Sparton Technology, Inc.
Former Coors Road Plant
Remedial Program

2009 Annual Report

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

June 11, 2010

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

June 11, 2010

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Subject: Sparton Technology, Inc. Former Coors Road Plant Remedial Program
2009 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 2009, 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.

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

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, NAE
Founder & Senior Principal

cc: Secretary, Sparton Technology, Inc., c/o Mr. Joseph S. Lerczak
Mr. Gregory A. Slome, Senior Vice President and Chief Financial Officer of Sparton Corporation
Mr. Joseph S. Lerczak, Director of Treasury and Forecasting and Secretary of Sparton Corporation (3 copies)
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Sparton Technology, Inc. Former Coors Road Plant Remedial Program

2009 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:
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June 11, 2010

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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 4800-foot clay unit, has been identified.

Investigations conducted at and around the Site in the 1980s revealed that soils beneath the Site and groundwater beneath and downgradient from the Site were contaminated. The primary contaminants were volatile organic compounds (VOCs), specifically trichloroethene (TCE), 1,1-dichloroethene (DCE), and 1,1,1-trichloroethane (TCA), and chromium. Remedial investigations that followed indicated that groundwater contamination was limited to the aquifer above the 4800-foot clay; current measures for groundwater remediation were, therefore, 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: (1) the installation and operation of an off-site containment system; (2) the installation and operation of a source containment system; and (3) the operation of an on-site, 400-cfm (cubic feet per minute) 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 began in late 1998 and was completed in early May 1999. The system consisted of (1) a containment well near the leading edge of the plume, designed to pump at a rate of about 225 gallons per minute (gpm), (2) an off-site treatment system, (3) an infiltration gallery in the Arroyo de las Calabacillas, and (4) associated conveyance and monitoring components. 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 2009 was the eleventh full year of operation of this well. The source containment system was installed during 2001 and began operating on January 3, 2002. This system consisted of (1) a containment well immediately downgradient from the site, designed to pump at a rate of about 50 gpm, (2) an on-site treatment system, (3) six[a] on-site infiltration ponds, and (4) associated conveyance and monitoring components. The year 2009 was the eighth 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 2009, considerable progress was made towards achieving the goals of the remedial measures:

- The off-site containment well continued to operate during the year at an average discharge rate of 218 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 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 an average rate of 47 gpm, sufficient for containing potential on-site source areas.
- Groundwater monitoring was conducted as specified in the Groundwater Monitoring Program Plan (Monitoring Plan [Attachment A to the Consent Decree]) and the State of New Mexico Groundwater Discharge Permit DP-1184 (Discharge Permit). 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 above plan and permit 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 Discharge Permit. All samples were analyzed for VOCs, total chromium, iron, and manganese.
- The groundwater flow and transport model that was developed in early 2000 to simulate the hydrogeologic system underlying the site and its vicinity, and which was revised in early 2004 and again in both early and late 2009, was used to evaluate the future performance of the containment systems and alternative groundwater extraction schemes. Based on these evaluations, Sparton recommended increasing the pumping rate of the off-site containment well to 300 gpm to accelerate aquifer restoration.[b] A slight

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[a] The performance of the six on-site infiltration ponds between 2002 and 2004 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 in 2005 to put the land to other beneficial use.

[b] This recommendation was approved by USEPA and NMED on March 26, 2010 (letter dated March 26, 2010 from John E. Kieling of NMED and Chuck Hendrickson of USEPA to Joseph S. Lerczak of Sparton), and will be implemented by Sparton as soon as the treatment system is tested and a higher capacity pump is purchased and installed in CW-1.

modification was again made to the model during the preparation of this report to incorporate into the model boundaries the faster rates of regional water-level declines that were observed in recent years, and the model was used to simulate TCE concentrations in the aquifer from start-up of the off-site containment well in December 1998 through December 2009, and to predict concentrations for December 2010.

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.

The extent of groundwater contamination during 2009, as defined by the extent of the TCE plume, was essentially the same as during 2008. Of 55 wells sampled both in November 2008 and 2009, the 2009 concentrations of TCE were lower than in 2008 in 23 wells, higher in 7 wells, and remained the same in 25 wells (24 below detection limits). Well MW-60, at 2,200 micrograms per liter (µg/L), continued to be the most contaminated off-site well. The corresponding results for DCE were 10 wells with lower, 6 wells with higher, and 39 wells with the same (38 below detection limits) concentrations. The TCA plume ceased to exist in 2003, and this condition continued through 2009; the highest concentration of TCA during 2009 was 8.4 µg/L (also in well MW-60) significantly below the maximum allowable concentration of 60 µg/L set for groundwater 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 (below detection limits). The only wells where significant increases occurred are the off-site containment well CW-1, and on-site monitoring well MW-19. The concentrations of contaminants in the water pumped from CW-1 rapidly increased after the start of its operation and have remained high since then. The high concentrations in this well and in well MW-60 indicated that areas of high concentration existed upgradient from both of these wells; however, most of the groundwater upgradient from these wells has been captured by CW-1 and concentrations both in CW-1 and MW-60 have begun a declining trend.

The off-site and source containment wells operated at a combined average rate of 265 gpm during 2009. A total of about 139.3 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 1.471 billion gallons and represents 130 percent of the initial volume of contaminated groundwater (pore volume).

A total of about 410 kilograms (kg) [900 pounds (lbs)] of contaminants consisting of about 380 kg (840 lbs) of TCE, 32 kg (70 lbs) of DCE, and 1.3 kg (2.8 lbs) of TCA were removed from the aquifer by the two containment wells during 2009. The total mass that was removed since the beginning of the of the current remedial operations is 5,880 kg (12,960 lbs) consisting of 5,510 kg (12,140 lbs) of TCE, 350 kg (760 lbs) of DCE, and 16 kg (36 lbs) of TCA. This represents about 75 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.

Two of the three monitoring wells completed below the 4800-foot clay (in the Deep Flow Zone or the DFZ), well MW-67 and well MW-79, which was installed in 2006 to address the continuing presence of contaminants in DFZ monitoring well MW-71R, continued to be free of any site-related contaminants throughout 2009. Well MW-71R continued to be contaminated; however, TCE concentrations in the well declined from 210 µg/L in August 2003 to 52 µg/L in November 2008 and remained in the 50 µg/L level throughout 2009; the November 2009 TCE concentration in the well was 57 µg/L. The absence of any contaminants in MW-67 and MW-79, and the declining concentrations in MW-71R indicate that the contamination in DFZ represents a contaminated groundwater slug of limited extent. Concentration trends in MW-71R will be closely monitored in the next few years to assess if there is a need for further action.

The containment systems were shut down several times during 2009 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 20 minutes to about 31 hours. Evaluation of migration rates in the aquifer indicates that the systems could be down for significantly much longer periods without affecting the capture of the contaminant plume.

Plans for next year include increasing the pumping rate of the off-site containment well to 300 gpm as recommended by Sparton[c] and approved by the agencies[d], continuing the operation of the off-site and source containment systems, and the collection of monitoring data as required by the plans and permits controlling system operation, groundwater discharge, and air emissions. Two monitoring wells that have been dry during the last several years will be plugged and abandoned, and measurement of the water level in the Corrales Main Canal will be discontinued, if approved by the agencies. A new monitoring well, MW-80, will be installed downgradient and outside the capture zone of CW-1, in accordance with the schedule presented in the Work Plan for its installation[e] submitted to and approved by the agencies.[f]

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[c] S.S. Papadopulos & Associates Inc. 2009b. Sparton Technology, Inc. Former Coors Road Plant Remedial Program, Evaluation of Alternative Systems and Technologies for Aquifer Restoration. Report prepared for Sparton Technology, Inc. and transmitted to USEPA and NMED, November 25, corrected December 3.

[d] See document cited in Footnote b.

[e] S.S. Papadopulos & Associates Inc., and Metric Corporation. 2010. Sparton Technology, Inc., Former Coors Road Plant Remedial Program, Work Plan for Installing Monitoring Well MW-80. Report prepared for Sparton Technology, Inc., and transmitted to USEPA and NMED, original issue May 4, revised issue May 25.

[f] Letter dated June 4, 2010 from John E. Kieling of NMED and Chuck Hendrickson of USEPA to Joseph S. Lerczak of Sparton Re: Work Plan for Installing Monitoring Well MW-80: Approval, Sparton Technology, Inc., EPA ID No. NMD083212332.

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List of Acronyms

μg/L	Micrograms per liter
3rdFZ	Third depth interval of the Lower Flow Zone
cfm	cubic feet per minute
Cis-12DCE	cis-1,2-Dichloroethene
cm^2/s	Centimeter squared per second
CMS	Corrective Measure Study
COA	City of Albuquerque
Cr	Chromium
DCE	1,1-Dichloroethylene
DFZ	Deep Flow Zone below the 4800 — foot clay
DO	Dissolved Oxygen
ft	foot or feet
ft MSL	feet above Mean Sea Level
ft/d	feet per day
ft/yr	feet per year
ft^2	square feet
ft^2/d	feet squared per day
ft^3	cubic feet
g/cm^3	grams per cubic centimeter
gpd	gallons per day
gpm	gallons per minute
IM	Interim Measure
kg	Kilogram
lbs	Pounds
LLFZ	Lower Lower Flow Zone
MCL	Maximum Contaminant Level
Metric	Metric Corporation
mg/L	Milligrams per liter
mg/m^3	Milligrams per cubic meter
MSL	Mean Sea Level
mV	Millivolt
ND	Not Detected
NMED	New Mexico Environment Department
NMEID	New Mexico Environmental Improvement Division
NMWQCC	New Mexico Water Quality Control Commission
ORP	Oxidation/Reduction Potential
O/S	On-Site
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
VC	Vinyl Chloride
VOC	Volatile Organic Compound

REPORT

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 on-site soils and groundwater were contaminated by volatile organic compounds (VOCs), primarily trichloroethene (TCE), 1,1,1-trichloroethane (TCA) and 1,1-dichloroethene (DCE), and by chromium, 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: (1) the installation, testing, and continuous operation of an off-site extraction well designed to contain the contaminant plume; (2) 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; (3) 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; (4) the implementation of a groundwater monitoring plan; (5) the assessment of aquifer restoration; and (6) 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 2009 constitutes the eleventh 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 2009 constitutes the eighth 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.

In accordance with the requirements of the Consent Decree [Attachment D - Work Plan for the Assessment of Aquifer Restoration (SSP&A, 2000b)], a numerical groundwater flow and contaminant transport model of the aquifer system underlying the Sparton site and its vicinity was developed in 2000 and recalibrated each year until 2009. The initial development of this model is described in the 1999 Annual Report (SSP&A, 2001a), and major revisions to the model in the 2003 and 2008 Annual Reports (SSP&A, 2004; 2009a). In 2009, the model was deemed reliable for making future predictions and was used to evaluate the performance of the existing system and of several alternate groundwater extraction systems with respect to the time each system would take to restore the aquifer (SSP&A, 2009b). Based on the results of this evaluation, it was recommended that the pumping rate of CW-1 be increased to 300 gpm to accelerate aquifer restoration (SSP&A, 2009b).[1]

The purpose of this 2009 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 2009,
- present the data collected during 2009 from operating and monitoring systems, and

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[1] This recommendation was approved by USEPA and NMED on March 26, 2010 (letter dated March 26, 2010 from John E. Kieling of NMED and Chuck Hendrickson of USEPA to Joseph S. Lerczak of Sparton), and will be implemented by Sparton as soon as the treatment system is tested and a higher capacity pump is purchased and installed in CW-1.

- 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 2008 is included in this section. Issues related to the year-2009 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 and the results of evaluations made using the 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 approximately a 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 several other small structures that were used for storage or as workshops (see Figure 2.1). Manufacturing of electronic components, including printed-circuit boards, began at the plant 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 more than 100 borings advanced for installing monitoring, production, and temporary wells, and soil vapor probes, and by a 1,505 ft 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-ft thick. Beneath the facility, and in an approximately 1,500 ft 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 assemblages 1 and 2 represent basin-floor alluvial deposits; assemblage 1 is primarily sand and gravel with lenses of silty clay, and assemblage 2 is primarily sand with lenses of pebbly sand and silty clay. Lithofacies assemblage 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 seven wells (MW-67, MW-71, MW-71R, MW-79, 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 89 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, 20 have been plugged and abandoned. The locations of the remaining 69 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 ft 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, subsequent 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 diameters and 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, MW-71R, and MW-79), 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 and 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 completed within the depth interval designated as ULFZ (see Figure 2.4); and MW-49 and MW-70 which are listed on Table 2.1 as 3rdFZ wells but are completed within the LLFZ. 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 4,800-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 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 ft per day (ft/d), corresponding to a transmissivity of about 4,000 to 5,000 ft 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 has resulted in a regional decline of water levels. During the 1990s this regional decline averaged about 0.65 foot per year (ft/yr); the rate of decline has slowed down in the early 2000s and averaged about 0.3 ft/yr until 2007, but after a rise of about one foot in early 2007 water levels began declining at a much faster rate of 1 ft/yr or more (see well hydrographs presented in Figure 2.5 and Figure 6.3).

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 were 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 indicated that the primary constituents of concern found in on-site soils and in both on-site and off-site groundwater were VOCs, primarily TCE, TCA and its abiotic transformation product DCE. Of these constituents, TCE had the highest concentrations and was the constituent used to define the extent of groundwater contamination. Concentrations of DCE in groundwater were lower relative to those of TCE, but it had the second largest plume extent. Groundwater contamination by TCA was primarily limited to the facility and its immediate vicinity. Various metals were also detected in both soil and groundwater samples; of these, chromium had 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 delineate further 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. The chromium treatment process was discontinued 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 locations of these components of the off-site containment system are 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 2.10), 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 Hydrogeologic Conditions

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 ft 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 (see also Figure 5.14).

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.

A discussion of water levels in the DFZ had not been included in the 2006 and earlier Annual Reports because data from only two monitoring wells (MW-67 and MW-71 or MW-71R) were available from this zone; these data indicated steep downward gradients across the 4,800-foot clay (water-level differences of about 6 feet between the LLFZ and the DFZ) but provided little information on the direction of groundwater flow in this zone. The installation of a third DFZ monitoring well (MW-79) in 2006, and the water-level data collected from the three DFZ wells between the installation of MW-79 and the end of 2008 indicate that the average direction of groundwater flow in the DFZ during this period was to the west-northwest (W 19.1° N) with an average gradient of about 0.00200 (see Figure 2.14). This direction of flow and gradient are similar to those observed in the flow zones above the 4800-foot clay.

The lower water levels in the DFZ are caused by municipal and industrial pumping from the deeper horizons of the aquifer several miles to the north, west, and southwest of the Sparton site. These lower water levels and the resulting steep gradients across the 4800-foot clay unit create a potential for the downward migration of contaminants. The off-site containment well which is fully penetrating the aquifer above the clay unit is expected to create horizontal gradients that may counteract the downward migration potential across the clay unit.

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 2.15 and the extent of the DCE and TCA plumes is shown in Figures 2.16 and 2.17, respectively. This initial extent of the plumes forms a basis for comparing their extent during the years of operation of the remedial systems that have been implemented at the site and for evaluating the effectiveness of these remedial systems.

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 2.15 through 2.17), 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 2.15 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 ft 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.[2] 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 ft (ft^3), or 1.13 billion gallons, or 3,450 acre-ft.

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. During the calibration process of this model, the initial TCE concentration distribution within

[2] 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.

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 2009 water-quality data, the initial dissolved TCE mass is currently estimated to be (see Table 6.1) about 7,360 kg (16,220 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 460 kg (1,020 lbs) and 22 kg (48 lbs), respectively. Thus, the total initial mass of dissolved contaminants is currently estimated to be about 7,840 kg (17,290 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 2.18, 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 2008 Operations

During 1999 through 2008, 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 2008 included the following:

- Between December 31, 1998 and April 14, 1999, and from May 6, 1999 through December 31, 2008, 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, 2008 at a rate sufficient for containing any potential sources that may remain at the site. Two of the six infiltration ponds were backfilled in 2005 when an evaluation of the pond performance indicated that four ponds were sufficient for infiltrating the treated water.
- Groundwater monitoring was conducted as specified in the Groundwater Monitoring Program Plan, hereafter "Monitoring Plan," (Consent Decree, 2000, Attachment A) and in the State of New Mexico Groundwater Discharge Permit DP-1184 that controls the discharge of the treated water through the infiltration gallery and ponds, hereafter "Discharge Permit." Water levels in monitoring wells, containment wells, 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 Monitoring Plan and the Discharge Permit, and analyzed for TCE, DCE, TCA, and other constituents, as required by these documents.
- 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 2008. The model was significantly modified in early 2009, during the preparation of the 2008 Annual Report and deemed reliable for making predictions of future conditions.

A total of about 1.154 billion 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 2008. An additional total of about 178 million gallons of water, corresponding to an average rate of 48 gpm, were pumped by the source containment well between the start of its operation on January 3, 2002 and the end of 2008. 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 2008 was about 1.332 billion gallons, and represents about 118 percent of the initial volume of contaminated groundwater (pore volume). Evaluation of quarterly water-level data indicated that the off-site containment well maintained control of the off-site contaminant plume throughout each year, and that the source containment well developed a capture zone that contains potential on-site source areas that may be contributing to groundwater contamination.

The total mass of contaminants that was removed by the off-site containment well between the start of its operation and the end of 2008 was about 5,240 kg (11,600 lbs) and consisted of 4,940 kg (10,900 lbs) of TCE, 288 kg (636 lbs) of DCE, and 11.5 kg (25.4 lbs.) of

TCA. An additional 219 kg (482 lbs) of contaminants consisting of about 189 kg (416 lbs) of TCE, 26 kg (58 lbs) of DCE, and 3.5 kg (7.6 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 2008 was about 5,460 kg (12,050 lbs) consisting of 5,130 kg (11,310 lbs) of TCE, 315 kg (694 lbs) of DCE, and 15 kg (33 lbs) of TCA. This removed mass represented about 70 percent of the contaminant 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 2008. 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. In 2006, the discharge rate of the source containment well began declining during the latter half of the year; it was thought that this was due to the inefficiency of its pump and a new pump was installed in 2007. Further testing conducted when the new pump did not improve the flow rate indicated that the pipeline between the well and the air-stripper building was clogged with iron and manganese deposits; the pipeline was cleaned with acid in June 2007 to restore the capacity of the well.

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 ft south of the original well, was installed in February 2002. Samples collected from the replacement well between its installation and the end of 2003 indicated the continuing presence of contaminants in the Deep Flow Zone (TCE concentrations of 130 to 210 μg/L). In late 2003, USEPA/NMED and Sparton began negotiating potential approaches for addressing this problem; these negotiations led to the agreement in October 2004 of installing 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 was to be based on whether the well is clean or contaminated. A Work Plan for the installation, testing, monitoring, and/or operation of this DFZ well was submitted to USEPA/NMED on December 6, 2004 and approved by USEPA/NMED on January 6, 2005. Difficulties in 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 delayed the installation of the well until the beginning of 2006. The well was installed in February 2006, and the first samples from the well were obtained during its testing in April 2006. The analyses of these samples indicated that the well did not contain any site-related contaminants. Details on the installation, testing and sampling of the well were included in a letter-report[3] presented to USEPA/NMED in June 2006, and the results of the analysis of aquifer test data from the well were presented in Appendix E of the 2007 Annual Report (SSP&A, 2008). Based on the sampling results, the well was designated as monitoring well MW-79, and added to the Monitoring Plan under a semi-annual sampling schedule. Water-quality data collected from MW-79 and MW-71R until the end of 2008 indicated that MW-79 continued to remain free of contaminants and that concentrations in MW-71R began declining in 2005; the November 2008 concentrations in the well were 52 μg/L for TCE, 1.9 μg/L for DCE and <1.0 μg/L for TCA.

Six water table (UFZ) monitoring wells (MW-14, MW-15, MW-28, MW-37, MW-50, and MW-52) 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 (MW-14R, MW-37R, and MW-52R) spanning both the UFZ and ULFZ. Three other water table monitoring wells that became dry during 2004 through 2006 (PW-1, MW-35, and MW-36) were plugged and abandoned in 2007. Well MW-53, which was dry in November 2005 and again in November 2007 and 2008, was deepened in December 2008; hereafter, the well will be referred to as MW-53D. Other minor problems during the past years of operation included the occasional shutdown of the containment systems due to power failures, failures of the monitoring or paging systems, and failures of the discharge pumps or air-stripper blower motors. Appropriate measures were taken to address these problems.

[3] Letter dated June 2, 2006 to USEPA and NMED representatives from Stavros S. Papadopulos of SSP&A and Gary L. Richardson of Metric with subject "Sparton Technology, Inc. Former Coors Road Plant Remedial Program - Transmittal of Data from the Installation, Testing, and Sampling of a new DFZ Well."

Section 3
System Operations - 2009

3.1 Monitoring Well System

During 2009, water levels were measured in and samples were collected from all monitoring wells that were not dry and had sufficient water during the measurement or sampling event. Water levels were measured quarterly and samples were collected from each well at the frequency specified either in the Monitoring Plan, or the Discharge Permit.

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. Water levels could not be measured in monitoring wells MW-13, MW-48, and MW-57 during all four of the scheduled quarterly water-level measurement events in 2009 because the wells were dry during these events. Well MW-33, which was dry during the first two quarters, as it had been the case during the last several years, was plugged and abandoned in July 2009. The water levels could not also be measured in well MW-61 during the second and fourth quarters, because it was dry during these two measuring events and in well OB-1 during the fourth quarter because the well was equipped with diffusion bags at that time. In addition, well MW-57, which is sampled quarterly, could not be sampled during any of the quarterly sampling events, and wells MW-13, MW-47, MW-48, MW-58, and MW-61, which are scheduled for annual sampling, could not be sampled in November 2009 because they were either dry or did not have sufficient water to be sampled.

3.1.2 Deeper Flow Zones

There were no problems associated with the measurement of the water levels or with the sampling of monitoring wells completed in the ULFZ, LLFZ, or the DFZ.

3.2 Containment Systems

3.2.1 Off-Site Containment System

The Off-Site Containment System operated for about 8,647 hours, or 98.7 percent of the 8,760 hours available during 2009. The system was down for about 113 hours due to 18 interruptions ranging in duration from 0.5 hour to about 24 hours. A summary of the downtime for the year is presented in Table 3.1 (a). These downtimes consisted of four shutdowns for routine maintenance, three shutdowns for system repairs, seven shutdowns due to power failure, one shutdown for sump pump failure, one shutdown for float switch failure, one shutdown due to gallery radio transmitter failure, and one shutdown for vandalism to the gallery radio.

3.2.2 Source Containment System

The Source Containment System operated for about 8,663 hours, or 98.9 percent of the 8,760 hours available during 2009. The system was down for about 97 hours due to 11 interruptions ranging in duration from 0.33 hour to about 31 hours. A summary of the downtime for the year is presented on Table 3.1 (b). These downtimes consisted of three shutdowns for routine maintenance, one shutdown for system repairs, four shutdowns due power failure, two shutdowns for plugged water meter screens, and one shutdown for a broken water meter.

The rapid infiltration ponds performed well during 2009. Ponds 1 and 4 were used during January, March, May, July, September, and November. Ponds 2 and 3 were used during February, April, June, August, October, and December. The amount of water evaporating from the ponds has been estimated to be about 1 percent of the discharged water, that is, about 0.5 gpm.

3.3 Problems and Responses

Most of the downtimes that occurred in 2009 were due to power failures (7 for the off-site system and 4 for the source system). The longest shutdown of a containment system during 2009 was that of the source system which occurred on April 6 and 7 due to a broken water meter; the meter was repaired and the system returned to operation after 31 hours.

Section 4
Monitoring Results - 2009

The following data were collected in 2009 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 2009 in all monitoring wells that were not dry during the measurement event, 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 Monitoring Plan and the Discharge Permit. 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 2009, 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 (November 2009) are summarized on Table 4.2. Quarterly samples 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) were analyzed for VOCs (primarily TCE, DCE, and TCA), total chromium, iron, and manganese, as specified in the Discharge Permit. 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 (November 2009) 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.

In addition to these sampling events that were carried out under the Site's Groundwater Monitoring Program Plan (Attachment A to the Consent Decree), during November 2009 eleven diffusion bags were installed in observation well OB-1, at 15-ft depth intervals, to obtain a concentration profile in this well;[4] the results of the analysis of these diffusion-bag samples are presented in Appendix A-3.

4.2 Containment Systems

4.2.1 Flow Rates

The volumes of groundwater pumped by the off-site and source containment wells during 2009 and the corresponding flow rates are summarized on Table 4.3. As shown on this table, a total of about 139.3 million gallons of water, corresponding to a combined flow rate of 265 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 2009 was monitored with a totalizer meter that was read at irregular frequencies. The intervals between meter readings ranged from about a day to about ten days, and averaged about six and a half 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 2009, as calculated from the totalizer data, are summarized on Table 4.3. As indicated on this table, approximately 114.8 million gallons of water, corresponding to an average rate of 218 gpm, were pumped in 2009.

4.2.1.2 Source Containment Well

The volume of the water pumped by the source containment well during 2009 was also monitored with a totalizer meter that was also read at irregular frequencies. The intervals between meter readings ranged from about two days to about ten days, and averaged 6.4 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

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[4] This diffusion-bag sampling event was associated with negotiations between USEPA/NMED and Sparton concerning the installation of a downgradient monitoring well requested by USEPA/NMED in their review of the 2003-2007 Annual Reports (see certified letter dated December 30, 2008 from Chuck Hendrickson of USEPA, Region 6 and John Kieling of NMED to Tony Hurst of Hurst Engineering Services, Re: 2003-2007 Annual Reports, Sparton Technology, Inc., Former Coors Road Plant, Sparton Technology, Inc., Consent Decree, Civil Action No. CIV 97 0206 LH/JHG, EPA ID No. NMD083212332, with enclosure on "EPA/NMED Comments on Sparton, Inc., Annual Reports for 2003-2007").

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 2009, as calculated from the totalizer data, are summarized on Table 4.3. As indicated on this table, approximately 24.5 million gallons of water, corresponding to an average rate of 47 gpm, were pumped in 2009.

4.2.2 Influent and Effluent Quality

4.2.2.1 Off-Site Containment System

During 2009, the influent[5] 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 2009 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 2009, 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 2009 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.

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[5] 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 - 2009

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 2009 of the performance of the off-site and source containment systems with respect to their above-stated goals.

5.1 Hydraulic Containment

5.1.1 Water Levels and Capture Zones

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 2009 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. The extent of the TCE plume shown in Figures 5.1 through 5.9 is based on previous year's (November 2008) water-quality data from monitoring wells; the extent of the plume is representative of the area that should have been contained between November 2008 and November 2009. The extent of the plume shown on the water-level maps for November 2009 (Figures 5.10, 5.11, and 5.12), however, is based on the November 2009 water-quality data since this extent represents the area to be captured in November and during the remainder of the year.

As shown in Figures 5.1, 5.4, 5.7, and 5.10, the pumping from the source containment well CW-2 has a relatively small effect on the on-site water table contours. Well CW-2 is screened between an elevation of 4,968.5 and 4,918.5 ft MSL. The sand-pack extends about 10 ft above the top of the screen, to an elevation of about 4,978.5 ft MSL. The top of the 4970-foot silt/clay at this location is also at an elevation of about 4,968.5 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 4,957 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 4,968.5 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 quarterly 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 vicinity of the ponds. Comparisons of the water-level data collected since the start of the operation of CW-2 and of the infiltration ponds on January 3, 2002 with those that prevailed prior to the start of CW-2 and pond operation indicate that, except for monitoring wells located near or along the southern limit of the 4970-foot silt/clay, water levels in the wells completed above the 4970-foot silt/clay unit quickly rose in response to the infiltrating water, but then resumed to decline under the regional trends, albeit at a smaller rate than unaffected wells (see for example the hydrographs of wells MW-17 and MW-22 shown in Figure 2.5). The difference between the water levels measured in these wells in November 2009 and those measured in November 2001 ranges from less than 0.1 ft in well MW-22 to almost 8 ft in well MW-27, and averages about 4 ft. The water levels in six wells along or near the southern limit of the silt/clay unit (MW-07, MW-09, MW-12, MW-18, MW-23, and MW-26) were not significantly affected by the infiltrating water, and continued to decline under the regional trends (see for example the hydrograph of well MW-12 in Figure 2.5). In fact, this regional decline caused two other wells along the southern boundary of the 4970-foot silt/clay (wells MW-13 and MW-33) to go dry in recent years. The lack of a response to the infiltrating water in the wells located along or near the southern boundary of the silt/clay unit suggests the presence of a low permeability barrier that isolates these wells from the effects of the water infiltrating from the ponds.

The quarterly water levels and the capture zones of the off-site and source containment wells within the UFZ/ULFZ are shown in Figures 5.2, 5.5, 5.8, and 5.11; those within the LLFZ are shown in Figures 5.3, 5.6, 5.9, and 5.12. As shown in these figures, throughout the year the capture zone of the off-site containment well, CW-1, contained the off-site groundwater contamination, as defined by the extent of the November 2008 or November 2009 TCE plume. Hydraulic containment of the plume was, therefore, maintained throughout 2009. The figures also indicate that the source containment well CW-2 has developed a capture zone that during 2009 continued to contain any potential on-site source areas that may still be contributing to groundwater contamination.

Cross-sectional views of the November 2009 water table are shown on the schematic east-west (C-C') and north-south (D-D') cross-sections that are presented in Figure 5.13 (see Figures 5.10 through 5.12 for the location of these cross-sections). The cross-sections also show the water table that prevailed in November 1998, prior to the start of the off-site containment system. Other features shown on these cross-sections are: (1) the 4970-ft silt/clay unit, (2) the 4800-ft clay unit, (3) the screened intervals of the wells through which the cross-sections are passing (the deepest well at cluster locations), (3) the screened intervals of the DFZ wells, (4) the limits of the containment well capture zones, and (5) the pump intake elevation in the containment wells. The divergence of the water table from the ULFZ potentiometric surface in the area underlain by the 4970-foot silt/clay is shown in greater detail, for both the 1998 and the 2009 conditions in Figure 5.14.

The direction of groundwater flow and the hydraulic gradient in the DFZ during each round of the 2009 quarterly water-level measurements in the three DFZ wells, MW-67, MW-71R and MW-79, are shown in Figure 5.15. As shown in this figure, during 2009 the direction of groundwater flow in the DFZ ranged from W 22.0° N to W 34.2° N, and the hydraulic gradient from 0.00239 to 0.00306. The average direction of groundwater flow in the DFZ during 2009 was W 25.4° N with an average hydraulic gradient of 0.00262.

5.1.2 Effects of Containment Well Shutdown on Capture

As discussed in Section 3, the containment systems are occasionally shut down for maintenance and repairs, and sometimes due to power or equipment failures. For example, during 2008 the off-site containment system was shut down for about 53 hours due to a radio communication failure, and in 2007 the source containment system was shut down for more than 5 days to replace the well pump. In their review of the 2007 Annual Report USEPA/NMED expressed some concern on whether these shutdowns may result in the escape of contaminants beyond the capture zones of these systems. The capture zone for the source containment well lies within the capture zone of the off-site containment well, and its downgradient limit is within the plume area. Any shutdown of this well would cause some contaminants to escape beyond its capture zone, but these contaminants will remain within the capture zone of the off-site containment well and eventually captured by this well. Thus, the shutdown of the source containment system for any length of time is of no consequence.

Any contaminants that escape beyond the capture zone of the off-site containment well during the shutdown of this well, however, cannot be recovered unless the capture zone is increased by increasing the pumping rate of the well. Calculations made to evaluate this possibility indicate that it is highly unlikely. Under non-pumping conditions, the hydraulic gradient near the leading edge of the plume is about 0.003 (see Figures 2.12, 2.13 and 2.15). The aquifer above the 4800-foot clay has a hydraulic conductivity of 25 ft/d and a porosity of 0.3. Thus, the rate at which groundwater, and hence contaminants, would move under non-pumping conditions is 0.25 ft/d. If it is assumed that water levels recover to non-pumping conditions immediately after the shutdown of the offsite containment well, a shutdown of 30 days could cause the leading edge of the plume to move 7.5 ft downgradient of its pre-shutdown position. The downgradient distance between the limit of the capture zone for the off-site containment well and the leading edge of the plume is considerably more than 7.5 ft (see Figures 5.11 and 5.12); therefore, shutdowns of the length that have been experienced in the past, and of even much longer periods, could not cause any contaminants to escape beyond the capture zone of the well. Note also that the pending increase of the pumping rate of the well to 300 gpm, as recommended by Sparton (SSP&A, 2009b) and approved by USEPA/NMED,[6] will increase the distance between the leading edge of the plume and the limit of the capture zone.

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[6] See document cited in Footnote 1.

5.2 Groundwater Quality

5.2.1 Monitoring Well VOC Data

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 5.16 and plots for off-site wells in Figure 5.17. The concentrations in the on-site wells (Figure 5.16) 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 concentrations in the well have been below 10 μg/L since November 2003; the November 2009 concentration was 4.3 μg/L. Since the termination of the SVE operations in 2001, relatively low concentrations have been observed not only in this well but also in other onsite wells completed above the 4970-foot silt/clay unit; in fact, only four out of the eleven such wells that were sampled in 2009 had TCE concentrations above 5 μg/L. These four wells (MW-09, MW-12, MW-25, and MW-26) had concentrations of 16 μg/L, 18 μg/L, 10 μg/L, and 9.2 μg/L, respectively. This indicates that the cleanup of the unsaturated zone beneath the former Sparton plant area by the SVE system, and the flushing provided by the water infiltrating from the infiltration ponds of the source containment system has been very effective in reducing contaminant concentrations in the saturated sediments overlying the 4970-foot silt clay.

As shown in Figure 5.16, the TCE concentrations in on-site well MW-19, which is completed in the ULFZ below the 4970-foot silt/clay unit (see Figure 2.4), were in the several thousand μg/L level when the well was installed in 1986 and remained at that level for a few years before starting to decline. By November 1998, the TCE concentrations in the well had declined to a few μg/L levels. This declining trend reversed in November 2002 when the TCE concentration rose to 23 μg/L, and then to 630 μg/L by November 2003. The TCE concentrations in the well remained at the several hundred μg/L level until November 2008; however, it appears that they began declining again during 2009 as the November 2009 TCE concentration was 110 μg/L. A similar pattern is also displayed in the DCE and TCA concentrations in this well, albeit at lower levels. The concentration increases that were observed during the last several years were most probably due to an increase in the downward migration rate of contaminants present within the 4970-foot silt/clay unit that was caused by increased downward leakage rates across this unit; the increase in leakage rates was induced by the drawdowns below the unit caused by the pumping at CW-2 and the simultaneous increases in the water levels above the unit caused by seepage from the infiltration ponds.

The concentration plots of the six off-site monitoring wells shown in Figure 5.17 do not display a consistent trend; while the concentrations have been declining in most wells (see for example wells MW-55, MW-60, and MW-65) there are others where concentrations remain relatively stable (see for example well MW-37/37R and MW-53) and some where concentrations began to increase after a period of stabilization (see for example MW-56). This is primarily due to changes in groundwater flow patterns that were caused by the operation of the off-site containment system.

The concentrations in well MW-60 continued to be the highest observed in an off-site well, as it has been the case since the beginning of remedial operations. 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; since then TCE concentrations in the well have declined to 2,200 μg/L in November 2009. The DCE and TCA concentrations in this well also declined from 830 μg/L and 59 μg/L in November 2004 to 230 μg/L and 8.4 μg/L, respectively, in November 2009. In general, the "rule-of-thumb" is that the presence of a contaminant at concentrations equal to or exceeding 1% of its solubility indicates the potential nearby presence of that contaminant as a free product (Newell and Ross, 1991; Pankow and Cherry, 1996) usually referred to as a non-aqueous phase liquid (NAPL). The solubility of TCE, a dense NAPL or DNAPL, is 1,100,000 μg/L; the concentrations of 11,000 μg/L and of 18,000 μg/L that were observed in MW-60 in November 1999 and 2004, respectively, meet the criteria of this rule-of-thumb. There are several factors, however, that preclude the presence of a DNAPL source near MW-60. First, the well is screened in the upper part of the aquifer and located almost 2,000 feet downgradient from the site; there is no plausible physical mechanism by which TCE could migrate to such a distance from the site as a DNAPL within a thick and fairly homogeneous aquifer. Second, although TCE concentrations above 10,000 μg/L and as high as 59,000 μg/L have been observed in several on-site wells in 1984 (Harding Lawson Associates, 1985), DNAPL has not been reported for any on-site boring or monitoring well. Finally, the gradual increase in the concentrations between 1993 and 1999, the occurrence of the high concentrations as two separate peaks with relatively lower concentrations in between, and the subsequent decrease in concentrations indicate that the contaminant concentrations in this well represent two slugs of highly contaminated groundwater that migrated from the site rather than a nearby DNAPL source. The migration of slugs of highly contaminated groundwater from the site is consistent with the high TCE concentrations that were observed at the site in 1984. It is of interest to note that Pankow and Cherry (1996, p. 459) state that "[t]he use of a 1% rule-of-thumb in any assessment of the spatial distribution of DNAPL zones must be performed cautiously, particularly in the downgradient direction. For example, the dissolved plume emitted from a very large DNAPL zone may exhibit dissolved concentrations above 1% of saturation for a substantial distance downgradient of the source zone."

Monitoring well MW-65, whose concentration trends are also shown in Figure 5.17, had low μg/L levels of TCE when first sampled after installation in 1996; TCE, at concentrations up to about 15 μg/L, was the only contaminant detected in this well before and at the start of the off-site containment system. The concentrations of TCE in the well declined rapidly after the start of the off-site containment system to "not detected" (at a detection limit of 1 μg/L) in August 1999, and remained "not detected" for almost two years. The well became contaminated again in 2001 but, as shown in Figure 5.17, this time the well contained not only TCE but also DCE and TCA with the dominant contaminant being DCE; the concentrations of these contaminants peaked around 2005 or 2006 and they have been declining since then. There are only two other wells, besides MW-65's post-2001 contamination, where the dominant contaminant is DCE; these are wells MW-62 and MW-52R. A plot of the contaminant concentrations in these two wells is presented in Figure 5.18; the plot for MW-65 is also repeated in this figure to provide for easy comparison. The dominant contaminant in all other wells associated with the Sparton Site is TCE (see for example the concentration plots of all the other wells shown in Figures 5.16 and 5.17). This indicates that the post-2001 contamination of MW-65 and that of MW-62 and MW-52R is due to a separate, DCE-dominated plume, although some mixing with the main plume may be occurring in the vicinity of MW-52R. Evaluations of the available data, including backward tracking from well MW-65 using water level data collected since 1992,[7] and review of historical water-quality data from monitoring wells MW-34 and MW-35,[8] which shows that these wells were historically free of contaminants, indicate that the source of this separate plume lies somewhere south or southeast of wells MW-62, MW-35, and MW-34, and that, therefore, this plume does not originate at the Sparton Facility.[9]

Of the three monitoring wells completed in the DFZ, well MW-67 of the MW-48/55/56/67 cluster had been clean since its installation in July 1996, and continued to be free of any contaminants in 2009. The second DFZ well, MW-71R, located about 30 ft south of the MW-60/61 cluster, was installed in February 2002 as a replacement for DFZ well MW-71 which was plugged and abandoned in October 2001 because of persistent contamination.[10] The first sample from MW-71R, obtained in February 2002, had a TCE concentration of 130 µg/L, and the well remained contaminated since then with TCE concentrations reaching a high of 210 µg/L in August 2003. After that, however, TCE concentrations in the well began steadily declining to 52 µg/L by November 2008; during 2009, the TCE concentrations in the well remained at the 50 µg/L level with the November 2009 concentration being 57 µg/L. The third DFZ well, MW-79, was installed near the off-site containment well CW-1 in February 2006 as a monitoring/stand-by extraction well to address the contamination detected in MW-71R; the

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[7] See Attachment 3 to letter dated February 12, 2009 from Charles B. Andrews of SSP&A to Chuck Hendrickson of USEPA Region 6, and John Kieling of NMED, on the subject: Response to EPA/NMED comments on Sparton Technology, Inc., Former Coors Road Plant Remedial Program, 2003-2007 Annual Reports (including 5 attachments), with cc to Susan Widener, James B. Harris, Tony Hurst, and Gary L. Richardson.

[8] Well MW-35 was located along Irving Boulevard, about 500 ft northwest of MW-34; it became dry in 2002 and was plugged and abandoned in 2007.

[9] USEPA and NMED agree that the contaminants detected in MW-65 and MW-62 are due to a separate plume, but they disagree that this plume did not originate at the Sparton facility; the agencies are also concerned that contaminants that belong to this plume or that have not been captured by the off-site containment system, may be present outside the capture zone of the off-site containment well, and they requested the installation of a sentinel well northwest of MW-65 (see documents cited in Footnotes 4 and 7 and memorandum dated March 24, 2009 from Stavros S. Papadopulos of SSP&A to Charles Hendrickson of USEPA, Region 6, and John Kieling, Braid Swanson, and Brian Salem of NMED on the subject: Sparton Technology, Inc. Former Coors Road Plant Remedial Program, Minutes of Conference Call between Representatives of Sparton, USEPA and NMED [including 2 attachments], with cc to Richard Langley and Susan Widener of Sparton, James B. Harris of Thompson & Knight, Tony Hurst of Hurst Eng.'g Services, and Gary Richardson of Metric). In ensuing negotiations, the parties reached agreement on the installation, location, and completion of such a sentinel well (see SSP&A and Metric, 2010).

[10] See 1999 Annual Report (SSP&A, 2001a) for a detailed discussion of the history of well MW-71, and SSP&A and Metric (2002) for actions taken prior to its plugging and abandonment.

decision on whether the well was to be a monitoring or an extraction well was to be based on the results of the initial sampling of the well. The initial sampling of the well showed the well to be free of site-related contaminants; therefore, the well was designated as a monitoring well, and added to the Monitoring Plan under a semi-annual sampling schedule. Samples collected from the well since then continued to be free of any site-related contaminants.

The direction of groundwater flow in the DFZ places wells MW-67 and MW-79 downgradient of the Sparton Facility. The lack of any contaminants in these two DFZ wells and the declining trend of TCE in well MW-71R indicate that this well is most likely affected by a contaminant slug of limited extent. The water quality in these three DFZ wells will continue to be monitored closely and periodically evaluated to determine if any future action might be necessary.

The Fourth Quarter (November) 2009 TCE and DCE data presented in Table 4.2 were used to prepare concentration distribution maps showing conditions near the end of 2009. The horizontal extent of the TCE and DCE plumes and the concentration distribution within these plumes in November 2009, as determined from the monitoring well data, are shown on Figures 5.19 and 5.20, respectively. The fact that wells MW-62, MW-65, and MW-52R are affected by a separate plume was taken into consideration in preparing these figures. (At well cluster locations, the concentration shown in Figures 5.19 and 5.20 is that for the well with the highest concentration.) Concentrations of TCA in all monitoring and extraction wells have been below regulatory standards since 2003; in November 2009 only seven of the 56 sampled wells contained TCA above the detection limit of 1 μg/L. The highest TCA concentration, 8.4 μg/L, was measured in well MW-60; the concentrations in the other six wells where TCA was detected were less than 3 μg/L (see Table 4.2). Based on the low concentrations of TCA that have been observed since 2003, Sparton proposed in the 2008 Annual Report (SSP&A, 2009a) that evaluations of TCA data be discontinued, unless concentrations increase above regulatory standards. This proposal was approved by both USEPA[11] and NMED[12] in May 2010; evaluations of TCA data are not, therefore, included in this 2009 Annual Report, except in the calculations of mass removal by the off-site containment well.

Fifty-five of the 56 wells sampled in November 2009 were also sampled in November 2008.[13] In these 55 wells, the November 2009 TCE concentrations were lower than the November 2008 concentrations in 23 wells, higher in 7 wells, and remained the same in 25 wells (24 below the detection limit of 1 μg/L). The largest decrease was in well MW-60 where the

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[11] E-mail dated May 11, 2010 from Charles Hendrickson of USEPA to Stavros Papadopulos of SSP&A with cc to Baird Swanson and Brian Salem of NMED on the subject "Re: Extension approval and Comments on 2008 Report," with an attachment titled "Annual Report 2008 draft comments" which included draft comments by C. Hendrickson, dated March 11, 2010.

[12] E-mail dated May 17, 2010 from John Kieling of NMED to Stavros Papadopulos of SSP&A with cc to Charles Hendrickson of USEPA, Baird Swanson and Brian Salem of NMED, Joe Lerczak of Sparton, James Harris of Thompson & Knight, Gary Richardson of Metric, and Tony Hurst of Hurst Engineering on the subject "Re: TCA valuation" indicating that NMED agrees to discontinuing TCA evaluations.

[13] These 55 wells include MW-53 which was dry in November 2008, but was deepened (MW-53D) and sampled in February 2009.

concentration of TCE decreased by 2,600 μg/L, from 4,800 μg/L in 2008 to 2,200 μg/L in 2009; the largest increase in a monitoring well was at MW-56 where the concentration of TCE increased by 37 μg/L, from 93 μg/L in 2008 to 130 μg/L in 2009. The November concentration of TCE was also higher in the off-site containment well CW-1, 1,100 μg/L in 2009 versus 990 μg/L in 2008; however, the average TCE concentration in this well during 2009 (870 μg/L) was 110 μg/L lower than that during 2008 (980 μg/L). The corresponding numbers for DCE were 10 wells with lower, 6 wells with higher, and 39 wells with the same (38 below the detection limit of 1 μg/L) concentrations. The largest decrease was also in well MW-60 where the concentration of DCE decreased by 170 μg/L, from 400 μg/L in 2008 to 230 μg/L in 2009; the largest increase was in well MW-72 where the concentration of DCE increased by 15 μg/L, from 74 μg/L in 2008 to 89 μg/L in 2009. On-site monitoring well MW-19, which had started having high TCE and DCE concentrations in 2003 due to increased downward leakage through the 4970 ft silt/clay unit after the start of the source containment system, had considerably lower concentrations during 2009; the concentration of TCE in the well went from 490 μg/L in 2008 to 110 μg/L in 2009 and that of DCE from 77 μg/L in 2008 to 19 μg/L in 2009.

Changes that occurred between November 1998 (prior to the implementation of the current remedial activities) and November 2009 in the TCE, and DCE concentrations at wells that were sampled during both sampling events are summarized on Table 5.1. Also included on this table are wells MW-72 and MW-73 which were installed in early 1999 and wells MW-77, MW-78, and CW-2, which were installed in late 2001; the listed changes in these wells are between November 2009 and the first available sample from these wells. Of the 52 wells listed on Table 5.1, the TCE concentrations decreased in 31, increased in 6 and remained unchanged in 15 (below detection limits during both sampling events). The corresponding number of wells where DCE concentrations decreased, increased, or remained unchanged are 27, 5, and 20. Of the 52 wells listed on Table 5.1, 37 are among the wells that were used for defining the November 1998 plume, or the November 2009 plume, or both. Concentration changes in these 37 wells are presented in Figures 5.21, and 5.22 to show the distribution of concentration changes that occurred since the implementation of the off-site and source containment systems. Also shown on these figures is the extent of the plumes in November 1998 and November 2009. Among these 37 wells, TCE concentrations decreased in 27 wells, increased in 4 wells, and remained unchanged in 6 wells (below detection limits during both sampling events); the corresponding number of these wells where DCE concentrations decreased, increased, or remained unchanged are 24, 4, and 9.

The largest decreases in contaminant concentrations since the beginning of the current remedial operations occurred in on-site wells. Concentrations of TCE in on-site wells MW-23, MW-25, and MW-26 decreased by 6,196, 5,590, and 6,491 μg/L, respectively, from levels that were in the 5,500-6,500 μg/L range in 1998 to levels of 10 μg/L and less in 2009; DCE concentrations in these three wells decreased by 400, 73, and 590 μg/L, to "not detected" (ND) since 2007 (since 2004 in MW-26). Among off-site wells, the largest decreases in TCE concentrations occurred in MW-60 (5,500 μg/L, from 7,700 μg/L in 1998 to 2,200 μg/L in 2009) and MW-46 (1,875 μg/L, from 2,200 μg/L to 325 μg/L).

The largest increases in TCE and DCE concentrations occurred in the off-site containment well CW-1 (960 μg/L, and 61 μg/L, respectively), and on-site ULFZ well MW-19 (106 μg/L and 19 μg/L, respectively

The concentrations of TCE in the water pumped from the off-site containment well CW-1 increased rapidly after the start of its operation to levels in the 1,000-1,500 μg/L range, and remained at those levels for several years. Although a declining trend appears to have started in 2005 [see Figure 6.8 (a)], TCE concentrations in the well are still near the 1,000 μg/L level; the average concentration during 2009 was about 870 μg/L. The persistence of these high concentrations in the water pumped from the well, and the concentrations detected at well MW--60 indicate that areas of high concentration were present upgradient from both of these wells. Most of the water in these upgradient areas of high concentration, however, has been already captured and pumped out by the off-site containment well (see Figure 5.26).

5.2.2 Monitoring Well DO and ORP Data

Based on an evaluation conducted in early 2008, Sparton recommended in the 2007 Annual Report (SSP&A, 2008) that collection of DO and ORP data be discontinued. This recommendation was approved by USEPA and NMED in December 2008[14] and, therefore, data on DO and ORP concentrations were not collected during 2009.

5.3 Containment Systems

5.3.1 Flow Rates

A total of about 139.3 million gallons of water, corresponding to an average pumping rate of about 265 gpm, were pumped during 2009 from the off-site and source containment wells (see Table 4.3). The volume of water pumped during each year of the operation of the containment wells is summarized on Table 5.2. As shown on this table, the total volume pumped from both wells since the beginning of remedial pumping in December 1998 is about 1.471 billion gallons, and corresponds to an average rate of 254 gpm over the 11 years of operation. This volume represents approximately 130 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 2009 is shown on Table 4.3; a plot of the monthly production is presented in Figure 5.23. Based on the total volume of water pumped during the year (approximately 114.8 million gallons), the average discharge rate for the year was 218 gpm. Due to a few downtimes (see Table 3.1), the well was operated 98.7 percent of the time available during the year, thus the average discharge rate of the well during its operating hours was about 221 gpm.

[14] See document cited in Footnote 4.

The volume of water pumped during each year of the operation of the well is summarized on Table 5.2. As shown on this table, the off-site containment well pumped a total of about 1.269 billion gallons of water from the aquifer since the beginning of its operation in December 1998. This represents approximately 112 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 5.24.

5.3.1.2 Source Containment Well

The volume of water pumped from the source containment well during each month of 2009 is shown on Table 4.3; a plot of the monthly production is presented in Figure 5.23. Based on the total volume of water pumped during the year (approximately 24.5 million gallons), the average discharge rate for the year was 47 gpm. The well was operated 98.9 percent of the time available during the year, thus the average discharge rate of the well during its operating hours was slightly above 47 gpm.

The volume of water pumped during each year of the operation of the well is summarized on Table 5.2. As shown on this table, the source containment well pumped a total of about 202 million gallons of water from the aquifer since the beginning of its operation on January 3, 2002. This represents approximately 18 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 source containment well is presented in Figure 5.24. Also shown in Figure 5.24 is a cumulative plot of the total volume of water pumped by both containment wells.

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 2009, as determined from samples collected 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 5.25.

The concentrations of TCE in the influent during 2009 ranged from a low of 690 µg/L in the October sample to a high of 1,100 µg/L in the November sample. The average concentration for the year was about 870 µg/L; this average concentration was 110 µg/L lower than the average concentration during 2008 (980 µg/L). The lowest (62 µg/L) and highest (97 µg/L) concentrations of DCE were detected in the May and February samples, respectively; the average concentration for the year was about 72 µg/L. Concentrations of TCA in the influent fluctuated within a relatively narrow range (2.5 µg/L to 2.9 µg/L) and averaged about 2.7 µg/L. 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 16 µg/L.

The concentrations of TCE, DCE, and TCA in the air stripper effluent were below the detection limit of 1 μg/L throughout 2009. Total chromium concentrations in the effluent were essentially the same as those in the influent.

5.3.2.2 Source Containment System

The 2009 concentrations of TCE, DCE, TCA, and total chromium in the influent to and effluent from air stripper for the source containment system, as also determined from samples collected 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 5.25.

The concentrations of TCE in the influent during 2009 ranged from 55 μg/L in September and October to 72 μg/L in November, and averaged about 64 μg/L. This average concentration was 26 μg/L lower than the average concentration during 2008 (90 μg/L). The concentrations of DCE fluctuated within a relatively narrow range during the year (6.8 μg/L to 10 μg/L) and averaged about 8.3 μg/L. The concentrations of TCA in the influent were below the detection limit of 1 μg/L throughout the year, and total chromium concentrations were below the 50 μg/L maximum allowable concentration in groundwater set by NMWQCC; the average total chromium concentration was 29 μg/L.

The concentrations of TCE, DCE, and TCA in the air stripper effluent were below detection limits throughout the year, and chromium concentrations 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 period was originally stored is referred to as the "area of origin" of the water pumped during that period. Particle tracking analysis (see Section 6.1.3) with the calibrated model of the site was used to determine the areas of origin of the water pumped from the off-site containment well during the last eleven years and from the source containment well during the last eight years. The results of this analysis are presented in Figure 5.26. The areas from where the water pumped during different periods originated are shown in Figure 5.26 (a); the schematic cross-section of Figure 5.26 (b) shows the vertical extent of these areas of origin. The areas of origin of the water pumped by each of the two containment wells are discussed below.

5.3.3.1 Off-Site Containment Well

For the off-site containment well, which is fully penetrating the aquifer above the 4,800-foot clay, the area of origin of the water pumped during the first few years of its operation (1999-2001) is an almost circular area around the well, with the well off-centered on the down-gradient side of the area [Figure 5.26 (a)]. The areas of origin corresponding to subsequent years of operation form rings around this first area, which become more and more elliptical and more and more skewed towards the upgradient side (southeast) of the well. The elliptical shape and the off-centered location of the areas of origin with respect to the containment well are controlled by the capture zone of the well. Since the capture zone is a limiting flow line, the areas of origin become narrower as they approach the downgradient (northwestern) limit of the capture zone and the stagnation point of the flow field. The area of origin of the water pumped during 2009 has already reached this limit of the capture zone; therefore, very little of the water pumped, or to be pumped, during 2010 and later years would be expected to originate from this area, except that the planned increase in the pumping rate of CW-1 would push the limit of the capture zone farther to the northwest. Note also that the 2009 area of origin has a tail at its eastern extent; this tail reflects water that originated from downward leakage through the 4970-foot silt/clay unit.

Since the well is fully penetrating, the areas of origin of the water pumped by this well remain essentially the same at different depths [see Figure 5.26 (b)], except that water derived from vertical drainage due to the decline of the water table reduces the areal extent of the area of origin in the upper horizons of the aquifer; the effect of vertical drainage is more pronounced during the early years of operation when the rapid decline of the water table in response to the start of pumping contributed a greater percentage of the pumped water than in later years.

5.3.3.2 Source Containment Well

Hydrogeologic conditions in the vicinity of the source containment well are different than in the vicinity of the off-site containment well because of the presence of the 4970-foot silt/clay unit, the presence of different deposits in the upper part of the aquifer between the Site and the Rio Grande (the Upper Sand Unit and the Recent Rio Grande deposits, as shown in Figure 6.1), and the partial penetration of the aquifer by the source containment well. The screened interval of the well extends about 40 ft into the aquifer below the 4970-foot silt/clay unit; groundwater flow towards this screened interval is, therefore, influenced by downward leakage through the silt/clay unit and from the Upper Sand Unit, by flow from the Recent Rio Grande deposits, and by upward leakage from horizons of the aquifer below the screened interval. Because of these influences the areas of origin of the water pumped by this well are more elongated towards the east-southeast [Figure 5.26 (a)]. Note that the area of origin of the water pumped by this well during 2009 has reached the limit of the capture zone for this well not only on the downgradient side but also along the northeastern and southwestern flanks; therefore, the areas of origin of water to be pumped in future years lie in the area between the Rio Grande and the southeastern extent of the 2009 area of origin. The elongation of the areas of origin towards the southeast is primarily caused by downward leakage and is limited to the upper horizons of the aquifer; within the screened interval of the well below the 4970-foot silt/clay, the areas of origin form concentric ellipses that are similar to those of the off-site containment well.

5.3.4 Contaminant Mass Removal

A total of about 410 kg (900 lbs) of contaminants, consisting of about 380 kg (840 lbs) of TCE, 32 kg (70 lbs) of DCE, and 1.3 kg (2.8 lbs) of TCA, were removed by the two containment wells during 2009 [see Table 5.3 (a)]. A plot of the TCE, DCE and total mass removed by the two containment wells during each month of 2009 is presented in Figure 5.27. The total mass of contaminants removed by the two containment wells during each year of their operation is summarized on Table 5.4 (a), and a plot of the cumulative TCE, DCE, and total mass removed by the wells is presented in Figure 5.28. As shown on Table 5.4 (a), the total mass removed by the containment wells, since the beginning of the current remedial operations in December 1998, is about 5,880 kg (12,960 lbs), consisting of about 5,510 kg (12,140 lbs) of TCE, 350 kg (760 lbs) of DCE, and 16 kg (36 lbs) of TCA. This represents about 75 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 2009 were estimated using the monthly discharge volumes presented on Table 4.3 and the concentration of these compounds shown on Table 4.4 (a). These monthly removal rates are summarized on Table 5.3 (b); plots of the monthly TCE and DCE removal rates are presented in Figure 5.27. As shown on Table 5.3 (b), about 400 kg (890 lbs) of contaminants, consisting of about 370 kg (820 lbs) of TCE, 31 kg (69 lbs) of DCE, and 1.2 kg (2.7 lbs) of TCA were removed by the off-site containment well during 2009.

The mass of contaminants removed by this well during each year of its operation is summarized on Table 5.4 (b), and a plot showing the cumulative TCE, DCE, and total mass removal by the off-site containment well is presented in Figure 5.28. As shown on Table 5.4 (b), by the end of 2009 the off-site containment well had removed a total of approximately 5,650 kg (12,460 lbs) of contaminants, consisting of approximately 5,310 kg (11,710 lbs) of TCE, 320 kg (700 lbs) of DCE, and 13 kg (28 lbs) of TCA. This represents about 72 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 and DCE by the source containment well during the 2009 were estimated using the monthly discharge volumes presented on Table 4.3 and the concentration of these compounds shown on Table 4.4 (b). These monthly removal rates are summarized on Table 5.3 (c) and plotted in Figure 5.27. As shown on Table 5.3 (c), about 6.7 kg (15 lbs) of contaminants, consisting of about 5.9 kg (13 lbs) of TCE and 0.76 kg (1.7 lbs) of DCE were removed by the source containment well during 2009.

The mass of contaminants removed by this well during each year of its operation is summarized on Table 5.4 (c), and a plot showing the cumulative TCE, DCE, and total mass removal by the source containment well since the beginning of its operation on January 3, 2002 is presented in Figure 5.28. As shown on Table 5.4 (c) and Figure 5.28, the total mass of contaminants removed by the well by the end of 2009 was about 230 kg (500 lbs), consisting of 200 kg (430 lbs) of TCE, 27 kg (60 lbs) of DCE, and 3.4 kg (7. 4 lbs) of TCA. This represents about 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).

5.4 Site Permits

5.4.1 Off-Site Containment System

The infiltration gallery associated with the off-site containment system is operated under the Discharge Permit (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.

As required by the current Discharge Permit, the analysis results of all samples collected during 2009 were reported to the NMED Groundwater Bureau on January 29, 2010. The sampling results met the permit requirements throughout the year. No violation notices were received during 2009 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 2009.

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 2009. No violation notices were received during 2009 for activities associated with operation of the source containment system.

5.5 Contacts

On November 2, 2009 and November 16, 2009, Baird Swanson and Brian Salem of NMED were on site to assist in diffusion bag sampling of monitoring well OB-1.

Under the terms of the Consent Decree,[15] 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

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[15] 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.

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. Draft Fact Sheets prepared by Sparton during the next several years did not get the approval of USEPA/NMED because the 2003 and subsequent Annual Reports had not been yet approved[16] and, therefore, were not distributed to the property owners. After the approval of the 2003-2006 Annual Reports in December 2008,[17] Sparton prepared a combined 2002-2006 Fact Sheet that was submitted to the USEPA/NMED on March 6, 2009 and approved on May 8, 2009; in June 2009, this combined Fact Sheet was distributed to the property owners located above the plume and adjacent to the off-site treatment plant water discharge pipeline.

[16] Under the terms of the Consent Decree the Fact Sheets cannot be finalized before the Annual Reports for the years covered by the Fact Sheets have been approved.

[17] See document cited in Footnote 4.

