Σ²Π

S. S. PAPADOPULOS & ASSOCIATES, INC.
ENVIRONMENTAL & WATER-RESOURCE CONSULTANTS

May 31, 2006

United States Environmental Protection Agency
Region VI – Technical Section (6EN-HX)
Compliance Assurance & Enforcement Division
1445 Ross Avenue
Dallas, TX 75202
Attn: Sparton Technology, Inc. Project
Coordinator Charles A. Barnes (3 copies)

Permits Program Manager
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303
Attn: Sparton Technology, Inc.
Project Coordinator John Kieling

Director, Water & Waste Management Division
New Mexico Environment Department
1190 St. Francis Drive, 4th Floor
Santa Fe, NM 87505

Chief, Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303

Chief, Groundwater Quality Bureau
New Mexico Environment Department
1190 St. Francis Drive, 4th Floor
Santa Fe, NM 87505

Mr. Baird Swanson
New Mexico Environment Department
4131 Montgomery NE
Albuquerque, NM 87109

Subject: Sparton Technology, Inc. Former Coors Road Plant Remedial Program
2005 Annual Report

Gentlemen:

On behalf of Sparton Technology, Inc. (Sparton), S. S. Papadopulos & Associates, Inc. (SSP&A) is pleased to submit the subject report. The report presents data collected at Sparton's former Coors Road Plant during the operation of the remedial systems in 2005, and evaluations of these data to assess the performance of the systems. This document was prepared by SSP&A with the assistance of Metric Corporation, Inc.

I certify under penalty of law that this document and all attachments were prepared under my direction and supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based upon my inquiry of either the person or persons who manage the system and/or the person or persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I further certify, to the best of my knowledge and belief, that this document is consistent with the applicable requirements of the Consent Decree entered among the New Mexico Environment Department, the U.S. Environmental Protection Agency, Sparton

7944 WISCONSIN AVENUE, BETHESDA, MARYLAND 20814-3620 • TEL: (301) 718-8900 • FAX: (301) 718-8909
www.sspa.com • e-mail: bethesda@sspa.com

Technology, Inc., and others in connection with Civil Action No. CIV 97 0206 LH/JHG, United States District Court for the District of New Mexico. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

If you have any questions concerning the report, please contact me.

Sincerely,

S. S. PAPADOPULOS & ASSOCIATES, INC.

Stavros S. Papadopulos, PhD, PE
Founder & Senior Principal

cc: Secretary, Sparton Technology, Inc., c/o Ms. Susan Widener
Ms. Terri Donahue, Controller, Sparton Technology, Inc.
Ms. Susan Widener (3 copies)
Mr. James B. Harris
Mr. Tony Hurst (2 copies)
Mr. Gary L. Richardson

Sparton Technology, Inc.
Former Coors Road Plant
Remedial Program

2005 Annual Report

S. S. PAPADOPULOS & ASSOCIATES, INC.
Environmental & Water-Resource Consultants

May 31, 2006

7944 Wisconsin Avenue, Bethesda, Maryland 20814-3620 • (301) 718-8900

Sparton Technology, Inc.
Former Coors Road Plant
Remedial Program

2005 Annual Report

Prepared For:

Sparton Technology, Inc.
Rio Rancho, New Mexico

Prepared By:

S. S. PAPADOPULOS & ASSOCIATES, INC.
Environmental & Water-Resource Consultants
In Association with:
Metric Corporation, Albuquerque, New Mexico

May 31, 2006

7944 Wisconsin Avenue, Bethesda, Maryland 20814-3620 • (301) 718-8900

Executive Summary

The former Coors Road Plant (*Site*) of Sparton Technology, Inc. (*Sparton*) is located at 9621 Coors Boulevard NW, Albuquerque, New Mexico. The Site is at an elevation of about 5,050 feet above mean sea level (*ft MSL*); the land slopes towards the Rio Grande on the east and rises to elevations of 5,150-5,200 ft MSL within a short distance to the west of the Site. The upper 1,500 feet of the fill deposits underlying the Site consist primarily of sand and gravel with minor amounts of silt and clay. The water table beneath the Site is at an elevation of 4,975-4,985 ft MSL and slopes towards the northwest to an elevation of about 4,960 ft MSL within about one-half mile of the Site. At an elevation of about 4,800 ft MSL a 2- to 3-foot clay layer, referred to as the 4,800-foot clay unit, has been identified.

Past waste management activities at the Site had resulted in the contamination of the Site soils and of groundwater beneath and downgradient from the Site. The primary contaminants are volatile organic compounds (*VOCs*), specifically trichloroethylene (*TCE*), 1,1-Dichloroethylene (*DCE*), and 1,1,1-Trichloroethane (*TCA*), and chromium. Remedial investigations at the Site had indicated that groundwater contamination was limited to the aquifer above the 4,800-foot clay and current measures for groundwater remediation have been designed to address contamination within this depth interval.

Under the terms of a Consent Decree entered on March 3, 2000, Sparton agreed to implement a number of remedial measures. These remedial measures consisted of: (a) the installation and operation of an off-site containment system; (b) the installation and operation of a source containment system; and (c) the operation of an on-site, 400-cfm soil vapor extraction (*SVE*) system for an aggregate period of one year. The goals of these remedial measures are: (a) to control hydraulically the migration of the off-site plume; (b) to control hydraulically any potential source areas that may be continuing to contribute to groundwater contamination at the on-site area; (c) to reduce contaminant concentrations in vadose-zone soils in the on-site area and thereby reduce the likelihood that these soils remain a source of groundwater contamination; and (d) in the long-term, restore the groundwater to beneficial use.

The installation of the off-site containment system, consisting of a containment well near the leading edge of the plume, an off-site treatment system, an infiltration gallery in the Arroyo de las Calabacillas, and associated conveyance and monitoring components, began in late 1998 and was completed in early May 1999. The off-site containment well began operating on December 31, 1998; except for brief interruptions for maintenance activities or due to power outages, the well has operated continuously since that date; the year 2005 was the seventh full year of operation of this well. The source containment system, consisting of a containment well immediately downgradient from the site, an on-site treatment system, six on-site infiltration ponds, and associated conveyance and monitoring components, was installed during 2001 and began operating on January 3, 2002; the year 2005 was the fourth year of operation of this well. The 400-cfm SVE system had operated for a total of about 372 days between April 10, 2000 and June 15, 2001 and thus met the length-of-operation requirements of the Consent Decree;

monitoring conducted in the Fall of 2001 indicated that the system had also met its performance goals, and the system was dismantled in May 2002.

During 2005, considerable progress was made towards achieving the goals of the remedial measures:

- The off-site containment well continued to operate during the year at a discharge rate of 225 gpm, sufficient for containing the plume.
- The pumped water was treated and returned to the aquifer through the infiltration gallery. The concentrations of constituents of concern in the treated water met all the requirements of the Groundwater Discharge Permit for the site. Chromium concentrations in the influent to the treatment system remained at levels that did not require treatment.
- The source containment well continued to operate during the year at a rate of 48 gpm, sufficient for containing potential on-site source areas.
- Groundwater monitoring was conducted as specified in Attachment A to the Consent Decree. Water levels in all accessible wells and/or piezometers, and the Corrales Main Canal were measured quarterly. Samples were collected for water-quality analyses from monitoring wells at the frequency specified in the Consent Decree and analyzed for VOCs and total chromium.
- Samples were obtained from the influent and effluent of the treatment plants for the off-site and source containment systems, and the infiltration gallery and infiltration pond monitoring wells at the frequency specified in the Groundwater Discharge Permit. All samples were analyzed for VOCs, total chromium, iron, and manganese.
- The groundwater flow and transport model that was developed in 1999 to simulate the hydrogeologic system underlying the site was recalibrated and used to simulate TCE concentrations in the aquifer from start-up of the off-site containment well in December 1998 through November 2005 and to predict concentrations in November 2006.

The off-site containment well continued to provide hydraulic control of the contaminant plume throughout the year. The source containment well that began operating in early 2002 quickly developed a capture zone that controls any potential on-site sources that may be contributing to groundwater contamination. Data from 2005 indicate that the well continued to maintain this capture zone throughout 2005.

The performance of the six on-site infiltration ponds during the last several years indicated that four ponds are more than adequate for handling the water pumped by the source containment well. With the approval of the regulatory agencies, Sparton backfilled two of the six ponds to put the land to other beneficial use.

The extent of groundwater contamination, as defined by the extent of the TCE plume, did not change significantly during 2005. Of the 57 wells sampled in November 2005, the concentrations of TCE were lower than in November 2004 in 20 wells, higher in 17 wells, and remained the same (below detection limits) in 20 wells. The corresponding numbers for DCE were 11 wells with lower, 12 wells with higher, and 34 wells with the same concentrations. Although the 2005 contaminant concentrations in off-site monitoring well MW-60 were considerably lower than they have been during the last several years, this well continued to be the most contaminated off-site well. The TCA plume ceased to exist during 2003, and this condition continued through 2005, that is, throughout the year there were no wells with TCA concentrations above the maximum allowable concentration in groundwater set by the New Mexico Water Quality Control Commission.

Changes in concentrations observed in monitoring wells since the implementation of the current remedial measures indicate that contaminant concentrations in the on-site area decreased significantly. Concentrations in most off-site wells have also decreased, or remained unchanged. The only wells were significant increases occurred are the off-site containment well CW-1, and on-site monitoring well MW-19. The persistence of the high concentrations that have been observed in the water pumped from CW-1 since the beginning of its operation, and the concentrations detected at MW-60 indicate the presence of high concentration areas upgradient from both CW-1 and MW-60. This conclusion is confirmed by the model calibration results.

The off-site and source containment wells operated at a combined average rate of 273 gpm during 2005. A total of about 143.5 million gallons of water were pumped from the wells. The total volume of water pumped since the beginning of the current remedial operations on December 1998 is about 915 million gallons and represents 81 percent of the initial volume of contaminated groundwater (pore volume).

Approximately 595 kg (1,310 lbs) of contaminants consisting of 558 kg (1,230 lbs) of TCE, 35 kg (77 lbs) of DCE, and 2.0 kg (4.4 lbs) of TCA were removed from the aquifer by the two containment wells during 2005. The total mass that was removed since the beginning of the of the current remedial operations is 3,940 kg (8,690 lbs) consisting of 3,710 kg (8,180 lbs) of TCE, 215 kg (475 lbs) of DCE, and 11 kg (24 lbs) of TCA. This represents about 54 percent of the total dissolved contaminant mass currently estimated to have been present in the aquifer prior to the testing and operation of the off-site containment well.

To address the continuing presence of contaminants in monitoring well MW-71R, which is completed in the Deep Flow Zone (DFZ) below the 4,800-foot clay, a decision was made in 2004 to install a DFZ monitoring/standby-extraction well near the off-site containment well CW-1. The Work Plan for the installation, testing, monitoring, and/or operation of this well was prepared in December 2004 and approved by the United States Environmental Protection Agency and the New Mexico Environment Department on January 6, 2005. Most of Sparton's effort during 2005 went into obtaining an easement agreement from the City of Albuquerque to provide access through a City owned park for moving a drilling rig to the proposed well location. This easement agreement was obtained by Sparton in October 2005, and Sparton began the construction of the monitoring/stand-by extraction well in early 2006.

The containment systems were shutdown several times during 2005 for routine maintenance activities, due to power and monitoring system failures, due to low levels in the chemical feed tanks, or due to the failure of other components of the systems. The downtime for these shutdowns ranged from 10 minutes to about 4 days.

Plans for next year include continuing the operation of the off-site and source containment systems and the collection of monitoring data as required by the Consent Decree and the permits controlling groundwater discharge and air emissions. Recalibration of the flow and transport model against data collected in 2006 and improvement of the model will continue next year. Three monitoring wells that were dry during the last several years will be plugged and abandoned. Work on the installation of a monitoring/standby-extraction well near the off-site containment well CW-1 will continue during 2006.[a]

[a] Installation and development of the well was completed on February 24, 2006. The well was pump-tested during the first week of April 2006 and samples were obtained during the test. Site-related contaminants were not found in any of the samples.

Table of Contents

Page

Figures

Tables

Appendices

List of Figures

List of Figures
(Continued)

List of Figures
(Continued)

List of Tables

List of Appendices

List of Acronyms

3rdFZ	Third depth interval of the Lower Flow Zone
COA	City of Albuquerque
CMS	Corrective Measure Study
cfm	cubic feet per minute
Cm^2/s	Centimeter square per second
DCE	1,1-Dichloroethylene
DFZ	Deep Flow Zone below the 4800 - foot clay
Ft	foot or feet
ft MSL	feet above Mean Sea Level
ft^2	square feet
ft^3	cubic feet
ft/d	feet per day
ft/yr	feet per year
ft^2/d	feet squared per day
g/cm^3	grams per cubic centimeter
gpd	gallons per day
gpm	gallons per minute
IM	Interim Measure
Kg	Kilogram
LLFZ	Lower Lower Flow Zone
Lbs	Pounds
MCL	Maximum Contaminant Level
MSL	Mean Sea Level
Metric	Metric Corporation
Mg/m^3	Milligrams per cubic meter
μg/L	Micrograms per liter
ND	Not Detected
NMED	New Mexico Environmental Department
NMEID	New Mexico Environmental Improvement Division
NMWQCC	New Mexico Water Quality Control Commission
ppmv	parts per million by volume
RFI	RCRA Facility Investigation
rpm	Revolutions per minute
Sparton	Sparton Technology, Inc.
SSP&A	S.S. Papadopulos & Associates, Inc.
SVE	Soil Vapor Extraction
TCA	1,1,1-Trichloroethane
TCE	Trichloroethylene
UFZ	Upper Flow Zone
ULFZ	Upper Lower Flow Zone
USEPA	United States Environmental Protection Agency
USF	Upper Santa Fe Group
USGS	United States Geological Survey
VOC	Volatile Organic Compound

REPORT

Section 1
Introduction

The former Coors Road Plant of Sparton Technology, Inc. (*Sparton*) is located at 9621 Coors Boulevard NW (the west side of the boulevard), Albuquerque, New Mexico, north of Paseo del Norte and south of the Arroyo de las Calabacillas (see Figure 1.1). Investigations conducted between 1983 and 1987 at and around the plant revealed that past waste management activities had resulted in the contamination of on-site soils and groundwater and that contaminated groundwater had migrated beyond the boundaries of the facility to downgradient, off-site areas.

In 1988, the United States Environmental Protection Agency (*USEPA*) and Sparton negotiated an Administrative Order on Consent, which became effective on October 1, 1988. Under the provisions of this Order, Sparton implemented in December 1988 an Interim Measure (*IM*) that consisted of an on-site, eight-well groundwater recovery and treatment system. The initial average recovery rate of the system was about 1.5 gallons per minute (*gpm*); however, the recovery rate began declining within a few years due to a regional decline in water levels. As a result, the system was shut-down and permanently taken out of service on November 16, 1999.

In 1998 and 1999, during settlement negotiations associated with lawsuits brought by the USEPA, the State of New Mexico, the County of Bernalillo, and the City of Albuquerque (*COA*), Sparton agreed to implement a number of remedial measures and take certain actions, including: (a) the installation, testing, and continuous operation of an off-site extraction well designed to contain the contaminant plume; (b) the replacement of the on-site groundwater recovery system by a source containment well designed to address the release of contaminants from potential on-site source areas; (c) the operation of a 400 cubic feet per minute (*cfm*) capacity on-site soil vapor extraction (*SVE*) system for a total operating time of one year over a period of eighteen months; (d) the implementation of a groundwater monitoring plan; (e) the assessment of aquifer restoration; and (f) the implementation of a public involvement plan. Work Plans for the implementation of the measures and actions agreed upon by the parties were developed and included in a Consent Decree entered by the parties on March 3, 2000 (Consent Decree, 2000; S.S. Papadopulos & Associates, Inc. [*SSP&A*], 2000a; 2000b; 2000c; and Chandler, 2000).

The off-site containment well was installed and tested in late 1998. Based on the test results, a pumping rate of about 225 gpm was determined to be adequate for containing the off-site plume (SSP&A, 1998), and the well began operating at approximately this rate on December 31, 1998. An air stripper for treating the pumped water and an infiltration gallery for returning the treated water to the aquifer were constructed in the spring of 1999, and the well was connected to these facilities in late April 1999. In 2000, due to chromium concentrations that exceeded the permit requirements for the discharge of the treated water, a chromium reduction process was added to the treatment system and began operating on December 15, 2000; however, chromium concentrations declined in 2001 and the process was discontinued on October 31,

2001. The year 2005 constitutes the seventh year of operation of the off-site containment system.

Throughout 1999 and 2000, Sparton applied for and obtained approvals for the different permits and work plans required for the installation of the source-containment system. The Construction Work Plan for the system was approved on February 20, 2001, and construction began soon after that date. The installation of the system was completed by the end of 2001, and the system began operating on January 3, 2002. Thus, the year 2005 constitutes the fourth year of operation of the source containment system.

SVE systems of different capacities were operated at the Sparton facility between April and October 1998, and between May and August 1999. The 400-cfm SVE system was installed in the spring of 2000 and operated for an aggregate of about 372 days between April 10, 2000 and June 15, 2001, meeting the one-year operation requirement of the Consent Decree. The performance of the system was evaluated by conducting two consecutive monthly sampling events of soil gas in September and October 2001, after a 3-month shut-off period. The results of these two sampling events, which were presented in the Final Report on the On-Site Soil Vapor Extraction System (Chandler and Metric Corporation, 2001) and on Table 4.7 of the 2001 Annual Report (SSP&A, 2002), indicated that TCE concentrations at all monitoring locations were considerably below the 10 parts per million by volume (*ppmv*) remediation goal of the Consent Decree. Based on these results, the operation of the SVE system was permanently discontinued by dismantling the system and plugging the vapor recovery well and vapor probes in May 2002.

The purpose of this 2005 Annual Report is to:

- provide a brief history of the former Sparton plant and affected areas downgradient from the plant,
- summarize remedial and other actions taken by the end of 2005,
- present the data collected during 2005 from operating and monitoring systems, and
- provide the interpretations of these data with respect to meeting remedial objectives.

This report was prepared on behalf of Sparton by SSP&A in cooperation with Metric. Background information on the site, the implementation of remedial actions, and initial site conditions, as they existed prior to the implementation of the remedial actions agreed upon in the Consent Decree, are discussed in Section 2; a brief summary of operations during 1999 through 2004 is included in this section. Issues related to the year-2005 operation of the off-site and source containment systems are discussed in Section 3. Data collected to evaluate system performance and to satisfy permit or other requirements are presented in Section 4. Section 5 presents the interpretations of the data and discusses the results with respect to the performance and the goals of the remedial systems. A description of the site's groundwater flow and transport model that was developed in 1999 (SSP&A, 2001a), modifications to the model based on data collected during 2005, and predictions made using this model are presented in Section 6. Section 7 summarizes the report and discusses future plans. References cited in the report are listed in Section 8.

Section 2 Background

2.1 Description of Facility

The site of Sparton's former Coors Road plant is an approximately 12-acre property located in northwest Albuquerque, on Coors Boulevard NW. The property is about one-quarter mile south of the Arroyo de las Calabacillas, about three-quarters of a mile north of the intersection of Coors Boulevard and Paseo del Norte, and about one-half mile west of the Rio Grande (see Figure 1.1). The property sits on a terrace about 60 feet (*ft*) above the Rio Grande floodplain. An irrigation canal, the Corrales Main Canal, is within a few hundred feet from the southeast corner of the property. About one-quarter mile west of the property, the land rises approximately 150 ft forming a hilly area with residential properties.

The plant consisted of a 64,000-square-foot manufacturing and office building and of several other small structures that were used for storage or as workshops (see Figure 2.1). Manufacturing of electronic components, including printed-circuit boards, at the plant began in 1961 and continued until 1994. Between 1994 and the end of 1999, Sparton operated a machine shop at the plant in support of manufacturing at the company's Rio Rancho plant and other locations. The property was leased to Melloy Dodge in October 1999. During 2000 and early 2001, the tenant made modifications and renovations to the property to convert it to an automobile dealership and began operating it as a dealership on April 23, 2001.

2.2 Waste Management History

The manufacturing processes at the plant generated two waste streams that were managed as hazardous wastes: a solvent waste stream and an aqueous metal-plating waste stream. Waste solvents were accumulated in an on-site concrete sump (Figure 2.1) and allowed to evaporate. In October 1980, Sparton discontinued using the sump and closed it by removing remaining wastes and filling it with sand. After that date, Sparton began to accumulate the waste solvents in drums and disposed of them off-site at a permitted facility.

The plating wastes were stored in a surface impoundment (Figure 2.1), and wastewater that accumulated in the impoundment was periodically removed by a vacuum truck for off-site disposal at a permitted facility. Closure of the former impoundment and sump area occurred in December 1986 under a New Mexico State-approved closure plan. The impoundment was backfilled, and an asphaltic concrete cap was placed over the entire area to divert rainfall and surface-water run on, and thus to minimize infiltration of water into the subsurface through this area.

2.3 Hydrogeologic Setting

The Sparton site lies in the northern part of the Albuquerque Basin. The Albuquerque Basin is one of the largest sedimentary basins of the Rio Grande rift, a chain of linked basins that extend south from central Colorado into northern Mexico. Fill deposits in the basin are as much as 15,000 ft thick. The deposits at the site have been characterized by 104 borings advanced for installing monitoring, production, and temporary wells, and soil vapor probes, and by a 1,505-foot-deep boring (the Hunters Ridge Park I Boring) advanced by the U. S. Geological Survey (USGS) about 0.5 mile north of the facility on the north side of the Arroyo de las Calabacillas (Johnson and others, 1996).

The fill deposits in the upper 1,500 ft of the subsurface consist primarily of sand and gravel with minor amounts of silt and clay. The near-surface deposits consist of less than 200 ft of Quaternary (Holocene and Pleistocene) alluvium associated with terrace, arroyo fan, and channel and floodplain deposits. These deposits are saturated beneath the facility and to the east of the facility toward the Rio Grande, but are generally unsaturated to the west of the site. Two distinct geologic units have been mapped in the saturated portion of these deposits: Recent Rio Grande deposits, and a silt/clay unit (Figure 2.2). The Recent Rio Grande deposits occur to the east of the facility adjacent to the Rio Grande. These deposits consist primarily of pebble to cobble gravel and sand, and sand and pebbly sand. These deposits are Holocene-age and are up to 70-feet thick. Beneath the facility, and in an approximately 1,500-foot-wide band trending north from the facility, a silty/clay unit has been mapped between an elevation of about 4,965 ft above mean sea level (*ft MSL*) and 4,975 ft MSL. This unit, which is referred to as the 4970-foot silt/clay unit, represents Late-Pleistocene-age overbank deposits. The areal extent of the unit at and in the vicinity of the Sparton site is shown in Figure 2.3. Additional information on this unit is presented in Appendix A to both the 1999 and 2000 Annual Reports (SSP&A, 2001a; 2001b).) Holocene-age arroyo fan and terrace deposits, which are primarily sand and gravel, overlie this unit.

The Pliocene-age Upper Santa Fe Group (USF) deposits underlie the Quaternary alluvium. These USF deposits, to an elevation of 4,800 ft MSL, consist primarily of sand with lenses of sand and gravel and silt and clay. The lithologic descriptions of these deposits are variable, ranging from "sandy clay," to "very fine to medium sand," to "very coarse sand, to small pebble gravel." Most of the borings into this unit were advanced using the mud-rotary drilling technique, and as a result, it has not been possible to map the details of the geologic structure. The sand and gravel unit is primarily classified as USF2 lithofacies assemblages 2 and 3 (Hawley, 1996). Locally, near the water table in some areas, the sands and gravels are classified as USF4 lithofacies assemblages 1 and 2. Lithofacies 2 represents basin-floor alluvial deposits that are primarily sand with lenses of pebble sand and silty clay. Lithofacies 3 represents basin-floor, overbank, and playa and lake deposits that are primarily interbedded sand and silty clay with lenses of pebbly sand.

At an elevation of approximately 4,800 ft MSL, a 2- to 3-foot thick clay layer is encountered. This clay, which is referred to as the 4800-foot clay unit (Figure 2.2), likely represents lake deposits. This clay unit was encountered in borings for six wells (MW-67, MW-71, MW-71R, CW-1, OB-1, and OB-2) installed during site investigations and remedial actions. The unit was also encountered in the USGS Hunter Park I Boring which is located about 0.5 mile north of the Sparton Site on the north side of the Arroyo de las Calabacillas. The nature of the depositional environment (i.e. lake deposits), and the fact that the unit has been encountered in every deep well drilled in the vicinity of the site, as well as at the more distant USGS boring, indicate that the unit is areally extensive. The deposits of the Santa Fe Group immediately below the 4800-foot clay are similar to those above the clay.

The water table beneath the Sparton Site and between the Site and the Rio Grande lies within the Quaternary deposits; however, to the west and downgradient from the site the water table is within the USF deposits. A total of 90 wells were installed at the site to define hydrogeologic conditions and the extent and nature of groundwater contamination and to implement and monitor remedial actions; of these wells, 18 have been plugged and abandoned. The locations of the remaining 72 wells are shown in Figure 2.3.

The off-site containment well, CW-1, and two associated observation wells, OB-1 and OB-2, were drilled to the top of the 4800-foot clay unit and were screened across the entire saturated thickness of the aquifer above the clay unit. The source containment well, CW-2, was drilled to a depth of 130 feet and equipped with a 50-foot screen from the water table to total depth. The monitoring wells have short screened intervals (5 to 30 ft) and during past investigations, were classified according to their depth and screened interval. Wells screened across, or within 15 ft of, the water table were referred to as Upper Flow Zone (*UFZ*) wells. Wells screened 15-45 and 45-75 ft below the water table were referred to as Upper Lower Flow Zone (*ULFZ*) and Lower Lower Flow Zone (*LLFZ*) wells, respectively. Wells completed below the 4800-foot clay unit were referred to as Deep Flow Zone (*DFZ*) wells. At cluster well locations where an ULFZ or LLFZ well already existed, wells screened at a deeper interval were referred to as LLFZ or Third Flow Zone (*3rdFZ*) wells, regardless of the depth of their screened interval with respect to the water table.

The completion flow zone, location coordinates, and measuring point elevation of all existing wells are presented in Table 2.1; their screened intervals are summarized in Table 2.2. In Figure 2.4, the screened interval of each well is projected onto a schematic cross-section through the site to show its position relative to the flow zones defined above. (Monitoring wells screened in the DFZ [MW-67 and MW-71R], wells screened across the entire aquifer above the 4800-foot clay [CW-1, OB-1 and OB-2], and infiltration gallery monitoring wells [MW-74, MW-75, and MW-76] are not included in this figure.) The screened intervals in three of the monitoring wells shown on Figure 2.4 are inconsistent with the completion flow zones listed on Table 2.1 which were defined at the time of well construction. These monitoring wells are: MW-32, which is listed in Table 2.1 as a LLFZ well but is shown on Figure 2.4 as a ULFZ well; and MW-49 and MW-70 which are listed on Table 2.1 as 3rdFZ wells but are shown on Figure 2.4 as LLFZ wells. In the evaluations of water-level and water-quality data for the flow zones, MW-32 is treated as a ULFZ well, and MW-49 and MW-70 are treated as LLFZ wells.

Data collected from these wells indicate that the thickness of the saturated deposits above the 4800-foot clay ranges from about 180 ft at the Site to about 160 ft west of the Site and averages about 170 ft. Outside the area underlain by the 4970-foot silt/clay unit, groundwater occurs under unconfined conditions; however, in the area where this unit is present, it provides confinement to the underlying saturated deposits. The water table in this area occurs within the Late-Pleistocene-age arroyo fan and terrace deposits that overlie the 4970-foot silt/clay unit and is considerably higher than the potentiometric surface of the underlying confined portion of the aquifer.

Analyses of data from aquifer tests conducted at the Site (Harding Lawson Associates, 1992; SSP&A, 1998; 1999b) indicate that the hydraulic conductivity of the aquifer is in the range of 25 to 30 feet per day (*ft/d*), corresponding to a transmissivity of about 4,000 to 5,000 feet squared per day (*ft^2/d*). A transmissivity of about 4,000 ft^2/d, corresponding to a hydraulic conductivity of about 25 ft/d, is also indicated by the response of water levels to long-term pumping from the off-site containment well CW-1. Analyses of the water levels measured quarterly in observation wells OB-1 and OB-2, and in monitoring wells within 1,000 ft of the off-site containment well, indicate that the response of these wells to the long-term pumping from CW-1 is best explained with a transmissivity of 4,000 ft^2/d; that is, a transmissivity of 4,000 ft^2/d produces the smallest residual between calculated and measured water levels in these wells.

Water-level data indicate that the general direction of groundwater flow is to the northwest with gradients that generally range from 0.0025 to 0.006. The direction of groundwater flow beneath the Sparton Site, however, in the part of the aquifer underlain by the 4970-foot silt/clay unit, is to the west-southwest and the water table has a steeper gradient ranging from 0.010 to 0.016. Vertical flow is downward with an average gradient of about 0.002. Groundwater production from the deeper aquifers and a reduction in the extent of irrigated lands in the vicinity of the Site have resulted in a regional decline of water levels. Until a few years ago, this regional decline averaged about 0.65 foot per year (*ft/yr*); however, the rate of decline has slowed down and averaged about 0.35 ft/yr during the last several years (see well hydrographs presented in Figure 2.5).

2.4 Site Investigations and Past Remedial Actions

In 1983, several groundwater monitoring wells were installed around the impoundment and sump area to determine whether there had been a release of constituents of concern from the impoundment or the sump. Analytical results from groundwater samples taken from these wells indicated concentrations of several constituents above New Mexico State standards.

Since this initial finding in 1983, several investigations have been conducted to define the nature and extent of the contamination and to implement remedial measures; these investigations continued through 1999. The results of the investigations indicate that the primary constituents of concern found in on-site soils and in both on-site and off-site groundwater are volatile organic compounds (*VOCs*), primarily trichloroethene (*TCE*), 1,1,1-trichloroethane (*TCA*) and its abiotic transformation product 1,1-dichloroethene (*DCE*). Of these constituents, TCE has the highest concentrations and is the constituent that has been used to define the extent of groundwater contamination. DCE has been detected at low concentrations relative to TCE in groundwater, but it has the second largest plume extent. Groundwater contamination by TCA is primarily limited to the facility and its immediate vicinity. Various metals have also been detected in both soil and groundwater samples. Historically, chromium has the highest frequency of occurrence at elevated concentrations.

During the period 1983 to 1987, Sparton worked closely with the New Mexico Environmental Improvement Division (*NMEID*), the predecessor to the New Mexico Environment Department (*NMED*). Several investigations were conducted during this period (Harding and Lawson Associates, 1983; 1984; 1985). In 1987, when it became apparent that contaminants had migrated beyond plant boundaries, the USEPA commenced negotiations with Sparton to develop an Administrative Order on Consent. This Order was signed and became effective on October 1, 1988. Under the provisions of this Order, Sparton implemented an IM in December 1988. The IM consisted of groundwater recovery through eight on-site wells (PW-1, MW-18, and MW-23 through MW-28), and treatment of the recovered water in an on-site air stripper (Figure 2.1). The purpose of this IM was to remove contaminants from areas of high concentration in the UFZ. Due to the regional decline of water levels, the total discharge rate from the IM system dropped to less than 0.25 gpm by November 1999. As a result, the system was shut-down and taken permanently out of service on November 16, 1999. Groundwater production from this system, during its 11-year operation, is summarized on Table 2.3. A total of 4.4 million gallons of water were recovered during the 11-year operation period, as shown on this table.

From 1988 through 1990, horizontal and vertical delineation of the groundwater plume continued under the October 1, 1988 Order on Consent. On July 6, 1990, the first draft of the RCRA Facility Investigation (*RFI*) report was submitted to USEPA; the final RFI was issued on May 20, 1992 (Harding Lawson Associates, 1992) and approved by USEPA on July 1, 1992. A draft Corrective Measures Study (*CMS*) report was submitted to USEPA on November 6, 1992. The report was revised in response to USEPA comments, and a draft Final CMS was issued on May 13, 1996; the draft was approved, subject to some additional revisions, by USEPA on June 24, 1996. The Revised Final CMS was issued on March 14, 1997 (HDR Engineering, Inc., 1997). Nine additional monitoring wells (MW-65 through MW-73) were installed between 1996 and 1999 to further delineate the groundwater plume.

The investigations conducted at the site included several soil-gas surveys to determine the extent of groundwater contamination and to characterize vadose zone soil contamination and its potential impacts on groundwater quality. The results of soil-gas surveys conducted in 1984, 1985, 1987, and 1991 were reported in the RFI and the CMS. Additional soil-gas investigations to characterize vadose zone contamination were conducted between April 1996 and February 1997 (Black & Veatch, 1997). This work included the installation and sampling of a six-probe vertical vapor probe cluster in the source area, five vapor sampling probes at various radial distances from the former sump area, and vapor sampling of nine on-site and four off-site UFZ monitoring wells that are screened across the water table. The locations of the vapor probes (VP-1-6 and VR-1 through VR-5) and of the sampled on-site monitoring wells are shown in Figure 2.6; the locations of the sampled off-site monitoring wells MW-48, MW-57, and MW-61 are shown on Figure 2.3. The fourth off-site monitoring well, MW-37, which became dry and was plugged in 2002, was located near its replacement well MW-37R. The area where TCE concentrations in soil-gas exceeded 10 ppmv was determined from the results of this investigation (Figure 2.7).

Following this investigation, a SVE pilot test was conducted on February 27 and 28, 1997 (Black & Veatch, 1997). The test was conducted on vapor recovery well VR-1 using an AcuVac System operating at a flow of 65 cfm at a vacuum of 5 inches of water.

Based on the results of this pilot test, an AcuVac System was installed at the site in the spring of 1998 and operated at a flow rate of 50 cfm on vapor recovery well VR-1 from April 8, 1998 to October 20, 1998 (195 days). Influent and effluent concentrations measured during the operation of the system are shown in Figure 2.8. As shown in this figure, influent TCE concentrations dropped from about 18,000 milligrams per cubic meter (*mg/m^3*), or about 4,000 ppmv, during the first day of operation, to about 150 mg/m^3 (34 ppmv) in about 120 days. Trend lines determined by analysis of the data (see Figure 2.8) indicate that influent TCE concentration was probably as low as 75 mg/m^3 (17 ppmv) prior to the shut-down of the system after 195 days of operation. The mass of TCE removed during this operation of the SVE system was calculated to be about 145 kilograms (kg) or 320 pounds (lbs).

2.5 Implementation of Current Remedial Actions

Based on settlement negotiations that led to the March 3, 2000 Consent Decree, Sparton agreed to implement the following remedial measures: (a) installation and operation of an off-site containment system designed to contain the contaminant plume; (b) replacement of the on-site groundwater recovery system by a source containment system designed to address the release of contaminants from potential on-site source areas; and (c) operation of a robust SVE system for a total operating time of one year over a period of eighteen months.

Implementation of the off-site containment system, as originally planned, was completed in 1999. A chromium reduction process was added to the treatment component of the system in 2000. Chromium treatment ceased in 2001 because the chromium concentration in the influent dropped below the New Mexico groundwater standard. The system currently consists of:

- a containment well (CW-1) installed near the leading edge of the TCE plume;
- an off-site treatment system for the water pumped by CW-1, consisting of an air stripper housed in a building;
- an infiltration gallery installed in the Arroyo de las Calabacillas for returning treated water to the aquifer;
- a pipeline for transporting the treated water from the treatment building to the gallery;

- a piezometer, PZG-1, with an horizontal screen placed near the bottom of the gallery, for monitoring the water level in the gallery; and
- three monitoring wells (MW-74, MW-75, and MW-76) for monitoring potential water-quality impacts of the gallery.

The location of these components of the off-site containment system is shown in Figure 2.9.

The containment well was installed in August 1998, and aquifer tests were conducted on the well and evaluated in December (SSP&A, 1998). The well began operating at a design rate of 225 gpm on December 31, 1998. During the testing of the well and during its continuous operation between December 31, 1998 and April 14, 1999, the groundwater pumped from the well was discharged into a sanitary sewer without treatment. Installation of the air stripper, the infiltration gallery, and other components of the system (except the chromium reduction process) was completed in early April, 1999. The containment well was shut-down on April 14, 1999 to install a permanent pump and to connect the well to the air stripper. Between April 14 and May 6, 1999, the well operated intermittently to test the air stripper and other system components. The tests were completed on May 6, 1999, and the well was placed into continuous operation. Due to increases in chromium concentrations in the influent to, and hence in the effluent from, the air stripper, a chromium reduction process was added to the treatment system on December 15, 2000. Chromium concentrations, however, declined during 2001 and the chromium reduction process was removed on November 1, 2001. The off-site containment system is now operating with all other system components functioning.

All permits and approvals required for the implementation of the source containment system were obtained between May 1999 and February 2001. The installation of the system began soon after the approval of the Construction Work Plan for the system in February 2001, and completed in December 2001. The system was tested in December 2001 and placed into operation on January 3, 2002. The system consists of:

- a source containment well (CW-2) installed immediately downgradient of the Site;
- an on-site treatment system for the water pumped by CW-2, consisting of an air stripper housed in a building;
- six on-site infiltration ponds for returning the treated water to the aquifer;
- pipelines for transporting the pumped water to the air stripper and the treated water to the ponds; and
- three monitoring wells (MW-17, MW-77, and MW-78) for monitoring the potential water-quality impacts of the ponds.

The layout of the system is shown in Figure 2.10. The chromium concentrations in the influent to, and hence in the effluent from, the air stripper meets the New Mexico water-quality standard for groundwater and, therefore, treatment for chromium is not necessary. Based on the first three years of operation of the system, Sparton concluded that four infiltration ponds were sufficient for returning to the aquifer the water treated by this system. Therefore, in April 2005 Sparton requested USEPA and NMED approval to backfill two of the six ponds (Ponds 5 and 6 in Figure .10), and upon approval of this request in June 2005, the two ponds were backfilled between August and December 2005.

An AcuVac SVE system was installed on vapor recovery well VR-1 (see Figure 2.6) in the spring of 1998 and operated between April 8 and October 20, 1998. Additional SVE operations at this location with the AcuVac system at 50 cfm and with a 200-cfm Roots blower occurred in 1999 between May 12 and June 23 and between June 28 and August 25, respectively. An additional 200-cfm Roots blower was installed in 2000, and the SVE system was operated at 400 cfm between April 10, 2000 and June 15, 2001. The total operating time during this period, 371 days and 13 hours, and the results of the performance monitoring conducted after the shut-down of the system met the requirements of the Consent Decree for the termination of the SVE operations at the site. The system was, therefore, dismantled, and the recovery well and vapor probes associated with the system were plugged in May 2002.

2.6 Initial Site Conditions

Initial site conditions, as referred to in this report, represent hydrogeologic and soil-gas conditions as they existed prior to the implementation of the current remedial measures (the installation and operation of the off-site and source containment systems, and the 1999-2001 operation of SVE systems).

2.6.1 <u>Hydrogeologic Conditions</u>

2.6.1.1 Groundwater Levels

The elevation of water levels in monitoring wells, based on measurements made in November 1998, is presented on Table 2.4. These data were used to prepare maps showing the configuration of the water levels at the site prior to the implementation of the current remedial measures.

Water-level data from UFZ and ULFZ well pairs indicate that UFZ wells screened above or within the 4970-foot silt/clay unit (most of the UFZ wells on the Sparton Site) have a water level that is considerably higher than that in the adjacent ULFZ wells that are screened below this unit. These water-level differences range from less than one foot near the western and southwestern limit of the unit to more than 10 feet north and northeast of the Sparton site. Outside the area underlain by the 4970-foot silt/clay unit, however, the water-level difference between UFZ and ULFZ well pairs is 0.2 foot or less. This relationship between UFZ and ULFZ water levels is illustrated in the schematic cross-section shown in Figure 2.4.

In early interpretations of water-level data, including those presented in the 1999 and 2000 Annual Reports (SSP&A, 2001a; 2001b), separate water-level maps were prepared using data from UFZ, ULFZ, and LLFZ wells without taking into consideration the above-discussed relationship between the water levels in UFZ and ULFZ wells. Since the 2001 Annual Report

(SSP&A, 2002), however, this relationship has been taken into consideration, and water level conditions at the site and its vicinity are presented in three maps depicting: (1) the water table above the 4970-foot silt/clay unit underlying the Sparton site and at the area north of the site, based on water-level data from UFZ wells screened above or within the silt/clay unit (referred to as the "on-site water table"); (2) the combined UFZ/ULFZ water levels based on data from UFZ and ULFZ wells outside the area underlain by the silt/clay unit (using the average water level at UFZ/ULFZ well pair locations) and ULFZ wells screened below this unit; and (3) the LLFZ water levels based on data from LLFZ wells.

The elevation of the on-site water table in November 1998 is shown in Figure 2.11. The corresponding water-level elevations in the UFZ/ULFZ and LLFZ are shown in Figures 2.12 and 2.13, respectively. These water-level maps indicate that in the off-site areas downgradient from the site, the direction of groundwater flow is generally to the northwest with a gradient of approximately 0.0025. On-site, the direction of flow is also northwesterly in both the UFZ/ULFZ and the LLFZ; however, the gradients are steeper, approximately 0.005 in the UFZ/ULFZ and 0.006 in the LLFZ. The on-site water table is affected by the on-site groundwater recovery system, which was operating during the November 1998 water-level measurements, and the presence of the 4970-foot silt/clay unit; the direction of flow changes from westerly north of the site to southwesterly on the site, with gradients that range from 0.01 to 0.016.

2.6.1.2 Groundwater Quality

The concentrations of TCE, DCE, and TCA in groundwater samples obtained from monitoring wells during the Fourth Quarter 1998 sampling event are summarized on Table 2.5. Also included on this table are data obtained on September 1, 1998, from the off-site containment well, CW-1, and the nearby observation wells, OB-1 and OB-2, and from temporary wells, TW-1 and TW-2, drilled in early 1998 at the current location of MW-73 and sampled on February 18 and 19, 1998, respectively. For each of the compounds reported on Table 2.5, concentrations that exceed the more stringent of its Maximum Contaminant Level (*MCL)* for drinking water or its maximum allowable concentration in groundwater set by the New Mexico Water Quality Control Commission (*NMWQCC*) are highlighted.

These concentration data were used to prepare maps showing the horizontal extent of the TCE, DCE and TCA plumes as they existed in November 1998, prior to the beginning of pumping from the off-site containment well. The procedures presented in the Work Plan for the Off-Site Containment System were used in preparing these maps (SSP&A, 2000a). The horizontal extent of the TCE plume (in November 1998) is shown in Figure 2.14 and the extent of the DCE and TCA plumes is shown in Figures 2.15 and 2.16, respectively. The extent of these plumes forms a basis for evaluating the effectiveness of the remedial actions that have been implemented at the site.

2.6.1.3 Pore Volume of Plume

TCE is the predominant contaminant at the Sparton site and has the largest plume. Calculation of the initial volume of water contaminated above MCLs, referred to as the pore volume of the plume, was therefore based on the horizontal and vertical extent of the TCE plume.

In preparing the plume maps presented in the previous section (Figures 2.14 through 2.16), the completion zone of monitoring wells was not considered; that is, data from an UFZ well at one location was combined with data from an ULFZ or LLFZ well at another location. At well cluster locations, the well with the highest concentration was used, regardless of its completion zone. As such, the horizontal extent of the TCE plume shown in Figure 2.14 represents the envelope of the extent of contamination at different depths, rather than the extent of the plume at a specific depth within the aquifer.

To estimate the initial pore volume of the plume, three separate maps depicting the horizontal extent of the TCE plume were prepared using water-quality data from UFZ, ULFZ, and LLFZ monitoring wells. The concentrations measured in the fully-penetrating containment well CW-1 and observation wells OB-1 and OB-2 were assumed to represent average concentrations present in the entire aquifer above the 4800-foot clay, and these data were used in preparing all three maps. An estimate of the horizontal extent of TCE contamination at the top of the 4800-foot clay was also made by preparing a fourth plume map using the data from the containment well and the two observation wells, and data from two temporary wells that obtained samples from about 30-35 feet above the top of the clay during the construction of DFZ wells MW-67 (July 1996) and MW-71 (June 1998). (These four TCE plume maps were presented in Appendix B to both the 1999 and the 2000 Annual Reports [SSP&A, 2001a; 2001b].)

The extent of the plume based on UFZ wells was assumed to represent conditions at the water table; based on the elevation of the screened intervals in ULFZ and LLFZ wells (see Figure 2.4), the extent of the plume estimated from ULFZ wells was assumed to represent conditions at an elevation of 4,940 ft MSL, and that estimated from LLFZ wells conditions at an elevation of 4,900 ft MSL. The extent of the plume at the top of the clay was assumed to represent conditions at an elevation of 4,800 ft MSL. The area of the TCE plumes at each of these four horizons was calculated. Using these areas, the thickness of the interval between horizons, and a porosity of 0.3, the pore volume was estimated to be approximately 150 million cubic feet (ft^3), or 1.13 billion gallons, or 3,450 acre-ft.[1]

2.6.1.4 Dissolved Contaminant Mass

As discussed in both the 1999 and 2000 Annual Reports (SSP&A, 2001a; 2001b), calculations of the initial dissolved contaminant mass based on a plume-map approach, such as the one used above to estimate the initial pore volume (Section 2.6.1.3), significantly underestimate the dissolved contaminant mass present in the aquifer underlying the site. The calibration of the numerical transport model that was developed for the site and its vicinity (see Section 6.2.3) was, therefore, used to provide an estimate of the initial contaminant mass.

[1] The features of the commercially available mapping program Surfer 7.0 (copyright © 1999, Golden Software, Inc.) were used in generating the plume maps and in calculating plume areas and pore volumes.

During the calibration process of this model, the initial TCE concentration distribution within each model layer is adjusted, in a manner consistent with the initial concentrations observed in monitoring wells, until the computed concentrations of TCE in the water pumped from each containment well, and hence the computed TCE mass removal rates, closely match the observed concentrations and mass removal rates. Based on the calibration of the model against 1999 through 2005 water-quality data, the initial dissolved TCE mass is currently estimated to be (see Table 6.1) about 6,910 kg (15,230 lbs). Using this estimate, and ratios of the removed TCE mass to the removed DCE and TCA mass, the initial masses of dissolved DCE and TCA are estimated to be approximately 400 kg (880 lbs) and 21 kg (46 lbs), respectively. Thus, the total initial mass of dissolved contaminants is currently estimated to be about 7,330 kg (16,160 lbs).

2.6.2 Soil Gas Conditions

A supplemental vadose zone characterization was conducted between March 15 and May 5, 1999, which included installation and sampling of eight additional vapor probes, VP-7 through VP-14 (Figure 2.6) and resampling of 15 vapor-monitoring points that had exhibited soil-gas concentrations greater than 10 ppmv during the initial characterization. The results of the supplemental investigation are presented in Figure 2.17, with the approximate 10 ppmv TCE plume limit delineated. The extent of the TCE plume presented in this figure represents the initial conditions prior to the resumption of soil vapor extraction remedial actions in 1999.

2.7 Summary of the 1999 through 2004 Operations

During 1999 through 2004, significant progress was made in implementing and operating the remedial measures Sparton agreed to implement under the terms of the Consent Decree entered on March 3, 2000. These remedial measures resulted in the containment of the plume at the site, the removal of a significant amount of mass from the plume of groundwater contamination, and a significant reduction in soil-gas concentrations in the on-site source areas.

The remedial measures undertaken in 1999 through 2004 included the following:

- Between December 31, 1998 and April 14, 1999, and from May 6, 1999, through December 31, 2004, the off-site containment well was operated at a rate sufficient to contain the plume. The air stripper for treating the pumped water and the infiltration gallery for returning the treated water to the aquifer were constructed in the spring of 1999. These systems were connected to the containment well and tested between April 14 and May 6, 1999. A chromium reduction process was added to the off-site treatment system on December 15, 2000, to control chromium concentrations in the air stripper effluent and thus meet discharge permit requirements for the infiltration gallery; the process was discontinued on November 1, 2001, after chromium concentrations in the influent decreased to levels that no longer required treatment.
- A 50-cfm AcuVac SVE system was operated at vapor recovery well VR-1 from May 12 through June 23, 1999, and a 200-cfm Root blower system was operated at this well from June 28 to August 25, 1999. A second 200-cfm Root blower was added to the system in the Spring of 2000, and the 400-cfm SVE system operated for a total of 372 days

between April 10, 2000 and June 15, 2001 meeting the length-of-operation requirement of the Consent Decree. The results of the performance monitoring that was conducted in September and October 2001 indicated that the system had met the termination criteria specified in the Consent Decree, and the system was dismantled in May 2002.

- The source containment system, consisting of a containment well immediately downgradient from the site, an on-site treatment system, six on-site infiltration ponds, and associated conveyance and monitoring components, was installed and tested during 2001. Operation of the system began on January 3, 2002, and the system continued to operate through December 31, 2004, at a rate sufficient for containing any potential sources that may remain at the site.
- Groundwater monitoring was conducted as specified in Attachment A to the Consent Decree. Water levels in accessible monitoring wells, the containment well, observation wells, piezometers, and the Corrales Main Canal were measured quarterly. Samples were collected for water-quality analyses from monitoring wells and from the influent and effluent of the air stripper at the frequency specified in the Consent Order. Water samples were analyzed for TCE, DCE, TCA, and other constituents, as required by the Consent Decree and the Groundwater Discharge Permit.
- A groundwater flow and transport model of the hydrogeologic system underlying the site was developed in 2000. The model was calibrated against data available at the end of 1999, and again against data available at the end of each subsequent year, and used to simulate TCE concentrations in the aquifer from the start-up of the containment well in December 1998 through November 2004 and to predict TCE concentrations in November 2005. Plans were made to continue the calibration and improvement of the model during 2005.

A total of about 690 million gallons of water, corresponding to an average rate of about 220 gpm, were pumped from the off-site containment well between the start of its operation and the end of 2004. Evaluation of quarterly water-level data indicated that containment of the contaminant plume was maintained throughout each year.

Since the beginning of its operation on January 3, 2002, the source containment well pumped a total of about 80 million gallons of water, corresponding to an average rate of 50 gpm. Evaluation of quarterly water-level data indicated that the well developed a capture zone that prevents the off-site migration of contaminants from the site

The total volume of water pumped by both the off-site and source containment wells between the start of the off-site containment well operation and the end of 2004 was about 770 million gallons, and represents about 68 percent of the initial volume of contaminated groundwater (pore volume).

The total mass of contaminants that was removed by the off-site containment well between the start of its operation and the end of 2004 was about 3,190 kg (7,020 lbs) and consisted of 3,020 kg (6,660 lbs) of TCE, 160 kg (350 lbs) of DCE, and 6.1 kg (13 lbs.) of TCA.

An additional 160 kg (350 lbs) of contaminants consisting of about 140 kg (300 lbs) of TCE, 20 kg (44 lbs) of DCE, and 3.1 kg (6.8 lbs.) of TCA were removed from the aquifer by the source containment well. Thus, the total mass of contaminants removed from the aquifer by both wells between the start of the off-site containment well operation on December 1998 and the end of 2004 was about 3,350 kg (7,380 lbs) consisting of 3,160 kg (6,960 lbs) of TCE, 180 kg (400 lbs) of DCE, and 9.2 kg (20 lbs) of TCA. This removed mass represents about 46 percent of the contaminant mass (46 percent of the TCE, 45 percent of the DCE, and 44 percent of the TCA mass currently estimated to have been present in the aquifer prior to the operation of the off-site containment well.

The operation of the soil vapor extraction systems at vapor recovery well VR-1 in 1999 and 2000 had a measurable impact on soil-gas concentrations at the site. The 1999 SVE operations had reduced TCE concentrations in soil gas below 10 ppmv at all but one of the monitored locations. Soil-gas was not monitored during the 2000 and 2001 operation of the 400-cfm system. The system was shut-down on June 15, 2001 and performance monitoring was conducted near the end of 2001, three months after the shut-down. The results of this monitoring indicated that soil gas concentrations at all monitoring locations were considerably below the 10 ppmv termination criterion for the system, and the system was dismantled in May 2002.

The remedial systems were operated with only minor difficulties during 1999 through 2004. In 1999, the metering pump adding anti-scaling chemicals to the influent to the off-site air-stripper was not operating correctly. This problem was solved in December 1999 by replacing the pump. Also, chromium concentrations in the influent to, and hence in the effluent from, the air stripper increased from 20 μg/L at system start-up to 50 μg/L by May 1999, and fluctuated near this level, which is the discharge permit limit for the infiltration gallery, throughout the remainder of 1999 and during 2000. To solve this problem, a chromium reduction process was added to the treatment system on December 15, 2000; the process was discontinued on November 1, 2001, after chromium concentrations declined to levels that no longer required treatment.

Another problem that developed during these years was the continuing presence of contaminants in the DFZ monitoring well MW-71. During 2001, an investigation was conducted on the well and the well was plugged. Based on the results of the investigation, a replacement well, MW-71R located about 30 feet south of the original well, was installed in February 2002. Samples collected from the replacement well since its installation indicated the continuing presence of contaminants in the Deep Flow Zone (TCE concentrations of 130 to 210 μg/L). Based on these results, Sparton proposed to pump the well and, after treatment, re-inject the pumped water in the unsaturated zone at allocation south of the well. A Work Plan for this proposed MW-71R pump-and-treat system was prepared in late 2003 and submitted to USEPA/NMED in January 2004 (SSP&A and Metric, 2004a). USEPA/NMED comments on this Work Plan (August 10, 2004[2]) led Sparton to invoke the dispute resolution mechanism

---

[2] Technical Review – Sparton Technology Inc. Former Coors Plant Remedial Program, Work Plan for the Proposed MW-71R Pump-and-Treat System, Sparton Technology, Inc. Albuquerque, New Mexico, EPA ID No.

allowed under the Consent Decree (September 13, 2004[3]). To resolve the dispute a conference call was held on October 13, 2004, between technical representatives of USEPA/NMED and Sparton. During this conference call the parties agreed to abandon the plan for a pump-and-treat system at MW-71R, and instead install a DFZ monitoring/stand-by extraction well near CW-1, with the understanding that the decision to use this well as a monitoring or extraction well will be based on whether the well is clean or contaminated. The agreement was documented in the minutes[4] of the conference call and upon approval of the minutes[5] a Work Plan (SSP&A and Metric, 2004b) for the installation, testing, monitoring, and/or operation of this well was submitted to USEPA/NMED on December 6, 2004.

