Third Five-Year Review Report for

Fresno Municipal Sanitary Landfill Superfund Site

Fresno County, California

PREPARED BY

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FOR

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Date

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Executive Summary

This document presents the third Five-Year Review (FYR) for the Fresno Municipal Sanitary Landfill (FSL) Superfund Site (Site) located in Fresno, California. The purpose of this FYR is to review information to determine if the remedy is and will continue to be protective of human health and the environment. The triggering action for this FYR was the signing of the previous FYR on September 30, 2010.

The FSL Site is located four miles southwest of the City of Fresno (City) in Fresno County, California at 1707 West Jensen Avenue. The surrounding area is primarily agricultural; however, there are several residences to the north and south of the landfill. The FSL was an unlined municipal landfill that operated from 1935 to 1987 and covered approximately 145 acres. The landfill has since been closed, covered, and re-vegetated. Part of the surrounding area has been redeveloped into a regional park and sports complex.

Hazardous constituents were disposed of in the landfill during use. Groundwater beneath the Site was contaminated with chlorinated volatile organic compounds (VOCs), primarily tetrachloroethylene (PCE), trichloroethylene (TCE), and vinyl chloride (VC). Soil gas contained VOCs, Freon-12, and methane gas, and soil gas contamination was initially discovered up to 1000 feet from the perimeter of the landfill.

The U.S. Environmental Protection Agency (EPA) subdivided the Site into two Operable Units (OUs) for the purpose of remedy selection. EPA selected the following remedy components for the landfill source area and landfill gas (OU1) in the 1993 Record of Decision (ROD):

- Landfill gas collection and conveyance system
- Landfill gas treatment system via on-site combustion
- Gas condensate collection system
- Contingency leachate collection system
- Landfill gas migration monitoring
- Landfill cover
- Storm water management system.

EPA selected the following remedy components for the groundwater (OU2) in the 1996 ROD:

- Groundwater monitoring
- Abandonment of certain wells
- Institutional controls (ICs) during remediation
- Three phase installation and analysis of the groundwater extraction system
- Extracted groundwater treatment system.

In 2012, EPA issued an Explanation of Significant Differences (ESD) that formally adopted specific Institutional Controls, updated select chemical cleanup standards, corrected several Applicable or

Relevant and Appropriate Requirements (ARARs), and identified new ARARs regarding land use covenants.

The landfill cap, landfill gas (LFG) control system, surface water management system, and groundwater treatment system were constructed between 1999 and 2001. The groundwater treatment plant began operation in 2001 with five extraction wells in the shallowest (A) aquifer. Phase 2 construction activities occurred between 2007 and 2008 with the addition of two extraction wells in the deeper B-aquifer. One additional lower B-aquifer extraction well was installed as part of Phase 2 Enhancements that occurred between 2011 and 2014.

Major cap repairs were completed in 2011 to address subsidence issues along the eastern edge of the landfill, and additional repairs were completed in April 2015.

Six contaminants of concern (COCs) at the Site (PCE, TCE, cis-1,2-dichloroethylene [cDCE], 1,2-dichloroethane [1,2-DCA], vinyl chloride (VC), and 1,2-dichlorobenzene [1,2-DCB]) remain at concentrations above cleanup standards in one or more of the A-, B-, and C-aquifers. Remedial efforts have greatly reduced COC concentrations in the A-aquifer. COC concentrations in the B- and C-aquifers have been more variable, with small recent increases observed in downgradient C-aquifer monitoring wells. The remedial action objective to prevent the plume from moving downgradient and impacting previously uncontaminated groundwater resources is currently being attained. Continued monitoring and evaluation of COC concentrations and trends will determine if the extraction system is effectively controlling the groundwater plume or if additional extraction wells are needed.

There have been a few changes to groundwater cleanup levels since the 1996 ROD. The 2012 ESD corrected cleanup levels for two COCs, trans-1,2-dichloroethylene (tDCE) and chloroform, to match current, more stringent state and/or federal MCLs. Toxicity values have changed for several chemicals, but the changes do not affect protectiveness.

Land use has not changed since the last FYR. Exposure pathways from soil and groundwater are being controlled through ICs. A Well Assessment and Prohibition Program prohibits and/or restricts well installation on or near the Site. Two restrictive covenants (one for the landfill and one for the adjacent Sports Complex) recorded in 2012 provide further restrictions on groundwater use and provide protections for the remedy.

The remedy for OU1 is protective of human health and the environment. The landfill cap prevents exposure to contaminated soil and materials within the landfill. The landfill gas extraction and treatment system controls the landfill gas exposure.

The remedy for OU2 currently protects human health and the environment because exposure pathways for groundwater are being controlled. Exposure pathways to contaminated groundwater that could result in unacceptable risks are prevented through restrictive covenants and a wellhead protection program; furthermore, wellhead filtration systems and bottled water substitutes are provided to some homes immediately adjacent to the Site. However, in order for the remedy to be protective in the long-term, effective capture of groundwater contamination in all aquifers beneath the Site must be achieved to prevent further plume migration and to ensure protectiveness.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Fresno Municipal Sanitary Landfill Superfund Site		
EPA ID: CAD980636914		
Region: 9	**State:** CA	**City/County:** Fresno/Fresno

SITE STATUS	
NPL Status: Final	
Multiple OUs? Yes	**Has the site achieved construction completion?** No

REVIEW STATUS
Lead agency: EPA **If "Other Federal Agency" was selected above, enter Agency name:** Click here to enter text.
Author name (Federal or State Project Manager): Patricia Bowlin
Author affiliation: EPA Region 9
Review period: October 1, 2014 – September 30, 2015
Date of site inspection: January 16, 2015
Type of review: Statutory
Review number: 3
Triggering action date: September 30, 2010
Due date *(five years after triggering action date)*: September 30, 2015

Five-Year Review Summary Form (continued)

Issues/Recommendations				
OU(s) without Issues/Recommendations Identified in the Five-Year Review:				
OU1				
Issues and Recommendations Identified in the Five-Year Review:				
OU(s): OU2 Groundwater	**Issue Category: Remedy Performance**			
	Issue: Hydraulic capture of groundwater plume migration has not yet been achieved in all aquifers. Available data indicates expansion of the plume in the C-aquifer.			
	Recommendation: Continue monitoring groundwater response to Phase 2 Enhancements and evaluate need for additional C-aquifer extraction wells.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA	09/2017

Protectiveness Statement(s)		
Operable Unit: OU1	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):* NA
Protectiveness Statement: The remedy for OU1 is protective of human health and the environment. The landfill cap prevents exposure to contaminated soil and materials within the landfill. The landfill gas extraction and treatment system controls the landfill gas exposure.		

Protectiveness Statement(s)		
Operable Unit: OU2	*Protectiveness Determination:* Short-term Protective	*Addendum Due Date (if applicable):* NA
Protectiveness Statement: The remedy for OU2 currently protects human health and the environment because exposure pathways for groundwater are being controlled. Exposure pathways to contaminated groundwater that could result in unacceptable risks are prevented through restrictive covenants and a wellhead protection program; furthermore, wellhead filtration systems and bottled water substitutes are provided to some homes immediately adjacent to the Site. However, in order for the remedy to be protective in the long-term, effective capture of groundwater contamination in all aquifers beneath the Site must be achieved to prevent further plume migration and to ensure protectiveness.		

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List of Abbreviations

Addendum	2009 Addendum to the Supplemental AOR
AOR	Analysis of Risk
ARARs	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
CA	California
CCR	California Code of Regulations
cDCE	cis-1,2-dichloroethylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
City	City of Fresno
1,1-DCA	1,1-dichloroethane
1,2-DCA	1,2-dichloroethane
1,2-DCB	1,2-dichlorobenzene
1,4-DCB	1,4-dichlorobenzene
1,1-DCE	1,1-dichloroethylene
1,2-DCP	1,2-dichloropropane
DHS	California Department of Health Services
DTSC	California Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
FSL	Fresno Municipal Sanitary Landfill
ft	feet
Freon 11	Trichlorofluoromethane
Freon 12	Dichlorodifluoromethane
FYR	Five-Year Review
GTP	Groundwater treatment plant
HQ	Hazard Quotient
IC	institutional control
IRIS	Integrated Risk Information System
LFG	landfill gas
MCL	Maximum Contaminant Level
NCP	National Contingency Plan
NPL	National Priorities List
O&M	Operation and maintenance
OM&M	Operation, maintenance, and monitoring
OU	Operable Unit
PCE	tetrachloroethylene
POTW	Publicly Owned Treatment Works
ppbv	parts per billion by volume
PRP	Potentially Responsible Party
PTA	Packed tower aeration
RA	Remedial Action
ROD	Record of Decision
RSL	Regional Screening Level
RWQCB	Regional Water Quality Control Board
SJVUAPCD	San Joaquin Valley Unified Air Pollution Control District
1,1,1-TCA	1,1,1-trichloroethane
TCE	trichloroethylene

TCFM	trichlorofluoromethane (see also Freon 11)
tDCE	trans-1,2-dichloroethylene
UAO	Unilateral Administrative Order
USACE	United States Army Corps of Engineers
VC	Vinyl chloride
VI	vapor intrusion
VISL	vapor intrusion screening level
VOC	volatile organic compound

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Third Five-Year Review Report

for

Fresno Municipal Sanitary Landfill

1. Introduction

The purpose of a Five-Year Review (FYR) is to evaluate the implementation and performance of a remedy in order to determine if the remedy will continue to be protective of human health and the environment. The methods, findings, and conclusions of FYRs are documented in FYR reports. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) prepares FYRs pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121 and the National Contingency Plan (NCP). CERCLA 121 states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

EPA interpreted this requirement further in the NCP, 40 Code of Federal Regulations (CFR) Section 300.430(f)(4)(ii), which states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such actions no less often than every five years after the initiation of the selected remedial action.*

This is the third FYR for the Fresno Municipal Sanitary Landfill (FSL) Superfund Site. The triggering action for this statutory review is the previous FYR dated September 30, 2010. The FYR is required due to the fact that hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure.

EPA Region 9, with support from the U.S. Army Corps of Engineers (USACE), conducted the FYR and prepared this report regarding the remedy implemented at the FSL Site in Fresno, Fresno County, California. The Regional Water Quality Control Board (RWQCB) and California Department of Toxic

Substances Control (DTSC) are support agencies representing the State of California and provided input to EPA during the FYR process.

The Site consists of two Operable Units (OUs). OU1 addresses landfill closure and source control, including landfill gas. OU2 addresses volatile organic compounds (VOCs) in groundwater in the landfill area.

2. Site Chronology

Table 1 lists the important events and dates for the FSL Site.

Table 1. Chronology of Site Events

Event	Date
FSL accepts waste	1937
FSL expanded south of Annadale Avenue	1945
City of Fresno began closing process for the FSL	1981
Off-site migration of soil gas and contaminated groundwater discovered	1984
FSL receives last waste	July 1, 1987
City installed methane barriers at north and south ends of landfill	1988
Site was listed on National Priorities List (NPL)	October 1989
EPA issued Unilateral Administrative Order (UAO) the City of Fresno to apply an active vacuum system to the methane barriers and install a landfill gas extraction system	September 1990
EPA and City of Fresno signed Administrative Consent Order (AOC) wherein the City agreed to conduct a Remedial Investigation (RI)/Feasibility Study (FS)	September 1990
EPA issued an amendment to the UAO to add a requirement that the City also implement a monitoring program of residences near the landfill	February 1991
Vacuum system added to methane barriers	1990-1991
FS completed for OU1 (source control)	September 1992
Record of Decision (ROD) for OU1 signed	30 September 1993
AOC was amended to include design of landfill cap	December 1993
RI for OU2 completed	May 1994
Human Health Risk Assessment completed for OU2	September 1994
FS completed for OU2	July 1996
ROD for OU2 signed	September 1996
Consent Decree signed that included agreements to initiate a groundwater monitoring program, construction of OU1 remedy, and remedial design development and cleanup activities for OU2	September 1997
Operation of Early Groundwater Remedial Action System	May 1999 – July 2001
OU1 landfill cover, landfill gas (LFG) control, and surface water management systems constructed	July 1999 – June 2000
Groundwater Treatment Plant (GTP) started up	September 2001
Fresno Regional Sports Complex completed	2001
Well Protection Program implemented	2003
Decommissioning of nearby agricultural water wells completed	April 2005
First FYR report completed	September 2005
Phase 2 Groundwater Remedial Action (RA): Remedial Design (RD) approved by EPA	September 2007
Phase 2 Groundwater RA: Construction activities occurred	2007 - 2008
Phase 2 Groundwater RA: Extraction well pumping initiated	2008
City completed design for landfill cap repairs	April 2010
Second FYR report completed	September 2010

Event	Date
Phase 2 Groundwater RA Evaluation Report completed	November 2010
Phase 2 Enhancements Basis of Design Report completed	September 2011
Landfill cap repairs completed	2011
Sports Complex Restrictive Covenant recorded	March 13, 2012
Landfill Restrictive Covenants recorded	March 29, 2012
Explanation of Significant Differences (ESD) signed	September 2012
Phase 2 Enhancements: Construction activities occurred	March 2013 – April 2014
Phase 2 Enhancements: New extraction well pumping initiated	April 2014
Performance Monitoring of GTP Influent/Effluent, Groundwater, and Landfill gas	Ongoing

3. Background

3.1. Physical Characteristics

The FSL Site is located four miles southwest of the City of Fresno in Fresno County, California, at 1707 West Jensen Avenue (Figure 1). The Site consists of approximately 145 acres in a primarily agricultural area of the San Joaquin Valley. The Site is bounded on the north by Jensen Avenue, on the east by West Avenue, on the south by North Avenue, and on the west by agricultural fields. Several residences are adjacent to the northern and southern boundaries.

The actual landfill is slightly less than a mile long. Prior to closure and capping, landfill refuse had been placed to an average height of 45 feet above the surrounding grade. The surrounding terrain is flat and contains large areas of agricultural fields. The region typically experiences hot, dry summers and moderate winters.

3.2. Hydrogeology

The FSL Site is located in the San Joaquin Valley, which is in the southern portion of the Central Valley (the northern part is called the Sacramento Valley and the middle section is the Sacramento-San Joaquin Delta). The Central Valley is composed of alluvial plains, flood plains, and dissected uplands. The majority of the groundwater originates as runoff from the Coast Ranges to the west and the Cascades and Sierra Nevadas to the east.

The Central Valley is in a structural trough approximately 400 miles long and 20 to 70 miles wide. The valley trough is filled to great depths with erosion-derived sediments from the Coast and Sierra Nevada mountain ranges, and marine, continental sediments derived from past lacustrine and inland sea environments.

The geology under the FSL Site consists of interbedded layers and lenses of clay, silt, sand, and gravels. These layers of Quaternary alluvium extend approximately 500 feet below ground surface (bgs). Two geologic formations, the Riverbank and Turlock Lake Formations, underlie the FSL Site. The Riverbank Formation is younger and is found in the upper few hundred feet of sediment in the Fresno area. The

Riverbank Formation varies in thickness from 1 to 265 feet (ft.) and is described as predominantly sandy in texture.

The Turlock Lake Formation varies in thickness from 165 ft. to 720 ft. and lies below the Riverbank Formation. The Turlock Lake Formation represents deposition as overbank sediments on the fluvial floodplain during periods of flooding when discharge exceeded river/stream channel capacity. The sequence becomes coarser as one moves upwards and contains fluvial sandstone with scattered pebbles overlying better-sorted, finer-grained floodplain siltstone.

The majority of groundwater in the area originates as runoff from distant mountains. Three main aquifers (A, B, and C) are identified beneath the Site. A description of the hydrostratigraphic units beneath the Site includes (in descending order):

- Sandy A-aquifer extending to approximately 90 feet below ground surface (bgs);
- Silt and clay B-aquitard (extends from approximately 90 to 100 feet bgs);
- B-aquifer with interbedded silts and discontinuous sands (approximately 100 to 250 feet bgs); and
- Continuous sandy C-aquifer.

All the groundwater zones are potential sources of drinking and/or irrigation water. The regional groundwater flow direction in this area is toward the southwest. In the immediate vicinity of the landfill, water flows in a southerly direction. Since the 1940s, the regional water table has steadily declined due to a combination of groundwater extraction and insufficient recharge; consequently, most of the A-aquifer wells are dry or produce insufficient yield to sample.

3.3. Land and Resource Use

Between approximately 1935 and 1987, the Site was used as a landfill for a variety of municipal wastes. Operations began in the north end in a series of unlined trenches that were covered with dirt from the next adjacent trench to the south. The landfill stopped receiving waste in 1987 and has since been undergoing remedial actions. Currently, the landfill has an impermeable vegetated cap. In 2001, the southwest portion of the Site was redeveloped into the Fresno Regional Sports Complex, which includes soccer fields, softball fields, restrooms, a playground, and other recreational facilities (Figure 2). Storm water detention ponds have been built on portions of the west, east, and south sides of the landfill.

The land use immediately surrounding the Site is primarily agricultural with residences located adjacent to the north and south boundaries of the landfill. West Park Elementary School is located 1 mile west of the Site, and the Fresno Regional Wastewater Facilities are approximately 3 miles west of the Site. The City has no plans to change future land use at the Site or surroundings.

Historically, groundwater in the immediate vicinity of the Site has been used for residential and agricultural purposes. The City of Fresno's water system provides drinking water to about 500,000 customers in the city. The primary source of this water is groundwater from approximately 260 water wells scattered throughout Fresno. In 2004, the city began augmenting the groundwater with treated water from the Sierra Nevada mountain range. At the time of the 1993 ROD, there were eight municipal wells

within 3 miles of the Site. Currently, there are multiple private wells present among the residences adjacent to the landfill.

The Fresno Colony Canal, an unlined irrigation supply canal, runs along the eastern side of the landfill and provides water for local irrigation activities. The canal previously extended through what is now the capped landfill, carrying water from the Fresno Colony Canal to fields west of the landfill. The original canal bisected the landfill, but was replaced by an 18-inch concrete pipeline sometime after 1956 as the landfill continued to expand southwards. In 1996, the pipeline was relocated to the south end of the landfill in anticipation of groundwater remedial activities. When water levels are low, water from Park Lake, a man-made lake that receives treated Site groundwater, is diverted to the Fresno Colony Canal for local irrigation purposes.

3.4. History of Contamination

The FSL is the oldest compartmentalized landfill in the western United States. Between 1935 and 1987, the City of Fresno operated and filled the unlined landfill with municipal trash and some liquid waste. Between the late 1950s and the mid-1960s, battery acid was also disposed of via 1,600-gallon tanker trucks. The estimate of total waste disposed is approximately 4.7 million tons.

In the early 1980s, complaints from nearby residents prompted the California Department of Health Services (DHS) to conduct a preliminary site inspection in 1984. DHS discovered methane gas migrating off-site, and also identified the potential for volatile organic compound (VOC) contamination of groundwater.

3.5. Initial Response

The City discontinued accepting wastes at the FSL in 1987. The following year, the City installed two methane barriers to protect residences to the north and south. In 1990, continued migrating soil gas contamination prompted the City to install a vacuum system on the methane barrier, which ultimately proved ineffective.

In 1992, the City offered bottled water and activated carbon wellhead treatment systems to residences within a city block of the landfill.

3.6. Basis for Taking Action

The primary contaminants of concern (COCs) for the FSL Site are VOCs in groundwater and soil gas. The 1993 ROD identified methane as a proxy for VOCs in landfill gas directly above the landfill (OU1). The 1996 ROD identified the following COCs for groundwater (OU2):

- Trichloroethylene (TCE)
- Tetrachloroethylene (PCE)
- Vinyl chloride (VC)
- 1,1-Dichloroethylene (1,1-DCE)
- 1,2-Dichloroethane (1,2-DCA)
- Trans-1,2-Dichloroethene (tDCE)

- Cis-1,2-Dichloroethene (cDCE)
- 1,2-Dichloropropane (1,2-DCP)
- 1,2-Dichlorobenzene (1,2-DCB)
- 1,4-Dichlorobenzene (1,4-DCB)
- Benzene
- Chlorobenzene
- Chloroform
- 1,1-Dichloroethane (1,1-DCA)
- Trichlorofluoromethane (TCFM, also known as Freon 11)
- Toluene

Locally impacted groundwater aquifers associated with the landfill are used as a source of water for residential and agricultural wells. In 1994, both residential and agricultural wells were located near the known extent of the groundwater plume, which contained several contaminants that exceeded drinking water standards (i.e., maximum contaminant levels [MCLs]). The groundwater contamination, if left unremediated, also presented a potential threat to the larger regional aquifer that provides the majority of the municipal drinking water for the residents of the City of Fresno. Furthermore, the Human Health Risk Assessment found that nearby residents were potentially at risk of exposure to landfill gases via vapor intrusion.

4. Remedial Actions

4.1. Remedy Selection

EPA organized the remedial action work at the FSL Site into two OUs: one for source control (OU1), and the other for groundwater treatment (OU2).

In 1993, EPA issued a Record of Decision to address the landfill source area and landfill gas (OU1). After completion of an RI in 1994, a second ROD was issued in 1996 to address the groundwater contamination (OU2).

In 2012, EPA issued an Explanation of Significant Differences (ESD) to provide notice of several modifications and clarifications to the remedies selected in the 1993 and 1996 RODs. None of the changes in the ESD fundamentally affected the previously selected remedies.

4.1.1. OU1 Source Control

The 1993 ROD addressed remedial actions associated with the landfill but excluded the surrounding area. The selected remedy for OU1 identified the following major components:

- Landfill cover system to minimize water infiltration, provide erosion control, and act as a barrier to fugitive landfill gas emissions;
- Landfill gas (LFG) migration monitoring system consisting of monitoring probes along the landfill perimeter;

- LFG collection and conveyance system that includes interior gas extraction wells, perimeter gas extraction wells, a blower system, and a piping system to move the LFG to the treatment system;
- LFG treatment system (flare) to combust LFG on-site;
- LFG condensate collection system to manage condensate formed during conveyance of LFG; and
- Contingency leachate collection system to be implemented if the leachate liquid found in the gas wells was determined to be a threat to groundwater.

The 1993 ROD further identified the following performance requirements:

- Periodic emissions monitoring to assess the effectiveness of the system in meeting the destruction efficiency; and
- Continued operation of the LFG extraction system until LFG production has declined to the extent that the LFG monitoring requirements (defined as a maximum concentration of 1000 ppm methane at the surface and a maximum of 5% methane at the perimeter monitoring wells) can be met without active LFG extraction.

4.1.2. OU2 Groundwater Remediation

The objective of the OU2 remedy is to prevent the plume from moving downgradient and impacting previously uncontaminated groundwater resources and to restore the aquifers to beneficial use so human health is protected. Beneficial use is defined as when groundwater contaminant levels are at or below the cleanup levels for the 16 COCs identified in the 1996 ROD (Table 2).

Table 2. Cleanup Standards for Groundwater COCs

Chemical	Cleanup Standard (µg/L)	Basis
1,1-DCA	5	Federal MCL
1,1-DCE	6	State MCL
1,2-DCA	0.5	State MCL
1,2-DCB	600	Federal MCL
1,2-DCP	5	Federal MCL
1,4-DCB	5	State MCL
Benzene	1	State MCL
cDCE	6	State MCL
Chlorobenzene	70	Federal MCL
Chloroform	100	Federal MCL
PCE	5	Federal MCL
tDCE	100	Federal MCL
TCE	5	Federal MCL
Trichlorofluoromethane (TCFM or Freon-11)	150	Federal MCL
Toluene	150	Federal MCL
VC	0.5	State MCL

The remedy selected in the 1996 ROD for groundwater (OU2) consisted of the following major elements:

- Groundwater monitoring;
- Groundwater extraction via wells on western side of landfill;
- Treatment of extracted groundwater via packed tower aeration;
- Decommissioning of certain agricultural, irrigation supply wells, and residential supply wells; and
- Institutional controls (ICs) to restrict the installation of water supply wells in the impacted aquifer and limit site access. Controls may also be placed on the use of the groundwater pumped from existing wells screened in the contaminated aquifer.

The 1996 ROD delineated a phased approach to make the best use of site-specific hydrogeologic and geochemical data collected during the early phases of the OU2 site remediation program in order to implement later actions in the most efficient and effective manner possible. The three distinct phases were defined as follows:

- Phase 1 – Create a hydraulic barrier at the downgradient perimeter of the FSL to contain the contaminated groundwater below the landfill.
- Phase 2 – Install additional extraction wells to prevent the downgradient expansion of the groundwater plume.
- Phase 3 – Complete any remaining actions necessary to restore of the aquifer to beneficial use.

