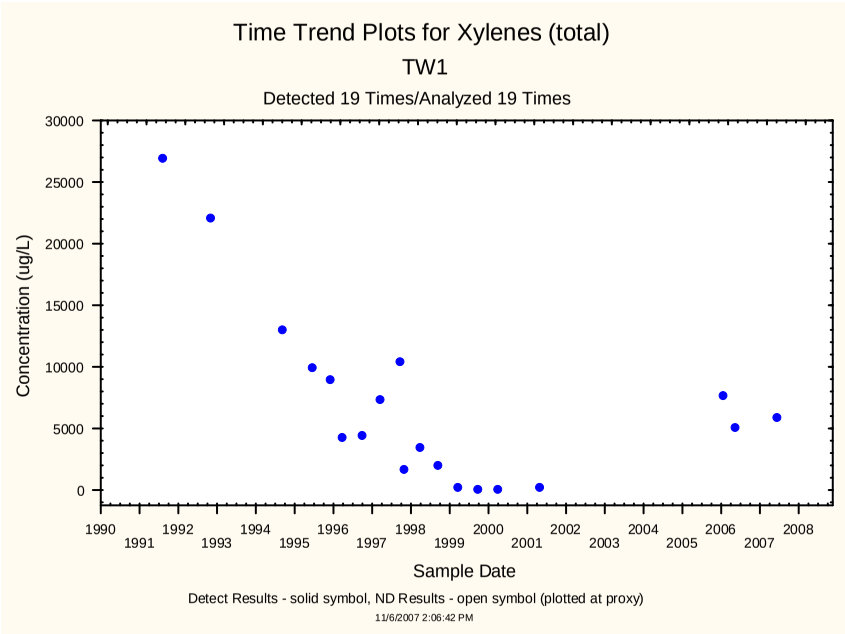

Time Trend Plots for Ethylbenzene
TW1
Detected 19 Times/Analyzed 19 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:43 PM

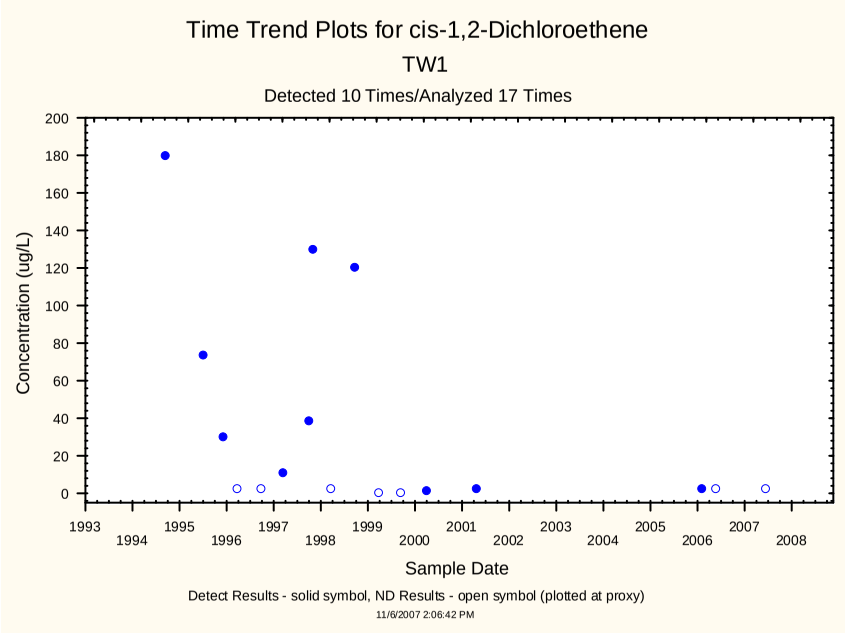

Time Trend Plots for Isopropylbenzene (Cumene)
TW1
Detected 10 Times/Analyzed 11 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:43 PM

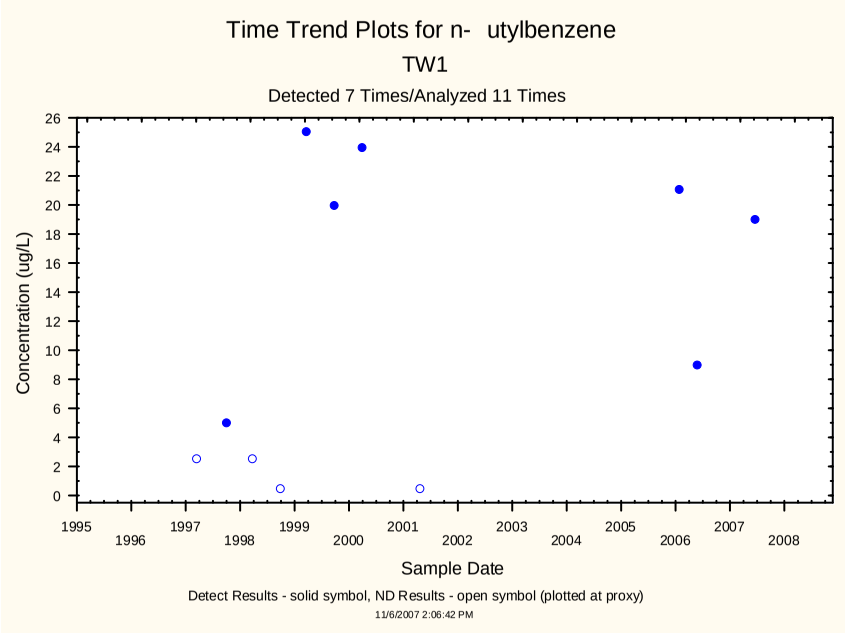

Time Trend Plots for Naphthalene
TW1
Detected 13 Times/Analyzed 13 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:43 PM

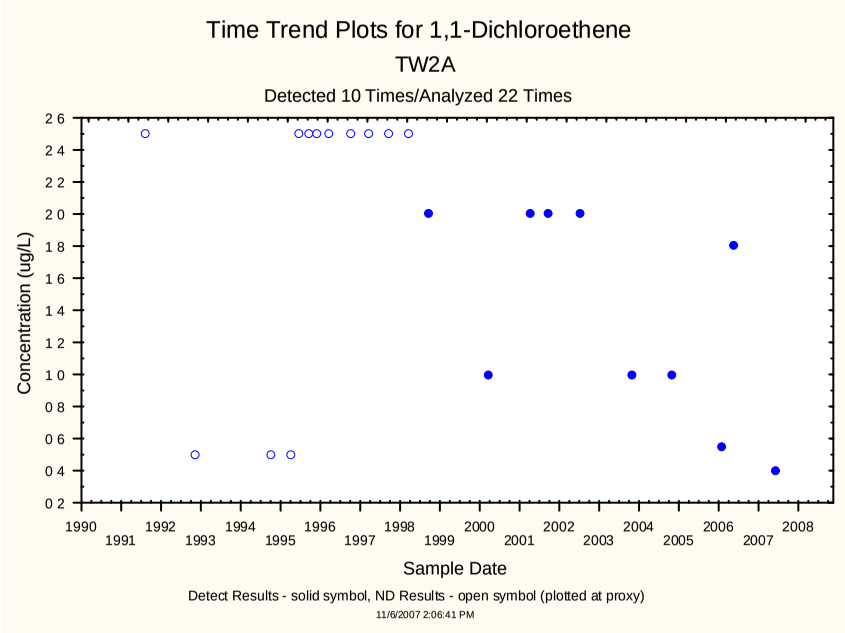

Time Trend Plots for Toluene
TW1
Detected 19 Times/Analyzed 19 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:42 PM

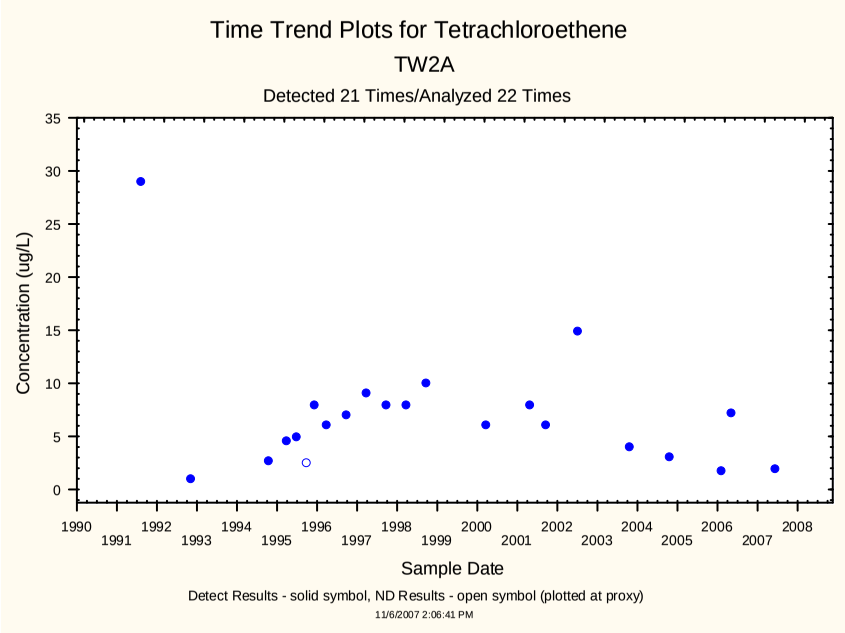

Time Trend Plots for Vinyl chloride (Chloroethene)
TW1
Detected 15 Times/Analyzed 19 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:42 PM

