Five-Year Review Report

Third Five-Year Review Report for

Watkins-Johnson Company (Steward Division) Superfund Site

Scotts Valley, Santa Cruz County, California

PREPARED BY
United States Army Corps of Engineers
Seattle District
Seattle, Washington

Approved by: Kathleen Salyer **Date:** 9/27/12

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Executive Summary

This is the third Five-Year Review of the Watkins-Johnson Company (Stewart Division) Superfund Site (Watkins-Johnson Superfund Site or Site) located in Scotts Valley, California. The purpose of this five-year review (FYR) is 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 26 September 2007.

The Site encompasses approximately 30 acres and is located in Santa Cruz County, approximately 5 miles north of the city of Santa Cruz. The Site is situated in a small valley located just west of the city of Scotts Valley. The Santa Margarita aquifer is a major source of groundwater in the study area and was discovered to be adversely affected by contamination from the Watkins-Johnson facility, which was originally attributed to a release event that occurred in 1984. According to the Record of Decision (ROD), original contaminants of concern included trichloroethylene (TCE) and trans-1,2-dichloroethylene (1,2-DCE), plus minute quantities of trichloroethane (TCA), tetrachlorothylene (PCE), and Freon 113 in groundwater under the Site. More recently, the key contaminants have been PCE and TCE, because they are the only contaminants of concern that continue to be detected above or just below their respective cleanup levels.

The 1990 Record of Decision (ROD) established the remedy selected for the Watkins-Johnson Site. The selected remedy addresses the primary threat by requiring extraction and treatment of groundwater to achieve cleanup levels. It also addresses soils by requiring cleanup to cleanup levels that would protect groundwater.

The major components of the remedy were to: 1) prevent off-property contaminant migration within the perched groundwater zone, 2) prevent migration of contaminated groundwater from the perched to the regional aquifer zone, 3) capture contaminated regional zone groundwater and treat it using granular activated carbon, 4) treat contaminated soils in the vadose zone by utilizing soil vapor extraction, and 5) minimize the potential for mobilization of contamination from soil to groundwater by installing an impermeable cap over the area of concern. The ROD called for identification and implementation of institutional controls as part of the remedial design/remedial action project phase.

Overall, the remedy is functioning as intended, in the short term. Based on all available data, the groundwater extraction and treatment system appears to be effectively containing the remaining dissolved contaminant mass within in the regional Santa Margarita aquifer. Since 2004, groundwater extraction occurs at just one well, RA-2. However, groundwater concentrations are increasing in the monitoring wells south of the property, which raises some uncertainty as to the effectiveness of the remedy. Therefore, potential exposure pathways to contaminated groundwater outside of the WJ site boundary have not been addressed and could pose a long-term protectiveness issue. The institutional controls specified by the ROD have not yet been implemented.

Some standards and TBCs identified in the ROD have been revised. Toxicity factors for PCE, TCE, cis 1,2-DCE, and 1,1,1-TCA have changed since the last five year review. However, these changes do not

affect the short term protectiveness of the remedy because the cleanup standards are within the protective carcinogenic risk range. In addition, no one is currently drinking the contaminated groundwater. Exposure pathways identified in the ROD have not changed. Progress towards meeting the RAO of restoring groundwater to its beneficial use is ongoing.

The remedy at the Watkins-Johnson Superfund Site is currently protective of human health and the environment because all exposure pathways that could result in unacceptable risks are being controlled. In order for the remedy to be protective in the long-term, the following actions need to be taken: 1) Implement institutional controls to control potential exposure pathways to groundwater and soil contamination until cleanup standards are achieved and to protect the integrity of the cap, 2) Implement the groundwater optimization work plan, and 3) Collect a complete set of groundwater elevation data from monitoring wells northwest of the Site.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Watkins-Johnson Company (Stewart Division)		
EPA ID: CAD980893234		
Region: 9	**State:** CA	**City/County:** Scotts Valley/Santa Cruz

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

REVIEW STATUS
Lead agency: EPA **If "Other Federal Agency" was selected above, enter Agency name:**
Author name (Federal or State Project Manager): Bruni Davila, Marlowe Laubach, Jefferey Powers, Deborah Johnston
Author affiliation: USEPA and USACE Seattle District
Review period: October 2011– September 2012
Date of site inspection: 18 January 2012
Type of review: Statutory
Review number: 3
Triggering action date: 26 September 2007
Due date *(five years after triggering action date)*: 26 September 2012

Five-Year Review Summary Form (continued)

Issues/Recommendations				
Issues and Recommendations Identified in the Five-Year Review:				
OU(s): 01	**Issue Category: Monitoring**			
	Issue: Increasing concentrations of PCE in southern wells.			
	Recommendation: Implement GW optimization work plan			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA	March 2013
OU(s): 01	**Issue Category: Institutional Controls**			
	Issue: Institutional controls (ICs) have not been implemented for the Site.			
	Recommendation: Identify and implement Institutional Controls			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA	June 2014
OU(s): 01	**Issue Category: Remedy Performance**			
	Issue: Lack of groundwater level monitoring to northwest of RA-2, does not allow verification that capture is still occurring.			
	Recommendation: Collect a complete set of groundwater level data to verify capture.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA	December 2013

Sitewide Protectiveness Statement	
Protectiveness Determination: Short-term Protective	*Addendum Due Date (if applicable):* Click here to enter date.
Protectiveness Statement: The remedy at the Watkins-Johnson Superfund Site is currently protective of human health and the environment in the short term because all exposure pathways that could result in unacceptable risks are being controlled. In order for the remedy to be protective in the long-term, the following actions need to be taken: 1) Implement the groundwater optimization work plan, 2) Implement institutional controls, and 3) Collect a complete set of groundwater elevation data in monitoring wells northwest of the Site.	

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List of Abbreviations

µg/L	micrograms per liter
ARAR	applicable or relevant and appropriate requirements
bgs	below ground surface
CA	California
CD	consent decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	contaminant of concern
CVOC	chlorinated volatile organic compound
EPA	Environmental Protection Agency
FYR	five-year review
IRIS	Integrated Risk Information System
MCL	maximum contaminant level
MTBE	methyltertiary butyl ether
N/A	not applicable
NCP	National Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
PCE	tetrachloroethylene
ppb	parts per billion
PRP	potentially responsible party
QA	quality assurance
RA	remedial action
RAOs	remedial action objectives
RI/FS	remedial investigation/feasibility study
ROD	record of decision
RPM	Remedial Project Manager
RWQCB	Regional Water Quality Control Board (California)
SVE	soil vapor extraction
TCA	trichloroethane
TCE	trichloroethylene
USACE	U.S. Army Corps of Engineers
VLEACH	[modeling software]
VOC	volatile organic compound
WJC	Watkins-Johnson Corporation

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Third Five-Year Review Report for the Watkins-Johnson Superfund Site

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 currently is, and will continue to be, protective of human health and the environment. The methods, findings, and conclusions of a FYR are documented in a five-year review report. 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.*"

EPA Region 9 and the U.S. Army Corps of Engineers (USACE) conducted the FYR and prepared this report for the Watkins-Johnson Superfund Site in Scotts Valley, California. EPA is the lead agency for developing and implementing the remedy for the Site. The California Regional Water Quality Control Board (RWQCB), Central Coast Region, as the support agency representing the State of California, has reviewed all supporting documentation and provided input to EPA during the FYR process.

This is the third FYR for the Watkins-Johnson Site. The triggering action for this statutory review is the previous FYR. The FYR is required because hazardous substances, pollutants, or contaminants remain at the site at levels above those that would allow for unlimited use and unrestricted exposure.

2. Site Chronology

Table 1 lists the dates of important events for the Watkins-Johnson Superfund Site.

Table 1. Chronology of Site Events

Event	Date
Site buildings were first utilized for manufacturing	1960
Site was purchased by Watkins-Johnson Company (WJC)	1963
Santa Cruz County and the RWQCB inspected the site and found trichloroethylene (TCE) and trichloroethane (TCA) in the wastewater disposal system. TCE had been used at WJC as an industrial solvent	1984
At RWQCB request, WJC initiated a groundwater monitoring program, a precursor to the current quarterly monitoring program	April 1984
RWQCB issued a Cleanup and Abatement Order requiring WJC to begin cleanup activities at the site	May 1984
Construction of a groundwater extraction and treatment system began	July 1986
Extraction and treatment system began operation	October 1986
Site was proposed for addition to the National Priorities List (NPL)	January 22, 1987
WJC began a Remedial Investigation/Feasibility Study (RI/FS)	September 21, 1987
RI phase was completed with EPA's approval of the RI Report final draft	April 1989
EPA approved the FS Report final draft	November 1989
EPA signed a Record of Decision (ROD)	June 1990
Site was added to the NPL	August 1990
Special Notice was issued	September 1990
Consent Decree was signed	October 1991

The groundwater extraction and treatment system was modified and a soil vapor extraction (SVE) system was added	September 1994
Preliminary Close Out Report	September 22, 1994
Final Remedial Action (RA) Report	December 1994
Operational and Functional Period began	September 1995
Final Quality Assurance QA Report	September 1996
Detectable tetrachloroethylene (PCE) first appeared at monitoring well WJ-43, located south of the Watkins-Johnson former source area	June 1999
Re-infiltration of perched aquifer discontinued; monthly sampling in WJ-41 was initiated to study impact.	June 2000
SVE system was turned off with EPA approval	April 2001
Groundwater monitoring was reduced to 2 wells (WJ-41, WJ-43); active groundwater extraction was reduced to 2 wells (RA-1, RA-2); site-wide groundwater level measurements were discontinued	September 2002
First FYR	September 2002
EPA approved elimination of groundwater level measurements as a monitoring requirement	January 2003
VLEACH Soil Vapor Modeling Report was issued	July 2003
National Pollution Discharge Elimination System (NPDES) permit was revised to reduce monitoring requirements for groundwater treatment system output and discharge to Bean Creek	July 11, 2003
Extraction pump in one well (RA-1) failed and a decision was made not to replace it; since that time, well RA-2 has been the only active extraction well	2nd Quarter 2004
Second FYR	September 2007
EPA approved the VLEACH Report	May 8, 2008
Groundwater extraction and treatment system was shut down to evaluate groundwater conditions and rebound effects under	December 2008 – November

a no-pumping state	2009
Summary of RA-2 Shutdown and Groundwater Concentration Rebound Evaluation was submitted to EPA by the potentially responsible party's (PRP's) remedial contractor, including a recommendation to permanently shut down the treatment system	July 2, 2009
At the request of EPA, the groundwater extraction and treatment system was restarted (at well RA-2 only; all treated water is discharged to Bean Creek)	November 19, 2009
EPA required PRP to conduct an investigation to evaluate upgradient contaminant sources	January 29, 2010
Background Groundwater Assessment field investigation was performed, including installation of new monitoring wells KV-1 through KV-4	August – December 2010
EPA required additional wells (WJ-11, WJ-37A, Wescosa Well, KV-1 through KV-4) to be included under the groundwater monitoring program	2010
Site manufacturing ceased; facility decommissioning began	2010
Although not a site contaminant, EPA requested that methyltertiary butyl ether (MTBE) be included as a tracer in the groundwater monitoring program; analyses have been conducted starting 4th Quarter 2010	November 2010
Background Groundwater Assessment Report was issued by PRP's remedial contractor	February 11, 2011
EPA rejected the Background Groundwater Assessment Report, indicating deficiencies in data and PRP interpretation asserting source of PCE in monitoring wells is from off-site source.	November 9, 2011
EPA issued letter to the PRP directing WJ to submit a remedy optimization workplan.	November 9, 2011

3. Background

3.1. Physical Characteristics

The Watkins-Johnson Superfund Site encompasses approximately 30 acres. It is located in Santa Cruz County, approximately 5 miles north of the city of Santa Cruz, in a small valley located west of the city of Scotts Valley and southwest of the Santa Cruz Mountains (see Figure 1). This area is considered to be within the California Coastal Range and is in close proximity to California's Pacific Ocean coast. The Santa Margarita aquifer, which consists of a perched zone and an underlying regional zone, is a major potential drinking water source. A detailed map of the site is provided in Figure 2.

Figure 1. Location Map for the Watkins-Johnson Superfund Site

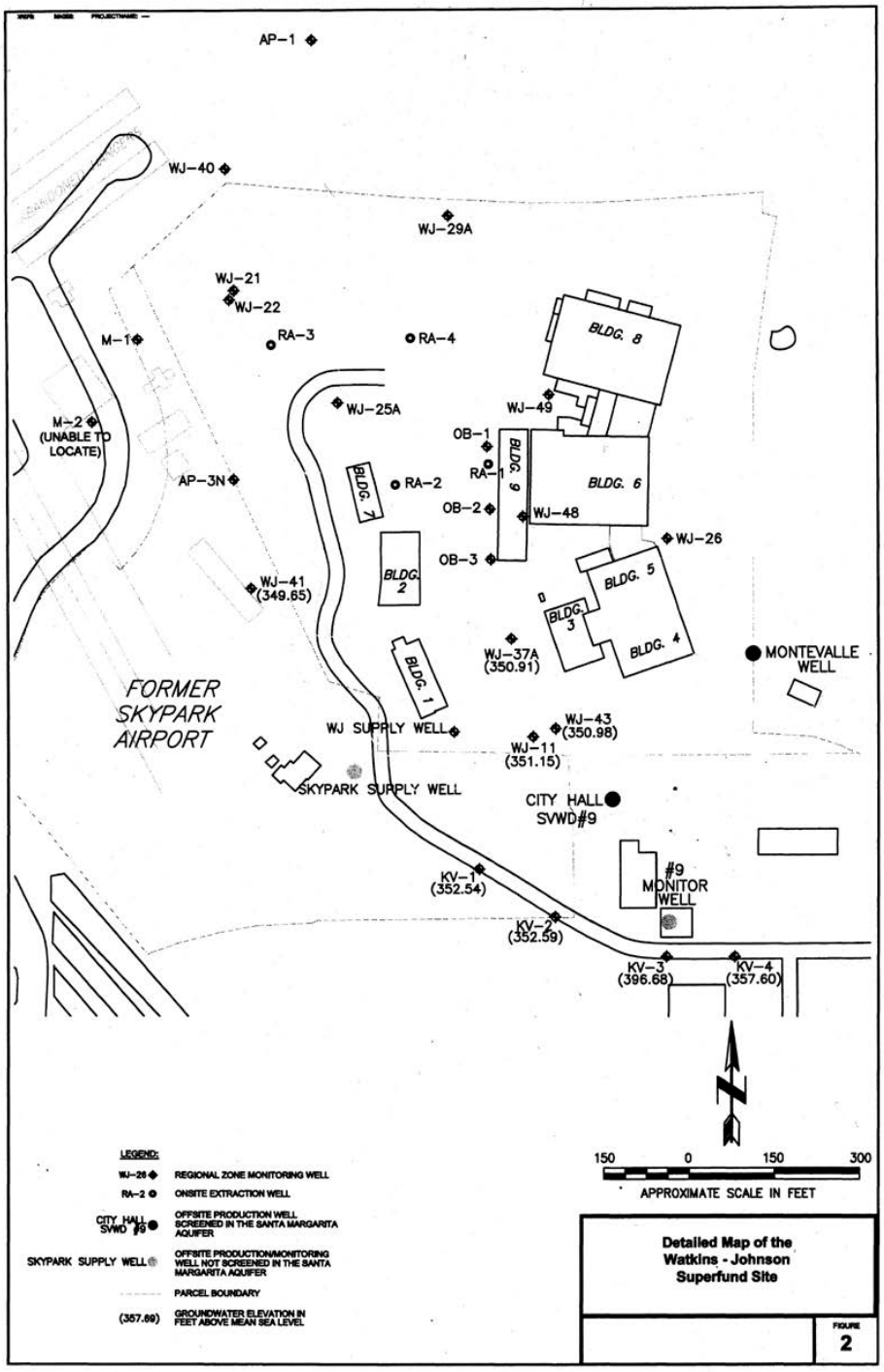

Figure 2. Detailed Map of the Watkins-Johnson Superfund Site

3.2. Hydrology

The Watkins-Johnson site lies within the Santa Margarita Basin, which consists of a sequence of sandstone, siltstone, and shale that is underlain by granitic rock. The geologic formations of the Santa Margarita Basin that contain significant sandstone layers are also the primary hydrostratigraphic units, or aquifers, for water supply. The three principal hydrostratigraphic units beneath the Watkins-Johnson Site are, from shallowest to deepest, the Santa Margarita, Monterey, and Lompico formations. Historically, the majority of the water supply in the Scotts Valley area has been derived from the Santa Margarita and Lompico units, in addition to the deeper Butano unit.

Groundwater contamination associated with the Watkins-Johnson site is limited to the Santa Margarita aquifer. At the Watkins-Johnson site, the Santa Margarita consists of weakly cemented sandstone except for a cemented conglomeritic interbed at approximately 100 feet below ground surface (bgs) (360 feet above mean sea level) that acts as an aquitard. Except for the conglomeritic interbed, the Santa Margarita is quite permeable. Groundwater on-site within the Santa Margarita occurs in a locally discontinuous, perched zone above the conglomeritic interbed, and in an unconfined aquifer sometimes referred to as the regional aquifer at about 140 feet bgs. Contamination was found in both the perched zone and the underlying regional aquifer. The historic groundwater flow direction is to the northwest, toward Bean Creek. The Santa Margarita regional aquifer discharges to Bean Creek north of the Site. However, since the beginning of remedial action implementation, gradients near the operating groundwater extraction wells have been locally altered. The aquifers in the Monterey and Lompico formations underlie the contaminated Santa Margarita formation; several water supply wells south of the Site tap into these aquifers, which may locally affect Santa Margarita groundwater gradients.

3.3. Land and Resource Use

Watkins-Johnson Company (WJC) began operations at the site in 1963, manufacturing industrial furnaces and electronic components and also using the site as a research facility. The facility is now owned and operated by Aviza Technology, Inc. (Aviza). Aviza designed and built semiconductor equipment at the site. The property is currently for sale and all process equipment has been removed from the facility. It is uncertain if the site will remain industrial or be converted to high-density residential use. A municipal airport was located immediately west of the Watkins-Johnson Site, but since the 1990s that land has been converted to a city park and high-density housing.

Watkins-Johnson Company became WJ Communications, Incorporated, which later became a subsidiary of TriQuint Semiconductor. Aviza is a subsidiary of TriQuint as well. Although the PRP is referred to in this report as WJC, TriQuint is now responsible for CERCLA compliance and liability.