4.2. Remedy Implementation

4.2.1. OU1 Source Control

Construction of the OU1 components occurred in 2000-2001. During that time, the landfill cover, landfill gas controls, and surface water management system were installed. The final cover system elements included a foundation layer, a geosynthetic low permeability membrane, a drainage geocomposite layer, filter fabric, and a soil layer capable of supporting vegetative growth. The installed LFG collection system included perimeter gas monitoring probes, LFG collection wells, a conveyance system, and an LFG treatment system (LFG flare). Over 100 gas extraction wells were installed throughout the landfill footprint. Thirteen active landfill gas monitoring wells are distributed evenly around the perimeter of the landfill; the perimeter gas monitoring wells are sampled monthly for percent methane by volume. The surface water management system consisted of drainage channels, down drains, and storm water retention basins.

The 1993 ROD also specified a leachate collection system, if necessary. EPA ultimately determined that a leachate collection system was not needed and, therefore, did not require one to be built. The basis for that determination was the small quantity of leachate reported in the 1994 RI report.

4.2.2. OU2 Groundwater Remediation

The primary components of the Groundwater Remedial Action (RA) include groundwater extraction wells, raw groundwater transmission piping, the groundwater treatment plant (GTP) and associated facilities, chemical pre-treatment, off-gas treatment, and treated effluent discharge piping. Removal of COCs from the raw groundwater is accomplished with a packed tower aerator (PTA). The treated water is

discharged to the on-site Park Lake which is part of the Fresno Regional Sports Complex. Park Lake is stocked seasonally with fish for park visitors.

Phases I and II of the remedy were implemented between 1999 through 2010.

Following completion of the Phase 2 Groundwater RA in 2010, the *Phase 2 Groundwater Remedial Action Evaluation Report* (CDM, 2010) recommended additional remedial actions at targeted locations within the downgradient VOC plume. The *Phase 2 Enhancements Basis of Design Report* (CDM, 2011) recommended the expansion of the existing groundwater extraction and groundwater monitoring systems. In order to address vertical migration of contamination, one new lower-B extraction well was installed. Construction activities began in March 2013, and the new extraction well began operating in April 2014.

Institutional Controls

The 1996 ROD selected ICs to prevent exposure to contaminated groundwater. In 2003, the City and County initiated a Well Assessment and Prohibition Program to prevent exposure to contaminated groundwater and protect the remedy. The 2012 ESD adopted two restrictive covenants to formally restrict groundwater use and protect the remedies for the Site and adjacent areas. Both covenants were recorded in March 2012.

Bottled Water and Residential Wellhead Treatment

Although not required in the selected remedy, the City has offered bottled water or wellhead treatment to homes near the landfill with residential wells. Available city records indicate that nine residences are currently receiving bottled water and five residences have wellhead treatment systems.

4.3. Operation and Maintenance (O&M)

Maintenance of the Site and its remedial action components is the responsibility of the current property owner, the City of Fresno. The City has a full-time employee on-site that is responsible for O&M of the OU2 Groundwater RA facilities and the OU1 Landfill Closure facilities.

4.3.1. OU1

The landfill gas collection system and flare operate continuously, and the gas extraction wells are inspected and adjusted monthly. Condensate from the gas extraction well piping is discharged directly into the sewer.

A flare bypass was installed in 2009 to allow continued operation of the GTP during LFG flare shutdowns. The City is required to report to the EPA when the LFG flare is in bypass mode. In the period May 2013-April 2014, three instances of this scenario occurred; two of the three shutdowns were the result of theft activities.

Originally, growth of vegetation on the cap required watering by a sprinkler system. However, the sprinklers are no longer used or maintained because the vegetative cover is currently well established.

Squirrel bait traps are used to prevent burrowing rodents from damaging the geomembrane. Traps are set up around the perimeter of the landfill and maintained by the City.

General subsidence has occurred throughout the landfill since the cap was completed. Gas extraction well concrete vaults that were once at grade are now exposed. More dramatic subsidence of the landfill final cover occurred along the east slope of the landfill, as indicated by a parallel series of depressions believed to correlate with the areas between access roads that were compacted to support vehicle access during landfill operations. In 2008, the City implemented a landfill cover and drainage system inspection and maintenance program. Due to the subsidence issues noted above, the City implemented and completed major cap repairs in 2011. Repairs were primarily conducted along the eastern edge of the landfill, although additional localized repairs occurred along the western edge. The repaired areas are visible in Figure 3 as the whitish marks along the eastern and western borders of the landfill cap. In February 2014, the City updated its inspection and maintenance guidance with the goal of preventing the need for major cap repairs by addressing subsidence on an annual basis. In April 2015, the City re-graded portions of the landfill cover system, using imported soil, to address ongoing subsidence on the east slope of the landfill.

4.3.2. OU2

O&M activities for OU2 are outlined in the *Performance Monitoring Program Plan* and include groundwater monitoring, groundwater extraction system monitoring, groundwater influent and effluent monitoring, off-gas (from the LFG flare), and groundwater effluent management monitoring (CDM Smith, 2000). Maintenance responsibilities at OU2 include adjusting extraction well flow rates and the groundwater treatment plant parameters, and conducting normal maintenance of the extraction wells and plant.

Until 2013, groundwater was extracted from the A-, B-, and lower B-aquifer extraction wells. Since 2009, only one A-aquifer well has been operational. In 2013, vegetative growth on the well screen forced its shutdown. Current water levels in the A-aquifer are too low to allow physical and chemical rehabilitation of the wells. Three B-aquifer wells continue to operate.

Treatment plant influent and effluent are monitored quarterly for COCs and inorganic water quality parameters. Effluent is piped to a junction box via gravity where the flow can be directed to Park Lake or to the South Detention Basin, depending on irrigation needs and time of year.

VOC-laden off-gas from the PTA is combusted at the LFG flare located within the GTP yard. LFG flare emissions are currently not being monitored.

Condensate in the off-gas piping is collected in a condensate pump adjacent to the PTA and pumped by automatic control to the GTP area drainage sump.

In 2014, the groundwater monitoring well network included 82 groundwater monitoring wells and piezometers, 8 extraction wells, and 9 residential supply wells (Figure 4). The groundwater monitoring program consists of depth-to-groundwater measurements and groundwater sampling and analysis performed on a mixed quarterly, semi-annual, and annual basis. A decline in regional water levels has

rendered many A-aquifer wells dry or near dry with insufficient water to sample. City staff employees perform the mixed quarterly, semi-annual, and annual groundwater monitoring.

Costs

According to the FYR Site interviews, the City estimates the annual operating cost for the Site to be $1.2 million. Annual operating costs are expected to fluctuate depending on the activities occurring at the Site.

5. Progress since the Last Five-Year Review

5.1. Previous Five-Year Review Protectiveness Statement and Issues

The protectiveness statement from the 2010 FYR for the FSL Site stated the following:

> *"The remedy at OU-1 currently protects human health and the environment because there is no exposure to hazardous waste due to a functioning landfill cap and landfill gas treatment system that prevents the release of landfill gases into ambient air. The remedy at OU-2 currently protects human health and the environment because the groundwater extraction and treatment systems are functioning as intended. Ongoing landfill gas and treated groundwater monitoring ensure that humans are not coming into contact with potentially harmful substances. In addition to the protections provided by the remedies the County and City of Fresno enforce informal well installation zoning restrictions that prohibit private well installation in areas surrounding the landfill. However, for the remedy to be protective in the long-term, the finalization, execution, and recording of land use covenants must be achieved."*

The 2010 FYR included one issue and recommendation. The recommendation and current status are summarized in Table below.

Table 3. Status of Recommendations from the 2010 FYR

Issues from previous FYR	Recommendations	Party Responsible	Milestone Date	Action Taken and Outcome	Date of Action
The institutional controls selected in the ROD have not yet been implemented.	Finalize, execute, and record landfill access and site use covenants.	City of Fresno	December 2012	The land use covenants for the landfill footprint and the sports complex were finalized and recorded.	March 2012

5.2. Work Completed at the Site during this Five-Year Review Period

The following activities have been conducted at the FSL Site since the last FYR.

Phase 2 Enhancements. One new lower B-aquifer extraction well (PW-6B2) was installed and subsequently integrated into the existing conveyance and treatment system; operation of the new extraction well began in April 2014. Three new groundwater monitoring well clusters were installed to

the west and south of the new extraction well to monitor the VOC plume in the upper B-aquifer, lower B-aquifer, and C-aquifer.

Landfill Cap: Major cap repairs were completed in 2011 to address subsidence issues along the eastern edge of the landfill, and additional repairs were completed in April 2015 as part of ongoing O&M.

6. Five-Year Review Process

6.1. Administrative Components

EPA Region 9 initiated the FYR in September 2014 and scheduled its completion for September 2015. The review team was led by Patricia Bowlin, EPA's Remedial Project Manager (RPM) for the Site. The team also included Heather Fourie (chemist) and David Clark (biologist) with USACE, Seattle District. In November 2014, EPA held a scoping call with the review team to discuss the Site and items of interest related to the protectiveness of the remedy currently in place. A review schedule was established that consisted of the following:

- Community notification;
- Document review;
- Data collection and review;
- Site inspection;
- Local interviews; and
- FYR report development and review.

6.2. Community Involvement

On March 2, 2015, a public notice was published in the *Fresno Bee* announcing the commencement of the FYR process, providing EPA's contact information and inviting community participation. The press notice is available in Appendix B. EPA received no comments or inquiries.

6.3. Document Review

This FYR included a review of relevant, Site-related documents including the ROD, remedial action reports, and recent monitoring data. A complete list of the documents reviewed can be found in Appendix A.

6.3.1. ARARs Review

Section 121(d)(2)(A) of CERCLA specifies that Superfund RAs must meet any federal standards, requirements, criteria, or limitations that are determined to be legally Applicable or Relevant and Appropriate Requirements (ARARs). ARARs are those standards, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, RA, location, or other circumstance at a CERCLA site.

Table 4 lists the chemical-specific ARARs identified in the RODs and the ESD for groundwater at this Site and considered for this FYR for continued groundwater treatment and monitoring. For six of the 16 COCs, the 1996 ROD identified the California MCL as the cleanup level; federal MCLs were selected for all other COCs. Since issuance of the 1996 ROD, the state has adopted a more stringent MCL for tDCE of 10 µg/L. The 2012 ESD updated the tDCE cleanup level to match the more stringent state MCL. Both the current state and federal MCLs for chloroform are more stringent than the original 1996 cleanup standard. The 2012 ESD updated the chloroform cleanup level to match the more stringent current state and federal MCLs. The federal MCL for chlorobenzene has been relaxed, and federal MCLs for 1,1-DCA and trichlorofluoromethane (Freon 11) are not available; the state MCL is available and equal to the cleanup level. The protectiveness of the existing 1996 cleanup levels is evaluated in Section 6.3.2.

Table 4. Summary of Ground Water ARAR Changes

Chemical	1996 ROD/ 2012 ESD Cleanup Standard (µg/L)	Basis	Current Regulations (µg/L)		ARARs Changed?
			State	Federal	
TCE	5	Federal	5	5	No changes
PCE	5	Federal	5	5	No changes
VC	0.5	State	0.5	2	No changes
1,1-DCE	6	State	6	7	No changes
1,2-DCA	0.5	State	0.5	5	No changes
tDCE	10[a]	State	10	100	No changes
cDCE	6	State	6	70	No changes
1,2-DCP	5	Federal	5	5	No changes
1,2-DCB	600	Federal	600	600	No changes
1,4-DCB	5	State	5	75	No changes
Benzene	1	State	1	5	No changes
Chlorobenzene	70	Federal	--	**100**	Less stringent federal MCL
Chloroform	80[b]	Federal	80	80[c]	No changes
1,1-DCA	5	State	5	--	No federal MCL
Trichlorofluoromethane (Freon-11)	150	State	150	--	No federal MCL
Toluene	150	State	150	1000	No changes

a – The 1996 ROD incorrectly cited the less stringent federal MCL. The 2012 ESD selected the more stringent state MCL.
b- The 1996 ROD selected 100 µg/L as the cleanup level. Since then, the federal MCL has changed to 80 µg/L. The 2012 ESD selected the more stringent federal MCL.
c – MCL shown is for Total Trihalomethanes, a class of chemicals that includes chloroform.
Bolded entries indicate changes to state and/or federal MCLs since the 1996 ROD.

All federal and state laws and regulations have been reviewed and are presented in Appendix F. There are no changes in these laws and regulations that affect protectiveness.

6.3.2. Human Health Risk Assessment Review

The 1993 ROD identified potential risks associated with landfill gas escaping through the existing cover, with subsurface landfill soil gas migrating laterally and then upward into living spaces, and with ingestion

of contaminated groundwater. Risk estimates were not calculated or presented for any of these scenarios in the 1993 ROD.

In 1994, a baseline human health risk assessment was completed by EPA to evaluate the potential exposure to contaminated groundwater, and the findings were summarized in the 1996 ROD.

Subsequently, an Analysis of Risk (AOR) was prepared as part of the Phase 1 Groundwater Remedial Action Evaluation Report (CDM, 2007) to supplement the 1994 baseline human health risk assessment. The AOR evaluated possible exposures of human receptors to conditions existing after the implementation of the remedial actions. The AOR determined that the only complete pathway was the inhalation of indoor air by maintenance workers. The risk estimates for this pathway were calculated using maximum groundwater concentrations and the Johnson and Ettinger vapor intrusion model.

An Addendum to the AOR (Addendum) was completed in 2009. In addition to re-evaluating all pathways considered in the AOR, the Addendum also evaluated risk due to the ingestion of fish stocked in Park Lake. The Addendum identified the inhalation of volatiles in indoor air for current and future maintenance workers as the only complete exposure pathway.

The potential pathways identified in the RODs and the complete pathways identified in the AOR and Addendum are summarized in Table . As shown in Table , the cancer risks are within or below the target risk range of 10^{-4} to 10^{-6} and the noncancer hazards do not exceed the threshold limit of 1.

Table 5. Summary of Site Risks

Document	Exposure Scenario & Pathway	Risk Driver(s)	Current/ Future	Average Excess Cancer Risk Estimate	Maximum Excess Cancer Risk Estimate	Non-cancer Risk Estimate	Maximum Non-cancer Risk Estimate
1993 ROD	Inhalation of volatiles in ambient air	Not defined	Not determined				
	Inhalation of volatiles in indoor air	Not defined	Not determined				
	Groundwater ingestion	Not defined	Not determined				
1996 ROD	Groundwater ingestion	Residential Adult	Current	$2x10^{-7}$	$1x10^{-6}$	0.05	0.1
		Residential Child	Current	$3x10^{-7}$	$6x10^{-7}$	0.1	0.2
		Residential Adult	Future	$1x10^{-5}$	$8x10^{-5}$	0.2	0.4
		Residential Child	Future	$2x10^{-5}$	$4x10^{-5}$	0.4	1
	Inhalation of vapors (showering)	Residential	Current/ Future	No risk values provided			
2007 AOR	Inhalation of volatiles in indoor air	Maintenance worker	Current/ future	$6x10^{-6}$	--	0.009	--
2009 Addendum	Inhalation of volatiles in indoor air	Maintenance worker	Current	$3x10^{-7}$	--	0.003	--
			Future	$3x10^{-6}$		0.005	

The risk assessments were reviewed to identify any changes in exposure pathways or toxicity that would affect protectiveness. Where appropriate, comparisons were made to EPA Regional Screening Levels (RSLs). RSLs are risk-based concentrations derived from standardized equations combining exposure information assumptions with EPA toxicity data. The values are used for site screening to help identify areas, contaminants, or conditions that may require further attention. RSLs are available for a variety of media including soil and groundwater.

Soil. Access to contaminated soil is restricted by the presence of a landfill cap. Soil exposure pathways are therefore incomplete.

Groundwater. The groundwater exposure pathways identified in the 1996 ROD are still valid. Groundwater from the deeper aquifers below the contaminated shallow aquifers (A, B, and C) is not currently used for drinking purposes. The groundwater ingestion exposure pathway is therefore incomplete. Installation of wellhead activated carbon systems at many residences further eliminates the potential risk of inhaling vapors while showering.

Vapor Intrusion. The soil gas pathways identified in the 1993 ROD and the groundwater-to-soil gas pathway subsequently evaluated in the 2007 AOR and 2009 Addendum are still valid. Residences adjacent to the landfill represent potential receptors. The potential for landfill gas to escape through the landfill surface or for soil gas to migrate laterally has been reduced through implementation of the landfill cap and gas collection and treatment system.

COCs in the groundwater plume (that extends off-site) include chlorinated VOCs such as TCE, PCE, and cDCE, all of which are sufficiently toxic and volatile to be considered for vapor intrusion potential. However, A-zone groundwater concentrations that exceed Vapor Intrusion Screening Levels (VISLs) only occur near the groundwater extraction wells or immediately adjacent to the landfill in areas (the sports complex) that lack overlying buildings or residents. The most recent groundwater monitoring data shows that there were no detections of VOCs in A-zone groundwater monitoring wells within at least 200 feet of buildings or residents. In addition, the depth to groundwater is approximately 80 feet bgs. At this time, given current site conditions, the groundwater data indicate that the exposure pathway is incomplete.

Toxicity Values. EPA's Integrated Risk Information System (IRIS) has a program to update toxicity values used by EPA in risk assessment when newer scientific information becomes available. In the past five years, there have been a number of changes to the toxicity values for certain COCs at the Site. Groundwater concentrations are compared to EPA's RSLs as a first step in determining whether response actions may be needed to address potential human health exposures due to toxicity value changes. RSLs are chemical-specific concentrations for individual contaminants that correspond to an excess cancer risk level of $1x10^{-6}$ or a Hazard Quotient (HQ) of 1 for non-carcinogens. RSLs have been developed for a variety of exposure scenarios (e.g., residential, commercial/industrial). RSLs are not de facto cleanup standards for a Superfund site, but they do provide a good indication of whether actions may be needed.

In 2011, EPA conducted an updated assessment for TCE which included a risk of fetal cardiac malformations due to short-term *in utero* exposures to TCE as a result of inhalation. This IRIS assessment set a reference concentration (RfC) of 2 µg/m3. In 2014 EPA Region 9 issued a

memorandum regarding *EPA Region 9 Interim Action Levels and Response Recommendations to Address Potential Developmental Hazards Arising from Inhalation Exposures to TCE in Indoor Air from Subsurface Vapor Intrusion* and EPA's Office Of Superfund Remediation and Technology Innovation issued a memorandum to the EPA Regional Superfund offices on *Compilation of Information Relating to Early/Interim Actions at Superfund Sites and the TCE IRIS Assessment*. Due to the lower action levels recommended to address a vapor intrusion risk, a follow-up action of sampling perimeter gas monitoring wells for VOCs is being recommended at the site.

A review of IRIS information indicates that there have been several recent toxicity value revisions for many of the groundwater COCs, with notable recent revisions for TCE and PCE. The impact of toxicity value revisions on protectiveness is evaluated by comparing ROD cleanup standards to the November 2014 EPA tapwater multi-pathway RSLs in Table .

Table 6. Comparison of ROD Cleanup Standards to November 2014 EPA RSLs

COC	ROD Cleanup Level (µg/L)	EPA RSLs, Residential Tapwater, all pathways (µg/L)			State MCL (µg/L)	Federal MCL (µg/L)	ROD Cleanup Level protective?
		Cancer	Protective Cancer Risk Range	Non-cancer			
TCE	5	**0.44**	0.44 - 44	**2.6**	5	5	Yes
PCE	5	9.7	9.7 - 970	35	5	5	Yes
VC	0.5	**0.015**	0.015 – 1.5	36	0.5	2	Yes
1,1-DCE	6	--	--	260	6	7	Yes
1,2-DCA	0.5	**0.17**	0.17 - 17	13	0.5	5	Yes
tDCE	10	--	--	360	10	100	Yes
cDCE	6	--	--	36	6	70	Yes
1,2-DCP	5	**0.44**	0.44 - 44	8.3	5	5	Yes
1,2-DCB	600	--	--	**280**	600	600	Yes
1,4-DCB	5	**0.48**	0.48 - 48	570	5	75	Yes
Benzene	1	**0.45**	0.45 - 45	33	1	5	Yes
Chlorobenzene	70	--	--	78	--	100	Yes
Chloroform	80	**0.22**	**0.22 - 22**	97	80	80	**No**
1,1-DCA	5	**2.4**	2.4 - 240	2900	5	--	Yes
Trichlorofluoro-methane	150	--	--	1,100	150	--	Yes
Toluene	150	--	--	1,100	150	1000	Yes

Notes: **Bold** indicates ROD cleanup level exceeds the RSL value. Non-cancer RSLs are based on a target hazard quotient of 1.

The ROD cleanup levels exceed the tapwater multi-pathway RSLs for nine COCs: TCE, VC, 1,2-DCA, 1,2-DCP, 1,2-DCB, 1,4-DCB, benzene, chloroform, and 1,1-DCA.

For cancer risk, EPA uses a lifetime excess cancer risk range between 10^{-4} and 10^{-6} for assessing potential exposures. Although eight COCs (TCE, VC, 1,2-DCA, 1,2-DCP, 1,4-DCB, benzene, chloroform, and 1,1-DCA) have ROD cleanup levels that exceed cancer RSLs, the respective cleanup levels are within EPA's protective excess cancer risk range of 10^{-4} to 10^{-6} for all but one COC (chloroform). The ROD cleanup

levels for TCE, VC, 1,2-DCA, 1,2-DCP, 1,2-DCB, benzene, and 1,1-DCA are therefore still considered protective of cancer risks. According to IRIS, the toxicity data for chloroform were last updated in 2001. The ROD cleanup level (80 µg/L) exceeds the cancer RSL (0.22 µg/L) and also the acceptable excess cancer risk range of 0.22 to 22 µg/L.

Chloroform has been predominantly non-detect at the Site in recent years. Since the last FYR, the maximum detected concentration of chloroform was 4.7 µg/L in well PZ-5A in 2013. This concentration is within the excess cancer risk range and well below the current state and federal MCLs. Therefore, the remedy is still protective with regard to chloroform risks.

For non-cancer risk, two COCs (TCE and 1,2-DCB) have ROD cleanup levels above the non-cancer RSL. Any concentration below the non-cancer RSL indicates that no adverse health effect from exposure is expected. Concentrations significantly above the non-cancer RSL may indicate an increased potential for non-cancer effects. The non-cancer RSL for 1,2-DCB (280 µg/L) is less than the ROD cleanup level (600 µg/L); however, the cleanup levels are equal to current state and federal MCLs. EPA considers the MCLs to be protective of human health. EPA's 2011 Toxicological Review for TCE also developed RSLs that included at least a 10-fold margin of safety for health effects other than cancer. The non-cancer RSL for TCE is 2.6 µg/L and is below the ROD cleanup level of 5 µg/L. Again, EPA considers the TCE MCL of 5 µg/L protective for non-cancer effects as supported by the federal MCL of 5 µg/L. Therefore, the ROD cleanup level is still considered protective of non-cancer risks.

6.3.3. Ecological Review

An ecological risk assessment was not conducted for the Site at the time of the RODs. The RODs did not address ecological risk.

In 2006, an ecological risk contaminant pathway analysis was performed to determine if any significant ecological risk was present due to landfill waste materials, leachate, and landfill gas (CDM, 2006). The analysis concluded no complete ecological exposure pathways were present. No changes to ecological exposure pathways have occurred since they were evaluated in the 2006 analysis.

6.4. Data Review

6.4.1. Groundwater

Groundwater is a primary medium of concern at the Site. Monitoring consists of quarterly depth-to-groundwater measurements, and groundwater sampling and analysis performed on a mixed quarterly, semi-annual, and annual basis consistent with the *Performance Monitoring Program Plan* (CDM Smith, 2000).

Groundwater Chemistry.

Data collected from 2010 through 2015 were evaluated to determine recent cleanup progress within the project boundary and downgradient. In the most recent comprehensive sampling event (April 2014), six COCs (PCE, TCE, cDCE, 1,2-DCA, VC, and 1,2-DCB) remained above their respective cleanup levels in

one or more of the A-, B-, and C-aquifer zones. Table 7 presents the maximum concentrations measured in each aquifer during the comprehensive April 2014 sampling event.

Table 7. April 2014 Maximum Groundwater Concentrations by Aquifer Zone

COC	Cleanup Level (µg/L)	A	B	C	Residential Wells
1,1-DCA	5	ND	4.7	0.94	ND
1,1-DCE	6	ND	ND	ND	ND
1,2-DCA	0.5	ND	**0.59**	ND	ND
1,2-DCB	600	ND	ND	ND	ND
1,2-DCP	5	ND	1.3	ND	ND
1,4-DCB	5	1.8	**5.2**	ND	ND
Benzene	1	ND	ND	ND	ND
cDCE	6	**35**	**58**	**9.5**	ND
Chlorobenzene	70	ND	0.62	ND	ND
Chloroform	80	0.50	0.78	ND	ND
PCE	5	**13**	**54**	**39**	0.78
tDCE	10	1.0	5.1	1.4	ND
TCE	5	4.7	**30**	**22**	ND
TCFM	150	ND	10	11	ND
Toluene	150	ND	ND	ND	ND
VC	0.5	**0.51**	**19**	ND	ND

Notes: All concentrations are in µg/L. Concentrations in **bold** exceed the ROD cleanup standard.