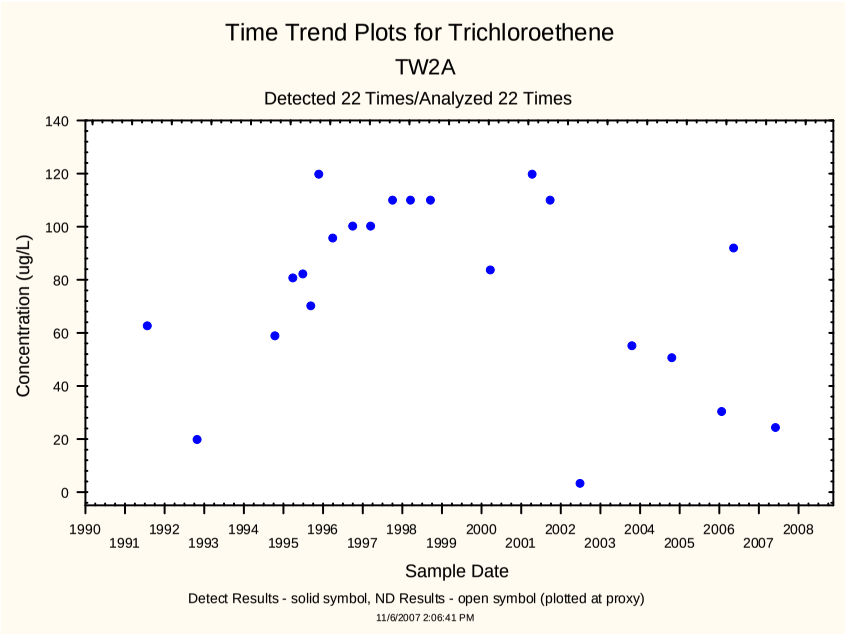

Time Trend Plots for Xylenes (total)
TW1
Detected 19 Times/Analyzed 19 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:42 PM

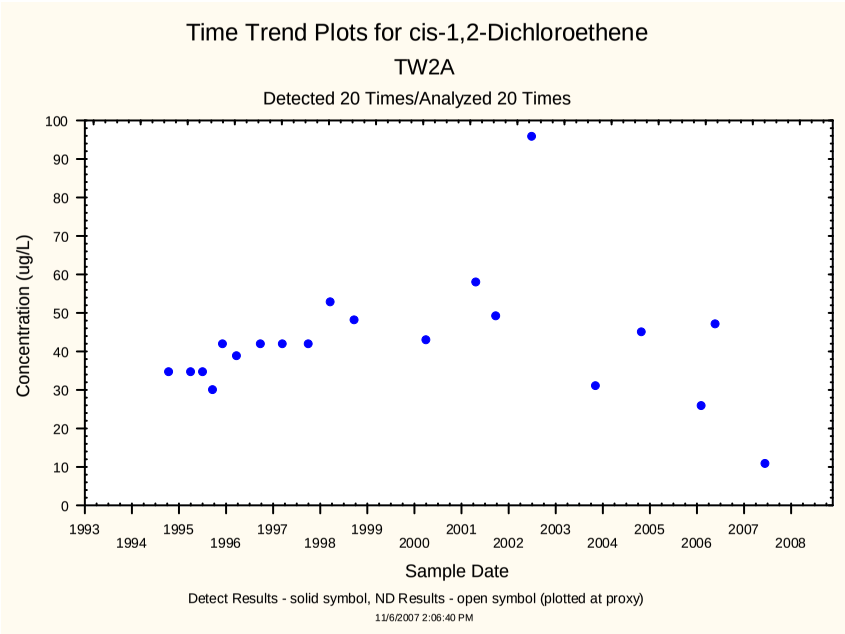

Time Trend Plots for cis-1,2-Dichloroethene
TW1
Detected 10 Times/Analyzed 17 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:42 PM

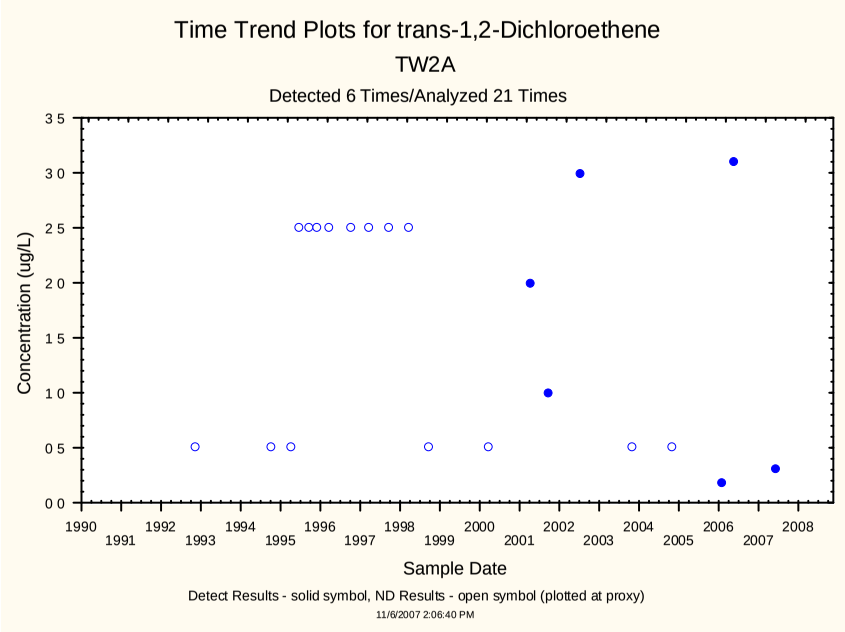

Time Trend Plots for n- utylbenzene
TW1
Detected 7 Times/Analyzed 11 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:42 PM

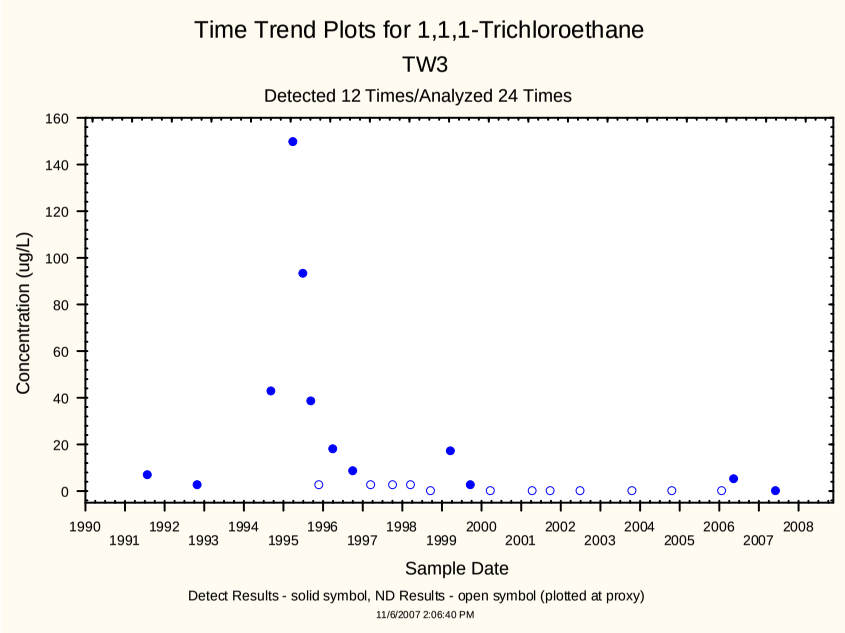

Time Trend Plots for 1,1-Dichloroethene
TW2A
Detected 10 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:41 PM