Section 6
Groundwater Flow and Transport Model

This section describes a numerical groundwater flow and contaminant transport model of the aquifer system underlying the Sparton site and its vicinity that has been used to evaluate water levels and TCE concentrations. 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 Decree. The development of the current version of the model is described in detail in the 2008 Annual Report (SSP&A, 2009a). The initial version of the model was described in the 1999 Annual Report (SSP&A, 2001) and the model has been updated and recalibrated several times since then as described in the 2008 Annual Report. The groundwater flow model is based on MODFLOW-2000 (Harbaugh and others, 2000). The flow model is coupled with the solute transport simulation code MT3D (Zheng, 2008; Zheng and SSP&A, 1999) for the simulation of the movement of constituents of concern in the aquifer underlying the site, and the particle tracking codes PATH3D (Zheng, 1991) and MODPATH (Pollock, 1994; 2008) for the calculation of capture zones and of areas of origin, respectively. The models have been used to simulate groundwater levels and TCE concentrations in the aquifer from start-up of the off-site containment well in December 1998 through December 2010.

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 15,000 ft by 9,500 ft. The model consists of 88 rows and 133 columns. The central part of the model covers a finely gridded area of 4,900 ft by 2,800 ft which includes the Site and the off-site plume; the grid spacing in this area is uniform at 50 ft. Outward from this central area, the grid spacing is gradually increased to as much as 1,000 feet at the limits of the model domain. The model grid is aligned with the principal axes corresponding to the approximate regional groundwater flow direction (25° clockwise rotation).

The model consists of 15 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 76-foot thick deep flow zone, layer 14 represents the 15-foot thick 4705-foot clay unit, and layer 15 represents the upper 165 ft of the deeper aquifer units.[18] The vertical discretization was selected to minimize vertical numerical dispersion.

[18] The units represented by Layers 13, 14, and 15 were identified from the log of the USGS Hunter Ridge Park 1 Boring (Johnson and others, 1996).

6.1.1.1 Boundary Conditions

The eastern boundary of the model is a no-flow boundary located just east of the Rio Grande and oriented approximately parallel to the river. The northern and southern boundaries of the model are specified as no-flow boundaries along the eastern portion of these boundaries and as constant head boundaries along the western portion of these boundaries (see Figure 6.1). In the eastern portion of the model area, regional groundwater flow is away from the Rio Grande and approximately parallel to the northern and southern boundaries of the model and thus it is appropriate to specify these portions of the model boundaries as no-flow boundaries. In the western portion of the model area, regional groundwater pumping creates a divergence in groundwater flow directions. As a result, in the western portion of the model area regional groundwater flow is not parallel to the northern and southern model boundaries. Consequently, the western 5,000-foot portions of these boundaries were specified as constant-head boundaries such that groundwater flows out of the model area across these boundaries could be simulated. The western boundary of the model area is also simulated as a constant-head boundary.

The water levels on the constant head boundaries were estimated during model calibration. In the model calibration process the water-levels on the constant head boundaries were specified on the basis of five parameters. The five parameters were water levels in 1998 at the following locations: (1) in layer 1 at the eastern end of the constant-head segment of the northern boundary (4,959.47 ft MSL); (2) in layer 1 at the eastern end of the constant head segment of the southern boundary (4,950.63 ft MSL), (3) in layer 1 in the northwest corner of the model grid (4,954.37 ft MSL); (4) in layer 1 in the southwest corner of the model grid (4,948.04 ft MSL); and (5) in layer 1 in the center of the western model boundary (4,951.05 ft MSL). The locations of these constant-head boundary parameters are shown on Figure 6.1. Based on these five water levels, water levels were estimated at all constant-head boundary cells using the following algorithm:

1. Water levels along the constant-head boundaries in layer 1 in 1998 were calculated by linear interpolation from the 5 water levels described above. Water levels in subsequent years were calculated based on annual regional water-level declines that were derived based on an evaluation of long-term hydrographs of monitoring wells; an annual rate of decline of 0.4 foot was specified from 1998 through 2007 and an annual rate of decline of 2.0 feet was specified for 2008 and 2009. In the model described in the 2008 Annual Report (SSP&A, 2009a) the annual rate of decline of 0.4 foot was used for the entire simulation period of 1998 to 2008; the rate of decline for 2008 was adjusted this year following a re-evaluation of trends in regional water levels. Examples of long-term hydrographs are shown on Figure 6.3.

2. Water levels in constant-head boundary cells in layers 2 through 11 were calculated based on the water levels estimated in layer 1 and a specified vertical hydraulic gradient of 0.02 ft/ft. This vertical hydraulic gradient was assumed to be constant through time.

3. Water levels in constant head cells in layers 12 and 13 were calculated based on the water levels estimated in layer 11 and a specified water-level change across the 4800-

foot clay of 2.34 feet. This water-level change was determined in the model calibration process.

4. Water levels in constant head cells in layers 14 and 15 were calculated based on water levels estimated in layer 13 and a specified water-level change of two feet across the clay unit represented by layer 14. The water-level change was estimated from water-level data from the USGS monitoring well cluster at Hunter Ridge adjacent to Arroyo de las Calabacillas.

6.1.1.2 Hydraulic Properties

Five hydrogeologic zones are specified within the model domain:

- Holocene-aged channel and flood plain deposits, also referred to as Recent Rio Grande deposits;
- the 4970-foot silt/clay unit, which represents Late-Pleistocene-aged overbank deposits;
- sands of the Upper Santa Fe Group, Late-Pleistocene-aged channel and flood plain deposits, and Late-Pleistocene-aged and Holocene-aged arroyo fan and terrace deposits, collectively referred to as the sand unit; and
- the 4800-foot clay unit;
- the 4705-foot clay unit.

The sand unit, which is primarily classified as USF2 facies assemblages 2 and 3 (Hawley, 1996), was subdivided into six subzones for purposes of model calibration:

1. Sand unit above the 4970-foot silt/clay unit, except near the far southeastern of the silt/clay unit, which represent Late-Pleistocene-aged arroyo fan and terrace deposits (this zone was defined north of the simulated discontinuity shown on Figure 6.1);
2. Sand unit above the 4970-foot silt/clay unit near the far southeastern extent of this unit (this zone was defined south of the simulated discontinuity shown on Figure 6.1);
3. Sand unit in the region between the western extent of the Rio Grande deposits and the eastern extent of the 4970-foot silt/clay unit (This zone is shown as the "Upper Sand Unit" on Figure 6.1);
4. Sand unit above the 4800-foot clay unit except above and in vicinity of 4970-foot silt/clay unit;
5. Sand unit between the 4800-foot clay unit and the 4705-foot clay unit (model layer 13);
6. Sand unit below the 4705-foot clay unit (model layer 15).

The spatial extent of the Recent Rio Grande deposits, the 4970-foot silt/clay unit, and the Upper Sand Unit are shown in Figure 6.1. Also shown on Figure 6.1 is the location of a discontinuity in the sand unit above the 4970-silt/clay unit. This discontinuity was simulated with the MODFLOW horizontal flow barrier package. The horizontal conductance of the barrier was specified as 10^{-6} per day.

The hydraulic conductivity, specific yield and specific storage in each of the hydrogeologic zones in the calibrated groundwater model are listed on the table below.

Hydrogeologic Zone		Hydraulic Conductivity, ft/d		Specific Yield	Specific[19] Storage, ft^{-1}	Model Layers in which zone is present
		Horizontal	Vertical			
Recent Rio Grande deposits		150	0.025	0.2	2×10^{-6}	1-6
4970-foot silt/clay unit		0.0041	0.00003		2×10^{-6}	3
Sand unit	above 4970-foot silt/clay unit	40	0.2	0.2	2×10^{-6}	1
Sand unit	above 4970-foot silt/clay unit	99	0.5	0.2	2×10^{-6}	2
Sand unit	above 4970-foot silt/clay unit near SE extent	40	0.3	0.2	2×10^{-6}	1,2
Sand unit	between Recent Rio Grande deposits and eastern extent of 4970-foot silt/clay unit (Upper Sand Unit)	120	0.05	0.2	2×10^{-6}	1,2
Sand unit	above the 4800-foot clay unit	25	0.2	0.2	2×10^{-6}	3-11
Sand unit	in Layer 13	23	0.068		2×10^{-6}	13
Sand unit	in Layer 15	22	0.1		2×10^{-6}	15
4800-foot clay unit		0.0042	0.00053		2×10^{-6}	12
4705-foot clay unit		0.2	0.058		2×10^{-6}	14

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 were extraction wells for an IM that was implemented in 1988. 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 213 gpm and 225 gpm. The average pumping rate in 2009 was 218 gpm. The pumping at CW-1 is distributed across model layers 6 through 11 and is apportioned based on layer transmissivities.[20] 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 and is specified at the same rate as the CW-1 pumping rate.

[19] 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). This value was not estimated during model calibration.

[20] The production wells CW-1 and CW-2 are simulated in MODFLOW with the Multi-Node Well (MNW) package which dynamically allocates production to model layers based on water levels, hydraulic conductivity and layer thickness.

The source containment well, CW-2, began operation in January 2002. The well has operated at an average annual pumping rate of between 46 gpm and 52 gpm. The average pumping rate in 2009 was 47 gpm. The pumping at CW-2 is distributed across model layers 3 through 8.[20] 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 some of the ponds are used for infiltration at any given time; during 2002 the treated discharge from the well was rotated among the six original ponds, in 2003 and 2004 only ponds 1 and 4 were used, and from 2004 to 2009 the discharge was rotated among ponds 1 through 4 (see Figure 2.10 for pond locations). Ponds 5 and 6 were backfilled during 2005. In the model, the amount of water directed to each of the ponds was based upon operation records.

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 0.24 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 is specified to occur from the Rio Grande and the Arroyo de las Calabacillas. 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 and the river-bed conductance was determined as part of the model calibration process. Recharge along the Arroyo de las Calabacillas was simulated with the MODFLOW recharge package. This recharge rate was determined during the model calibration process to be 0.2 ft/year.

6.1.2 Model Simulated Water Levels from 1999 through 2009

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 2009 for purposes of evaluating correspondence between model calculated and observed water levels. An initial steady-state stress period was used to simulate conditions prior to startup, and this was followed by a month-long stress period for December 1998, and annual stress periods for the years 1999 through 2009. The average annual pumping rates specified for the containment wells CW-1 and CW-2 are those specified on Table 5.2.

A total of 755 water-level targets were used to evaluate the correspondence between model calculated and observed water levels. These targets were developed from average annual water levels for each year from 1998 to 2009 calculated from available water-level data for seventy-seven monitoring wells at the Sparton site and four piezometers maintained by the USGS at the Hunters Ridge site located near the infiltration basin on the north side of the Arroyo de las Calabacillas.

The calculated water levels in December 2009 with the calibrated groundwater model for the water table (UFZ), ULFZ, and LLFZ[21] are shown in Figures 6.4, 6.5, and 6.6, respectively. These calculated water levels are similar to observed water levels. The correspondence between observed and model-calculated water levels was evaluated using both qualitative and quantitative measures. The qualitative measures included: (1) the preparation of scatter plots of observed versus calculated water levels to provide a visual comparison of the fit of model to the observed water level data; (2) plots of observed and calculated water levels for the period 1998 through 2009 for each of the monitoring wells and piezometers used for model calibration; (3) maps of the difference between observed and calculated water levels for each of the major aquifer units; and (4) evaluation of model water balance.

Scatter plots of observed water levels versus calculated water levels between 1998 and 2009 for all monitoring wells in the UFZ above the 4970-foot silt/clay unit (on-site UFZ wells), for all wells in the UFZ, ULFZ and LLFZ except for those above the 4970-foot silt/clay unit, and for all wells in the DFZ are shown on Figure 6.7. In a model with good correspondence between calculated and observed water levels, the points on the scatter plot are random and closely distributed about the straight line that represents an exact match between the calculated and observed groundwater levels. The scatter plots shown in Figure 6.7 plot the average observed water level in each monitoring well during each year of the simulation against the average water level calculated for each well during each year of the simulation.[22] These scatter plots visually illustrate the excellent comparison between model calculated water levels and observed water levels in the UFZ/ULFZ/LLFZ and DFZ zones. In the on-site UFZ the correspondence between observed and calculated water levels is not as good as in the other zones. This is the result of significant heterogeneity in the sands above the 4970-foot silt/clay unit.

Plots of observed versus calculated water levels at all monitoring wells and piezometers used are shown in Appendix D on Figures D-1, D-2, and D-3. These plots indicate that the water-level trends in the observed and calculated water levels are very similar at almost all monitoring wells illustrating the close correspondence between observed and calculated water levels. The areal distribution of residuals in the on-site UFZ, the UFZ/ULFZ/LLFZ and the DFZ in 2009 are shown in Appendix D on Figures D-4, D-5 and D-6, respectively. An evaluation of these figures indicates that the spatial distribution of residuals is relatively random.

The model water balance was compiled for 1998, 2001, and 2009 to evaluate the reasonableness of groundwater flows within the model domain. The water balance consists of water inflows into the model domain, groundwater outflow from the model domain, and changes in groundwater storage within the model area. Water inflows consist of leakage from the Rio Grande, recharge along the Arroyo de las Calabacillas, on-site infiltration ponds and the infiltration gallery. Groundwater outflows consist of groundwater pumping from containment

[21] The ULFZ water levels shown on Figure 6.5 are based on model calculated water levels in model Layer 5 and the LLFZ water levels shown on Figure 6.6 are based on model calculated water levels in model Layer 9.

[22] Observed 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 observed water levels were compared to the transmissivity weighted average of the calculated water levels in the layers penetrated by the well.

wells CW-1 and CW-2 and groundwater flow out of the model domain across the constant-head boundaries. The water balance summaries for 1998, 2001 and 2009 in terms of gallons per minute (gpm) on an average annual basis are listed below:

	Component	1998 (gpm)	2001 (gpm)	2009 (gpm)
Inflows	Storage (net)	0	79	310
	Infiltration Gallery and Ponds	0	216	265
	River	1,177	1,224	1,366
	Recharge	7	7	7
	Total Inflows	**1,184**	**1,526**	**1,948**
Outflows	Containment Wells	0	216	265
	Constant Head (net)	1,184	1,314	1,687
	Total Outflows	**1,184**	**1,530**	**1,952**

The balance between total water inflows and outflows from the model area has a maximum error of less than 0.3 percent and is judged to be reasonable. The increases through time in inflows from storage and the river and outflows from constant heads are the result of increasing regional pumping.

The quantitative evaluation of the model simulation consisted of examining the difference between the 755 average annual water levels observed in the monitoring wells and piezometers at the former Sparton site and its vicinity and the corresponding calculated water levels for these monitoring wells. The difference between an observed and a measured water level is called a residual. Three statistics were calculated for the residuals to quantitatively describe the model calibration: the mean of the residuals, the mean of the absolute value of the residuals, and the root mean-squared error.[23] The mean of all the residuals is -0.30 ft, the mean of the absolute value of the residuals is 0.94 ft, and the root mean-squared error is 1.3. The minimum residual is -6.12 ft and the maximum residual is 5.24 ft, both for on-site monitoring wells. The absolute mean residual of 0.94 ft is considered acceptable since the observed water-level measurements applied as calibration targets have a total range of about 51.2 ft, and seasonal fluctuations of water levels are on the order of several feet. The quantitative statistics based on the monitoring wells in the major flow zones are listed below:

[23] The root mean-squared error is defined as $RMSE = \left[\frac{1}{N} \sum_{i=1}^{N} R_i^2 \right]^{1/2}$ where N is the number of calibration targets, and R is the residual. The root mean-squared error is close to the standard deviation when the mean error is small and the number of targets is large.

Flow Zone	Count	Mean Residuals	Absolute Mean Residual	Root-Mean-Squared Error	Minimum Residual	Maximum Residual
On-Site UFZ	168	-0.09	1.33	1.85	-6.12	5.24
UFZ/ULFZ/LLFZ	550	-0.39	0.86	1.10	-2.94	3.57
DFZ	37	0.17	0.43	0.59	-0.84	1.26

The differences between observed and calculated water levels at each monitoring well for the period 1998 through 2009 are presented in Appendix D, Tables D-1 through D-3. The qualitative and quantitative evaluations of the comparisons between observed and model calculated water levels indicate that the groundwater model is a reliable simulator of existing conditions.

6.1.3 Capture Zone Analysis

The capture zones of containment wells CW-1 and CW-2 at the water table (UFZ) , and in the ULFZ and LLFZ were calculated by applying particle tracking to the calculated average 2009 water levels in these horizons of the aquifer (Figures 6.4. 6.5, and 6.6), assuming that these water levels represented a steady-state condition. The particle tracking was carried out using the PATH3D computer code (Zheng, 1991), and by releasing particles at one-foot intervals along a line upgradient from both containment wells, and near and parallel to Rio Grande (along column 129 of the model grid shown in Figure 6.1). The calculated capture zones of containment wells CW-1 and CW-2 in the UFZ (water table), 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 2009.[24]

Particle tracking analysis was also used to determine the aquifer area where the water extracted at CW-1 between 1999 and 2009 was located at the start of extraction in 1998 and where the water extracted at CW-2 between 2002 and 2009 was located at the start of extraction in January 2002 (the "areas of origin"). This particle tracking analysis was carried out using the MODPATH computer code (Pollock 1994, 2008); particles were released on a twenty foot grid at the top of each model layer throughout the model domain, and keeping track of those particles that discharged at CW-1 and CW-2. The results of this analysis are discussed in Section 5 and are shown on Figure 5.26 in both map [Figure 5.26 (a)] and cross-section view [Figure 5.26 (b)]. The outlines of the areas of origin of the water pumped during different time periods [Figure 5.26 (a)] represent the outer boundary of the envelope of particle traces that discharged at each of the wells during that period.

[24] In Figures 6.4, 6.5, and 6.6, the tail of the DCE dominated separate plume is shown as being slightly outside the model calculated capture zones. As previously discussed (see document cited in Footnote 7), the groundwater model is an approximation of the real system, and as shown in Figures 5.1 through 5.12, the entire plume is well within the data-based capture zones. It should be also noted that the location of this tail of the plume is uncertain and that it was estimated from the measured water-levels presented in Figures 5.11 and 5.12.

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 were estimated using the particle-tracking method. These travel times were calculated as 1 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 2009 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 TCE in groundwater at the site. The three-dimensional contaminant transport simulation code MT3D (Zheng, 2008; 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 2010.

Model input parameters were specified based on available data. 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 used only to predict TCE concentrations in the aquifer and 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 2009, DCE was about 8 percent of the total mass of chlorinated volatile organic compounds extracted by CW-1 and 11 percent of that extracted by CW-2.

The other constituent of concern, TCA, had been historically 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; prior to 2003 TCA had been detected at levels above 60 μg/L in only one off-site well, MW-46. The concentrations of TCA have been below 60 μg/L since 2003; the maximum TCA concentration reported this year was 8.4 μg/L at MW-60. 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	4.3

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. 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 and Model Calibration

The transport model has been calibrated for each annual report since 1999, except for the 2006 annual report, by adjusting the TCE concentrations in the aquifer in 1998 prior to startup of the groundwater remediation systems; these concentrations are referred to as the model's initial concentration distribution. The calibration process consisted of 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 CW-2, throughout their respective period of operation. The last recalibration of the transport model is described in the report describing an evaluation of alternative remedial systems and technologies (SSP&A, 2009b)["Alternatives Report"]. The transport model was not recalibrated for this report.

The calibration procedure has varied through time. In the last recalibration, the initial concentration distribution was interpolated based on the November 1998 measured concentration data and a number of the pilot points along the center line of the plume using three-dimensional kriging. The parameter estimation program PEST (Doherty, 2002) was used to estimate TCE concentrations at the pilot points. Calibration procedures used in previous years are described in the 2006 Annual Report (SSP&A, 2007). 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 initial mass and the maximum TCE concentrations within each model layer, under the initial concentration distribution specified in the model based on the recalibration described in the Alternatives Report, are summarized on Table 6.1[25]. The estimated initial mass of TCE is 7,356 kg (16,579 lbs). The estimate of initial mass has varied with each recalibration of the model as additional information has been learned from long-term operation of the containment wells, though the estimate of mass has not changed significantly since 2003. The estimates of initial mass presented in previous annual reports as estimated from model recalibration are listed below:

	Year										
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Estimated Initial Mass (kg)	2178	3097	3295	4647	7342	6638	6908	6908	6881	6601	7356

6.2.3 Model Calculated TCE Mass Removal Rates and Concentration

The measured cumulative amount of TCE removed by operation of the on-site and off-site containment systems through the end of each year since 1999 and the model calculated amount of TCE removed are tabulated below:

Year	Cumulative TCE mass removed by both wells through end of year (kg)		Average Concentration at CW-1 (µg/L)		Average Concentration at CW-2 (µg/L)	
	Measured	Calculated	Measured	Calculated	Measured	Calculated
1999	359	373	829	1,093		
2000	822	896	1,055	1,119		
2001	1,341	1,443	1,205	1,155		
2002	1,944	2,051	1,225	1,087	723	681
2003	2,561	2,651	1,275	1,148	473	412
2004	3,157	3,217	1,317	1,251	301	267
2005	3,715	3,769	1,217	1,247	191	172
2006	4,228	4,255	1,166	1,165	153	123
2007	4,695	4,727	1,050	1,022	130	101
2008	5,128	5,152	982	889	90	88
2009	5,507	5,404	869	783	64	80

There is excellent agreement between the observed and model calculated amount of TCE removed. The total TCE removed through the end of 2009 is about 5,510 kg; this amount is about 75 percent of the amount of TCE estimated to have been in the aquifer in 1998. The model calculated total TCE removal is about 5,400 kg, or 73.5 percent of the amount of TCE estimated to have been in the aquifer in 1998. Also listed on this table are the average annual measured

[25] The TCE masses listed on Table 6.1 differ slightly from those listed on Table A-2 of the Alternatives Report (SSP&A, 2009b). For example, the total initial TCE mass is listed on Table 6.1 as 7,356 kg, whereas it was listed as 7,381 kg on Table A-2. The small discrepancy is due to a change in the procedure used to calculate the total TCE mass from the model outputs.

and model calculated concentrations in the water pumped from CW-1 and CW-2 from 1999 through 2009.

A comparison of calculated to observed concentrations of TCE at all monitoring wells for all samples analyzed between November 1998 and November 2009 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 2009 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. Plots of calculated and observed TCE concentrations at selected monitoring wells during the period 1998 through 2009 are shown in Appendix D on Figure D-7. The calibrated initial TCE plume (November 1998), and model calculated TCE plumes for November 2001, 2005, 2008, and 2009 are presented in Figure 6.10; the concentration contours shown on this figure are based on the maximum TCE concentration simulated in any layer.

6.3 Simulation of TCE Concentrations in 2010

The groundwater model was used to forecast TCE concentrations in the aquifer and the mass extracted from CW-1 and CW-2 from January through December 2010. Two sets of simulations were made; one with the CW-1 pumping rate at 218 gpm and a second with the CW-1 pumping rate at 300 gpm during 2010. In both simulations, the pumping rate at CW-2 was specified at 47 gpm.

The calculated TCE concentrations in December 2010 are presented on Figure 6.11; TCE concentrations with CW-1 pumping at a rate of 218 gpm are shown on Figure 6.11 (a) and TCE concentrations with CW-1 pumping at a rate of 300 gpm are shown on Figure 6.11 (b). The concentration contours shown on Figure 6.11 are based on the maximum TCE concentration simulated in any layer. The calculated TCE concentration in December 2010 at CW-1 is 659 μg/L if the well is pumped at a rate of 218 gpm during 2010, and 563 μg/L if the well is pumped at a rate of 300 gpm. The calculated TCE concentration in CW-2 in December 2010 is 76 μg/L under both pumping scenarios for CW-1.

The calculated concentration at CW-2 in December 2010 is slightly higher than the average concentration observed in the well in 2009, which was 64 μg/L. This suggests the potential that the initial TCE concentrations specified in the 4970-foot silt/clay unit, which act as a long-term source of contamination to the underlying aquifer units, overestimate actual TCE concentrations in this unit. In future years, if the calculated TCE concentrations at CW-2 continue to overestimate observed concentrations, the initial TCE concentrations in the 4970-foot silt/clay unit will be re-evaluated.

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 ft 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.

Investigations conducted at and around the Site in the 1980s revealed that soils beneath the Site and groundwater beneath and downgradient from the Site were contaminated. The primary contaminants were VOCs, specifically TCE, DCE, and TCA, and chromium. Remedial investigations that followed indicated that groundwater contamination was limited to the aquifer above the 4800-foot clay; current measures for groundwater remediation were, therefore, 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: (1) the installation and operation of an off-site containment system; (2) the installation and operation of a source containment system; and (3) 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 began in late 1998 and was completed in early May 1999. The system consisted of (1) a containment well near the leading edge of the plume, designed to pump at a rate of about 225 gpm, (2) an off-site treatment system, (3) an infiltration gallery in the Arroyo de las Calabacillas, and (4) associated conveyance and monitoring components. 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 2009 was the eleventh full year of operation of this well. The source containment system was installed during 2001 and began operating on January 3, 2002. This system consisted of (1) a containment well immediately downgradient from the site, designed to pump at a rate of about 50 gpm, (2) an on-site treatment system, (3) six[26] on-site infiltration ponds, and (4) associated conveyance and monitoring components. The year 2009 was the eighth 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 2009, considerable progress was made towards achieving the goals of the remedial measures:

- The off-site containment well continued to operate during the year at an average discharge rate of 218 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 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 an average rate of 47 gpm, sufficient for containing potential on-site source areas.
- Groundwater monitoring was conducted as specified in the Groundwater Monitoring Program Plan [Monitoring Plan (Attachment A to the Consent Decree)] and the State of New Mexico Groundwater Discharge Permit DP-1184 (Discharge Permit). 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 above plan and permit 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 Discharge Permit. All samples were analyzed for VOCs, total chromium, iron, and manganese.
- The groundwater flow and transport model that was developed in early 2000 to simulate the hydrogeologic system underlying the site and its vicinity, and which was revised in early 2004 and again in both early and late 2009, was used to evaluate the future performance of the containment systems and alternative groundwater extraction schemes. Based on these evaluations, Sparton recommended increasing the pumping rate of the off-site containment well to 300 gpm to accelerate aquifer restoration (SSP&A, 2009b); this recommendation was approved by the agencies.[27] A slight modification was again made to the model during the preparation of this report to incorporate into the model boundaries the faster rates of regional water-level declines that were observed in recent

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[26] The performance of the six on-site infiltration ponds between 2002 and 2004 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 in 2005 to put the land to other beneficial use.

[27] See document cited in Footnote 1.

years, and the model was used to simulate TCE concentrations in the aquifer from start-up of the off-site containment well in December 1998 through December 2009, and to predict concentrations for December 2010.

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.

The extent of groundwater contamination during 2009, as defined by the extent of the TCE plume, was essentially the same as during 2008. Of 55 wells sampled both in November 2008 and 2009, the 2009 concentrations of TCE were lower than in 2008 in 23 wells, higher in 7 wells, and remained the same in 25 wells (24 below detection limits). Well MW-60, at 2,200 µg/L continued to be the most contaminated off-site well. The corresponding results for DCE were 10 wells with lower, 6 wells with higher, and 39 wells with the same (38 below detection limits) concentrations. The TCA plume ceased to exist in 2003, and this condition continued through 2009; the highest concentration of TCA during 2009 was 8.4 µg/L (also in well MW-60) significantly below the maximum allowable concentration of 60 µg/L set for groundwater by the 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 (below detection limits). The only wells where significant increases occurred are the off-site containment well CW-1, and on-site monitoring well MW-19. The concentrations of contaminants in the water pumped from CW-1 rapidly increased after the start of its operation and remained high since then. The high concentrations in this well and in well MW-60 indicated that areas of high concentration existed upgradient from both of these wells; however, most of the groundwater upgradient from these wells has been captured by CW-1 and concentrations both in CW-1 and MW-60 have begun a declining trend.

off-site and source containment wells operated at a combined average rate of 265 gpm during 2009. A total of about 139.3 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 1.471 billion gallons and represents 130 percent of the initial volume of contaminated groundwater (pore volume).

A total of about 410 kg (900 lbs) of contaminants consisting of about 380 kg (840 lbs) of TCE, 32 kg (70 lbs) of DCE, and 1.3 kg (2.8 lbs) of TCA were removed from the aquifer by the two containment wells during 2009. The total mass that was removed since the beginning of the of the current remedial operations is 5,880 kg (12,960 lbs) consisting of 5,510 kg (12,140 lbs) of TCE, 350 kg (760 lbs) of DCE, and 16 kg (36 lbs) of TCA. This represents about 75 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.

Two of the three DFZ monitoring wells, well MW-67 and well MW-79, which was installed in 2006 to address the continuing presence of contaminants in DFZ monitoring well

MW-71R, continued to be free of any site-related contaminants throughout 2009. Well MW-71R continued to be contaminated; however, TCE concentrations in the well declined from 210 µg/L in August 2003 to 52 µg/L in November 2008 and remained in the 50 µg/L level throughout 2009; the November 2009 TCE concentration in the well was 57 µg/L. The absence of any contaminants in MW-67 and MW-79, and the declining concentrations in MW-71R indicate that the contamination in DFZ represents a contaminated groundwater slug of limited extent. Concentration trends in MW-71R will be closely monitored in the next few years to assess if there is a need for further action.

The containment systems were shutdown several times during 2008 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 20 minutes to about 53 hours. Evaluation of migration rates in the aquifer indicates that the systems could be down for significantly much longer periods without affecting the capture of the contaminant plume.

7.2 Future Plans

The off-site and source containment systems will continue to operate during 2010. The pumping rate of the off-site containment well will be increased to 300 gpm as recommended by Sparton (SSP&A, 2009b) and approved by the agencies.[28] Data collection will continue in accordance with the Monitoring Plan and the Discharge Permit, and as necessary for the evaluation of the performance of the remedial systems. As additional data are collected, they will compared to predictions made with the calibrated flow and transport model of the Site, and adjustments to the model will be made, if necessary.

It is proposed that monitoring wells MW-13 and MW-48, which have been dry during the last several years, be plugged and abandoned; ULFZ monitoring wells MW-29 and MW-56, which are adjacent to these wells, respectively, will provide data on water levels and water quality at these locations. Well MW-57 which also has been dry for several years will be deepened to continue to provide data for the shallow zones of the aquifer at its location. Shallow monitoring wells MW-47 and MW-58, which did not have sufficient water for sampling during 2009, and well MW-61 which was dry during one or more quarters of 2008 and 2009 and which also could not be sampled in 2009, will continue to be monitored during 2010 to assess whether they should be abandoned, deepened, or replaced. It is also proposed that measurements of the water level in the Corrales Main Canal, which are made at a point of the canal near the southeast corner of the Sparton Facility, be discontinued. The water level in the canal, when it is not dry, is considerably above the water table at this location, and water-level data collected from the canal serve no useful purpose in site-related evaluations. These proposed monitoring well and measurement modifications will be implemented upon approval of this Annual Report by USEPA and NMED.

A Work Plan for the installation of monitoring well, MW-80, which will be installed northwest and outside the capture zone of the off-site containment well, CW-1, was prepared and

[28] See document cited in Footnote 1

submitted to USEPA and NMED on May 4, 2010 and revised in response to agency comments on May 25, 2010 (SSP&A, 2010). The revised Work Plan was approved by the agencies on June 4, 2010,[29] and the well will be installed in the coming months in accordance with the schedule provided in the Work Plan.

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.

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[29] Letter dated June 4, 2010 from John e. Kieling of NMED and Chuck Hendrickson of USEPA to Joseph S. Lerczak of Sparton Re: Work Plan for Installing Monitoring Well MW-80: Approval, Sparton Technology, Inc., EPA ID No. NMD083212332.

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FIGURES

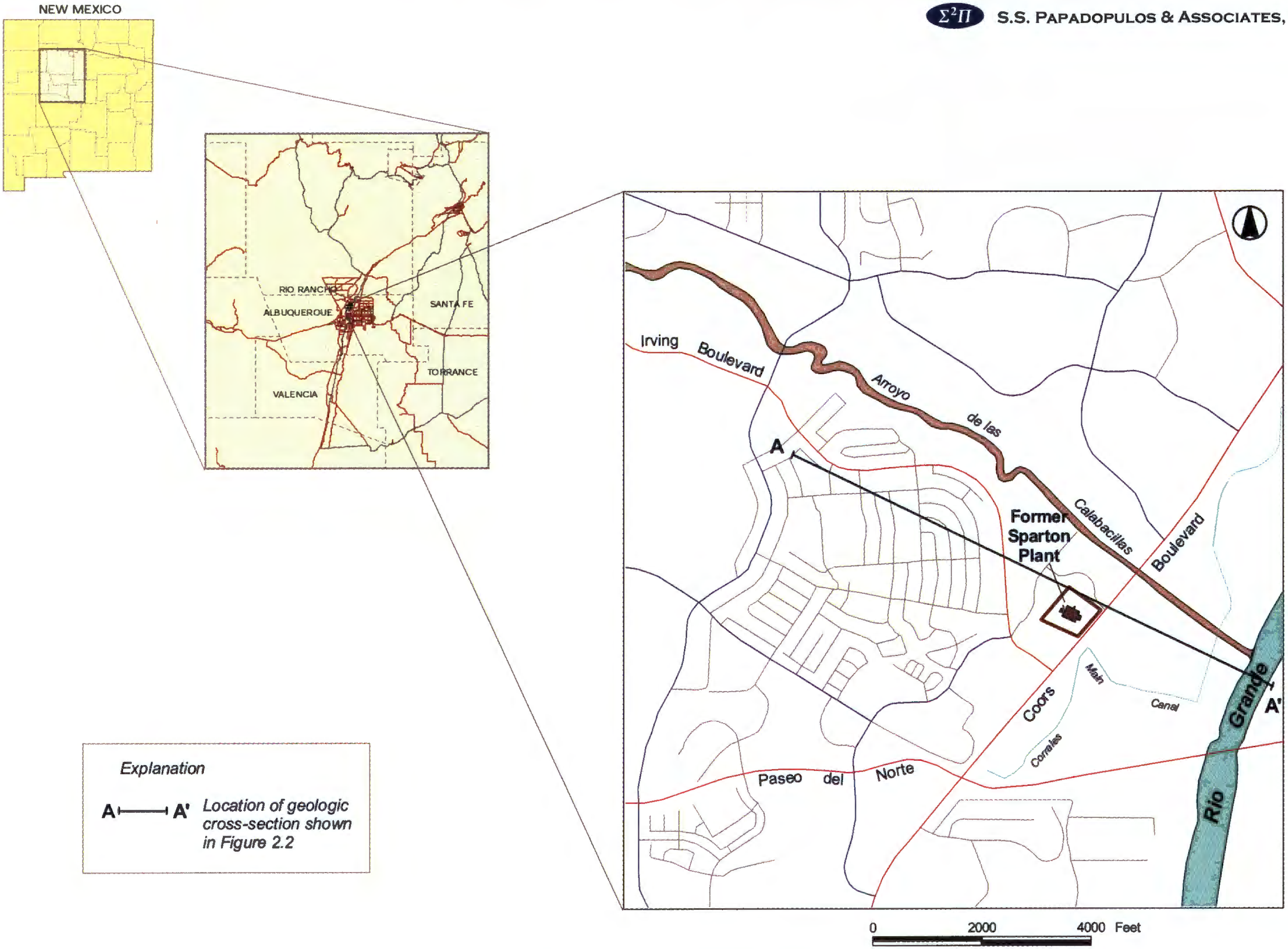


Figure 1.1 Location of the Former Sparton Coors Road Plant

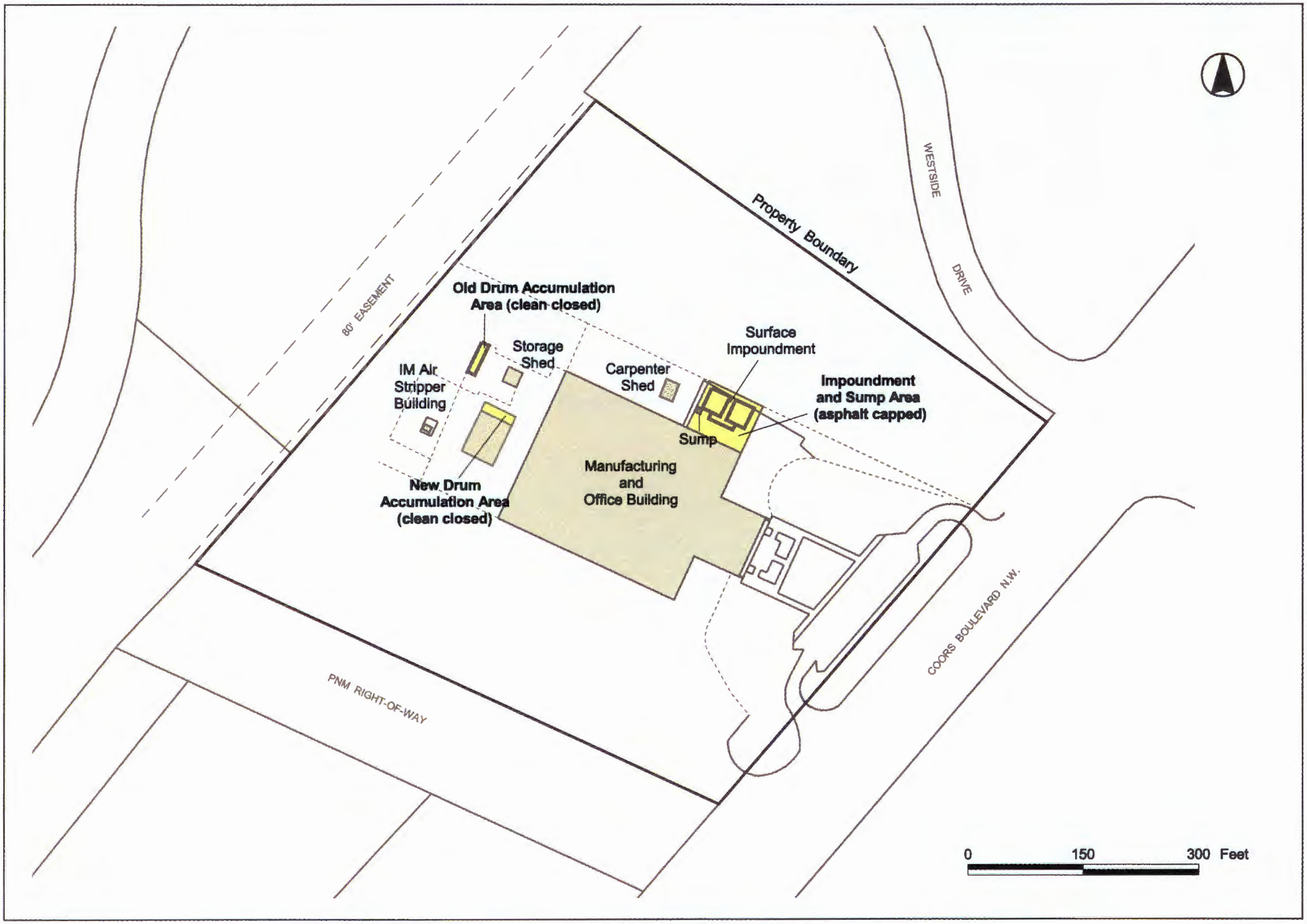
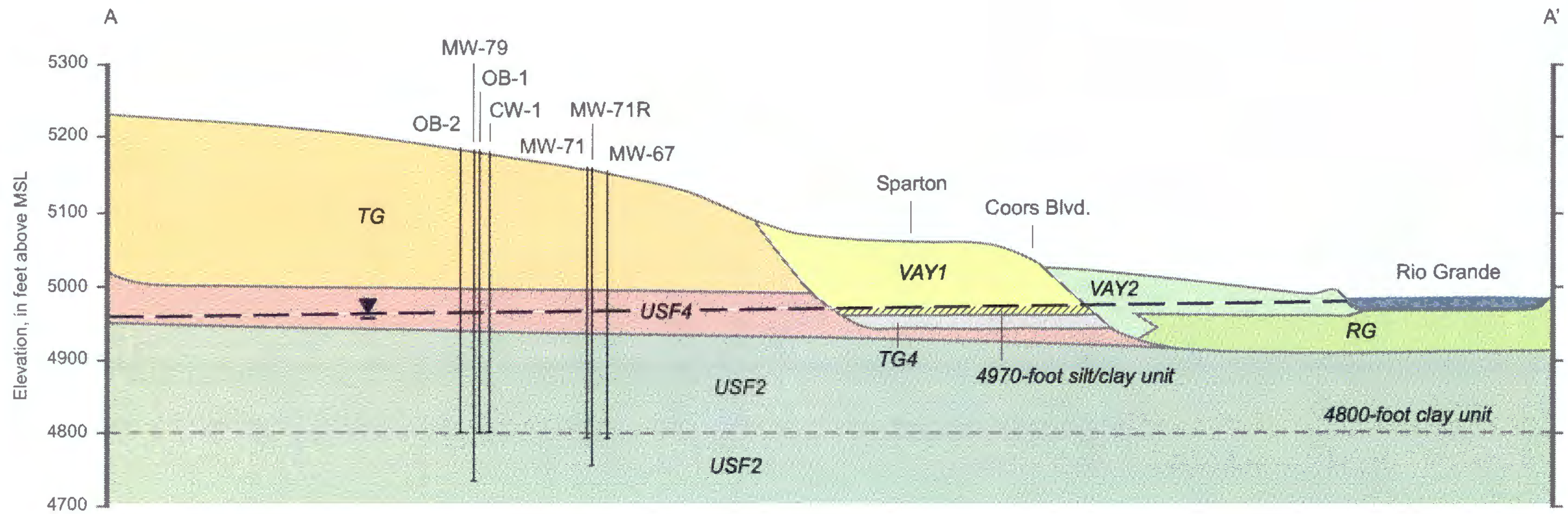


Figure 2.1 The Former Sparton Coors Road Plant



Vertical Exaggeration 5x

Note: See Figure 1.1 for location of cross section

Explanation

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

Figure 2.2 Geologic Cross Section Showing Shallow Deposits

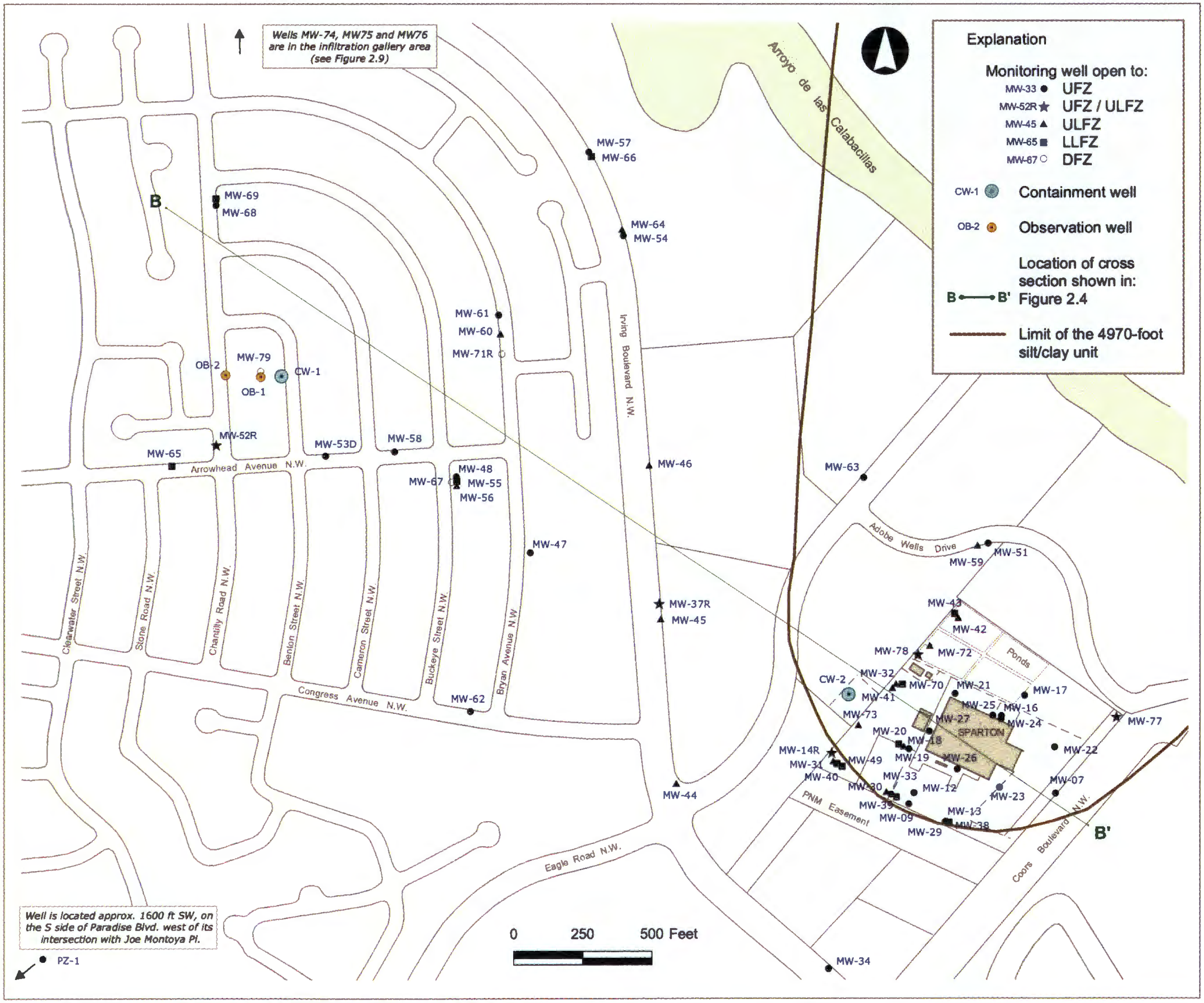


Figure 2.3 Location of Wells

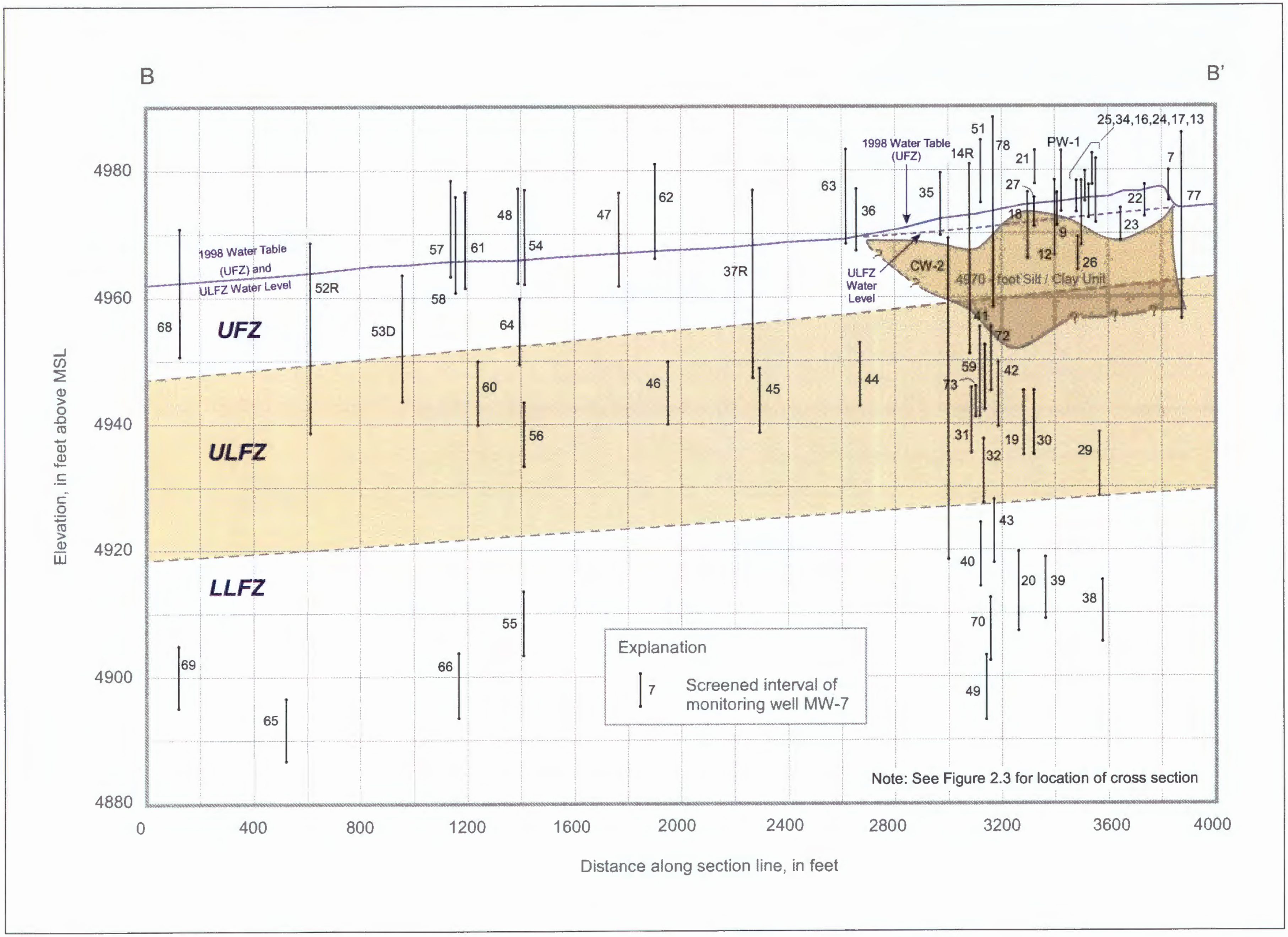


Figure 2.4 Schematic Cross-Section Showing Screened Interval of Monitoring Wells and Relation to Flow Zones

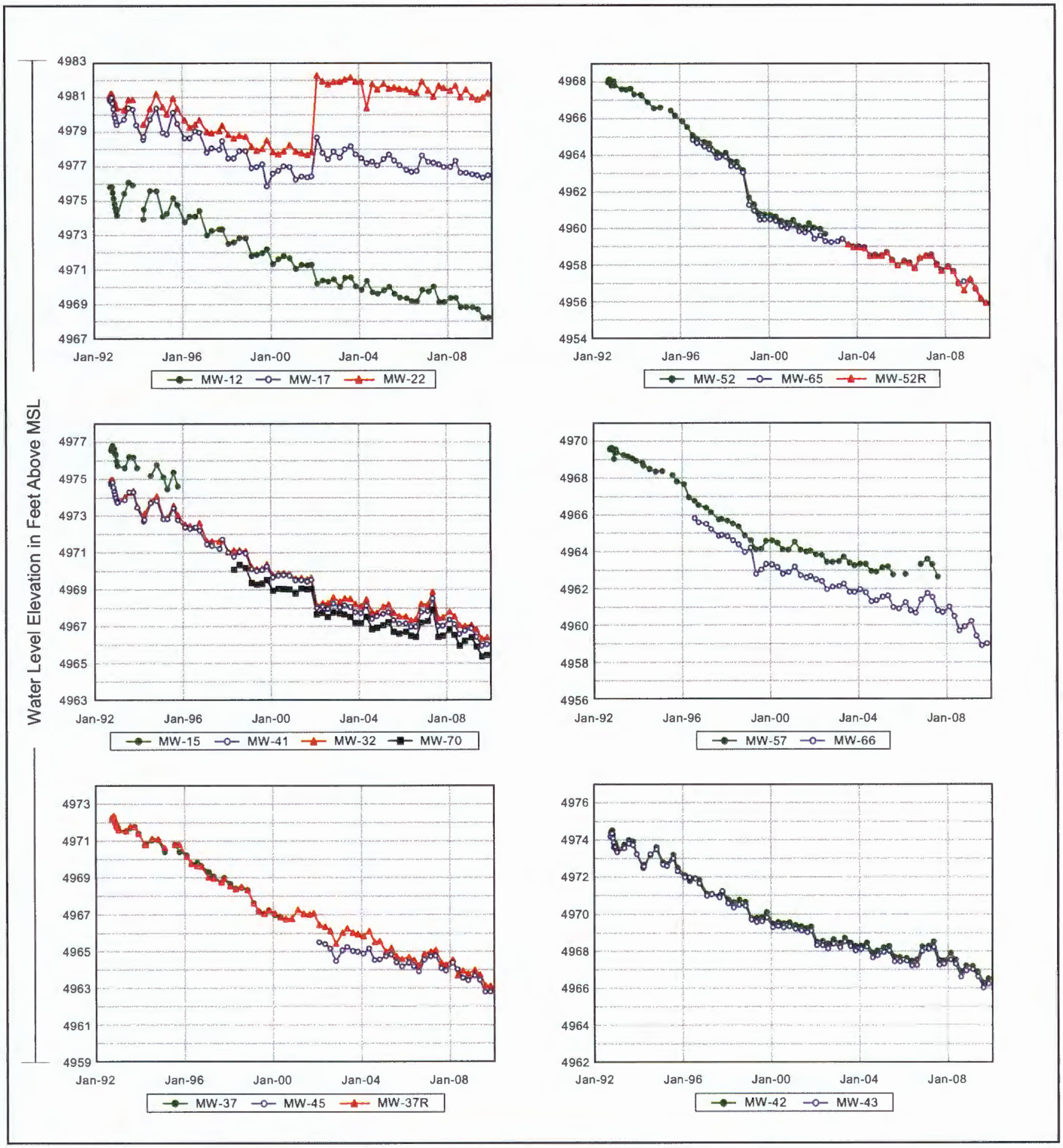


Figure 2.5 Monitoring Well Hydrographs

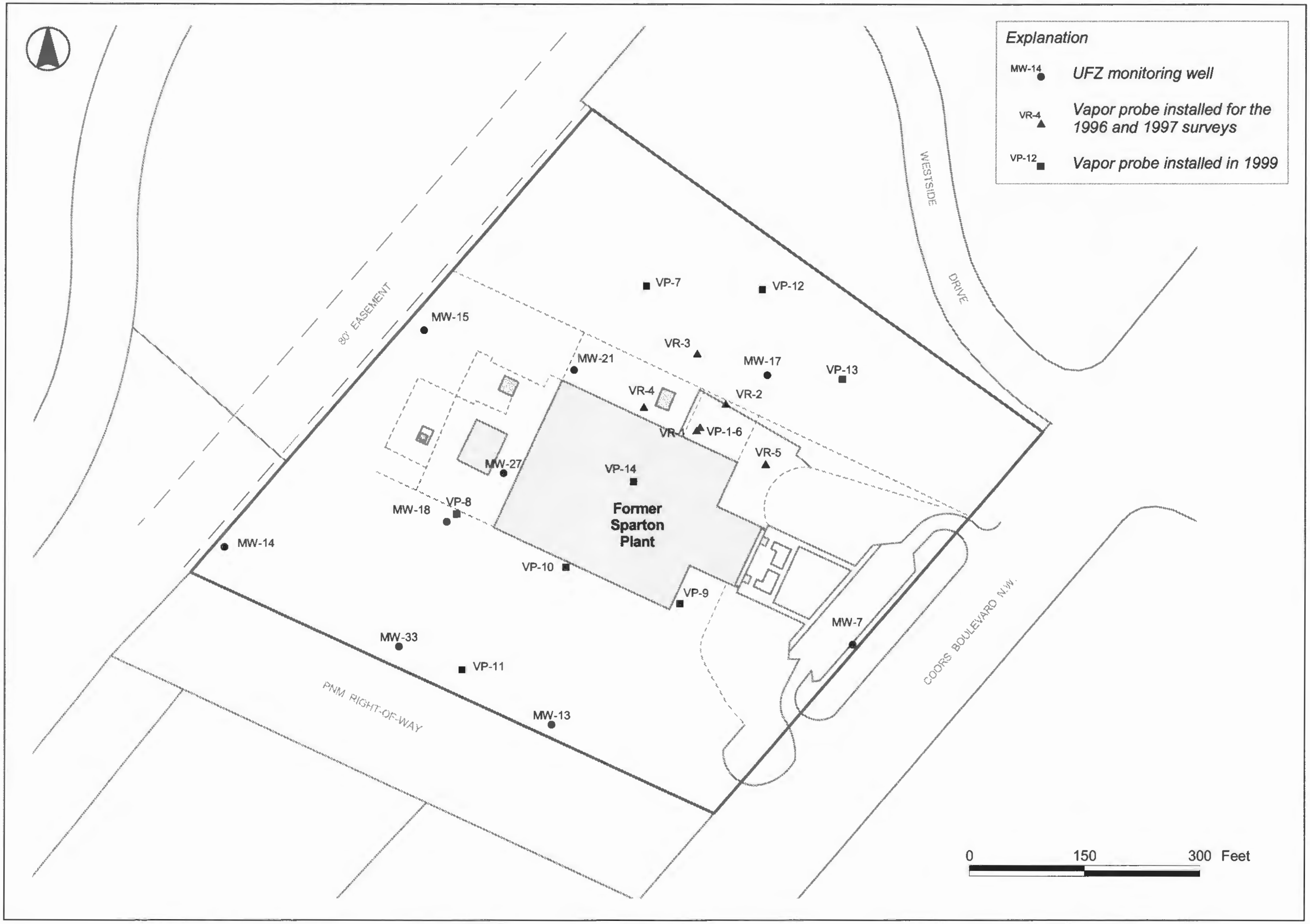


Figure 2.6 Location of Vapor Probes and On-Site Monitoring Wells Used in Vadose Zone Characterizations