April 2014 individual well concentration data for PCE, cDCE, TCE, and VC are presented for aquifers A, B, and C in Figure 9, Figure 10, and Figure 11, respectively. In general, the highest VOC concentrations are located in the southwest portion of the Site, although an area of contamination is evident in the northwest portion of the Site in the B- and C-aquifers. Inorganic parameters, including hardness, total dissolved solids, nitrate, sulfate, and total Kjeldahl nitrogen are measured at a small subset of B- and C-aquifer wells (5 wells in 2014).

PCE, one of the primary COCs present at the Site, can degrade through reductive dechlorination to TCE, cDCE or tDCE, and VC. Measureable concentrations of degradation products at the Site indicate that natural degradation is likely occurring.

Long-term data trends since 2010 were evaluated qualitatively and quantitavely for the two most prevalent COCs (PCE and cDCE). Table 8 presents the Mann-Kendall nonparametric test for trends on the January 2010 through February 2015 dataset; in general, only data from wells with 6 or more samples and at least one data point with an exceedance of the PCE or cDCE cleanup standards were evaluated. Time-series plots for PCE and cDCE generated for several wells within the A-, B-, and C-aquifers are included in Appendix E. Each aquifer is discussed in more detail in the following subsections.

Table 8. Statistical Evaluation Results for Select Groundwater Wells, January 2010 - February 2015

Well	PCE Trend (2010-2014)	Confidence Factor (%)	PCE Maximum (µg/L)	Most Recent PCE (µg/L)	cDCE Trend (2010-2014)	Confidence Factor (%)	cDCE Maximum (µg/L)	Most Recent cDCE (µg/L)
A-Aquifer								
CDM-12A	Decreasing	97.7	**3.2**	dry	Probably Decreasing	94.3	**110**	dry
CDM-13A	Stable	60.6	**32**	dry	Decreasing	98.9	**110**	dry
CDM-15A	Stable	80.1	**5.1**	dry	Decreasing	99.0	**33**	dry

Well	PCE Trend (2010-2014)	Confidence Factor (%)	PCE Maximum (µg/L)	Most Recent PCE (µg/L)	cDCE Trend (2010-2014)	Confidence Factor (%)	cDCE Maximum (µg/L)	Most Recent cDCE (µg/L)
B-Aquifer								
CDM-4B	Decreasing	99.9	**53**	**12**	Decreasing	>99.9	**30**	**6.3**
CDM-5B	Decreasing	97.1	**38**	**9.2**	Stable	81.3	**13**	**7.2**
CDM-12B	**Increasing**	99.5	**35**	**35**	Stable	46.0	**49**	**36**
CDM-13B	No Trend	72.7	**15**	**12**	Decreasing	98.4	**9.9**	5.9
CDM-15B	Decreasing	>99.9	**19**	**6.7**	Decreasing	98.4	**31**	**13**
CDM-16B*	Stable	88.7	1.4	0.85	Non-detect/stable	NA	ND	ND
CDM-19B	Decreasing	99.8	**54**	**41**	Decreasing	99.8	**56**	**28**
DW-1B	Probably Decreasing	93.4	**40**	**23**	Decreasing	99.8	**160**	**82**
DW-2B	Probably Decreasing	94.6	**19**	**19**	Decreasing	>99.9	**45**	**8.9**
PZ-2B	Decreasing	>99.9	**17**	**5.7**	Decreasing	>99.9	**47**	**9**
PZ-4B	**Probably Increasing**	91.1	0.81	0.64	**Increasing**	99.5	**6.2**	**6.2**
PZ-5B	Decreasing	99.8	**89**	**31**	Probably Decreasing	93.8	**190**	**48**
PZ-5B2	**Increasing**	>99.9	**45**	**50**	**Increasing**	>99.9	**12**	**12**
C-Aquifer								
CDM-4C	**Increasing**	>99.9	**46**	**38**	**Increasing**	99.1	**15**	**8.8**
CDM-5C	**Increasing**	>99.9	**19**	**19**	**Increasing**	>99.9	5.1	4.7
CDM-8C	Decreasing	100.0	**12**	2.3	Decreasing	100.0	**6.1**	1
CDM-16C*	**Increasing**	99.9	4.3	4.3	Non-detect/Stable	NA	ND	ND
CDM-17C*	No Trend	72.9	3.1	2.3	Non-detect/Stable	NA	ND	ND
PZ-5C	**Increasing**	99.8	**54**	**17**	**Increasing**	100	**48**	3.0

*Although wells CDM-16B, CDM-16C, and CDM-17C do not have any detections above cleanup levels, they are included in the trend analysis because of their downgradient location relative to the new extraction well PW-6B2.
Bold concentrations exceed the cleanup value (5 and 6 µg/L for PCE and cDCE, respectively)

A-Aquifer.

Long-term groundwater data from the mid-1990s through present clearly show that remedial efforts have greatly reduced COC concentrations in the A-aquifer at the Site. In the past five years, A-aquifer COC concentrations have been generally stable or decreasing. Only three COCs (PCE, cDCE, and VC) have been detected above the cleanup standards in the A-aquifer since the last FYR; all April 2014 exceedances shown in Table occurred at well CDM-13A. Previously elevated cDCE concentrations in the A-aquifer have recently decreased to below cleanup levels for all but well CDM-13A.

Due to declines in the regional water table over the past several years, the depth to groundwater in a number of A-aquifer monitoring wells is below the top of the sampling pump or below the bottom of the well. In April 2014, seven A-aquifer wells were sampled, but none of the upgradient A-aquifer background wells located east of the landfill could be sampled. VOCs were detected in only two wells located in the southwest portion of the Site, and only one of the two wells sampled in April 2014 (CDM-13A) had detections above cleanup standards.

With no A-aquifer pumping occurring, overall hydraulic control within the A-aquifer has decreased. However, groundwater monitoring data indicate that groundwater quality in the A-aquifer has not been negatively impacted by the declining water levels.

B-Aquifer.

Long-term groundwater data since the mid-1990s show variable responses in contaminant concentrations in the B-aquifer. As of April 2014, six COCs remain above the cleanup standards in one or more wells in the B-aquifer. In the past five years, B-aquifer COC concentrations have been primarily decreasing, with the exception of three monitoring wells (CDM-12B, PZ-4B, and PZ-5B2) along the southwest edge of the landfill near extraction well PW-4B. There are no wells listed in Table 8 with an increasing trend that are downgradient of the recently installed extraction well PW-6B2.

Since 2010, PCE and/or cDCE concentrations were consistently elevated above cleanup levels in several source area wells, with the highest concentrations observed in wells CDM-12B, CDM-19B, and DW-1B. While PCE and cDCE remain elevated in downgradient wells, concentrations are declining in all downgradient B-aquifer wells with the exception of a slight increase in PCE in well CDM-22B2.

Downward migration of PCE is evident by the recent data in well pair PZ-5B/PZ-5B2. According to Table 8, PCE and cDCE concentrations are decreasing in PZ-5B, but the deeper associated well (PZ-5B2) showed a marked increase during the same timeframe.

C-Aquifer.

Three COCs remain above the cleanup standard in one or more C-aquifer wells. Table 8 shows that C-aquifer COC concentrations are variable, with more than half of the wells showing an increasing trend (especially for PCE) rather than a decreasing or stable trend.

VOC concentrations in well CDM-4C have shown a consistent increase since the last FYR, and all of the April 2014 maximum concentrations for C-Aquifer wells shown in Table 7 are from this well.

PCE concentrations at well CDM-5C in the northwest area of the Site were previously below the cleanup level of 5 µg/L, but have more recently exceeded the cleanup level. Just south of CDM-5C at well CDM-8C, PCE concentrations have now decreased to below the cleanup level.

Well CDM-16C, which is downgradient of the new extraction well PW-6B2, shows an increasing trend for the period analyzed (2010 to February 2015). While the concentrations measured in CDM-16C are below cleanup standards, the increasing trend could become a concern given the close proximity of private wells downgradient of CDM-16C. An increasing trend is also noted in well CDM-5C, which lies downgradient of extraction well PW-1B.

Well PZ-5C exhibited an unexplained spike in PCE and cDCE concentrations in April 2014. The cause of the sudden increase is not known, although subsequent measurements in October 2014 and February 2015 were more consistent with previous concentrations.

Continued monitoring and evaluation of COC concentrations and trends is recommended for all C-aquifer wells to determine if the extraction system is effectively controlling the groundwater plume in this aquifer. If increasing trends continue in downgradient wells, steps may be needed to improve the extraction performance in the C-aquifer.

The new lower B-aquifer extraction well PW-6B2, which began pumping in early 2014, is anticipated to exert some effect on groundwater concentrations in the C-aquifer; however, limited monitoring data at the time of this FYR prevents a clear determination of the magnitude of the hydraulic control exerted by the new extraction well.

Given the presence of PCE degradation daughter products, an expanded evaluation of groundwater geochemistry parameters may be useful to evaluate the ability of natural attenuation to help control and/or mitigate the C-aquifer plume.

Groundwater Treatment Plant Performance.

The GTP influent and effluent is sampled quarterly to monitor system effectiveness. For the period 2010 through 2014, COCs detected in the influent included 1,1-DCA, Freon 11, PCE, TCE, and VC. No COCs were detected in the effluent during this same period, indicating that the treatment system is functioning effectively.

Residential Wells.

Monitoring is performed at nine residential wells located near the landfill (Figure 4). At those monitoring locations where wellhead treatment systems are present, tapwater samples are collected upstream of the treatment system. Since the last FYR, there have been no COC detections above groundwater cleanup standards. PCE was the only COC detected, at a maximum concentration of 0.78 µg/L in April 2014 in a well that lies southeast of the landfill and not in the immediate downgradient path of the groundwater plume.

6.4.2. Landfill Gas

The City analyzes gas samples monthly for methane from the 13 permanent landfill gas perimeter monitoring wells. For the period July 2014 through January 2015, methane gas was detected in slight excess of 5% methane by volume in one well (MMW3) during the December 2014 (5.7%; 25 ft. bgs) and January 2015 (5.4%; 45 ft. bgs) monitoring events.

According to the 1993 ROD, methane gas was detected in the perimeter gas monitoring wells at a maximum of 58% methane by volume prior to implementation of the remedy. The current maximum measurements of ~5% methane by volume represent an order of magnitude decrease in concentration and demonstrate that the remedy has significantly reduced off-site gas migration.

While the perimeter landfill gas monitoring wells are being regularly sampled for methane gas. However, the primary COCs for inhalation concern (VC, PCE, TCE, etc.) have not been evaluated in soil gas adjacent to the landfill since before the 1993 ROD. While it could be assumed that the control of the methane gas collection and treatment system would also capture all COCs, this should still be formally evaluated and confirmed.

6.5. Site Inspection

A site inspection was conducted on January 16, 2015. Participants included Patricia Bowlin, EPA's RPM, George Slater from the City of Fresno, John (Yash) Nyznyk of CDM Smith, James Rohrer from California DTSC, Peter Phillips from Gilbane, Dan Carlson from the RWQCB, and Heather Fourie and David Clark from USACE. The Site Inspection Checklist and the Trip Report are presented in Appendices D and E, respectively. Photos from the site inspection are included in the Trip Report.

The participants reviewed the site remedial history and discussed current issues and concerns. The participants then toured the Site to evaluate current conditions. Monitoring and extraction wells appeared to be properly secured. Landfill settlement observed during the last FYR was still evident. In general, the Site appeared to be in good condition.

6.6. Interviews

During the FYR process, interviews were conducted with parties affected by or involved with the Site, including regulatory agencies. The purpose of the interviews was to document the perceived status of the Site and any perceived problems or successes with the phases of the remedy that have been implemented to date. All of the interviews were conducted during the Site visit on January 16, 2015.

The interviewees were generally positive about the Site and the performance of the remedy. Some concern was expressed about groundwater contamination in the C-aquifer, which currently does not have a dedicated extraction well. Groundwater data are being monitored closely following the installation of the lower-B aquifer extraction well PW-6B2 as part of the Phase II enhancements. Vandalism, while continuing, has been on the decline since modifications were made to the extraction well vaults. Details of the formal interview and discussion items are included in the Interview Record (Appendix C) and the Trip Report (Appendix E).

6.7. Institutional Controls

<u>Well Assessment and Prohibition Program</u>

In 2003, the City and Fresno County developed an IC Well Assessment and Prohibition Program to limit installation of wells in certain areas near the landfill. The program established two zones: a Well Prohibition Zone and a Well Assessment Zone (Figure 12). When a well permit application is submitted to the County for a proposed well location within the Well Prohibition Zone, the permit is denied by the County. If the proposed well location is within the Well Assessment Zone, the County notifies the City and the City further evaluates the well application based on location, depth, assumed flow rate, usage characteristics, and potential impact to the plume migration and remediation system effectiveness. After evaluating the well design, including well depth, the City determines if the applicant can install and operate the well as proposed, or it specifies any necessary design modification.

In general, the program has functioned as intended with one exception. In 2013 a driller installed a private residential well, 3165, in the Well Assessment Zone prior to obtaining a permit, which circumvented the IC process established by the City and administered by the County. Well 3165H is approximately 300 feet deep and screened from 200 to 300 ft. bgs, which corresponds to the lower B and C-aquifers. In response

to this incident, the County issued a letter to all well drilling contractors operating in Fresno County restating the basic elements of the well installation ICs in the general vicinity of the FSL Site. No known subsequent incidents have occurred.

Landfill Restrictive Covenant

The Landfill Restrictive Covenant establishes land-use controls for the parcel of property that contains the entire landfill. This covenant restricts access to the landfill cap and prohibits activities that could damage the cap or otherwise interfere with the cap's function. The Landfill Restrictive Covenant was recorded with the Fresno County Recorder's Office on March 29, 2012.

Sports Complex Restrictive Covenant

The Sports Complex Restrictive Covenant establishes land-use controls for the parcels of property that include the City of Fresno's Regional Sports Park and the south and east detention basins. The Covenant prohibits activities that could interfere with the operation of the remedies or expose humans to contaminants at the Site. The Sports Complex Restrictive Covenant was recorded with the Fresno County Recorder's Office on March 13, 2012.

Table 9 lists the ICs associated with areas of interest at the Site.

Table 9. IC Summary Table

Media	ICs Called for in the Decision Documents	Impacted OU(s)	IC Objective	Instrument in Place	Notes
Ground water	Yes	OU2	Restrict installation of groundwater wells and groundwater use on and near the Site.	Well Assessment and Prohibition Program	Implemented in 2003; still in use.
	Yes	OU2	Prohibit groundwater use on-site and protect remedy operations.	Landfill Restrictive Covenant	Adopted in 2012 ESD.
	Yes	OU2	Prohibit groundwater use and protect remedy operations.	Sports Complex Restrictive Covenant	Adopted in 2012 ESD.
Soil	Yes	OU1	Protect remedy operations and prevent exposure to Site contaminants.	Sports Complex Restrictive Covenant	Adopted in 2012 ESD.
	Yes	OU1	Protect landfill cap function and prevent exposure to Site contaminants.	Landfill Restrictive Covenant	Adopted in 2012 ESD.

7. Technical Assessment

7.1. Question A: Is the remedy functioning as intended by the decision documents?

The landfill cap and gas extraction system continue to operate and function as designed. Major cap repairs were completed in 2011 to address subsidence issues along the eastern edge of the landfill, and additional repairs were completed in April 2015 as part of ongoing O&M. Extracted gas is combusted in an on-site flare. Current operating procedures are maintaining the effectiveness of the response actions. Horizontal migration of landfill gases other than methane has not been re-evaluated since before the 1993 ROD. Perimeter landfill gas monitoring wells are currently assessed for methane gas. However, in light of the 2011 IRIS toxilogical review of TCE and the short term risk associated with inhalation, collecting additional VOC data from these wells are recommended to help fill this data gap. Methane is assessed on a monthly basis in the perimeter gas monitoring wells; methane concentrations are generally below or in slight excess of the required level.

Remedial efforts have greatly reduced COC concentrations in the A-aquifer. COC concentrations in the B- and C-aquifers have been more variable, with small recent increases observed in downgradient C-aquifer monitoring wells. A well protection program agreement has been established between the City and County to prohibit groundwater well installation without review and approval. In addition, two restrictive covenants have been recorded since the last FYR to prevent unauthorized groundwater use and to protect the remedy.

The remedial action objective to prevent the plume from moving downgradient and impacting previously uncontaminated groundwater resources is currently being attained, but may not be attained in the future if the C-aquifer plume continues to expand in the proximity of existing residential wells screened in the C-aquifer. Current monitoring data indicate the potential for an increasing trend in the C-aquifer plume in downgradient wells. Continued monitoring and evaluation of COC concentrations and trends is recommended for all C-aquifer wells to determine if the extraction system is effectively controlling the groundwater plume in this aquifer. If increasing trends continue in downgradient wells, steps may be needed to improve the extraction performance in the C-aquifer.

The remedy at the Site continues to make progress toward groundwater restoration. A-aquifer concentrations have dropped considerably, although variable or slightly increasing B- and C-aquifer concentrations indicate that further remedy operation is needed and that possible future modifications may be required.

7.2. Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives (RAOs) Used at the Time of Remedy Selection Still Valid?

There have been no changes to chemical-specific ARARs since the 2012 ESD. No new contaminants have been identified since the ROD. The exposure pathways identified in the RODs are still valid. While COCs in the groundwater plume (that extends off-site) include chlorinated VOCs which are sufficiently

toxic and volatile to be considered for vapor intrusion potential, maximum groundwater concentrations generally occur in areas (agricultural fields and the sports complex) that lack overlying buildings or residents, and the depth to contaminated groundwater is fairly significant. Without a human receptor, risk of exposure to COCs due to volatilization from groundwater to indoor air is reduced.

Toxicity values have changed for several chemicals, although the changes do not affect protectiveness. The groundwater ROD cleanup standard for chloroform (80 µg/L) exceeds EPA's acceptable excess cancer risk range (0.22-22 µg/L). However, the maximum concentration of chloroform detected since the last FYR (4.7 µg/L) is within the acceptable excess cancer risk range, indicating that the remedy is still protective for chloroform.

Land use has not changed since the last FYR. The current and future exposure pathways identified in the ROD are still valid. A well protection program is in place that prohibits the installation of groundwater wells near the Site without prior review and approval. Two restrictive covenants (one for the landfill and one for the adjacent areas) recorded in 2012 provide further restrictions on land and groundwater use and provide protections for the remedy.

7.3. Question C: Has Any Other Information Come to Light That Could Call Into Question the Protectiveness of the Remedy?

There is no other information known at this time that calls into question the protectiveness of the remedy. There have been no impacts from earthquakes or other natural disasters at the Site in the last five years.

7.4. Technical Assessment Summary

Major cap repairs were completed in 2011 to address subsidence issues along the eastern edge of the landfill, and additional repairs were completed in April 2015.

Remedial efforts have greatly reduced COC concentrations in the A-aquifer. COC concentrations in the B- and C-aquifers have been more variable, with small recent increases observed in downgradient C-aquifer monitoring wells.

There have been a few changes to groundwater cleanup levels since the 1996 ROD. The 2012 ESD corrected cleanup levels for tDCE and chloroform to match current more stringent state and/or federal MCLs. Toxicity value revisions have occurred for several chemicals, but the revisions do not affect protectiveness.

Land use has not changed since the last FYR. Exposure pathways from soil and groundwater are being controlled through ICs. A well protection program prohibits and/or restricts well installation on or near the Site. Two restrictive covenants (one for the landfill and one for the adjacent areas) recorded in 2012 provide further restrictions on groundwater use and provide protections for the remedy.

Methane is assessed on a monthly basis in the perimeter gas monitoring wells; methane concentrations are generally below or in slight excess of the required level.

Risk due to vapor intrusion as a result of volatilization of contaminated groundwater is considered low. Risk due to horizontal soil gas migration could not be determined at this time and may require further evaluation.

8. Issues

Table 10 summarizes the current issues for the FSL Site.

Table 10. Current Issues for the FSL Site

Issue	Affects Current Protectiveness (Yes or No)	Affects Future Protectiveness (Yes or No)
Hydraulic capture of groundwater plume migration has not yet been achieved in all aquifers. Available data indicates expansion of the plume in the C-aquifer.	No	Yes

9. Recommendations and Follow-up Actions

Table 11 provides recommendations to address the current issues at the FSL Site.

Table 11. Recommendations to Address Current Issues at the FSL Site

Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness?	
					Current	Future
Hydraulic capture of groundwater plume migration has not yet been achieved in all aquifers. Available data indicates expansion of the plume in the C-aquifer.	Continue monitoring groundwater response to Phase 2 Enhancements and evaluate need for additional C-aquifer extraction wells.	City of Fresno	EPA	09/2017	No	Yes

In addition, the following are recommendations that do not affect current protectiveness but were identified during the Five-Year Review as needing follow-up action:

- The remedy requires periodic emissions monitoring to assess the effectiveness of the LFG treatment system in meeting destruction efficiency. Recommend evaluating, and if needed, implementing flare emissions monitoring.
- Sampling of the landfill perimeter gas monitoring wells for VOCs is recommended to evaluate the continued protectiveness of the remedy in controlling horizontal soil gas migration.
- Provide a summary of LFG extraction system operations and monitoring as part of the annual groundwater monitoring report or under separate cover.

10. Protectiveness Statements

10.1. OU1

The remedy for OU1 is protective of human health and the environment. The landfill cap prevents exposure to contaminated soil and materials within the landfill. The landfill gas extraction and treatment system controls the landfill gas exposure.

10.2. OU2

The remedy for OU2 currently protects human health and the environment because exposure pathways for groundwater are being controlled. Exposure pathways to contaminated groundwater that could result in unacceptable risks are prevented through restrictive covenants and a wellhead protection program; furthermore, wellhead filtration systems and bottled water substitutes are provided to some homes immediately adjacent to the Site. However, in order for the remedy to be protective in the long-term, effective capture of groundwater contamination in all aquifers beneath the Site must be achieved to prevent further plume migration and to ensure protectiveness.

11. Next Review

This is a statutory Site that requires ongoing FYRs as long as waste is left on site that does not allow for unlimited use and unrestricted exposure. The next FYR will be due within five years of the signature date of this FYR.