The land to the south of the Watkins-Johnson site is currently zoned for moderate density, commercial and industrial uses. This area contains two retail shopping centers.

3.4. History of Contamination

Historically, on-site industrial processes included metal machining, degreasing operations, metal plating, glass etching, welding, soldering, painting, and photo lab activities. A variety of organic and inorganic chemicals were used at the site. Soil and groundwater contamination resulted from the disposal of trichloroethylene (TCE) and trichloroethane (TCA) solvents into the septic leach-field drainage system at the facility. Site investigations showed the presence of TCE and trans-1,2- dichloroethylene (1,2-DCE), plus minute quantities of TCA, tetrachloroethylene (PCE), and Freon 113 in groundwater under the site. The contamination was originally attributed to a release which occurred in 1984 and was reported to regulatory authorities. Whether the original release resulted from a single event or a series of releases over a longer period of time has never been established. However, the distribution of contaminants in the soil and groundwater is consistent with contaminants being introduced into the subsurface through the septic drainage system, which consisted of leach fields and drainage pits. The site was added to the National Priorities List (NPL) in 1990.

3.5. Initial Response

In 1984, prompted by an anonymous phone call, the San Francisco Bay Regional Water Quality Control Board (RWQCB), conducted an inspection of the plant's septic drainage system and dilution tanks. The inspection revealed the presence of several industrial solvents in the septic drainage system, a dilution tank, and groundwater beneath the site. In April 1984, the RWQCB requested that WJC initiate a groundwater monitoring program at the site. The RWQCB subsequently issued an order to WJC to investigate the local hydrogeology, determine the extent of the groundwater contamination, and design an aquifer restoration program. The aquifer restoration program included, among other activities, excavation of a dilution tank. A groundwater extraction and treatment system was constructed and began operating in October 1986. The treated water was then used on site, recharged to the perched zone on-site, or discharged to Bean Creek.

In January 1987, the Watkins-Johnson Site was proposed for NPL listing.

3.6. Basis for Taking Action

The primary contaminant of concern for the Watkins-Johnson Site was TCE and its degradation products. The presence of these contaminants in groundwater and soil provided the basis for taking action under CERCLA. TCE and related VOCs were considered possible and/or probable human carcinogens. The primary threat to human health was posed by potential ingestion of the contaminated groundwater.

4. Remedial Actions

4.1. Remedy Selection

The 1990 Record of Decision (ROD) established the remedy selected for the Watkins- Johnson Site. The selected remedy addresses the primary threat by extracting contaminated groundwater and treating it to achieve cleanup levels. Soils were to be remediated to levels that would protect groundwater quality. The goal of this remedial action was to restore groundwater to its beneficial use as drinking water. The major components of the selected remedy were designed to:

- Prevent off-site migration of contaminants within the perched zone by using infiltration leach fields (also referred to as perched zone recharge galleries);
- Transfer contaminated groundwater within the perched zone to the regional zone by means of gravity drains for more efficient extraction;
- Capture and extract contaminated groundwater within the regional zone by using extraction wells;
- Treat extracted groundwater by using a granular activated carbon adsorption treatment system;
- Remove soil contamination from the soil/vadose zone by using a soil vapor extraction system; and
- Minimize the potential for mobilization of contamination from the soil into the groundwater by installing an impermeable cap over the area of concern.
- Implement institutional controls as part of the RD/RA.

4.2. Remedy Implementation

In response to the Cleanup and Abatement Order issued in May 1984 from RWQCB to WJC, a groundwater extraction, treatment, and infiltration system was constructed and began operating in 1986. In the late 1980s, groundwater contamination was identified as an elongated plume in the regional aquifer that extended from the Watkins-Johnson Site northwest to Bean Creek. Groundwater extraction rates associated with the treatment system during the late 1980s were approximately 320 gallons per minute (gpm). Aggressive groundwater pumping from the regional plume successfully captured and reduced the concentrations such that by 1994 the plume was entirely contained on the property and maximum concentrations of TCE were in the tens of micrograms per liter (µg/L). The Remedial System Construction Program began on June 1, 1994, and was completed on September 22, 1994. As part of the construction, a SVE and treatment system was installed and the groundwater extraction and treatment system initiated in 1986 was modified. In a further effort to remove the residual contaminants and prevent recontamination, the septic leach-field and drainage system were replaced with a gravity sewer system to manage wastewater. The gravity sewer system rerouted wastewater to a lift station on the northern portion of the property. The lift station was designed to pump wastewater to the City of Scotts Valley Publicly-Owned Treatment Works.

The 1994 modifications to the groundwater extraction system included the installation of six perched-zone extraction wells and seven perched-zone infiltration wells. The original system relied on gravity drainage of water from the perched to the regional zone. This was inefficient for moving contamination

out of the perched zone. Therefore, a groundwater flushing approach was implemented. It involved injection of treated groundwater around the perimeter of the perched zone. The injected water was then extracted from the approximate center of the perched zone and routed back to the treatment unit. The original drainage wells were converted to perched-zone groundwater extraction wells. This modification to the system had the beneficial effect of flushing the contaminants from the perched zone, hence increasing the efficiency of contaminant removal.

In 1994, TCE in the perched zone had a maximum TCE concentration of 400 µg/L. The regional zone aquifer contained a maximum TCE concentration of 76 µg/L. The modified system was operational from 1994 through 2000. The combined groundwater extraction rate from both the perched zone and the regional zone was approximately 120 gpm. Approximately one-third of this water was re-injected into the perched zone to provide flushing action for the removal of TCE. Another third was used by the on-site plant as process water, and the final third was discharged to Bean Creek per the National Pollutant Discharge Elimination System (NPDES) permit requirements. In June 2000, the re-infiltration of treated water into the perched zone was discontinued. Between 2000 and 2009, the discharge of treated groundwater was approximately split between usage by the on-site plant and discharge to Bean Creek. Since 2009, in response to plant closure, the NPDES discharge permit was revised, and all treated water is being discharged to Bean Creek.

The SVE system was shut down in April 2001, with EPA's concurrence, as soil vapor concentrations for TCE were below the remedial goal of 260 parts per billion by volume (ppbv). Soil vapor conditions were allowed to equilibrate for a year and confirmatory soil vapor samples were collected in February 2002. As of 2002, the soil vapor monitoring network at the site consisted of five extraction and 21 monitoring wells. These samples were analyzed using very low detection limits (< 0.72 ppbv). The soil gas results were used to develop input parameters for the VLEACH computer model to evaluate impact to groundwater from the residual soil vapor concentrations, not to assess the potential for vapor intrusion from soil vapor concentrations.

4.3. Operation and Maintenance (O&M)

The groundwater treatment plant is currently operating and meeting the requirements set forth in the NPDES discharge permit. In November - December 2011, the treatment plant shut down due to mechanical issues and repairs to fix the system from discharging loose activated carbon after the latest carbon changeout. Repairs were made and the system was in operation by December 28, 2011.

Annual O&M costs were originally estimated in the ROD to be $167,820 per year. Actual O&M costs have generally been less than that amount.

5. Progress Since the Last Five-Year Review

5.1. Previous Five-Year Review Protectiveness Statement and Issues

Following is the protectiveness statement from the second FYR for the Watkins-Johnson Superfund Site:

> *The remedy at the Watkins-Johnson site is currently protective of human health and the environment because all exposure pathways that could result in unacceptable risks are being controlled. However, in order for the remedy to be protective in the long-term, institutional controls that prevent exposure to, or the ingestion of, contaminated groundwater need to be implemented.*

The second FYR included two issues and recommendations. Each recommendation and its current status is summarized in Table 2.

Table 2. Status of Recommendations from the second FYR, 2007

Issues from previous FYR	Recommendations	Party Responsible	Milestone Date	Action Taken and Outcome	Date of Action
Increasing concentrations of PCE and TCE	Investigations to identify causes and/or sources	WJC	12/30/2008	An investigation was conducted in 2010 to identify potential upgradient sources. The investigation was inconclusive.	August – December 2010
Lack of institutional controls	a) Identify necessary institutional controls b) Implement selected institutional controls	WJC/EPA WJC/DTSC	12/30/2008 12/30/2008	No institutional controls have been identified.	N/A

5.2. Work Completed at the Site Since the Last Five Year Review

The groundwater treatment plant has continued to operate and groundwater monitoring has continued since the last 5YR. RA-2 has been the only active extraction well since 2004. During the period from December 2008 to November 2009, the groundwater extraction and treatment system was shut down to evaluate groundwater conditions and contaminant rebound effects under a no-pumping condition.

The current groundwater monitoring network consists of the following nine wells: WJ-41, WJ-43, WJ-11, WJ-37A, Wescosa Well, KV-1, KV-2, KV-3, and KV-4. Although not a Site contaminant, methyltertiary butyl ether (MTBE) was included as an analyte in the monitoring program beginning in the 4th Quarter of 2010 in order to assess the possibility of non-Site-related plume migration onto the Watkins-Johnson Site. To date, no MTBE has been detected. Lastly, a background assessment investigation was conducted in 2010 to determine whether an upgradient source of PCE is present. The investigation included installation and monitoring of four groundwater monitoring wells designated KV-1 through KV-4 to the south of the Watkins-Johnson property. The report concluded that the PCE and TCE concentrations detected in well KV-2 represent background groundwater quality. However, EPA did not concur, primarily because of the lack of data supporting the hydraulic gradient determination.

6. Five-Year Review Process

6.1. Administrative Components

EPA Region 9 initiated the FYR in October 2011. The EPA review team was led by Brunilda Davila, US EPA Remedial Project Manager (RPM), and included USACE Seattle District personnel Marlowe Laubach (chemical engineer), Jeff Powers (hydrogeologist), and Deborah Johnston (biologist). In October 2011, EPA held a scoping meeting (teleconference) with the review team to discuss the Site and items of interest as they 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
- Five-Year Review Report development and review

6.2. Community Involvement

On February 19, 2012, a public notice was published in the *Santa Cruz Sentinel* announcing the commencement of the Five-Year Review process for the Watkins-Johnson Superfund Site, providing EPA Community Involvement Coordinator Alejandro Diaz's contact information, and inviting community participation. The press notice is attached as Appendix B. No one contacted EPA as a result of this advertisement.

The Five-Year Review report will be made available to the public once it has been finalized. Copies of this document will be placed in the designated public repository: Scotts Valley Branch Library, 251 Kings Village Road, Scotts Valley, CA 95066. Upon completion of the FYR, a public notice will be placed in the *Santa Cruz Sentinel* to announce the availability of the final FYR report in the Site document repository.

6.3. Document Review

This FYR included a review of relevant, Site-related documents including the Remedial Investigation report, ROD, remedial action reports, Background Groundwater Assessment Report, 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.

Since the ROD, the majority of the ARARs have remained unchanged except as noted in Table 4 (page 16).

Changes in chemical-specific ARARs since the last FYR are summarized in . As discussed in the second FYR, the State of California did not have promulgated Maximum Contaminant Levels (MCLs) for 1,2 dichlorobenzene, 1,1 dichloroethane, 1,1,2-trichloroethane, cadmium, or lead at the time the ROD was finalized (June 29, 1990). Since that time, the State has adopted MCLs for these compounds that are the same as the federal standard. In addition, the federal and state MCL for chloroform (compound in the total trihalomethanes value) was reduced from 0.1 ppm to 0.08 ppm and the federal and state arsenic MCL was reduced from 0.05 to 0.01 ppm. Silver and zinc are secondary standards.

Table 3. Summary of Groundwater ARAR Changes Since the Last FYR

Contaminants of Concern	Groundwater (mg/L)	Federal MCL (mg/L)	State MCL (mg/L)	ARAR Changed Since Last FYR
	***1990 ROD ARAR*[1]**	***Current Regulations***		
Chloroform	0.1	0.08	0.08 [3]	Yes
1,2-Dichlorobenzene	0.6	0.6	0.6	No
1,4 Dichlorobenzene (p DCB)	0.075	0.075	0.005	No
1,1 Dichloroethane (1,1 DCA)	NA [2]	NA	0.005	No
1,1 Dichloroethylene (1,1 DCE)	0.007	0.007	0.006	No
Cis 1,2 Dichloroethylene	0.07	0.007	0.006	No
Methylene Chloride (Dichloromethane)	0.005	0.005	0.005	No
Tetrachloroethylene (PCE)	0.005	0.005	0.005	No
1,1,1 Trichloroethane (1,1,1 TCA)	0.2	0.2	0.2	No
1,1,2 Trichloroethane (1,1,2 TCA)	NA	0.005	0.005	No
Trichloroethylene (TCE)	0.005	0.005	0.005	No
Vinyl Chloride	0.002	0.002	0.0005	No
Arsenic	0.05	0.01	0.01	Yes; State revision effective 11-28-08
Barium	5	1	1	No

Contaminants of Concern	Groundwater (mg/L)	Federal MCL (mg/L)	State MCL (mg/L)	ARAR Changed Since Last FYR
	***1990 ROD ARAR*[1]**	***Current Regulations***		
Cadmium	0.005	0.005	0.005	No
Chromium	0.05	0.05	0.05	No
Copper	1.3	1.3	1.3[4]	No
Lead	0.005	0.015	0.015[4]	No
Mercury	0.002	0.002	0.002	No
Nickel	NA	0.1	0.1	No
Silver	0.05	0.1		Secondary standard
Vanadium	NA[2]		unregulated	
Zinc	5	5		Secondary standard

1. See Table 6 in the ROD
2. NA – no level promulgated
3. MCL for total trihalomethanes including chloroform
4.MCLs for copper and lead are called "Action Levels" (22 California Code of Regulations (CCR)§64672.3)

Since the soil vapor extraction system was discontinued in 2001 with EPA approval, the ARARs concerning discharges of soil gases into the air are no longer relevant. Site manufacturing ceased and the facility decommissioning began in 2010 so the ARAR for solid waste/hazardous waste control is no longer relevant (Table 5).

Table 4. Applicable or Relevant and Appropriate Requirements Evaluation

Require-ment	Citation	Document	Description	Effect on Protectiveness	Comments	Amendment Date
Federal Drinking Water Standards	Federal SDWA[1] Section 1412, 42 USC §300f-1 and 40 CFR Part 141.11-141.6 National Primary Drinking Water Regulations	1990 ROD	Standards have been adopted as enforceable standards for public drinking water systems.	The MCL for choloform has been replaced with an MCL for total trihalomethanes.	Protectiveness is not affected.	
State Drinking Water Standards	CA SDWA Health and Safety Code, Div 5, Part 1, Chapter 7, 4020 et seq., California Domestic Water Quality Monitoring Regulations, CAC Title 22, Division 4, Chapter 15,§ 64401 et seq.	1990 ROD	Establishes state MCL[3] used to establish groundwater cleanup levels.	The state standard for arsenic was lowered from 50 ppb to 10 ppb since the last FYR review.	Arsenic concentrations < 10 ppb. Protectiveness is not affected.	California Domestic Water Quality Monitoring Regulations, CAC Title 22, Division 4, Chapter 15,§ 64401 et seq – Nov 11, 2008
Porter-Cologne Water Quality Control Act	California Water Code Division 7, Chapter 4, Article 4 §13263	1990 ROD	Establishes authority for State and Regional Water Boards to determine site-specific discharge requirements.	No changes have been made to this requirement. Protectiveness is not affected.	Discharges into Bean Creek are regulated under NPDES[4] permit.	
Federal Clean Water Act (CWA)	33 USC 1251 et seq. and California Water Code Division 7, Chapter 3 Article 4, §13160	1990 ROD	Establishes authority for State to be the water pollution control agency for all purposes stated in the CWA NPDES requirements (Section 402 of CWA)	No changes have been made to the federal requirement. Administrative changes have been made to the California Water Code. Protectiveness is not affected.	Discharge regulated under General NPDES Permit CAG993002.	California Water Code Division 7, Chapter 3 Article 4, §13160 – March 24, 2011

Require-ment	Citation	Document	Description	Effect on Protectiveness	Comments	Amendment Date
Monterey Bay Unified Air Pollution Control	Monterey Bay Unified Air Pollution Control District, Rule 1000	1990 ROD	Requires pretreatment of all ambient discharges	No changes have been made since the last FYR. Protectiveness is not affected.	Soil Vapor Extraction system turned off with EPA approval April 2001.	
Clean Air Act	42 USC 7401 et seq.	1990 ROD	Regulates air emissions to protect human health and the environment	No changes have been made to this requirement. Protectiveness is not affected.	Soil Vapor Extraction system turned off with EPA approval April 2001.	
Solid Waste Hazardous Waste Control	California Hazardous Waste Control Health and Safety Code Division 20, Chapter 6.5, Articles 2, 4, 4.5, 5, 6, 6.5, and 7.7	1990 ROD	Remedial activities involving on-site management of hazardous wastes	No changes have been made since that last FYR. Protectiveness is not affected.	Site manufacturing ceased and facility decommissioning began 2010.	

1.SDWA – Safe Drinking Water Act

2. FYR – five-year review

3. MCL – maximum contaminant level

4. NPDES – National Pollutant Discharge Elimination System

6.3.2. Risk Assessment Review

A human health risk assessment was completed for the Site as part of the 1990 ROD. The risk assessment identified the exposure pathways at Watkins-Johnson as hypothetical domestic use of groundwater through ingestion, ingestion and dermal contact with contaminated soils, and inhalation of air from contaminated groundwater.

The risk assessment for the ROD identified the exposure pathways and associated risks listed in Table 5.

Table 5. Summary of Risk Assessment for the ROD

Exposure Scenario & Pathway[1]	Risk Driver(s)	Risk Estimate (cancer risk/subchronic noncancer risk/chronic noncancer risk)
Ingestion of groundwater in the perched zone (off-property)	Adult residents Child residents	8.9E-4/0.036/0.249 --/0.063/0.435
Ingesting of groundwater in the perched zone (on-property)	Adult worker	1.0E-4/0.018/0.134
Ingestion of groundwater in the regional zone (off-property)	Adult residents Child residents	1.0E-4/0.041/0.245 --/0.072/0.428
Ingestion of groundwater in the regional zone (off-property)	Adult worker	2.9E-4/0.021/0.149
Ingestion of soil in the perched zone (off-property)	Adult residents Child residents	6.3E-8/0.000/0.000 --/0.009/0.011
Ingestion of soil in the regional zone (off-property)	Adult residents Child residents	6.3E-8/0.002/0.002 --/0.009/0.011
Ingeston of soil in the perched zone (on-property)	Adult worker	4.9E-8/0.001/0.002
Ingestion of soil in the regional zone (on-property)	Adult worker	4.9E-8/0.001/0.002
Dermal contact with soil in the perched zone (off-property)	Adult residents Child residents	3.3E-7/0.001/0.001 --/0.006/0.006
Dermal contact with with soil in the regional zone (off-property)	Adult residents Child residents	3.3E-7/0.001/0.001 --/0.006/0.006
Dermal contact with soil in the perched zone (on-property)	Adult worker	8.1E-7/0.002/0.002
Dermal contact with soil in the regional zone (on-property)	Adult worker	8.1E-7/0.002/0.002
Inhalation of air	Fish Hatchery Worker	2.5E-7/--/--

1 - The exposure scenarios are based on a hypothetical drinking water well in the perched or regional zones.