Six water table (UFZ) monitoring wells that became dry due to declining water levels were plugged during 2002 and 2003; three of these wells were replaced by wells with longer screens spanning both the UFZ and ULFZ. Two other monitoring wells continued to be dry throughout 2004 and several others were dry during one or more monitoring/sampling events during 2004; however, no action was taken concerning these wells. Other minor problems during these years included the occasional shutdown of the off-site system due to power failures or failures of the monitoring or paging systems, and the discharge pump starter. Appropriate measures were taken to address these problems.

NMD083212332, transmitted by letter dated August 10, 2004, from Charles A. Barnes of USEPA to Tony Hurst of Hurst Engineering Services, Project Coordinator for Sparton.

[3] Notice of Dispute, Sparton Technology, Inc. Consent Decree, Civil Action No. CIV 97 0206 CH/JHG, EPA ID No. NMD083212332, September 13, 2004, letter to the Plaintiffs from James B. Harris of Thompson & Knight, counsel to Sparton.

[4] Memorandum dated October 20, 2004, to Charles A. Barnes (USEPA), and Baird Swanson and Carolyn Cooper (NMED) from Gary L. Richardson (Metric) and Stavros S. Papadopulos (SSP&A) on the subject of Sparton Technology, Inc., Former Coors Road Plant Remedial Program – Minutes of the October 13, 2004 Conference Call.

[5] E-mail dated October 21, 2004, from Charles A. Barnes of USEPA to Stavros Papadopulos of SSP&A on the subject of "Re: Minutes of the October 13, 2004 Conference Call."

Section 3
System Operations - 2005

3.1 Monitoring Well System

3.1.1 Upper Flow Zone

The continuing water-level declines in the Albuquerque area continued to affect shallow monitoring wells (UFZ wells) at the Site. Monitoring wells PW-1 and MW-35, which had been dry for the last several years, continued to be dry during 2005. In the 2004 Annual Report (SSP&A, 2005) Sparton proposed to plug these two wells during 2005, however, this action was not implemented as Sparton had not received approval of the 2004 Annual Report as of the end of 2005. Well MW-36 which was dry during the 1st, 3rd, and 4th quarter rounds of water-level measurements in 2004 was dry during all four quarters in 2005, and wells MW-13, MW-33 and MW-57 were dry during the 4th quarter of 2005. In addition, wells MW-9 and MW-53 did not have sufficient water for sampling in November 2005.

3.1.2 Deep Flow Zone

The Work Plan for installing a monitoring/stand-by extraction well in the DFZ (SSP&A and Metric, 2004b) was approved by USEPA/NMED on January 6, 2005.[6] Installation of this well required that a drilling rig be moved to the site through a park owned by the City of Albuquerque (COA); therefore, on February 3, 2005, Sparton representatives contacted the COA representatives to initiate work on an agreement for an easement to access the site through the park. Sparton representatives met with the COA Parks Department on February 17, 2005, and reached a verbal agreement concerning access to the well site. Negotiations on the agreement continued through March 2005 with the COA Parks Department and the City Attorney's Office. At the City's request, Sparton hired an appraiser in April 2005 and a surveyor in May 2005 to survey the easement and appraise its value. A survey was delivered to the City on May 2, 2005, and Sparton representatives met with COA representatives on July 29, 2005 to discuss draft easement agreements. During August and early September 2005, negotiations concerning the draft easement agreements continued. Based on the appraiser's report, on September 16, 2005, Sparton sent a check for $11,300.00 to the COA for the needed easement. Sparton received the signed easement agreements on October 5, 2005. On November 2, 2005, Sparton submitted a revised schedule for the Work Plan to USEPA/NMED, and notified the COA on December 19, 2005 that construction of the monitoring-extraction well would begin on January 9, 2006.[7]

---

[6] E-mail dated January 6, 2005 from Charles A. Barnes of USEPA to Tony Hurst of Hurst Engineering Services, Project Coordinator for Sparton, on the subject of "Approval of Work Plan submitted December 6, 2004," with cc to John Kieling, Carolyn Cooper, and Baird Swanson of NMED.

[7] Installation and development of the well was completed on February 24, 2006. The well was pump-tested during the first week of April 2006 and samples were obtained during the test. Site-related contaminants were not found in any of the samples.

3.2 Containment Systems

3.2.1 Off-Site Containment System

The Off-Site Containment System operated for about 8,735 hours, or 99.7 percent of the 8,760 hours available during 2005. The system was down for about 25 hours due to eleven interruptions ranging in duration from 0.17 hours to 5.03 hours. A summary of the downtime for the year is presented in Table 3.1 (a). These downtimes consisted of two shutdowns for routine maintenance activities, seven shutdowns due to power failures, and two shutdowns due to the occurrence of a low level in the chemical feed tank.

3.2.2 Source Containment System

The Source Containment System operated for about 8,391 hours, or 96.8 percent of the 8,760 hours available during 2005. The system was down for about 279 hours due to fourteen interruptions ranging in duration from 0.50 hours to about 96 hours. A summary of the downtime for the year is presented on Table 3.1 (b). These downtimes consisted of two shutdowns for routine maintenance activities, five shutdowns due power failure, two shutdowns due to high water level in the air stripper sump, three shutdowns due to problems with the blower motor, and two shutdowns due to problems with the submersible pump in the containment well. The duration of one of the power failures was extended due to a failure in the monitoring system. The duration of one of the shutdowns caused by high water level in the air stripper sump was extended because the phone-line was down. The duration of one shutdown caused by the blower motor was extended because a replacement motor was not available locally.

Operations during the past years indicated that Infiltration Ponds 1 through 4 (see Figure 2.10) were more than adequate for handling the water pumped from the source containment well. To put the land of Ponds 5 and 6 to other beneficial use, in April 2005 Sparton submitted a request to backfill these two ponds (Metric, 2005). This request was approved by USEPA/NMED[8] in June 2005. The backfilling of rapid infiltration ponds 5 and 6 (as proposed in Sparton's request) started in August 2005 and was completed in December 2005.

The rapid infiltration ponds performed well during 2005. Ponds 1 and 4 were used until July 26, 2005, and Ponds 2 and 3 were used during the remainder of the year. The amount of water evaporating from the ponds was estimated to be about 1 percent of the discharged water, that is, about 0.5 gpm.

3.3 Problems and Responses

Except for the downtimes discussed in the previous section, no other significant problems were experienced during the 2005 operation of the off-site and source containment systems.

[8] Letter dated June 23, 2005 from Charles A. Barnes, Project Manager, USEPA and John Kieling, Program Manager, NMED to Gary L. Richardson of Metric Corporation, RE: Sparton Technology, Inc., Former Coors Road Plant Remedial Program, Request to Modify the Source Containment System Approved Workplan.

The original blower motor on the source containment system was rebuilt, and is available for immediate replacement should the blower motor fail in the future.

Section 4
Monitoring Results - 2005

The following data were collected in 2005 to evaluate the performance of the operating remedial systems and to meet the requirements of the Consent Decree and of the permits for the site:

- water-level and water-quality data from monitoring wells,
- data on containment well flow rates, and
- data on the quality of the influent to and effluent from the water-treatment systems.

4.1 Monitoring Wells

4.1.1 Water Levels

The depth to water was measured quarterly during 2005 in all accessible monitoring wells, the off-site and source containment wells, the two observation wells, the piezometer installed in the infiltration gallery, and the Corrales Main Canal near the southeast corner of the Sparton property. The quarterly elevations of the water levels, calculated from these data, are summarized on Table 4.1.

4.1.2 Water Quality

Monitoring wells within and in the vicinity of the plume were sampled at the frequency specified in the Groundwater Monitoring Program Plan (Attachment A to Consent Order). The samples were analyzed for VOCs (primarily for determination of TCE, DCE, and TCA concentrations), and for total chromium (unfiltered, and occasionally filtered, samples). The results of the analysis of the samples collected from these monitoring wells during all sampling events conducted in 2005, and for all of the analyzed constituents, are presented in Appendix A-1. Data on TCE, DCE, and TCA concentrations, in samples collected during the Fourth Quarter of 2005 (November 2005), are summarized on Table 4.2. Samples were also obtained quarterly from the infiltration gallery monitoring wells (MW-74, MW-75, and MW-76) and from the infiltration pond monitoring wells (MW17, MW-77, and MW-78); these samples were analyzed for VOCs (primarily TCE, DCE, and TCA), total chromium, iron, and manganese, as specified in the Groundwater Discharge Permit for the infiltration gallery and the infiltration ponds. The results of the analysis of these samples are presented in Appendix A-2; data on TCE, DCE and TCA concentrations in the Fourth Quarter of 2005 (November 2005) samples from these wells are also included on Table 4.2. For each of the compounds reported on Table 4.2 and in Appendix A, concentrations that exceed the more stringent of its MCL for drinking water or its maximum allowable concentration in groundwater set by NMWQCC are highlighted.

4.2 Containment Systems

4.2.1 Flow Rates

The volumes of groundwater pumped by the off-site and source containment wells during 2005, and the corresponding flow rates are summarized on Table 4.3. As shown on Table 4.3 (a), a total of about 143.5 million gallons of water, corresponding to a combined flow rate of 273 gpm were pumped by the two containment wells. The volume and average flow rate of each well are discussed further below.

4.2.1.1 Off-Site Containment Well

The volume of the water pumped by the off-site containment well during 2005 was monitored with a totalizer meter that was read at irregular frequencies. The intervals between meter readings ranged from less than a day to about sixteen days, and averaged about six days. During each reading of the meter, the instantaneous flow rate of the well was calculated by timing the volume pumped over a specific time interval. The totalizer data collected from these flow meter readings and the calculated instantaneous discharge rate during each reading of the meter are presented in Appendix B-1. Also included in this appendix are the average discharge rate between readings and the total volume pumped between the start of continuous pumping on December 31, 1998, and the time of the measurement, calculated from the totalizer meter readings.

The average monthly discharge rate and the total volume of water pumped from the off-site containment well during each month of 2005, as calculated from the totalizer data, are summarized on Table 4.3 (b). As indicated on this table, approximately 118 million gallons of water, corresponding to an average rate of 225 gpm, were pumped in 2005.

4.2.1.2 Source Containment Well

The volume of the water pumped by the source containment well during 2005 was also monitored with a totalizer meter that was also read at irregular frequencies. The intervals between meter readings ranged from one day to about twenty days, and averaged about six days. During each reading of the meter, the instantaneous flow rate of the well was calculated by timing the volume pumped over a specific time interval. The totalizer data collected from these flow meter readings and the calculated instantaneous discharge rate during each reading of the meter are presented in Appendix B-2. Also included in this appendix are the average discharge rate between readings and the total volume pumped between the start of continuous pumping on January 3, 2002, and the time of the measurement, calculated from the totalizer meter readings.

The average monthly discharge rate and the total volume of water pumped from the source containment well during each month of 2004, as calculated from the totalizer data, are summarized on Table 4.3 (c). As indicated on this table, approximately 25.5 million gallons of water, corresponding to an average rate of 48 gpm, were pumped in 2004.

4.2.2 Influent and Effluent Quality

4.2.2.1 Off-Site Containment System

During 2005, the influent[9] to and effluent from the treatment plant for the off-site containment system was sampled monthly. These monthly samples were analyzed for VOCs (primarily TCE, DCE, and TCA), total chromium, iron, and manganese. The results of these influent and effluent sample analyses are presented in Appendix C-1. Concentrations of TCE, DCE, TCA, and total chromium in samples collected during 2005 are summarized on Table 4.4 (a). For each of the compounds shown on Table 4.4 (a), concentrations that exceed the more stringent of its MCL for drinking water or its maximum allowable concentrations in groundwater set by NMWQCC are highlighted. Data on TCE, DCE, and TCA concentrations for the November sample of influent are also included in Table 4.2, as the Fourth Quarter concentrations in CW-1, and were used in the preparation of the plume maps discussed in the next section.

4.2.2.2 Source Containment System

During 2005, the influent to and effluent from the treatment plant for the source containment system was sampled monthly. These monthly samples were analyzed for VOCs (primarily TCE, DCE, and TCA), total chromium, iron, and manganese. The results of these influent and effluent sample analyses are presented in Appendix C-2. Concentrations of TCE, DCE, TCA, and total chromium in samples collected during 2005 are summarized on Table 4.4 (b). For each of the compounds shown on Table 4.4 (b), concentrations that exceed the more stringent of its MCL for drinking water or its maximum allowable concentrations in groundwater set by NMWQCC are highlighted. Data on TCE, DCE, and TCA concentrations for the November sample of influent are also included in Table 4.2, as the Fourth Quarter concentrations in CW-2, and were used in the preparation of the plume maps discussed in the next section.

[9] The "discharge from the containment wells" is the "influent" to the treatment systems; therefore, the two terms are used interchangeably in this report.

Section 5
Evaluation of Operations - 2005

The goal of the off-site containment system is to control hydraulically the migration of the plume in the off-site area and, in the long-term, restore the groundwater to beneficial use. The goal of the source containment system is to control hydraulically, within a short distance from the site, any potential source areas that may be continuing to contribute to groundwater contamination at the on-site area. This section presents the results of evaluations based on data collected during 2005 of the performance of the off-site and source containment systems with respect to their above-stated goals.

5.1 Hydraulic Containment

The quarterly water-level elevation data presented in Table 4.1 were used to evaluate the performance of both the off-site and source containment wells with respect to providing hydraulic containment for the plume and potential on-site source areas. Maps of the elevation of the on-site water table and of the water levels in the UFZ/ULFZ and the LLFZ during each of the four rounds of water-level measurements during 2005 are shown in Figures 5.1 through 5.12. Also shown in these figures are: (1) the limit of the capture zones of the containment wells in the UFZ/ULFZ or the LLFZ, as determined from the configuration of the water levels; and (2) the extent of the TCE plume based on previous year's (November 2004) water-quality data from monitoring wells. (The November 2004 extent of the plume is used as representative of the area that should have been contained during 2005.)

As shown in Figures 5.1, 5.4, 5.7, and 5.10, the pumping from the source containment well CW-2 has a small effect on the on-site water table contours. Well CW-2 is screened between an elevation of 4968.5 and 4918.5 ft MSL. The sand-pack extends about ten feet above the top of the screen, to an elevation of about 4978.5 ft MSL. The top of the 4970-foot silt/clay at this location is also at an elevation of about 4968.5 ft MSL. Most of the water pumped from the well, therefore, comes from the ULFZ and LLFZ underlying the 4970-foot silt/clay unit. The pumping water level in CW-2 is about 4957 ft MSL, more than 10 ft below the top of the silt/clay unit; thus, the direct contribution of water from the aquifer above the silt/clay unit into the well is by leakage through the sand pack, and is controlled by the elevation of the top of the silt/clay unit at the well location. In preparing the water-table maps for the on-site area, the elevation of the water table at the location of CW-2 was, therefore, assumed to be near the top of the 4970-foot silt/clay, that is, at an elevation of 4968.5 ft MSL. A similar condition exists at the location of infiltration pond monitoring wells MW-77 and MW-78. These two monitoring wells are equipped with 30-foot screens that span across the silt/clay unit, and thus allow water to flow from the on-site water table into the underlying ULFZ. The effects of this downward flow were also considered in preparing the water table maps.

The on-site water table maps (Figures 5.1, 5.4, 5.7, and 5.10) also indicate that the treated groundwater infiltrating from the infiltration ponds has created a water-table mound in the pond area. Comparison of the 2005 water table elevations with those that prevailed prior to the operation of CW-2 and of the infiltration ponds indicates that water levels in monitoring wells close to the ponds have risen by one foot or more; the highest rise of the water table, about 8.5 ft, occurred in the vicinity of wells MW-21 and MW-27. The water levels in monitoring wells along or near the southern limit of the silt/clay unit (MW-07, MW-09, MW-12, MW-13, MW-23, MW-26, and MW-33), however, continued to decline due to the off-setting effects of regional declining trends. These changes in water levels have resulted in steeper gradients, and hence, faster flow rates, both horizontally and vertically. These faster flow rates and the flushing effects of the infiltrating water expedite the migration of contaminants remaining above the 4970-foot silt/clay unit into the capture zones of the source and off-site containment wells.

The figures showing the water levels within the UFZ/ULFZ (Figures 5.2, 5.5, 5.8, and 5.11) and the LLFZ (Figures 5.3, 5.6, 5.9, and 5.12) indicate that the source containment well has developed a capture zone that controls any potential on-site source areas that may be contributing to groundwater contamination. The capture zone of the well in both the UFZ/ULFZ and the LLFZ is wider than predicted during its design (SSP&A, 2000c). As also shown in these figures, the limits of the off-site containment well capture zone during 2005 were beyond the extent of the plume. Hydraulic containment of the plume was, therefore, maintained throughout the year.

5.2 Groundwater Quality

Plots showing temporal changes in the concentrations of TCE, DCE, and TCA were prepared for a number of on-site and off-site wells to evaluate long-term water-quality changes at the Sparton site. Plots for on-site wells are shown in Figure 5.13 and plots for off-site wells in Figure 5.14. The concentrations in the on-site wells (Figure 5.13) indicate a general decreasing trend. In fact, the data from wells MW-9 and MW-16, which have the longest record, suggest that this decreasing trend may have started before 1983. A significant decrease in concentrations occurred in well MW-16 during 1999 through 2001. This well is located near the area where the SVE system was operating during those years, and it is apparent that the SVE operations affected the concentrations in the well. The TCE concentration in the well increased from 6 μg/L in November 2001 to 22 μg/L in November 2002, but then declined again to 5 μg/L in November 2003; the November 2004 and 2005 TCE concentrations in the well were 6.3 and 7.4 μg/L, respectively. These low and relatively constant concentrations indicate that the SVE system was very effective in cleaning up the unsaturated zone in this area.

A plot for well MW-72 is also included in Figure 5.13. Well MW-72 (see Figure 2.3 for well location) was installed in late February 1999 (SSP&A, 1999a) to provide a means for assessing whether source areas exist outside the then-predicted capture zone of the source containment well. The first sampling of the well in March 1999 indicated a TCE concentration of 1,800 μg/L and, under the terms of the Consent Decree (see Attachment F to the Consent Decree [SSP&A, 2000c]), the well was scheduled for semi-annual sampling for a period of five years (starting in May 1999). The 5-year semi-annual sampling period was completed in 2003 and, as required by the Consent Decree, an evaluation of the data collected during these five years was made and presented in the 2003 Annual Report (SSP&A, 2004). Based on the declining trend of the concentrations observed during several years prior to the evaluation and on the relative position of the well with respect to the capture zone of the source containment well, the evaluation concluded that there are no source areas outside the capture zone of CW-2, and recommended that sampling frequency of the well be reduced to annually. The well was, however, sampled semi-annually in 2004 and the change in its sampling frequency became effective in 2005. In November 2005, the TCE concentration in this well (720 μg/L) was higher than it was in November 2004 (170 μg/L). During the next few years the TCE concentrations in the well will be closely monitored to assess whether they continue to remain below the 1,000 μg/L criterion specified in the Consent Decree (see Attachment F to the Consent Decree [SSP&A, 2000c]).

In general, the concentrations in most off-site wells have also been decreasing. Of the six wells shown in Figure 5.14, the November 2005 concentrations in well MW-60 continued to be the highest observed in an off-site well, as it has been the case during the last several years. The concentrations of TCE in this well increased from low μg/L levels in 1993 to a high of 11,000 μg/L in November 1999 and then declined to 2,900 μg/L in November 2000. Then, they began increasing again reaching a second peak of 18,000 μg/L in November 2004. In November 2005, the TCE concentration in the well declined to 7,800 μg/L. This two-peak trend is also apparent in the other five wells shown in Figure 5.14.

One of the two DFZ wells, MW-67 of the MW-48/55/56/67 cluster, continued to be free of any contaminants in 2005 as it has been since its installation in July 1996. The other DFZ well, MW-71R, was installed in February 2002 as a replacement for MW-71. Well MW-71, which was located near the MW-60/61 cluster, had been problematic since its installation in June 1998, and its recompletion in October 1998 (see 1999 Annual Report [SSP&A, 2001a] for a detailed discussion of the history of this well). A purge test and the deviation survey were conducted on the well in July and September 2001 to investigate its behavior. Based on the results of these tests (SSP&A and Metric, 2002), the well was plugged in October 2001 and the replacement well, MW-71R, was installed about 30 feet south of the original well (see Figure 2.3 for location); this well is equipped with a 5-foot screen installed 20 feet below the screen of the original well (see Table 2.2 for elevation of screened interval).

The first sample from MW71R, obtained in February 2002, had a TCE concentration of 130 μg/L. The TCE concentration in the well then gradually increased to 210 μg/L by August 2003. Quarterly samples collected during the remainder of 2003 and during 2004 had TCE concentrations in the 170 and 190 μg/L range. During 2005, the TCE concentrations in the well declined; they were 140 μg/L in February, 120 μg/L in May, 130 μg/L in August, and 120 μg/L in November. To address the continuing presence of contaminants in this well, proposals for action were made by Sparton (SSP&A and Metric, 2004a) and several discussions on potential actions were held between technical representatives of USEPA, NMED, and Sparton. In October 2004, the parties agreed to install a DFZ monitoring/stand-by extraction well near the off-site containment well CW-1 with the decision on whether the well will be a monitoring or an extraction well to be based on the results of the initial sampling of the well. A Work Plan

(SSP&A and Metric 2004b) for the installation, testing, monitoring, and/or operation of this well was prepared and submitted to USEPA and NMED on December 6, 2004. Sparton received approval[10] of this Work Plan on January 6, 2005, and began the process of its implementation. Most of Sparton's effort during 2005 went into obtaining an easement agreement from the COA to provide access through a COA owned park for moving a drilling rig to the proposed well location (see Section 3.1.2 for additional details). The signed easement agreement was received by Sparton on October 5, 2005, and Sparton notified the COA on December 19, 2005 that construction of the monitoring/stand-by extraction well would begin on January 9, 2006.[11]

The Fourth Quarter (November) 2005 water-quality data presented in Table 4.2 were used to prepare concentration distribution maps showing conditions near the end of 2005. The horizontal extent of the TCE and DCE plumes and the concentration distribution within these plumes in November 2005, as determined from the monitoring well data, are shown on Figures 5.15 and 5.16, respectively; the concentrations of TCA are shown on Figure 5.17. (At well cluster locations only the well with the highest concentration is shown in these figures.) Also shown on Figure 5.15 are the approximate areas of origin[12] of the water pumped by the off-site containment well during the last seven years and from the source containment well during the last four years.

The extent of the TCE and DCE plumes in November 2005 (Figures 5.15 and 5.16) is similar to that in November 2004. Of the 57 wells that were sampled in November 2005, the TCE concentrations were lower than in November 2004 in 20 wells, higher in 17 wells, and remained the same (below the detection limit of 1 μg/L) in 20 wells. The corresponding numbers for DCE were 11 wells with lower, 12 wells with higher, and 34 wells with the same (below the detection limit of 1 μg/L) concentrations. The highest decrease was in well MW-60 where the concentration of TCE decreased from 18,000 μg/L in 2004 to 7,800 μg/L in 2005, and that of DCE from 830 μg/L to 455 μg/L. The highest increase was in well MW-72 where the concentration of TCE increased from 170 to 720 μg/L, and that of DCE from 15 to 67 μg/L. In most wells where the concentrations of TCE and/or DCE increased, the increase was less than 10 μg/L. The concentrations of TCA presented in Figure 5.17 indicate that a TCA plume (defined as the area with concentrations exceeding the more stringent of the federal or state allowable limits in groundwater) continued not to exist in November 2005, as it has been the case since November 2003. None of the monitoring wells had a TCA concentration above the 60 μg/L

---

[10] E-mail dated January 6, 2005 from Charles A. Barnes of USEPA to Tony Hurst of Hurst Engineering Services, Project Coordinator for Sparton, on the subject of "Approval of Work Plan submitted December 6, 2004," with cc to John Kieling, Carolyn Cooper, and Baird Swanson of NMED.

[11] Installation and development of the well was completed on February 24, 2006. The well was pump-tested during the first week of April 2006 and samples were obtained during the test. Site-related contaminants were not found in any of the samples.

[12] Area of origin refers to the areal extent of the volume of the aquifer within which the water pumped during a particular year was stored prior to the start of pumping from that particular well, that is, in late December 1998 for extraction well CW-1 and in early January 2002 for extraction well CW-2.

maximum allowable concentration in groundwater set by the NMWQCC. The highest TCA concentration in November 2005 was 28 μg/L and occurred in well MW-65.

Note that the leading edge of the DCE plume (Figure 5.16) extends towards the southeast to monitoring well MW-65. Until late 2001, DCE concentrations in this well had been below detection limits; DCE above the detection limit of 1 μg/L first occurred in November 2001 (2.6 μg/L), and its concentration rose above the MCL of 5 μg/L in February 2002 (5.4 μg/L). The DCE concentrations in the well continued to increase since that time reaching 73 μg/L in November 2005. A similar situation also exists with the TCA and TCE concentrations in MW-65. The first detection of TCA at the detection limit of 1 μg/L occurred in February 2002 and its concentration rose since that time to 28 μg/L in November 2005. Prior to the start of remedial pumping, TCE was the only compound that was detected in this well above the detection limit of 1 μg/L. Its concentration in November 1998, a few months before the start of pumping from the off-site containment well CW-1, was 13 μg/L. After the start of pumping from CW-1 on December 31, 1998, TCE concentrations in the well rapidly decreased and were below the detection limit by August 1999. The concentrations of TCE in the well remained below the detection limit until November 2001 when it was again detected and began rising reaching 19 μg/L in November 2005. Given the direction of groundwater flow (see Figures 5.1 through 5.12), and the lack of any significant historical concentrations of DCE or TCA in wells MW-53, MW-58, MW-55, MW-47, and MW-37R (or its predecessor MW-37), the contaminants detected in MW-65 during the last several years may represent a separate source south of the Sparton Site.

Changes that occurred between November 1998 (prior to the implementation of the current remedial activities) and November 2005 in the TCE, DCE, and TCA concentrations at wells that were used for plume definition and sampled during both sampling events are shown in Figures 5.18, 5.19, and 5.20. Also shown on these figures is the extent of the plumes in November 1998 and November 2005. (Changes in monitoring wells MW-72, MW-73 and MW-77, and containment well CW-2, which were installed after November 1998 are also included in these figures; the changes in these wells are between their first sampling after installation and November 2005.) Among the 35 wells that were used to prepare these figures, TCE concentrations decreased in 23 wells, increased in 7 wells, and remained unchanged (below detection limit) in 5 wells. The corresponding number of wells where concentrations decreased, increased, or remained unchanged are 18, 8, and 9 for DCE, and 19, 4, and 12 for TCA.

The largest decreases in contaminant concentrations occurred in on-site wells MW-23, MW-25, and MW-26. Concentrations of TCE in these wells decreased by 6,150, 5,579, and 6,481 μg/L, respectively, from levels that were in the 5,500-6,500 μg/L range in 1998 to levels of 50 μg/L and less; DCE concentrations decreased by 396, 71, and 590 μg/L, to very low μg/L levels or to "not detected" (*ND*); and TCA concentrations decreased from levels that were at the 550-720 μg/L levels to ND. The largest increases in TCE concentrations occurred in the off-site containment well CW-1 (1,060 μg/L), and on-site ULFZ well MW-19 (811 μg/L). The TCE concentration in CW-1 increased from 140 μg/L in September 1998 to 1,000 μg/L levels soon after the start of its operation and stayed at those levels since then; it was 1,200 μg/L in November 2005. In well MW-19, the TCE concentration increased from 4.2 μg/L in 1998 to 815 μg/L in November 2005. When first sampled in 1991, well MW-19 had a TCE concentration of 680 μg/L and a DCE concentration of 57 μg/L; the concentration of both TCE and DCE began declining after that reaching 4.2 μg/L for TCE and ND for DCE by November 1998 (TCA concentrations during this period had been ND or at low μg/L levels). Contaminant concentrations in the well remained at these low levels until November 2001 and then began rising in 2002; the November 2005 concentrations were 815 μg/L for TCE, 81 μg/L for DCE, and 8 μg/L for TCA (see Table 4.2). This increase in contaminant concentrations in MW-19 is attributed to the presence of residual contaminants within the 4970-foot silt/clay unit and the higher leakage rates through this unit that were induced by the water table that rose since the source containment system and the associated on-site infiltration ponds began operating in January 2002. This process is probably also responsible for the increased contaminant concentrations observed in well MW-72.

The persistence of the high concentrations that have been observed in the water pumped from containment well CW-1 since the beginning of its operation, and the concentrations detected at well MW-60 indicate the presence of high concentration areas upgradient from both the off-site containment well and MW-60. This conclusion is confirmed by the model calibration results discussed in Section 6.

5.3 Containment Systems

5.3.1 Flow Rates

A total of about 143.5 million gallons of water, corresponding to an average pumping rate of about 273 gpm, were pumped during 2005 from the off-site and source containment wells [see Table 4.3 (a)]. The total volume pumped from both wells since the beginning of remedial pumping in December 1998 is about 915 million gallons (Figure 5.22), and represents approximately 81 percent of the initial plume pore volume reported in Subsection 2.6.1.3 of this report. The volume pumped from each well and the average flow rates are discussed below.

5.3.1.1 Off-Site Containment Well

The volume of water pumped from the off-site containment well during each month of 2005 is shown on Table 4.3 (b); a plot of the monthly production is presented in Figure 5.21. Based on the total volume of water pumped during the year (approximately 118 million gallons), the average discharge rate for the year was 225 gpm. The well was operated 99.7 percent of the time available during the year, thus the average operating discharge rate was not significantly different.

Since the beginning of its operation in December 1998, the off-site containment well pumped a total of about 810 million gallons of water from the aquifer. (This total includes about 2 million gallons pumped during the testing and the first day of operation of the well in December 1998.) This represents approximately 72 percent of the initial plume pore volume reported in Subsection 2.6.1.3 of this report. A cumulative plot of the volume of water pumped from the off-site containment well is presented in Figure 5.22.

5.3.1.2 Source Containment Well

The volume of water pumped from the source containment well during each month of 2005 is shown on Table 4.3 (c); a plot of the monthly production is presented in Figure 5.21. Based on the total volume of water pumped during the year (approximately 25.5 million gallons), the average discharge rate for the year was 48 gpm. The well was operated 96.8 percent of the time available during the year, thus the average operating discharge rate was about 50 gpm.

Since the beginning of its operation in January 3, 2002, the source containment well pumped a total of about 104 million gallons of water from the aquifer. This represents approximately 9 percent of the initial plume pore volume reported in Subsection 2.6.1.3 of this report. A cumulative plot of the volume of water pumped from the off-site containment well is presented in Figure 5.22.

5.3.2 Influent and Effluent Quality

5.3.2.1 Off-Site Containment System

The concentrations of TCE, DCE, TCA, and total chromium in the influent to and effluent from the off-site air stripper during 2005, as determined at the beginning of each month, are presented on Table 4.4 (a). Plots of the TCE, DCE, and total chromium concentrations in the influent are presented in Figure 5.23.

The concentrations of TCE in the influent during 2005 ranged from 1,100 μg/L to 1,300 μg/L and averaged about 1,220 μg/L. The concentrations of DCE and TCA also fluctuated within a relatively narrow range and averaged 72 μg/L and 4 μg/L, respectively. Throughout the year, total chromium concentrations in the influent were below the 50 μg/L maximum allowable concentration in groundwater set by NMWQCC and averaged about 27 μg/L.

The concentrations of TCE, DCE, and TCA in the air stripper effluent were below the detection limit of 1 μg/L throughout 2005. Total chromium concentrations in the effluent were essentially the same as those in the influent, except for the April sample that was reported as 51 μg/L. This is obviously an error as the chromium concentration in the influent during that month was 32 μg/L.

5.3.2.2 Source Containment System

The 2005 concentrations of TCE, DCE, TCA, and total chromium in the influent to and effluent from air stripper for the source containment system, as determined at the beginning of each month, are presented on Table 4.4 (b). Plots of the TCE, DCE, and total chromium concentrations in the influent are presented in Figure 5.23.

The concentrations of TCE in the influent during 2005 ranged from 220 μg/L to 160 μg/L, and averaged about 190 μg/L. The concentrations of DCE and TCA also fluctuated during the year within a relatively narrow range and averaged about 24 μg/L and 2.3 μg/L, respectively. Except for the February sample, the total chromium concentrations in the influent were below the 50 μg/L maximum allowable concentration in groundwater set by NMWQCC and averaged 31 μg/L. The chromium concentrations for the February sample were reported as 50 μg/L, but the chromium data for this month are suspect as the influent concentration has been reported as 3 μg/L, a value which is not consistent with other monthly data.

The concentrations of TCE, DCE, and TCA in the air stripper effluent were below detection limits throughout the year. Except for the February sample mentioned above, chromium concentrations in the effluent were at about the same level as those in the influent.

5.3.3 Origin of the Pumped Water

The groundwater pumped from the off-site and the source containment wells is water that was originally (prior to the start of pumping) in storage around each well. The areal extent of the volume of the aquifer within which the water pumped during a particular year was originally stored is referred to as the "area of origin" of the water pumped during that year. The approximate areas of origin of the water pumped from the off-site containment well during each of the last seven years and from the source containment well during each of the last four years are shown in Figure 5.15. Particle tracking analysis (see Section 6.1.4) with the calibrated model of the site was used to determine these areas of origin. The area of origin of the water pumped by each well during the first year of its operation (1999 for the off-site and 2002 for the source containment well) is a slightly elliptical area around each well, with the well off-centered on the down-gradient side of the elliptical area. The areas of origin corresponding to subsequent years of operation form elliptical rings around the first year's area of origin. (The elliptical shape and the off-centered location with respect to the containment wells are due to the effects of the regional gradient.)

5.3.3.1 Off-Site Containment Well

Approximately 810 million gallons of groundwater have been removed from the aquifer during the seven-year operation of the off-site containment well. The well is screened across the entire thickness of the aquifer above the 4,800-foot clay. Using an average thickness of 160 ft for the aquifer, a porosity of 0.3, and assuming that the flow is primarily horizontal, the areal extent of the original storage volume for this water is estimated to be 2.26 million square feet (ft^2). This is consistent with the extent of the model calculated areas of origin for this well shown in Figure 5.15 (about 2.45 million ft^2). Note that the above estimate assumes horizontal flow, whereas the model takes into consideration the fact that the water table is declining and that, therefore, the source of some of the pumped water is vertical drainage from the water table rather than purely horizontal flow. The storage volume from which the pumped water is derived has a smaller area near the water table than in the deeper horizons of the aquifer. The area shown in Figure 5.15 represents the horizon where the area is the largest.

5.3.3.2 Source Containment Well

Approximately 104 million gallons of groundwater have been removed from the aquifer during the four-year operation of the source containment well. About 40 feet of the screen of this well is open to the aquifer below the 4970-foot silt/clay. Assuming that groundwater flow toward the well is primarily within this 40-foot screened interval, and a porosity of 0.3, the areal extent of the original storage volume of the water pumped from the well is estimated to be 1.16 million ft^2. The extent of the model calculated areas of origin for this well shown in Figure 5.15 is about 0.81 million ft^2. The difference in the estimated and model based areas indicates that about 30 percent of the water pumped by this well is vertical leakage that originates from the aquifer above the 4970-foot silt/clay, and from deeper horizons of the aquifer below the screened interval of the well.

5.3.4 Contaminant Mass Removal

A total of about 595 kg (1,310 lbs) of contaminants, consisting of 558 kg of TCE (1,230 lbs), 35 kg of DCE (77 lbs), and 2.0 kg of TCA (4.4 lbs), were removed by the two containment wells during 2005 [see Table 5.1 (a)]. The total mass removed by the containment wells since the beginning of operations in December 1998 is about 3,940 kg (8,690 lbs), consisting of about 3,710 kg (8,180 lbs) of TCE, 215 kg (475 lbs) of DCE, and 11 kg (24 lbs) of TCA. This represents about 53.8 percent of the total dissolved contaminant mass currently estimated to have been present in the aquifer prior to the testing and operation of the off-site containment system (see Section 2.6.1.4). The mass removal rates by each well are discussed below.

5.3.4.1 Off-Site Containment Well

The monthly mass removal rates of TCE, DCE, and TCA by the off-site containment well during the 2005 were estimated using the monthly discharge volumes presented on Table 4.3 (b) and the concentration of these compounds shown on Table 4.4 (a). These monthly removal rates are summarized on Table 5.1 (b) and plotted in Figure 5.24. As shown on Table 5.1 (b), about 575 kg (1,265 lbs) of contaminants, consisting of about 540 kg (1,190 lbs) of TCE, 32 kg (71 lbs) of DCE, and 1.8 kg (4.0 lbs) of TCA were removed by the off-site containment well during 2005.

A plot showing the cumulative mass removal by the off-site containment well, including 1.3 kg (3 lbs) removed during the December 1998 testing and operation of the well, is presented in Figure 5.25. By the end of 2005 the off-site containment well had removed a total of approximately 3,760 kg (8,290 lbs) of contaminants, consisting of approximately 3,560 kg (7,850 lbs) of TCE, 190 kg (420 lbs) of DCE, and 7.9 kg (17 lbs) of TCA. This represents about 51.3 percent of the total dissolved contaminant mass currently estimated to have been present in the aquifer prior to the testing and operation of the off-site containment system (see Section 2.6.1.4).

5.3.4.2 Source Containment Well

The monthly mass removal rates of TCE, DCE, and TCA by the source containment well during the 2005 were estimated using the monthly discharge volumes presented on Table 4.3 (c) and the concentration of these compounds shown on Table 4.4 (b). These monthly removal rates are summarized on Table 5.1 (c) and plotted in Figure 5.24. As shown on Table 5.1 (c), about 21 kg (46 lbs) of contaminants, consisting of 18 kg (40 lbs) of TCE, 2.3 kg (5.0 lbs) of DCE, and 0.2 kg (0.5 lbs) of TCA were removed by the source containment well during 2004.

A plot showing the cumulative mass removal by the source containment well since the beginning of its operation on January 3, 2002 is presented in Figure 5.25. The total mass of contaminants removed by the well by the end of 2005 was 180 kg (400 lbs), consisting of 155 kg (340 lbs) of TCE, 22 kg (49 lbs) of DCE, and 3.3 kg (7.2 lbs) of DCA. This represents about 2.5 percent of the total dissolved contaminant mass currently estimated to have been present in the aquifer prior to the testing and operation of the off-site containment system (see Section 2.6.1.4).

5.4 Site Permits

5.4.1 Off-Site Containment System

The infiltration gallery associated with the off-site containment system is operated under State of New Mexico Groundwater Discharge Permit DP-1184. This permit requires monthly sampling of the treatment system effluent, and the quarterly sampling of the infiltration gallery monitoring wells MW-74, MW-75 and MW-76. The samples are analyzed for TCE, DCE, TCA, chromium, iron, and manganese. The concentrations of these constituents must not exceed the maximum allowable concentrations for groundwater set by NMWQCC, and the results of the analyses must be reported quarterly.

As required by the Groundwater Discharge Permit, all sample analysis results during 2005 were reported quarterly to the NMED Groundwater Bureau. Except for the April sample of the treatment system effluent, the sampling results met the permit requirements. The April sample of the effluent was reported as having a chromium concentration of 51 μg/L which exceeded the 50 μg/L maximum allowable concentration for groundwater set by NMWQCC; however, this reported concentration was obviously an error as the April sample of the treatment influent had a chromium concentration of only 32 μg/L.

No violation notices were received during 2005 for activities associated with the operation of the off-site containment system

5.4.2 Source Containment System

The rapid infiltration ponds associated with the source containment system are also operated under State of New Mexico Groundwater Discharge Permit DP-1184, and are subject to the above-stated requirements of this permit. The monitoring wells for this system are MW-17, MW-77 and MW-78. The data collected from the system met the requirements of the Groundwater Discharge Permit throughout 2005.

The air stripper associated with the source containment system is operated under Albuquerque/Bernalillo County Authority-to-Construct Permit No. 1203. This permit specifies emission limits for total VOCs, TCE, DCE, and TCA. Emissions from the air stripper are calculated annually by using influent water-quality concentrations and the air stripper blower capacity. The calculated emissions are reported to the Albuquerque Air Quality Division by March 15 every year as required by the permit.

The requirements of Permit No. 1203 were met throughout 2005. No violation notices were received during 2005 for activities associated with operation of the source containment system.

5.5 Contacts

During 2005, Baird Swanson (NMED Groundwater Bureau) visited the site during the sampling of DFZ well MW-71R and obtained split samples from this well.

Under the terms of the Consent Decree,[13] Sparton is required to prepare an annual Fact Sheet summarizing the status of the remedial actions, and after approval by USEPA/NMED, distribute this Fact Sheet to property owners located above the plume and adjacent to the off-site treatment plant water discharge pipeline. Annual Fact Sheets reporting on remedial activities during 1999, 2000, and 2001 were prepared by Sparton, approved by the regulatory agencies, and distributed to the property owners. During the last three years, however, such Fact Sheets were not distributed to the property owners. Sparton prepared Draft Fact Sheets for 2002, for 2002 and 2003 combined, and for 2002 through 2004 combined, but could not distribute these Fact Sheets because approval had not been issued by USEPA/NMED. The last Draft Fact Sheet, for the years 2002 through 2004, was submitted to the agencies for approval on August 2005, but approval had not been obtained as of the end of 2005.

[13] Attachment B to the Consent Decree in Albuquerque v. Sparton Technology, Inc., No. CV 07 0206 (D.N.M.), Public Involvement Plan for Corrective Measure Activities.

Section 6
Groundwater Flow and Transport Model

This section describes a numerical groundwater and contaminant transport model of the aquifer system underlying the Sparton site and its vicinity. This model was developed following the general outline described in Task 3 of the "Work Plan for the Assessment of Aquifer Restoration" (SSP&A,2000b), which is incorporated as Attachment D in the Consent Order. The development of the model is described in the 1999 Annual Report (SSP&A, 2001a) and in the 2003 Annual Report (SSP&A, 2004).

The groundwater flow model is based on MODFLOW-2000 (Harbaugh and others, 2000). This flow model has been calibrated to the average annual water levels observed since the start of the operation of the off-site containment well (1999-2005). The flow model is coupled with the solute transport simulation code MT3D99 for the simulation of constituents of concern underlying the site (Zheng and SSP&A, 1999). The model has been used to simulate TCE concentrations in the aquifer from start-up of the off-site containment well in December 1998 through December 2006.

6.1 Groundwater Flow Model

6.1.1 Structure of Model

The model area and model grid are presented in Figure 6.1. The overall model dimensions are 12,800 ft by 7,300 ft. The model consists of 88 rows and 133 columns. The fine model area consists of uniform discretization of 50 ft, covering an area of 4,100 ft by 2,600 ft. The grid spacing is gradually increased to 200 ft towards the limits of model domain. The model grid is aligned with principal axes corresponding to the approximate groundwater flow direction and plume orientation (45° clockwise rotation).

The model consists of 13 layers. The vertical discretization used in the model is shown in Figure 6.2. Layers 1 through 11 correspond to the surficial aquifer. Layer 1 is 15 ft thick, layer 2 is 5 ft thick, layers 3 through 7 are 10 ft thick, layers 8 and 9 are 20 ft thick, and layers 10 and 11 are 40 ft thick. Layer 12 is a 4-foot-thick unit that represents the 4800-foot clay unit. Layer 13 represents the upper 100 ft of the aquifer underlying the 4800-foot clay unit. The vertical discretization was selected to minimize vertical numerical dispersion.

6.1.1.1 Boundary Conditions

The northeast and southwest model boundaries are specified as no-flow boundaries. The rationale for no-flow boundaries on the northeast and southwest boundaries is that these boundaries are oriented approximately parallel to the direction of groundwater flow. The boundary on the southeast is the Rio Grande. The northwest model domain boundary is a constant head boundary (Figure 6.1). The procedure used to estimate heads on the constant head boundaries is described in the 2001 Annual Report (SSP&A, 2002). This procedure captures the regional water decline that has been observed at the Site over the past decade (Figure 6.3). Regional water levels, based on the water-level data shown on Figure 6.3, have declined at a relatively constant rate of 0.6 feet per year for the past 13 years. The method incorporates the following assumptions:

- the water levels from the ULFZ and LLFZ wells are best represented by a planar surface,
- the water levels vary linearly with depth,
- the coefficients of the plane of best-fit vary linearly over time, and
- the head drop across the 4800-foot silt/clay unit is about 6 ft.

6.1.1.2 Hydraulic Properties

Four different geologic zones are specified within the model domain:

- Holocene channel and flood plain deposits, also referred to as Recent Rio Grande deposits;
- the 4970-foot silt/clay unit;
- sands of the Upper Santa Fe Group, Late-Pleistocene channel and flood plain deposits, and Late-Pleistocene and Holocene arroyo fan and terrace deposits, collectively referred to as the sand unit; and
- the 4800-foot clay unit.

The sand unit is primarily classified as USF2 facies assemblages 2 and 3 (Hawley, 1996). Locally, near the water table, in some areas, the sands and gravels are classified as USF4 facies assemblages 1 and 2. In areas where the 4970-foot silt/clay unit is present, the sands and gravels overlying this unit are Late-Pleistocene arroyo fan and terrace deposits. The 4970-foot silt/clay unit represents Late-Pleistocene overbank deposits. The 4800-foot clay unit is included in the USF2.

The specific storage of all model units was specified at 2×10^{-6} ft^{-1} consistent with the value specified in the USGS model of the Albuquerque Basin (Kernodle, 1998). The specific yield of the sand unit and the Recent Rio Grande deposits was specified as 0.20.

The spatial extent of the recent Rio Grande deposits and the 4970-foot silt/clay unit are shown in Figure 6.1. The following table summarizes the estimates of hydraulic properties:

Hydrogeologic Zone	Hydraulic Conductivity, ft/d		Specific Yield	Specific Storage, ft^{-1}	Model Layers in which zone is present
	Horizontal	Vertical			
Sand unit above 4970-silt/clay unit	39	0.2	0.2	2×10^{-6}	1,2
Sand unit above 4970-silt/clay unit near southeastern extent	20	0.2	0.2	2×10^{-6}	1,2
4970-foot silt/clay unit	16	0.00006		2×10^{-6}	3
Recent Rio Grande deposits	91	0.008	0.2	2×10^{-6}	1-6
Sand unit	25	0.1	0.2	2×10^{-6}	3-11, 13
4800-foot clay unit	0.017	0.00002		2×10^{-6}	12

6.1.1.3 Sources and Sinks

The groundwater sinks in the model domain are the off-site containment well CW-1, the source containment well CW-2, and eight on-site shallow wells (PW-1, MW-18, and MW-23 through MW-28) that are, or were, used for remedial extraction. The off-site containment well has been in operation since December 31, 1998 with a brief shut down in April 1999. The average annual pumping rate has varied between 215 gpm and 225 gpm. The average pump rate in 2005 was 225 gpm. The pumping at CW-1 is distributed across model layers 4 through 11 and is apportioned based on layer transmissivities. The discharge from well CW-1 to the infiltration gallery is simulated using wells injecting into layer 2. The discharge is distributed across the area of the gallery.

The source containment well, CW-2, began operation in January 2002. The well has operated at an average annual pumping rate of between 48 gpm and 52 gpm. The average pump rate in 2005 was 48 gpm. Ninety-nine percent of the treated water from this well is assumed to infiltrate back to the aquifer from the six on-site infiltration ponds based on consumptive use calculations. Only two ponds are used for infiltration at any given time; during 2002 the treated discharge from the well was rotated among the ponds, but since then discharge was only to ponds 1,2,3, and 4 (see Figure 2.10 for pond locations). The other two infiltration ponds were backfilled during 2005.

The shallow extraction wells were operated from December 1988 to November 1999. Total extraction rates from the wells declined with time. The average pump rate was 0.26 gpm in 1999. Since discharge from the shallow extraction wells was to the city sewer, infiltration of this water was not simulated in the model. Infiltration of precipitation is considered to be negligible due to high evapotranspiration and low precipitation.

Recharge within the modeled area was assumed to occur from the Arroyo de las Calabacillas, the Corrales Main Canal, irrigated fields and the Rio Grande. The recharge rate for the arroyo and the canal was estimated in the model calibration process described below. The calibrated recharge rate from the arroyo and the canal was 19 ft/yr. Recharge from the irrigated fields east of the Corrales Main Canal was simulated at a rate of 1.1 ft/yr. Recharge was applied to the highest layer active within the model. The resulting total recharge rates within the modeled area were 141 gpm from the arroyo, 8 gpm from the canal, and 24 gpm from irrigated fields.

Infiltration from the Rio Grande was simulated with the MODFLOW river package. The water level in the Rio Grande was estimated from the USGS 7.5 minute topographic map for the Los Griegos, New Mexico quadrangle. The ratio of the vertical hydraulic conductivity of the sediments beneath the river to the thickness of these sediments was a parameter in the model calibration process. The calibrated ratio of the vertical hydraulic conductivity to the thickness was 0.1 per day. The model calculated infiltration rates from the Rio Grande range from about 400 gpm in 1998 to 453 gpm in 2005.

6.1.2 Model Calibration

The groundwater flow model initially calibrated as described in the 1999 Annual Report (SSP&A, 2001a) was recalibrated during the preparation of the 2003 Annual Report (SSP&A, 2004), to obtain better estimates of the hydraulic properties of the 4970-foot silt/clay unit, the sand unit above the 4970-foot silt clay unit, and the recent Rio Grande deposits. The annual averages of the water levels measured in each monitoring well between 1999 and 2003 were used as calibration targets, and the model was recalibrated by making transient simulations of the period between December 1998 and December 2003 and adjusting the above-listed hydraulic parameters to minimize the water-level residuals, that is, the difference between measured and calculated average water levels. The results of this recalibration were presented in the 2003 Annual Report.

A new recalibration of the groundwater flow model was not conducted this year. The average water levels for 2005 were added to the set of calibration targets and a transient simulation between December 1998 and December 2005 was conducted. The results of this simulation indicated that the model, as calibrated for the 2003 Annual Report, was able to match satisfactorily the 2005 water levels, and that, therefore, further recalibration was not necessary this year. The transient simulation between December 1998 and December 2005 and its results are discussed in the next section.

6.1.3 Transient Simulation – December 1998 to December 2005

The groundwater model was used to simulate groundwater levels in the aquifer system underlying the former Sparton site and its vicinity from December 1998, just prior to the startup of containment well CW-1, until December 2005. With the exception of the month-long stress period for December 1998, annual stress periods were used in the transient simulation. The 2005 pumping rates specified for the containment wells CW-1 and CW-2 were those specified on Table 4.3; the pumping rates for earlier years were those listed in Table 4.3 of the earlier Annual Reports (SSP&A, 2001a; 2001b; 2002; 2003; 2004). The calculated water levels at the end of this simulation, representing December 2005, for the water table (UFZ), ULFZ, and LLFZ are shown in Figures 6.4, 6.5, and 6.6, respectively.

The annual averages of the water levels measured between 1999 and 2005 at each of the monitoring wells at the former Sparton site and its vicinity were compared to model-simulated water levels. Measured water levels were compared to calculated water levels in the model layer corresponding to the location of the screened interval of the monitoring well. When the screened interval of a monitoring well spanned more than one model layer, the measured water levels were compared to the average of the calculated water levels in the layers penetrated by the well.

The correspondence between measured and model-calculated water levels was evaluated using both qualitative and quantitative measures. Scatter plots of observed versus calculated water levels were used to provide a visual comparison of the fit of model to the measured water level data. For a calibrated model, the points on the scatter plot should be randomly and closely distributed about the straight line that represents an exact match between the calculated and observed groundwater levels. The scatter plot shown in Figure 6.7 is a plot of measured versus calculated average water levels for all of the water level data collected between 1999 and 2005. This scatter plot visually illustrates the excellent comparison between model calculated water levels and observed water levels.

The quantitative evaluation of the model simulation consisted of examining the residuals between the 439 average annual water levels measured in the monitoring wells at the former Sparton site and its vicinity and the corresponding calculated water levels for these monitoring wells. The residual is defined as the observed water level minus the calculated water level. To quantify model error, three statistics were calculated for the residuals: the mean of the residuals, the mean of the absolute value of the residuals, and the sum of squared residuals. The mean of the residuals is 0.15 ft, the mean of the absolute value of the residuals is 0.78 ft, and the sum of squared residuals is 505 ft^2. The minimum residual is -3.0 ft and the maximum residual is 4.5 ft. The absolute mean residual of 0.78 feet is considered acceptable since the observed water-level measurements applied as calibration targets have a total range of 27 ft, and seasonal fluctuations of water levels are on the order of several feet. The residuals at each monitoring well for each monitoring period and the calibration statistics are presented in Appendix D.

6.1.4 Capture Zone Analysis

The capture zones of containment wells CW-1 and CW-2 in November 2005 were calculated using particle tracking. The particle tracking was applied to the calculated November 2005 water levels, assuming that these water levels represented a steady-state condition. The particle tracking was carried out using the PATH3D computer code (Zheng, 1991).

The calculated capture zones of containment wells CW-1 and CW-2 in the water table (UFZ), the ULFZ, and the LLFZ are presented in Figures 6.4, 6.5, and 6.6, respectively. Also shown in these figures is the extent of the TCE plume in November 2004. Note that, since well CW-2 is not screened across the aquifer above the 4,970-foot silt/clay unit, the capture zone of this well shown in Figure 6.4 represents water that flows eastward, over the edge of the 4,970-foot silt/clay, and then westward under the silt/clay unit to be eventually captured by CW-2. It should also be noted that Figure 6.6 represents the water levels in the middle of model layer 8 which corresponds to an elevation of 4,910 ft MSL (see Figure 6.2). This is an elevation 8.5 ft below the bottom of the screen in well CW-2; thus, the capture zone of this well shown in Figure 6.6 represents the area through which water moves upward and is captured by CW-2. Particle tracking analysis was also used to determine the aquifer area where the water extracted at CW-1 in each year from 1999 to 2005 was located at the start of extraction in 1998 and where the water at extracted at CW-2 in each year from 2002 to 2005 was located at the start of extraction in January 2002. These areas form a set of elliptical rings about the production wells as shown on Figure 5.15, with the outer ring in the vicinity of CW-1 representing the area where water extracted in 2005 resided within the aquifer in 1998, the year extraction began at the site.