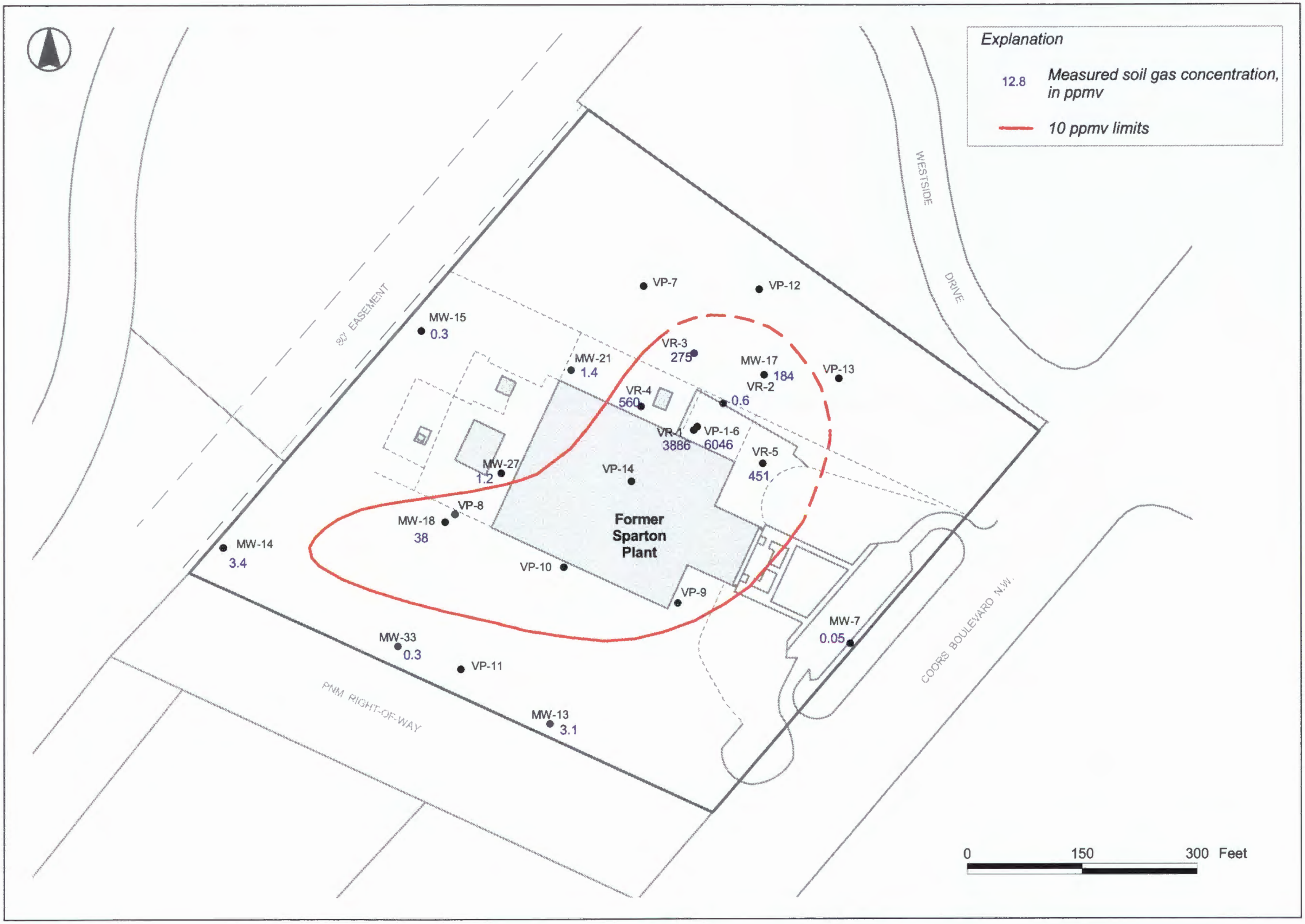


Figure 2.7 TCE Concentrations in Soil Gas - April 1996 - February 1997 Survey

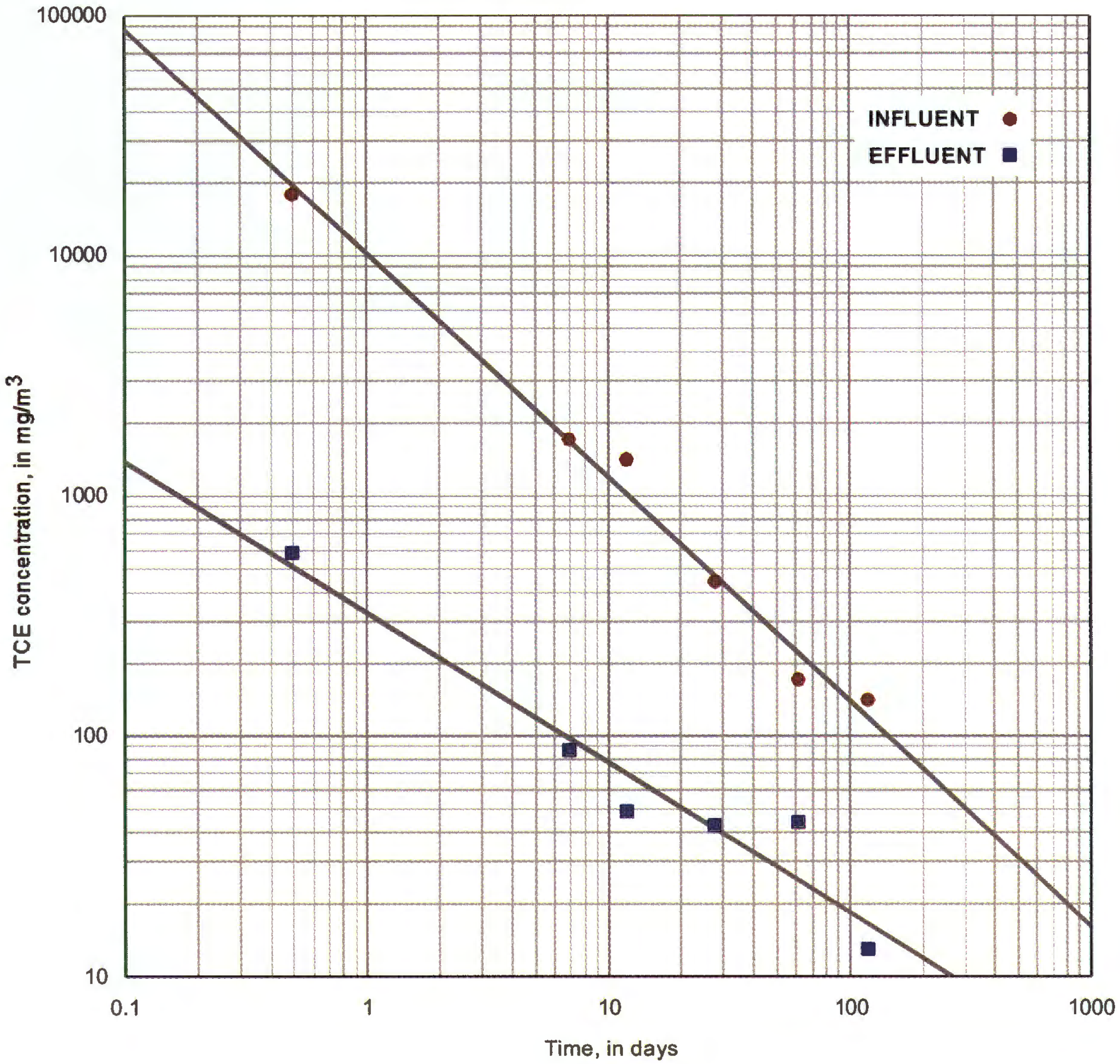


Figure 2.8 Influent and Effluent Concentrations - SVE Operation
April 8 - October 20, 1998

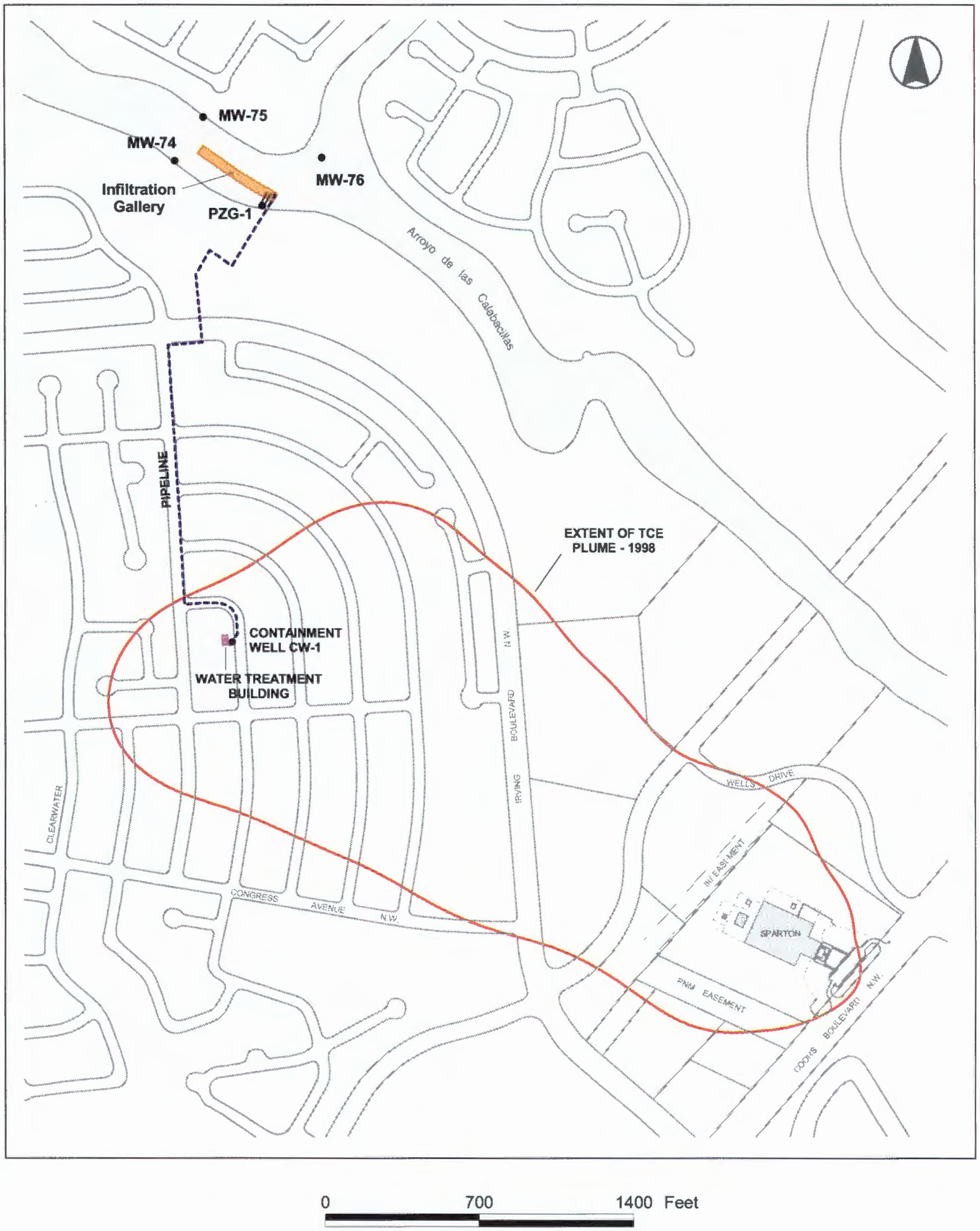


Figure 2.9 Layout of the Off-Site Containment System Components

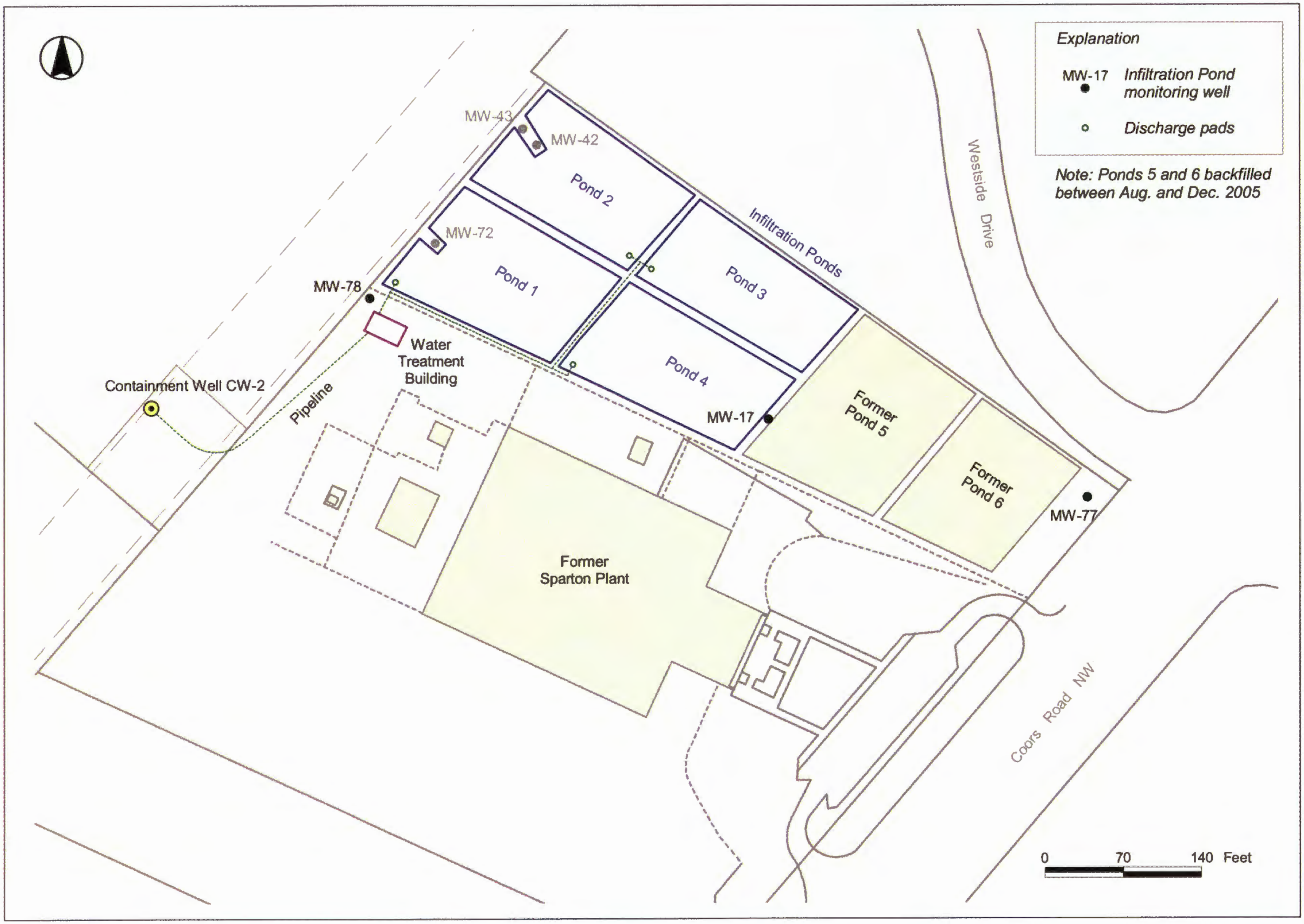


Figure 2.10 Layout of the Source Containment System Components

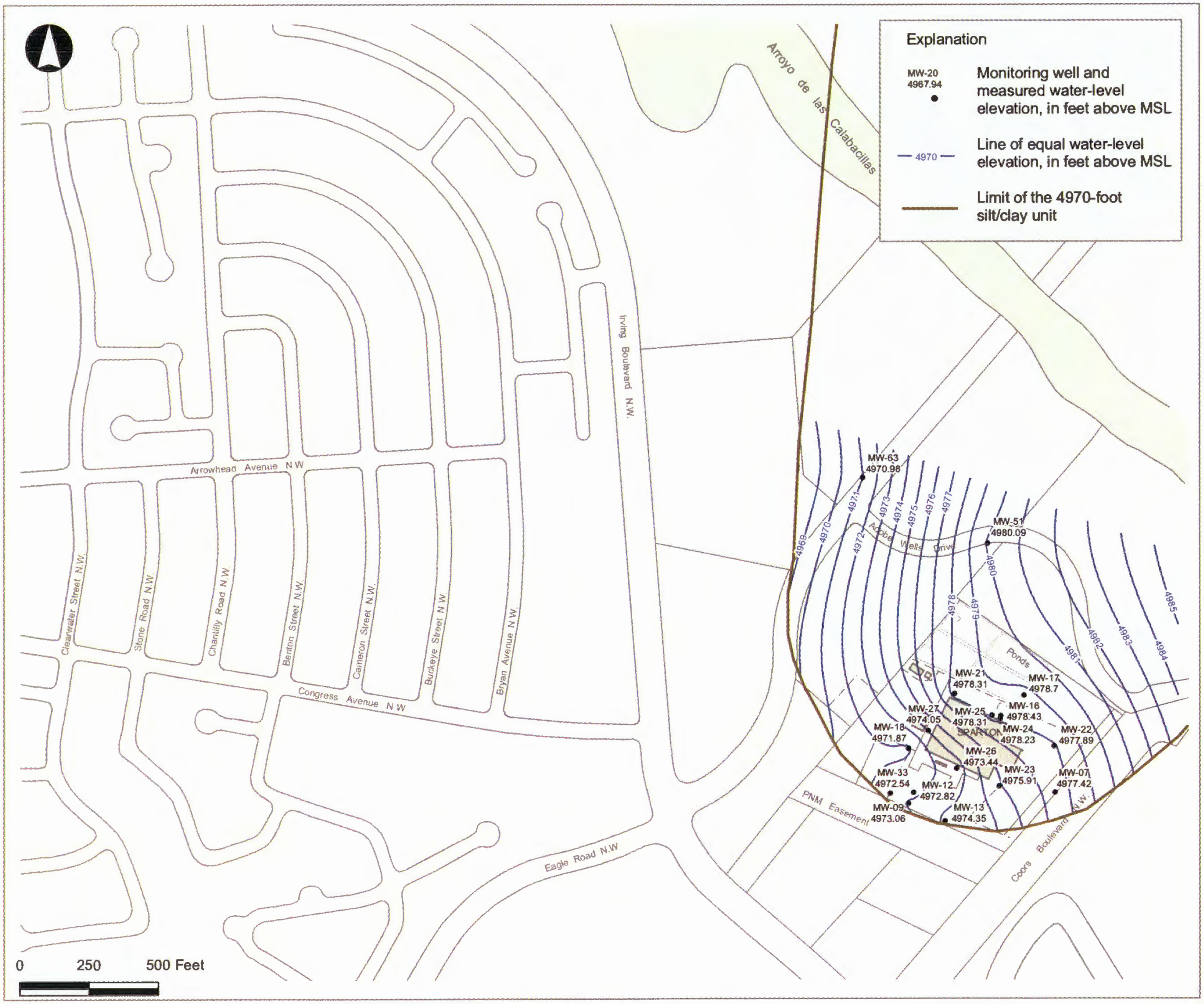


Figure 2.11 Elevation of the On-Site Water Table - November 1998

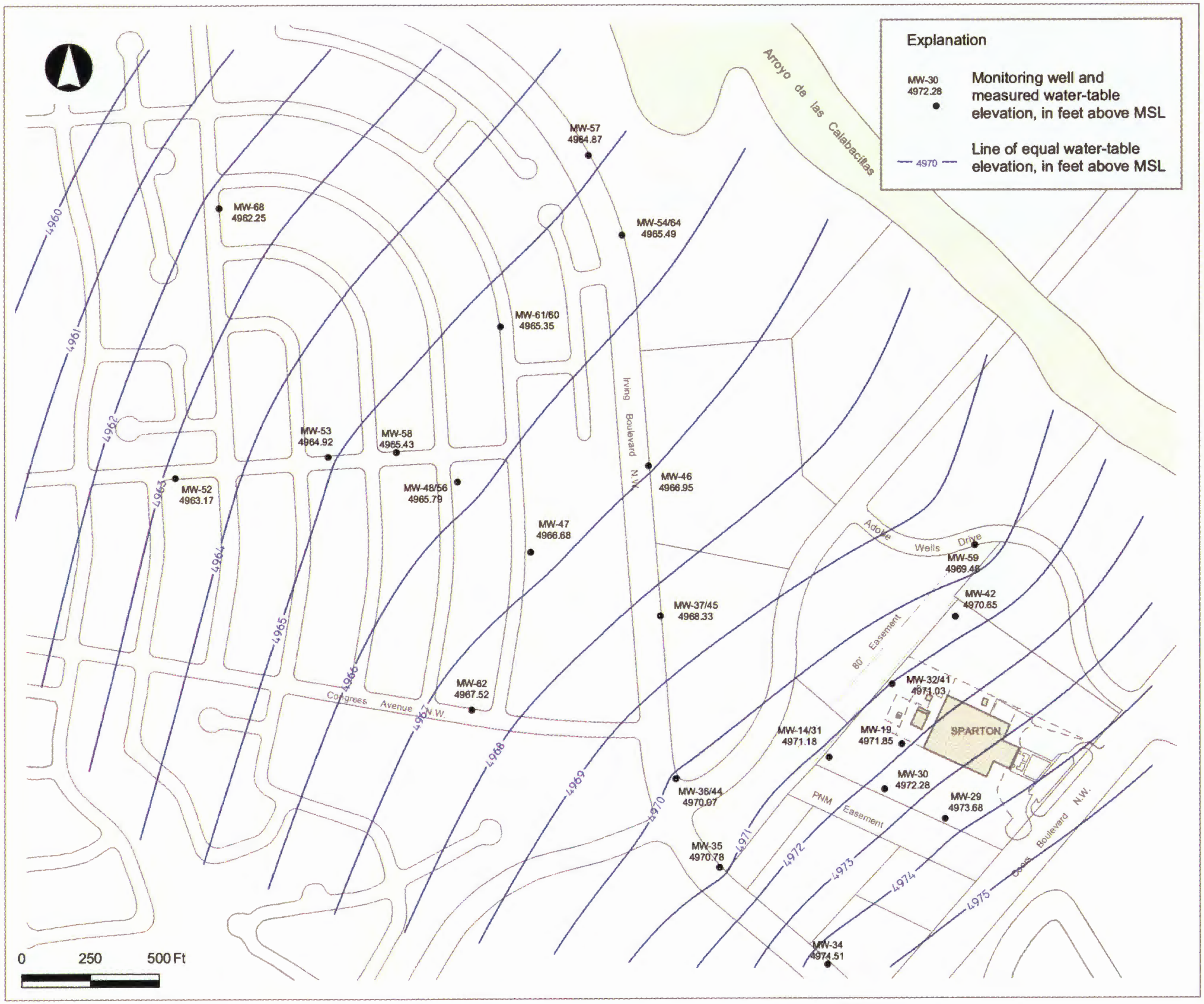


Figure 2.12 Elevation of the Water Levels in the UFZ/ULFZ - November 1998

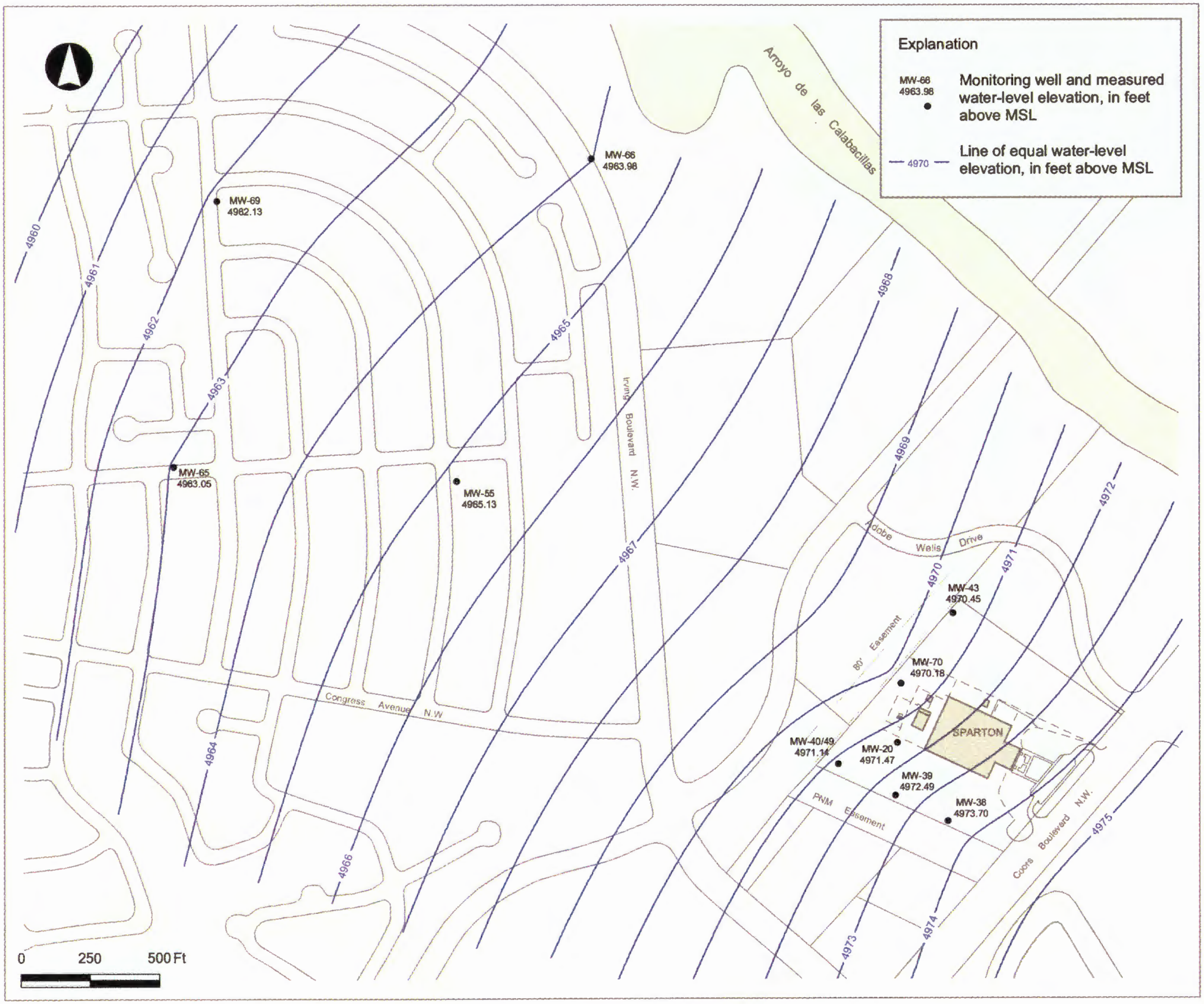


Figure 2.13 Elevation of the Water Levels in the LLFZ - November 1998

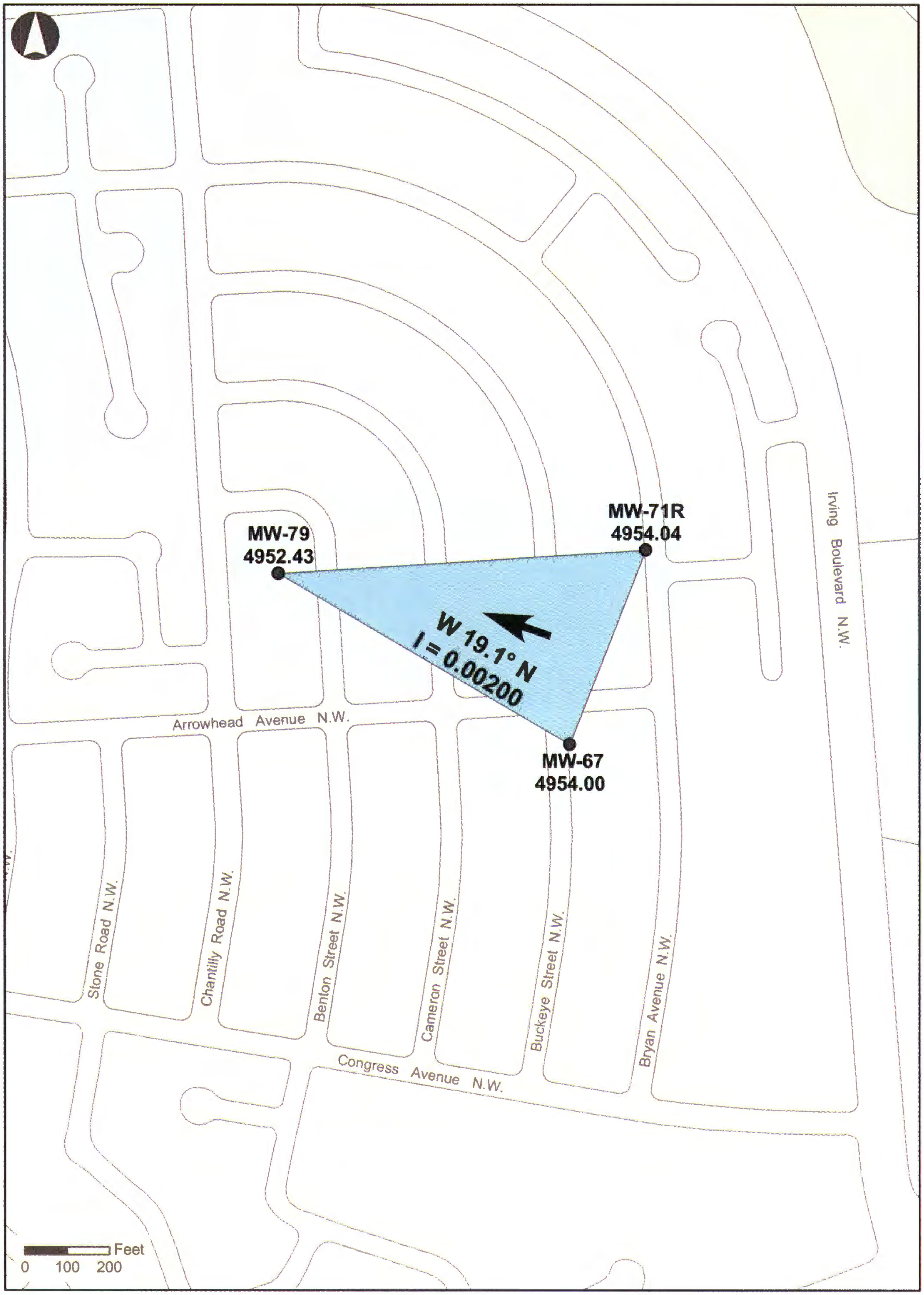


Figure 2.14 Average Groundwater Flow Direction and Hydraulic Gradient in the DFZ (2006 - 2008)

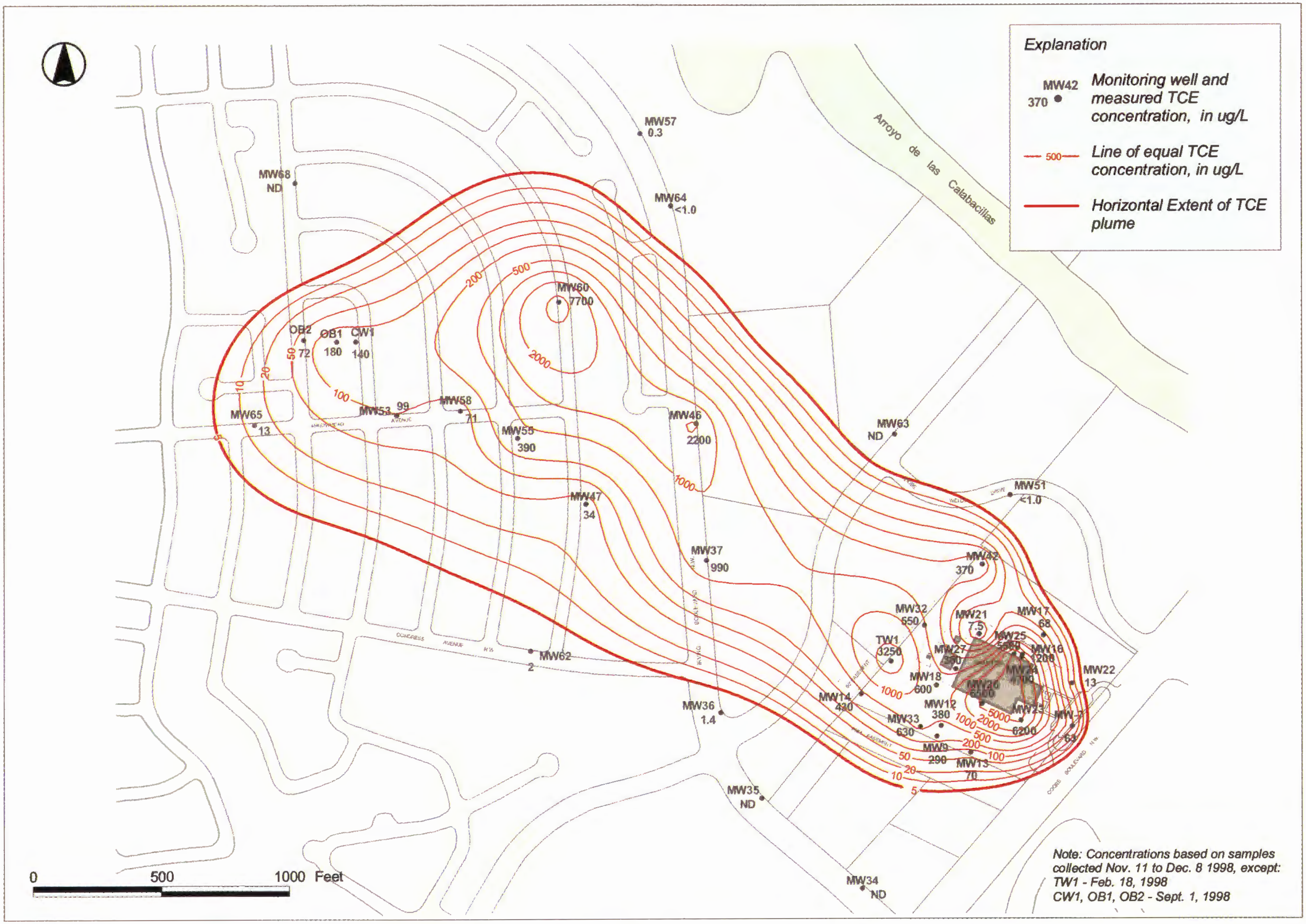


Figure 2.15 Horizontal Extent of TCE Plume - November 1998

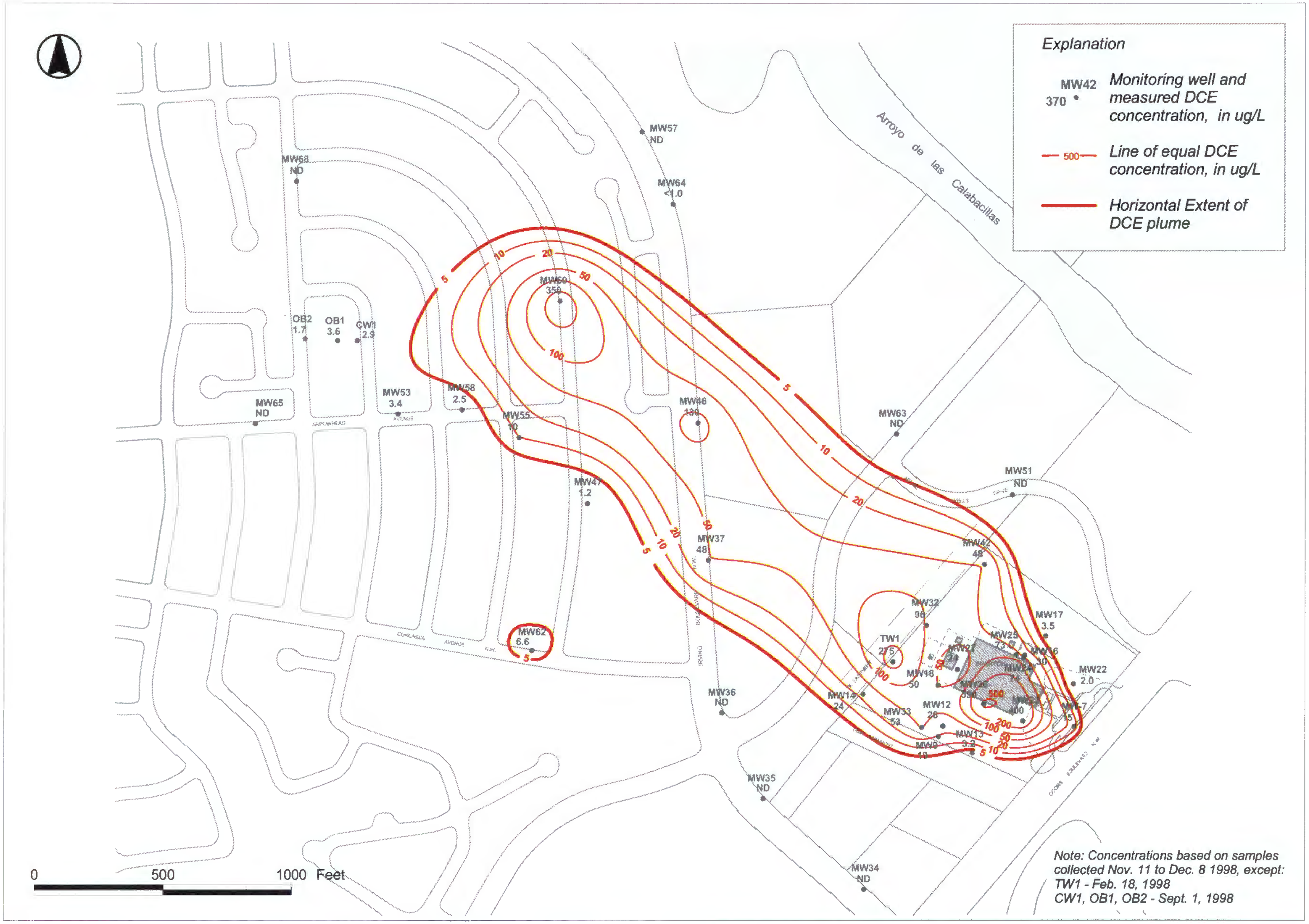


Figure 2.16 Horizontal Extent of DCE Plume - November 1998

Figure 2.17 Horizontal Extent of TCA Plume - November 1998

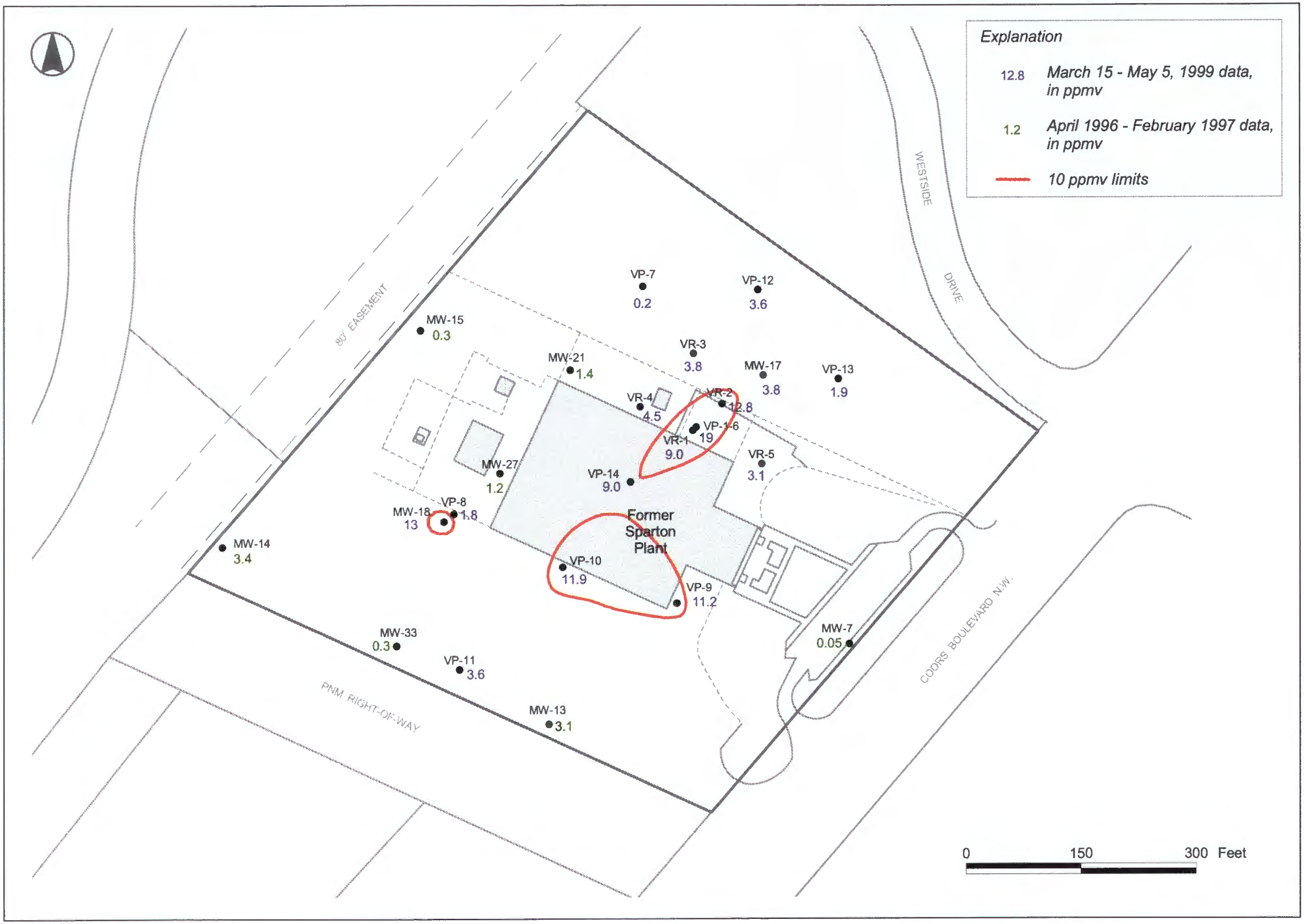


Figure 2.18 TCE Soil Gas Concentrations Prior to the 1999 Resumption of SVE System Operations

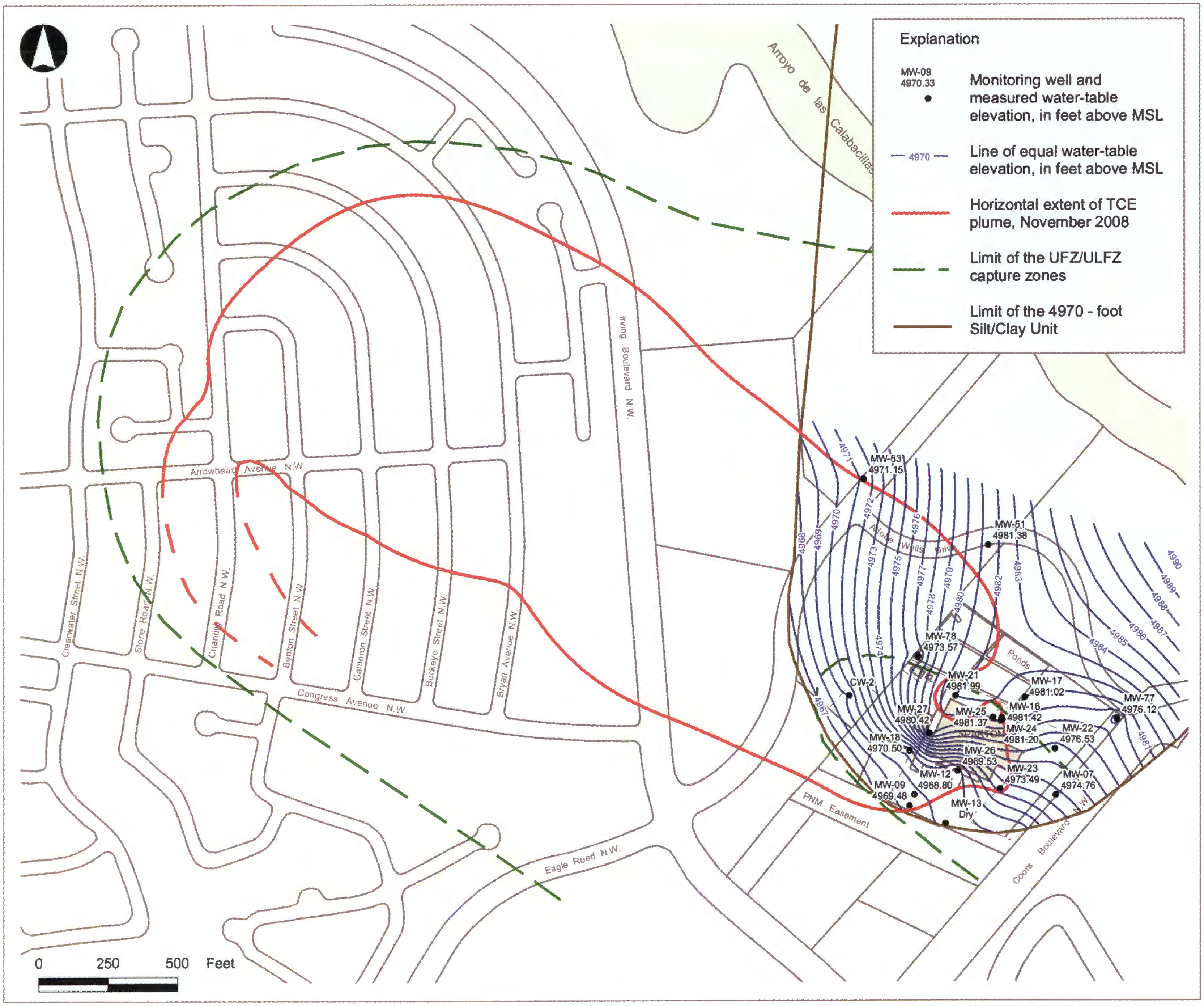


Figure 5.1 Elevation of the On-Site Water Table - February 17, 2009

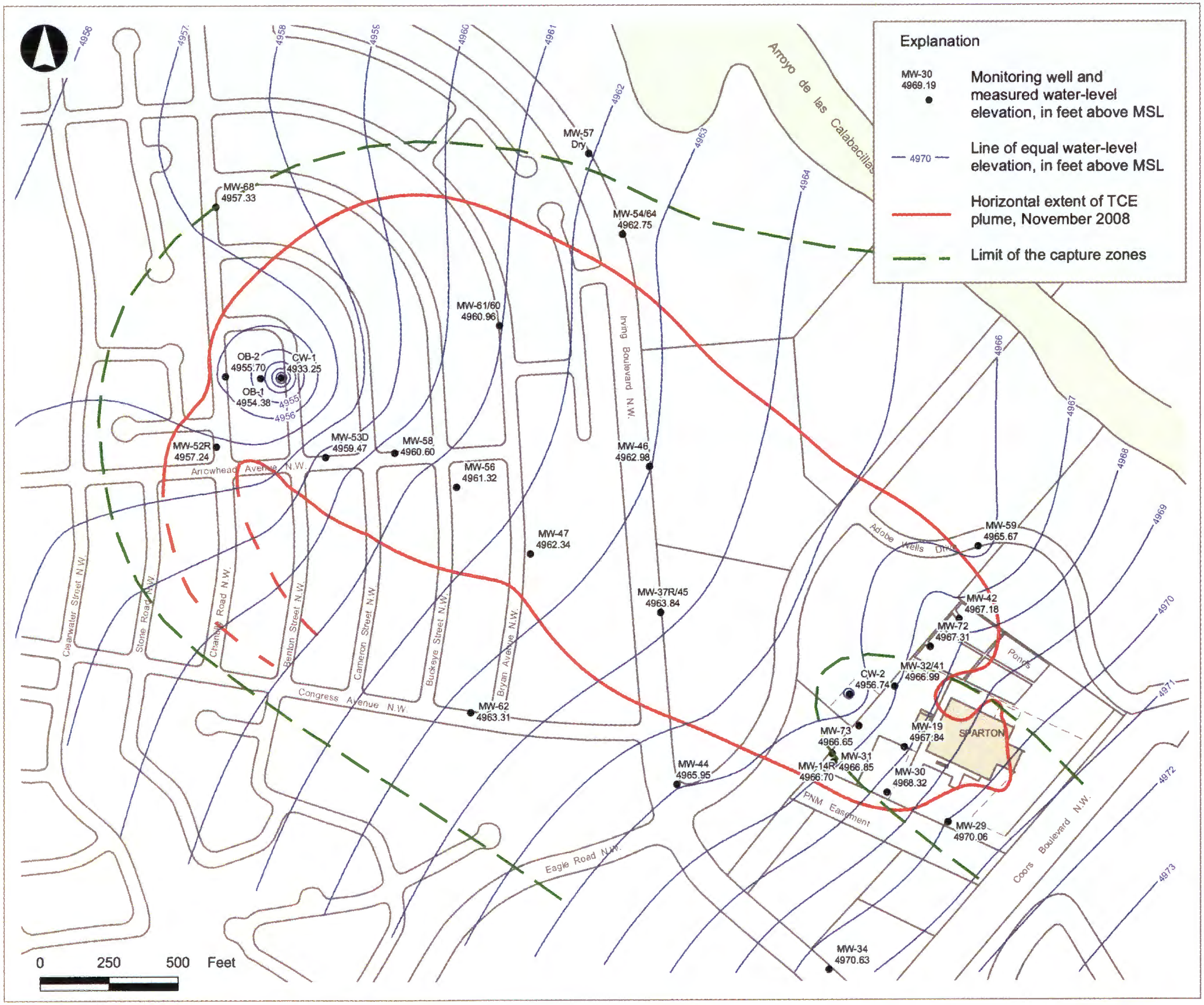


Figure 5.2 Elevation of Water Levels and Limits of Containment Well Capture Zones in the UFZ/ULFZ - February 17, 2009

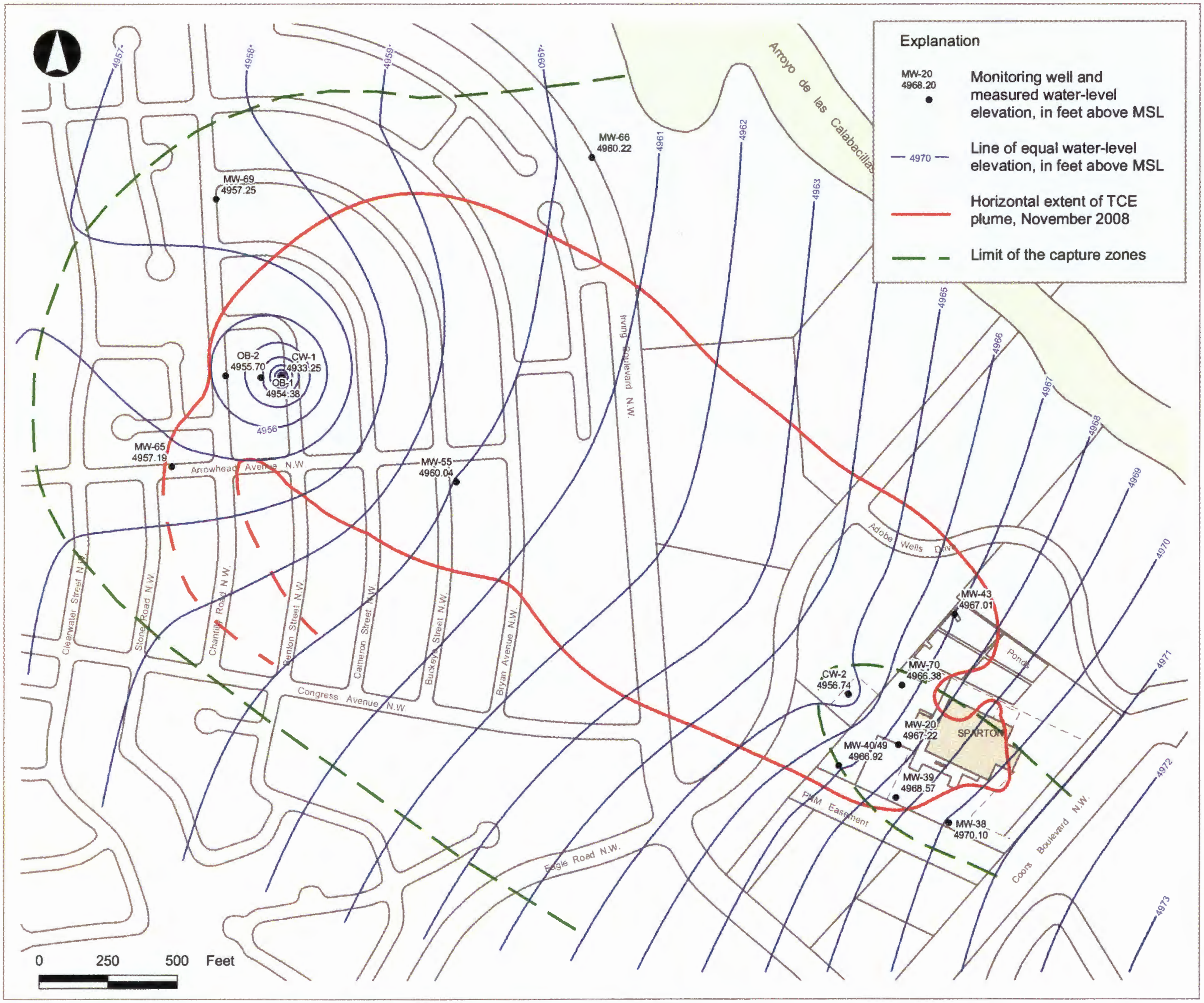


Figure 5.3 Elevation of Water Levels and Limits of Containment Well Capture Zones in the LLFZ - February 17, 2009

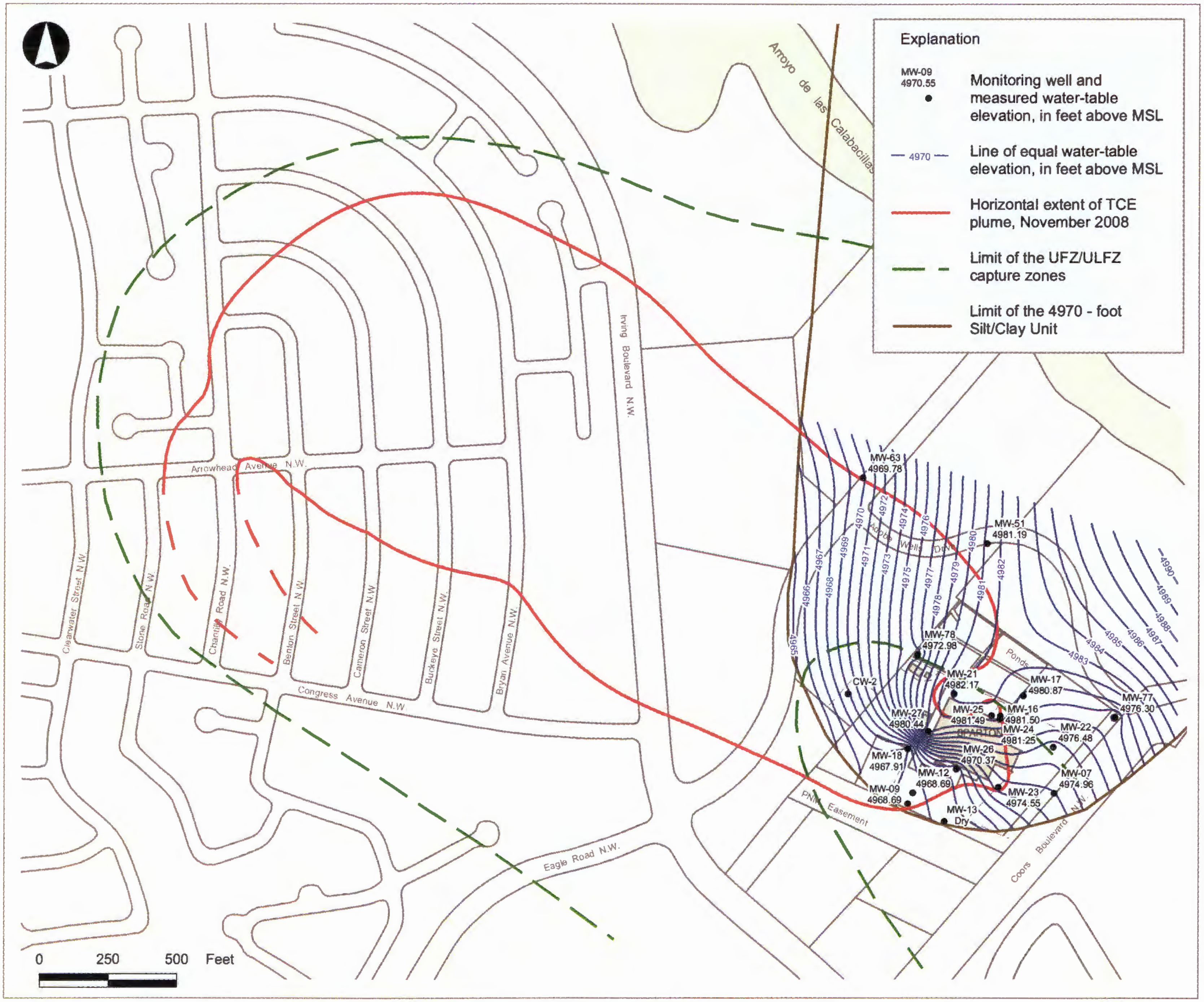


Figure 5.4 Elevation of the On-Site Water Table - May 13, 2009

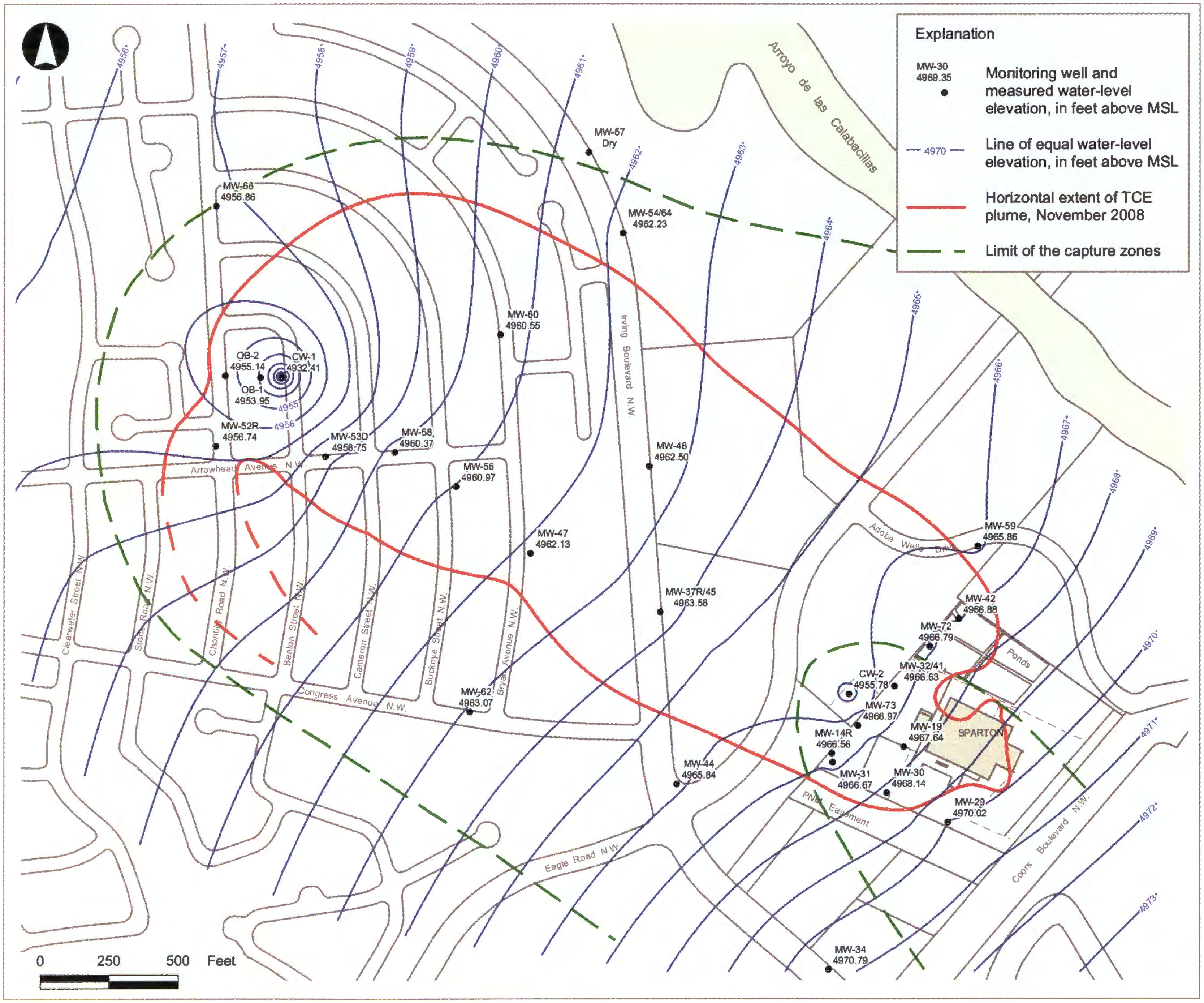


Figure 5.5 Elevation of Water Levels and Limits of Off-Site Containment Well Capture Zones in the UFZ/ULFZ - May 13, 2009

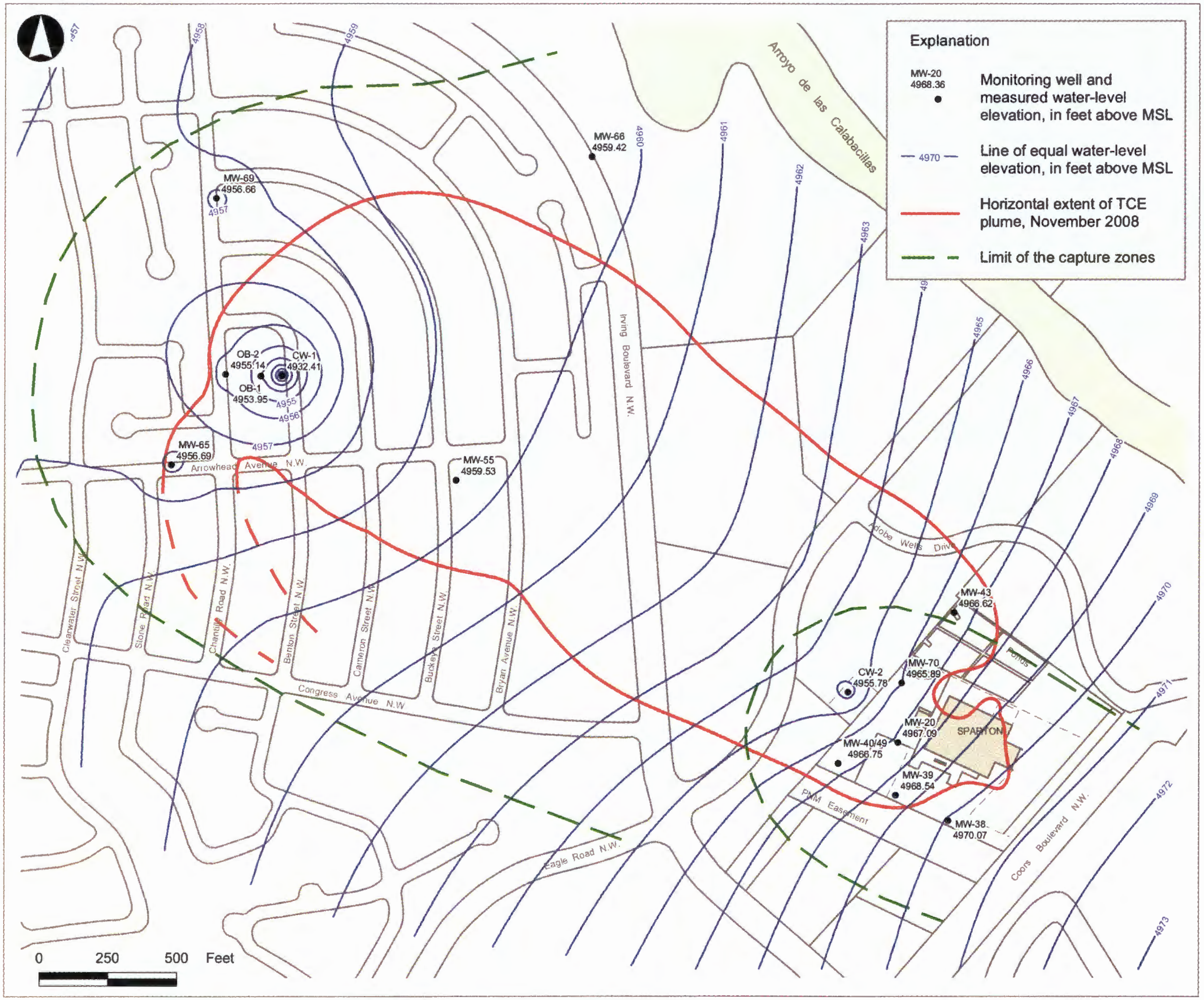


Figure 5.6 Elevation of Water Levels and Limits of Off-Site Containment Well Capture Zone in the LLFZ - May 13, 2009