The risk assessment was reviewed to identify any changes in exposure or toxicity that would impact protectiveness. Issues identified include: (1) the risk assessment did not calculate cancer risk for child residents drinking from a hypothetical well; (2) vapor intrusion was not evaluated as part of the original risk assessment and (3) toxicity values of contaminants of concern (COCs) from EPA's Integrated Risk Information System (IRIS) toxicity assessments have changed since the last FYR.

Child resident ingestion risk. The site has not used its on-site well for approximately 10 years and is currently connected to city water. The site sewer is also connected to the city system eliminating the

contribution to the contaminant source (the septic leach field was the original source of contamination to groundwater). Currently, the land use on site is industrial. ICs are needed to address potential future risks if the land use changed to residential.

Vapor Intrusion. EPA's understanding of contaminant migration from soil gas and/or groundwater into buildings has evolved over the past few years leading to the conclusion that vapor intrusion may have a greater potential for posing risk to human health than assumed when the ROD was prepared. In September 2002, EPA released an external review draft version of its vapor intrusion guidance titled "Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils" (EPA 2002).

The potential for vapor intrusion was not addressed by the ROD remedy. At the time of the ROD, TCE was the major contaminant of concern in both perched and regional groundwater zones. TCE concentrations in the perched zone ranged from 34 to 13,000 μg/L. Current groundwater data (as of October 2011) show detections of TCE and PCE in property wells at significantly lower concentrations. The maximum PCE and TCE concentrations in October 2011 are 48 μg/L and 3.8 μg/L, respectively. Using the 2002 vapor intrusion guidance and the current toxicity values for PCE and TCE, a new screening level in groundwater was calculated below which there is no concern for the potential of vapor intrusion[1]. The current screening level concentration for assessing the potential of vapor intrusion is 20 μg/L of TCE and 64 μg/L for PCE for groundwater beneath industrial buildings. However, if land use changes, the current groundwater concentrations would require a reassessment for the potential for vapor intrusion (residential screening levels are 13 μg/L and 1 μg/L, for PCE and TCE, respectively.) The contaminated groundwater plume passes beneath one corner of a Site building (Building 3, see Figure 2).

Toxicity values. EPA's IRIS has a program to update toxicity values used by the Agency when newer scientific information becomes available. In the past five years, there have been a number of changes to the toxicity values for certain contaminants of concern at the Site. Revisions to the toxicity values for PCE (non-cancer), TCE, and cis-1,2-DCE, indicate a higher risk from exposure to these chemicals than previously considered. Revisions to the toxicity values for 1,1,1-TCA indicate a lower risk from exposure to this chemical than previously considered. The following table lists the new toxicity values.

[1] The screening levels correspond to excess carcinogenic risk of 10^{-6} and are protective for noncancer risk.

Table 6. Toxicity Value Updates

Contaminant of Concern	New Toxicity Values[1]
TCE[2]	Inhalation RfC[3]: NEW: 0.002 mg/m^3 Oral RfD[4]: NEW: 0.0005 mg/kg/day Inhalation unit risk: OLD: 7.3 E-3/mg-kg-day NEW: 4E-6/µg/m^3 Oral slope factor: OLD: 1.3E-2 NEW: 4.6E-2/mg/kg-day
PCE[5]	Oral RfD: OLD: 1.0E-2 mg/kg-day NEW: 0.006 mg/kg-day Inhalation RfC: NEW: 0.04 mg/m^3 Inhalation unit risk: OLD: 5.9E-6/mg/mg^3 NEW: 2.6E-7/µg/m^3 Oral slope factor: OLD: 5.4E-1/mg/kg-day NEW: 2.1E-3/mg/kg-day
Cis-1,2-dichloroethylene	Oral RfD: OLD: 1.0E-2 mg/kg-day NEW: 0.002 mg/kg-day
1,1,1-trichloroethane	Oral RfD: OLD: 2.8E-01 mg/kg-day NEW: 2 mg/kg-day Inhalation RfC: OLD: 6.3 E-1 mg/kg-day NEW: 5 mg/mg^3

1 – Toxicity values were not provided in the risk assessment discussion in the ROD. Old toxicity values presented here are from 2004 EPA Region 9 preliminary remedial goals except for PCE. Old PCE toxicity values presented here are from 2011 EPA regional screening levels table.
2. TCE – trichloroethylene
3. RfC – reference concentration
4. RfD – reference dose
5. PCE – tetrachloroethylene

Groundwater results are compared to U.S. EPA Regional Screening Levels (RSLs) as a first step in determining whether response actions may be needed to address potential human health exposures. The RSLs are chemical-specific concentrations that correspond to an excess cancer risk level of $1x10^{-6}$ (or a Hazard Quotient (HQ) of 1 for noncarcinogens) developed for standard exposure scenarios (e.g., residential and 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 September 2011, EPA completed a review of the TCE toxicity literature, resulting in lower RSLs for both cancer and non-cancer effects. The screening level for chronic exposure for cancer excess risk level of $1x10^{-6}$ is 0.44 µg/L. EPA uses an excess cancer risk range between 10^{-4} and 10^{-6} for assessing potential exposures, which means a TCE concentration between 0.44 and 44 µg/L. The current Maximum Contaminant Level (MCL) for TCE of 5 µg/L is within the revised protective carcinogenic risk range. EPA's 2011 Toxicological Review for TCE also developed safe levels that include at least a 10-fold margin of safety for health effects other than cancer. Any concentration below the non-cancer RSL indicates that no adverse health effect from exposure is expected. Concentrations significantly above the RSL may indicate an increased potential of non-cancer effects. The non-cancer screening level for TCE is 2.6 µg/L. EPA considers the TCE MCL of 5 µg/L protective for both cancer and non-cancer effects.

EPA also recently reassessed PCE toxicity literature for both cancer and non-cancer effects and released the toxicological review in February 2012, posted on IRIS. The reassessment determined that risk for cancer excess of $1x10^{-6}$ was less stringent than previously assumed, and has raised the cancer RSL for PCE to 9.7 µg/L. The non-cancer RSL was also revised based on adverse neurological effects and

resulted in a non-cancer risk RSL of 35 µg/L. The PCE MCL of 5 µg/L remains protective for both carcinogenic and non-cancer effects.

Non-cancer toxicity values for cis-1,2-DCE decreased indicating that this compound is more toxic than previously considered. The current Maximum Contaminant Level (MCL) for cis-1,2-DCE of 70 µg/L is within the revised protective carcinogenic risk range. The recent toxicity information also developed safe levels that include at least a 10-fold margin of safety for health effects other than cancer. Concentrations significantly above the RSL may indicate an increased potential of non-cancer effects. The non-cancer screening level for cis-1,2-DCE is 28 µg/L. EPA considers the cis-1,2-DCE MCL protective for both cancer and non-cancer effects. Non-cancer toxicity values for 1,1,1-TCA increased indicating that these compounds are less toxic than previously considered. These changes do not impact the protectiveness of the remedy.

6.3.3. Ecological Risk Review

As stated previously, contaminated groundwater historically entered Bean Creek from the western end of the site, beyond the Watkins-Johnson property boundary. Bean Creek was designated as critical habitat for both steelhead trout (January 2006) and coho salmon (June 2005). The treatment plant discharges to Bean Creek to the northern end of the site, which coincides with the northern property boundary, and the treated water is discharged under NPDES permit requirements. There has been an increase in chemicals in monitoring wells at the southern end of the site; however, the groundwater flow gradient flows from Bean Creek to the Site, and as such there is no direct exposure route for impacts to Bean Creek.

6.4. Data Review

6.4.1. Soil

Soil was an original medium of concern for the Site. Site soil contamination originated from the disposal of TCE solvents into the septic leach-field drainage system (leach fields and drainage pits) at the facility. The soil component of the Site remedy, as stated in the ROD, was to remove soil contamination from the vadose zone by using a soil vapor extraction (SVE) system, and to minimize the potential for mobilization of soil contamination into the groundwater by installing an impermeable cap over the area of concern. An asphalt cap was constructed over the relatively flat portion of the site between the buildings, including the former source area, and became the parking lot and vehicular access routes for the facility. The SVE system was operated from November 1994 until April 2001, at which time the active soil remedy was considered complete based on data indicating soil vapor concentrations no longer presented a continuing threat to Site groundwater. These data and conclusions were documented in the VLEACH modeling report (Arcadis 2003).

6.4.2. Groundwater

As discussed in the Background section of the VLEACH modeling report, contamination was once present in both the perched groundwater zone and the Regional Aquifer of the Santa Margarita formation beneath the Site. The groundwater extraction and treatment system removed and treated groundwater

between 1994 and 2000 in both zones, and achieved remedial goals in the perched zone by 2000. Extraction and treatment of only regional zone groundwater has occurred since 2000, and only select perched and regional zone wells have been monitored since that time.

Groundwater data for chlorinated volatile organic compounds (CVOCs) and Freon 113 were reviewed for key Site wells from 1985 to October 2011. CVOCs of particular interest were trichloroethylene (TCE), 1,1,2-trichloroethane (TCA), trans-1,2-dichloroethylene (1,2-DCE), and tetrachloroethylene (PCE) because these chemicals, in addition to Freon 113, were present in Site groundwater during past investigations. Site groundwater sampling began in 1984 and evolved to become to the current quarterly monitoring program. At the time of the data review, the most recent data available were the 4th Quarter 2011 monitoring results, from October 2011. No compounds except TCE and PCE were detected at levels above their respective MCLs or cleanup criteria. Key monitoring wells are defined as Site monitoring wells exhibiting either TCE or PCE levels near or above the 5 µg/L MCL. Key wells are RA-2, WJ-41, WJ-43, WJ-11, WJ-37A, and KV-2. These wells are all screened in the regional, Santa Margarita aquifer. See Figure 2 for key well locations.

Trends for TCE and PCE concentrations in groundwater have been variable since the beginning of Site groundwater monitoring in 1984. A steady decline was observed in Site groundwater TCE concentrations from 1986, when groundwater remediation began, to 1995. TCE was first detected in 1995 at well WJ-41, located topographically upslope from the Site to the west, at the former Sky Park Airport, which is now a city park. During the initial Site investigations in the mid 1980s, PCE was only detected at a few source area wells at very low concentrations. PCE began appearing at Site wells away from the immediate source area in 1997, first at WJ-41, then later at WJ-43 (in 1999), WJ-37A (2001), and WJ-11 (2005) which are all located to the south of – and what has been historically interpreted as hydraulically upgradient from – the former source area. Shortly after PCE was first detected in wells WJ-43 and WJ-37A, low detections of TCE appeared in these same wells. By 2004, as documented in the second Five-Year Review report (USEPA 2007), PCE concentrations had risen significantly in several wells including RA-2, WJ-43, and WJ-11.

For this third Five-Year Review, trend evaluations were conducted using the Mann-Kendall test for PCE and TCE at wells RA-2, WJ-41, WJ-43, WJ-11, and WJ-37A for data covering the time period of February 2007 to October 2011. Results from this period indicated most TCE and PCE concentrations have stabilized, with no trends present at the 90% significance level except at wells WJ-41 and RA-2. Both TCE and PCE concentrations show decreasing trends at WJ-41 since 2007. Data indicates TCE and PCE concentrations peaked at well WJ-41 in 2003 (at 33 and 4.8 µg/L, respectively), which also supports the recent decreasing trend conclusion. Since February 2007, PCE at well RA-2 has exhibited an increasing trend. RA-2 has been in near-continuous operation during the last five years. Note that PCE and TCE concentrations at the 180-foot depth at new well KV-2 (multiple screen depths are routinely sampled using passive diffusion bag samplers at the new KV- series wells) showed modest potentially increasing trends with just five data points each since the well was first sampled in early 2011, but they were not statistically significant.

PCE concentrations in wells WJ-43, WJ-11, WJ-37A, and KV-2 are currently above the MCL of 5 µg/L, with no decreasing trends currently present over the last five years. The well exhibiting the highest PCE concentration of 48 µg/L is KV-2, at 180 ft. depth. While PCE is just below the MCL at well RA-2, overall concentrations have been trending upward since 2007. No wells currently exceed the MCL for TCE. The well exhibiting the highest TCE concentration of 3.8 µg/L is WJ-41.

W-J's contractor has hypothesized that PCE in wells WJ-43, WJ-11, WJ-37A, and KV-2 is from an off-site source, but has failed over a period of years to provide information to support this hypothesis, especially information about hydraulic head and groundwater flow. A draft Remedy Optimization Work Plan (Arcadis 2012), which is intended to address data gaps and refine the site conceptual model has been submitted to EPA for review.

6.4.3. Surface Water

Bean Creek defines the northern border of the Watkins-Johnson Superfund Site. This creek is a small perennial stream and is the only surface water feature on or within close proximity to the Site. Historical groundwater monitoring data has shown that TCE-contaminated groundwater that had once discharged into the creek was quickly remediated by the early operations of the groundwater extraction and treatment system. In early 1987, the TCE contaminant plume extended to Bean Creek, where a concentration of 81 µg/L was detected. Since 1987, the TCE plume has been considerably reduced in size. Currently, no contaminated groundwater is believed to exist in the downgradient direction of the Site beyond the extraction wells. Treated water from the Site's groundwater treatment plant is piped to and discharged into Bean Creek under the Site's NPDES permit. When the system is in operation, this water is tested monthly at the effluent sampling port of the treatment plant to confirm applicable discharge criteria are attained. For PCE, the discharge limit is 0.8 µg/L.

6.4.4. Sediment

Sediment is not a medium of concern at the Site.

6.4.5. Soil Gas/Indoor Air

Soil gas remediation was considered a component of the active soils remedy which included the implementation of an SVE system from November 1994 until April 2001. VLEACH soil-groundwater interaction modeling, conducted in 2003, determined there would be negligible future impacts to groundwater from the leaching of residual TCE from site soils based on Site data at that time. Maximum soil pore water concentrations for TCE, computed from soil gas concentrations, ranged from 0.060 to 1.6 µg/L, with a mean of 0.46 µg/L. The VLEACH model did not assess the impact from soil gas on indoor air concentrations.

6.5. Site Inspection

A site inspection was conducted at the Watkins-Johnson Superfund Site on January 18th, 2012. The site inspection was conducted by the USEPA and the USACE Seattle District, and was coordinated with

Aviza Technology, Inc., the current property owner who was also in attendance during the site inspection. The inspection began with a site walk of most of the currently monitored wells, the groundwater treatment plant, the asphalt soil cap (parking lot and vehicular access behind Building 8), and a drive to view Bean Creek where it intersects Green Valley Road. The site inspection concluded in the Building 9 conference room, where an interview was conducted with Mr. Patrick O'Connor of Aviza. In general, the site inspection documented site conditions showing acceptable conditions for the groundwater treatment plant, asphalt soil cap, and groundwater monitoring well conditions. See the Site Inspection Checklist (Appendix D) for details of the inspection, and a roster of attendees.

6.6. Institutional Controls

The ROD states that the identification of institutional controls will occur during the remedial design/remedial action phase. However, institutional controls have not been identified or implemented to date. Institutional controls must be implemented at this Site to achieve long term protectiveness of the remedy, and they should take into account the change in the reasonably anticipated future use of the property from industrial to residential, given that the property is currently for sale and could be re-zoned.The institutional controls should: 1) address potential risks associated with contaminated groundwater, 2) ensure that the integrity of the soil cap is maintained, and 3) require an evaluation of the potential for vapor intrusion if the land use changes from commercial/industrial to residential.

6.7. Interviews

During the FYR process, interviews were conducted with parties involved with the Site, including the current property owner, regulatory agencies involved in Site activities, and one nearby resident. The purpose of the interviews was to document the perceived status of the Site and any perceived problems or successes with the implementation of the remedy to date. The interviews were conducted between January 18 and February 1, 2012. The common themes and more important issues brought up during the interviews are summarized below and complete interview transcripts are included in Appendix C.

Representatives from local, county, and state agencies having a stake in the Watkins-Johnson Superfund Site were interviewed. These individuals, and their respective agencies, are as follows: Mr. Wei Liu with the California RWQCB, Central Coast Region; Mr. Scott E. Carson with the Santa Cruz County Environmental Health Service; Mr. Colin Smith with the Scotts Valley Water District. These interviewees were asked similar questions regarding their agencies' roles in the project, their level of participation in site activities and data review, compliance issues, and regulatory changes or updates.

A sentiment consistently expressed by both Mr. Carson (Santa Cruz County) and Mr. Smith (Scotts Valley Water District) was that while their agencies receive regular groundwater monitoring reports and other written reports and documents pertinent to the Site, the agencies are not fully included in the decision-making and coordination processes that transpire between the EPA and WJC. Additionally, Mr. Smith was concerned that despite the large number of groundwater monitoring wells on site, the monitoring program has, in recent times, been reduced to just four wells, so that it may not provide a complete snapshot of groundwater quality and water levels. Mr Smith felt that this was a missed

opportunity for up-to-date characterization. Mr. Smith also expressed concern that since the focus of the Site in earlier times had been on protection of groundwater, evolving science with respect to soil vapor and related exposure (e.g. vapor intrustion) should be re-evaluated before closure of the site.

Mr. Patrick O'Connor and Mr. Tom Fleming, both with Aviza Technologies, Inc., the property owner, were also interviewed. Their overall sentiment was that the Site is and has been clean for some time with respect to the original contamination and the site closure process is taking too long. Mr. O'Connor believes the contamination showing up in the Site wells south of the original source area is coming from other nearby properties, from either one or both of the dry cleaners or the former airport that is now a city park.