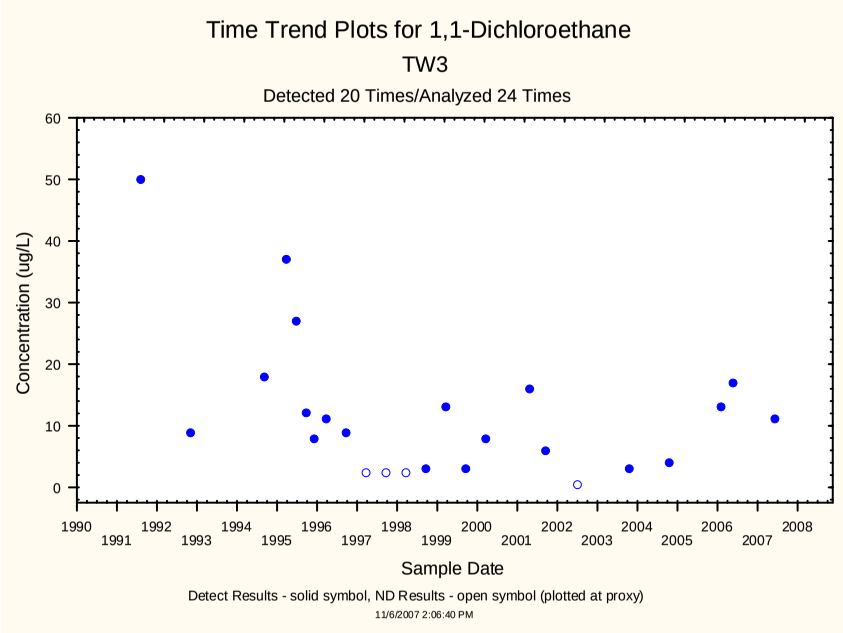

Time Trend Plots for Tetrachloroethene
TW2A
Detected 21 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:41 PM

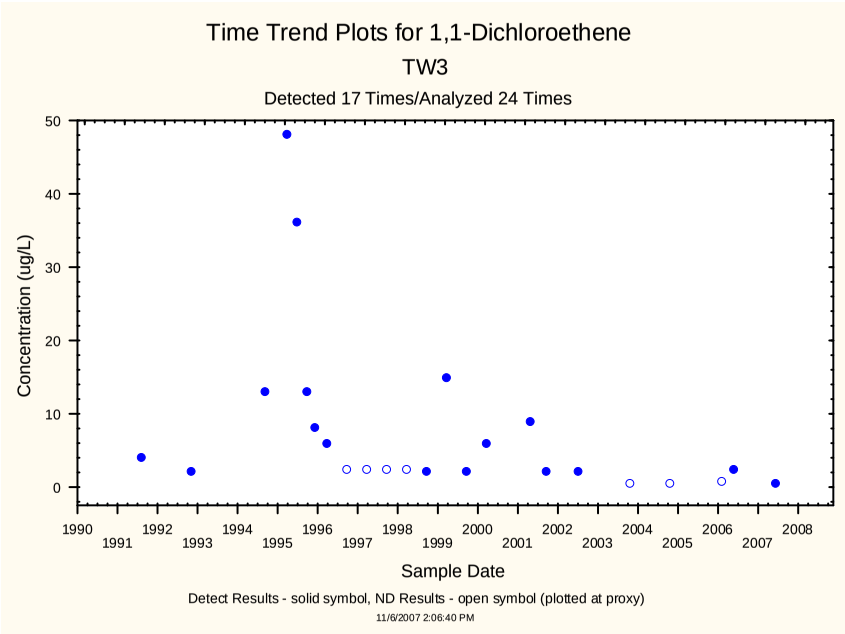

Time Trend Plots for Trichloroethene
TW2A
Detected 22 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:41 PM

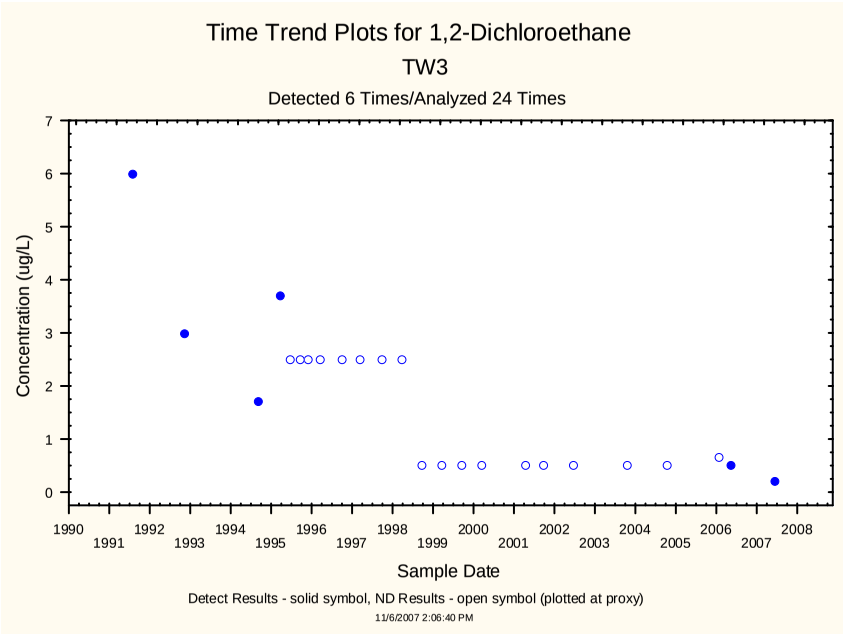

Time Trend Plots for cis-1,2-Dichloroethene
TW2A
Detected 20 Times/Analyzed 20 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:40 PM

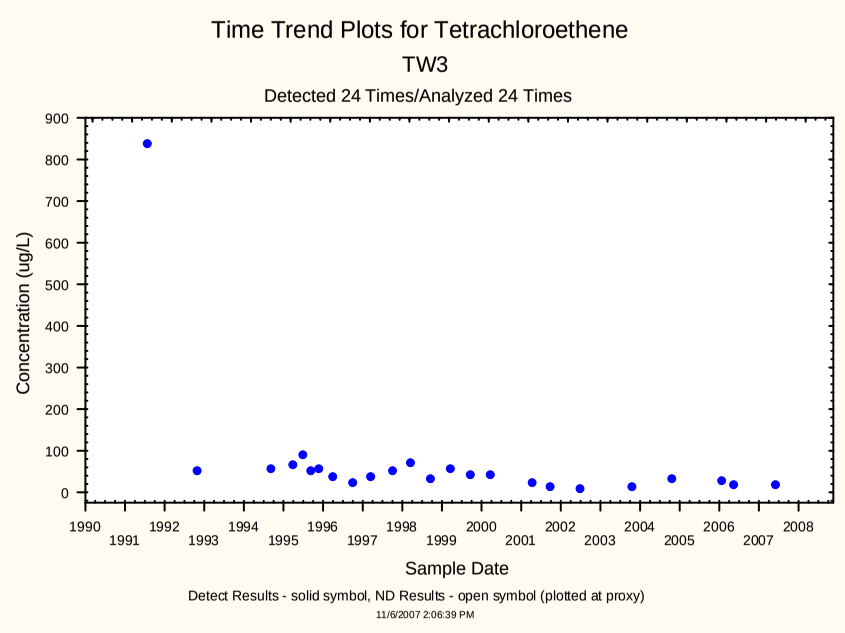

Time Trend Plots for trans-1,2-Dichloroethene
TW2A
Detected 6 Times/Analyzed 21 Times
Concentration (ug/L)
3 5
3 0
2 5
2 0
1 5
1 0
0 5
0 0
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:40 PM

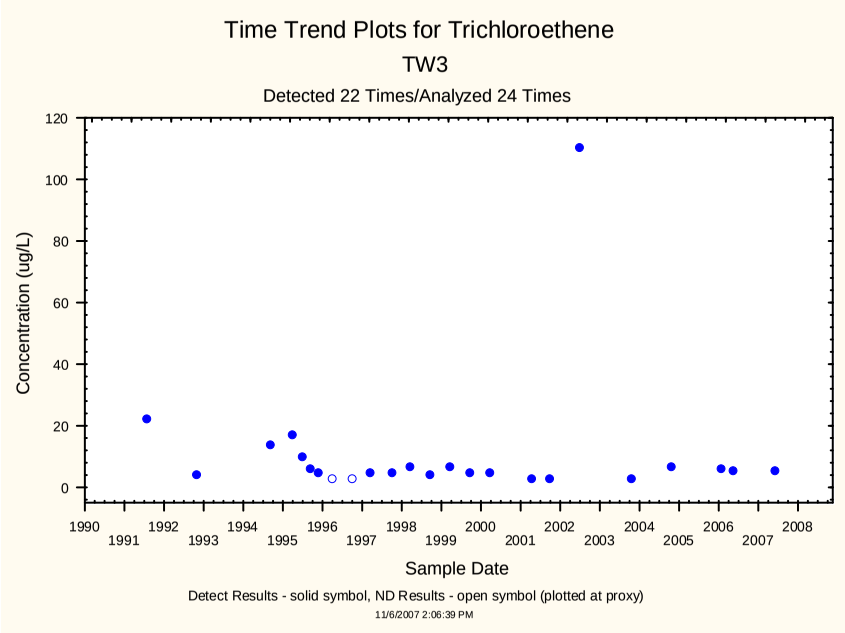

Time Trend Plots for 1,1,1-Trichloroethane
TW3
Detected 12 Times/Analyzed 24 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:40 PM