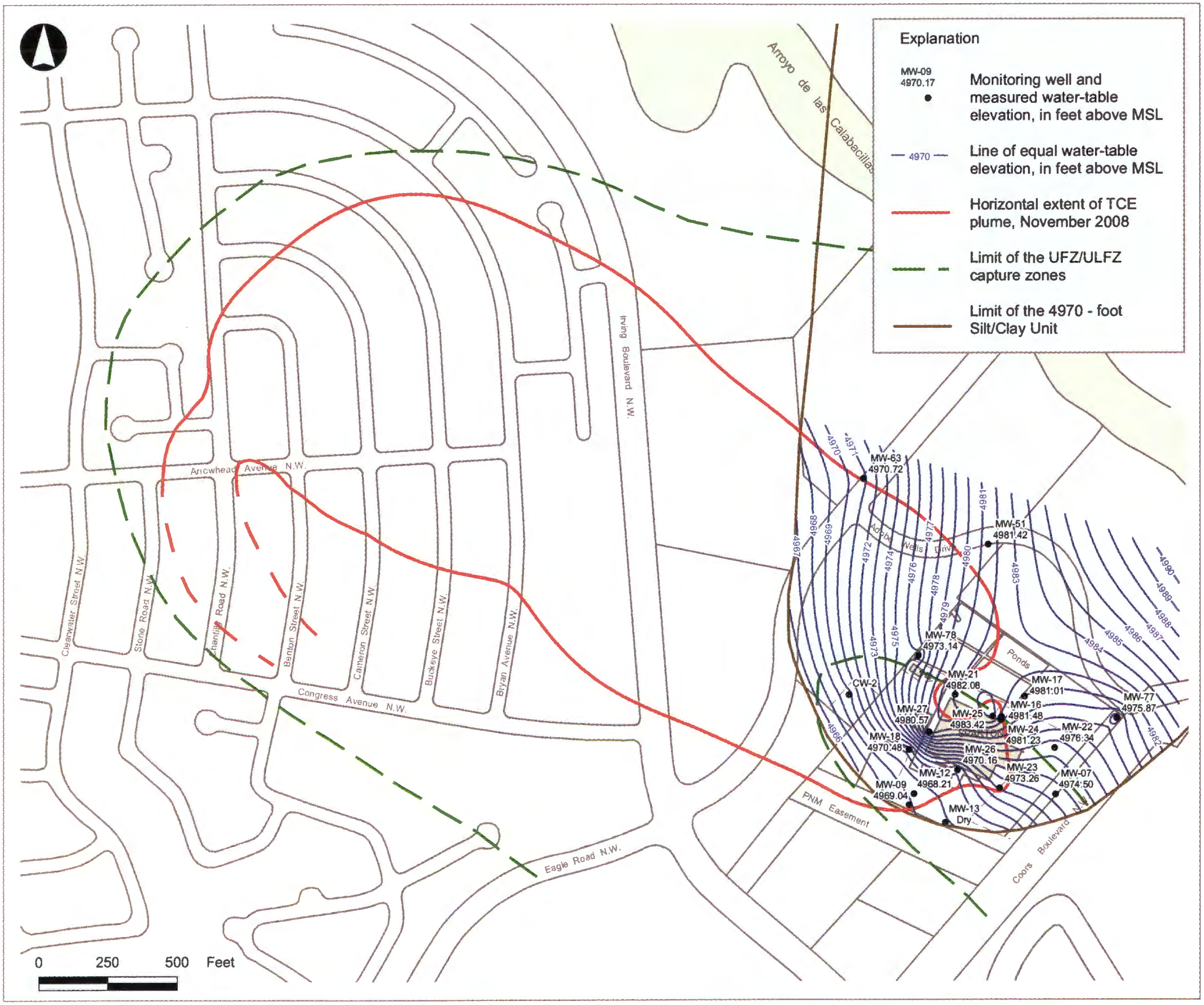


Figure 5.7 Elevation of the On-Site Water Table - August 10, 2009

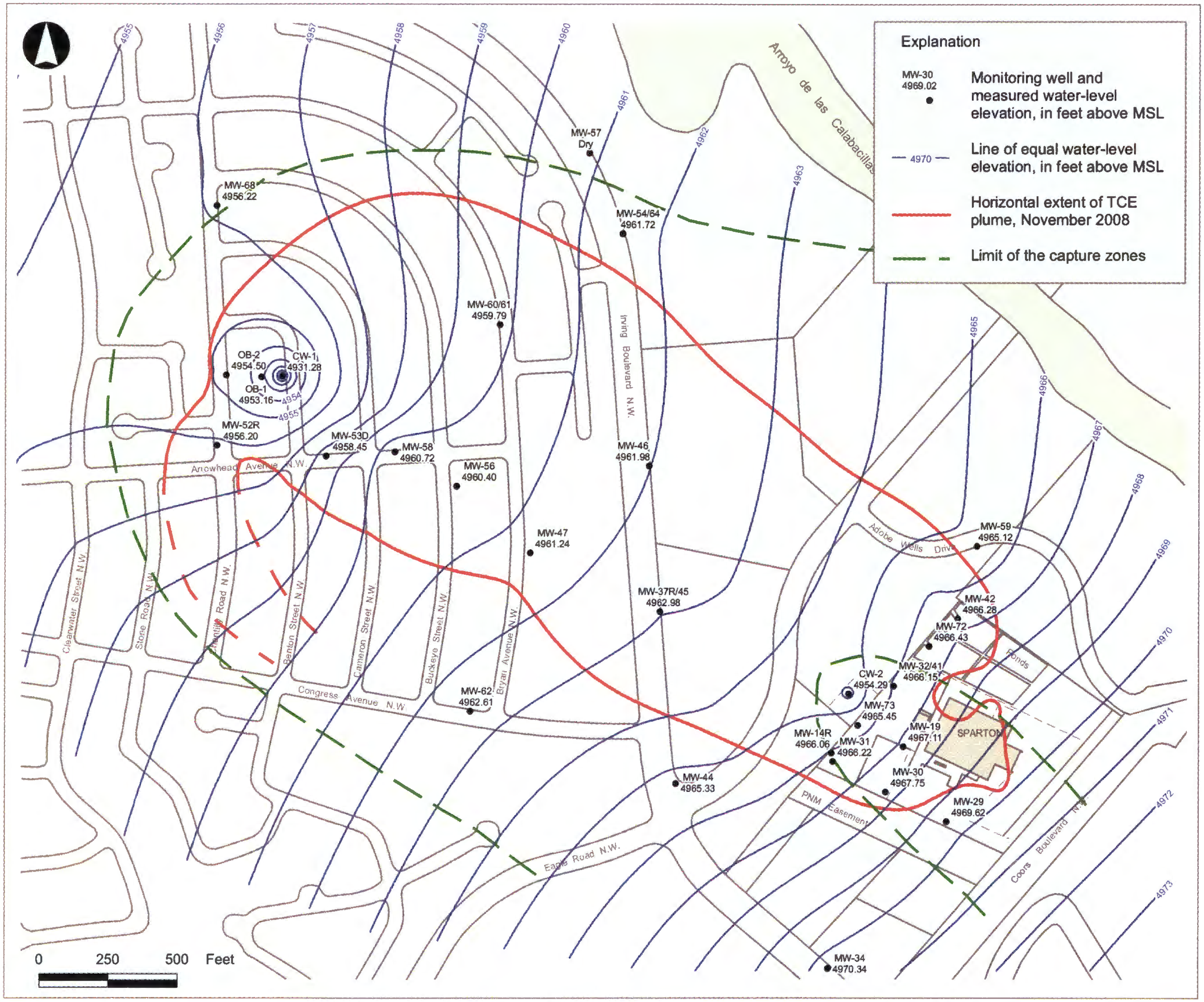


Figure 5.8 Elevation of Water Levels and Limits of Containment Well Capture Zones in the UFZ/ULFZ - August 10, 2009

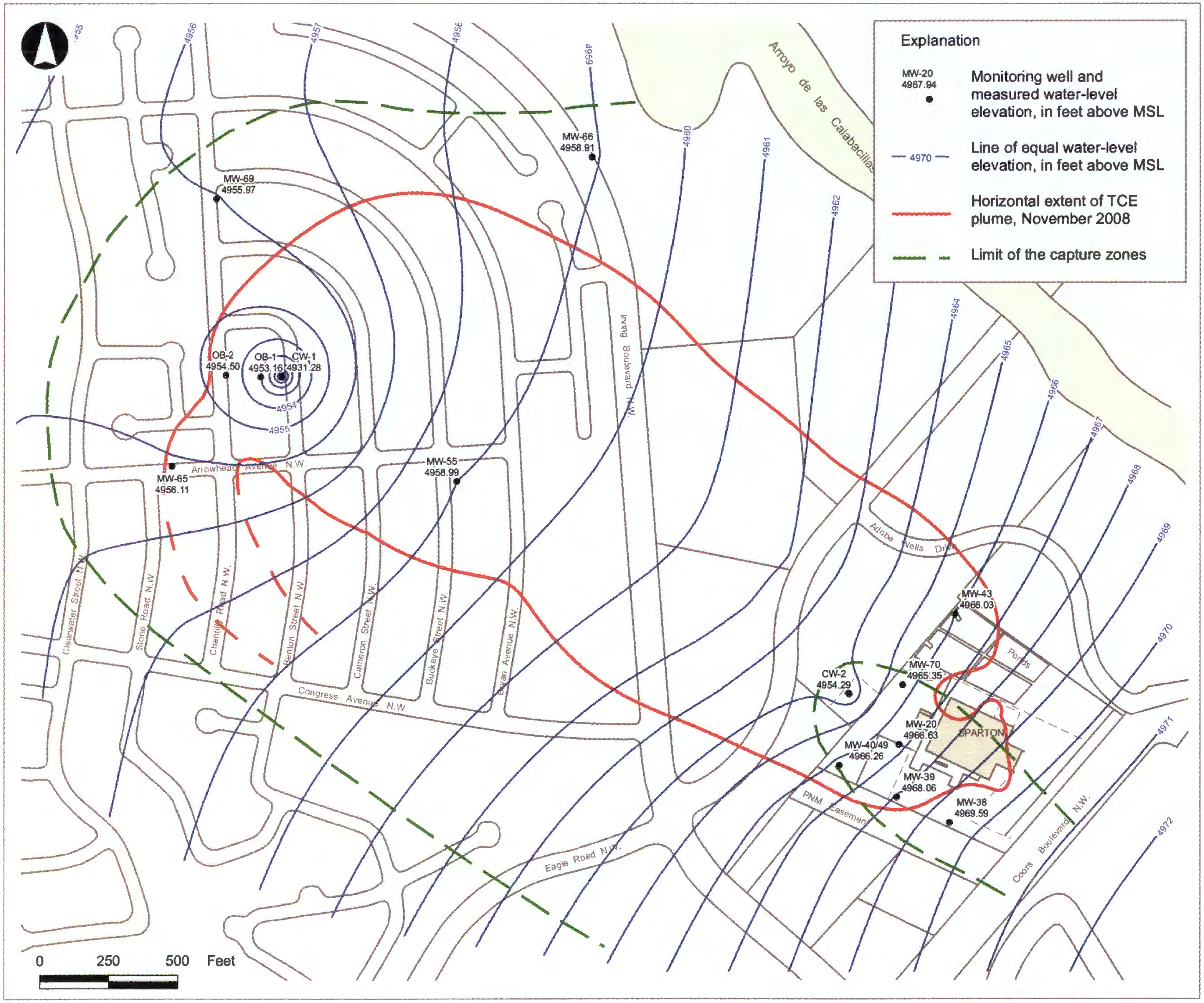


Figure 5.9 Elevation of Water Levels and Limits of Containment Well Capture Zones in the LLFZ - August 10, 2009

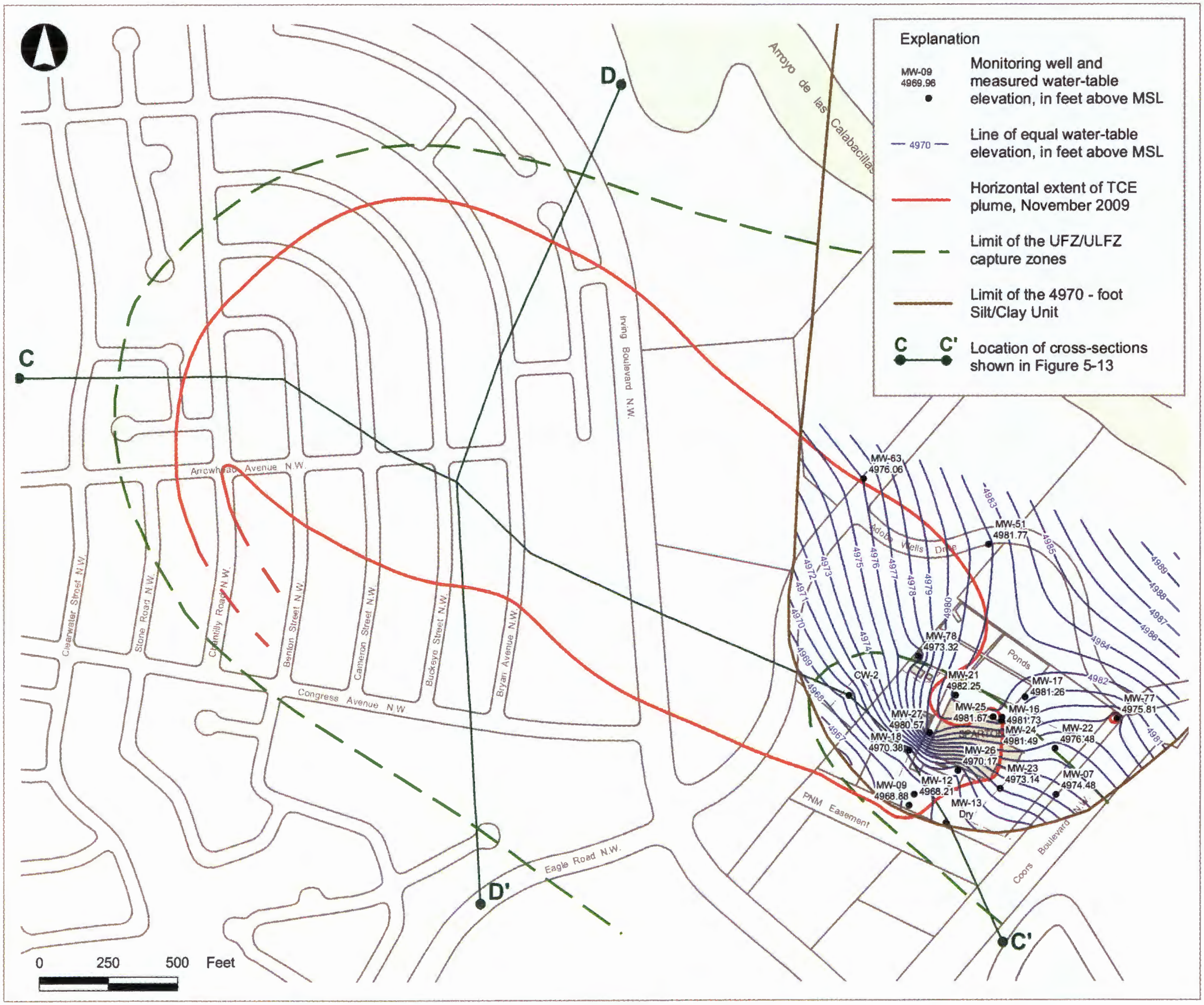


Figure 5.10 Elevation of the On-Site Water Table - November 3, 2009

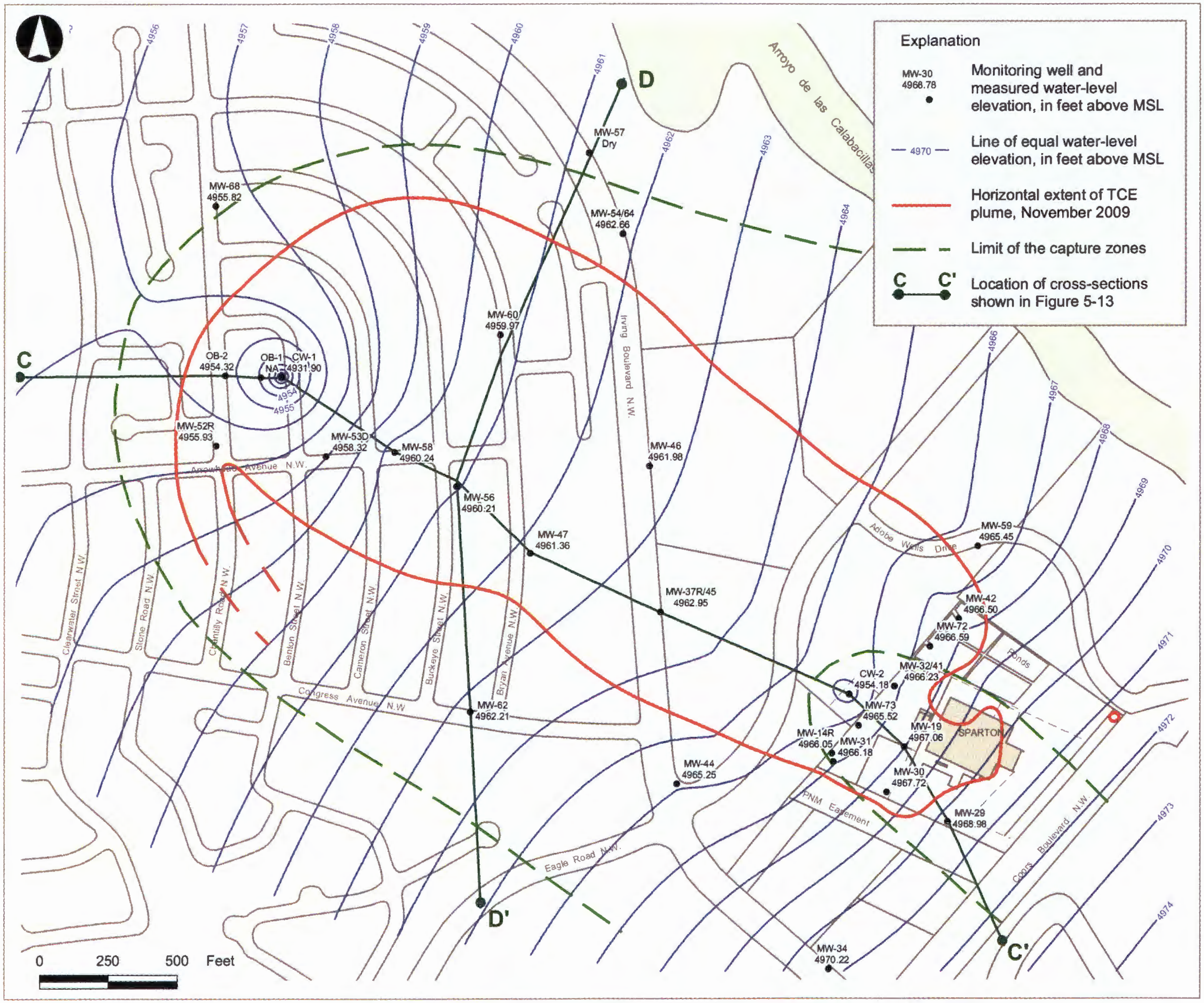


Figure 5.11 Elevation of Water Levels and Limits of Containment Well Capture Zones in the UFZ/ULFZ - November 3, 2009

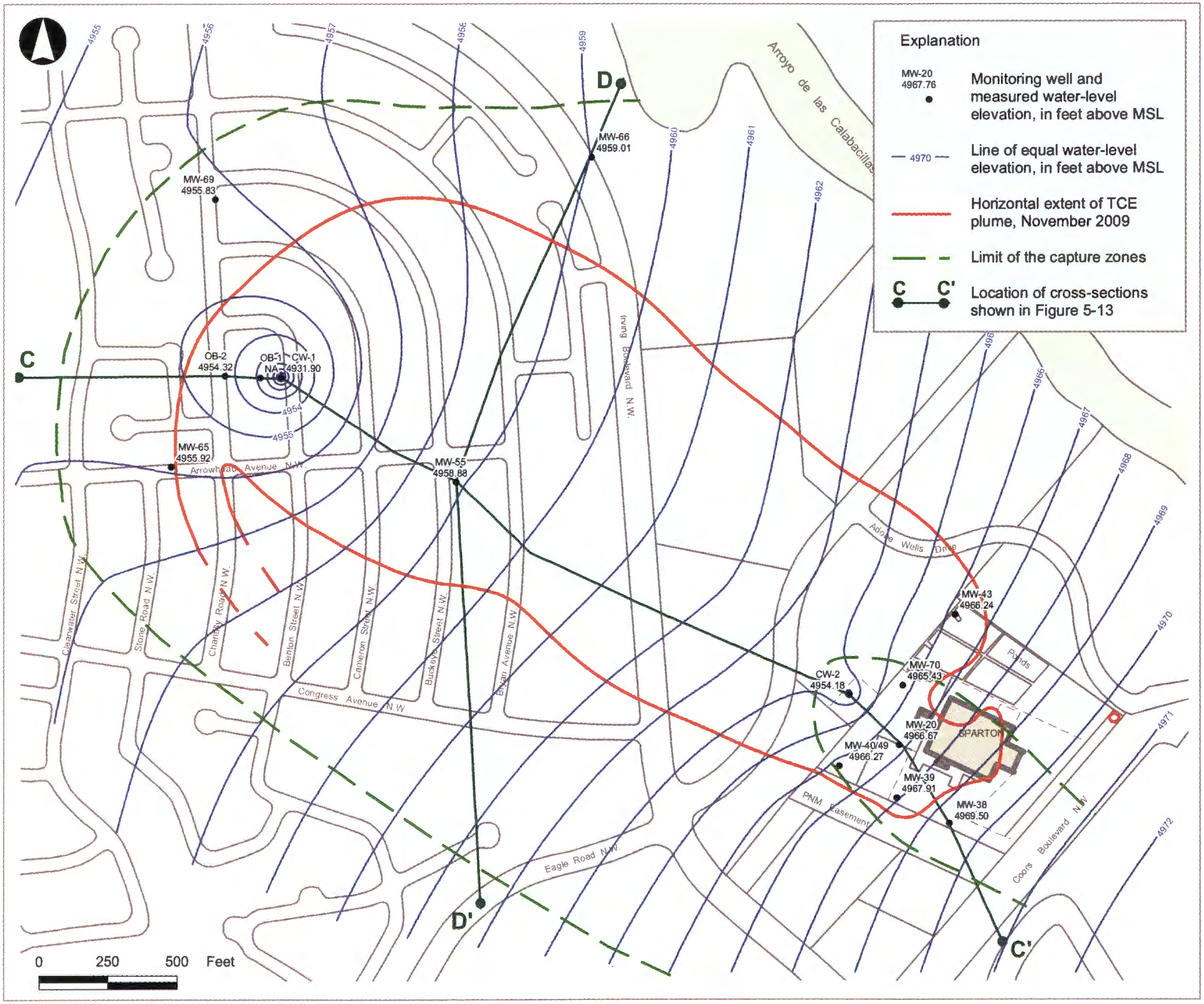


Figure 5.12 Elevation of Water Levels and Limits of Containment Well Capture Zones in the LLFZ - November 3, 2009

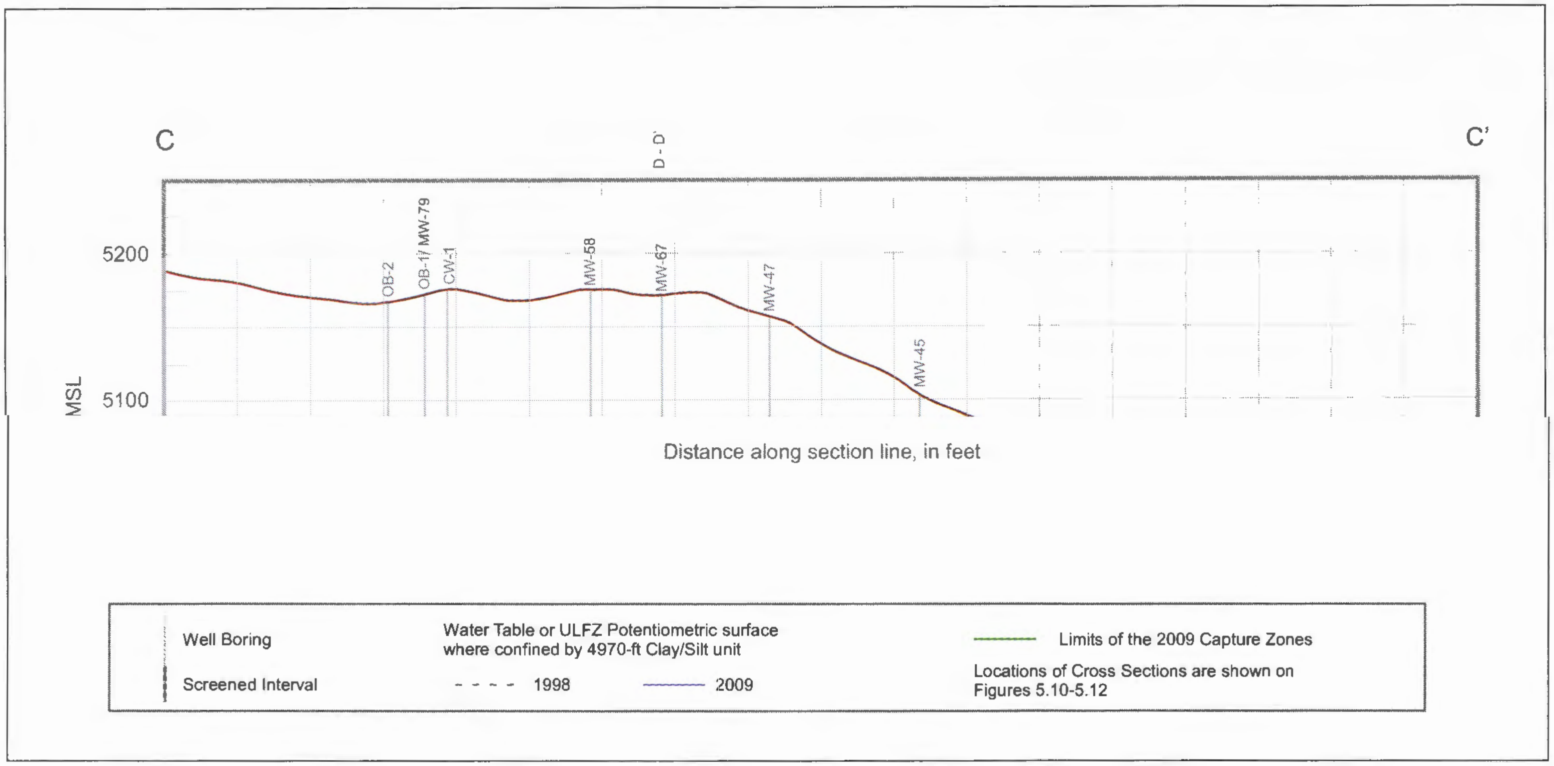


Figure 5.13 Schematic Cross-Sections Showing November 1998 and 2009 Water Levels and Containment Well Capture Zones

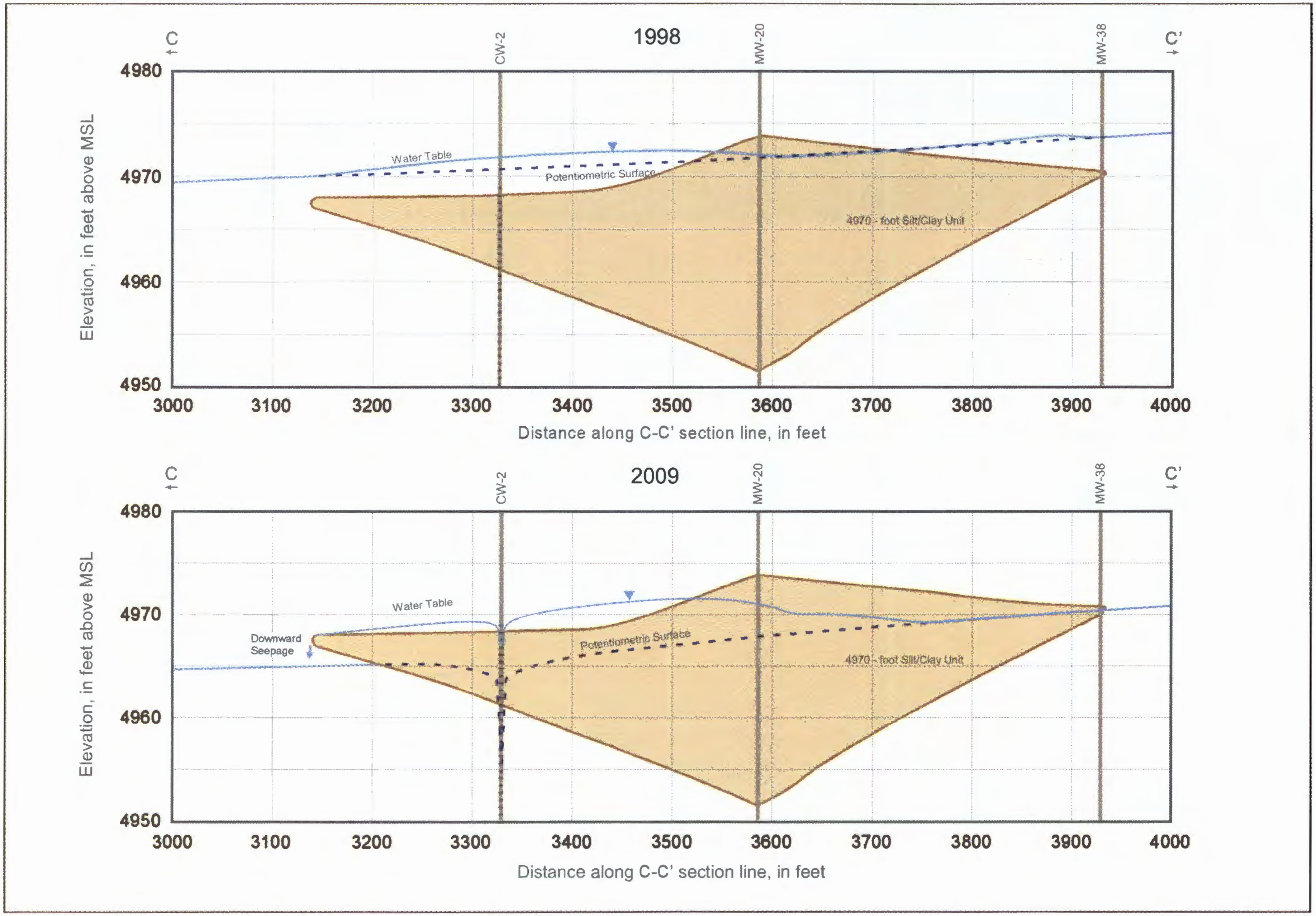


Figure 5.14 Details of Water Level Conditions at the Area Underlain by the 4970 - foot Silt/Clay Unit

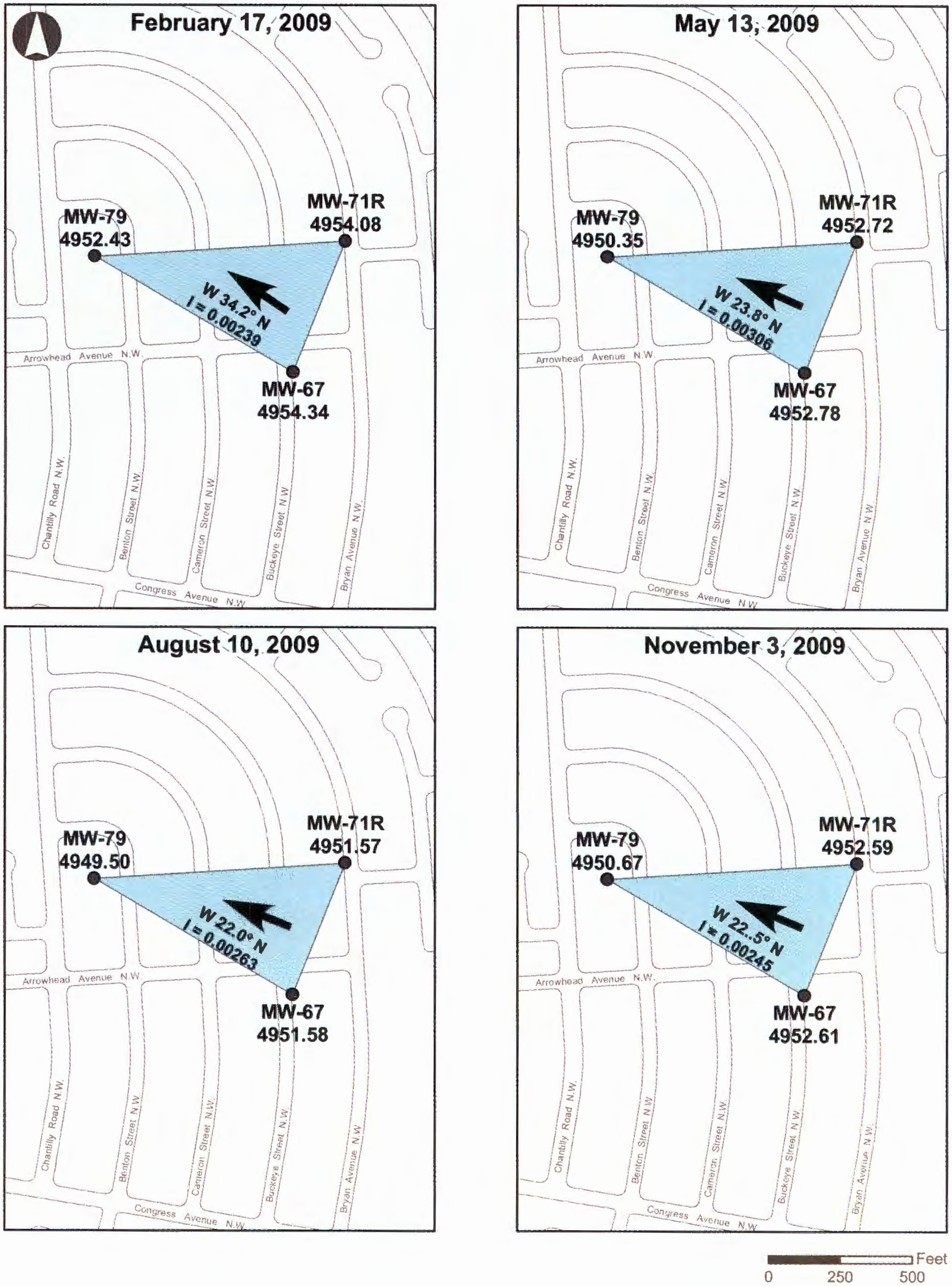
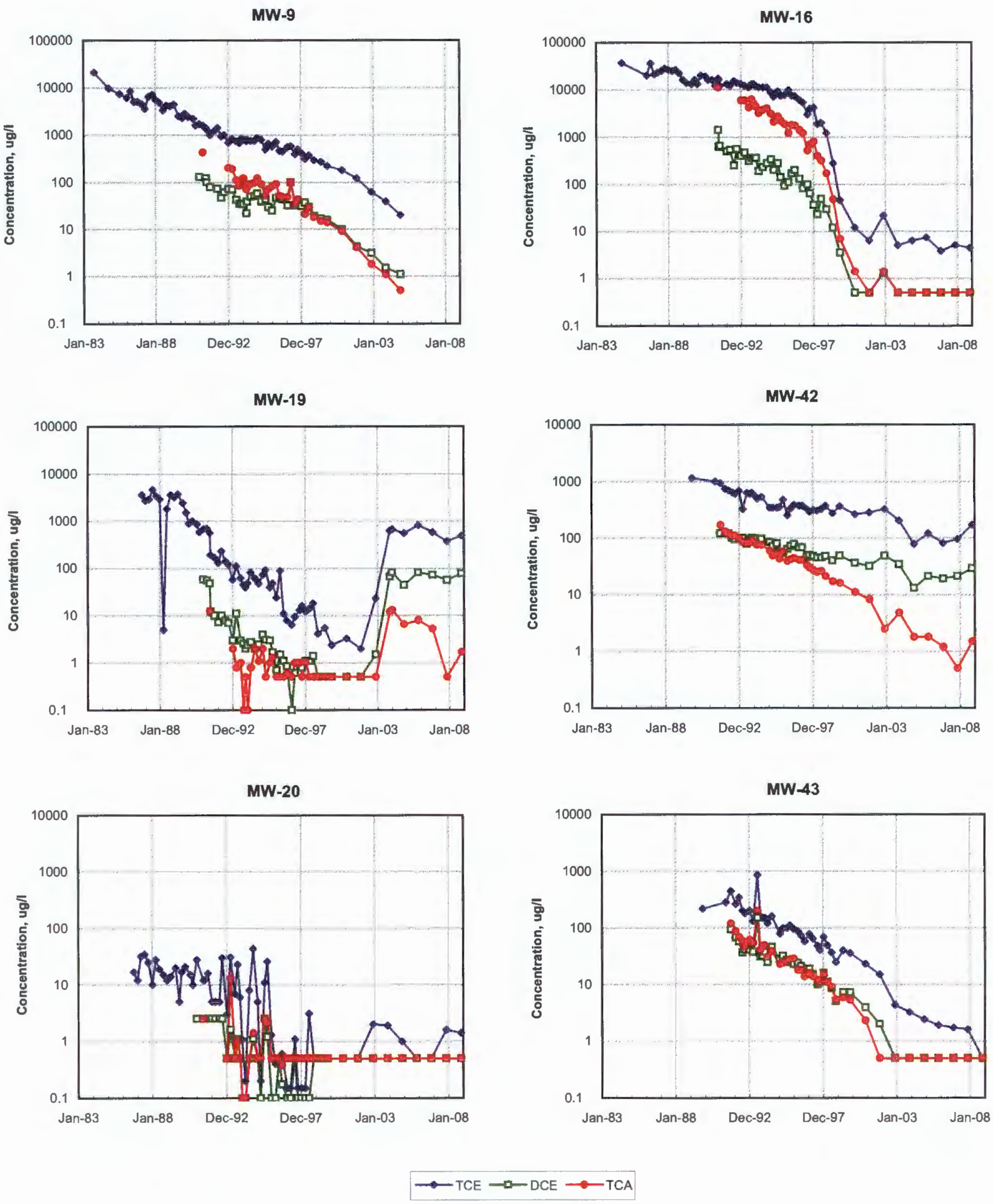
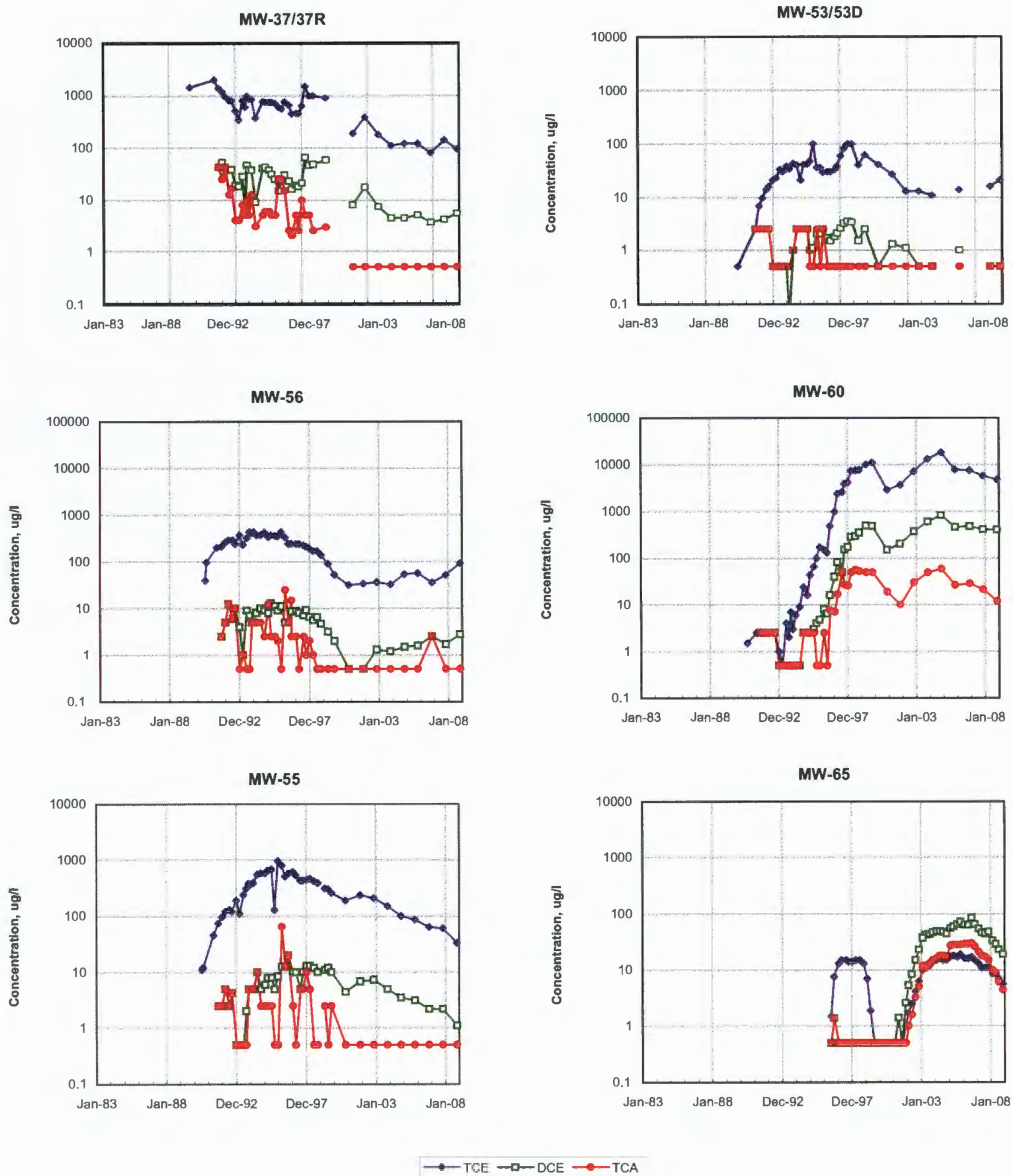


Figure 5.15 Groundwater Flow Direction and Hydraulic Gradient in the DFZ - 2009



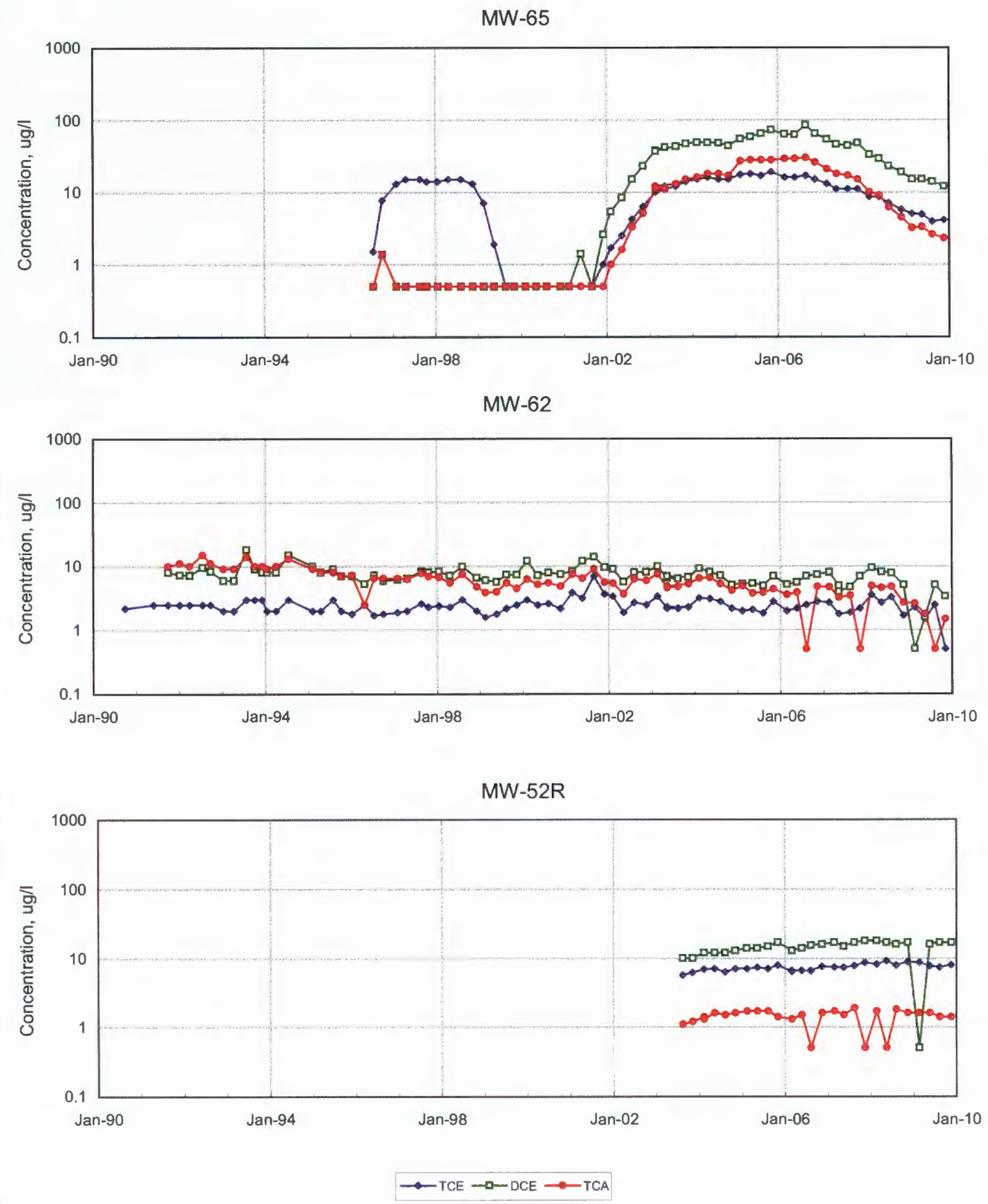
Note: Concentrations reported as less than the detection limit are plotted as 1/2 the detection limit.

Figure 5.16 Contaminant Concentration Trends in On-Site Monitoring Wells



Note: Concentrations reported as less than the detection limit are plotted as 1/2 the detection limit.

Figure 5.17 Contaminant Concentration Trends in Off-Site Monitoring Wells



Note: Concentrations reported as less than the detection limit are plotted as 1/2 the detection limit.

Figure 5.18 Concentration Trends in Monitoring Wells with DCE Dominated Contamination

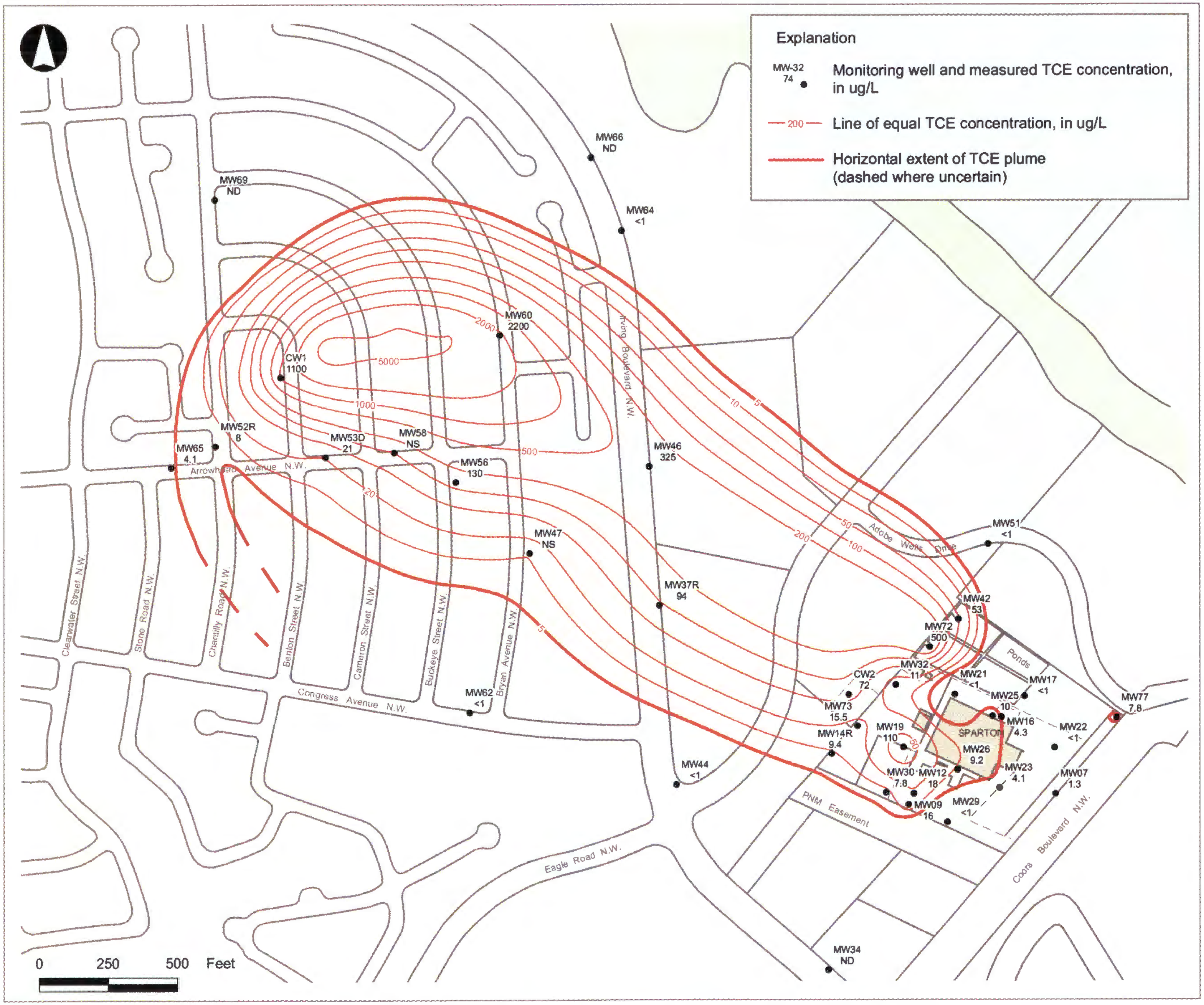


Figure 5.19 Horizontal Extent of TCE Plume - November 2009

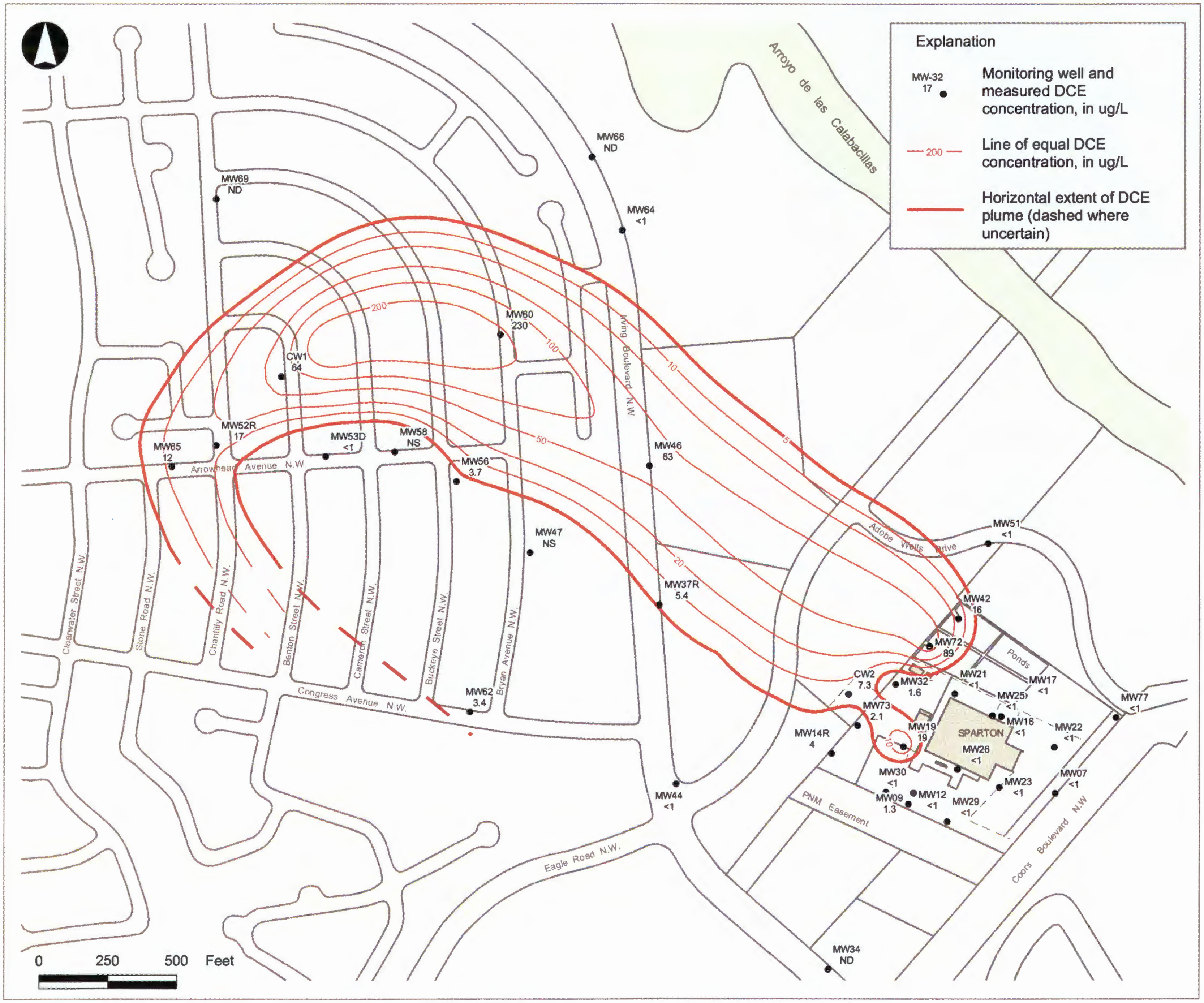


Figure 5.20 Horizontal Extent of DCE Plume - November 2009

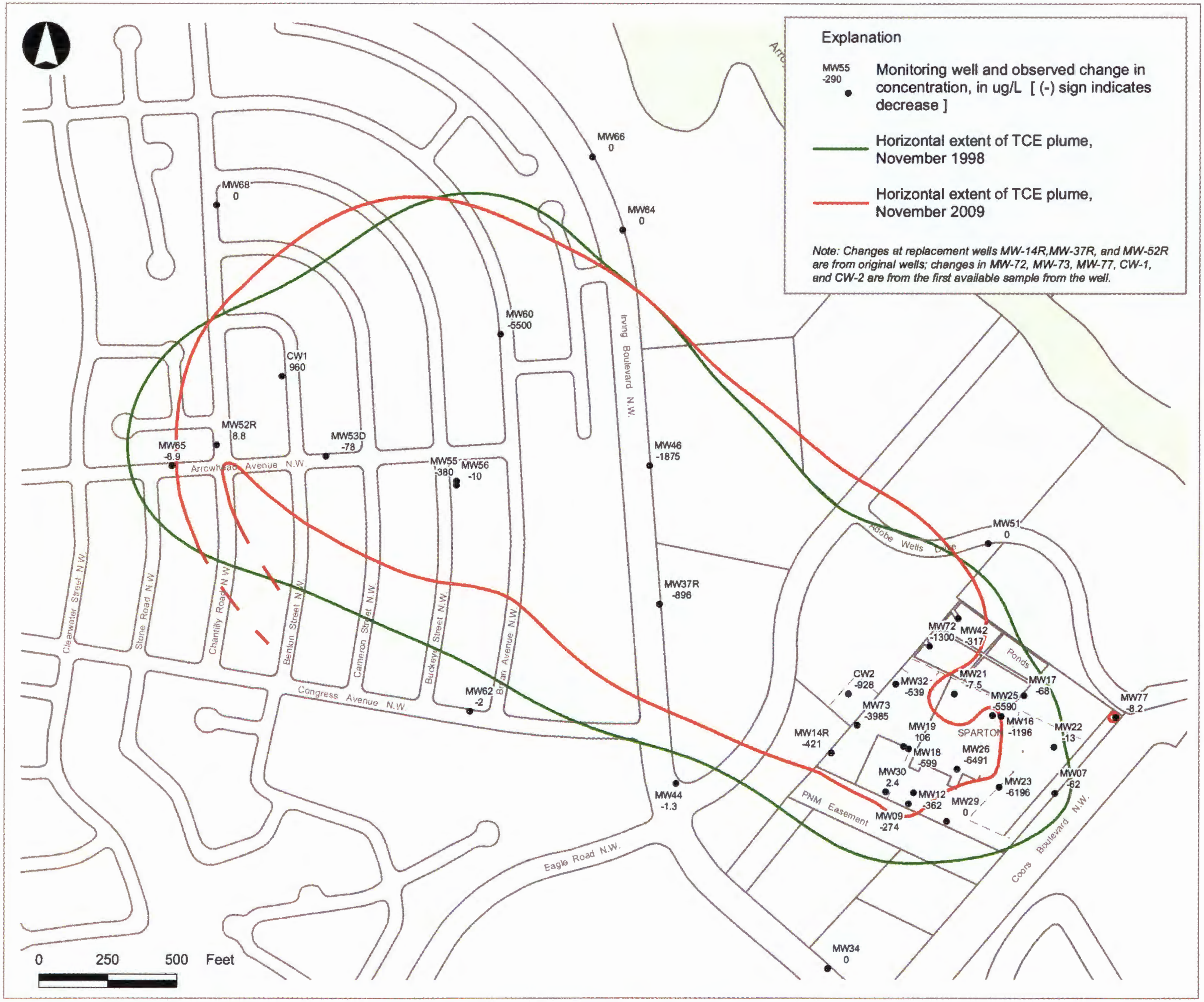


Figure 5.21 Changes in TCE Concentrations at Wells Used for Plume Definition - November 1998 to November 2009

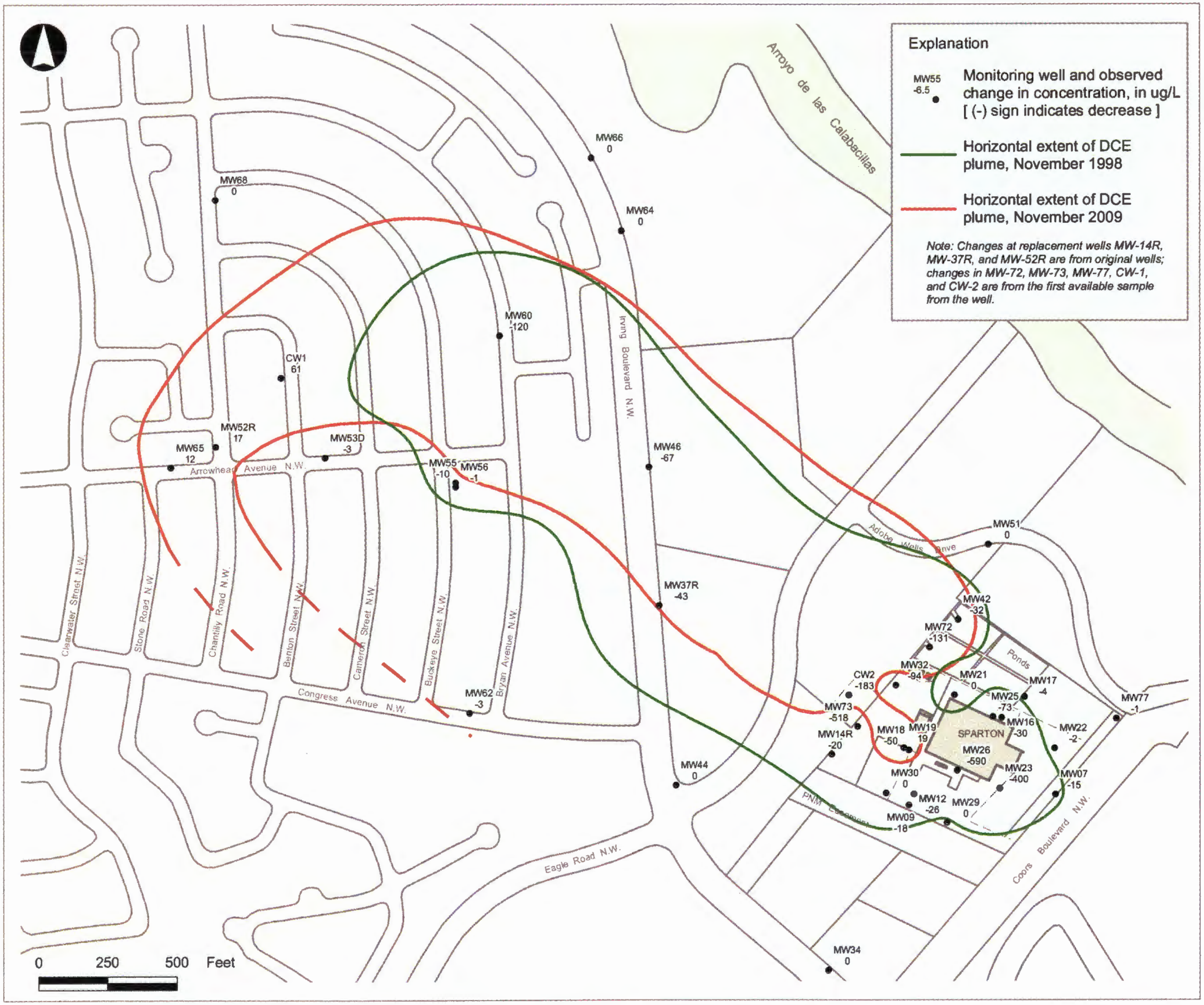


Figure 5.22 Changes in DCE Concentrations at Wells Used for Plume Definition - November 1998 to November 2009