A resident living in close proximity to the Site was also interviewed. The interviewee's name and other potentially sensitive information to interview questions have been withheld from the interview transcript to protect the individual's privacy. The resident's main concern centered on a desire to have a way of keeping better informed of the activities and status of the Site. The resident indicated the EPA's website appeared to be lacking more recent information regarding the Site. The resident also expressed concerns about cleanup progress, potential health risks associated with living near the site, and impacts to property value.

7. Technical Assessment

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

Overall, the remedy is functioning as intended by the decision document, as described below.

Remedial Action Performance

The groundwater extraction and treatment system continues to operate and function as designed. Since 2004, groundwater extraction occurs at just one well, RA-2. However, there is uncertainty associated with the increasing concentrations in the monitoring wells south of the property. The treated water discharged to Bean Creek continues to achieve permitted limits. Due to the increased age of the system, components periodically fail. However, when they are deemed critical, system components repairs are made. For example, in 2009 a failed downhole pump was replaced with a new pump in extraction well RA-2. The 4th Quarter 2011 Monitoring Report discusses a granular activated carbon change-out in November 2011, after detection of PCE in the effluent water at a concentration just below the permitted limit. After the carbon was replaced and the system restarted, carbon was observed in the effluent water. Therefore, the system was shut down again. The report indicated that inspections and repairs were underway to make necessary repairs to get the system operational.

The groundwater extraction and treatment system is performing as expected. These systems typically remove the majority of dissolved contamination early in their operational life cycle. The system at Watkins-Johnson is no exception; it has been in near-continuous operation for over 25 years and is currently removing only minor amounts of contaminant mass, primarily PCE. Based on most recent available data, cleanup levels have been achieved for all contaminants of concern except PCE, which is present above the MCL of 5 µg/L at 4 currently monitored wells, and is just below the MCL at one additional well. The latest data show TCE to be near but just below the MCL of 5 µg/L at one currently monitored well.

Based on all available data, the groundwater extraction and treatment system is believed to be effectively containing the remaining dissolved contaminant mass remaining in the regional Santa Margarita aquifer. Groundwater is no longer extracted, treated, or monitored in the perched zone because cleanup levels were achieved. The treatment system is believed to be effective primarily because of the low contaminant levels present in Site regional zone groundwater and because of the presumably low hydraulic gradient magnitude in the vicinity of RA-2. The system is believed to be effective in spite of the reduced quantity of treated groundwater due to the shutdown of several extraction wells. However, since 2010 only nine monitoring wells have been included in the quarterly program, plus the treatment plant influent which indirectly monitors RA-2 since it is the only extraction well in operation. There are no longer any wells being monitored that are positioned historically downgradient of RA-2. Furthermore, between 2002 and 2010, only two wells were routinely monitored, and in 2003 EPA approval was granted to discontinue groundwater elevation measurements as a monitoring requirement. Groundwater elevation monitoring

was reinstated in 2010, but still at only nine monitored wells and none downgradient of well RA-2. A complete and accurate measure of contaminant containment effectiveness may best be achieved through a single monitoring event in which a larger set of wells are monitored for COCs and water elevations.

System Operations/O&M

Operating procedures, as now implemented, should maintain the effectiveness of the response actions. No information is available on potential O&M cost variances. The groundwater monitoring level of effort has decreased since its inception; as has the volume of contaminated water treated with the GAC treatment system. New Site costs are being incurred related to the investigation to determine whether there are off-site CVOC sources.

Opportunities for Optimization

There are opportunities to improve system performance. EPA is expecting a final Optimization Workplan for the system.

Early Indicators of Potential Issues

While equipment breakdowns do occur, they are not considered excessive or detrimental to the overall remedy because they appear to be corrected relatively quickly. Recent data has shown an increase in PCE concentrations south of the Site. Additionally, due to the limited number of wells being routinely monitored north of the the on-site groundwater extraction and treatment system, there are no recent data which would demonstrate that the system is capturing all the dissolved mass associated with the TCE and PCE plumes. While these issues do not currently affect protectiveness because of the lack of a groundwater receptor, they could affect future protectiveness if Site or nearby water usage changes.

Implementation of Institutional Controls and Other Measures

No institutional controls have been identified for the Site as required by the ROD. Therefore, the lack of ICs remains a Site issue requiring redress.

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?

Changes in Standards and TBCs

Applicable or relevant and appropriate (ARAR) and “to be considered” (TBC) standards identified in the ROD have been revised. However, these revisions do not affect the protectiveness of the remedy. Additionally, no new promulgated standards affect the protectiveness of the remedy.

Changes in Exposure Pathways

Currently, the land use on site remains industrial. However, the site property is for sale and the reasonably anticipated future land use has changed from industrial to residential use.

No additional human health routes of exposure were observed. Because the risk assessment described in the ROD was based on the use of a hypothetical drinking water well, the remedy is still protective as all new real estate developments are required to connect to city water in accordance with local and county requirements.

No new contaminants have been identified. However, an investigation was conducted in 2010 to determine whether contaminant sources exist off-property that are contributing to the increase of PCE and TCE in wells reportedly upgradient from the property. The results of this investigation were inconclusive.

Changes in Toxicity and Other Contaminant Characteristics

Toxicity factors for PCE, TCE, cis 1,2-DCE, and 1,1,1-TCA changed since the last FYR. These changes do not affect the short term protectiveness of the remedy because the cleanup standards are within the protective carcinogenic risk range. In addition, no one is currently drinking the contaminated groundwater.

Changes in Risk Assessment Methods

No changes to standardized risk assessment methodologies have occurred.

Expected Progress Towards Meeting Remedial Action Objectives (RAOs)

Per the ROD, the goal of the remedial action is to restore groundwater to its beneficial use. The site no longer uses the contaminated groundwater as a drinking water source. In the eighteen years since the completion of the treatment system, groundwater concentrations in the perched zone have met cleanup levels and PCE and TCE have decreased significantly in the regional aquifer. However, PCE concentrations have increased recently with concentrations above the MCLs. Until contaminant levels are below MCLs, groundwater has not been restored to its beneficial use.

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 that calls into question the protectiveness of the remedy.

7.4. Technical Assessment Summary

Overall, the remedy is functioning as intended. The groundwater extraction and treatment system continues to operate and function as designed. Since 2004, groundwater extraction occurs at just one well, RA-2. However, there currently is some uncertainty associated with increasing contaminant concentrations in monitoring wells south of the property. Based on all available data, the groundwater extraction and treatment system is believed to be effectively containing the remaining dissolved contaminant mass in the regional Santa Margarita aquifer. The institutional controls required by the ROD have not yet been implemented, such that the remedy is not protective in the long term.

Standards and TBCs identified in the ROD have been revised. However, these revisions do not affect the protectiveness of the remedy. Exposure pathways identified in the ROD have not changed. Toxicity factors for PCE, TCE, cis 1,2-DCE, and 1,1,1-TCA have changed since the last five year review. These changes do not affect the short term protectiveness of the remedy because the cleanup standards are within the protective carcinogenic risk range. In addition, no one is currently drinking the contaminated groundwater. Progress towards meeting the RAO of restoring groundwater to its beneficial use is ongoing.

8. Issues

Table 7 summarizes the current issues for the Watkins-Johnson Superfund Site.

Table 7. Current Issues for the Watkins-Johnson Site

Issue	Affects Current Protectiveness (Yes or No)	Affects Future Protectiveness (Yes or No)
Increasing concentrations of PCE and TCE in southern wells .	No	Yes
Institutional controls (ICs) have not been implemented for the Site.	No	Yes
Groundwater level monitoring northwest of RA-2 is insufficient to verify that capture is occurring	No	Yes

9. Recommendations and Follow-up Actions

Table 8 provides recommendations to address the current issues at the Watkins-Johnson Superfund Site, along with proposed milestone dates to achieve the recommended follow-up actions

In addition to the recommendations included in Table 8, a recommendation that does not necessarily affect current or future protectiveness is to increase security for all Site wells. All Site wells should be clearly labeled and have lockable lids with locks securely in place to prevent tampering, especially considering that the on-site business facility on-site is idle.

Table 8. Recommendations to Address Current Issues at the Watkins-Johnson Site

Issue	Recommendations / Follow-Up Actions	Party Respon -sible	Over-sight Agency	Mile-stone Date	Affects Protectiveness? (Yes or No)	
					Current	Future
Increasing concentrations of PCE and TCE in southern wells	Implement GW optimization remedy work plan	WJC	EPA	March 2014	No	Yes
Institutional controls (ICs) have not been implemented for the Site.	Identify and implement Institutional Controls	WJC DTSC	EPA DTSC	June 2014	No	Yes
Groundwater level monitoring northwest of RA-2 is not sufficient to verify that capture is occurring.	Collect a complete concurrent set of groundwater level data to verify capture.	WJC	EPA	December 2013	No	Yes

10. Protectiveness Statement

The remedy at the Watkins-Johnson Superfund Site is currently protective of human health and the environment in the short term, because all exposure pathways that could result in unacceptable risks are being controlled. In order for the remedy to be protective in the long-term, the following actions need to be taken: 1) implement the groundwater optimization work plan, 2) implement institutional controls, and 3) collect a complete concurrent set of groundwater elevation data in monitoring wells north of the Site.

11. Next Review

The next Five Year Review will be due within five years of the signature date of this Five Year Review.

Appendix A. List of Documents Reviewed

Arcadis, 2012. *Remedy Optimization Work Plan for Watkins-Johnson Superfund Site, 440 Kings Village Road, Scotts Valley, California.* February 9, 2012.

Arcadis, 2012. USEPA Second Quarter 2012 Monitoring Report, Watkins-Johnson Superfund Site, 440 Kings Village Road, Scotts Valley, California. June 30, 2012.

Arcadis, 2011. USEPA Fourth Quarter 2011 Monitoring Report, Watkins-Johnson Superfund Site, 440 Kings Village Road, Scotts Valley, California. December 31, 2011.

Arcadis, 2011. Letter, Subject: Groundwater Extraction System, Watkins-Johnson Superfund Site, 440 Kings Village Road, Scotts Valley, California. To Ms. Bruni Davila, USEPA Region 9. October 18, 2011.

Arcadis, 2011. USEPA First Quarter 2011 Monitoring Report, Watkins-Johnson Superfund Site, 440 Kings Village Road, Scotts Valley, California. March 31, 2011.

Arcadis, 2011. Background Groundwater Assessment, Watkins-Johnson Superfund Site, 440 Kings Village Road, Scotts Valley, California. February 11, 2011.

Arcadis, 2010. Notice of Claim for Remediation Cost Contribution to Kings Cleaners, Scotts Valley, California. May 20, 2010.

Arcadis, 2009. USEPA Third Quarter 2009 Monitoring Report, Watkins-Johnson Superfund Site, 440 Kings Village Road, Scotts Valley, California. October 30, 2009.

Arcadis, 2009. USEPA Second Quarter 2009 Monitoring Report, Watkins-Johnson Superfund Site, 440 Kings Village Road, Scotts Valley, California. August 7, 2009.

Arcadis, 2006. Letter, Subject: Site Status and Evaluation of Offsite Sources, Watkins Johnson Superfund Site, 440 Kings Village Road, Scotts Valley, California. To Mr. Pankaj Arora, USEPA Region 9. June 19, 2006.

Arcadis, 2003. Final VLEACH Modeling Report, Watkins-Johnson Superfund Site, Scotts Valley, California. July 2, 2003.

Delta Consultants, 2009. Quarterly Groundwater Monitoring Report, Second Quarter 2009, Camp Evers Area, Scotts Valley, California. Prepared for ConocoPhillips, Shell Oil Products US, and Chevron Environmental Management Co. July 20, 2009.

ETIC Engineering, Inc., 2006. Groundwater Modeling Study of the Santa Margarita Groundwater Basin. Prepared for Scotts Valley Water District. May 2006.

Kennedy/Jenks Consultants, 2011. Revised 2010 Urban Water Management Plan. Prepared for Scotts Valley Water District. July 2011.

Kennedy/Jenks Consultants, 2010. Annual Report 2009 Water Year, Scotts Valley Water District Groundwater Management Program. Prepared for Scotts Valley Water District. June 2010.

Kennedy/Jenks Consultants, 2009. Annual Report 2008 Water Year, Scotts Valley Water District Groundwater Management Program. Prepared for Scotts Valley Water District. May 2009.

R.L. Stollar and Associates, Inc., 1989. Remedial Investigation, Watkins-Johnson Company, Scotts Valley, California (Vols. 1 & 2). April 28, 1989.

Rincon Consultants, Inc., 2008. Phase I Environmental Site Assessment, Scotts Valley Town Center, Scotts Valley, California. Prepared for RRM Design Group, San Luis Obispo, California. April 25, 2008.

Stantec Consulting Corporation, 2011. Fourth Quarter 2010 Groundwater Monitoring and Remediation Status Report, Scotts Valley Dry Cleaners, 272A Mount Herman Road, Scotts Valley, California. Prepared for The Pratt Company. February 2, 2011.

U.S. Army Corps of Engineers (USACE), 2007. Second Five-Year Review Report for Watkins-Johnson Company (Stewart Division) Superfund Site, Scotts Valley, Santa Cruz County, California. Prepared for USEPA Region 9. September 26, 2007.

U.S. Environmental Protection Agency (USEPA) Region 9, 2011. Letter; RE: EPA Direction to Initiate Work to Optimize the Remedy; Watkins Johnson Superfund Site, 440 Kings Village Road, Scotts Valley, California. To Joseph Pugh, Legal Counsel, TriQuint Semiconductor, Inc. November 9, 2011.

USEPA 2002. OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance). November 2002.

USEPA Region 9, 1990. Record of Decision, Watkins-Johnson Superfund Site, Scotts Valley, California. June 29, 1990.

Appendix B. Press Notices

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SPACE FOR COURT CLERK'S FILING STAMP

Proof of Publication

(2015.5 C.C.P.)

STATE OF CALIFORNIA]
SS
COUNTY OF SANTA CRUZ]

Public Notice

I, THE UNDERSIGNED, DECLARE:

That I am over the age of eighteen and not interested in the herein-referenced matter; that I am now, and at all times embraced in the publication herein mentioned was, a principal employee of the printer of the Santa Cruz Sentinel, a daily newspaper printed, published and circulated in the said county and adjudged a, newspaper of general circulation by the Superior Court of California in and for the County of Santa Cruz, under Proceeding No. 25794; that the advertisement (of which the annexed is a true printed copy) was published in the above-named newspaper on the following dates, to wit: **February 19, 2012**

I DECLARE under penalty of perjury that, the foregoing is true and correct to the best of my knowledge.

This **20th day** of **February, 2012**, at Santa Cruz, California.

JACKIE WHITE

PUBLIC NOTICE
THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY BEGINS THIRD FIVE-YEAR REVIEW OF CLEANUP AT THE WATKINS-JOHNSON SUPERFUND SITE

The U.S. Environmental Protection Agency (EPA) has begun the third five-year review of cleanup actions undertaken at the Watkins-Johnson Company (Stewart Division) Superfund Site located in Scotts Valley, CA. A remedy was selected for the site in 1990 to address contaminated soil and groundwater. Currently, there is a groundwater extraction and treatment system operating at the site, with discharge of the treated water to Bean Creek. Treated water does not present any human health concerns and is not used as drinking water.

THE REVIEW PROCESS
The purpose of the five-year review is to understand how the constructed remedy is operating and to measure the progress towards meeting the Site's cleanup objectives in order to protect human health and the environment. Because hazardous substances remain onsite above risk-based levels that prevent unrestricted use and exposure, EPA will be conducting this review. Specifically, EPA will be looking into the movement or breakdown of site contaminants, the operation of mechanical components, the application of property restrictions, the integrity of the cap and fences, changes in scientific knowledge about site contaminants, changes in exposure pathways, and changes in regulations. EPA will be interviewing State regulatory authorities, and interested members of the public.

COMMUNITY INVOLVEMENT
If you have any concerns about the Watkins-Johnson Site, and particularly if you have direct knowledge regarding the operation and maintenance of the remedy, then EPA would like to talk with you. Please contact Bruni Dávila, Project Manager for the Site. When completed, a copy of the final report will be placed in the information repository and be available on-line at the location and website given below.

SITE HISTORY
Watkins-Johnson Company (WJC) began operations at the site in 1963, which included manufacturing industrial furnaces and electronic components, and using the site as a research facility. Soil and groundwater contamination occurred when chemical waste was disposed into the drainage system. In 1984 investigations found chemicals such as trichloroethylene (TCE); 1,1,2 – trichloroethane (TCA); and trans-1,2 dichlorethylene (1,2-DCE) among other chemicals at the site. In 1990 the Site cleanup plan included the capping of certain surface areas to reduce infiltration and contaminant migration, a groundwater pump and treat system (with discharge to the nearby Bean Creek), and a soil vapor extraction (SVE) system to cleanup the soil. Currently, the groundwater system continues to operate.

FOR MORE INFORMATION
Please visit EPA's website for the Watkins-Johnson Site: **www.epa.gov/region09/Watkins-Johnson**. Or visit the information repositories to review the administrative record or contact EPA representatives.