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Figures

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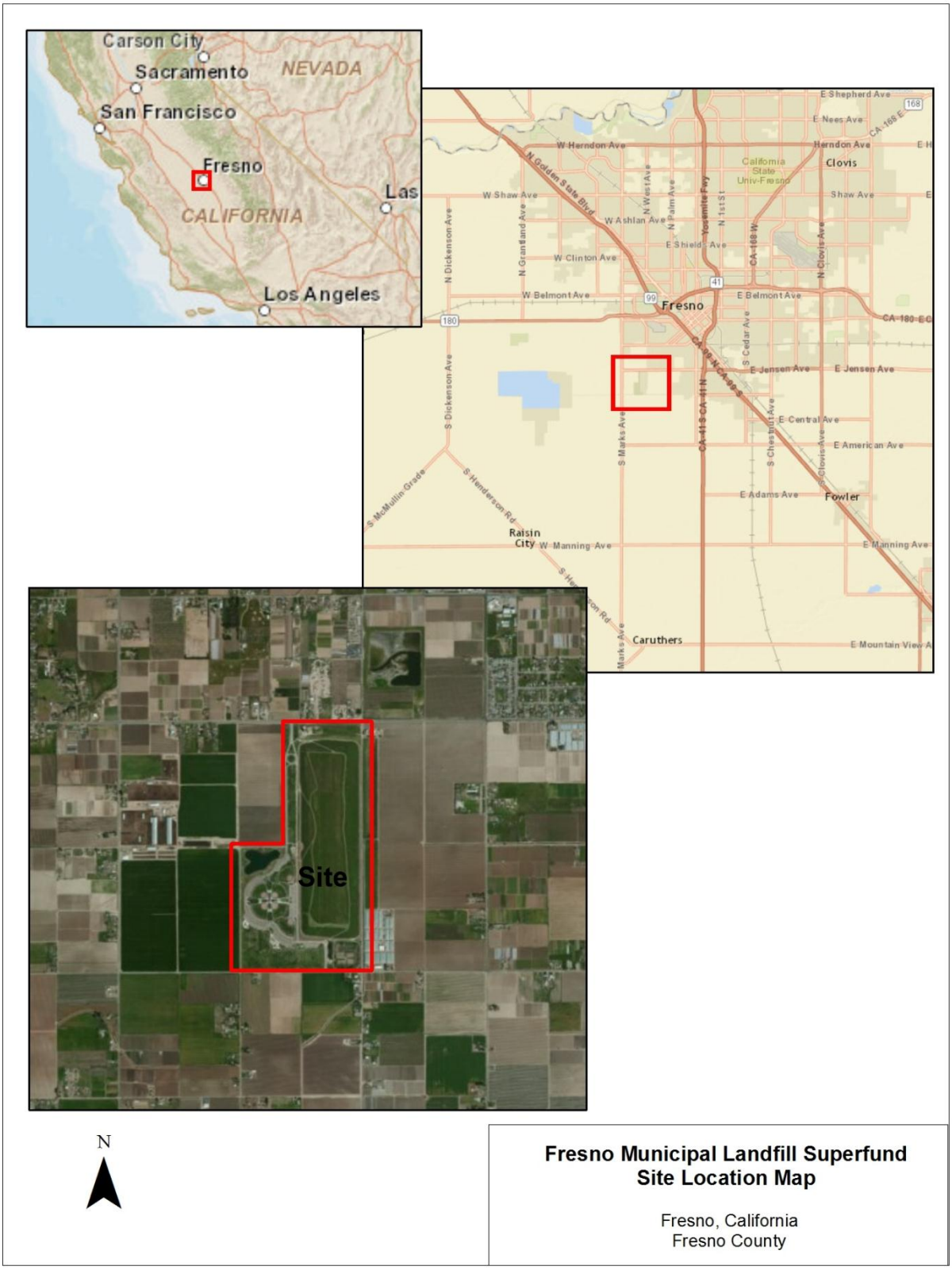

Figure 1. Location Map for the Fresno Municipal Sanitary Landfill Superfund Site

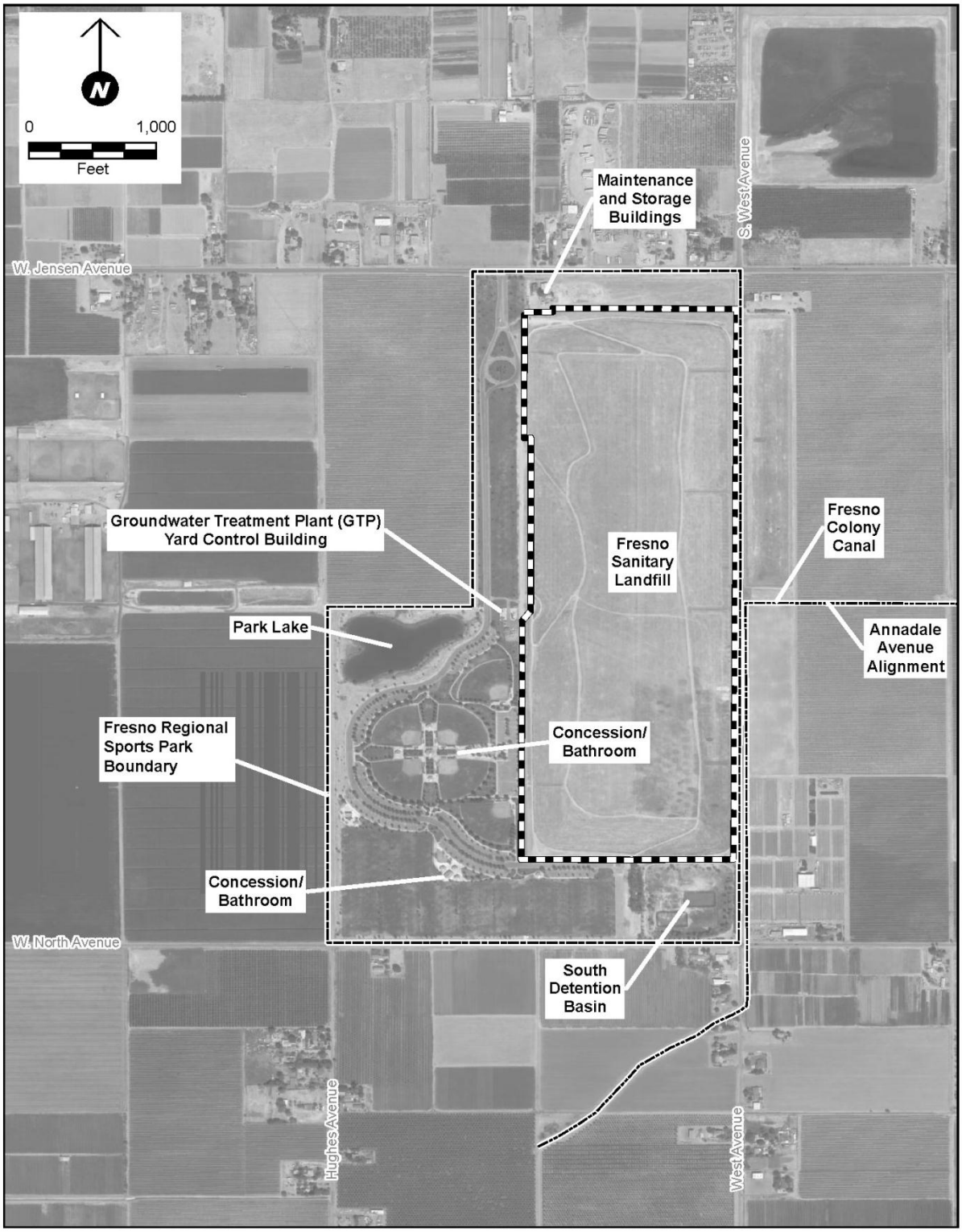

Figure 2. Detailed Site Map

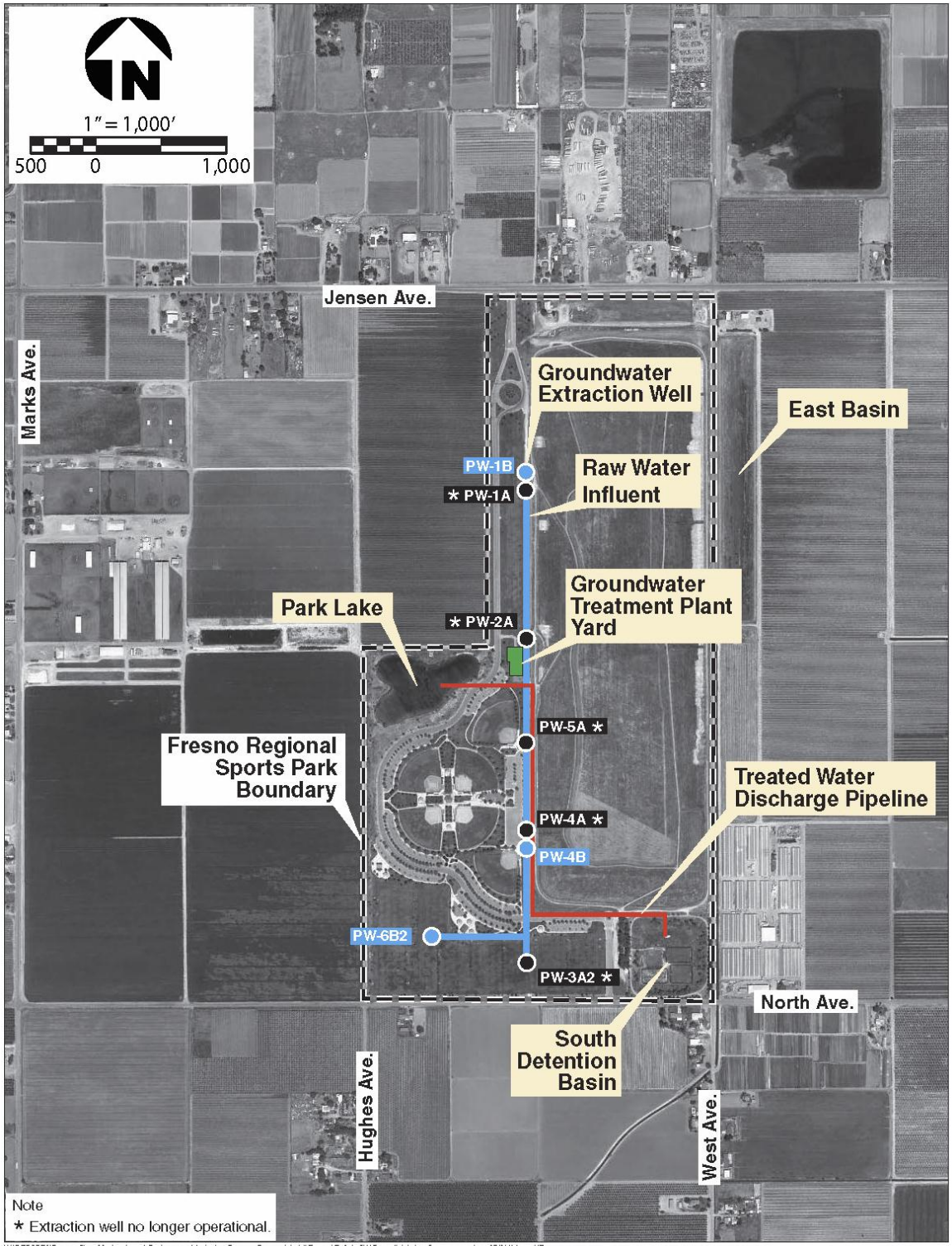

Figure 3. Groundwater Remedial Action Components (OU2)

Note: Figure adapted from CDMSmith, 2014.

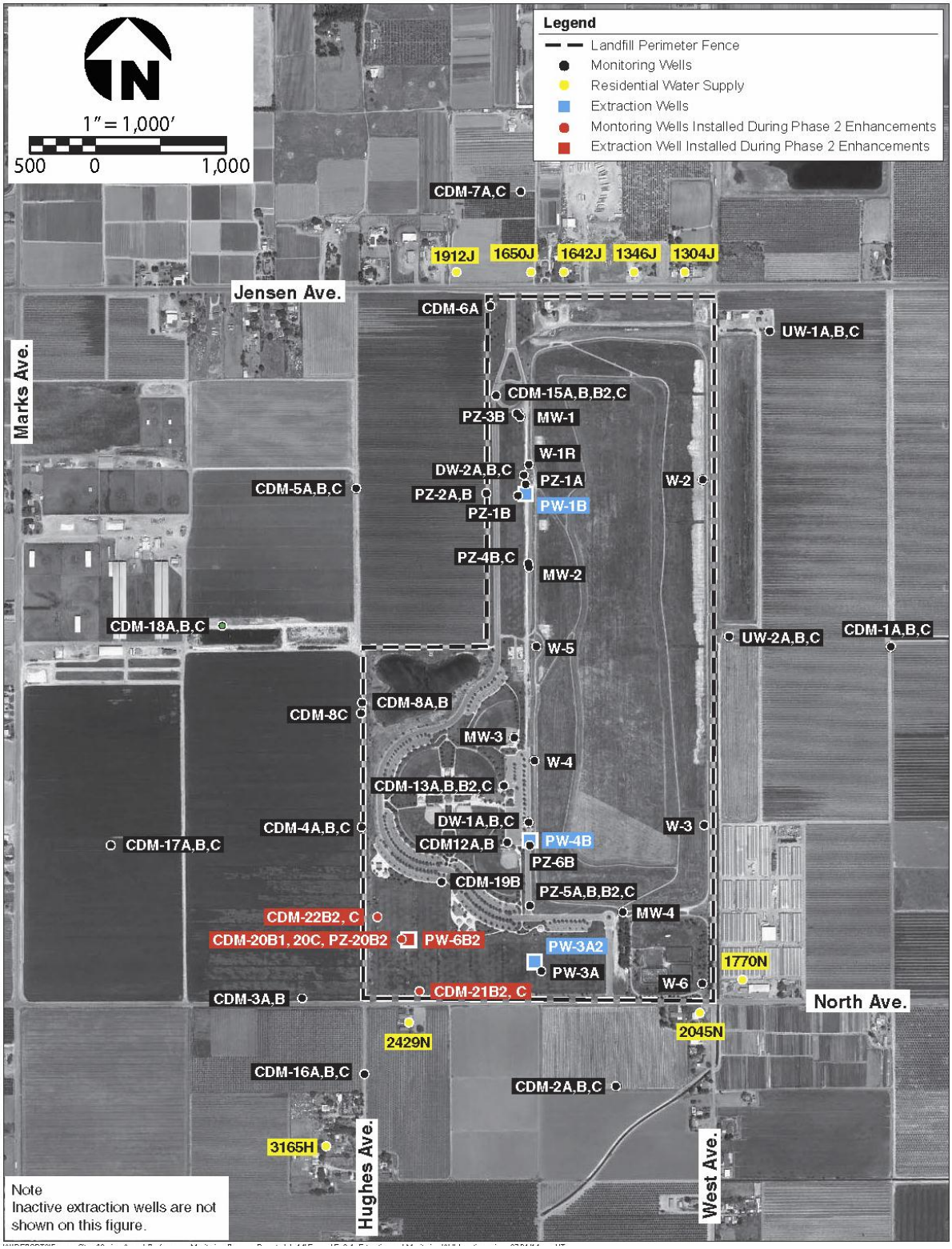

Figure 4. Well Locations Map

Table 4-1
Performance Monitoring Program Optimization – July 2014
Fresno Sanitary Landfill Groundwater Remedial Action
Performance Monitoring Program

Well	Groundwater Sampling				Quarterly Water Level Measurements	Proposed Program Modifications
	July 2014	October 2014	January 2015	April 2015		
A-Aquifer Extraction Wells						
PW-1A				V	Water level data obtained from SCADA reports	Dry
PW-2A				V		Dry
PW-3A2		V		V		
PW-4A				V		Dry
PW-5A				V		Dry
PTA Influent (INF)	V/I	V/I	V/I	V/I		
PTA Effluent (EFF)	V/I	V/I	V/I	V/I		
B-Aquifer Extraction Wells						
PW-1B	V	V	V	V/I	Water level data obtained from SCADA reports	
PW-4B	V	V	V	V/I		
PW-6B2	V	V	V	V/I		
A-Aquifer Monitoring Wells						
CDM-1A				V/I	X	Dry
CDM-2A				V	X	
CDM-3A				V	X	
CDM-4A				V	X	
CDM-5A				V	X	
CDM-6A				V	X	Dry
CDM-7A				V	X	
CDM-8A				V	X	
CDM-12A	V	V	V	V	X	
CDM-13A		V		V	X	
CDM-15A		V		V	X	
CDM-16A				V	X	
CDM-17A				V	X	
CDM-18A				V	X	
DW-1A						Consider decomission; dry and redundant with CDM-12A.
DW-2A						Consider decomission; dry and redundant with PZ-1A.
MW-1					X	
MW-2				V	X	Dry
MW-3						Consider decomission; dry and redundant with W4.
MW-4		V		V	X	Dry
PZ-1A					X	Dry
PZ-2A		V		V	X	Dry
PW-3A (piezometer)					X	
PZ-5A				V	X	
UW-1A				V	X	Dry
UW-2A					X	Consider decomission; dry and redundant with W2/W3/CDM-1A.
W1R					X	Consider decomission; dry and redundant with PZ-1A.
W2					X	Consider decomission; dry for lengthy period.
W3					X	Consider decomission; dry for lengthy period.
W4				V	X	Dry
W5				V	X	Dry
W6				V	X	Dry
B-Aquifer Monitoring Wells						
CDM-1B	V			V/I	X	New bladder pump installed and sampled during July 2014
CDM-2B	V			V	X	New bladder pump installed and sampled during July 2014
CDM-3B	V			V	X	New bladder pump installed and sampled during July 2014
CDM-4B		V		V	X	
CDM-5B	V	V	V	V	X	
CDM-8B		V		V	X	
CDM-12B		V		V	X	
CDM-13B		V		V	X	
CDM-13B2				V	X	
CDM-15B	V	V	V	V	X	
CDM-15B2				V	X	
CDM-16B				V	X	
CDM-17B				V	X	
CDM-18B				V	X	

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Table 4-1
Performance Monitoring Program Optimization – July 2014
Fresno Sanitary Landfill Groundwater Remedial Action
Performance Monitoring Program

Well	Groundwater Sampling				Quarterly Water Level Measurements	Proposed Program Modifications
	July 2014	October 2014	January 2015	April 2015		
B-Aquifer Monitoring Wells (con't)						
CDM-19B		V		V/I	X	
CDM-20B1	V	V	V	V	X	
CDM-21B2	V	V	V	V	X	
CDM-22B2	V	V	V	V	X	
PZ-20B2 (piezometer)		V		V	X	
DW-1B		V		V	X	
DW-1C		V		V	X	
DW-2B				V	X	
DW-2C		V		V	X	Increase to Semi-annual; PCE > MCL
PZ-1B		V		V	X	
PZ-2B		V		V	X	
PZ-3B	V	V		V	X	New bladder pump installed and sampled during July 2014
PZ-4B		V		V	X	
PZ-5B	V	V	V	V	X	
PZ-5B2	V	V	V	V	X	
PZ-6B					X	
UW-1B	V			V	X	New bladder pump installed and sampled during July 2014
UW-1C					X	
UW-2B				V	X	
UW-2C					X	
C-Aquifer Monitoring Wells						
CDM-1C				V/I	X	
CDM-2C				V	X	
CDM-4C	V	V	V	V	X	
CDM-5C	V	V	V	V	X	
CDM-7C				V	X	
CDM-8C		V		V	X	
CDM-13C				V	X	
CDM-15C				V	X	
CDM-16C	V	V	V	V	X	
CDM-17C	V	V	V	V	X	
CDM-18C				V	X	
CDM-20C	V	V	V	V	X	
CDM-21C	V	V	V	V	X	
CDM-22C	V	V	V	V	X	
PZ-4C				V	X	
PZ-5C		V		V	X	
Residential Wells						
1770 North Avenue				V		
2045 North Avenue				V		
2429 North Avenue	V	V	V	V		
1304 Jensen Avenue				V		
1346 Jensen Avenue				V		
1642 Jensen Avenue				V		Well no longer utilized; removed from monitoring program
1650 Jensen Avenue				V		
1912 Jensen Avenue				V		
3165 Hughes Avenue				V		New well added to monitoring program

Notes:

1. VOC = Volatile Organic Compound
2. V = Well to be sampled for VOCs only.
3. V/I = Well to be sampled for VOCs and inorganic constituents.
4. MCLs = Maximum Contaminant Level, California Department of Public Health, updated July 1, 2014.

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Figure 5. Groundwater Monitoring Wells and Frequency for 2014-2015