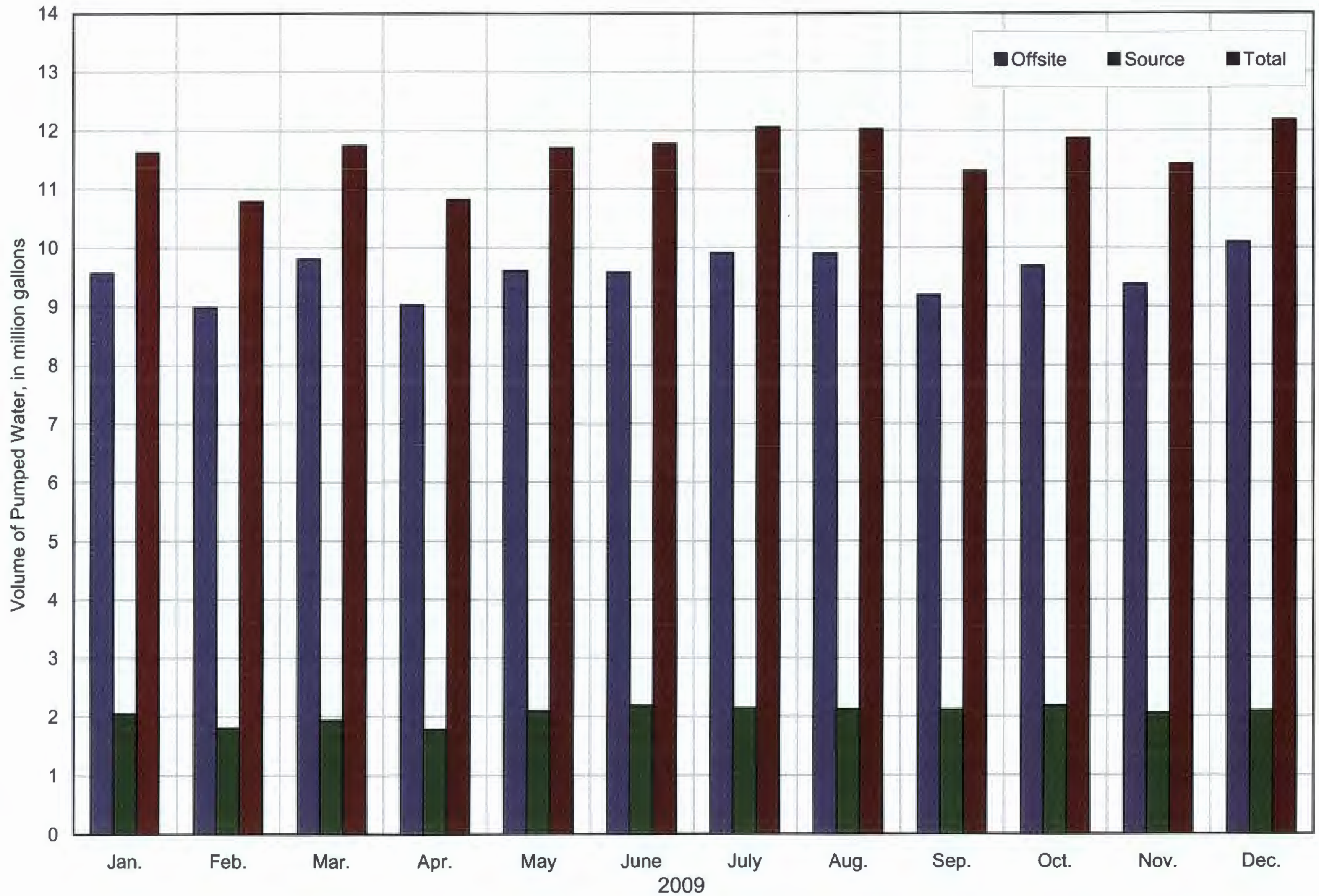


Figure 5.23 Monthly Volume of Water Pumped by the Off-Site and Source Containment Wells - 2009

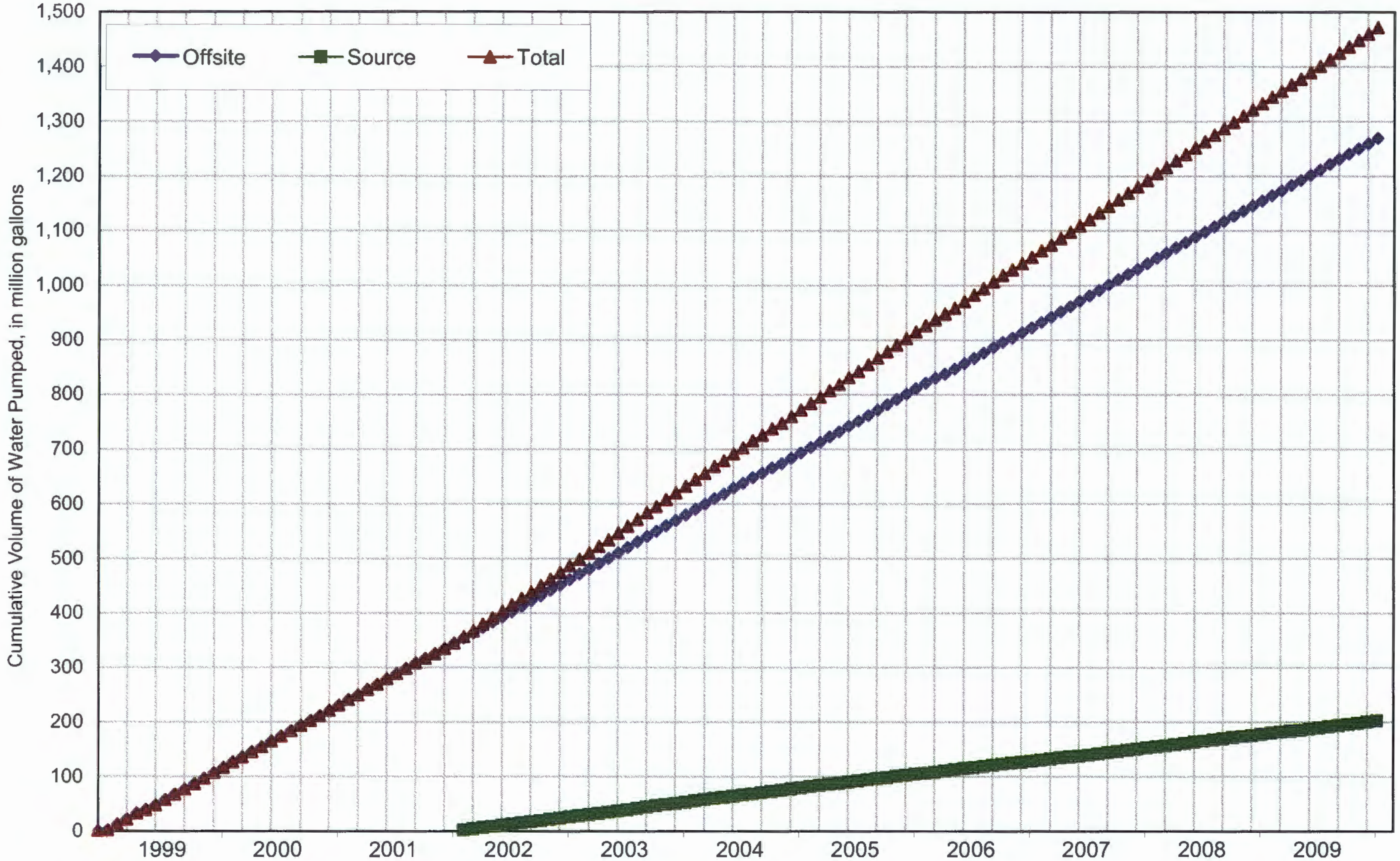


Figure 5.24 Cumulative Volume of Water Pumped by the Off-Site and Source Containment Wells

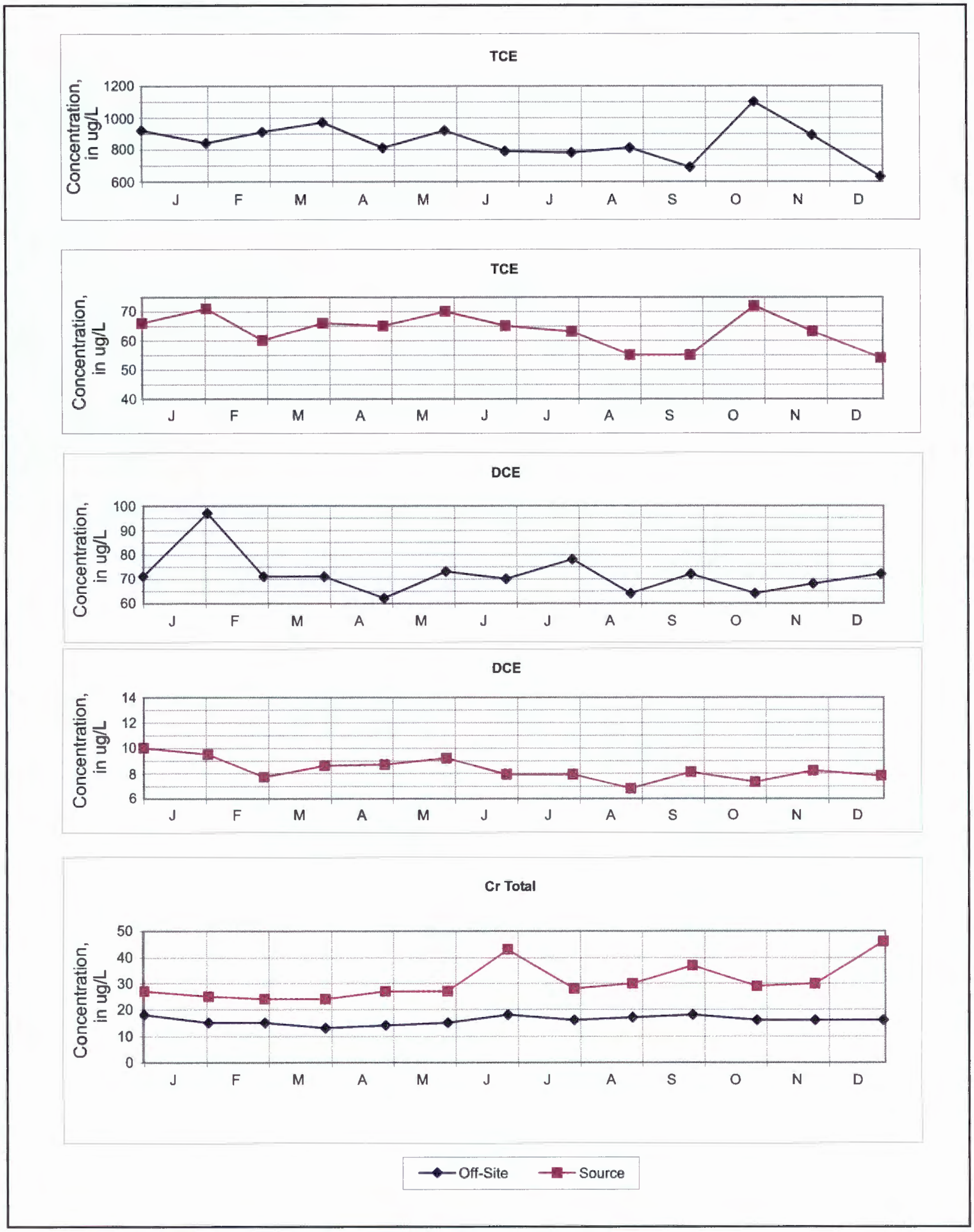


Figure 5.25 Off-Site and Source Containment Systems - TCE, DCE, and Total Chromium Concentrations in the Influent - 2009

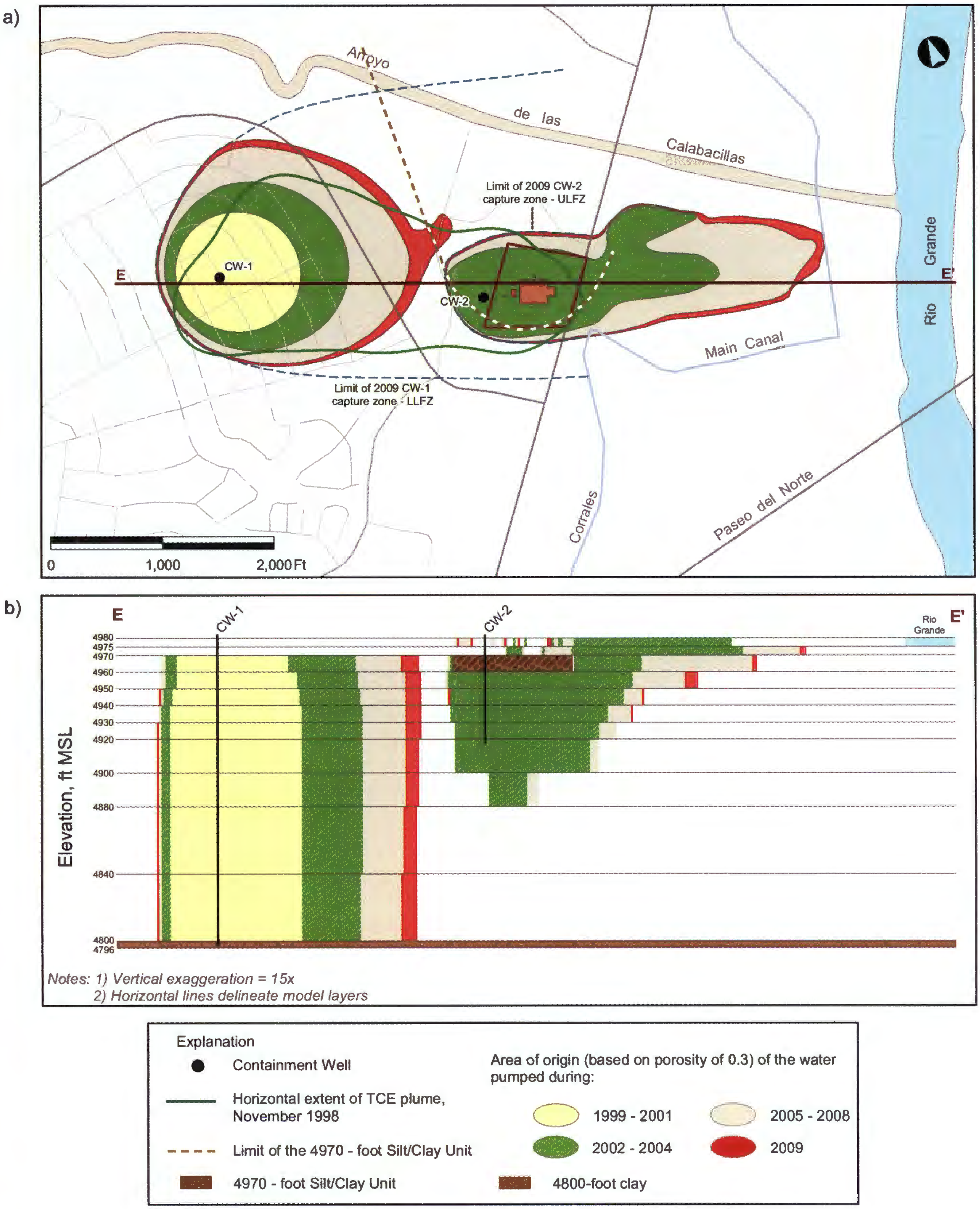


Figure 5.26 Areas of Origin of Water Pumped Since the Beginning of Remedial Operations

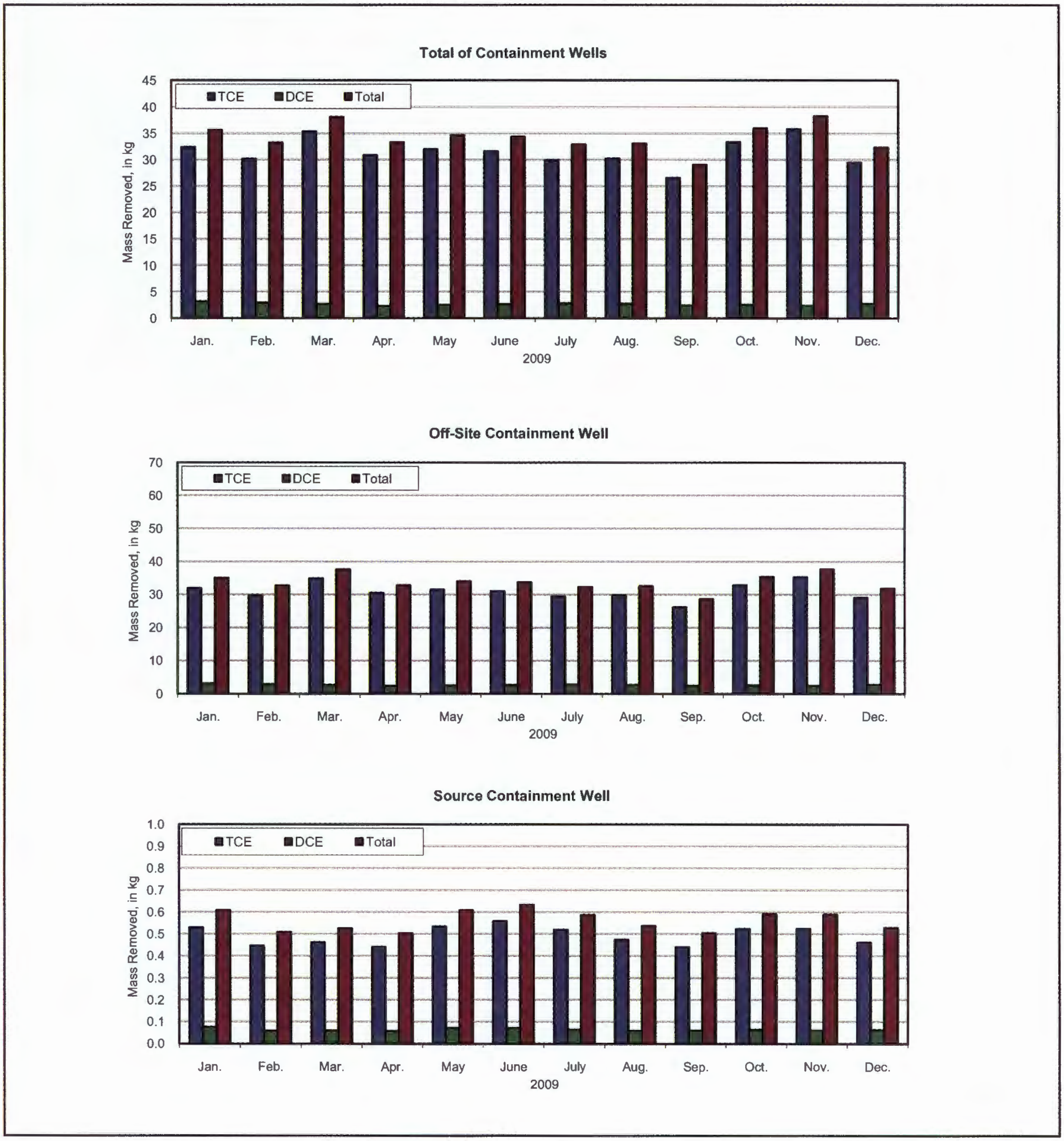


Figure 5.27 Monthly Contaminant Mass Removal by the Containment Wells - 2009

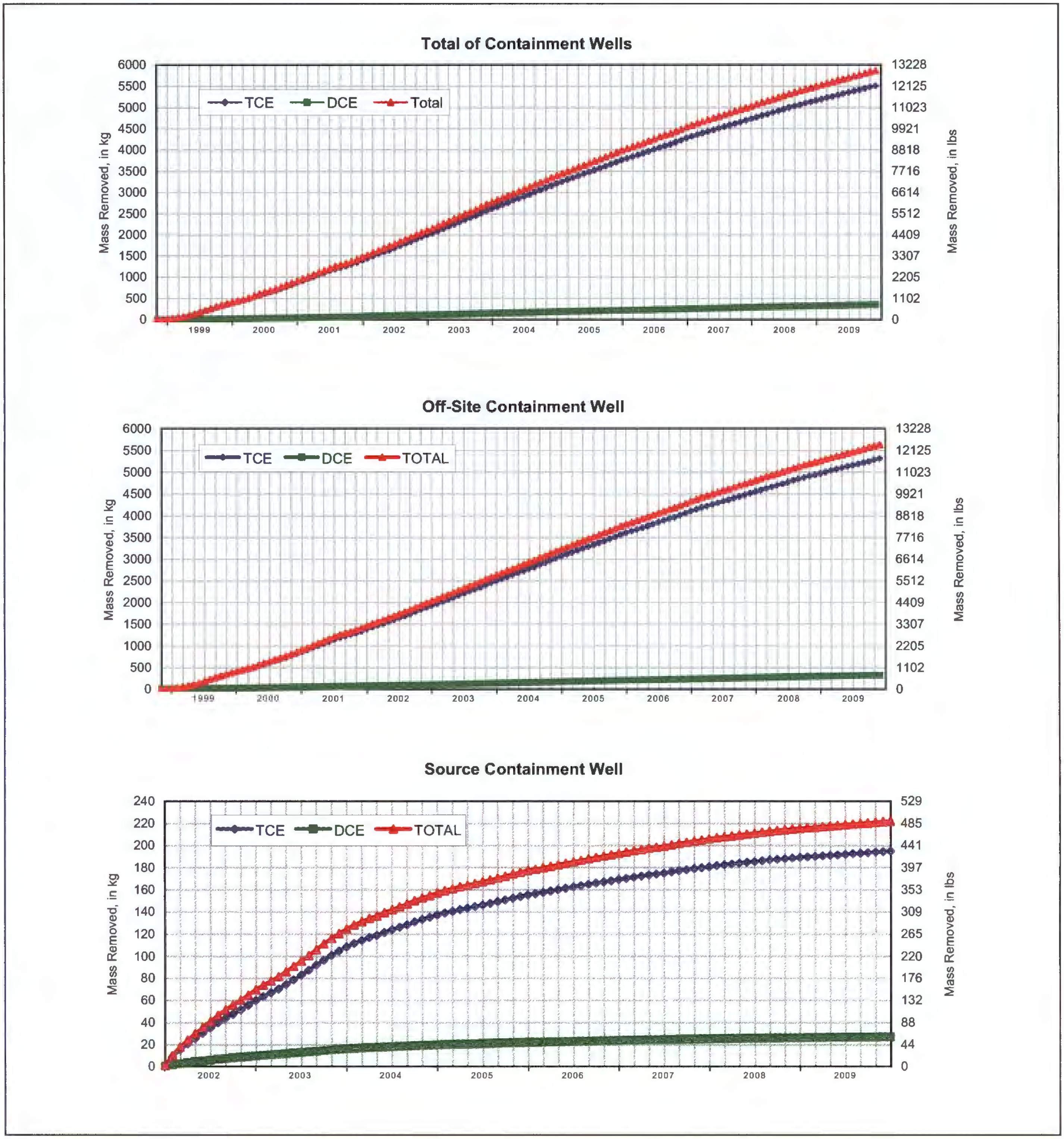


Figure 5.28 Cumulative Contaminant Mass Removal by the Source and Off-Site Containment Wells

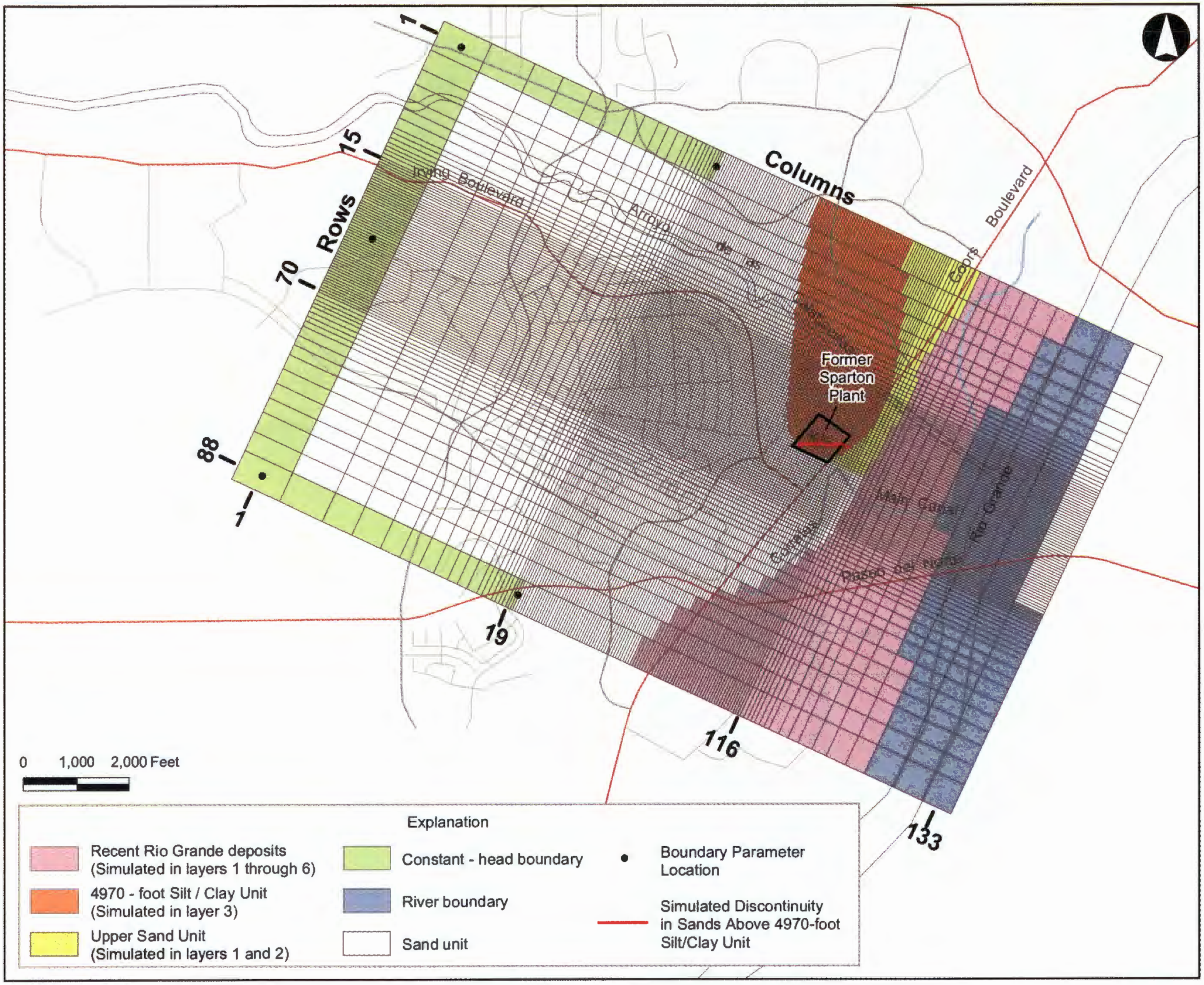


Figure 6.1 Model Grid, Hydraulic Property Zones and Boundary Conditions

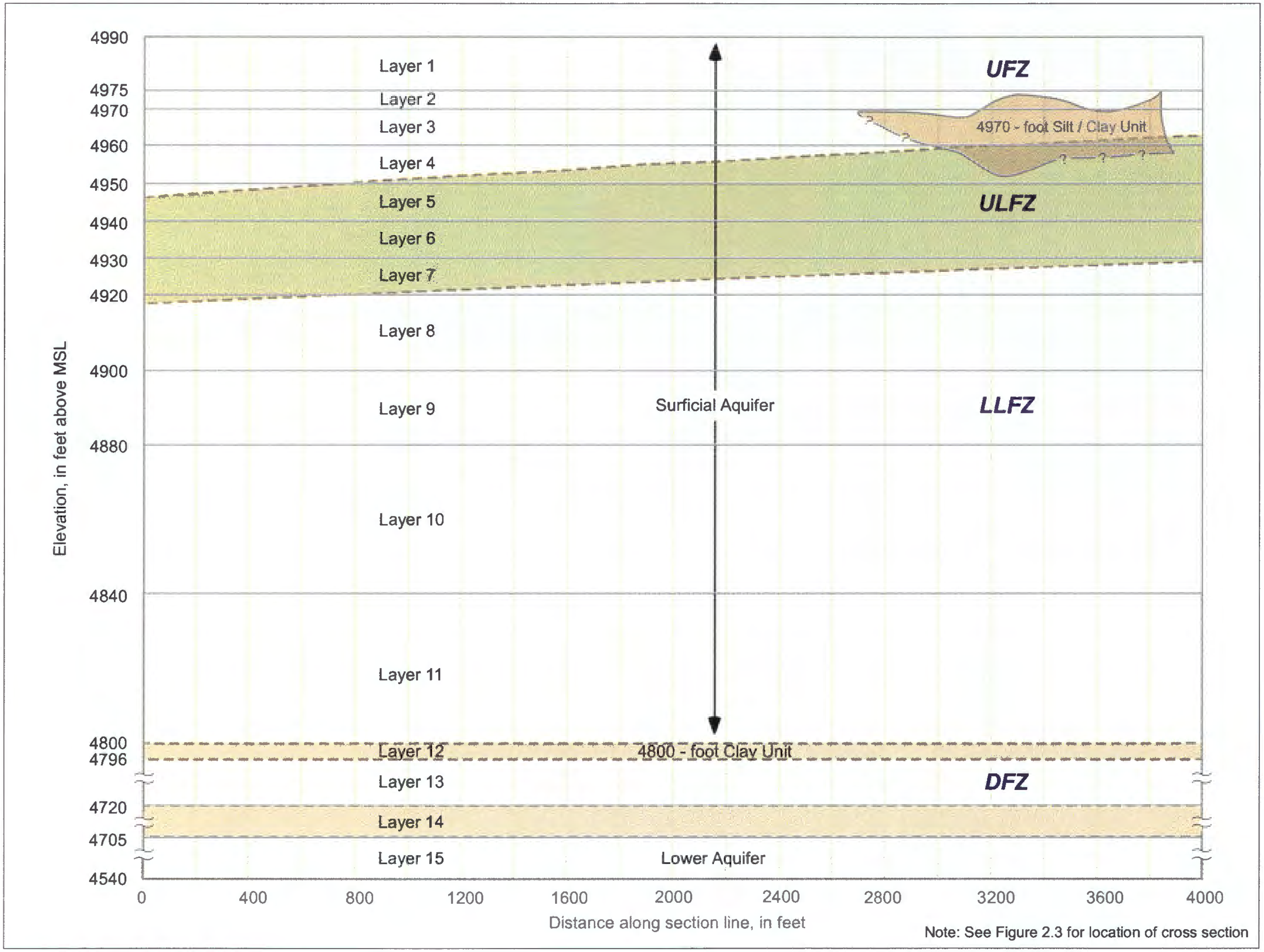


Figure 6.2 Model Layers

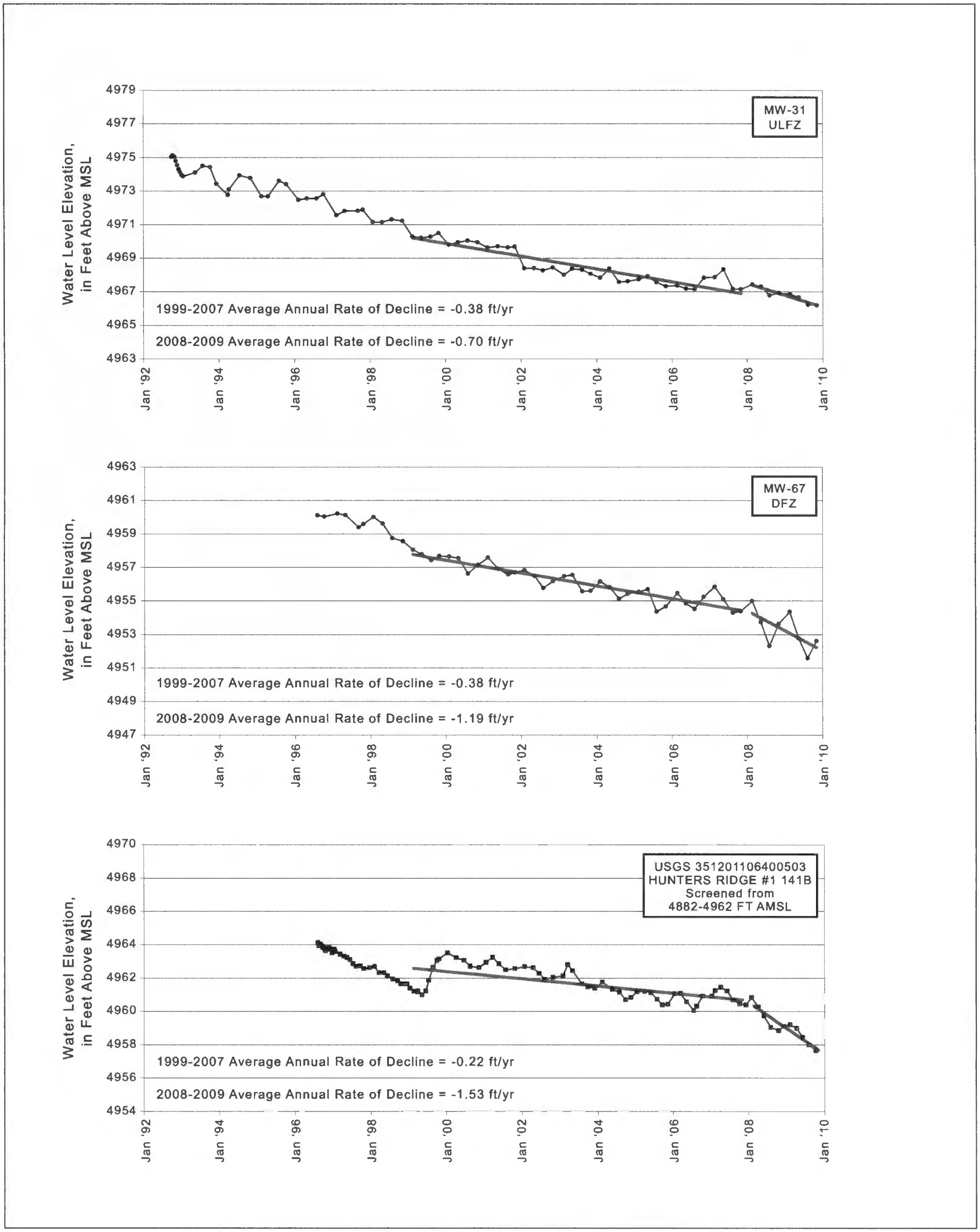


Figure 6.3 Regional Water Level Trends

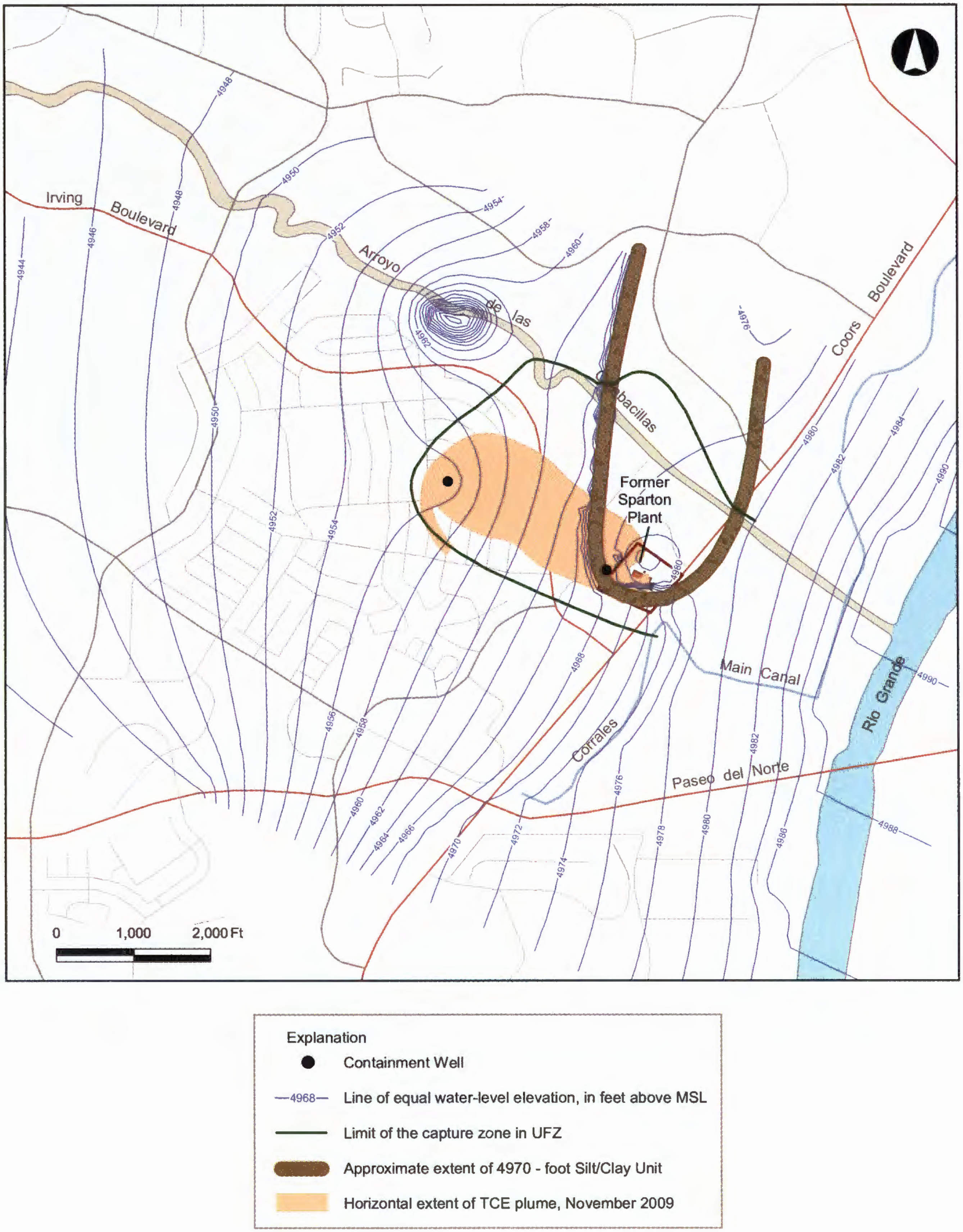
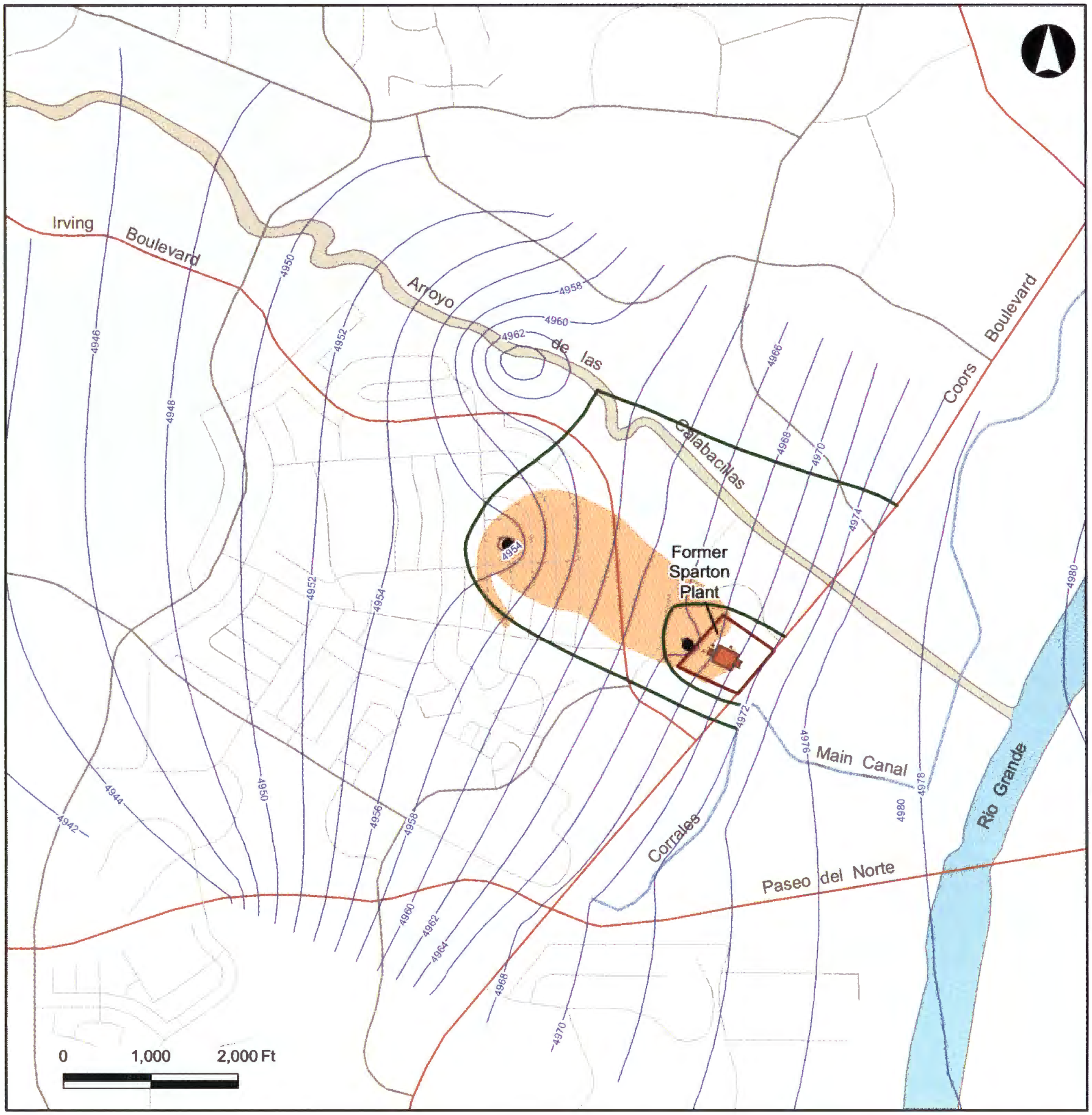


Figure 6.4 Calculated Water Table (UFZ) and Comparison of the Calculated Capture Zone to the TCE Plume Extent



Explanation

- Containment Well
- 4968 Line of equal water-level elevation, in feet above MSL
- Limit of the capture zones in ULFZ
- Horizontal extent of TCE plume, November 2009

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

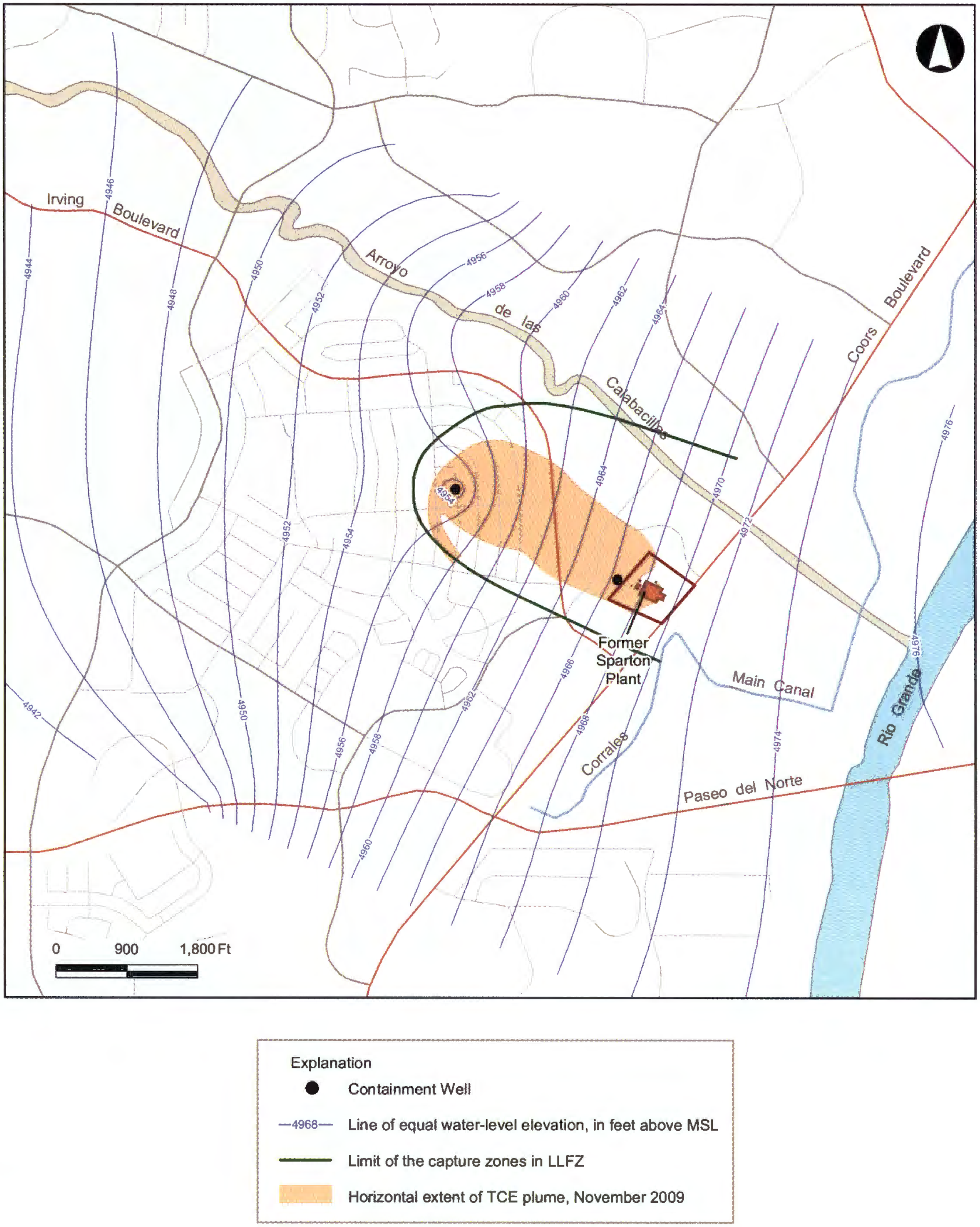


Figure 6.6 Calculated Water Levels in the LLFZ and Comparison of the Calculated Capture Zone to the TCE Plume Extent

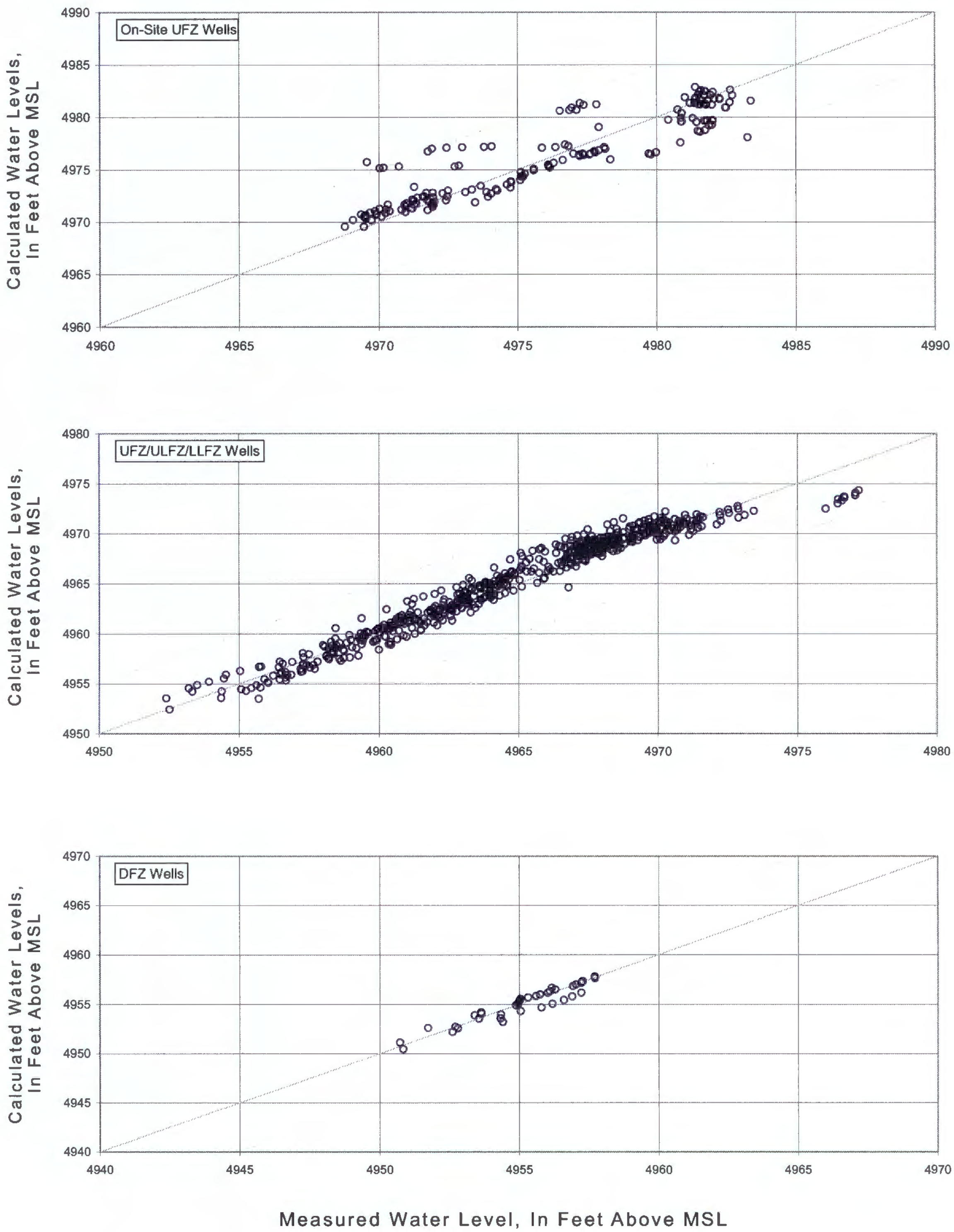


Figure 6.7 Comparison of Calculated to Observed Water Levels - November 1998 to November 2009

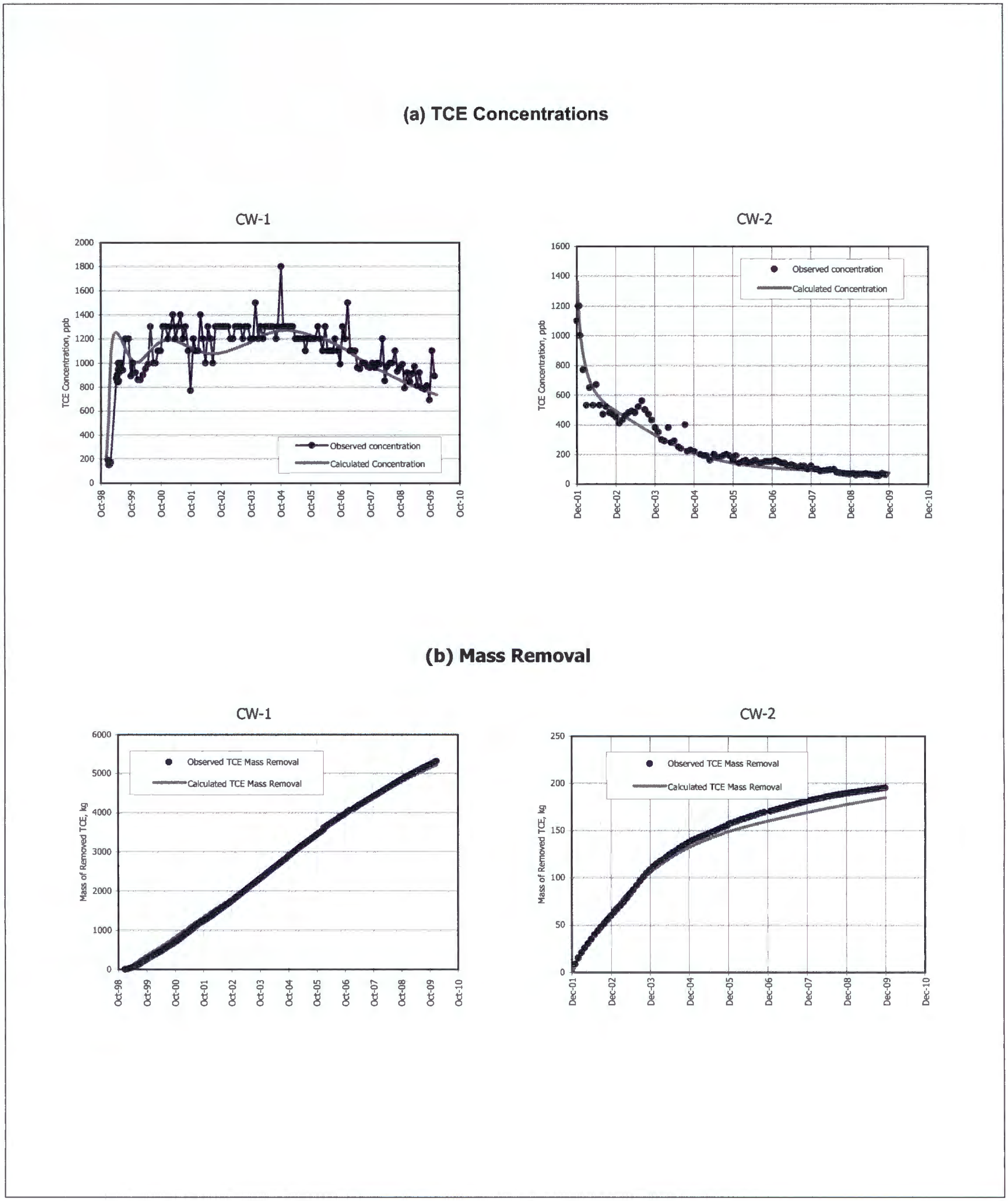


Figure 6.8 Comparison of Calculated to Observed TCE Concentrations in and Mass Removal by the Containment Wells

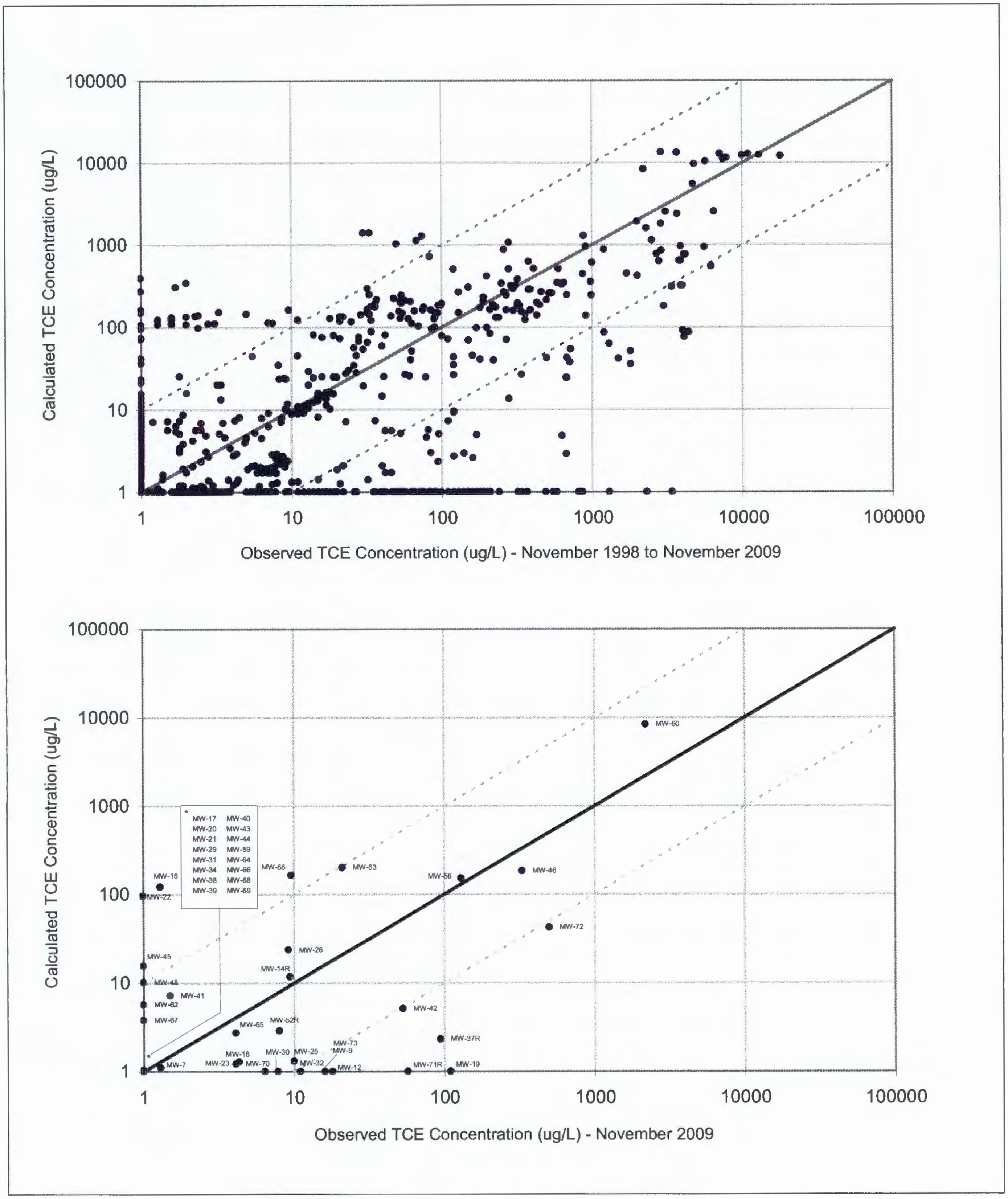


Figure 6.9 Comparisons of Calculated to Observed TCE Concentrations in Monitoring Wells

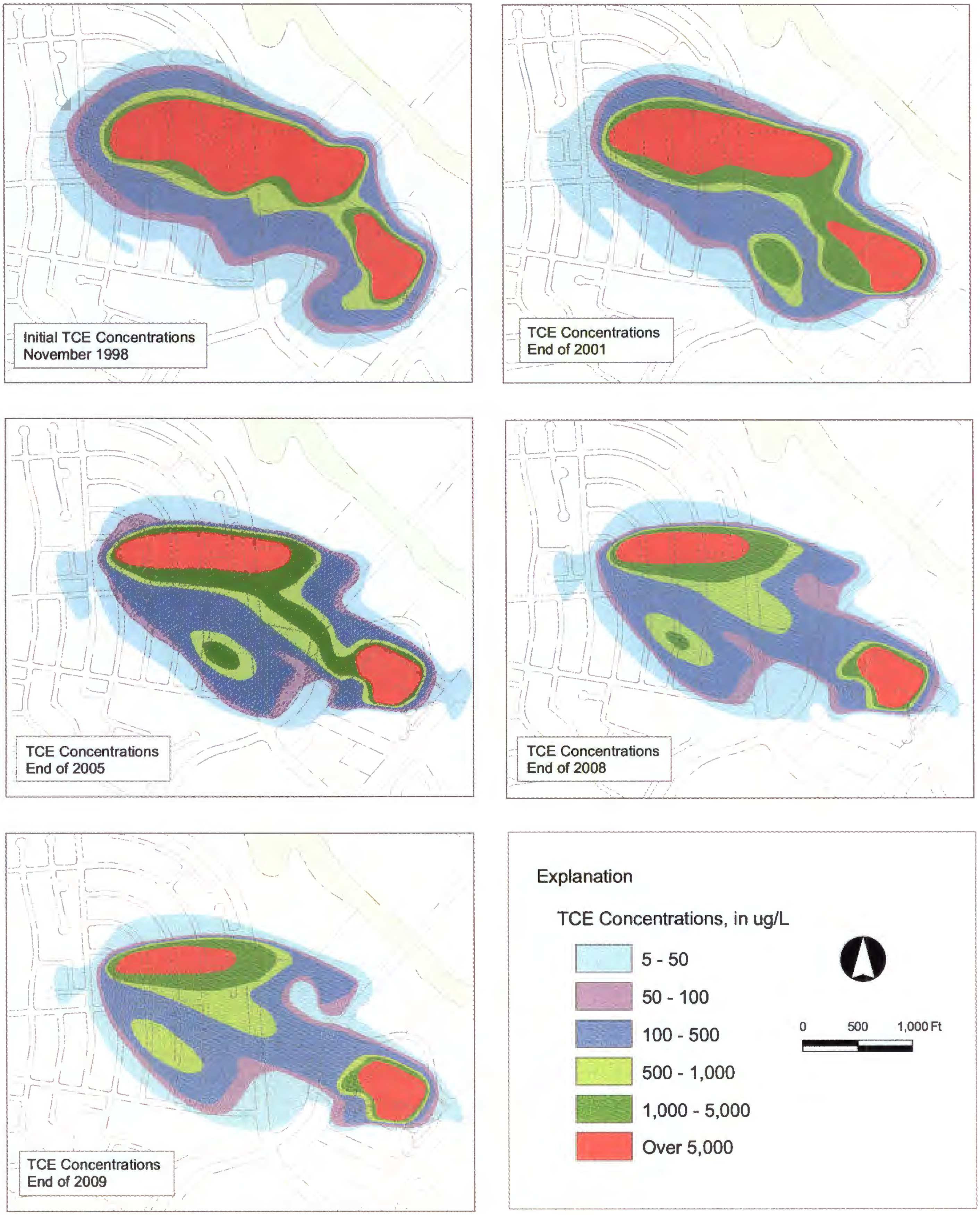


Figure 6.10 Horizontal Extent of Calibrated Initial TCE Plume and Model Calculated TCE Plumes for Later Years

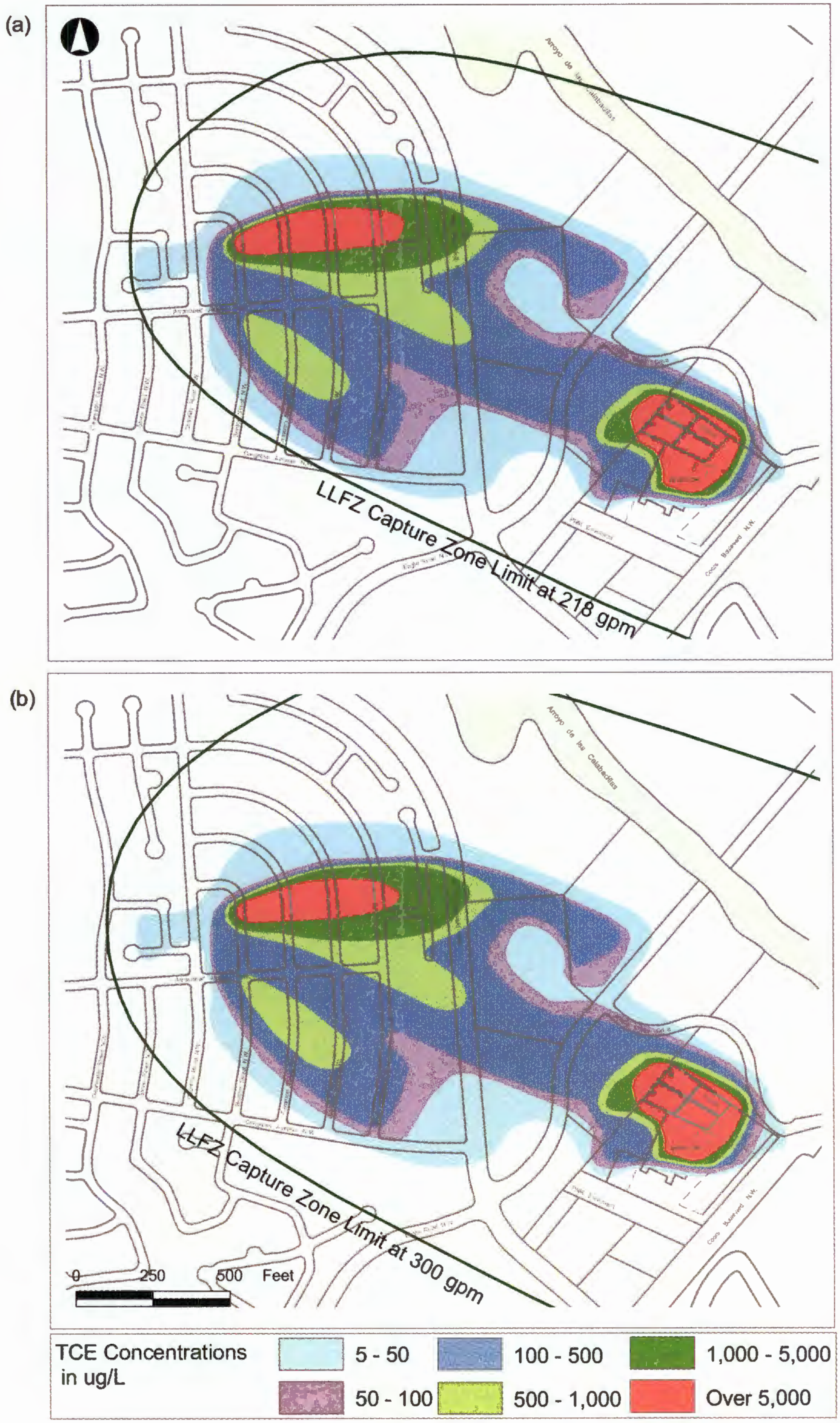


Figure 6.11 Horizontal Extent of Model Predicted TCE Plume in December 2010

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
PZ-1	UFZ	372283.60	1523143.31	5147.36[e]
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-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-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-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-51	UFZ	377291.45	1525000.02	5060.34
MW-52R	UFZ/ULFZ	374504.50	1525353.60	5156.37
MW-53D	UFZ/ULFZ	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
MW-79	DFZ	374662.64	1525626.72	5168.50
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

[e] Elevation effective March 12, 2008.