Information Repositories:

Scotts Valley Branch Library
251 Kings Village Road
Scotts Valley, CA 95066
Telephone: (831) 427-7712
Hours: Mon & Sat: 1 - 5 pm,
Tue & Thu: 10 am - 7 pm,
Wed: 11 am - 7 pm, Fri & Sun: Closed

U.S. EPA Superfund Records Center
95 Hawthorne Street, Room 403
San Francisco, CA 94105-3901

Contact Information:

Brunilda Dávila
Project Manager
75 Hawthorne St. (SFD 7-2)
San Francisco, CA 94105
(415) 972-3162
davila.brunilda@epa.gov

Alejandro Díaz
Community Involvement Coordinator
75 Hawthorne St. (SFD-6-3)
San Francisco, CA 94105
(800) 231-3075 or (415) 972-3242
diaz.alejandro@epa.gov

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Appendix C. Interview Forms

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Watkins-Johnson Third Five-Year Review

Interview Questions and Responses

WATKINS-JOHNSON SUPERFUND SITE
440 KINGS VILLAGE ROAD
SCOTTS VALLEY, CALIFORNIA

Interviewees and dates interviews were conducted:

- Property Owner (Aviza) – Patrick O'Connor (Executive VP & Chief Financial Officer)
  In-person interview at time of site inspection on 1/18/2012
- State (CA RWQCB Central Coast Region) – Wei Liu, Ph.D., P.G.
  Phone interview conducted 1/25/2012
- County (Santa Cruz County Environmental Health Service, Site Mitigation Program) – Scott E. Carson, P.G., CEG, REA
  Phone interview conducted 2/3/2012
- Local (Scotts Valley Water District) – Colin Smith, Associate Engineer
  Phone interview conducted 1/25/2012
- Nearby Resident (name withheld)
  Phone interview conducted 1/25/2012

Interviewers: Marlowe Laubach and Jefferey Powers (USACE, Seattle District)

Table C-1. Interview Questions for State (Wei Liu), County (Scott Carson), and Local (Colin Smith) Interviewees

Q1: What is your overall impression of the W-J Superfund Site (general sentiment)? A1: Mr. Wei Liu: It's been under cleanup for many years. Some low concentrations in the groundwater haven't reached EPA's cleanup goals. Hoping it can be cleaned up soon. A1: Mr. Colin Smith: Overall general sentiment of concern. We know that there is a long history of water extraction. On-going PCE detections speculated to be off-site source; however, elevated PCE detections on-site. PCE detection in one well is 10 times TCE concentration. Feel that there is a complex source on the site and is not convinced that there is an off-site source. KV series and SA series wells were to be installed at off-site areas but only the KV series were installed. Existing PCE site at the dry cleaners. Deep groundwater at Kings Cleaners has no PCE. The Scotts Valley Cleaners site on Mt. Herman road located south of Watkins-Johnson site has PCE. At a site near Scotts Valley Road and Mt Herman Rd there is an MBTE investigation related to petroleum which shows the migration pathway. But the migration from Scotts Valley cleaners is unknown. A1: Mr. Scott Carson: I've been the oversight person for this site for the last 3-4 years. Essentially, I keep track all the reports that come through on behalf of the county to make sure we are comfortable with what has been occurring. I am familiar with the site since I do review the reports. Although, I'm a little out-of-date with the latest reports. I haven't reviewed them in detail; primarily the background report. The consultant has been notifying us of their field work and that's good. There are some concerns about the project.
Q2: What is your current role and your agency's role with respect to the site? A2: Mr. Liu: I'm with the California Regional Water Board – Central Coast Region. Involved with regulating the NPDES discharge permit at Watkins-Johnson. Involved with the treatment of the contaminated groundwater that discharges into Bean Creek. They [Regional Water Board] do routinely receive the monitoring reports. A2: Mr. Smith: With the Scotts Valley Water District. Mañana Woods Well is regulated by the San Lorenzo Water District (Jim Mueller – POC.) Some of the wells are located in the Lompico aquifer which is below the Santa Margarita aquifer. The site monitoring and extraction wells are located in the Santa Margarita aquifer. Well No. #9 operated by Scotts Valley Water District does not have a high flow. Well 10A, also operated by Scotts Valley, has a flow of 300 gallons per minute. The Wescosa Well used for the northern border for the Scotts Valley Cleaners site is a private well. There is a Suburban Propane well which is a private shallow well. Arcadis used it for background information recently. There appears to be a vertical range but not defined in the north parking lot (at the 7-11 site). A2: Mr. Scott Carson: I'm with the Santa Cruz County, Environmental Health Science, Site Mitigation Program. USEPA is the lead agency. We feel we have a role to provide local input and feedback. We have commented and provided the EPA with comments.

Q3: Have there been routine communications or activities (for example, site visits, inspections, etc) conducted by your office regarding the site? If so, please give purpose and results.
A3: Mr. Liu: Previously attended the once a year inspection for discharge. But it's been several years, since they attended an inspection. This is because the concentrations are low (influent below cleanup goals) and because our task load cannot support site inspections. There have been no violations to the NPDES permit.
A3: Mr. Smith: Our office was on site on a daily basis during the KV series well installation in the fall/late summer of 2011. We were also invited on-site to look at the cores for those wells. Arcadis does periodically contact our office re: water depths and water quality at our well facilities through email. During PCE investigation in Kings Cleaners, the cleaners' remedial contractor invited Arcadis and the Santa Cruz County official to look at those cores.
A3: Mr. Scott Carson: We [the county] asked to be notified of all field work. I went out and inspected the drilling work for the background study. I was able to see the cores. There have been some meetings with USEPA and the responsible party and want to be more in-tuned to those discussions so that we understand the progress of the project. I did attend one of those but it's been awhile. It would be nice to be included in this discussion; more for information earlier in the process rather than later.

Q4: Are you aware if the site has been in compliance with permitting or reporting requirements?
A4: Mr. Liu: There have been no violations to the NPDES permit.
A4: Mr. Smith: The site has been in compliance with permitting and reporting. For over a year, the PRP wanted to stop pumping from the extraction well and was not switching the lead-lag carbon; likely in anticipation of the shutdown of the extraction and treatment system. Also, it was my understanding in the scope [to determine up gradient sources]; KV series wells were installed but not the SA series wells. Groundwater elevations in the KV wells do not appear to show that they are upgradient [from the site]. I don't see a gradient between the KV wells and the on-site wells. Lompico extractions may affect water levels.
A4: Mr. Scott Carson: Drilling and well permits go through county. The CUPA (certified unified program agency) oversees the use of hazardous materials on site. The site requested a business closure permit and they satisfied all business closure requirements. This includes making sure that no residual hazardous material remain. There's a septic system in place and it looks like they didn't contribute additional hazardous materials through the septic system. They disconnected the septic system when they acquired the site and discharges directly into sewer system.

Q5: Have there been any complaints, violations, or other incidents related to the site requiring a response by your office? If so, please give details of the events and results of the responses.
A5: Mr. Liu: A couple times. Last month, we received a call from the PRP who stated they needed to do a carbon exchange and needed to shut down the plant. Rather than filing an incident report, we requested they include this info in the monitoring report. [Incident referred to here was after a carbon change out, it was noticed that carbon was leaking through to the discharge point requiring shutdown of the plant to make repairs.]
A5: Mr. Smith: No legitimate complaints/violations. [Minor concerns include: breakthrough in the mid-GAC vessel since the water district has an interest in the discharge. The water district provides water for fire services; apparently they re-plumbed such that they were recycling water when they were not supposed to (referring to the water use of ½ the 75 gpm water being treated). However, currently all the extraction is being discharged to Bean Creek.]
A5: Mr. Scott Carson:
I'm not the CUPA inspector and he would be the most appropriate. I am not aware of any complaints or violations. The CUPA inspector for Watkins-Johns is: Jose Deanda (831-454-2759).
Mr. Jose Deanda (contacted separately for Question 5 as per advice of Mr. Carson): Can only recall one instance where there was a small discharge of a gaseous substance into a work area; this discharge occurred within a building. They dealt with the indicated leak and reported it to us. This is the only incident I recall in the last 5 years. This incident has no relevance to the Superfund Site. They handled their chemicals as we would expect them to. Diesel and oil remains on site for emergency generators and oil for their elevator.

Q6: Do you feel well informed about the site's activities and progress?
A6: Mr. Liu: Yes.
A6: Mr. Smith: We are well informed in quarterly and semi-annually reporting; when the EPA and Santa Cruz County take action. Feel there is poor communications of decisions made between the responsible party (RP) and EPA that are referenced in a public record. During the KV well installations, good communication during permitting process but no communication as to why the other wells (SA series) were not installed.
A6: Mr. Scott Carson: I am getting the information in the form of reports. We are not necessarily being included on decision/discussion that occurs in the interim. It would be preferable to be included in these discussions.

Q7: Are you aware of any changes in State/County/Local laws and regulations that may impact the protectiveness of the site?
A7: Mr. Liu: Not aware of any changes.
A7: Mr. Smith: I don't think so. Santa Cruz county revised their well ordinance but it does not apply because the site is in an incorporated area of the County, where the Scotts Valley Water District ordinance applies.
A7: Mr. Scott Carson: The science has evolved since the start of the project. When this project started the emphasis was on protection of water (Scotts Valley is a main aquifer district). Now there is an emphasis on all the exposure pathways, especially the soil vapor in the shallow soils before closure of this site. Methods used back then are not up to today's standards for soil vapor. This has been brought up to EPA. I don't know if there's been a current investigation on soil vapor using the latest methodology. We would like to see that soil was sampled using current methodology. We, now, would not "allow" a cap to remain in place for contaminated shallow soils in this day. Did they go back and re-sample the hot spots of soil? Instead used the shallow GW monitoring to confirm that soil is clean. Would like to see soil data.

Q8: Do you have any comments, suggestions, or recommendations regarding the site's management, operation, or any other aspects of the site?
A8: Mr. Liu: None at this time.
A8: Mr. Smith: 1. There are a large number of monitoring wells but the sampling requirement is reduced to only 4 wells. It would be nice to have a larger snapshot of water quality/levels at the on-site and off-site monitoring wells.
2. MBTE is included in the sampling requirements which is a good indicator for determining groundwater direction. PBA (pert-butyl alcohol), a breakdown product of MBTE, is not included in the sampling requirement but should be.
3. Freon-113 (trichlorotrifluoronaphthalene) isn't included [in the sample analyte list].
4. Responsible Party (RP) consultants for the other nearby cleanup sites should communicate with Arcadis – it's clear that they (Arcadis) don't receive the reports on Scotts Valley Dry Cleaner or Camp Evers. If the RP on the W-J were included in the adjacent sites' distribution lists for documents this would give them insight to the groundwater direction at Watkins-Johnson. These sites (Scotts Valley Dry Cleaner and Camp Evers) are under the Central Region Water Board. The other sites are collecting additional data that could be used at W-J.
5. Mike Cloud Santa Cruz County geologist speculated there is not a flat contact between the Santa Margarita and the Lompico aquifers. When they installed the KV wells; there could be contact introduced. Mr. Cloud is a structural geologist.
6. What does the value from passive diffuse bags represent? What are the pros/cons for using this technology compared to taking purged samples?
A8: Mr. Scott Carson:
Main things: soil vapor issues that need to be appropriately addressed before site closure.
Would like to be included in the significant dialog rather than learning about it after the decision was made. Example: upgradient investigation; it would have been nice to be able to provide input especially since some of the upgradient areas are our sites.

Table 2. Interview Questions for Property Owner (Aviza) Interviewees (Patrick O'Connor, and also with Mr. Tom Fleming present)

Q1: What is your overall impression of the W-J Superfund Site (general sentiment)? A1: Mr. O'Connor stated he believed the path to site closure is taking too long. He believes the site is clean with respect to the original contamination. He believes the groundwater contamination showing up in the hydraulically upgradient wells is coming from elsewhere, either one or both of the dry cleaners or from the former airport which is now a park. Mr. Fleming also agreed with this general sentiment.
Q2: What is the current and projected future ownership status of the site (Is the property for sale, has it been sold, or subject to a pending sale?)? What is the current zoning status of the property, and has that changed in the last five years? A2: The property is currently for sale and no sale is pending. The current zoning is industrial, and the zoning status has not changed. When the property is sold, and depending on plans a new owner might have for property redevelopment, the zoning may change in the future but it would have to be approved by the city of Scotts Valley, and likely the county would be involved as well. Both the city and county are aware of the W-J Superfund Site.
Q3: Are you aware of any trespassing or vandalism to the property within the last five years? Are any of the buildings currently occupied? What security measures are in place to prevent vandalism and/or trespass? A3: Generally trespassing and vandalism are not problems on the property. Mr. O'Connor recalled one instance of on an on-site intrusion. The property is fenced, and the only way onto the property is through a secured gate. There is either an Aviza staff presence or security guards on patrol 24 hours/day, 7 days/week. No known vandalism to Superfund Site components.
Q4: Do you have any comments, suggestions, or recommendations regarding any aspects of the W-J Superfund site? A4: Mr. O'Connor indicated, as he stated previously, in his opinion the site should have been closed out already. He feels at times he is stuck in the middle between the two parties (EPA and the PRP remedial consultant) who at times have had a contentious relationship. He is hopeful that the two parties can resolve differences for the benefit of moving toward site closure.

Table 3. Interview Questions for Nearby Resident (name withheld)

Q1: Where is your residence located with respect to the W-J Superfund Site? A1: (Response is withheld from official documentation to maintain resident's privacy).
Q2: What is your overall impression of the W-J Superfund Site (general sentiment)? A2: I don't think the information is current on the website. I'm not finding information regarding current events. I saw something about increase in toxicity but I don't know what's going on at the site. I'm nervous about being downstream to the site and what I'm being exposed to. The flow (the concrete culvert) discharges somewhat near this resident's property. Would like more information about the site.
Q3: What effects have site operations had on the surrounding community? A3: That [groundwater treatment] filtration system is the only physical thing that shows the treatment. The zoning issues may affect community. The fact that this is a Superfund Site affected the sale of the site property.
Q4: Are you aware of any community concerns regarding the site or its past or current operations and administration? If so, please give details. A4: There is a concern that the site is affecting soils, irrigation water, and gardens. Concerned if the site will affect my health. I know that the water I use is supplied from the city distribution lines. [The interviewee asked if there was sampling of Bean Creek or the surrounding area soils.]
Q5: Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency responses from local authorities? If so, please give details. A5: Trespassing does occur all the time but it's just kids playing on the sand hill.
Q6: Do you feel well informed about the site's activities and progress? A6: The EPA website is not up to date.
Q7: Do you have any additional comments, suggestions, or recommendations regarding any aspects of the W-J Superfund Site, the property, or adjacent properties? A7: Updating the website so people know what's going on. Once the cleanup ends, everyone is concerned about property values. If I try to sell my property, and there's a Superfund site how does that affect my property values? More information regarding potential closure of the site would help. Purchase of resident's property was somewhat recent. Title search during the property purchase indicated a Superfund site nearby. Interviewee asked about the timeline regarding the investigation of upgradient source.

Appendix D. Site Inspection Checklist

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Site Inspection Checklist

I. SITE INFORMATION	
Site name: Watkins-Johnson Superfund Site	**Date of inspection:** January 18, 2012
Location: Scotts Valley, CA	**EPA ID:** CAD980893234
Agency, office, or company leading the five-year review: EPA Region 9	**Weather/temperature:** 55° F, Sunny

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☐ Access controls
- ☐ Institutional controls
- ☒ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☒ Other: impermeable asphalt soils cap
- ☐ 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** _____ _____ _____
   Name Title Date
   Interviewed ☐ at site ☐ at office ☐ by phone Phone no. _____
   Problems, suggestions; ☐ Report attached _____
   _____

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: Contact: _____ _____ _____ Name Title Date Phone no. Problems; suggestions; ☐ Report attached _____ _____ Agency _____ Contact _____ _____ _____ _____ Name Title Date Phone no. Problems; suggestions; ☐ Report attached _____ _____ Agency _____ Contact _____ _____ _____ _____ Name Title Date Phone no. Problems; suggestions; ☐ Report attached _____ _____ Agency _____ Contact _____ _____ _____ _____ Name Title Date Phone no. Problems; suggestions; ☐ Report attached _____ _____
4.	**Other interviews** (optional) ☒ Report attached.
Mr. Patrick O'Connor and Mr. Tom Fleming, both with Aviza Technology (Aviza is the property owner).	
Other interviews were conducted via phone subsequent to the site inspection; results are documented separately.	

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: No documents were observed present on site. Pertinent documents are reportedly kept by the PRP and their remedial contractor at their respective offices.			
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: No documents were observed present on site. Pertinent documents are reportedly kept by the PRP and their remedial contractor at their respective offices.			
3.	**O&M and OSHA Training Records**	☐ Readily available	☐ Up to date	☐ N/A
	Remarks: No documents were observed present on site. Pertinent documents are reportedly kept by the PRP and their remedial contractor at their respective offices.			
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: No documents were observed present on site. Pertinent documents are reportedly kept by the PRP and their remedial contractor at their respective offices. Effluent discharge permit verified prior to inspection.			
5.	**Gas Generation Records**	☐ Readily available	☐ Up to date	☒ N/A
	Remarks_____			
6.	**Settlement Monument Records**	☐ Readily available	☐ Up to date	☒ N/A
	Remarks_____			
7.	**Groundwater Monitoring Records**	☒ Readily available	☒ Up to date	☐ N/A
	Remarks: Although not kept on site, recent groundwater monitoring reports were reviewed prior to inspection.			
8.	**Leachate Extraction Records**	☐ Readily available	☐ Up to date	☒ N/A
	Remarks_____			
9.	**Discharge Compliance Records**			
	☐ Air	☐ Readily available	☐ Up to date	☐ N/A
	☒ Water (effluent)	☒ Readily available	☒ Up to date	☐ N/A
	Remarks: Although not kept on site, recent groundwater monitoring discharge compliance data were reviewed prior to inspection.			
10.	**Daily Access/Security Logs**	☐ Readily available	☐ Up to date	☐ N/A
	Remarks: No documents were observed present on site.			

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_____ 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
From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost

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

Describe costs and reasons: Attempts to obtain O&M cost data for the past five years have been unsuccessful. Based on typical P&T system operation of a single extraction operating (RA-2), and a reduced list of sampled monitoring wells, costs are expected to be equal to or less than previous O&M costs.

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

A. Fencing

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

Remarks: Fencing appears in good condition; secure gate was observed to be functional. Note that access controls are not a required component of the remedy as stated in the ROD.

B. Other Access Restrictions

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

Remarks: No signs are present that would indicate the property is a Superfund Site; however, on-site staff are aware of the site's status.