The travel time from the center of the Sparton property (a point near monitoring well MW-26) to the source containment well CW-2, and the travel time from a point downgradient from and outside the capture zone of CW-2 to the off-site containment well CW-1 was estimated. These travel times were calculated as 1.5 and 15 years, respectively. This calculation assumed that both the off-site and the source containment wells are operating continuously at their current pumping rates and that 2005 water level conditions exist throughout the 15-year period.

6.2 Solute Transport Model

A solute transport model is linked to the groundwater flow model to simulate the concentration of constituents of concern at the site. The three-dimensional contaminant transport simulation code MT3D99 (Zheng and SSP&A, 1999) was applied for this study. The model was used to simulate TCE concentrations in the aquifer from December 1998 through December 2006.

Model input parameters were specified based on available data and the TCE concentrations in the model domain at the start of the simulation period were estimated from November 1998 measured concentration data. The model was calibrated by adjusting the initial TCE concentration distribution in the aquifer in a manner consistent with available data until a reasonable match was obtained between the calculated and measured TCE concentrations, and the calculated and measured TCE mass removal at both containment wells, CW-1 and CW2, throughout their respective period of operation. Once the model was calibrated, the model was used to predict TCE concentrations in the aquifer between January 2006 and December 2006. No attempt was made to simulate DCE and TCA. Generally, DCE is detected at monitoring wells where TCE is detected, but DCE concentrations are much lower than TCE concentrations. During 2005, DCE was about 6 percent of the total mass of chlorinated volatile organic compounds extracted by CW-1 and 13 percent of that extracted by CW-2.

The other constituent of concern, TCA, had been detected at concentrations greater than the 60 μg/L maximum allowable concentration in groundwater set by the NMWQCC, primarily in monitoring wells at the facility; TCA has been detected historically at levels above 60 μg/L in only one off-site well, MW-46. During the last three years, including the sampling round conducted in November 2005, none of the monitoring wells had TCA concentrations that exceeded 60 μg/L. The limited distribution of TCA and the reduction in its concentrations are the result of the abiotic transformation of TCA to acetic acid and DCE; a transformation that occurs relatively rapidly when TCA is dissolved in water. Only about 20 percent of TCA degrades to DCE, the rest degrades to acetic acid (Vogel and McCarty, 1987). The current concentrations of

TCA and DCE in monitoring wells at the facility indicate that it is not likely that DCE concentrations will increase significantly in the future as the result of TCA degradation.

6.2.1 Transport Parameters

A number of aquifer and chemical properties are required as input parameters for the contaminant transport simulation. The required aquifer properties are porosity, bulk density, and dispersivity. The required chemical property is the retardation coefficient which is a function of the fraction organic carbon, the organic-carbon partition coefficient for the organic compound being simulated, and the effective diffusion coefficient. The following table summarizes the transport parameters:

Transport Parameter	Geologic Unit	Value
Effective porosity	All	0.3
Longitudinal dispersivity	All	25 ft
Transverse horizontal dispersivity	All	0.25 ft
Transverse vertical dispersivity	All	0.025 ft
Retardation Coefficient	All except 4,970-foot silt/clay	1
	4,970-foot silt clay	4.5

The rationale for choosing these transport parameters is described in the 2000 Annual Report (SSP&A, 2001b) with the exception of the retardation coefficient for the 4,970-foot silt/clay unit.

The retardation coefficient for TCE was specified as unity in all geologic units, except for the 4970-foot silt/clay unit, because the total organic carbon content of the sandy units is very small. Initially, a retardation coefficient of unity was also assigned to this unit, but with this value of the retardation coefficient calculated TCE concentrations at CW-2 were underestimated. A likely explanation for the underestimation of concentrations is that the model did not correctly simulate the slow release of TCE from the fine-grained 4970-foot silt/clay unit which underlies much of the site area where historical surface releases of TCE occurred. To better simulate TCE in the 4970-foot silt/clay unit, the retardation coefficient for this unit was estimated during model calibration. The retardation coefficient specified for the 4970-foot silt/clay unit most likely represents a number of physical/chemical processes including desorption and diffusion from lower to more permeable zones within the unit.

6.2.2 Initial Concentration Distribution

The initial TCE distribution was generated based on the November 1998 measured concentration data. An interpolated concentration distribution was created for each flow zone and the base of the contaminated zone using linear kriging of the log values of concentration. The zones for which concentration distributions were generated are the following:

- the upper flow zone (UFZ), corresponding to concentrations at the water table;
- the upper lower flow zone (ULFZ), corresponding to concentrations at an elevation of 4,940 ft MSL;
- the lower flow zone (LLFZ), corresponding to an elevation of 4920 ft MSL at the facility and an elevation of 4,900 ft MSL west of the facility; and
- the base of the contaminated zone, corresponding to top of 4800-foot clay west of facility and an elevation of 4,910 ft MSL at the facility.

The concentration distributions generated for these four zones were used as the basis for specifying initial concentrations at each node in the model domain. The concentrations generated for a given flow zone were assumed to represent concentrations on an approximately horizontal surface. These surfaces generally did not coincide with the node centers of the model grid and, therefore, the initial concentration at a given node was calculated by vertical linear interpolation of the log values of concentration corresponding to the overlying and underlying surfaces.

The concentration distribution for the UFZ was assumed to represent concentration at the water table as estimated based on November 1998 water levels at wells screened within the UFZ. The concentration distribution for the ULFZ was assumed to represent concentrations on a horizontal surface at an elevation of 4,940 ft MSL. The concentration distribution for the LLFZ was assumed to represent concentrations on a horizontal surface at an elevation of 4,920 ft MSL at the facility and at an elevation of 4,900 ft MSL west of the facility. The concentration distribution for the bottom zone was assumed to represent concentrations on a horizontal surface at an elevation of 4,910 ft MSL at the facility and at an elevation of 4,800 ft MSL west of the facility. The 4,910 ft MSL elevation at the facility is based on no detections of TCE in monitoring wells MW-38, MW-39, MW-40, and MW-70. A processor was developed to generate one horizontal concentration distribution for each model layer, representing the initial contaminant distribution for the transport model.

6.2.3 Model Calibration

Calibration of the transport model has consisted of adjustment of the initial contaminant (TCE) concentration distribution, prior to startup of off-site containment well CW-1, to achieve a reasonable match between calculated and observed TCE concentrations and mass removal at containment wells CW-1 and CW-2. The transport model was initially calibrated in 2000 when the model was developed (1999 Annual Report, SSP&A, 2001a), and has been recalibrated annually to incorporate new concentration data (SSP&A, 2001b; 2002; 2003; 2004; 2005). The parameter estimation program PEST (Doherty, 2002) was used in these calibration and recalibration processes. A better representation of the TCE distribution prior to startup of the containment systems has been obtained with each model calibration effort.

The concentration distributions calculated with the procedures described in the previous section resulted in an underestimation of the total TCE mass extracted at well CW-1 in the initial model calibration effort in 2000. The likely reason for the underestimation of the TCE mass is that the kriging procedure leads to an underestimation of TCE concentrations along the centerline of the plume. The procedure for estimating the initial TCE distribution was modified by adding a number of control points along the center line of the plume to the monitoring well data for use in estimating the concentration distributions in each flow zone. The concentrations specified at the control points were the parameters varied during the model calibration process.

The calibration process has resulted in good agreement between observed and calculated TCE mass removal from containment wells CW-1 and CW-2, and between observed and calculated concentrations at CW-1 and CW-2 (Figure 6.8). The observed and calculated TCE mass removal and TCE concentrations at CW-1 and CW-2 are tabulated below:

Date	Cumulative TCE mass removed (kg)		Concentration at CW-1 (µg/L)		Concentration at CW-2 (µg/L)	
	Measured	**Calculated**	**Measured**	**Calculated**	**Measured**	**Calculated**
12/31/1998	1.3	0.1	190	252		
1/3/2000	359	407	860	1,028		
1/2/2001	822	855	1,200	1,054		
1/3/2002	1,340	1,337	1,100	1,188	1,100	964
1/3/2003	1,944	1,954	1,300	1,288	450	563
1/6/2004	2,560	2,579	1,200	1,298	380	345
1/4/ 2005	3,156	3,159	1,300	1,249	220	231
1/4/2006	3,714	3706	1,300	1,131	160	167

The initial mass and the maximum TCE concentrations within each model layer, under the recalibrated initial concentration distribution specified in the model, are summarized on Table 6.1. The estimated initial mass of TCE is 6,908 kg (15,230 lbs). The estimate of the mass of TCE in the aquifer prior to startup of the containment wells has changed from 2,180 kg (4,800 lbs) in the initial model calibration, to 3,100 kg (6,840 lbs) after the first recalibration, to 3,300 kg (7,280 lbs) after the second recalibration, to 4,650 kg (12,250 lbs) after the third recalibration, to 7,342 kg (16,152 lbs) after the fourth recalibration to 6,638 kg (14,634 lbs) after the fifth recalibration, and 6,908 kg (15,230 lbs) after this recalibration.

A comparison of calculated to observed concentrations of TCE at all monitoring wells for all samples analyzed between November 1998 and November 2005 is presented in Figure 6.9. Also presented in Figure 6.9 is a comparison of calculated to observed concentrations of TCE for only those samples analyzed in November 2005 on which the individual data points are labeled with the well number. The general agreement between observed and computed concentrations is reasonable given the uncertainty of the initial contaminant distribution.

6.2.4 Predictions of TCE Concentrations in 2006

The groundwater transport model was applied to predict TCE concentrations through December 2006 after 97 months of pumping at well CW-1, and after 60 months of pumping at CW-2. The off-site containment well CW-1 was assumed to pump at an average rate of 224.4 gpm, and the source containment well CW-2 was assumed to pump at an average rate of 49.5

gpm in 2006. The TCE concentrations calculated for December 2005 are specified as the initial conditions for the predictive groundwater transport model.

The predicted TCE concentrations in November 2006 are presented in Figure 6.10. The concentration distribution is based on the maximum TCE concentration simulated within any given layer. A mass removal of 531 kg (1,170 lbs) of TCE by containment well CW-1 and 13 kg (29 lbs) from containment well CW-2 is predicted for the period of January 2006 to December 2006. The calculated TCE concentration in December 2006 is 1,026 µg/L at well CW-1 and 128 µg/L at CW-2.

The calibrated TCE concentration in November 1998 prior to start of groundwater extraction, the calculated TCE concentrations in November 2000, November 2002, November 2004, and the predicted TCE concentrations for November 2006 are presented in Figure 6.11. Note that the on-site area TCE concentrations shown in this figure, and also in Figure 6.10, are higher than those calculated during previous recalibrations of the transport model. These concentrations represent the presence of contaminated groundwater within the 4970-foot silt/clay that was incorporated into the model during this year's recalibration to simulate better the concentration and mass removal rates observed at the source containment well CW-2, and (2) the process that resulted in the higher concentrations that were observed during 2005 in on-site wells MW-19 and MW-72.

6.3 Future Simulations

The accuracy of this modeling effort will be evaluated again during the next 12 months based on the concentrations measured at the containment well and the monitoring wells. As new data are collected, the initial conditions and parameters in the model will be adjusted as necessary to improve the model.

Section 7
Conclusions and Future Plans

7.1 Summary and Conclusions

Sparton's former Coors Road Plant is located at 9621 Coors Boulevard NW, Albuquerque, New Mexico. The Site is at an elevation of about 5,050 ft MSL; the land slopes towards the Rio Grande on the east and rises to elevations of 5,150-5,200 ft MSL within a short distance to the west of the Site. The upper 1,500 feet of the fill deposits underlying the Site consist primarily of sand and gravel with minor amounts of silt and clay. The water table beneath the Site is at an elevation of 4,975-4,985 ft MSL and slopes towards the northwest to an elevation of about 4,960 ft MSL within about one-half mile of the Site. At an elevation of about 4,800 ft MSL a 2- to 3-foot clay layer, referred to as the 4,800-foot clay unit, has been identified.

Past waste management activities at the Site had resulted in the contamination of the Site soils and of groundwater beneath and downgradient from the Site. The primary contaminants are VOCs, specifically TCE, DCE, and TCA, and chromium. Remedial investigations at the Site had indicated that groundwater contamination was limited to the aquifer above the 4,800-foot clay and current measures for groundwater remediation have been designed to address contamination within this depth interval.

Under the terms of a Consent Decree entered on March 3, 2000, Sparton agreed to implement a number of remedial measures. These remedial measures consisted of: (a) the installation and operation of an off-site containment system; (b) the installation and operation of a source containment system; and (c) the operation of an on-site, 400-cfm SVE system for an aggregate period of one year. The goals of these remedial measures are: (a) to control hydraulically the migration of the off-site plume; (b) to control hydraulically any potential source areas that may be continuing to contribute to groundwater contamination at the on-site area; (c) to reduce contaminant concentrations in vadose-zone soils in the on-site area and thereby reduce the likelihood that these soils remain a source of groundwater contamination; and (d) in the long-term, restore the groundwater to beneficial use.

The installation of the off-site containment system, consisting of a containment well near the leading edge of the plume, an off-site treatment system, an infiltration gallery in the Arroyo de las Calabacillas, and associated conveyance and monitoring components, began in late 1998 and was completed in early May 1999. The off-site containment well began operating on December 31, 1998; except for brief interruptions for maintenance activities or due to power outages, the well has operated continuously since that date; the year 2005 was the seventh full year of operation of this well. The source containment system, consisting of a containment well immediately downgradient from the site, an on-site treatment system, six on-site infiltration ponds, and associated conveyance and monitoring components, was installed during 2001 and began operating on January 3, 2002; the year 2005 was the fourth year of operation of this well. The 400-cfm SVE system had operated for a total of about 372 days between April 10, 2000 and

June 15, 2001 and thus met the length-of-operation requirements of the Consent Decree; monitoring conducted in the Fall of 2001 indicated that the system had also met its performance goals, and the system was dismantled in May 2002.

During 2005, considerable progress was made towards achieving the goals of the remedial measures:

- The off-site containment well continued to operate during the year at a discharge rate of 225 gpm, sufficient for containing the plume.
- The pumped water was treated and returned to the aquifer through the infiltration gallery. The concentrations of constituents of concern in the treated water met all the requirements of the Groundwater Discharge Permit for the site. Chromium concentrations in the influent to the treatment system remained at levels that did not require treatment.
- The source containment well continued to operate during the year at a rate of 48 gpm, sufficient for containing potential on-site source areas.
- Groundwater monitoring was conducted as specified in Attachment A to the Consent Decree. Water levels in all accessible wells and/or piezometers, and the Corrales Main Canal were measured quarterly. Samples were collected for water-quality analyses from monitoring wells at the frequency specified in the Consent Decree and analyzed for VOCs and total chromium.
- Samples were obtained from the influent and effluent of the treatment plants for the off-site and source containment systems, and the infiltration gallery and infiltration pond monitoring wells at the frequency specified in the Groundwater Discharge Permit. All samples were analyzed for VOCs, total chromium, iron, and manganese.
- The groundwater flow and transport model that was developed in 1999 to simulate the hydrogeologic system underlying the site was recalibrated and used to simulate TCE concentrations in the aquifer from start-up of the off-site containment well in December 1998 through November 2005 and to predict concentrations in November 2006.

The off-site containment well continued to provide hydraulic control of the contaminant plume throughout the year. The source containment well that began operating in early 2002 quickly developed a capture zone that controls any potential on-site sources that may be contributing to groundwater contamination. Data from 2005 indicate that the well continued to maintain this capture zone throughout 2005.

The performance of the six on-site infiltration ponds during the last several years indicated that four ponds are more than adequate for handling the water pumped by the source containment well. With the approval of the regulatory agencies, Sparton backfilled two of the six ponds to put the land to other beneficial use.

The extent of groundwater contamination, as defined by the extent of the TCE plume, did not change significantly during 2005. Of the 57 wells sampled in November 2005, the concentrations of TCE were lower than in November 2004 in 20 wells, higher in 17 wells, and remained the same (below detection limits) in 20 wells. The corresponding numbers for DCE were 11 wells with lower, 12 wells with higher, and 34 wells with the same concentrations. Although the 2005 contaminant concentrations in off-site monitoring well MW-60 were considerably lower than they have been during the last several years, this well continued to be the most contaminated off-site well. The TCA plume ceased to exist during 2003, and this condition continued through 2005, that is, throughout the year there were no wells with TCA concentrations above the maximum allowable concentration in groundwater set by NMWQCC.

Changes in concentrations observed in monitoring wells since the implementation of the current remedial measures indicate that contaminant concentrations in the on-site area decreased significantly. Concentrations in most off-site wells have also decreased, or remained unchanged. The only wells were significant increases occurred are the off-site containment well CW-1, and on-site monitoring well MW-19. The persistence of the high concentrations that have been observed in the water pumped from CW-1 since the beginning of its operation, and the concentrations detected at MW-60 indicate the presence of high concentration areas upgradient from both CW-1 and MW-60. This conclusion is confirmed by the model calibration results discussed in Section 6.

The off-site and source containment wells operated at a combined average rate of 273 gpm during 2005. A total of about 143.5 million gallons of water were pumped from the wells. The total volume of water pumped since the beginning of the current remedial operations on December 1998 is about 915 million gallons and represents 81 percent of the initial volume of contaminated groundwater (pore volume).

Approximately 595 kg (1,310 lbs) of contaminants consisting of 558 kg (1,230 lbs) of TCE, 35 kg (77 lbs) of DCE, and 2.0 kg (4.4 lbs) of TCA were removed from the aquifer by the two containment wells during 2005. The total mass that was removed since the beginning of the of the current remedial operations is 3,940 kg (8,690 lbs) consisting of 3,710 kg (8,180 lbs) of TCE, 215 kg (475 lbs) of DCE, and 11 kg (24 lbs) of TCA. This represents about 54 percent of the total dissolved contaminant mass currently estimated to have been present in the aquifer prior to the testing and operation of the off-site containment well.

To address the continuing presence of contaminants in the DFZ monitoring well MW-71R, a decision was made in 2004 to install a DFZ monitoring/standby-extraction well near the off-site containment well CW-1. The Work Plan for the installation, testing, monitoring, and/or operation of this well (SSP&A and Metric, 2004b) was prepared in December 2004 and approved by USEPA and NMED on January 6, 2005. Most of Sparton's effort during 2005 went into obtaining an easement agreement from COA to provide access through a COA owned park for moving a drilling rig to the proposed well location. This easement agreement was obtained by Sparton in October 2005, and Sparton began the construction of the monitoring/stand-by extraction well in early 2006.

The containment systems were shutdown several times during 2005 for routine maintenance activities, due to power and monitoring system failures, due to low levels in the chemical feed tanks, or due to the failure of other components of the systems. The downtime for these shutdowns ranged from 10 minutes to about 4 days.

7.2 Future Plans

Both the off-site and source containment systems will continue to operate at the average discharge rates that have been maintained during the last several years. Data collection will continue in accordance with the Groundwater Monitoring Program Plan and site permits, and as necessary for the evaluation of the performance of the remedial systems. As additional data are being collected, calibration and improvement of the flow and transport model developed to assess aquifer restoration will continue.

Monitoring wells PW-1, MW-35, and MW-36, which have been dry for the last several years, will be plugged and abandoned during 2006. Well PW-1 is next to MW-9, and data from MW-34 and MW-44 provide adequate data in the area of MW-35 and MW-36; therefore, replacement wells for these three wells are not planned. Monitoring wells MW-13, MW-33 and MW-57 which were dry during the 4th quarter of 2005, and wells MW-9 and MW-53 which had too little water to be sampled in November 2005, will continue to be monitored during 2006 prior to deciding whether to plug or replace them.

Work on the installation and testing of the proposed DFZ monitoring/standby-extraction well near the off-site containment well CW-1 will continue during 2006.[14] Upon approval of the combined Draft Fact Sheet for 2002 through 2004 by USEPA and NMED, the Fact Sheet will be distributed to the property owners located above the plume and adjacent to the off-site treatment plant water discharge pipeline.

Regulatory agencies will continue to be kept informed of any significant milestones or changes in remedial system operations. The goal of the systems will continue to be the return of the contaminated groundwater to beneficial use.

---

[14] Installation and development of the well was completed on February 24, 2006. The well was pump-tested during the first week of April 2006 and samples were obtained during the test. Site-related contaminants were not found in any of the samples.

Section 8
References

Black & Veatch. 1997. Report on Soil Gas Characterization and Vapor Extraction System Pilot Testing. Report prepared for Sparton Technology, Inc. June.

Chandler, P.L., Jr. 2000. Vadose Zone Investigation and Implementation Workplan. Attachment E to the Consent Decree. City of Albuquerque and The Board of County Commissioners of the County of Bernalillo v. Sparton Technology, Inc. U.S. District Court for the District of New Mexico. Civil Action No. CIV 97 0206. March 3.

Chandler, P.L., Jr. and Metric Corporation. 2001. Sparton Technology, Inc., Coors Road Plant Remedial Program, Final Report on the On-Site Soil Vapor Extraction System. Report prepared for Sparton Technology, Inc. in association with S.S. Papadopulos & Associates, Inc. November 29.

Consent Decree. 2000. City of Albuquerque and the Board of County Commissioners of the County of Bernalillo v. Sparton Technology, Inc. U.S. District Court for the District of New Mexico. CIV 97 0206. March 3.

Doherty, J. 2002. PEST: Model Independent Parameter Estimation. Version 5.5. Queensland, Australia: Watermark Numerical Computing.

Harbaugh, A.W., E. Banta, M. Hill, and M. McDonald. 2000. MODFLOW-2000, The U.S. Geological Survey Modular Ground-Water Model-User Guide to Modularization Concepts and the Ground-Water Flow Process. U.S. Geological Survey Open-File Report 00-92. Reston, Virginia.

Harding Lawson Associates. 1983. Groundwater Monitoring Program, Sparton Southwest, Inc. Report prepared for Sparton Corporation. June 29.

Harding Lawson Associates. 1984. Investigation of Soil and Groundwater Contamination, Sparton Technology, Coors Road Facility. Report prepared for Sparton Corporation. March 19.

Harding Lawson Associates. 1985. Hydrogeologic Characterization and Remedial Investigation, Sparton Technology, Inc. Report prepared for Sparton Technology. March 15.

Harding Lawson Associates. 1992. RCRA Facility Investigation. Report revised by HDR Engineering, Inc. in conjunction with Metric Corporation. Report prepared for Sparton Technology, Inc. May 1.

Hawley, J.W. 1996. Hydrogeologic Framework of Potential Recharge Areas in the Albuquerque Basin, Central New Mexico. New Mexico Bureau of Mines and Mineral Resources, Open-File Report 402D, Chapter 1.

HDR Engineering Inc. 1997. Revised Final Corrective Measure Study. Report revised by Black & Veatch. Report prepared for Sparton Technology, Inc. March 14.

Johnson, P., B. Allred, and S. Connell. 1996. Field Log and Hydrogeologic Interpretation of the Hunter Park I Boring. New Mexico Bureau of Mines and Mineral Resources, Open-File Report 426c, 25 p.

Kernodle, J.M. 1998. Simulation of Ground-Water Flow in the Albuquerque Basin, Central New Mexico, 1901-1995, With Projections to 2020. U.S. Geological Survey, Open-File Report 96-209.

Metric Corporation, 2005, Sparton Technology, Inc., Former Coors Road Plant Remedial Program, Request to Modify Approved Source Containment System Workplan, April 22.

S.S. Papadopulos & Associates Inc. 1998. Interim Report on Off-Site Containment Well Pumping Rate. Report prepared for Sparton Technology, Inc. December 28.

S.S. Papadopulos & Associates Inc. 1999a. Report on the Installation of On-Site Monitoring Wells MW-72 and MW-73. Report prepared for Sparton Technology, Inc. April 2.

S.S. Papadopulos & Associates Inc. 1999b. Groundwater Investigation Report: Performance Assessment of the Off-Site Containment Well, Sparton Technology, Inc. Report prepared for Sparton Technology, Inc. August 6.

S.S. Papadopulos & Associates Inc. 2000a. Work Plan for the Off-Site Containment System. Attachment C to the Consent Decree. City of Albuquerque and The Board of County Commissioners of the County of Bernalillo v. Sparton Technology, Inc. U.S. District Court for the District of New Mexico. CIV 97 0206. March 3.

S.S. Papadopulos & Associates Inc. 2000b. Work Plan for the Assessment of Aquifer Restoration. Attachment D to the Consent Decree. City of Albuquerque and The Board of County Commissioners of the County of Bernalillo v. Sparton Technology, Inc. U.S. District Court for the District of New Mexico. CIV 97 0206. March 3.

S.S. Papadopulos & Associates Inc. 2000c. Work Plan for the Installation of a Source Containment System. Attachment F to the Consent Decree. City of Albuquerque and The Board of County Commissioners of the County of Bernalillo v. Sparton Technology, Inc. U.S. District Court for the District of New Mexico. CIV 97 0206. March 3.

S.S. Papadopulos & Associates Inc. 2001a. Sparton Technology, Inc., Coors Road Plant Remedial Program, 1999 Annual Report. Report prepared for Sparton Technology, Inc. in association with Metric Corporation and Pierce L. Chandler, Jr. Original issue: June 1, 2000; Modified issue: February 9.

S.S. Papadopulos & Associates Inc. 2001b. Sparton Technology, Inc., Former Coors Road Plant Remedial Prgram, 2000 Annual Report. Report prepared for Sparton Technology, Inc. in association with Metric Corporation. May 17.

S.S. Papadopulos & Associates Inc. 2002. Sparton Technology, Inc., Former Coors Road Plant Remedial Program, 2001 Annual Report. Report prepared for Sparton Technology, Inc. in association with Metric Corporation. May 7.

S.S. Papadopulos & Associates Inc. 2003. Sparton Technology, Inc., Former Coors Road Plant Remedial Program, 2002 Annual Report. Report prepared for Sparton Technology, Inc. in association with Metric Corporation. May 16.

S.S. Papadopulos & Associates Inc. 2004. Sparton Technology, Inc., Former Coors Road Plant Remedial Program, 2003 Annual Report. Report prepared for Sparton Technology, Inc. in association with Metric Corporation. May 28.

S.S. Papadopulos & Associates Inc. 2005. Sparton Technology, Inc., Former Coors Road Plant Remedial Program, 2004 Annual Report. May 31.

S.S. Papadopulos & Associates Inc., and Metric Corporation. 2002. Sparton Technology, Inc., Former Coors Road Plant Remedial Program, Results of Investigation Conducted in Monitoring Well MW-71. Report prepared for Sparton Technology, Inc. January 9.

S.S. Papadopulos & Associates Inc., and Metric Corporation. 2004a. Sparton Technology, Inc., Former Coors Road Plant Remedial Program Work Plan for the Proposed MW-71R Pump-and-Treat System. Report prepared for Sparton Technology, Inc., and transmitted to USEPA and NMED on January 14.

S.S. Papadopulos & Associates Inc., and Metric Corporation. 2004b. Sparton Technology, Inc., Former Coors Road Plant Remedial Program, Work Plan for Installing a Monitoring/Standby-Extraction Well in the Deep Flow Zone. Report prepared for Sparton Technology, Inc., and transmitted to USEPA and NMED on December 6.

S.S. Papadopulos & Associates Inc. 2005. Sparton Technology, Inc., Former Coors Road Plant Remedial Program, 2004 Annual Report. Report prepared for Sparton Technology, Inc. in association with Metric Corporation. May 31.

Vogel, T.M., and P.L. McCarty. 1987. Abiotic and Biotic Transformations of 1,1,1-Trichloroethane under Methanogenic Conditions: Environmental Science &Technology 21: 1208-1213.

Zheng, C. 1991. PATH3d, A Groundwater and Travel-Time Simulator. Version 3.2. Bethesda, Maryland: S.S. Papadopulos & Associates, Inc.

Zheng, C., and S.S. Papadopulos & Associates Inc. 1999. MT3D99, A Modular, Three-Dimensional Transport Model for Simulation of Advection, Dispersion, and Chemical Reactions of Contaminants in Groundwater Systems. Bethesda, Maryland: S.S. Papadopulos & Associates, Inc.

FIGURES

S.S. PAPADOPULOS & ASSOCIATES, INC.

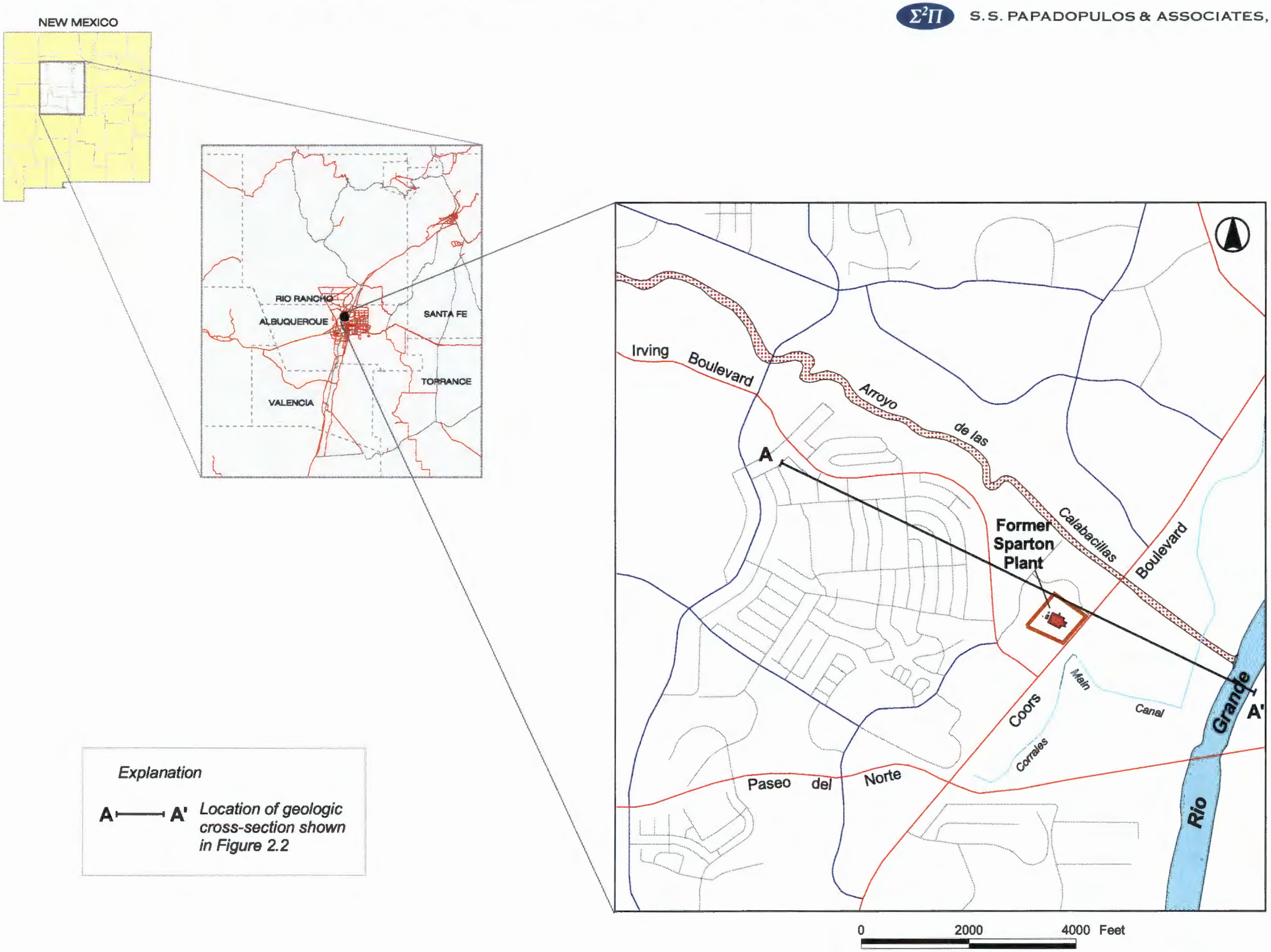


Figure 1.1 Location of the Former Sparton Coors Road Plant

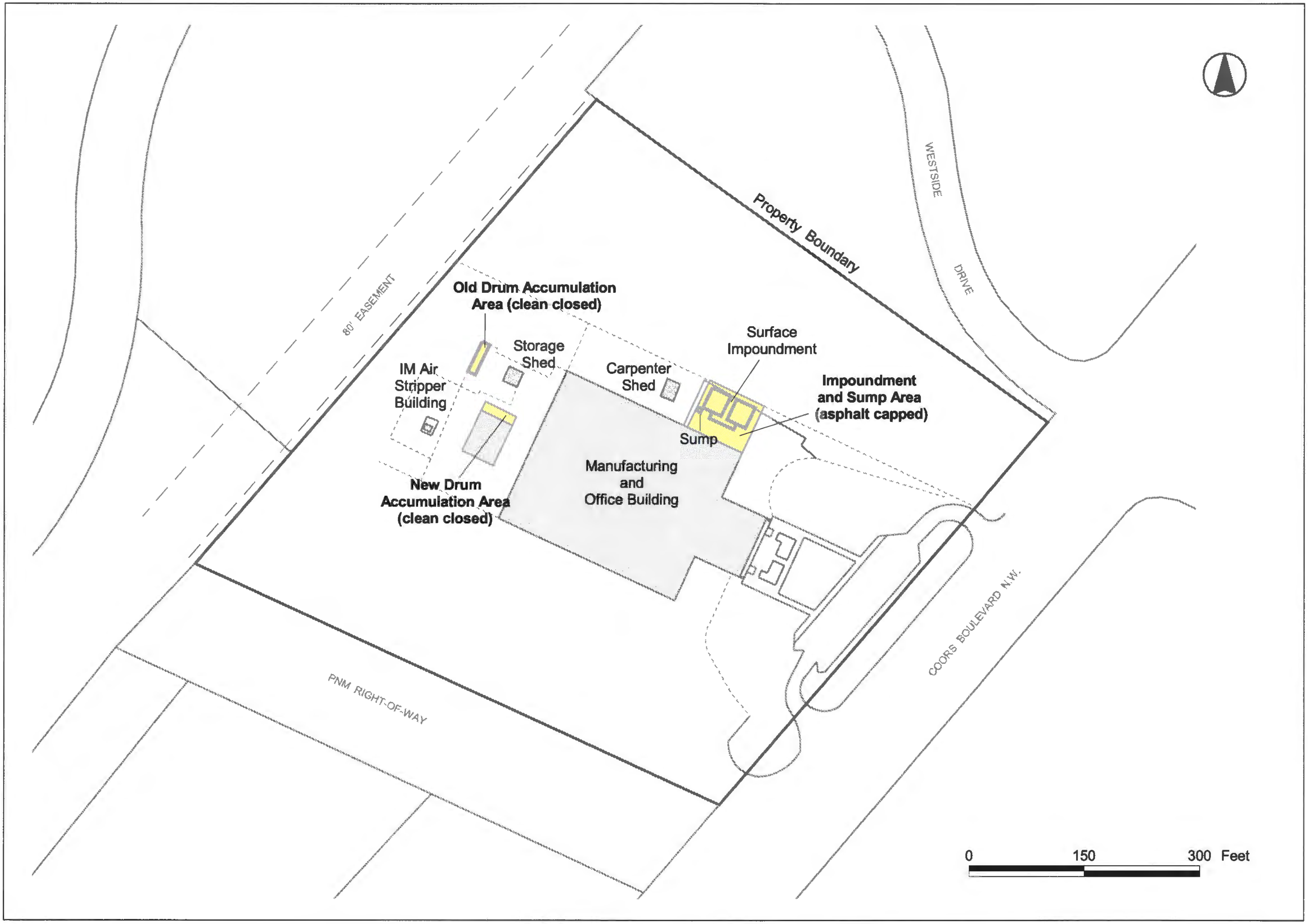
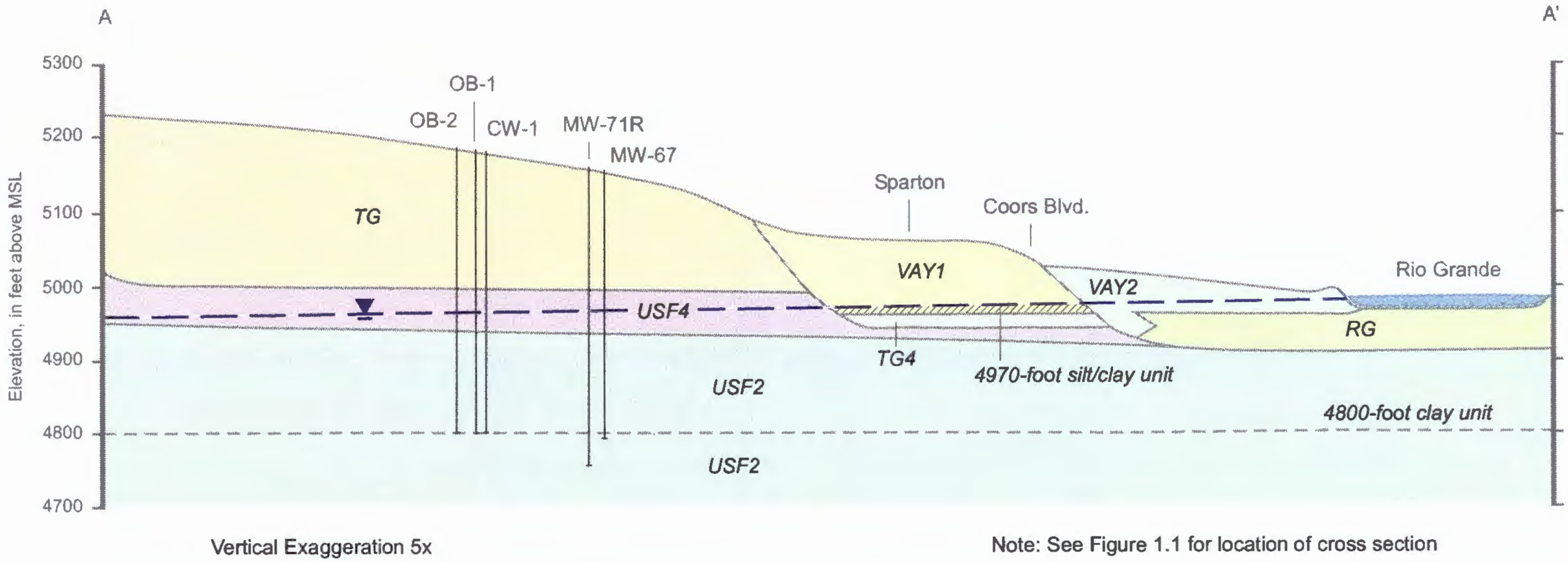


Figure 2.1 The Former Sparton Coors Road Plant



Explanation

RG	Holocene channel and flood plain deposits	*TG*	Middle Pleistocene undifferentiated deposits
VAY2	Holocene arroyo fan and terrace deposits	*USF4*	Pliocene Upper Santa Fe Group Western Basin fluvial facies
VAY1	Late Pleistocene arroyo fan and terrace deposits	*USF2*	Pliocene Upper Santa Fe Group Rio Grande facies
TG4	Late Pleistocene channel and flood plain deposits, upper portion is the 4970-foot silt/clay unit		

Figure 2.2 Geologic Cross Section Showing Shallow Deposits

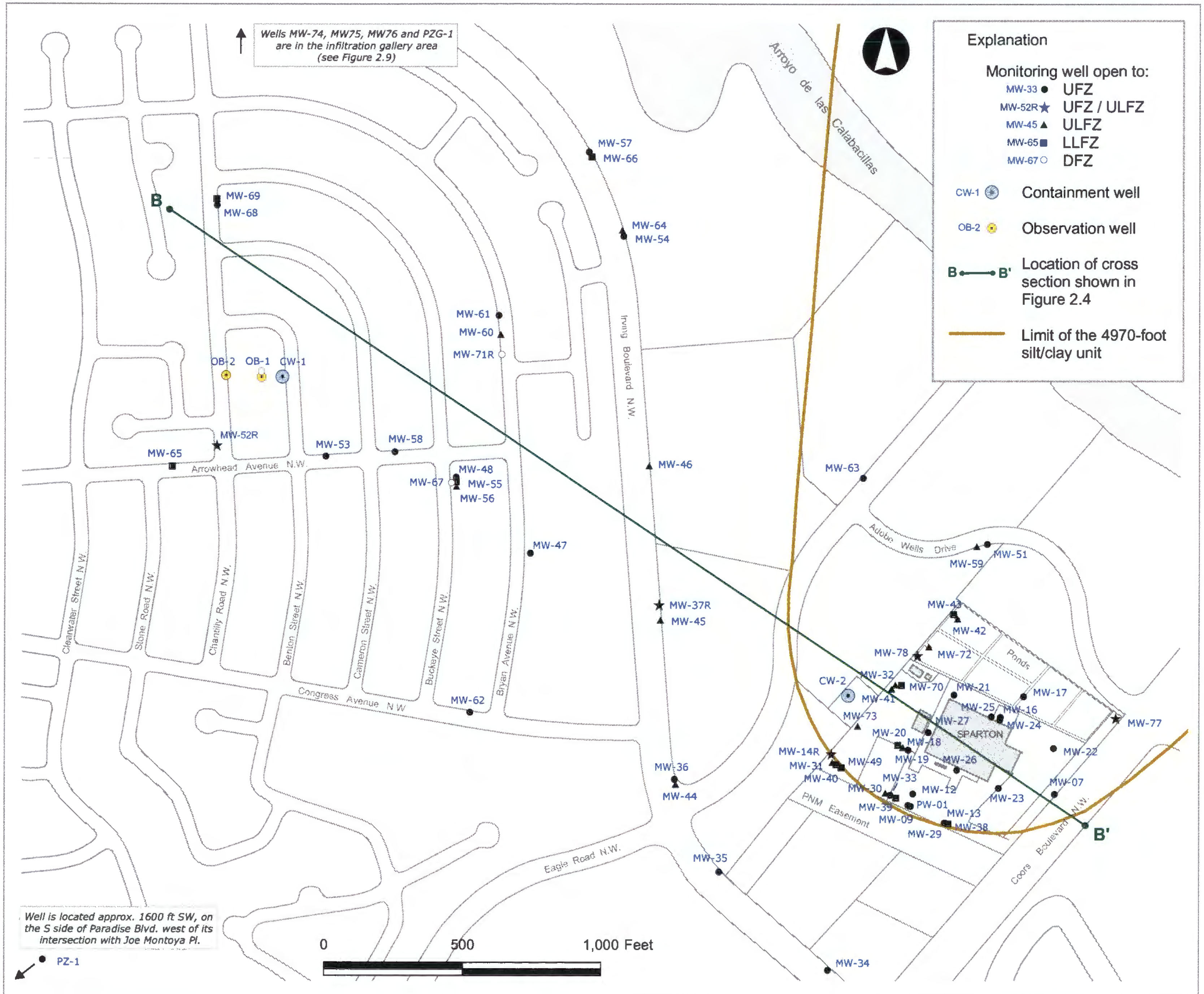


Figure 2.3 Location of Wells

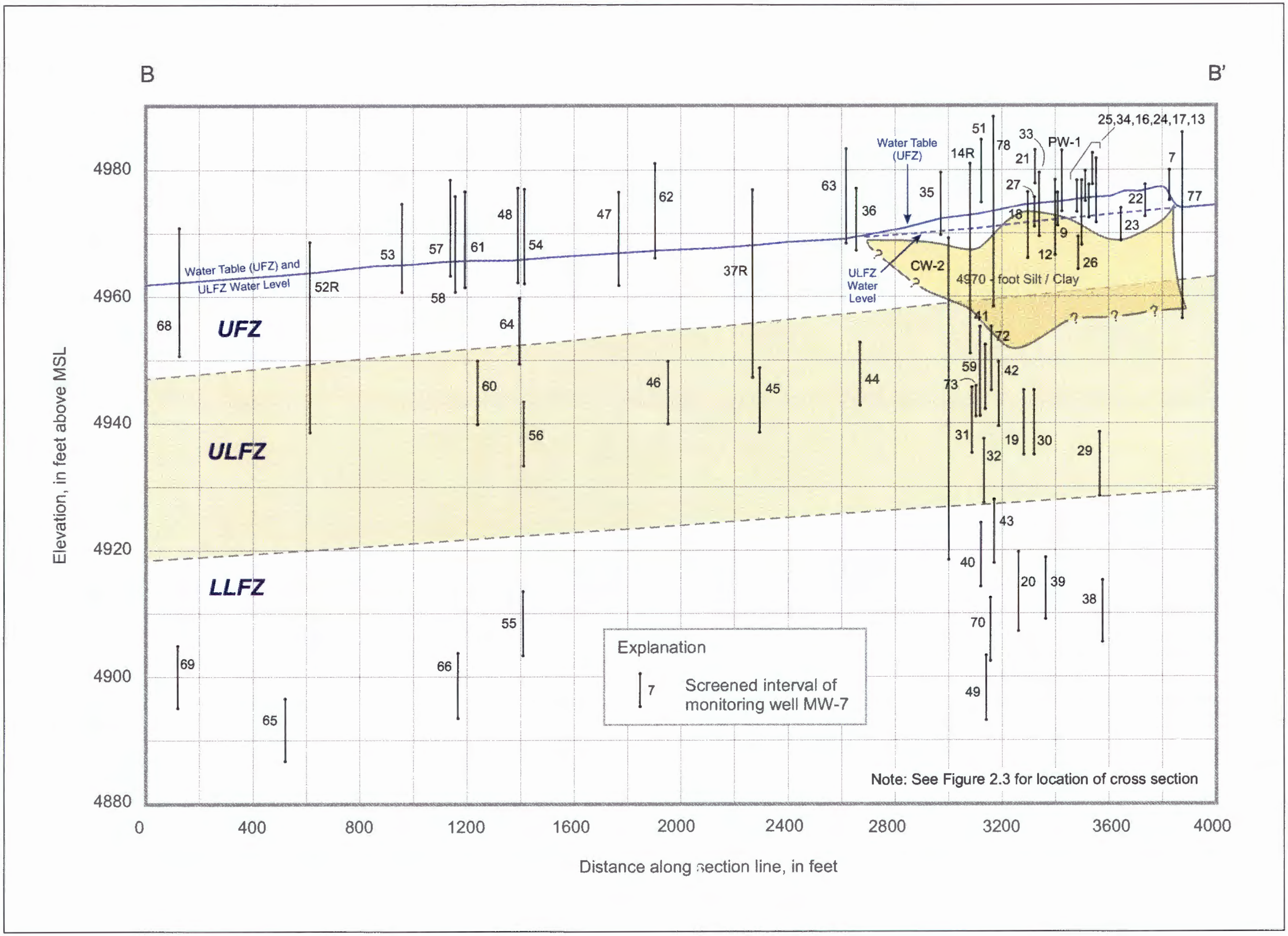
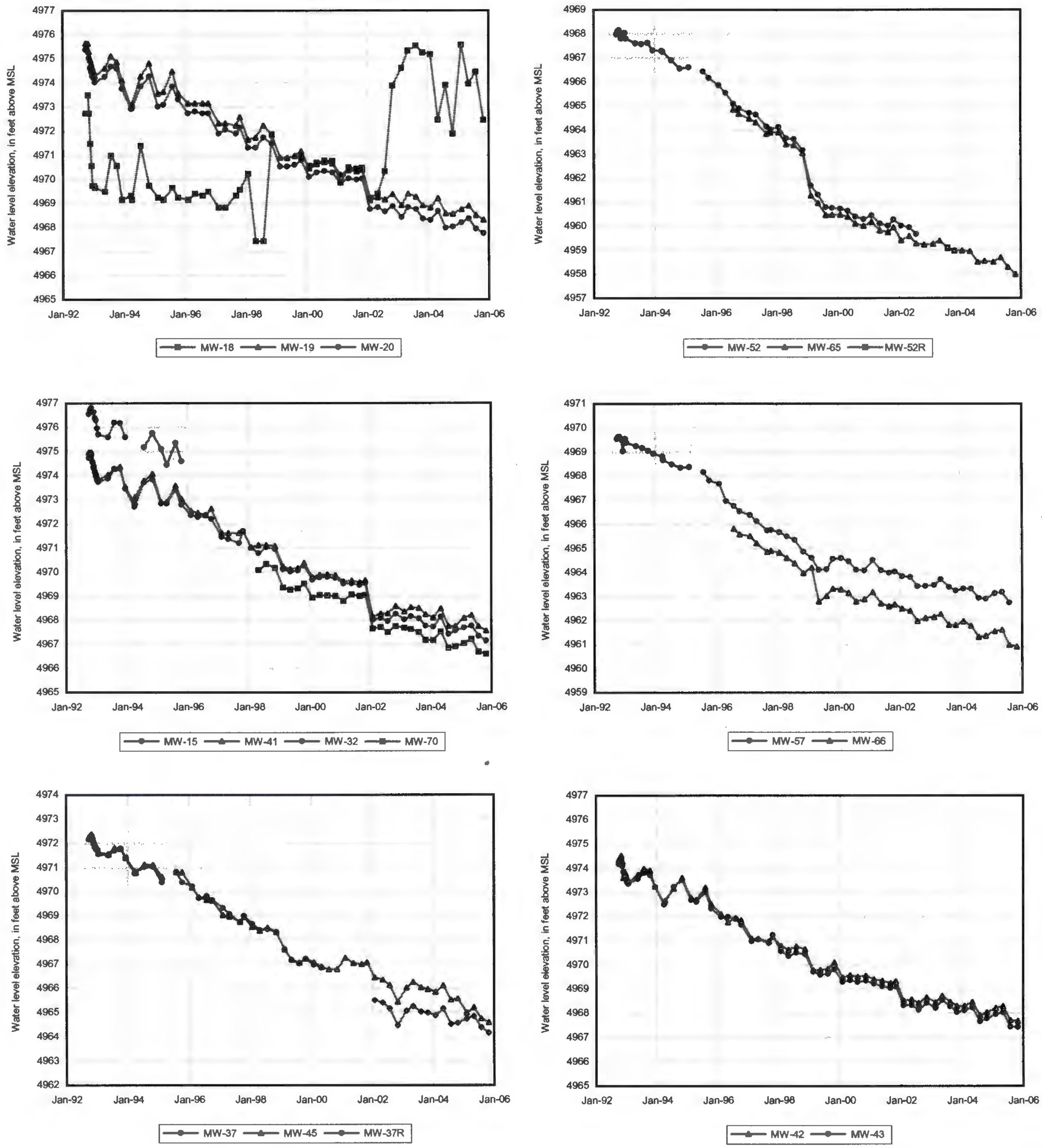


Figure 2.4 Schematic Cross-Section Showing Screened Interval of Monitoring Wells and Relation to Flow Zones



Note: MW-18 was an IM recovery well

Figure 2.5 Monitoring Well Hydrographs

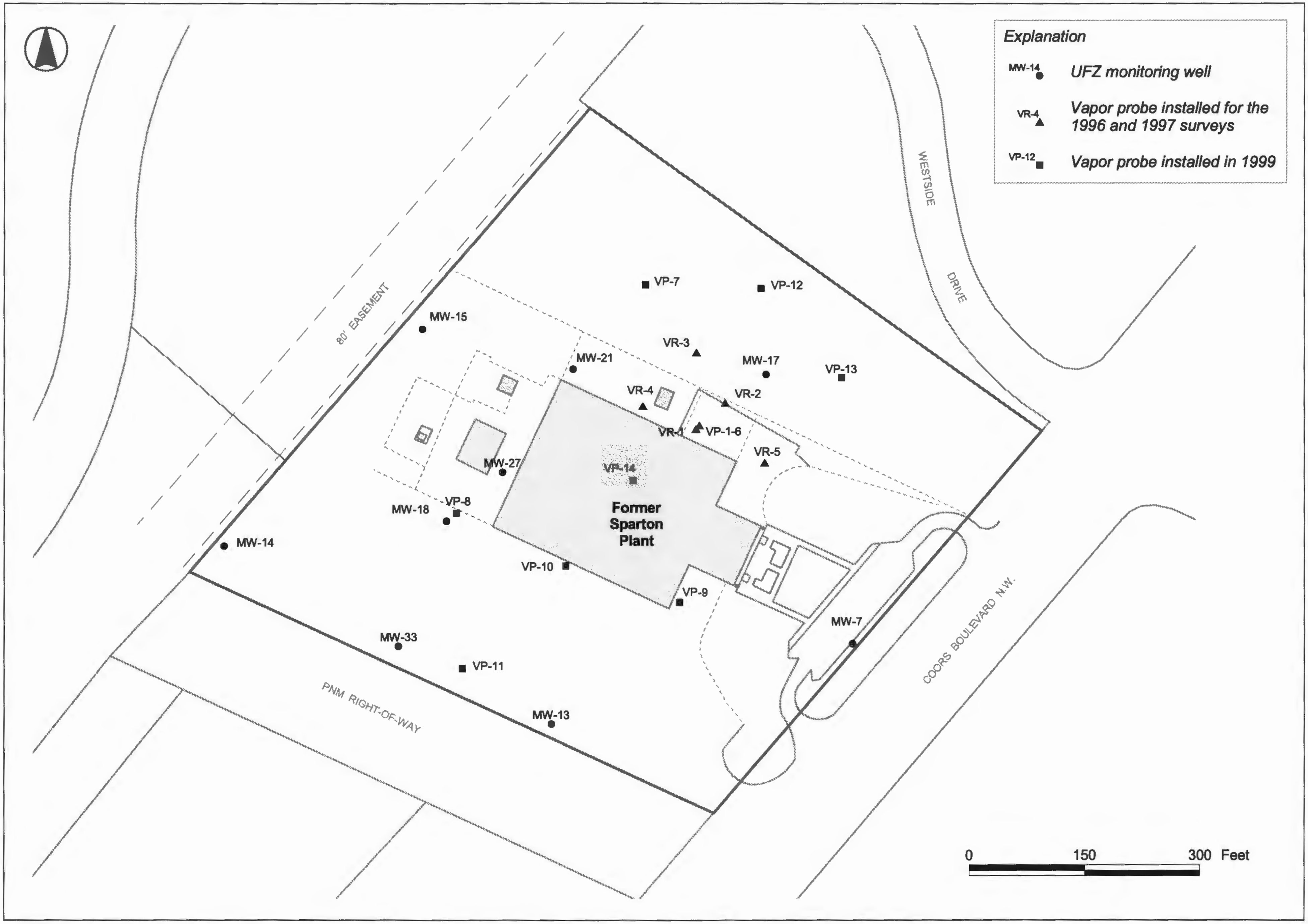


Figure 2.6 Location of Vapor Probes and On-Site Monitoring Wells Used in Vadose Zone Characterizations