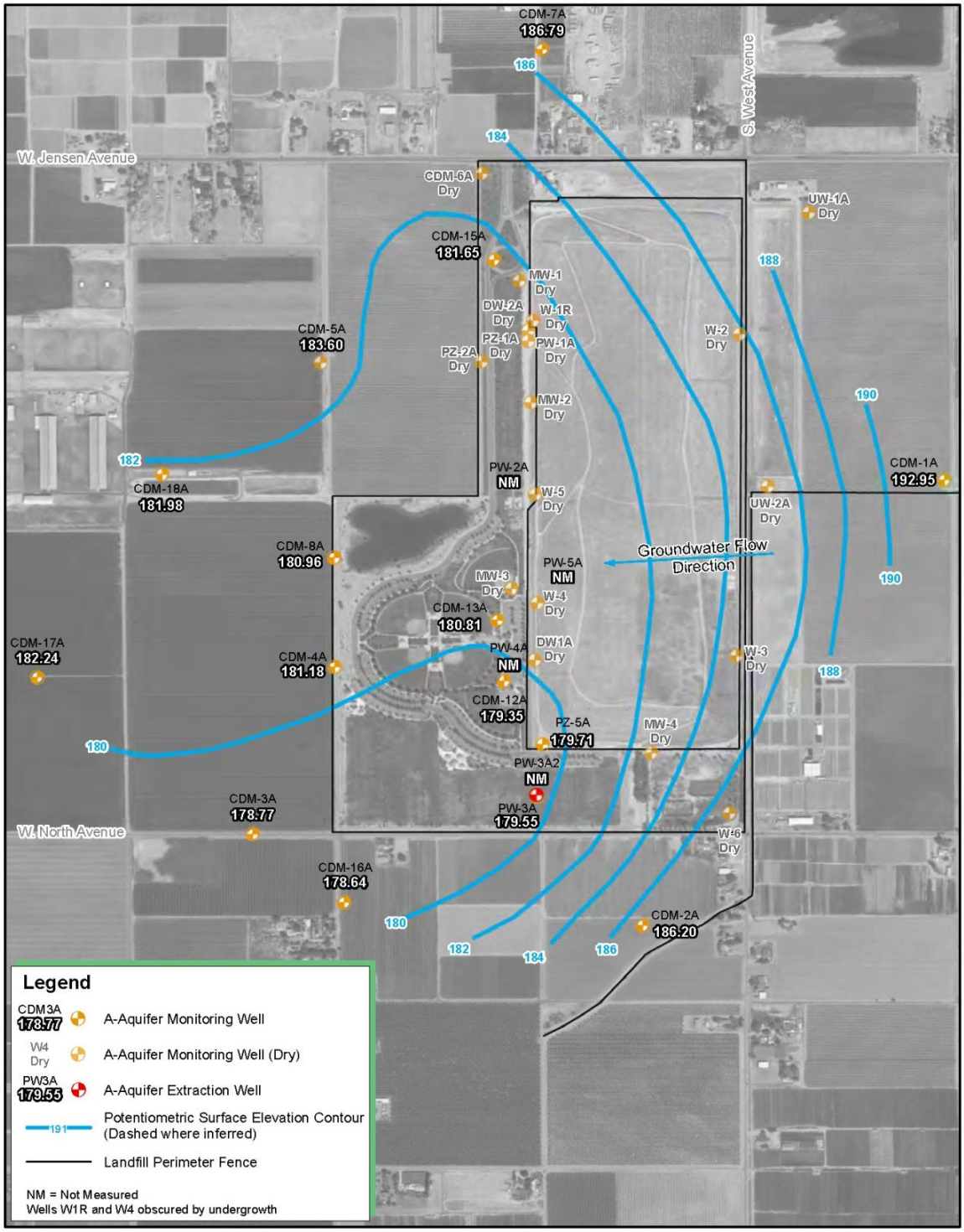

Figure 6. April 2014 A-aquifer Groundwater Elevation Contours

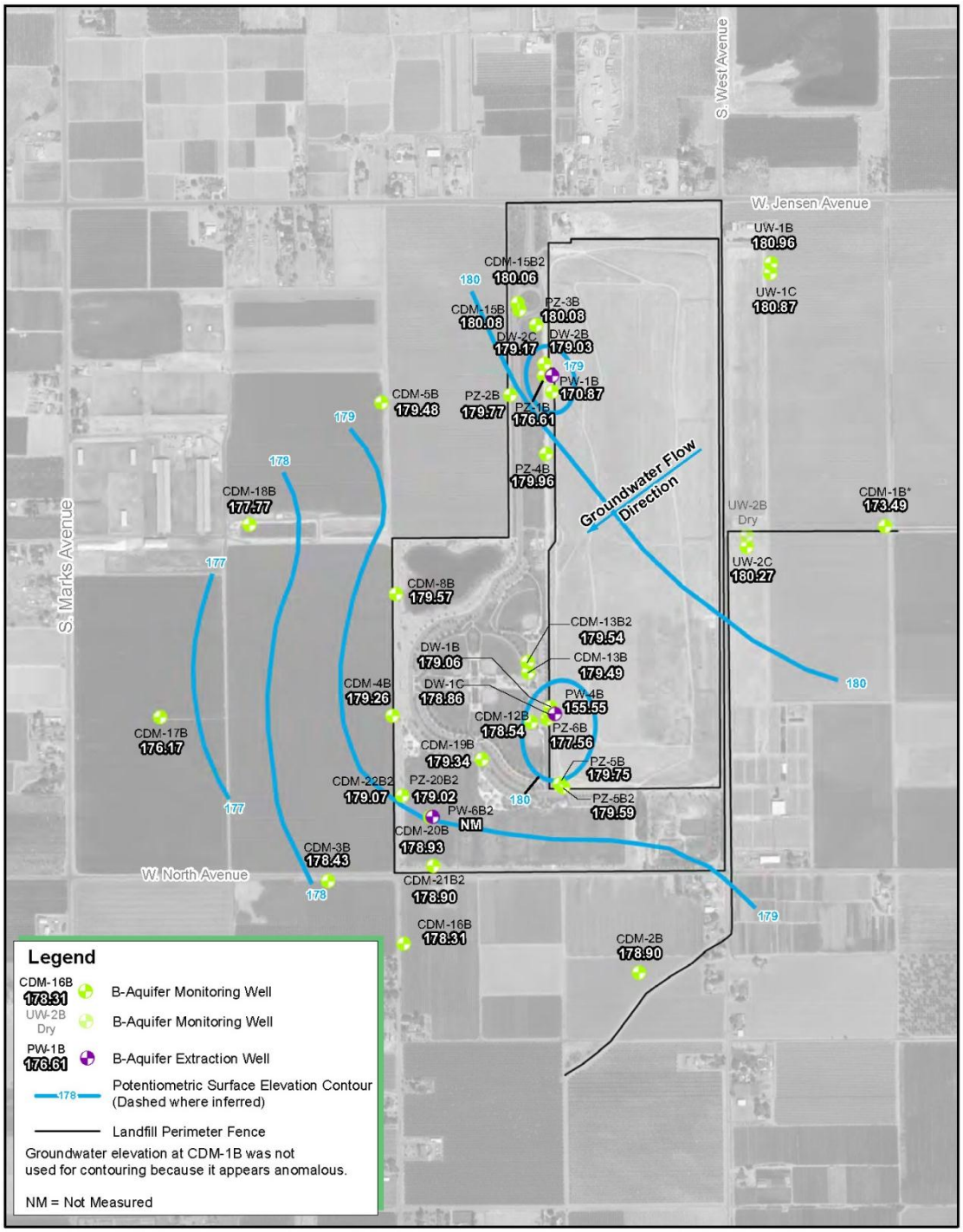

Figure 7. April 2014 B-aquifer Groundwater Elevation Contours

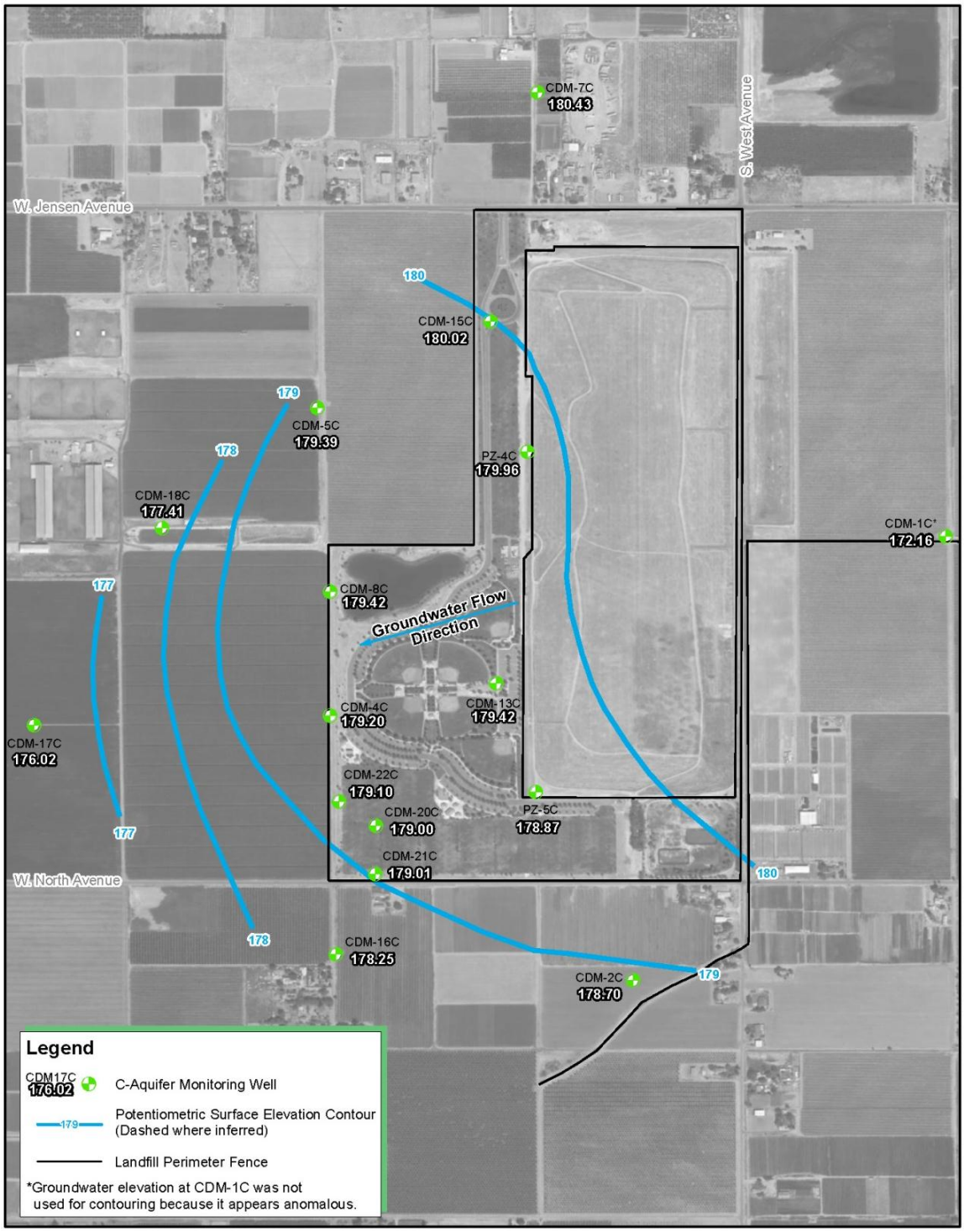

Figure 8. April 2014 C-aquifer Groundwater Elevation Contours

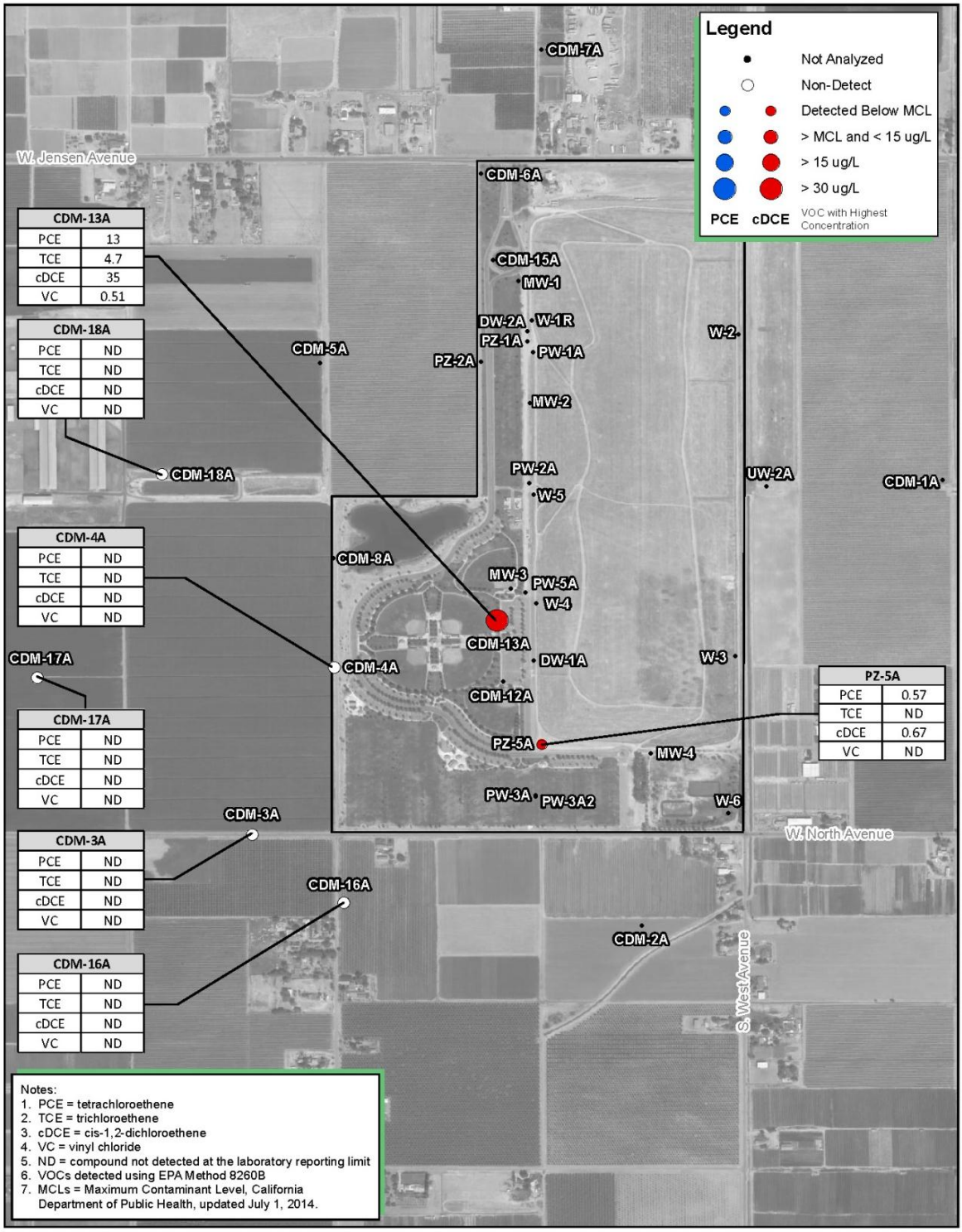

Figure 9. April 2014 A-aquifer VOC Concentration Plot

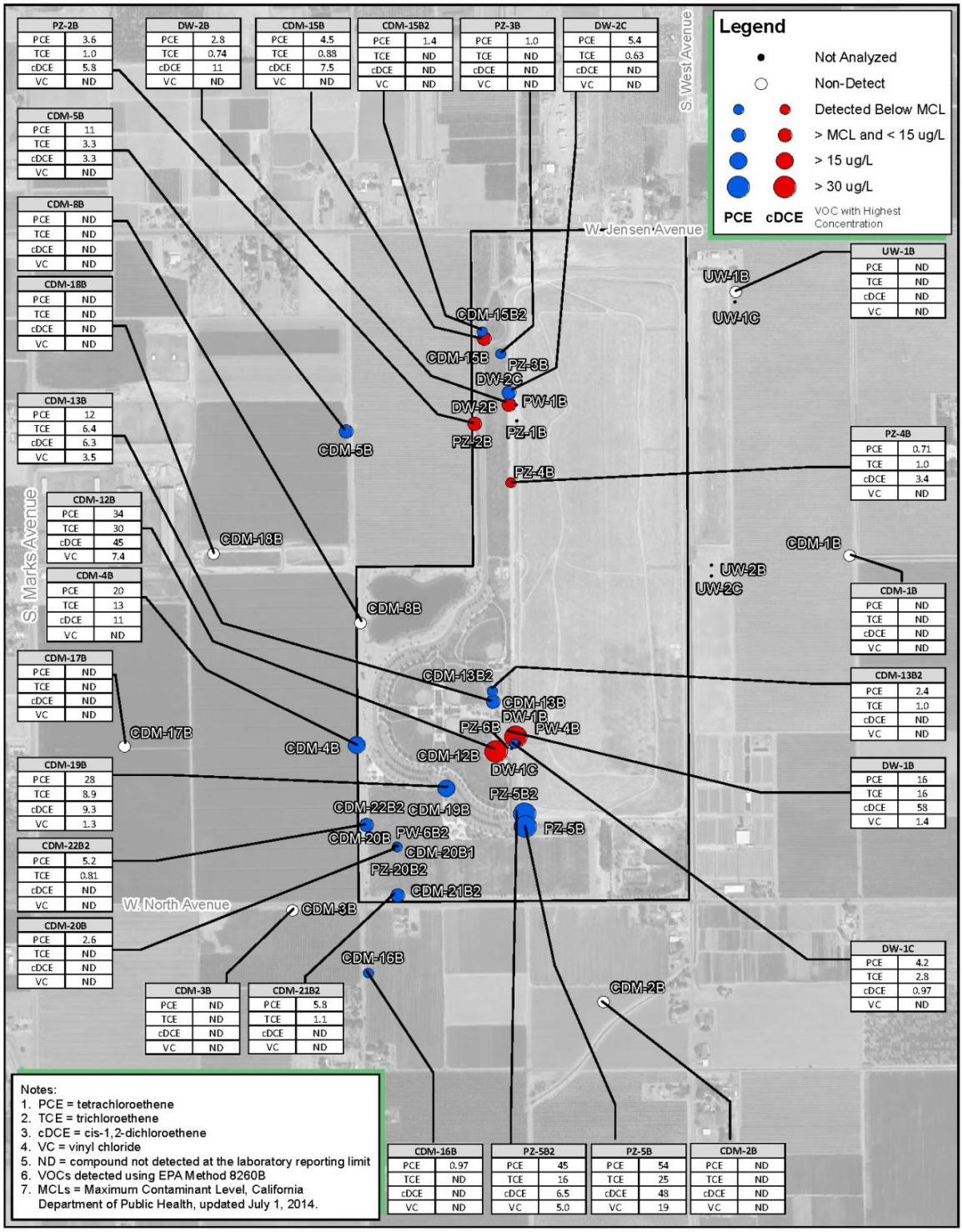

Figure 10. April 2014 B-aquifer VOC Concentration Plot

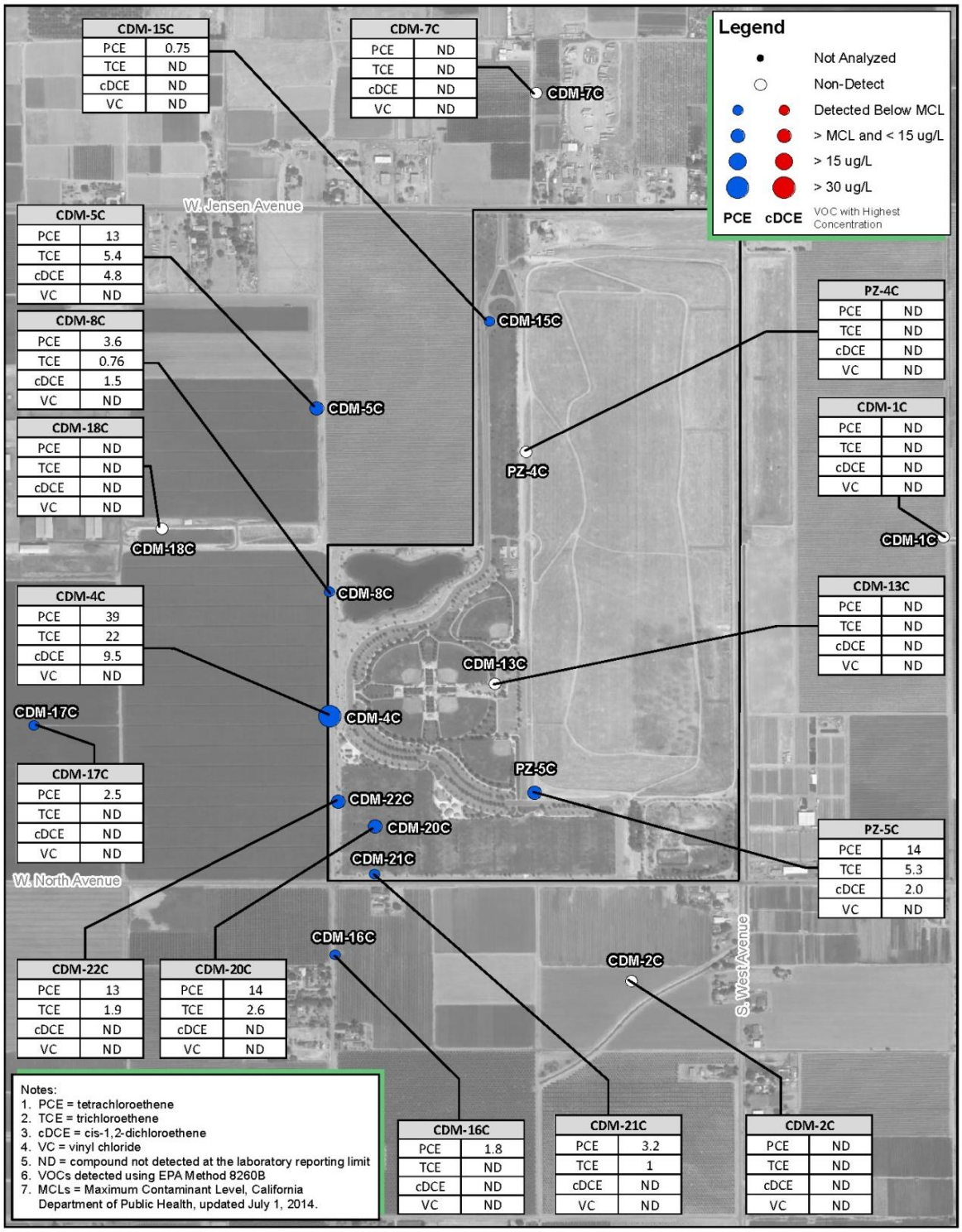

Figure 11. April 2014 C-aquifer VOC Concentration

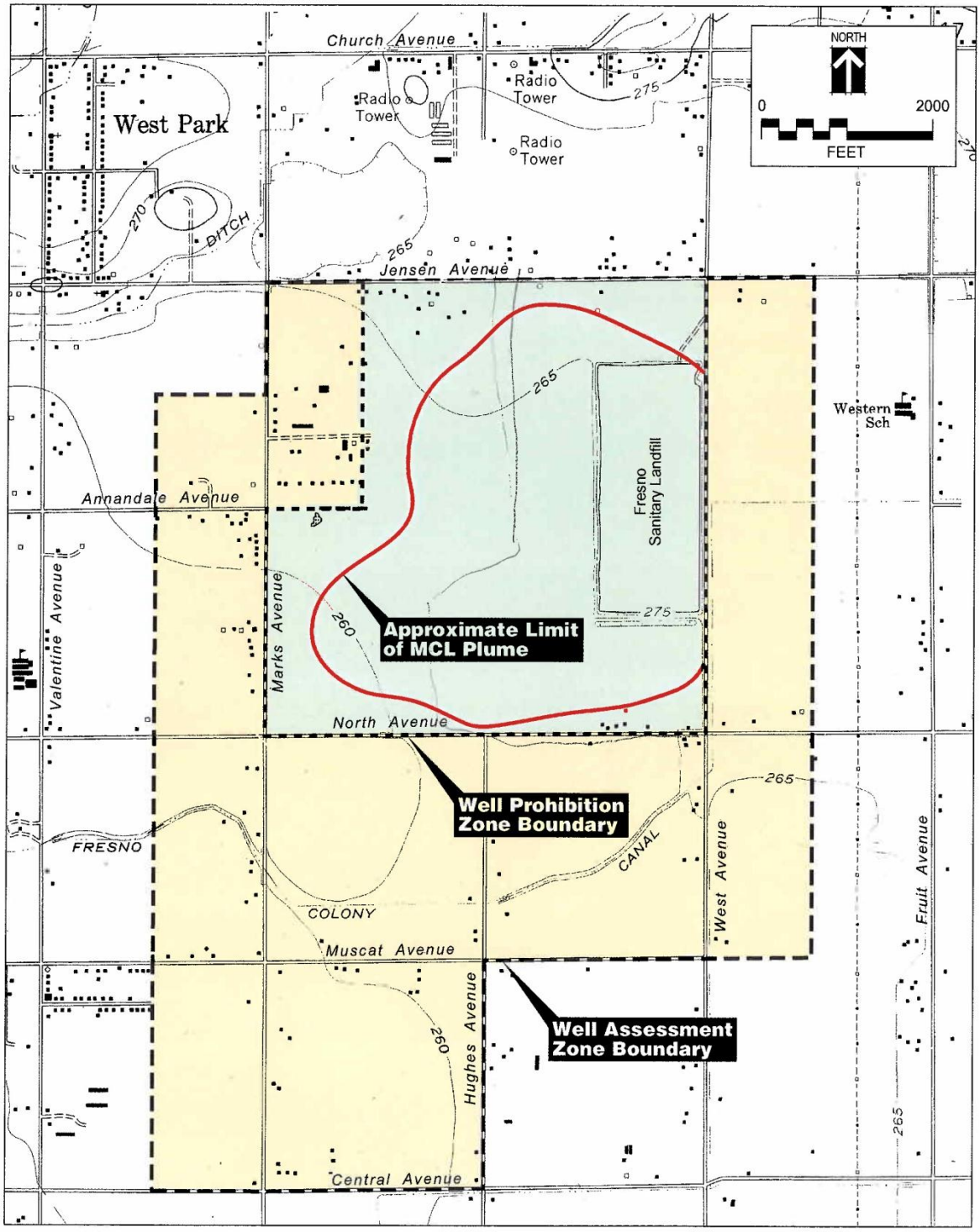

Figure 12. Well Protection Program Institutional Control Zone

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Appendix A: List of Documents Reviewed

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List of Documents Reviewed

CDM 1993. Excerpt: Fresno Sanitary Landfill Draft Remedial Investigation. February 1993.

CDM 1994. Excerpt: Fresno Sanitary Landfill Remedial Investigation. May 1994.

CDM, 2000. Performance Monitoring Program Plan Operable Unit 2, City of Fresno, Fresno Sanitary Landfill, November 30.

CDM, 2003. Fresno Sanitary Landfill Technical Memorandum – Institutional Controls. January 21.

CDM, 2006. Ecological Risk Contaminant Pathway Analysis. October 2.

CDM, 2007. Final Phase 1 Groundwater Remedial Action Evaluation Report #2, Fresno Sanitary Landfill. March 15.

CDM, 2009. Addendum to Supplemental Analysis of Risk, Fresno Sanitary Landfill. April 2.

CDM, 2010a. Phase 2 Groundwater Remedial Action Interim Remedial Action Report, Fresno Sanitary Landfill, Operable Unit No. 2. March 10.

CDM, 2010b. Phase 2 Groundwater Remedial Action Evaluation Report, Fresno Sanitary Landfill, November 29.

CDM, 2011. Phase 2 Enhancements Basis of Design Report, Groundwater Remedial Design/Remedial Action, Fresno Sanitary Landfill. September 15.

CDM Smith, 2014a. Guidance for Landfill Cover/Drainage System Maintenance, Fresno Sanitary Landfill, Update: February 2014.

CDM Smith, 2014b. Annual Performance Monitoring Program Report, Fresno Sanitary Landfill, July 31.

CDMSmith, 2014c. Phase 2 Enhancements Groundwater Remedial Action Interim Remedial Action Reported, Fresno Sanitary Landfill, Operable Unit No. 2, August 11.

CH2MHill, 2005. First Five-Year Review Report for Fresno Sanitary Landfill Superfund Site, Fresno County, California. September.

City of Fresno, 2014. Fresno Sanitary Landfill Quarterly Progress Report – 3rd Quarter 2014. October 3, 2014.

City of Fresno, 2015. Fresno Sanitary Landfill Quarterly Progress Report – 4th Quarter 2014. January 27, 2015.

ITSI Gilbane, 2013. Technical Memorandum Re: Installation of a Domestic Water Well at 3165 South Hughes Avenue, Fresno, California, December 6.

USEPA, 1993. Record of Decision, Fresno Municipal Sanitary Landfill, OU1, Fresno, California, September 30.

USEPA, 1994. Revised Draft Human Health Risk Assessment for the Fresno Sanitary Landfill Superfund Site, Fresno, California. Prepared by ICF Technology, Inc. April.

USEPA, 1996. Record of Decision, Fresno Municipal Sanitary Landfill, OU2, Fresno, California, September 30.

USEPA, 2010. Second Five-Year Review Report for Fresno Municipal Sanitary Landfill Superfund Site, Fresno County, California. September.

Appendix B: Press Notices

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CODE

Continued from A1

ter by way of Granville's sentiments.

The timeline is the easy part of this story.

Fresno's development code got its last overhaul in the early 1960s. Planning directors and city councils tweaked it periodically for a half-century. Mayor Ashley Swearengin a few years ago put her team to work on a full-scale code reform at the same time it pursued a new general plan.

An advisory committee full of local planning and development experts met for 18 months to chew on code nuances. The committee is done with its work. Clark and her staff are polishing a draft.

Clark says the public should get its first look at the proposed code in late March. Two months of community meetings and staff presentations will conclude with a City Council vote in late May or early June. The new code is expected to go live July 1.

Don't be fooled by all this administrative drudgery. There is a fight brewing here.

All about details

It begins with complexity.

Roberts says a development code for a city as big and varied as Fresno has "millions of bits of information." The current code, for example, says a new house must have a yard on each side at least five feet wide. Unless the house has an attached garage. Unless the house is on a corner lot. Unless the house is on a reversed corner lot. Unless the side lot of the house next door is less than five feet wide.

Development-code experts, it's safe to say, appreciate the value of detail.

Yet, such detail plays a big part in defining the look and feel of a city. The City Council, planning staff and Granville recently tore into each other over whether the developer must build a small housing project with the mandated 20-foot driveways or could get by with 8-footers.

Different opinions on market demand, housing density and developer profit collided head-on. Unstated, but never far from anyone's mind, was City Hall's reputation (perhaps overblown) as a sucker for every squeal of outrage from a developer.

An advisory committee full of local planning and development experts met for 18 months to chew on code nuances. The committee is done with its work.