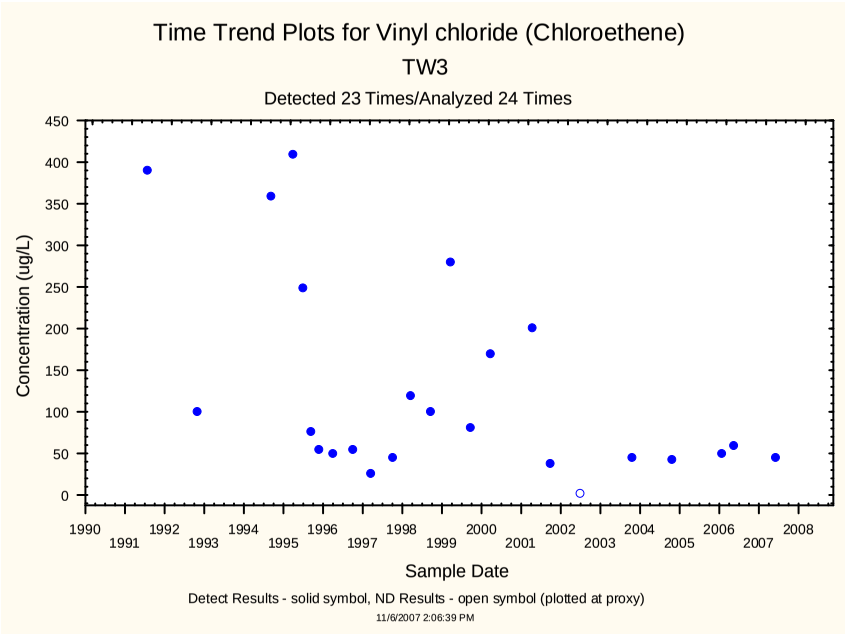

Time Trend Plots for 1,1-Dichloroethane
TW3
Detected 20 Times/Analyzed 24 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:40 PM

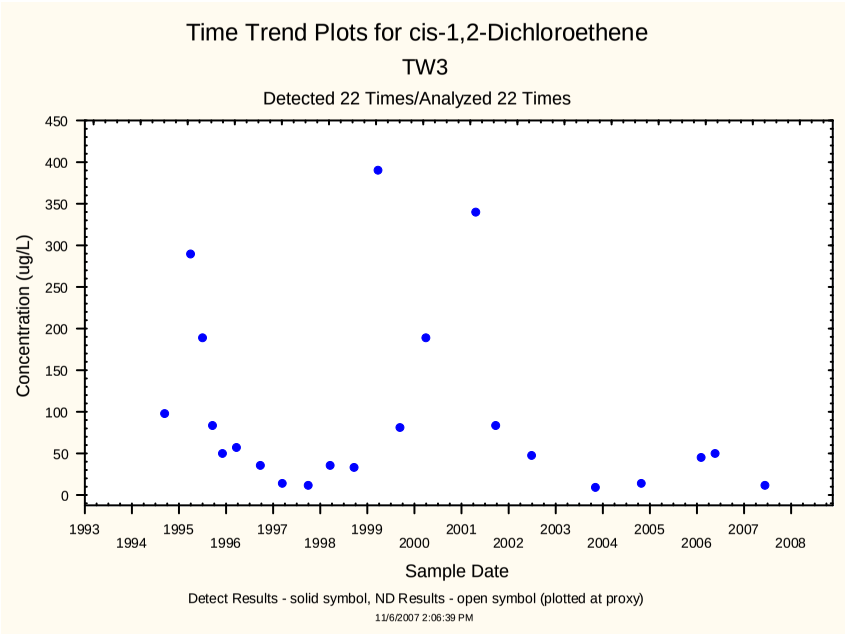

Time Trend Plots for 1,1-Dichloroethene
TW3
Detected 17 Times/Analyzed 24 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:40 PM

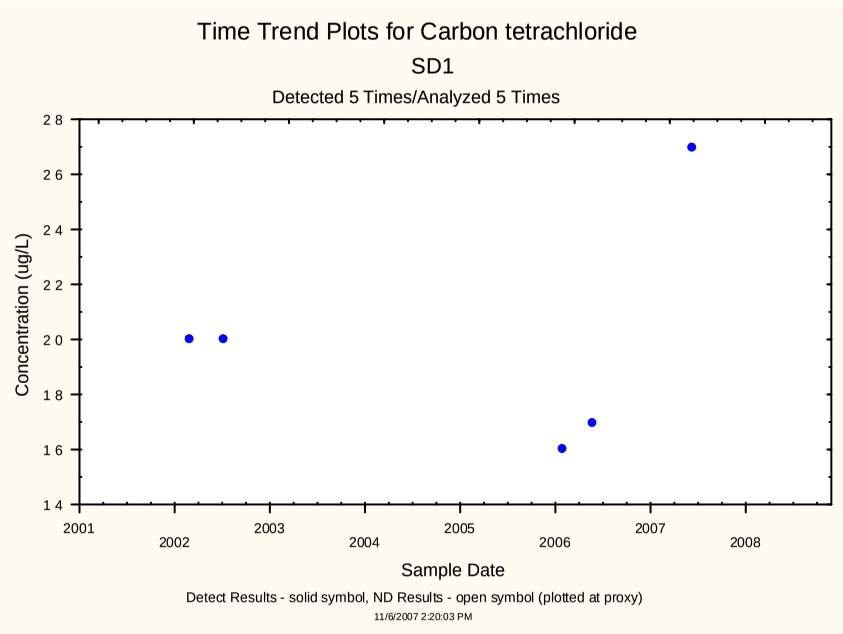

Time Trend Plots for 1,2-Dichloroethane
TW3
Detected 6 Times/Analyzed 24 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:40 PM

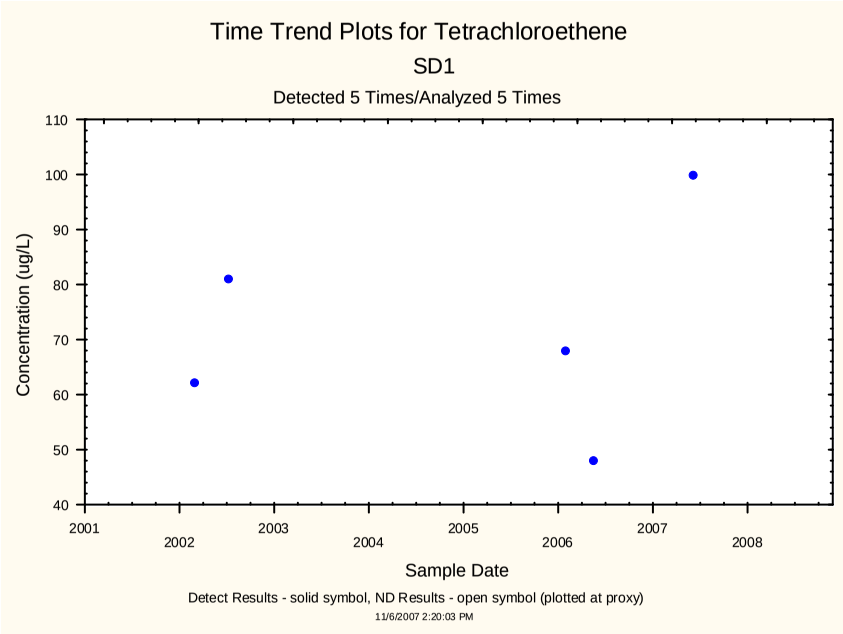

Time Trend Plots for Tetrachloroethene
TW3
Detected 24 Times/Analyzed 24 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:39 PM

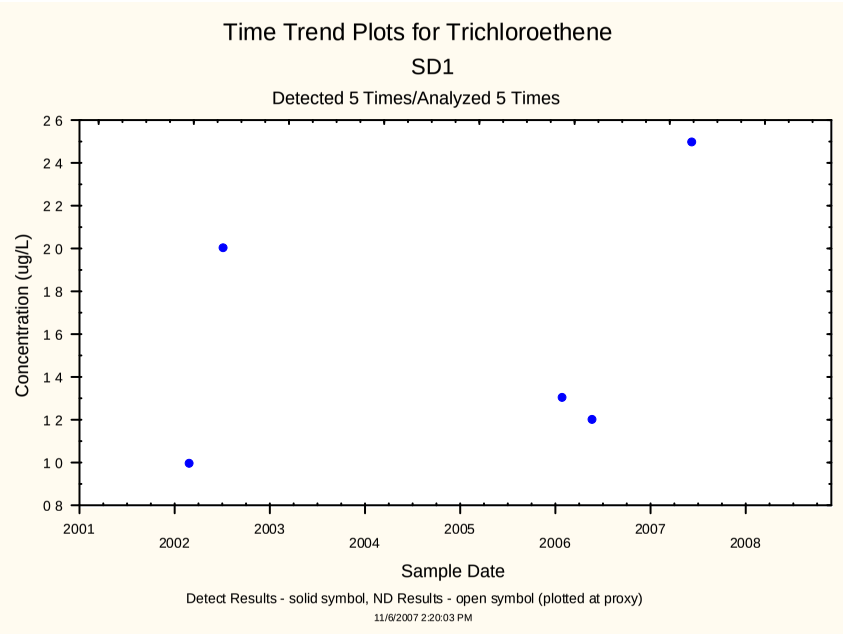

Time Trend Plots for Trichloroethene
TW3
Detected 22 Times/Analyzed 24 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:39 PM

