SECTION 5.0

Five-Year Review Findings

The following section discusses findings from the Five-Year Review.

5.1 Five-Year Review Process

Lisa Hanusiak, USEPA Remedial Project Manager (RPM), led the FSL Five-Year Review. CH2M HILL provided technical support to the USEPA. Activities to involve the community in the Five-Year Review included preparation and distribution of a fact sheet in March 2005. The Five-Year Review consisted of a review of relevant documents (see Appendix A), a regulatory review, a site inspection, and interviews with FSL onsite staff and their consultants, former USEPA RPMs, DTSC oversight staff, and the California Regional Water Quality Control Board (RWQCB) oversight staff.

Following the release of this document, USEPA will produce and distribute a fact sheet to the community near the site.

5.2 Community Notification and Involvement

USEPA distributed a fact sheet in March 2005 and placed a notice in the paper announcing the start of the Five-Year Review. The fact sheet outlined the process associated with conducting a Five-Year Review and invited community involvement.

Copies of the fact sheet and newspaper ad are included in an Appendix B. A second fact sheet explaining the conclusions of the review and announcing the availability of the Five-Year Review Report and how to access a copy will be issued following the release of this document.

5.3 Documents Review

As a part of the Five-Year Review process, CH2M HILL conducted a brief review of numerous documents related to site activities. The documents chosen for review ranged in publication date from 1991 to 2005. Appendix A provides a list of the documents reviewed as part of this report.

5.4 Data Reviewed

The following sections describe the periodic reporting and/or monitoring at the treatment facility for the FSL.

5.4.1 Groundwater

The City of Fresno is responsible for submitting semi-annual reports to USEPA that estimate the lateral and vertical capture of VOC-impacted groundwater along the downgradient edge of the FSL, assess the VOC concentration trends at the monitoring wells influenced by groundwater extraction, and verify that treatment goals are being met prior to surface discharge. The reports also document the operational summary of the extraction well pumping rates, depth to groundwater in the extraction wells, groundwater treatment plant influent flow rates, PTA differential pressure, PTA blower flow rates, and off-gas discharge pressure.

Groundwater level measurements are collected quarterly in all wells. Groundwater sampling and analysis is performed on a mixed quarterly, semi-annual, and annual basis. These efforts have been conducted since 1993. From 1992 to 1993, the remedial investigation included quarterly groundwater levels and sample analysis of all available site wells. The early groundwater remediation action started in May 1999. This consisted of full-time operation of extraction wells PW-1A, PW-2A, and PW-3A. PW-4A was brought online in February 2000. In September 2001, the Phase 1 groundwater extraction and treatment at the FSL began, and the monitoring expanded to follow the performance monitoring program plan. In May 2002, PW-5A was brought on-line (CDM 2005a).

The performance monitoring program plan for OU-2 provides a detailed description of the plan. Table 2-1 of that report (shown as Table 5-1 below) describes the sampling schedule for the wells during Early Action monitoring and Phase 1 monitoring, as well as a description of the purpose for the specific sampling.

TABLE 5-1
Groundwater Monitoring for OU-2 (as Required by the 2000 Performance Monitoring Program Plan)
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

	Early Action Monitoring		Phase I Monitoring		Phase I Sampling Purpose		
Well ID	**Water Levels**	**Water Quality**	**Water Levels**	**Water Quality**	**Source Control**	**Plume Migration**	**TI Waiver Evaluation**
Monitoring Wells							
CDM-1A/B/C	Q	A	Q	A	X		
CDM-2A/B/C	Q	A	Q	A	X		
CDM-3A/B	Q	S	Q	S	X	X	
CDM-4A/B	Q	Q	Q	Q	X	X	X
CDM-4C	Q	S	Q	S	X	X	
CDM-5A/B	Q	Q	Q	Q	X	X	X
CDM-5C	Q	S	Q	S	X	X	
CDM-6A	Q	S	Q	S	X	X	
CDM-7A/C	Q		Q		X		
CDM-8A/B	Q	Q	Q	Q	X	X	X
CDM-8C	Q	Q	Q	S	X	X	

TABLE 5-1
Groundwater Monitoring for OU-2 (as Required by the 2000 Performance Monitoring Program Plan)
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

	Early Action Monitoring		Phase I Monitoring		Phase I Sampling Purpose		
Well ID	**Water Levels**	**Water Quality**	**Water Levels**	**Water Quality**	**Source Control**	**Plume Migration**	**TI Waiver Evaluation**
CDM-12A	Q	Q	Q	A	X		
CDM-12B	Q	Q	Q	S	X	X	X
CDM-13A	Q	Q	Q	A	X		
CDM-13B	Q	Q	Q	S	X	X	X
CDM-13C	Q	Q	Q	S	X	X	
CDM-15AB	Q	Q	Q	Q	X	X	X
CDM-15C	Q	S	Q	S		X	
CDM-16A/B/C	Q	Q	Q	S		X	
CDM-17AB/C	Q	Q	Q	S		X	
CDM-18A/B/C	Q	Q	Q	S		X	
DW-1A	Q		Q		X		
DW-1 B/C	Q	S	Q	S	X	X	X
DW-2A	Q		Q		X		
DW-2B/C	Q	S	Q	S	X	X	X
MW-1	Q	S	Q	S	X	X	X
PZ-3B	Q		Q		X		
MW-2	Q	A	Q	A	X		
PZ-4B	Q	S	Q	S	X	X	X
PZ-4C	Q	0	Q	A		X	
MW-3	Q		Q		X		
MW-4	Q	S	Q	S	X		
PZ-1A	Q		Q		X		
PZ-2A/B	Q	Q	Q	Q	X	X	X
PZ-5A	Q	A	Q	A	X		
PZ-5B	Q	S	Q	S	X	X	X
PZ-5C	Q	Q	Q	A	X	X	
UW-1A/B/C	Q	A	Q	A	X		
UW-2A/B/C	Q		Q		X		
W-1 R	Q	A	Q	A	X		
W-2/W-3	Q		Q		X		
W-4	Q	S	Q	S	X		

TABLE 5-1
Groundwater Monitoring for OU-2 (as Required by the 2000 Performance Monitoring Program Plan)
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

	Early Action Monitoring		Phase I Monitoring		Phase I Sampling Purpose		
Well ID	**Water Levels**	**Water Quality**	**Water Levels**	**Water Quality**	**Source Control**	**Plume Migration**	**TI Waiver Evaluation**
W-5	Q	S	Q	S	X		
W-6	Q	Q	Q	Q	X	X	
Residential Wells							
1770 North Ave		A		A			
2045 North Ave		S		S			
2429 North Ave		S		S			
1304 Jensen Ave		A		A			
1346 Jensen Ave		A		A			
1642 Jensen Ave		A		A			
1650 Jensen Ave		S		A			
1912 Jensen Ave		A		A			
2121 Jensen Ave		A		A			
Groundwater Extraction Wells							
Residential Wells							

Notes:

A Annual sampling

S Semi-annual sampling

Q Quarterly Sampling

Source: CDM 2000.

This monitoring program has been approved by USEPA and revised in recent years. Table 3-2 in the *Fall 2004 Semi-Annual Performance Monitoring Program Report* (CDM 2005a) provides a description of the current monitoring. This is included below as Table 5-2. In 2004, sampling of six wells, all in the A-Aquifer, was not possible because insufficient water in the well casing made it impossible to sample with the bladder pump or a bailer. The City performed well rehabilitation activities, including a downhole video log, brushing the well screen with a wire brush to remove biological growth, and swabbing. Information about the flow since the well rehabilitation activities was not available at the time of this report.

Quarterly water level measurements are currently taken from the five extraction wells, 31 A-Aquifer monitoring wells, 27 B-Aquifer monitoring wells, and 13 C-Aquifer monitoring wells. VOC analysis and inorganic analysis are conducted on numerous A, B, and C wells, including the extraction wells and nine residential wells. Figure 5-1 shows all the locations of the monitoring and extraction wells.

TABLE 5-2
Fall 2004 Groundwater Monitoring
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

Well	Groundwater Sampling				Water Level Measurements Quarterly
	July 2004	October 2004	January 2005	April 2005	
A-Aquifer Extraction Wells					
PW-1A				V/I	X
PW-2A				VA	X
PW-3A				V/I	X
PW-4A				V/I	X
PW-5A	V/I	V/I	V/I	V/I	X
A-Aquifer Monitoring Wells					
CDM1A		V/1			X
CDM2A		V/I			X
CDM3A		V		V/I	X
CDM4A	V	V	V	VA	X
CDMSA	V	V/I	V	VA	X
CDM6A		V/I		VA	X
CDM7A		V/I			X
CDMSA	V	V/I	V	VA	X
CDM12A	V	V/I	V	V/1	X
CDM13A	V	V	V	V/I	X
CDM15A	V	V	V	VA	X
CDM16A	V/I	VA	V/I	V/I	X
CDM17A	VII	V/I	V/I	V/I	X
CDM18A	V/I	VA	V/I	VA	X
DW1A					X
DW2A					X
MW1		NS		VA	X
MW2				V/I	X
MW3					X
MW4		NS		VA	X
PZ1A					X
PZ2A	NS	NS	V	V/I	X
PZSA				VA	X
UW1A				VII	X
UW2A					X
W1R				V/I	X
W2					X

TABLE 5-2
Fall 2004 Groundwater Monitoring
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

Well	Groundwater Sampling				Water Level Measurements Quarterly
	July 2004	October 2004	January 2005	April 2005	
W3					X
W4		NS		V/I	X
W5		NS		V/I	X
W6	V	NS	V	VA	X
Aquifer Monitoring Wells					
CDM1 B		VII			X
CDM2B		V/1			X
CDM3B		V		VA	X
CDM4B	V	VA	V	VA	X
CDM5B	V	VA	V	VA	X
CDMBB	V	VA	V	VA	X
CDM12B	V	V	V	V/I	X
CDM13B	V	VA	V	VA	X
CDM13B2	V/I	V/I	V/I	V/I	X
CDM15B	V	V	V	V/I	X
CDM15B2	V/I	V/I	V/I	V/I	X
CDM16B	V/I	V/I	V/I	V/I	X
CDM17B	V/I	V/I	V/I	VII	X
CDM18B	V/I	V/I	V/I	V/I	X
DW1B		V		V/I	X
DW1C		V/I		V/1	X
DW2B	V		V/I		X
DW2C	V/1				x
PZ2B	V	V	V	V/I	X
PZ3B					X
PZ4B	V		V/I		X
PZ513	V/1		VII		X
PZ5132	V/I	V/I	V/I	V/I	X
UW1B				V/1	x
UW1C				V/I	X
UW2B					X
UW2C					X

TABLE 5-2
Fall 2004 Groundwater Monitoring
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

Well	Groundwater Sampling				Water Level Measurements Quarterly
	July 2004	October 2004	January 2005	April 2005	
C-Aquifer Monitoring Wells					
CDM1C		V/I			X
CDMSC		V/1			X
CDM4C		V		V/I	X
CDMSC		V		V/I	X
CDM7C		VII			X
CDMSC	V/I	V/I	V/I	V/I	X
CDM13C		V	V	V/I	X
CDM15C		V/I		V/I	X
CDM16C	V/1	V/I	V/I	V/I	X
CDM17C	V/I	V/	V/I	V/I	X
CDM18C	V/I	V/I	V/I	V/I	X
PZ4C		V/I		V/1	X
PZ5C	V/I	VII	V/I	V/I	X
Residential Wells					
1770 North Avenue				V/1	
2045 North Avenue		V/I		V/1	
2429 North Avenue		V/I		V/1	
1304 Jensen Avenue				V/I	
1346 Jensen Avenue				V/I	
1642 Jensen Avenue				V/I	
1650 Jensen Avenue				V/I	
1912 Jensen Avenue				VII	
2121 Jensen Avenue				V/1	

Notes:
V = Well to be sampled for VOCs only.
V/I = Well to be sampled for VOCs and inorganic constituents.
NS = Well not sampled.
Source: CDM 2005a.

5.4.1.1 Elevation and Flow Directions

As stated in Section 3.2.1, there are three aquifers below the FSL. The shallow unconfined aquifer is defined as the A-Aquifer. The B-Aquifer the mid-depth aquifer and is confined. The C-Aquifer is the deepest aquifer and is also confined. The A-Aquifer spans from

approximately 50 to 95 feet bgs, the B-Aquifer from approximately 110 to 150 feet bgs, and the C-Aquifer from approximately 200 to 240 feet bgs.

Groundwater elevation has been decreasing in the FSL area since 2001. The elevation was decreasing until about 1993 and then began increasing until 2001 in all wells. Since 2001, the water has decreased 10 feet, back to 1993 water levels (around 200 feet) (CDM 2005b). This is consistent with a continuing decline in the regional water table.

The groundwater contours from April 2000 and June 2004 are shown on Figures 5-2a, 5-2b, 5-3a, 5-3b, 5-4a, and 5-4b. The decrease in groundwater from 2000 to 2004 is evident in these contours, as is the southwest groundwater flow direction.

Groundwater elevation across the site currently ranges from approximately 199.5 feet above mean sea level in the northeast to approximately 195 feet above mean sea level in the southwest of the landfill. Measurements from April (wet season) are about 0.5 foot higher than in November (dry season). Cones of depression form around the five groundwater extraction wells to the west of the landfill. Because the groundwater elevation has decreased, it is not possible to obtain water levels from numerous A-Aquifer wells. Groundwater flow is predominantly to the west. West of the landfill, the groundwater flows predominantly to the south.

In the B-Aquifer, groundwater elevations are also decreasing. The groundwater flows are to the southwest, similar to those in the A-Aquifer. The extraction wells in the A-Aquifer appear to have an influence on groundwater flow in the B-Aquifer, as shown in the deflection of contour lines. Groundwater elevation contours in the C-Aquifer are also decreasing. Flow is generally to the southwest (CDM 2005a).

5.4.1.2 A-Aquifer

The five extraction wells operate in this shallow aquifer. There are 31 A-Aquifer monitoring wells that are currently sampled and analyzed for VOCs and/or inorganics. Concentrations of VOCs are highest in the A-Aquifer as compared to B- and C-Aquifers. Constituents detected above MCLs in the A-Aquifer include PCE, TCE, vinyl chloride, and cis-1,2-DCE. Other VOCs that were detected but are below MCLs include 1,1-DCA, 1,1-DCE, 1,2-DCB, 1,2-DCA,1,2-dichloropropane,1,4-DCB, benzene, chlorobenzene, dichlorodifluoromethane, and trans-1,2-DCE.

TCE, PCE, Vinyl Chloride, and cis-1,2-DCE. Table 5-3 shows the maximum concentrations of TCE, PCE, vinyl chloride, and cis-1,2-DCE each year with available data. These are analyzed because they are above the MCL in numerous wells. Interestingly, the concentrations generally increased from 1995 to 1999. In 1999, Early Action began. The 2004 data shows that the maximum concentrations for all constituents have decreased below their 1999 maximum concentrations. PZ-5A is located in the southwestern corner of the landfill recorded numerous maximum concentrations. This well is located in the plume downgradient of the landfill and was installed in 1998. CDM-12A is located just northwest of PZ-5A. CDM-15A, which recorded the maximum cis-1,2-DCE concentration in 2003, is actually located in the northwest corner.

TABLE 5-3
A-Aquifer Maximum Groundwater Concentrations of PCE, TCE, Vinyl Chloride, and cis-1,2-DCE
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

Year	PCE (µg/L)	TCE (µg/L)	Vinyl Chloride (µg/L)	cis-1,2-DCE (µg/L)
1995	58 (MW-1)	32 (MW-1)	21 (W-5)	120 (MW-1)
1996	49 (MW-1)	37 (MW-4)	180 (MW-4)	240 (MW-4)
1997	28 (MW-4)	39 (MW-4)	170 (MW-4)	210 (MW-4)
1998	29 (MW-1)	42 (MW-4)	130 (MW-4)	140 (MW-4)
1999	57 (PZ-5A)	100 (MW-4)	130 (MW-4)	420 (PZ-5A)
2000	190 (PZ-5A)	99 (PZ-5A)	190 (W-4)	240 (CDM-12A)
2001	130 (PZ-5A)	74 (PZ-5A)	77 (CDM-12A)	250 (CDM-12A)
2002	140 (PZ-5A)	80 (PZ-5A)	61 (CDM-12A)	260 (CDM-12A)
2003	92 (PZ-5A)	64 (PZ-5A)	52 (CDM-12A)	190 (CDM-15A)
2004[a]	23 (CDM-12A)[a]	19 (CDM-12A)*	46 (CDM-12A)[a]	170 (CDM-12A)[a]

Source: CDM 2005c.
* CDM 2005a.
µg/L micrograms per liter

The *Fall 2004 Semi-Annual Performance Monitoring Program Report* (CDM 2005) includes concentration trends for PCE, TCE, vinyl chloride, and cis-1,2,-DCE at selected wells. The graphs indicate a decreasing or stable concentration trend in most wells for these VOCs, with a few exceptions. PCE shows a slight increase (2 to 3.7 micrograms per liter [µg/L]) in well CDM-6A but still remains below the MCL in that well. cis,1-2,DCE is increasing in extraction well PW-2A and monitoring wells CDM-12A, MW-1, and CDM-15A.

The constituents plumes for TCE, PCE, and vinyl chloride were compared from April 2000 and April 2004 and are included as Figures 5-5a to 5-7b. The TCE plume has shrunk in size since 2000. The western boundary of the plume is now closer to the landfill. The PCE plume has also shrunk closer to the landfill. The southern plume has dramatically decreased from a maximum concentration of 190 µg/L to 1.4 µg/L. The center of the western plume has slightly increased to 15 µg/L from 2.1 µg/L. The northern section of the plume has decreased in concentration from a maximum of 20 µg/L to 9.8 µg/L. The southern section of the vinyl chloride plume has decreased from a maximum of 190 µg/L to 39 µg/L. The entire southern plume has decreased slightly in size but more so in concentration. The northern part of the plume has also decreased in concentration from 76 µg/L to 5 µg/L.

There are no plume maps available for cis-1,2-DCE.

Inorganic Constituents: Nitrate and Total Dissolved Solids. Many of the A-Aquifer monitoring wells have concentrations of nitrate and total dissolved solids (TDS) above their respective MCLs. Nitrate has recently been found at concentrations of up to 42 milligrams per liter (mg/L) at well CDM-16A. The MCL for nitrate is 10 mg/L. TDS concentrations are as high as 1,166 mg/L at well CDM-12A. The MCL for TDS is 500 mg/L.

5.4.1.3 B-Aquifer

The constituents detected at concentrations above the MCL in the B-Aquifer are the same as in the A-Aquifer: PCE, TCE, cis-1,2-DCE, and vinyl chloride. Other VOCs detected below the MCL include 1,1-DCA, 1,2-dichoropropane, 1,4-DCB, cis-1,2-DCE, dichlorodifluoromethane, trans-1,2-DCE, and trichlorofluoromethane.

TCE, PCE, Vinyl Chloride, and cis-1,2,-DCE. Table 5-4 presents the maximum concentrations of TCE, PCE, vinyl chloride, and cis-1,2-DCE each year with available data. Interestingly, the concentrations generally increased from 1995 to 1999. These constituents follow a similar trend in the B-Aquifer as in the A-Aquifer. The maximum generally increases until 1999/2000 and has decreased in recent years. DW-1B is located southwest of landfill. It was installed in 1986. CDM-4B is actually on the western side of the park. CDM-12B is located on the southwestern area of the landfill just east of the park.

TABLE 5-4
B-Aquifer Maximum Groundwater Concentrations of PCE, TCE, Vinyl Chloride, and cis-1,2-DCE
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

Year	PCE (µg/L)	TCE (µg/L)	Vinyl Chloride (µg/L)	cis-1,2-DCE (µg/L)
1995	39 (DW-1B)	26 (DW-1B)	8.4 (CDM-8B)	33 (DW-1B)
1996	43 (DW-1B)	37 (DW-1B)	10 (CDM-8B)	48 (DW-1B)
1997	62 (DW-1B)	62 (DW-1B)	23 (DW-1B)	100 (DW-1B)
1998	51 (DW-1B)	52 (DW-1B)	18 (DW-1B)	80 (DW-1B)
1999	110 (PZ-5B)	59 (DW-1B)	21 (PZ-5B)	100 (DW-1B)
2000	54 (PZ-5B)	50 (CDM-12B)	23 (CDM-12B)	150 (CDM-12B)
2001	43 (CDM-4B)	29 (CDM-12B)	24 (CDM-12B)	69 (CDM-12B)
2002	55 (CDM-4B)	29 (CDM-4B)	19 (CDM-12B)	66 (CDM-12B)
2003	54 (PZ-5B)	20 (CDM-4B)	12 (CDM-12B)	38 (CDM-12B)
2004*	55 (CDM-4B)	25 (CDM-4B)	7.3 (CDM-13B)	22 (CDM-12B)

Source: CDM 2005c.
* CDM 2005a.

VOC concentrations at CDM-4B have been increasing ever since the onset of the Early Action groundwater extraction. PCE concentrations have increased from approximately 25 µg/L to approximately 50 µg/L in 2004. CDM-5B has had a slight increase since the onset of the Early Action groundwater extraction for PCE, cis-1,2-DCE, and TCE, but is stable for vinyl chloride. VOC concentrations at CDM-15B and DW-1B have remained stable since the onset of Early Action. VOC concentrations at CDM-8B remained steady during the onset of the Early Action but have been decreasing ever since startup of Phase 1.

Figures 5-8a, 5-8b, 5-9a, and 5-9b show the TCE and PCE plumes from April 2000 and April 2004 in the B-Aquifer. The TCE and PCE plumes appear to be similar in concentration, size, and shape in April 2000 and April 2004. The vinyl chloride plume appears slightly

closer to the landfill, with slightly lower concentrations in 2004 than in 2000 (Figures 5-10a and 5-10b).

Inorganic Constituents: Nitrate and TDS. Nitrate and TDS concentrations exceed the MCLs in the B-Aquifer. Concentrations of nitrate in July 2004 were as high as 43.9 mg/L as N in well CDM-18B. TDS was as high as 1,239 mg/L in October of 2004 in CDM-18B as well. CDM-18B is located next to an active dairy pond (CDM 2005a). Exceedances also occurred at wells CDM-16B and CDM-17B for nitrate, as well as eight others for TDS, but the concentrations were much lower.

5.4.1.4 C-Aquifer

PCE is the only constituent that was detected above the MCL in C-Aquifer in 2004. It was detected at 6.3 ug/L in CDM-15C and 5.4 µg/L in PZ-5C. The MCL for PCE is 5 µg/L. This was the first exceedance of the MCL for PCE in well PZ-5C. Other VOCs detected below the MCL include cis-1,2-DCE, dichlorodifluoromethane, TCE, and trichlorofluoromethane, all in very low concentrations. No trend graphs were provided for the C-Aquifer in the *Fall 2004 Semi-Annual Performance Monitoring Report* (CDM 2005a).