The new development code, even in draft form, is causing heartburn among some developers. Their worry: It will be long on utopianism and coercion, short on wisdom and flexibility.

The City Council in December approved the 2035 general plan update that promises nothing less than a revolution in Fresno's development patterns. Sprawl is to slow to a crawl, if not end altogether. Inner-city development is to soar. Poverty won't entirely disappear, but the vast swaths of concentrated poverty that shames Fresno on the national level will.

All of Fresno will then enjoy the fruits of a strong local economy, one blessed with access to plenty of water and the modernized infrastructure to deliver it. The threat of municipal bankruptcy that so terrorized city officials a few years ago will recede as Fresno fills with productive taxpayers.

So goes the thinking at City Hall. So goes the hopes of community activists who cheered the 2035 general plan's vision.

The only missing piece is a development code that delivers development.

Roberts says Granville looks forward to reviewing the draft code and suggesting reasonable changes.

A general plan with an anti-developer, anti-market development code "won't catch the momentum it needs to succeed," Roberts says.

Clark promises a development code with three virtues.

"Easy, flexible, clear."

▶ Contact George Hostetter: ghostetter@fresnobee.com, (559) 441-6272 or @GeorgeHostetter on Twitter.

FRESNO POLICE DEPARTMENT

Two Fresno police officers were injured, and their patrol car heavily damaged, early Sunday after a collision with a suspected drunken driver at Shaw and Fruit avenues in northwest Fresno.

IN BRIEF

Bee staff

POLICE

Fresno officers hurt in crash with DUI suspect

Police arrested a woman early Sunday morning after they say she ran a red light in northwest Fresno and collided with a patrol car, injuring the two officers inside.

Regina Garcia

Fresno police Sgt. Diana Trueba said that Regina Garcia, 41, was driving under the influence when the crash occurred just after 3 a.m. near the intersection of Shaw and Fruit avenues.

Garcia was on parole for home invasion robbery. She was booked on suspicion of felony DUI causing bodily injury, driving on a suspended license, failing to stop at a red light and a parole violation.

Both police officers were taken to Clovis Community Hospital where they were treated for minor injuries and released, Trueba said.

The crash caused the patrol car to hit a light pole and Garcia's car smashed a fire hydrant, flooding the street.

Man hurt in Pixley drive-by shooting

A drive-by shooting early Saturday morning in Pixley left one man injured, the Tulare County Sheriff's Office said.

The man was taken to a local hospital with a single gunshot wound to the lower abdomen, and his condition is unknown.

An investigation indicated that an occupant in a white car fired a single shot at the man while he was standing in the front yard of a home on the 400 block of West Bradbury Avenue.

Anyone with information on the shooting is asked to call the Tulare County Sheriff's Department dispatch line at (559) 733-6218 or the anonymous tip line at (559) 725-4194.

Chowchilla officer shoots fleeing suspect

Chowchilla police are investigating an officer-involved shooting that happened during a foot pursuit Sunday afternoon.

The incident was reported at 4:07 p.m. after officers were involved in a vehicle pursuit that ended with the suspect crashing into a home in the area of South 3rd Street and Mariposa Avenue, according to a Chowchilla police press release.

The occupants fled from the vehicle and officers began to chase them.

During the foot chase one of the suspects was shot in the hand by police.

That person was taken by ambulance to Community Regional Medical Center in Fresno.

No officers were injured, according to the release.

The officers and dispatcher who were involved in the shooting will be placed on paid administrative leave during the investigation, the department said.

The Madera County Sheriff's Office will investigate the shooting.

The identities of the suspects and the officer involved in the case have not been released.

No other details were immediately available Sunday.

Police are asking anyone with information about the case to call Madera County Sheriff's Office at (559) 675-7770.

ECO-FRIENDLY

Continued from A3

will learn and move on. We have several ideas for using reeds and bamboo — plentiful, free materials — to support the new structure."

The Eco Village Project accepted a $5,000 donation from Temple Beth Israel synagogue that will go to fund the second small shelter. Rabbi Rick Winer opened the ceremony by thanking the project for allowing his synagogue to help those in need, and he challenged other local faith organizations to do the same.

The Dakota EcoGarden has served as a model for how the future village will work.

Mai Yang, who lives in a tent on the grounds with her husband, Steve, said the board members enforce strict rules for living there. These include curfews, visitor restrictions, a firm drug-testing policy and the requirement that each resident be actively seeking work.

Yang, who became homeless after losing her job at a laundromat, said her six months at the garden have been a great experience.

"We were on the street before this," she said.

▶ Contact Rory Appleton: (559) 441-6015, rappleton@fresnobee.com or @RoryDoesPhonics on Twitter.

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972 E. Barstow (Between Clovis & Sunnyside) 299-2700
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U.S. EPA CONDUCTS THIRD REVIEW OF CLEANUP AT THE FRESNO MUNICIPAL SANITARY LANDFILL SUPERFUND SITE

The United States Environmental Protection Agency (EPA) is conducting a third Five-Year Review (FYR) of the cleanup remedies at the Fresno Municipal Sanitary Landfill Superfund Site (Site) in Fresno, California. This review will evaluate the effectiveness of the landfill cover and groundwater remediation systems installed by the City of Fresno.

According to the Superfund law, if a cleanup takes more than five years to complete or hazardous wastes remain on the Site, the cleanup will be reviewed every five years. The second FYR conducted in 2010 determined that the cleanup remedies were protective of human health and the environment. The purpose of this third FYR is to determine whether the remedies continue to be protective. EPA invites the community to learn more about this process. If you have information to contribute, please call Patricia Bowlin, Remedial Project Manager prior to April 1, 2015 at (415) 972-3177 or email her at bowlin.patricia@epa.gov.

EPA maintains repositories that contain the Site's Administrative Records and other relevant information at the Fresno County Central Library, 2420 Mariposa Street, Fresno, CA and the EPA Superfund Records Center, 95 Hawthorne Street, 4th floor, San Francisco, California 94105, (415) 820-4700. The final Third FYR report will be available to the public after September 30, 2015 at the repositories above and on EPA's web page: www.epa.gov/region09/FresnoMunicipalLandfill.

CNS#2721904

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Appendix C: Interview Forms

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Interviews

Five-Year Review Interview Record			
Site:	Fresno Municipal Sanitary Landfill	**EPA ID No:**	CAD980636914

Interview Type: **Site visit**
Location of Visit: Fresno, California
Date: January 16, 2015
Time: 0900 - 1330

Interviewers

Name	Title	Organization
Heather Fourie	Chemist	USACE
David Clark	Biologist	USACE

Interviewees

Name	Organization	Title	Telephone	Email
Patricia Bowlin	EPA	Remedial Project Manager		
George Slater	City of Fresno			
John (Yash) Nyznyk	CDMSmith	Associate	(925)933-2900	NyznykJP@cdmsmith.com
Peter Phillips	Gilbane	Senior Geologist		
Jim Rohrer	California DTSC	Project Manager		
Dan Carlson	RWQCB	Senior Engineering Geologist	(559)444-2484	daniel.carlson@waterboards.ca.gov

Summary of Conversation

1) What is your overall impression of the project?

The project is going well; things are moving along. Related to groundwater OU, one issue is the downward migration of contaminants to the C-aquifer. Over the next six months, we will be evaluating the potential for a C-zone extraction well. The new B-aquifer extraction well (PW-6B2) may help capture in both the B and C aquifers.

For OU1, the remedy is also going well and we are achieving the remedial goals.

2) Is the remedy functioning as expected? How well is the remedy performing?

See the answer to Question 1.

3) What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?

The monitoring data show that contaminants are migrating downwards. This was one reason for the Phase 2 Enhancements. Contaminants are decreasing in the A-aquifer, but with declining water levels, hydraulic control of A-aquifer is decreasing. Some wells are increasing while others are decreasing. We are watching CDM-16C (a C-aquifer well) closely, since it is downgradient of the new B-aquifer extraction well.

4) Is there a continuous O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.

Yes, the City has a full-time on-site technician during working hours. The technician's responsibilities include checking and adjusting the gas wellhead flows and running and maintaining the GTP facilities. The technician also performs all the groundwater and residential well sampling, which occurs on a mixed quarterly, semi-annual, and annual schedule.

5) Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.

No. There have been no significant O&M changes. The well sampling schedule is continuously revisited and adjusted as needed in the annual reports depending on groundwater data.

6) What are the annual operating costs for your organization's involvement with the site?

Mr. Slater: The city's annual operating cost is approximately 1.2 million.

7) Have there been unexpected O&M difficulties or costs at the site in the last five years? If so, please give details.

There have been the occasional valve replacements and vandalism-related replacements.

8) Have there been opportunities to optimize O&M or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.

The well sampling list is re-visited annually and adjusted as needed to meet sampling needs.
Mr. Slater: The City has decided to conduct landfill cap subsidence repair in-house as ongoing maintenance rather than contract out the work.
Mr. Nyznyk: The City intends to decommission approximately 6 wells mostly in the A-Zone and rehabilitate PW-1B.
Mr. Rohrer asked if the A-zone wells should be considered for soil gas analysis or extraction. A discussion on this topic followed. M. Nyznyk stated that A-zone concentrations have been reduced and said there may be some sorbed VOC mass, but this does not seem likely. Mr. Slater recollected that in-house and crawl-space gas sampling survey was conducted in the early 1990s that produced all non-detects.

9) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?

No.

10) Do you have any comments, suggestions, or recommendations regarding the project?

[Nothing specific in response to this question; however, multiple topics were discussed, including watching C-aquifer contaminant migration (in particular, well CDM-16C), evaluating the perimeter gas wellhead data to check for horizontal gas migrations.

Additional Site-Specific Questions

11) Land Use at site and surroundings: Are there any plans to change current or future land use at or surrounding the site?

No changes.

12) Municipal Water Supply: According to the 1993 ROD, there were 8 municipal wells within 3 miles of the site. Are there still municipal wells within close proximity to the site?

Closest municipal well is 1 mile upgradient.

13) Private Wells: The 2014 Phase 2 Interim RA Report indicated that adjacent residences are still on private wells. How many nearby residential wells currently have wellhead treatment systems or receive bottled water?

Nine homes are currently receiving bottled water.

Does the City have any plans to expand municipal water network to these residences?

No, it is too expensive and many of the home-owners prefer to have their own wells.

14) General landfill maintenance: Who takes care of surface maintenance, flare maintenance, landfill gas monitoring, etc? Is landfill gas still monitored? Is this information recorded in annual reports?

The City takes care of these activities. Landfill gas is monitored; data is not included in CDMSmith's annual report. Suggestion was made by group to look at perimeter wellhead gas data to ensure that horizontal gas migration is being controlled.

What is the status of the slope restoration work on northeastern side of landfill?

Nothing has been done since the 2008 restoration.

15) Are there any plans for additional Phase II groundwater remedial action enhancements?

The City is currently evaluating the Phase II enhancements to determine if a C-zone extraction well may be needed to control contaminant migration.

16) Institutional Controls: What is the status of the environmental restrictive covenant(s) for landfill and surrounding property?

Site has a well protection program implemented between City and County that includes prohibition and well evaluation zones. If a well is proposed in these areas, the City will notify the County. An issue occurred recently in which a private well (3165) was installed without going through this process.

The ESD added two new ICs: 1) Landfill cap; 2) Groundwater.

17) Ecological: Have there been any changes in the frequency of bird kills observed due to the landfill gas flare?

Nothing unusual.

How are burrowing animals controlled on the landfill cap? Is squirrel bait still used?

Yes, squirrel bait is still used.

18) Hydrogeology: Nomenclature has changed. Now there is an Upper and Lower B aquifer.

19) Landfill gas extraction system: Does landfill gas condensate get pumped into the GTP for treatment? Or is it discharged directly to sewer?

Landfill gas condensate from the gas extraction system is discharged to the sewer.

20) GTP. Does off-gas condensate from the piping near the PTA get re-pumped into the PTA for treatment?

Yes.

21) Landfill gas flare: Has bypass mode been used since it was installed in 2009?

Yes, occasionally during GTP maintenance or temporary vandalism-induced shutdowns of the GTP.

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Five-Year Review Interview Record			
Site:	Fresno Municipal Sanitary Landfill	**EPA ID No:**	CAD980636914

Interview Type: **Phone**
Location of Visit: Teleconference call
Date: January 23, 2015
Time: 0900 – 0930

Interviewers		
Name	**Title**	**Organization**
Heather Fourie	Chemist	USACE

Interviewees				
Name	**Organization**	**Title**	**Telephone**	**Email**
Dan Carlson	RWQCB	Senior Engineering Geologist	(559)444-2484	daniel.carlson@waterboards.ca.gov
Ronald Holcomb	RWQCB	Engineering Geologist		
Greg Issinghof	RWQCB	Engineering Geologist		

Summary of Conversation

Introduction: Greg and Ronald were previous case-workers on the site prior to Dan. Dan, Ronald, and Greg are part of the Central Valley Water Board.

1) What is your overall impression of the project?

It's working. A large part of the base contamination has been removed.

2) Is the remedy functioning as expected? How well is the remedy performing?

See answer to Question 1. Remedy seems to be working well. There are still some distal plume issues.

3) What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?

Yes, there are some decreasing trends, but we need to keep watching the well data especially since the new extraction well was installed. CDMSmith is tracking and monitoring the data.

4) Is there a continuous O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.

Not involved.

5) Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.

Not involved.

6) What are the annual operating costs for your organization's involvement with the site?

$10-12,000/year, which is billed to the City. Our involvement varies depending on the activities.

7) Have there been unexpected O&M difficulties or costs at the site in the last five years? If so, please give details.

O&M subsidence issue is a problem.

8) Have there been opportunities to optimize O&M or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.

Yes, some slight changes have been made. CDMSmith has been providing annual recommendations to the sampling program.

9) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?

No.
10) Do you have any comments, suggestions, or recommendations regarding the project?

Our largest concern is the landfill cap subsidence. We recommend that close attention be kept on how the city addresses the subsidence. We have some concern about using in-house manpower. Does the City have the expertise to repair the cap? We noted that some of the 4" diameter corrugated plastic pipes that drain the soils above the geomembrane were poking out, upwards, and missing screens. Is the City going to peel back the cap and fill the depression, or will dirt just be piled on top of the existing depressions? What is the City's proposed procedure for the cap repairs? We are also concerned about the integrity of the geomembrane layer. Flare permitting: We are a bit confused as to why the landfill flare is not permitted nor the effluent measured. All other landfills monitored by the RWQCB with landfill flares have permits issued by the Air Pollution Control District under Title V requirements. It is unclear how/why the flare at the Fresno landfill gas flare is exempt from this permitting, and why the flare effluent is not measured.
Additional Site-Specific Questions
The interviewees did not have input for the majority of the additional site-specific questions, with the following exception: 17) Ecological: Have there been any changes in the frequency of bird kills observed due to the landfill gas flare? How are burrowing animals controlled on the landfill cap? Is squirrel bait still used? We noted that the squirrel bait dispensers were empty. Ground squirrels were noted on the landfill [by Mr. Carlson] during the site tour.

Appendix D: Site Inspection Checklist

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Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site name: Fresno Municipal Sanitary Landfill	**Date of inspection:** January 16, 2015
Location: Fresno, California	**EPA ID:** CAD980636914
Agency, office, or company leading the five-year review: EPA Region 9	**Weather/temperature** : Foggy, then partly sunny.

Remedy Includes: (Check all that apply)

- ☒ Landfill cover/containment
- ☒ Access controls
- ☒ Institutional controls
- ☒ Groundwater pump and treatment
- ☒ Surface water collection and treatment
- ☒ Other: *e.g. Groundwater monitoring*

  Landfill gas collection and treatment system; Groundwater Monitoring
- ☐ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☐ Inspection-team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** George Slater, City of Fresno _____ 1/16/2015
   Name Title Date
   Interviewed ☒ at site ☐ at office ☐ by phone Phone no. _____
   Problems, suggestions; ☒ Report attached See Report

2. **O&M staff** _____ _____ _____
   Name Title Date
   Interviewed ☐ at site ☐ at office ☐ by phone Phone no. _____
   Problems, suggestions; ☒ Report attached _____

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency EPA Region 9
Contact Patricia Bowlin | Remedial Project Manager | 1/16/2015 | _____
Name | Title | Date | Phone no.
Problems; suggestions; ■ Report attached _____

Agency CDMSmith (contractor for City of Fresno)
Contact John (Yash) Nyznyk | _____ | _____ | _____
Name | Title | Date | Phone no.
Problems; suggestions; ■ Report attached _____

Agency Gilbane (contractor for EPA)
Contact Peter Phillips | Senior Geologists | 1/16/2015 | _____
Name | Title | Date | Phone no.
Problems; suggestions; ■ Report attached _____

Agency California Department of Toxic Substances Control
Contact Jim Rohrer | Project Manager | 1/16/2015 | _____
Name | Title | Date | Phone no.
Problems; suggestions; ■ Report attached _____

4. **Other interviews** (optional) ■ Report attached.

Dan Carlson, Regional Water Quality Control Board, Senior Engineering Geologist, 1/16/2015.

Follow-up telephone interview conducted with RWQCB representatives (see interview report) on 1/23/2015.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

■ O&M manual	■ Readily available	■ Up to date	☐ N/A
■ As-built drawings	■ Readily available	■ Up to date	☐ N/A
■ Maintenance logs	■ Readily available	■ Up to date	☐ N/A

Remarks

2. **Site-Specific Health and Safety Plan** ■ Readily available ■ Up to date ☐ N/A
■ Contingency plan/emergency response plan ■ Readily available ■ Up to date ☐ N/A
Remarks

3.	**O&M and OSHA Training Records** Remarks	■ Readily available	☐ Up to date	☐ N/A
4.	**Permits and Service Agreements**			
	☐ Air discharge permit	☐ Readily available	☐ Up to date	■ N/A
	☐ Effluent discharge	☐ Readily available	☐ Up to date	■ N/A
	☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	■ N/A
	☐ Other permits_____	☐ Readily available	☐ Up to date	■ N/A
	Remarks There is no air discharge permit for the landfill gas flare.			
5.	**Gas Generation Records**	☐ Readily available	☐ Up to date	■ N/A
	Remarks City indicated that methane is measured at the landfill gas wellheads, although data was not available. The effluent from the landfill gas flare is not measured.			
6.	**Settlement Monument Records** Remarks	☐ Readily available	☐ Up to date	■ N/A
7.	**Groundwater Monitoring Records**	■ Readily available	■ Up to date	☐ N/A
	Remarks CDMSmith produces annual groundwater reports with data.			
8.	**Leachate Extraction Records**	■ Readily available	■ Up to date	☐ N/A
	Remarks Groundwater influent data is recorded in CDMSmith's annual reports.			
9.	**Discharge Compliance Records**			
	☐ Air	■ Readily available	☐ Up to date	■ N/A
	■ Water (effluent)	■ Readily available	■ Up to date	☐ N/A
	Remarks Monitoring is not required of landfill gas flare. Effluent from the GTP is measured and reported in CDMSmith's annual reports.			
10.	**Daily Access/Security Logs**	☐ Readily available	☐ Up to date	■ N/A
	Remarks Logs were not checked.			

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☐ Contractor for State
■ PRP in-house ■ Contractor for PRP
☐ Federal Facility in-house ☐ Contractor for Federal Facility
☐ Other

2. **O&M Cost Records**

■ Readily available ☐ Up to date ☐ Funding mechanism/agreement in place
Original O&M cost estimate_____ ☐ Breakdown attached

Total annual cost by year for review period if available

From FY2014	To _____	1.2 milion	☐ Breakdown attached
Date	Date	Total cost	
From _____	To _____	_____	☐ Breakdown attached
Date	Date	Total cost	
From _____	To _____	_____	☐ Breakdown attached
Date	Date	Total cost	
From _____	To _____	_____	☐ Breakdown attached
Date	Date	Total cost	
From _____	To _____	_____	☐ Breakdown attached
Date	Date	Total cost	

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons:

Valve replacements at the GTP.
Vandalism-related parts replacements at the GTP.

V. ACCESS AND INSTITUTIONAL CONTROLS ■ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ☐ Gates secured ☐ N/A

Remarks GTP is surrounded by a solid wall with a gate to prevent vehicular access after hours. Landfill is not fenced.

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A

Remarks Surveillance cameras are installed at the GTP.

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented ☐ Yes ■ No ☐ N/A
Site conditions imply ICs not being fully enforced ☐ Yes ■ No ☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) Agreement between City and County.
Frequency As-needed (when wells are proposed for installation, the City reports them to the County for evaluation)
Responsible party/agency City of Fresno
Contact George Slater
Name Title Date Phone no.

Reporting is up-to-date ☐ Yes ☐ No ☐ N/A
Reports are verified by the lead agency ☐ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met ☐ Yes ☐ No ☐ N/A
Violations have been reported ■ Yes ☐ No ☐ N/A
Other problems or suggestions: ☐ Report attached

A private well was installed recently without going through the well protection evaluation program IC. This caused some angst amongst the agencies and resulted in a letter issued to the local drillers.
The recent ESD implemented two new ICs (landfill and groundwater).

2. **Adequacy** ■ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☐ No vandalism evident
Remarks Sporadic vandalism has been a re-occurring problem at the GTP and wellheads. Recent upgrades have resulted in a general decline in vandalism.

2. **Land use changes on site** ■ N/A
Remarks None.

3. **Land use changes off site** ■ N/A
Remarks None

VI. GENERAL SITE CONDITIONS

A. Roads ■ Applicable ☐ N/A

1. **Roads damaged** ☐ Location shown on site map ■ Roads adequate ☐ N/A
Remarks

B. Other Site Conditions
Remarks The irrigation system (which is no longer used) has been vandalized over the years. Because there are no further plans to use the irrigation system, the City has no plans to repair the system.

VII. LANDFILL COVERS ☐ Applicable ☐ N/A			
A. Landfill Surface			
1.	**Settlement** (Low spots) Areal extent_____ Remarks Settlement is observed across the landfill and in particular on the eastern side of the landfill. This is an on-going problem and the City intends to make in-house repairs.	☐ Location shown on site map Depth_____	☐ Settlement not evident
2.	**Cracks** Lengths_____ Widths_____ Depths_____ Remarks	☐ Location shown on site map	■ Cracking not evident
3.	**Erosion** Areal extent_____ Remarks	☐ Location shown on site map Depth_____	■ Erosion not evident
4.	**Holes** Areal extent_____ Remarks	☐ Location shown on site map Depth_____	■ Holes not evident
5.	**Vegetative Cover** Remarks	■ Grass ☐ No signs of stress	■ Cover properly established ☐ Trees/Shrubs (indicate size and locations on a diagram)
6.	**Alternative Cover (armored rock, concrete, etc.)** Remarks		■ N/A
7.	**Bulges** Areal extent_____ Remarks	☐ Location shown on site map Height_____	■ Bulges not evident

8.	**Wet Areas/Water Damage**	■ Wet areas/water damage not evident	
	☐ Wet areas	☐ Location shown on site map	Areal extent_____
	☐ Ponding	☐ Location shown on site map	Areal extent_____
	☐ Seeps	☐ Location shown on site map	Areal extent_____
	☐ Soft subgrade	☐ Location shown on site map	Areal extent_____
	Remarks		
9.	**Slope Instability** ☐ Slides	☐ Location shown on site map	■ No evidence of slope instability
	Areal extent_____		
	Remarks		
B. Benches	■ N/A	☐ Applicable	
	(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)		
1.	**Flows Bypass Bench**	☐ Location shown on site map	■ N/A or okay
	Remarks		
2.	**Bench Breached**	☐ Location shown on site map	■ N/A or okay
	Remarks		
3.	**Bench Overtopped**	☐ Location shown on site map	■ N/A or okay
	Remarks		
C. Letdown Channels	■ Applicable	☐ N/A	
	(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)		
1.	**Settlement**	☐ Location shown on site map	■ No evidence of settlement
	Areal extent_____	Depth_____	
	Remarks		
2.	**Material Degradation**	☐ Location shown on site map	■ No evidence of degradation
	Material type_____	Areal extent_____	
	Remarks		
3.	**Erosion**	☐ Location shown on site map	■ No evidence of erosion
	Areal extent_____	Depth_____	
	Remarks		

4.	**Undercutting** ☐ Location shown on site map ■ No evidence of undercutting Areal extent_____ Depth_____ Remarks
5.	**Obstructions** Type_____ ■ No obstructions ☐ Location shown on site map Areal extent_____ Size_____ Remarks
6.	**Excessive Vegetative Growth** Type_____ ■ No evidence of excessive growth ☐ Vegetation in channels does not obstruct flow ☐ Location shown on site map Areal extent_____ Remarks
D. Cover Penetrations	■ Applicable ☐ N/A
1.	**Gas Vents** ■ N/A ☐ Active ☐ Passive ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration Remarks Gas is extracted and sent to the flare for combustion.
2.	**Gas Monitoring Probes** ☐ Properly secured/locked ■ Functioning ■ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A Remarks Gas wellheads are routinely sampled. Not in locked enclosures.
3.	**Monitoring Wells** (within surface area of landfill) ■ Properly secured/locked ■ Functioning ■ Routinely sampled ■ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A Remarks
4.	**Leachate Extraction Wells** ■ Properly secured/locked ■ Functioning ■ Routinely sampled ■ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A Remarks
5.	**Settlement Monuments** ☐ Located ☐ Routinely surveyed ■ N/A Remarks None seen.

