LMS/PIN/N01514

Pinellas Environmental Restoration Project

Semiannual Progress Report for the 4.5 Acre Site December 2009 through May 2010

June 2010

U.S. DEPARTMENT OF ENERGY | Legacy Management

LMS/PIN/N01514

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Abbreviations

cDCE	*cis*-1,2-dichloroethene
COPCs	contaminants of potential concern
CTL	cleanup target level
DCE	dichloroethene
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
F.A.C.	*Florida Administrative Code*
FDEP	Florida Department of Environmental Protection
ft	foot (feet)
IRA	Interim Remedial Action
LDA	large-diameter auger
µg/L	micrograms per liter
mg/L	milligrams per liter
QA/QC	quality assurance/quality control
RBCA	Risk-Based Corrective Action
RPD	relative percent difference
STAR Center	Young - Rainey Science, Technology, and Research Center
TCE	trichloroethene
TCOPCs	total contaminants of potential concern
tDCE	*trans*-1,2-dichloroethene
VC	vinyl chloride
VOCs	volatile organic compounds

1.0 Introduction

The *Pinellas Environmental Restoration Project Semiannual Progress Report for the 4.5 Acre Site* describes environmental restoration activities for the Pinellas 4.5 Acre Site located in Pinellas County, Largo, Florida (Figure 1). The former U.S. Department of Energy (DOE) Pinellas Plant facility consisted of the 4.5 Acre Site and what is now the Young - Rainey Science, Technology, and Research Center (STAR Center) (Figure 2). The facility was constructed in the mid-1950s as part of a nationwide nuclear weapons research, development, and production complex. Production of weapons-related components ceased in September 1994. However, as a result of these operations, contamination exists in the surficial groundwater beneath the site.

Administration of DOE activities at the 4.5 Acre Site is the responsibility of the DOE Office of Legacy Management in Grand Junction, Colorado. S.M. Stoller Corporation (Stoller), a prime contractor to DOE's Office of Legacy Management, provides technical support to DOE for the remediation and closure of all active solid-waste management units on the STAR Center and for the 4.5 Acre Site.

The 4.5 Acre Site is located to the northwest of the STAR Center, in the northeast quarter of Section 13, Township 30 South, Range 15 East (Figure 2). DOE owned this parcel from 1957 to 1972, at which time it was sold to a private landowner. During the period of DOE ownership, the property was used for disposal of drums of waste resins and solvents. As a result of this practice, the surficial aquifer was impacted by volatile organic compounds (VOCs), primarily vinyl chloride (VC), toluene, trichloroethene (TCE), and 1,2-dichloroethene (DCE). DOE completed a source removal in 1985.

An Interim Remedial Action (IRA), consisting of groundwater extraction and treatment via air stripping, and a routine groundwater monitoring program were initiated in May 1990. In July 1997, a modification of the IRA, involving the installation of dual-phase extraction wells, provided a more aggressive system to remove groundwater contamination. In November 1999, the dual-phase extraction/air-stripping system was replaced with an in situ biosparge treatment system.

The *4.5 Acre Site Biosparge System Integration Plan* (DOE 2000) was approved by the Florida Department of Environmental Protection (FDEP) on January 17, 2001. This plan states that performance monitoring would be undertaken on a quarterly basis. Therefore, in April 2001, performance monitoring of the remedial system through the use of direct-push technology was undertaken. However, the biosparge systems were shut off in May 2003 with no plans to restart them, and no performance monitoring data have been collected since April 2003. Subsequent monitoring was then adapted to fit the new remediation scenario and performance monitoring as defined in the *Interim Remedial Action Plan for Ground Water Recovery at the 4.5 Acre Site* (DOE 2003b).

The IRA Plan for Ground Water Recovery at the 4.5 Acre Site was submitted to FDEP on August 29, 2003, and approved by FDEP on September 19, 2003. Implementation of the IRA Plan commenced on March 8, 2004, when construction activities began on the IRA treatment system. The treatment system consisted of an extraction well field (three recovery wells), pumps

and associated piping, a water transmission pipeline, a utility connection, a low profile tray air-stripper unit, and effluent piping. The new IRA system began operations on April 26, 2004.

The IRA system was a temporary measure that was outlined in the *Remedial Action Plan for the Pinellas 4.5 Acre Site* (DOE 2001) as a contingency option in the event that biosparging resulted in extending the contaminant plume. In April 2005, the *Pinellas Environmental Restoration Project 4.5 Acre Site Remedial Action Plan Addendum* (DOE 2005) was submitted to FDEP. That document presented a proposed final action for the 4.5 Acre Site that involves the closure of the site using the provisions of the recently adopted State of Florida Global Risk-Based Corrective Action (RBCA) regulations.

Technical discussions between FDEP and DOE regarding the proposed final action continue. Part of DOE's proposed final action for the 4.5 Acre Site was to shut down the IRA system and begin a 2-year monitoring period. Approval from FDEP to shut down the IRA system was received on December 20, 2005, thus commencing the DOE's 2-year monitoring period.

Although DOE has conducted numerous remediation activities at the 4.5 Acre Site since 1985, FDEP in 2005 suggested that, based on elevated levels of VOCs in groundwater, a source of VOCs may remain in the subsurface, and that removal of contaminated soil may be necessary (FDEP 2005). To investigate this concern, 1,172 soil samples were collected from 138 soil borings installed at two areas of the site during the summer of 2007. Analytical results demonstrated that the following contaminants were present in site sediments at concentrations that likely represent a source of contamination to groundwater: TCE, *cis*-1,2-DCE (cDCE), *trans*-1,2-DCE (tDCE), and toluene. Results from this characterization effort are available in the *4.5 Acre Site Source Characterization Data Report* (DOE 2007).

In April 2008, DOE completed a feasibility study that evaluated the available contaminant source removal technologies. The preferred option for source removal at the 4.5 Acre Site was determined to be soil excavation using a large-diameter auger (LDA) and off-site disposal of soil (DOE 2008a). In a letter dated May 17, 2008, FDEP states "the report is acceptable for its intended purpose" and "the preferred option for source removal of soil excavation using large diameter auger and off-site soil disposal is also acceptable to the Department."

An *Interim Remedial Action Plan for Source Removal at the 4.5 Acre Site* (DOE 2008b) was prepared in late July 2008 and approved by FDEP on August 19, 2008. The objective of this IRA was to remove the source of contamination at the site. On March 31, 2009, LDA operations commenced at the 4.5 Acre Site and were completed on May 27, 2009. Two hundred twenty-one large-diameter and 325 small-diameter borings were completed. Approximately 7,035 cubic yards of soil were excavated; of this total, 4,464 cubic yards were removed as clean overburden, and 2,571 cubic yards of contaminated soil were removed, characterized for waste disposal, and disposed of at a Resource Conservation and Recovery Act Subtitle D landfill. Additional information regarding the 4.5 Acre Site LDA work is available in the *Data Report for Overburden Soil at the Northeast Site and the 4.5 Acre Site* (DOE 2009b) and the *Interim Remedial Action Final Report for Source Removal at the 4.5 Acre Site* (DOE 2009c).

As a follow-up to the LDA work, emulsified soybean oil and the microorganism *Dehalococcoides ethenogenes* were injected into the subsurface at 95 points at the site in February 2010. The *Injection of Emulsified Soybean Oil at the Northeast Site and 4.5 Acre Site*

(DOE 2010) was prepared to describe the work performed for this task. This project should result in a significant decrease in contaminant mass and concentration around the former contaminant source areas and in the downgradient contaminant plume.

With the completion of the LDA project to remove contaminant source material and the follow-up enhanced bioremediation around the previous source areas to treat any residual contaminants located outside the excavation areas, DOE is proceeding to close the site under FDEP's RBCA rules (Chapter 62-780.680 *Florida Administrative Code* [F.A.C.]). The *Closure Monitoring Plan for the Northeast Site and 4.5 Acre Site* (DOE 2009a) describes the closure monitoring that is necessary under RBCA, according to the requirements for Post Active Remediation Monitoring (Chapter 62-780.750 F.A.C.). That document was approved by FDEP on December 21, 2009. In the approval letter, FDEP suggested semiannual instead of quarterly closure monitoring and this was implemented starting with the March 2010 sampling event.

Routine monitoring at the site in March 2009 identified VC in a sample from off-site monitoring well PIN20-M035. DOE reported this discovery to FDEP and to the property owner in accordance with FDEP notification requirements.

This document is the semiannual progress report for the 4.5 Acre Site for December 2009 through May 2010, as requested by FDEP. This report provides the results of monitoring activities and a summary of ongoing and projected work.

1.1 Site Activities

- Emulsified soybean oil and the microorganism *Dehalococcoides ethenogenes* were injected into the subsurface at 95 locations in February 2010. The purpose of the project was to enhance biodegradation of TCE, DCE, and VC in groundwater and soil as a polishing step following source removal by soil excavation.
- Conducted quarterly closure monitoring which consisted of collection of groundwater samples for VOCs analysis from 13 monitoring wells from December 2 through 6, and measuring water levels in all monitoring wells on December 1.
- Conducted semiannual closure monitoring which consisted of collection of groundwater samples for VOCs analysis from 13 monitoring wells from March 11 through 13, and measuring water levels in all monitoring wells on March 10.
- Reported the results of the quarterly and semiannual closure monitoring (this document).