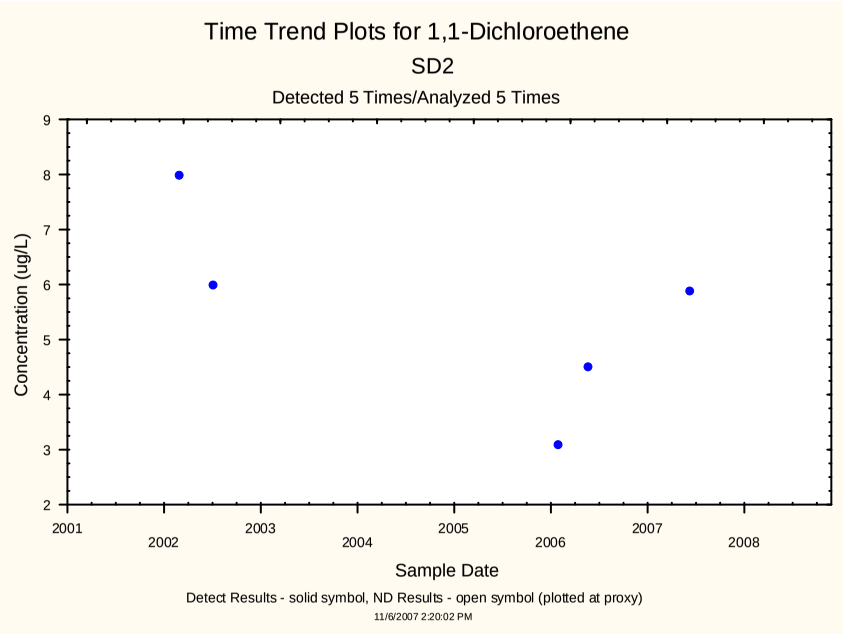

Time Trend Plots for Vinyl chloride (Chloroethene)
TW3
Detected 23 Times/Analyzed 24 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:39 PM

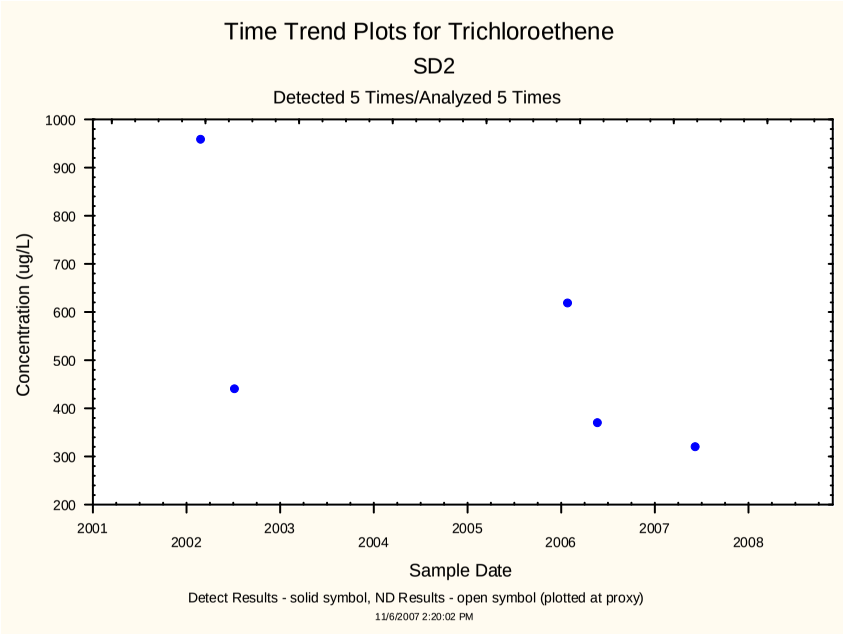

Time Trend Plots for cis-1,2-Dichloroethene
TW3
Detected 22 Times/Analyzed 22 Times
Concentration (ug/L)
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:06:39 PM

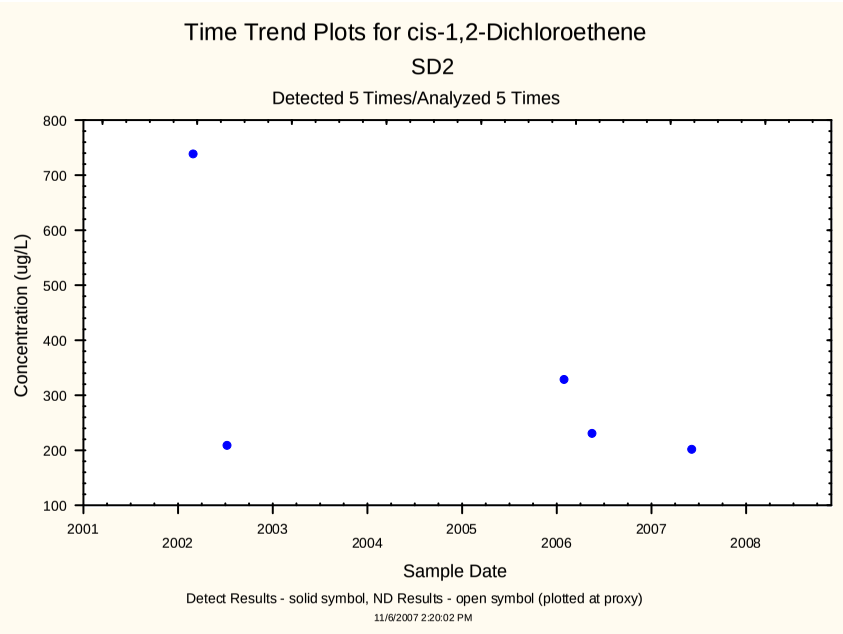

Time Trend Plots for Carbon tetrachloride
SD1
Detected 5 Times/Analyzed 5 Times
Concentration (ug/L)
2 8
2 6
2 4
2 2
2 0
1 8
1 6
1 4
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:20:03 PM

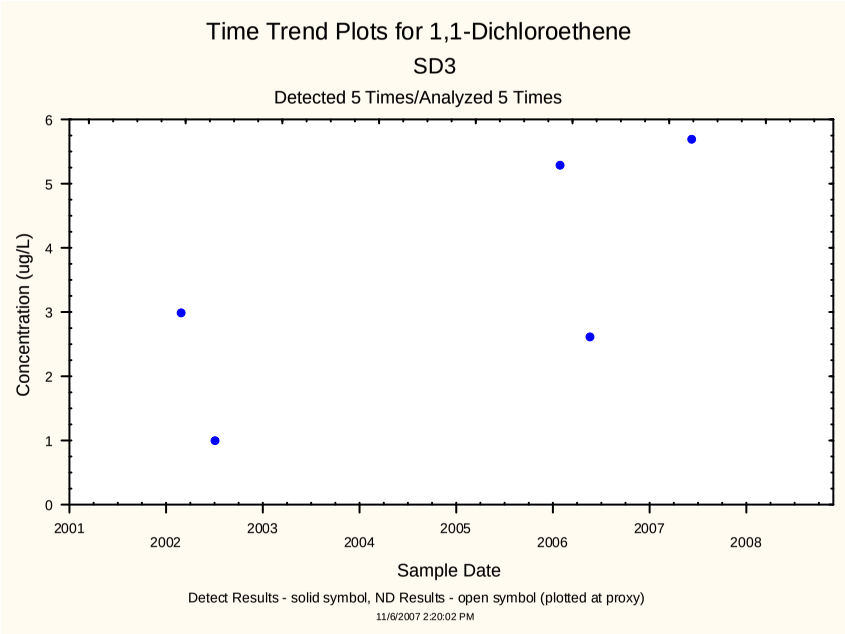

Time Trend Plots for Tetrachloroethene
SD1
Detected 5 Times/Analyzed 5 Times
Concentration (ug/L)
110
100
90
80
70
60
50
40
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:20:03 PM