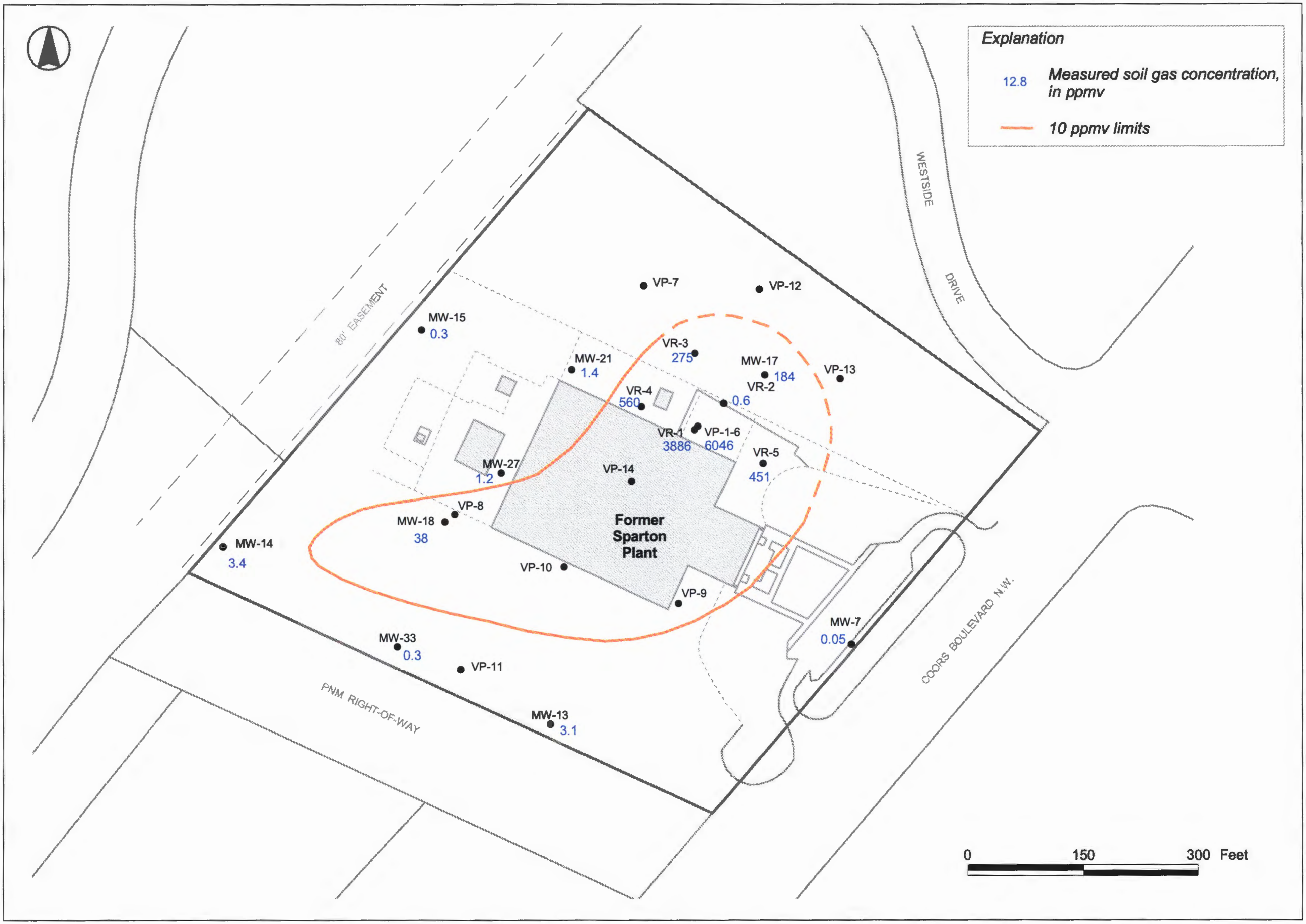


Figure 2.7 TCE Concentrations in Soil Gas - April 1996 - February 1997 Survey

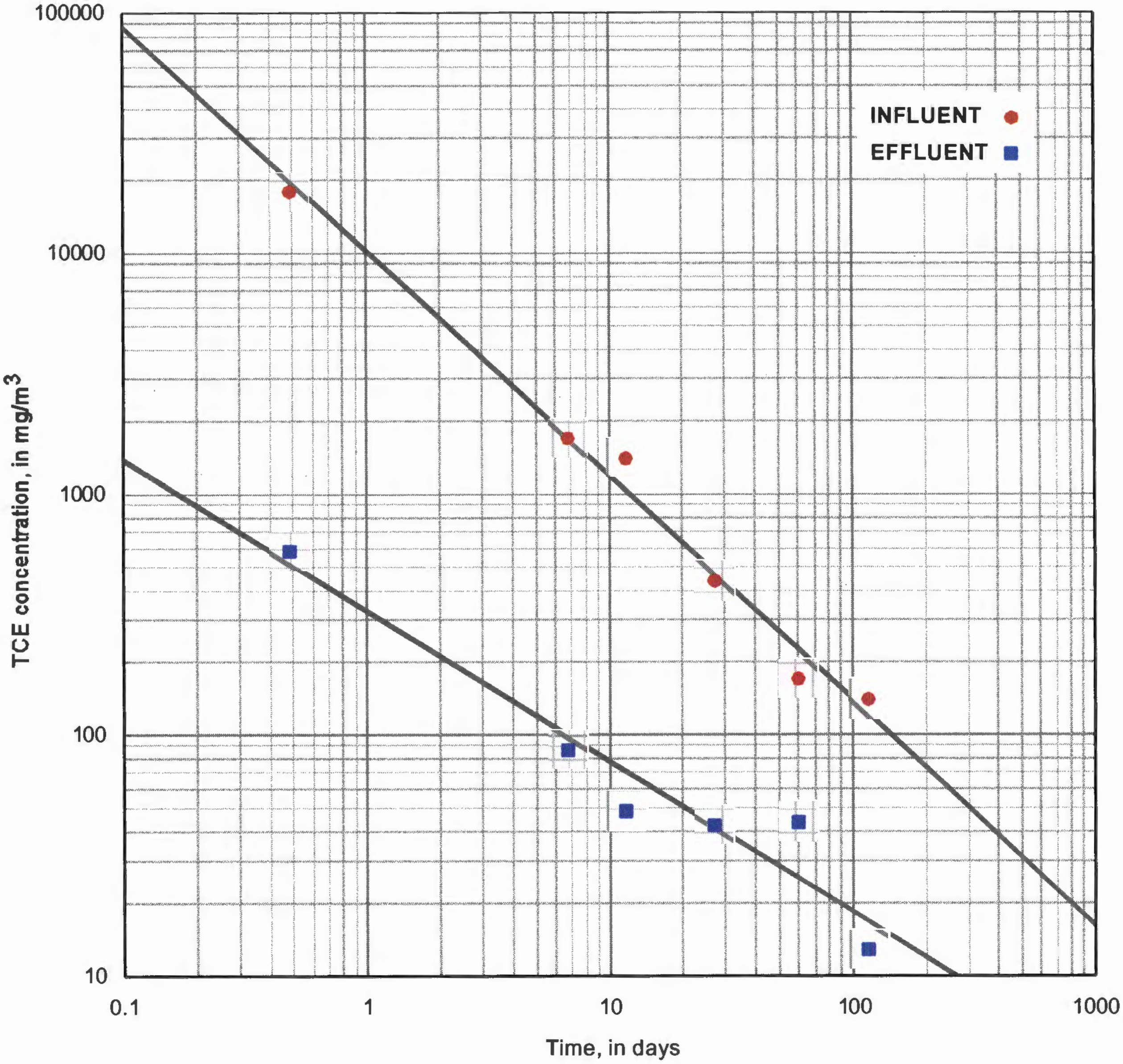


Figure 2.8 Influent and Effluent Concentrations - SVE Operation
April 8 - October 20, 1998

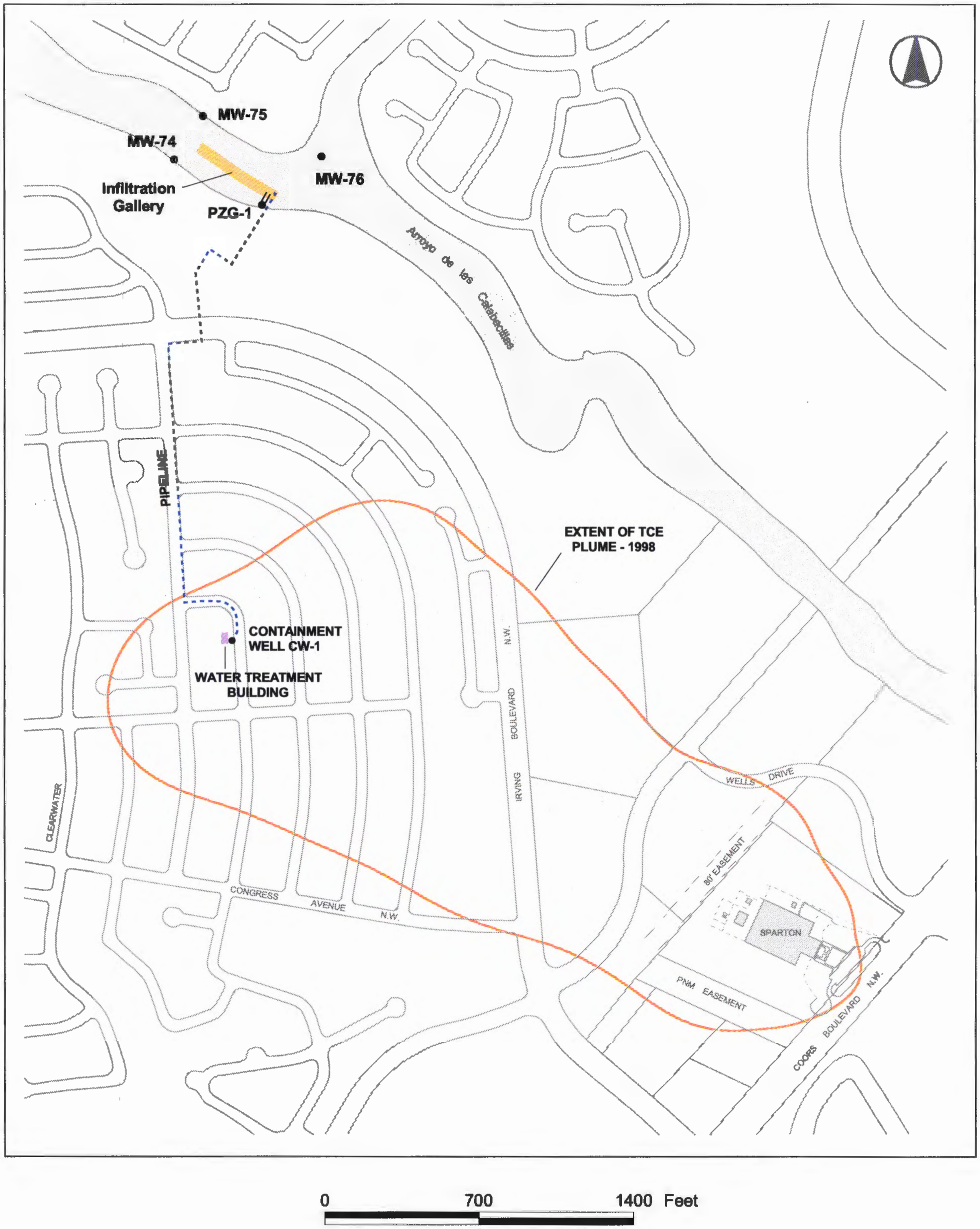


Figure 2.9 Layout of the Off-Site Containment System Components

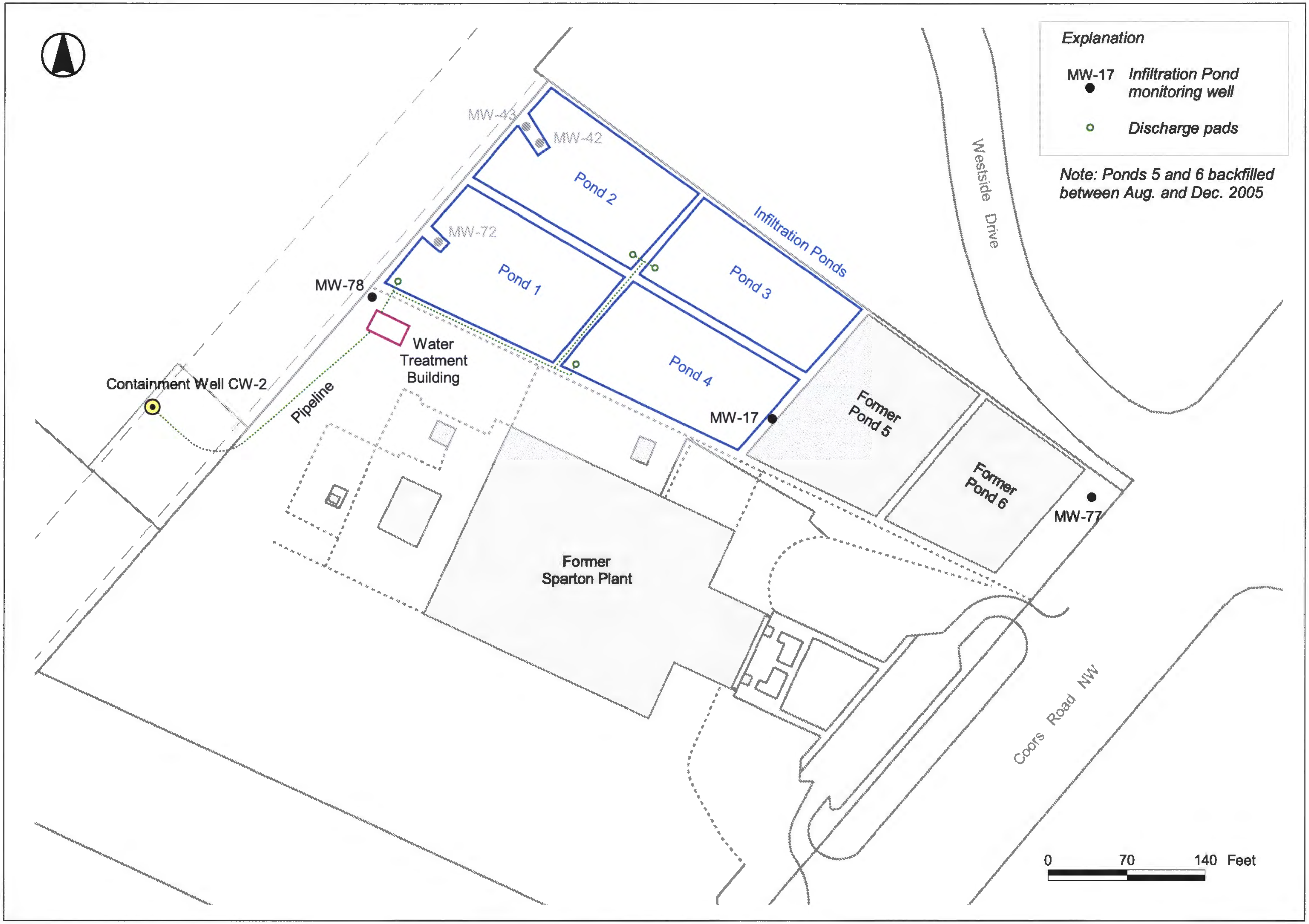


Figure 2.10 Layout of the Source Containment System Components

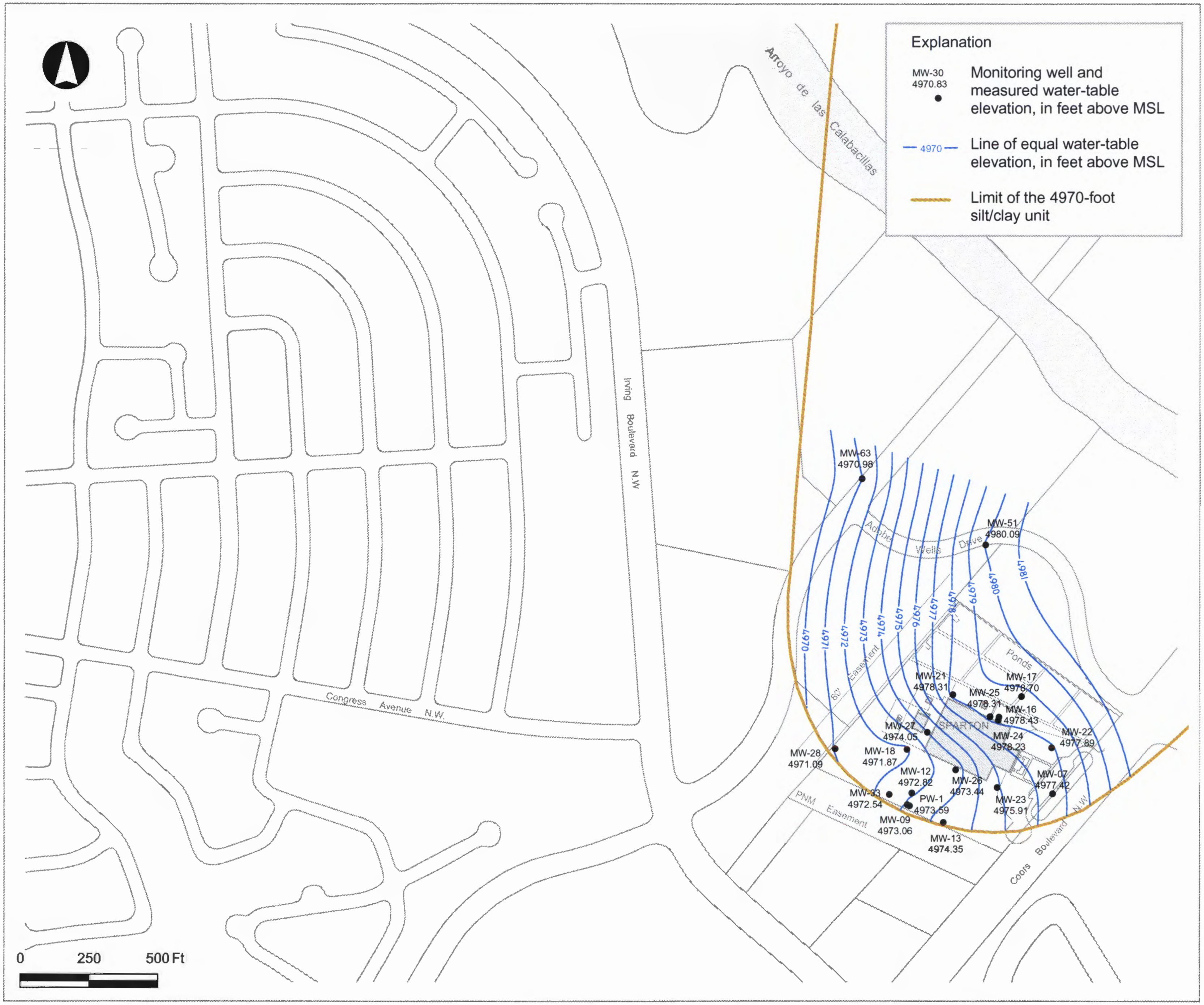


Figure 2.11 Elevation of the On-Site Water Table - November 1998

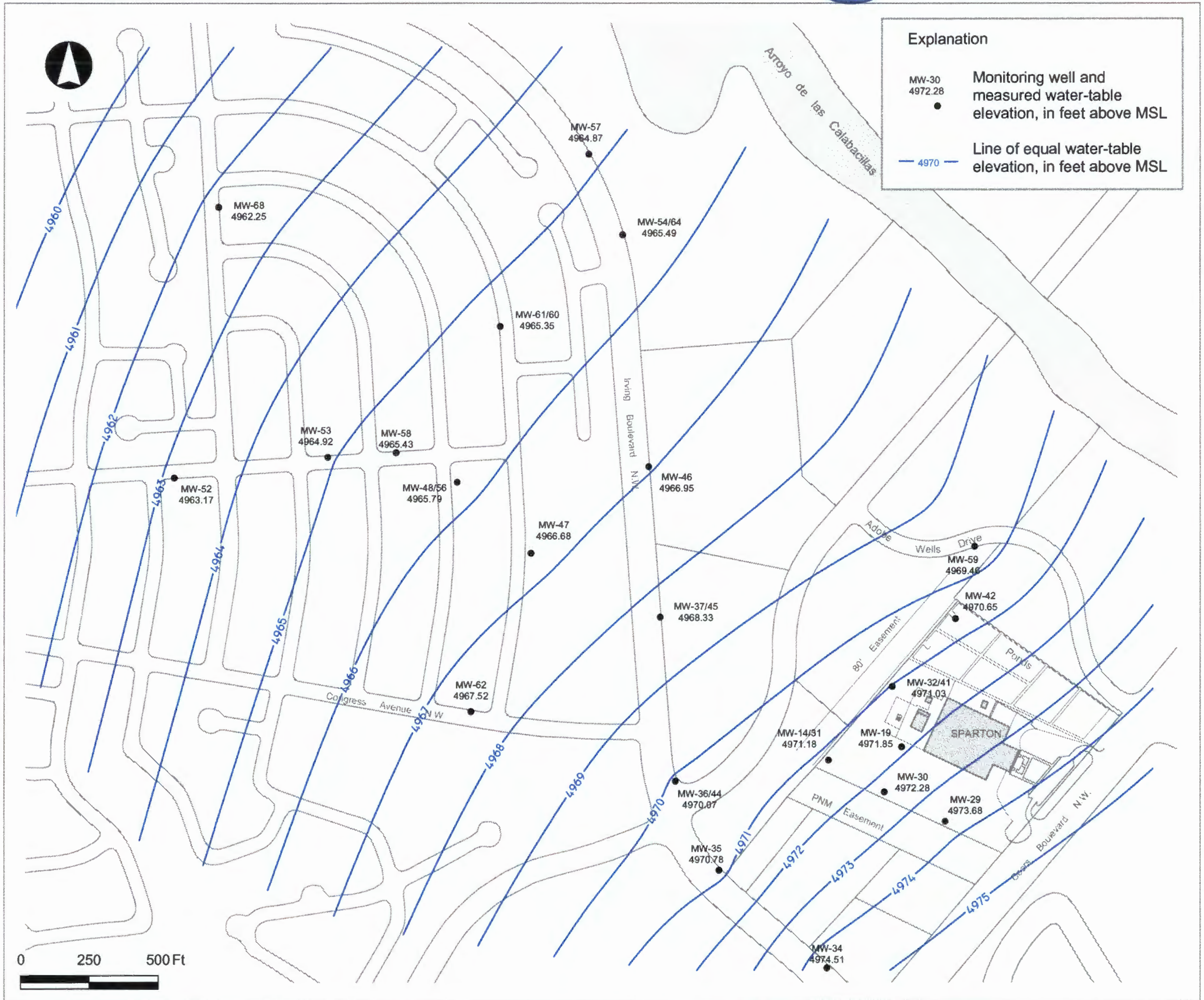


Figure 2.12 Elevation of the Water Levels in the UFZ/ULFZ - November 1998

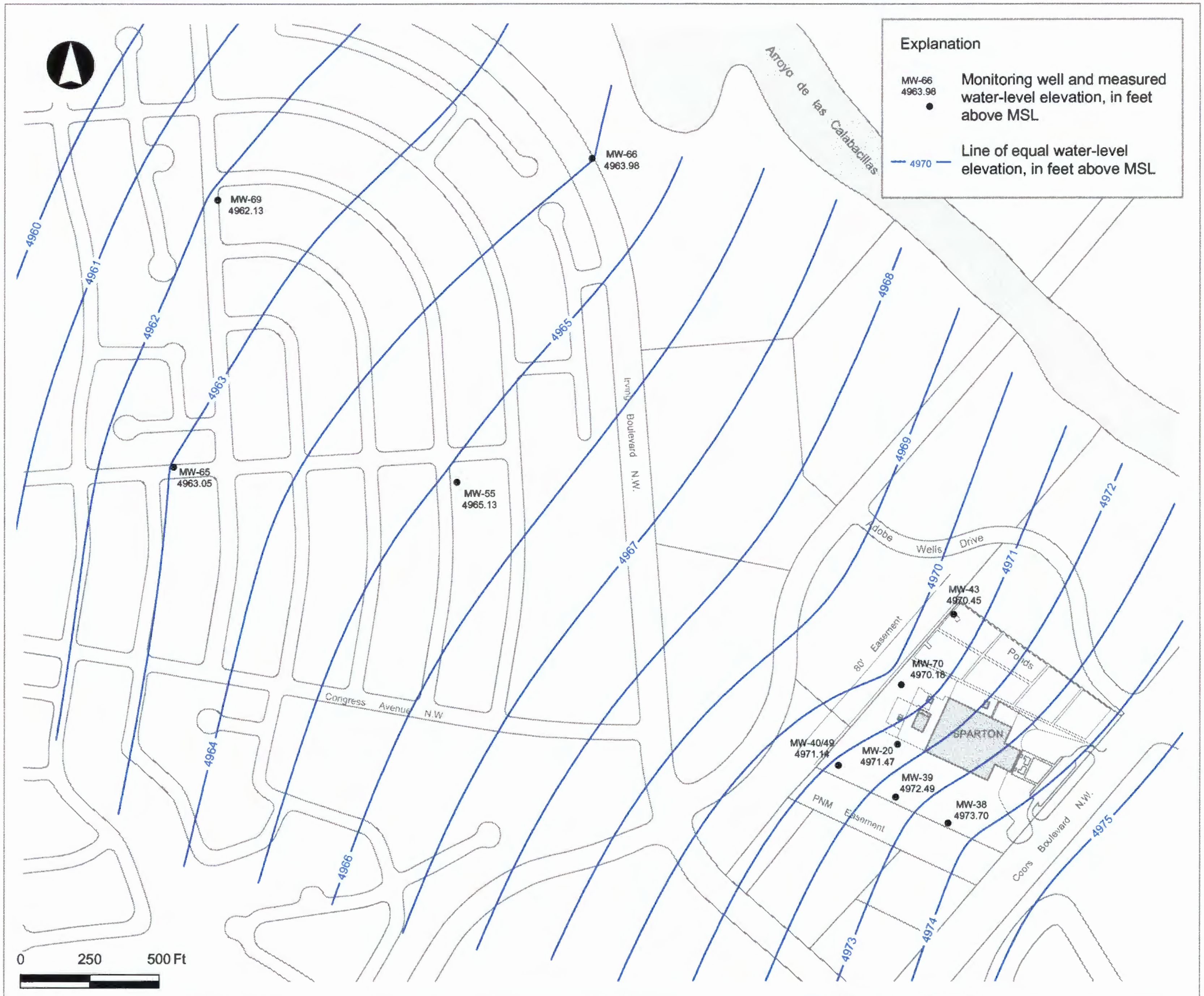


Figure 2.13 Elevation of the Water Levels in the LLFZ - November 1998

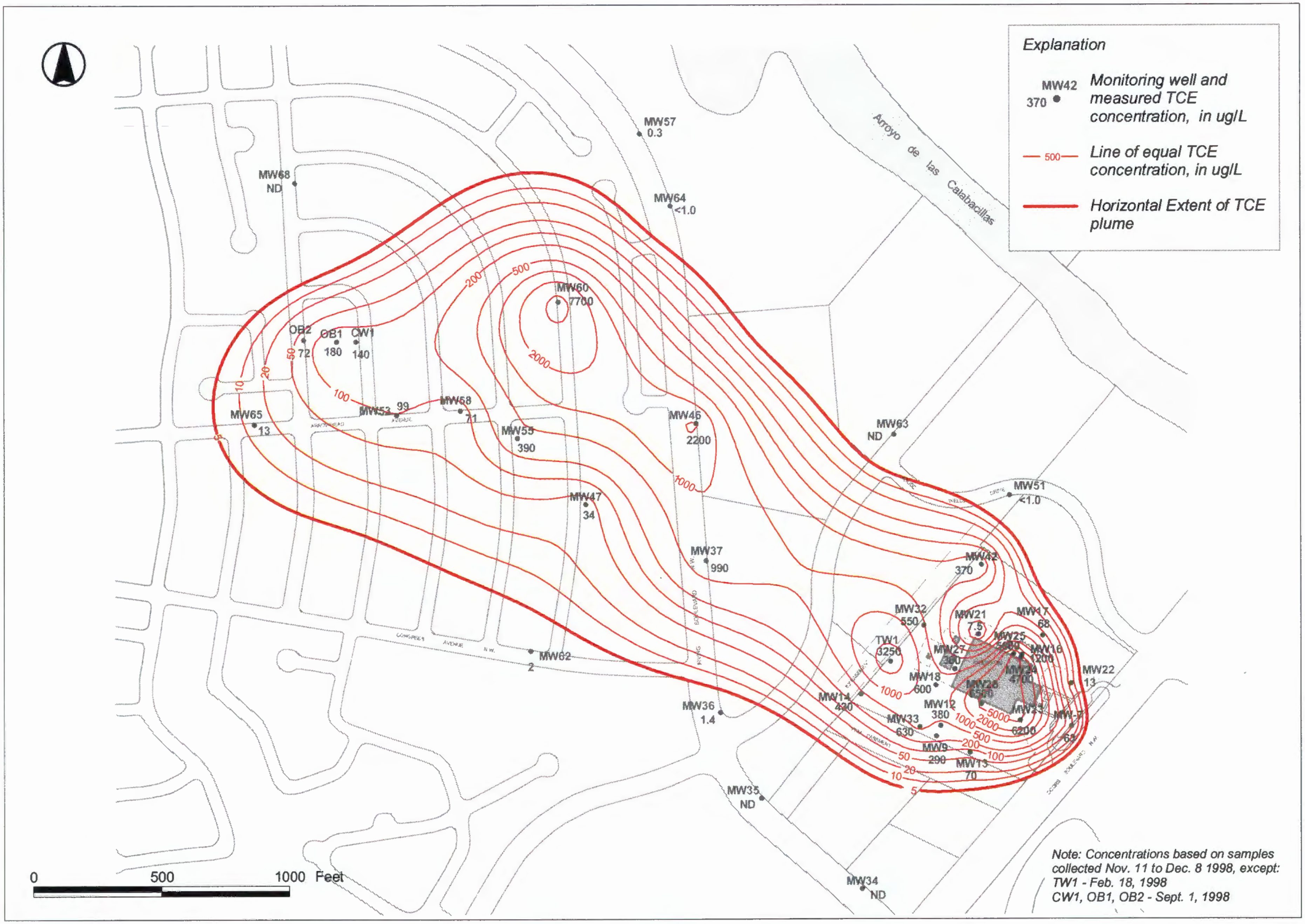


Figure 2.14 Horizontal Extent of TCE Plume - November 1998

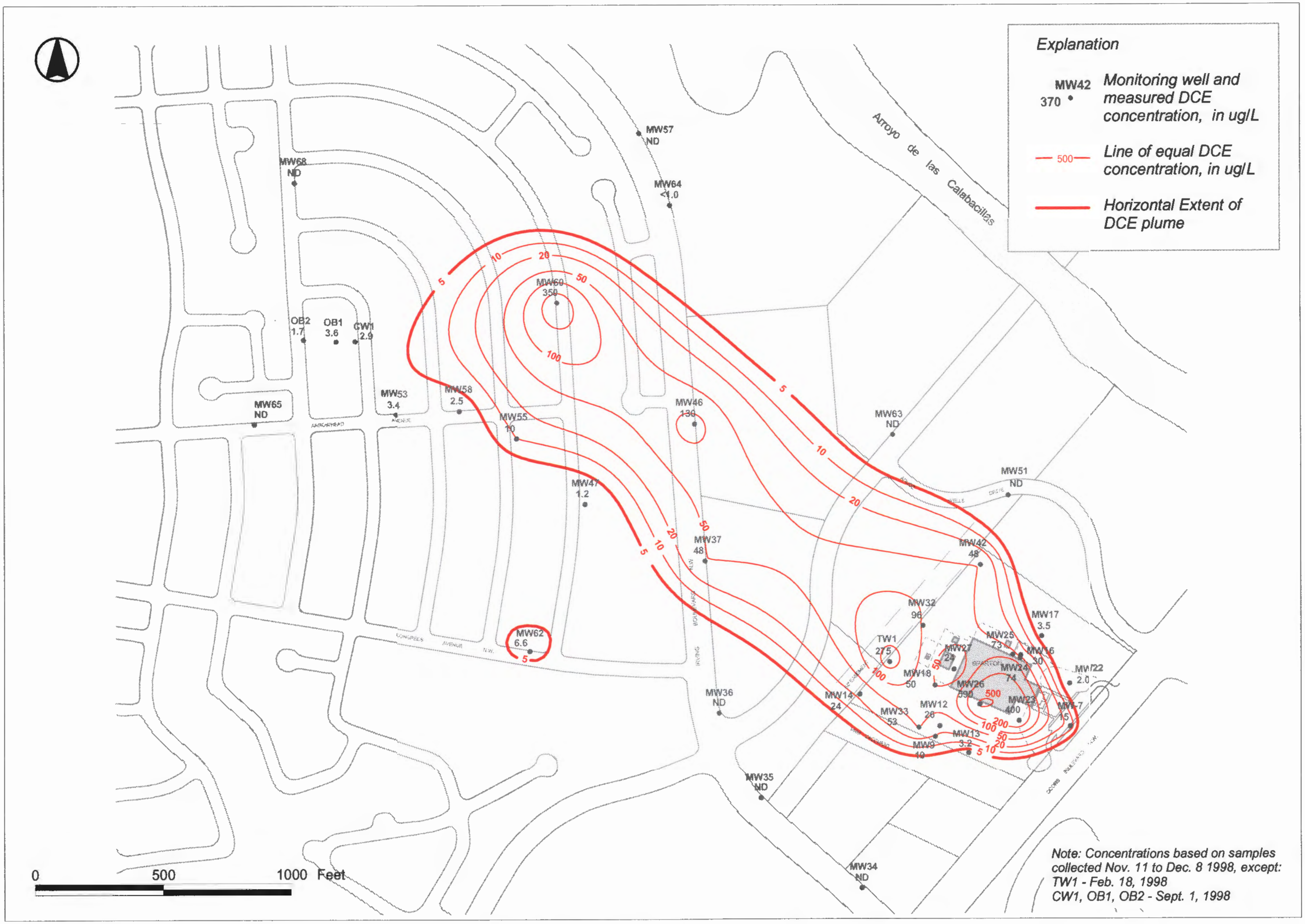


Figure 2.15 Horizontal Extent of DCE Plume - November 1998

Figure 2.16 Horizontal Extent of TCA Plume - November 1998

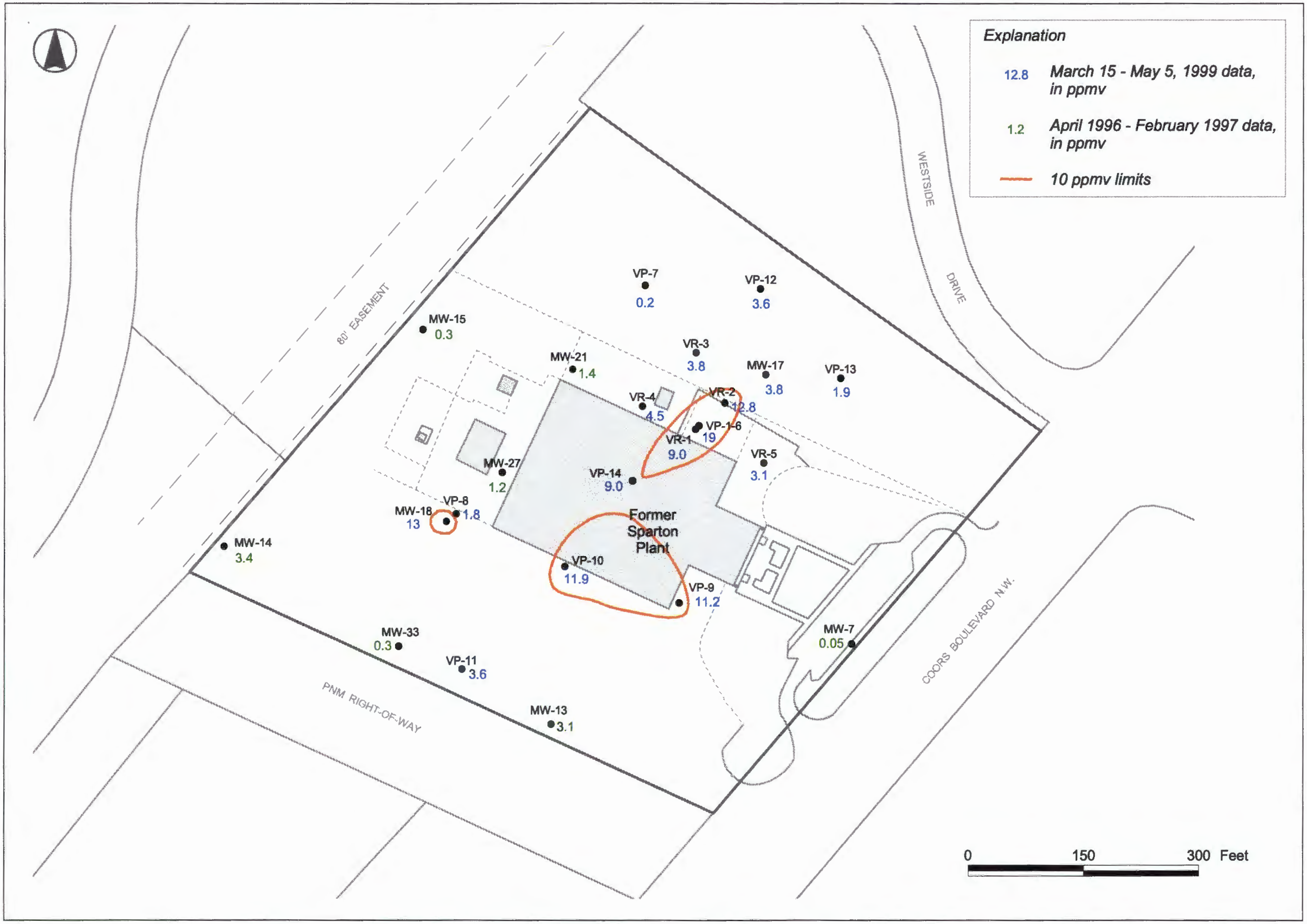


Figure 2.17 TCE Soil Gas Concentrations Prior to the 1999 Resumption of SVE System Operations

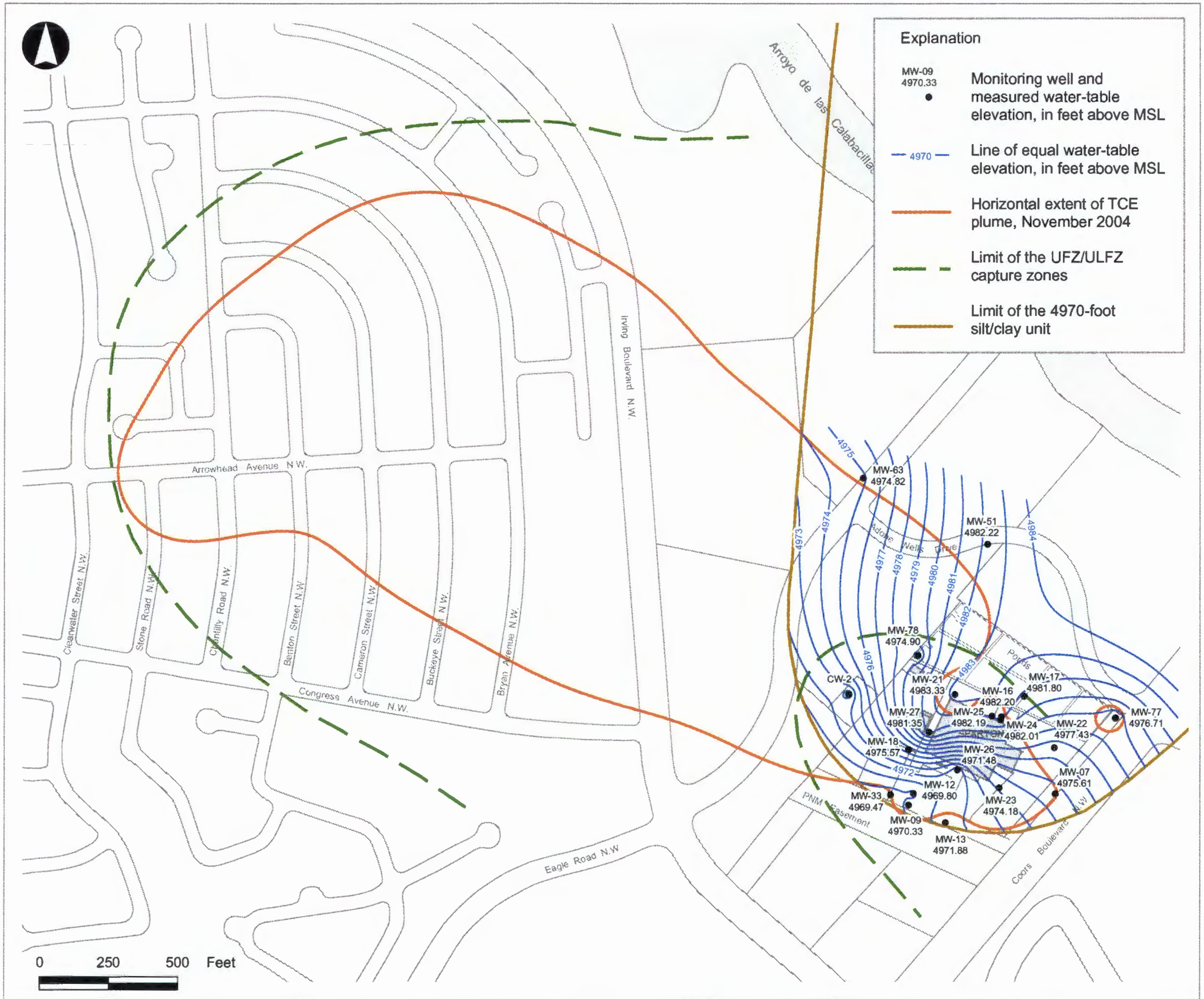


Figure 5.1 Elevation of the On-Site Water Table - February 10, 2005

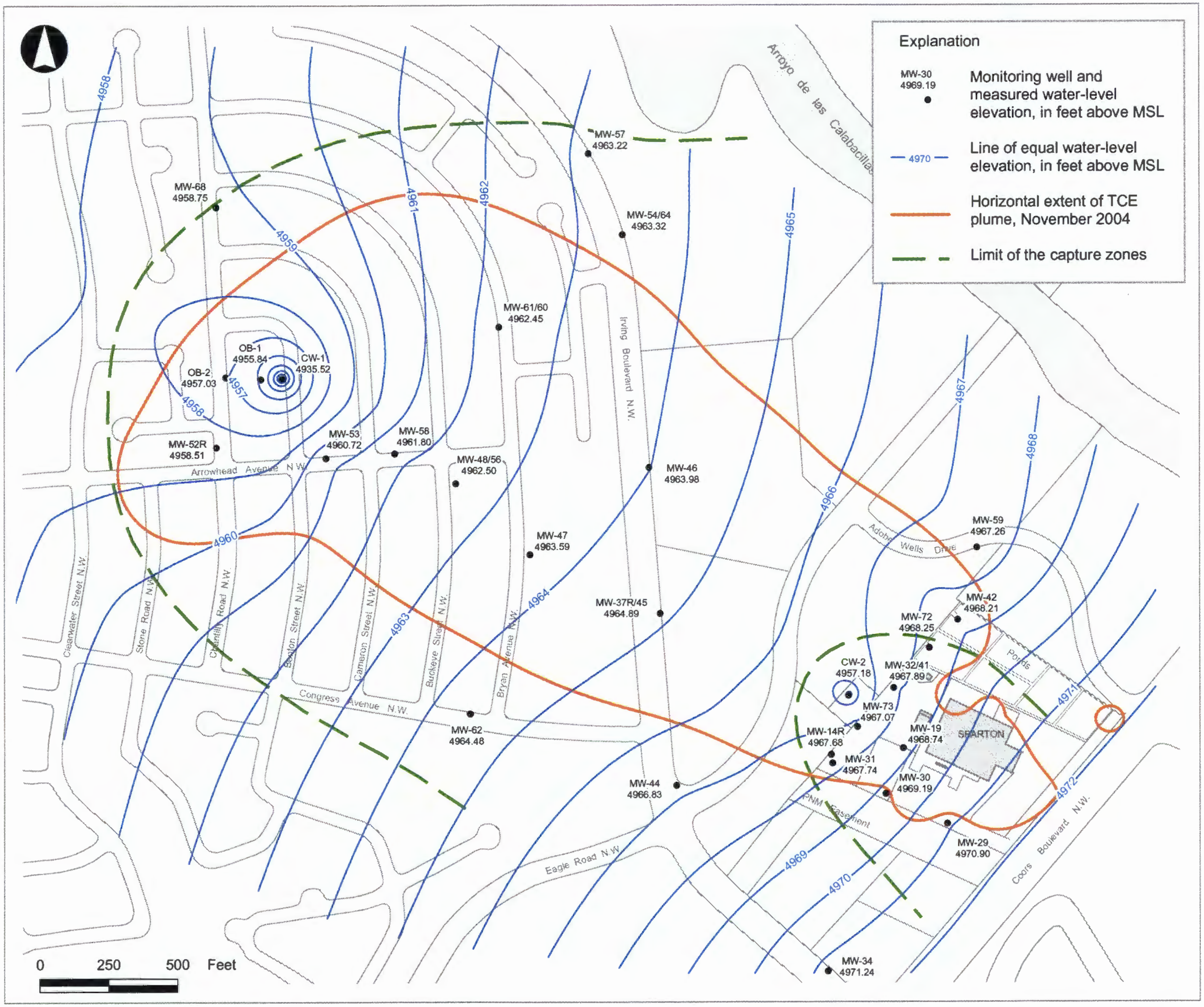


Figure 5.2 Elevation of Water Levels and Limits of Containment Well Capture Zones in the UFZ/ULFZ - February 10, 2005

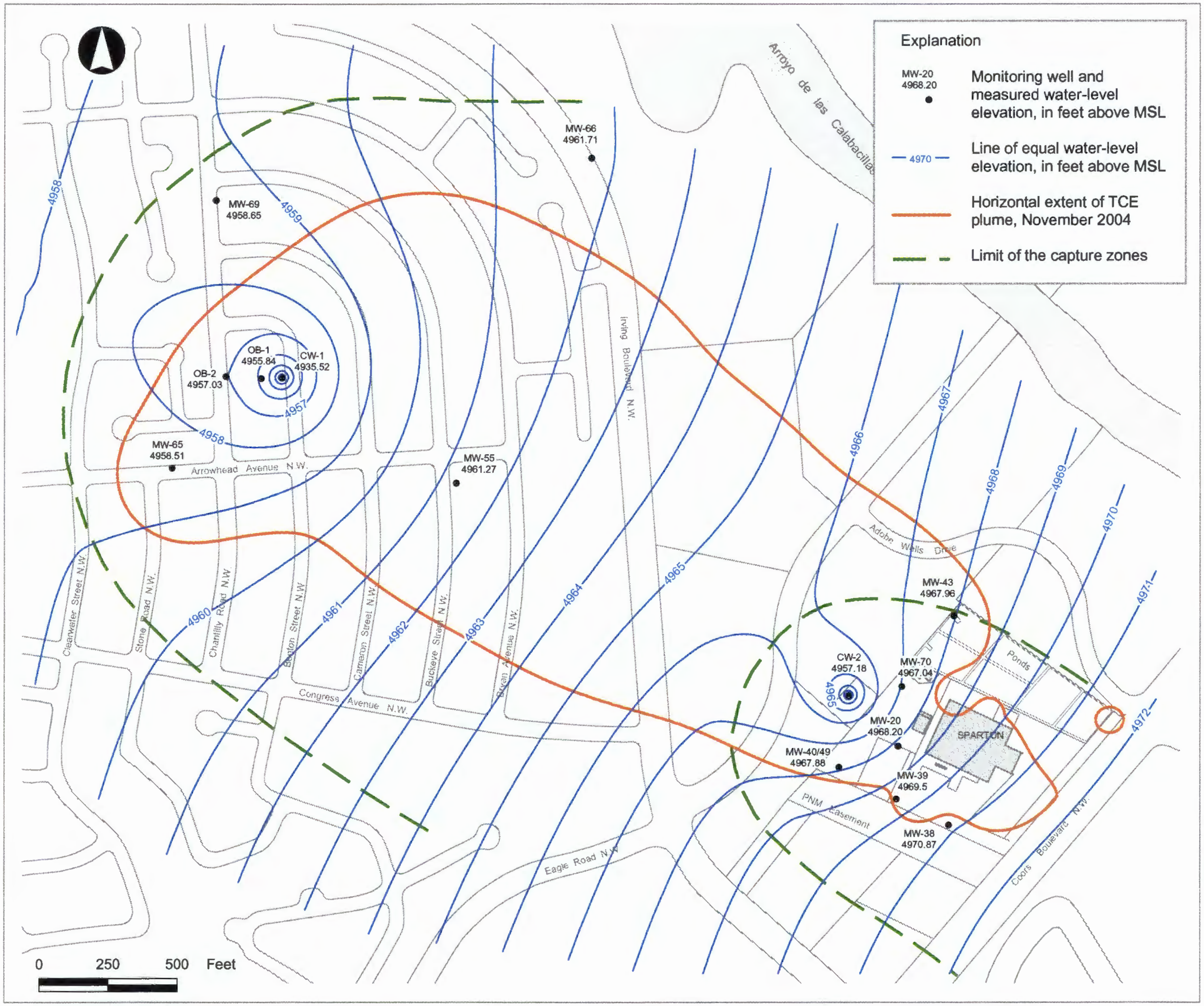


Figure 5.3 Elevation of Water Levels and Limits of Containment Well Capture Zones in the LLFZ - February 10, 2005

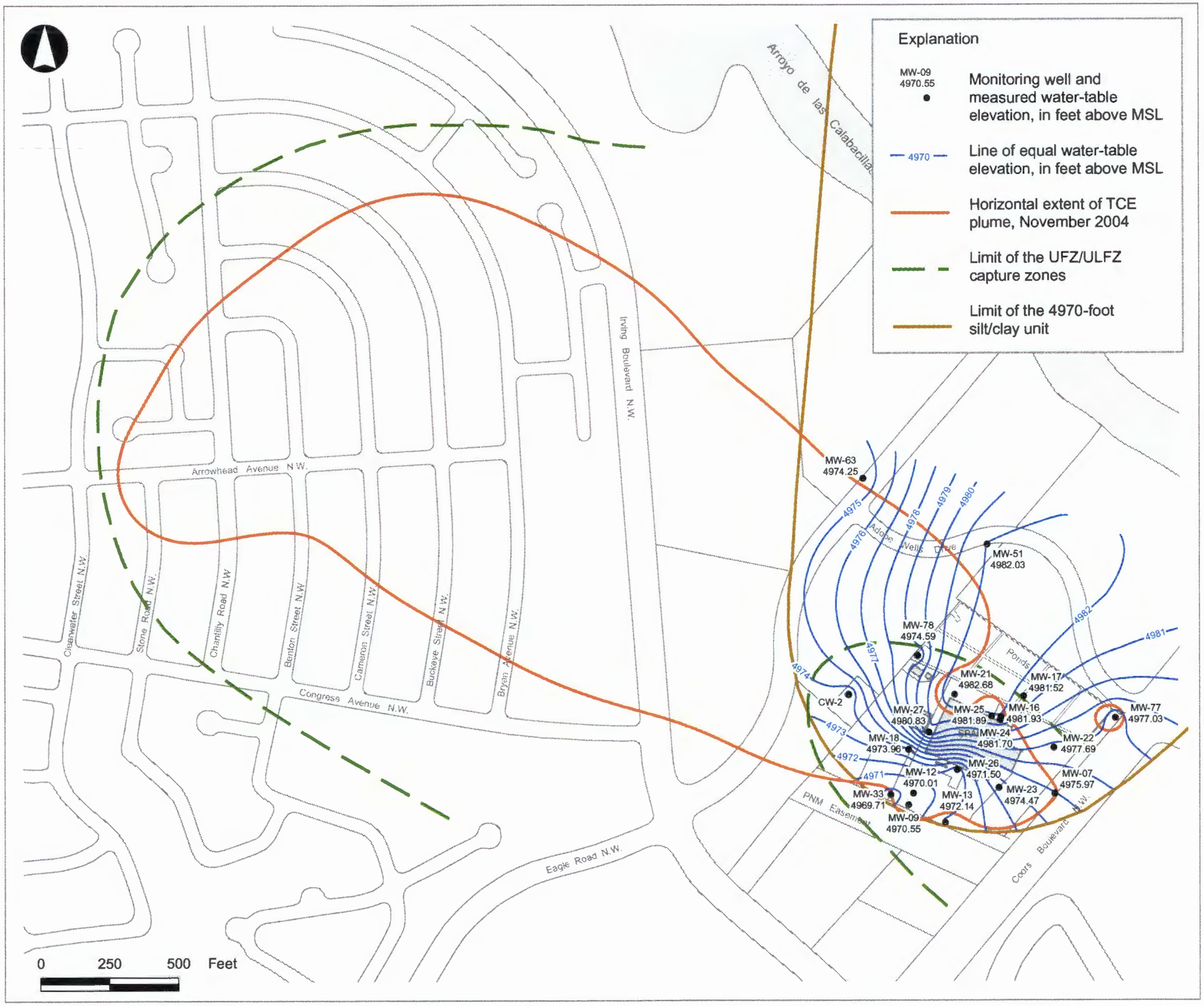


Figure 5.4 Elevation of the On-Site Water Table - May 9, 2005

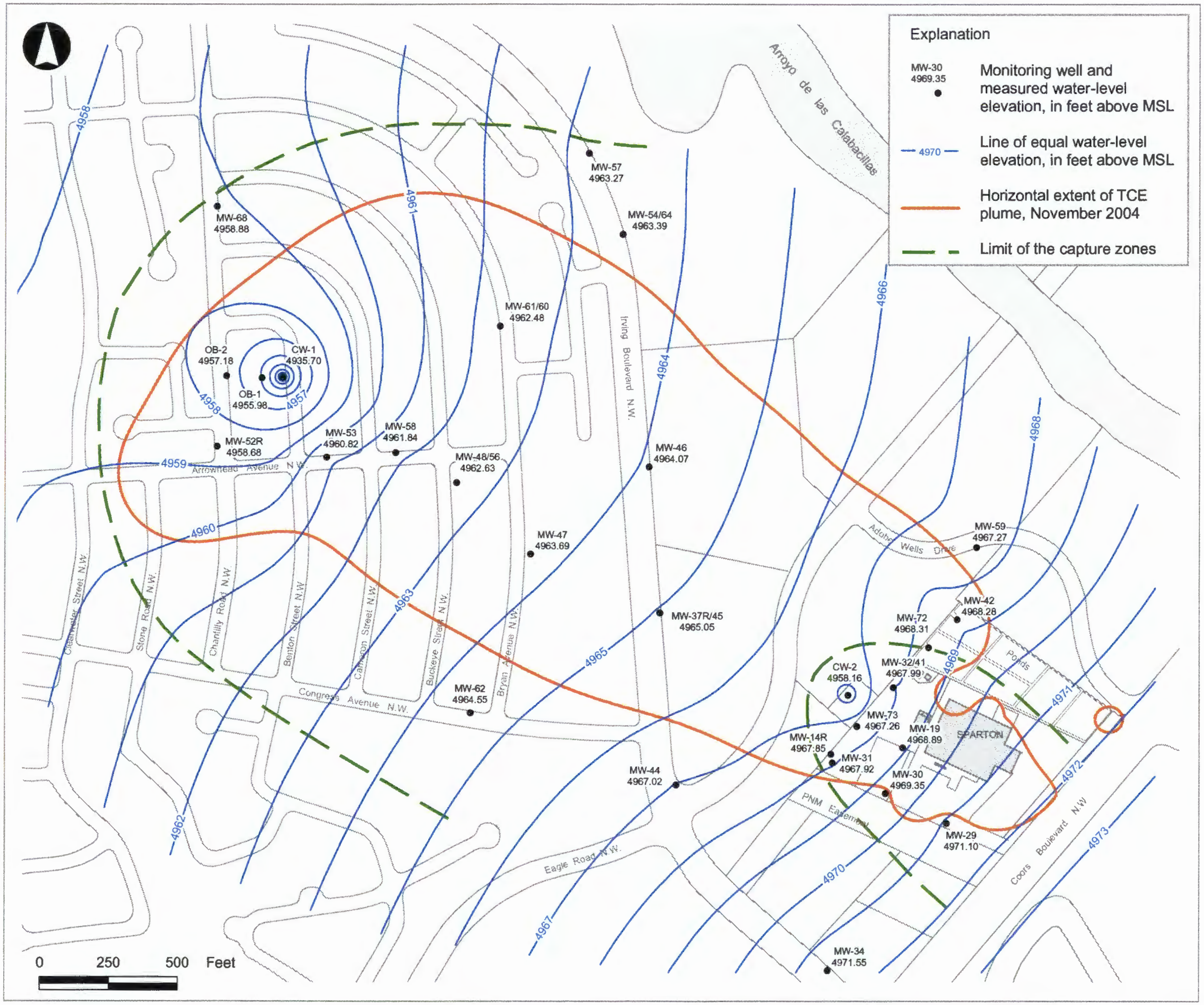


Figure 5.5 Elevation of Water Levels and Limits of Containment Well Capture Zones in the UFZ/ULFZ - May 9, 2005