Table 5-5 shows the maximum concentrations of PCE, TCE, vinyl chloride, and cis-1,2-DCE since 1995. PCE and TCE have been increasing, with maximums found in the southwest corner in wells PZ-5C and CDM-13C. Vinyl chloride and cis-1,2-DCE were not detected until 2003 and 2002, respectively.

TABLE 5-5
C-Aquifer Maximum Groundwater Concentration of PCE, TCE, Vinyl Chloride, and cis-1,2-DCE
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

Year	PCE (µg/L)	TCE (µg/L)	Vinyl Chloride (µg/L)	cis-1,2-DCE (µg/L)
1995	ND	ND	ND	ND
1996	ND	ND	ND	ND
1997	1.3 (CDM-5C)	ND	ND	ND
1998	.6 (CDM-4C)	ND	ND	ND
1999	.89 (CDM-15C)	ND	ND	ND
2000	1.4 (PZ-5C)	ND	ND	ND
2001	4.5 (PZ-5C)	1 (PZ-5C)	ND	ND
2002	3.5 (PZ-5C)	.74 (PZ-5C)	ND	.58 (CDM-8C)
2003	7.6 (CDM-13C)	4.4 (CDM-13C)	7.8 (CDM-13C)	3.3 (CDM-13C)
2004*	6.3 (CDM-15C)	.66 (PZ-5C)	ND	.58 (CDM-13C)

Source: CDM 2005c.
* CDM 2005a.

Plume maps were not created in April 2000 for the C-Aquifer because only three wells were sampled. All VOCs were non-detect for two of the wells, but CDM-4C had concentrations of dichlorodifluoromethane at 5.9 µg/L (Nyznyk 2005) and PCE at 0.8 µg/L (CDM 2005c). In

April 2004, there was no detection of vinyl chloride in the C-Aquifer in any wells, including CDM-13C. Figures 5-11, 5-12, and 5-13 show the PCE, TCE, and vinyl chloride plumes for April 2004. TCE was detected at .72 µg/L and .65 µg/L at two locations directly next to the landfill. PCE was detected as high as 4.6 µg/L in CDM-15C, whereas it was not detected at all in CDM-15C in April of 2000. In the April of 2004, dichlorodifluormethane was found at well CDM-4C at 11 µg/L and at a maximum of 22 µg/L in well CDM-8C (CDM 2004).

Inorganic Constituents: Nitrate and TDS. Nitrate and TDS concentrations exceeded the MCLs in three wells in the C-Aquifer. CDM-18C had the highest exceedances of nitrate at 19.3 mg/L and TDS (762 mg/L) in July 2004.

5.4.1.5 Vertical Gradient

Three additional monitoring wells, CDM-13B2, CDM-15B2, and PZ-5B2 were installed deep into the B-Aquifer in the summer of 2001 to evaluate vertical migration of constituents. Three C-Aquifer wells have seen stable to decreasing concentrations of constituents regardless of the trends in the A- and B-Aquifers. PZ-5C, PZ-5B, and PZ-5B2 have shown stable to slightly increasing trends in PCE, while the concentration in the PZ-5A aquifer has decreased. Table 3-4 of the CDM report (2005a) shows the head differentials at well clusters. In July 2004, a downward gradient of .03 foot existed between PZ-5A and PZ-5B. A downward gradient of .18 foot existed between PZ-5B and PZ-5C. A downward gradient of .21 foot existed between PZ-5A and PZ-5C.

5.4.1.6 Residential Wells

Water quality measurements have been taken for residential areas. Concentrations of PCE have remained steady and below MCL (5 µg/L) since 1995. Cis-1,2-DCE was measured for the first time in a well on Jensen Avenue in 2003 at .84 µg/L, just above the detection limit of 0.5 µg/L.

TABLE 5-6
Residential Wells Maximum Groundwater Concentration of PCE, TCE, Vinyl Chloride, and cis-1,2-DCE
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

Residential Wells	PCE (µg/L)	TCE (µg/L)	Vinyl Chloride (µg/L)	cis-1,2-DCE (µg/L)
1995	2.3 (North St.)	ND	ND	ND
1996	2.8 (North St.)	ND	ND	ND
1997	2.6 (North St.)	ND	ND	ND
1998	3.1 (North St.)	ND	ND	ND
1999	2.4 (North St.)	ND	ND	ND
2000	1.8 (North St.)	ND	ND	ND
2001	2.4 (North St.)	ND	ND	ND
2002	2.1 (North St.)	ND	ND	ND
2003	1.4 (North St.)	ND	ND	0.84 (Jensen Ave.)
2004	2.2 (North St.)	ND	ND	ND

5.4.1.7 Extraction Wells

Extraction well PW-4A has been consistently drawing in water with the highest concentrations of PCE, TCE, vinyl chloride, and cis-1,2-DCE. The concentrations have remained consistent since pumping began in 1999.

TABLE 5-7
Extraction Wells Maximum Groundwater Concentration of PCE, TCE, Vinyl Chloride and cis-1,2-DCE
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

Extraction Wells	PCE (µg/L)	TCE (µg/L)	Vinyl Chloride (µg/L)	cis-1,2-DCE (µg/L)
1999	54 (PW-3A)	25 (PW-3A)	10 (PW-2A)	130 (PW-1A)
2000	49 (PW-4A)	47 (PW-4A)	67 (PW-4A)	230 (PW-4A)
2001	46 (PW-4A)	32 (PW-4A)	21 (PW-4A)	120 (PW-4A)
2002	41 (PW-4A)	34 (PW-4A)	16 (PW-4A)	120 (PW-4A)
2003	52 (PW-4A)	39 (PW-4A)	17 (PW-4A)	110 (PW-4A)

Influent/Effluent. The *Fall 2004 Semi-Annual Performance Monitoring Report* includes a table that shows the influent concentrations for two sampling events in 2004. This is included in Table 5-8 below. TCE, PCE, vinyl chloride, and cis-1,2-DCE were present in the influent above the MCLs. Other VOCs were detected but were under their MCLs. The effluent must be treated to the level of non-detect for COCs. No COCs were detected in the effluent. Two trihalomethanes (THMs), bromoform and dibromochloromethane, were detected in the effluent at .97 and .63 µg/L, respectively. The THMs were not present in the influent. The THMs are formed during the treatment process. Sodium hypochlorite reacts with the raw groundwater, leaving residual chlorine. The residual chlorine then is oxidized to hypochlorous acid. The hypochlorous acid reacts with organics in the water to form THMs. The drinking water regulations place a limit of 80 µg/L on total THMs. The combination of bromoform and dibromochloromethane is 1.6 µg/L, well below the drinking-level regulation (CDM 2005a).

TABLE 5-8
Phase 1 Groundwater Treatment Plant Influent and Effluent Concentrations of Select Constituents
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

Contaminant of Concern (PQL - µg/L)	Treatment Standards	Results (µg/L)			
		Sample 35 7120/2004		Sample 36 11/1/2004	
		Influent	Effluent	Influent	Effluent
Trichloroethene (0.5)	ND	9.8	—	9.1	—
Tetrachloroethene (0.5)	ND	22	—	18	—
Vinyl Chloride (0.5)	ND	2.6	—	2.1	—
1,1-dichloroethene (0.5)	ND	—	—	—	—
1,2-dichloroethane (0.5)	ND	—	—	—	—

TABLE 5-8
Phase 1 Groundwater Treatment Plant Influent and Effluent Concentrations of Select Constituents
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

Contaminant of Concern (PQL - µg/L)	Treatment Standards	Results (µg/L)			
		Sample 35 7120/2004		Sample 36 11/1/2004	
		Influent	Effluent	Influent	Effluent
Trans-1,2-dichloroethene (0.5)	ND	1.5	-	1.2	—
CIS-1,2-dichloroethene (0.5)	ND	32	-	33	—
1,2-dichloropropane (0.5)	ND	0.60	—	0.57	—
1,2-dichlorobenzene (0.5)	ND	—	—	—	—
1,4-dichlorobenzene (0.5)	ND	1.7	—	0.88	—
Benzene (0.5)	ND	—	—	—	—
Chlorobenzene (0.5)	ND	—	—	—	—
Chloroform (0.5)	ND	—	—	—	—
1,1-dichloroethane (0.5)	ND	1.7	—	1.9	—
Trichlorofluoromethane (0.5)	ND	1.0	—	1.2	—
Toluene (0.5)	ND	—	—	—	—
Other Constituents					
Bromodichloromethane (0.5)	NS	—	—	—	—
Bromoform (0.5)	NS	—	0.97	—	1.5
Dibromochloromethane (0.5)	NS	—	0.63	—	—
Dichlorodifluoromethane (0.5)	NS	11	—	11	—

Notes:
VOC analysis – USEPA Method 8260B.
PQL = Practical Quantitation Limit.
Treatment Standards are defined in the Clean Water Act, Title 33, Code of Federal Regulations, Parts 301 and 302.
ND = Non-detect.
NS = Not Specified.
— = Compound not detected.
Source: CDM 2005a.

The treatment of the influent groundwater has resulted in the removal of 238 kilograms of VOCs since 1999. Table 5-9 shows the amount removed each quarter. This includes 165 kilograms that were removed during the Early Action system and 72.7 kilograms that have been removed during Phase 1 treatment thus far.

TABLE 5-9
VOC Mass Removal
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

Quarter	Pumping Period (days)	Average VOC Concentration[a] (µg/L)	Average Flow Rate (Meter-Based) (gpd)	VOC Removal (kg)
Phase 1 GTP				
4th Quarter 2001	107	77.4	302,540[b]	9.5
1st Quarter 2002	90	136.5	124,792[b]	5.8
2nd Quarter 2002	91	89.5	113,745[b]	3.5
3rd Quarter 2002	92	72.1	101,922[b]	2.6
4th Quarter 2002	92	80[d]	74,339[c]	2.1
1st Quarter 2003	90	87.9	236,117[c]	7.1
2nd Quarter 2003	91	65.4	272,744[c]	6.1
3rd Quarter 2003	90	86.7	205,618[c]	6.1
4th Quarter 2003	91	97.5	214,121[c]	7.2
1st Quarter 2004	91	79.9	249,846[c]	6.9
2nd Quarter 2004	91	73.3	182,967[c]	4.6
3rd Quarter 2004	92	83.9	184,680[c]	5.4
4th Quarter 2004	92	79	212,451[c]	5.8
Subtotal				**72.7**
Early Action System				
May 1999 -Sept. 2001				165
Total				**237.7**

Notes:

[a] Non-detects assumed to be at a concentration of zero for the purpose of estimating the total VOC concentration.

[b] Average based on the total PTA influent flow divided by the number of days in the quarter.

[c] Average based on the sum of the flows from the individual extraction wells divided by the number of days in the quarter.

[d] Influent and effluent samples were not collected 4th Quarter 2002. The VOC concentration represents an average of the VOC concentration in 3rd Quarter 2002 and 1st Quarter 2003.

Source: CDM 2005a.

5.4.1.8 Emerging Constituents of Concern

Emerging constituents include unknown constituents at the time of the ROD, constituents for which a MCL is not established, or constituents for which the treatment system cannot remediate as currently constructed.

The emerging COCs for FSL are 1,4-dioxane, 1,2,3-trichloropropane, perchlorate, cyanide, and N-nitrosodimethylamine. The City collected treatment plant influent and effluent and tested the samples for all five of these COCs in the April/May 2005 monitoring round. The

results of the emerging COC analysis were presented in the *Spring 2005 Semi-annual Performance Monitoring Program Report*, dated July 29, 2005. The COCs were non-detect in all samples collected from the influent and effluent of the groundwater treatment plant (CDM 2005d).

5.4.2 Air

The Consent Decree specified testing and limits for some aspects of air quality at the FSL. Areas of interest were the LFG surface emissions, the landfill perimeter probe gases, and the LFG flare emissions. The compliance testing activities, submitted in the *First Compliance Testing Report* (Kleinfelder 2004) were conducted according to the *Final Testing Plan* (GeoSyntec 2003).

5.4.2.1 Landfill Surface Emissions

The regulatory instantaneous threshold limit for landfill surface emissions is set at 1,000 ppmv above the background levels as described in the Consent Decree. The surface is to be monitored quarterly. Quarterly measurements were not available for this review but measurements for the compliance testing report were reviewed. Kleinfelder monitored the landfill surface for VOCs on March 17 and 18, 2004 with a Foxboro model OVA108™ portable organic vapor analyzer. Measurements were recorded approximately every 120 feet from the north to the south of the landfill. This resulted in 14 north south traverses (approximately 90 feet apart) with 33 to 36 measurements at each traverse. The VOC concentrations ranged from 3 to 14 ppmv, well under the 1,000 ppmv threshold limit.

5.4.2.2 Landfill Gas Monitoring

The FSL has clusters of monitoring probes that were required under CCR Title 27 to assess the potential subsurface migration of landfill gases from the disposal area. The probe clusters at the FSL consist of three separate gas monitoring probes that extend to depths of 5, 25, and 45 feet below grade. The three gas monitoring probes have color-coded PVC casings that are contained in one larger casing. The probes are analyzed for methane, carbon dioxide, oxygen, and balance (nitrogen) using a GES Landtec Model GEM 2000 portable landfill gas monitoring device. For compliance testing, measurements were taken at 13 probe clusters along the perimeter of the landfill on April 19 and 20, 2004. The first compliance testing report indicates that some of the monitoring wells needed maintenance. Many of the caps were missing from the ends of the LFG monitoring probe sampling tubing and should be replaced. Debris and/or water were inside the tubing at two landfill locations (MMW4 at depths of 5 feet, 25 feet, and 45 feet and MMW3 at 5 feet), shown on Figure 5-14. Two of the vault lids were partially buried by surface soil (GMW-1 and GMW-3). The location of CMW-7 did not correspond with its location on the map.

CCR Title 2720921 allows 5 percent methane by volume at the facility property line. Methane was detected in three of the 13 clusters. In the 45-foot deep probes, methane was detected at 1.5 percent (probe MMW2) and.7 percent (probe MMW3), well below the requirement. Methane was detected at probe MMW5 below the 5 percent limit at the 5-foot and 45-foot depths. Methane was recorded above the limit at MMW5 at the 25-foot depth at 13.4 percent by volume. MMW5 is located close to the waste and not near the property line. Kleinfelder recommends that the monitoring probe location be re-measured to provide ongoing methane levels in that area. If the levels do not decrease, the City may need to

install an additional well between MMW5 and the property line along Jensen Avenue. Carbon dioxide was detected at a range of 0 to 18 percent. Neither typical ranges nor limits for carbon dioxide are presented in the report, but Kleinfelder states that the levels are consistent with the methane detected. Oxygen was detected ranging from 7.6 percent to 21.3 percent at the monitoring probes. Acceptable or optimal concentrations were not presented in the report.

5.4.2.3 Landfill Gas Treatment

The performance standards for the LFG flare identified in the 1993 ROD are twofold. The first standard is that the remedy must meet the reactive organic destruction efficiency requirements of the SJVUAPCD Rule 4642. This rule states that the flare must achieve a VOC destruction efficiency of 98 percent by weight, or the VOC concentration must be under 20 ppmv (measured as methane) corrected to 3 percent oxygen. The second standard is that the emissions shall not exceed a level, as determined by the USEPA, which would cause a 10^{-6} excess cancer risk as determined pursuant to the California Air Pollution Control Officers' Association Air Toxics "Hot spots" Program Risk Assessment Guidelines, January 1991.

Three sampling events were conducted in February 2004. Field measurements of the intake air ranged from 20.4 percent to 36.5 percent methane concentrations, and the discharge gases ranged from 0.0 percent to 0.01 percent methane. The LFG flare did not achieve 98 percent destruction efficiency for VOCs. The concentration of VOCs was 20.2 ppmv, just above the 20 ppmv requirement. The effluent gas temperature was apparently 1,363 °F, which has reportedly been increased to approximately 1,450 °F since the testing. The sampling location was also identified as a potential cause for the non-compliance. The oxygen content apparently is increased with the current location at the sampling ports located between the collection system blowers and the flare. Kleinfelder recommends moving it to just upstream of the lower system for the second round of compliance. Also, no samples were collected from the PTA exhaust air. This is the second source of VOCs and, while it is a much lower concentration than the LFG itself, the destruction efficiency is calculated lower than reality. Therefore, Kleinfelder recommends that they test the influent stream from the PTA for VOCs and add that into the calculation for destruction efficiency (Kleinfelder 2004). The second round of testing was performed in April 2005. While conducting the second compliance test, samples of the effluent air emissions at the PTA were collected to determine the concentration of VOCs in the exhaust air from the groundwater treatment packed tower aerator (PTA). The laboratory analytical results from these samples will be included in the 2nd Compliance Testing Report and will be used to verify that this potential source emits very low VOC concentrations. At the time of this Five-Year Review, the second compliance testing report was still in preparation by Kleinfelder and therefore results were not available for review. A recommendation will be made to evaluate the performance of the flare in a follow-up to the Five-Year Review.

The City has requested that the groundwater treatment plant remain online while the flare is taken offline for routine maintenance. The flare normally receives influent air from the PTA and the LFG. It is required to meet 98 percent destruction efficiency. USEPA conditionally approved the City's request in a letter to the project coordinator for the City of Fresno, dated April 7, 2005. The conditions that the City must examine include compliance with local air discharge limits and sustained compliance with air discharge. The two criteria

to be met, according to the SJVAPCD, are that the flare must emit less than 2 pounds per day of any of the five criteria pollutants and must not be a hazardous air pollutant emissions source that will cause a significant health risk. If the PTA does not meet these requirements, it would need to meet substantive air permit requirements. The community must be notified, and clarification of the proposed 14-day downtime and operating procedure that the flare will be manually disconnected and reconnected to the PTA must be documented.

The potential need for dioxin testing of the flare has been an issue raised in the past. *De novo* dioxin formation is a potential concern under certain operating conditions. These conditions are related to incinerator design and gas residence time in the temperature window favoring dioxin formation. This issue is addressed in Section 7.0 and recommendations are provided.

5.4.3 Stormwater

The City of Fresno submits an annual report to the RWQCB every year by July 1. This is required by the Regional Board Industrial Storm Water Permit. For this Five-Year Review, annual stormwater reports from 1999 to 2004 were reviewed.

The City is required to collect and analyze samples from two storm events in accordance with sections B.12 or 15 of the General Permit. In 2003 and 2004, the City met this requirement. The samples were collected from the three stormwater discharge locations: the west side, the south side, and the east side during the first hour of discharge after at least three working days without a stormwater discharge. In 2002 and 2003, the City collected samples from only one storm but did not state the reason. In 2000, 2001 and 2002, the City did not collect any samples during a storm because the site was under closure construction as required by the USEPA and there was reportedly no runoff. In 1999 and 2000, the City collected one sample from one discharge location. An exception form was filled out indicating that significant stormwater discharges occurred at times other than scheduled facility operating hours or within 2 hours, following scheduled operating hours, hence only one storm event was captured.

Visual observations were made of all drainage areas to detect the presence of unauthorized non-stormwater discharges and their sources, as required by Section B.3.a of the General Permit. No unauthorized non-stormwater discharges were detected in any year.
Monthly visual observations of stormwater discharges occurred at all locations during the wet season, as required in Section B.4.a of the General Permit. The wet season months are October through May. In 2003 and 2004, all observations were made. In April 2004, no storms occurred, and in May 2004 no discharge occurred. In 1999 and 2000, 2000 and 2001, and 2001 and 2002, the reports were filled out, indicating that the observations were not made at all locations, but the attached Form 4 shows that the observations were made at one location on West Avenue and that no pollutants were observed.

An Annual Comprehensive Site Compliance Evaluation, as required by Section A.9 of the General Permit, was conducted each year according to the stormwater reports. The potential pollutant source/industrial activity area was not applicable to the Fresno Sanitary Landfill.

The samples were analyzed for pH, TSS, total organic carbon, specific conductance, and oil and grease. Reporting limits were not provided in the reports, but the laboratory results from the stormwater analysis were reviewed. pH ranged from 7.9 to 8.1 in 2003 and 2004, 6.7 to 7.4 in 2002 and 2003, and was 6.93 in 1999 and 2000. TSS ranged from 15 to 180 mg/L

in 2003 and 2004, 180 to 600 mg/L in 2002 and 2003, and was 820 mg/L in 1999 and 2000. Total organic carbon ranged from 6.6 to 15 mg/L in 2003 and 2004, 5.3 to 7.4 mg/L in 2002 and 2003, and was not tested for in 1999 and 2000. Specific conductance ranged from 170 to 450 µmho/cm in 2003 and 2004, was not tested for in 2002 and 2003, and was 200 µmho/cm in 1999 and 2000. Oil and grease has not been detected in any of the stormwater discharge analyzed (City of Fresno 2000, 2001, 2002, 2003, 2004).

5.4.4 Landfill Gas Condensate

Six sumps (five at the toe of the landfill slopes and one adjacent to the landfill gas flare) are connected via a common piping system. The condensate from the landfill gas collection system is conveyed via piping to a sewer manhole located in the intersection of North and West Avenues. It is then conveyed approximately 4 miles west to the Fresno-Clovis Regional Wastewater Treatment Facility. The sumps each have float sensors that trigger automatic pumping to the manhole when the condensate level reaches a designated height. The City is looking into installing a gauge to obtain a numeric value for the condensate volume discharged to the publicly-owned treatment works (POTW).

The Consent Decree does not specify gas condensate limits but general discharge criteria were obtained from the Fresno-Clovis Regional Wastewater Treatment Plant. The original intent, as specified in the Consent Decree was to sample from the manhole. Because the manhole is located in the middle of the intersection, the sumps are instead sampled at condensate sump CS-1, next to the LFG flare area. The condensate from CS-1 is actually from the LFG from the entire site. Therefore, Kleinfelder states that it is actually a more representative sample than the manhole sample would have been. According to George Slater, Project Coordinator for the City of Fresno, the condensate samples for the second round of flare testing were taken from CS-1, located adjacent to the LFG flare; CS-2, located along the southwest edge of the landfill; and CS-6, located along the southeast edge of the landfill. This change was approved by the EPA and the Regional Water Quality Control Board because of the difficulty of sampling from the manhole in the intersection of West Ave and North Ave. This change was discussed in the 2nd Compliance Testing Report which was not available at the time of this Five-Year Review.