Table 2.2

Well Screen Data

Well ID[a]	Flow Zone	Diameter (in)	Elevation (ft above MSL) Ground Surface	Elevation (ft above MSL) Top of Screen	Elevation (ft above MSL) Bottom of Screen	Depth below Ground (ft) Top of Screen	Depth below Ground (ft) Bottom of Screen	Screen Length (ft)
CW-1	UFZ&LFZ	8	5166.4	4957.5	4797.5	208.9	368.9	160.0
CW-2	UFZ-LLFZ	4	5048.5	4968.5	4918.5	80.0	130.0	50.0
OB-1	UFZ&LFZ	4	5166.2	4960.3	4789.8	205.9	376.4	170.5
OB-2	UFZ&LFZ	4	5164.8	4960.3	4789.7	204.5	375.1	170.6
PZ-1	UFZ	2	5141.3	4961.5	4951.3	179.8	190.0	10.2
MW-7	UFZ	2	5043.0	4979.7	4974.7	63.3	68.3	5.0
MW-9	UFZ	2	5042.4	4975.8	4970.8	66.6	71.6	5.0
MW-12	UFZ	4	5042.3	4978.2	4966.2	64.1	76.1	12.0
MW-13	UFZ	2	5041.9	4981.5	4971.6	60.4	70.3	9.9
MW-14R	UFZ/ULFZ	2	5040.8	4980.5	4950.5	60.3	90.3	30.0
MW-16	UFZ	2	5046.2	4979.7	4974.7	66.5	71.5	5.0
MW-17	UFZ	2	5047.5	4982.3	4977.3	65.2	70.2	5.0
MW-18	UFZ	4	5042.9	4976.0	4966.0	66.9	76.9	10.0
MW-19	ULFZ	4	5042.9	4944.8	4934.8	98.1	108.1	10.0
MW-20	LLFZ	4	5042.8	4919.2	4906.8	123.6	136.0	12.4
MW-21	UFZ	2	5045.7	4982.8	4977.8	62.9	67.9	5.0
MW-22	UFZ	2	5044.6	4977.2	4972.2	67.4	72.4	5.0
MW-23	UFZ	4	5045.6	4973.8	4968.8	71.8	76.8	5.0
MW-24	UFZ	4	5046.2	4977.5	4972.5	68.7	73.7	5.0
MW-25	UFZ	4	5046.1	4977.9	4972.9	68.2	73.2	5.0
MW-26	UFZ	2	5045.4	4969.1	4964.1	76.3	81.3	5.0
MW-27	UFZ	2	5045.8	4975.4	4970.4	70.4	75.4	5.0
MW-29	ULFZ	4	5041.9	4938.3	4928.3	103.6	113.6	10.0
MW-30	ULFZ	4	5041.7	4944.8	4934.8	96.9	106.9	10.0
MW-31	ULFZ	4	5040.9	4945.2	4935.2	95.7	105.7	10.0
MW-32	LLFZ	4	5044.8	4937.3	4927.3	107.5	117.5	10.0
MW-33[b]	UFZ	4	5042.1	4980.1	4969.1	62.0	73.0	11.0
MW-34	UFZ	2	5034.4	4978.0	4968.0	56.4	66.4	10.0
MW-37R	UFZ/ULFZ	2	5093.0	4976.6	4946.6	116.4	146.4	30.0
MW-38	LLFZ	4	5041.6	4915.0	4905.0	126.6	136.6	10.0
MW-39	LLFZ	4	5042.2	4918.7	4908.7	123.5	133.5	10.0
MW-40	LLFZ	4	5040.0	4923.9	4913.9	116.1	126.1	10.0
MW-41	ULFZ	4	5044.1	4952.1	4942.1	92.0	102.0	10.0
MW-42	ULFZ	4	5054.8	4949.3	4939.3	105.5	115.5	10.0
MW-43	LLFZ	4	5055.2	4927.7	4917.7	127.5	137.5	10.0
MW-44	ULFZ	4	5058.8	4952.4	4942.4	106.4	116.4	10.0
MW-45	ULFZ	4	5090.1	4948.5	4938.5	141.6	151.6	10.0

Table 2.2

Well Screen Data

Well ID[a]	Flow Zone	Diameter (in)	Elevation (ft above MSL) Ground Surface	Top of Screen	Bottom of Screen	Depth below Ground (ft) Top of Screen	Bottom of Screen	Screen Length (ft)
MW-46	ULFZ	4	5118.5	4949.4	4939.4	169.1	179.1	10.0
MW-47	UFZ	4	5120.7	4976.4	4961.4	144.3	159.3	15.0
MW-48	UFZ	4	5143.0	4976.9	4961.9	166.1	181.1	15.0
MW-49	3rd FZ	4	5041.0	4903.2	4893.2	137.8	147.8	10.0
MW-51	UFZ	2	5059.9	4984.5	4974.5	75.4	85.4	10.0
MW-52R	UFZ/ULFZ	4	5156.2	4968.5	4938.5	187.0	217.0	30.0
MW-53D	UFZ/ULFZ	2	5148.6	4963.6	4943.6	185.0	205.0	20.0
MW-54	UFZ	4	5097.2	4976.8	4961.8	120.4	135.4	15.0
MW-55	LLFZ	4	5143.1	4913.1	4903.1	230.0	240.0	10.0
MW-56	ULFZ	4	5141.0	4942.9	4932.9	198.1	208.1	10.0
MW-57	UFZ	4	5103.1	4978.0	4963.0	125.1	140.1	15.0
MW-58	UFZ	4	5146.4	4975.4	4960.4	171.0	186.0	15.0
MW-59	ULFZ	4	5060.2	4954.9	4944.4	105.3	115.8	10.5
MW-60	ULFZ	4	5134.4	4949.5	4939.5	184.9	194.9	10.0
MW-61	UFZ	4	5134.8	4976.2	4961.2	158.6	173.6	15.0
MW-62	UFZ	2	5073.7	4980.8	4965.8	92.9	107.9	15.0
MW-63	UFZ	2	5063.1	4983.1	4968.1	80.0	95.0	15.0
MW-64	ULFZ	4	5097.4	4959.3	4949.1	138.1	148.3	10.2
MW-65	LLFZ	4	5156.5	4896.4	4886.4	260.1	270.1	10.0
MW-66	LLFZ	4	5102.6	4903.3	4893.3	199.3	209.3	10.0
MW-67	DFZ	4	5142.2	4798.1	4788.1	344.1	354.1	10.0
MW-68	UFZ	4	5168.5	4970.5	4950.5	198.0	218.0	20.0
MW-69	LLFZ	4	5167.8	4904.7	4894.7	263.1	273.1	10.0
MW-70	3rd FZ	2	5046.3	4912.1	4902.1	134.2	144.2	10.0
MW-71R	DFZ	4	5134.2	4761.5	4756.5	372.7	377.7	5.0
MW-72	ULFZ	2	5053.7	4955.0	4945.0	98.7	108.7	10.0
MW-73	ULFZ	2	5050.6	4945.5	4940.5	105.1	110.1	5.0
MW-74	UFZ/ULFZ	2	5092.4	4969.2	4939.2	123.2	153.2	30.0
MW-75	UFZ/ULFZ	2	5111.6	4971.2	4941.2	140.4	170.4	30.0
MW-76	UFZ/ULFZ	2	5105.5	4972.4	4942.4	133.1	163.1	30.0
MW-77	UFZ/ULFZ	2	5045.5	4985.9	4955.9	59.6	89.6	30.0
MW-78	UFZ/ULFZ	2	5050.5	4988.1	4958.1	62.4	92.4	30.0
MW-79	DFZ	6	5166.7	4767.7	4752.7	399.0	414.0	15.0
				4747.7	4732.7	419.0	434.0	15.0

[a] The letter R after the number in the Well ID indicates that the well is a new and deeper replacement well installed near the original well location; the letter D after the number in the Well ID indicates that the well has been deepened.

[b] Well plugged and abandoned in July, 2009.

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 operations were terminated on November 16, 1999.

Table 2.4

Water-Level Elevations - Fourth Quarter 1998[a]

Well ID	Flow Zone	Elevation (ft above MSL)	Well	Flow Zone	Elevation (ft above MSL)
PW-1	UFZ	4973.59	MW-40	LLFZ	4971.25
PZ-1	UFZ	4956.59	MW-41	ULFZ	4971.09
MW-7	UFZ O/S [b]	4977.42	MW-42	ULFZ	4970.65
MW-9	UFZ O/S	4973.06	MW-43	LLFZ	4970.45
MW-12	UFZ O/S	4972.82	MW-44	ULFZ	4970.11
MW-13	UFZ O/S	4974.35	MW-45	ULFZ	4968.33
MW-14	UFZ	4971.12	MW-46	ULFZ	4966.95
MW-15	UFZ	Dry	MW-47	UFZ	4966.68
MW-16	UFZ O/S	4978.43	MW-48	UFZ	4965.81
MW-17	UFZ O/S	4978.70	MW-49	LLFZ [c]	4971.03
MW-18	UFZ O/S	4971.87	MW-50	UFZ	Dry
MW-19	ULFZ	4971.85	MW-51	UFZ O/S	4980.09
MW-20	LLFZ	4971.47	MW-52	UFZ	4963.17
MW-21	UFZ O/S	4978.31	MW-53	UFZ	4964.92
MW-22	UFZ O/S	4977.89	MW-54	UFZ	4965.56
MW-23	UFZ O/S	4975.91	MW-55	LLFZ	4965.13
MW-24	UFZ O/S	4978.23	MW-56	ULFZ	4965.76
MW-25	UFZ O/S	4978.31	MW-57	UFZ	4964.87
MW-26	UFZ O/S	4973.44	MW-58	UFZ	4965.43
MW-27	UFZ O/S	4974.05	MW-59	ULFZ	4969.46
MW-28	UFZ O/S	4971.09	MW-60	ULFZ	4965.33
MW-29	ULFZ	4973.68	MW-61	UFZ	4965.37
MW-30	ULFZ	4972.28	MW-62	UFZ	4967.52
MW-31	ULFZ	4971.23	MW-63	UFZ O/S	4970.98
MW-32	ULFZ [c]	4970.96	MW-64	ULFZ	4965.41
MW-33	UFZ O/S	4972.54	MW-65	LLFZ	4963.05
MW-34	UFZ	4974.51	MW-66	LLFZ	4963.98
MW-35	UFZ	4970.78	MW-67	DFZ	4958.56
MW-36	UFZ	4970.03	MW-68	UFZ	4962.25
MW-37	UFZ	4968.32	MW-69	LLFZ	4962.13
MW-38	LLFZ	4973.70	MW-70	LLFZ [d]	4970.18
MW-39	LLFZ	4972.49	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 February 18, 1998 data from temporary well TW-1/2 which was drilled at the current location of well MW-73, and September 1, 1998 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 - 2009

(a) Off-Site Containment System

Date of Downtime		Duration (hours)	Cause
From	To		
11-Jan	11-Jan	4.17	Power outage
21-Jan	21-Jan	5.83	Power outage
25-Feb	25-Feb	1.00	Power outage
9-Mar	9-Mar	9.20	Power outage
5-Apr	5-Apr	14.00	Radio communication failure
9-Apr	9-Apr	9.50	Vandalism
14-Apr	14-Apr	0.50	O&M
15-Apr	15-Apr	0.50	O&M
15-Apr	16-Apr	20.00	Power outage
22-May	23-May	24.00	Sump pump failure
29-May	29-May	1.00	Sump pump replacement
8-Jun	8-Jun	0.67	Discharge pump adjustment
16-Sep	17-Sep	14.49	Electrical connection failure
17-Sep	17-Sep	4.51	Electrical connection repair
22-Sep	22-Sep	0.83	Power outage
22-Sep	22-Sep	1.00	Float switch repair
3-Oct	3-Oct	0.50	Power outage
8-Dec	8-Dec	1.17	Discharge pump adjustment
Total Downtime		**112.87**	

(b) Source Containment System

Date of Downtime		Duration (hours)	Cause
From	To		
21-Jan	21-Jan	5.67	Power outage
17-Feb	17-Feb	0.33	Power outage
9-Mar	9-Mar	0.33	Plugged water meter screen
6-Apr	7-Apr	31.00	Broken water meter
10-Apr	10-Apr	0.50	Water meter installation
14-Apr	14-Apr	22.00	Power outage
21-May	21-May	2.00	Pipeline cleaning
2-Jun	2-Jun	8.33	Power outage
1-Jul	1-Jul	24.00	Plugged discharge meter
9-Jul	9-Jul	2.00	Discharge meter cleaning
8-Sep	8-Sep	0.83	Pressure valve removal
Total Downtime		**96.99**	

Table 4.1

Quarterly Water-Level Elevations - 2009

Well ID	Flow Zone	Elevation (feet above MSL)			
		Feb. 17	May 13	Aug. 10	Nov. 3
CW-1	UFZ&LFZ	4933.25	4932.41	4931.28	4931.90
CW-2	UFZ&LFZ	4956.74	4955.78	4954.29	4954.18
OB-1	UFZ&LFZ	4954.38	4953.95	4953.16	NA[b]
OB-2	UFZ&LFZ	4955.70	4955.14	4954.50	4954.32
PZ-1	UFZ	4952.52	4951.96	4950.84	4950.83
MW-7	UFZ O/S	4974.76	4974.96	4974.50	4974.48
MW-9[a]	UFZ O/S	4969.48	4968.69	4969.04	4968.88
MW-12	UFZ O/S	4968.80	4968.69	4968.21	4968.21
MW-13	UFZ O/S	Dry	Dry	Dry	Dry
MW-14-R	UFZ/ULFZ	4966.70	4966.56	4966.06	4966.05
MW-16	UFZ O/S	4981.42	4981.50	4981.48	4981.73
MW-17	UFZ O/S	4981.02	4980.87	4981.01	4981.26
MW-18	UFZ O/S	4970.50	4967.91	4970.48	4970.38
MW-19	ULFZ	4967.84	4967.64	4967.11	4967.06
MW-20	LLFZ	4967.22	4967.09	4966.63	4966.67
MW-21	UFZ O/S	4981.99	4982.17	4982.08	4982.25
MW-22	UFZ O/S	4976.53	4976.48	4976.34	4976.48
MW-23	UFZ O/S	4973.49	4974.55	4973.26	4973.14
MW-24	UFZ O/S	4981.20	4981.25	4981.23	4981.49
MW-25	UFZ O/S	4981.37	4981.49	4983.42	4981.67
MW-26	UFZ O/S	4969.53	4970.37	4970.16	4970.17
MW-27	UFZ O/S	4980.42	4980.44	4980.57	4980.57
MW-29	ULFZ	4970.06	4970.02	4969.62	4968.98
MW-30	ULFZ	4968.32	4968.14	4967.75	4967.72
MW-31	ULFZ	4966.85	4966.67	4966.22	4966.18
MW-32	ULFZ	4966.89	4966.43	4965.96	4966.04
MW-33	UFZ O/S	Dry	Dry	Plugged	Plugged
MW-34	UFZ	4970.63	4970.79	4970.34	4970.22
MW-37-R	UFZ/ULFZ	4963.67	4963.43	4962.80	4962.79
MW-38	LLFZ	4970.10	4970.07	4969.59	4969.50
MW-39	LLFZ	4968.57	4968.54	4968.06	4967.91
MW-40	LLFZ	4966.88	4966.75	4966.27	4966.24
MW-41	ULFZ	4967.08	4966.83	4966.34	4966.41
MW-42	ULFZ	4967.18	4966.88	4966.28	4966.50
MW-43	LLFZ	4967.01	4966.62	4966.03	4966.24
MW-44	ULFZ	4965.95	4965.84	4965.33	4965.25

Well ID	Flow Zone	Elevation (feet above MSL)			
		Feb. 17	May 13	Aug. 10	Nov. 3
MW-45	ULFZ	4964.00	4963.72	4963.15	4963.11
MW-46	ULFZ	4962.98	4962.50	4961.98	4961.98
MW-47	UFZ	4962.34	4962.13	4961.24	4961.36
MW-48	UFZ	Dry	Dry	Dry	Dry
MW-49	LLFZ	4966.96	4966.74	4966.24	4966.30
MW-51	UFZ O/S	4981.38	4981.19	4981.42	4981.77
MW-52R	UFZ/ULFZ	4957.24	4956.74	4956.20	4955.93
MW-53D	UFZ/ULFZ	4959.47	4958.75	4958.45	4958.32
MW-54	UFZ	4963.44	4962.91	4962.19	4961.82
MW-55	LLFZ	4960.04	4959.53	4958.99	4958.88
MW-56	ULFZ	4961.32	4960.97	4960.40	4960.21
MW-57	UFZ	Dry	Dry	Dry	Dry
MW-58	UFZ	4960.60	4960.37	4960.72	4960.24
MW-59	ULFZ	4965.67	4965.86	4965.12	4965.45
MW-60	ULFZ	4960.97	4960.55	4960.12	4959.97
MW-61	UFZ	4960.95	Dry	4959.45	Dry
MW-62	UFZ	4963.31	4963.07	4962.61	4962.21
MW-63	UFZ O/S	4971.15	4969.78	4970.72	4976.06
MW-64	ULFZ	4962.06	4961.54	4961.24	4963.50
MW-65	LLFZ	4957.19	4956.69	4956.11	4955.92
MW-66	LLFZ	4960.22	4959.42	4958.91	4959.01
MW-67	DFZ	4954.34	4952.78	4951.58	4952.61
MW-68	UFZ	4957.33	4956.86	4956.22	4955.82
MW-69	LLFZ	4957.25	4956.66	4955.97	4955.83
MW-70	LLFZ	4966.38	4965.89	4965.35	4965.43
MW-71-R	DFZ	4954.08	4952.72	4951.57	4952.59
MW-72	ULFZ	4967.31	4966.79	4966.43	4966.59
MW-73	ULFZ	4966.65	4966.97	4965.45	4965.52
MW-74	UFZ/ULFZ	4959.46	4958.58	4957.66	4957.64
MW-75	UFZ/ULFZ	4964.00	4963.34	4962.94	4962.74
MW-76	UFZ/ULFZ	4965.27	4964.63	4964.38	4966.27
MW-77	UFZ/ULFZ	4976.12	4976.30	4975.87	4975.81
MW-78	UFZ/ULFZ	4973.57	4972.98	4973.14	4973.32
MW-79	DFZ	4952.43	4950.35	4949.50	4950.67
PZG-1	Infilt. Gall.	Dry	Dry	5067.27	5067.30
Canal[c]		Dry	4992.23	4990.99	4991.15

[a] Water level was at or below screen May 13, 2009

[b] Water level unavailable due to diffusion bag sampling.

[c] Measurement of depth to water believed to be in error, corrected by 2 feet.

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

Table 4.2

Water-Quality Data - Fourth Quarter 2009
VOC Data

Well ID	Sampling Date	Concentration (μg/L) TCE	DCE	TCA
CW1	11/02/09	1100	64	2.5
CW2	11/02/09	72	7.3	<1.0
MW-7	11/06/09	1.3	<1.0	<1.0
MW-9	11/06/09	16	1.3	<1.0
MW-12	11/06/09	18	<1.0	<1.0
MW-13[a]	11/06/09	NS	NS	NS
MW-14R	11/11/09	9.4	4	<1.0
MW-16	11/06/09	4.3	<1.0	<1.0
MW-17	11/10/09	<1.0	<1.0	<1.0
MW-18	11/06/09	1.3	<1.0	<1.0
MW-19	11/11/09	110	19	<1.0
MW-20	11/11/09	<1.0	<1.0	<1.0
MW-21	11/05/09	<1.0	<1.0	<1.0
MW-22	11/12/09	<1.0	<1.0	<1.0
MW-23	11/05/09	4.1	<1.0	<1.0
MW-25	11/06/09	10	<1.0	<1.0
MW-26	11/06/09	9.2	<1.0	<1.0
MW-29	11/16/09	<1.0	<1.0	<1.0
MW-30	11/16/09	7.8	<1.0	<1.0
MW-31	11/12/09	<1.0	<1.0	<1.0
MW-32	11/10/09	11	1.6	<1.0
MW-34	11/06/09	<1.0	<1.0	<1.0
MW-37R	11/13/09	94	5.4	<1.0
MW-38	11/17/09	<1.0	<1.0	<1.0
MW-39	11/17/09	<1.0	<1.0	<1.0
MW-40	11/12/09	<1.0	<1.0	<1.0
MW-41	11/09/09	1.5	<1.0	<1.0
MW-42	11/10/09	53	16	<1.0
MW-43	11/10/09	<1.0	<1.0	<1.0
MW-44	11/13/09	<1.0	<1.0	<1.0
MW-45	11/17/09	<1.0	<1.0	<1.0
MW-46[b]	11/13/09	325	63	2.75
MW-47[a]	11/10/09	NS	NS	NS
MW-48[a]	11/16/09	NS	NS	NS
MW-49	11/16/09	<1.0	<1.0	<1.0
MW-51	11/18/09	<1.0	<1.0	<1.0
MW-52R	11/18/09	8	17	1.4
MW-53D	11/19/09	21	<1.0	<1.0
MW-55	11/19/09	9.6	<1.0	<1.0
MW-56	11/19/09	130	3.7	<1.0
MW-57[a]	11/19/09	NS	NS	NS
MW-58[a]	11/19/09	NS	NS	NS
MW-59	11/18/09	<1.0	<1.0	<1.0
MW-60	11/20/09	2200	230	8.4
MW-61[a]	11/18/09	NS	NS	NS
MW-62	11/09/09	<1.0	3.4	1.5
MW-64	11/20/09	<1.0	<1.0	<1.0
MW-65	11/18/09	4.1	12	2.3
MW-66	11/20/09	<1.0	<1.0	<1.0
MW-67	11/19/09	<1.0	<1.0	<1.0
MW-68	11/18/09	<1.0	<1.0	<1.0
MW-69	11/18/09	<1.0	<1.0	<1.0
MW-70	11/10/09	6.4	<1.0	<1.0
MW-71R	11/20/09	57	2.2	<1.0
MW-72	11/10/09	500	89	1.8
MW-73[b]	11/11/09	15.5	2.1	<1.0
MW-74	11/23/09	<1.0	<1.0	<1.0
MW-75	11/23/09	<1.0	<1.0	<1.0
MW-76	11/23/09	<1.0	<1.0	<1.0
MW-77	11/09/09	7.8	<1.0	<1.0
MW-78	11/09/09	<1.0	<1.0	<1.0
MW-79	12/09/09	<1.0	<1.0	<1.0

[a] Well not sampled (NS) because it was dry or did not have sufficient water for sampling.

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

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 4.3

Flow Rates - 2009

Month	Off-Site Containment Well		Source Containment Well		Total	
	Volume Pumped (gal)	Average Rate (gpm)	Volume Pumped (gal)	Average Rate (gpm)	Volume Pumped (gal)	Average Rate (gpm)
Jan.	9,573,471	214	2,043,697	46	11,617,168	260
Feb.	8,984,813	223	1,799,410	45	10,784,223	267
Mar.	9,806,874	220	1,936,213	43	11,743,087	263
Apr.	9,033,416	209	1,778,427	41	10,811,842	250
May	9,606,460	215	2,088,808	47	11,695,268	262
June	9,588,211	222	2,187,004	51	11,775,215	273
July	9,910,358	222	2,142,372	48	12,052,730	270
Aug.	9,897,605	222	2,120,216	47	12,017,822	269
Sep.	9,194,921	213	2,113,675	49	11,308,597	262
Oct.	9,688,508	217	2,174,912	49	11,863,420	266
Nov.	9,372,450	217	2,055,040	48	11,427,491	265
Dec.	10,095,695	226	2,084,965	47	12,180,660	273
Total or Average	**114,752,782**	**218**	**24,524,740**	**47**	**139,277,522**	**265**

Table 4.4

Influent and Effluent Quality - 2009[a]

(a) Off-Site Containment System

Sampling Date	Concentration (µg/L)							
	Influent				Effluent			
	TCE	DCE	TCA	Cr Total	TCE	DCE	TCA	Cr Total
01/01/09	920	71	2.8	18	<1.0	<1.0	<1.0	18
02/02/09	840	97	<5.0	15	<1.0	<1.0	<1.0	15
03/02/09	910	71	2.8	15	<1.0	<1.0	<1.0	15
04/01/09	970	71	2.8	13	<1.0	<1.0	<1.0	14
05/01/09	810	62	2.6	14	<1.0	<1.0	<1.0	16
06/01/09	920	73	2.8	15	<1.0	<1.0	<1.0	16
07/01/09	790	70	2.7	18	<1.0	<1.0	<1.0	18
08/03/09	780	78	2.9	16	<1.0	<1.0	<1.0	14
09/01/09	810	64	2.6	17	<1.0	<1.0	<1.0	17
10/01/09	690	72	2.7	18	<1.0	<1.0	<1.0	18
11/02/09	1100	64	2.5	16	<1.0	<1.0	<1.0	16
12/01/09	890	68	2.5	16	<1.0	<1.0	<1.0	15
01/04/10	630	72	2.5	16	<1.0	<1.0	<1.0	16

(b) Source Containment System

Sampling Date	Concentration (µg/L)							
	Influent				Effluent			
	TCE	DCE	TCA	Cr Total	TCE	DCE	TCA	Cr Total
01/01/09	66	10	<1.0	27	<1.0	<1.0	<1.0	27
02/02/09	71	9.5	<1.0	25	<1.0	<1.0	<1.0	23
03/02/09	60	7.7	<1.0	24	<1.0	<1.0	<1.0	26
04/01/09	66	8.6	<1.0	24	<1.0	<1.0	<1.0	24
05/01/09	65	8.7	<1.0	27	<1.0	<1.0	<1.0	26
06/01/09	70	9.2	<1.0	27	<1.0	<1.0	<1.0	28
07/01/09	65	7.9	<1.0	43	<1.0	<1.0	<1.0	34
08/03/09	63	7.9	<1.0	28	<1.0	<1.0	<1.0	28
09/01/09	55	6.8	<1.0	30	<1.0	<1.0	<1.0	30
10/01/09	55	8.1	<1.0	37	<1.0	<1.0	<1.0	32
11/02/09	72	7.3	<1.0	29	<1.0	<1.0	<1.0	29
12/01/09	63	8.2	<1.0	30	<1.0	<1.0	<1.0	30
01/04/10	54	7.8	<1.0	46	<1.0	<1.0	<1.0	29

[a] Data from January 4, 2010 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).

Table 5.1

Concentration Changes in Monitoring Wells - 1998 to 2009

Well ID	Change in Concentration (µg/l)		
	TCE	DCE	TCA
CW-1	960	61	2.5
CW-2[a]	-928	-183	-35
MW-7	-62	-15	-12
MW-9	-274	-18	-18
MW-12	-362	-26	-18
MW-14R[b]	-421	-20	-4.2
MW-16	-1196	-30	-170
MW-17	-68	-4	-13
MW-18	-599	-50	-42
MW-19	106	19	0
MW-20	0	0	0
MW-21	-7.5	0	-1.1
MW-22	-11	-2	-4.6
MW-23	-6196	-400	-720
MW-25	-5390	-73	-540
MW-26	-6491	-590	-550
MW-29	0	0	0
MW-30	2.4	0	0
MW-31	0	0	0
MW-32	-539	-94	-30
MW-34	0	0	0
MW-37R[b]	-896	-43	0
MW-38	0	0	0
MW-39	0	0	0
MW-40	0	0	0
MW-41	-169	-26	0
MW-42	-317	-32	-21
MW-43	-25	-5.1	-5.4
MW-44	-1.3	0	0
MW-45	-40	-1.7	0
MW-46	-1875	-67	0.5
MW-49	0	0	0
MW-51	0	0	0
MW-52R[b]	8.8	17	1.4
MW-53D[b]	-78	-3	0
MW-55	-380	-10	0
MW-56	-10	-1	0
MW-59	0	0	0
MW-60	-5500	-120	-44
MW-62	-2	-3	-3.3
MW-64	0	0	0
MW-65	-8.9	12	2.3
MW-66	0	0	0
MW-67	0	0	0
MW-68	0	0	0
MW-69	0	0	0
MW-70	6.4	0	0
MW-71R[b]	1	0.6	0
MW-72[a]	-1300	-131	-97
MW-73[a]	-3985	-518	-240
MW-77[a]	-8.2	-1	0
MW-78[a]	-6	0	0

[a] Change from concentration in first available sample.

[b] Change from concentration in original well.

[c] "0" indicates concentration below detection limits during both sampling events.

Note: Shaded cells indicate well used in original and/or current plume definition.

Table 5.2

Summary of Annual Flow Rates - 1998 to 2009

Year	Off-Site Containment Well		Source Containment Well		Total	
	Volume Pumped (gal)	Average Rate (gpm)	Volume Pumped (gal)	Average Rate (gpm)	Volume Pumped (gal)	Average Rate (gpm)
1998[a]	1,694,830				1,694,830	
1999	114,928,700	219			114,928,700	219
2000	114,094,054	216			114,094,054	216
2001	113,654,183	216			113,654,183	216
2002	116,359,389	221	25,403,490	49	141,762,879	270
2003	118,030,036	225	27,292,970	52	145,323,006	277
2004	113,574,939	215	26,105,202	50	139,680,141	265
2005	118,018,628	225	25,488,817	48	143,507,445	273
2006	112,213,088	213	24,133,264	46	136,346,352	259
2007	117,098,422	223	23,983,802	46	141,082,224	269
2008	114,692,635	218	25,432,013	48	140,124,648	266
2009	114,752,782	218	24,524,740	47	139,277,522	265
Total or Average	**1,269,111,686**	**219**	**202,364,298**	**48**	**1,471,475,984**	**254**

[a] Volume pumped during the testing of the well in early December, and during the first day of operation on December 31, 1998.

Table 5.3
Contaminant Mass Removal - 2009

(a) Total

	Mass Removed	(kg)	(lbs)
2009	TCE	379	836
	DCE	31.9	70.4
	TCA	1.23	2.71
	Total	411	900

(b) Off-Site Containment Well

Month	Mass Removed						Total	
	TCE		DCE		TCA			
	(kg)	(lbs)	(kg)	(lbs)	(kg)	(lbs)	(kg)	(lbs)
Jan.	31.9	70.3	3.04	6.71	0.1323	0.292	35.1	77.3
Feb.	29.8	65.6	2.86	6.30	0.1241	0.274	32.7	72.2
Mar.	34.9	76.9	2.64	5.81	0.1039	0.229	37.6	83.0
Apr.	30.4	67.1	2.27	5.01	0.0923	0.204	32.8	72.3
May	31.5	69.3	2.45	5.41	0.0982	0.216	34.0	75.0
June	31.0	68.4	2.60	5.72	0.0998	0.220	33.7	74.4
July	29.4	64.9	2.78	6.12	0.1050	0.232	32.3	71.3
Aug.	29.8	65.7	2.66	5.86	0.1030	0.227	32.5	71.8
Sep.	26.1	57.6	2.37	5.22	0.0922	0.203	28.6	63.0
Oct.	32.8	72.4	2.49	5.50	0.0954	0.210	35.4	78.1
Nov.	35.3	77.8	2.34	5.16	0.0887	0.196	37.7	83.2
Dec.	29.0	64.0	2.68	5.90	0.0955	0.211	31.8	70.1
Total	**372**	**820**	**31.2**	**68.7**	**1.23**	**2.71**	**404**	**890**

(c) Source Containment Well

Month	Mass Removed						Total	
	TCE		DCE		TCA			
	(kg)	(lbs)	(kg)	(lbs)	(kg)	(lbs)	(kg)	(lbs)
Jan.	0.530	1.17	0.075	0.166	<0.0045	<0.009	0.61	1.34
Feb.	0.446	0.98	0.059	0.129	<0.0045	<0.009	0.51	1.11
Mar.	0.462	1.02	0.0597	0.132	<0.0045	<0.009	0.52	1.15
Apr.	0.441	0.97	0.0582	0.128	<0.0045	<0.009	0.50	1.10
May	0.534	1.18	0.0708	0.156	<0.0045	<0.009	0.60	1.34
June	0.559	1.23	0.0708	0.156	<0.0045	<0.009	0.63	1.39
July	0.519	1.14	0.0641	0.141	<0.0045	<0.009	0.58	1.28
Aug.	0.474	1.04	0.0590	0.130	<0.0045	<0.009	0.53	1.17
Sep.	0.440	0.97	0.0596	0.131	<0.0045	<0.009	0.50	1.10
Oct.	0.523	1.15	0.0634	0.140	<0.0045	<0.009	0.59	1.29
Nov.	0.525	1.16	0.0603	0.133	<0.0045	<0.009	0.59	1.29
Dec.	0.462	1.02	0.0631	0.139	<0.0045	<0.009	0.53	1.16
Total	**5.92**	**13.0**	**0.76**	**1.68**	**<0.05**	**<0.1**	**6.68**	**14.7**

Table 5.4

Summary of Contaminant Mass Removal - 1998 to 2009

(a) Total

Year	Mass Removed							
	TCE		DCE		TCA		Total	
	kg	lbs	kg	lbs	kg	lbs	kg	lbs
1998[a]	1.31	2.89	0.030	0.066	0.00	0.00	1.34	2.95
1999	358	789	16.2	35.7	0.00	0.00	374	825
2000	463	1,020	23.3	51.4	0.00	0.00	486	1,070
2001	519	1,140	26.6	58.6	0.00	0.00	546	1,200
2002	603	1,330	40.6	89.4	3.66	8.07	647	1,426
2003	617	1,360	38.1	84.1	3.05	6.72	658	1,454
2004	596	1,310	35.3	77.7	2.42	5.34	634	1,403
2005	558	1,230	34.7	76.4	2.01	4.43	595	1,315
2006	513	1,130	34.3	75.5	1.66	3.67	549	1,215
2007	468	1,040	33.0	72.9	1.03	2.27	502	1,109
2008	433	955	32.6	71.8	1.08	2.39	468	1,031
2009	379	836	32.0	70.5	1.23	2.72	412	910
Total	**5,510**	**12,140**	**347**	**764**	**16.1**	**35.6**	**5,875**	**12,960**

(b) Off-Site Containment Well

Year	Mass Removed							
	TCE		DCE		TCA		Total	
	kg	lbs	kg	lbs	kg	lbs	kg	lbs
1998[a]	1.31	2.89	0.030	0.066	0.000	0.000	1.34	2.95
1999	358	789	16.2	35.7	0.000	0.000	374	825
2000	463	1,020	23.3	51.4	0.000	0.000	486	1,070
2001	519	1,140	26.6	58.6	0.000	0.000	546	1,200
2002	543	1,200	30.9	68.1	2.05	4.52	576	1,270
2003	568	1,250	31.6	69.7	2.06	4.54	602	1,330
2004	567	1,250	31.7	69.9	1.96	4.32	601	1,330
2005	540	1,190	32.4	71.4	1.79	3.95	574	1,270
2006	499	1,100	32.5	71.6	1.57	3.46	533	1,180
2007	456	1,010	31.6	69.7	1.03	2.27	489	1,080
2008	425	937	31.5	69.5	1.08	2.39	458	1,010
2009	372	821	31.2	68.8	1.23	2.72	405	890
Total	**5,310**	**11,710**	**320**	**704**	**12.8**	**28.2**	**5,645**	**12,460**

(c) Source Containment Well

Year	Mass Removed							
	TCE		DCE		TCA		Total	
	kg	lbs	kg	lbs	kg	lbs	kg	lbs
2002	59.6	131	9.66	21.3	1.61	3.55	70.9	156
2003	48.7	107	6.53	14.4	0.989	2.18	56.2	124
2004	29.0	63.9	3.55	7.83	0.464	1.02	33.1	72.8
2005	18.1	39.9	2.28	5.03	0.218	0.481	20.6	45.4
2006	13.8	30.4	1.76	3.88	0.0933	0.206	15.7	34.5
2007	11.5	25.4	1.44	3.17	<0.05	<0.1	13.0	28.6
2008	8.42	18.6	1.04	2.29	<0.05	<0.1	9.51	21.0
2009	6.14	13.5	0.79	1.75	<0.05	<0.1	6.98	15.4
Total	**200**	**430**	**27.1**	**60.0**	**3.37**	**7.44**	**230**	**500**

[a] Mass removed during the testing of the off-site well in early December, and during the first day of operation on December 31, 1998.

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	1.2	2.5	1000.0
2	44.0	97.0	12000.0
3	539.1	1188.5	150000.0
4	678.8	1496.5	25000.0
5	1132.6	2496.8	40000.0
6	987.0	2176.0	40000.0
7	876.3	1931.9	30000.0
8	1551.1	3419.5	37000.0
9	1305.3	2877.6	25000.0
10	239.5	528.0	1100.0
11	0.9	1.9	7.2
12	0.0	0.0	0.0
13	0.0	0.0	0.0
14	0.0	0.0	0.0
15	0.0	0.0	0.0
Total Mass	**7,356**	**16,216**	

APPENDIX A

APPENDIX A

Appendix A

2009 Groundwater Quality Data

A-1: Groundwater Monitoring Program Wells

A-2: Infiltration Gallery and Pond Monitoring Wells

A-3: OB-1 Diffusion Bag Sampling

Figure A-3.1: Vertical Concentration Profile of Observation Well OB-1

Table A-3.1: Concentration Data from Diffusion Bag Samples At OB-1

Appendix A-1

Groundwater Monitoring Program Wells
2009 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-7	11/06/09	1.3	<1.0	<1.0	0.0061	<0.0060	
MW-9	11/06/09	16	1.3	<1.0	<.0060	<0.0060	
MW-12	11/06/09	18	<1.0	<1.0	0.0073	0.0068	
MW-14R	11/11/09	9.4	4	<1.0	0.25	NA	
MW-16	11/06/09	4.3	<1.0	<1.0	0.11	0.18	
MW-17	11/10/09	<1.0	<1.0	<1.0	0.061	0.029	
MW-18	11/06/09	1.3	<1.0	<1.0	0.028	0.029	
MW-19	11/11/09	110	19	<1.0	0.028	NA	
MW-20	11/11/09	<1.0	<1.0	<1.0	<0.0060	NA	
MW-21	11/05/09	<1.0	<1.0	<1.0	0.098	0.029	
MW-22	11/12/09	<1.0	<1.0	<1.0	0.032	0.031	
MW-23	11/05/09	4.1	<1.0	<1.0	0.13	1.2	
MW-25	11/06/09	10	<1.0	<1.0	0.077	0.058	
MW-26	11/06/09	9.2	<1.0	<1.0	0.087	0.082	
MW-29	11/16/09	<1.0	<1.0	<1.0	<0.0060	NA	
MW-30	11/16/09	7.8	<1.0	<1.0	<0.0060	NA	
MW-31	11/12/09	<1.0	<1.0	<1.0	<0.0060	NA	
MW-32	11/10/09	11	1.6	<1.0	0.0075	NA	
MW-34	02/21/09	NA	NA	NA	NA	<0.0060	
	11/06/09	<1.0	<1.0	<1.0	0.41	0.00096	
MW-37R	11/13/09	94	5.4	<1.0	0.061	NA	
MW-38	11/17/09	<1.0	<1.0	<1.0	<0.0060	NA	
MW-39	11/17/09	<1.0	<1.0	<1.0	<0.0060	NA	
MW-40	11/12/09	<1.0	<1.0	<1.0	0.013	NA	
MW-41	11/09/09	1.5	<1.0	<1.0	0.027	NA	
MW-42	11/10/09	53	16	<1.0	0.027	NA	
MW-43	11/10/09	<1.0	<1.0	<1.0	<0.0060	NA	
MW-44	11/13/09	<1.0	<1.0	<1.0	<0.0060	NA	
MW-45	11/17/09	<1.0	<1.0	<1.0	0.01	NA	
MW-46	11/13/09	330	62	2.7	0.018	NA	
	11/13/09	320	64	2.8	0.018	NA	

Appendix A-1

Groundwater Monitoring Program Wells
2009 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-48	11/16/09	<1.0	<1.0	<1.0	<0.0060	NA	
MW-50	11/18/09	<1.0	<1.0	<1.0	0.026	NA	
MW-52R	02/19/09	8.7	<1.0	1.6	0.014	NA	
	05/19/09	7.7	16	1.6	0.014	NA	
	08/12/09	7.4	17	1.4	0.01	NA	
	11/18/09	8.0	17	1.4	0.012	NA	
MW-53D	02/23/09	16	<1.0	<1.0	0.022	0.019	
	11/19/09	21	<1.0	<1.0	0.28	0.27	
MW-55	11/19/09	9.6	<1.0	<1.0	0.013	NA	
MW-56	11/19/09	130	3.7	<1.0	0.027	NA	
MW-59	11/18/09	<1.0	<1.0	<1.0	0.027	NA	
MW-60	11/20/09	2200	230	8.4	0.19	0.026	
MW-62	02/21/09	2.3	<1.0	2.6	<0.0060	<0.0060	
	05/19/09	1.5	1.6	1.8	0.021	<0.010	
	08/11/09	2.5	5.1	<1.0	<0.0060	0.0073	
	11/09/09	<1.0	3.4	1.5	0.02	<0.0060	
MW-64	11/20/09	<1.0	<1.0	<1.0	0.021	NA	
MW-65	02/20/09	5	15	3.2	<0.0060	NA	
	05/15/09	4.9	15	3.3	<0.010	NA	
	08/12/09	3.9	14	2.6	<0.0060	NA	
	11/18/09	4.1	12	2.3	<0.0060	NA	
MW-66	02/20/09	<1.0	<1.0	<1.0	<0.0060	NA	
	05/18/09	<1.0	<1.0	<1.0	<0.010	NA	
	08/13/09	<1.0	<1.0	<1.0	<0.0060	NA	
	11/20/09	<1.0	<1.0	<1.0	<0.0060	NA	
MW-67	05/20/09	<1.0	<1.0	<1.0	<0.010	NA	
	11/19/09	<1.0	<1.0	<1.0	<0.0060	NA	
MW-68	02/18/09	<1.0	<1.0	<1.0	<0.0060	<0.50	
	05/18/09	<1.0	<1.0	<1.0	<0.0010	NA	
	08/12/09	<1.0	<1.0	<1.0	<0.0060	NA	
	11/18/09	<1.0	<1.0	<1.0	<0.0060	NA	

Appendix A-1

Groundwater Monitoring Program Wells
2009 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-69	02/19/09	<1.0	<1.0	<1.0	<0.0060	NA	
	05/19/09	<1.0	<1.0	<1.0	<0.010	NA	
	08/12/09	<1.0	<1.0	<1.0	<0.0060	NA	
	11/18/09	<1.0	<1.0	<1.0	<0.0060	NA	
MW-70	11/10/09	6.4	<1.0	<1.0	<0.0060	NA	
MW-71R	02/20/09	53	1.8	<1.0	<0.002	<0.0060	
	05/20/09	51	1.7	<1.0	<0.010	NA	
	08/13/09	57	2.1	<1.0	<0.0060	NA	
	08/13/09	55	2	<1.0	<0.0060	NA	
	11/20/09	57	2.2	<1.0	<0.0060	<0.0060	
MW-72	11/10/09	500	89	1.8	0.035	NA	
MW-73	11/11/09	16	2.1	<1.0	0.034	0.036	
	11/11/09	15	2.1	<1.0	0.036	0.035	
MW-79	05/20/09	<1.0	<1.0	<1.0	<0.010	NA	
	12/09/09	<1.0	<1.0	<1.0	<0.0060	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).

Appendix A-2

Infiltration Gallery and Pond Monitoring Wells
2009 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	02/23/09	1.5	<1.0	<1.0	0.0300	0.7700	0.0410	0.025	NA	NA
	05/19/09	<1.0	<1.0	<1.0	0.0680	11.0000	0.5400	0.031	<0.10	<0.010
	08/11/09	<1.0	<1.0	<1.0	0.0520	8.2000	0.4900	0.030	0.0500	0.0074
	11/10/09	<1.0	<1.0	<1.0	0.0610	13.0000	0.3600	0.029	0.0280	<0.0020
MW-74	02/23/09	<1.0	<1.0	<1.0	0.0170	<0.50	0.0020			
	05/18/09	<1.0	<1.0	<1.0	0.0180	<0.10	<0.010			
	08/13/09	<1.0	<1.0	<1.0	0.0150	<0.050	0.0022			
	11/23/09	<1.0	<1.0	<1.0	0.0160	<0.050	<0.0020			
MW-75	02/18/09	<1.0	<1.0	<1.0	0.0180	<0.0053	<0.00030			
	05/18/09	<1.0	<1.0	<1.0	0.0170	<0.10	<0.010			
	08/13/09	<1.0	<1.0	<1.0	0.0140	<0.050	0.0023			
	11/23/09	<1.0	<1.0	<1.0	0.0160	<0.050	<0.0020			
MW-76	02/23/09	<1.0	<1.0	<1.0	0.0180	<0.050	<0.0020			
	05/18/09	<1.0	<1.0	<1.0	0.0180	<0.10	<0.010			
	08/13/09	<1.0	<1.0	<1.0	0.0150	<0.050	0.0023			
	11/23/09	<1.0	<1.0	<1.0	0.0170	<0.050	<0.0020			
MW-77	02/23/09	5.8	<1.0	<1.0	<0.0060	0.0800	9.8000	<0.0060	NA	NA
	05/15/09	2.6	<1.0	<1.0	<0.10	<0.10	6.1000	<0.010	<0.10	0.3700
	08/13/09	1.9	<1.0	<1.0	<0.0060	<0.020	1.8000	<0.0060	<0.020	0.2500
	11/09/09	7.8	<1.0	<1.0	<0.0060	0.6500	6.8000	<0.0060	<0.020	0.2400
MW-78	02/19/09	<1.0	<1.0	<1.0	0.0260	0.1300	0.0190	NA	NA	NA
	05/15/09	<1.0	<1.0	<1.0	0.0290	0.4400	0.0450	0.0280	<0.10	<0.010
	08/13/09	<1.0	<1.0	<1.0	0.0260	<0.050	0.0055	0.0260	<0.020	0.0210
	11/09/09	<1.0	<1.0	<1.0	0.0280	<0.020	<0.0020	0.0280	<0.050	<0.0020

[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).