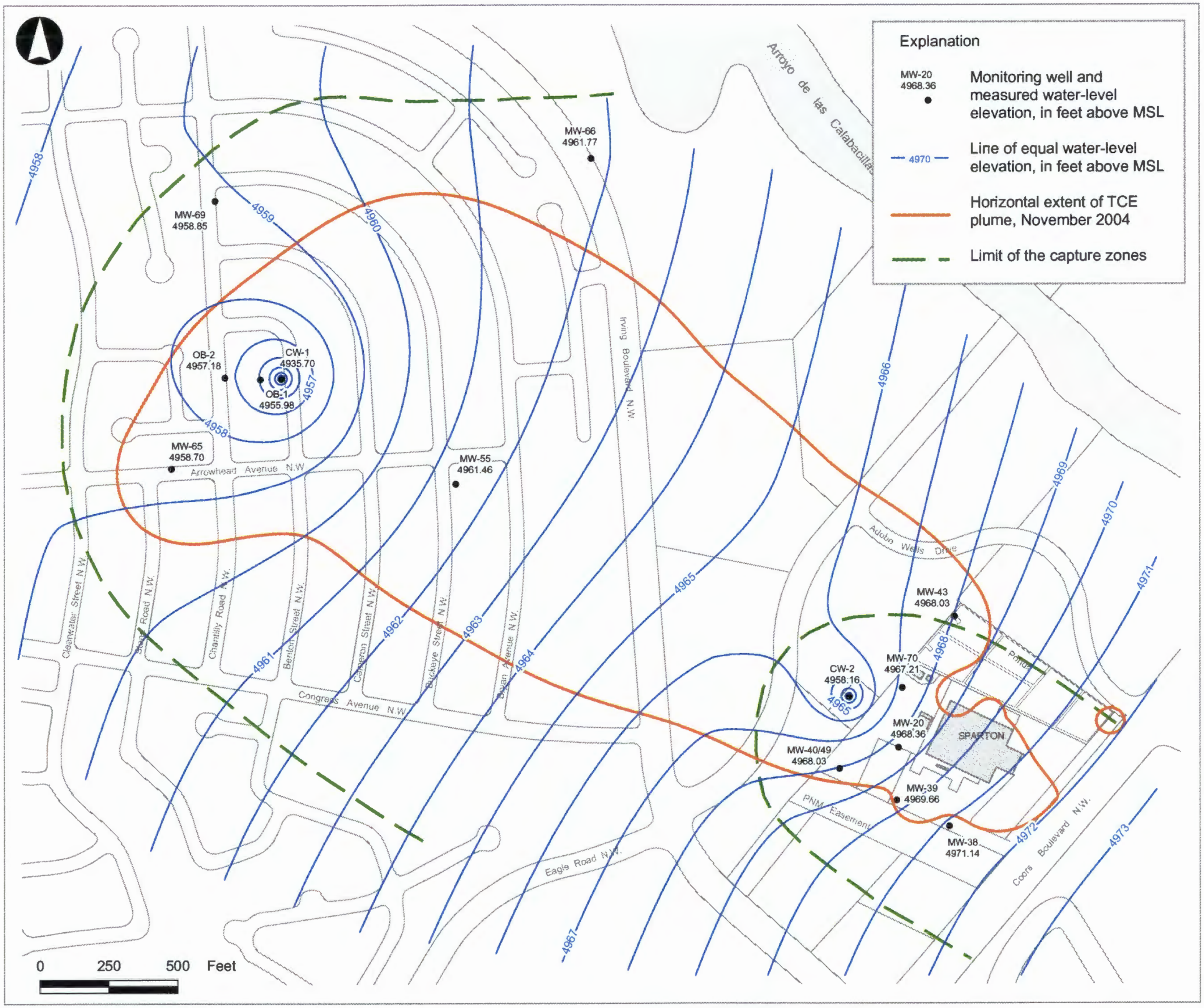


Figure 5.6 Elevation of Water Levels and Limits of Containment Well Capture Zones in the LLFZ - May 9, 2005

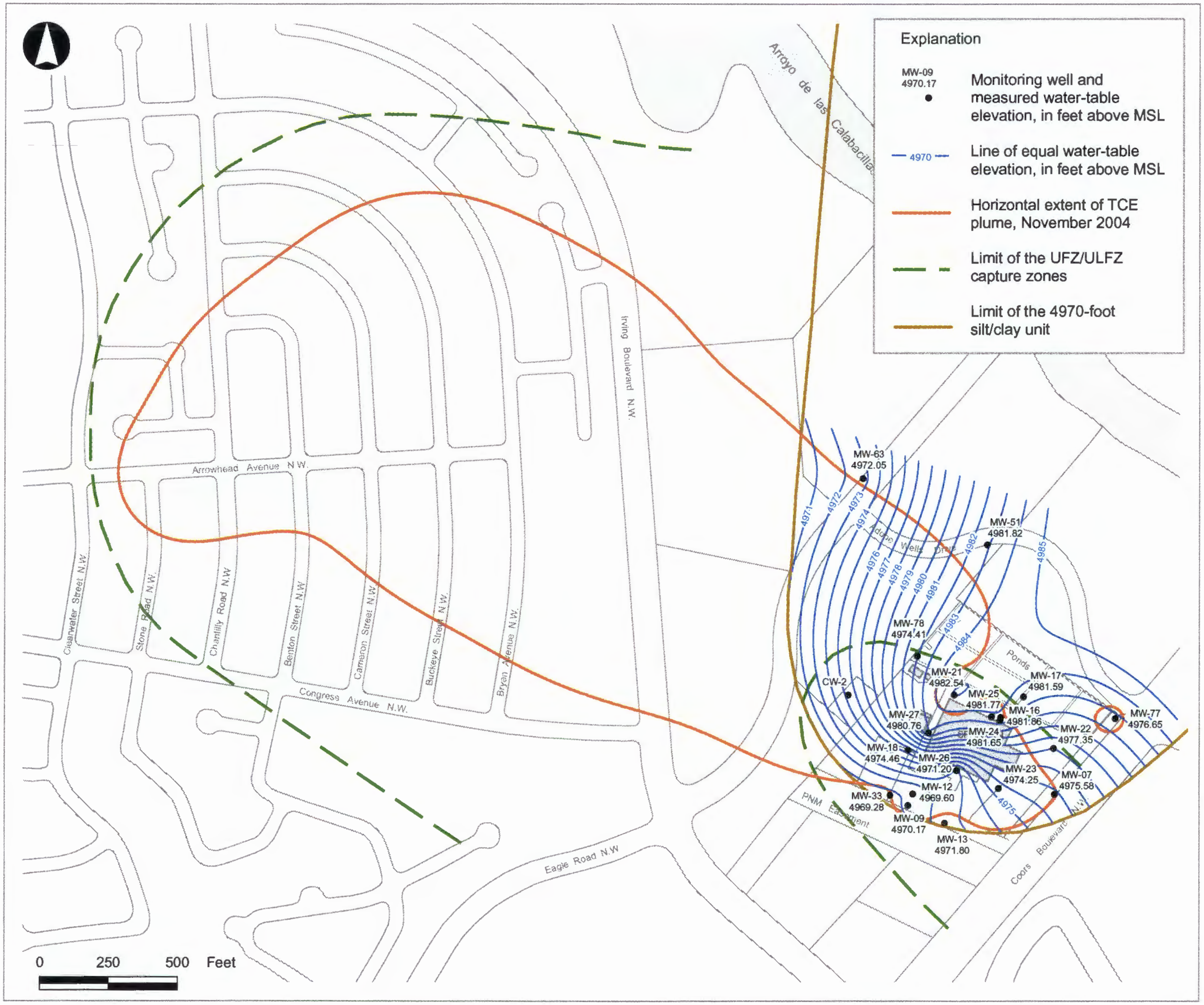


Figure 5.7 Elevation of the On-Site Water Table - August 3, 2005

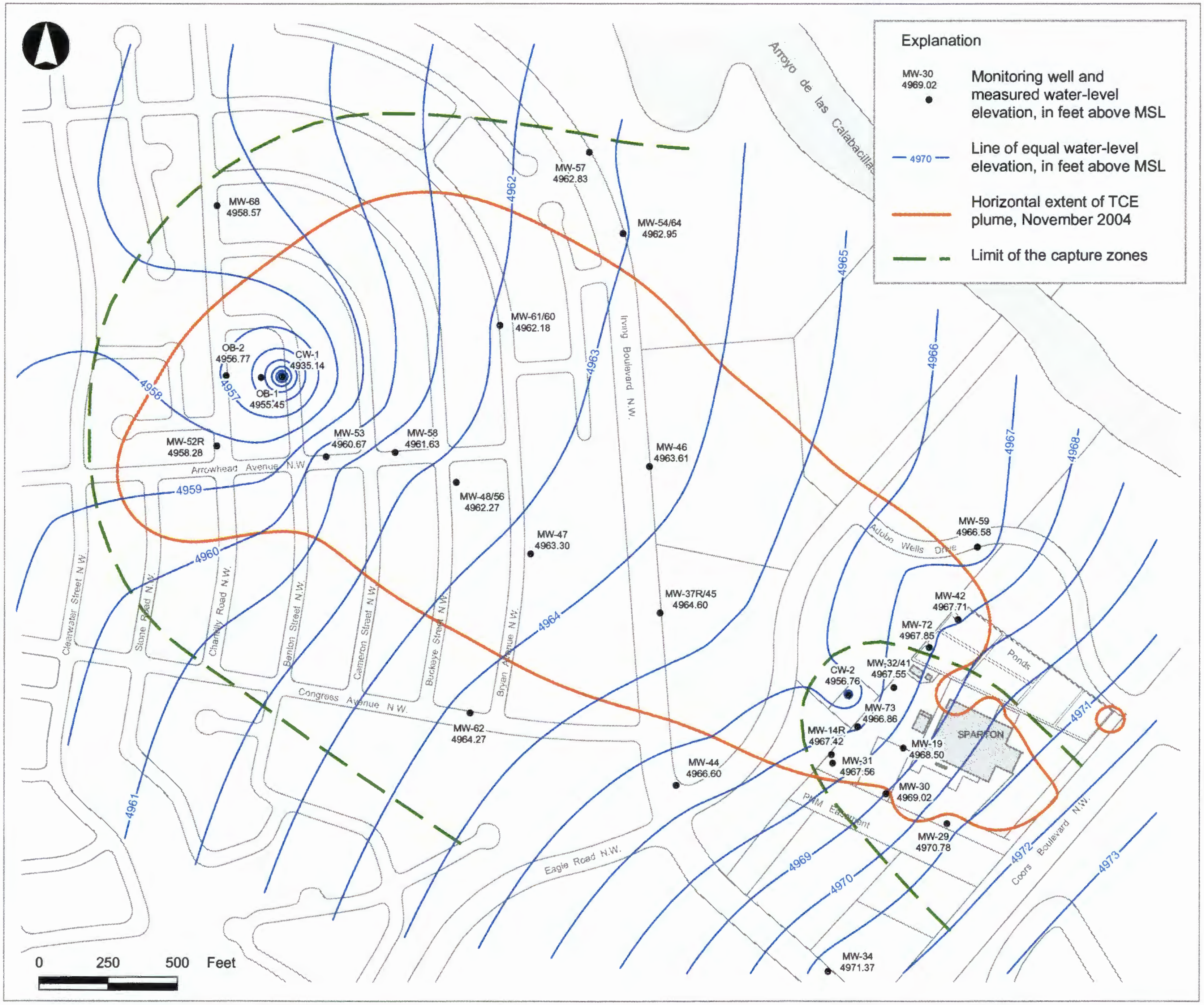


Figure 5.8 Elevation of Water Levels and Limits of Containment Well Capture Zones in the UFZ/ULFZ - August 3, 2005

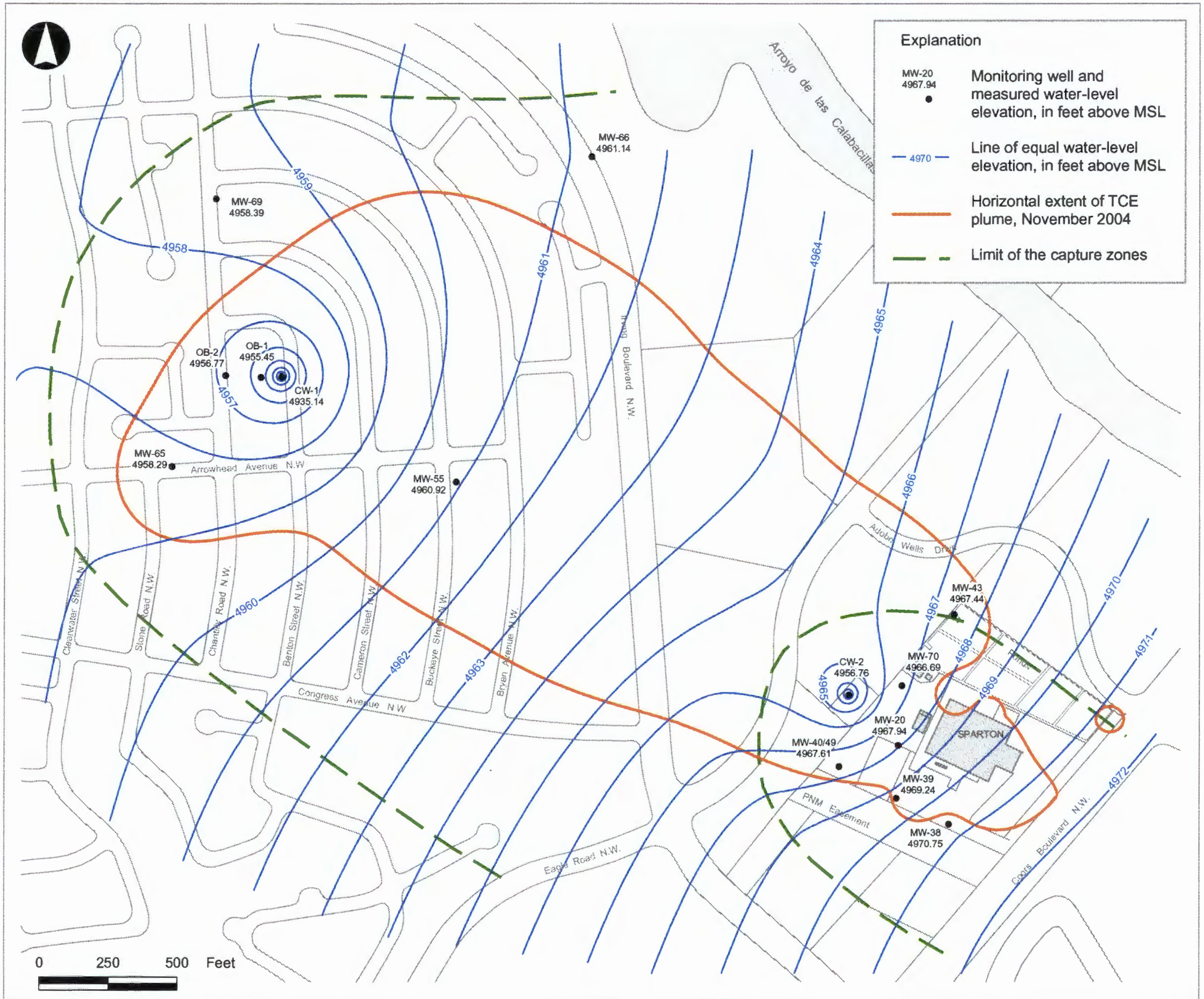


Figure 5.9 Elevation of Water Levels and Limits of Containment Well Capture Zones in the LLFZ - August 3, 2005

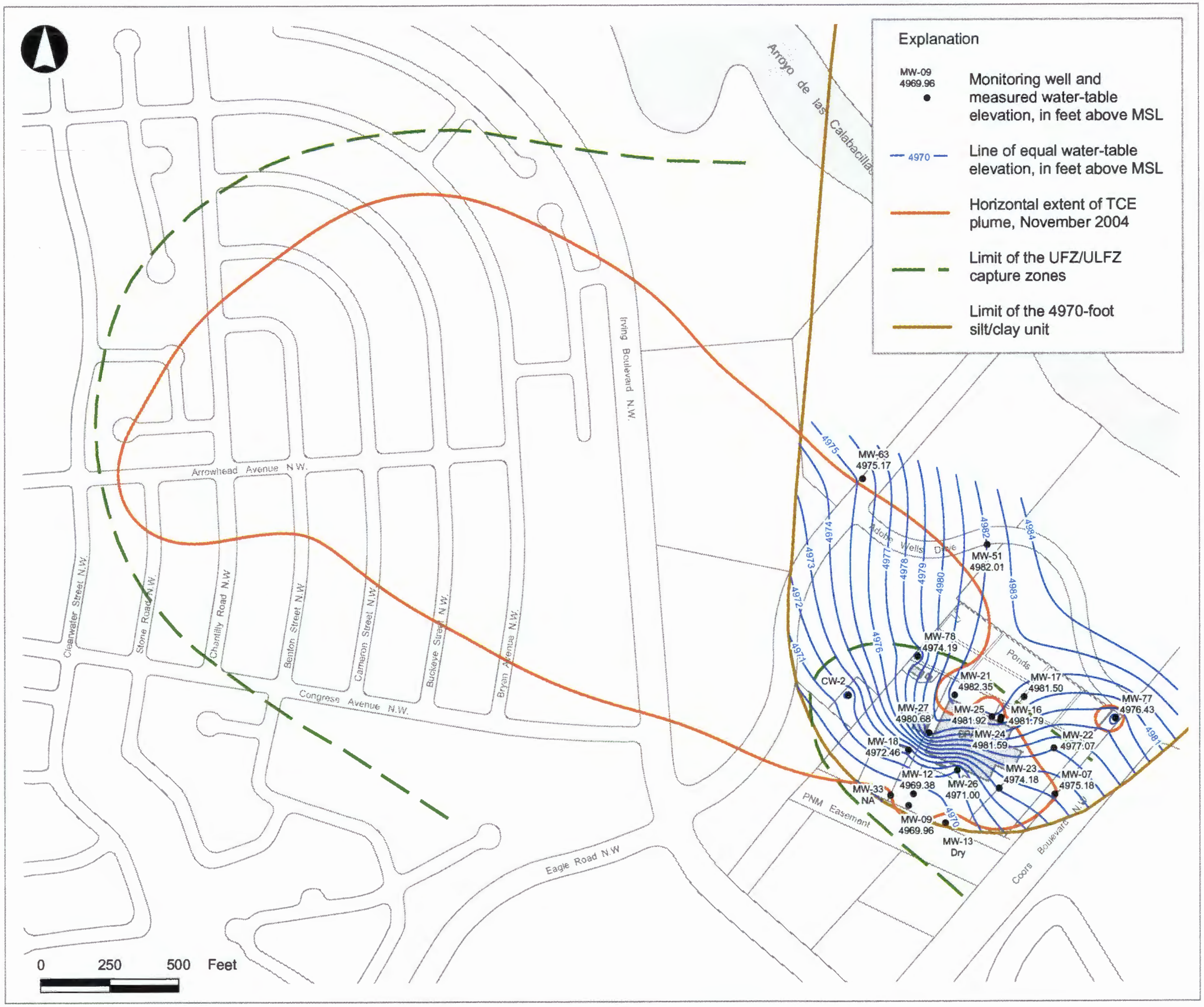


Figure 5.10 Elevation of the On-Site Water Table - November 1, 2005

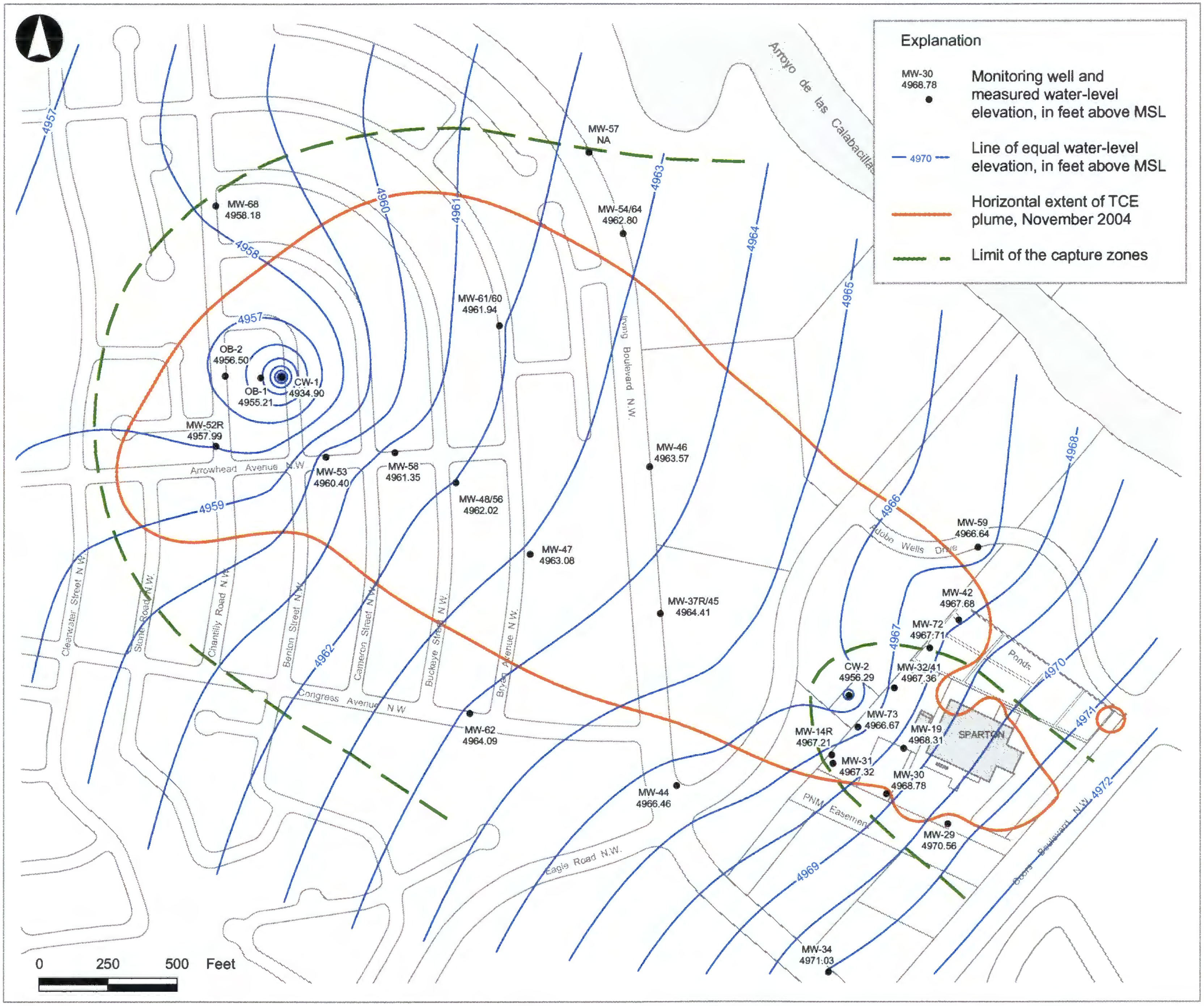


Figure 5.11 Elevation of Water Levels and Limits of Containment Well Capture Zones in the UFZ/ULFZ - November 1, 2005

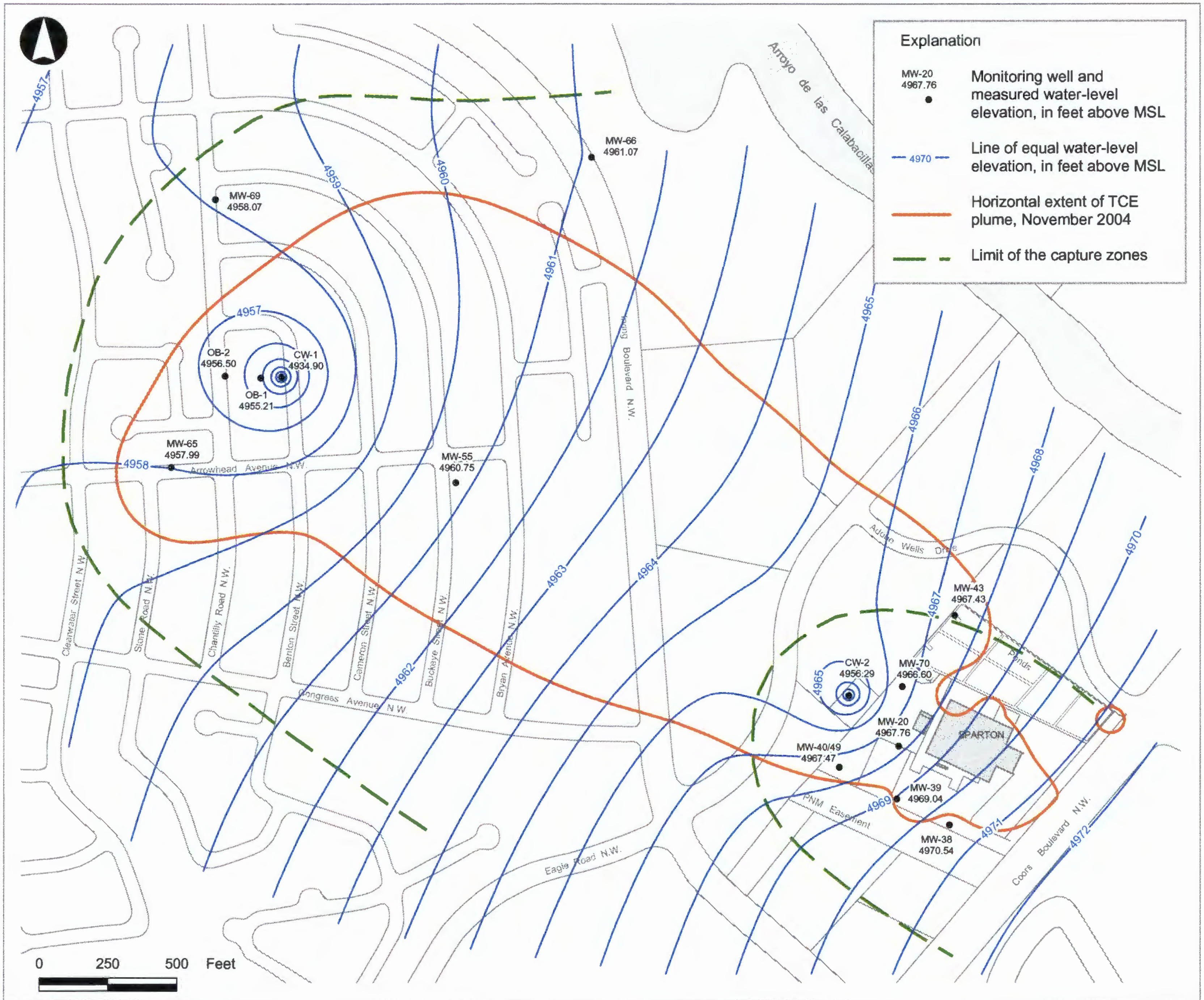


Figure 5.12 Elevation of Water Levels and Limits of Containment Well Capture Zones in the LLFZ - November 1, 2005

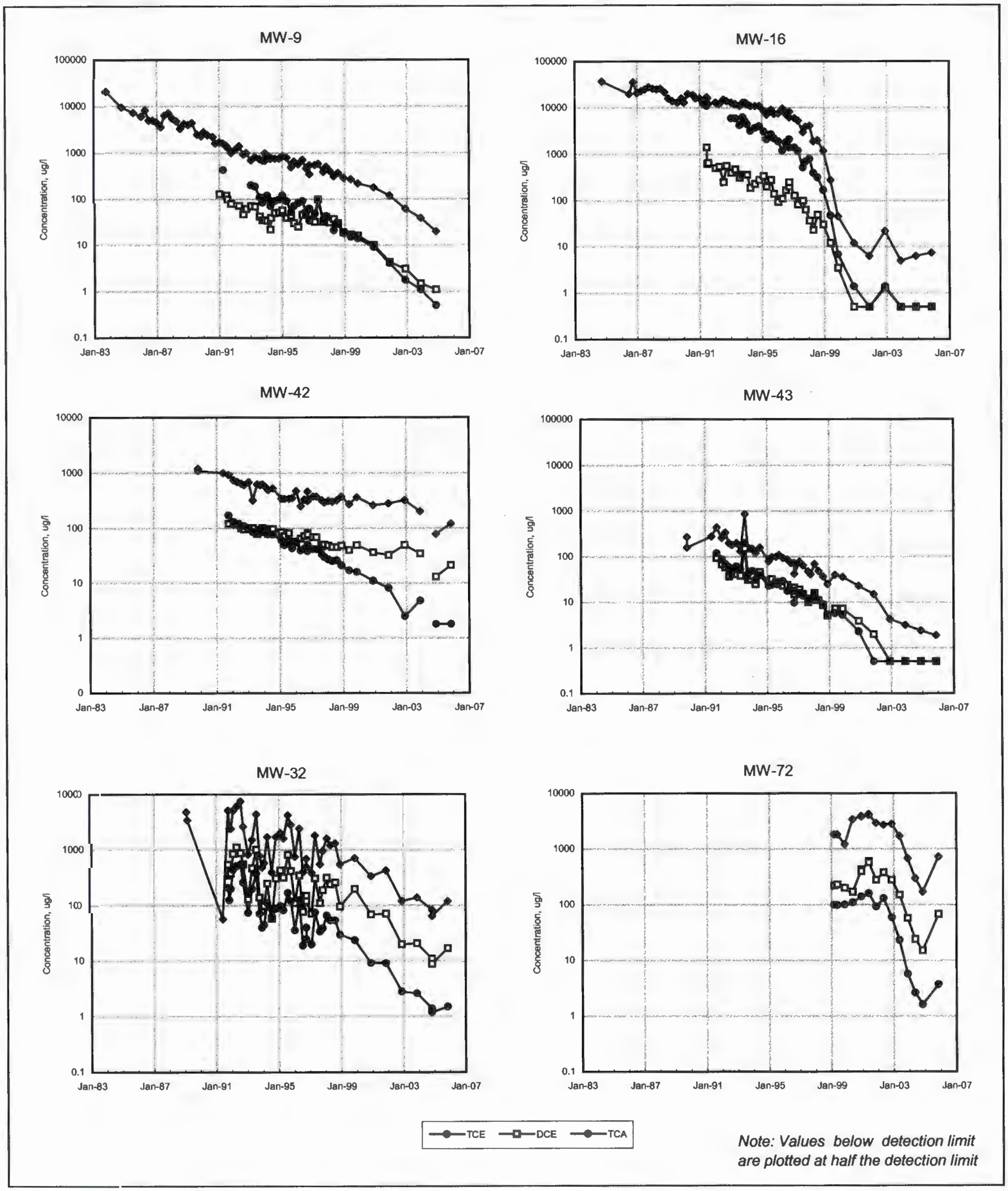


Figure 5.13 Contaminant Concentration Trends in On-Site Monitoring Wells

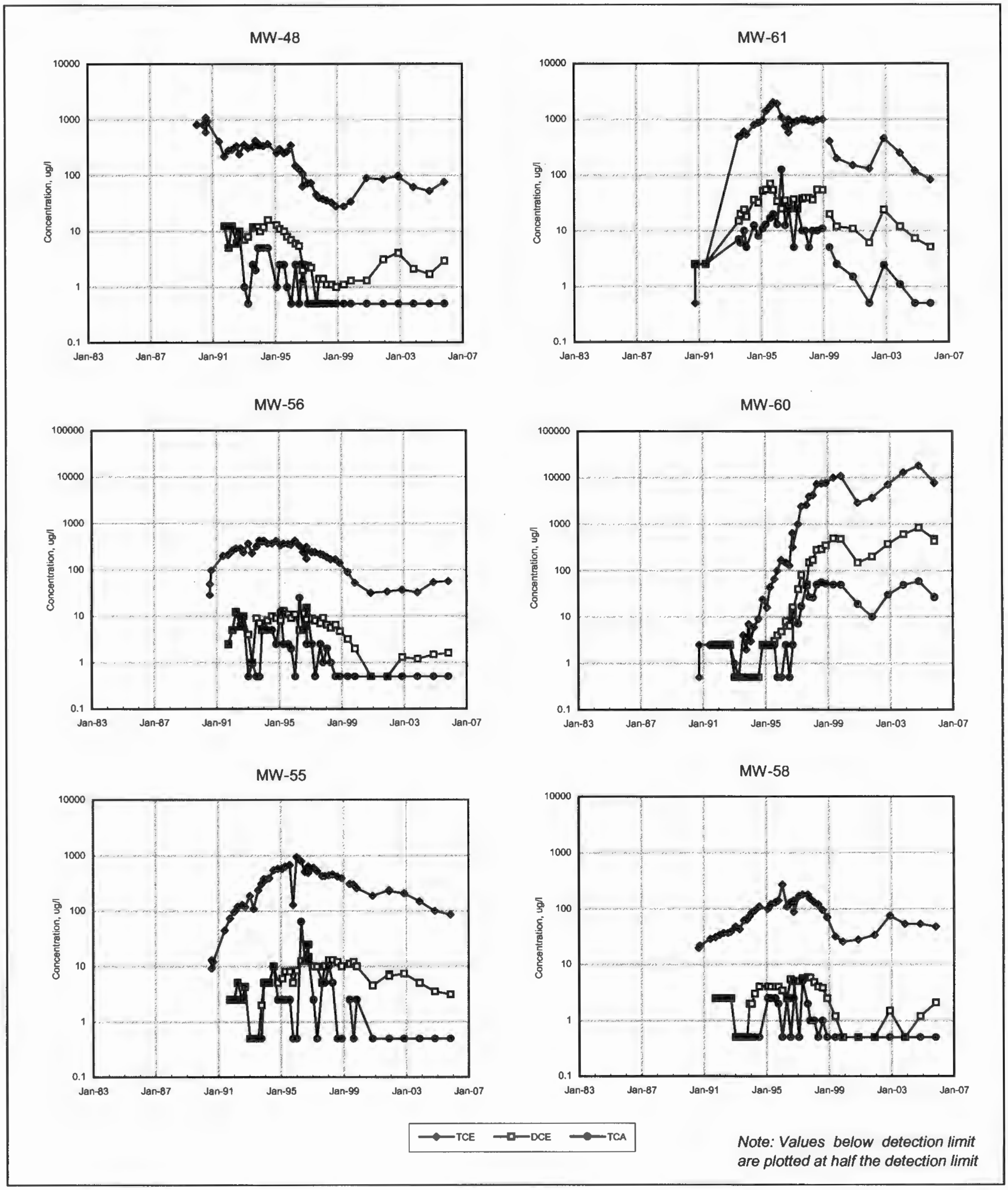


Figure 5.14 Contaminant Concentration Trends in Off-Site Monitoring Wells

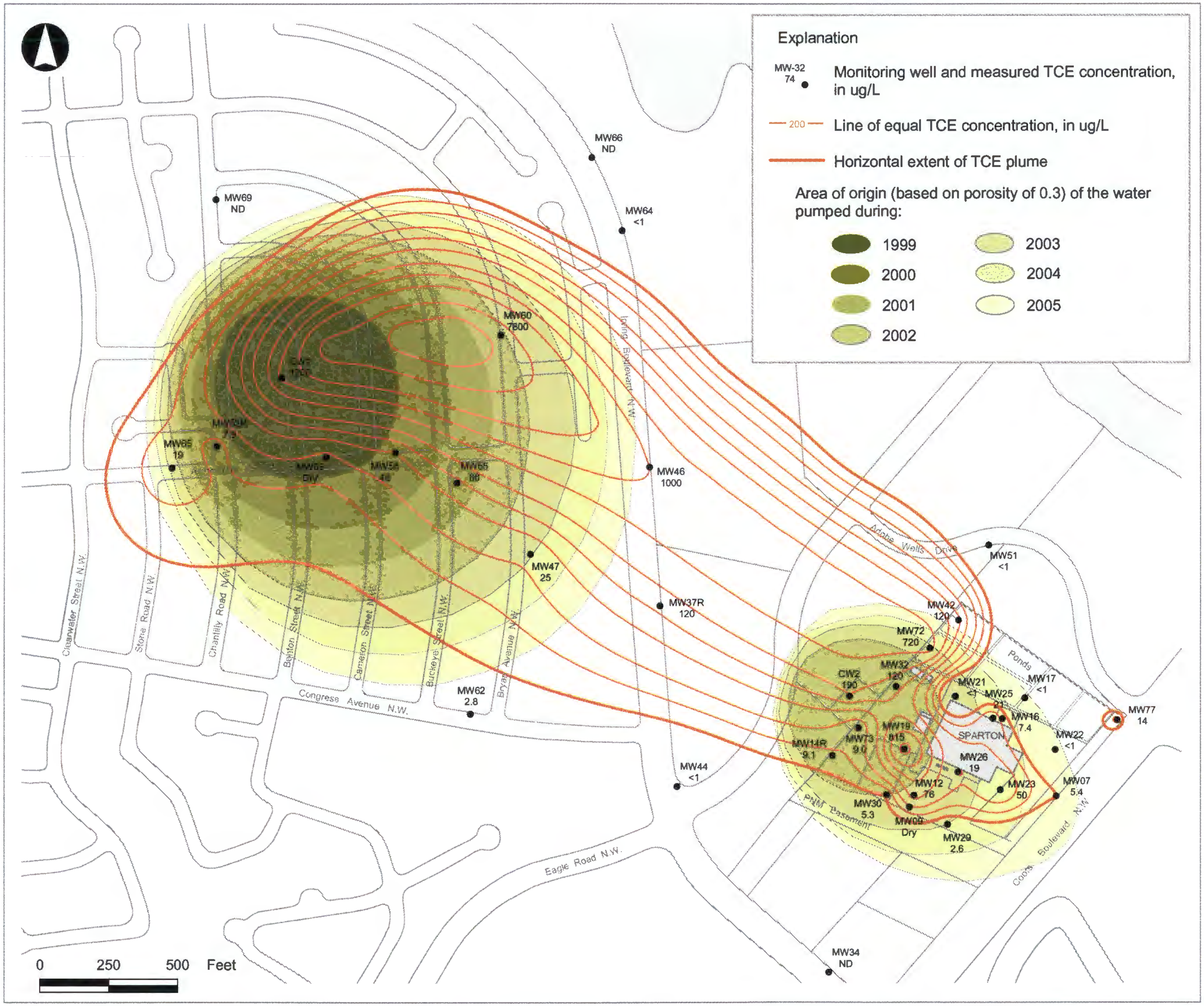


Figure 5.15 Horizontal Extent of TCE Plume - November 2005

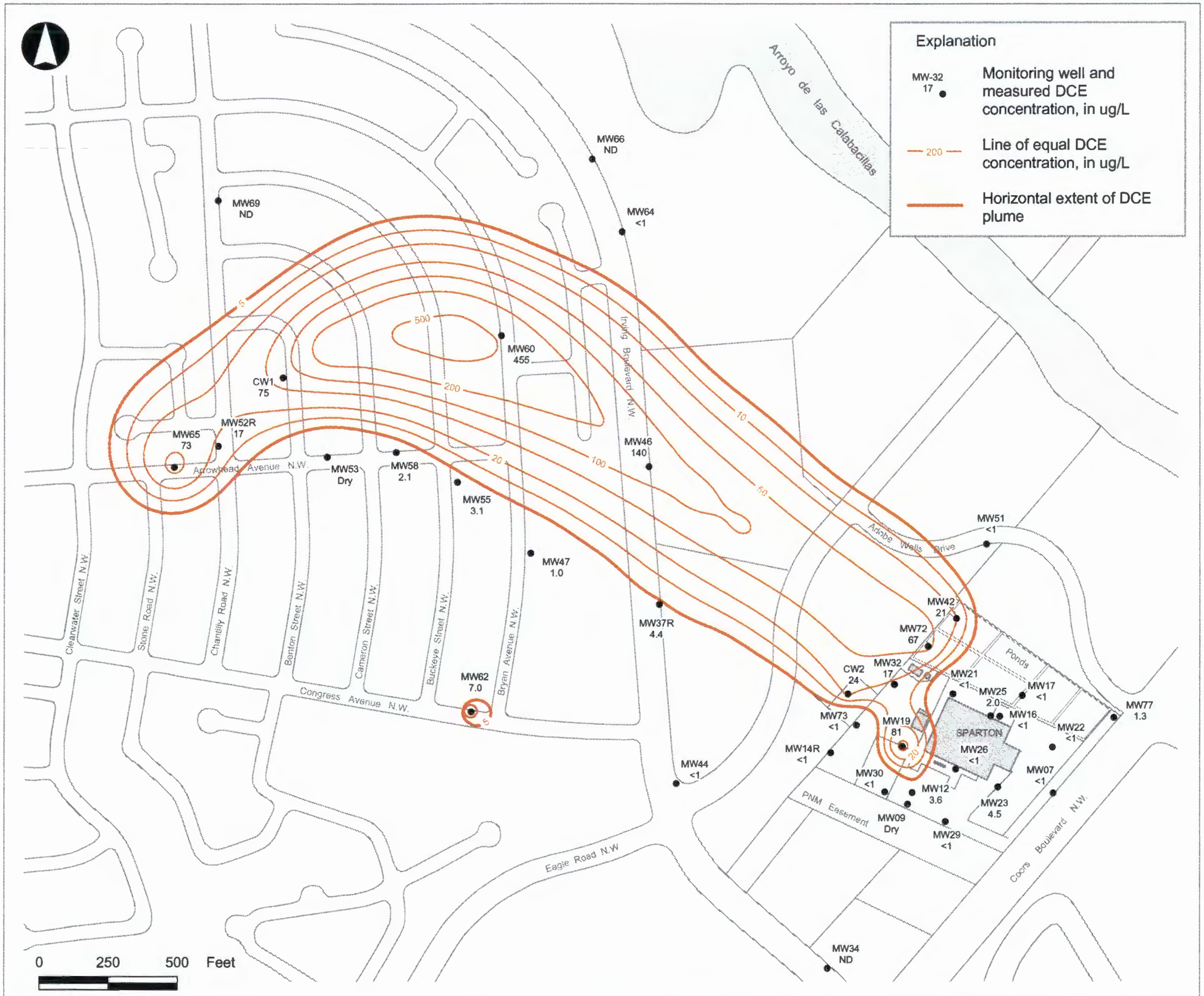


Figure 5.16 Horizontal Extent of DCE Plume - November 2005

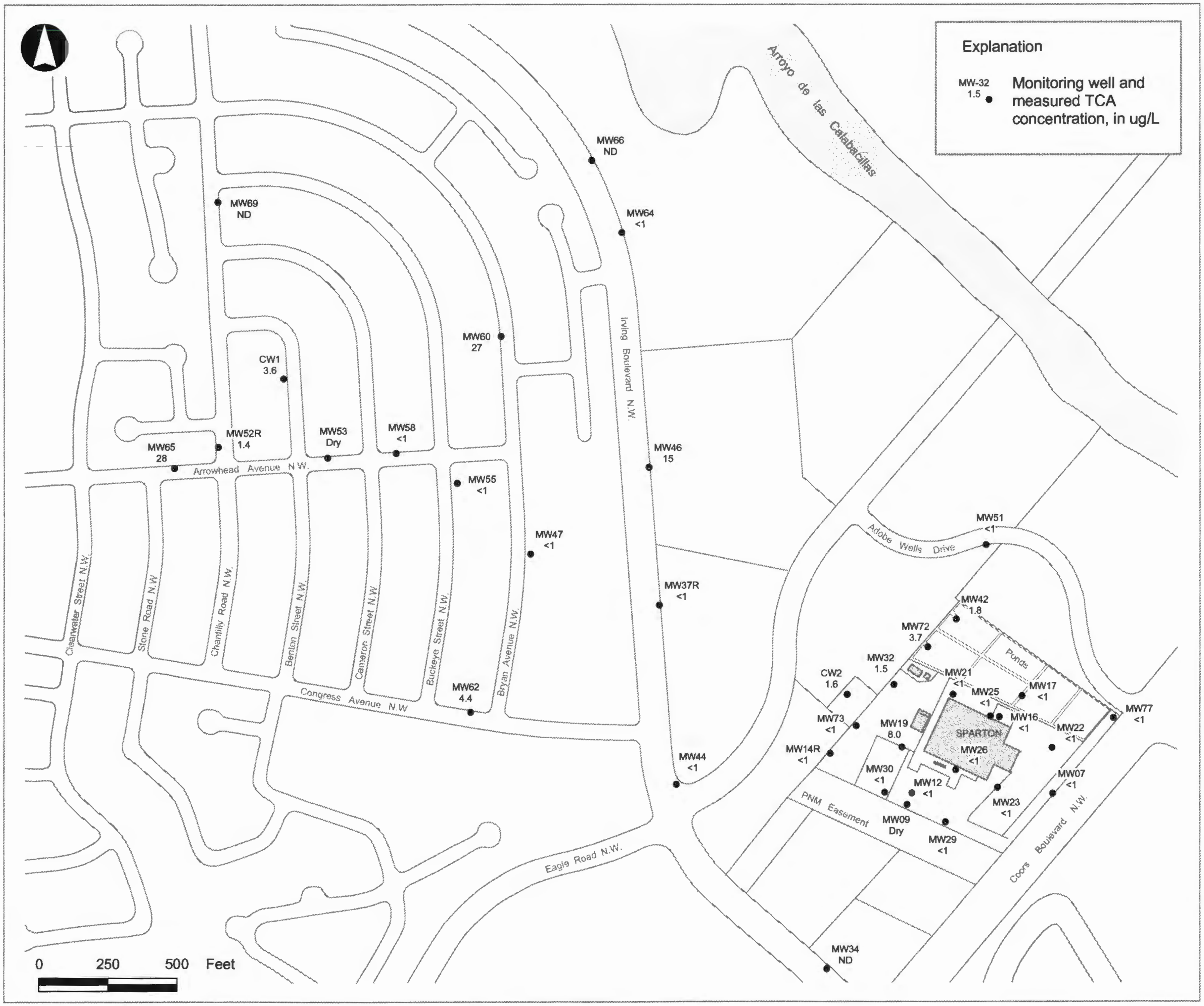


Figure 5.17 Maximum Concentrations of TCA in Wells - November 2005

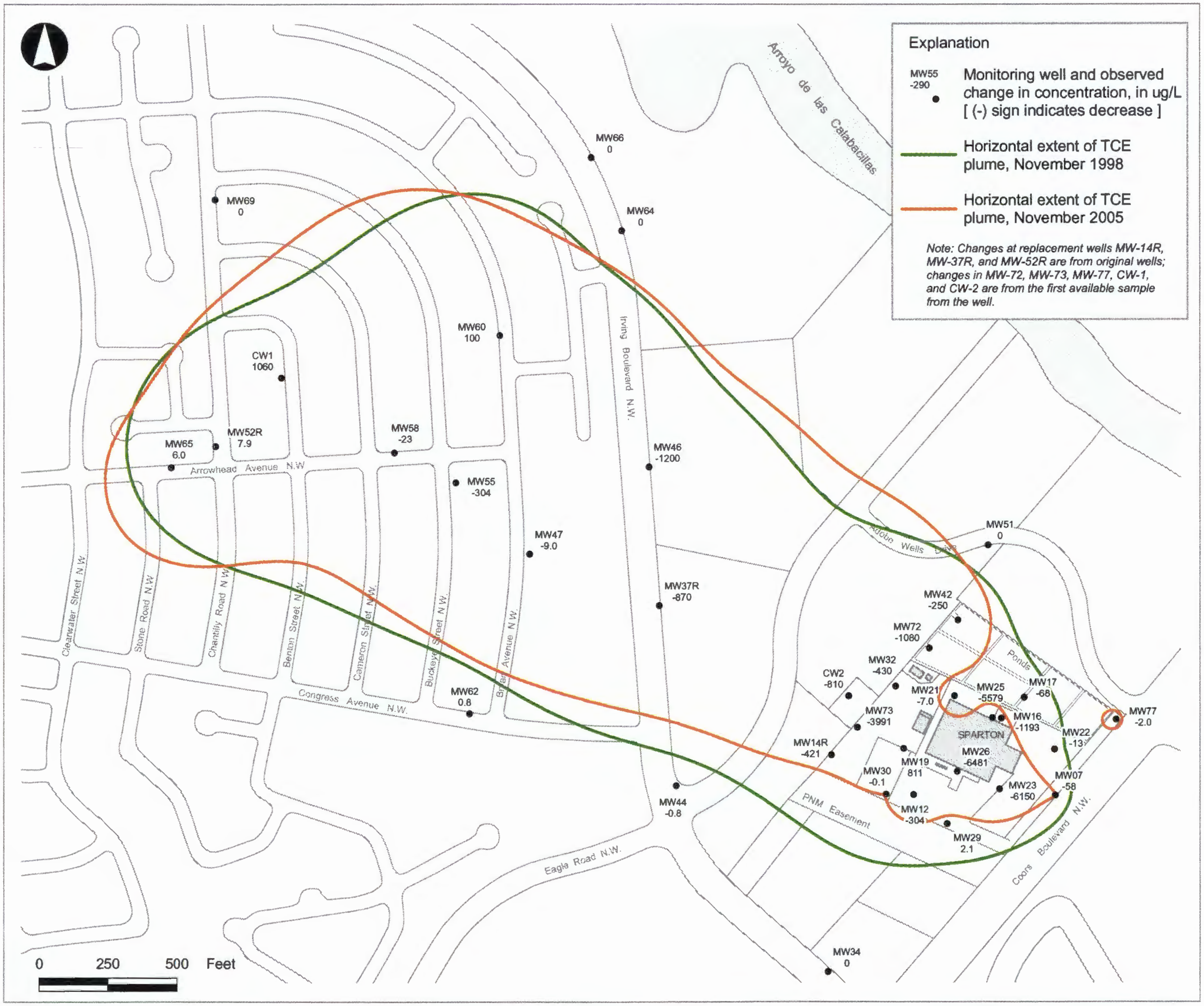


Figure 5.18 Changes in TCE Concentrations at Wells Used for Plume Definition - November 1998 to November 2005