Kleinfelder collected samples of the LFG condensate from CS-1 on March 9, 2004. Numerous VOCs, semivolatile organic compounds, metals, and other characteristics were detected in the condensate. Those that exceeded the discharge limits include arsenic, cyanide, and pH. Arsenic at.349 mg/L was above its discharge limit of.32 mg/L. Cyanide, at 28.2 mg/L, was well over its.77 mg/L discharge limit. The pH, at 4.87, was outside of its limit of 6 to 12.4. Discharge limits for many of the detected VOCs do not exist. Kleinfelder recommended that the Fresno-Clovis Regional Wastewater Treatment Facility staff be informed of the characteristics of the condensate discharge.

5.4.5 Operations and Maintenance Activities, 1998 to 2003

The total flow, the average flow rate, and the percent well operation are presented in Table 5-10 for the five extraction wells. The extraction wells were all consistently operating at around 80 to 95 percent of the time in 2004. From October 2000 through June 2002, PW-1A, PW-2A, PW-3A, and PW-4A were operating at lower percentages of time than their usual percent well operation. The Early Action treatment system was operating during the first part

of this time frame (until September 2001). The downtime was largely attributed to construction activities, power outages, and the changeover to the Phase 1 treatment system. Pumps were removed from PW-1A, PW-3A, and PW-4A from June 5 to June 20, 2001 in order to redevelop the wells and install new subsurface vaults. The North Treatment Unit was down for a week in the beginning of August 2001 while a broken pressure manhole on an irrigation line was replaced. Activities to connect PW-1A, PW-2A, PW-3A, and PW-4A to the Phase 1 treatment system resulted in a 25 percent operation time from August 9 to September 25, 2001. The Phase 1 treatment system, online in September of 2001, experienced downtime due to troubleshooting, well pump replacement, and anti-scalent system problems (CDM 2001a).

Average flow rates have also decreased at all of the wells except PW-5A. PW1A has had a decrease in average flow rate from 96 gallons per minute (gpm) in 1999 to 43 gpm in the fourth quarter 2004. PW-2A has had a decrease in average flow rate from 105 to 32 gpm, PW3A from 175 to 39 gpm, and PW-4A from 26 to 13 gpm during that similar time period. The extraction well flow rates have been adjusted because of lowered groundwater conditions (CDM 2005a). PW-5A was placed online in the summer of 2002 and has remained consistent in its average flow rate and its percent operation time.

TABLE 5-10
Groundwater Extraction Rates and Percent Operation
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

Extraction Well	Date	Total Flow (gallons)	Average Flow Rate (gpm)	% Well Operation
PW-1A	1999 Oct 19 - Dec 30	9,705,961 meter-based 10,200,679 calculated	96	95
	2000 Dec 30 '99 – Apr 24 '00	14,397,061 meter-based 14,436,504 calculated	87	100
	2000 Apr 24 – Oct 27	18,288,847 meter-based 22,522,752 calculated	84	81
	2000 – 2001 Oct 27 '00 – May 31 '01	17,967,172 meter-based 27,632,304 calculated	79	65
	2001 May 31 – Dec 31	8,577,059 meter-based 23,238,605 calculated	75	37
	2002 Jan 1 – June 30	12,709,000 meter-based 23,982,500 calculated	92	53
	2002 July 1 – Dec 31	7,960,717 meter-based	44	68
	2003 Q1	7,439,000 meter-based 9,553,338 calculated	68	78
	2003 Q2	5,099,000 meter-based	51	82
	2003 Q3	5,182,000 meter-based	44	90
	2003 Q4			Data not available
	2004 Q1	5,990,000 meter-based	52	89
	2004 Q2	4,567,000 meter-based	45	77
	2004 Q3	4,913,000 meter-based	43	81

TABLE 5-10
Groundwater Extraction Rates and Percent Operation
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

Extraction Well	Date	Total Flow (gallons)	Average Flow Rate (gpm)	% Well Operation
	2004 Q4	5,349,000 meter-based	43	98
PW-2A	1999 Oct 19 – Dec 30	10,752,048 meter-based 11,218,061 calculated	105	96
	1999 Dec 30 '99 – April 24 '00	19,136,130 meter-based 19,193,040 calculated	115	100
	2000 Apr 24 – Oct 27	30,731,060 meter-based 37,001,664 calculated	138	83
	2000 – 2001 Oct 27 '00 – May 31 '01	30,052,230 meter-based 45,645,768 calculated	131	66
	2001 May 31 – Dec 31	14,597,054 meter-based 29,357,280 calculated	95	49
	2002 Jan 1 – June 30	13,562,000 meter-based 27,892,100 calculated	107	49
	2002 July 1 – Dec 31	10,506,637 meter-based	49.1	81
	2003 Q1	10,584,885 calculated 7,995,000 meter-based	76	76
	2003 Q2	4,966,000 meter-based	49	85
	2003 Q3	2,597,000 meter-based	22	90
	2003 Q4			Data not available
	2004 Q1	5,038,000 meter-based	43	89
	2004 Q2	3,609,000 meter-based	35	78
	2004 Q3	3,156,000 calculated	26	91
	2004 Q4	4,069,000 calculated	32	97
PW-3A	1999 Oct 19 – Dec 30	16,851,341 meter-based 18,648,548 calculated	175	90
	1999 Dec 30 '99 – April 24 '00	29,030,881 meter-based 29,540,592 calculated	177	98
	2000 Apr 24 – Oct 27	36,904,639 meter-based 46,654,272 calculated	174	79
	2000 – 2001 Oct 27 '00 – May 31 '01	42,904,264 meter-based 63,149,142 calculated	181	68
	2001 May 31 – Dec 31	7,334,919 meter-based 25,378,596 calculated	82	29
	2002 Jan 1 – June 30	Unknown meter-based 21,405,060 calculated	82	unknown
	2002 July 1 – Dec 31	7,729,627	35	83

TABLE 5-10
Groundwater Extraction Rates and Percent Operation
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

Extraction Well	Date	Total Flow (gallons)	Average Flow Rate (gpm)	% Well Operation
	2003 Q1	4,140,688 meter-based 7,167,463 calculated	51	58
	2003 Q2	5,558,731 meter-based	53	87
	2003 Q3	5,522,000 meter-based	51	82
	2003 Q4			Data not available
	2004 Q1	6,568,000 meter-based	60	83
	2004 Q2	4,006,000 meter-based	41	75
	2004 Q3	3,775,000 calculated	35	81
	2004 Q4	4,599,000 calculated	39	90
PW-4A	1999 Oct 19 – Dec 30			Not Installed Until 12/7/99
	1999 Dec 30 '99 – Apr 24 '00	1,744,054 meter-based 2,059,200 calculated	26	85
	2000 Apr 24 – Oct 27 00	7,102,193 meter-based 7,775,712 calculated	29	91
	2000 – 2001 Oct 27 '00 – May 31 '01	9,054,816 meter-based 11,690,534 calculated	33	77
	2001 May 31 – Dec 31	1,862,800 meter-based 7,725,600 calculated	25	24
	2002 Jan 1 – June 30th	Unknown meter-based 11,865,636 calculated	46	unknown
	2002 July 1 – Dec 31	2,972,756 meter-based	11.6	97
	2003 Q1	1,127,884 meter-based 2,334,353 calculated	17	48
	2003 Q2	1,909,763 meter-based	17	92
	2003 Q3	1,622,000 meter-based	13	92
	2003 Q4			Data not available
	2004 Q1	1,388,000 meter-based	12	86
	2004 Q2	1,021,000 meter-based	10	82
	2004 Q3	1,466,000 calculated	13	85
	2004 Q4	1,680,000 calculated	13	98

TABLE 5-10
Groundwater Extraction Rates and Percent Operation
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

Extraction Well	Date	Total Flow (gallons)	Average Flow Rate (gpm)	% Well Operation
PW-5A	1999			Not Installed Until 6/15/01
	2000			Not Installed Until 6/15/01
	2001s			Not Installed Until 6/15/01
	2002 Jan 1– June 30			Not Installed Until 6/15/01
	2002 July 1 – Dec 31	3,085,994 meter-based	12.0	97
	2003 Q1	4,722,142 calculated 3,879,000 meter-based	34	82
	2003 Q2	3,400,000 meter-based	30	92
	2003 Q3	3,750,000 meter-based	30	93
	2003 Q4			Data not available
	2004 Q1	3,752,000 meter-based	32	89
	2004 Q2	3,447,000 meter-based	32	82
	2004 Q3	3,485,000 meter-based	28	95
	2004 Q4	3,140,000 meter-based	25	99

5.5 Regulatory Review

A review of applicable or relevant and appropriate requirements (ARARs) and other standards to be considered (TBCs) was conducted for the selected remedy at the FSL Superfund Site. The review was conducted to determine if changes to standards and TBCs have occurred since the RODs were issued in 1993 and 1996 that might affect current protectiveness of the selected remedies.

The specific documents that were reviewed for any changes, additions, or deletions are as follows:

- ROD signed on September 30, 1993 for OU 01.
- ROD signed on September 30, 1996 for OU 02.
- City of Fresno Department of Public Utilities, "November 17, 1997 meeting re 40 CFR 51 et seq.," Letter, December 1997.
- Consent Decree signed in August 1998.

- SJVUAPC, "Air Pollution Requirements for Fresno Landfill Remediation Project," Letter, 1998.

The following general requirements were identified as ARARs in the 1993 source control operable unit ROD:

- **Central Valley RWQCB Standards** – Selected sections from CCR, Title 23, Chapter 15, which pertains to landfill closure, including cover design and construction standards, as well as ancillary facilities.
- **California Integrated Waste Management Board Standards** – Selected sections from CCR, Title 14, which requires establishment of monitoring and control during closure and post-closure of a landfill.

In addition, performance criteria relating to constituent emissions into ambient air were established.

- Ambient air concentrations from both the landfill gas treatment system and the landfill itself can not exceed a level (determined by USEPA) that would cause a 10^{-6} excess cancer risk. The determination of the cancer risk was to be based on the California Air Pollution Control Officers Association Air Toxics "Hot Spots" Program Risk Assessment Guidelines (January 1991).
- The treatment system was required to meet the Solid Waste Disposal Sites – Draft Rule 46-42, which established a reactive organic destructive efficiency of 98 percent for any reactive organic except methane, any flares designed as part of the LFG control system be enclosed in a shroud, and the maximum concentration of organic compounds measured as methane, measured at any point on the surface of the landfill shall not exceed 1,000 ppm.
- The gas extraction system will be operated until the LFG production has declined to the extent that the compliance points monitoring requirements can be met without continued gas extraction.
- The flares shall be operated as long as the LFG extraction system is in operation.

The following general requirements were identified as ARARs in the 1996 groundwater operable unit ROD:

- **Safe Drinking Water Act** – Sections relating to maximum contaminant MCLs and underground injection.
- **Clean Water Act** – Sections relating to effluent limitations for point source pollution discharges and establishment of pretreatment standards for the control of pollutants to POTWs.
- **Clean Air Act** – Relates to emission standards for specific chemicals and requires the groundwater treatment facility to meet all substantive conditions stipulated in the SJVUAPCD rules.
- **Central Valley RWQCB Standards** – Selected sections from CCR, Title 23, relating to assurances that implementation of a remedial action is meeting objectives.

- **Central Valley RWQCB Standards –** Selected sections from CCR, Title 22, relating to hazardous waste storage in containers and design and management standards for tanks.
- **California Health and Safety Code –** Prohibits the discharge or release to water or to land of chemical known to the State of California to cause cancer or reproduce toxicity when the chemical will probably pass through a source of drinking water.

Tables 5-11 and 5-12 provide an evaluation of ARARs using the regulations and requirements listed in the RODs as a basis. No location-specific ARARs were identified in either of the RODs. The evaluation includes a determination of whether the regulation is currently an ARAR or TBC and whether the requirements have been met. Most of the listed ARARs remain applicable or relevant and appropriate to the site and most are being complied with. A summary of changes to existing ARARs can be found in Section 6.2.

5.6 Site Inspection

Representatives of USEPA, FSL, and CH2M HILL performed a site inspection on March 9 and 10, 2005 to observe the current status of operations. The inspection included the components of OU-1 and OU-2, as well as a driving tour of the surrounding area including the agricultural wells. A summary of the inspection findings is presented below. The site inspection checklist and photos are provided in Appendices C and D, respectively. Conditions during the inspection were favorable, sunny, with temperatures of 75 to 80 °F. There were numerous birds at the site. According to the tour guides, coyotes, ground squirrels, and foxes all visit the site. The entire landfill has a perimeter fence around it, which is well maintained and locked.

The tour of OU-1 included a drive around the landfill with numerous stops to inspect different components. Overall, the landfill appeared to be in good condition with no apparent settlement. The vegetation was dense and healthy. The gravel roads on the landfill were also in good condition. There are 1,200 sprinkler heads on the landfill to ensure the vegetative cover is a success. Bait dispensers are placed around the landfill to prevent squirrels from damaging the liner.

There are 115 gas collection wells connected to a 12-inch loop system. On the day of the visit, approximately 80 percent of the gas extraction wells were in operation. The wells were operating at around 750 to 800 cubic feet per minute. The gate valves on the wells allow for manual operation. The ideal conditions (<5 percent oxygen, 25 percent nitrogen, 40 percent methane, low temperature) can be achieved manually. Kleinfelder, the City's subcontractor for landfill O&M, is asked to visit the site to modify extraction as necessary. Appendix D contains a photo of an example LFG well. The lids on the LFG wells were left open for easier access for maintenance because they weigh 200 pounds each. The City budgeted money to replace the heavy lids with plywood lids. There was a dead squirrel in one of the boxes. The LFG wells are approximately 45 to 50 feet bgs. The wells are analyzed every 2 weeks for methane, carbon dioxide, oxygen, and temperature. The results are not reported but are used to modify gas flow as needed. There are three ports for the Gym200 gas analyzer. There is no leak detection system for the LFG, but an elevated oxygen reading reflects a leak.

TABLE 5-11
Chemical-specific ARARs
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

Source	Citation	Description	Findings and Comments
Safe Drinking Water Act (SDWA) National Primary Drinking Water Standards	40 CFR Part 141.61	Chemical-specific drinking water standard MCLs have been promulgated under the SDWA.	Applicable or relevant and appropriate Several VOCs (including TCE, cis-1,2-DCE, vinyl chloride, and PCE), nitrates and TDS exceeded MCLs in groundwater samples collected during the fall 2004 event. The 1996 ROD requires that the ultimate objective is to obtain aquifer restoration, in other words, all constituents at or below MCLs.
Clean Air Act National Emission Standards for Hazardous Air Pollutants	40 CFR 61	Identifies and establishes emission standards for specific chemicals.	Applicable or relevant and appropriate. List of amendments: § 61.12 Compliance with standards and maintenance requirements. [50 FR 46292, Nov. 7, 1985, as amended 62 FR 8328, Feb. 24, 1997] § 61.18 Incorporations by reference.[48 FR 3740, Jan. 27, 1983, as amended at 48 FR 55266, Dec. 9, 1983; 49 FR 23520, June 6, 1984; 51 FR 34914, Sept. 30, 1986; 54 FR 38073, Sept. 14, 1989; 54 FR 51704, Dec. 15, 1989; 55 FR 8341, Mar. 7, 1990; 55 FR 18331, May 2, 1990; 55 FR 22027, May 31, 1990; 55 FR 32914, Aug. 13, 1990; 65 FR 62150, Oct. 17, 2000; 65 FR 78280, Dec. 14, 2000; 67 FR 57166, Sept. 9, 2002; 69 FR 18803, Apr. 9, 2004]
Porter-Cologne Water Quality Control Act Plan (Basin Plan) for the RWQCB, CCR (Tulare Lake Basin Plan)	Water Quality Control Plan (Basin Plan) for the RWQCB, CCR (Tulare Lake Basin Plan) Water quality objectives	Establishes water quality objectives, including narrative and numerical standards that protect the beneficial uses and water quality objectives of surface and ground waters in the region.	Applicable or relevant and appropriate. The Basin Plan has been updated in August 1995 and January 2004.
California Code of Regulations	Title 22, CCR, Division 4, Chapter 15, Articles 4, 5.5, and 8	Requirements for public water systems. Includes MCLs.	Applicable or relevant and appropriate.

TABLE 5-11
Chemical-specific ARARs
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

Source	Citation	Description	Findings and Comments
Groundwater Protection	Title 22, CCR, Division 4.5, Chapter 14, Article 6 §66264.90-66264.101	Creates broad groundwater monitoring and compliance standards. Includes concentrations standards, monitoring requirements and corrective action requirements.	Applicable or relevant and appropriate. There have been no significant changes.
Health and Safety Code	Title 22, CCR, Division 2, Subdivision 1, Chapter 3; §25249.5 of the Health and Safety Code	Prohibits the discharge or release to water or to land of a significant amount of any chemical known to the State of California to cause cancer or reproduce toxicity when the chemical will probably pass through a source of drinking water.	Applicable or relevant and appropriate. There have been no significant changes.
State Water Resources Control Board	Resolution No. 88-63 ("Sources of Drinking Water Policy") (as contained in the RWQCB's Water Quality Control Plan)	Specifies that, with certain exceptions, all ground and surface waters have the beneficial use of municipal or domestic water supply.	Applicable or relevant and appropriate. There have been no significant changes.

TABLE 5-12
Action-specific ARARs
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

Source	Citation	Description	Findings and Comments
Porter-Cologne Water Quality Control Act Plan (California Water Code 13240)	Title 23, CCR, Chapter 15, Sections 2510 (a), 2510(c), and 2510 (d).	Applies to applicability of Chapter 15 and to engineered alternative to the prescriptive standard for final cover at a waste management unit.	The measurements remain applicable or relevant and appropriate and have been complied with. Section 2510: Amendment of subsections (a) and (d)-(h), repealer of subsection (i) and amendment of Note filed 6-18-97; operative 7-18-97 (Register 97, No. 25).
	Title 23, CCR, Chapter 15, Sections 2580 and 2581.	Applies to general closure requirements and landfill closure requirements.	The measurements remain applicable or relevant and appropriate and have been complied with. Section 2581 - Repealer filed 6-18-97; operative 7-18-97 (Register 97, No. 25).
	Title 23, CCR, Chapter 15, Sections 2540, 2541, 2546, 2547, and 2596.	These sections apply to: Design and construction standards for containment structures. Design, construction, and maintenance of drainage, collection and holding facilities for waste management units. Design and construction of landfill structures to withstand seismic events. Requirements in the design reports and operations plans for containment structures, precipitation and drainage control facilities and ancillary facilities.	The measurements remain applicable or relevant and appropriate and have been complied with. 2540 - Amendment of article heading and subsections (a)-(d) filed 6-18-97; operative 7-18-97 (Register 97, No. 25). 2541 - Amendment of subsections (d) and (e), Table 4.1 and Figure 4.1, and repealer of figure 4.2 filed 6-18-97; operative 7-18-97 (Register 97, No. 25). 2546 - Amendment of subsections (a)-(d) and (f) filed 6-18-97; operative 7-18-97 (Register 97, No. 25). 2547 - Amendment filed 6-18-97; operative 7-18-97 (Register 97, No. 25). 2596 - Amendment of subsections (a)(2), (a)(3) and (a)(3)(B)7.-8. filed 6-18-97; operative 7-18-97 (Register 97, No. 25).

TABLE 5-12
Action-specific ARARs
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

Source	Citation	Description	Findings and Comments
California Code of Regulations	Title 23, Division 3, Chapter 15, Article 1 CCR 2510 (g)	Applies to the development and implementation of a monitoring program for closed, abandoned, or inactive waste management units in accordance to Article 5 of Chapter 15.	The measurements remain applicable or relevant and appropriate and have been complied with. Section 2510: Amendment of subsections (a) and (d)-(h), repealer of subsection (i) and amendment of Note filed 6-18-97; operative 7-18-97 (Register 97, No. 25).
California Code of Regulations	Title 23, CCR, §2550.6, §2550.7, §2550.9, and §2550.10	Requires monitoring for compliance with remedial action objectives for three years from the date of achieving cleanup levels. Requires general soil, surface water, and groundwater monitoring. Requires an assessment of the nature and extent of the release, including a determination of the spatial distribution and concentration of each constituent. Requires implementation of corrective action measures.	The measurements remain applicable or relevant and appropriate and have been complied with. 2550.6- Amendment of subsection (a) filed 6-18-97; operative 7-18-97 (Register 97, No. 25). 2550.9 - Amendment of subsection (e)(6) filed 6-18-97; operative 7-18-97 (Register 97, No. 25).
Closure and Post Closure	Title 22, CCR, Division 4.5, Chapter 14, Article 7, §66264.117	States that monitoring, maintenance and reporting requirements must continue for 30 years past closure.	The measurements remain applicable or relevant and appropriate and have been complied with. There have been no significant changes.
Containers	Title 22, CCR, Division 4.5, Article 9, §66264.170-66264.178	Requirements for facilities that store containers of hazardous waste.	The measurements remain relevant and appropriate. Section §66264.175 added new subsections (d)-(e) on 07/24/97
Tanks	Title 22, CCR, Division 4.5, Chapter 14, Article 10, §66264.190-66264.200	Outlines design and management standards for tanks.	The measurements remain relevant and appropriate. Changes in the following subparts have no regulatory effect: 66264.192; 66264.193; and 66264.200

TABLE 5-12
Action-specific ARARs
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

Source	Citation	Description	Findings and Comments
State Water Resources Control Board	Resolution No. 92-49 III G. (As amended April 21, 1994)	Establishes requirements for investigation and cleanup and abatement of discharges that impact or threaten water quality. Discharges must clean up and abate the effects of discharges in a manner that promotes the attainment of either background water quality or the best water quality that is reasonable if background is not technically and economically feasible.	Applicable or relevant and appropriate. Amended on October 7, 1996. To include provisions for a containment zone policy. These policies and procedures apply to all investigations, and cleanup and abatement activities, for all types of discharges subject to Section 13304 of the WC http://www.epa.gov/ost/standards/wqslibrary/ca/ca_9_92_49.htm.
CAPCOA	California Air Pollution Control Officers Association (CAPCOA) Air Toxics "Hot Spots" Program Risk Assessment Guidelines (January 1991)	Ambient air concentrations of landfill gas contaminants or landfill gas treatment facility contaminant emissions shall not exceed a level, as determined by USEPA, which would cause a 10^{-6} excess cancer risk as determined pursuant to CAPCOA.	Additional Requirements - Performance The guidance document has been updated in 1996 and 1997 subsequently, and is due for an update in 2005. The 1996 and 1997 amendments include an emission inventory plan amendment and a high risk facilities reporting requirements. The proposed 2005 amendment will include changes in the risk assessment methodology, as well as provisions for diesel engines.
	Solid Waste Disposal Sites – Draft Rule 46-42	At a threshold minimum, the remedy must meet the requirements of: • Establishes a reactive organic destruction efficiency of 98% for any reactive organic except methane. • Requires that flares designed as part of the landfill gas control system be enclosed in a shroud. • Requires that the maximum concentration of organic compounds measured as methane, measured at any point on the surface of the landfill, shall not exceed 1,000 ppm.	Applicable or relevant and appropriate.