2.0 Monitoring Data

2.1 Groundwater Elevations and Flow

During this reporting period, depth-to-water measurements were taken in all monitoring wells and former recovery wells at the 4.5 Acre Site on December 1, 2009, and again on March 10, 2010. The depth to water in each well was measured with an electronic water level indicator. The surface water elevation in the pond north of the 4.5 Acre Site was measured from a nail-and-disk set in a concrete culvert. The groundwater elevation data are listed in Table 1 for the December 2009 event and in Table 2 for the March 2010 event. Surface water elevations for

Pond 5 (southeast of the 4.5 Acre Site), the West Pond (to the east), and the pond north of the 4.5 Acre Site for March 2010 are listed in Table 3. The water elevation data were used to construct contours of water levels in the shallow and deep portions of the surficial aquifer for December 2009 (Figures 3 and 4) and March 2010 (Figures 5 and 6).

In December 2009, groundwater in the shallow surficial aquifer (Figure 3) generally flowed to the west, with a northward component of flow toward the pond north of the 4.5 Acre Site. The flow patterns in the deep surficial aquifer (Figure 4) indicate flow to the west/northwest. The average hydraulic gradient across the site was approximately 0.002 foot per foot (ft/ft). This gradient is similar to those observed the previous 3½ years at the site. Calculations using Darcy's Law along with approximations of 1 ft/day for hydraulic conductivity and 0.3 for effective porosity indicate that groundwater at the site is estimated to move about 2.5 ft/year. Groundwater velocities at the site have historically ranged from 2 to 10 ft/year.

In March 2010, groundwater in the shallow surficial aquifer (Figure 5) generally flowed to the northwest, with a southeastern component of flow in the southern part of the site. The flow patterns in the deep surficial aquifer (Figure 6) were similar to those observed in the shallow surficial aquifer, but with a component of flow to the north in the northeastern part of the site. The average hydraulic gradient across the site was approximately 0.001 ft/ft. Calculations using the approximations of hydraulic conductivity and porosity mentioned above indicate an estimated groundwater velocity of less than 2 ft/year.

2.2 Groundwater Sampling

Groundwater samples were collected from the 13 closure monitoring wells at the 4.5 Acre Site in December 2009 and March 2010. All samples were analyzed for VOCs.

All samples were collected in accordance with the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* (LMS/PLN/S04351), using FDEP procedures. All samples were submitted to TestAmerica, Denver, Colorado, for analysis. TestAmerica Denver is accredited by the Florida Department of Health in accordance with the National Environmental Laboratory Accreditation Conference, certification number E87667. VOCs were analyzed using U.S. Environmental Protection Agency (EPA) method SW-846 8260B. All monitoring wells were micropurged using a dedicated bladder pump or a peristaltic pump, and sampling was performed when the field measurements stabilized. Tables 4 and 5 list the December 2009 and March 2010 field measurements of temperature, specific conductance, turbidity, pH, oxidation-reduction potential, and dissolved oxygen recorded at the time the samples were collected. Measurements were made with a flow cell and a multiparameter instrument, and turbidity was measured using a nephelometer.

2.3 Groundwater Analytical Results

Table 6 presents individual contaminants of potential concern (COPCs) and total COPCs (TCOPCs) concentrations in samples collected from wells at the 4.5 Acre Site. The results from the previous two semiannual sampling events are included in Table 6 for comparison. Figures 7 and 8 show the TCOPCs concentrations for December 2009 and March 2010.

The maximum TCOPCs value detected in December 2009 was 2,332 micrograms per liter (µg/L) at PIN20-M001. The compound detected at the highest concentration in PIN20-M001 was VC at a concentration of 2,100 µg/L. The maximum TCOPCs value detected in March 2010 was 1,143 µg/L at PIN20-M001. The compound detected at the highest concentration in PIN20-M001 was VC at a concentration of 930 µg/L.

Laboratory reports for samples collected in December 2009 and March 2010 are provided in Appendixes A and B.

2.4 Quality Assurance/Quality Control

The results from the analytical laboratory, TestAmerica, were checked for quality assurance/quality control (QA/QC) through duplicate samples and trip blanks. Detected analytes for each duplicate sample collected from the 4.5 Acre Site in March 2010 are listed in Table 7. The duplicate sample results were compared, and the relative percent differences (RPDs) between the results were calculated. All duplicate results met the EPA recommended laboratory duplicate criteria of less than 20 percent RPD for results that are greater than 5 times the practical quantitation limit. All data passed QA/QC criteria at a Class A level, indicating that the data may be used for quantitative and qualitative purposes.

As specified in the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites*, duplicate samples should be collected at a frequency of one duplicate for every 20 or fewer samples. During the March 2010 event 13 samples were collected and 2 duplicate samples were collected, so this criterion was met.

A data validation software module for identifying and tracking anomalous groundwater data within the SEEPro database was used to generate a report of analytical results that fall outside of historical minimum or maximum values. There were no anomalies associated with these results, and the data are acceptable as qualified.

3.0 Data Interpretation

This data interpretation section is included to aid in evaluating plume stability. This section consists of plots showing contaminant concentration trends (Section 3.1), plume maps (Section 3.2), and a discussion of site geochemistry (Section 3.3).

While most of the previous documents for the Pinellas site have compared groundwater contaminant concentrations to drinking water standards (i.e., maximum contaminant levels), those standards are not the applicable default cleanup target levels (CTLs) for the purpose of evaluating site remediation under RBCA. Based on a comprehensive review of background data for the site (DOE 2003a), it has been determined that aluminum and iron levels in the shallow groundwater in the site vicinity are naturally elevated and far exceed State of Florida Secondary Drinking Water Standards (Chapter 62-550, F.A.C.). Specifically, the average background concentration of 1.1 milligrams per liter (mg/L) for aluminum exceeds the 0.2 mg/L secondary standard, and the average background concentration for iron (9.3 mg/L) exceeds the 0.3 mg/L secondary standard. The ambient shallow groundwater in the area is therefore designated as "poor quality" as defined in 62-780.200 (35), F.A.C. Thus, the applicable groundwater CTLs are

those for groundwater of "low yield/poor quality" provided in Table 1 of Chapter 62-777, F.A.C. In essence, these CTL values are a factor of 10 higher than the maximum contaminant level values.

3.1 Contaminant Concentration Trends

Figures 9 and 10 show the cDCE and VC concentration trends in wells PIN20-0502 and -M001, respectively. These two wells, located hydraulically downgradient from the area of highest contaminant concentrations, have shown increasing concentration trends in previous years, but concentrations in both wells are now generally decreasing.

In previous reports, contaminant concentration trend charts were shown for other wells, but these wells were all abandoned prior to or during the soil excavation work in 2009. Several new closure monitoring wells were installed in late 2009 to replace some of the abandoned wells. The new wells have only been sampled twice, in December 2009 and March 2010, and the data are listed in Table 6.

3.2 Plume Maps

Plume maps were generated for TCOPCs (Figure 8) and VC (Figure 11) based on March 2010 data. The inferred plume boundary for VC represents either the 10 µg/L on-site CTL or the 1 µg/L off-site CTL. The concentrations that are below the CTL are not included in the VC plume. The plume maps also show the plume boundary from the previous year to show any changes over the last year.

Plume maps for TCE and cDCE have been shown in previous reports, but these COPCs were not detected above their respective CTLs, so plume maps are not necessary. This lack of TCE and cDCE exceedances is significant and reflects the recent efforts at contaminant source removal (spring 2009; the LDA area shown on plume maps), enhancement of naturally occurring biodegradation (February 2010), and placement of wells for closure monitoring.

3.3 Geochemical Parameters

Geochemical parameters measured in the field at the 4.5 Acre Site during December 2009 and March 2010 are summarized in Tables 4 and 5. Conditions across the site generally are reducing, as evidenced by the low values of dissolved oxygen and oxidation-reduction potentials.

4.0 Upcoming Tasks

The major task scheduled during the next semiannual period (June through November 2010) is the semiannual closure monitoring of 13 monitoring wells, which will include water level measurements and sampling and analysis of groundwater in September 2010.

5.0 References

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DOE (U.S. Department of Energy), 2010. *Injection of Emulsified Soybean Oil at the Northeast Site and 4.5 Acre Site*, LMS/PIN/N01494, Office of Legacy Management, Grand Junction, Colorado, April.

FDEP (Florida Department of Environmental Protection), 2005. Letter from John Armstrong (FDEP) to David Ingle (DOE), dated July 7, 2005.

Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites, LMS/PLN/S04351, continually updated, prepared by S.M. Stoller Corporation for the U.S. Department of Energy Office of Legacy Management, Grand Junction, Colorado.