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) _____

Frequency _____

Responsible party/agency _____

Contact _____ _____ _____ _____

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

_____

_____

_____

_____

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_____

_____

2. **Land use changes on site** ☐ N/A

Remarks_____

_____

3. **Land use changes off site** ☐ N/A

Remarks_____

_____

VI. GENERAL SITE CONDITIONS

A. Roads ☐ Applicable ☒ N/A

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

Remarks: <u>There are limited roads on the property and they appear to be in good condition; however, they are not a component of the remedy.</u>

B. Other Site Conditions

Remarks _____

_____

_____

_____

_____

_____

VII. LANDFILL COVERS ☐ Applicable ☒ N/A

A. Landfill Surface

1. **Settlement** (Low spots) ☐ Location shown on site map ☐ Settlement not evident
   Areal extent_____ Depth_____
   Remarks_____
   _____

2. **Cracks** ☐ Location shown on site map ☐ Cracking not evident
   Lengths_____ Widths_____Depths_____
   Remarks_____
   _____

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident
   Areal extent_____ Depth_____
   Remarks_____
   _____

4. **Holes** ☐ Location shown on site map ☐ Holes not evident
   Areal extent_____ Depth_____
   Remarks_____
   _____

5. **Vegetative Cover** ☐ Grass ☐ Cover properly established ☐ No signs of stress
   ☐ Trees/Shrubs (indicate size and locations on a diagram)
   Remarks_____
   _____

6. **Alternative Cover (armored rock, concrete, etc.)** ☐ N/A
   Remarks_____
   _____

7. **Bulges** ☐ Location shown on site map ☐ Bulges not evident
   Areal extent_____ Height_____
   Remarks_____
   _____

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		☐ Applicable ☒ N/A (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** ☐ Active G Passive
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance
☐ N/A
Remarks_____
_____

2. **Gas Monitoring Probes**
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____
_____

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_____
_____

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

1. **Gas Treatment Facilities**
   ☐ Flaring ☐ Thermal destruction ☐ Collection for reuse
   ☐ Good condition G 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_____
   _____

F. Cover Drainage Layer ☐ Applicable ☒ N/A

1. **Outlet Pipes Inspected** ☐ Functioning ☐ N/A
   Remarks_____
   _____

2. **Outlet Rock Inspected** ☐ Functioning ☐ N/A
   Remarks_____
   _____

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

1. **Siltation** Areal extent_____ Depth_____ ☐ N/A
   ☐ Siltation not evident
   Remarks_____
   _____

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 Frequency_____ ☐ Evidence of breaching 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: Extraction well RA-2 is only well currently required to operate; the well, pump, plumbing and electrical between it and the treatment system are apparently in good working order.
2.	**Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☐ Good condition ☒ Needs Maintenance Remarks: Good condition except as noted in the latest monitoring report reviewed, "November 11, 2011: System restart attempted. Carbon was observed in the effluent after the restart [immediately after carbon change-out completion]. The system was immediately shut down to assess the carbon vessels. Following internal inspection and repair of the carbon vessels, the system restart is anticipated in December 2011." Note the system restarted on December 28, 2011 after carbon vessel repairs were made.
3.	**Spare Parts and Equipment** ☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks: Unknown.
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)_____
   - ☐ 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: 5,272,400 gallons based on prorated 4th Quarter 2011 total of 1,318,100 gallons (likely underestimated total due to system down-time during the 4th quarter).
   - ☐ Quantity of surface water treated annually_____

   Remarks: Carbon was observed in the effluent line in November 2011; the repair was made in December 2011. See remarks to IX. 2. for details.

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

3. **Tanks, Vaults, Storage Vessels**
   ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance
   Remarks_____
   _____

4. **Discharge Structure and Appurtenances**
   ☐ N/A ☐ Good condition ☐ Needs Maintenance
   Remarks: Discharge is to Bean Creek via underground concrete pipe. Condition is assumed adequate.

5. **Treatment Building(s)**
   ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair
   ☐ Chemicals and equipment properly stored
   Remarks: Treatment system is unenclosed. Roof only over control panels and storage area and appears in good condition.

6. **Monitoring Wells** (pump and treatment remedy)
   ☒ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☒ Good condition
   ☐ All required wells located ☐ Needs Maintenance ☐ N/A
   Remarks: The wells inspected (WJ-41, WJ-11, and WJ-37A) appeared in good condition but most were not labeled. Also, the wells had caps with locks secured; however, the caps could still be removed.

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_____

_____

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.

1) Soil vapor extraction (SVE) was an original component of the remedy but SVE was successfully accomplished and the system shut down upon EPA approval of a VLEACH soil vapor rebound study in 2003. The soil vapor component of remedy is considered complete.

2) Additionally, the ROD called for an impermeable cap to be installed over the original high-concentration source area of concern to minimize the potential for mobilization of soil contamination into groundwater. The property's asphalt parking lot was constructed to meet the capping requirements, and remains in place and in relatively good condition. Minor cracking due to aging was observed in the asphalt; however, the vast majority of surface runoff would be directed to the parking lot drains and directed away from the original source area of concern.

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.). The current remedy includes extraction and carbon-treatment of groundwater within the regional (Santa Margarita) aquifer, NPDES-permitted discharge of treated water to Bean Creek, and continued quarterly groundwater monitoring and monthly treatment system monitoring. The soils cap continues to be a component of the current remedy, and while it currently is of less concern than the active groundwater remedy, its importance may be elevated should the property be sold to a residential developer. The goal of the groundwater remedy is to reduce Site contaminant concentrations to below the clean-up criteria. Despite occasional operational issues with the treatment system (e.g., carbon spillage into effluent line, November 2011), overall it is containing the TCE and PCE groundwater plumes on site and reducing contaminant mass in the aquifer. At issue is whether an off-site source is contributing to the PCE and/or TCE site contamination.
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. O&M of the treatment system appears adequate. Down time during non-routine repairs such as that for extraction well pumps, and in November 2011 due to carbon in effluent line should be minimized to the extent practical.
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. There are no O&M operational issues or observations that would suggest the protectiveness of the remedy may be compromised in the future.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

Site Inspection Roster:

The Watkins-Johnson Third Five-Year Review Site Inspection was conducted on January 18, 2012. The site inspection tour consisted of a site walk of the hydraulically up-gradient groundwater monitoring well locations, the original source area, the vicinity of the groundwater extraction wells, and the groundwater treatment plant; a walk of the asphalt parking lot which serves as the impermeable soils cap; a drive to Bean Creek; and a drive behind Buildings 8 and 6. After the site tour, USEPA and USACE staff conducted the interviews with Aviza personnel in the Building 9 conference room. The following personnel were in attendance:

Ms. Brunilda Davila
USEPA Region 9 Remedial Project Manager
Phone: (415) 972-3162

Mr. Jefferey Powers
US Army Corps of Engineers (USACE), Seattle District
Phone: (206) 764-3561

Mr. Patrick O'Connor
Aviza Technology
Phone: (831) 439-6360

Mr. Tom Fleming
Aviza Technology

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Appendix E. Photographs from Site Inspection Visit

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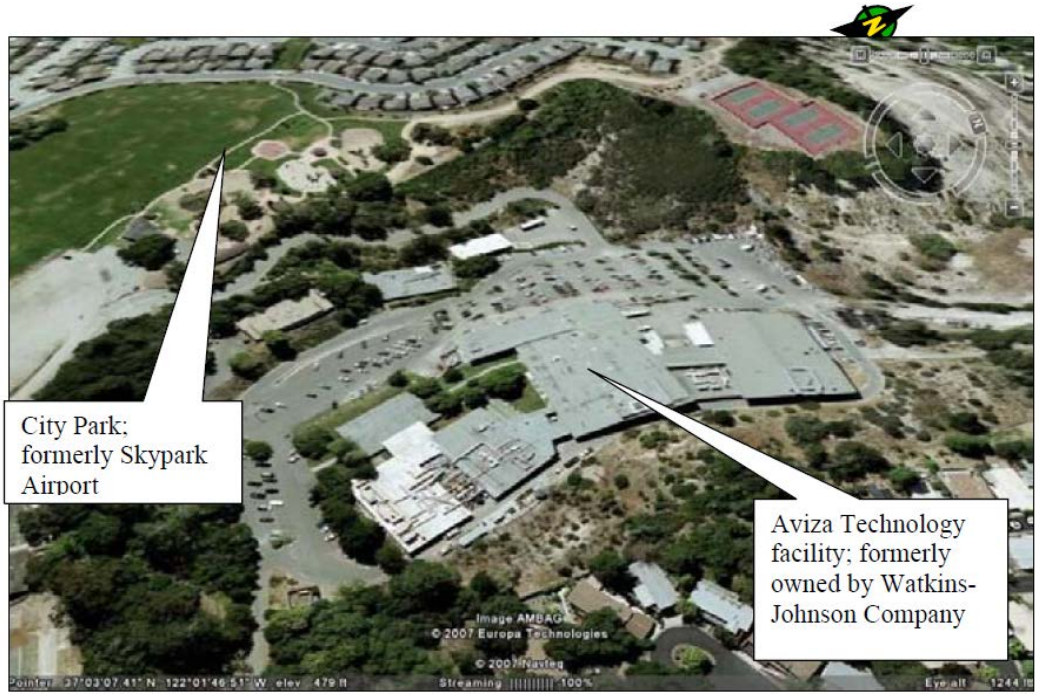
Photographs from Site Inspection Visit



Aerial view of the Watkins-Johnson Site (reproduced from Second Five-Year Review).

Gate to Watkins-Johnson Site at end of Kings Village Road, from city park parking lot.

Well WJ-11 in foreground and W-J asphalt parking lot in background, facing northwest.

Groundwater treatment plant.

Just north of W-J parking lot towards Bean Creek, facing north.

KV series wells vicinity, facing north toward Kings Village Road.

Well KV-2 in southbound lane of Kings Village Road.

Appendix F. Data Review Evaluation

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Compiled Data from Quarterly Monitoring Reports

WJ-41		
Date	PCE	TCE
06/15/88	<1	<1
09/13/88	<1	<1
11/30/88	<0.5	<0.5
06/21/89		<0.5
12/11/90		<0.5
03/12/91		<0.5
05/14/91		<0.5
06/26/91		<0.5
12/09/91		<0.5
03/03/92		<0.5
09/15/92		<0.5
06/14/94		<0.5
06/07/95		0.8
06/13/96	<0.5	4
09/25/96		0.9
12/17/96		0.8
06/26/97		3.3
12/15/97	1.8	11
03/12/98	1.2	6.3
06/22/98	0.9	4.5
12/14/98		7.2
03/17/99	1.3	7.7
06/01/99	1.6	8.9
10/15/99	2.09	9.72
12/18/99	4.1	18.1
03/08/00	1.31	6.84
05/05/00	1.82	9.24
06/14/00	3	15
07/21/00	1.64	7.81
09/28/00	3.4	16.5
10/26/00	4.1	20.9
11/28/00	2.8	13.8
12/15/00	3.43	17
01/17/01	4.37	22.5
02/09/01	2.79	21.6
04/30/01	4.23	13.2
05/15/01	2.43	17.4
06/12/01	0.89	4.2
07/31/01	2.2	12
08/30/01	2.8	6.2
09/20/01	2.4	12
10/25/01	2.4	12
11/21/01	2.8	14
01/31/02	5	1.1
03/27/02	<0.5	1.5
05/10/02	1.9	12
07/02/02	0.54	2.2
09/24/02	0.56	2.3
11/24/02	0.79	2.7
12/26/02	0.65	2.3
01/31/03	1.4	7.4
05/13/03	2	11
08/14/03	4.8	33
11/19/03	3.9	21
12/30/03	2.9	14

WJ-41 (Continued)		
Date	PCE	TCE
01/28/04	1.1	4.9
02/25/04	1.4	9.6
03/25/04	1.7	14
05/11/04	3	14
08/03/04	2.8	16
11/02/04	4.5	19
02/10/05	3.6	19
05/03/05	2.6	16
08/05/05	2.9	19
11/18/05	1.1	14
02/06/06	1.5	11
04/24/06	2.3	14
08/03/06	3.2	17
11/03/06	3.2	16
02/02/07	4	16
05/01/07	1.4	16
08/15/07	3.7	18
11/13/07	3.5	14
02/12/08	3	12
05/13/08	2.5	11
08/05/08	2.7	10
12/19/08	<0.5	5.5
02/20/09	1.1	5.6
03/20/09	0.7	6.4
04/21/09	1.5	8.2
05/20/09	1.3	8.7
08/06/09	1.7	6.9
10/20/09	0.7	1.5
02/23/10	0.8	2.1
05/12/10	2	8.9
08/19/10	2.8	9.8
11/17/10	2.1	6.5
02/09/11	1.6	6.2
04/13/11	0.7	2.4
07/19/11	2	5.5
10/18/11	1.4	3.8

WJ-11		
Date	PCE	TCE
01/03/85		<1
08/02/86	0.03	<0.01
11/26/86	<1	<1
12/10/86	<1	<1
01/07/87	<1	<1
01/29/87	<0.5	<0.5
05/23/87	<0.5	<0.5
08/26/87	<0.5	<0.5
09/11/91	<0.5	<0.5
03/03/92		<0.5
12/08/92		<0.5
06/14/93		<0.5
11/18/05	7.2	<0.5
02/06/06	8.4	<0.5
04/24/06	16	<0.5
02/02/07	8.6	<0.5
12/19/08	9.5	<0.5
02/20/09	23	<0.5
03/20/09	16	<0.5
04/21/09	16	<0.5
05/20/09	15	<0.5
02/23/10	20	<0.5
05/12/10	2.1	<0.5
08/19/10	2	<0.5
11/17/10	13	<0.5
02/09/11	11	<0.5
04/13/11	26	<0.5
07/19/11	20	<0.5
10/18/11	25	<0.5

WJ-43		
Date	PCE	TCE
06/14/88	<1	<1
09/14/88	<1	<1
03/29/89		<0.12
06/22/89	<0.5	<0.5
09/21/89		<0.5
12/13/89		<0.5
03/20/90		<0.5
12/11/90		<0.5
03/12/91		<0.5
06/25/91		<0.5
12/09/91		<0.5
06/16/92		<0.5
12/08/92		<0.5
06/15/93		<0.5
06/14/94		<0.5
06/06/95		<0.5
06/10/96	<0.5	<0.5
06/24/97		<0.5
06/23/98	<0.5	<0.5
06/02/99	2.7	<0.5
06/19/00	5.9	<0.5
06/07/01	8	<0.5
05/09/02	4.9	<0.5
06/26/02	9.8	<0.5
01/31/03	6	<0.5
05/13/03	5.9	<0.5
08/14/03	5.4	<0.5
11/19/03	5.3	<0.5
12/30/03	4.6	<0.5
01/28/04	6.1	<0.5
02/25/04	8.8	<0.5
03/25/04	8.9	<0.5
05/11/04	10	<0.5
08/03/04	13	<0.5
11/02/04	8.6	<0.5
02/10/05	17	<0.5
05/03/05	25	<0.5
08/05/05	29	<0.5
11/18/05	23	<0.5
02/06/06	21	<0.5
04/24/06	34	0.5
08/03/06	46	0.6
11/03/06	31	<0.5
02/02/07	25	<0.5
05/01/07	28	0.9
08/15/07	45	1
11/13/07	24	<0.5
02/12/08	20	<0.5
05/13/08	30	0.6
08/05/08	35	0.5
12/19/08	17	<0.5
02/20/09	21	<0.5
03/20/09	12	<0.5
04/21/09	11	<0.5
05/20/09	12	<0.5

WJ-43 (Continued)		
Date	PCE	TCE
08/06/09	13	<0.5
10/20/09	18	<0.5
02/23/10	20	<0.5
05/12/10	30	0.6
08/19/10	36	0.5
11/17/10	34	0.6
02/09/11	31	<0.5
04/13/11	27	<0.5
07/19/11	30	<0.5
10/18/11	23	<0.5

WJ-37A		
Date	PCE	TCE
05/25/87	<0.5	
08/24/87	<0.5	<0.5
11/17/87	<0.5	<0.5
03/10/88	<1	
06/19/88	<1	
09/15/88	<1	
06/22/89		<0.5
09/02/89		<0.5
06/20/90		<0.5
09/18/90		<0.5
09/12/91		<0.5
03/04/92		<0.5
09/15/92	0.73	<0.5
12/08/92	ND	ND
12/10/92	<0.5	<0.5
06/14/93	ND	ND
06/16/93	<0.5	<0.5
12/14/93	0.5	ND
12/15/93	0.5	<0.5
06/15/94		<0.5
12/20/94	ND	ND
12/22/94	<0.5	<0.5
06/05/95	ND	ND
06/07/95	<0.5	0.8
12/27/95		<0.5
06/12/96	<0.5	<0.5
06/18/96	<0.5	<0.5
12/16/96		<0.5
06/23/97		<0.5
06/22/98	<0.5	<0.5
06/24/98	<0.5	<0.5
06/01/99	<0.5	<0.5
06/19/00	<0.5	<0.5
06/06/01	0.63	<0.5
06/27/02	0.63	<0.5
11/18/05	1.8	<0.5
02/06/06	1	<0.5
04/24/06	2.1	<0.5
02/02/07	0.97	0.55
12/19/08	22	6.4
02/20/09	42	6.4
03/20/09	25	9.3
04/21/09	23	6.4
05/20/09	17	3.7
02/23/10	20	0.7
05/12/10	<0.5	<0.5
08/19/10	22	0.9
11/17/10	25	0.9
02/09/11	20	1.1
04/13/11	26	1.9
07/19/11	31	1.8
10/18/11	22	1.1

RA-2		
Date	PCE	TCE
11/30/86		225
03/08/88	<0.5	27
06/13/88	1	18
09/12/88	1	38
08/19/04	1.5	0.73
11/02/04	1.5	0.86
02/10/05	1.7	0.93
05/03/05	1.6	0.9
08/05/05	2.1	0.8
11/08/05	1.7	0.6
02/06/06	2	0.8
04/24/06	2.1	0.9
08/03/06	2.6	0.8
11/03/06	4.3	0.8
12/19/08		
02/20/09	<0.5	<0.5
03/20/09	<0.5	4.2
04/21/09	0.5	4.4
05/20/09	0.5	<0.5
12/22/10	5.3	<0.5
01/18/11	6.3	0.6
02/09/11	5.5	0.5
06/02/11	6.9	0.6
07/06/11	9.3	0.6
08/17/11	7.1	<0.5
09/13/11	4.2	<0.5

KV-1		
Date	PCE 180	TCE 180
01/05/11	0.9	<0.5
02/09/11	<0.5	<0.5
04/13/11	1.1	<0.5
07/19/11	1.4	<0.5
10/18/11	1.3	<0.5

KV-2		
Date	PCE 180	TCE 180
01/05/11	35	0.8
02/09/11	22	1.1
04/13/11	39	0.9
07/19/11	53	1.8
10/18/11	48	1.5

KV-2		
Date	PCE 190	TCE 190
01/05/11	14	1.4
02/09/11	11	1.6
04/13/11	19	1.2
07/19/11	27	1.9
10/18/11	24	1.9