TABLE 5-12
Action-specific ARARs
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

Source	Citation	Description	Findings and Comments
Safe Drinking Water Act Underground Injection	40 CFR Part 144	Provides requirements for underground injection program.	No longer applicable or relevant and appropriate. It has been amended in 1999 and 2002. The amendment applies to owners and operators of Class V well that is not a large-capacity cesspool or a motor vehicle waste disposal well, as described in the December 7, 1999 Class V Rule (64 FR 68546) at 40 CFR 144.81 (2) and 144.81 (16), respectively.
Clean Water Act-Effluent Limitations	33 USC Chapter 26, Subchapter III, § 1311-1312as derived from Clean Water Act Sections 301 and 302 Note: These ARARs were cited incorrectly in the 1996 ROD as 33 CFR Parts 301 and 302	Requires establishment of technology-based discharge limits for point sources of pollution.	Applicable or relevant and appropriate.
Clean Water Act Toxic and Pretreatment Standards	33 USC Chapter 26, Subchapter III, § 1317 derived from Clean Water Act Section 307 Note: This ARAR was cited incorrectly in the 1996 ROD as 33 CFR Part 307	Requires the establishment of pretreatment standards for the control of pollutants to POTW.	Applicable or relevant and appropriate.
California Code of Regulations	Title 23, Division 3, Chapter 15, Article1CCR 2511(d)	Exemptions to actions taken by or at the direction of public agencies to clean up or abate conditions of pollution or nuisance resulting from unintentional or unauthorized releases of waste or pollutants to the environment.	Applicable or relevant and appropriate. Amendment of first paragraph and subsections (a), (b)(1)-(2), (c), (d), (e)(1)-(3), (g)(1) and (h), and amendment of Note filed 6-18-97; operative 7-18-97 (Register 97, No. 25).

TABLE 5-12
Action-specific ARARs
First Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California

Source	Citation	Description	Findings and Comments
California Code of Regulation Title 14	Title 14, CCR Sections 17776	Applies to final grading.	The measurements remain applicable or relevant and appropriate and have been complied with.
California Code of Regulations Title 14 and Title 27 Combined			
Title 27, CCR Section 20324	Title 14, CCR Section 17774	Applies to construction quality assurance.	Applicable or relevant and appropriate.
Title 27, CCR Sections: 20932 and 20933	Title 14, CCR Sections 17783, 17783.9, and 17783.11.	Applies to gas monitoring and control during closure and post-closure; monitored parameters, and monitoring frequency.	Applicable or relevant and appropriate.
Title 27, CCR Section 21140	Title 14, CCR Sections 17773	Applies to final cover.	Applicable or relevant and appropriate.
Title 27, CCR Sections: 21145 and 21142	Title 14, CCR Sections 17777	Applies to final site face.	Applicable or relevant and appropriate.
Title 27, CCR Section 21150	Title 14, CCR Sections 17778	Applies to final drainage.	Applicable or relevant and appropriate.
Title 27, CCR Sections: 21090 and 21150	Title 14, CCR Sections 17779	Applies to slope protection and erosion control.	Applicable or relevant and appropriate.
Title 27, CCR Section 21150	Title 14, CCR Sections 17778.5	Applies to perimeter monitoring network.	Applicable or relevant and appropriate.
Title 27, CCR Section 20937	Title 14, CCR Sections 17783.7 and 17783.15	Applies structure monitoring and gas control.	Applicable or relevant and appropriate.
Title 27, CCR Section 21180	Title 14, CCR Sections 17788	Applies to post-closure maintenance.	Applicable or relevant and appropriate.
Title 27, CCR Section 21200	Title 14, CCR Sections 17792	Applies to change of ownership during closure and post-closure maintenance.	Applicable or relevant and appropriate.
Title 27, CCR Section 21190	Title 14, CCR Sections 17796	Applies to post-closure land use.	Applicable or relevant and appropriate.

Georges Lake lies west of the landfill. It is a man-made lake where some of the treated groundwater is discharged. The lake water is used for irrigation. The South Basin is used for treated groundwater when the lake water level is high. Stormwater sampling, required by the RWQCB, is performed twice a year at the three culverts. The three culverts are located near the three basins – Georges Lake, South Basin, and the East Basin. The culverts are gravel and go under the road to one of the three detention ponds. Georges Lake is the only lined pond. The data are sent to the Department of Water Resources in an annual report.

The tour of OU-2 included the extraction wells, monitoring wells, and treatment area, including the flare and PTA, and the office, including the SCADA system. All five extraction wells were operating at the time of the site inspection. The extraction wells are outfitted with Grundfos pumps. Transducers are placed in all extraction wells and electronically transmit data to SCADA (in the office). The groundwater extraction wells are located in vault boxes that do not lock but are very heavy and have control panel locks. If the vault box is opened, it sends a warning to the SCADA system. There was no leaking around the inspected extraction well. The extraction wells are inspected weekly and sampled at least once per year.

The decrease in water elevation levels has created a dramatic decrease in the extraction rates. For example, PW-3 first started extracting groundwater at approximately 200 gpm. Over the past years, this has decreased to about 20 gpm. The flow meters are currently going to be replaced for lower-purge range magnetic pumps. The flow meters have not been working for the past 18 months. The flow is therefore currently calculated based on a pump test that the City performs periodically at CDM's request. CDM obtains groundwater effluent and influent records. There have also been issues with the throttle valves. Replacement of the valves may resolve the need to frequently adjust the flow rate in the extraction wells. Plant shutdown would be required to replace the valves. The totalizer is also not operating (it is off by about 20 gpm). Well rehabilitation has also been conducted. Monitoring wells CDM-5A, 5B, and 5C were observed during the site inspection. These wells were all locked and have dedicated bladder pumps. A-, B-, and C-Aquifer wells at locations CDM-2, CDM-13, CDM-16, and CDM-17 were all observed while driving by.

The treatment system area has a well maintained fence and gate around it. The gate is closed in the evenings and contains a security system. The PTA, flare, propane tanks, chemicals, and office are all contained in the fenced in area. The interim groundwater treatment equipment is left unused in this gated area. It should be removed. In general, all the machinery is well-maintained and labeled.

Power failure is the biggest problem in terms of interrupted operations. The system is operating 98 percent of the time. The groundwater treatment system has been in operation for the past 4 years. Shutdown occurs when the packing media requires cleaning or the flare shuts down.

Dead bees are abundant on the ground around the flare. The bees fly over the flare and are killed by the heat. There were no dead birds around the flare during the inspection, but the operators report that occasionally dead birds can be found around the flare. There is corrosion around the flare caused by the heat, and the City is preparing to paint the flare. There are louvers around the base of the stack to control oxygen and, therefore, the temperature at which the flare operates. All the records are available for the flare but are not

reported except during compliance testing. A blower creates a vacuum on the system. There is a 2-inch vacuum line. A safety shut-off valve is present on the blower manifold by the compressed air. If there is a loss of air pressure or power, the system will shut down. There is no long-term sampling planned for the flare. The City has coordinated with SJVAPCD on an as-needed basis to ensure compliance with SJVAPCD requirements.

The flow rate for LFG into the flare is recorded. There are no data for the volume of VOC emissions that are burned by the flare. The moisture is separated from the gas before entering the flare, and the condensate flows into the groundwater treatment sump. The condensate is only sampled during compliance testing. One 300-gallon propane tank is onsite to light the flare, if necessary.

The PTA consists of the air stripper and blower. It is operated at 95 to 98 °F. The anti-scalent used is GE Flogard POT 807. It is stored in one 1,000-gallon tank onsite. The hypochlorite is stored in a separate area that is well-maintained. All the health and safety precautions are in place. The influent sampling ports are in good condition. They are sampled every 3 months. The solvent gas is not tested regularly—it is sent to the flare. Any fluid in the sumps is sent to the PTA for treatment prior to discharge. The treated water is sampled every 3 months. The VOCs from the PTA are sent to the flare, where they are burned off.

The SCADA system that controls and relays information regarding the groundwater treatment system is located in the office. The alarm was on because during the inspection the extraction well vault box was opened. The SCADA system shows the flow of the wells. Well PW-5A was operating at 14 gpm, Well PW-4A at 20 gpm, and the totalizer read 137 gpm. There are five methane sensors in the office all reading 0 percent methane. This is a building requirement because it is within 300 feet of a landfill. Two fire extinguishers are in the office, as well as the main circuit breakers. The sampling equipment is stored in the office. The equipment is clean and well-maintained.

The area is currently zoned for agricultural use, and there has been no development in the area for several years. There are vineyards to the east and west of the landfill and a dairy farm further to the west. The community master plan called for a park in southwest Fresno. The City decided to use the land around the landfill to build a park to fund the long-term maintenance of the FSL. The park cost $9 million. Soil that was piled up while the park was built was then used to cap the landfill. The Parks Department will take over the maintenance of the landscaping on the landfill by the end of 2005. The sports complex is a part of a 72-acre purchase by the City. Land to the east of the landfill was purchased because the vineyard was affected by the LFG. As the east pond was dug; the soil that was removed was used to create part of the landfill cap. There are greenhouses east of the landfill. The owner previously claimed loss against the City. The unlined irrigation canal runs along the east side of the landfill. This is often filled with water after mid-March. There are currently no deed restrictions.

The tour also included a look at the agricultural wells that were to be decommissioned. The new replacement agricultural irrigation wells are screened at 250 to 500 feet bgs. One irrigation well was installed in January of 2005 but is not in service yet. Another agricultural well was installed in October 2004. The well pump is connected, but there is no generator. Eventually, a permanent power supply will be installed.

Four homes were purchased by the City along the southwest boundary of the site. The City provides bottled water to seven residences and businesses to the north and south of the site. The water has been provided since the early 1990s. This began as a "good neighbor" activity, as the City was not aware of the contamination at the time except at a home to the south of the landfill. The City tests their water regularly.

5.7 Interviews

Interview summary forms are provided in Appendix C. Interviews were conducted with the following City of Fresno staff, their consultants (Kleinfelder and CDM), former USEPA RPMs, DTSC, and the RWQCB:

- George Slater/City of Fresno/City Project Manager and Coordinator/ March 10, 2005/Onsite
- Jeff Garner/City of Fresno/Groundwater Treatment Plant Operator/March 10, 2005/ Onsite
- John (Yash) Nyznyk/CDM/CDM Project Manager/March 28, 2005/Telephone
- Wayne Pickus/CDM/CDM Project Director/March 22, 2005/Telephone
- Jeff Dunn/Kleinfelder/Kleinfelder Project Manager/March 28, 2005/Telephone
- Lynn Suer/USEPA/Former RPM/April 12, 2005/Telephone
- Cynthia Wetmore/USEPA/Former RPM/April 8, 2005/Telephone
- Bret Moxley/USEPA/Former RPM/May 4, 2005/Telephone
- Pete Phillips/URS/Technical Oversight for USEPA/April 6, 2005/In Person
- Bruce Myers/RWQCB/RWQCB Project Manager/ March 10, 2005/RWQCB Office
- Emmanuel Mensah/DTSC/DTSC Project Manager/March 22, 2005/telephone

All interviewees noted that the FSL is well run, with a great amount of open communication between all involved parties. As issues arise, they are discussed openly and resolutions are quickly sought.

A main concern of the interviewees dealing with the implementation of institutional controls has been the nearby agricultural wells. Lynn Suer, former RPM for USEPA, spoke of how the preliminary Phase 1 report did not provide enough information because of the agricultural well influence. Decommissioning the nearby agricultural wells was a long process filled with negotiations, according to George Slater, Project Coordinator for the City of Fresno. Yash Nyznyk, Project Manager for CDM, spoke of how the delay in acquiring the agricultural wells on private property had recently been solved, as the wells were acquired in October 2004. Yash Nyznyk and Wayne Pickus, Project Director for CDM, spoke of how this was an important step because of the agricultural wells effect on vertical migration. According to Jeff Garner, Groundwater Treatment Plant Operator for the City of Fresno, new irrigation wells for neighboring properties are currently being constructed. Bruce Myers, Project Manager for RWQCB, spoke of how the model will be corrected following 1

year of sampling after the destruction of the agricultural wells because of the wells' influence on vertical plume movement and decreasing the water table, leading to a less-than-full capture of the plume during Phase 1. The decommissioning of the agricultural wells will change site conditions; therefore, monitoring wells near the decommissioned agricultural wells may need to be sampled to establish a baseline. Also, Bruce noted that there are no site monitoring wells as deep as the new agricultural replacement wells (CDM 2003c).

Wayne Pickus noted that CDM has developed an institutional control plan to regulate the installation of new wells. The status is discussed earlier in this report.

A problem that occurred during construction of the remedy was when the City's consultant, the IT Corporation, went bankrupt. George Slater and Jeff Dunn spoke about the delay on OU-1 due to IT's bankruptcy but that the remedy has been functioning well since its construction.

A current issue with systems operations is decreased groundwater levels; therefore, the flow meters cannot read the low levels of flow. The flow meter issue was mentioned by George Slater, Jeff Garner, Yash Nyznyk, and Wayne Pickus. New flow meters are scheduled to be installed this year. The extraction wells also needed to be cleaned more often than originally planned, according to George Slater and Yash Nyznyk.

Lynn Suer and George Slater both noted that during the first compliance testing, the flare did not meet its goal of 98 percent destruction efficiency. Jeff Dunn, Project Manager for Kleinfelder, noted that the flare was not operating at a high enough temperature when it was sampled. There was no evidence of gas leakage, determined by a surface sweep. Emanuel Mensah, Project Manager for DTSC, spoke of the improved performance of the flare after increasing its operating temperature since the first performance test failure.

There have also been successes in operations and maintenance. For example, George Slater mentioned the strides in efficiency due to computerized O&M schedule, the decreased O&M costs since the City's takeover of groundwater sampling, and the City's proposal to use the City's wastewater treatment lab for analyses of some compounds.

George Slater, Project Coordinator for the City of Fresno, was interviewed onsite on March 10, 2005. George is onsite regularly and thinks that the overall operations are conducted very well. George would like to see the FSL eventually delisted from the National Priorities List because the community places a negative association with Superfund sites.

Jeff Garner, Treatment Plant Operator for the City of Fresno, was also interviewed on site on March 10, 2005. Jeff diligently runs daily operations. Jeff spoke of the poor design of the throttle valves on the extraction wells and the heavy vault lids on the gas monitoring wells that remain open. These issues are all in the process of being resolved. The City has budgeted $15,000 for new lids and will replace the throttle valves during plant shutdown. A sampling trailer will soon be built to increase sampling efficiency. Jeff's suggestions for the site include gravel or pavement on the often muddy perimeter road, removing the old air strippers that are no longer used, and looking into the option of using the extracted gas for power generation either onsite or at the wastewater treatment plant. Jeff does not think that baiting for squirrels is a problem for the wildlife around the landfill because of the safe manner in which it is done.

Yash Nyznyk, Project Manager for CDM, was interviewed by phone on March 28, 2005. Yash has been impressed with the collaborative effort in addressing issues at the site as well as the City's proactive implementation of the early groundwater remedial action. It is the first time USEPA incorporated phased-implementation of remedial action into a ROD. Some issues with the SCADA system were resolved by improving the computer system and adding a protective box for the hard drive to address dust problems. Yash doesn't believe that vapor intrusion is an issue any more because of the operation of the gas collection system. The City recently collected treatment plant influent and effluent sample for analysis of cyanide, 1,4-dioxane, perchlorate, and 1,2,3-trichloropropane.

Jeff Dunn, Project Manager for Kleinfelder, was interviewed by phone on March 28, 2005. OU-1 is functioning well and consistent with land use. Jeff mentioned the LFG condensate is pumped to the sanitary sewer line and, even though it does not meet the City's discharge requirements, the POTW allows it because of the low-flow volume (a few hundred gallons/day). The LFG condensate is discharged to the POTW rather than being retained and treated onsite in the PTA because OU-1 was constructed before OU-2. Therefore, the LFG condensate has been discharged to the POTW before OU-2 was constructed.

Mr. Wayne Pickus, Project Director for CDM, was interviewed on March 22, 2005 by phone. The early groundwater action system initiated cleanup of the plume and provided useful data for the effective design of the Phase 1 remedial action. Wayne thinks that the Phase 1 evaluation will provide an indication for the need for any improvements to OU-2. Wayne also noted the local retention ponds influence on the groundwater near the site.

Emanuel Mensah, Project Manager for DTSC, was interviewed by phone on March 22, 2005. He mentioned that there were minor concerns from neighbors regarding their wells and site constituents.

Bruce Myers, Project Manager for RWQCB, was interviewed in person on March 10, 2005. His overall impression of the work at the site and communication is favorable and stresses the continued need to evaluate the site based on new data collected. Because the City discharges treated water to onsite ponds, Waste Discharge Requirements will be necessary along with monthly reporting. The first round of baseline sampling for the Waste Discharge Requirements was reported in the Fall 2004 monitoring report. As far as emerging COCs, perchlorate could be present from the Chilean nitrate fertilizer.

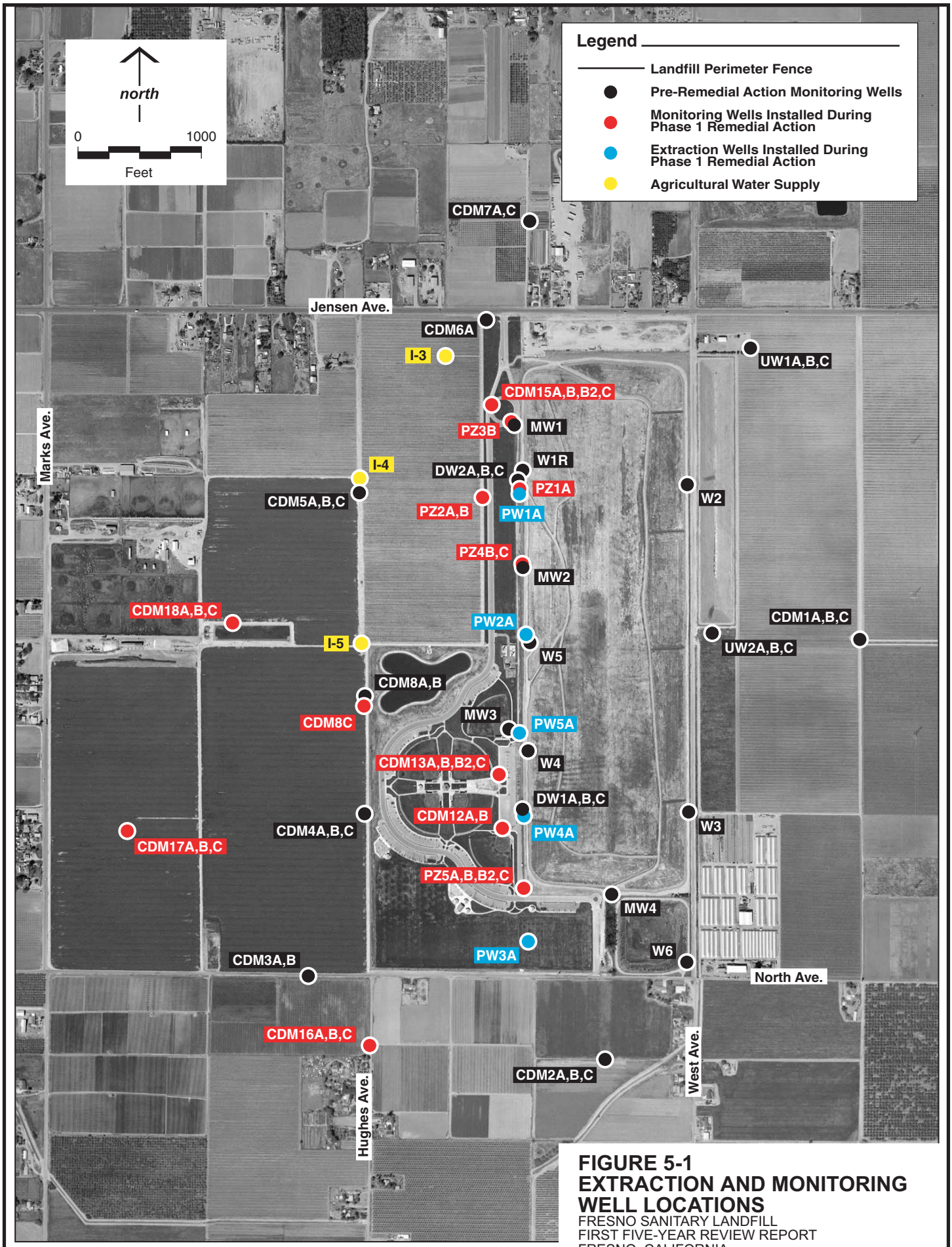
Pete Phillips, URS Technical Oversight for USEPA, was interviewed in person on April 6, 2005. He commented on the ability of the potentially-responsible party to complete the elements of the remedial design under difficult conditions and the cooperative environment that the consultants and regulatory members work in. There were typical startup-type shakedown adjustments and modifications made.

Lynn Suer, RPM for USEPA in 2003 and 2004, was interviewed by phone on April 12, 2005. Lynn commented on the open communication. While the LFG was not reported, it was monitored and believes that records are kept by the City. There was concern raised by another consultant that the electrical panel was placed in a hazardous place on the soccer field. Lynn suggested that the Air and Water Boards should be involved in ensuring compliance. The Air Board requirements were not detailed in the Consent Decree, RODs, nor compliance testing plan. Sampling for dioxins from the flare was an issue raised during

Lynn's time as RPM. There are numerous issues regarding when and where to collect samples. The cost is around $150,000 per sampling event. USEPA is currently conducting more research on this issue. Also, the groundwater effluent is cleaned up to MCLs and not RWQCB cleanup standards (NPDES effluent discharge limits) because there was concern that these standards could not be met.

Cynthia Wetmore was the USEPA RPM in the mid-1990s. The cap had not yet been constructed during her work on the site. There was not a lot of public participation in a public meeting that focused on groundwater. Leachate investigation/recovery was determined not to be technically and economically feasible.

Bret Moxley was the USEPA RPM until 1993. The FSL was in its early stages of treatment. A methane barrier was not properly installed at that time. There was little public concern for the site except for a few comments about effects on vegetation, property value, and health.



Source: CDM, 2005.