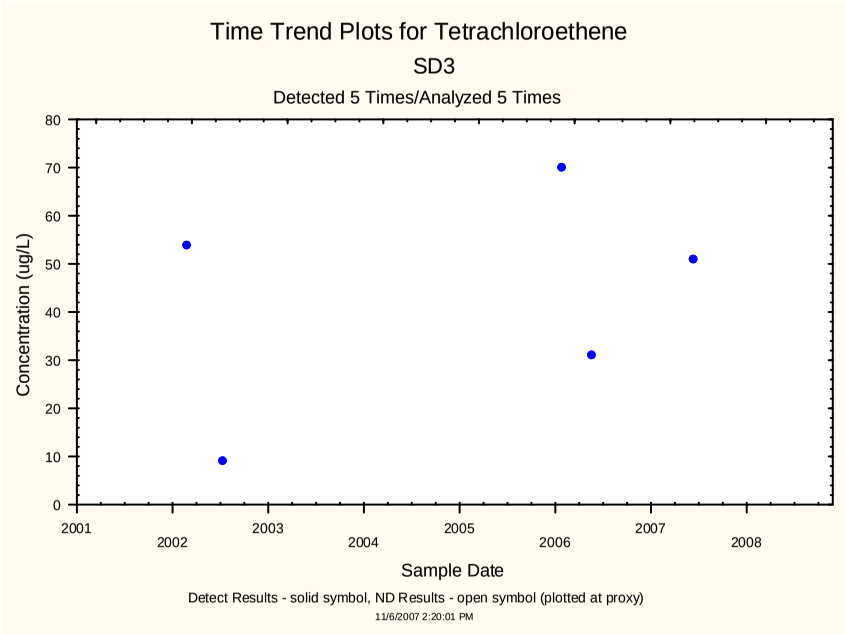

Time Trend Plots for Trichloroethene
SD1
Detected 5 Times/Analyzed 5 Times
Concentration (ug/L)
2 6
2 4
2 2
2 0
1 8
1 6
1 4
1 2
1 0
0 8
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:20:03 PM

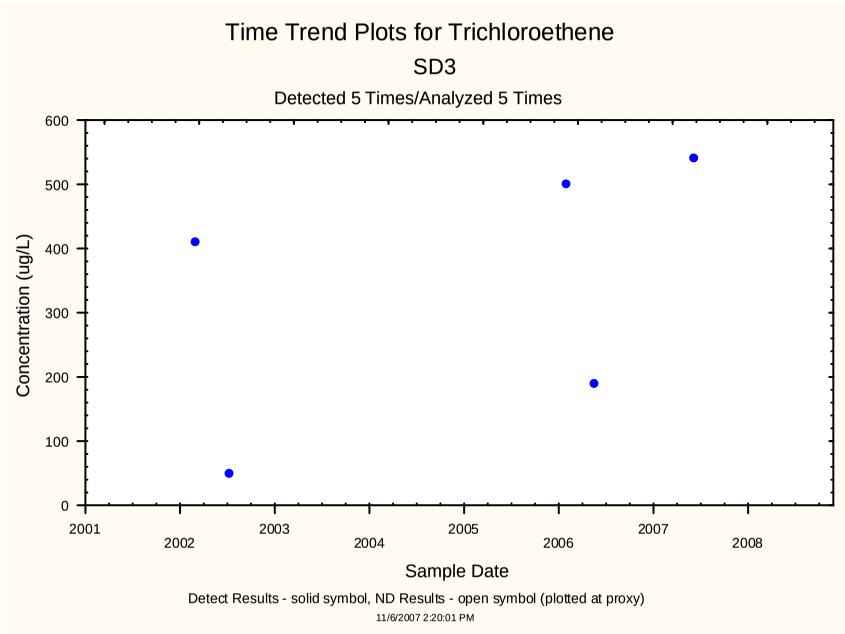

Time Trend Plots for 1,1-Dichloroethene
SD2
Detected 5 Times/Analyzed 5 Times
Concentration (ug/L)
9
8
7
6
5
4
3
2
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:20:02 PM

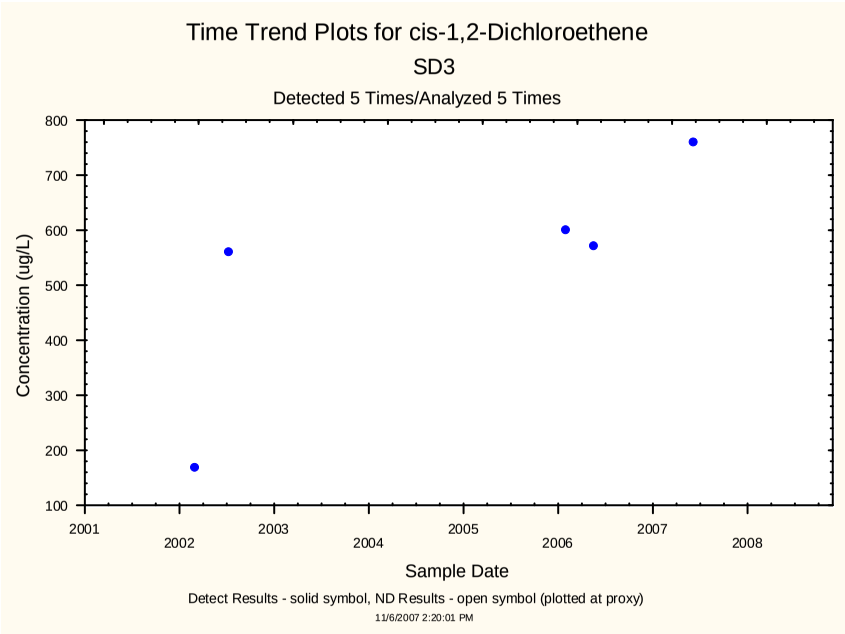

Time Trend Plots for Trichloroethene
SD2
Detected 5 Times/Analyzed 5 Times
Concentration (ug/L)
1000
900
800
700
600
500
400
300
200
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:20:02 PM

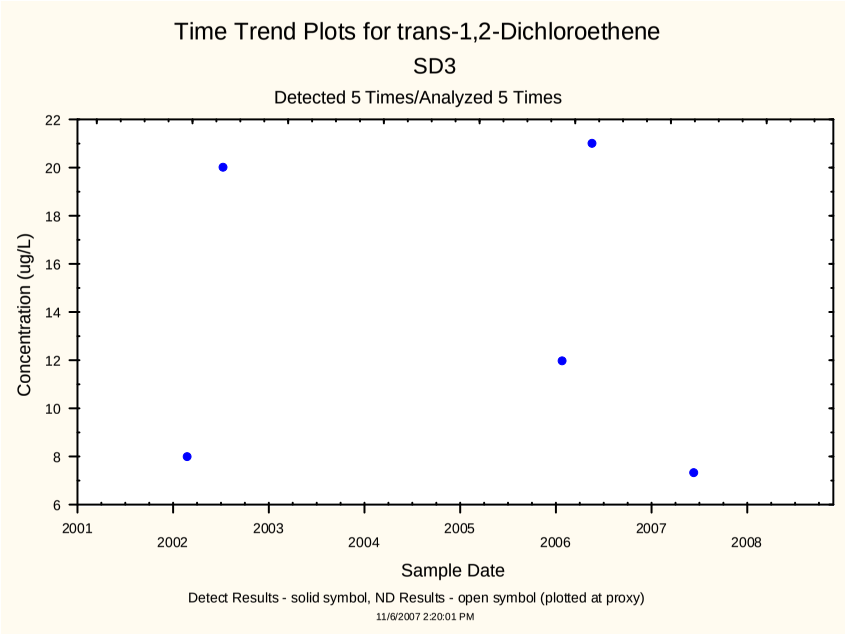

Time Trend Plots for cis-1,2-Dichloroethene
SD2
Detected 5 Times/Analyzed 5 Times
Concentration (ug/L)
800
700
600
500
400
300
200
100
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:20:02 PM


Time Trend Plots for 1,1-Dichloroethene
SD3
Detected 5 Times/Analyzed 5 Times
Concentration (ug/L)
0
1
2
3
4
5
6
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:20:02 PM


Time Trend Plots for Tetrachloroethene
SD3
Detected 5 Times/Analyzed 5 Times
Concentration (ug/L)
0
10
20
30
40
50
60
70
80
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:20:01 PM