E. Gas Collection and Treatment	■ Applicable	☐ N/A	
1. **Gas Treatment Facilities** ■ Flaring ■ Thermal destruction ☐ Collection for reuse ■ Good condition ☐ Needs Maintenance Remarks			
2. **Gas Collection Wells, Manifolds and Piping** ■ Good condition ☐ Needs Maintenance Remarks			
3. **Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings) ■ Good condition ☐ Needs Maintenance ☐ N/A Remarks Methane monitors noted within site office.			
F. Cover Drainage Layer	■ Applicable	☐ N/A	
1. **Outlet Pipes Inspected** ■ Functioning ☐ N/A Remarks Outlet pipes observed around landfill perimeter. Missing screens and upward pointing outlets were observed.			
2. **Outlet Rock Inspected** ■ Functioning ☐ N/A Remarks			
G. Detention/Sedimentation Ponds	■ Applicable	☐ N/A	
1. Siltation ☐ N/A ■ Siltation not evident Areal extent_____ Depth_____ Remarks Detention ponds were dry during site visit.			
2. **Erosion** Areal extent_____ Depth_____ ■ Erosion not evident Remarks			
3. **Outlet Works** ■ Functioning ☐ N/A Remarks			
4. **Dam** ☐ Functioning ■ N/A Remarks			

H. Retaining Walls	☐ Applicable	☒ N/A
1.	**Deformations** ☐ Location shown on site map ☐ Deformation not evident Horizontal displacement_____ Vertical displacement_____ Rotational displacement_____ Remarks	
2.	**Degradation** ☐ Location shown on site map ☐ Degradation not evident Remarks	
I. Perimeter Ditches/Off-Site Discharge	☒ Applicable	☒ N/A
1.	**Siltation** ☐ Location shown on site map ☒ Siltation not evident Areal extent_____ Depth_____ Remarks	
2.	**Vegetative Growth** ☐ Location shown on site map ☒ N/A ☐ Vegetation does not impede flow Areal extent_____ Type_____ Remarks	
3.	**Erosion** ☐ Location shown on site map ☒ Erosion not evident Areal extent_____ Depth_____ Remarks	
4.	**Discharge Structure** ☐ Functioning ☐ N/A Remarks	
VIII. VERTICAL BARRIER WALLS	☐ Applicable	☒ N/A
1.	**Settlement** ☐ Location shown on site map ☐ Settlement not evident Areal extent_____ Depth_____ Remarks	
2.	**Performance Monitoring** Type of monitoring_____ ☐ Performance not monitored ☐ Evidence of breaching Frequency_____ Head differential_____ Remarks	
IX. GROUNDWATER/SURFACE WATER REMEDIES	☐ Applicable	☒ N/A
A. Groundwater Extraction Wells, Pumps, and Pipelines	☒ Applicable	☒ N/A
1.	**Pumps, Wellhead Plumbing, and Electrical** ☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance ☐ N/A Remarks	

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☒ Good condition ☐ Needs Maintenance
Remarks

3. **Spare Parts and Equipment**
☒ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks

B. Surface Water Collection Structures, Pumps, and Pipelines ☒ Applicable ☐ N/A

1. **Collection Structures, Pumps, and Electrical**
☒ Good condition ☐ Needs Maintenance
Remarks

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☒ Good condition ☒ Needs Maintenance
Remarks

3. **Spare Parts and Equipment**
☒ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks

C. Treatment System ☒ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)
☐ Metals removal ☐ Oil/water separation ☐ Bioremediation
☒ Air stripping ☐ Carbon adsorbers
☐ Filters_____
☐ Additive (*e.g.*, chelation agent, flocculent) Sodium Hypochlorite added for anti-fouling properties
☐ Others_____
☒ Good condition ☐ Needs Maintenance
☒ Sampling ports properly marked and functional
☒ Sampling/maintenance log displayed and up to date
☒ Equipment properly identified
☐ Quantity of groundwater treated annually_____
☐ Quantity of surface water treated annually NA
Remarks

2. **Electrical Enclosures and Panels** (properly rated and functional)
☐ N/A ☐ Good condition ☐ Needs Maintenance
Remarks Locked and in good condition.

3.	**Tanks, Vaults, Storage Vessels** ☐ N/A ■ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks Recent upgrades to the extraction well vaults discourage vandalism.
4.	**Discharge Structure and Appurtenances** ☐ N/A ■ Good condition ☐ Needs Maintenance Remarks
5.	**Treatment Building(s)** ☐ N/A ■ Good condition (esp. roof and doorways) ☐ Needs repair ■ Chemicals and equipment properly stored Remarks
6.	**Monitoring Wells** (pump and treatment remedy) ■ Properly secured/locked ■ Functioning ■ Routinely sampled ■ Good condition ☐ All required wells located ☐ Needs Maintenance ☐ N/A Remarks
D. Monitoring Data	
1.	Monitoring Data ■ Is routinely submitted on time ■ Is of acceptable quality
2.	Monitoring data suggests: ☐ Groundwater plume is effectively contained ■ Contaminant concentrations are declining
D. Monitored Natural Attenuation	
1.	**Monitoring Wells** (natural attenuation remedy) ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ All required wells located ☐ Needs Maintenance ■ N/A Remarks
X. OTHER REMEDIES	
	If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

Overall, the landfill (OU1) remedy is effective and functioning as designed. Landfill gas emissions are being captured and treated. Surface water is being managed. Landfill condensate in the gas collecton system is discharged to the sewer.

Overall, the groundwater (OU2) remedy is effective and functioning as designed. Groundwater contamination beneath the site is contained in the A and B aquifers. The effectiveness of the groundwater extraction and treatment system on plume containment in the C-aquifer remains to be seen with the recent implementation of Phase II enhancements. Groundwater contaminant concentrations are below cleanup levels in all monitored residential wells.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Current O&M procedures are generally sufficient. Damaged landfill cap drainage outlets were noted. Subsidence issues have not yet been addressed.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.

Recent small increases in C-aquifer well groundwater contamination (e.g. CDM-16C) require continued monitoring to evaluate is the new Lower B extraction well (PW-6B2) is effectively containing the downgradient groundwater contamination in both the B and C aquifers. This could become a concern because of the proximity of nearby private wells that may become exposed to groundwater contamination if the groundwater plume continues to migrate toward those residences.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

No specific optimization of the remedy has been noted. CDMSmith provides recommendations to optimize the groundwater monitoring in their annual monitoring reports.

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Appendix E: Trip Report and Photos

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Trip Report and Photos

Trip Report
Fresno Municipal Sanitary Landfill

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1. INTRODUCTION

a. Date of Visit: January 16, 2015
b. Location: Fresno, California
c. Purpose: A site visit was conducted to visually inspect and document the conditions of the remedy, the Site, and the surrounding area for inclusion into the Five-Year Review Report.
d. Participants: *List all attendees*

Patricia Bowlin	EPA Remedial Project Manager
George Slater	City of Fresno
John (Yash) Nyznyk	CDM Smith
James Rohrer	California DTSC, Project Manager
Peter Phillips	Gilbane, Senior Geologist
Dan Carlson	Regional Water Quality Control Board
Heather Fourie	USACE
David Clark	USACE

2. SUMMARY

USACE personnel conducted a site visit to the Fresno Municipal Sanitary Landfill Superfund Site on January 16, 2015. The participants discussed the Site, remedial history, and current issues at the office adjacent to the Groundwater Treatment Plant. Interviews were conducted during the Site discussion. Following the Site discussion, the participants toured the GTP, landfill, and adjacent areas.

3. DISCUSSION

On January 15, 2015 David Clark and Heather Fourie flew to Fresno, California to meet the rest of the site visit participants at the Site at 9 a.m. on January 16, 2015. The weather was cool and foggy in morning, followed by mostly sunny in the afternoon. The Site is accessed from Jensen Avenue and is located southwest of downtown Fresno.

The participants met at the GTP office. Mr. Slater and Mr. Nyznyk provided a Site and remedial history overview, which included the Record of Decisions, Early Action, Phase 1, Phase 2, and Phase 2 Enhancements. Construction of the Phase 2 Enhancements, which included the installation one new B-aquifer extraction well (PW-6B2) and monitoring wells downgradient of the landfill, was completed in 2014. The ensuing discussion was prompted by questions prepared by USACE and touched upon many different aspects of the landfill. A summary of the main points is provided here.

Ms. Bowlin explained that an Explanation of Significant Differences (ESD) was issued, and two new institutional controls (for the landfill cap and the groundwater) were recorded recently. One IC for the well protection program was already in place. According to this IC, the City has an agreement with the

County to inform the County of any wells proposed for installation within the prohibition zone or well evaluation zone.

The well protection program IC prompted the discussion of residential well 3165, which was installed south of the landfill without proper evaluation prior to installation. This incident led to a letter issued to all the local drilling companies to prevent this from happening again. Well 3165 is of particular concern given its proximity to monitoring well CDM-16C, which has been showing an increasing trend in COC concentrations during the last few monitoring events (although concentrations remain below the cleanup standard). Additional private wells exist between CDM-16C and 3165 that are not monitored, and all participants were in general agreement that a close watch on CDM-16C is needed to ensure that concentrations in the downgradient unmonitored wells and monitored well 3165 remain protective.

The overview explained that downward vertical migration to the C-aquifer following conclusion of Phase 2 construction activities prompted the need for the Phase 2 enhancements. Extraction well PW-6B2 has been operating since April 2014. The August 2014 data indicate a depression in elevation around well PW-6B2 in both the B- and C-aquifers. However, without additional data, long-term trends are difficult to determine at this time.

USACE asked why more private wells are not on a municipal water source. The City and CDMSmith representatives explained that the expense and desire to remain independent drive most residents to remain on private wells. Currently, nine homes around the landfill are receiving bottled water. An undetermined (but small) number of homes have wellhead treatment systems.

Discussion of the landfill gas and gas management followed. The gas flare is not sampled. Methane entering the flare is measured weekly, and concentrations have declined over time. A City technician is on-site full-time. The technician's responsibilities include checking and adjusting the gas wellhead flows and running and maintaining the GTP facilities. Discussion of the gas wellhead monitoring revealed that data are being collected but evaluation of the data may not be occurring. A suggestion was made to review the perimeter gas wellhead data and to include other COCs (not just methane) in the perimeter gas wellhead monitoring to evaluate horizontal soil gas migration. The idea was presented that sorbed COCs are being exposed in the vadose zone due to declining regional water table, and may be a continuing soil gas source. Furthermore, the participants noted that soil gas migration (primarily of methane, but also of chlorinated solvents) was a driving factor in the 1993 ROD. However, since then, soil gas has not been measured off-site to assess current conditions.

USACE next went through the standard FYR interview questions. Mr. Carlson requested a follow-up interview since he is relatively new to the project and would like time to consult with his colleagues.

Following the site discussion, the participants toured the site, starting with the GTP. Both the landfill gas flare and the packed tower aerator (PTA) were operational. A small storage shed is located to the south of the PTA that contains the sodium hypochlorite solution that is injected into the influent to the PTA. Surface water and treated groundwater from the site are released into Park Lake or used for irrigation purposes. Additional overflow is sent to the South Detention Pond, which also doubles as a paintball facility when dry. No water was present in the South Detention Pond during the site visit.

Various components of the remedy, including the surface water management system, gas extraction wellheads, and perimeter gas wellheads were noted. Condensate in the gas extraction system piping is released to the sewer. Poison bait traps for burrowing animals are placed around the site, but the traps that we checked did not currently have any bait present. The unused irrigation system was also present. Vandalism was acknowledged, especially of the irrigation system. Cameras have been installed around the GTP. The extraction wells have been upgraded with larger concrete pads to prevent theft as well.

Settling of the landfill was also noted, especially on the eastern side, where undulations and depressions occur. In several places along the eastern perimeter, the 4-inch corrugated plastic pipe outlets from the surface water drainage system were either pointing upwards or broken off at the end, especially in the area of subsidence-related depressions. Screens were also missing from some pipe ends as well. The City intends to conduct future minor cap repairs and maintenance on an ongoing basis.

The participants stopped to take photographs of a gas extraction well on the cap. Settlement of up to 2 feet was noted by the exposed concrete sides of the wellhead.

The participants next visited the new B-aquifer extraction well PW-6B2, which came online in 2014. The new extraction well is located in the grassy sports fields of the Fresno Regional Sports Complex. The well was locked.

4. Actions

The USACE will incorporate information obtained from the site visit into the Five-Year Review report.

Heather Fourie	David Clark
Chemist	Biologist
CENWS-EN-TS-ET	CENWS-EN

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Site Visit Photos

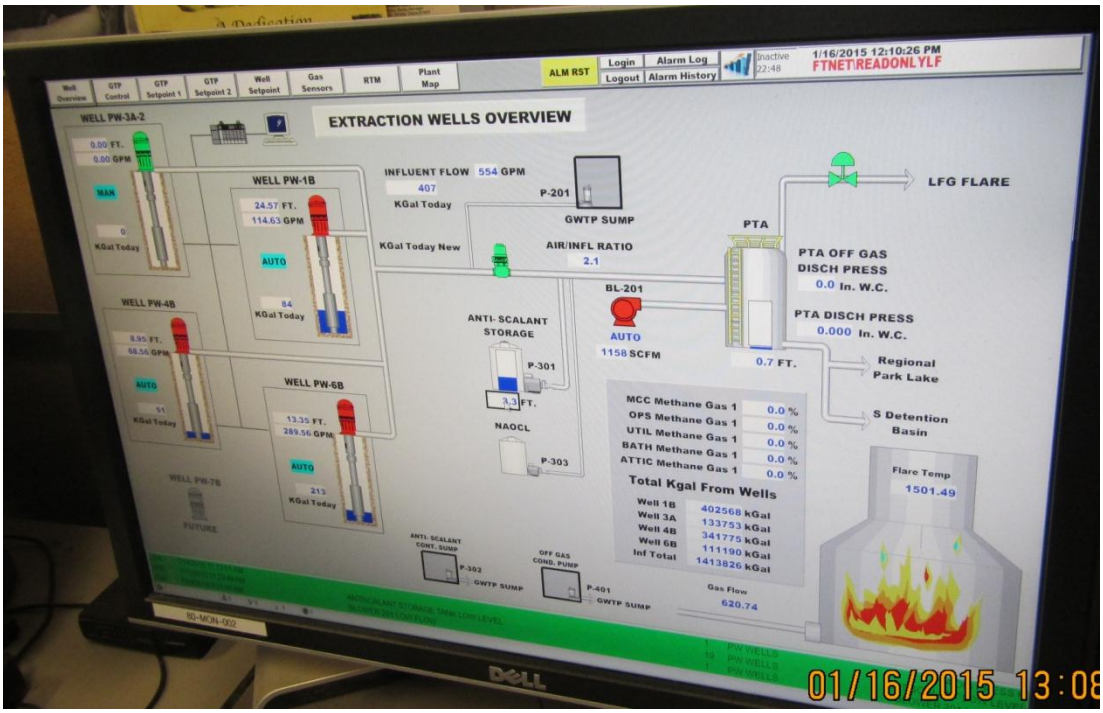

Photo 1: Treatment System Overview Screen

Photo 2: Gas Monitoring Device in Site Office

Photo 3: Landfill Gas Flare Overview

Photos 4-5: Landfill Gas Flare Detail

Photos 6-7: Landfill Gas Flare Detail Continued

Photo 8: Packed Tower Aerator

Photo 9: Hazardous Materials Storage Shed

Photo 10: Evidence of Electrical Components Theft

Photo 11: Landfill Gas Condensate Sump

Photo 12: Detention Pond Standpipe Leading to Paintball Area

Photo 13: Surface Water Drainage from Top of the Landfill

Photo 14: Subsidence on Eastern Face of Landfill

Photo 15: Subsidence on Eastern Face of Landfill

Photo 16: Subsidence on Eastern Face of Landfill

Photo 17: Squirrel Poison Trap

Photo 18: Groundwater Monitoring Well

Photo 19: Surrounding Area and Offsite Canal, East of Landfill

Photo 20: Perimeter Gas Well

Photo 21: Gas Extraction Wellhead

Photo 22: Gas Extraction Wellhead. Note the subsidence, as rim of well box was once at grade.

Photo 23: Groundwater Extraction Well PWS-6B2

Photo 24: "B" Zone Monitoring Well

Photo 25: "C" Zone Monitoring Well

Photo 26. Surface drainage ditch on the east side of the landfill. Due to subsidence, ditch is now lined.

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Appendix F: Supporting Documentation for Data Review

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Supporting Documentation for Data Review

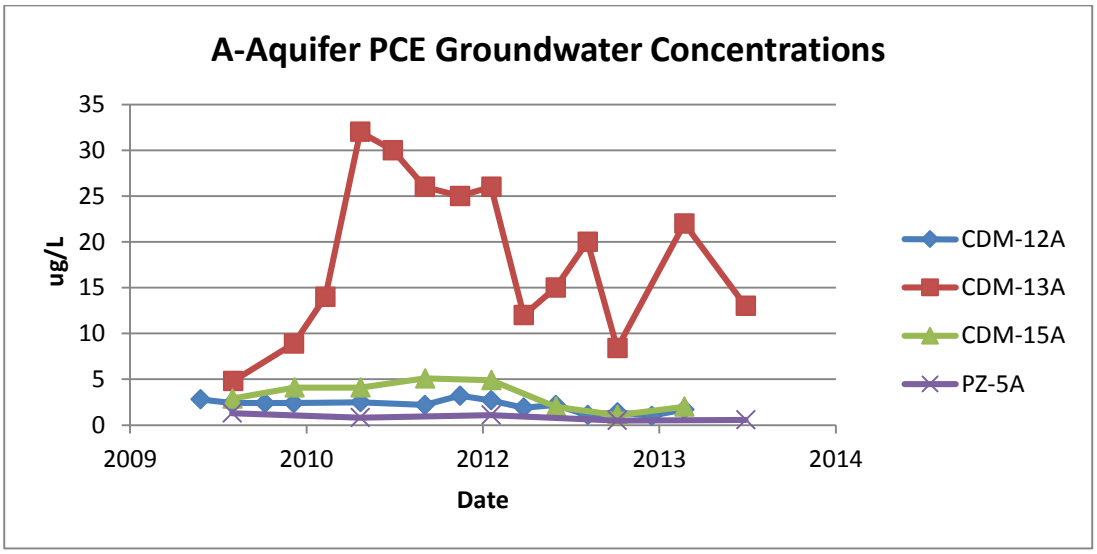

Figure E1. A-Aquifer PCE Groundwater Concentrations Time Series Plot

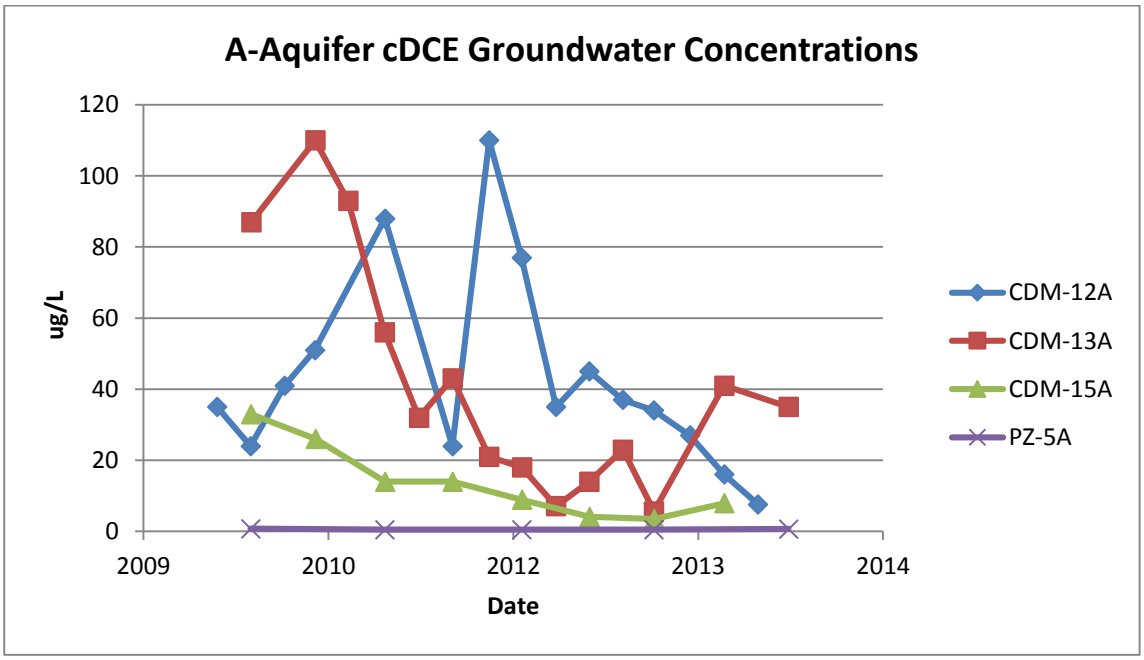

Figure E2. A-Aquifer cDCE Groundwater Concentrations Time Series Plot

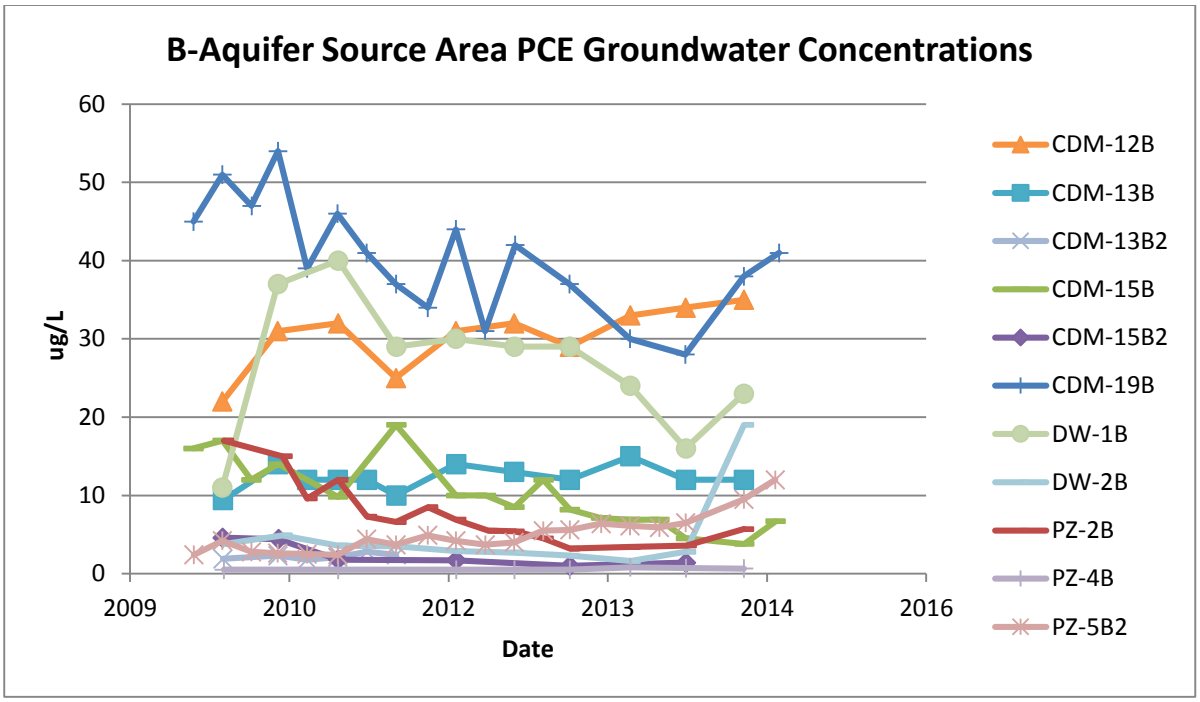

Figure E3. B-Aquifer Source Area PCE Groundwater Concentrations Time Series Plot

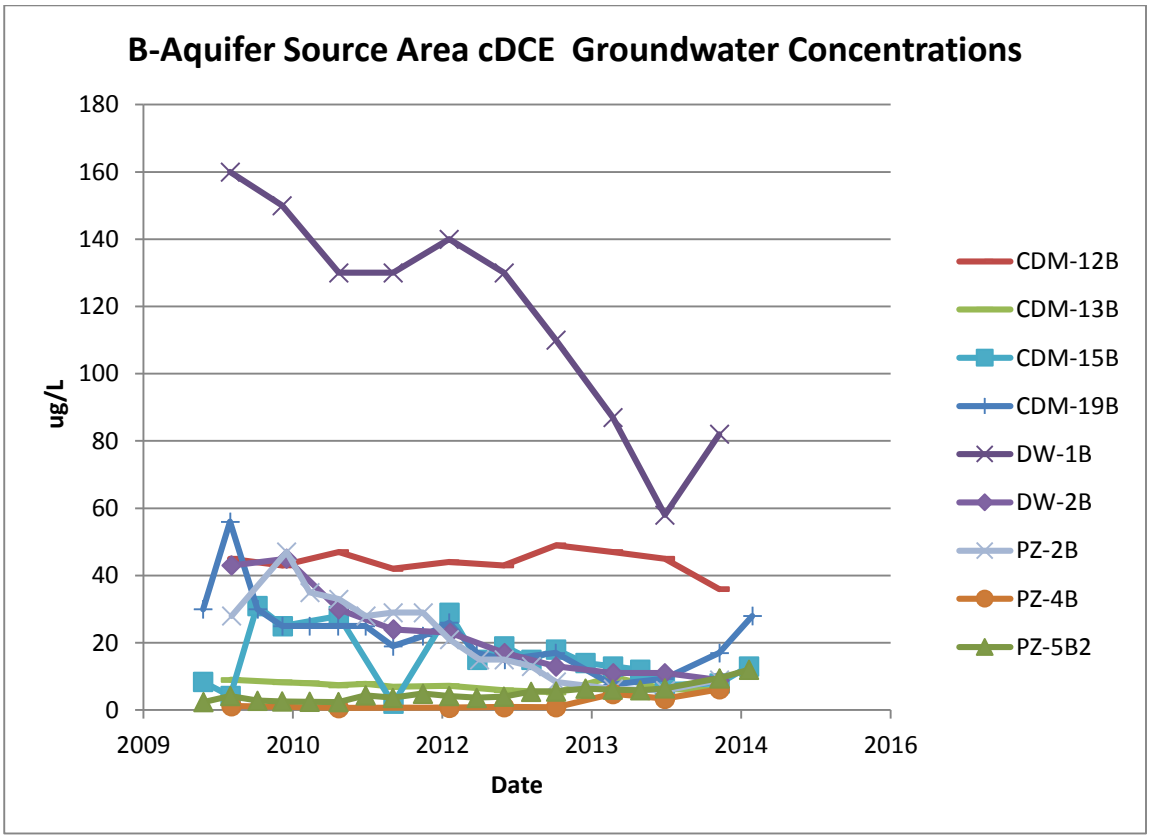

Figure E4. B-Aquifer Source Area cDCE Groundwater Concentrations Time Series Plot