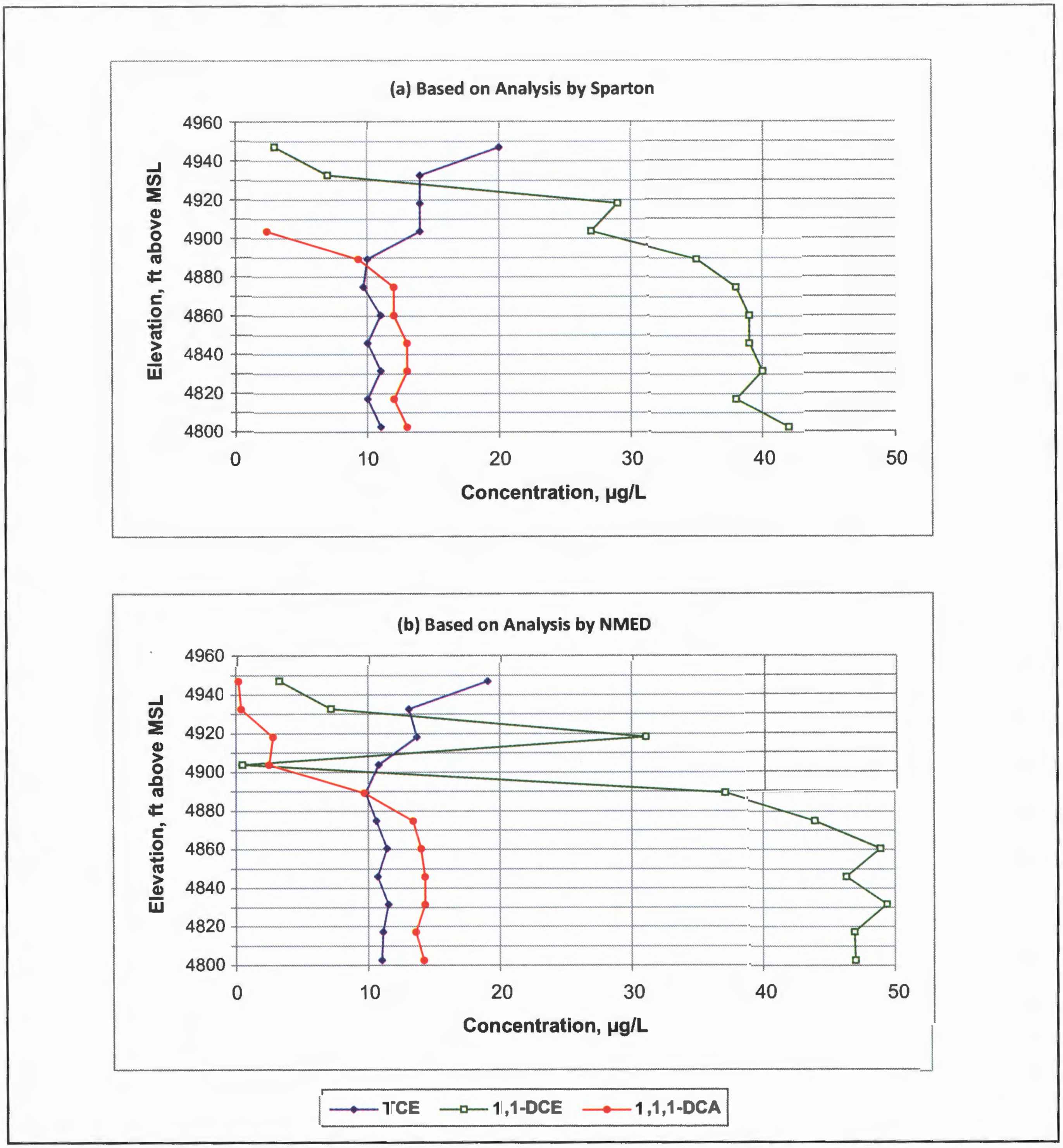


Figure A-3.1 Vertical Concentration Profile in Observation Well OB-1

Table A-3.1

Concentration Data from Diffusion Bag Samples at OB-1
11/2-16/2009

Sparton Technology, Inc. Analyses

Elevation ft,MSL	Concentration, in mg/l, of		
	TCE	1,1 DCE	1,1,1 TCA
4947.2	20	3	ND
4932.7	14	7	ND
4918.3	14	29	ND
4903.9	14	27	2.4
4889.4	10	35	9.3
4875.0	9.7	38	12
4860.6	11	39	12
4846.1	10	39	13
4831.7	11	40	13
4817.3	10	38	12
4802.8	11	42	13

New Mexico Environment Department Analyses

Elevation ft,MSL	Concentration, in μg/l, of		
	TCE	1,1 DCE	1,1,1 TCA
4947.2	19.1	3.3	0.2
4932.7	13.1	7.2	0.4
4918.3	13.7	31.1	2.8
4903.9	10.8	0.5	2.5
4889.4	9.8	37.1	9.7
4875.0	10.6	43.9	13.4
4860.6	11.4	48.9	14
4846.1	10.7	46.3	14.3
4831.7	11.5	49.4	14.3
4817.3	11.1	46.9	13.6
4802.8	11	47	14.2

APPENDIX B

APPENDIX B

Appendix B

2009 Flow Rate Data from Containment Well

B-1: Off-Site Containment Well

B-2: Source Containment Well

B-1: Off-Site Containment Well

Appendix B-1

Off-Site Containment Well
2009 Flow Rate Data

Date	Time	Instantaneous Discharge (gpm)	Totalizer Reading (gallons)	Average Discharge (gpm)	Total Volume (gallons)[a]
12/29/2008	7:25	222.0	1116896000		1152578500
				196	
1/5/2009	7:15	222.0	1118864900		1154547400
				222	
1/12/2009	7:15	222.0	1121105360		1156787860
				219	
1/19/2009	7:15	222.0	1123309000		1158991500
				215	
1/26/2009	7:00	222.0	1125475000		1161157500
				223	
2/2/2009	7:10	222.0	1127730000		1163412500
				224	
2/9/2009	7:12	222.0	1129985500		1165668000
				223	
2/16/2009	9:00	222.0	1132254700		1167937200
				223	
2/23/2009	6:35	222.0	1134473000		1170155500
				222	
3/2/2009	7:00	222.0	1136711300		1172393800
				222	
3/9/2009	6:35	222.0	1138942700		1174625200
				210	
3/16/2009	6:55	222.0	1141060800		1176743300
				223	
3/23/2009	7:00	222.0	1143312800		1178995300
				223	
3/30/2009	7:15	222.0	1145565700		1181248200
				221	
4/1/2009	17:15	222.0	1146335100		1182017600
				198	
4/6/2009	7:30	222.0	1147646600		1183329100
				211	
4/15/2009	8:10	222.0	1150389700		1186072200
				184	
4/20/2009	7:06	100.0	1151704900		1187387400
				223	
4/27/2009	8:02	100.0	1153962500		1189645000
				223	
5/1/2009	6:53	230.0	1155229800		1190912300
				223	
5/8/2009	16:35	222.0	1157602700		1193285200
				222	
5/15/2009	14:01	222.0	1159809800		1195492300

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Off-Site Containment Well
2009 Flow Rate Data

Date	Time	Instantaneous Discharge (gpm)	Totalizer Reading (gallons)	Average Discharge (gpm)	Total Volume (gallons)[a]
				201	
5/25/2009	14:45	222.0	1162711200		1198393700
				221	
6/1/2009	6:51	224.3	1164835600		1200518100
				222	
6/8/2009	6:52	227.3	1167078100		1202760600
				221	
6/15/2009	7:23	221.7	1169312800		1204995300
				222	
6/22/2009	7:06	222.2	1171548600		1207231100
				222	
6/29/2009	6:35	227.0	1173780700		1209463200
				222	
7/1/2009	8:11	224.8	1174441500		1210124000
				222	
7/6/2009	6:55	218.9	1176024200		1211706700
				222	
7/13/2009	6:50	---	1178260500		1213943000
				222	
7/20/2009	7:04	---	1180500100		1216182600
				222	
7/27/2009	7:15	---	1182740000		1218422500
				222	
8/3/2009	8:10	223.2	1184990000		1220672500
				222	
8/10/2009	7:19	222.2	1187214400		1222896900
				222	
8/17/2009	7:17	222.2	1189449300		1225131800
				222	
8/24/2009	7:12	222.2	1191681000		1227363500
				222	
9/1/2009	5:20	222.2	1194210600		1229893100
				222	
9/8/2009	10:45	222.2	1196516500		1232199000
				222	
9/14/2009	6:41	222.2	1198377100		1234059600
				193	
9/21/2009	7:12	217.4	1200333200		1236015700
				209	
9/22/2009	9:11	---	1200659600		1236342100
				215	
9/28/2009	11:55	217.4	1202553200		1238235700
				217	

Appendix B-1

Off-Site Containment Well
2009 Flow Rate Data

Date	Time	Instantaneous Discharge (gpm)	Totalizer Reading (gallons)	Average Discharge (gpm)	Total Volume (gallons)[a]
10/1/2009	9:02	214.3	1203453100		1239135600
				216	
10/8/2009	16:43	214.3	1205730200		1241412700
				217	
10/16/2009	17:15	215.0	1208235300		1243917800
				217	
10/23/2009	7:40	---	1210297700		1245980200
				217	
10/29/2009	7:25	217.0	1212169600		1247852100
				219	
11/2/2009	8:15	217.0	1213443900		1249126400
				217	
11/9/2009	7:20	217.0	1215621700		1251304200
				217	
11/16/2009	8:33	217.0	1217822500		1253505000
				217	
11/23/2009	7:25	217.0	1219995500		1255678000
				217	
12/1/2009	8:25	216.0	1222510300		1258192800
				217	
12/7/2009	7:10	---	1224370200		1260052700
				223	
12/15/2009	7:40	---	1226943800		1262626300
				227	
12/21/2009	7:10	---	1228895200		1264577700
				229	
12/28/2009	7:40	---	1231210700		1266893200
				230	
1/4/2010	7:10	---	1233525200		1269207700

[a]Total pumpage since December 31, 1998

B-2: Source Containment Well

Appendix B-2

Source Containment Well
2009 Flow Rate Data

Date	Time	Instantaneous Discharge (gpm)	Totalizer Reading (gallons)	Average Discharge (gpm)	Total Volume (gallons)
12/29/08	8:10	50	177752640		177752640
				47	
1/5/2009	8:10	50	178222000		178222000
				46	
1/12/2009	8:20	50	178689750		178689750
				46	
1/19/2009	8:00	50	179154290		179154290
1/26/2009	7:40	50	179699720		179699720
				45	
2/2/2009	7:50	50	180057960		180057960
				45	
2/9/2009	8:00	50	180514419		180514419
				45	
2/16/2009	9:30	50	180968490		180968490
				44	
2/23/2009	7:10	50	181408670		181408670
				44	
3/2/2009	7:35	50	181854470		181854470
				44	
3/9/2009	7:00	50	182292460		182292460
				44	
3/16/2009	7:30	50	182734550		182734550
				44	
3/23/2009	7:55	50	183174680		183174680
				43	
3/30/2009	7:55	50	183606110		183606110
				43	
4/1/2009	16:45	50	183753130		183753130
				17	
4/6/2009	8:00		183866699		183866699
4/8/2009	16:05	10	12386530		Bad Reading
4/10/2009	14:40		6000		184233019
				37	
4/15/2009	8:57	50	256500		184483519
				45	
4/20/2009	7:19	50	573700		184800719
				45	
4/27/2009	10:20	50	1031900		185258919

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Source Containment Well
2009 Flow Rate Data

Date	Time	Instantaneous Discharge (gpm)	Totalizer Reading (gallons)	Average Discharge (gpm)	Total Volume (gallons)
				45	
5/1/2009	7:46	50	1281700		185508719
				44	
5/8/2009	15:47	44	1751600		185978619
				44	
5/15/2009	15:46	44	2199100		186426119
				47	
5/25/2009	15:05	57	2878700		187105719
				51	
6/1/2009	8:00	58	3373200		187600219
				49	
6/8/2009	7:55	57.8	3869100		188096119
				51	
6/15/2009	8:03	59.1	4388400		188615419
				51	
6/22/2009	7:40	58.3	4902400		189129419
				51	
6/29/2009	7:14	1:00	5412200		189639219
				50	
7/1/2009	6:55	59.6	5556200		189783219
				40	
7/6/2009	7:23	59.3	5848600		190075619
				50	
7/13/2009	7:20	59.8	6348100		190575119
				50	
7/20/2009	7:25	1:00:63	6847800		191074819
				49	
7/27/2009	7:47	1:01:22	7344800		191571819
				49	
8/3/2009	6:50	1:03	7834300		192061319
				48	
8/10/2009	7:46	1:03	8324700		192551719
				47	
8/17/2009	8:00	2:07/100	8803900		193030919
				49	
8/24/2009	7:35	2:07.3/100	9299500		193526519
				45	
9/1/2009	5:59	64.56	9815800		194042819
				47	
9/8/2009	7:50	1:05	10291000		194518019
				50	

Appendix B-2

Source Containment Well
2009 Flow Rate Data

Date	Time	Instantaneous Discharge (gpm)	Totalizer Reading (gallons)	Average Discharge (gpm)	Total Volume (gallons)
9/14/2009	7:12	1:01	10718700		194945719
				50	
9/21/2009	7:35	1:01	11221600		195448619
				50	
9/28/2009	11:34	1:00	11732600		195959619
				49	
10/1/2009	7:26	59.19	11933600		196160619
				49	
10/8/2009	6:51	1:00:62	12425900		196652919
				49	
10/16/2009	7:33	1:00:03	12990000		197217019
				49	
10/22/2009	6:57	1:00:04	13407600		197634619
				48	
10/29/2009	7:40	1:00:14	13896900		198123919
				49	
11/2/2009	7:07	1:00:88	14175600		198402619
				48	
11/9/2009	8:07	1:00:40	14661800		198888819
				48	
11/16/2009	7:20	1:00:42	15140800		199367819
				47	
11/23/2009	7:45	1:01:65	15619500		199846519
				47	
12/1/2009	7:14	1:01:25	16162100		200389119
				47	
12/7/2009	7:28	1:01:35	16568900		200795919
				47	
12/15/2009	8:10	1:04:78	17110800		201337819
				47	
12/21/2009	7:33	1:04:07	17512200		201739219
				46	
12/28/2009	8:15	1:04	17982700		202209719
				46	
1/4/2010	8:20	1:02:50	18450400		202677419

APPENDIX C

APPENDIX C

Appendix C

2009 Influent/Effluent Quality Data

C-1: Off-Site Treatment System 2009 Analytical Results

C-2: Source Treatment System 2009 Analytical Results

C-1: Off-Site Treatment System 2009 Analytical Results

Appendix C-1

Off-Site Treatment System
2009 Analytical Results[a]

Sample Date	Influent TCE (ug/l)	Influent 1,1DCE (ug/l)	Influent 1,1,1TCA (ug/l)	Influent Cr(total) (mg/l)	Influent Fe(total) (mg/l)	Influent Mn(total) (mg/l)	Effluent TCE (ug/l)	Effluent 1,1DCE (ug/l)	Effluent 1,1,1TCA (ug/l)	Effluent Cr(total) (mg/l)	Effluent Fe(total) (mg/l)	Effluent Mn(total) (mg/l)
01/01/09	920	71	2.8	0.018	<0.030	<0.01	<1.0	<1.0	<1.0	0.018	<0.030	<0.01
02/02/09	840	97	<5.0	0.015	<0.50	<0.0020	<1.0	<1.0	<1.0	0.015	<0.050	<0.0020
03/02/09	910	71	2.8	0.015	<0.050	<0.00030	<1.0	<1.0	<1.0	0.015	<0.050	<0.0020
04/01/09	970	71	2.8	0.013	<0.050	<0.0020	<1.0	<1.0	<1.0	0.014	<0.050	<0.0020
05/01/09	810	62	2.6	0.014	<0.050	<0.0020	<1.0	<1.0	<1.0	0.016	<0.050	<0.0020
06/01/09	920	73	2.8	0.015	<0.050	<0.0020	<1.0	<1.0	<1.0	0.016	<0.50	<0.0020
07/01/09	790	70	2.7	0.018	<0.030	<0.010	<1.0	<1.0	<1.0	0.018	<0.030	<0.010
08/03/09	780	78	2.9	0.016	<0.050	<0.0020	<1.0	<1.0	<1.0	0.014	<0.50	<0.0020
09/01/09	810	64	2.6	0.017	<0.050	<0.0020	<1.0	<1.0	<1.0	0.017	<0.050	<0.0020
10/01/09	690	72	2.7	0.018	<0.10	<0.010	<1.0	<1.0	<1.0	0.018	<0.10	<0.010
11/02/09	1100	64	2.5	0.016	<0.050	<0.0020	<1.0	<1.0	<1.0	0.016	<0.050	<0.0020
12/01/09	890	68	2.5	0.016	<0.10	<0.010	<1.0	<1.0	<1.0	0.015	<0.10	<0.010
01/04/10	630	72	2.5	0.016	<0.10	<0.010	<1.0	<1.0	<1.0	0.016	<0.10	<0.010

[a] Data from January 4, 2010 has been included to show conditions at the end of the year.

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 ug/L for TCE and DCE, 60 ug/L for TCA and 50 ug/L for total chromium).

C-2: Source Treatment System 2009 Analytical Results

Appendix C-2

Source Treatment System
2009 Analytical Results[a]

Sample Date	Influent TCE (ug/l)	Influent 1,1DCE (ug/l)	Influent 1,1,1TCA (ug/l)	Influent Cr(total) (mg/l)	Influent Fe(total) (mg/l)	Influent Mn(total) (mg/l)	Effluent TCE (ug/l)	Effluent 1,1DCE (ug/l)	Effluent 1,1,1TCA (ug/l)	Effluent Cr(total) (mg/l)	Effluent Fe(total) (mg/l)	Effluent Mn(total) (mg/l)
01/01/09	66	10	<1.0	0.027	<0.030	0.070	<1.0	<1.0	<1.0	0.027	<0.030	0.040
02/02/09	71	9.5	<1.0	0.025	<0.050	0.310	<1.0	<1.0	<1.0	0.023	<0.050	0.037
03/02/09	60	7.7	<1.0	0.024	<0.050	0.047	<1.0	<1.0	<1.0	0.026	<0.050	0.037
04/01/09	66	8.6	<1.0	0.024	<0.050	0.061	<1.0	<1.0	<1.0	0.024	<0.050	0.040
05/01/09	65	8.7	<1.0	0.027	<0.050	<0.061	<1.0	<1.0	<1.0	0.026	<0.050	0.042
06/01/09	70	9.2	<1.0	0.027	1.2000	0.110	<1.0	<1.0	<1.0	0.028	0.1400	0.086
07/01/09	65	7.9	<1.0	0.043	0.5300	0.220	<1.0	<1.0	<1.0	0.034	0.0600	0.120
08/03/09	63	7.9	<1.0	0.028	<0.050	0.160	<1.0	<1.0	<1.0	0.028	<0.050	0.064
09/01/09	55	6.8	<1.0	0.030	<0.050	0.083	<1.0	<1.0	<1.0	0.030	<0.050	0.060
10/01/09	55	8.1	<1.0	0.037	0.4400	0.380	<1.0	<1.0	<1.0	0.032	<0.10	0.081
11/02/09	72	7.3	<1.0	0.029	<0.050	0.220	<1.0	<1.0	<1.0	0.029	<0.050	0.042
12/01/09	63	8.2	<1.0	0.030	<0.10	0.230	<1.0	<1.0	<1.0	0.030	<0.10	0.043
01/04/10	54	7.8	<1.0	0.046	0.8000	0.880	<1.0	<1.0	<1.0	0.029	<0.10	0.100

[a] Data from January 4, 2010 has been included to show conditions at the end of the year.

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 ug/L for TCE and DCE, 60 ug/L for TCA and 50 ug/L for total chromium).

APPENDIX D

APPENDIX D

Appendix D

Observed and Calculated Water Levels and Concentrations – December 1998 to December 2009 Simulation

Figure D-1: Comparison of Observed and Calculated Water Levels in On-Site UFZ Wells

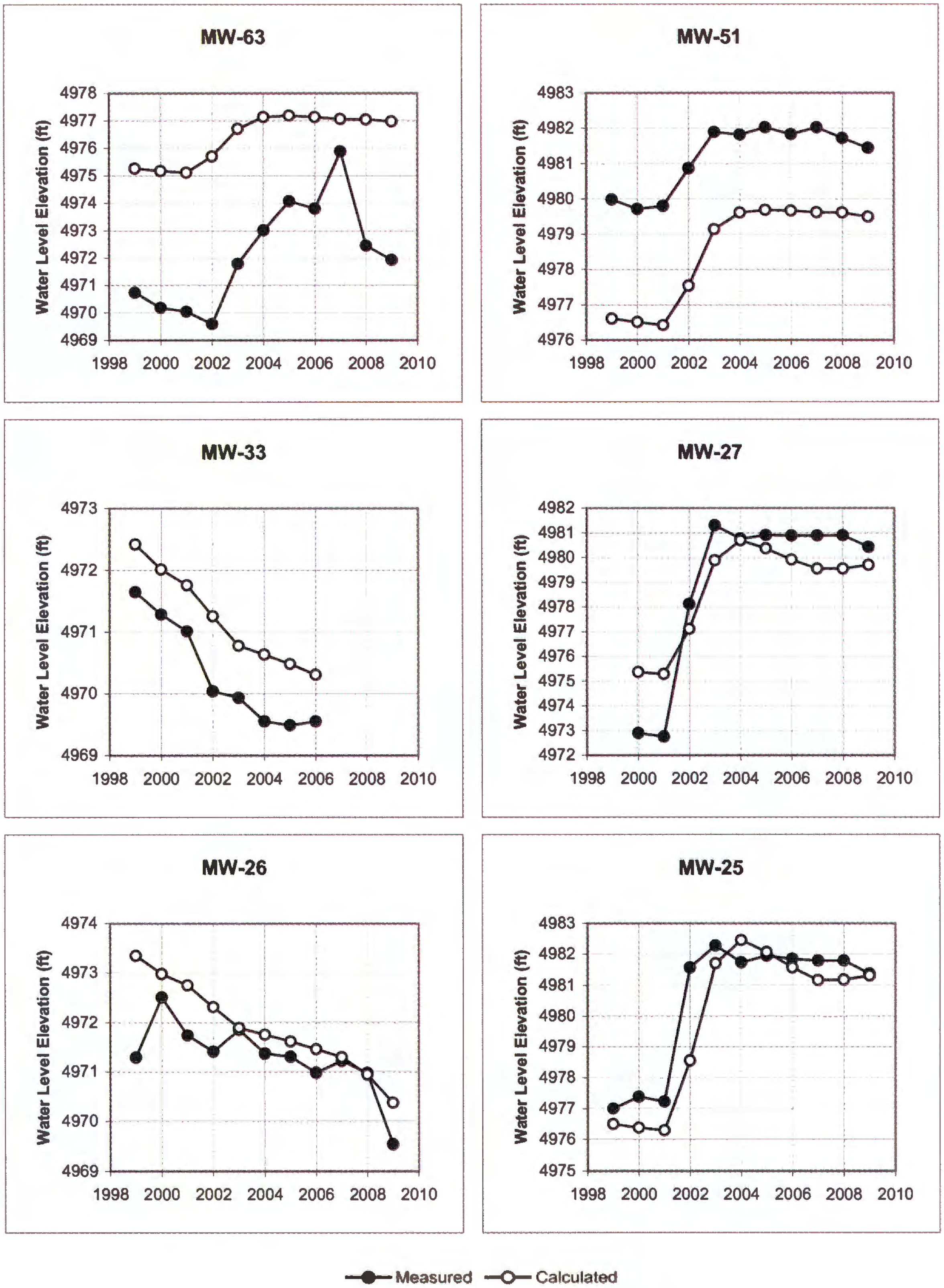

Figure D.1 Comparison of Observed and Calculated Water Levels in On-Site UFZ Wells

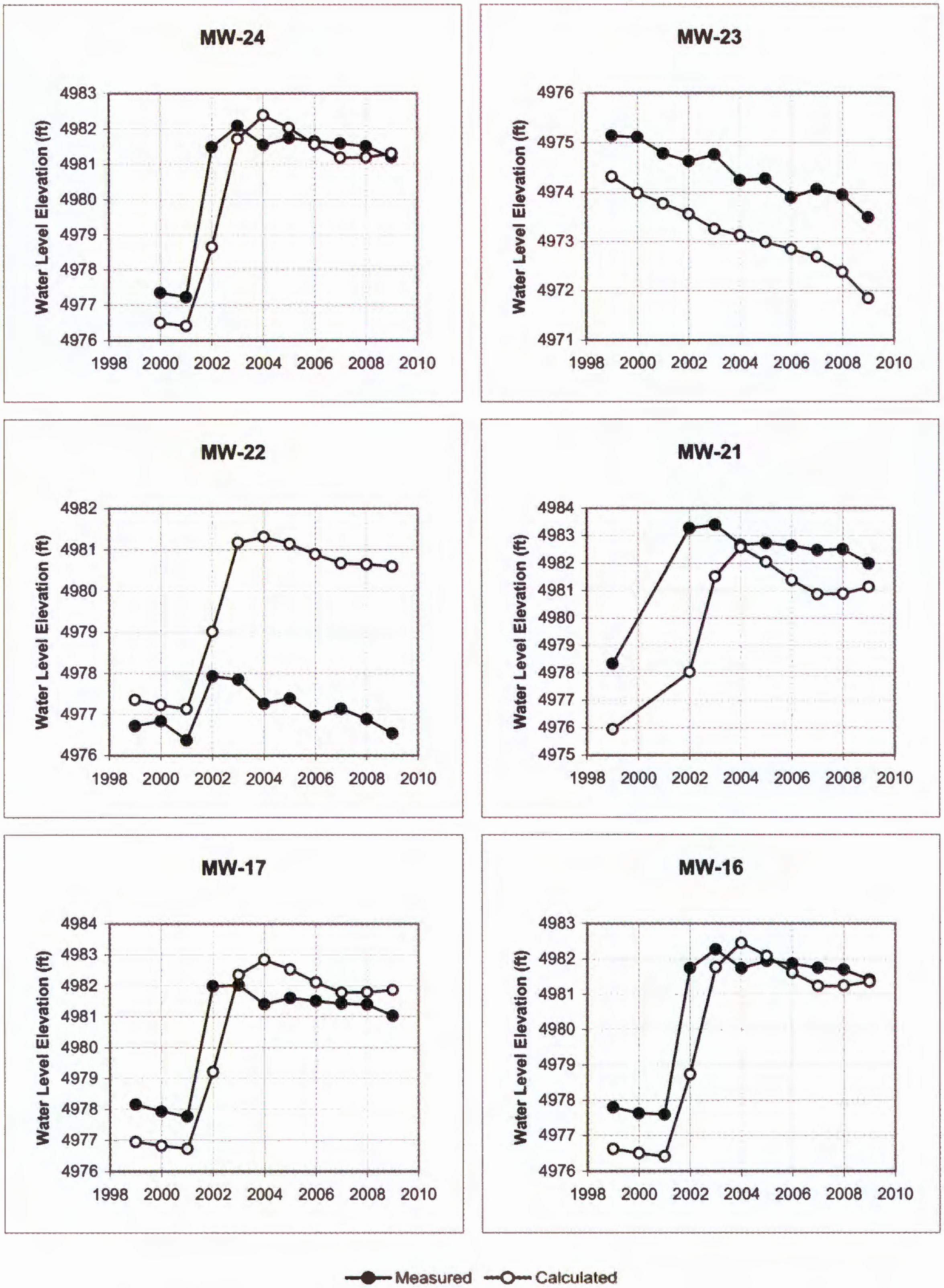

Figure D.1 Comparison of Observed and Calculated Water Levels in On-Site UFZ Wells
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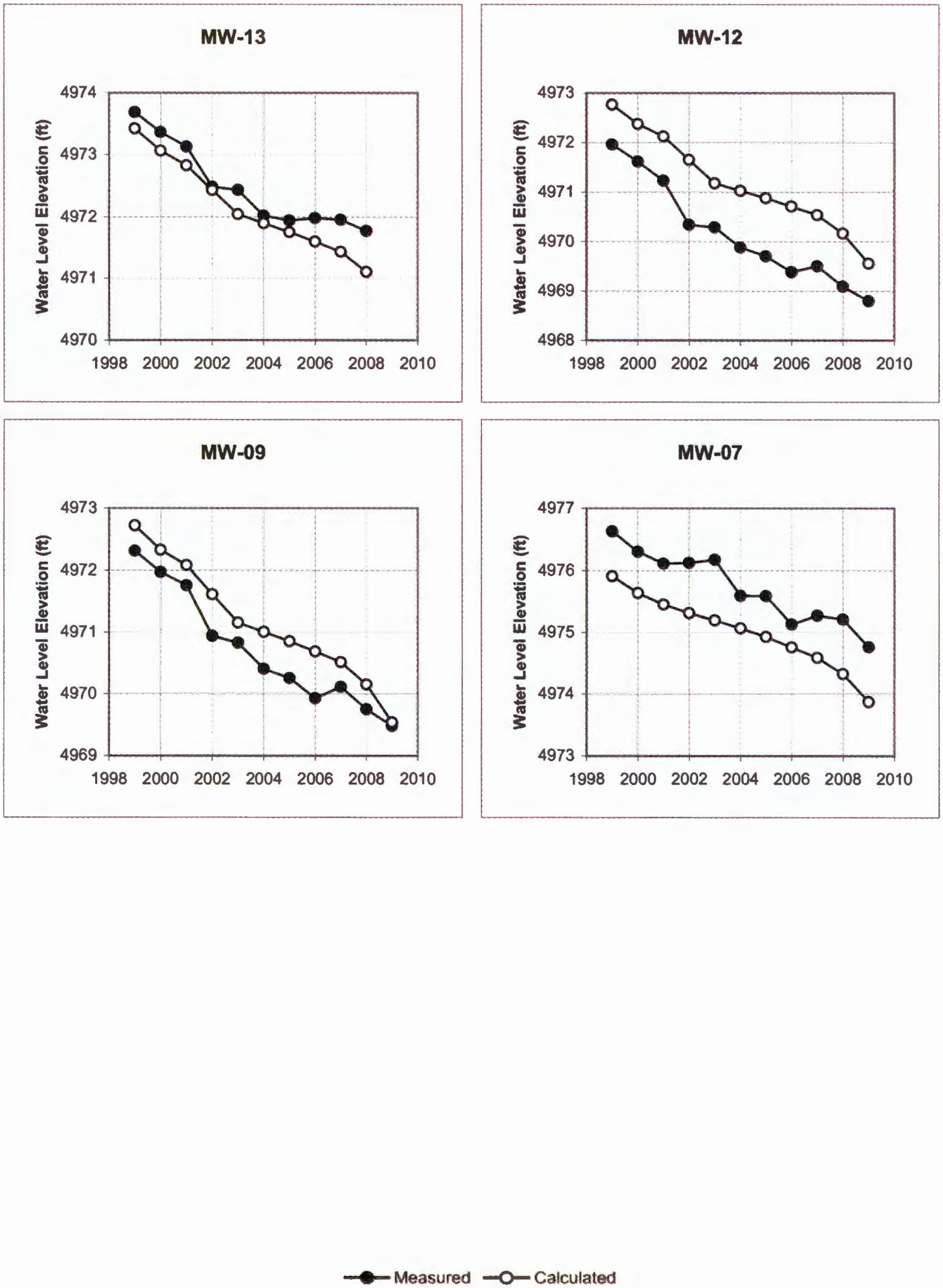

Figure D.1 Comparison of Observed and Calculated Water Levels in On-Site UFZ Wells
Page 3 of 3

Figure D-2: Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells

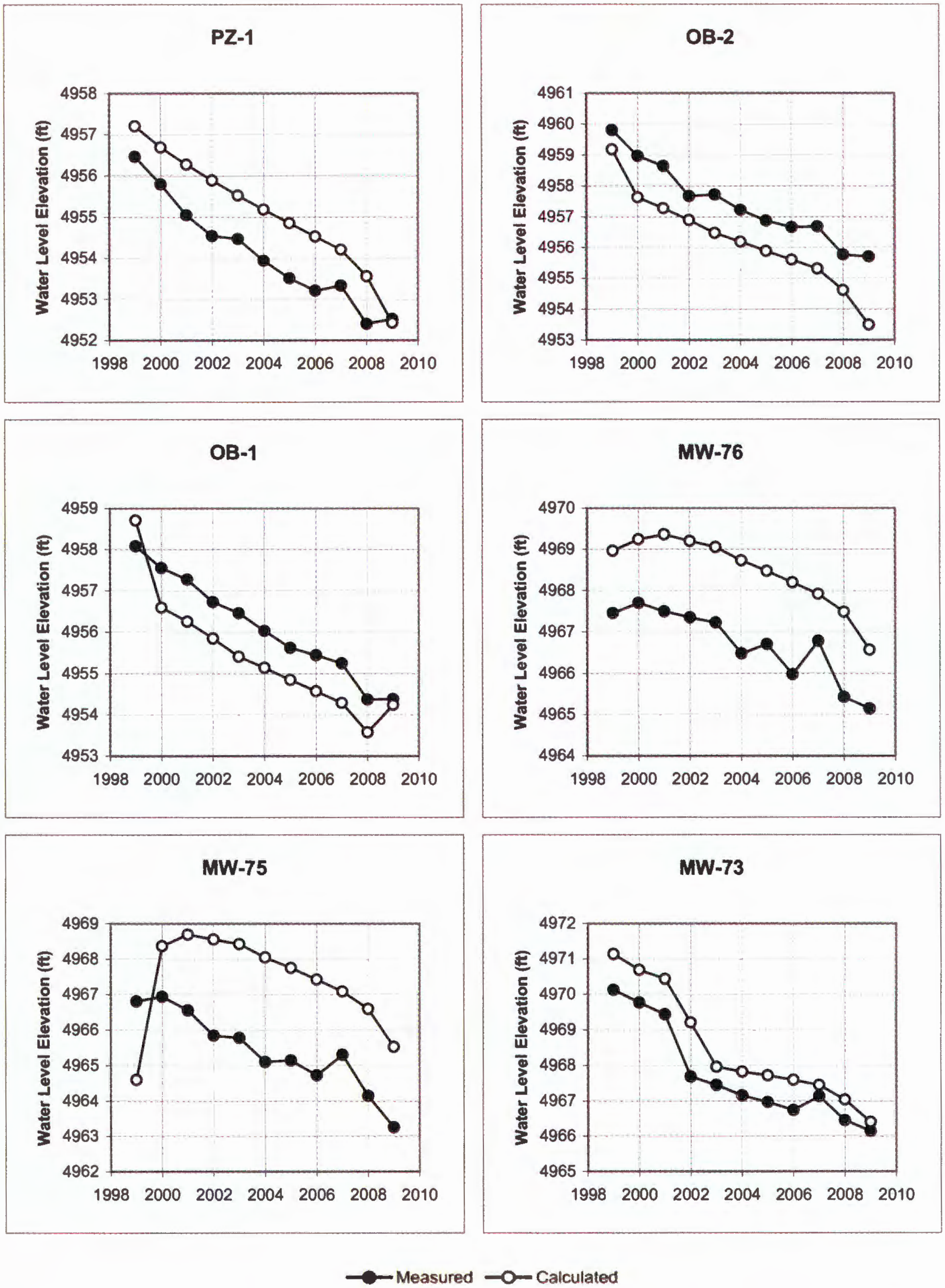

Figure D.2 Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells
Page 1 of 10

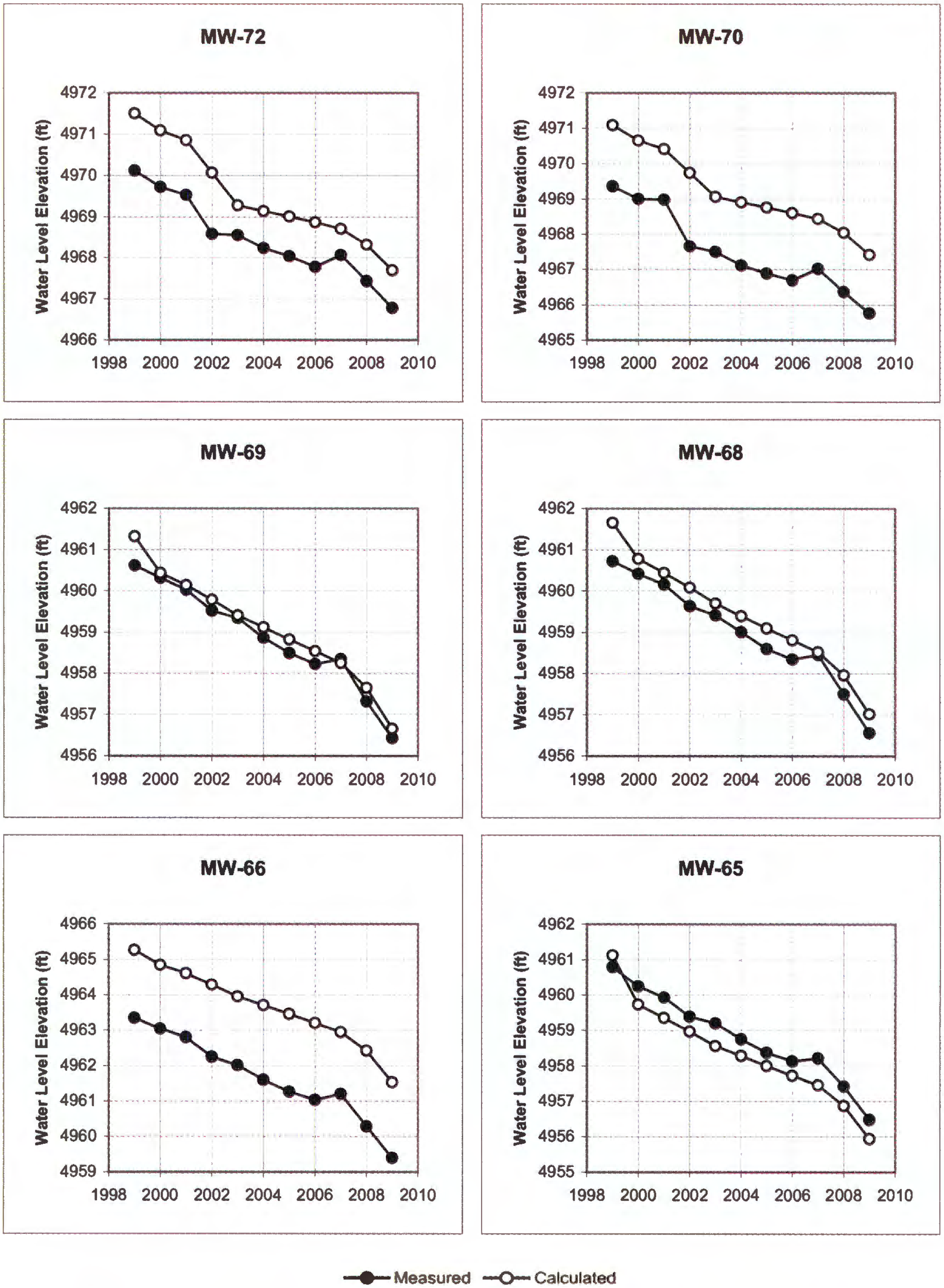

Figure D.2 Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells

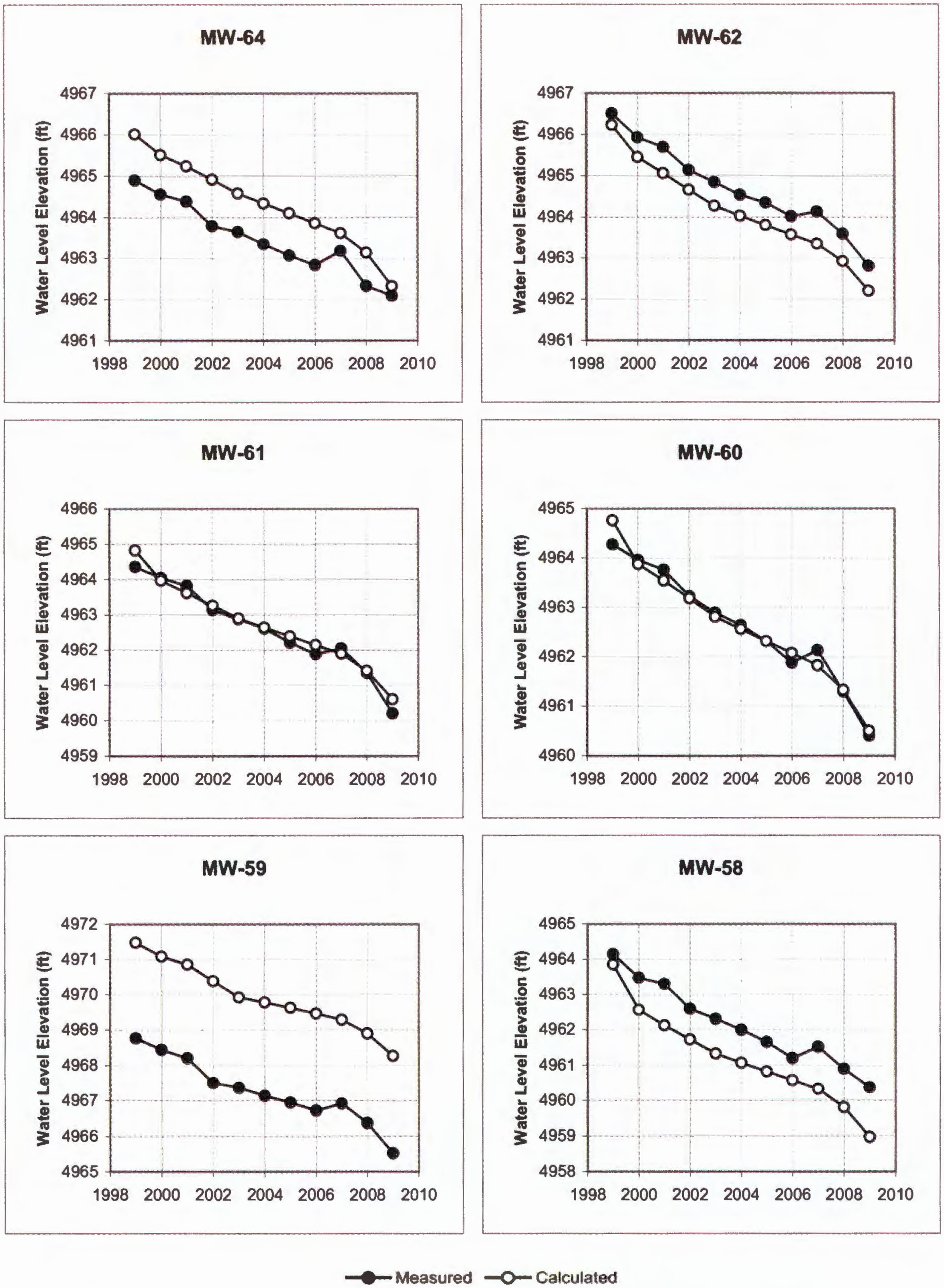

Figure D.2 Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells

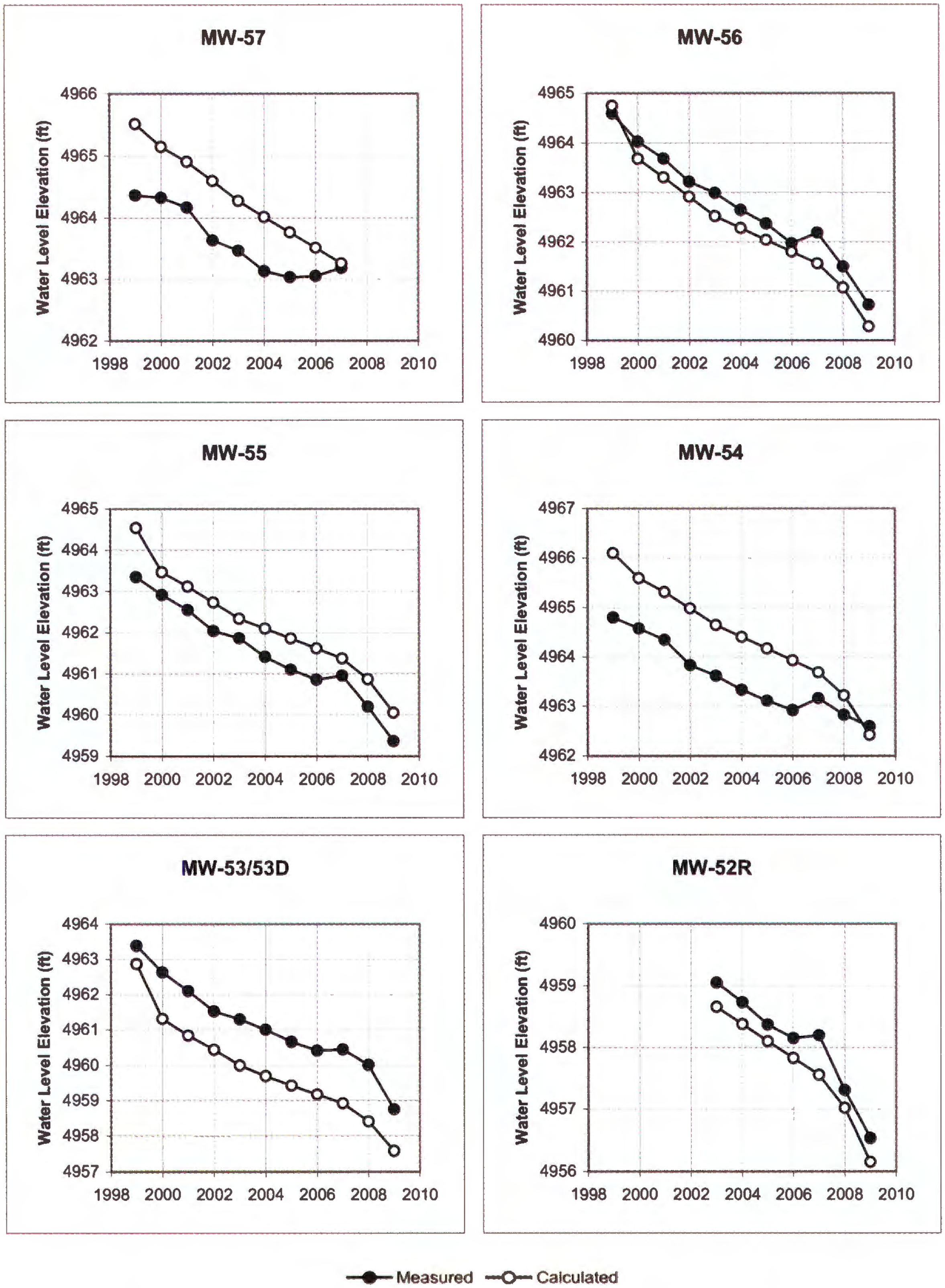

Figure D.2 Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells

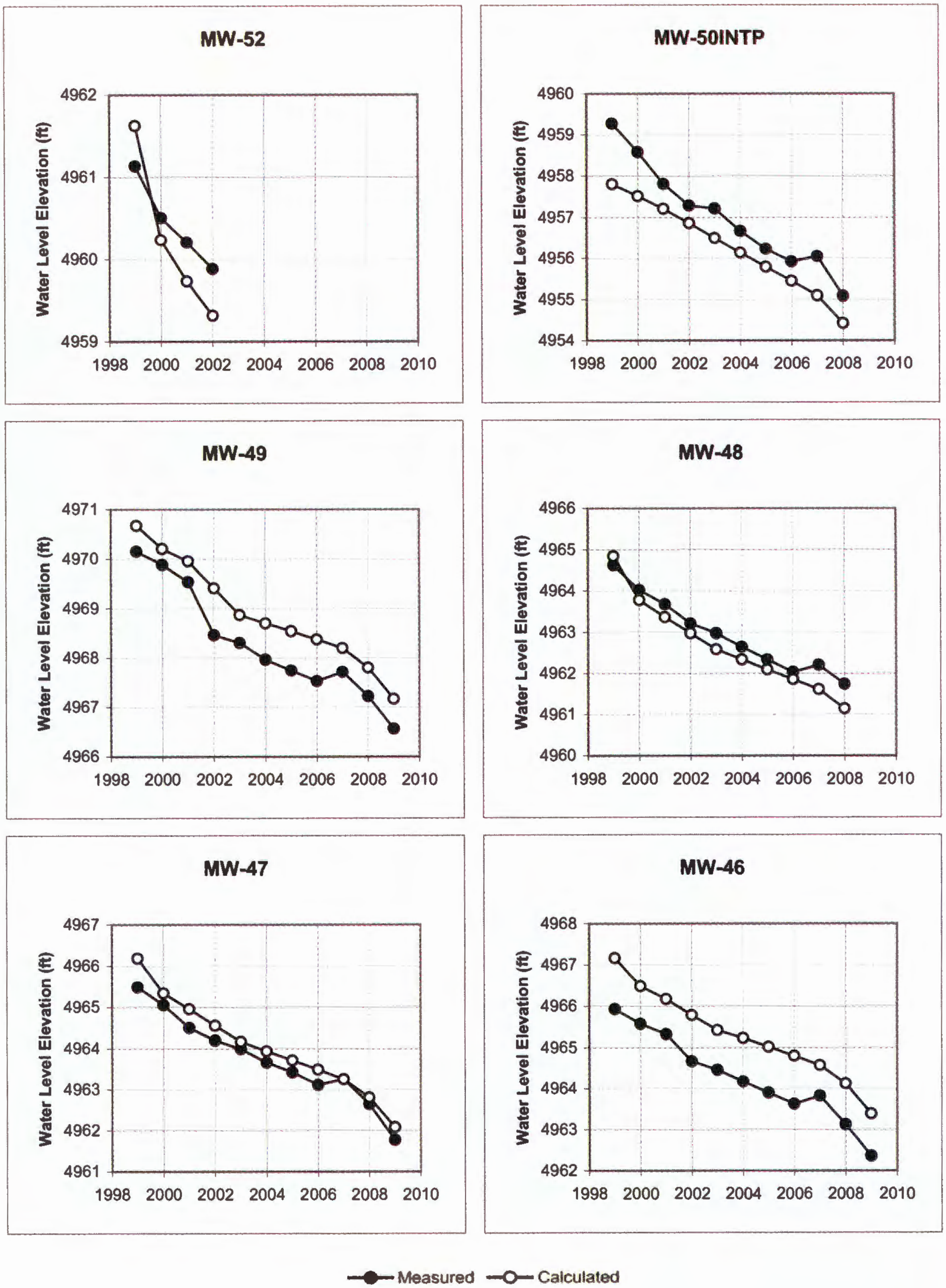

Figure D.2 Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells

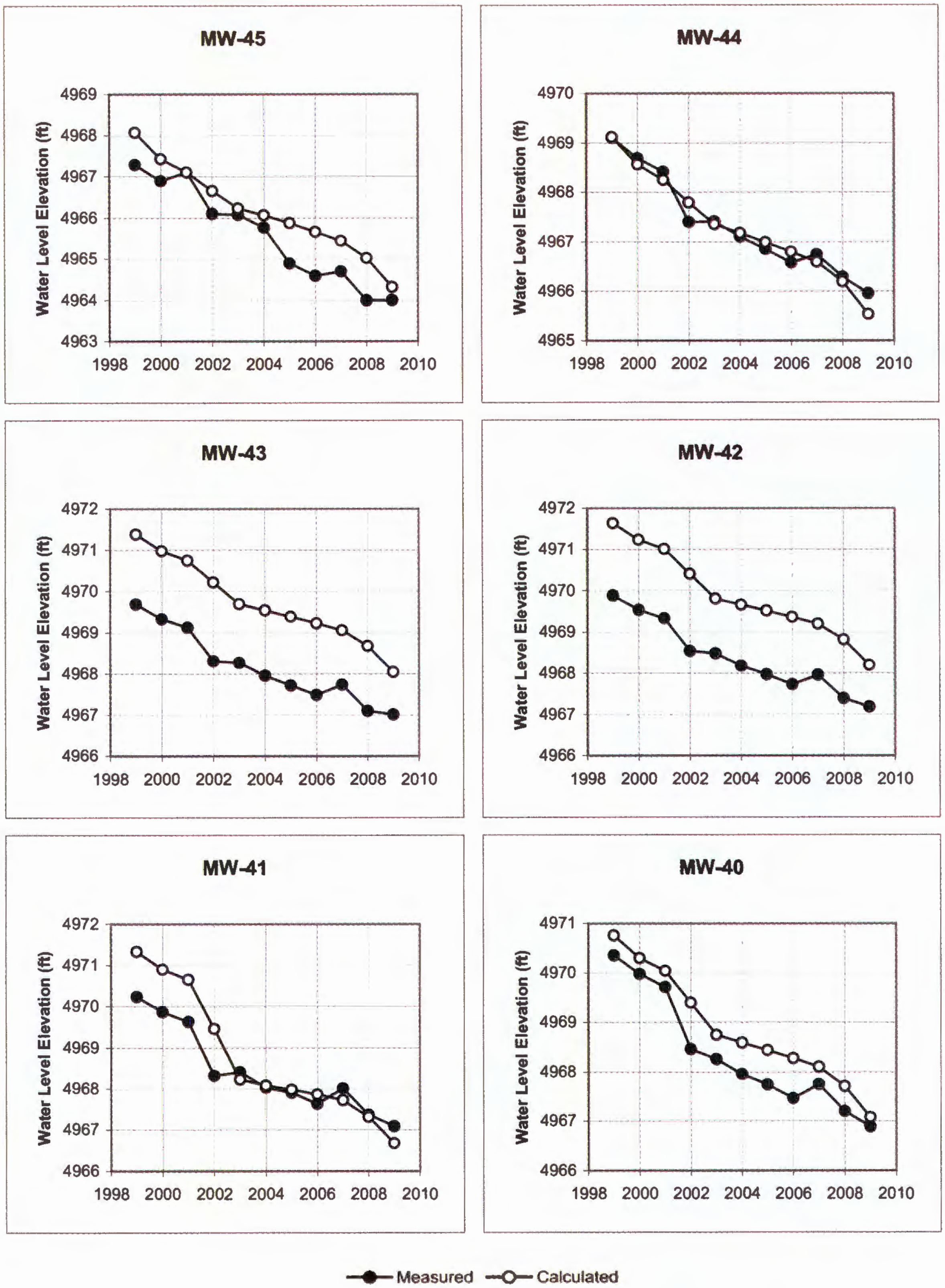

Figure D.2 Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells

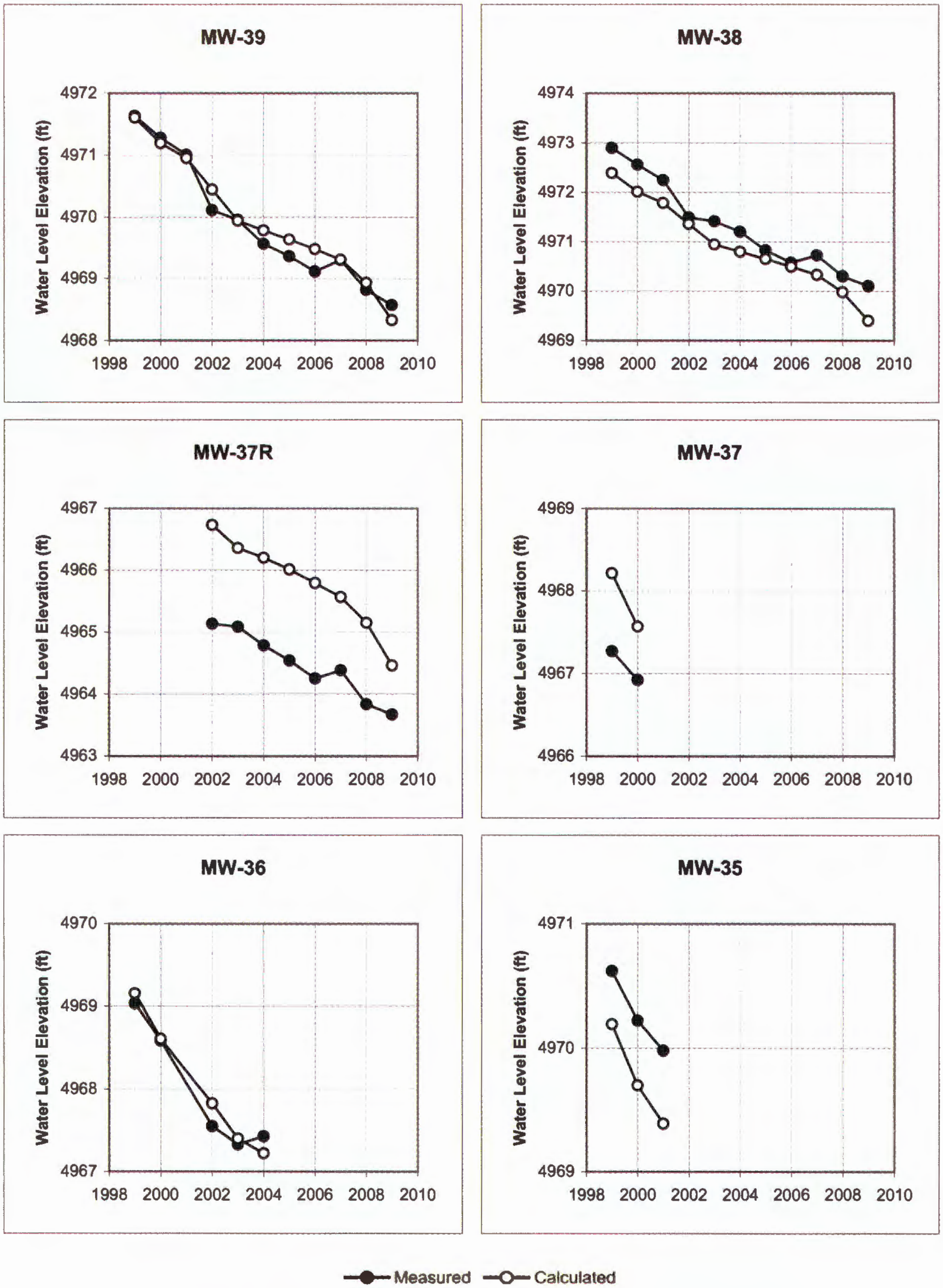

Figure D.2 Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells

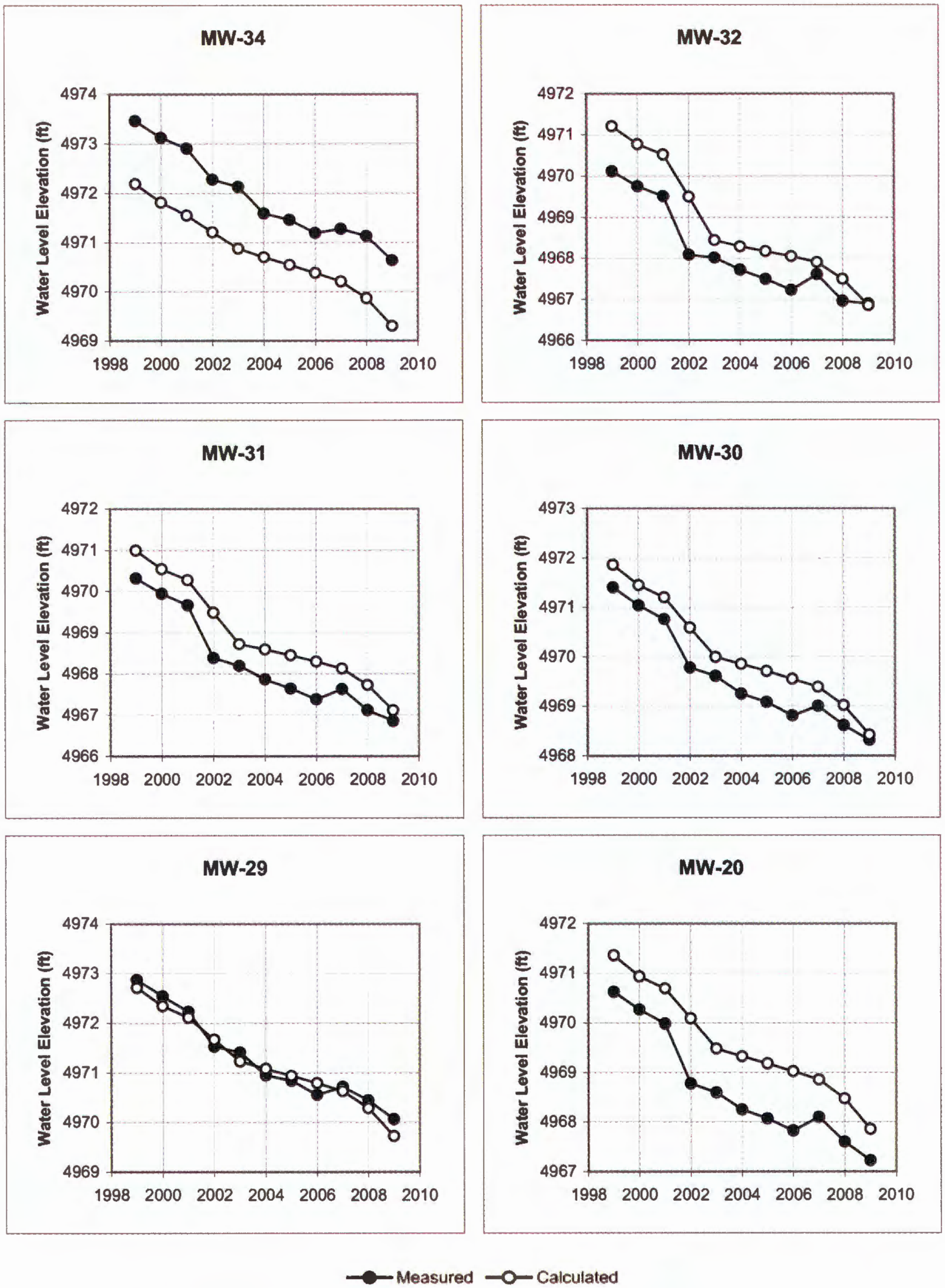

Figure D.2 Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells

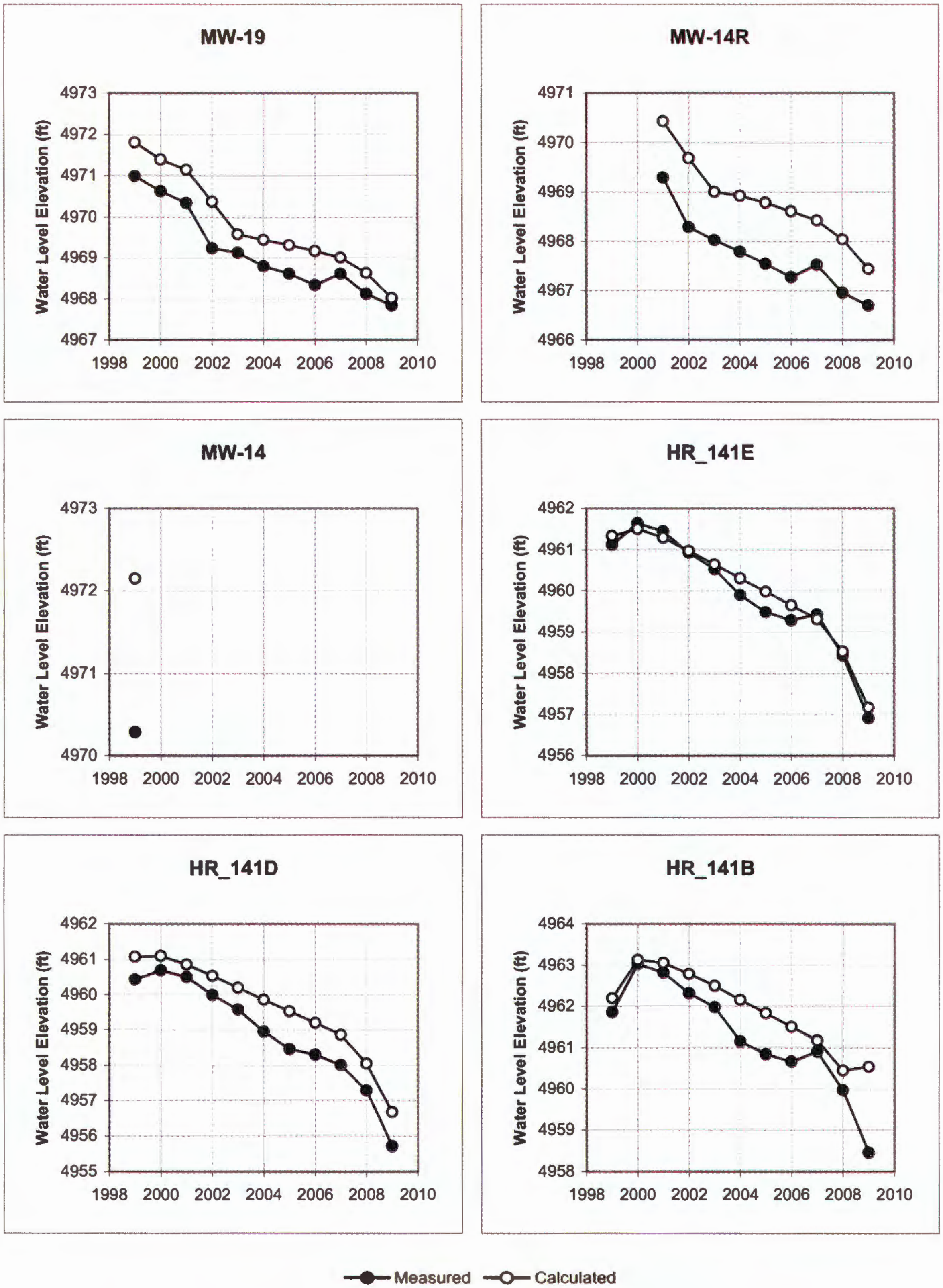

Figure D.2 Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells
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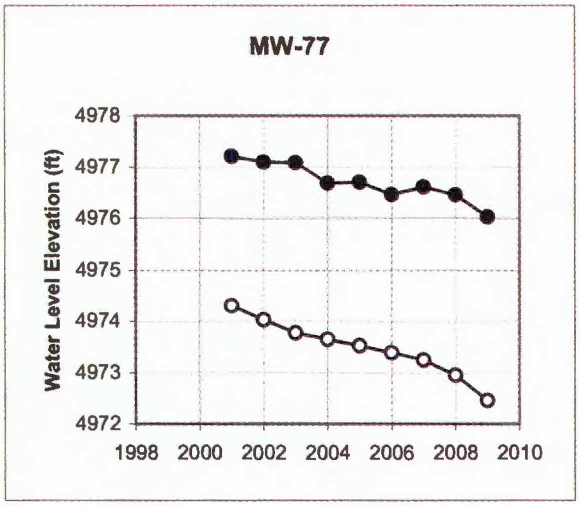

Measured Calculated

Figure D.2 Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells

Figure D-3: Comparison of Observed and Calculated Water Levels in DFZ Wells

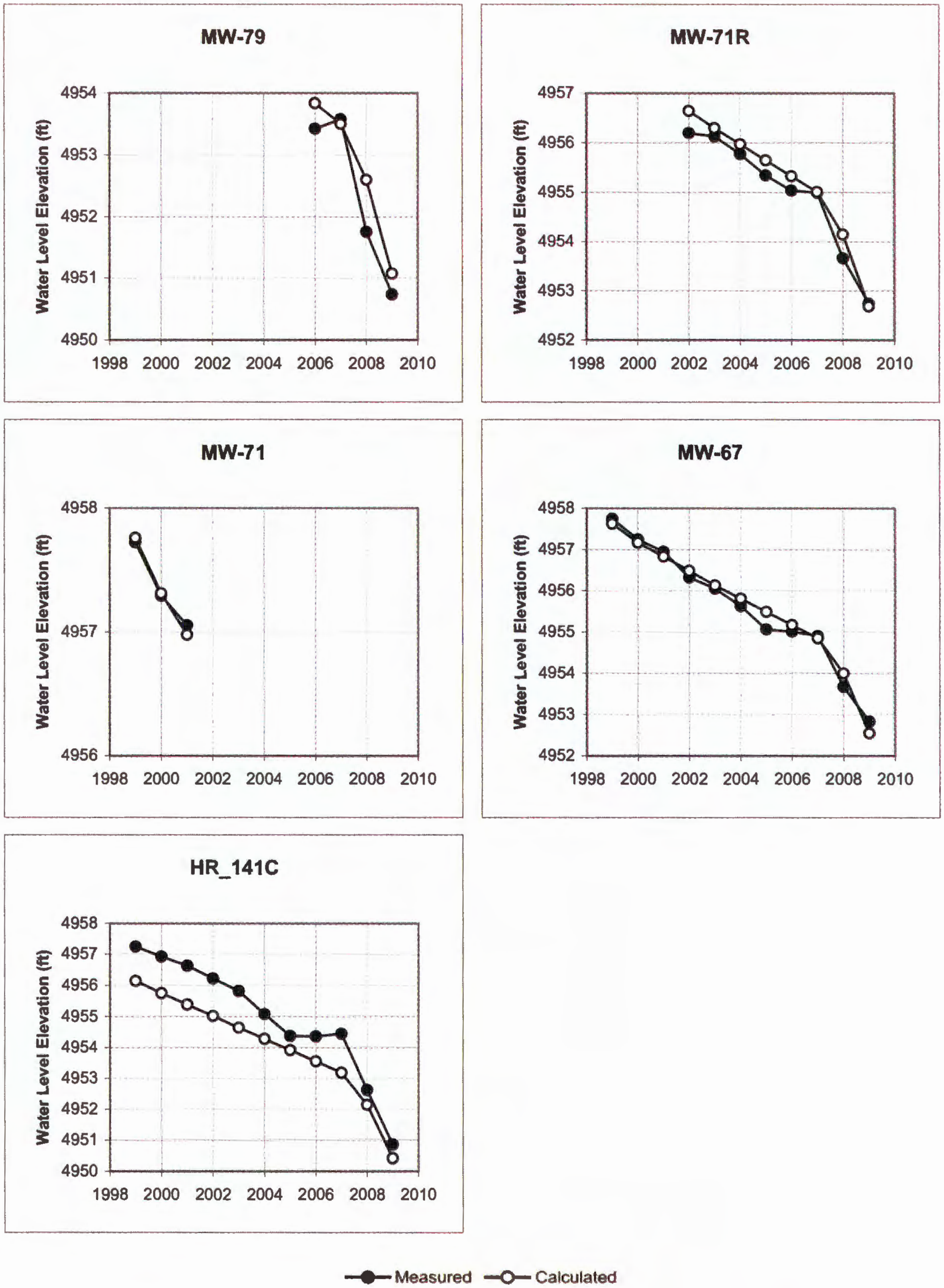

Figure D.3 Comparison of Observed and Calculated Water Levels in DFZ Wells
Page 1 of 1