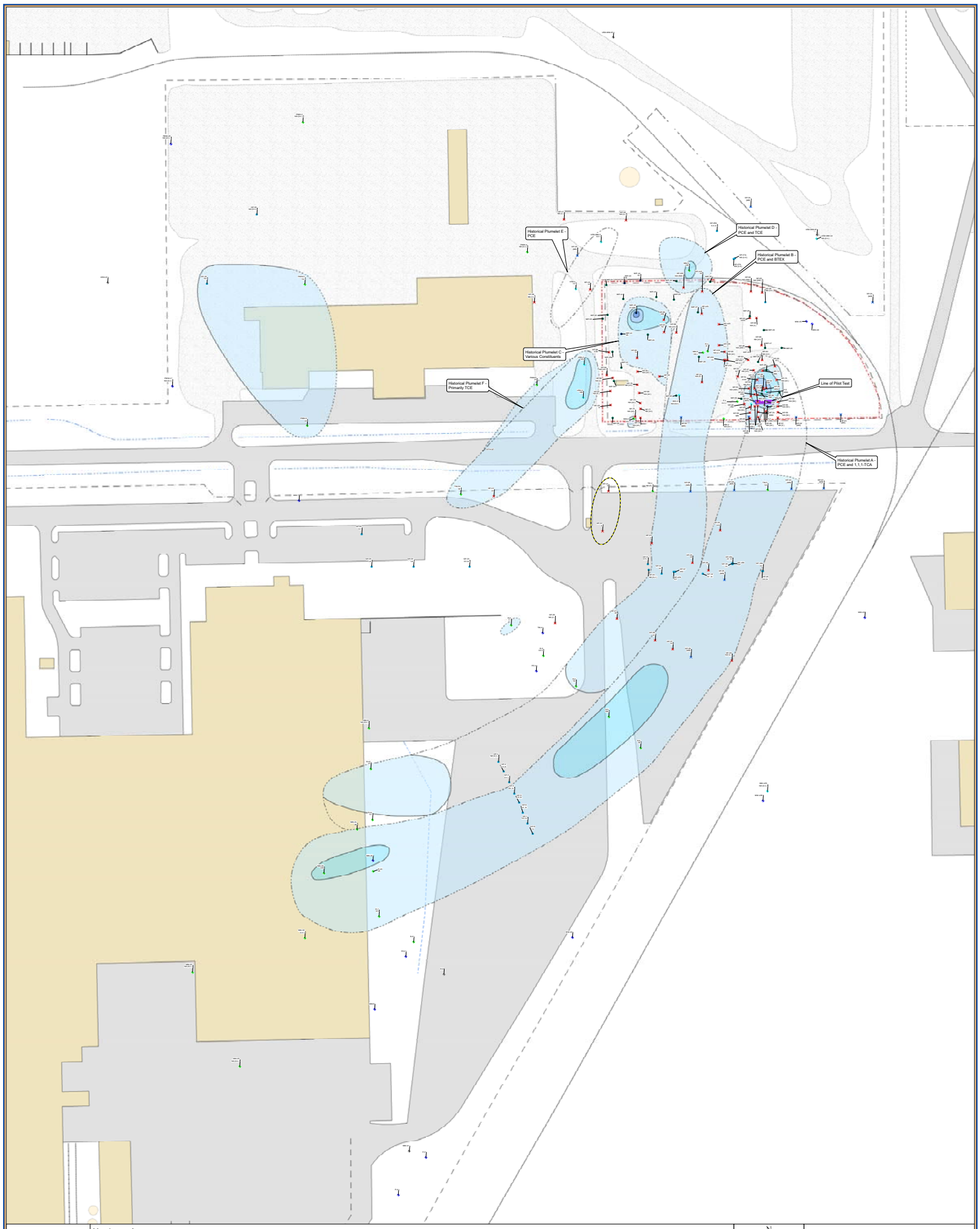

Time Trend Plots for Trichloroethene
SD3
Detected 5 Times/Analyzed 5 Times
Concentration (ug/L)
0
100
200
300
400
500
600
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:20:01 PM


Time Trend Plots for cis-1,2-Dichloroethene
SD3
Detected 5 Times/Analyzed 5 Times
Concentration (ug/L)
100
200
300
400
500
600
700
800
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:20:01 PM


Time Trend Plots for trans-1,2-Dichloroethene
SD3
Detected 5 Times/Analyzed 5 Times
Concentration (ug/L)
22
20
18
16
14
12
10
8
6
2001
2002
2003
2004
2005
2006
2007
2008
Sample Date
Detect Results - solid symbol, ND Results - open symbol (plotted at proxy)
11/6/2007 2:20:01 PM

APPENDIX D

COC Results for 2006 Annual Monitoring Event with Historical and Supplemental Data



Former Unocal Chemical Distribution Facility
Wichita, Kansas

URS

Map Legend

Monitoring Well Location (PZ)

Monitoring Well Locations (2006 Results)

Groundwater Elevation Measured

Groundwater Elevation Measured and Sample Taken

Sample Taken

Not Used

GP Locations

GPT Locations with Multiple Results - refer to Figures 2.20 and 2.21

GPT Location

MIP Location (No DIF Data)

MIP Location (DIF Results)

Historical Plumelet

Extent of Plume

Estimated Extent of Plume

Historical Area of Interest

Line of Pilot Test

<5 µg/L TCE (MCL)

100 µg/L TCE

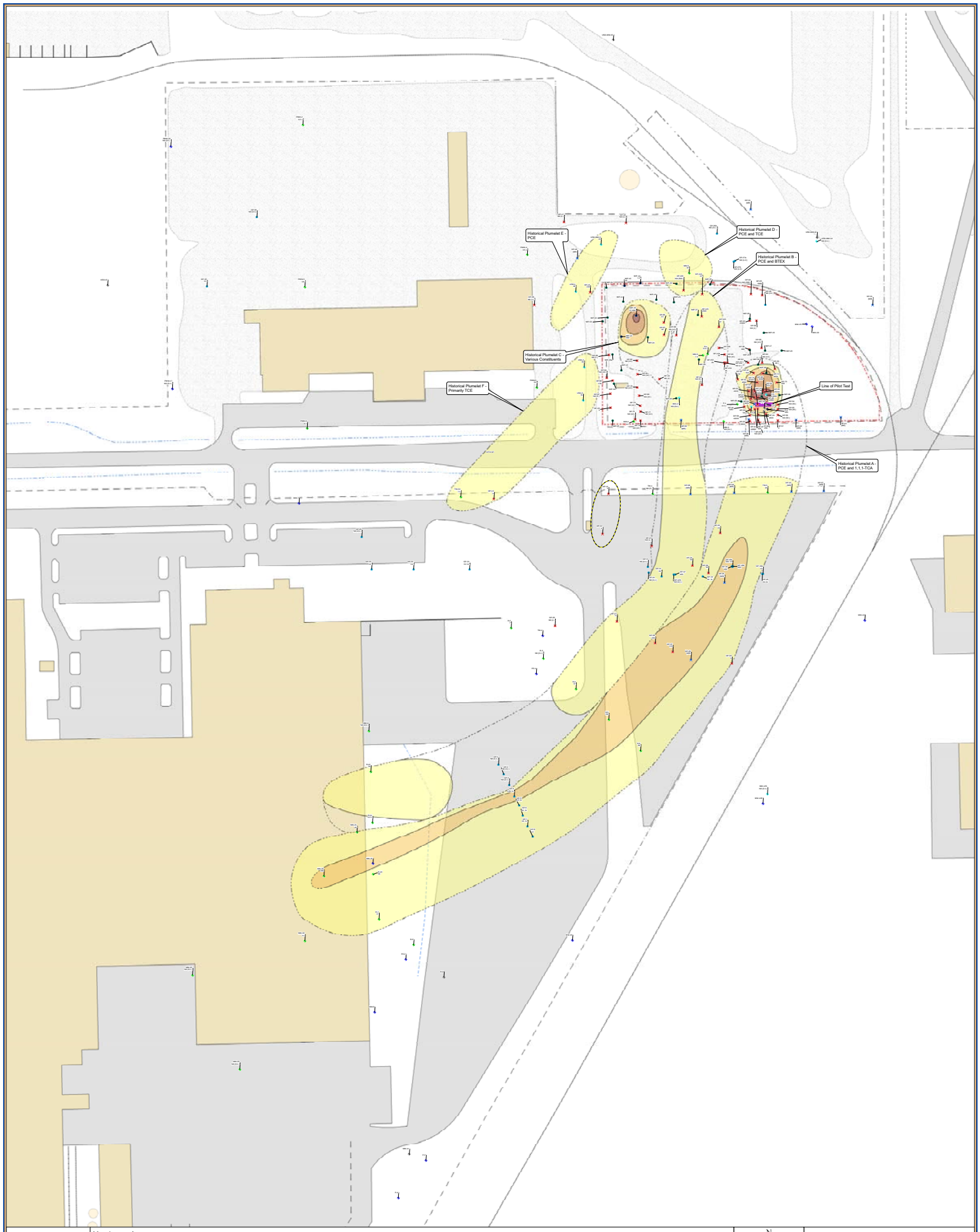
1000 µg/L TCE

10,000 µg/L TCE

N

0 50 100
Feet

TCE IN GROUNDWATER 2006



Former Unocal Chemical Distribution Facility
Wichita, Kansas

URS

Map Legend

Monitoring Well Location (PC-2)

Monitoring Well Locations (2006 Results)

Groundwater Elevation Measured

Groundwater Elevation Measured and Sample Taken

Sample Taken

Not Used

GP Locations

GPT Locations with Multiple Results (MR) - refer to Figures 2.20 and 2.21

GPT Location

MIP Location (No DSF Data)

MIP Location (DSF Results)

Historical Plumelet

Extent of Plume

Estimated Extent of Plume

Historical Area of Interest

Line of Pilot Test

5 µg/L PCE (MCL)