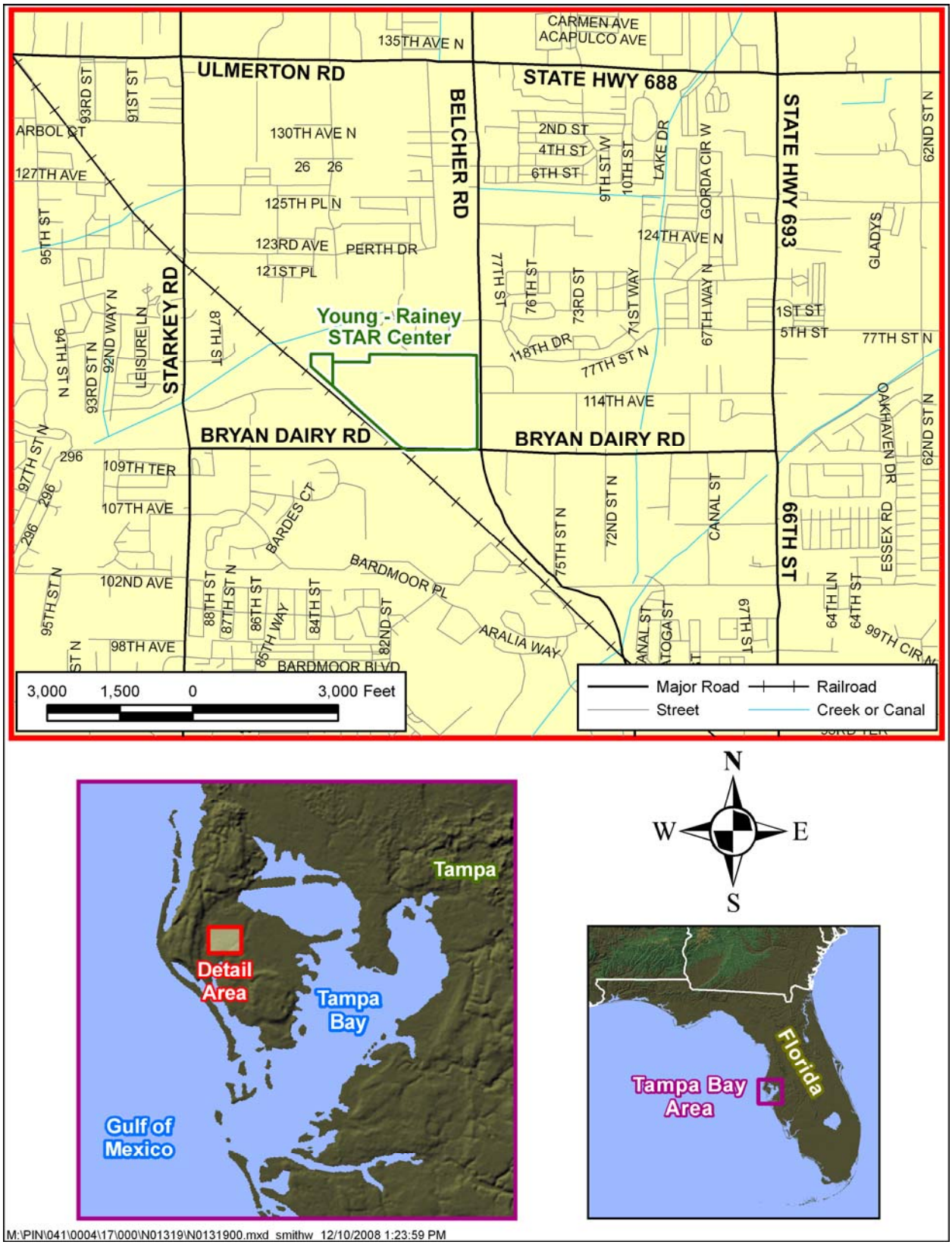

Figure 1. Young - Rainey STAR Center Location

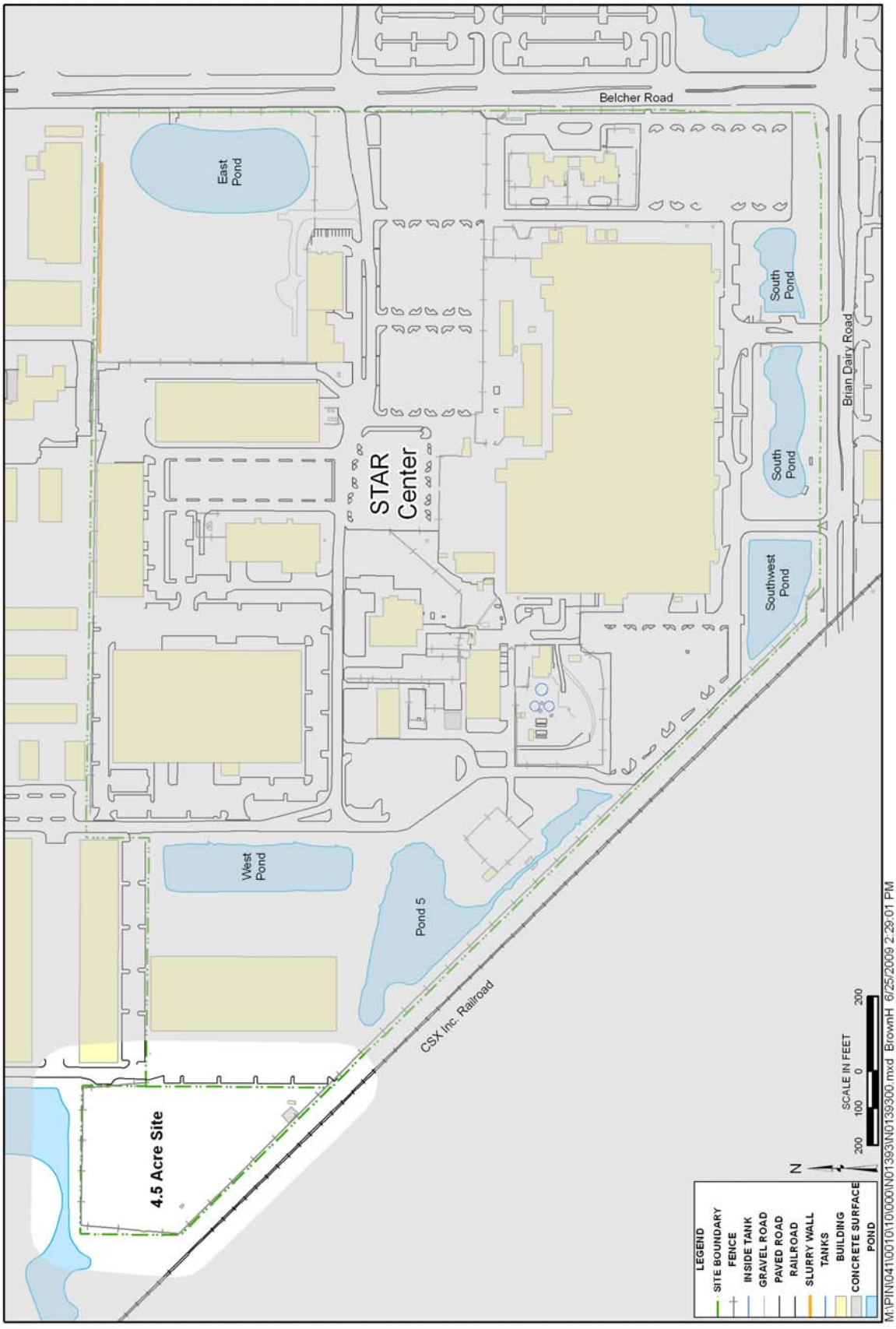

Figure 2. 4.5 Acre Site Location

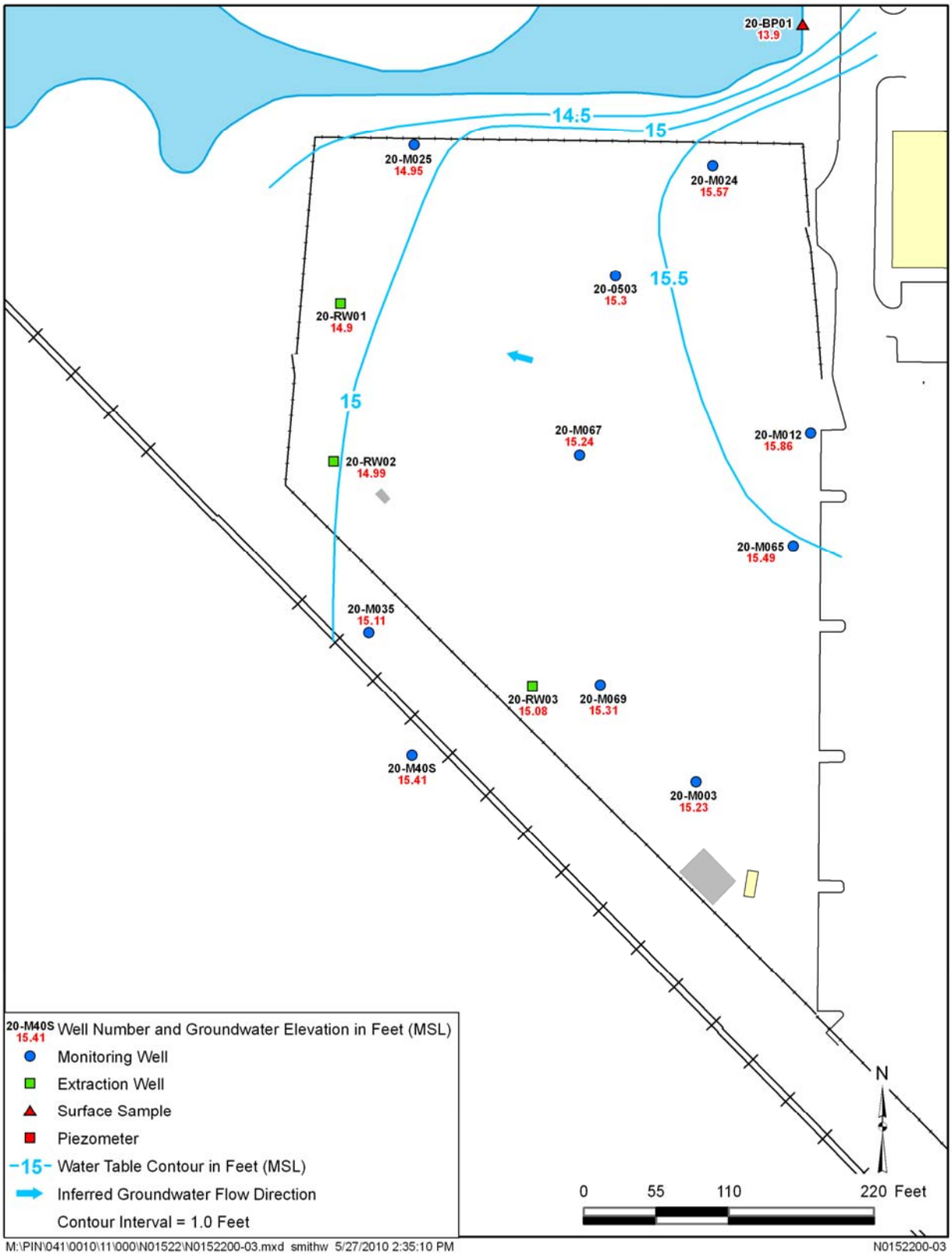

Figure 3. Shallow Surficial Aquifer Flow, 4.5 Acre Site, December 2009

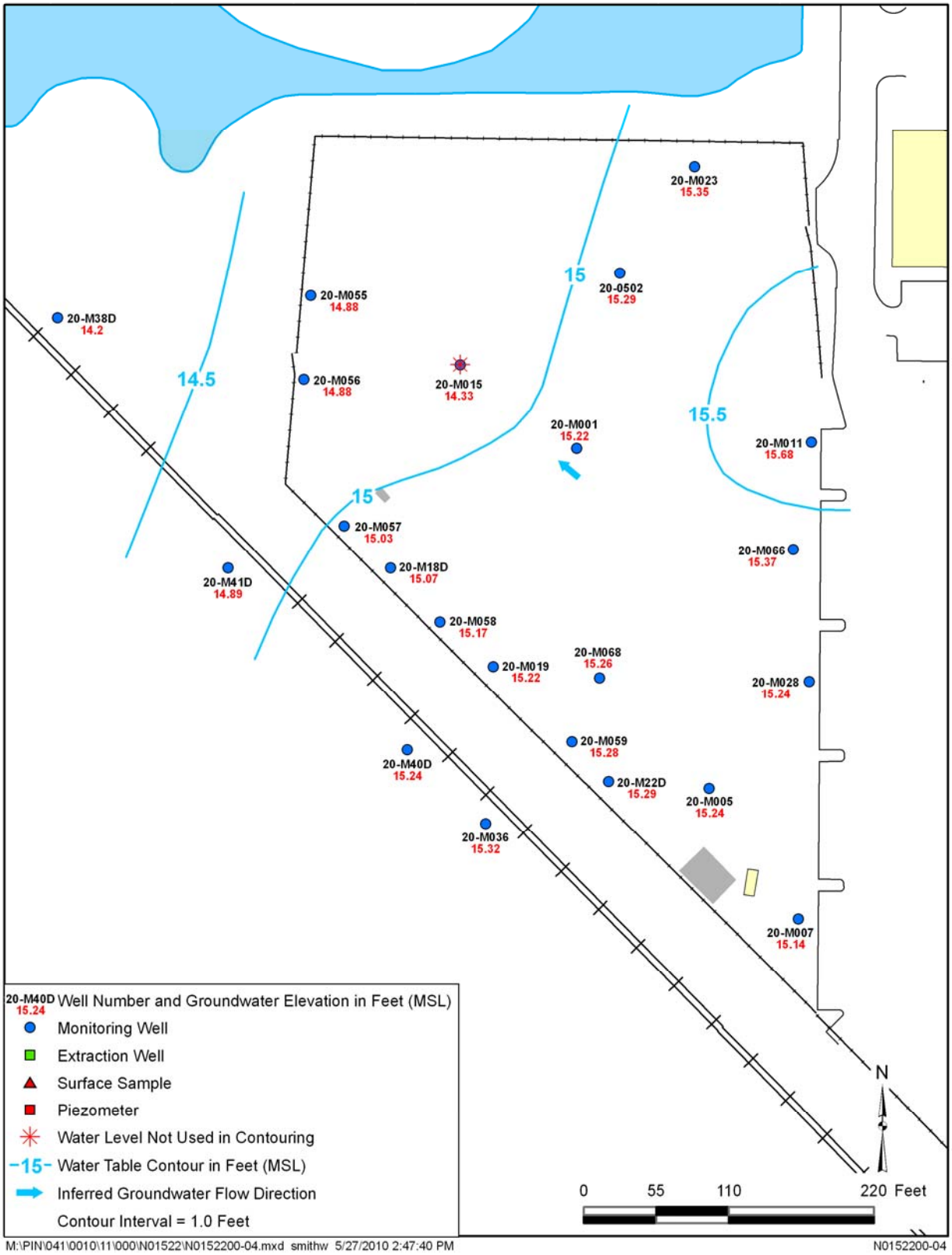

Figure 4. Deep Surficial Aquifer Flow, 4.5 Acre Site, December 2009

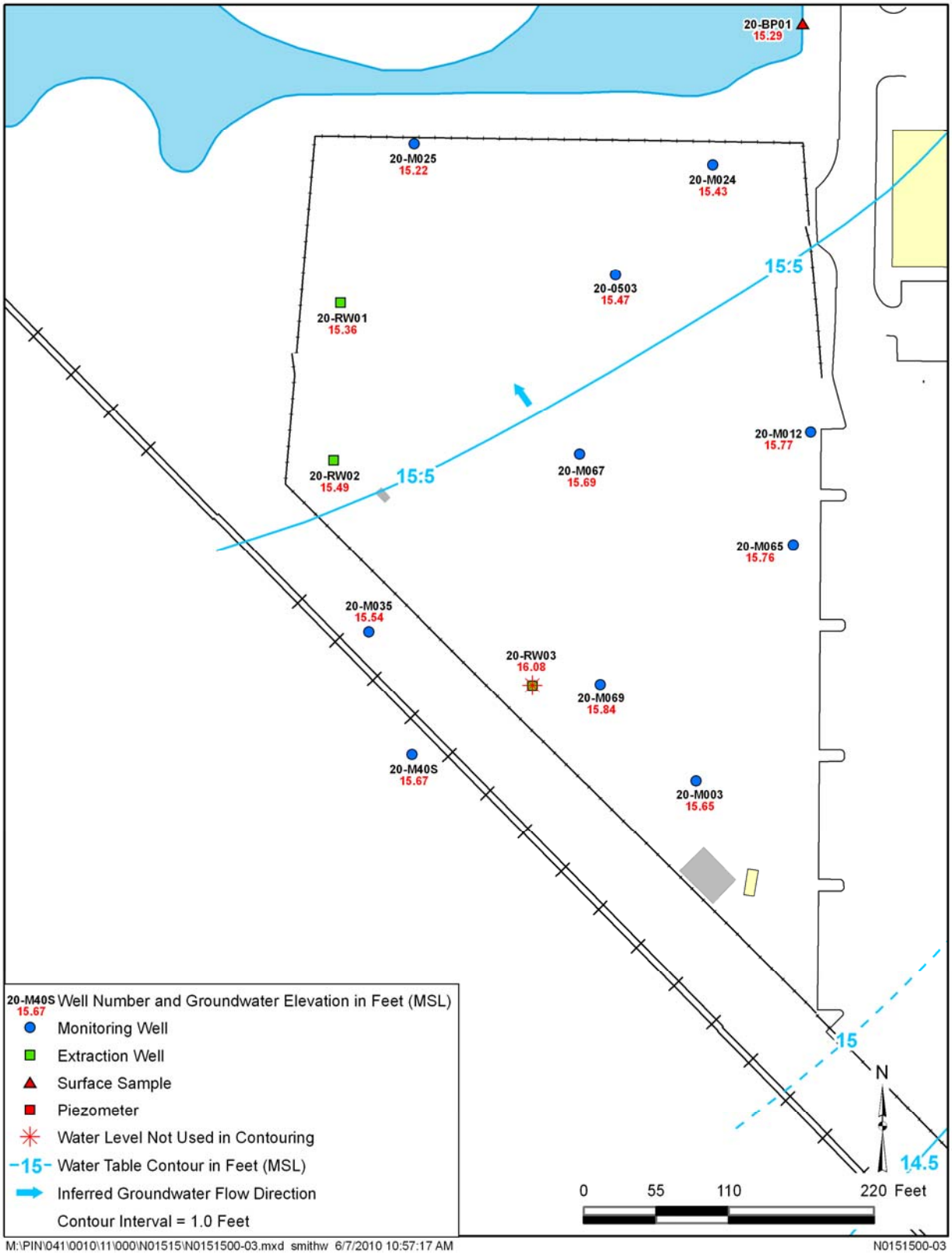

Figure 5. Shallow Surficial Aquifer Flow, 4.5 Acre Site, March 2010

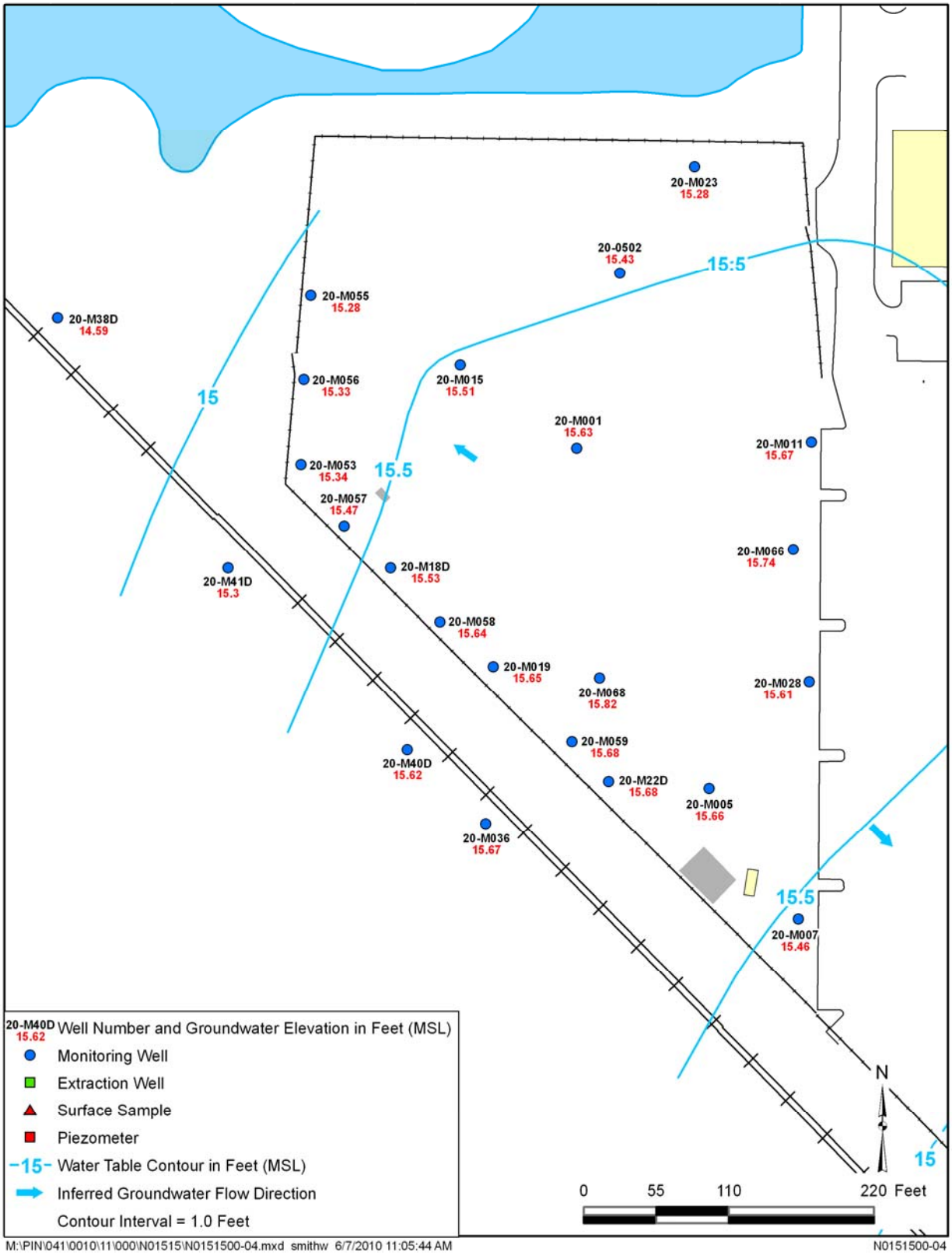

Figure 6. Deep Surficial Aquifer Flow, 4.5 Acre Site, March 2010

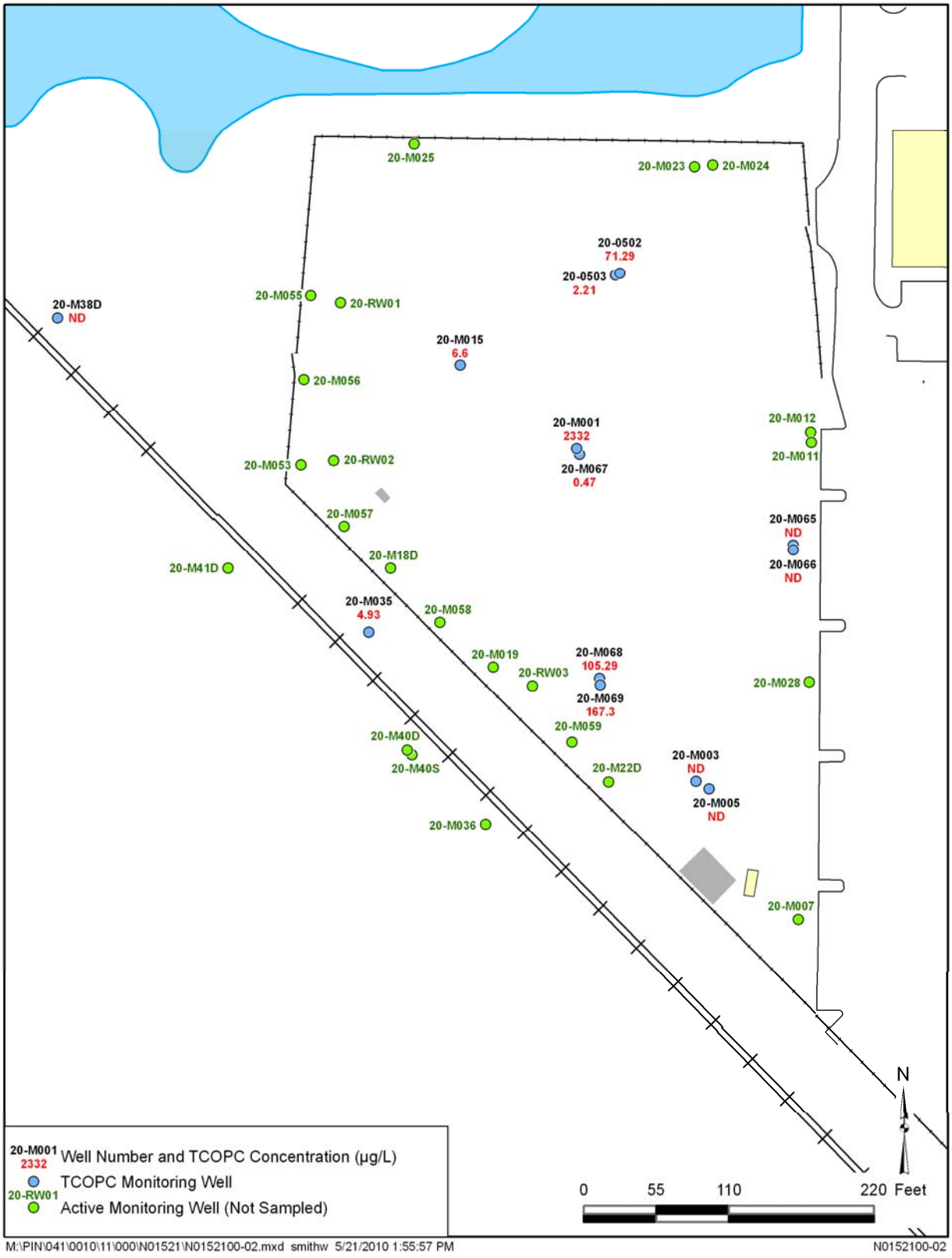

Figure 7. TCOPCs Concentrations, 4.5 Acre Site, December 2009

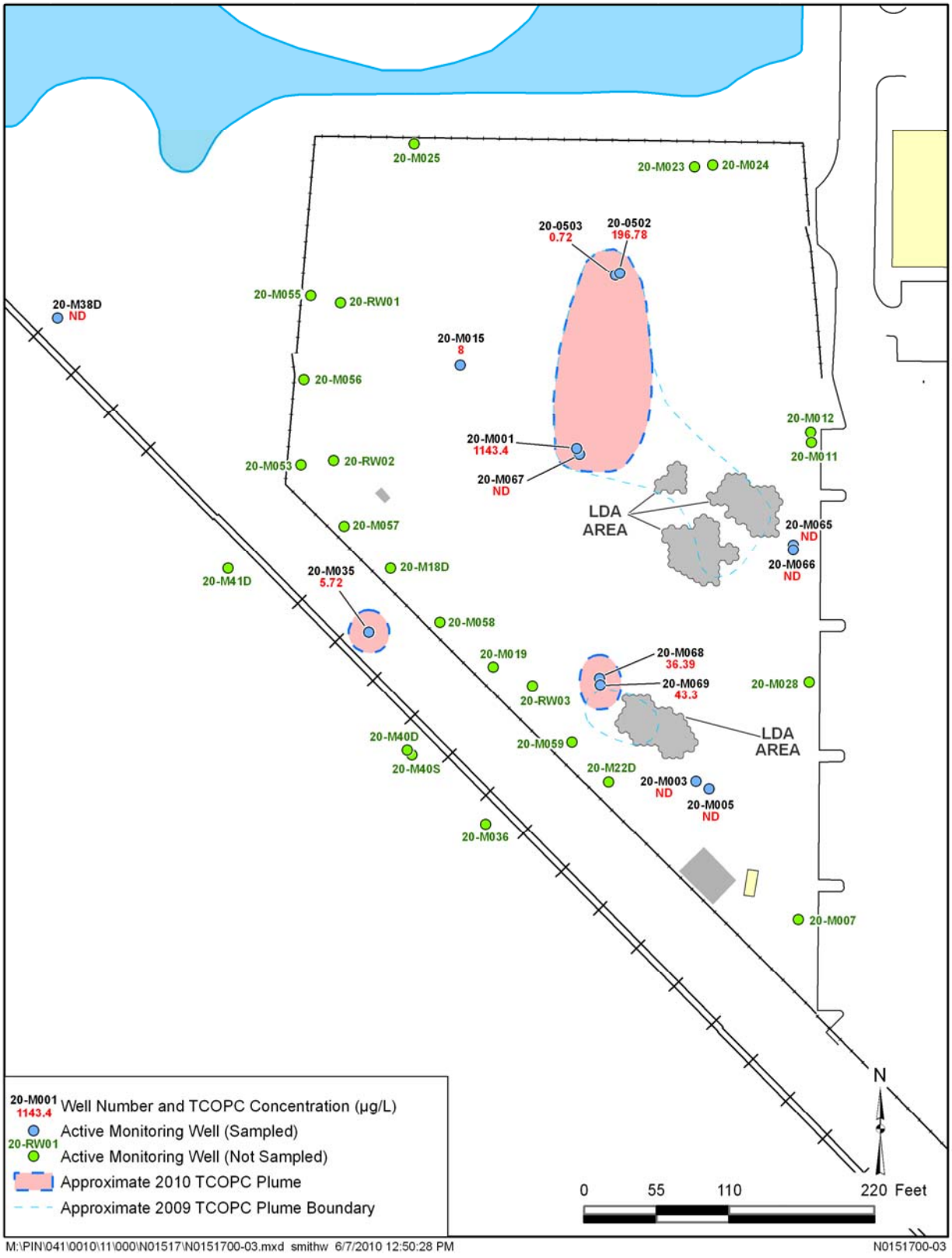

Figure 8. TCOPCs Concentrations, 4.5 Acre Site, March 2010

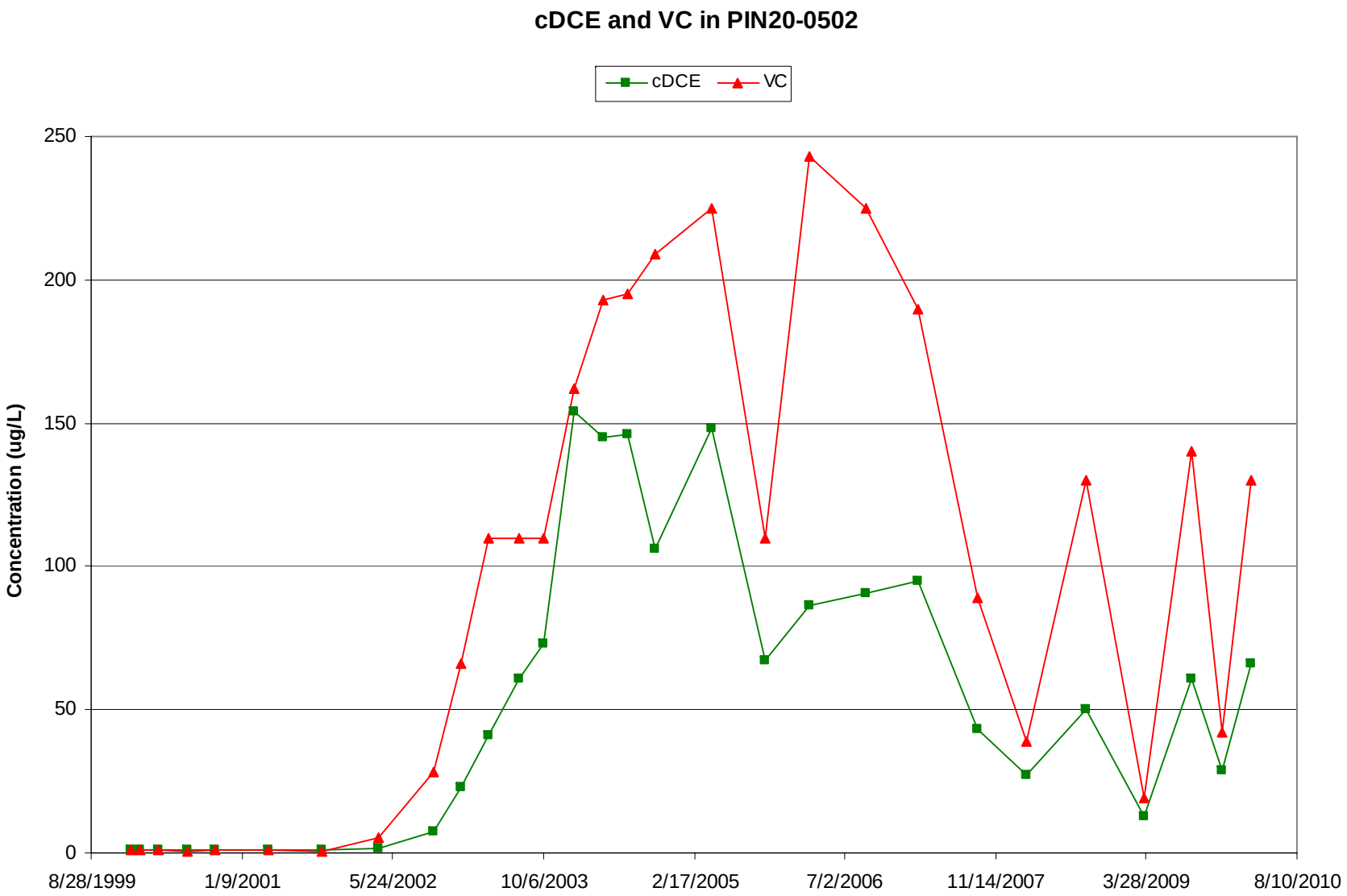

Figure 9. cDCE and VC in PIN20-0502

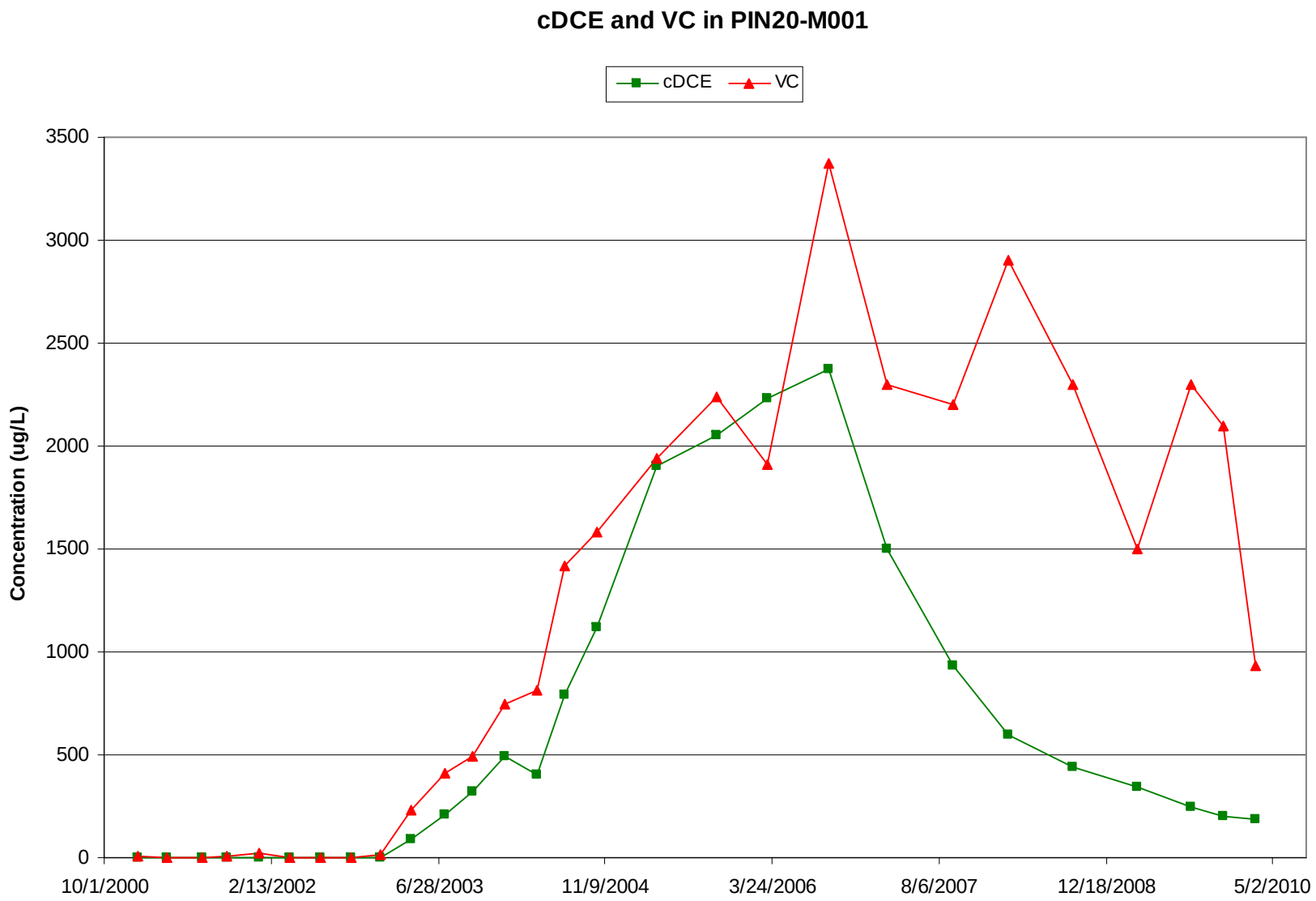

Figure 10. cDCE and VC in PIN20-M001

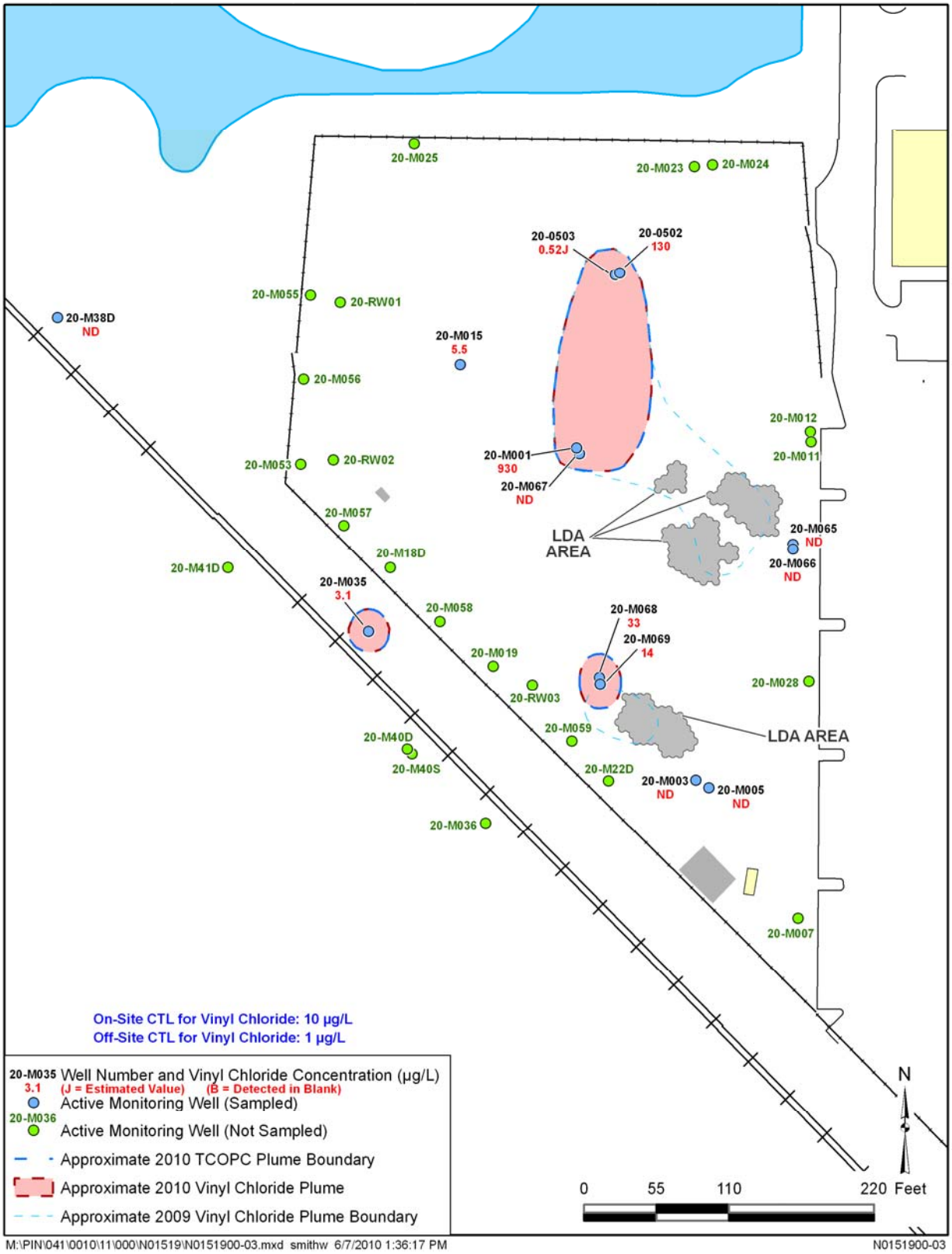