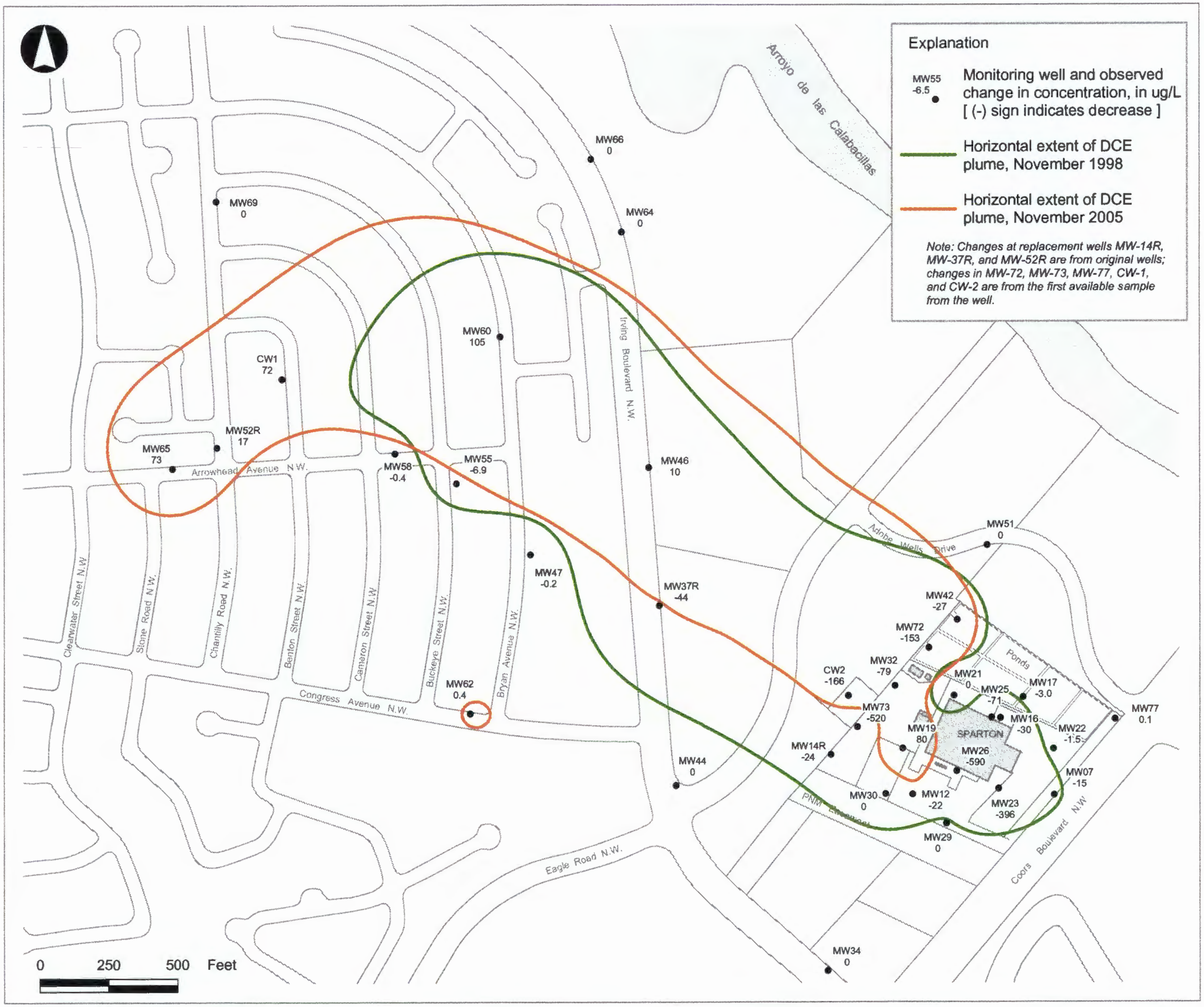


Figure 5.19 Changes in DCE Concentrations at Wells Used for Plume Definition - November 1998 to November 2005

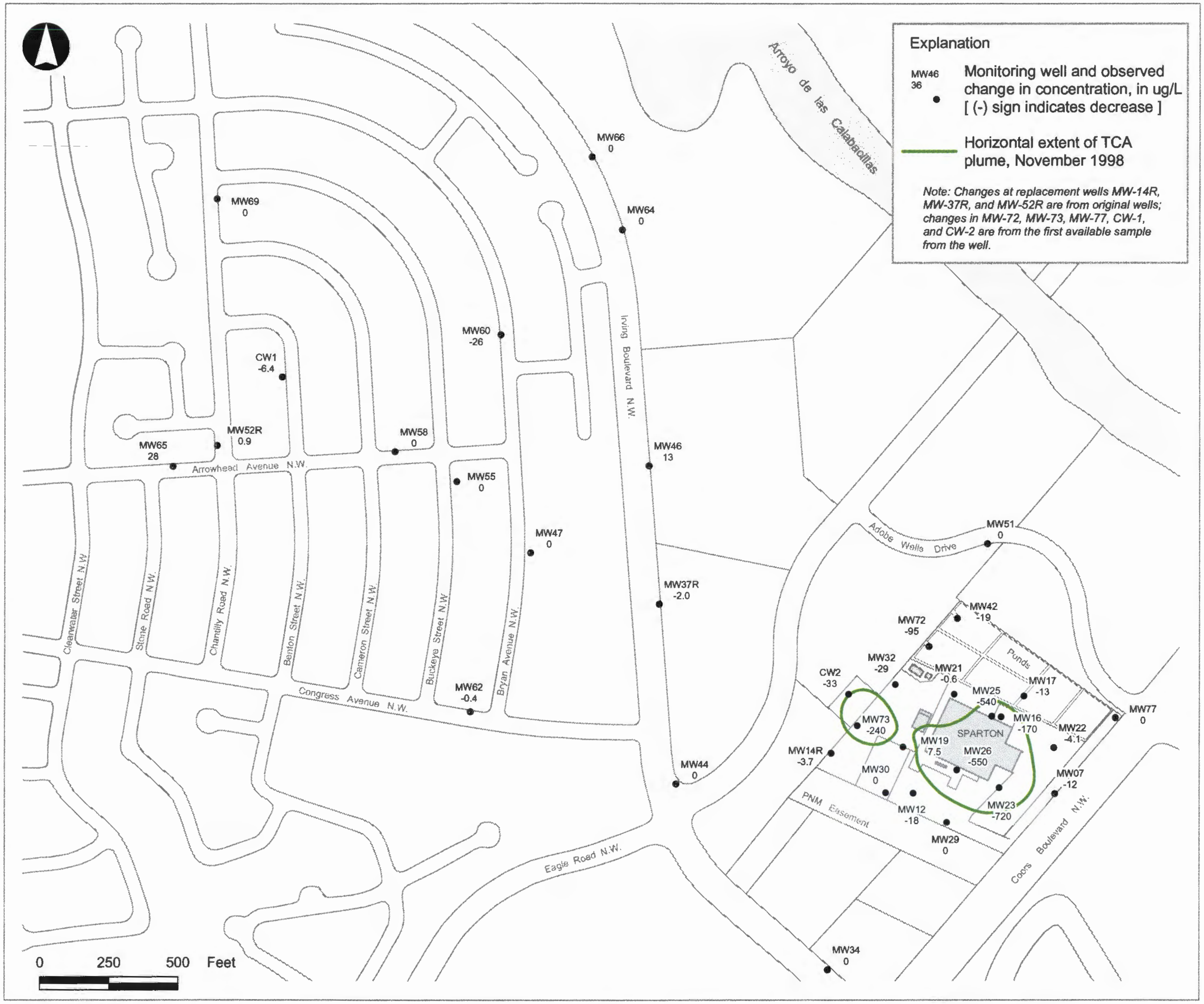


Figure 5.20 Changes in TCA Concentrations at Wells Used for Plume Definition - November 1998 to November 2005

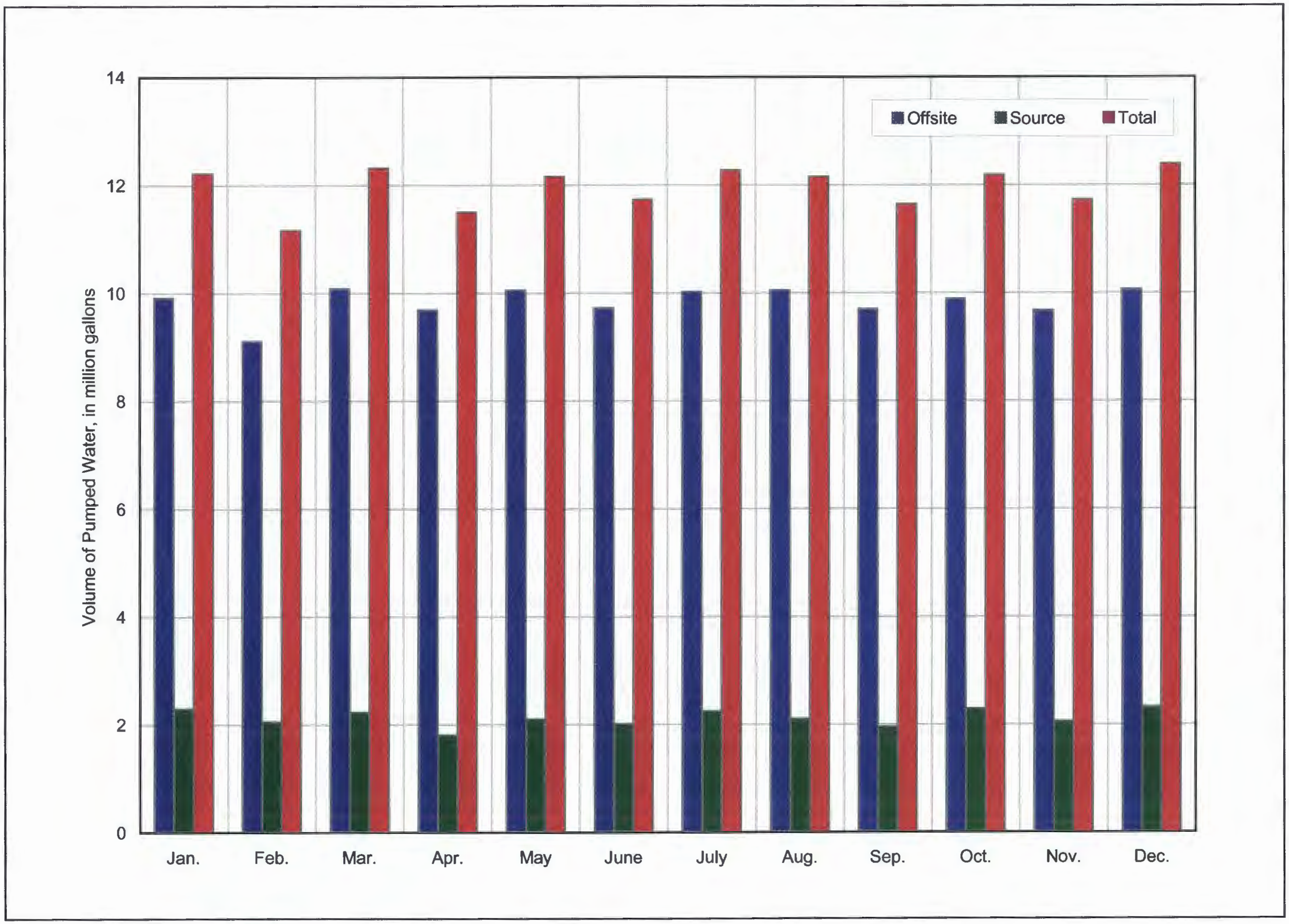


Figure 5.21 Monthly Volume of Water Pumped by the Off-Site and Source Containment Wells - 2005

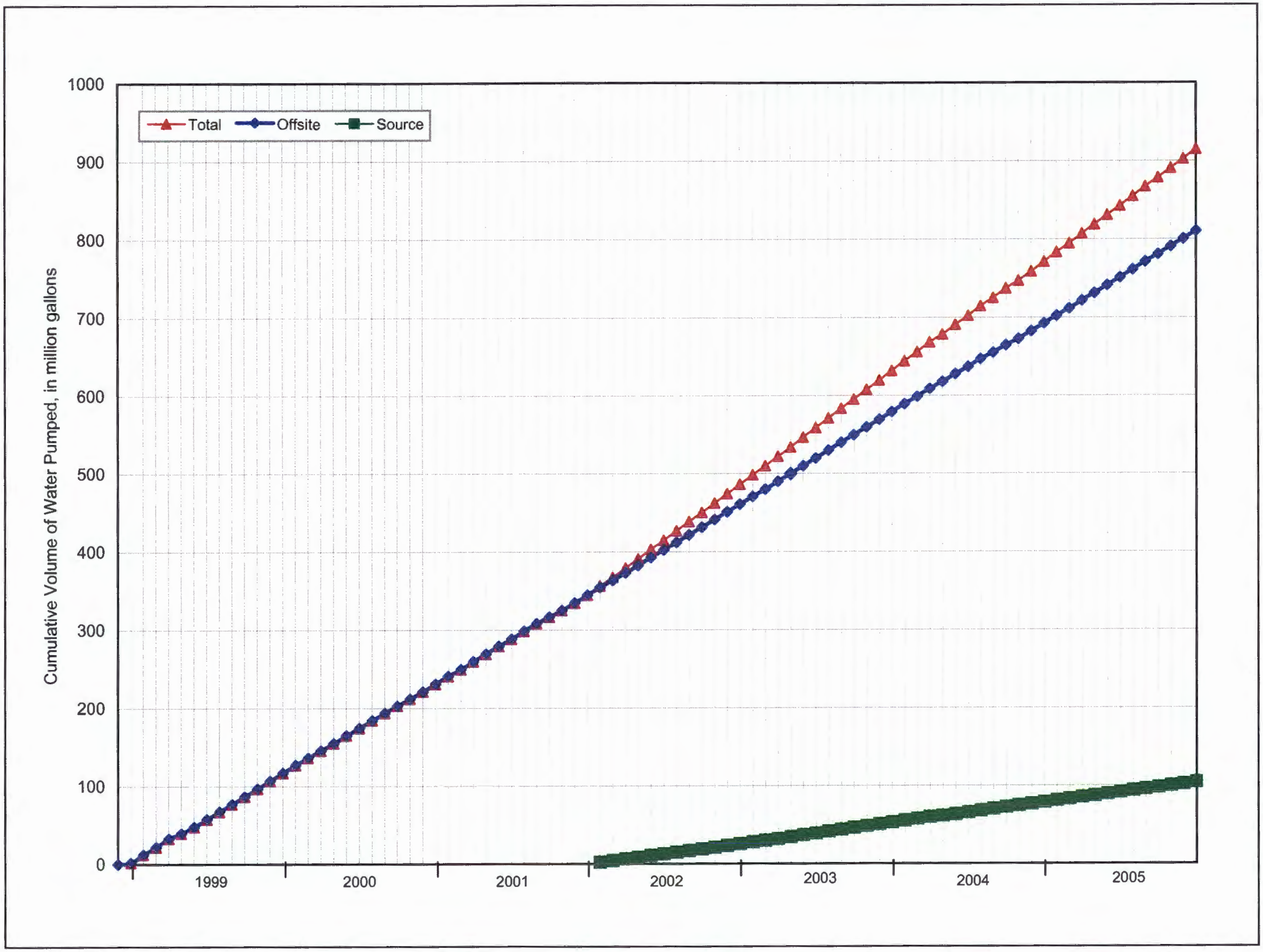


Figure 5.22 Cumulative Volume of Water Pumped by the Off-Site and Source Containment Wells

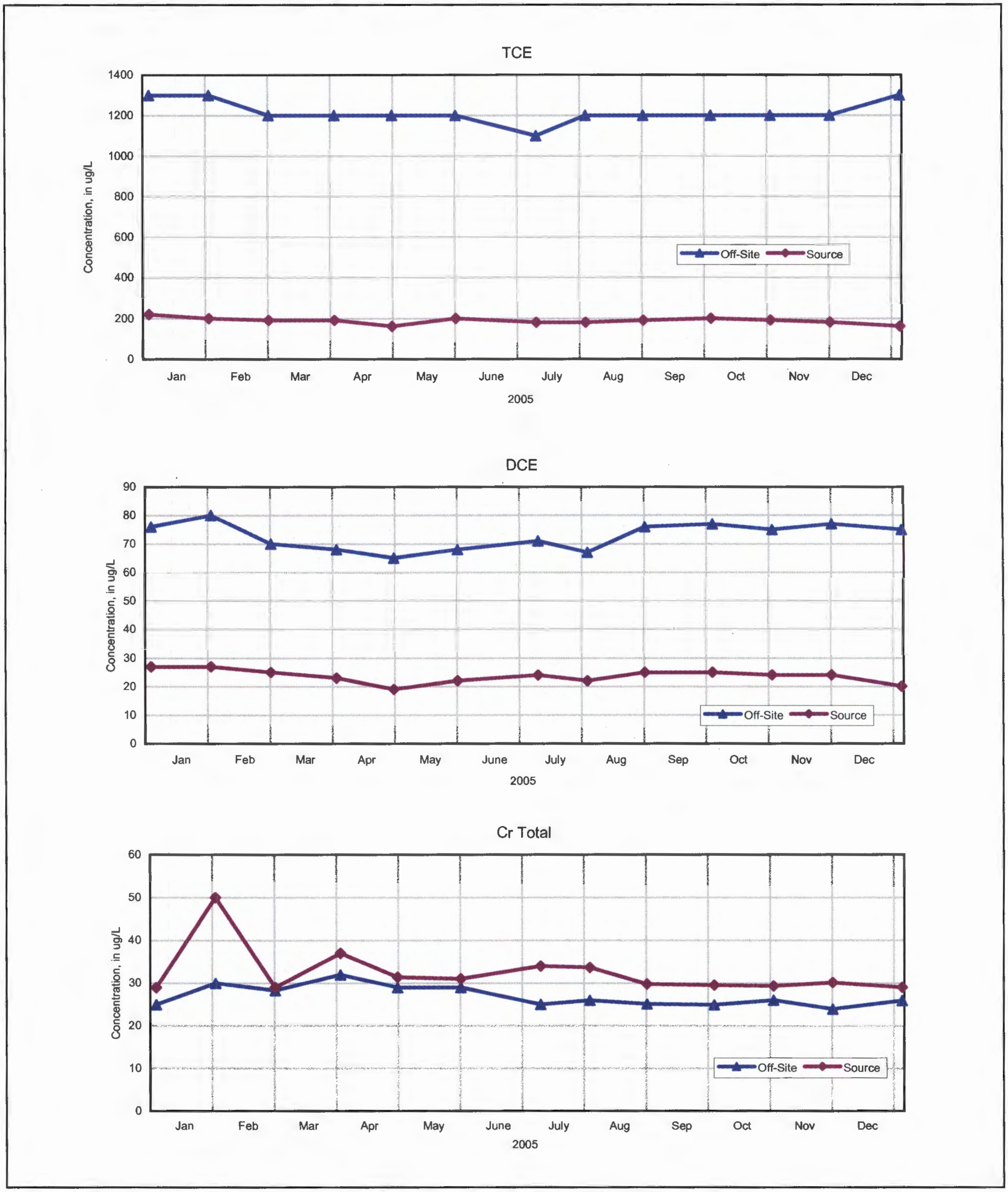
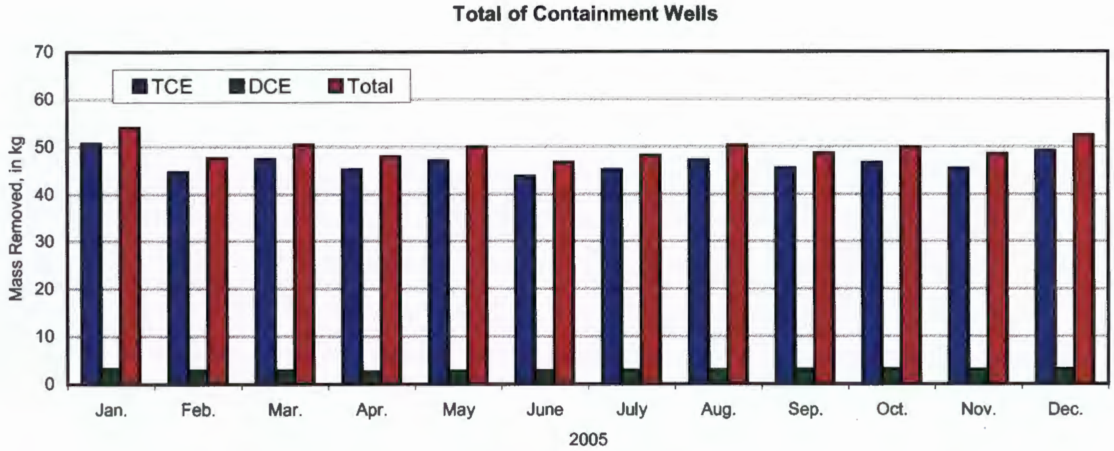
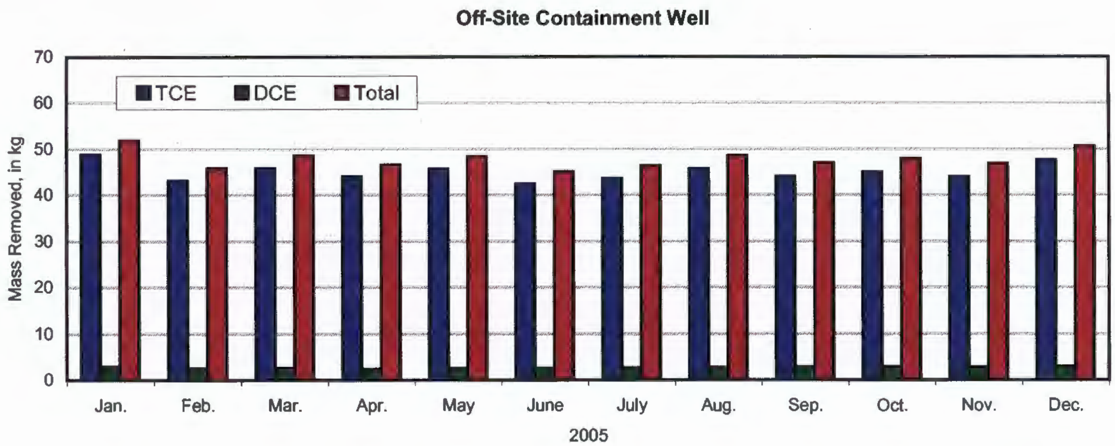


Figure 5.23 Source and Off-Site Containment Systems - TCE, DCE, and Total Chromium Concentrations in the Influent - 2005





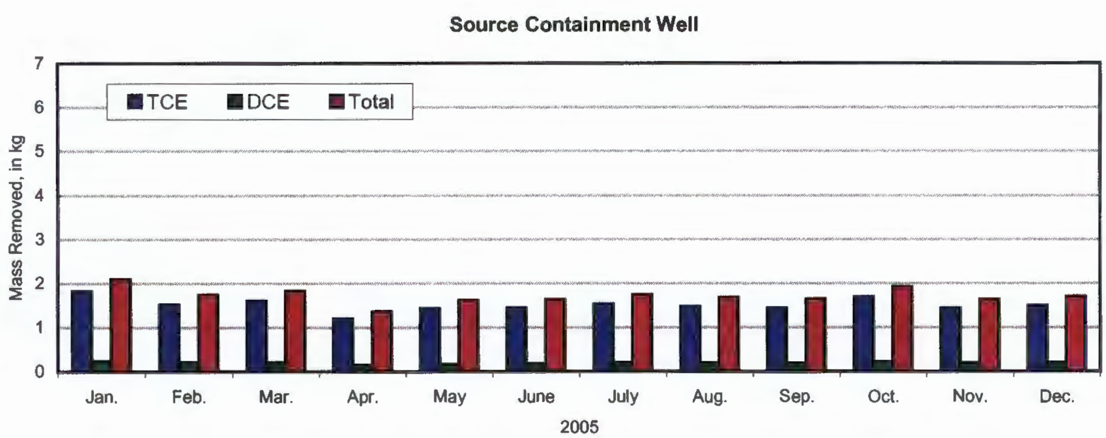


Figure 5.24 Monthly Contaminant Mass Removal by the Containment Wells - 2005

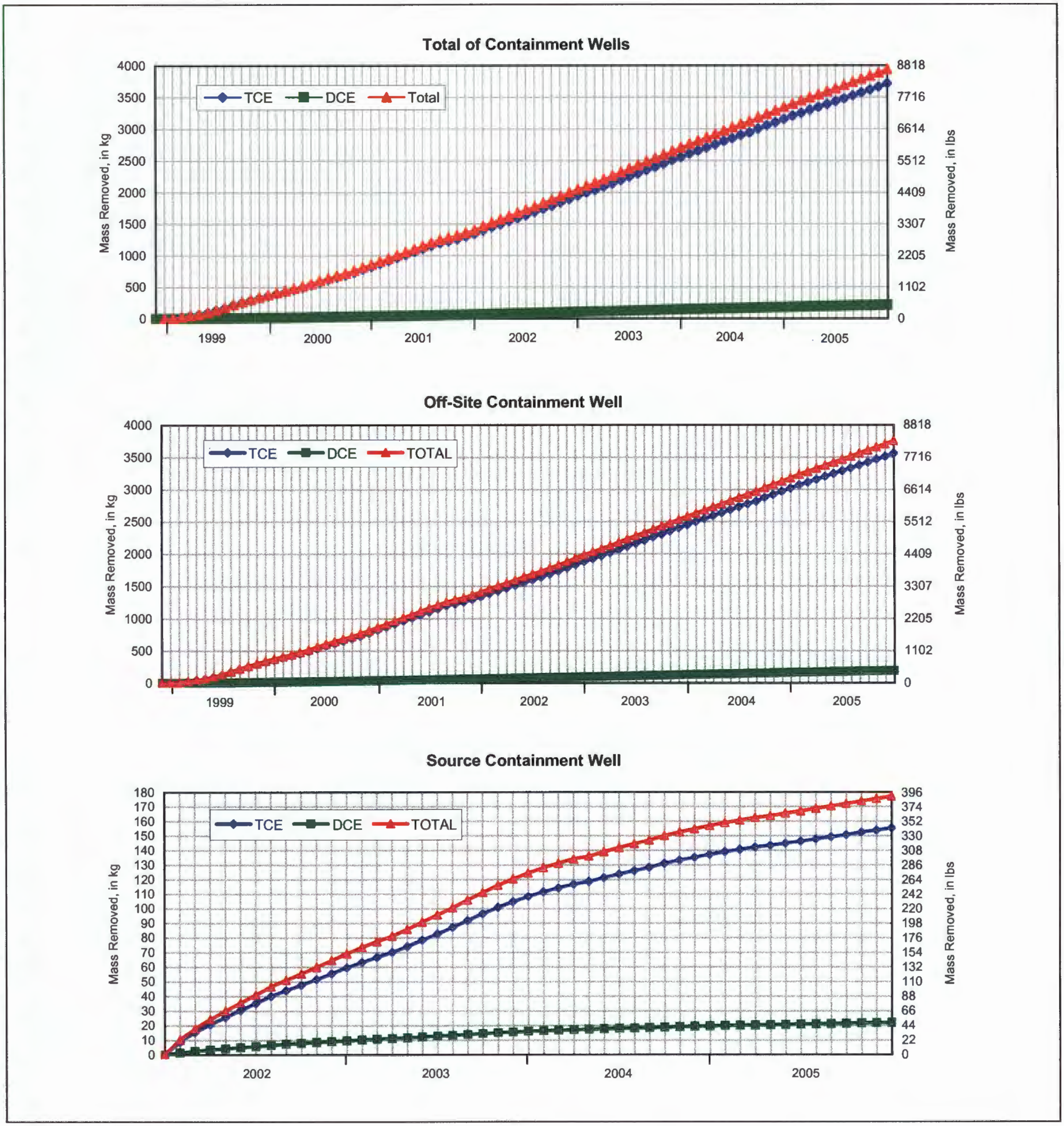


Figure 5.25 Cumulative Containment Mass Removal by the Source and Off-Site Containment Wells

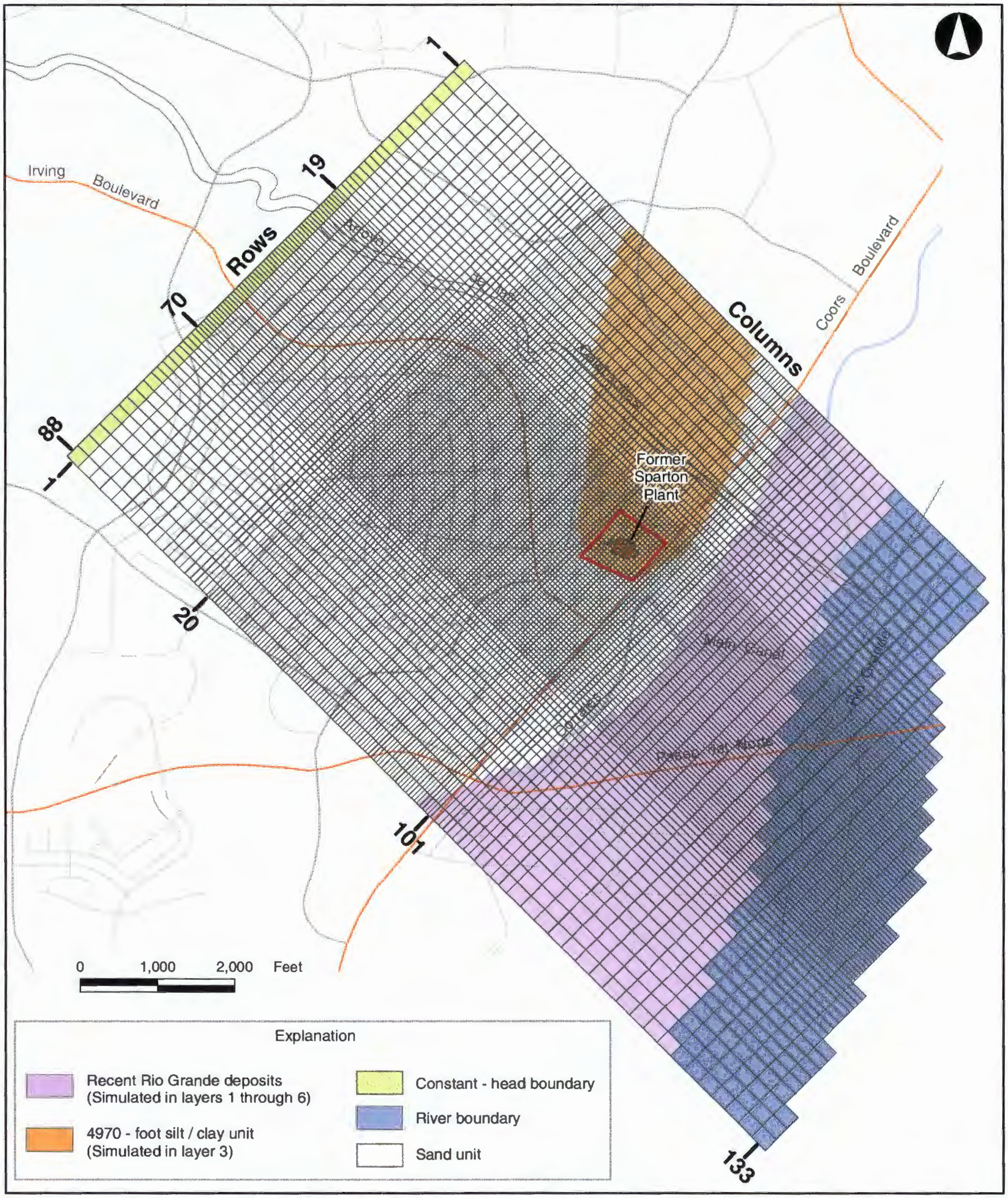


Figure 6.1 Model Grid, Hydraulic Property Zones and Boundary Conditions

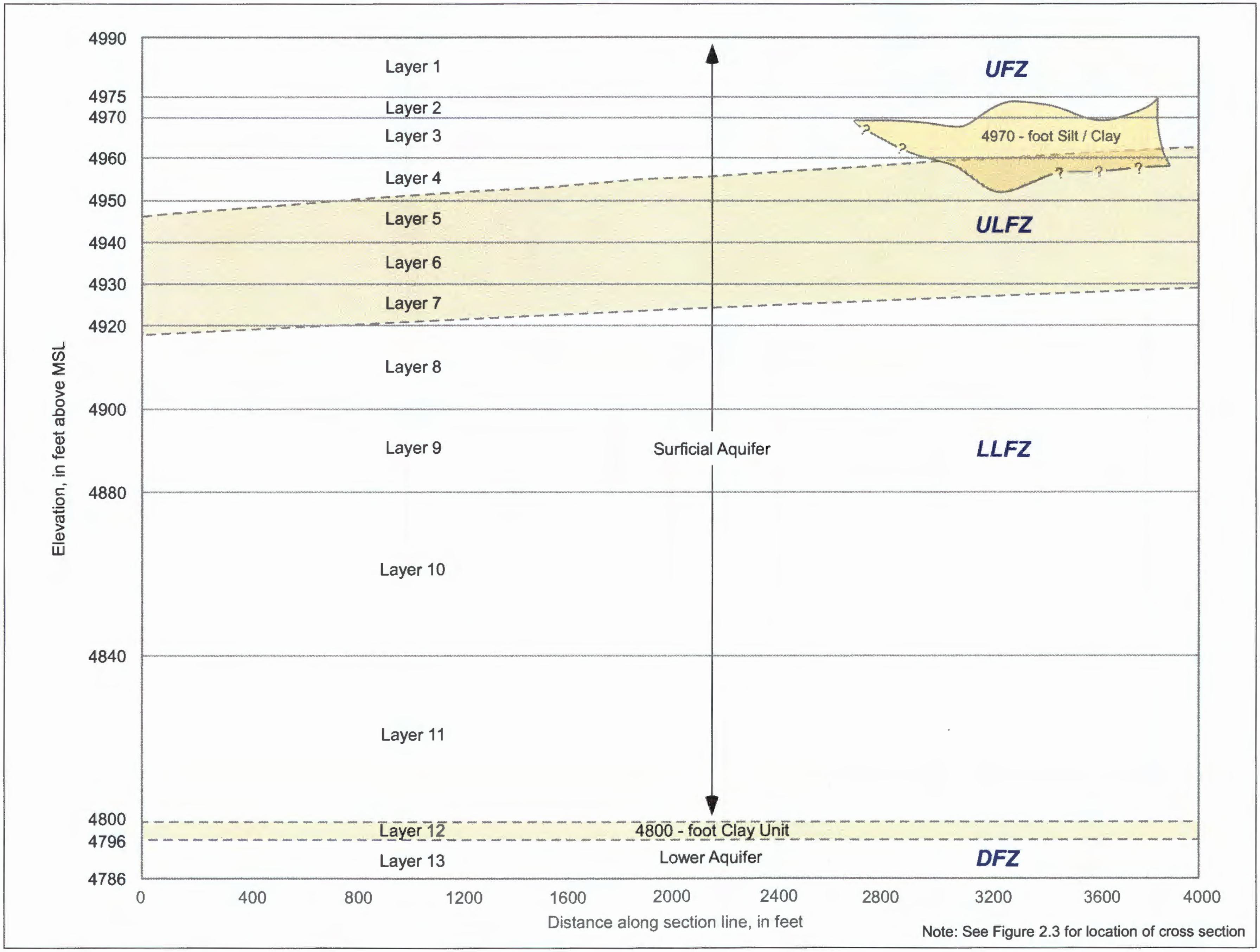


Figure 6.2 Model Layers

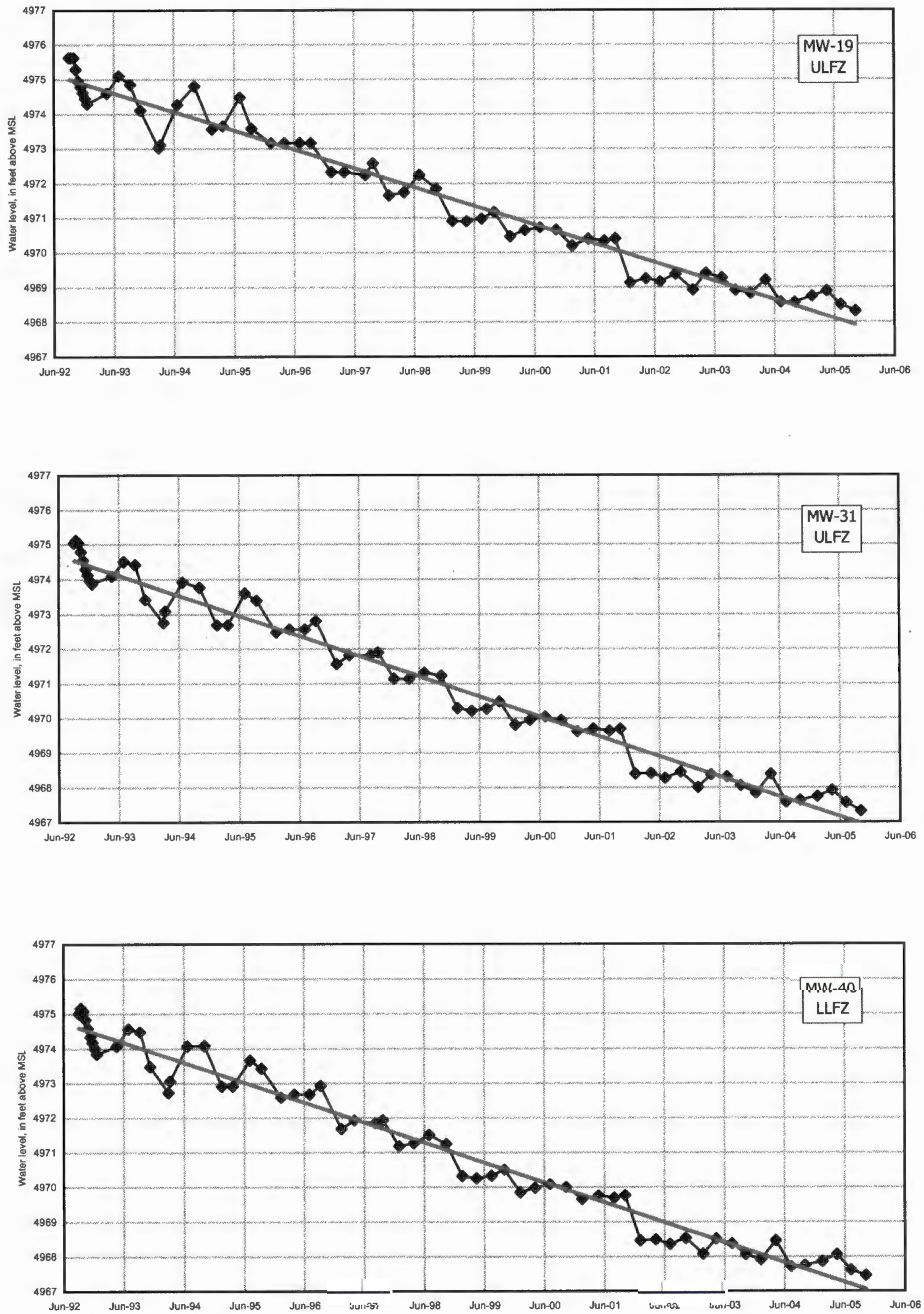
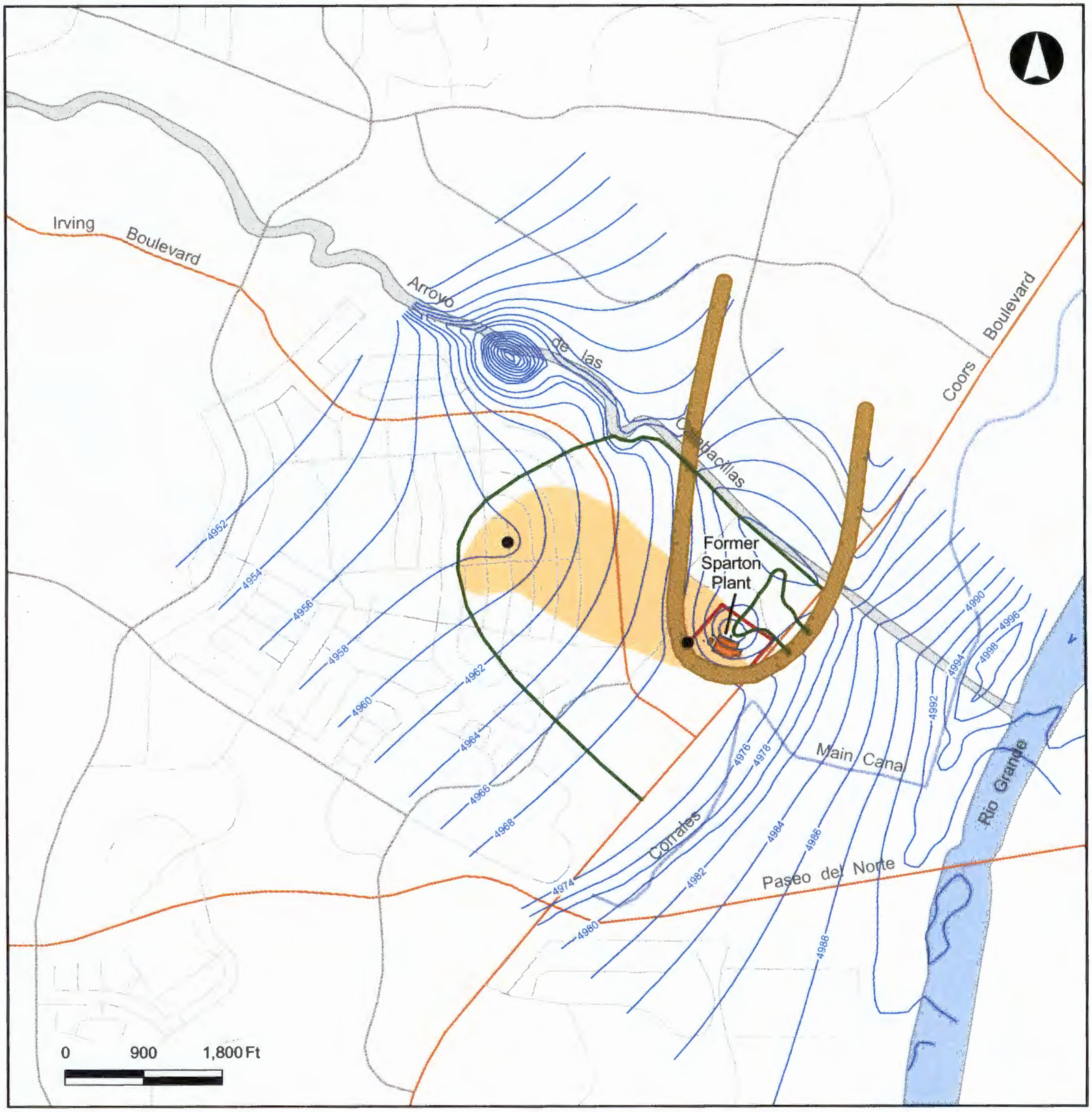


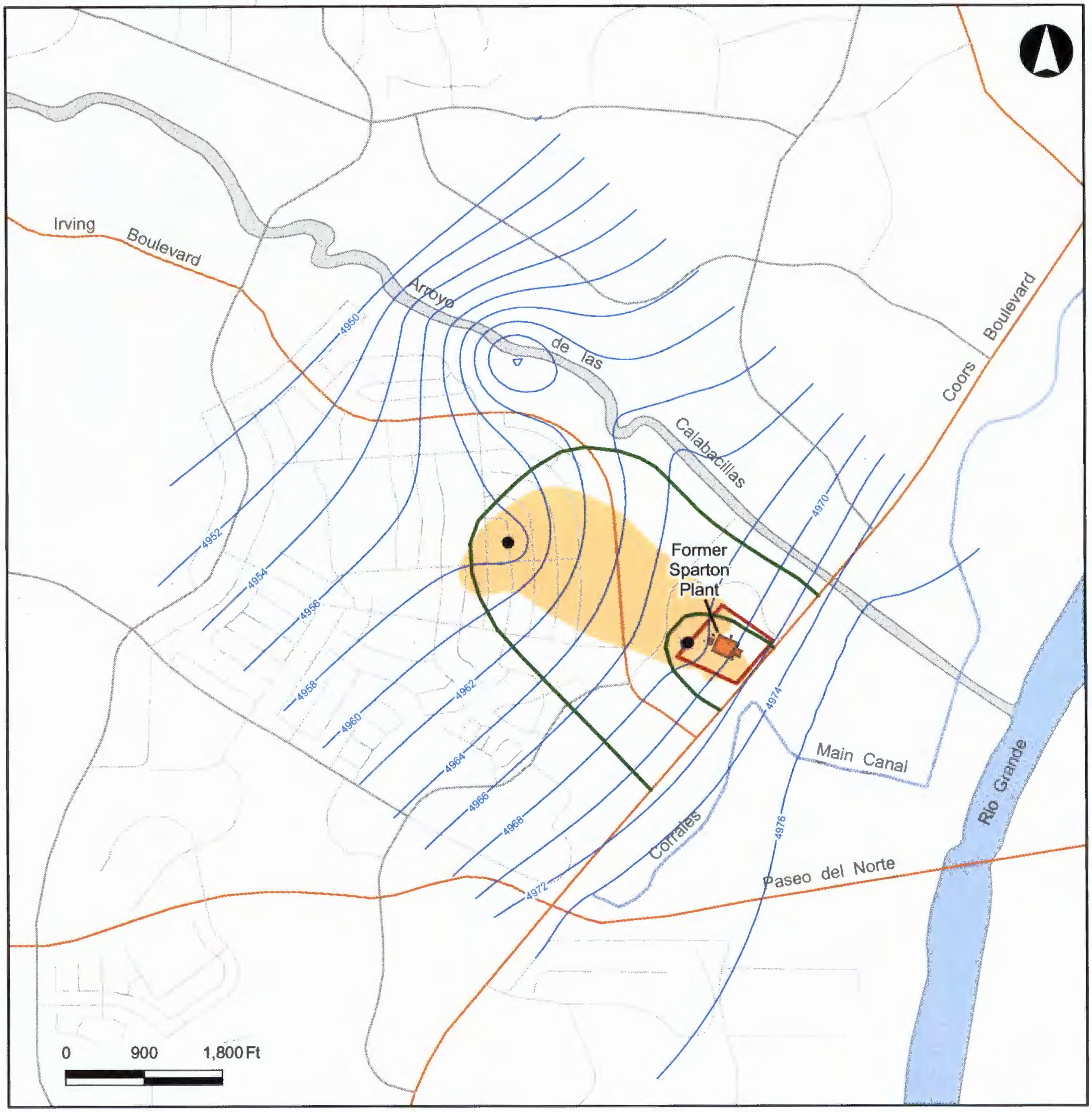
Figure 6.3 Regional Water Level Trends



Explanation

- ● Containment Well
- —4968— Line of equal water-level elevation, in feet above MSL
- Limit of the capture zones
- Approximate extent of 4970-foot silt/clay unit
- Horizontal extent of TCE plume, November 2004

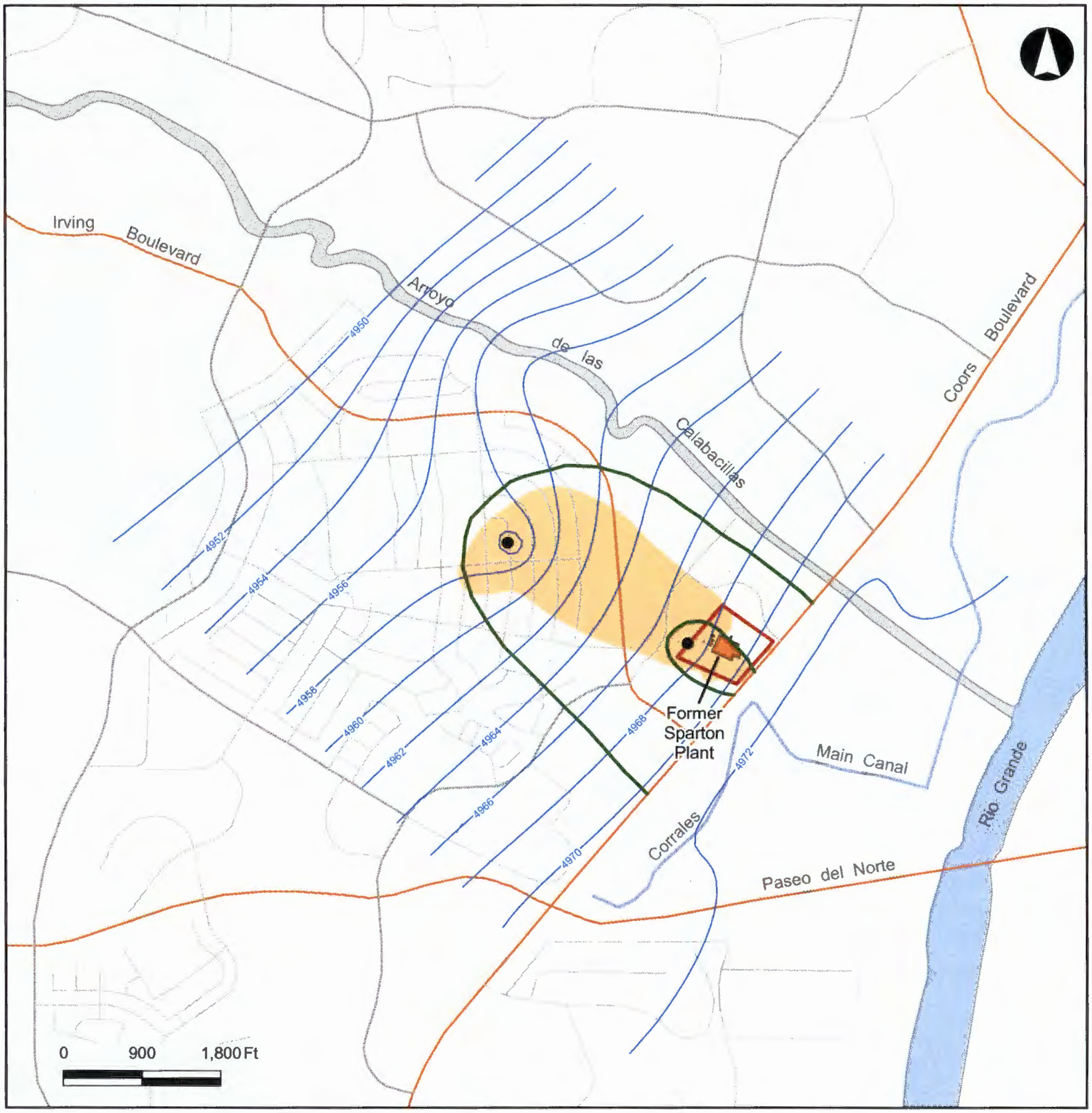
Figure 6.4 Calculated Water Table (UFZ) and Comparison of the Calculated Capture Zone to the TCE Plume Extent



Explanation

- ● Containment Well
- —4968— Line of equal water-level elevation, in feet above MSL
- Limit of the capture zones
- Horizontal extent of TCE plume, November 2004

Figure 6.5 Calculated Water Levels in the ULFZ and Comparison of the Calculated Capture Zone to the TCE Plume Extent



Explanation

- Containment Well
- 4968 — Line of equal water-level elevation, in feet above MSL
- Limit of the capture zones
- Horizontal extent of TCE plume, November 2004

Figure 6.6 Calculated Water Levels in the LLFZ and Comparison of the Calculated Capture Zone to the TCE Plume Extent

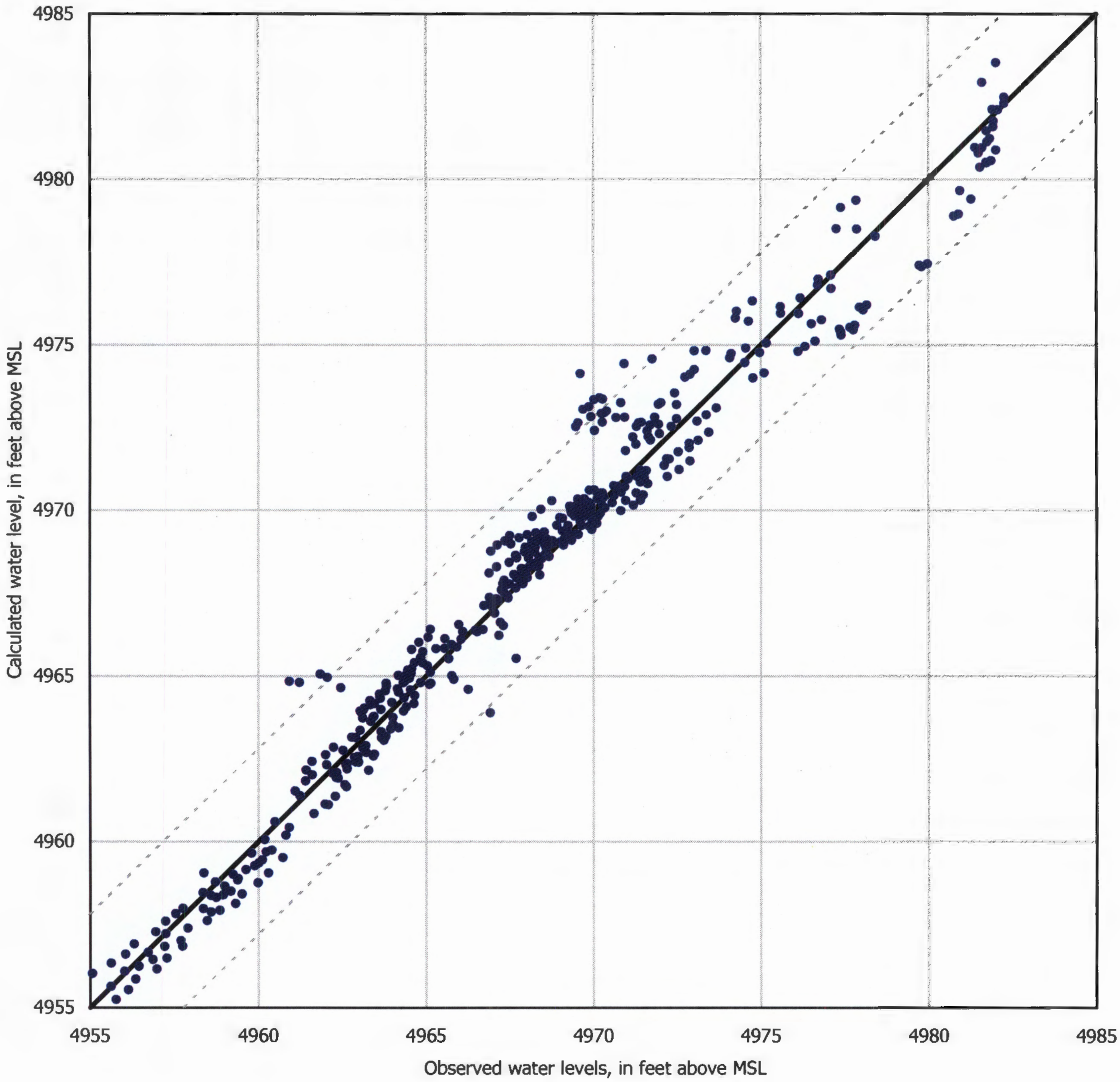


Figure 6.7 Comparison of Calculated to Observed Water Levels - November 1998 to November 2005