FIGURE 5-1
EXTRACTION AND MONITORING WELL LOCATIONS
FRESNO SANITARY LANDFILL
FIRST FIVE-YEAR REVIEW REPORT
FRESNO, CALIFORNIA

CH2MHILL

324131.FR.01_Fig 5-1 Extraction and Monitoring Well Locations _7/26/05_ez_sfo

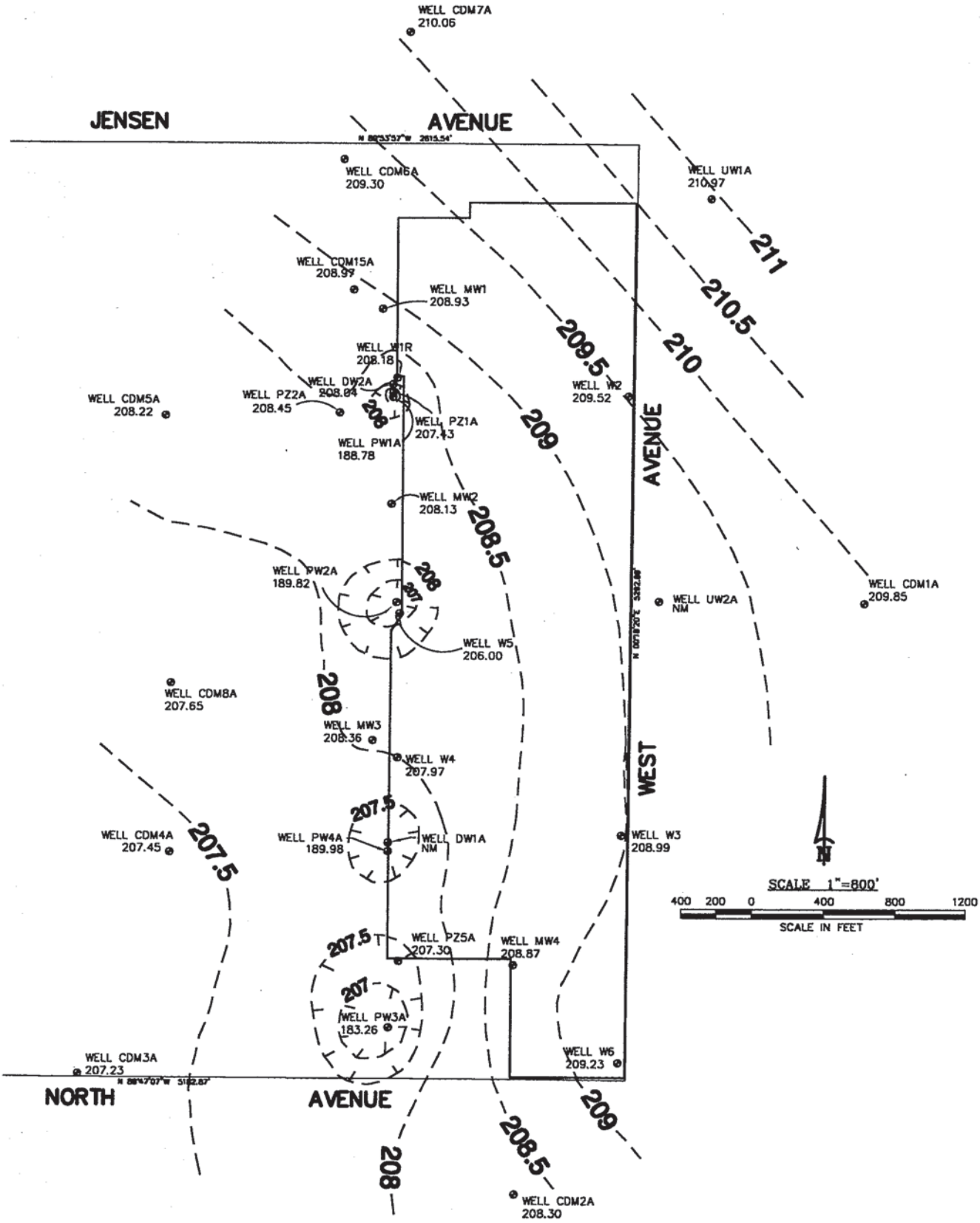


FIGURE 5-2A
A-AQUIFER GROUNDWATER ELEVATION CONTOURS
APRIL 2000
FRESNO SANITARY LANDFILL
FIRST FIVE-YEAR REVIEW REPORT
FRESNO, CALIFORNIA

Source: CDM, 2000.

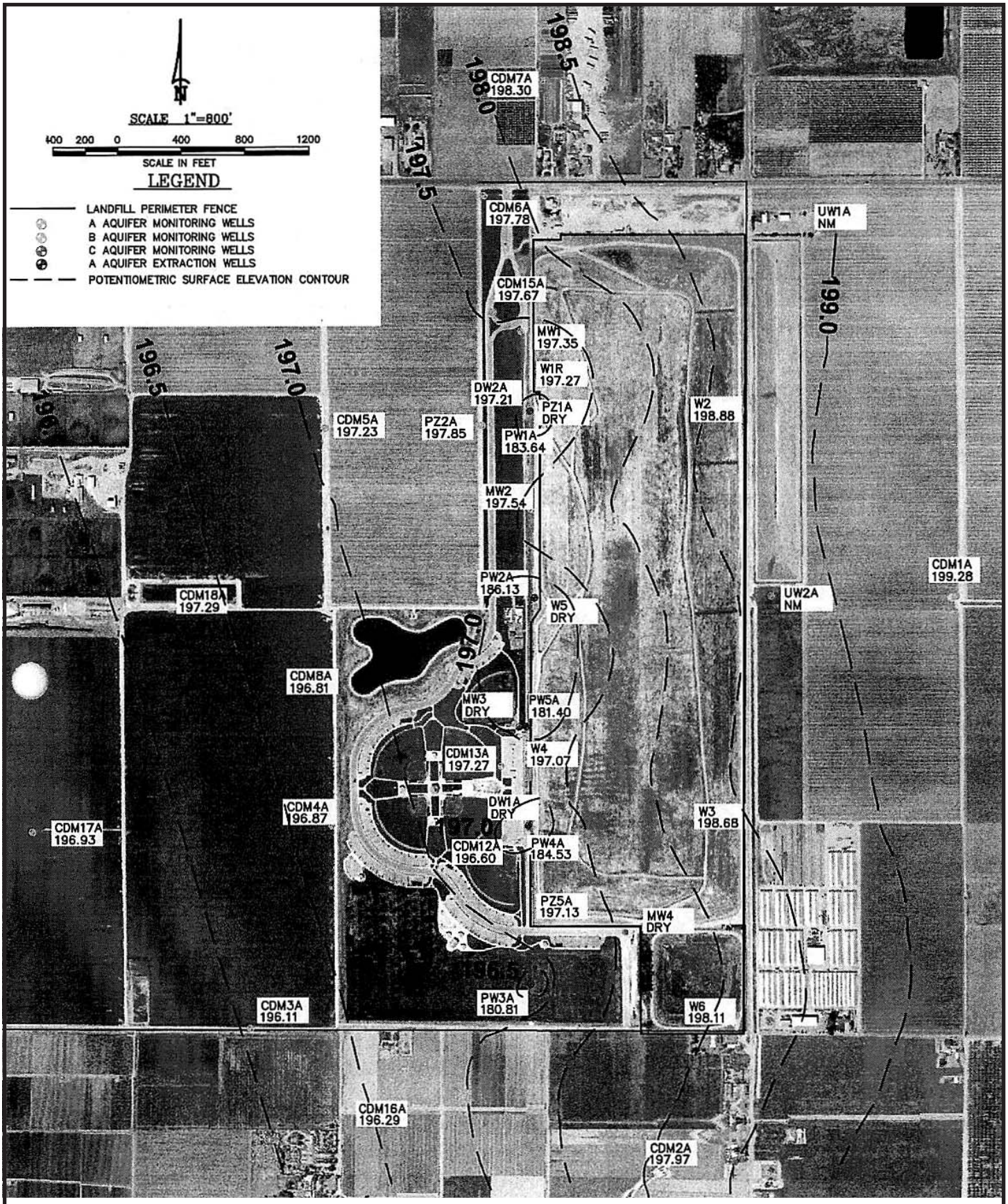


FIGURE 5-2B
A-AQUIFER GROUNDWATER ELEVATION CONTOURS
JUNE 2004
FRESNO SANITARY LANDFILL
FIRST FIVE-YEAR REVIEW REPORT
FRESNO, CALIFORNIA

Source: CDM, 2004.

CH2MHILL

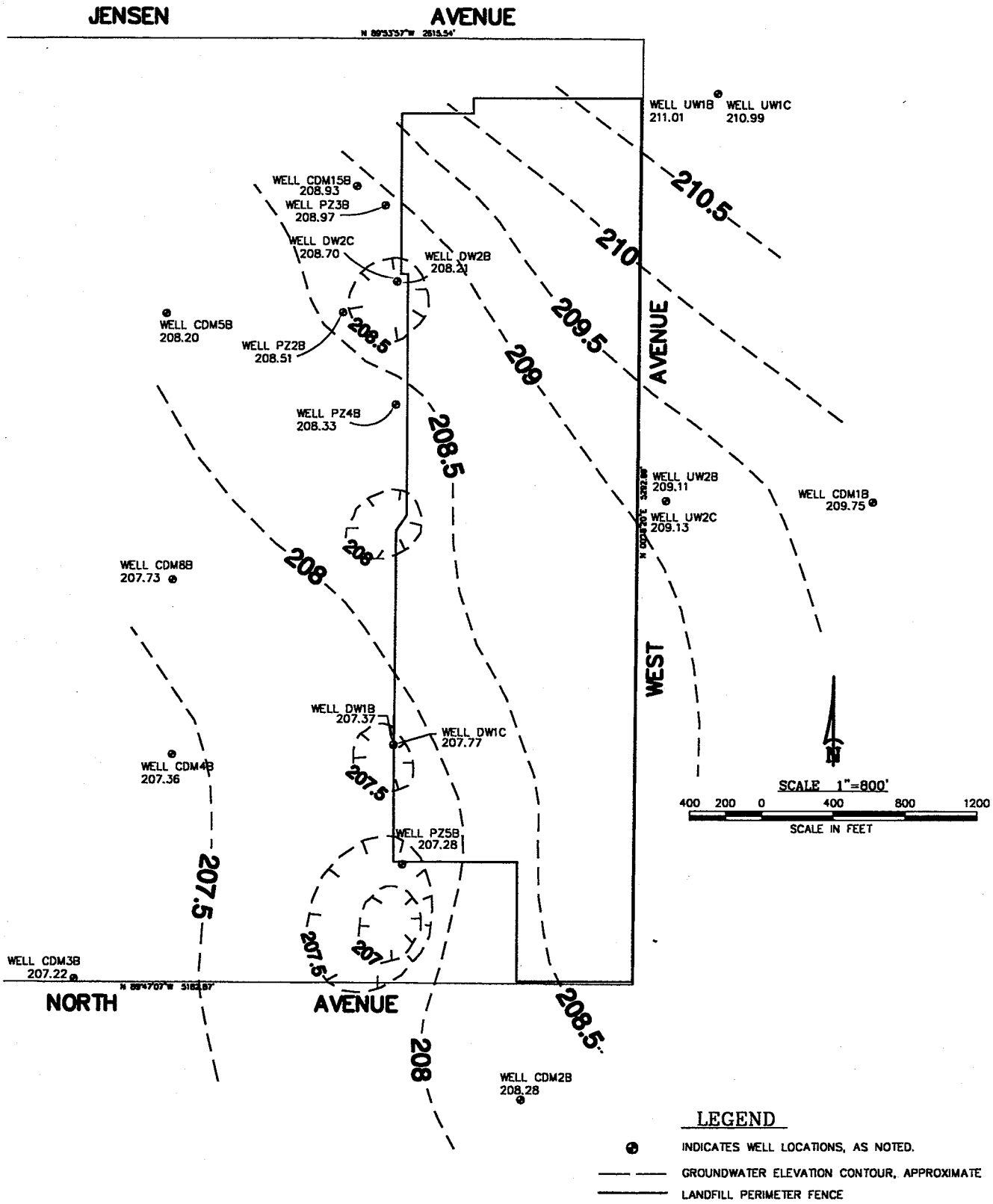


FIGURE 5-3A
B-AQUIFER GROUNDWATER ELEVATION CONTOURS
APRIL 2000
FRESNO SANITARY LANDFILL
FIRST FIVE-YEAR REVIEW REPORT
FRESNO, CALIFORNIA

Source: CDM, 2000.

CH2MHILL

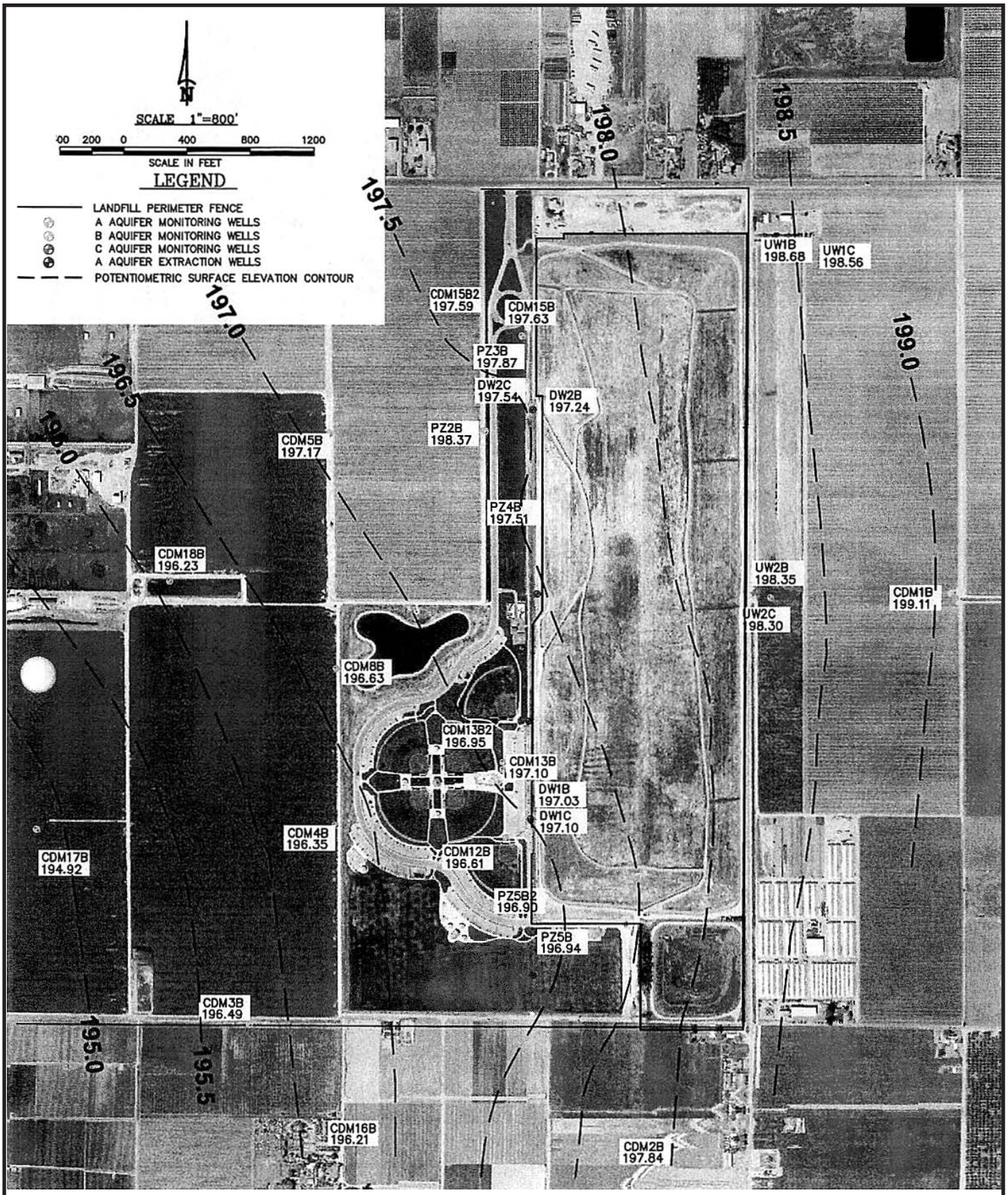


FIGURE 5-3B
B-AQUIFER GROUNDWATER ELEVATION CONTOURS
JUNE 2004
FRESNO SANITARY LANDFILL
FIRST FIVE-YEAR REVIEW REPORT
FRESNO, CALIFORNIA

Source: CDM, 2004.

CH2MHILL

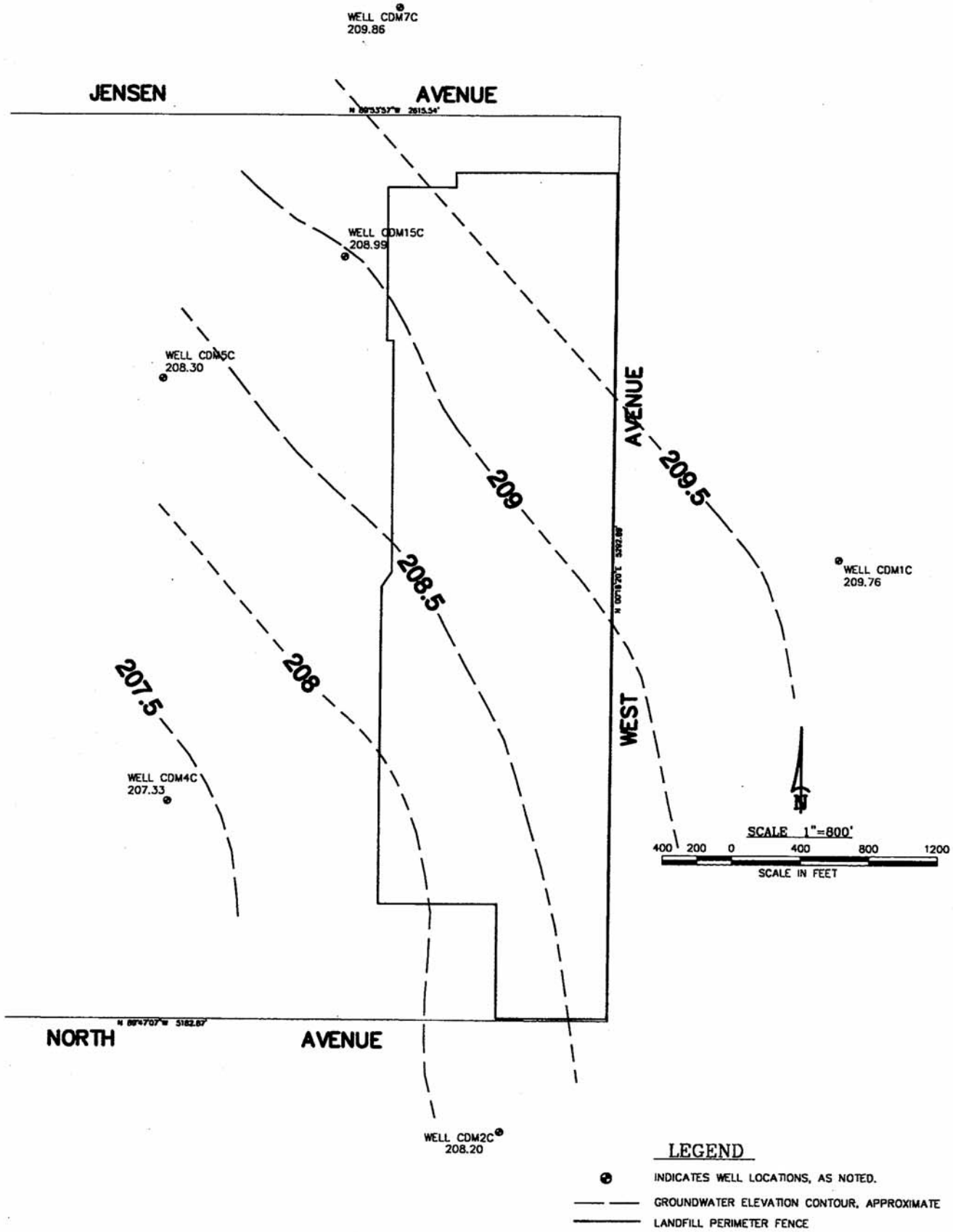


FIGURE 5-4A
C-AQUIFER GROUNDWATER ELEVATION CONTOURS
APRIL 2000
FRESNO SANITARY LANDFILL
FIRST FIVE-YEAR REVIEW REPORT
FRESNO, CALIFORNIA

Source: CDM, 2000.

CH2MHILL

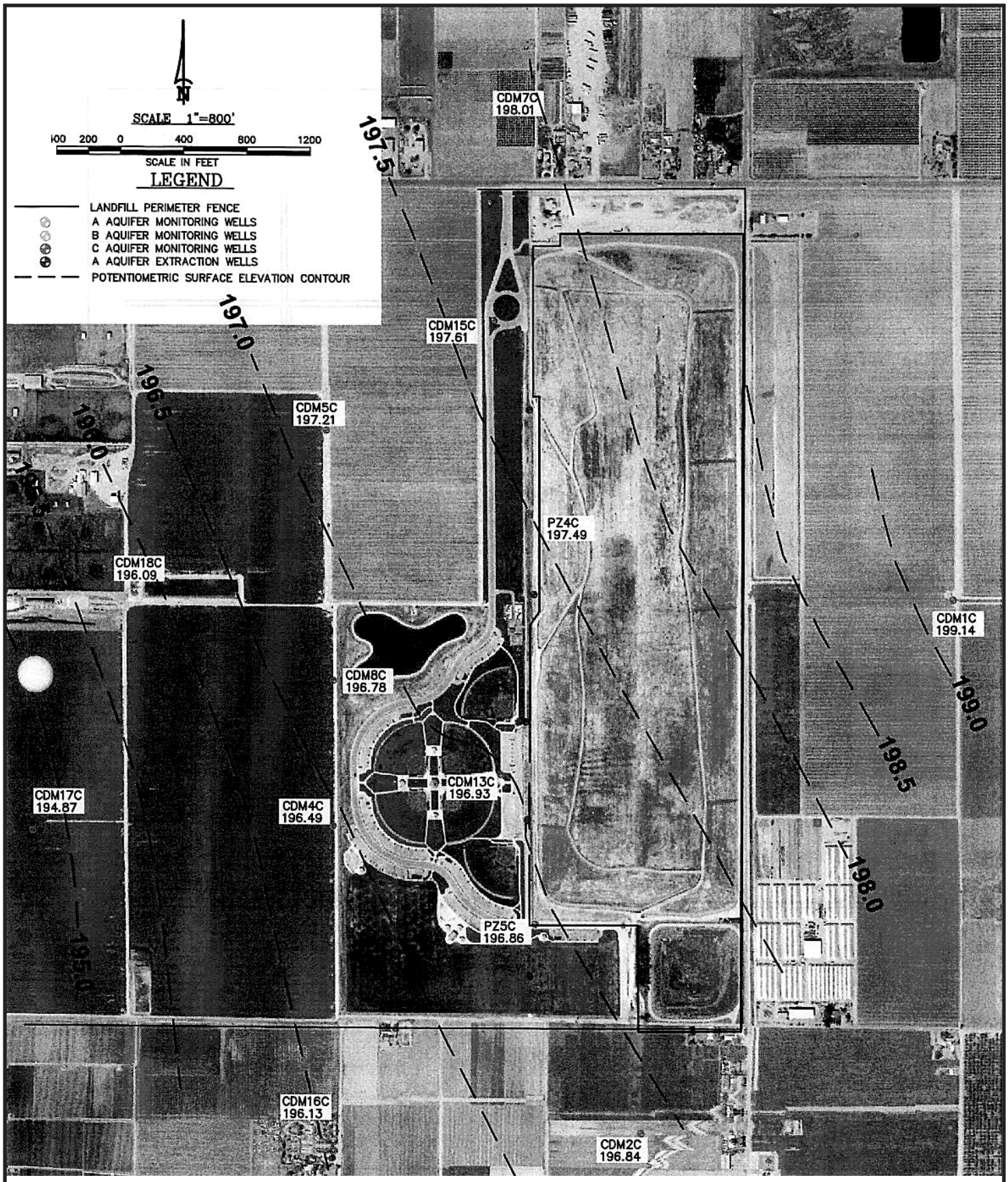


FIGURE 5-4B
C-AQUIFER GROUNDWATER ELEVATION CONTOURS
JUNE 2004
FRESNO SANITARY LANDFILL
FIRST FIVE-YEAR REVIEW REPORT
FRESNO, CALIFORNIA

Source: CDM, 2004.