Figure 11. VC Concentrations, 4.5 Acre Site, March 2010

Table 1. Groundwater-Level Data at the 4.5 Acre Site, December 2009

Location	Measurement		Water Depth (ft bls[a])	Groundwater Elevation (ft amsl[b])
	Date	Time		
PIN20				
0502	12/1/2009	10:10	2.11	15.29
0503	12/1/2009	10:11	2.10	15.30
M001	12/1/2009	10:17	2.38	15.22
M003	12/1/2009	09:49	2.67	15.23
M005	12/1/2009	09:50	3.06	15.24
M007	12/1/2009	09:51	4.31	15.14
M011	12/1/2009	09:59	2.42	15.68
M012	12/1/2009	10:03	2.14	15.86
M015	12/1/2009	10:12	4.06	14.33
M019	12/1/2009	09:43	2.78	15.22
M023	12/1/2009	10:06	4.12	15.35
M024	12/1/2009	10:04	2.23	15.57
M025	12/1/2009	10:37	1.35	14.95
M028	12/1/2009	09:53	2.96	15.24
M035	12/1/2009	09:25	3.69	15.11
M036	12/1/2009	09:30	3.98	15.32
M055	12/1/2009	10:36	2.52	14.88
M056	12/1/2009	09:32	2.22	14.88
M057	12/1/2009	09:38	2.87	15.03
M058	12/1/2009	09:41	2.53	15.17
M059	12/1/2009	09:46	2.52	15.28
M065	12/1/2009	09:59	2.91	15.49
M066	12/1/2009	09:56	2.83	15.37
M067	12/1/2009	10:24	3.46	15.24
M068	12/1/2009	10:31	2.89	15.26
M069	12/1/2009	10:26	2.69	15.31