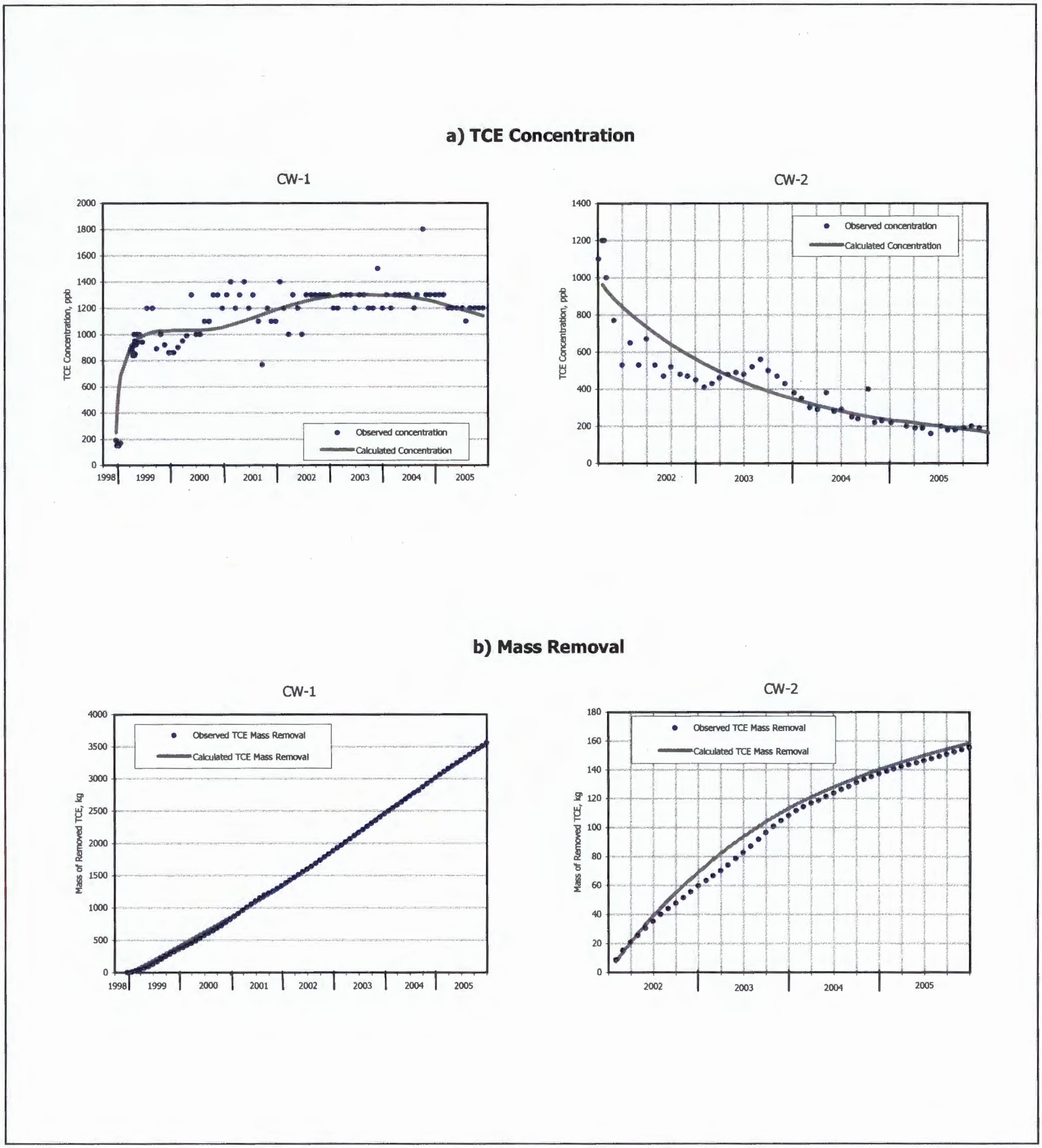


Figure 6.8 Comparisons of Calculated to Observed TCE Concentrations and Mass Removal

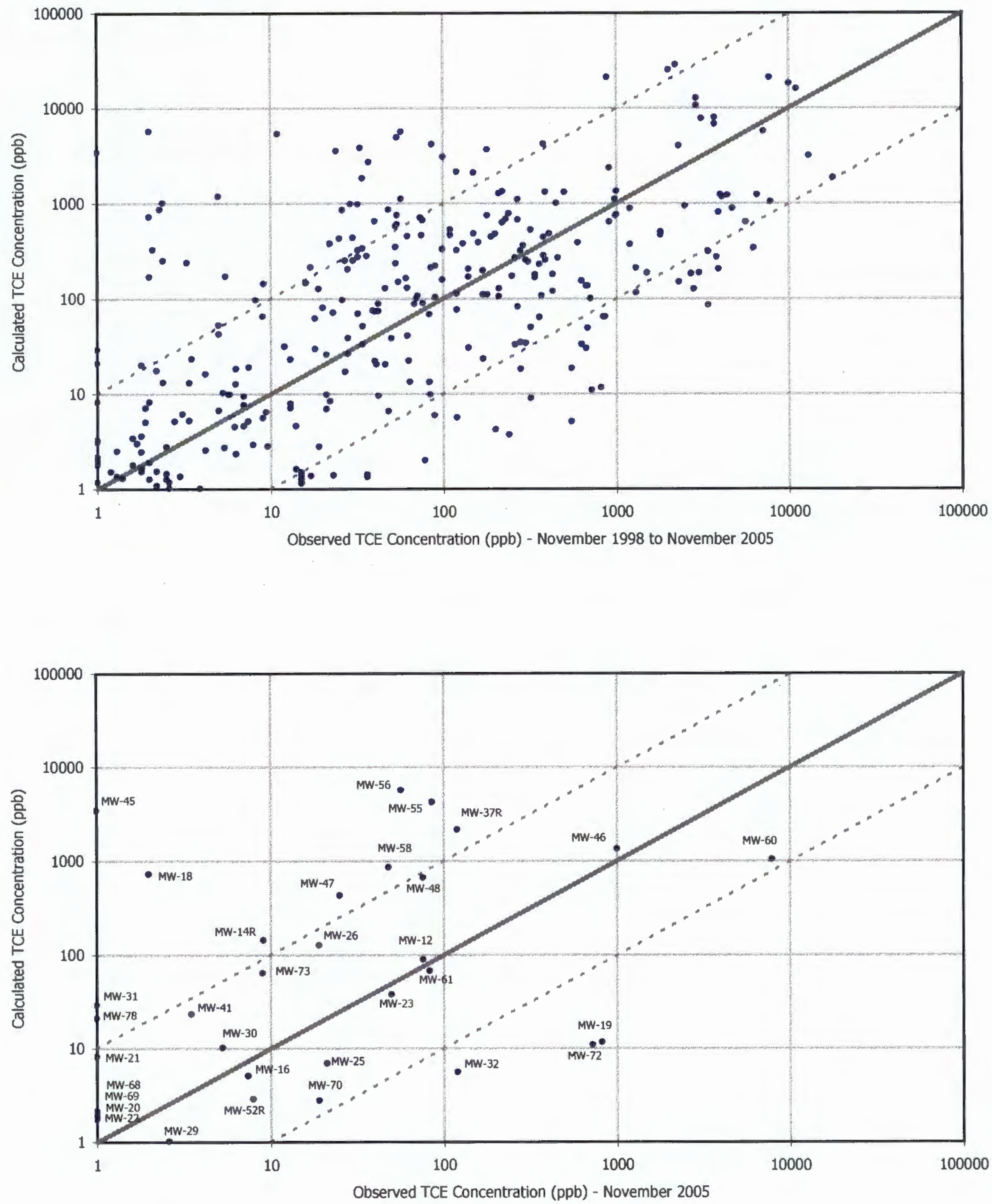


Figure 6.9 Comparisons of Calculated to Observed TCE Concentrations

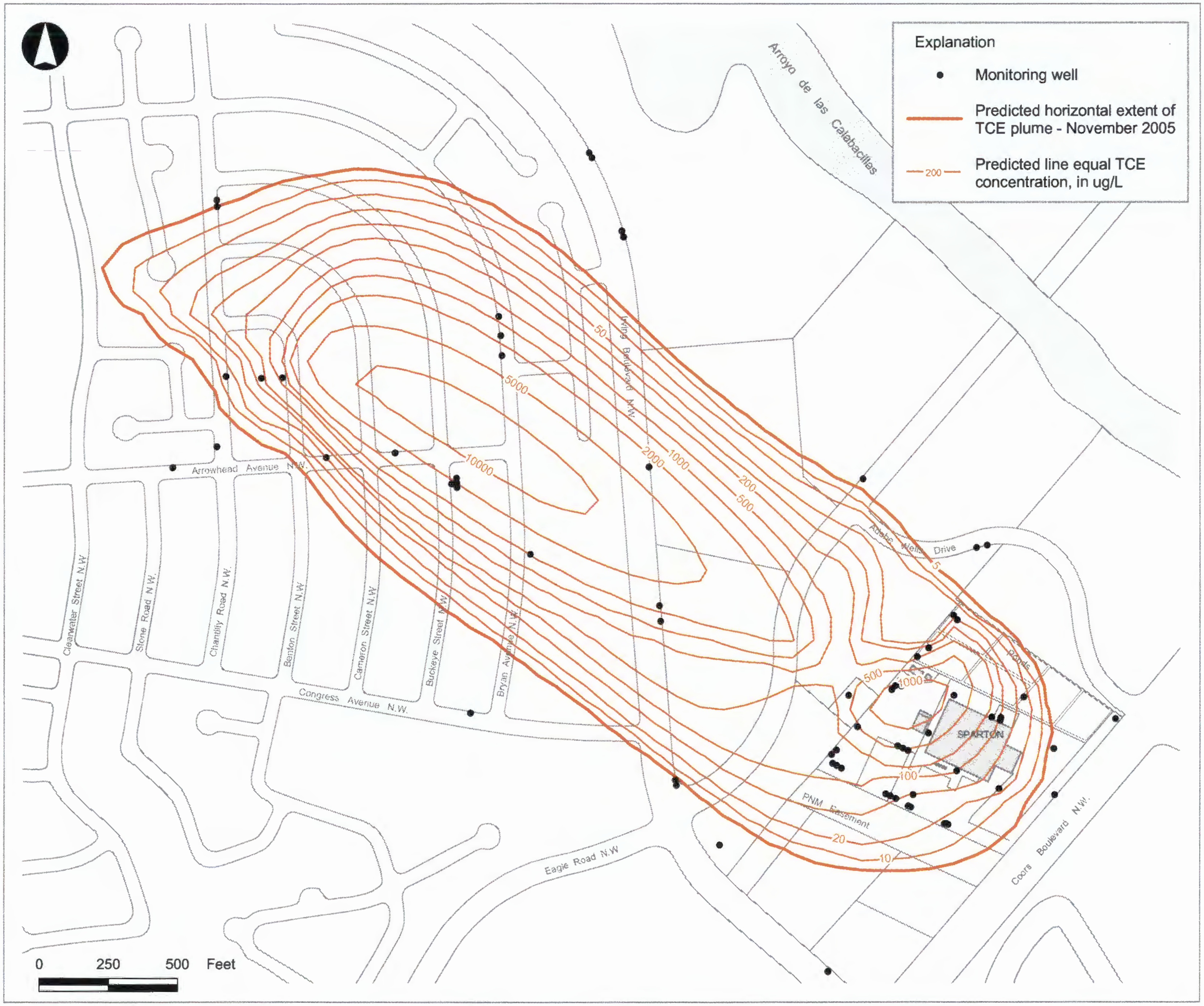


Figure 6.10 Predicted Extent of TCE Plume - November 2006

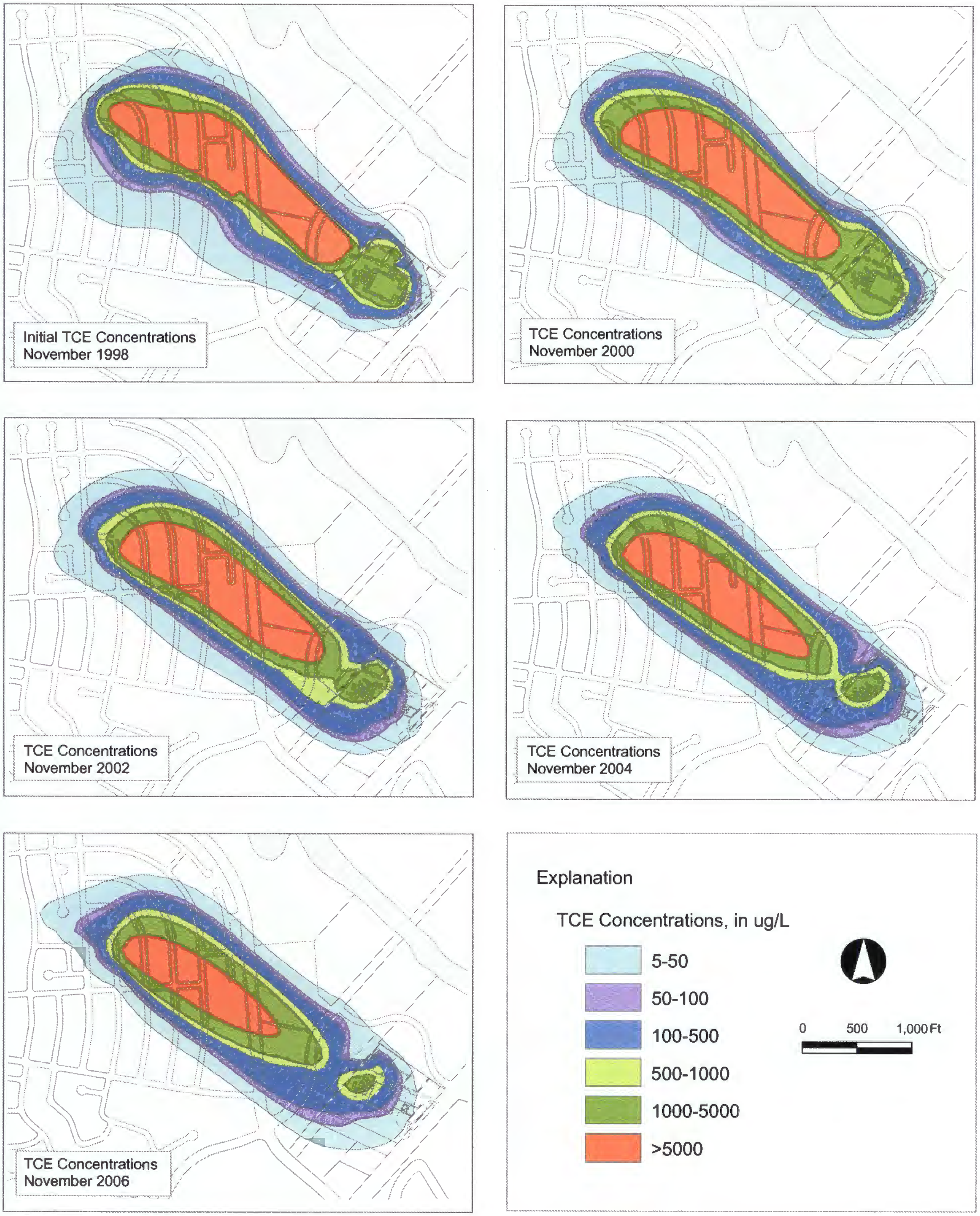


Figure 6.11 TCE Concentrations Calculated with the Recalibrated Model

TABLES

Table 2.1

Completion Flow Zone, Location Coordinates, and Measuring Point Elevation of Wells

Well ID	Flow Zone[a]	Easting[b]	Northing[b]	Elevation[c]
CW-1	UFZ&LFZ	374740.43	1525601.48	5168.02
CW-2	UFZ-LLFZ	376788.70	1524459.40	5045.61
OB-1	UFZ&LFZ	374665.16	1525599.52	5169.10
OB-2	UFZ&LFZ	374537.98	1525606.65	5165.22
PW-1	UFZ	377014.89	1524058.48	5042.30
PZ-1	UFZ	372283.60	1523143.31	5141.79
MW-7	UFZ	377535.41	1524101.14	5043.48
MW-9	UFZ	377005.75	1524062.25	5042.46
MW-12	UFZ	377023.27	1524102.56	5042.41
MW-13	UFZ	377137.23	1523998.34	5041.98
MW-14R	UFZ/ULFZ	376727.10	1524246.40	5040.92
MW-15	UFZ	376976.13	1524514.13	5047.63
MW-16	UFZ	377340.57	1524378.38	5047.50
MW-17	UFZ	377423.18	1524452.68	5049.28
MW-18	UFZ	377005.22	1524260.58	5043.38
MW-19	ULFZ	376986.52	1524269.27	5043.30
MW-20	LLFZ	376967.98	1524277.98	5043.20
MW-21	UFZ	377171.22	1524458.71	5045.78
MW-22	UFZ	377531.77	1524267.24	5044.73
MW-23	UFZ	377333.63	1524123.03	5045.74
MW-24	UFZ	377338.05	1524367.39	5048.70
MW-25	UFZ	377307.91	1524380.40	5046.17
MW-26	UFZ	377180.89	1524187.40	5045.37
MW-27	UFZ	377078.91	1524323.46	5046.04
MW-28	UFZ	376745.76	1524262.70	5041.31
MW-29	ULFZ	377144.48	1523998.74	5041.88
MW-30	ULFZ	376924.12	1524105.15	5042.12
MW-31	ULFZ	376731.49	1524215.04	5041.38
MW-32	LLFZ	376958.37	1524494.18	5045.29
MW-33	UFZ	376940.80	1524097.74	5042.20
MW-34	UFZ	376715.25	1523469.17	5034.33[d]
MW-35	UFZ	376322.45	1523922.39	5042.33[d]
MW-36	UFZ	376161.85	1524154.66	5059.34[d]
MW-37R	UFZ/ULFZ	376104.50	1524782.90	5093.15[d]
MW-38	LLFZ	377150.52	1523995.17	5041.70
MW-39	LLFZ	376961.13	1524088.17	5042.30
MW-40	LLFZ	376745.33	1524207.40	5041.44
MW-41	ULFZ	376945.67	1524479.28	5044.56
MW-42	ULFZ	377183.28	1524730.69	5057.33
MW-43	LLFZ	377169.66	1524747.27	5057.74
MW-44	ULFZ	376166.14	1524136.09	5058.63[d]
MW-45	ULFZ	376108.80	1524726.75	5089.50[d]
MW-46	ULFZ	376067.09	1525279.84	5118.86[d]
MW-47	UFZ	375638.14	1524967.74	5121.16
MW-48	UFZ	375369.75	1525239.86	5143.44
MW-49	3rd FZ	376763.40	1524197.32	5041.44
MW-50	UFZ	372810.17	1527180.09	5211.51
MW-51	UFZ	377291.45	1525000.02	5060.34
MW-52R	UFZ/ULFZ	374504.50	1525353.60	5156.37
MW-53	UFZ	374899.50	1525314.41	5148.62
MW-54	UFZ	375974.55	1526106.27	5097.69[d]
MW-55	LLFZ	375370.70	1525224.15	5143.45
MW-56	ULFZ	375371.31	1525207.68	5141.45
MW-57	UFZ	375849.02	1526406.98	5103.62[d]
MW-58	UFZ	375148.43	1525330.73	5146.40
MW-59	ULFZ	377253.38	1524991.51	5060.65
MW-60	ULFZ	375530.19	1525753.61	5134.40
MW-61	UFZ	375523.16	1525821.65	5134.74
MW-62	UFZ	375421.24	1524395.94	5073.69
MW-63	UFZ	376840.50	1525236.52	5063.10
MW-64	ULFZ	375968.81	1526127.81	5097.84
MW-65	LLFZ	374343.87	1525277.92	5156.45
MW-66	LLFZ	375859.24	1526389.09	5103.19[d]
MW-67	DFZ	375352.47	1525220.38	5142.21
MW-68	UFZ	374503.81	1526216.71	5168.54
MW-69	LLFZ	374502.80	1526239.55	5167.79
MW-70	3rd FZ	376981.33	1524492.75	5046.74
MW-71R	DFZ	375534.49	1525681.93	5134.12
MW-72	ULFZ	377079.68	1524630.73	5056.25
MW-73	ULFZ	376821.45	1524346.08	5051.08
MW-74	UFZ/ULFZ	374484.30	1527810.76	5094.80
MW-75	UFZ/ULFZ	374613.33	1528009.97	5113.74
MW-76	UFZ/ULFZ	375150.41	1527826.10	5108.32
MW-77	UFZ/ULFZ	377754.90	1524374.20	5045.64
MW-78	UFZ/ULFZ	377038.50	1524599.30	5052.91
PZG-1	Infilt. Gall.	374871.44	1527608.15	5090.90
Canal				4996.07

[a] UFZ denotes the Upper Flow Zone; ULFZ, LLFZ, and 3rdFZ denote the upper, lower, and deeper intervals of the Lower Flow Zone (LFZ); DFZ denotes a deeper flow zone separated from the Lower Flow Zone by a continuous clay layer that causes significant head differences between LFZ and DFZ.

[b] New Mexico "Modified State Plane" coordinates, in feet.

[c] In feet above mean sea level (MSL).

[d] Elevation effective February 1, 2005.

Table 2.2

Well Screen Data

Well ID	Flow Zone	Elevation (ft above MSL)			Depth below Ground (ft)		Screen Length (ft)
		Ground Surface	Top of Screen	Bottom of Screen	Top of Screen	Bottom of Screen	
CW-1	UFZ&LFZ	5166.4	4957.5	4797.5	208.9	368.9	160.0
CW-2	UFZ-LLFZ	5048.5	4968.5	4918.5	80.0	130.0	50.0
OB-1	UFZ&LFZ	5166.2	4960.3	4789.8	205.9	376.4	170.5
OB-2	UFZ&LFZ	5164.8	4960.3	4789.7	204.5	375.1	170.6
PW-1	UFZ	5042.2	4982.9	4972.9	59.3	69.3	10.0
PZ-1	UFZ	5141.3	4961.5	4951.3	179.8	190.0	10.2
MW-7	UFZ	5043.0	4979.7	4974.7	63.3	68.3	5.0
MW-9	UFZ	5042.4	4975.8	4970.8	66.6	71.6	5.0
MW-12	UFZ	5042.3	4978.2	4966.2	64.1	76.1	12.0
MW-13	UFZ	5041.9	4981.5	4971.6	60.4	70.3	9.9
MW-14R	UFZ/ULFZ	5040.8	4980.5	4950.5	60.3	90.3	30.0
MW-15	UFZ	5047.2	4986.1	4974.4	61.1	72.8	11.7
MW-16	UFZ	5046.2	4979.7	4974.7	66.5	71.5	5.0
MW-17	UFZ	5047.5	4982.3	4977.3	65.2	70.2	5.0
MW-18	UFZ	5042.9	4976.0	4966.0	66.9	76.9	10.0
MW-19	ULFZ	5042.9	4944.8	4934.8	98.1	108.1	10.0
MW-20	LLFZ	5042.8	4919.2	4906.8	123.6	136.0	12.4
MW-21	UFZ	5045.7	4982.8	4977.8	62.9	67.9	5.0
MW-22	UFZ	5044.6	4977.2	4972.2	67.4	72.4	5.0
MW-23	UFZ	5045.6	4973.8	4968.8	71.8	76.8	5.0
MW-24	UFZ	5046.2	4977.5	4972.5	68.7	73.7	5.0
MW-25	UFZ	5046.1	4977.9	4972.9	68.2	73.2	5.0
MW-26	UFZ	5045.4	4969.1	4964.1	76.3	81.3	5.0
MW-27	UFZ	5045.8	4975.4	4970.4	70.4	75.4	5.0
MW-28	UFZ	5040.9	4975.8	4970.8	65.1	70.1	5.0
MW-29	ULFZ	5041.9	4938.3	4928.3	103.6	113.6	10.0
MW-30	ULFZ	5041.7	4944.8	4934.8	96.9	106.9	10.0
MW-31	ULFZ	5040.9	4945.2	4935.2	95.7	105.7	10.0
MW-32	LLFZ	5044.8	4937.3	4927.3	107.5	117.5	10.0
MW-33	UFZ	5042.1	4980.1	4969.1	62.0	73.0	11.0
MW-34	UFZ	5034.4	4978.0	4968.0	56.4	66.4	10.0
MW-35	UFZ	5042.1	4979.3	4969.3	62.8	72.8	10.0
MW-36	UFZ	5059.5	4976.9	4966.9	82.6	92.6	10.0
MW-37R	UFZ/ULFZ	5093.0	4976.6	4946.6	116.4	146.4	30.0
MW-38	LLFZ	5041.6	4915.0	4905.0	126.6	136.6	10.0
MW-39	LLFZ	5042.2	4918.7	4908.7	123.5	133.5	10.0
MW-40	LLFZ	5040.0	4923.9	4913.9	116.1	126.1	10.0

Table 2.2

Well Screen Data

Well ID	Flow Zone	Elevation (ft above MSL)			Depth below Ground (ft)		Screen Length (ft)
		Ground Surface	Top of Screen	Bottom of Screen	Top of Screen	Bottom of Screen	
MW-41	ULFZ	5044.1	4952.1	4942.1	92.0	102.0	10.0
MW-42	ULFZ	5054.8	4949.3	4939.3	105.5	115.5	10.0
MW-43	LLFZ	5055.2	4927.7	4917.7	127.5	137.5	10.0
MW-44	ULFZ	5058.8	4952.4	4942.4	106.4	116.4	10.0
MW-45	ULFZ	5090.1	4948.5	4938.5	141.6	151.6	10.0
MW-46	ULFZ	5118.5	4949.4	4939.4	169.1	179.1	10.0
MW-47	UFZ	5120.7	4976.4	4961.4	144.3	159.3	15.0
MW-48	UFZ	5143.0	4976.9	4961.9	166.1	181.1	15.0
MW-49	3rd FZ	5041.0	4903.2	4893.2	137.8	147.8	10.0
MW-50	UFZ	5211.5	4976.5	4961.5	235.0	250.0	15.0
MW-51	UFZ	5059.9	4984.5	4974.5	75.4	85.4	10.0
MW-52R	UFZ/ULFZ	5156.2	4968.5	4938.5	187.0	217.0	30.0
MW-53	UFZ	5148.6	4974.4	4960.4	174.2	188.2	14.0
MW-54	UFZ	5097.2	4976.8	4961.8	120.4	135.4	15.0
MW-55	LLFZ	5143.1	4913.1	4903.1	230.0	240.0	10.0
MW-56	ULFZ	5141.0	4942.9	4932.9	198.1	208.1	10.0
MW-57	UFZ	5103.1	4978.0	4963.0	125.1	140.1	15.0
MW-58	UFZ	5146.4	4975.4	4960.4	171.0	186.0	15.0
MW-59	ULFZ	5060.2	4954.9	4944.4	105.3	115.8	10.5
MW-60	ULFZ	5134.4	4949.5	4939.5	184.9	194.9	10.0
MW-61	UFZ	5134.8	4976.2	4961.2	158.6	173.6	15.0
MW-62	UFZ	5073.7	4980.8	4965.8	92.9	107.9	15.0
MW-63	UFZ	5063.1	4983.1	4968.1	80.0	95.0	15.0
MW-64	ULFZ	5097.4	4959.3	4949.1	138.1	148.3	10.2
MW-65	LLFZ	5156.5	4896.4	4886.4	260.1	270.1	10.0
MW-66	LLFZ	5102.6	4903.3	4893.3	199.3	209.3	10.0
MW-67	DFZ	5142.2	4798.1	4788.1	344.1	354.1	10.0
MW-68	UFZ	5168.5	4970.5	4950.5	198.0	218.0	20.0
MW-69	LLFZ	5167.8	4904.7	4894.7	263.1	273.1	10.0
MW-70	3rd FZ	5046.3	4912.1	4902.1	134.2	144.2	10.0
MW-71R	DFZ	5134.2	4761.5	4756.5	372.7	377.7	5.0
MW-72	ULFZ	5053.7	4955.0	4945.0	98.7	108.7	10.0
MW-73	ULFZ	5050.6	4945.5	4940.5	105.1	110.1	5.0
MW-74	UFZ/ULFZ	5092.4	4969.2	4939.2	123.2	153.2	30.0
MW-75	UFZ/ULFZ	5111.6	4971.2	4941.2	140.4	170.4	30.0
MW-76	UFZ/ULFZ	5105.5	4972.4	4942.4	133.1	163.1	30.0
MW-77	UFZ/ULFZ	5045.5	4985.9	4955.9	59.6	89.6	30.0
MW-78	UFZ/ULFZ	5050.5	4988.1	4958.1	62.4	92.4	30.0

Table 2.3

Production History of the Former On-Site Groundwater Recovery System

Year	Volume of Recovered Water (gal)	Average Discharge Rate (gpm)
1988[a]	25,689	1.05
1989	737,142	1.40
1990	659,469	1.25
1991	556,300	1.06
1992	440,424	0.84
1993	379,519	0.72
1994	370,954	0.71
1995	399,716	0.76
1996	306,688	0.58
1997	170,900	0.33
1998	232,347	0.44
1999[b]	137,403	0.26
Total Recovered Volume (gal)	**4,416,550**	
Average Discharge Rate (gpm)		**0.77**

[a] System began operating on December 15, 1988.

[b] System was terminated on November 16, 1999.

Table 2.4

Water-Level Elevations - Fourth Quarter 1998[a]

Well ID	Flow Zone	Elevation (ft above MSL)
PW-1	UFZ	4973.59
PZ-1	UFZ	4956.59
MW-7	UFZ O/S [b]	4977.42
MW-9	UFZ O/S	4973.06
MW-12	UFZ O/S	4972.82
MW-13	UFZ O/S	4974.35
MW-14	UFZ	4971.12
MW-15	UFZ	Dry
MW-16	UFZ O/S	4978.43
MW-17	UFZ O/S	4978.70
MW-18	UFZ O/S	4971.87
MW-19	ULFZ	4971.85
MW-20	LLFZ	4971.47
MW-21	UFZ O/S	4978.31
MW-22	UFZ O/S	4977.89
MW-23	UFZ O/S	4975.91
MW-24	UFZ O/S	4978.23
MW-25	UFZ O/S	4978.31
MW-26	UFZ O/S	4973.44
MW-27	UFZ O/S	4974.05
MW-28	UFZ O/S	4971.09
MW-29	ULFZ	4973.68
MW-30	ULFZ	4972.28
MW-31	ULFZ	4971.23
MW-32	ULFZ [c]	4970.96
MW-33	UFZ O/S	4972.54
MW-34	UFZ	4974.51
MW-35	UFZ	4970.78
MW-36	UFZ	4970.03
MW-37	UFZ	4968.32
MW-38	LLFZ	4973.70
MW-39	LLFZ	4972.49

Well	Flow Zone	Elevation (ft above MSL)
MW-40	LLFZ	4971.25
MW-41	ULFZ	4971.09
MW-42	ULFZ	4970.65
MW-43	LLFZ	4970.45
MW-44	ULFZ	4970.11
MW-45	ULFZ	4968.33
MW-46	ULFZ	4966.95
MW-47	UFZ	4966.68
MW-48	UFZ	4965.81
MW-49	LLFZ [c]	4971.03
MW-50	UFZ	Dry
MW-51	UFZ O/S	4980.09
MW-52	UFZ	4963.17
MW-53	UFZ	4964.92
MW-54	UFZ	4965.56
MW-55	LLFZ	4965.13
MW-56	ULFZ	4965.76
MW-57	UFZ	4964.87
MW-58	UFZ	4965.43
MW-59	ULFZ	4969.46
MW-60	ULFZ	4965.33
MW-61	UFZ	4965.37
MW-62	UFZ	4967.52
MW-63	UFZ O/S	4970.98
MW-64	ULFZ	4965.41
MW-65	LLFZ	4963.05
MW-66	LLFZ	4963.98
MW-67	DFZ	4958.56
MW-68	UFZ	4962.25
MW-69	LLFZ	4962.13
MW-70	LLFZ [d]	4970.18
MW-71	DFZ	4958.51

[a] Water levels were measured on November 10, 1998, except for wells PW-1, MW-18, and MW-23 through MW-28 which were measured on November 25, 1998.

[b] UFZ O/S denotes UFZ wells, mostly on-site, which are screened above or within the 4970-foot silt/clay.

[c] Previously classified as LLFZ.

[d] Previously classified as 3rdFZ.

Table 2.5

Water-Quality Data - Fourth Quarter 1998[a]

Well ID	Sampling Date	Concentration (µg/L)		
		TCE	DCE	TCA
CW-1	09/01/98	140	2.9	<20
OB-1	09/01/98	180	3.6	<20
OB-2	09/01/98	72	1.7	<20
PW-1	12/04/98	48	1.0	2.2
MW-7	12/01/98	63	15	12
MW-9	12/03/98	290	19	18
MW-12	12/07/98	380	26	18
MW-13	12/01/98	70	3.2	8.0
MW-14	12/01/98	430	24	4.2
MW-16	12/08/98	1200	30	170
MW-17	12/01/98	68	3.5	13
MW-18	12/02/98	600	50	42
MW-19	11/23/98	4.2	<1.0	<1.0
MW-20	11/23/98	<1.0	<1.0	<1.0
MW-21	12/02/98	7.5	<1.0	1.1
MW-22	11/19/98	13	2.0	4.6
MW-23	12/03/98	6200	400	720
MW-24	12/08/98	4700	74	480
MW-25	12/08/98	5600	73	540
MW-26	12/03/98	6500	590	550
MW-27	12/02/98	380	24	90
MW-29	11/19/98	<1.0	<1.0	<1.0
MW-30	11/23/98	5.4	<1.0	<1.0
MW-31	11/23/98	<1.0	<1.0	<1.0
MW-32	11/30/98	550	96	30
MW-33	12/02/98	630	53	28
MW-34	11/18/98	<1.0	<1.0	<1.0
MW-35	12/08/98	<1.0	<1.0	<1.0
MW-36	12/07/98	1.4	<1.0	<1.0
MW-37	12/03/98	990	48	<5
MW-38	11/19/98	<1.0	<1.0	<1.0
MW-39	11/23/98	<1.0	<1.0	<1.0
MW-40	11/30/98	<1.0	<1.0	<1.0

Well ID	Sampling Date	Concentration (µg/L)		
		TCE	DCE	TCA
MW-41	11/19/98	170	26	<15
MW-42	11/19/98	370	48	21
MW-43	11/19/98	25	5.1	5.4
MW-44	11/18/98	1.3	<1.0	<1.0
MW-45	11/18/98	40	1.7	<1.0
MW-46	11/19/98	2200	130	2.3
MW-47	11/17/98	34	1.2	<1.0
MW-48	11/17/98	28	1.0	<1.0
MW-49	11/23/98	<1.0	<1.0	<1.0
MW-51	11/18/98	<1.0	<1.0	<1.0
MW-52	11/30/98	<1.0	<1.0	<1.0
MW-53	11/16/98	99	3.4	<1.0
MW-55	11/16/98	390	10	<1.0
MW-56	11/16/98	140	4.7	<1.0
MW-57	12/08/98	<1.0	<1.0	<1.0
MW-58	11/16/98	71	2.5	<1.0
MW-59	11/18/98	<1.0	<1.0	<1.0
MW-60	11/17/98	7700	350	52
MW-61	12/07/98	1000	54	11
MW-62	12/07/98	2.0	6.6	4.8
MW-63	12/02/98	<1.0	<1.0	<1.0
MW-64	11/17/98	<1.0	<1.0	<1.0
MW-65	11/16/98	13	<1.0	<1.0
MW-66	11/17/98	<1.0	<1.0	<1.0
MW-67	11/17/98	<1.0	<1.0	<1.0
MW-68	11/12/98	<1.0	<1.0	<1.0
MW-69	11/12/98	<1.0	<1.0	<1.0
MW-70	11/23/98	<1.0	<1.0	<1.0
MW-71	11/17/98	56	1.6	<1.0
TW-1	02/18/98	3100	280	180
	02/18/98	3400	270	170
TW-2	02/19/98	18	<1.0	<1.0
	02/19/98	16	<1.0	<1.0

[a] Includes 2/18/98 data from temporary well TW-1/2 which was drilled at the current location of well MW-73, and 9/1/98 data from the containment well CW-1 and observation wells OB-1 and OB-2.

Note: Shaded cells indicate concentrations that exceed MCLs based on the more stringent of the drinking water standards or the maximum allowable concentrations in groundwater set by the NMWQCC (5 mg/L for TCE and DCE, and 60 mg/L for TCA).

Table 3.1

Downtime in the Operation of the Containment Systems - 2005

(a) Off-Site Containment System

Date of Downtime		Duration (hours)	Cause
From	To		
3-Jan	3-Jan	0.67	Low Level in Chemical Feed Tank
18-Apr	18-Apr	4.10	Power Failure
9-May	9-May	0.17	Routine Maintenance
31-May	31-May	1.32	Low Level in Chemical Feed Tank
23-Jun	23-Jun	1.62	Power Failure
26-Jul	26-Jul	2.37	Routine Maintenance
24-Sep	24-Sep	2.25	Power Failure
4-Oct	4-Oct	3.32	Power Failure
9-Oct	9-Oct	3.10	Power Failure
30-Oct	30-Oct	5.03	Power Failure
16-Nov	16-Nov	3.97	Power Failure
Total Downtime		**27.92**	

(b) Source Containment System

Date of Downtime		Duration (hours)	Cause
From	To		
18-Apr	19-Apr	16.32	Power Failure
24-Apr	24-Apr	4.25	Blower Starter
25-Apr	27-Apr	47.86	Blower Starter
13-Jun	13-Jun	1.08	Test Submersible Pump
29-Jun	29-Jun	10.35	Replace Submersible Pump
26-Jul	26-Jul	4.67	Routine Maintenance
15-Aug	16-Aug	21.55	High Stripper Sump Alarm/Phone Line
2-Sep	2-Sep	1.70	High Stripper Sump Alarm
16-Sep	16-Sep	0.50	Routine Maintenance
24-Sep	28-Sep	96.20	Power Failure/Monitoring System
4-Oct	4-Oct	3.17	Power Failure
9-Oct	9-Oct	3.27	Power Failure
30-Oct	30-Oct	4.70	Power Failure
20-Nov	22-Nov	63.37	Blower Motor Replacement
Total Downtime		**278.99**	

Table 4.1

Quarterly Water-Level Elevations - 2005

Well ID	Flow Zone	Elevation (feet above MSL)			
		Feb. 10	May 9	Aug. 3	Nov. 1
CW-1	UFZ&LFZ	4935.52	4935.70	4935.14	4934.90
CW-2	UFZ&LFZ	4957.18	4958.16	4956.76	4956.29
OB-1	UFZ&LFZ	4955.84	4955.98	4955.45	4955.21
OB-2	UFZ&LFZ	4957.03	4957.18	4956.77	4956.50
PW-1	UFZ	Dry	Dry	Dry	Dry
PZ-1	UFZ	4953.80	4954.05	4953.37	4952.82
MW-7	UFZ O/S	4975.61	4975.97	4975.58	4975.18
MW-9	UFZ O/S	4970.33	4970.55	4970.17	4969.96
MW-12	UFZ O/S	4969.80	4970.01	4969.60	4969.38
MW-13	UFZ O/S	4971.88	4972.14	4971.80	Dry
MW-14-R	UFZ/ULFZ	4967.68	4967.85	4967.42	4967.21
MW-16	UFZ O/S	4982.20	4981.93	4981.86	4981.79
MW-17	UFZ O/S	4981.80	4981.52	4981.59	4981.50
MW-18	UFZ O/S	4975.57	4973.96	4974.46	4972.46
MW-19	ULFZ	4968.74	4968.89	4968.50	4968.31
MW-20	LLFZ	4968.20	4968.36	4967.94	4967.76
MW-21	UFZ O/S	4983.33	4982.68	4982.54	4982.35
MW-22	UFZ O/S	4977.43	4977.69	4977.35	4977.07
MW-23	UFZ O/S	4974.18	4974.47	4974.25	4974.18
MW-24	UFZ O/S	4982.01	4981.70	4981.65	4981.59
MW-25	UFZ O/S	4982.19	4981.89	4981.77	4981.92
MW-26	UFZ O/S	4971.48	4971.50	4971.20	4971.00
MW-27	UFZ O/S	4981.35	4980.83	4980.76	4980.68
MW-29	ULFZ	4970.90	4971.10	4970.78	4970.56
MW-30	ULFZ	4969.19	4969.35	4969.02	4968.78
MW-31	ULFZ	4967.74	4967.92	4967.56	4967.32
MW-32	ULFZ	4967.69	4967.77	4967.34	4967.15
MW-33	UFZ O/S	4969.47	4969.71	4969.28	Dry
MW-34	UFZ	4971.24	4971.55	4971.37	4971.03
MW-37-R	UFZ/ULFZ	4964.77	4964.87	4964.42	4964.20
MW-38	LLFZ	4970.87	4971.14	4970.75	4970.54
MW-39	LLFZ	4969.50	4969.66	4969.24	4969.04
MW-40	LLFZ	4967.86	4968.06	4967.61	4967.45
MW-41	ULFZ	4968.09	4968.21	4967.75	4967.56
MW-42	ULFZ	4968.21	4968.28	4967.71	4967.68
MW-43	LLFZ	4967.96	4968.03	4967.44	4967.43

Note: Wells MW-35 and MW-36 are not listed because they were dry all year.

Well ID	Flow Zone	Elevation (feet above MSL)			
		Feb. 10	May 9	Aug. 3	Nov. 1
MW-44	ULFZ	4966.83	4967.02	4966.60	4966.46
MW-45	ULFZ	4965.01	4965.22	4964.77	4964.61
MW-46	ULFZ	4963.98	4964.07	4963.61	4963.45
MW-47	UFZ	4963.59	4963.69	4963.30	4963.08
MW-48	UFZ	4962.49	4962.59	4962.25	4962.00
MW-49	LLFZ	4967.89	4967.99	4967.61	4967.49
MW-51	UFZ O/S	4982.22	4982.03	4981.82	4982.01
MW-52R	UFZ/ULFZ	4958.51	4958.68	4958.28	4957.99
MW-53	UFZ	4960.72	4960.82	4960.67	4960.40
MW-54	UFZ	4963.37	4963.40	4962.97	4962.90
MW-55	LLFZ	4961.27	4961.46	4960.92	4960.75
MW-56	ULFZ	4962.50	4962.67	4962.29	4962.03
MW-57	UFZ	4963.22	4963.27	4962.83	Dry
MW-58	UFZ	4961.80	4961.84	4961.63	4961.35
MW-59	ULFZ	4967.26	4967.27	4966.58	4966.64
MW-60	ULFZ	4962.51	4962.53	4962.22	4961.99
MW-61	UFZ	4962.39	4962.43	4962.13	4961.88
MW-62	UFZ	4964.48	4964.55	4964.27	4964.09
MW-63	UFZ O/S	4974.82	4974.25	4972.05	4975.17
MW-64	ULFZ	4963.27	4963.37	4962.92	4962.70
MW-65	LLFZ	4958.51	4958.70	4958.29	4957.99
MW-66	LLFZ	4961.71	4961.77	4961.14	4961.07
MW-67	DFZ	4955.54	4955.69	4954.36	4954.67
MW-68	UFZ	4958.75	4958.88	4958.57	4958.18
MW-69	LLFZ	4958.65	4958.85	4958.39	4958.07
MW-70	LLFZ	4967.04	4967.21	4966.69	4966.60
MW-71R	DFZ	4955.62	4955.72	4955.30	4954.72
MW-72	ULFZ	4968.25	4968.31	4967.85	4967.71
MW-73	ULFZ	4967.07	4967.26	4966.86	4966.67
MW-74	UFZ/ULFZ	4961.23	4961.25	4960.74	4960.52
MW-75	UFZ/ULFZ	4965.40	4965.39	4964.95	4964.84
MW-76	UFZ/ULFZ	4967.05	4967.04	4966.40	4966.32
MW-77	UFZ/ULFZ	4976.71	4977.03	4976.65	4976.43
MW-78	UFZ/ULFZ	4974.90	4974.59	4974.41	4974.19
PZG-1	Infilt. Gall.	Condensation	Condensation	Condensation	Condensation
Canal[a]		Dry	4992.42	4992.82	Dry

[a] Measured near the SE corner of Sparton property.

Table 4.2
Water-Quality Data - Fourth Quarter 2005

Well ID	Sampling Date	Concentration (μg/L) TCE	DCE	TCA
MW-7	11/08/05	5.4	<1.0	<1.0
MW-9	11/04/05	NA	NA	NA
MW-12	11/10/05	76	3.6	<1.0
MW-13	11/04/05	NA	NA	NA
MW-14R	11/08/05	9.1	<1.0	<1.0
MW-16	11/10/05	7.4	<1.0	<1.0
MW-17	11/07/05	<1.0	<1.0	<1.0
MW-18	11/07/05	2.0	<1.0	<1.0
MW-19[a]	11/11/05	815	81	8.0
MW-20	11/11/05	<1.0	<1.0	<1.0
MW-21	11/08/05	<1.0	<1.0	<1.0
MW-22	11/03/05	<1.0	<1.0	<1.0
MW-23	11/10/05	50	4.5	<1.0
MW-25	11/10/05	21	2.0	<1.0
MW-26[a]	11/10/05	19	<1.0	<1.0
MW-29	11/14/05	2.6	<1.0	<1.0
MW-30	11/11/05	5.3	<1.0	<1.0
MW-31	11/10/05	<1.0	<1.0	<1.0
MW-32	11/10/05	120	17	1.5
MW-33	11/04/05	NA	NA	NA
MW-34	11/08/05	<1.0	<1.0	<1.0
MW-35	11/04/05	NA	NA	NA
MW-36	11/04/05	NA	NA	NA
MW-37R	11/07/05	120	4.4	<1.0
MW-38	11/14/05	<1.0	<1.0	<1.0
MW-39	11/14/05	<1.0	<1.0	<1.0
MW-40	11/14/05	<1.0	<1.0	<1.0
MW-41	11/11/05	3.5	<1.0	<1.0
MW-42	11/11/05	120	21	1.8
MW-43	11/11/05	1.9	<1.0	<1.0
MW-44	11/08/05	<1.0	<1.0	<1.0
MW-45	11/07/05	<1.0	<1.0	<1.0

Well ID	Sampling Date	Concentration (μg/L) TCE	DCE	TCA
MW-46	11/07/05	1000	140	15
MW-47	11/03/05	25	1.0	<1.0
MW-48	11/04/05	76	2.9	<1.0
MW-49	11/14/05	<1.0	<1.0	<1.0
MW-51	11/07/05	<1.0	<1.0	<1.0
MW-52R	11/03/05	7.9	17	1.4
MW-53	11/04/05	NA	NA	NA
MW-55	11/03/05	86	3.1	<1.0
MW-56	11/03/05	57	1.6	<1.0
MW-57	11/05/05	NA	NA	NA
MW-58	11/04/05	48	2.1	<1.0
MW-59	11/07/05	<1.0	<1.0	<1.0
MW-60[a]	11/04/05	7800	455	27
MW-61	11/04/05	83	5.1	<1.0
MW-62	11/03/05	2.8	7.0	4.4
MW-64	11/04/05	<1.0	<1.0	<1.0
MW-65	11/04/05	19	73	28
MW-66	11/04/05	<1.0	<1.0	<1.0
MW-67	11/02/05	<1.0	<1.0	<1.0
MW-68	11/04/05	<1.0	<1.0	<1.0
MW-69	11/02/05	<1.0	<1.0	<1.0
MW-70	11/08/05	19	1.0	<1.0
MW-71R	11/04/05	120	3.4	<1.0
MW-72	11/10/05	720	67	3.7
MW-73	11/10/05	9.0	<1.0	<1.0
MW-74	11/07/05	<1.0	<1.0	<1.0
MW-75	11/07/05	<1.0	<1.0	<1.0
MW-76	11/07/05	<1.0	<1.0	<1.0
MW-77	11/07/05	14	1.3	<1.0
MW-78	11/07/05	<1.0	<1.0	<1.0
CW-1	11/02/05	1200	75	3.6
CW-2	11/02/05	190	24	1.6

[a] Results for well are the average of duplicate samples.

Notes: Shaded cells indicate concentrations that exceed MCLs based on the more stringent of the drinking water standards or the maximum allowable concentrations in groundwater set by the NMWQCC (5 mg/L for TCE and DCE, and 60 mg/L for TCA).

NA = Not analyzed

Table 4.3
Flow Rates - 2005

(a) Containment Well Summary

2005	Total Volume of Water Pumped from both Wells (gal)	143,507,445
	Total Average Discharge Rate from both Wells (gpm)	273

(b) Off-Site Containment Well

Month	Volume of Water Pumped (gal)		Average Discharge Rate (gpm)	
	Monthly	Annual	Monthly	Annual
Jan.	9,918,422		222	
Feb.	9,115,792		226	
Mar.	10,088,713		226	
Apr.	9,695,451		224	
May	10,056,940		225	
June	9,726,208		225	
July	10,025,293		225	
Aug.	10,056,745		225	
Sep.	9,698,505		225	
Oct.	9,895,876		222	
Nov.	9,673,601		224	
Dec.	10,067,082	**118,018,628**	226	**225**

(c) Source Containment Well

Month	Volume of Water Pumped (gal)		Average Discharge Rate (gpm)	
	Monthly	Annual	Monthly	Annual
Jan.	2,299,564		52	
Feb.	2,054,660		51	
Mar.	2,235,771		50	
Apr.	1,809,189		42	
May	2,102,832		47	
June	2,010,150		47	
July	2,249,740		50	
Aug.	2,104,908		47	
Sep.	1,951,022		45	
Oct.	2,292,791		51	
Nov.	2,054,536		48	
Dec.	2,323,653	**25,488,817**	52	**48**

Table 4.4
Influent and Effluent Oualitv - 2005[a]

(a) Off-Site Containment System

Sampling Date	Concentration (µg/L)							
	Influent				Effluent			
	TCE	DCE	TCA	Cr Total	TCE	DCE	TCA	Cr Total
01/04/05	1300	76	4.5	25	<1.0	<1.0	<1.0	26
2/2/2005	1300	80	4.5	30	<1.0	<1.0	<1.0	27
03/03/05	1200	70	4.0	28	<1.0	<1.0	<1.0	27
04/04/05	1200	68	4.0	32	<1.0	<1.0	<1.0	51[b]
05/02/05	1200	65	3.6	29	<1.0	<1.0	<1.0	26
06/02/05	1200	68	4.2	29	<1.0	<1.0	<1.0	22
07/11/05	1100	71	3.8	25	<1.0	<1.0	<1.0	25
08/04/05	1200	67	3.8	26	<1.0	<1.0	<1.0	27
09/01/05	1200	76	4.3	25	<1.0	<1.0	<1.0	29
10/04/05	1200	77	4.3	25	<1.0	<1.0	<1.0	27
11/02/05	1200	75	3.6	26	<1.0	<1.0	<1.0	24
12/01/05	1200	77	3.8	24	<1.0	<1.0	<1.0	24
01/04/06	1300	75	3.9	26	<1.0	<1.0	<1.0	30

(b) Source Containment System

Sampling Date	Concentration (µg/L)							
	Influent				Effluent			
	TCE	DCE	TCA	Cr Total	TCE	DCE	TCA	Cr Total
01/04/05	220	27	3.2	29	<1.0	<1.0	<1.0	29
2/2/2005	200	27	3.1	50[b]	<1.0	<1.0	<1.0	3[b]
03/03/05	190	25	2.7	29	<1.0	<1.0	<1.0	30
04/04/05	190	23	2.5	37	<1.0	<1.0	<1.0	30
05/02/05	160	19	2.2	31	<1.0	<1.0	<1.0	30
06/02/05	200	22	2.5	31	<1.0	<1.0	<1.0	32
07/11/05	180	24	2.2	34	<1.0	<1.0	<1.0	33
08/04/05	180	22	2.1	34	<1.0	<1.0	<1.0	29
09/01/05	190	25	2.2	30	<1.0	<1.0	<1.0	34
10/04/05	200	25	2.0	30	<1.0	<1.0	<1.0	33
11/02/05	190	24	1.6	29	<1.0	<1.0	<1.0	35
12/01/05	180	24	1.7	30	<1.0	<1.0	<1.0	29
01/04/06	160	20	1.5	29	<1.0	<1.0	<1.0	33

[a] Data from 01/04/06 has been included to show conditions at the end of the year.

[b] These data appear to be reported incorrectly as they are not consistent with other monthly data on chromium concentrations.

Note: Shaded cells indicate concentrations that exceed MCLs based on the more stringent of the drinking water standards or the maximum allowable concentrations in groundwater set by the NMWQCC (5 ug/L for TCE and DCE, 60 ug/L for TCA and 50 ug/L for total chromium).