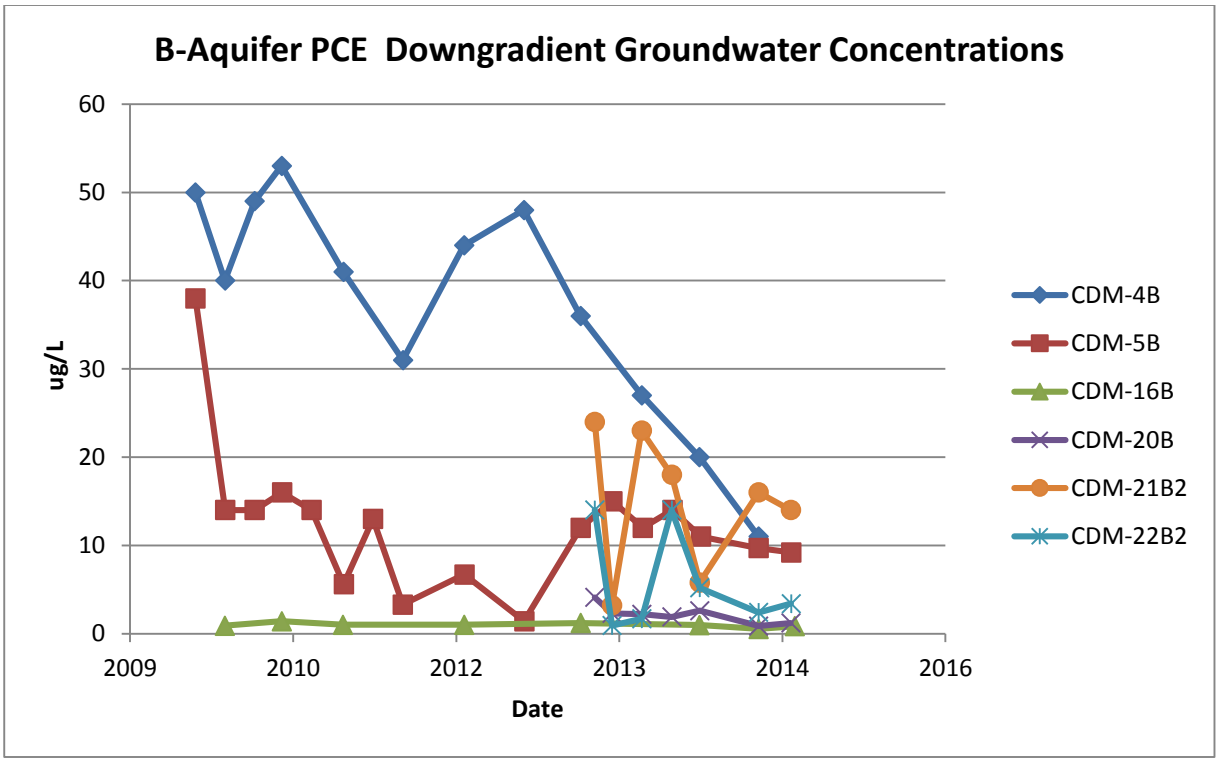

Figure E5. B-Aquifer Downgradient PCE Groundwater Concentrations Time Series Plot

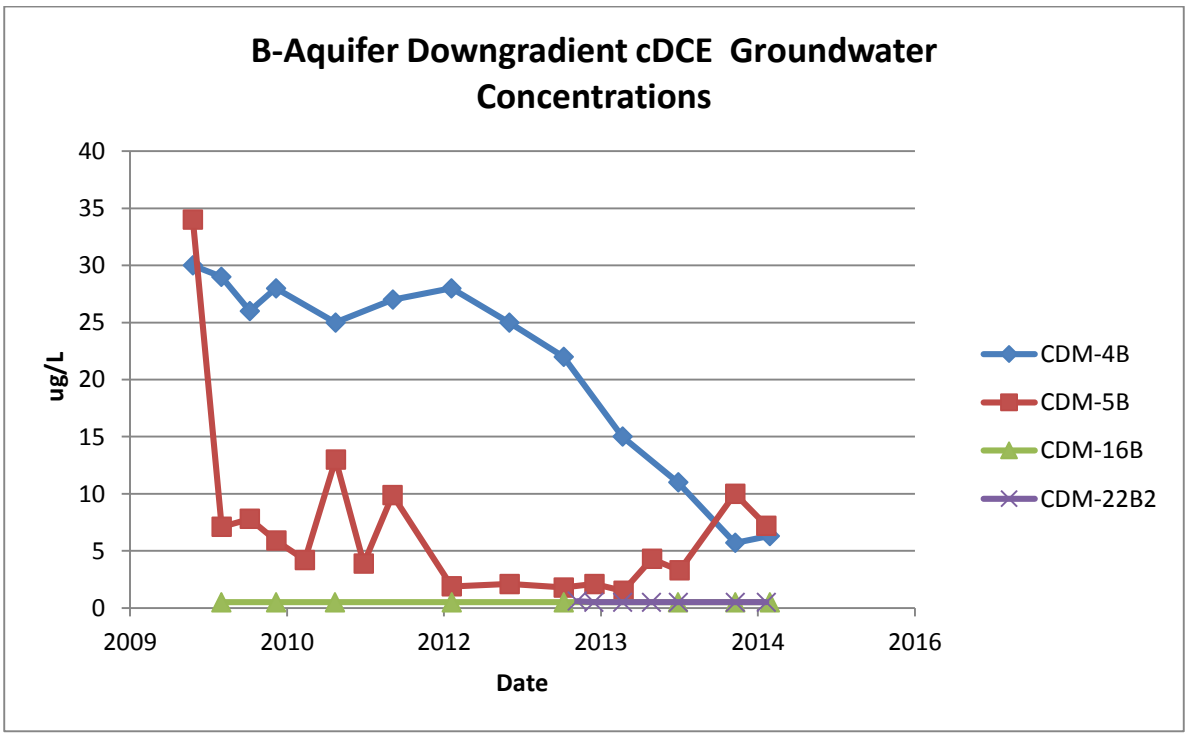

Figure E6. B-Aquifer Downgradient cDCE Groundwater Concentrations Time Series Plot

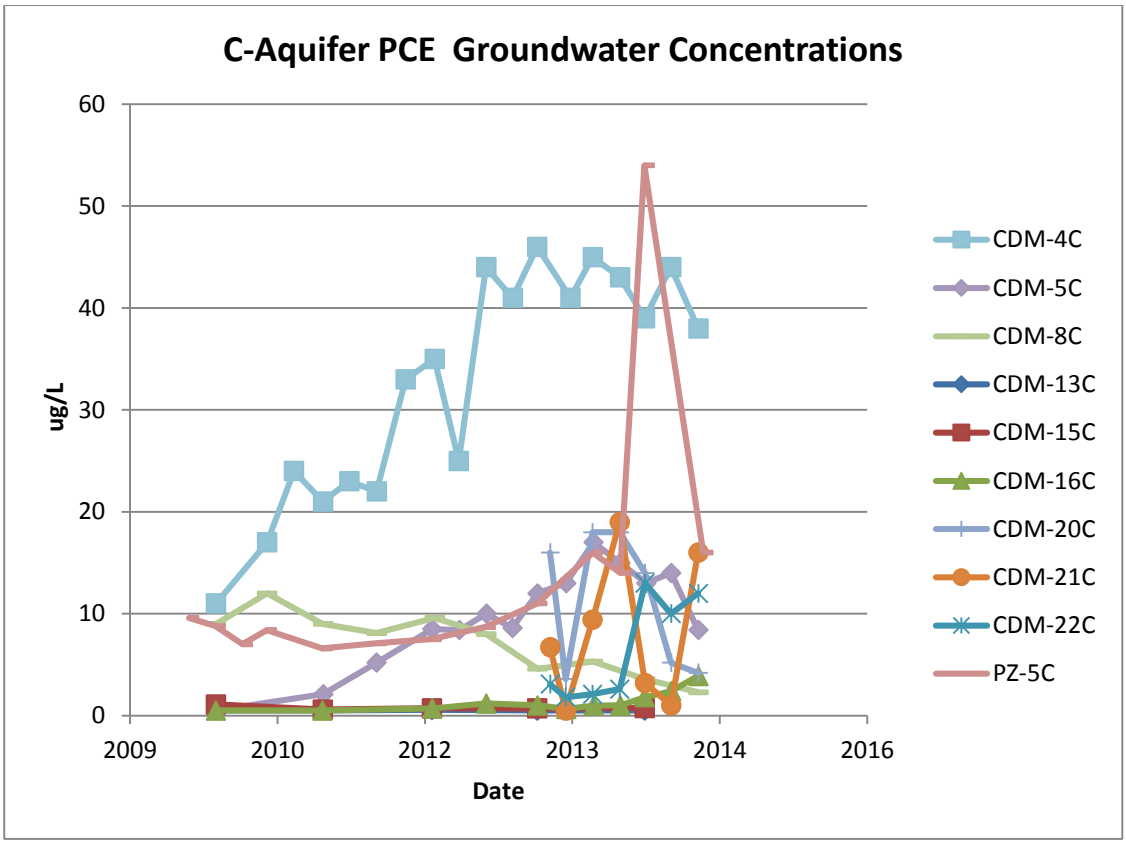

Figure E7. C-Aquifer PCE Groundwater Concentrations Time Series Plot

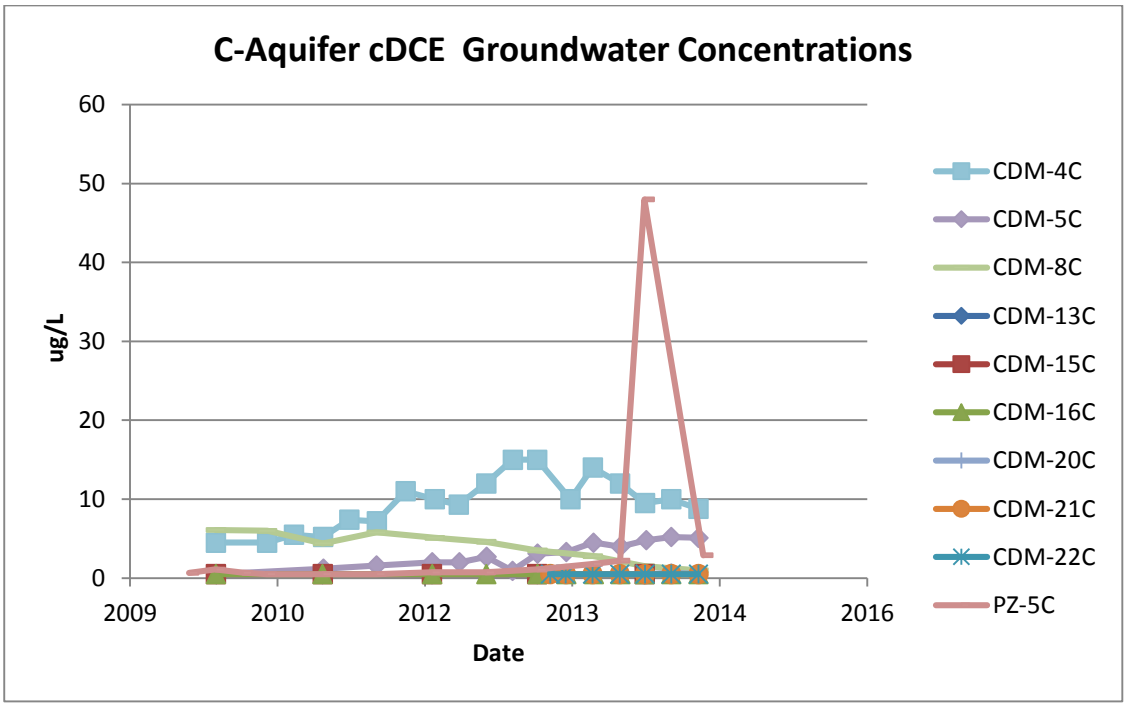

Figure E8. C-Aquifer cDCE Groundwater Concentrations

Appendix G: ARARs Evaluation

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ARARs Evaluation

Requirement	Citation	Description	Comments	Effect on Protectiveness
National Emissions Standards for Hazardous Air Pollutants	Clean Air Act 40 CFR 61	Identifies and establishes emissions standards for specific chemicals.	No new changes in chemical standards.	Revisions do not affect protectiveness.
Maximum contaminant levels (MCLs) for drinking water	Safe Drinking Water Act, 40 CFR 141.61	Provides MCLs for drinking water.	The federal MCL for chlorobenzene has become less stringent.	Revisions do not affect protectiveness.
Water quality objectives	Water Quality Control Plan (Basin Plan) for the RWQCB and CCR	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.	No new changes in chemical standards.	Revisions do not affect protectiveness.
Emission monitoring	San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) Rule 4642	Establishes requirements for 98% destruction efficiency, flare construction, and maximum allowable concentrations of organic compounds (not to exceed 1000 ppm) to be measured at any point on the surface of the landfill.	Rule 4642 was amended in 1998. No new changes to chemical standards.	Rule revisions are not expected to affect remedy protectiveness.
Re-injection of treated groundwater	Safe Drinking Water Act 40 CFR 144	Provides requirements for Underground Injection Program.		None.
POTW pretreatment standards	Clean Water Act 33 CFR Part 307	Requires the establishment of pretreatment standards for the control of pollutants to POTW.		Revisions do not affect protectiveness.
Cleanup exemptions	Title 23, Division 3, chapter 15, Article 123, CCR 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.		Revisions do not affect protectiveness.
Monitoring program	Title 23, Division 3, chapter 15, Article 123 CCR 2510(g)	Requires persons responsible for discharges at waste management units that are closed, abandoned, or inactive to develop and implement a monitoring program in accordance with Article 5 of this chapter.		Revisions do not affect protectiveness.
Discharge requirements	State Water Resources Control Board Resolution No. 92-49 III G	Establishes requirements for investigation and cleanup and abatement of discharges that impact or threaten water quality. Dischargers 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.		Revisions do not affect protectiveness
Groundwater beneficial use	State Water Resources Control Board Resolution No. 88-63	Specifies that with certain exceptions, all ground and surface waters have the beneficial use of municipal or domestic water supply.		Revisions do not affect protectiveness
Monitoring	Title 23 CCR, §2550.6	Requires monitoring for compliance with remedial action objectives for three years from the date of achieving cleanup levels.		None.
Monitoring	Title 23, CCR §2550.7	Requires general soil, surface water, and groundwater monitoring.		None.
Monitoring	Title 23, CCR §2550.9	Requires an assessment of the nature and extent of the release, including a determination of the spatial distribution and concentration of each constituent.		None.

Requirement	Citation	Description	Comments	Effect on Protectiveness
Cleanup corrective action	Title 23, CCR §2550.10	Requires implementation of corrective action measures that ensure that cleanup levels are achieved throughout the zone affected by the release by removing the waste constituents or treating them in place. Source control may be required. Also requires monitoring to determine the effectiveness of the corrective actions.		None.
Discharge requirements	Health and Safety Code §25249.5; Title 22, CCR Division 2, Subdivision 1, Chapter 3	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 reproductive toxicity when the chemical will probably pass through a source of drinking water		Revisions do not affect protectiveness
Groundwater protection	Title 22, CCR, Division 4.5, Chapter 14, Article 6, §66264.90-66264.101	Creates broad groundwater monitoring and compliance standards. Includes concentration standards, monitoring requirements, and corrective action requirements.		Revisions do not affect protectiveness
Hazardous waste requirements	Title 22, CCR, Division 4.5, Chapter 14, Article 7, §66264.117	Closure and post-closure. States that monitoring, maintenance and reporting requirements must continue for 30 years past closure.		Revisions do not affect protectiveness
Hazardous waste requirements	CCR Title 22, Division 4,5, Chapter 14, Article 9, §66264.170-66264.178	Containers. Requirements for facilities that store containers of hazardous waste.		Revisions do not affect protectiveness
Landfill closure requirements	CCR Title 23 Chapter 15, Section 2580	Pertains to general closure requirements.	Superseded.	Revisions do not affect protectiveness
Landfill closure requirements	CCR Title 23 Chapter 15, Section 2581	Pertains to landfill closure requirements.	Superseded.	Revisions do not affect protectiveness
Drainage and collection system requirements	CCR Title 23 Chapter 15, Section 2546	Pertains to the design, construction, and maintenance of drainage, collection, and holding facilities for waste management units.	Superseded.	Revisions do not affect protectiveness
Construction requirements	CCR Title 23 Chapter 15, Section 2547	Pertains to design and construction of landfill structures to withstand seismic events.	Superseded.	Revisions do not affect protectiveness
Construction requirements	CCR Title 23 Chapter 15, Section 2596	Pertains to the information required in the design reports and operations plan for containment structures, precipitation and drainage control facilities, and ancillary facilities.	Superseded.	Revisions do not affect protectiveness
Gas control	CCR Title 14, Section 17705; California Code of Regulations, Title 14, Section 17783.15	Pertains to gas control.	Superseded.	Revisions do not affect protectiveness
Gas monitoring	CCR Title 14, Section 17783	Pertains to gas monitoring and control during closure and post-closure.	Superseded.	Revisions do not affect protectiveness
Gas monitoring	CCR Title 14, Sections 17783.9 and 17783.11	Pertains to monitored parameters and monitoring frequency.	Superseded.	Revisions do not affect protectiveness
Landfill cover	CCR Title 14, Section 17773	Pertains to final cover.	Superseded.	Revisions do not affect protectiveness
Final site face	CCR Title 14, Section 17777	Pertains to final site face.	Superseded.	Revisions do not affect protectiveness
Drainage	CCR Title 14, Section 17778	Pertains to final drainage.	Superseded.	Revisions do not affect protectiveness
Slope protection and erosion control	CCR Title 14, Section 17779	Pertains to slope protection and erosion control.	Superseded.	Revisions do not affect protectiveness
Perimeter monitoring	CCR Title 14, Section 17778.5	Pertains to perimeter monitoring network.	Superseded.	Revisions do not affect protectiveness
Structure monitoring	CCR Title 14, Section 17783.7	Pertains to structure monitoring.	Superseded.	Revisions do not affect protectiveness

Requirement	Citation	Description	Comments	Effect on Protectiveness
Final grading	CCR Title 14, Section 17776	Pertains to final grading.	Superseded.	Revisions do not affect protectiveness
Post-closure maintenance	CCR Title 14, Section 17788	Pertains to post-closure maintenance.	Superseded.	Revisions do not affect protectiveness
Ownership	CCR Title 14, Section 17792	Pertains to change of ownership during closure and post-closure maintenance.	Superseded.	Revisions do not affect protectiveness
Land use	CCR Title 14, Section 17796	Pertains to post-closure land-use.	Superseded.	Revisions do not affect protectiveness
Institutional Controls	CCR Title 22, Section 67391.1	Environmental land use covenants.	Since issuance of the 1996 ROD, the State implemented a new regulation regarding environmental land use covenants.	None
Landfill cover	CCR Title 27, 20080(a)-(d)	Engineered alternatives to the prescriptive standard for final cover at a waste management unit.	Citation supersedes Title 23, 2510(a)-(d).	None
Construction standards	CCR Title 27, 20310	General construction standards for containment structures.	Citation supersedes Title 23, 2540.	None
Construction standards	CCR Title 27, 20320	General design and construction requirements for containment structures.	Citation supersedes Title 23, 2541.	None
Construction and maintenance standards	CCR Title 27, 20365	Design, construction, and maintenance of drainage, collection, and holding facilities for waste management units.	Citation supersedes Title 23, 2546.	None
Construction standards	CCR Title 27, 20370, 21750	Design and construction of landfill structures to withstand seismic events.	Citation supersedes Title 23, 2547.	None
Closure Requirements	CCR Title 27,20950, 22207	General closure requirements.	Citation supersedes Title 23, 2580.	None
Closure Requirements	CCR Title 27, 21090	Landfill closure requirements.	Citation supersedes Title 23, 2581.	None
Landfill	CCR Title 27, 21760	Information required in the design reports and operations plan for containment structures, precipitation and drainage control facilities, and ancillary facilities.	Citation supersedes Title 23, 2596.	None
Landfill	CCR Title 27, 20919	Gas control.	Citation supersedes Title 14, 17705.	None
Construction	CCR Title 27, 20324	Construction quality assurance.	Citation supersedes Title 14,17774	None
Monitoring	CCR Title 27, 20918, 20415, 20921	Gas monitoring and control during closure and post-closure.	Citation supersedes Title 14, 17783.	None
Gas Monitoring	CCR Title 27, 20932	Monitored parameters.	Citation supersedes Title 14, 17783.9. Landfill gas monitoring is a component of the remedy. This requirement is still applicable.	None
Gas Monitoring	CCR Title 27, 20933	Monitoring frequency.	Citation supersedes Title 14, 17783.11.	None
Landfill	CCR Title 27, 21140	Final cover.	Citation supersedes Title 14, 17773.	None
Landfill	CCR Title 27, 21090, 21750	Final site face.	Citation supersedes Title 14, 17777.	None
Landfill	CCR Title 27, 20365, 21150, 21769	Final drainage.	Citation supersedes Title 14, 17778.	None
Landfill	CCR Title 27, 21090, 21150	Slope protection and erosion control.	Citation supersedes Title 14, 17779.	None
Monitoring	CCR Title 27, 20415, 20925	Perimeter monitoring network.	Citation supersedes Title 14, 17783.5.	None
Monitoring	CCR Title 27, 20931	Structure monitoring.	Citation supersedes Title 14, 17783.7.	None
Landfill	CCR Title 27, 21142, 21769	Final grading.	Citation supersedes Title 14, 17776.	None

Requirement	Citation	Description	Comments	Effect on Protectiveness
Landfill	CCR Title 27, 20937	Gas control.	Citation supersedes Title 14, 17783.15.	None
Closure Requirements	CCR Title 27, 21180	Post-closure maintenance.	Citation supersedes Title 14, 17788.	None
Closure Requirements	CCR Title 27, 21200	Change of ownership during closure and post-closure maintenance.	Citation supersedes Title 14, 17792.	None
Closure Requirements	CCR Title 27, 21190	Post-closure land use.	Citation supersedes Title 14, 17796.	None