M18D	12/1/2009	09:40	2.63	15.07
M22D	12/1/2009	09:47	2.51	15.29
M38D	12/1/2009	09:20	4.30	14.20
M40D	12/1/2009	09:29	4.16	15.24
M40S	12/1/2009	09:27	3.79	15.41
M41D	12/1/2009	09:22	4.21	14.89
RW01	12/1/2009	10:31	2.70	14.90
RW02	12/1/2009	09:37	2.11	14.99
RW03	12/1/2009	09:44	2.52	15.08

[a] bls = below land surface
[b] amsl = above mean sea level

Table 2. Groundwater-Level Data at the 4.5 Acre Site, March 2010

Location	Measurement		Water Depth (ft bls[a])	Groundwater Elevation (ft amsl[b])
	Date	Time		
PIN20				
0502	3/10/10	07:07	1.97	15.43
0503	3/10/10	07:08	1.93	15.47
M001	3/10/10	08:10	1.97	15.63
M003	3/10/10	08:03	2.25	15.65
M005	3/10/10	08:04	2.64	15.66
M007	3/10/10	08:26	3.99	15.46
M011	3/10/10	08:23	2.43	15.67
M012	3/10/10	08:20	2.23	15.77
M015	3/10/10	07:13	2.88	15.51
M019	3/10/10	07:52	2.35	15.65
M023	3/10/10	07:06	4.19	15.28
M024	3/10/10	06:52	2.37	15.43
M025	3/10/10	07:08	1.08	15.22
M028	3/10/10	08:24	2.59	15.61
M035	3/10/10	07:35	3.26	15.54
M036	3/10/10	07:41	3.63	15.67
M053	3/10/10	07:22	1.86	15.34