100 µg/L PCE

1,000 µg/L PCE

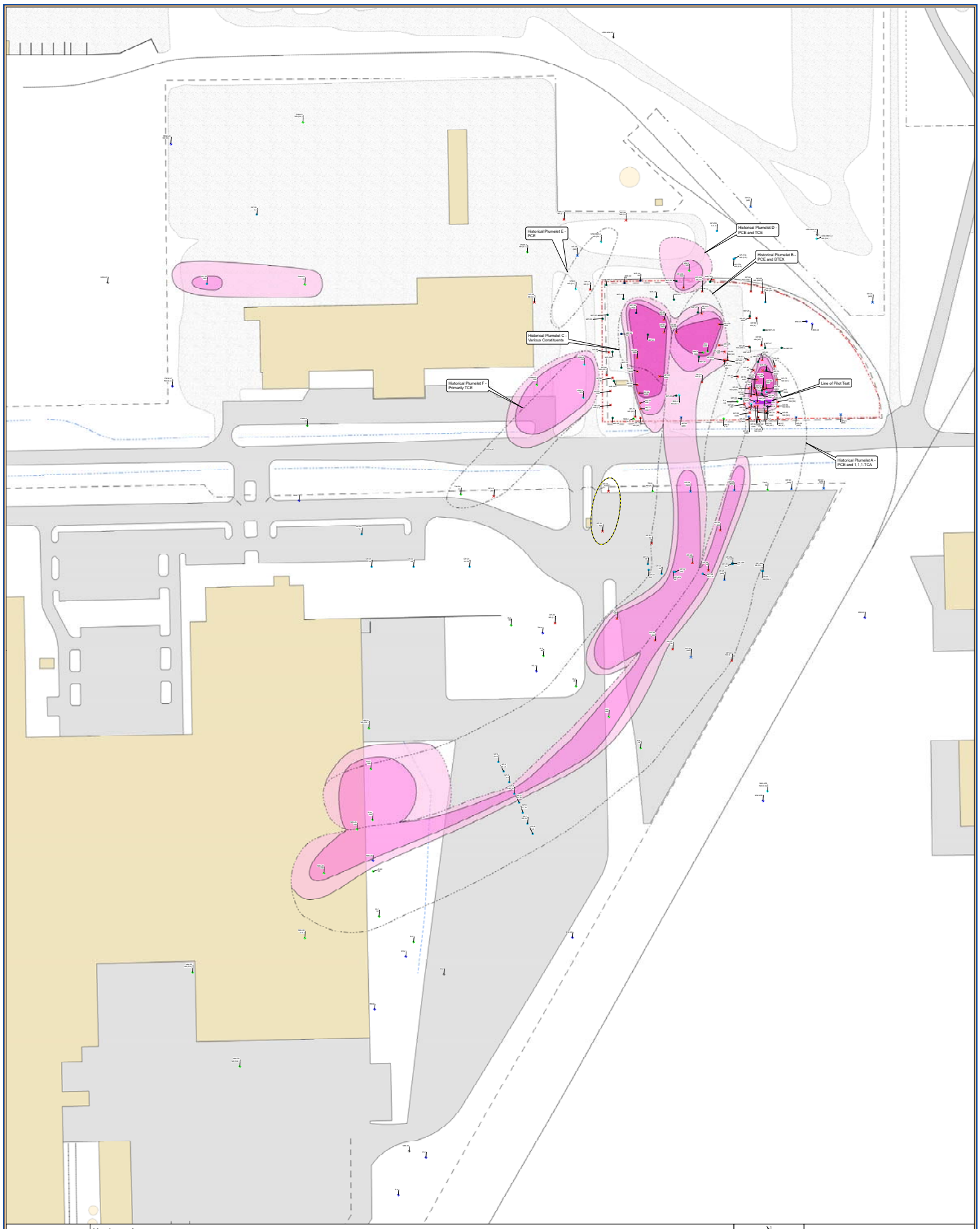
10,000 µg/L of PCE

N

0 50 100

Feet

PCE IN GROUNDWATER 2006



Former Unocal Chemical Distribution Facility
Wichita, Kansas

URS

Map Legend

Monitoring Well Location (PC-2)

Monitoring Well Locations (2006 Results)

Groundwater Elevation Measured

Groundwater Elevation Measured and Sample Taken

Sample Taken

Not Used

GP Locations

DPT Locations with Multiple Results (MR) - refer to Figures 2.22 and 2.23

DPT Location

MIP Location (No VOF Data)

MIP Location (VOF Results)

Historical Plumelet

Extent of Plume

Estimated Extent of Plume

Historical Area of Interest

Line of Pilot Test

70 µg/L (MCL)

100 µg/L DCE

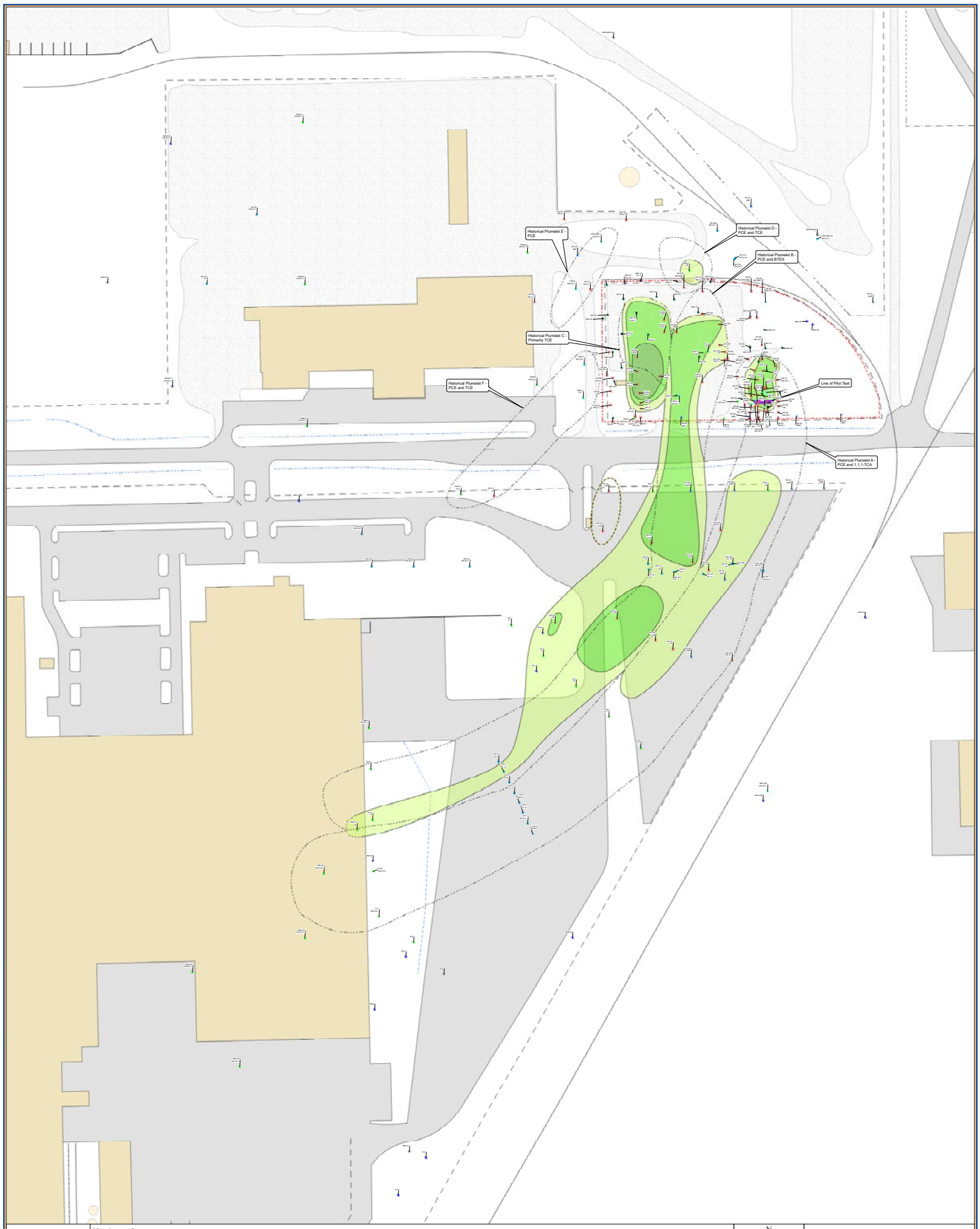
1000 µg/L DCE

N

0 50 100

Feet

DCE IN GROUNDWATER 2006



Former Unocal Chemical Distribution Facility
Wichita, Kansas

URS

Map Legend

Monitoring Well Location (PZ)

Monitoring Well Locations (2006 Results)

Groundwater Elevation Measured

Groundwater Elevation Measured and Sample Taken

Sample Taken

Not Used

GP Locations

DPT Locations with Multiple Results - refer to Figures 2.20 and 2.22

DPT Location

MIP Location (No DIV Data)

MIP Location (DIV Results)

Historical Plumelet

Extent of Plume

Delineated Extent of Plume

Historical Area of Interest

Line of Pilot Test

7 µg/L Vinyl Chloride (MCL)

100 µg/L Vinyl Chloride

1000 µg/L Vinyl Chloride

N

0 50 100

Feet

VC IN GROUNDWATER 2006