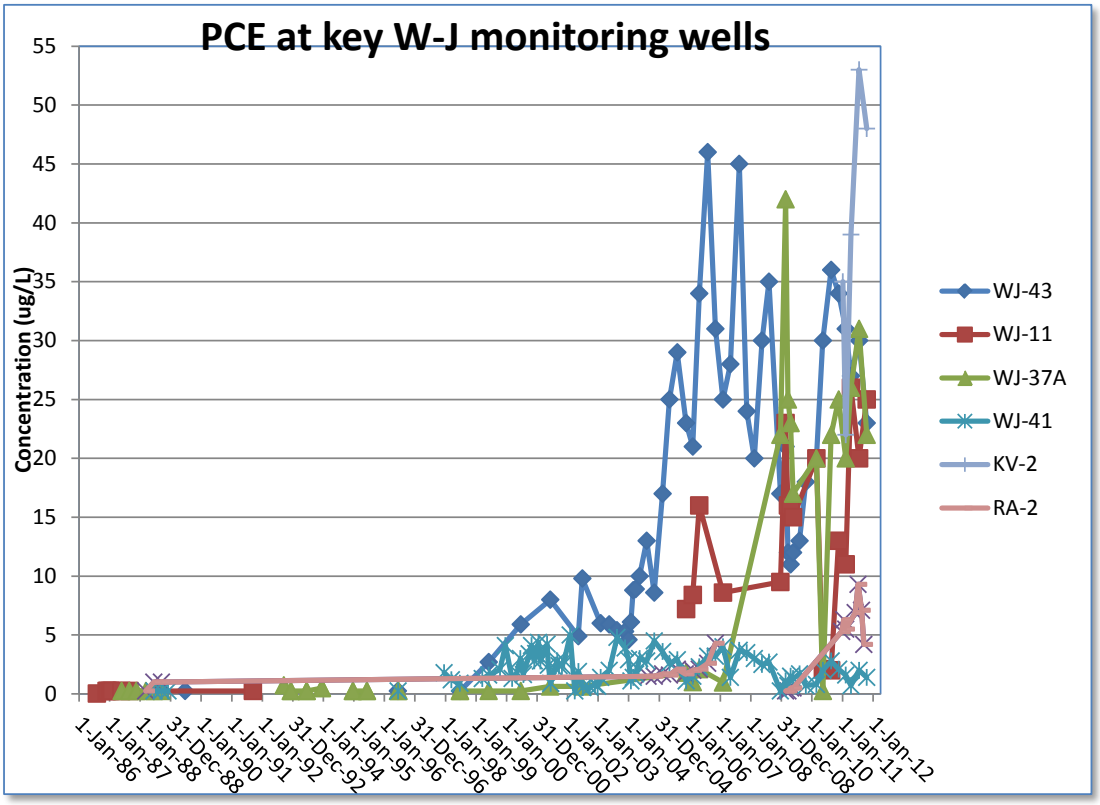
KV-2		
Date	PCE 200	TCE 200
01/05/11	3.7	<0.5
02/09/11	1.6	<0.5
04/13/11	5.9	1.5
07/19/11	8.1	2.4
10/18/11	8	2.3

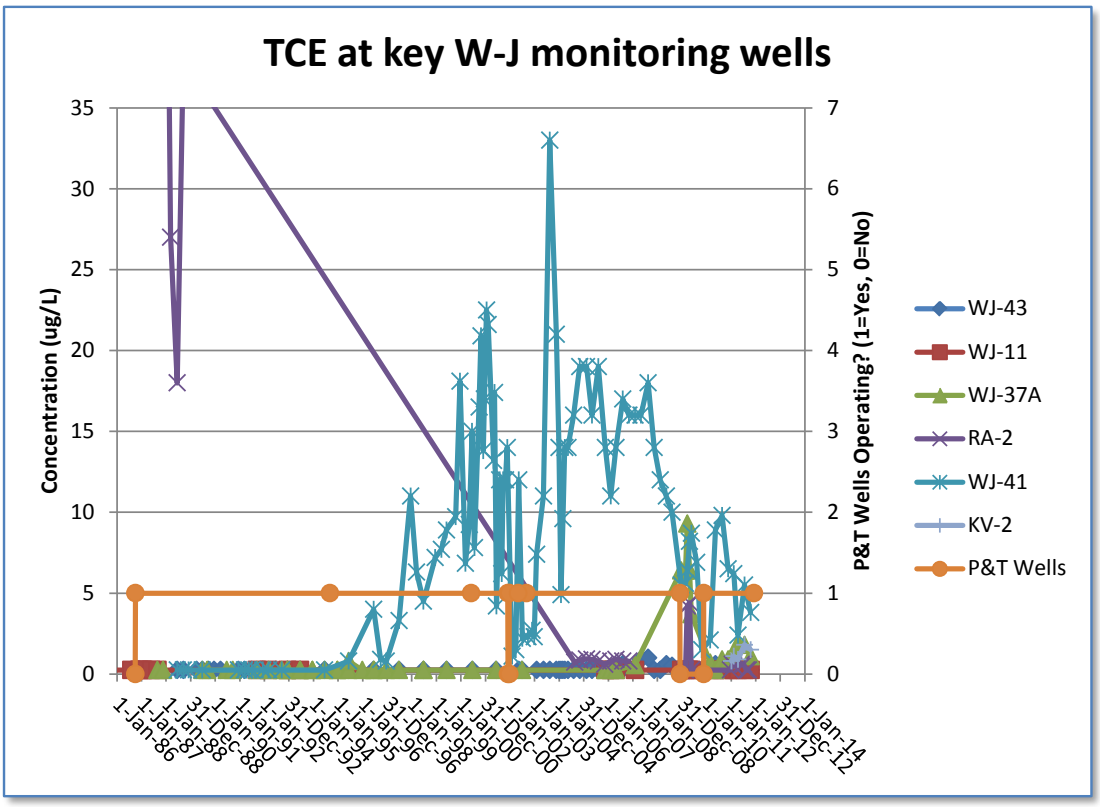
KV-3		
Date	PCE 172	TCE 172
11/17/10	<0.5	1.2
01/05/11	0.7	1
02/17/11	<0.5	1.3
04/13/11	1	1.6
07/19/11	1.1	1.8
10/18/11	1	1.8

KV-3		
Date	PCE 182	TCE 182
11/17/10	<0.5	1.2
01/05/11	0.5	0.9
02/17/11	<0.5	1.4
04/13/11	1.1	1.5
07/19/11	1.2	1.4
10/18/11	1	1.4

KV-4		
Date	PCE 185	TCE 185
02/09/11	<0.5	<0.5
04/13/11	<0.5	<0.5
07/19/11	<0.5	<0.5
10/18/11	<0.5	<0.5

Note:
< symbol indicates not detected at or above laboratory detection limit as shown.


PCE at key W-J monitoring wells
Concentration (ug/L)
55
50
45
40
35
30
25
20
15
10
5
0
1-Jan-86
1-Jan-87
1-Jan-88
31-Dec-88
1-Jan-90
1-Jan-91
1-Jan-92
31-Dec-92
1-Jan-94
1-Jan-95
31-Dec-96
1-Jan-98
1-Jan-99
31-Dec-00
1-Jan-02
1-Jan-03
31-Dec-04
1-Jan-06
1-Jan-07
31-Dec-08
1-Jan-10
1-Jan-11
1-Jan-12
WJ-43
WJ-11
WJ-37A
WJ-41
KV-2
RA-2


TCE at key W-J monitoring wells
Concentration (ug/L)
P&T Wells Operating? (1=Yes, 0=No)
35
30
25
20
15
10
5
0
7
6
5
4
3
2
1
0
1-Jan-86
1-Jan-87
31-Dec-88
1-Jan-90
1-Jan-91
31-Dec-92
1-Jan-94
1-Jan-95
31-Dec-96
1-Jan-98
1-Jan-99
31-Dec-00
1-Jan-02
1-Jan-03
31-Dec-04
1-Jan-06
1-Jan-07
31-Dec-08
1-Jan-10
1-Jan-11
31-Dec-12
1-Jan-14
WJ-43
WJ-11
WJ-37A
RA-2
WJ-41
KV-2
P&T Wells

Mann-Kendall Analysis for
Third Watkins-Johnson Five-Year Review

1. BACKGROUND

The Mann-Kendall test was performed to evaluate recent PCE and TCE trends at the 90% significance level for data from several key monitoring wells at the Watkins-Johnson Superfund Site in Scotts Valley, California. The trend testing utilized analytical data from the key wells since the data evaluation conducted in the last Five-Year Review; therefore, data was from the period of February 2007 to October 2011. Data trends prior to February 2007 were conducted and reported on previously. Overall, complete time-series data trend discussion is included in the Data Review section of the third Five-Year Review.

2. MANN-KENDALL ANALYSIS

The Mann-Kendall test is a non-parametric test for identifying trends in time-series data. The test compares the relative magnitudes of sample data rather than the data values themselves. One benefit of this test is that the data does not need to conform to any one distribution type. Data reported as non-detects (i.e., the analyte was not detected in the sample) can be included by assigning them a common value that is smaller than the lowest detected value in the dataset, although the number of non-detects should not be greater than 50% of the sample size, n.

Determining Mann-Kendall Statistic (S). Data are evaluated as an ordered time series. Each data value is compared to all subsequent data values. If a data value from a later time is higher than a data value from an earlier time, S is incremented by 1. Conversely, if a data value from a later time is lower than a data value from an earlier time, S is decremented by 1. The net result of all such increments and decrements yields the final value of S. A positive value of S is an indicator of a potentially increasing trend. Likewise, a negative value of S is an indicator of a potentially decreasing trend. A very high positive S is an indicator of a likely significant increasing trend; however, it is necessary to compute the probability associated with S and the sample size, n, to statistically quantify the significance of the trend.

Calculation of the Test Statistic (Z). Mann-Kendall describes a normal-approximation test that may be used for datasets with more than 10 values, provided there are not many tied values within the dataset. First, S is determined and then the variance (VAR) of S is calculated based on the following equation:

$$VAR(S) = [n*(n-1)*(2n+5)]/18$$

A normalized Test Statistic (Z) is calculated using the following equations:

Z = (S-1)/Square root[VAR(S)] if S>0

Z=0 if S=0

Z= (S+1)/Square root[VAR(S)] if S<0

Statistically Significant Trend Determination. For a trend to attain at least a 90% level of significance, the Test Statistic Z must be greater than 1.645 for a positive trend, or must be less than -1.645 for a negative trend. If neither of these conditions are met, then the dataset shows no trend at that level of significance. A 90% level of significance was chosen as the relevant probability level of significance for the 2007-2011 Watkins-Johnson datasets.

The following table summarizes the Mann-Kendall analysis results for the Third Watkins-Johnson Five-Year Review.

Table 1 - Mann-Kendall Trend Analysis Results, 1st Qtr 2007 to 4th Qtr 2011

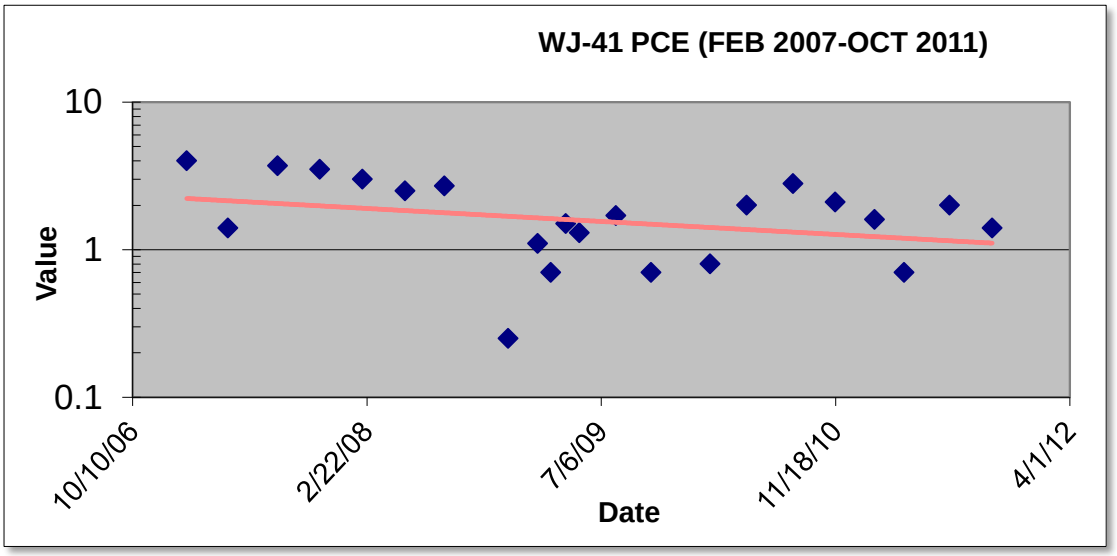
Well ID	Contaminant of Concern	Number of Data Points	Number of Non-detects	Minimum Value	Maximum Value	Mann Kendall Statistic (S)	Test Statistic (Z)	Trend (At 90% level of significance)
WJ-41	PCE	22	1	0.25	4	-60	-1.664	Decreasing
WJ-41	TCE	22	0	1.5	18	-129	-3.609	Decreasing
RA-2	PCE	11	2	0.25	9.3	37	2.803	Increasing
RA-2	TCE	11	5	0.25	4.4	-8	-0.545	No Trend
WJ-37A	PCE	14	1	0.25	42	14	0.712	No Trend
WJ-37A	TCE	14	1	0.25	9.3	-14	-0.712	No Trend
WJ-43	PCE	22	0	11	45	8	0.197	No Trend
WJ-43[1]	TCE	22	15	0.25	1.0	-32	-0.874	No Trend
WJ-11	PCE	14	0	2.0	26	19	0.985	No Trend
WJ-11[1]	TCE	14	14	0.25	0.25	0	0.055	No Trend
KV-2[2]	PCE	5	0	22	53	6	1.225	No Trend
KV-2[2]	TCE	5	0	0.8	1.8	6	1.225	No Trend

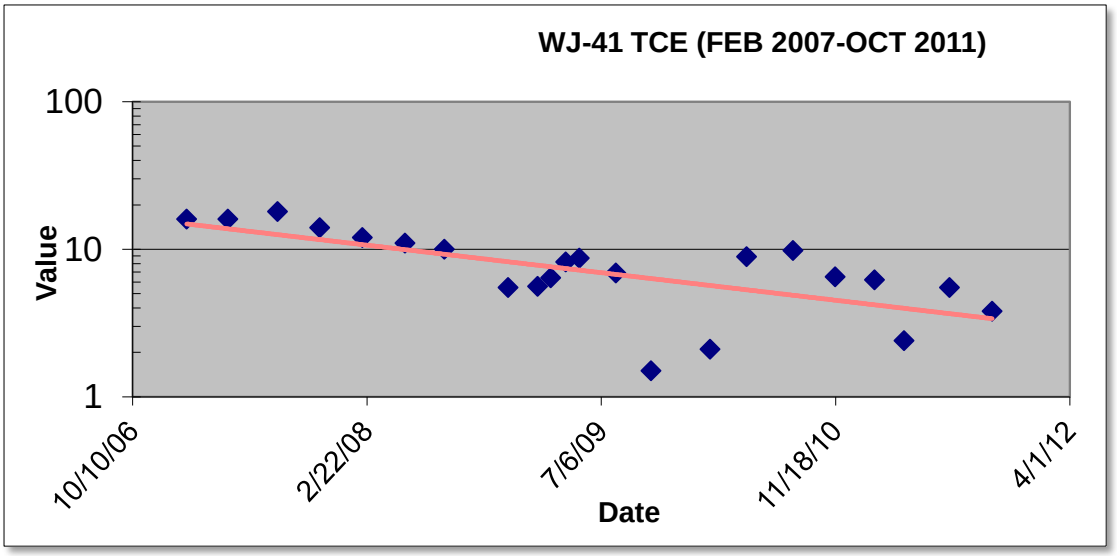
Notes:

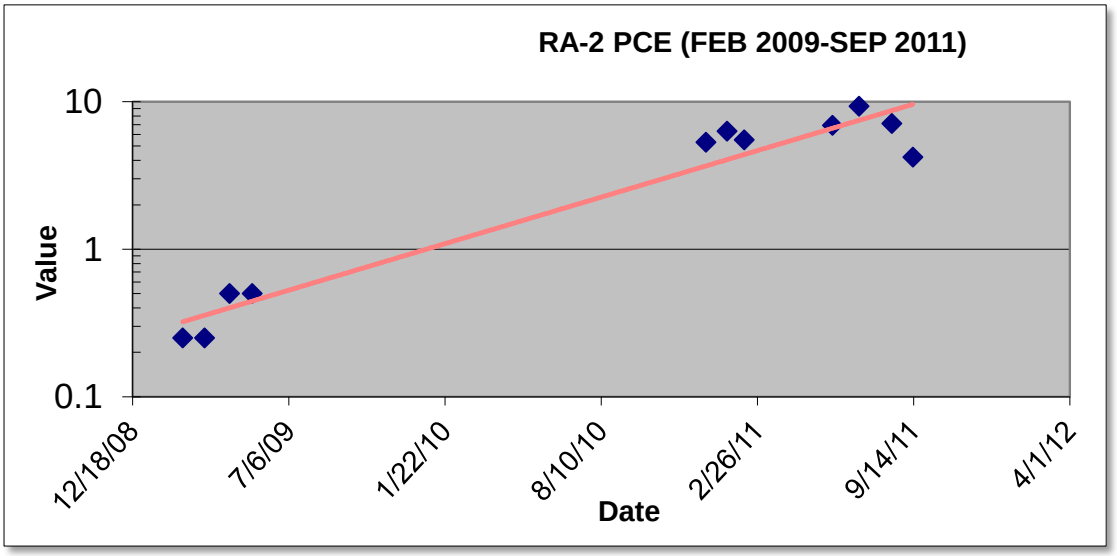
[1]Mann-Kendall Test not appropriate when no. of non-detects exceeds 50% of data points.

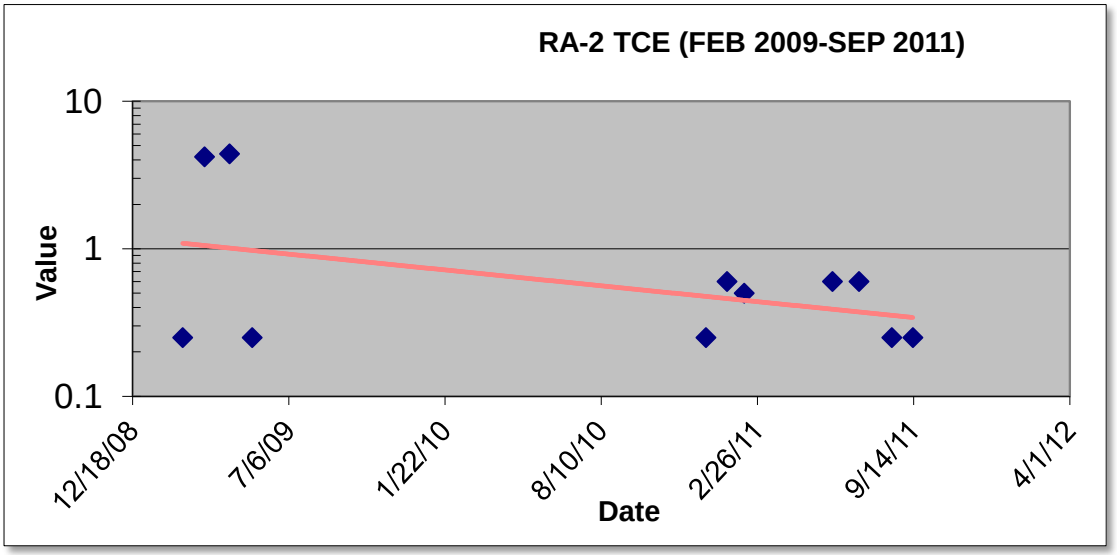
[2]Mann-Kendall Test not appropriate when there are fewer than 10 data points.