M055	3/10/10	07:17	2.12	15.28
M056	3/10/10	07:25	1.77	15.33
M057	3/10/10	07:42	2.43	15.47
M058	3/10/10	07:50	2.06	15.64
M059	3/10/10	07:53	2.12	15.68
M065	3/10/10	08:09	2.64	15.76
M066	3/10/10	08:05	2.46	15.74
M067	3/10/10	08:13	3.01	15.69
M068	3/10/10	07:56	2.33	15.82
M069	3/10/10	07:59	2.16	15.84
M18D	3/10/10	07:48	2.17	15.53
M22D	3/10/10	08:01	2.12	15.68
M38D	3/10/10	07:27	3.91	14.59
M40D	3/10/10	07:37	3.78	15.62
M40S	3/10/10	07:38	3.53	15.67
M41D	3/10/10	07:32	3.80	15.30
RW01	3/10/10	07:21	2.24	15.36
RW02	3/10/10	07:25	1.61	15.49
RW03	3/10/10	07:55	1.52	16.08

[a] bls = below land surface
[b] amsl = above mean sea level

Table 3. Surface Water Elevations at the 4.5 Acre Site, March 2010

Location	Measurement		Surface Water Elevation (ft amsl[a])
	Date	Time	
PIN01	**Pond 5**		
P501	3/10/10	10:08	13.83
P502	3/10/10	10:24	14.00
PIN02	**West Pond**		
W005	3/10/10	8:28	14.02
PIN20	**Pond North of the 4.5 Acre Site**		
BP01	3/10/10	8:13	15.29

[a] amsl = above mean sea level

Table 4. Field Measurements of Samples Collected at the 4.5 Acre Site, December 2009