Figure D-4: **Residuals between Observed and Calculated 2009 Water Levels in UFZ Wells**

Figure D.4 Residuals between Observed and Calculated 2009 Water Levels in On-Site UFZ Wells

Figure D-5: Residuals between Observed and Calculated 2009 Water Levels in UFZ/ULFZ/LLFZ Wells

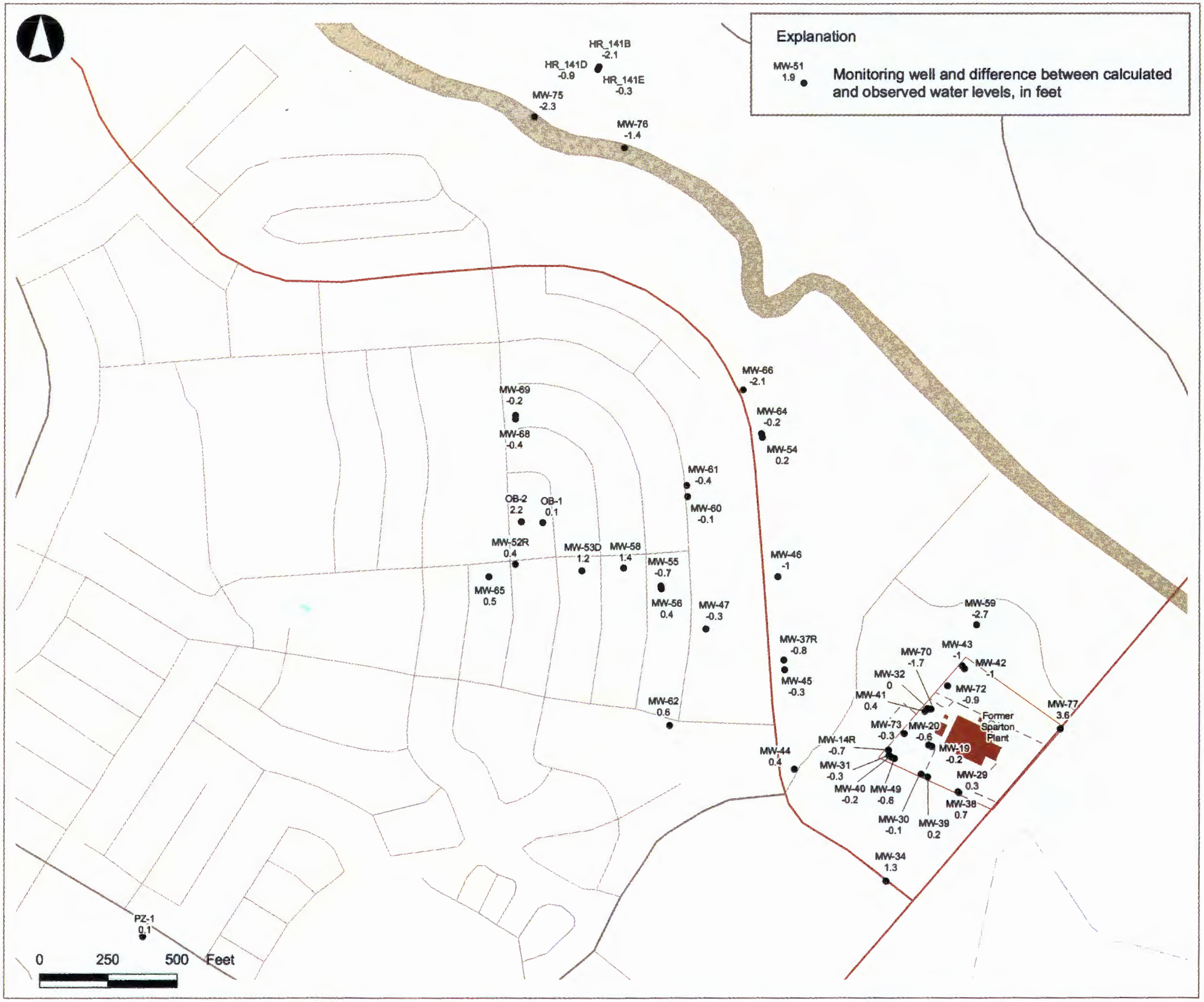

Figure D.5 Residuals between Observed and Calculated 2009 Water Levels in UFZ/UFLZ/LLFZ Wells

Figure D-6: Residuals between Observed and Calculated 2009 Water Levels in DFZ Wells

Figure D.6 Residuals between Observed and Calculated 2009 Water Levels in DFZ Wells

Figure D.7: Comparison of Calculated to Observed TCE Concentrations in Select Monitoring Wells

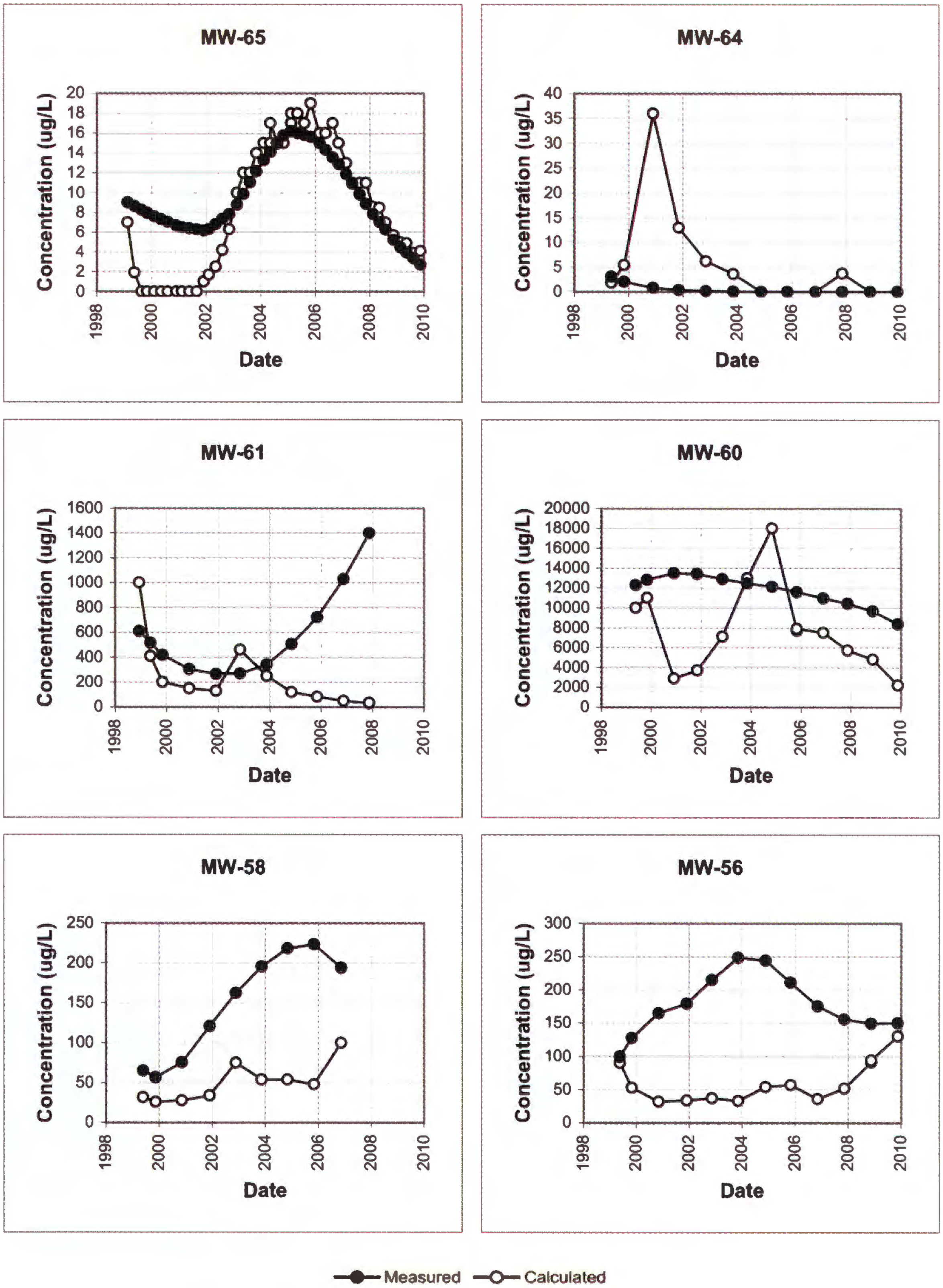

Figure D.7 Comparison of Calculated to Observed TCE Concentrations at Selected Monitoring Wells

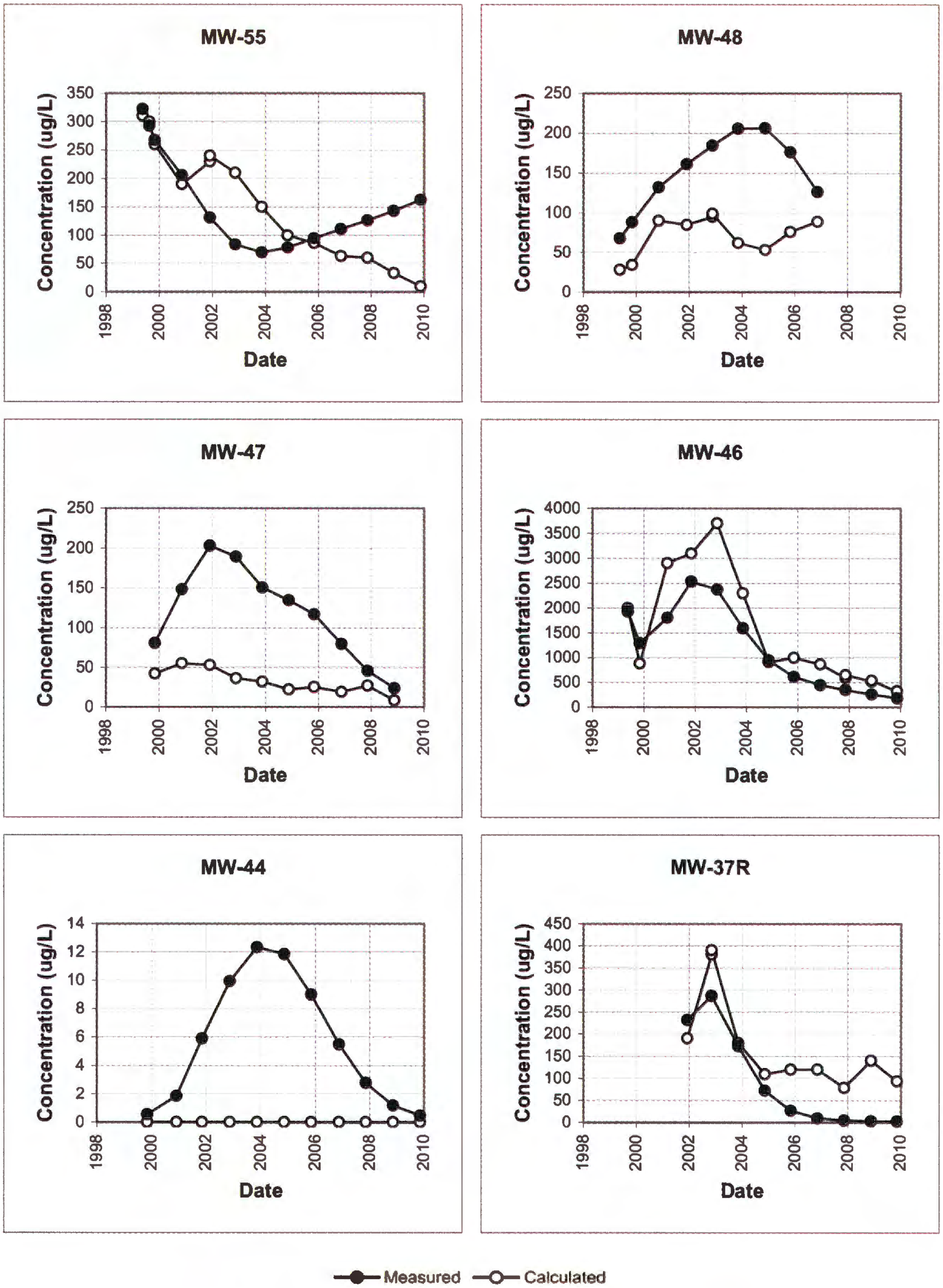

Figure D.7 Comparison of Calculated to Observed TCE Concentrations at Selected Monitoring Wells
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Table D-1: Comparison of Observed and Calculated Water Levels On-Site Wells – December 1998 to December 2009

Table D-1

Comparison of Observed and Calculated Water Levels in On-Site UFZ Wells December 1998 to December 2009

Monitoring Well	Year	Water Level Elevation in feet above MSL		Difference (ft)
		Observed	Calculated	
MW-07	1999	4976.6	4975.9	0.7
MW-07	2000	4976.3	4975.6	0.7
MW-07	2001	4976.1	4975.4	0.7
MW-07	2002	4976.1	4975.3	0.8
MW-07	2003	4976.2	4975.2	1.0
MW-07	2004	4975.6	4975.1	0.5
MW-07	2005	4975.6	4974.9	0.7
MW-07	2006	4975.1	4974.8	0.4
MW-07	2007	4975.3	4974.6	0.7
MW-07	2008	4975.2	4974.3	0.9
MW-07	2009	4974.8	4973.9	0.9
MW-09	1999	4972.3	4972.7	-0.4
MW-09	2000	4972.0	4972.3	-0.4
MW-09	2001	4971.8	4972.1	-0.3
MW-09	2002	4970.9	4971.6	-0.7
MW-09	2003	4970.8	4971.2	-0.3
MW-09	2004	4970.4	4971.0	-0.6
MW-09	2005	4970.3	4970.9	-0.6
MW-09	2006	4969.9	4970.7	-0.8
MW-09	2007	4970.1	4970.5	-0.4
MW-09	2008	4969.7	4970.1	-0.4
MW-09	2009	4969.5	4969.5	-0.1
MW-12	1999	4972.0	4972.8	-0.8
MW-12	2000	4971.6	4972.4	-0.8
MW-12	2001	4971.2	4972.1	-0.9
MW-12	2002	4970.3	4971.6	-1.3
MW-12	2003	4970.3	4971.2	-0.9
MW-12	2004	4969.9	4971.0	-1.1
MW-12	2005	4969.7	4970.9	-1.2
MW-12	2006	4969.4	4970.7	-1.3
MW-12	2007	4969.5	4970.5	-1.0
MW-12	2008	4969.1	4970.2	-1.1
MW-12	2009	4968.8	4969.6	-0.8
MW-13	1999	4973.7	4973.4	0.3
MW-13	2000	4973.4	4973.1	0.3
MW-13	2001	4973.1	4972.8	0.3
MW-13	2002	4972.5	4972.4	0.1
MW-13	2003	4972.4	4972.0	0.4
MW-13	2004	4972.0	4971.9	0.1
MW-13	2005	4971.9	4971.8	0.2

Table D-1

Comparison of Observed and Calculated Water Levels in On-Site UFZ Wells December 1998 to December 2009

Monitoring Well	Year	Water Level Elevation in feet above MSL		Difference (ft)
		Observed	Calculated	
MW-13	2006	4972.0	4971.6	0.4
MW-13	2007	4972.0	4971.4	0.5
MW-13	2008	4971.8	4971.1	0.7
MW-16	1999	4977.8	4976.6	1.2
MW-16	2000	4977.6	4976.5	1.1
MW-16	2001	4977.6	4976.4	1.2
MW-16	2002	4981.7	4978.7	3.0
MW-16	2003	4982.3	4981.8	0.5
MW-16	2004	4981.7	4982.4	-0.7
MW-16	2005	4981.9	4982.1	-0.1
MW-16	2006	4981.9	4981.6	0.3
MW-16	2007	4981.8	4981.2	0.5
MW-16	2008	4981.7	4981.2	0.5
MW-16	2009	4981.4	4981.4	0.1
MW-17	1999	4978.2	4976.9	1.2
MW-17	2000	4977.9	4976.8	1.1
MW-17	2001	4977.8	4976.7	1.0
MW-17	2002	4982.0	4979.2	2.8
MW-17	2003	4982.0	4982.4	-0.3
MW-17	2004	4981.4	4982.8	-1.4
MW-17	2005	4981.6	4982.5	-0.9
MW-17	2006	4981.5	4982.1	-0.6
MW-17	2007	4981.4	4981.8	-0.4
MW-17	2008	4981.4	4981.8	-0.4
MW-17	2009	4981.0	4981.9	-0.8
MW-18	1999	4970.9	4974.8	-3.9
MW-18	2000	4970.7	4974.7	-4.0
MW-18	2001	4970.3	4974.6	-4.3
MW-18	2002	4970.7	4976.0	-5.3
MW-18	2003	4975.2	4977.9	-2.7
MW-18	2004	4973.4	4978.6	-5.2
MW-18	2005	4974.1	4978.3	-4.2
MW-18	2006	4970.9	4977.9	-7.0
MW-18	2007	4973.6	4977.6	-4.0
MW-18	2008	4973.2	4977.6	-4.4
MW-18	2009	4970.5	4977.6	-7.1
MW-21	1999	4978.3	4975.9	2.4
MW-21	2002	4983.3	4978.0	5.2
MW-21	2003	4983.4	4981.5	1.9
MW-21	2004	4982.7	4982.6	0.1

Table D-1

Comparison of Observed and Calculated Water Levels in On-Site UFZ Wells December 1998 to December 2009

Monitoring Well	Year	Water Level Elevation in feet above MSL		Difference (ft)
		Observed	Calculated	
MW-21	2005	4982.7	4982.0	0.7
MW-21	2006	4982.6	4981.4	1.3
MW-21	2007	4982.5	4980.9	1.6
MW-21	2008	4982.5	4980.9	1.6
MW-21	2009	4982.0	4981.1	0.9
MW-22	1999	4976.7	4977.4	-0.6
MW-22	2000	4976.8	4977.2	-0.4
MW-22	2001	4976.4	4977.1	-0.8
MW-22	2002	4977.9	4979.0	-1.1
MW-22	2003	4977.8	4981.2	-3.3
MW-22	2004	4977.3	4981.3	-4.1
MW-22	2005	4977.4	4981.1	-3.8
MW-22	2006	4977.0	4980.9	-3.9
MW-22	2007	4977.1	4980.7	-3.5
MW-22	2008	4976.9	4980.6	-3.8
MW-22	2009	4976.5	4980.6	-4.1
MW-23	1999	4975.1	4974.3	0.8
MW-23	2000	4975.1	4974.0	1.1
MW-23	2001	4974.8	4973.8	1.0
MW-23	2002	4974.6	4973.6	1.1
MW-23	2003	4974.8	4973.3	1.5
MW-23	2004	4974.2	4973.1	1.1
MW-23	2005	4974.3	4973.0	1.3
MW-23	2006	4973.9	4972.8	1.1
MW-23	2007	4974.1	4972.7	1.4
MW-23	2008	4973.9	4972.4	1.6
MW-23	2009	4973.5	4971.8	1.6
MW-24	2000	4977.3	4976.5	0.8
MW-24	2001	4977.2	4976.4	0.8
MW-24	2002	4981.5	4978.6	2.8
MW-24	2003	4982.1	4981.7	0.4
MW-24	2004	4981.5	4982.4	-0.8
MW-24	2005	4981.7	4982.0	-0.3
MW-24	2006	4981.6	4981.6	0.1
MW-24	2007	4981.6	4981.2	0.4
MW-24	2008	4981.5	4981.2	0.3
MW-24	2009	4981.2	4981.3	-0.1
MW-25	1999	4977.0	4976.5	0.5
MW-25	2000	4977.4	4976.4	1.0
MW-25	2001	4977.2	4976.3	0.9

Table D-1

Comparison of Observed and Calculated Water Levels in On-Site UFZ Wells December 1998 to December 2009

Monitoring Well	Year	Water Level Elevation in feet above MSL		Difference (ft)
		Observed	Calculated	
MW-25	2002	4981.6	4978.5	3.0
MW-25	2003	4982.3	4981.7	0.6
MW-25	2004	4981.7	4982.5	-0.7
MW-25	2005	4981.9	4982.1	-0.1
MW-25	2006	4981.8	4981.6	0.3
MW-25	2007	4981.8	4981.2	0.6
MW-25	2008	4981.8	4981.2	0.6
MW-25	2009	4981.4	4981.3	0.1
MW-26	1999	4971.3	4973.3	-2.1
MW-26	2000	4972.5	4973.0	-0.5
MW-26	2001	4971.7	4972.8	-1.0
MW-26	2002	4971.4	4972.3	-0.9
MW-26	2003	4971.8	4971.9	0.0
MW-26	2004	4971.4	4971.7	-0.4
MW-26	2005	4971.3	4971.6	-0.3
MW-26	2006	4971.0	4971.4	-0.5
MW-26	2007	4971.2	4971.3	-0.1
MW-26	2008	4971.0	4970.9	0.0
MW-26	2009	4969.5	4970.4	-0.9
MW-27	2000	4972.9	4975.4	-2.5
MW-27	2001	4972.8	4975.3	-2.5
MW-27	2002	4978.1	4977.1	1.0
MW-27	2003	4981.3	4979.9	1.4
MW-27	2004	4980.8	4980.7	0.1
MW-27	2005	4980.9	4980.4	0.5
MW-27	2006	4980.9	4979.9	1.0
MW-27	2007	4980.9	4979.5	1.3
MW-27	2008	4980.9	4979.5	1.4
MW-27	2009	4980.4	4979.7	0.7
MW-33	1999	4971.6	4972.4	-0.8
MW-33	2000	4971.3	4972.0	-0.7
MW-33	2001	4971.0	4971.8	-0.7
MW-33	2002	4970.0	4971.3	-1.2
MW-33	2003	4969.9	4970.8	-0.8
MW-33	2004	4969.6	4970.6	-1.1
MW-33	2005	4969.5	4970.5	-1.0
MW-33	2006	4969.6	4970.3	-0.8
MW-51	1999	4980.0	4976.6	3.4
MW-51	2000	4979.7	4976.5	3.2
MW-51	2001	4979.8	4976.4	3.4

Table D-1

Comparison of Observed and Calculated Water Levels in On-Site UFZ Wells December 1998 to December 2009

Monitoring Well	Year	Water Level Elevation in feet above MSL		Difference (ft)
		Observed	Calculated	
MW-51	2002	4980.9	4977.5	3.3
MW-51	2003	4981.9	4979.1	2.7
MW-51	2004	4981.8	4979.6	2.2
MW-51	2005	4982.0	4979.7	2.3
MW-51	2006	4981.8	4979.7	2.2
MW-51	2007	4982.0	4979.6	2.4
MW-51	2008	4981.7	4979.6	2.1
MW-51	2009	4981.4	4979.5	1.9
MW-63	1999	4970.7	4975.3	-4.5
MW-63	2000	4970.2	4975.2	-5.0
MW-63	2001	4970.0	4975.1	-5.1
MW-63	2002	4969.6	4975.7	-6.1
MW-63	2003	4971.8	4976.7	-4.9
MW-63	2004	4973.0	4977.1	-4.1
MW-63	2005	4974.1	4977.2	-3.1
MW-63	2006	4973.8	4977.1	-3.3
MW-63	2007	4975.9	4977.1	-1.2
MW-63	2008	4972.5	4977.0	-4.6
MW-63	2009	4971.9	4977.0	-5.0

Table D-2: Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells

Table D-2

Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells December 1998 to December 2009

Monitoring Well	Year	Water Level Elevation in feet above MSL		Difference (ft)
		Observed	Calculated	
CW-1	1999	4938.4	4958.9	-20.4
CW-1	2000	4938.4	4956.5	-18.1
CW-1	2001	4937.9	4956.0	-18.2
CW-1	2002	4937.4	4955.6	-18.2
CW-1	2003	4936.7	4955.2	-18.5
CW-1	2004	4935.9	4955.0	-19.1
CW-1	2005	4935.3	4954.7	-19.4
CW-1	2006	4935.0	4954.5	-19.5
CW-1	2007	4934.7	4954.3	-19.5
CW-1	2008	4933.2	4953.8	-20.6
CW-1	2009	4932.2	4953.0	-20.8
CW-2	2002	4958.8	4968.1	-9.2
CW-2	2003	4957.5	4966.1	-8.6
CW-2	2004	4957.2	4965.9	-8.7
CW-2	2005	4957.1	4965.8	-8.7
CW-2	2006	4957.0	4965.8	-8.7
CW-2	2007	4956.9	4965.7	-8.8
CW-2	2008	4955.9	4965.2	-9.3
CW-2	2009	4956.7	4964.5	-7.8
HR-141B	1999	4961.9	4962.2	-0.3
HR-141B	2000	4963.0	4963.1	-0.1
HR-141B	2001	4962.8	4963.1	-0.2
HR-141B	2002	4962.3	4962.8	-0.5
HR-141B	2003	4962.0	4962.5	-0.5
HR-141B	2004	4961.1	4962.2	-1.0
HR-141B	2005	4960.8	4961.8	-1.0
HR-141B	2006	4960.7	4961.5	-0.8
HR-141B	2007	4960.9	4961.2	-0.3
HR-141B	2008	4960.0	4960.5	-0.5
HR-141B	2009	4958.5	4960.5	-2.1
HR-141D	1999	4960.4	4961.1	-0.6
HR-141D	2000	4960.7	4961.1	-0.4
HR-141D	2001	4960.5	4960.9	-0.4
HR-141D	2002	4960.0	4960.5	-0.5
HR-141D	2003	4959.6	4960.2	-0.6
HR-141D	2004	4958.9	4959.9	-0.9
HR-141D	2005	4958.5	4959.5	-1.1
HR-141D	2006	4958.3	4959.2	-0.9
HR-141D	2007	4958.0	4958.9	-0.9
HR-141D	2008	4957.3	4958.1	-0.8

Table D-2

Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells December 1998 to December 2009

HR-141D	2009	4955.7	4956.7	-0.9
HR-141E	1999	4961.1	4961.3	-0.2
HR-141E	2000	4961.6	4961.5	0.1
HR-141E	2001	4961.4	4961.3	0.1
HR-141E	2002	4960.9	4961.0	0.0
HR-141E	2003	4960.5	4960.6	-0.1
HR-141E	2004	4959.9	4960.3	-0.4
HR-141E	2005	4959.5	4960.0	-0.5
HR-141E	2006	4959.3	4959.6	-0.4
HR-141E	2007	4959.4	4959.3	0.1
HR-141E	2008	4958.4	4958.5	-0.1
HR-141E	2009	4956.9	4957.2	-0.3
MW-14	1999	4970.3	4972.2	-1.9
MW-14R	2001	4969.3	4970.4	-1.1
MW-14R	2002	4968.3	4969.7	-1.4
MW-14R	2003	4968.0	4969.0	-1.0
MW-14R	2004	4967.8	4968.9	-1.1
MW-14R	2005	4967.5	4968.8	-1.2
MW-14R	2006	4967.3	4968.6	-1.3
MW-14R	2007	4967.5	4968.4	-0.9
MW-14R	2008	4967.0	4968.0	-1.1
MW-14R	2009	4966.7	4967.4	-0.7
MW-19	1999	4971.0	4971.8	-0.8
MW-19	2000	4970.6	4971.4	-0.8
MW-19	2001	4970.3	4971.1	-0.8
MW-19	2002	4969.2	4970.4	-1.1
MW-19	2003	4969.1	4969.6	-0.5
MW-19	2004	4968.8	4969.4	-0.6
MW-19	2005	4968.6	4969.3	-0.7
MW-19	2006	4968.3	4969.2	-0.8
MW-19	2007	4968.6	4969.0	-0.4
MW-19	2008	4968.1	4968.6	-0.5
MW-19	2009	4967.8	4968.0	-0.2
MW-20	1999	4970.6	4971.4	-0.7
MW-20	2000	4970.3	4970.9	-0.7
MW-20	2001	4970.0	4970.7	-0.7
MW-20	2002	4968.8	4970.1	-1.3
MW-20	2003	4968.6	4969.5	-0.9
MW-20	2004	4968.2	4969.3	-1.1
MW-20	2005	4968.1	4969.2	-1.1
MW-20	2006	4967.8	4969.0	-1.2
MW-20	2007	4968.1	4968.9	-0.8
MW-20	2008	4967.6	4968.5	-0.9

Table D-2

Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells
December 1998 to December 2009

MW-20	2009	4967.2	4967.9	-0.6
MW-29	1999	4972.9	4972.7	0.2
MW-29	2000	4972.5	4972.3	0.2
MW-29	2001	4972.2	4972.1	0.1
MW-29	2002	4971.5	4971.7	-0.1
MW-29	2003	4971.4	4971.2	0.2
MW-29	2004	4970.9	4971.1	-0.1
MW-29	2005	4970.8	4970.9	-0.1
MW-29	2006	4970.6	4970.8	-0.2
MW-29	2007	4970.7	4970.6	0.1
MW-29	2008	4970.4	4970.3	0.2
MW-29	2009	4970.1	4969.7	0.3
MW-30	1999	4971.4	4971.9	-0.5
MW-30	2000	4971.0	4971.4	-0.4
MW-30	2001	4970.8	4971.2	-0.4
MW-30	2002	4969.8	4970.6	-0.8
MW-30	2003	4969.6	4970.0	-0.4
MW-30	2004	4969.3	4969.9	-0.6
MW-30	2005	4969.1	4969.7	-0.6
MW-30	2006	4968.8	4969.6	-0.7
MW-30	2007	4969.0	4969.4	-0.4
MW-30	2008	4968.6	4969.0	-0.4
MW-30	2009	4968.3	4968.4	-0.1
MW-31	1999	4970.3	4971.0	-0.7
MW-31	2000	4969.9	4970.5	-0.6
MW-31	2001	4969.7	4970.3	-0.6
MW-31	2002	4968.4	4969.5	-1.1
MW-31	2003	4968.2	4968.7	-0.5
MW-31	2004	4967.9	4968.6	-0.7
MW-31	2005	4967.6	4968.5	-0.8
MW-31	2006	4967.4	4968.3	-0.9
MW-31	2007	4967.6	4968.1	-0.5
MW-31	2008	4967.1	4967.7	-0.6
MW-31	2009	4966.9	4967.1	-0.3
MW-32	1999	4970.1	4971.2	-1.1
MW-32	2000	4969.8	4970.8	-1.0
MW-32	2001	4969.5	4970.5	-1.0
MW-32	2002	4968.1	4969.5	-1.4
MW-32	2003	4968.0	4968.4	-0.4
MW-32	2004	4967.7	4968.3	-0.6
MW-32	2005	4967.5	4968.2	-0.7
MW-32	2006	4967.2	4968.0	-0.8
MW-32	2007	4967.6	4967.9	-0.3

Table D-2

Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells December 1998 to December 2009

MW-32	2008	4967.0	4967.5	-0.5
MW-32	2009	4966.9	4966.9	0.0
MW-34	1999	4973.5	4972.2	1.3
MW-34	2000	4973.1	4971.8	1.3
MW-34	2001	4972.9	4971.5	1.4
MW-34	2002	4972.3	4971.2	1.1
MW-34	2003	4972.1	4970.9	1.3
MW-34	2004	4971.6	4970.7	0.9
MW-34	2005	4971.5	4970.5	0.9
MW-34	2006	4971.2	4970.4	0.8
MW-34	2007	4971.3	4970.2	1.1
MW-34	2008	4971.1	4969.9	1.3
MW-34	2009	4970.6	4969.3	1.3
MW-35	1999	4970.6	4970.2	0.4
MW-35	2000	4970.2	4969.7	0.5
MW-35	2001	4970.0	4969.4	0.6
MW-36	1999	4969.0	4969.2	-0.1
MW-36	2000	4968.6	4968.6	0.0
MW-36	2002	4967.6	4967.8	-0.3
MW-36	2003	4967.3	4967.4	-0.1
MW-36	2004	4967.4	4967.2	0.2
MW-37	1999	4967.3	4968.2	-0.9
MW-37	2000	4966.9	4967.6	-0.6
MW-37R	2002	4965.1	4966.7	-1.6
MW-37R	2003	4965.1	4966.4	-1.3
MW-37R	2004	4964.8	4966.2	-1.4
MW-37R	2005	4964.5	4966.0	-1.5
MW-37R	2006	4964.3	4965.8	-1.5
MW-37R	2007	4964.4	4965.6	-1.2
MW-37R	2008	4963.8	4965.1	-1.3
MW-37R	2009	4963.7	4964.5	-0.8
MW-38	1999	4972.9	4972.4	0.5
MW-38	2000	4972.6	4972.0	0.5
MW-38	2001	4972.2	4971.8	0.5
MW-38	2002	4971.5	4971.4	0.1
MW-38	2003	4971.4	4970.9	0.5
MW-38	2004	4971.2	4970.8	0.4
MW-38	2005	4970.8	4970.6	0.2
MW-38	2006	4970.6	4970.5	0.1
MW-38	2007	4970.7	4970.3	0.4
MW-38	2008	4970.3	4970.0	0.3
MW-38	2009	4970.1	4969.4	0.7
MW-39	1999	4971.6	4971.6	0.0

Table D-2

Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells December 1998 to December 2009

MW-39	2000	4971.3	4971.2	0.1
MW-39	2001	4971.0	4971.0	0.1
MW-39	2002	4970.1	4970.4	-0.3
MW-39	2003	4970.0	4969.9	0.0
MW-39	2004	4969.6	4969.8	-0.2
MW-39	2005	4969.4	4969.6	-0.3
MW-39	2006	4969.1	4969.5	-0.4
MW-39	2007	4969.3	4969.3	0.0
MW-39	2008	4968.8	4968.9	-0.1
MW-39	2009	4968.6	4968.3	0.2
MW-40	1999	4970.4	4970.8	-0.4
MW-40	2000	4970.0	4970.3	-0.3
MW-40	2001	4969.7	4970.0	-0.3
MW-40	2002	4968.5	4969.4	-0.9
MW-40	2003	4968.3	4968.7	-0.5
MW-40	2004	4968.0	4968.6	-0.6
MW-40	2005	4967.7	4968.4	-0.7
MW-40	2006	4967.5	4968.3	-0.8
MW-40	2007	4967.8	4968.1	-0.4
MW-40	2008	4967.2	4967.7	-0.5
MW-40	2009	4966.9	4967.1	-0.2
MW-41	1999	4970.2	4971.3	-1.1
MW-41	2000	4969.9	4970.9	-1.0
MW-41	2001	4969.6	4970.7	-1.0
MW-41	2002	4968.3	4969.5	-1.1
MW-41	2003	4968.4	4968.2	0.2
MW-41	2004	4968.0	4968.1	-0.1
MW-41	2005	4967.9	4968.0	-0.1
MW-41	2006	4967.6	4967.9	-0.2
MW-41	2007	4968.0	4967.7	0.3
MW-41	2008	4967.4	4967.3	0.1
MW-41	2009	4967.1	4966.7	0.4
MW-42	1999	4969.9	4971.6	-1.8
MW-42	2000	4969.5	4971.2	-1.7
MW-42	2001	4969.3	4971.0	-1.7
MW-42	2002	4968.5	4970.4	-1.9
MW-42	2003	4968.5	4969.8	-1.3
MW-42	2004	4968.2	4969.7	-1.5
MW-42	2005	4968.0	4969.5	-1.5
MW-42	2006	4967.7	4969.4	-1.6
MW-42	2007	4968.0	4969.2	-1.2
MW-42	2008	4967.4	4968.8	-1.4
MW-42	2009	4967.2	4968.2	-1.0

Table D-2

Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells December 1998 to December 2009

MW-43	1999	4969.7	4971.4	-1.7
MW-43	2000	4969.3	4971.0	-1.6
MW-43	2001	4969.1	4970.7	-1.6
MW-43	2002	4968.3	4970.2	-1.9
MW-43	2003	4968.3	4969.7	-1.4
MW-43	2004	4967.9	4969.5	-1.6
MW-43	2005	4967.7	4969.4	-1.7
MW-43	2006	4967.5	4969.2	-1.7
MW-43	2007	4967.7	4969.1	-1.3
MW-43	2008	4967.1	4968.7	-1.6
MW-43	2009	4967.0	4968.0	-1.0
MW-44	1999	4969.1	4969.1	0.0
MW-44	2000	4968.7	4968.6	0.1
MW-44	2001	4968.4	4968.2	0.2
MW-44	2002	4967.4	4967.8	-0.4
MW-44	2003	4967.4	4967.4	0.1
MW-44	2004	4967.1	4967.2	-0.1
MW-44	2005	4966.8	4967.0	-0.1
MW-44	2006	4966.6	4966.8	-0.2
MW-44	2007	4966.7	4966.6	0.2
MW-44	2008	4966.3	4966.2	0.1
MW-44	2009	4966.0	4965.5	0.4
MW-45	1999	4967.3	4968.1	-0.8
MW-45	2000	4966.9	4967.4	-0.5
MW-45	2001	4967.1	4967.1	0.0
MW-45	2002	4966.1	4966.6	-0.6
MW-45	2003	4966.1	4966.2	-0.2
MW-45	2004	4965.8	4966.1	-0.3
MW-45	2005	4964.9	4965.9	-1.0
MW-45	2006	4964.6	4965.7	-1.1
MW-45	2007	4964.7	4965.4	-0.8
MW-45	2008	4964.0	4965.0	-1.0
MW-45	2009	4964.0	4964.3	-0.3
MW-46	1999	4965.9	4967.2	-1.2
MW-46	2000	4965.6	4966.5	-0.9
MW-46	2001	4965.3	4966.2	-0.9
MW-46	2002	4964.7	4965.8	-1.1
MW-46	2003	4964.5	4965.4	-1.0
MW-46	2004	4964.2	4965.2	-1.1
MW-46	2005	4963.9	4965.0	-1.1
MW-46	2006	4963.6	4964.8	-1.2
MW-46	2007	4963.8	4964.6	-0.7
MW-46	2008	4963.1	4964.1	-1.0

Table D-2

Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells December 1998 to December 2009

MW-46	2009	4962.4	4963.4	-1.0
MW-47	1999	4965.5	4966.2	-0.7
MW-47	2000	4965.1	4965.3	-0.3
MW-47	2001	4964.5	4965.0	-0.5
MW-47	2002	4964.2	4964.6	-0.4
MW-47	2003	4964.0	4964.2	-0.2
MW-47	2004	4963.7	4963.9	-0.3
MW-47	2005	4963.4	4963.7	-0.3
MW-47	2006	4963.1	4963.5	-0.4
MW-47	2007	4963.3	4963.2	0.0
MW-47	2008	4962.6	4962.8	-0.2
MW-47	2009	4961.8	4962.1	-0.3
MW-48	1999	4964.6	4964.8	-0.2
MW-48	2000	4964.0	4963.8	0.2
MW-48	2001	4963.7	4963.4	0.3
MW-48	2002	4963.2	4963.0	0.2
MW-48	2003	4963.0	4962.6	0.4
MW-48	2004	4962.6	4962.3	0.3
MW-48	2005	4962.3	4962.1	0.2
MW-48	2006	4962.0	4961.9	0.2
MW-48	2007	4962.2	4961.6	0.6
MW-48	2008	4961.7	4961.1	0.6
MW-49	1999	4970.2	4970.7	-0.5
MW-49	2000	4969.9	4970.2	-0.3
MW-49	2001	4969.5	4970.0	-0.4
MW-49	2002	4968.5	4969.4	-0.9
MW-49	2003	4968.3	4968.9	-0.6
MW-49	2004	4968.0	4968.7	-0.7
MW-49	2005	4967.7	4968.5	-0.8
MW-49	2006	4967.5	4968.4	-0.8
MW-49	2007	4967.7	4968.2	-0.5
MW-49	2008	4967.2	4967.8	-0.6
MW-49	2009	4966.6	4967.2	-0.6
MW-50INTP	1999	4959.3	4957.8	1.5
MW-50INTP	2000	4958.6	4957.5	1.1
MW-50INTP	2001	4957.8	4957.2	0.6
MW-50INTP	2002	4957.3	4956.9	0.4
MW-50INTP	2003	4957.2	4956.5	0.7
MW-50INTP	2004	4956.7	4956.1	0.5
MW-50INTP	2005	4956.2	4955.8	0.4
MW-50INTP	2006	4955.9	4955.4	0.5
MW-50INTP	2007	4956.0	4955.1	0.9
MW-50INTP	2008	4955.1	4954.4	0.7

Table D-2

Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells December 1998 to December 2009

MW-52	1999	4961.1	4961.6	-0.5
MW-52	2000	4960.5	4960.2	0.3
MW-52	2001	4960.2	4959.7	0.5
MW-52	2002	4959.9	4959.3	0.6
MW-52R	2003	4959.0	4958.7	0.4
MW-52R	2004	4958.7	4958.4	0.4
MW-52R	2005	4958.4	4958.1	0.3
MW-52R	2006	4958.1	4957.8	0.3
MW-52R	2007	4958.2	4957.6	0.6
MW-52R	2008	4957.3	4957.0	0.3
MW-52R	2009	4956.5	4956.2	0.4
MW-53	1999	4963.4	4962.9	0.5
MW-53	2000	4962.6	4961.3	1.3
MW-53	2001	4962.1	4960.8	1.3
MW-53	2002	4961.5	4960.4	1.1
MW-53	2003	4961.3	4960.0	1.3
MW-53	2004	4961.0	4959.7	1.3
MW-53	2005	4960.7	4959.4	1.2
MW-53	2006	4960.4	4959.2	1.2
MW-53	2007	4960.4	4958.9	1.5
MW-53	2008	4960.0	4958.4	1.6
MW-53D	2009	4958.7	4957.6	1.2
MW-54	1999	4964.8	4966.1	-1.3
MW-54	2000	4964.6	4965.6	-1.0
MW-54	2001	4964.3	4965.3	-1.0
MW-54	2002	4963.8	4965.0	-1.1
MW-54	2003	4963.6	4964.6	-1.0
MW-54	2004	4963.3	4964.4	-1.1
MW-54	2005	4963.1	4964.2	-1.1
MW-54	2006	4962.9	4963.9	-1.0
MW-54	2007	4963.2	4963.7	-0.5
MW-54	2008	4962.8	4963.2	-0.4
MW-54	2009	4962.6	4962.4	0.2
MW-55	1999	4963.3	4964.5	-1.2
MW-55	2000	4962.9	4963.5	-0.5
MW-55	2001	4962.5	4963.1	-0.6
MW-55	2002	4962.0	4962.7	-0.7
MW-55	2003	4961.9	4962.3	-0.5
MW-55	2004	4961.4	4962.1	-0.7
MW-55	2005	4961.1	4961.9	-0.8
MW-55	2006	4960.9	4961.6	-0.8
MW-55	2007	4960.9	4961.4	-0.4
MW-55	2008	4960.2	4960.9	-0.7

Table D-2

Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells
December 1998 to December 2009

MW-55	2009	4959.4	4960.0	-0.7
MW-56	1999	4964.6	4964.7	-0.2
MW-56	2000	4964.0	4963.7	0.3
MW-56	2001	4963.7	4963.3	0.4
MW-56	2002	4963.2	4962.9	0.3
MW-56	2003	4963.0	4962.5	0.5
MW-56	2004	4962.6	4962.3	0.4
MW-56	2005	4962.4	4962.0	0.3
MW-56	2006	4962.0	4961.8	0.2
MW-56	2007	4962.2	4961.6	0.6
MW-56	2008	4961.5	4961.1	0.4
MW-56	2009	4960.7	4960.3	0.4
MW-57	1999	4964.4	4965.5	-1.2
MW-57	2000	4964.3	4965.1	-0.8
MW-57	2001	4964.2	4964.9	-0.7
MW-57	2002	4963.6	4964.6	-1.0
MW-57	2003	4963.5	4964.3	-0.8
MW-57	2004	4963.1	4964.0	-0.9
MW-57	2005	4963.0	4963.8	-0.7
MW-57	2006	4963.1	4963.5	-0.5
MW-57	2007	4963.2	4963.3	-0.1
MW-58	1999	4964.1	4963.9	0.3
MW-58	2000	4963.5	4962.6	0.9
MW-58	2001	4963.3	4962.1	1.2
MW-58	2002	4962.6	4961.7	0.9
MW-58	2003	4962.3	4961.3	1.0
MW-58	2004	4962.0	4961.1	0.9
MW-58	2005	4961.7	4960.8	0.8
MW-58	2006	4961.2	4960.6	0.6
MW-58	2007	4961.5	4960.3	1.2
MW-58	2008	4960.9	4959.8	1.1
MW-58	2009	4960.4	4959.0	1.4
MW-59	1999	4968.8	4971.5	-2.7
MW-59	2000	4968.4	4971.1	-2.6
MW-59	2001	4968.2	4970.9	-2.7
MW-59	2002	4967.5	4970.4	-2.9
MW-59	2003	4967.4	4969.9	-2.6
MW-59	2004	4967.1	4969.8	-2.6
MW-59	2005	4966.9	4969.6	-2.7
MW-59	2006	4966.7	4969.5	-2.7
MW-59	2007	4966.9	4969.3	-2.4
MW-59	2008	4966.4	4968.9	-2.5
MW-59	2009	4965.5	4968.3	-2.7

Table D-2

**Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells
December 1998 to December 2009**

MW-60	1999	4964.3	4964.8	-0.5
MW-60	2000	4964.0	4963.9	0.1
MW-60	2001	4963.8	4963.5	0.2
MW-60	2002	4963.2	4963.2	0.0
MW-60	2003	4962.9	4962.8	0.1
MW-60	2004	4962.6	4962.6	0.1
MW-60	2005	4962.3	4962.3	0.0
MW-60	2006	4961.9	4962.1	-0.2
MW-60	2007	4962.1	4961.8	0.3
MW-60	2008	4961.3	4961.3	0.0
MW-60	2009	4960.4	4960.5	-0.1
MW-61	1999	4964.4	4964.8	-0.5
MW-61	2000	4964.0	4964.0	0.1
MW-61	2001	4963.8	4963.6	0.2
MW-61	2002	4963.1	4963.3	-0.1
MW-61	2003	4962.9	4962.9	0.0
MW-61	2004	4962.6	4962.6	0.0
MW-61	2005	4962.2	4962.4	-0.2
MW-61	2006	4961.9	4962.1	-0.3
MW-61	2007	4962.0	4961.9	0.1
MW-61	2008	4961.3	4961.4	-0.1
MW-61	2009	4960.2	4960.6	-0.4
MW-62	1999	4966.5	4966.2	0.3
MW-62	2000	4965.9	4965.5	0.5
MW-62	2001	4965.7	4965.1	0.6
MW-62	2002	4965.1	4964.7	0.5
MW-62	2003	4964.8	4964.3	0.6
MW-62	2004	4964.5	4964.0	0.5
MW-62	2005	4964.3	4963.8	0.5
MW-62	2006	4964.0	4963.6	0.4
MW-62	2007	4964.1	4963.3	0.8
MW-62	2008	4963.6	4962.9	0.7
MW-62	2009	4962.8	4962.2	0.6
MW-64	1999	4964.9	4966.0	-1.1
MW-64	2000	4964.6	4965.5	-1.0
MW-64	2001	4964.4	4965.2	-0.9
MW-64	2002	4963.8	4964.9	-1.1
MW-64	2003	4963.6	4964.6	-0.9
MW-64	2004	4963.3	4964.3	-1.0
MW-64	2005	4963.1	4964.1	-1.0
MW-64	2006	4962.8	4963.9	-1.0
MW-64	2007	4963.2	4963.6	-0.4
MW-64	2008	4962.3	4963.1	-0.8

Table D-2

Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells
December 1998 to December 2009

MW-64	2009	4962.1	4962.3	-0.2
MW-65	1999	4960.8	4961.1	-0.3
MW-65	2000	4960.2	4959.7	0.5
MW-65	2001	4959.9	4959.4	0.6
MW-65	2002	4959.4	4959.0	0.4
MW-65	2003	4959.2	4958.6	0.6
MW-65	2004	4958.8	4958.3	0.5
MW-65	2005	4958.4	4958.0	0.4
MW-65	2006	4958.1	4957.7	0.4
MW-65	2007	4958.2	4957.5	0.8
MW-65	2008	4957.4	4956.9	0.6
MW-65	2009	4956.5	4955.9	0.5
MW-66	1999	4963.3	4965.3	-1.9
MW-66	2000	4963.0	4964.8	-1.8
MW-66	2001	4962.8	4964.6	-1.8
MW-66	2002	4962.2	4964.3	-2.0
MW-66	2003	4962.0	4964.0	-1.9
MW-66	2004	4961.6	4963.7	-2.1
MW-66	2005	4961.3	4963.5	-2.2
MW-66	2006	4961.0	4963.2	-2.2
MW-66	2007	4961.2	4962.9	-1.7
MW-66	2008	4960.3	4962.4	-2.1
MW-66	2009	4959.4	4961.5	-2.1
MW-68	1999	4960.7	4961.7	-0.9
MW-68	2000	4960.4	4960.8	-0.4
MW-68	2001	4960.2	4960.4	-0.3
MW-68	2002	4959.6	4960.1	-0.4
MW-68	2003	4959.4	4959.7	-0.3
MW-68	2004	4959.0	4959.4	-0.4
MW-68	2005	4958.6	4959.1	-0.5
MW-68	2006	4958.3	4958.8	-0.5
MW-68	2007	4958.5	4958.5	-0.1
MW-68	2008	4957.5	4958.0	-0.5
MW-68	2009	4956.6	4957.0	-0.4
MW-69	1999	4960.6	4961.3	-0.7
MW-69	2000	4960.3	4960.4	-0.1
MW-69	2001	4960.0	4960.1	-0.1
MW-69	2002	4959.5	4959.8	-0.3
MW-69	2003	4959.3	4959.4	-0.1
MW-69	2004	4958.9	4959.1	-0.3
MW-69	2005	4958.5	4958.8	-0.3
MW-69	2006	4958.2	4958.5	-0.3
MW-69	2007	4958.3	4958.2	0.1

Table D-2

Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells
December 1998 to December 2009

MW-69	2008	4957.3	4957.6	-0.3
MW-69	2009	4956.4	4956.7	-0.2
MW-70	1999	4969.4	4971.1	-1.7
MW-70	2000	4969.0	4970.7	-1.6
MW-70	2001	4969.0	4970.4	-1.4
MW-70	2002	4967.7	4969.7	-2.1
MW-70	2003	4967.5	4969.1	-1.6
MW-70	2004	4967.1	4968.9	-1.8
MW-70	2005	4966.9	4968.8	-1.9
MW-70	2006	4966.7	4968.6	-1.9
MW-70	2007	4967.0	4968.4	-1.4
MW-70	2008	4966.4	4968.0	-1.7
MW-70	2009	4965.8	4967.4	-1.7
MW-72	1999	4970.1	4971.5	-1.4
MW-72	2000	4969.7	4971.1	-1.4
MW-72	2001	4969.5	4970.9	-1.3
MW-72	2002	4968.6	4970.1	-1.5
MW-72	2003	4968.5	4969.3	-0.7
MW-72	2004	4968.2	4969.1	-0.9
MW-72	2005	4968.0	4969.0	-1.0
MW-72	2006	4967.8	4968.9	-1.1
MW-72	2007	4968.1	4968.7	-0.6
MW-72	2008	4967.4	4968.3	-0.9
MW-72	2009	4966.8	4967.7	-0.9
MW-73	1999	4970.1	4971.1	-1.0
MW-73	2000	4969.8	4970.7	-0.9
MW-73	2001	4969.4	4970.4	-1.0
MW-73	2002	4967.7	4969.2	-1.5
MW-73	2003	4967.5	4968.0	-0.5
MW-73	2004	4967.2	4967.8	-0.7
MW-73	2005	4967.0	4967.7	-0.7
MW-73	2006	4966.7	4967.6	-0.9
MW-73	2007	4967.1	4967.5	-0.3
MW-73	2008	4966.5	4967.0	-0.6
MW-73	2009	4966.1	4966.4	-0.3
MW-74	1999	4963.0	4963.7	-0.7
MW-74	2000	4963.0	4966.2	-3.1
MW-74	2001	4962.7	4966.2	-3.5
MW-74	2002	4962.1	4966.0	-4.0
MW-74	2003	4961.9	4965.8	-4.0
MW-74	2004	4961.2	4965.5	-4.3
MW-74	2005	4960.9	4965.2	-4.3
MW-74	2006	4960.5	4964.9	-4.4

Table D-2

Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells
December 1998 to December 2009

MW-74	2007	4961.0	4964.6	-3.7
MW-74	2008	4959.6	4964.1	-4.5
MW-74	2009	4958.3	4963.1	-4.8
MW-75	1999	4966.8	4964.6	2.2
MW-75	2000	4966.9	4968.4	-1.4
MW-75	2001	4966.6	4968.7	-2.1
MW-75	2002	4965.8	4968.5	-2.7
MW-75	2003	4965.8	4968.4	-2.6
MW-75	2004	4965.1	4968.0	-2.9
MW-75	2005	4965.1	4967.8	-2.6
MW-75	2006	4964.7	4967.4	-2.7
MW-75	2007	4965.3	4967.1	-1.8
MW-75	2008	4964.1	4966.6	-2.4
MW-75	2009	4963.3	4965.5	-2.3
MW-76	1999	4967.5	4969.0	-1.5
MW-76	2000	4967.7	4969.2	-1.5
MW-76	2001	4967.5	4969.4	-1.9
MW-76	2002	4967.3	4969.2	-1.8
MW-76	2003	4967.2	4969.0	-1.8
MW-76	2004	4966.5	4968.7	-2.3
MW-76	2005	4966.7	4968.5	-1.8
MW-76	2006	4966.0	4968.2	-2.2
MW-76	2007	4966.8	4967.9	-1.1
MW-76	2008	4965.4	4967.5	-2.1
MW-76	2009	4965.1	4966.6	-1.4
MW-77	2001	4977.2	4974.3	2.9
MW-77	2002	4977.1	4974.0	3.1
MW-77	2003	4977.1	4973.8	3.3
MW-77	2004	4976.7	4973.6	3.0
MW-77	2005	4976.7	4973.5	3.2
MW-77	2006	4976.5	4973.4	3.1
MW-77	2007	4976.6	4973.3	3.4
MW-77	2008	4976.5	4973.0	3.5
MW-77	2009	4976.0	4972.5	3.6
MW-78	2001	4971.4	4975.3	-3.9
MW-78	2002	4972.8	4977.4	-4.6
MW-78	2003	4975.0	4980.7	-5.7
MW-78	2004	4974.5	4981.8	-7.3
MW-78	2005	4974.5	4981.3	-6.8
MW-78	2006	4973.9	4980.7	-6.7
MW-78	2007	4974.3	4980.1	-5.9
MW-78	2008	4973.7	4980.2	-6.5
MW-78	2009	4973.3	4980.4	-7.2

Table D-2

Comparison of Observed and Calculated Water Levels in UFZ/ULFZ/LLFZ Wells December 1998 to December 2009

OB-1	1999	4958.1	4958.7	-0.6
OB-1	2000	4957.6	4956.6	1.0
OB-1	2001	4957.3	4956.3	1.0
OB-1	2002	4956.7	4955.8	0.9
OB-1	2003	4956.5	4955.4	1.1
OB-1	2004	4956.0	4955.1	0.9
OB-1	2005	4955.6	4954.8	0.8
OB-1	2006	4955.4	4954.6	0.9
OB-1	2007	4955.2	4954.3	1.0
OB-1	2008	4954.4	4953.6	0.8
OB-1	2009	4954.4	4954.2	0.1
OB-2	1999	4959.8	4959.2	0.6
OB-2	2000	4959.0	4957.6	1.3
OB-2	2001	4958.6	4957.3	1.4
OB-2	2002	4957.7	4956.9	0.8
OB-2	2003	4957.7	4956.5	1.2
OB-2	2004	4957.2	4956.2	1.0
OB-2	2005	4956.9	4955.9	1.0
OB-2	2006	4956.7	4955.6	1.1
OB-2	2007	4956.7	4955.3	1.4
OB-2	2008	4955.8	4954.6	1.2
OB-2	2009	4955.7	4953.5	2.2
PZ-1	1999	4956.5	4957.2	-0.7
PZ-1	2000	4955.8	4956.7	-0.9
PZ-1	2001	4955.0	4956.3	-1.2
PZ-1	2002	4954.5	4955.9	-1.4
PZ-1	2003	4954.5	4955.5	-1.1
PZ-1	2004	4953.9	4955.2	-1.2
PZ-1	2005	4953.5	4954.9	-1.3
PZ-1	2006	4953.2	4954.5	-1.3
PZ-1	2007	4953.3	4954.2	-0.9
PZ-1	2008	4952.4	4953.6	-1.2
PZ-1	2009	4952.5	4952.4	0.1

Table D-3: Comparison of Observed and Calculated Water Levels in DFZ Wells

Table D-3

Comparison of Observed and Calculated Water Levels in DFZ Wells December 1998 to December 2009

Monitoring Well	Year	Water Level Elevation in feet above MSL		Difference (ft)
		Observed	Calculated	
HR-141C	1999	4957.2	4956.1	1.1
HR-141C	2000	4956.9	4955.7	1.2
HR-141C	2001	4956.6	4955.4	1.2
HR-141C	2002	4956.2	4955.0	1.2
HR-141C	2003	4955.8	4954.6	1.2
HR-141C	2004	4955.1	4954.3	0.8
HR-141C	2005	4954.4	4953.9	0.5
HR-141C	2006	4954.4	4953.5	0.8
HR-141C	2007	4954.4	4953.2	1.3
HR-141C	2008	4952.6	4952.2	0.5
HR-141C	2009	4950.9	4950.4	0.4
MW-67	1999	4957.7	4957.6	0.1
MW-67	2000	4957.2	4957.2	0.1
MW-67	2001	4956.9	4956.8	0.1
MW-67	2002	4956.3	4956.5	-0.2
MW-67	2003	4956.0	4956.1	-0.1
MW-67	2004	4955.6	4955.8	-0.2
MW-67	2005	4955.1	4955.5	-0.4
MW-67	2006	4955.0	4955.2	-0.2
MW-67	2007	4954.9	4954.8	0.1
MW-67	2008	4953.7	4954.0	-0.3
MW-67	2009	4952.8	4952.5	0.3
MW-71	1999	4957.7	4957.8	0.0
MW-71	2000	4957.3	4957.3	0.0
MW-71	2001	4957.1	4957.0	0.1
MW-71R	2002	4956.2	4956.6	-0.4
MW-71R	2003	4956.1	4956.3	-0.2
MW-71R	2004	4955.8	4956.0	-0.2
MW-71R	2005	4955.3	4955.6	-0.3
MW-71R	2006	4955.0	4955.3	-0.3
MW-71R	2007	4955.0	4955.0	0.0
MW-71R	2008	4953.7	4954.1	-0.5
MW-71R	2009	4952.7	4952.7	0.1
MW-79	2006	4953.4	4953.8	-0.4
MW-79	2007	4953.6	4953.5	0.1
MW-79	2008	4951.8	4952.6	-0.8
MW-79	2009	4950.7	4951.1	-0.3