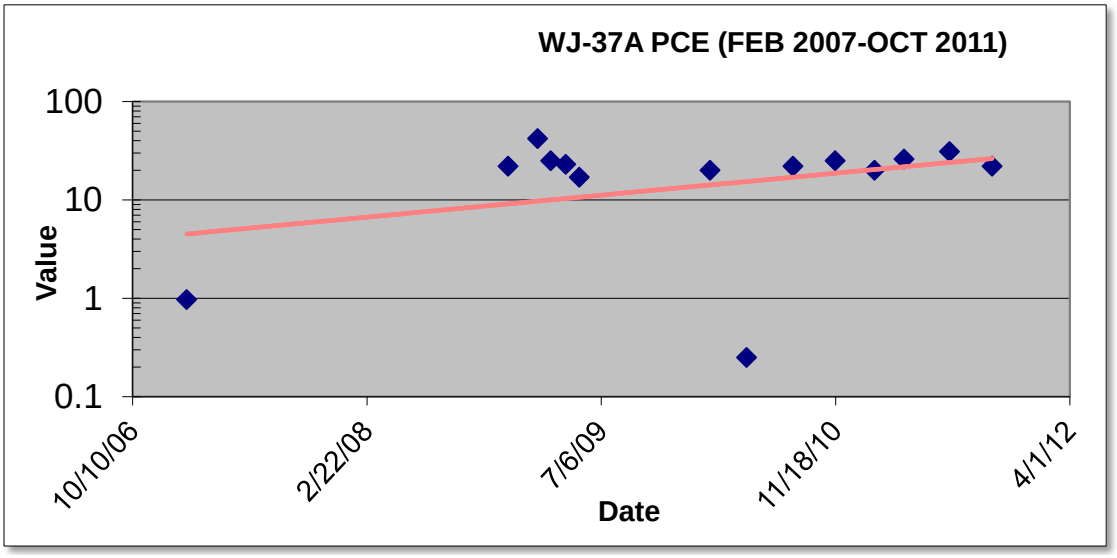
The following graphs depict PCE and TCE time-series data evaluated for this Five-Year Review.

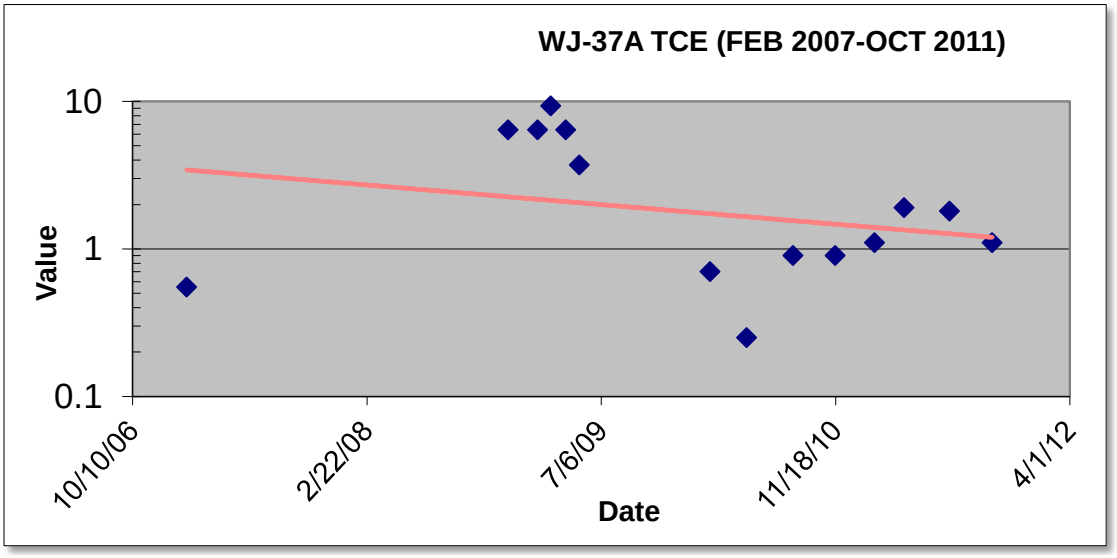


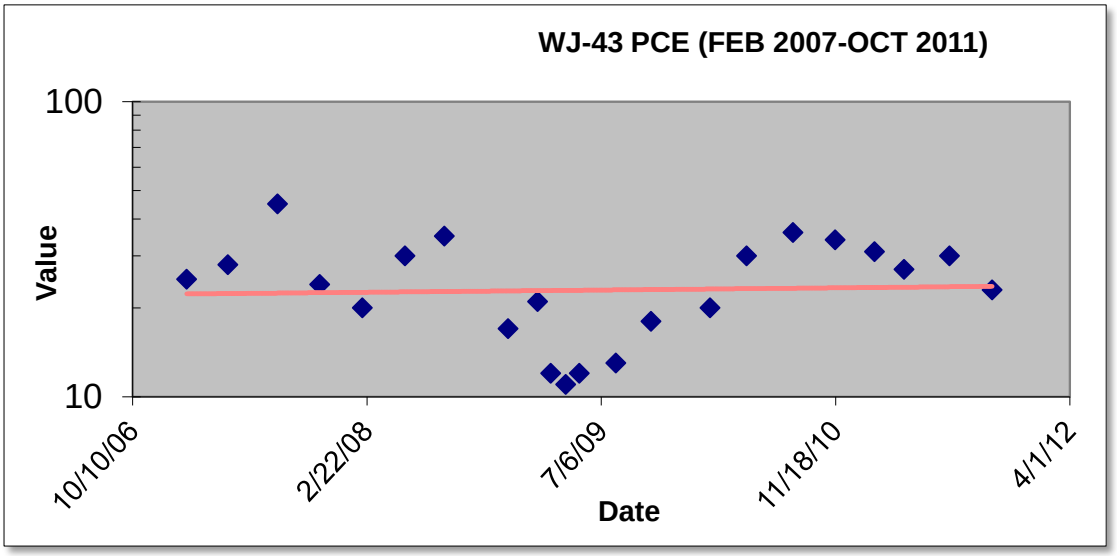


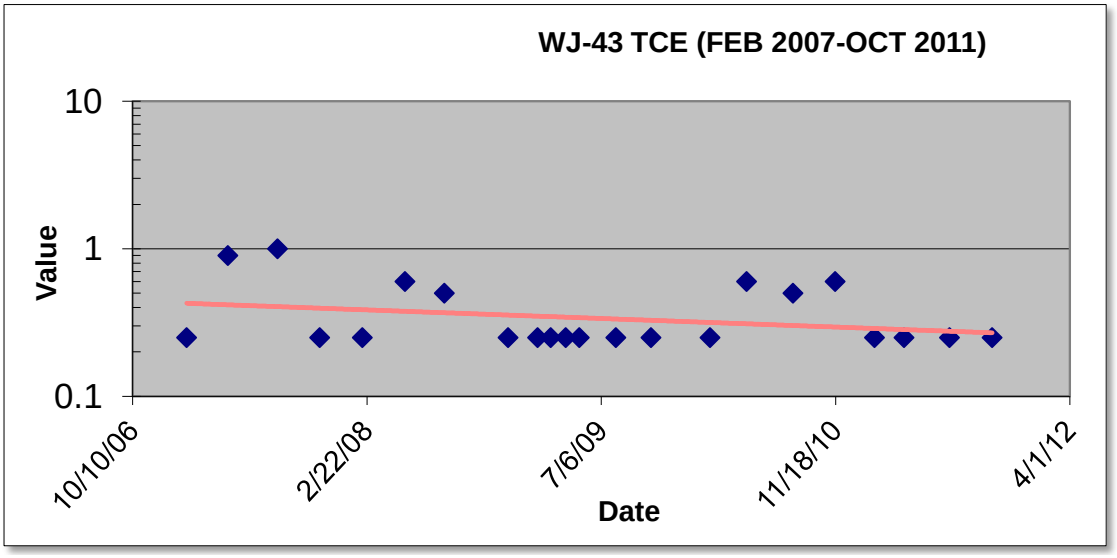

RA-2 PCE (FEB 2009-SEP 2011)
10
1
0.1
Value
12/18/08
7/6/09
1/22/10
8/10/10
2/26/11
9/14/11
4/1/12
Date

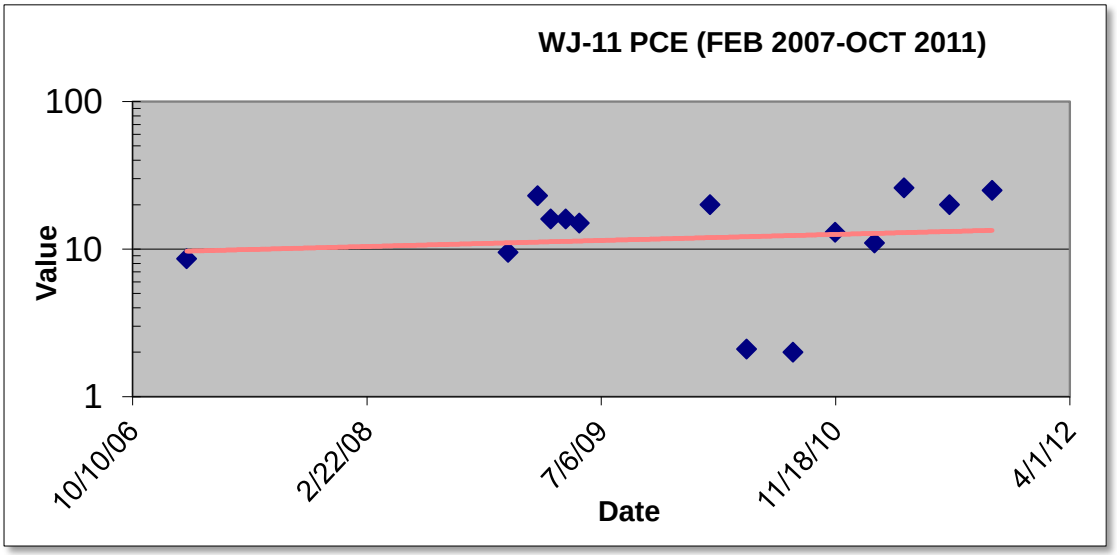

RA-2 TCE (FEB 2009-SEP 2011)
10
1
0.1
Value
12/18/08
7/6/09
1/22/10
8/10/10
2/26/11
9/14/11
4/1/12
Date

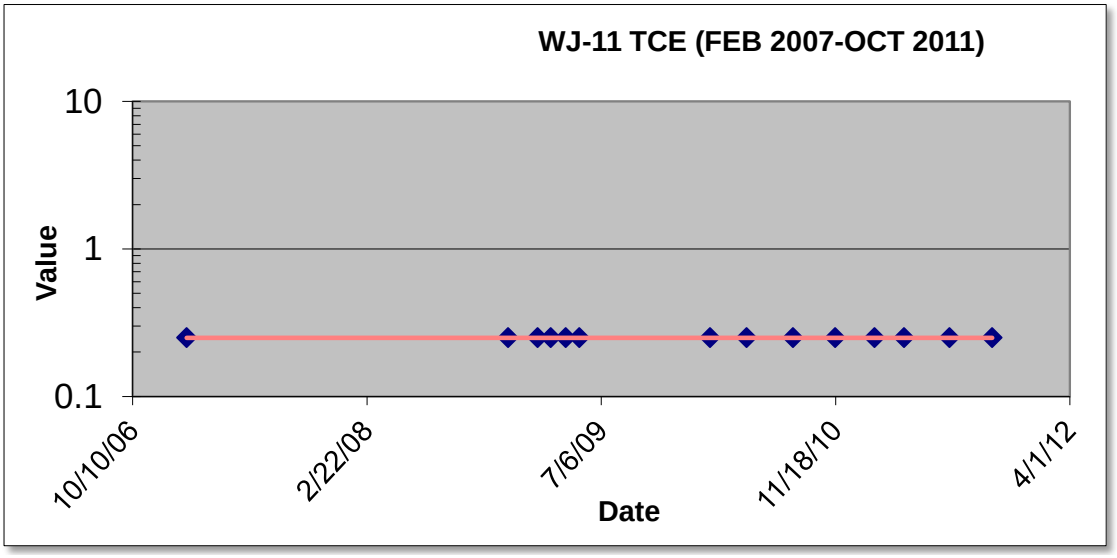

WJ-37A PCE (FEB 2007-OCT 2011)
100
10
1
0.1
Value
10/10/06
2/22/08
7/6/09
11/18/10
4/1/12
Date

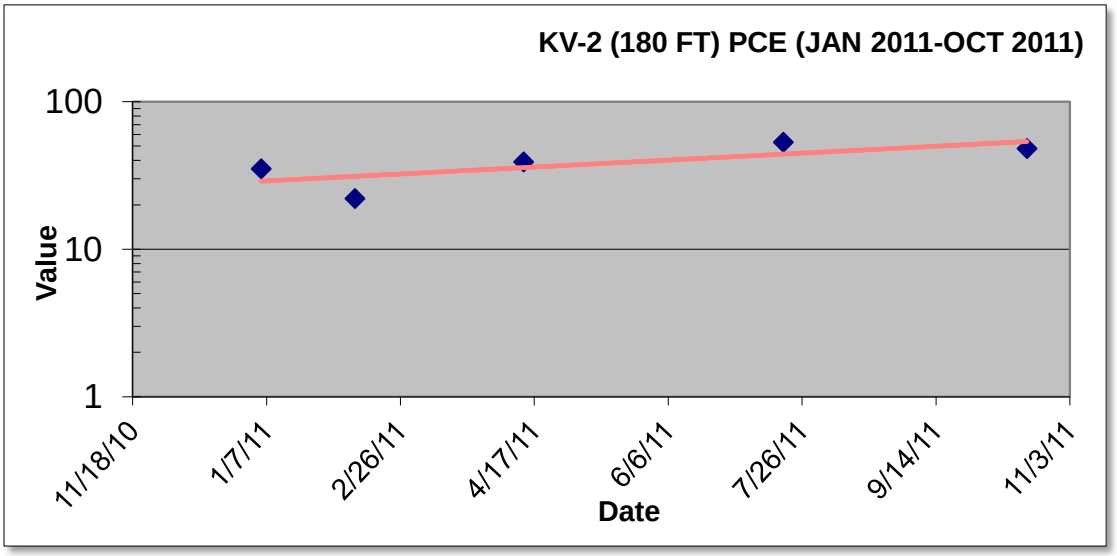

WJ-37A TCE (FEB 2007-OCT 2011)
10
1
0.1
Value
10/10/06
2/22/08
7/6/09
11/18/10
4/1/12
Date

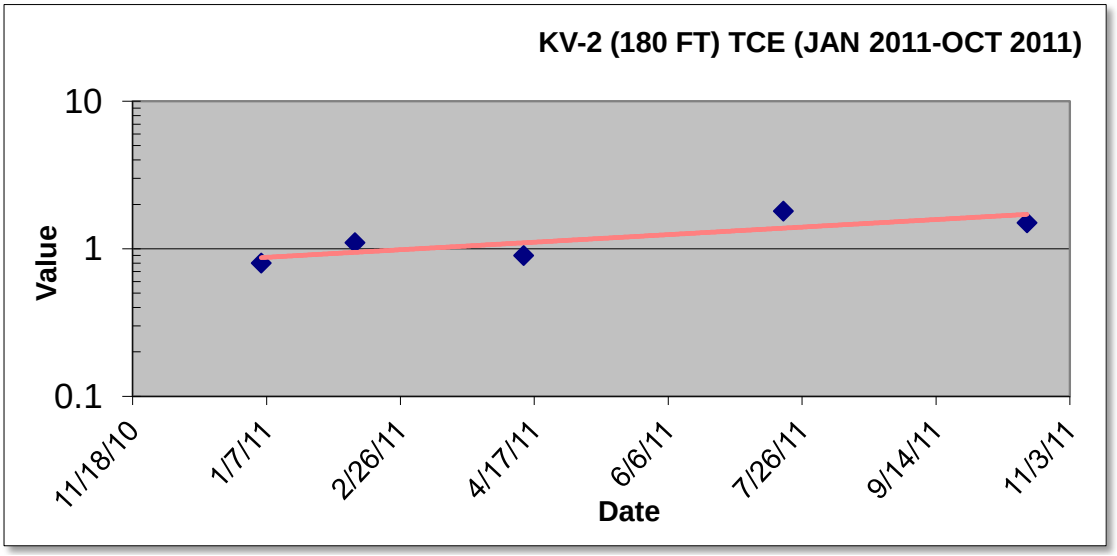

WJ-43 PCE (FEB 2007-OCT 2011)
100
10
Value
10/10/06
2/22/08
7/6/09
11/18/10
4/1/12
Date


WJ-43 TCE (FEB 2007-OCT 2011)
10
1
0.1
Value
10/10/06
2/22/08
7/6/09
11/18/10
4/1/12
Date


WJ-11 PCE (FEB 2007-OCT 2011)
100
10
1
Value
10/10/06
2/22/08
7/6/09
11/18/10
4/1/12
Date


WJ-11 TCE (FEB 2007-OCT 2011)
10
1
0.1
Value
10/10/06
2/22/08
7/6/09
11/18/10
4/1/12
Date


KV-2 (180 FT) PCE (JAN 2011-OCT 2011)
100
10
1
Value
11/18/10
1/7/11
2/26/11
4/17/11
6/6/11
7/26/11
9/14/11
11/3/11
Date


KV-2 (180 FT) TCE (JAN 2011-OCT 2011)
10
1
0.1
Value
11/18/10
1/7/11
2/26/11
4/17/11
6/6/11
7/26/11
9/14/11
11/3/11
Date