CH2MHILL

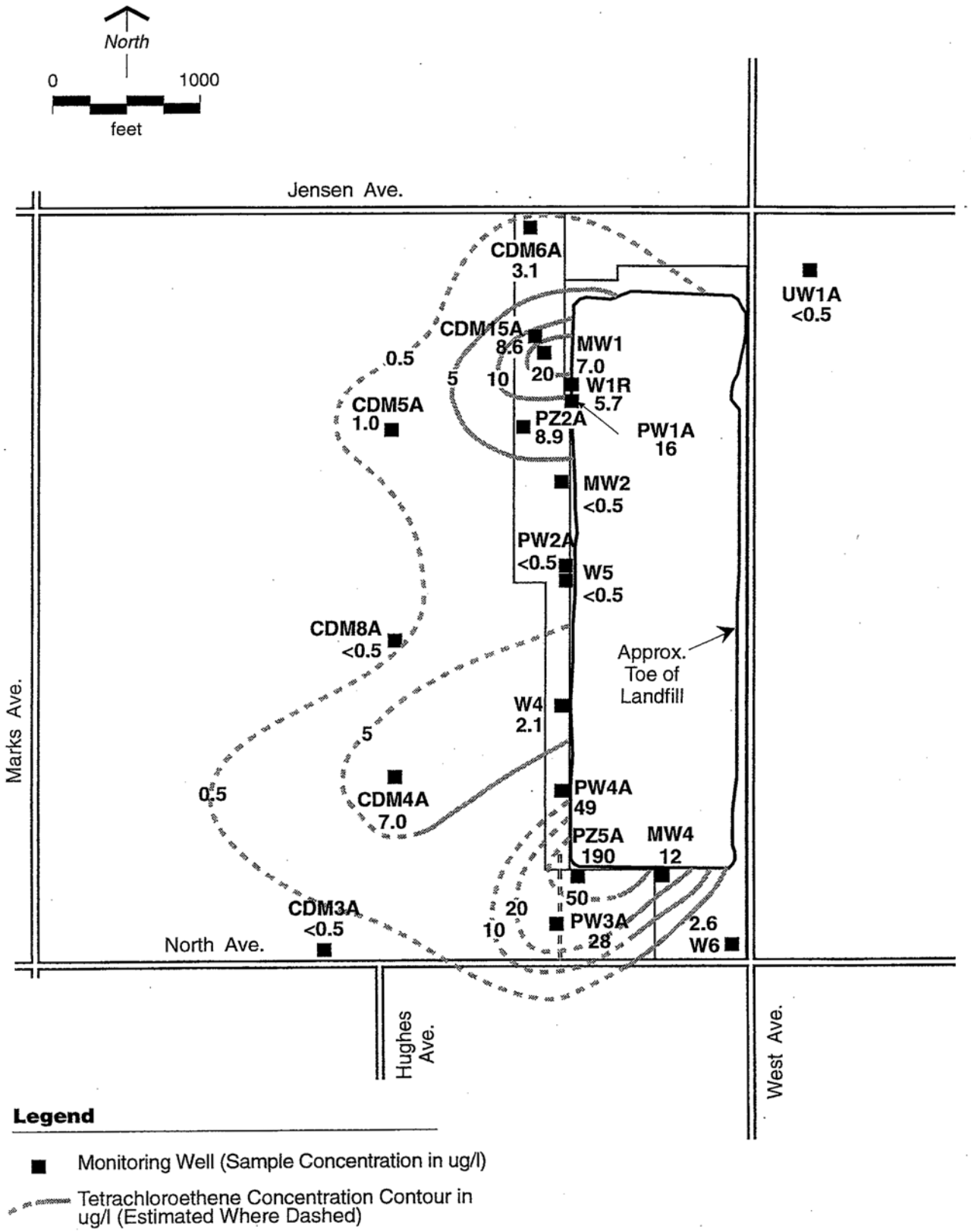


FIGURE 5-5A
PCE CONCENTRATIONS
IN A-AQUIFER
APRIL 2000
FRESNO SANITARY LANDFILL
FIRST FIVE-YEAR REVIEW REPORT
FRESNO, CALIFORNIA

Source: CDM, 2000.

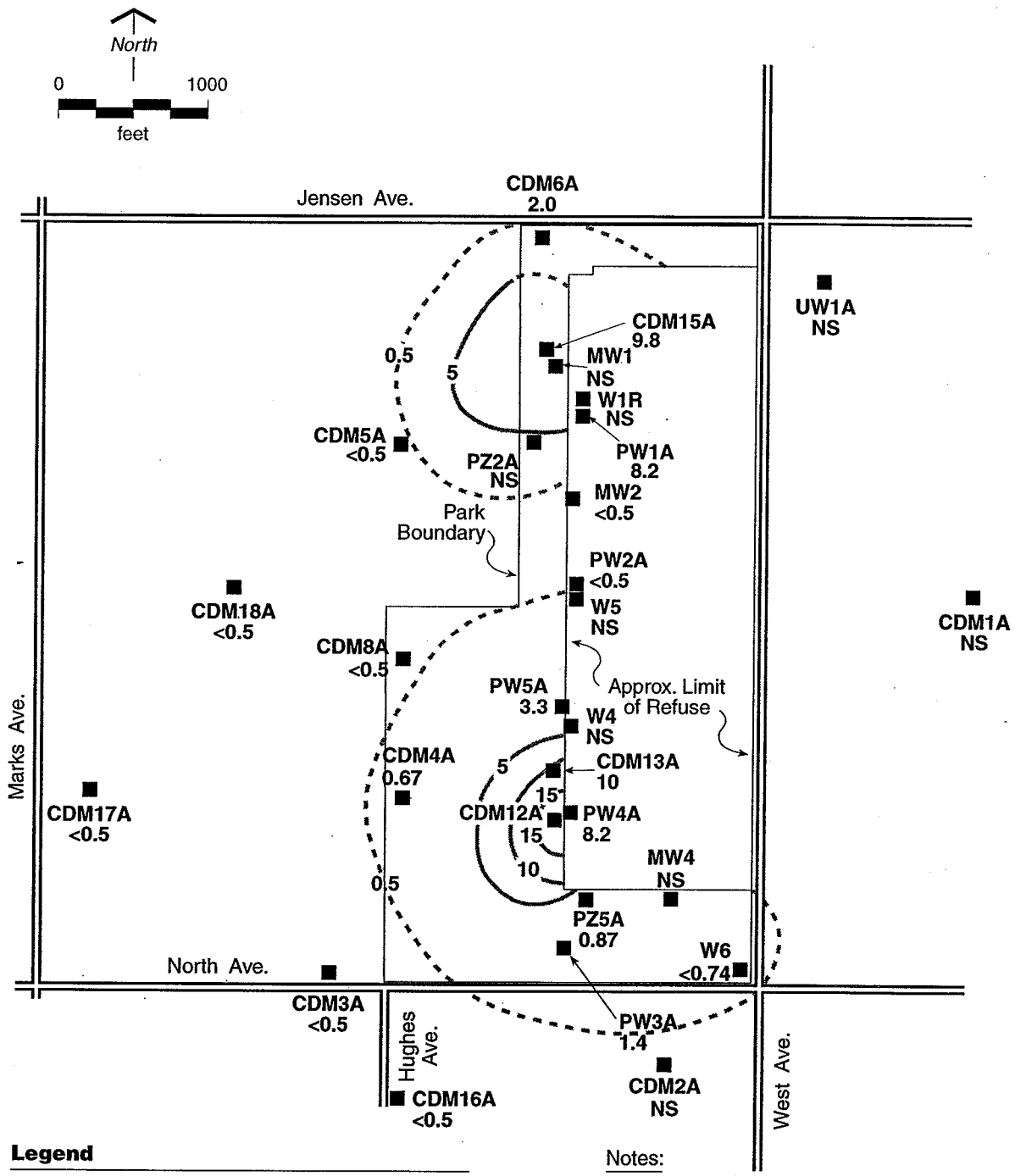
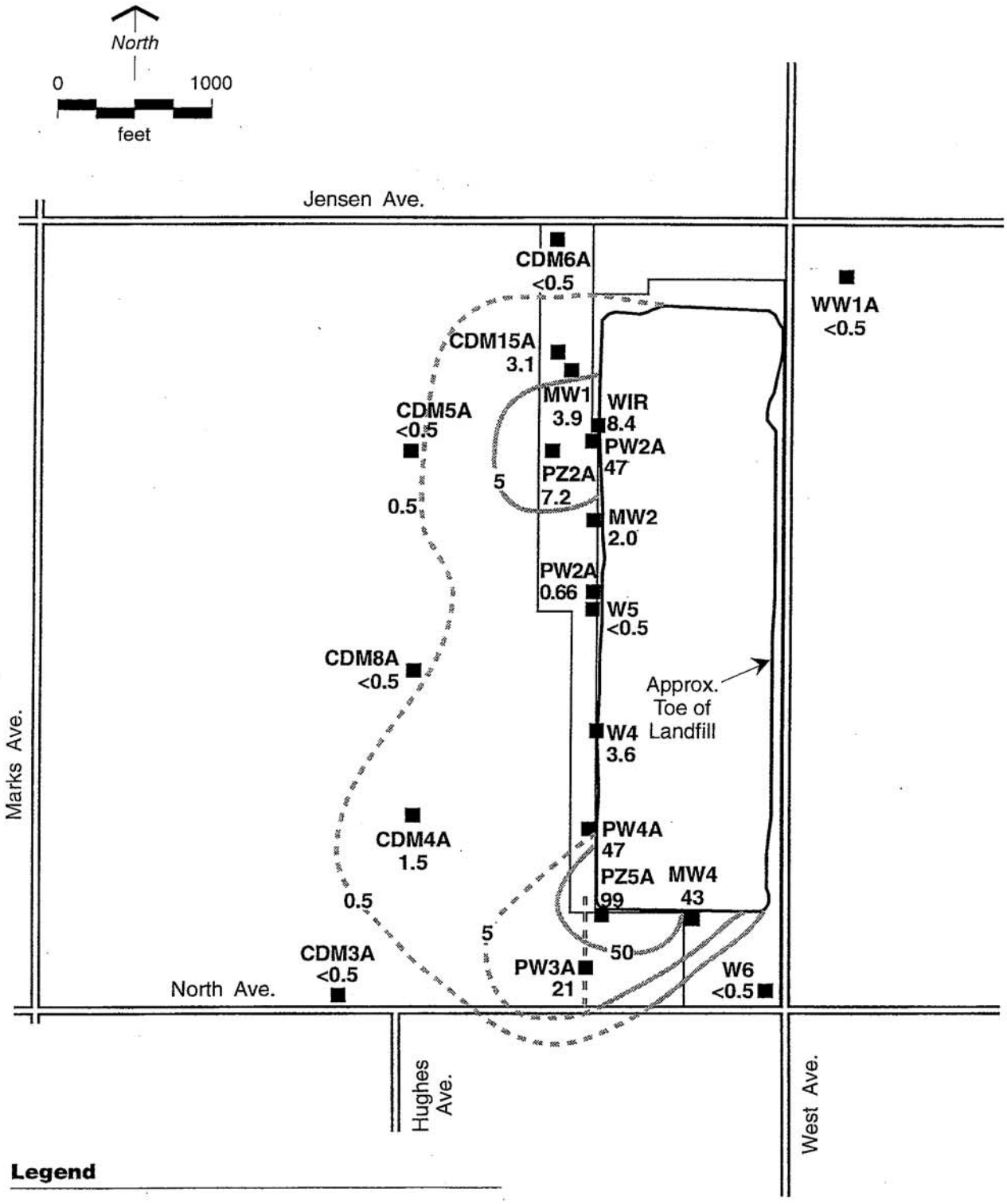


FIGURE 5-5B
PCE CONCENTRATION IN A-AQUIFER
APRIL 2004
FRESNO SANITARY LANDFILL
FIRST FIVE-YEAR REVIEW REPORT
FRESNO, CALIFORNIA

Source: CDM, 2004.



Legend

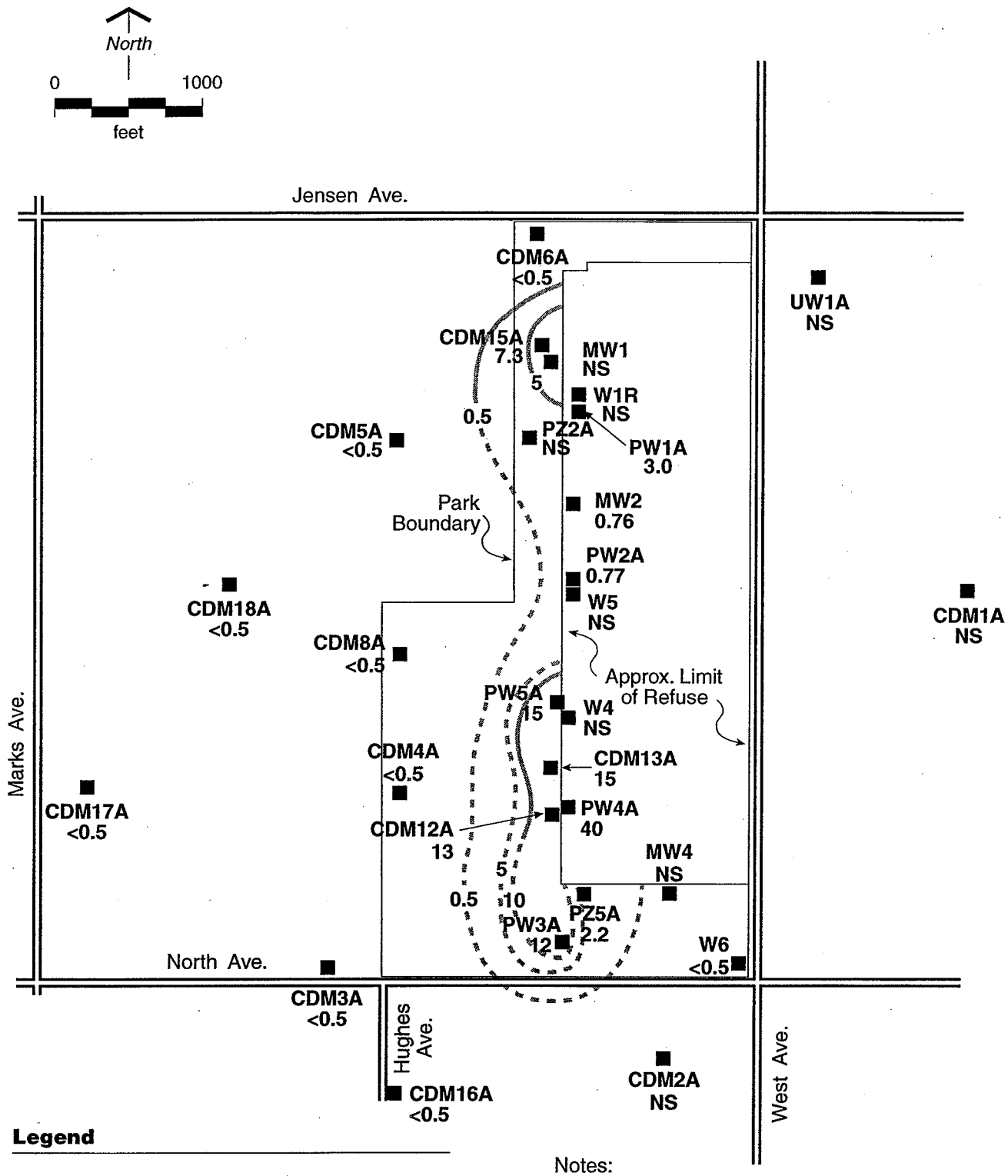
■ Monitoring Well (Sample Concentration in ug/l)

Trichloroethene Concentration Contour in ug/l (Estimated Where Dashed)

FIGURE 5-6A
TCE CONCENTRATION IN A-AQUIFER
APRIL 2000
FRESNO SANITARY LANDFILL
FIRST FIVE-YEAR REVIEW REPORT
FRESNO, CALIFORNIA

Source: CDM, 2000.

CH2MHILL



Legend

■ Monitoring Well

Trichloroethene Concentration Contour in ug/l (Estimated Where Dashed)

Notes:

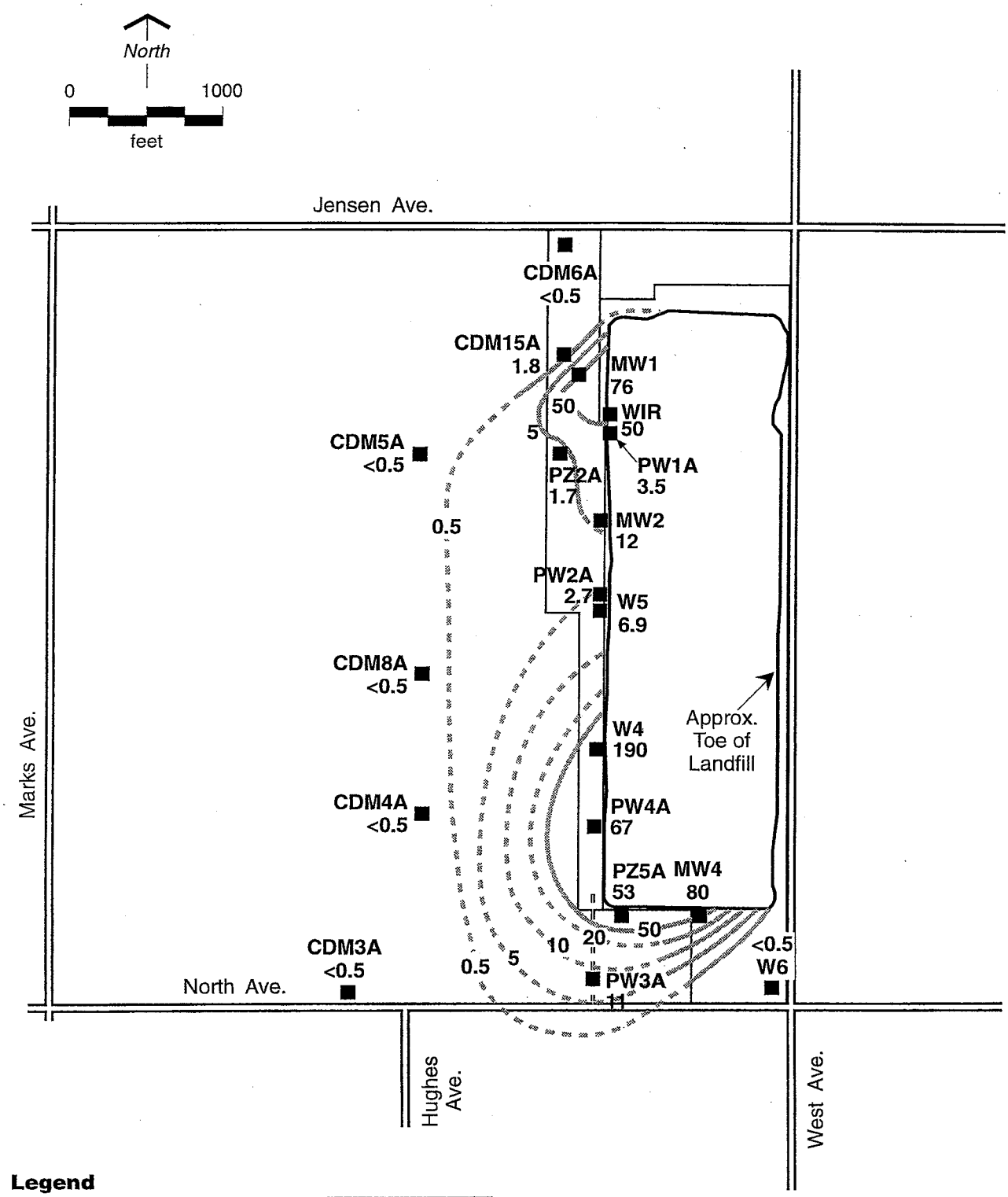
Sample Concentration in ug/l

NS = Not Sampled

FIGURE 5-6B
TCE CONCENTRATION IN A-AQUIFER
APRIL 2004
FRESNO SANITARY LANDFILL
FIRST FIVE-YEAR REVIEW REPORT
FRESNO, CALIFORNIA

Source: CDM, 2004.

CH2MHILL



Legend

■ Monitoring Well (Sample Concentration in ug/l)

Vinyl Chloride Concentration Contour in ug/l (Estimated Where Dashed)

FIGURE 5-7A
VC CONCENTRATION IN A-AQUIFER
APRIL 2000
FRESNO SANITARY LANDFILL
FIRST FIVE-YEAR REVIEW REPORT
FRESNO, CALIFORNIA

Source: CDM, 2000.