Location	Screen Depth (ft bls)[a]	Temperature (°C)	Specific Conductance (µmhos/cm)[b,c]	Turbidity (NTU)[d]	pH	Oxidation Reduction Potential (mV)[e]	Dissolved Oxygen (mg/L)
PIN20							
0502	21.2–31.2	24.95	1,479	25.4	6.79	–42.7	1.01
0503	13.2–23.2	24.78	1,934	6.7	6.71	–57.7	1.36
M001	20–25	24.93	1,724	5.9	6.68	–48.1	0.73
M003	9–14	25.5	1,035	0.9	6.8	–4.2	0.8
M005	25.8–30.7	25.12	1,163	0.7	6.83	–54.9	0.65
M015	20.8–25.8	25.72	1,180	9.1	6.83	–73.3	0.96
M035	9–14	25.77	2,838	10.3	6.92	–86.7	0.63
M065	10–20	25.13	792	13.5	6.88	–64	0.68
M066	20–30	24.82	906	14.9	6.86	–68.8	0.67
M067	10–20	21.95	2,876	6.7	6.86	–70.2	0.92
M068	20–30	23.5	985	29.6	7.15	–89.5	0.56
M069	10–20	23.81	2,678	16.5	6.94	–67.4	0.76
M38D	20–30	25.77	834	0.6	7.01	–69.4	0.65

[a] bls = below land surface
[b] Temperature corrected to 25 °C
[c] µmhos/cm = micromhos per centimeter
[d] NTU = nephelometric turbidity units
[e] mV = millivolts

Table 5. Field Measurements of Samples Collected at the 4.5 Acre Site, March 2010