Table 5.1
Contaminant Mass Removal - 2005

(a) Containment Well Summary

		(kg)	(lbs)
2005	Total Mass of Removed TCE	558	1230
	Total Mass of Removed DCE	35	77
	Total Mass of Removed TCA	2.0	4.4
	Total Mass Removed	595	1311

(b) Off-Site Containment Well

Month	Mass of Removed TCE		Mass of Removed DCE		Mass of Removed TCA		Total Mass Removed	
	(kg)	(lbs)	(kg)	(lbs)	(kg)	(lbs)	(kg)	(lbs)
Jan.	49	108	2.9	6.5	0.17	0.37	52	114
Feb.	43	95	2.6	5.7	0.15	0.32	46	101
Mar.	46	101	2.6	5.8	0.15	0.34	49	107
Apr.	44	97	2.4	5.4	0.14	0.31	47	103
May	46	101	2.5	5.6	0.15	0.33	48	107
June	42	93	2.6	5.6	0.15	0.32	45	99
July	44	96	2.6	5.8	0.14	0.32	46	102
Aug.	46	101	2.7	6.0	0.15	0.34	49	107
Sep.	44	97	2.8	6.2	0.16	0.35	47	104
Oct.	45	99	2.8	6.3	0.15	0.33	48	106
Nov.	44	97	2.8	6.1	0.14	0.30	47	103
Dec.	48	105	2.9	6.4	0.15	0.32	51	112
Total	**540**	**1190**	**32.4**	**71.3**	**1.79**	**3.95**	**574**	**1265**

(c) Source Containment Well

Month	Mass of Removed TCE		Mass of Removed DCE		Mass of Removed TCA		Total Mass Removed	
	(kg)	(lbs)	(kg)	(lbs)	(kg)	(lbs)	(kg)	(lbs)
Jan.	1.8	4.0	0.24	0.52	0.03	0.06	2.1	4.6
Feb.	1.5	3.3	0.20	0.45	0.02	0.05	1.7	3.8
Mar.	1.6	3.5	0.20	0.45	0.02	0.05	1.8	4.0
Apr.	1.2	2.6	0.14	0.32	0.02	0.04	1.4	3.0
May	1.4	3.2	0.16	0.36	0.02	0.04	1.6	3.6
June	1.4	3.2	0.18	0.39	0.02	0.04	1.6	3.6
July	1.5	3.4	0.20	0.43	0.02	0.04	1.7	3.9
Aug.	1.5	3.2	0.19	0.41	0.02	0.04	1.7	3.7
Sep.	1.4	3.2	0.18	0.41	0.02	0.03	1.6	3.6
Oct.	1.7	3.7	0.21	0.47	0.02	0.03	1.9	4.2
Nov.	1.4	3.2	0.19	0.41	0.01	0.03	1.6	3.6
Dec.	1.5	3.3	0.19	0.43	0.01	0.03	1.7	3.8
Total	**18.0**	**40.0**	**2.28**	**5.03**	**0.22**	**0.48**	**20.5**	**45.5**

Table 6.1
Initial Mass and Maximum Concentration of TCE in Model Layers

Model Layer	Approximate Mass (kg)	Approximate Mass (lbs)	Maximum Concentration (µg/L)
1	0.2	0.5	5607.8
2	9.0	19.9	5083.7
3	190.3	419.5	4002.5
4	463.8	1022.4	12004.7
5	1846.5	4070.7	35629.9
6	1859.4	4099.3	35766.9
7	1803.6	3976.2	35818.8
8	372.7	821.7	4058.0
9	179.1	394.9	1982.8
10	138.0	304.2	1002.0
11	45.4	100.2	408.7
Total Mass	**6,908**	**15,230**	

APPENDIX A

APPENDIX A

Appendix A

2005 Groundwater Quality Data

A-1: Groundwater Monitoring Program Wells

A-2: Infiltration Gallery and Pond Monitoring Wells

A-1: Groundwater Monitoring Program Wells

Appendix A-1

Groundwater Monitoring Program Wells
2005 Analytical Results[a]

	Sample Date	TCE ug/L	1,1-DCE ug/L	1,1,1-TCA ug/L	Cr Total (mg/L) Unfiltered	Cr Total (mg/L) Filtered	Other
MW-7	11/08/05	5.4	<1.0	<1.0	0.0157	0.0123	
MW-12	11/10/05	76	3.6	<1.0	0.00778	0.00490	
MW-14-R	11/08/05	9.1	<1.0	<1.0	0.201	NA	
MW-16	11/10/05	7.4	<1.0	<1.0	0.431	0.131	
MW-17	11/07/05	<1.0	<1.0	<1.0	0.0388	0.0297	
MW-18	11/07/05	2.0	<1.0	<1.0	0.0331	0.0292	
MW-19	11/11/05	820	83	8.1	0.0221	NA	Chloroform: 1.3, Tetrachloroethene: 2.6, 1,1-Dichloroethane: 1.7
	11/11/05	810	78	7.9	0.0264	NA	1,1-Dichloroethane: 1.5, Chloroform:1.2, Tetrachloroethene: 2.4
MW-20	11/11/05	<1.0	<1.0	<1.0	0.00156	NA	
MW-21	11/08/05	<1.0	<1.0	<1.0	0.0728	0.0305	
MW-22	11/03/05	<1.0	<1.0	<1.0	0.0353	0.0384	
MW-23	11/10/05	50	4.5	<1.0	0.218	0.0412	
MW-25	11/10/05	21	2.0	<1.0	0.0636	0.0616	MeCl: 1.2, cis-1,2-DCE: 2.0,
MW-26	11/10/05	19	<1.0	<1.0	0.168	0.131	
	11/10/05	19	<1.0	<1.0	0.179	0.112	
MW-29	11/14/05	2.6	<1.0	<1.0	<0.00100	NA	
MW-30	11/11/05	5.3	<1.0	<1.0	0.00656	NA	
MW-31	11/10/05	<1.0	<1.0	<1.0	<0.00100	NA	
MW-32	11/10/05	120	17	1.5	<0.00100	NA	PCE: 1.3
MW-34	11/08/05	<1.0	<1.0	<1.0	0.197	0.0113	
MW-35	11/04/05	NA	NA	NA	NA	NA	
MW-36	11/04/05	NA	NA	NA	NA	NA	
MW-37-R	11/07/05	120	4.4	<1.0	0.0797	NA	
MW-38	11/14/05	<1.0	<1.0	<1.0	0.00778	NA	
MW-39	11/14/05	<1.0	<1.0	<1.0	0.00850	NA	
MW-40	11/14/05	<1.0	<1.0	<1.0	0.00267	NA	
MW-41	11/11/05	3.5	<1.0	<1.0	0.0341	NA	
MW-42	11/11/05	120	21	1.8	0.0546	NA	PCE: 1.2
MW-43	11/11/05	1.9	<1.0	<1.0	0.00244	NA	
MW-44	11/08/05	<1.0	<1.0	<1.0	<0.00100	NA	
MW-45	11/07/05	<1.0	<1.0	<1.0	0.0322	NA	

Appendix A-1

Groundwater Monitoring Program Wells
2005 Analytical Results[a]

	Sample Date	TCE ug/L	1,1-DCE ug/L	1,1,1-TCA ug/L	Cr Total (mg/L)		Other
					Unfiltered	Filtered	
MW-46	02/11/05					0.0370	
	11/07/05	1000	140	15	0.0392	NA	112-TCTFA:8.4, 11DCA:1.7, Chlor:4.9, 112-TCA:1.1, TTCE:8.9
MW-47	11/03/05	25	1.0	<1.0	0.0262	0.0227	
MW-48	11/04/05	76	2.9	<1.0	0.298	0.0383	
MW-49	11/14/05	<1.0	<1.0	<1.0	0.00244	NA	
MW-51	11/07/05	<1.0	<1.0	<1.0	0.0322	NA	
MW-52R	02/11/05	7.0	14	1.7	0.0184	NA	
	05/11/05	7.3	14	1.7	0.016	NA	
	08/09/05	7.0	15	1.7	0.0170	NA	
	11/03/05	7.9	17	1.4	0.0151	NA	
MW-55	11/03/05	86	3.1	<1.0	0.0309	NA	
MW-56	11/03/05	57	1.6	<1.0	0.0422	NA	
MW-57	02/11/05	NA	NA	NA	NA	NA	
	05/11/05	NA	NA	NA	NA	NA	
MW-58	11/04/05	48	2.1	<1.0		0.0831	
MW-59	11/07/05	<1.0	<1.0	<1.0	0.0277	NA	
MW-60	11/04/05	7900	480	27	0.0331	0.0258	1,1,2-TCA:77, PCE:87
	11/04/05	7700	430	26	0.0298	0.0236	1,1,2-TCA:76, PCE:83
MW-61	11/04/05	83	5.1	<1.0	0.0150	0.00880	
MW-62	02/14/05	2.0	5.3	4.9	0.0110	0.00500	
	05/11/05	2.1	5.4	3.8	0.0100	0.00600	
	08/10/05	1.8	4.9	3.8	0.00700	0.00910	
	08/10/05	1.9	5.1	4.0	0.00978	0.00500	
	11/03/05	2.8	7.0	4.4	0.00822	0.00690	
MW-64	11/04/05	<1.0	<1.0	<1.0	0.00511	NA	
MW-65	02/14/05	17	55	27	0.00500	NA	
	02/14/05	18	55	27	0.00210	NA	
	05/11/05	18	59	28	0.00400	NA	
	08/10/05	17	65	28	0.00300	NA	
	11/04/05	19	73	28	<0.00100	NA	

Appendix A-1

Groundwater Monitoring Program Wells
2005 Analytical Results[a]

	Sample Date	TCE ug/L	1,1-DCE ug/L	1,1,1-TCA ug/L	Cr Total (mg/L) Unfiltered	Cr Total (mg/L) Filtered	Other
MW-66	02/14/05	<1.0	<1.0	<1.0	0.00500	NA	
	05/12/05	<1.0	<1.0	<1.0	0.00311	NA	
	08/09/05	<1.0	<1.0	<1.0	0.00300	NA	
	11/04/05	<1.0	<1.0	<1.0	<0.00100	NA	
MW-67	05/11/05	<1.0	<1.0	<1.0	<0.00100	NA	
	11/02/05	<1.0	<1.0	<1.0	<0.00100	NA	
MW-68	02/11/05	<1.0	<1.0	<1.0	0.00400	NA	
	05/11/05	<1.0	<1.0	<1.0	<0.00100	NA	
	08/09/05	<1.0	<1.0	<1.0	0.00200	NA	
	11/04/05	<1.0	<1.0	<1.0	0.00133	NA	
MW-69	02/11/05	<1.0	<1.0	<1.0	0.00330	NA	
	05/11/05	<1.0	<1.0	<1.0	0.00300	NA	
	08/09/05	<1.0	<1.0	<1.0	0.00178	NA	
	11/02/05	<1.0	<1.0	<1.0	<0.00100	NA	
MW-70	11/08/05	19	1.0	<1.0	0.00122	NA	
MW-71R	02/11/05	140	4.2	<1.0	<0.00100	0.002	MeCl:1.2
	05/11/05	120	3.6	<1.0	<0.00100	<0.00100	MeCl:1.2
	05/11/05	120	3.4	<1.0	<0.00100	<0.00100	MeCl:1.1
	08/10/05	130	4.2	<1.0	<0.00100	NA	MeCl:1.0
	11/04/05	120	3.4	<1.0	<0.00100	NA	
MW-72	11/10/05	720	67	3.7	0.0424	NA	1,1,2-TCTFA:7.3, Chlor:1.8, PCE:4.3
MW-73	11/10/05	9.0	<1.0	<1.0	0.0369	NA	

[a]VOCs by EPA Method 8260

Notes: NA = Not analyzed

Shaded cells indicate concentrations that exceed MCLs based on the more stringent of the drinking water standards or the maximum allowable concentrations in groundwater set by the NMWQCC (5 ug/L for TCE and DCE, 60 ug/L for TCA, and 50 ug/L for total chromium).

A-2: Infiltration Gallery and Pond Monitoring Wells

Appendix A-2

Infiltration Gallery and Pond Monitoring Wells
2005 Analytical Results[a]

Well	Sample Date	TCE (ug/l)	1,1DCE (ug/l)	1,1,1TCA (ug/l)	Cr (total) (mg/l)	Fe (total) (mg/l)	Mn (total) (mg/l)	Cr (diss) (mg/l)	Fe (diss) (mg/l)	Mn (diss) (mg/l)
MW-17	02/14/05	<1.0	<1.0	<1.0	0.0314	1.11	0.035	0.0310	0.02	0.0060
	05/11/05	1.3	<1.0	<1.0	0.0626	7.04	0.213	0.0420	0.0189	<0.00500
	08/10/05	<1.0	<1.0	<1.0	0.0387	2.47	0.0861	0.0416	0.0256	0.0063
	11/07/05	<1.0	<1.0	<1.0	0.0388	3.74	0.137	0.0297	0.0198	<0.00500
MW-74	02/14/05	<1.0	<1.0	<1.0	0.030	0.028	<0.00500			
	05/12/05	<1.0	<1.0	<1.0	0.024	0.034	<0.00500			
	08/10/05	<1.0	<1.0	<1.0	0.023	0.011	0.0104			
	11/07/05	<1.0	<1.0	<1.0	0.026	1.050	0.0926			
MW-75	02/14/05	<1.0	<1.0	<1.0	0.024	0.0311	<0.00500			
	05/12/05	<1.0	<1.0	<1.0	0.026	0.200	<0.00500			
	08/10/05	<1.0	<1.0	<1.0	0.024	0.0274	0.0193			
	11/07/05	<1.0	<1.0	<1.0	0.021	0.0164	<0.00500			
MW-76	02/14/05	<1.0	<1.0	<1.0	0.0303	0.0153	<0.00500			
	05/12/05	<1.0	<1.0	<1.0	0.026	0.0210	<0.00500			
	08/10/05	<1.0	<1.0	<1.0	0.0222	<0.0100	0.0104			
	11/07/05	<1.0	<1.0	<1.0	0.0233	0.0168	<0.00500			
MW-77	02/11/05	16	1.4	<1.0	0.007	0.169	5.94	0.006	0.035	0.6990
	05/12/05	16	1.4	<1.0	0.003	0.031	2.61	0.001	0.0138	0.5710
	08/10/05	15	1.4	<1.0	0.002	0.168	5.79	0.002	<0.0100	0.4970
	11/07/05	14	1.3	<1.0	0.00289	0.118	6.74	0.0034	<0.0100	0.7720
MW-78	02/11/05	<1.0	<1.0	<1.0	0.0330	0.081	0.007	0.023	0.0176	0.006
	05/12/05	<1.0	<1.0	<1.0	0.0310	0.046	<0.00500	0.0213	<0.0100	<0.00500
	08/10/05	<1.0	<1.0	<1.0	0.0260	0.038	0.0169	0.029	<0.0100	<0.00500
	11/07/05	<1.0	<1.0	<1.0	0.0234	<0.0100	<0.00500	0.0208	<0.0100	<0.00500

[a]VOCs by EPA Method 8260

Note: Shaded cells indicate concentrations that exceed MCLs based on the more stringent of the drinking water standards or the maximum allowable concentrations in groundwater set by the NMWQCC (5 ug/L for TCE and DCE, 60 ug/L for TCA, and 50 ug/L for total chromium).

APPENDIX B

APPENDIX B

Appendix B

2005 Containment Well Flow Rate Data

B-1: Off-Site Containment Well

B-2: Source Containment Well

B-1: Off-Site Containment Well

Appendix B-1

Off-Site Containment Well
2005 Flow Rate Data

Date	Time	Instantaneous Discharge (gpm)	Totalizer Reading (gallons)	Average Discharge (gpm)	Total Volume (gallons)[a]
12/18/04	9:09	---	651,065,760		686,748,260
				219	
01/03/05	9:42	---	656,262,800		691,945,300
				120	
01/04/05	11:13	225	656,446,200		692,128,700
				226	
01/10/05	12:00	---	658,410,400		694,092,900
				226	
01/13/05	10:00	---	659,361,500		695,044,000
				225	
01/14/05	7:55	---	659,657,800		695,340,300
				226	
01/28/05	7:30	---	664,210,000		699,892,500
				226	
02/02/05	7:46	224	665,841,700		701,524,200
				226	
02/15/05	8:10	227	670,080,600		705,763,100
				226	
02/21/05	8:22	---	672,035,000		707,717,500
				226	
02/23/05	7:38	---	672,676,100		708,358,600
				226	
03/03/05	11:30	---	675,333,400		711,015,900
				226	
03/18/05	12:40	---	680,233,100		715,915,600
				226	
03/24/05	20:05	---	682,286,500		717,969,000
				226	
04/01/05	8:10	---	684,725,900		720,408,400
				223	
04/04/05	9:55	226	685,712,700		721,395,200
				223	
04/18/05	7:32	---	690,178,285		725,860,785
				226	
04/25/05	8:50	---	692,476,000		728,158,500
				226	
05/02/05	16:30	---	694,859,300		730,541,800
				226	
05/16/05	7:55	---	699,293,400		734,975,900
				226	
05/27/05	8:15	---	702,874,100		738,556,600
				223	
05/31/05	23:32	---	704,361,370		740,043,870
				226	
06/01/05	8:00	---	704,476,000		740,158,500
				226	
06/02/05	8:08	---	704,802,700		740,485,200
				226	

Appendix B-1
Off-Site Containment Well
2005 Flow Rate Data

Date	Time	Instantaneous Discharge (gpm)	Totalizer Reading (gallons)	Average Discharge (gpm)	Total Volume (gallons)[a]
06/09/05	15:30	---	707,177,300		742,859,800
				226	
06/14/05	13:40	---	708,778,100		744,460,600
				226	
06/16/05	7:30	---	709,344,600		745,027,100
				225	
06/22/05	7:30	---	711,292,800		746,975,300
				214	
06/23/05	16:18	228	711,714,690		747,397,190
				226	
07/01/05	8:30	---	714,208,800		749,891,300
				226	
07/06/05	15:45	---	715,931,000		751,613,500
				225	
07/11/05	7:45	---	717,444,900		753,127,400
				212	
07/18/05	18:30	---	719,723,500		755,406,000
				283	
07/20/05	9:40	---	720,388,000		756,070,500
				225	
07/26/05	7:30	---	722,306,230		757,988,730
				0	
07/26/05	9:55	---	722,306,230		757,988,730
				225	
08/01/05	7:51	---	724,225,300		759,907,800
				225	
08/04/05	8:55	---	725,213,200		760,895,700
				225	
08/16/05	7:30	---	729,086,800		764,769,300
				225	
08/19/05	7:34	---	730,060,700		765,743,200
				225	
08/24/05	13:08	---	731,757,500		767,440,000
				225	
08/30/05	19:30	---	733,791,900		769,474,400
				225	
09/01/05	9:10	223	734,299,800		769,982,300
				225	
09/09/05	13:31	---	736,954,700		772,637,200
				225	
09/13/05	7:55	---	738,176,200		773,858,700
				225	
09/15/05	18:45	---	738,971,000		774,653,500
				225	
09/22/05	12:26	---	741,155,000		776,837,500
				216	
09/24/05	17:30	---	741,841,200		777,523,700
				225	

Appendix B-1
Off-Site Containment Well
2005 Flow Rate Data

Date	Time	Instantaneous Discharge (gpm)	Totalizer Reading (gallons)	Average Discharge (gpm)	Total Volume (gallons)[a]
09/30/05	8:00	---	743,658,300		779,340,800
				225	
10/04/05	8:45	---	744,967,000		780,649,500
				214	
10/07/05	7:20	---	745,874,700		781,557,200
				146	
10/10/05	12:37	---	746,552,800		782,235,300
				225	
10/15/05	15:00	---	748,205,700		783,888,200
				265	
10/21/05	6:52	---	750,365,300		786,047,800
				225	
10/28/05	8:00	---	752,650,600		788,333,100
				200	
10/30/05	6:05	---	753,203,700		788,886,200
				225	
11/01/05	8:00	---	753,878,400		789,560,900
				225	
11/04/05	7:25	---	754,842,900		790,525,400
				225	
11/05/05	12:26	---	755,234,000		790,916,500
				222	
11/16/05	20:00	---	758,847,300		794,529,800
				225	
11/23/05	13:35	---	761,032,200		796,714,700
				225	
12/01/05	11:10	---	763,595,000		799,277,500
				225	
12/08/05	16:40	---	765,941,400		801,623,900
				226	
12/14/05	15:00	---	767,867,400		803,549,900
				225	
12/20/05	15:20	---	769,819,200		805,501,700
				225	
12/29/05	12:26	226	772,702,200		808,384,700
				226	
01/03/06	11:45	---	774,318,400		810,000,900

[a]Total pumpage since 12/31/98

B-2: Source Containment Well

Appendix B-2

Source Containment Well
2005 Flow Rate Data

Date	Time	Instantaneous Discharge (gpm)	Totalizer Reading (gallons)	Average Discharge (gpm)	Total Volume (gallons)
12/15/04	10:00	---	77,631,280		77,631,280
				52	
01/04/05	10:29	51.0	79,123,930		79,123,930
				52	
01/13/05	9:10	---	79,789,780		79,789,780
				48	
01/29/05	14:05	---	80,916,550		80,916,550
				65	
02/02/05	8:20	50.4	81,267,400		81,267,400
				51	
02/11/05	7:47	---	81,927,250		81,927,250
				46	
02/22/05	7:50	---	82,661,940		82,661,940
				56	
03/03/05	10:55	---	83,400,250		83,400,250
				59	
03/08/05	15:15	---	83,843,200		83,843,200
				46	
03/18/05	12:30	---	84,491,400		84,491,400
				50	
04/01/05	8:00	---	85,481,350		85,481,350
				49	
04/04/05	8:45	49.1	85,694,330		85,694,330
				45	
04/19/05	7:50	---	86,666,090		86,666,090
				47	
04/24/05	11:44	---	87,013,048		87,013,048
				1	
04/25/05	12:36	---	87,014,610		87,014,610
				0	
04/27/05	8:24	---	87,015,453		87,015,453
				48	
05/02/05	16:10	---	87,381,835		87,381,835
				47	
05/12/05	15:05	---	88,062,100		88,062,100
				47	
05/27/05	18:15	---	89,086,330		89,086,330
				47	
06/01/05	8:30	---	89,395,270		89,395,270
				47	
06/02/05	8:25	---	89,463,130		89,463,130
				47	
06/07/05	18:24	47.0	89,829,880		89,829,880
				47	

Appendix B-2

Source Containment Well
2005 Flow Rate Data

Date	Time	Instantaneous Discharge (gpm)	Totalizer Reading (gallons)	Average Discharge (gpm)	Total Volume (gallons)
06/09/05	15:55	---	89,957,950		89,957,950

06/13/05	8:45	47.0	---		---

06/16/05	8:00	47.6	90,406,000		90,406,000
				47	
06/23/05	16:43	47.3	90,906,734		90,906,734
				45	
07/01/05	8:47	---	91,408,000		91,408,000
				51	
07/06/05	15:00	---	91,796,920		91,796,920
				51	
07/11/05	8:00	---	92,142,300		92,142,300
				51	
07/20/05	9:30	---	92,805,320		92,805,320
				51	
07/26/05	10:19	---	93,244,819		93,244,819
				48	
08/01/05	8:03	---	93,654,500		93,654,500
				50	
08/04/05	8:10	---	93,869,000		93,869,000
				49	
08/09/05	17:10	---	94,249,430		94,249,430
				42	
08/16/05	7:45	---	94,651,910		94,651,910
				49	
08/19/05	8:20	---	94,863,500		94,863,500
				49	
08/24/05	13:33	---	95,228,190		95,228,190
				48	
08/25/05	17:20	---	95,308,920		95,308,920
				47	
09/01/05	8:15	---	95,761,830		95,761,830
				49	
09/02/05	14:50	---	95,851,460		95,851,460
				52	
09/09/05	13:10	---	96,367,350		96,367,350
				52	
09/13/05	8:10	---	96,651,100		96,651,100
				53	
09/22/05	12:09	---	97,348,000		97,348,000
				18	
09/28/05	15:30	---	97,509,500		97,509,500
				52	
09/30/05	8:10	---	97,637,420		97,637,420
				52	

Appendix B-2

Source Containment Well
2005 Flow Rate Data

Date	Time	Instantaneous Discharge (gpm)	Totalizer Reading (gallons)	Average Discharge (gpm)	Total Volume (gallons)
10/04/05	9:30	---	97,942,700		97,942,700
				50	
10/07/05	7:30	---	98,152,130		98,152,130
				49	
10/09/05	12:48	---	98,308,766		98,308,766
				52	
10/14/05	15:10	---	98,691,640		98,691,640
				52	
10/28/05	8:15	---	99,720,270		99,720,270
				47	
10/30/05	5:40	---	99,847,607		99,847,607
				52	
11/01/05	7:48	---	100,004,150		100,004,150
				52	
11/16/05	19:09	---	101,165,960		101,165,960
				49	
11/20/05	8:10	---	101,414,256		101,414,256
				0	
11/22/05	17:58	---	101,414,298		101,414,298
				52	
12/01/05	10:30	---	102,066,990		102,066,990
				52	
12/08/05	17:00	---	102,612,370		102,612,370
				52	
12/14/05	15:25	---	103,057,821		103,057,821
				52	
12/20/05	15:35	---	103,506,880		103,506,880
				52	
12/29/05	12:00	---	104,167,105		104,167,105
				52	
01/03/06	11:35	---	104,537,440		104,537,440

APPENDIX C

Appendix C

2005 Influent / Effluent Quality Data

C-1: Off-Site Treatment System

C-2: Source Treatment System

C-1: Off-Site Treatment System

Appendix C-1

Off-Site Treatment System
2005 Analytical Results[a]

Sample Date	Influent						Effluent					
	TCE (ug/l)	1,1DCE (ug/l)	1,1,1TCA (ug/l)	Cr (total) (mg/l)	Fe (total) (mg/l)	Mn (total) (mg/l)	TCE (ug/l)	1,1DCE (ug/l)	1,1,1TCA (ug/l)	Cr (total) (mg/l)	Fe (total) (mg/l)	Mn (total) (mg/l)
01/04/05	1300	76	4.5	0.025	<0.025	<0.0050	<1.0	<1.0	<1.0	0.026	0.034	<0.0050
2/2/2005	1300	80	4.5	0.030	<0.0100	<0.0050	<1.0	<1.0	<1.0	0.027	0.267	<0.0050
03/03/05	1200	70	4.0	0.028	0.012	<0.0050	<1.0	<1.0	<1.0	0.027	0.094	<0.0050
04/04/05	1200	68	4.0	0.032	0.203	<0.0050	<1.0	<1.0	<1.0	0.051	0.055	<0.0050
05/02/05	1200	65	3.6	0.029	0.112	<0.0050	<1.0	<1.0	<1.0	0.026	0.017	<0.0050
06/02/05	1200	68	4.2	0.029	0.289	<0.0050	<1.0	<1.0	<1.0	0.022	0.125	<0.0050
07/11/05	1100	71	3.8	0.025	0.010	<0.0050	<1.0	<1.0	<1.0	0.025	0.026	<0.0050
08/04/05	1200	67	3.8	0.026	<0.0100	<0.0050	<1.0	<1.0	<1.0	0.027	0.056	<0.0050
09/01/05	1200	76	4.3	0.025	0.015	<0.0050	<1.0	<1.0	<1.0	0.029	0.080	<0.0050
10/04/05	1200	77	4.3	0.025	<0.0100	<0.0050	<1.0	<1.0	<1.0	0.027	0.236	<0.0050
11/02/05	1200	75	3.6	0.026	0.039	<0.0050	<1.0	<1.0	<1.0	0.024	0.080	<0.0050
12/01/05	1200	77	3.8	0.024	0.027	<0.0050	<1.0	<1.0	<1.0	0.024	0.194	<0.0050
01/04/06	1300	75	3.9	0.026	<0.0100	<0.0050	<1.0	<1.0	<1.0	0.030	0.716	<0.0050

[a] Data from 01/04/06 has been included to show conditions at the end of the year.

Note: Shaded cells indicate concentrations that exceed MCLs based on the more stringent of the drinking water standards or the maximum allowable concentrations in groundwater set by the NMWQCC (5 ug/L for TCE and DCE, 60 ug/L for TCA, and 50 ug/L for total chromium).

C-2: Source Treatment System

Appendix C-2

Source Treatment System
2005 Analytical Results[a]

Sample Date	Influent						Effluent					
	TCE (ug/l)	1,1DCE (ug/l)	1,1,1TCA (ug/l)	Cr (total) (mg/l)	Fe (total) (mg/l)	Mn (total) (mg/l)	TCE (ug/l)	1,1-DCE (ug/l)	1,1,1-TCA (ug/l)	Cr (total) (mg/l)	Fe (total) (mg/l)	Mn (total) (mg/l)
01/04/05	220	27	3.2	0.029	<0.025	0.110	<1.0	<1.0	<1.0	0.029	0.039	0.120
02/02/05	200	27	3.1	0.050	0.377	0.349	<1.0	<1.0	<1.0	0.003	0.014	0.130
03/03/05	190	25	2.7	0.029	0.036	0.175	<1.0	<1.0	<1.0	0.030	<0.010	0.109
04/04/05	190	23	2.5	0.037	0.156	1.320	<1.0	<1.0	<1.0	0.030	0.024	0.099
05/02/05	160	19	2.2	0.031	0.170	0.333	<1.0	<1.0	<1.0	0.030	0.053	0.086
06/02/05	200	22	2.5	0.031	0.073	2.890	<1.0	<1.0	<1.0	0.032	0.017	0.064
07/11/05	180	24	2.2	0.034	0.100	0.230	<1.0	<1.0	<1.0	0.033	<0.010	0.061
08/04/05	180	22	2.1	0.034	0.241	0.202	<1.0	<1.0	<1.0	0.029	<0.010	0.057
09/01/05	190	25	2.2	0.030	0.198	0.553	<1.0	<1.0	<1.0	0.034	0.012	0.072
10/04/05	200	25	2.0	0.030	<0.010	0.236	<1.0	<1.0	<1.0	0.033	0.013	0.064
11/02/05	190	24	1.6	0.029	0.047	1.770	<1.0	<1.0	<1.0	0.035	0.022	0.048
12/01/05	180	24	1.7	0.030	0.038	2.380	<1.0	<1.0	<1.0	0.029	<0.010	0.057
01/04/06	160	20	1.5	0.033	<0.010	0.094	<1.0	<1.0	<1.0	0.033	0.032	0.108

[a] Data from 01/04/06 has been included to show conditions at the end of the year.

Note: Shaded cells indicate concentrations that exceed MCLs based on the more stringent of the drinking water standards or the maximum allowable concentrations in groundwater set by the NMWQCC (5 ug/L for TCE and DCE, 60 ug/L for TCA, and 50 ug/L for total chromium).

APPENDIX D

APPENDIX D

Appendix D

Water Level Residuals – December 1998 to December 2005 Simulation

Appendix D

Water Level Residuals
December 1998 to December 2005 Simulation

Monitoring Well	Year	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-07	1999	4976.62	4975.11	1.51
MW-09	1999	4972.33	4972.53	-0.20
MW-12	1999	4971.95	4972.59	-0.65
MW-13	1999	4973.67	4973.09	0.58
MW-16	1999	4977.80	4975.59	2.20
MW-17	1999	4978.16	4976.21	1.95
MW-19	1999	4970.99	4971.01	-0.02
MW-20	1999	4970.62	4970.44	0.18
MW-29	1999	4972.86	4972.02	0.85
MW-30	1999	4971.40	4971.21	0.19
MW-31	1999	4970.32	4970.40	-0.08
MW-32	1999	4970.12	4970.34	-0.21
MW-33	1999	4971.64	4972.21	-0.57
MW-34	1999	4973.45	4972.35	1.09
MW-35	1999	4970.57	4970.23	0.34
MW-36	1999	4969.02	4969.03	-0.01
MW-37	1999	4967.30	4967.77	-0.47
MW-38	1999	4972.88	4971.49	1.39
MW-39	1999	4971.63	4970.80	0.83
MW-40	1999	4970.35	4970.07	0.28
MW-41	1999	4970.23	4970.51	-0.28
MW-42	1999	4969.89	4970.61	-0.72
MW-43	1999	4969.69	4970.25	-0.56
MW-44	1999	4969.11	4968.94	0.18
MW-45	1999	4967.25	4967.60	-0.35
MW-46	1999	4965.98	4966.56	-0.58
MW-47	1999	4965.56	4965.84	-0.28
MW-48	1999	4964.66	4964.41	0.25
MW-49	1999	4970.15	4969.82	0.33
MW-51	1999	4979.97	4977.45	2.52
MW-52	1999	4961.24	4961.38	-0.14
MW-53	1999	4963.42	4962.58	0.84
MW-54	1999	4964.83	4965.55	-0.72
MW-55	1999	4963.44	4963.78	-0.34
MW-56	1999	4964.63	4964.17	0.46
MW-57	1999	4964.41	4965.04	-0.63
MW-58	1999	4964.19	4963.44	0.75
MW-59	1999	4968.77	4970.28	-1.52
MW-60	1999	4964.33	4963.94	0.39
MW-61	1999	4964.41	4964.07	0.34
MW-62	1999	4966.53	4966.34	0.19
MW-64	1999	4964.90	4965.40	-0.50

Appendix D

Water Level Residuals
December 1998 to December 2005 Simulation

Monitoring Well	Year	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-65	1999	4960.92	4960.43	0.49
MW-66	1999	4963.35	4963.63	-0.28
MW-67	1999	4957.76	4957.99	-0.23
MW-68	1999	4960.83	4960.19	0.63
MW-69	1999	4960.73	4959.51	1.22
MW-70	1999	4969.37	4970.06	-0.69
MW-71	1999	4957.75	4956.85	0.90
MW-72	1999	4970.03	4970.61	-0.58
MW-73	1999	4970.15	4970.44	-0.29
OB-1	1999	4958.39	4959.05	-0.66
OB-2	1999	4960.02	4959.36	0.67
MW-07	2000	4976.31	4974.95	1.36
MW-09	2000	4971.97	4972.31	-0.34
MW-12	2000	4971.61	4972.39	-0.78
MW-13	2000	4973.37	4972.88	0.49
MW-16	2000	4977.65	4975.53	2.12
MW-17	2000	4977.94	4976.14	1.80
MW-18	2000	4970.68	4972.79	-2.11
MW-19	2000	4970.62	4970.74	-0.12
MW-20	2000	4970.26	4970.16	0.10
MW-22	2000	4976.81	4975.76	1.05
MW-23	2000	4975.10	4974.15	0.95
MW-24	2000	4977.35	4975.47	1.88
MW-25	2000	4977.38	4975.38	2.00
MW-26	2000	4972.49	4972.76	-0.27
MW-27	2000	4972.89	4974.11	-1.22
MW-29	2000	4972.54	4971.77	0.77
MW-30	2000	4971.04	4970.94	0.10
MW-31	2000	4969.94	4970.11	-0.17
MW-32	2000	4969.76	4970.05	-0.29
MW-33	2000	4971.28	4971.99	-0.71
MW-34	2000	4973.13	4972.11	1.02
MW-35	2000	4970.22	4969.91	0.31
MW-36	2000	4968.58	4968.69	-0.11
MW-37	2000	4966.90	4967.37	-0.47
MW-38	2000	4972.56	4971.23	1.33
MW-39	2000	4971.28	4970.52	0.76
MW-40	2000	4969.98	4969.77	0.21
MW-41	2000	4969.86	4970.23	-0.37
MW-42	2000	4969.54	4970.34	-0.80
MW-43	2000	4969.33	4969.98	-0.65
MW-44	2000	4968.68	4968.59	0.09

Appendix D

Water Level Residuals
December 1998 to December 2005 Simulation

Monitoring Well	Year	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-45	2000	4966.90	4967.20	-0.30
MW-46	2000	4965.56	4966.13	-0.57
MW-47	2000	4965.04	4965.31	-0.27
MW-48	2000	4964.01	4963.75	0.26
MW-49	2000	4969.89	4969.52	0.37
MW-51	2000	4979.73	4977.40	2.33
MW-52	2000	4960.50	4960.61	-0.11
MW-53	2000	4962.62	4961.65	0.97
MW-54	2000	4964.57	4965.22	-0.65
MW-55	2000	4962.90	4963.15	-0.24
MW-56	2000	4964.01	4963.53	0.48
MW-57	2000	4964.32	4964.80	-0.48
MW-58	2000	4963.46	4962.64	0.82
MW-59	2000	4968.44	4970.02	-1.58
MW-60	2000	4963.94	4963.40	0.54
MW-61	2000	4964.02	4963.52	0.50
MW-62	2000	4965.92	4965.87	0.05
MW-63	2000	4970.20	4973.40	-3.20
MW-64	2000	4964.55	4965.08	-0.52
MW-65	2000	4960.24	4959.69	0.54
MW-66	2000	4963.03	4963.36	-0.33
MW-67	2000	4957.24	4957.61	-0.37
MW-68	2000	4960.40	4959.74	0.67
MW-69	2000	4960.31	4959.05	1.26
MW-70	2000	4969.01	4969.77	-0.76
MW-71	2000	4957.28	4956.49	0.80
MW-72	2000	4969.73	4970.34	-0.61
MW-73	2000	4969.77	4970.15	-0.39
MW-74	2000	4963.03	4963.94	-0.92
MW-75	2000	4966.92	4963.89	3.03
MW-76	2000	4967.69	4965.53	2.17
OB-1	2000	4957.54	4957.83	-0.29
OB-2	2000	4958.96	4958.39	0.57
MW-07	2001	4976.10	4974.80	1.31
MW-09	2001	4971.71	4972.12	-0.41
MW-12	2001	4971.18	4972.21	-1.02
MW-13	2001	4973.09	4972.69	0.40
MW-16	2001	4977.76	4975.46	2.31
MW-17	2001	4978.05	4976.06	1.98
MW-18	2001	4970.28	4972.65	-2.38
MW-19	2001	4970.28	4970.52	-0.24
MW-20	2001	4969.92	4969.93	-0.01

Appendix D

Water Level Residuals
December 1998 to December 2005 Simulation

Monitoring Well	Year	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-22	2001	4976.51	4975.64	0.87
MW-23	2001	4974.77	4974.00	0.77
MW-24	2001	4977.38	4975.38	2.00
MW-25	2001	4977.39	4975.30	2.09
MW-26	2001	4971.70	4972.57	-0.87
MW-27	2001	4972.74	4974.03	-1.29
MW-29	2001	4972.19	4971.56	0.63
MW-30	2001	4970.72	4970.72	0.00
MW-31	2001	4969.60	4969.87	-0.27
MW-32	2001	4969.44	4969.82	-0.38
MW-33	2001	4970.96	4971.80	-0.83
MW-34	2001	4972.86	4971.89	0.97
MW-35	2001	4969.97	4969.66	0.31
MW-36	2001	4968.32	4968.41	-0.10
MW-38	2001	4972.21	4971.02	1.20
MW-39	2001	4970.97	4970.29	0.68
MW-40	2001	4969.65	4969.53	0.12
MW-41	2001	4969.55	4970.00	-0.45
MW-42	2001	4969.30	4970.12	-0.82
MW-43	2001	4969.09	4969.76	-0.67
MW-44	2001	4968.38	4968.32	0.06
MW-45	2001	4967.06	4966.90	0.16
MW-46	2001	4965.30	4965.82	-0.53
MW-47	2001	4964.50	4964.94	-0.43
MW-48	2001	4963.66	4963.32	0.34
MW-49	2001	4969.49	4969.28	0.21
MW-51	2001	4979.79	4977.36	2.43
MW-52	2001	4960.20	4960.06	0.14
MW-53	2001	4962.08	4961.12	0.96
MW-54	2001	4964.34	4964.97	-0.63
MW-55	2001	4962.53	4962.76	-0.23
MW-56	2001	4963.67	4963.14	0.54
MW-57	2001	4964.15	4964.62	-0.47
MW-58	2001	4963.28	4962.15	1.13
MW-59	2001	4968.18	4969.81	-1.63
MW-60	2001	4963.74	4963.06	0.68
MW-61	2001	4963.80	4963.17	0.63
MW-62	2001	4965.68	4965.52	0.16
MW-63	2001	4970.02	4973.34	-3.32
MW-64	2001	4964.36	4964.84	-0.48
MW-65	2001	4959.90	4959.27	0.64
MW-66	2001	4962.79	4963.15	-0.36

Appendix D

Water Level Residuals
December 1998 to December 2005 Simulation

Monitoring Well	Year	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-67	2001	4956.95	4957.28	-0.33
MW-68	2001	4960.12	4959.44	0.68
MW-69	2001	4960.00	4958.75	1.24
MW-70	2001	4968.91	4969.54	-0.63
MW-71	2001	4956.98	4956.16	0.82
MW-72	2001	4969.48	4970.12	-0.64
MW-73	2001	4969.35	4969.92	-0.57
MW-74	2001	4962.46	4964.64	-2.18
MW-75	2001	4966.26	4964.59	1.67
MW-76	2001	4967.18	4966.22	0.96
OB-1	2001	4957.25	4957.23	0.02
OB-2	2001	4958.61	4957.88	0.72
MW-07	2002	4976.12	4975.95	0.18
MW-09	2002	4970.95	4972.80	-1.86
MW-12	2002	4970.35	4972.95	-2.60
MW-13	2002	4972.49	4973.20	-0.71
MW-14R	2002	4968.29	4969.31	-1.02
MW-16	2002	4981.76	4981.12	0.63
MW-17	2002	4981.91	4982.11	-0.20
MW-18	2002	4970.93	4974.43	-3.50
MW-19	2002	4969.24	4969.30	-0.07
MW-20	2002	4968.78	4969.07	-0.29
MW-22	2002	4977.86	4978.50	-0.64
MW-23	2002	4974.63	4975.72	-1.08
MW-24	2002	4981.50	4980.79	0.71
MW-25	2002	4981.61	4980.95	0.66
MW-26	2002	4971.44	4972.65	-1.22
MW-27	2002	4978.42	4978.28	0.14
MW-29	2002	4971.53	4970.98	0.54
MW-30	2002	4969.78	4969.83	-0.05
MW-31	2002	4968.39	4968.57	-0.19
MW-32	2002	4968.10	4968.30	-0.20
MW-33	2002	4970.04	4972.40	-2.36
MW-34	2002	4972.27	4971.55	0.73
MW-36	2002	4967.34	4967.88	-0.54
MW-37R	2002	4965.13	4966.41	-1.28
MW-38	2002	4971.49	4970.46	1.03
MW-39	2002	4970.11	4969.60	0.51
MW-40	2002	4968.46	4968.54	-0.07
MW-41	2002	4968.35	4968.29	0.06
MW-42	2002	4968.54	4969.34	-0.79
MW-43	2002	4968.31	4969.05	-0.74

Appendix D

Water Level Residuals
December 1998 to December 2005 Simulation

Monitoring Well	Year	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-44	2002	4967.40	4967.75	-0.35
MW-45	2002	4966.10	4966.34	-0.25
MW-46	2002	4964.65	4965.41	-0.76
MW-47	2002	4964.18	4964.51	-0.33
MW-48	2002	4963.20	4962.90	0.30
MW-49	2002	4968.46	4968.58	-0.11
MW-51	2002	4980.94	4979.65	1.29
MW-52	2002	4959.81	4959.65	0.16
MW-53	2002	4961.52	4960.28	1.23
MW-54	2002	4963.82	4964.69	-0.87
MW-55	2002	4962.03	4962.32	-0.28
MW-56	2002	4963.21	4962.70	0.51
MW-57	2002	4963.62	4964.38	-0.76
MW-58	2002	4962.57	4961.72	0.86
MW-59	2002	4967.50	4969.23	-1.72
MW-60	2002	4963.21	4962.69	0.52
MW-61	2002	4963.12	4962.82	0.29
MW-62	2002	4965.13	4965.11	0.02
MW-63	2002	4969.61	4974.13	-4.51
MW-64	2002	4963.78	4964.55	-0.77
MW-65	2002	4959.39	4958.84	0.55
MW-66	2002	4962.24	4962.85	-0.61
MW-67	2002	4956.31	4956.91	-0.61
MW-68	2002	4959.64	4959.15	0.49
MW-69	2002	4959.52	4958.42	1.10
MW-70	2002	4967.68	4968.63	-0.95
MW-71R	2002	4956.36	4955.85	0.50
MW-72	2002	4968.59	4969.14	-0.55
MW-73	2002	4967.69	4967.66	0.04
MW-74	2002	4962.06	4964.96	-2.90
MW-75	2002	4965.83	4964.90	0.93
MW-76	2002	4967.31	4966.52	0.79
MW-77	2002	4977.09	4976.71	0.38
MW-78	2002	4973.01	4974.25	-1.25
OB-1	2002	4956.73	4956.66	0.06
OB-2	2002	4957.91	4957.39	0.52
MW-07	2003	4976.17	4976.42	-0.25
MW-09	2003	4970.82	4973.25	-2.42
MW-12	2003	4970.28	4973.36	-3.08
MW-13	2003	4972.42	4973.54	-1.12
MW-14R	2003	4968.03	4969.25	-1.22
MW-16	2003	4982.26	4982.48	-0.22

Appendix D

Water Level Residuals
December 1998 to December 2005 Simulation

Monitoring Well	Year	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-17	2003	4982.02	4983.52	-1.50
MW-18	2003	4975.16	4975.05	0.11
MW-19	2003	4969.13	4969.11	0.02
MW-20	2003	4968.59	4968.87	-0.28
MW-21	2003	4983.36	4983.79	-0.43
MW-22	2003	4977.84	4979.36	-1.52
MW-23	2003	4974.75	4976.32	-1.58
MW-24	2003	4982.08	4982.10	-0.02
MW-25	2003	4982.27	4982.30	-0.03
MW-26	2003	4971.84	4972.81	-0.97
MW-27	2003	4981.28	4979.40	1.88
MW-29	2003	4971.41	4970.85	0.55
MW-30	2003	4969.61	4969.67	-0.06
MW-31	2003	4968.19	4968.35	-0.17
MW-32	2003	4968.01	4968.05	-0.05
MW-33	2003	4969.93	4972.83	-2.89
MW-34	2003	4972.12	4971.36	0.77
MW-36	2003	4967.27	4967.60	-0.33
MW-37R	2003	4965.06	4966.17	-1.11
MW-38	2003	4971.41	4970.30	1.11
MW-39	2003	4969.96	4969.41	0.55
MW-40	2003	4968.26	4968.31	-0.06
MW-41	2003	4968.41	4968.04	0.36
MW-42	2003	4968.48	4969.17	-0.69
MW-43	2003	4968.27	4968.87	-0.60
MW-44	2003	4967.35	4967.50	-0.15
MW-45	2003	4966.05	4966.11	-0.06
MW-46	2003	4964.45	4965.17	-0.72
MW-47	2003	4963.98	4964.20	-0.23
MW-48	2003	4962.97	4962.57	0.39
MW-49	2003	4968.30	4968.37	-0.07
MW-51	2003	4981.88	4980.57	1.32
MW-52R	2003	4959.26	4959.01	0.24
MW-53	2003	4961.29	4959.92	1.37
MW-54	2003	4963.61	4964.46	-0.84
MW-55	2003	4961.61	4962.01	-0.41
MW-56	2003	4962.98	4962.39	0.59
MW-57	2003	4963.46	4964.16	-0.71
MW-58	2003	4962.29	4961.37	0.93
MW-59	2003	4967.36	4969.07	-1.71
MW-60	2003	4962.90	4962.41	0.49
MW-61	2003	4962.87	4962.53	0.33

Appendix D

Water Level Residuals
December 1998 to December 2005 Simulation

Monitoring Well	Year	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-62	2003	4964.84	4964.80	0.04
MW-63	2003	4971.76	4974.57	-2.81
MW-64	2003	4963.63	4964.33	-0.69
MW-65	2003	4959.19	4958.51	0.68
MW-66	2003	4962.01	4962.62	-0.61
MW-67	2003	4956.05	4956.61	-0.56
MW-68	2003	4959.40	4958.88	0.52
MW-69	2003	4959.33	4958.14	1.20
MW-70	2003	4967.49	4968.42	-0.93
MW-71R	2003	4956.13	4955.54	0.59
MW-72	2003	4968.55	4968.97	-0.42
MW-73	2003	4967.45	4967.35	0.10
MW-74	2003	4961.85	4965.06	-3.21
MW-75	2003	4965.77	4965.01	0.76
MW-76	2003	4967.22	4966.62	0.60
MW-77	2003	4977.08	4977.11	-0.02
MW-78	2003	4974.97	4974.77	0.20
OB-1	2003	4956.46	4956.24	0.21
OB-2	2003	4957.70	4957.02	0.68
MW-07	2004	4975.59	4975.96	-0.37
MW-09	2004	4970.40	4973.00	-2.60
MW-12	2004	4969.88	4973.12	-3.25
MW-13	2004	4972.02	4973.25	-1.23
MW-14R	2004	4967.79	4969.16	-1.37
MW-16	2004	4981.74	4980.50	1.24
MW-17	2004	4981.40	4980.96	0.44
MW-18	2004	4973.36	4974.82	-1.46
MW-19	2004	4968.79	4968.99	-0.20
MW-20	2004	4968.25	4968.73	-0.49
MW-21	2004	4982.66	4982.48	0.17
MW-22	2004	4977.25	4978.51	-1.26
MW-23	2004	4974.23	4975.81	-1.57
MW-24	2004	4981.54	4980.36	1.18
MW-25	2004	4981.73	4980.51	1.21
MW-26	2004	4971.36	4972.64	-1.28
MW-27	2004	4980.76	4978.89	1.87
MW-29	2004	4970.94	4970.70	0.24
MW-30	2004	4969.25	4969.53	-0.28
MW-31	2004	4967.86	4968.24	-0.38
MW-32	2004	4967.71	4967.95	-0.24
MW-33	2004	4969.55	4972.64	-3.08
MW-34	2004	4971.59	4971.19	0.40

Appendix D

Water Level Residuals
December 1998 to December 2005 Simulation

Monitoring Well	Year	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-36	2004	4967.43	4967.42	0.01
MW-37R	2004	4964.78	4966.01	-1.23
MW-38	2004	4971.20	4970.15	1.05
MW-39	2004	4969.56	4969.26	0.30
MW-40	2004	4967.96	4968.18	-0.22
MW-41	2004	4968.03	4967.96	0.07
MW-42	2004	4968.17	4969.05	-0.88
MW-43	2004	4967.95	4968.74	-0.79
MW-44	2004	4967.10	4967.33	-0.22
MW-45	2004	4965.77	4965.95	-0.19
MW-46	2004	4964.17	4965.01	-0.85
MW-47	2004	4963.65	4963.99	-0.34
MW-48	2004	4962.64	4962.35	0.29
MW-49	2004	4967.96	4968.22	-0.25
MW-51	2004	4981.84	4981.22	0.62
MW-52R	2004	4958.73	4958.78	-0.06
MW-53	2004	4961.00	4959.69	1.31
MW-54	2004	4963.33	4964.26	-0.94
MW-55	2004	4961.41	4961.83	-0.42
MW-56	2004	4962.64	4962.19	0.45
MW-57	2004	4963.13	4963.96	-0.84
MW-58	2004	4961.99	4961.14	0.85
MW-59	2004	4967.13	4968.94	-1.81
MW-60	2004	4962.64	4962.21	0.43
MW-61	2004	4962.61	4962.32	0.29
MW-62	2004	4964.54	4964.58	-0.04
MW-63	2004	4973.01	4974.81	-1.80
MW-64	2004	4963.34	4964.14	-0.80
MW-65	2004	4958.75	4958.32	0.43
MW-66	2004	4961.60	4962.42	-0.82
MW-67	2004	4955.63	4956.34	-0.71
MW-68	2004	4959.00	4958.65	0.35
MW-69	2004	4958.86	4957.93	0.93
MW-70	2004	4967.11	4968.29	-1.17
MW-71R	2004	4955.77	4955.24	0.53
MW-72	2004	4968.23	4968.87	-0.64
MW-73	2004	4967.15	4967.28	-0.13
MW-74	2004	4961.23	4964.80	-3.57
MW-75	2004	4965.10	4964.74	0.36
MW-76	2004	4966.48	4966.38	0.10
MW-77	2004	4976.69	4976.81	-0.12
MW-78	2004	4974.54	4974.90	-0.35

Appendix D

Water Level Residuals
December 1998 to December 2005 Simulation

Monitoring Well	Year	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
OB-1	2004	4956.02	4956.10	-0.07
OB-2	2004	4957.22	4956.84	0.38
MW-07	2005	4975.58	4976.16	-0.57
MW-09	2005	4970.25	4972.92	-2.67
MW-12	2005	4969.70	4973.05	-3.35
MW-13	2005	4971.94	4973.21	-1.27
MW-14R	2005	4967.54	4968.97	-1.43
MW-16	2005	4981.94	4981.76	0.19
MW-17	2005	4981.60	4982.93	-1.33
MW-18	2005	4974.11	4974.73	-0.62
MW-19	2005	4968.61	4968.82	-0.21
MW-20	2005	4968.06	4968.55	-0.49
MW-21	2005	4982.73	4982.54	0.18
MW-22	2005	4977.38	4979.14	-1.76
MW-23	2005	4974.27	4976.02	-1.75
MW-24	2005	4981.74	4981.47	0.27
MW-25	2005	4981.94	4981.59	0.35
MW-26	2005	4971.29	4972.53	-1.24
MW-27	2005	4980.90	4978.95	1.95
MW-29	2005	4970.83	4970.55	0.29
MW-30	2005	4969.08	4969.37	-0.28
MW-31	2005	4967.63	4968.06	-0.42
MW-32	2005	4967.49	4967.77	-0.28
MW-33	2005	4969.49	4972.52	-3.04
MW-34	2005	4971.30	4971.03	0.27
MW-37R	2005	4964.56	4965.80	-1.23
MW-38	2005	4970.83	4969.98	0.84
MW-39	2005	4969.36	4969.09	0.27
MW-40	2005	4967.75	4967.99	-0.25
MW-41	2005	4967.90	4967.78	0.12
MW-42	2005	4967.97	4968.87	-0.90
MW-43	2005	4967.71	4968.55	-0.84
MW-44	2005	4966.73	4967.12	-0.40
MW-45	2005	4964.90	4965.73	-0.83
MW-46	2005	4963.81	4964.78	-0.98
MW-47	2005	4963.42	4963.75	-0.34
MW-48	2005	4962.33	4962.09	0.25
MW-49	2005	4967.75	4968.03	-0.28
MW-51	2005	4982.02	4980.88	1.14
MW-52R	2005	4958.37	4958.46	-0.09
MW-53	2005	4960.65	4959.41	1.24
MW-54	2005	4963.16	4964.03	-0.87

Appendix D

Water Level Residuals
December 1998 to December 2005 Simulation

Monitoring Well	Year	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-55	2005	4961.10	4961.53	-0.43
MW-56	2005	4962.37	4961.91	0.46
MW-57	2005	4963.11	4963.73	-0.63
MW-58	2005	4961.65	4960.85	0.81
MW-59	2005	4966.94	4968.76	-1.82
MW-60	2005	4962.31	4961.94	0.38
MW-61	2005	4962.21	4962.06	0.14
MW-62	2005	4964.35	4964.34	0.01
MW-63	2005	4974.07	4974.61	-0.53
MW-64	2005	4963.06	4963.90	-0.84
MW-65	2005	4958.37	4957.99	0.39
MW-66	2005	4961.42	4962.16	-0.74
MW-67	2005	4955.06	4956.02	-0.96
MW-68	2005	4958.60	4958.38	0.22
MW-69	2005	4958.49	4957.62	0.87
MW-70	2005	4966.88	4968.10	-1.22
MW-71R	2005	4955.34	4954.92	0.42
MW-72	2005	4968.03	4968.68	-0.65
MW-73	2005	4966.96	4967.11	-0.14
MW-74	2005	4960.94	4964.84	-3.90
MW-75	2005	4965.15	4964.78	0.37
MW-76	2005	4966.70	4966.40	0.30
MW-77	2005	4976.71	4976.99	-0.28
MW-78	2005	4974.52	4974.46	0.06
OB-1	2005	4955.62	4955.64	-0.02
OB-2	2005	4956.87	4956.45	0.42

Number of active observation points =	439	
Number of inactive observation points =	7	
Mean of residuals =	0.15	ft
Standard Deviation of residuals =	1.06	ft
Sum of squared residuals =	505	ft^2
Mean of absolute residuals =	0.78	ft
Maximum residual =	-3.03	ft
Minimum residual =	4.51	ft
Range in observed heads =	27.20	ft