CH2MHILL

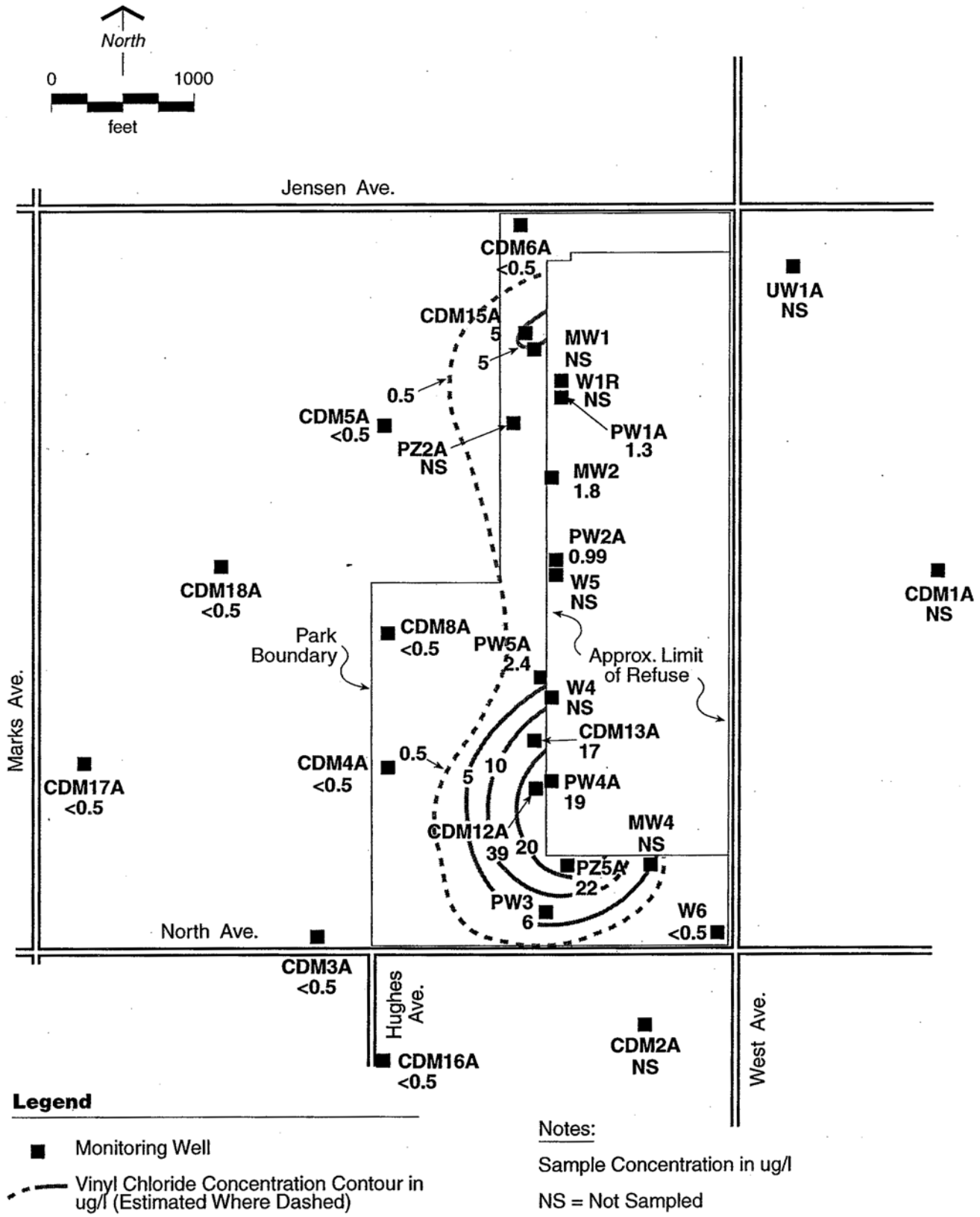
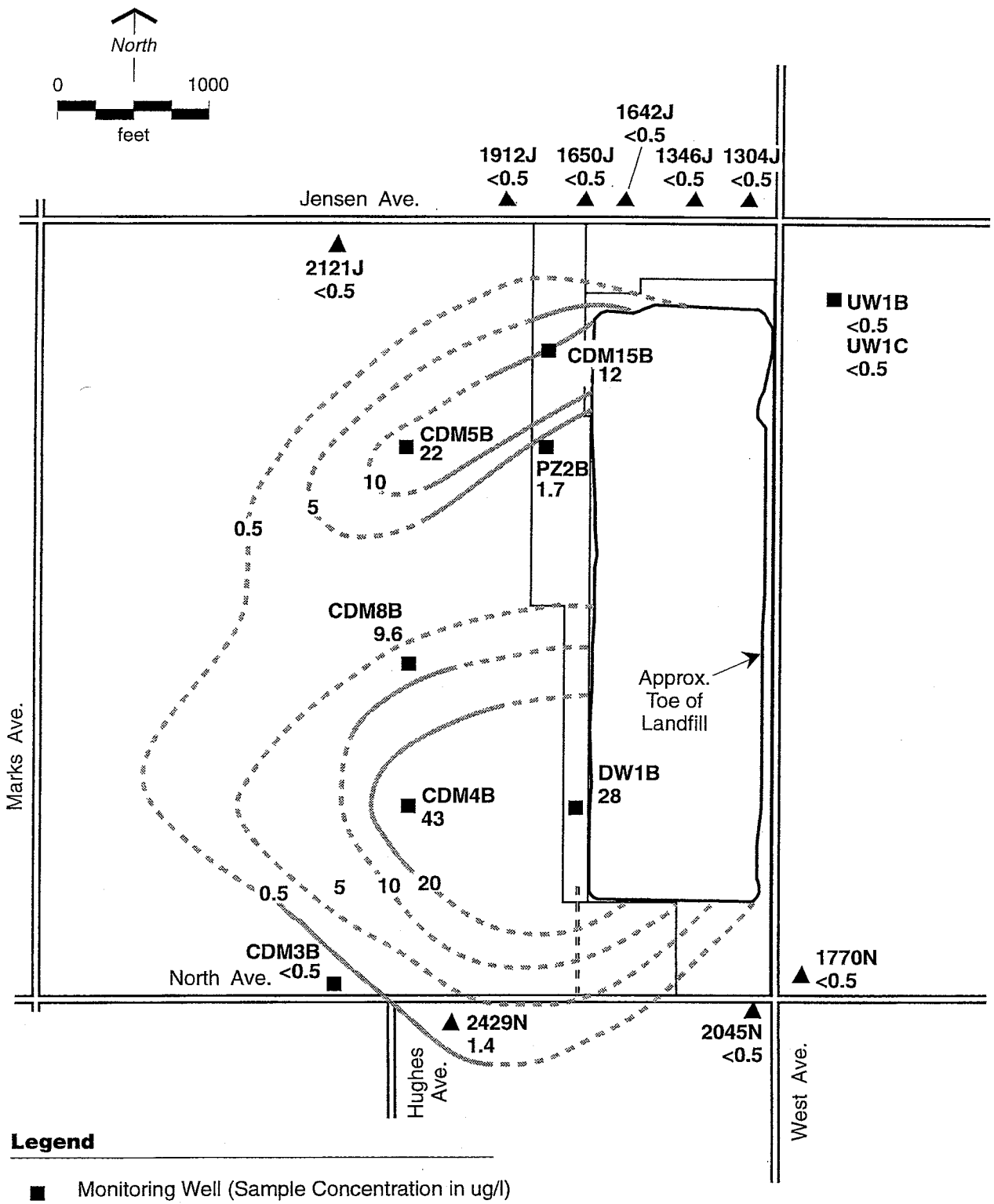


FIGURE 5-7B
VC CONCENTRATION IN A-AQUIFER
APRIL 2004
FRESNO SANITARY LANDFILL
FIRST FIVE-YEAR REVIEW REPORT
FRESNO, CALIFORNIA

Source: CDM, 2004.



Legend

- ■ Monitoring Well (Sample Concentration in ug/l)
- ▲ Residential Well (Sample Concentration in ug/l; NS=Not Sampled)
- Tetrachloroethene Concentration Contour in ug/l (Estimated Where Dashed)

FIGURE 5-8A
PCE CONCENTRATION IN B-AQUIFER
APRIL 2000
FRESNO SANITARY LANDFILL
FIRST FIVE-YEAR REVIEW REPORT
FRESNO, CALIFORNIA

Source: CDM, 2000.

CH2MHILL

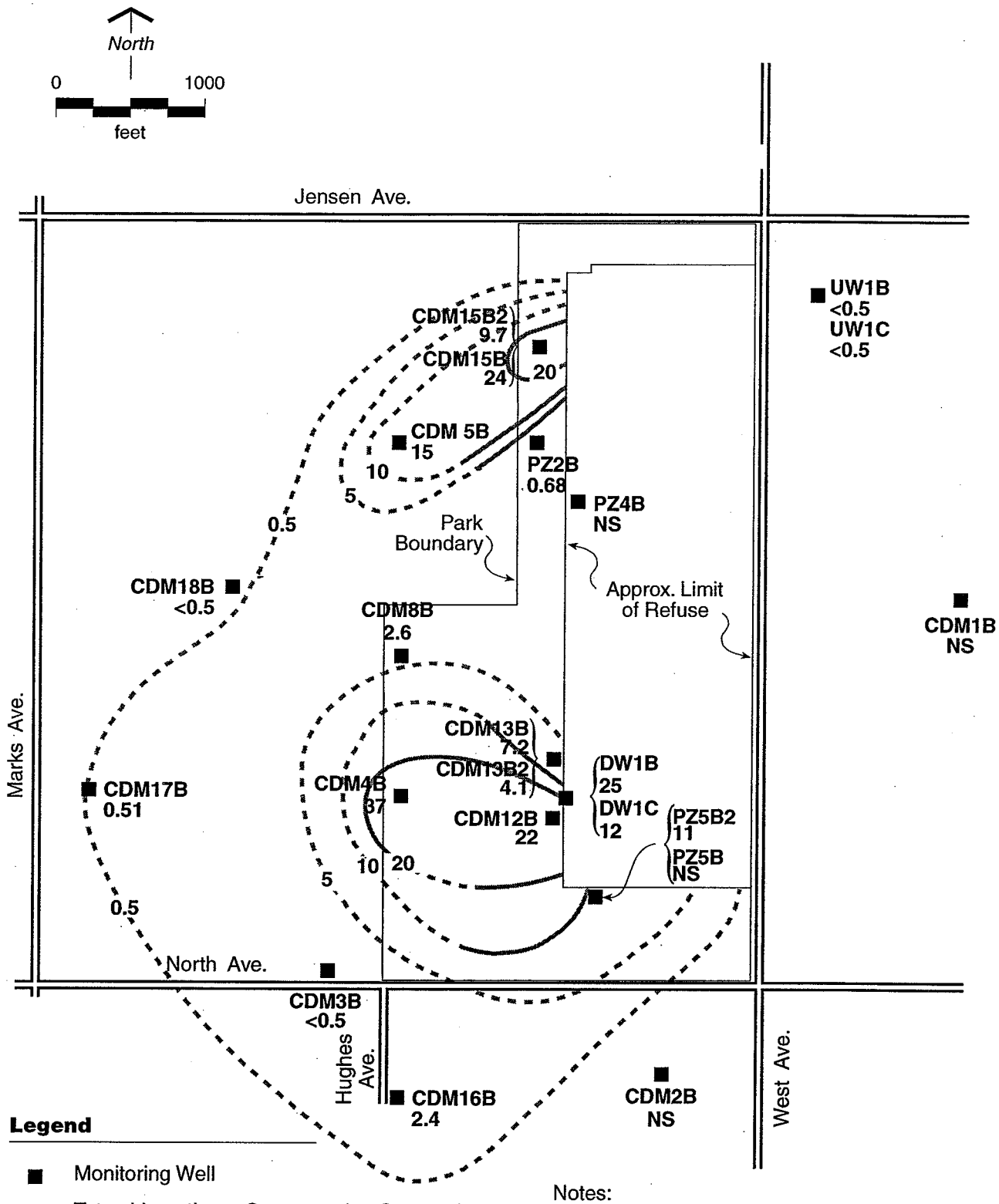
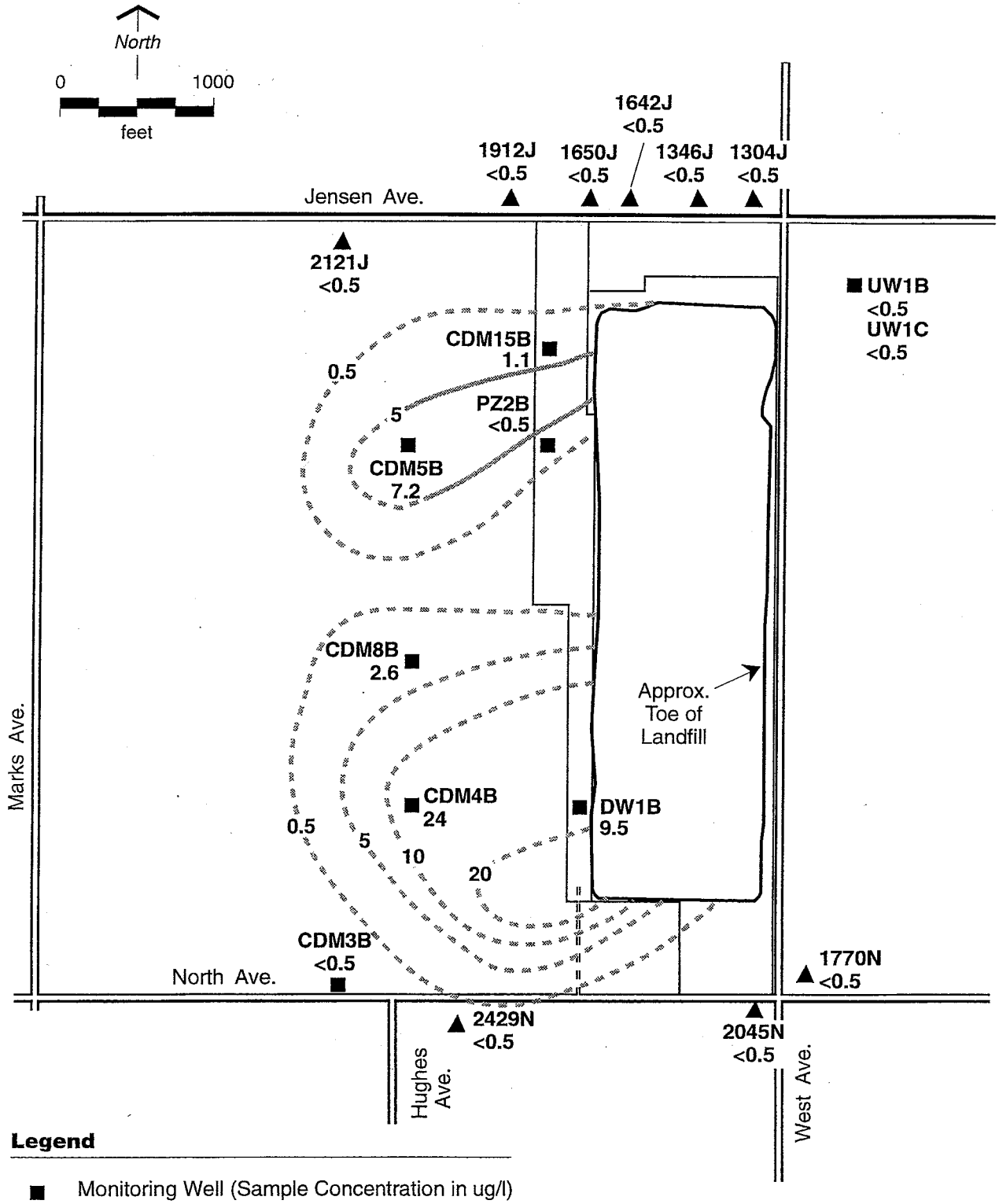


FIGURE 5-8B
PCE CONCENTRATION IN B-AQUIFER
APRIL 2004
FRESNO SANITARY LANDFILL
FIRST FIVE-YEAR REVIEW REPORT
FRESNO, CALIFORNIA

Source: CDM, 2004.

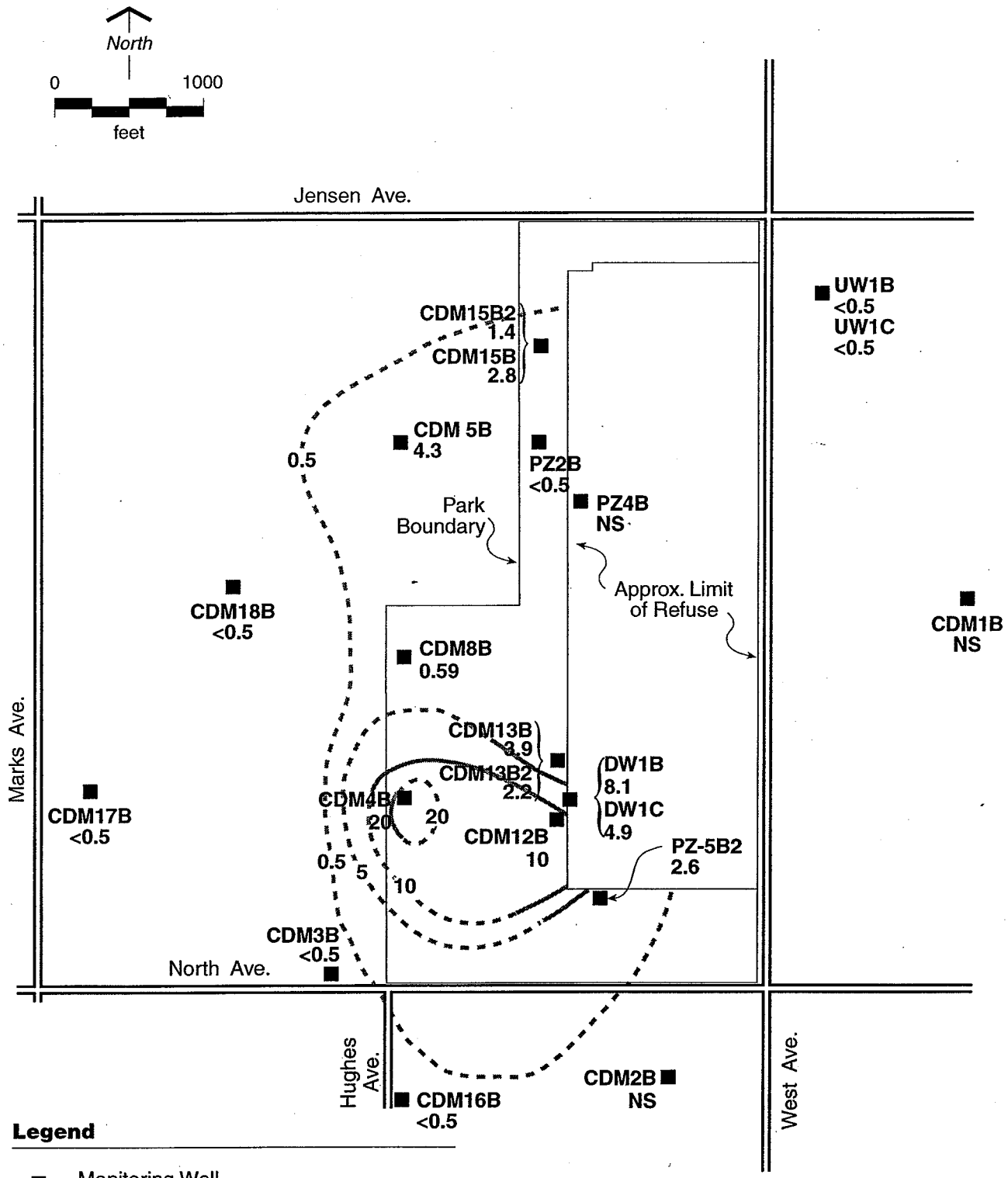


Legend

- ■ Monitoring Well (Sample Concentration in ug/l)
- ▲ Residential Well (Sample Concentration in ug/l; NS=Not Sampled)
- Trichloroethene Concentration Contour in ug/l (Estimated Where Dashed)

FIGURE 5-9A
TCE CONCENTRATION IN B-AQUIFER
APRIL 2000
FRESNO SANITARY LANDFILL
FIRST FIVE-YEAR REVIEW REPORT
FRESNO, CALIFORNIA

Source: CDM, 2000.



Legend

■ Monitoring Well

richloroethene Concentration Contour in ug/l (Estimated Where Dashed)

Notes:

Sample Concentration in ug/l

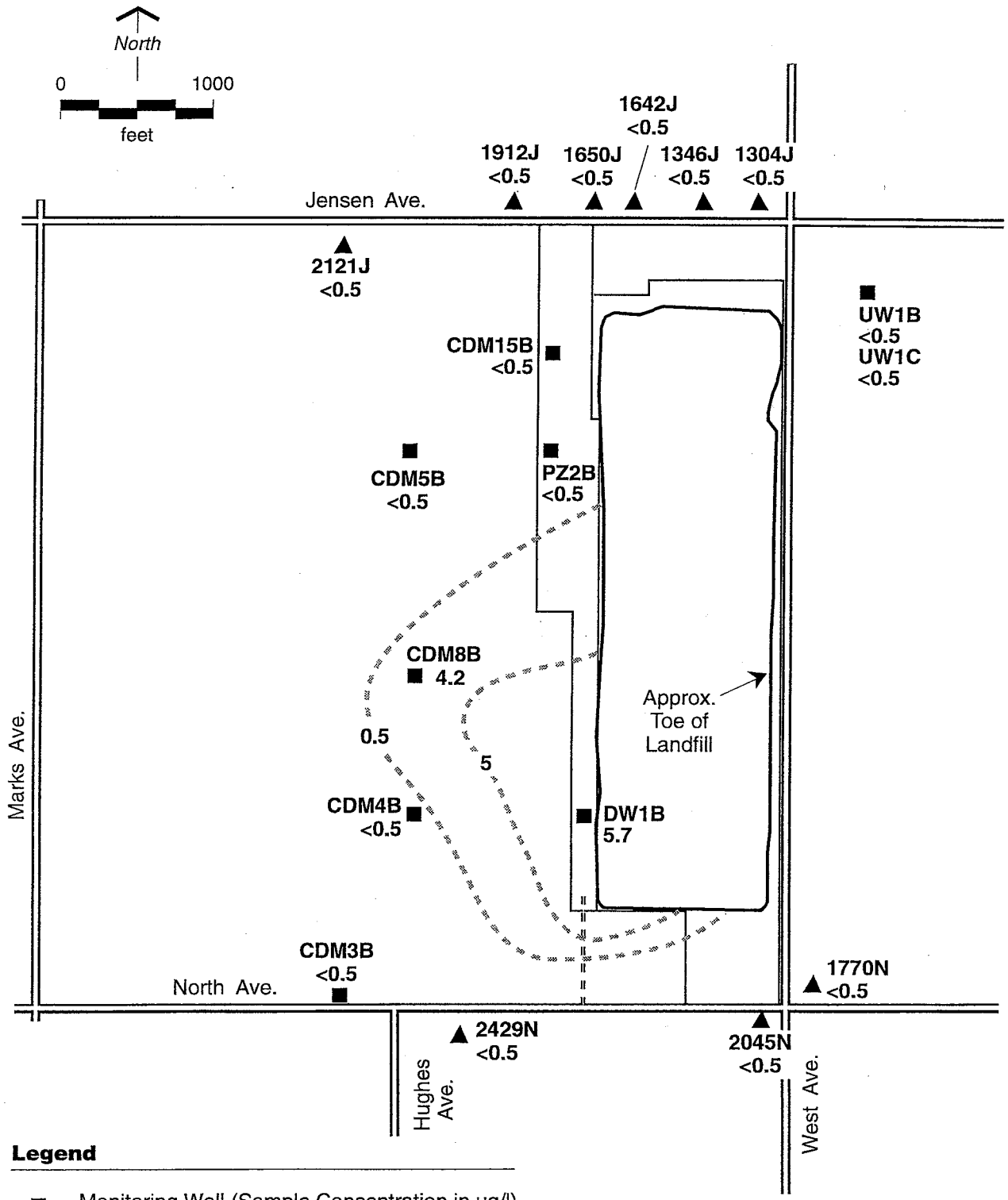
NS = Not Sampled

FIGURE 5-9B
TCE CONCENTRATION IN B-AQUIFER
APRIL 2004
FRESNO SANITARY LANDFILL
FIRST FIVE-YEAR REVIEW REPORT
FRESNO, CALIFORNIA

Source: CDM, 2004.