Location	Screen Depth (ft bls)[a]	Temperature (°C)	Specific Conductance (µmhos/cm)[b,c]	Turbidity (NTU)[d]	pH	Oxidation Reduction Potential (mV)[e]	Dissolved Oxygen (mg/L)
PIN20							
0502	21.2–31.2	22.35	1,402	21.5	6.55	–11.2	0.57
0503	13.2–23.2	21.92	1,407	20.5	6.6	–5.1	0.62
M001	20–25	23.38	2,474	52	5.78	–299.5	-
M003	9–14	19.75	858	23.9	6.54	–3.5	0.6
M005	25.8–30.7	20.99	1,095	0.6	6.69	22.8	0.83
M015	20.8–25.8	21.92	1,256	3.35	6.56	16.9	0.62
M035	9–14	21.23	2,754	27.6	6.63	–60.6	0.67
M065	10–20	20.4	682	14.9	6.67	–36.5	0.82
M066	20–30	21.23	861	16.5	6.65	–39.4	0.77
M067	10–20	21.97	2,841	14.1	6.54	–61.6	0.85
M068	20–30	21.19	909	18.3	6.69	–29.6	0.95
M069	10–20	20.6	1,885	4.2	6.47	–35.2	1.21
M38D	20–30	22.99	732	14.8	6.89	–19.1	0.62

[a] bls = below land surface
[b] Temperature corrected to 25 °C
[c] µmhos/cm = micromhos per centimeter
[d] NTU = nephelometric turbidity units
[e] mV = millivolts
- = not measured

Table 6. COPC Concentrations from Wells at the 4.5 Acre Site[a]
(µg/L)

Location	Screen Depth (ft)	Date Sampled	TCE	cDCE	tDCE	Total 1,2-DCE[b]	Vinyl chloride	Benzene	TCOPCs[c]
Cleanup Target Level[d]			**30**	**700**	**1,000**	**630**	**10**	**10**	
PIN20									
0502	21.2–31.2	3/19/2009	<0.5	13	<0.44	13	19	<0.5	32
		8/27/2009	<0.5	61	<0.44	61	140	<0.5	201
		12/3/2009	<0.16	29	0.29J	29.29	42	<0.16	71.29
		3/11/2010	<0.16	66	0.78J	66.78	130	<0.16	196.78
0503	13.2–23.2	3/20/2009	<0.5	<0.65	<0.44	ND	4.1	<0.5	4.1
		8/27/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
		12/3/2009	<0.16	0.41J	<0.15	0.41	1.8	<0.16	2.21
		3/11/2010	<0.16	0.2J	<0.15	0.2	0.52J	<0.16	0.72
M001	20–25	3/20/2009	<12	340	140	480	1,500	<12	1,980
		8/31/2009	<0.5	250	43	293	2,300	1.4	2,594.4
		12/3/2009	<0.16	200	30	230	2,100	2	2,332
		3/13/2010	<0.64	190	22	212	930	1.4J	1,143.4
M003	9–14	3/23/2009	<5	<6.5	<4.4	ND	<5	<5	ND
		8/28/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
		12/2/2009	<0.16	<0.15	<0.15	ND	<0.4	<0.16	ND
		3/11/2010	<0.16	<0.15	<0.15	ND	<0.4	<0.16	ND
M005	25.8–30.7	3/23/2009	<0.5	<0.65	<0.44	ND	0.88J	<0.5	0.88
		8/31/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
		12/2/2009	<0.16	<0.15	<0.15	ND	<0.4	<0.16	ND
		3/11/2010	<0.16	<0.15	<0.15	ND	<0.4	<0.16	ND
M011	23.7–28.7	3/20/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
		8/28/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
M012	8.6–13.6	3/20/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
		8/28/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
M015	20.8–25.8	3/19/2009	<0.5	1.3	<0.44	1.3	3.8	<0.5	5.1
		8/31/2009	<0.5	<0.65	<0.44	ND	0.6J	<0.5	0.6
		12/2/2009	<0.16	1.7	<0.15	1.7	4.9	<0.16	6.6
		3/11/2010	<0.16	2.5	<0.15	2.5	5.5	<0.16	8
M019	22–27	3/23/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
		8/31/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
M023	19.8–24.8	3/19/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
		8/27/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
M024	8.7–13.7	3/19/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
		8/27/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
M025	8.6–13.6	3/19/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
		9/10/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND

Table 6 (continued). COPC Concentrations from Wells at the 4.5 Acre Site[a] (µg/L)

Location	Screen Depth (ft)	Date Sampled	TCE	cDCE	tDCE	Total 1,2-DCE[b]	Vinyl chloride	Benzene	TCOPCs[c]
Cleanup Target Level[d]			**30**	**700**	**1,000**	**630**	**10**	**10**	
M028	22–27	3/20/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
		8/28/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
M035	9–14	3/19/2009	<0.5	2.9	<0.44	2.9	<0.5	<0.5	2.9
		8/28/2009	0.54J	2.1	0.53J	2.63	3.8	<0.5	6.97
		9/10/2009	<0.5	2.7	0.79J	3.49	3.9	<0.5	7.39
		12/2/2009	0.23J	2.7	0.4J	3.1	1.6	<0.16	4.93
		3/11/2010	0.22J	2.1	0.3J	2.4	3.1	<0.16	5.72
M036	25–30	3/19/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
		8/28/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
M053	20–30	3/19/2009	<0.5	13	<0.44	13	4.7	<0.5	17.7
		8/27/2009	<0.5	8.2	<0.44	8.2	<0.5	<0.5	8.2
M055	21–31	3/19/2009	<0.5	1.3	<0.44	1.3	4.4	<0.5	5.7
		8/27/2009	<0.5	1.1	<0.44	1.1	1.3	<0.5	2.4
M056	19–29	3/19/2009	<0.5	3.7	<0.44	3.7	5.6	<0.5	9.3
		8/31/2009	<0.5	2.2	<0.44	2.2	1.7	<0.5	3.9
M057	20–30	3/20/2009	<0.5	16	<0.44	16	5.1	<0.5	21.1
		8/27/2009	<0.5	10	0.46J	10.46	<0.5	<0.5	10.46
M058	18–28	3/20/2009	<0.5	1.4	<0.44	1.4	4.1	<0.5	5.5
		8/31/2009	<0.5	1.9	<0.44	1.9	3.6	<0.5	5.5
M059	19–29	3/20/2009	<0.5	<0.65	<0.44	ND	4.8	<0.5	4.8
		8/31/2009	<0.5	2.7	0.48J	3.18	56	<0.5	59.18
M065	10–20	12/3/2009	<0.16	<0.15	<0.15	ND	<0.4	<0.16	ND
		3/13/2010	<0.16	<0.15	<0.15	ND	<0.4	<0.16	ND
M066	20–30	12/3/2009	<0.16	<0.15	<0.15	ND	<0.4	<0.16	ND
		3/13/2010	<0.16	<0.15	<0.15	ND	<0.4	<0.16	ND
M067	10–20	12/6/2009	<0.16	0.47J	<0.15	0.47	<0.4	<0.16	0.47
		3/13/2010	<0.16	<0.15	<0.15	ND	<0.4	<0.16	ND
M068	20–30	12/4/2009	0.27J	0.26J	4.5	4.76	100	0.26J	105.29
		3/13/2010	0.59J	0.5J	2.3	2.8	33	<0.16	36.39
M069	10–20	12/4/2009	9.3	100	12	112	46	<0.16	167.3
		3/13/2010	2	24	3.3	27.3	14	<0.16	43.3
M18D	20–30	3/20/2009	<0.5	11	<0.44	11	6.5	<0.5	17.5
		8/31/2009	<0.5	3.8	<0.44	3.8	6.3	<0.5	10.1
M22D	20–30	3/20/2009	<0.5	<0.65	<0.44	ND	4.2	<0.5	4.2
		8/31/2009	<0.5	<0.65	<0.44	ND	2	<0.5	2
M38D	20–30	3/19/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
		8/27/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
		12/2/2009	<0.16	<0.15	<0.15	ND	<0.4	<0.16	ND
		3/11/2010	<0.16	<0.15	<0.15	ND	<0.4	<0.16	ND
M40D	18–28	3/19/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
		8/28/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND

Table 6 (continued). COPC Concentrations from Wells at the 4.5 Acre Site[a] (µg/L)

Location	Screen Depth (ft)	Date Sampled	TCE	cDCE	tDCE	Total 1,2-DCE[b]	Vinyl chloride	Benzene	TCOPCs[c]
Cleanup Target Level[d]			**30**	**700**	**1,000**	**630**	**10**	**10**	
M40S	4–14	3/19/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
		8/28/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
M41D	16–26	3/19/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND
		8/27/2009	<0.5	<0.65	<0.44	ND	<0.5	<0.5	ND

[a] "<" values are method detection limits.
[b] Total 1,2–DCE is the sum of cDCE and tDCE.
[c] TCOPCs is the sum of the individual COPCs concentrations. The Total 1,2-DCE value is not included in the TCOPCs value because the cDCE and tDCE values are already included in the TCOPCs value.
[d] The off-site CTL is a factor of 10 lower than the listed on-site CTL.
ND = Not detected.
J = Estimated value, result is between the reporting limit and the method detection limit.

Table 7. Relative Percent Difference for Duplicate Samples (µg/L)

Sample ID	Duplicate ID	Analyte	Result	Duplicate Result	MDL[a]	RPD
PIN20-M035	PIN20-2867	cDCE	2.1	2.3	0.15	9.1
		vinyl chloride	3.1	3.6	0.4	14.9
PIN20-M068	PIN20-2868	tDCE	2.3	2.3	0.15	0.0
		vinyl chloride	33	30	0.4	9.5

[a] MDL = method detection limit