CH2MHILL

324131.FR.01_Fig 5-9b TCE Concentration in B-Aquifer; April 2004_ez_sfo

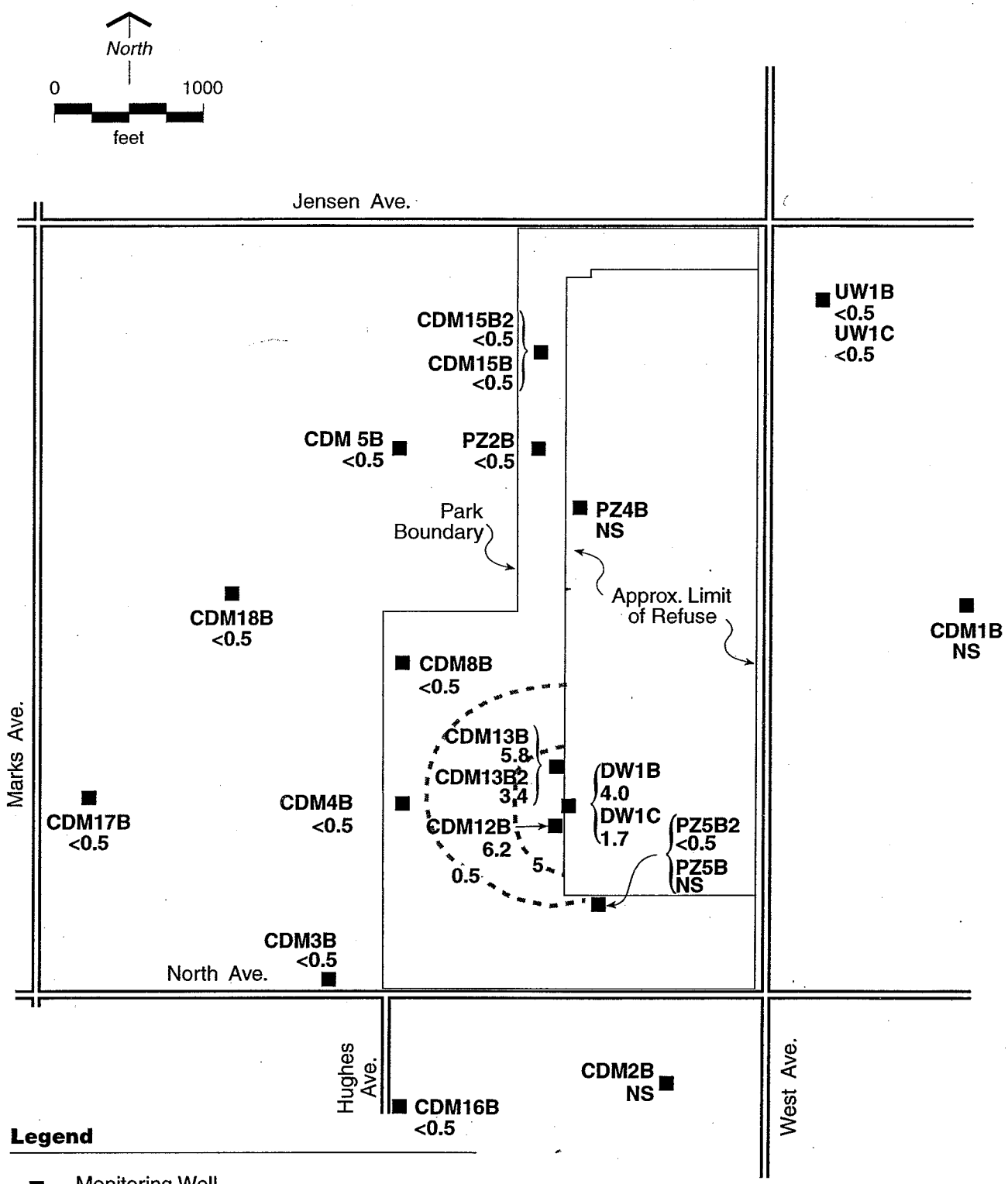


Legend

- ■ Monitoring Well (Sample Concentration in ug/l)
- ▲ Residential Well (Sample Concentration in ug/l; NS=Not Sampled)
- Vinyl Chloride Concentration Contour in ug/l (Estimated Where Dashed)

FIGURE 5-10A
VC CONCENTRATION IN B-AQUIFER
APRIL 2000
FRESNO SANITARY LANDFILL
FIRST FIVE-YEAR REVIEW REPORT
FRESNO, CALIFORNIA

Source: CDM, 2000.



Legend

■ Monitoring Well

Vinyl Chloride Concentration Contour in ug/l (Estimated Where Dashed)

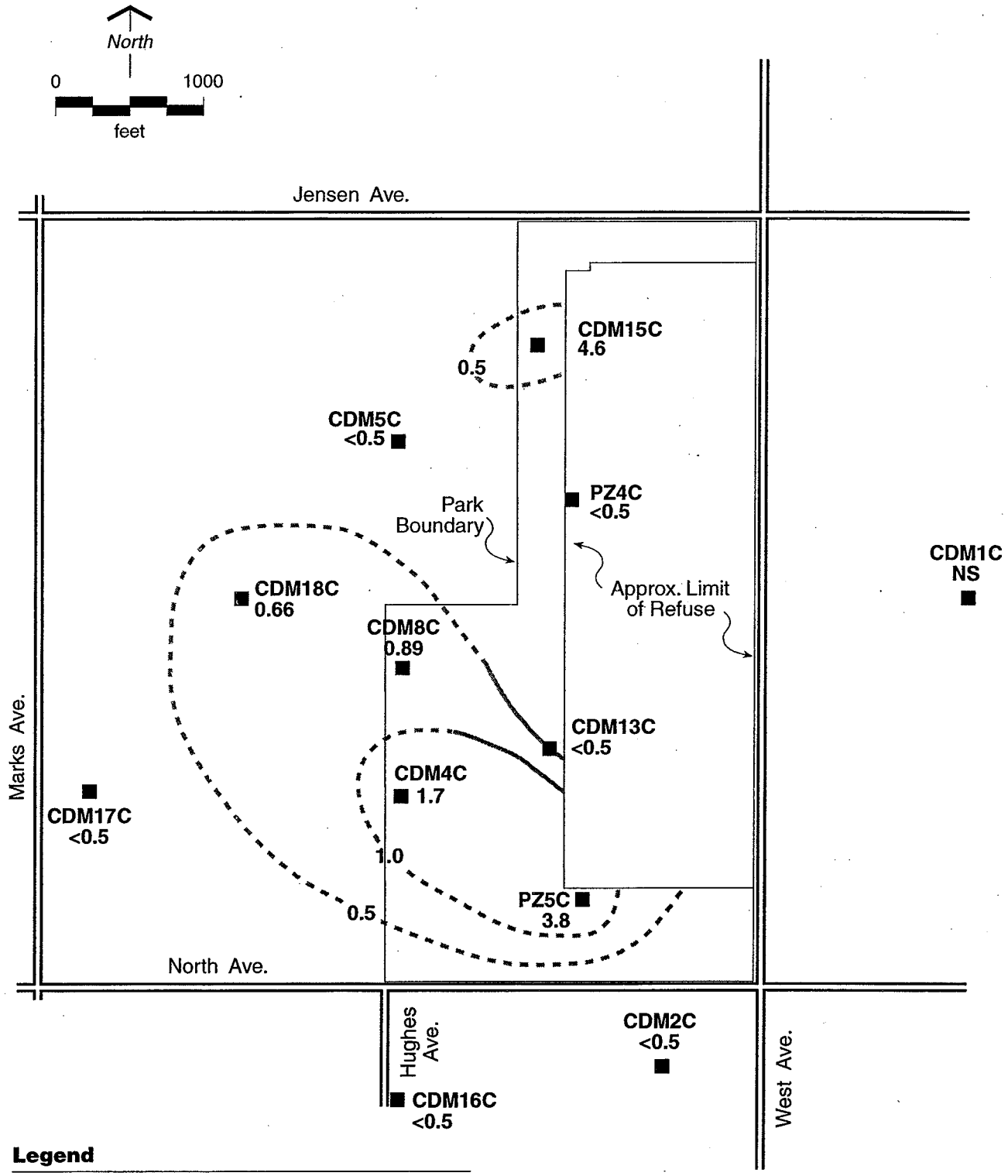
Notes:

Sample Concentration in ug/l

NS = Not Sampled

FIGURE 5-10B
VC CONCENTRATION IN B-AQUIFER
APRIL 2004
FRESNO SANITARY LANDFILL
FIRST FIVE-YEAR REVIEW REPORT
FRESNO, CALIFORNIA

Source: CDM, 2004.



Legend

■ Monitoring Well

Tetrachloroethene Concentration Contour in ug/l (Estimated Where Dashed)

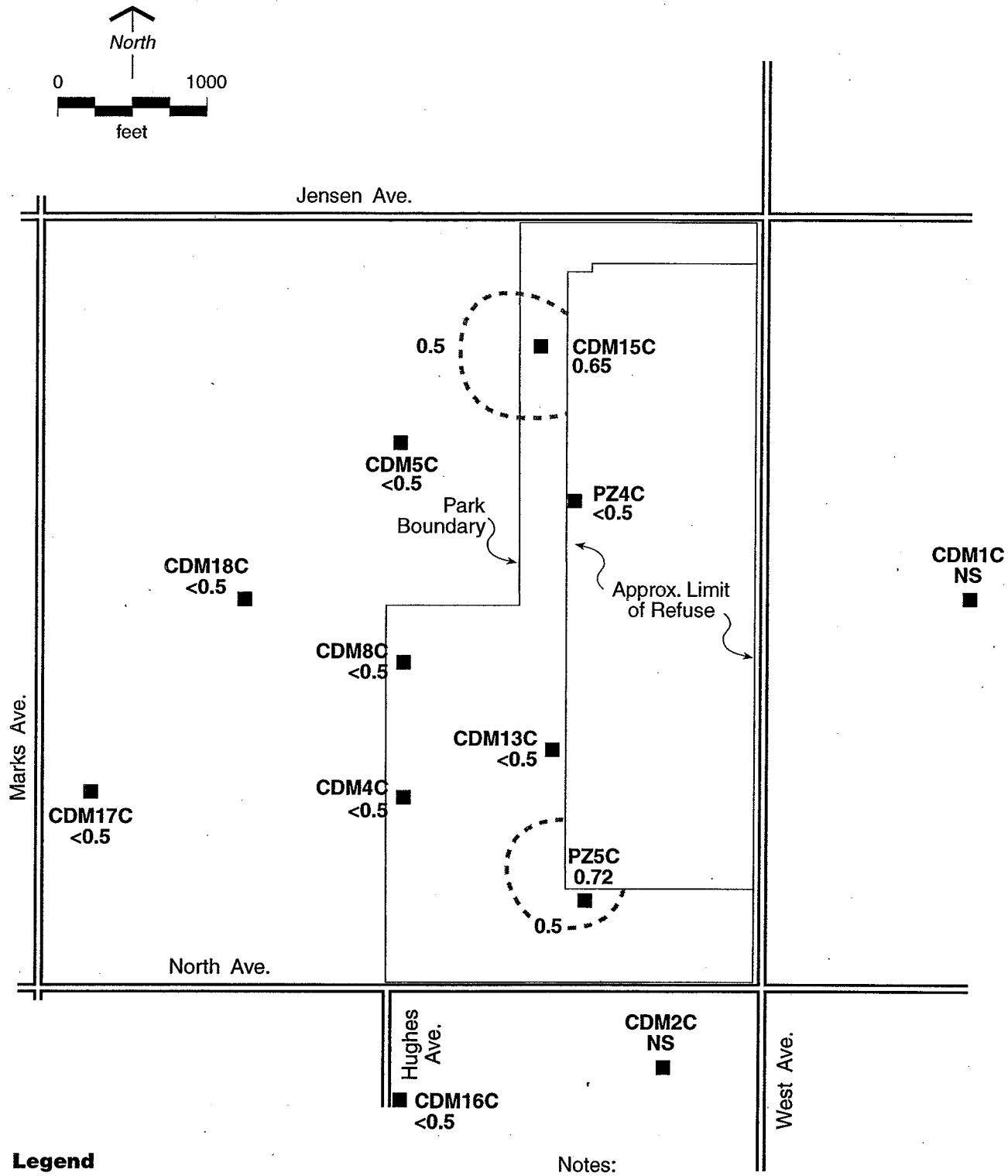
Notes:

Sample Concentration in ug/l

NS = Not Sampled

FIGURE 5-11
PCE CONCENTRATION IN C-AQUIFER
APRIL 2004
FRESNO SANITARY LANDFILL
FIRST FIVE-YEAR REVIEW REPORT
FRESNO, CALIFORNIA

Source: CDM, 2004.



Legend

■ Monitoring Well

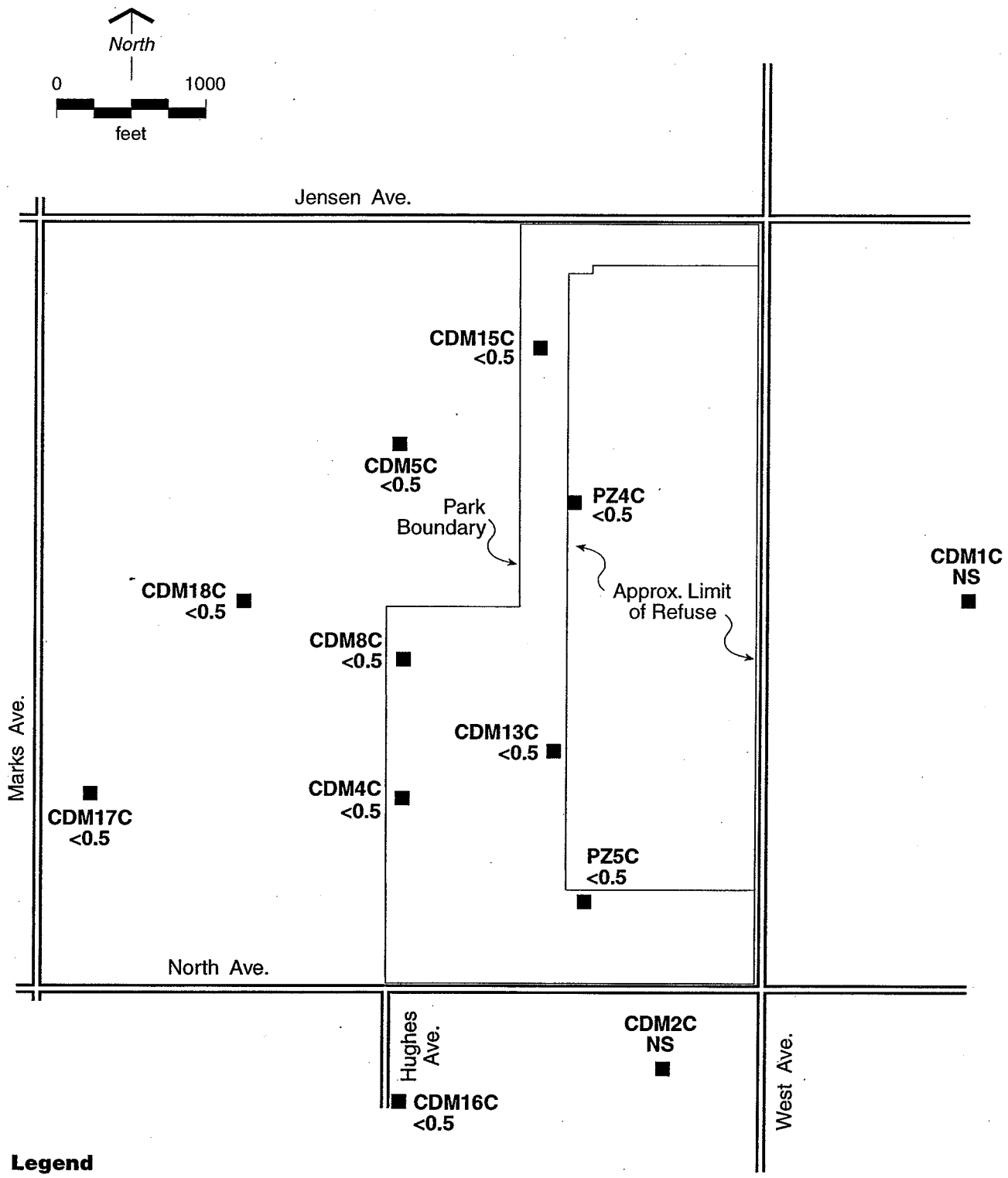
Notes:

Sample Concentration in ug/l

NS = Not Sampled

FIGURE 5-12
TCE CONCENTRATION IN C-AQUIFER
APRIL 2004
FRESNO SANITARY LANDFILL
FIRST FIVE-YEAR REVIEW REPORT
FRESNO, CALIFORNIA

Source: CDM, 2004.



Legend

■ Monitoring Well

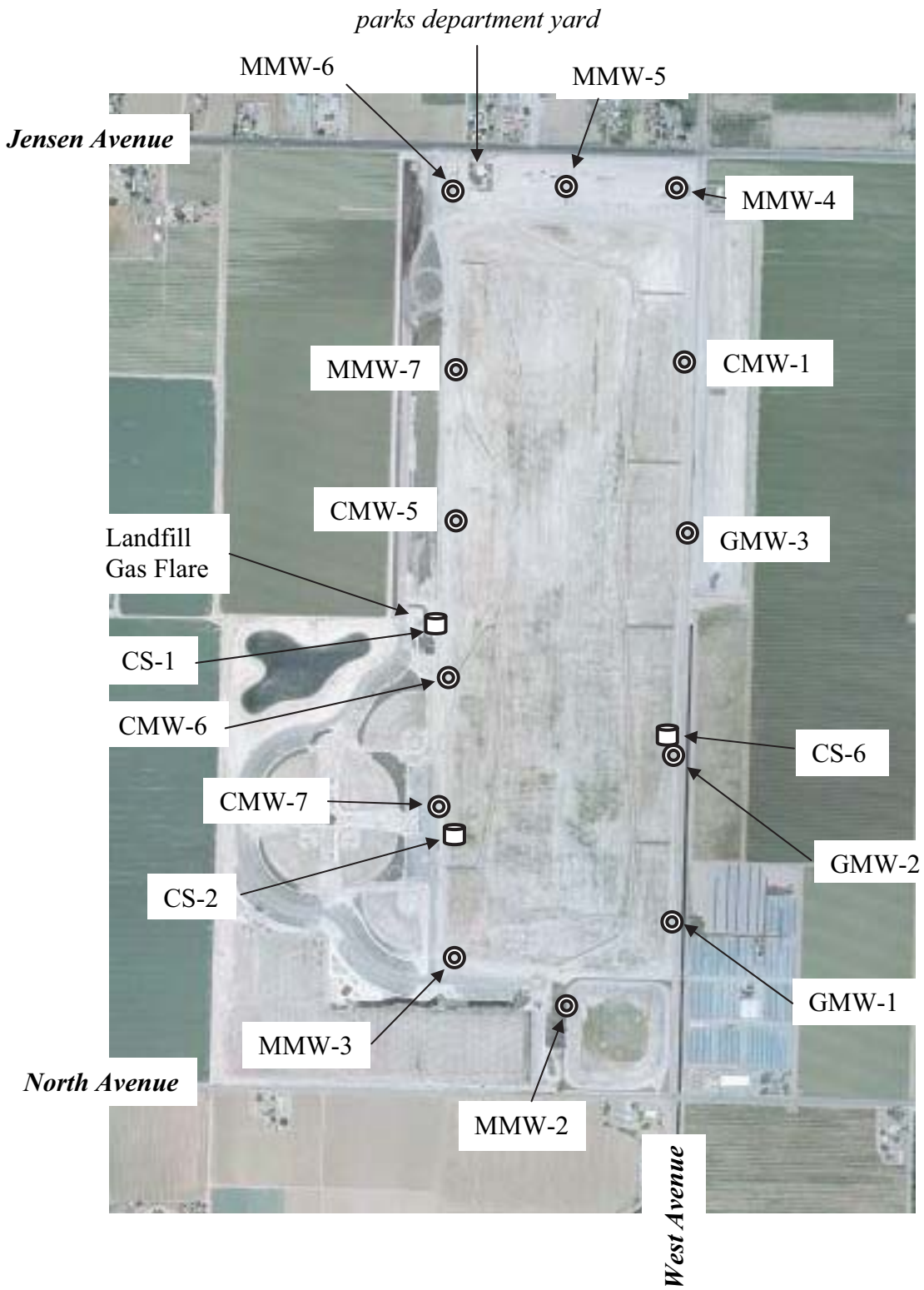
Notes:

Sample Concentration in ug/l

NS = Not Sampled

FIGURE 5-13
VC CONCENTRATION IN C-AQUIFER
APRIL 2004
FRESNO SANITARY LANDFILL
FIRST FIVE-YEAR REVIEW REPORT
FRESNO, CALIFORNIA

Source: CDM, 2004.



◎ MMW-1 = Landfill Gas Monitoring Probe Cluster designation and location.

⛁ CS-1 = Condensate Sump designation and location.

FIGURE 5-14
LANDFILL GAS FLARE, CONDENSATE SUMP, AND PERIMETER PROBE LOCATIONS
FRESNO SANITARY LANDFILL
FIRST FIVE-YEAR REVIEW REPORT
FRESNO, CALIFORNIA

Source: Kleinfelder, 2005.