SECOND FIVE-YEAR REVIEW REPORT FOR TUCSON INTERNATIONAL AIRPORT AREA SUPERFUND SITE PIMA COUNTY, ARIZONA

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Executive Summary

This is the second Five-Year Review of the Tucson International Airport Area (TIAA) Superfund Site (Site) located in Tucson, Arizona. The purpose of this Five-Year Review (FYR) is to review information to determine if the remedy is and will continue to be protective of human health and the environment.

The TIAA Site is located in southeastern Arizona and encompasses sections of southwest Tucson, as well as adjoining lands south of the city. The Site boundaries are the Santa Cruz River on the west, Ajo Way on the north, Alvernon Way on the east, and the Hughes Access Road on the south.

The Site consists of five operable units (OUs), but only three of them are addressed in this FYR: OU1 (Area A and Area B groundwater), OU2, and OU3. OU1 groundwater is divided into Area A (western half) and Area B (eastern half). OU1 Area A groundwater includes the Tucson Airport Remediation Project (TARP) area. OU1 Area B groundwater includes the following locations: Texas Instruments property, the 162nd Arizona Air National Guard (AANG) Base, the West Cap area, and the West Plume B area. OU2 includes the Airport property soil and shallow groundwater zone (including the Three Hangars Building), and soil at Texas Instruments property, AANG, and West Cap. OU3 is the Air Force Plant 44/Raytheon (APF44) soil and groundwater. The Air Force has the lead for remediation on AFP44 and completed its own FYR; EPA has incorporated their findings into this sitewide FYR.

The groundwater and soil at the Site were contaminated by former aircraft and electronics manufacturing activities, fire drill training activities, and unlined landfills. The primary contaminant of concern (COC) is trichloroethylene (TCE). Other contaminants found at lower concentrations include 1,4-dioxane, tetrachloroethylene (PCE), 1,1-dichloroethylene (DCE), chloroform, benzene, and chromium. Perfluorinated compounds have recently been identified in various areas at the Site.

The remedy at OU1 Area A, as defined by the 1988 Record of Decision (ROD), includes extraction and treatment of the contaminated groundwater consisting of two well fields (north and south) and includes the use of packed column aeration. The North Well Field provides containment of the plume and the South Well Field provides for mass reduction. The extraction and treatment facility began operating in 1994. In 2014, an advanced oxidation process was incorporated into the existing treatment system, consisting of ultra-violet reactors, peroxide storage and feed equipment, and a granular activated carbon tank farm for peroxide quenching. The treated water is discharged to a reservoir that is part of the municipal potable water distribution system. The groundwater treatment facility is functioning as designed. Groundwater is treated to meet primary drinking water standards. Pumping rates in the North Well Field were reduced between 2016 and 2017 because of pump failures and the work by the City of Tucson to rehabilitate and replace aging remediation wells. To date, repairs of the remediation well field have been successful, and the plume is contained. In general, the TCE plume has been reduced as the South Well field continues to effectively remove contaminant mass.

The remedy at OU1 Area B, as defined by the 2012 ROD Amendment, includes in-situ chemical oxidation (ISCO) injections of potassium permanganate for the Texas Instruments property, the AANG Base, and the West Cap area. The remedy for the West Plume B area is monitored natural

attenuation (MNA). Potassium permanganate ISCO injections were performed in 2014 at the West Cap area and in 2016 at the Texas Instruments property. Post-injection performance monitoring is ongoing. Full-scale ISCO injections using potassium permanganate at the AANG Base are being planned. Groundwater monitoring to evaluate MNA is ongoing. Performance monitoring results at the West Cap area indicate decreasing TCE concentrations within the source area. Performance monitoring results at the Texas Instruments property do not provide conclusive information to determine whether ISCO has been effective. Continued monitoring at the Texas Instruments property will provide additional data to assess ISCO performance. Performance monitoring results at the AANG Base indicated increasing TCE concentrations. At the West Plume B area, natural attenuation is occurring. TCE concentrations are decreasing or stable.

The remedy at OU1 currently protects of human health and the environment. Contaminant containment is occurring and the groundwater treatment systems are operating to treat contaminated groundwater to below MCLs and to reduce groundwater contaminant concentrations. However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure protectiveness: re-evaluate the operation of the remedy, if groundwater levels continue to rise; and investigate the extent of PFCs in groundwater.

The remedy at OU2 consists of excavation of contaminated sludges and soils, closure of the Tucson Airport Area landfill, soil vapor extraction (SVE), and groundwater extraction and treatment. Excavation of contaminated sludges and soils occurred between 2007 and 2010. The landfill was closed in 2012. Two SVE systems currently operate within this OU. The groundwater extraction and treatment system treats the Shallow Groundwater Zone using an air stripper. The SVE systems are removing contaminant mass in the vadose zone with concentrations reaching asymptotic conditions. The groundwater extraction and treatment systems may not be fully containing contaminants, as indicated by increasing TCE concentrations in monitoring wells on- and off-property.

The remedy at OU2 currently protects human health and the environment because contamination in the vadose zone is decreasing via SVE, reducing transport to groundwater. However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure protectiveness: evaluate site conditions and groundwater extraction treatment systems to determine whether to optimize the existing extraction and treatment systems or evaluate alternative remedial technologies; re-evaluate the operation of the remedy, if groundwater levels continue to rise; and investigate the possible presence of PFCs in groundwater.

The remedy at OU3 consists of four soil sites and one groundwater plume. The remedial actions at the four soil sites are complete and the Air Force is preparing an Explanation of Significant Difference document for the Record of Decision for those sites to add Land Use Controls. The remedy for site Regional Groundwater Beneath AFP44, as defined by a 1985 Record of Decision includes extraction and treatment of contaminated groundwater using packed column aeration. The extraction and treatment system began operating in 1987. The treated water is reinjected into the regional groundwater zone. In 2008, an advanced oxidation process was incorporated into the treatment system, consisting of ozone feed equipment and hydrogen peroxide reactors. The packed column aeration system was removed from service. Treatability studies for soil source areas of chromium

groundwater contamination are ongoing at AFP44; based on the results of the studies, the Air Force may revise the Record of Decision for the site to include alternate remedies.

The remedy at OU3 currently protects human health and the environment because treated groundwater meets drinking water standards and regional screening levels, and there is no exposure pathway for human health or the environment. However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure protectiveness: prepare an ESD to include Land Use Restrictions the remedy for these sites; consider alternative technology for high chromium area; complete the indoor air investigation at Building 801; re-evaluate the operation of the remedy, if groundwater levels continue to rise; and investigate the extent of PFCs in groundwater.

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List of Abbreviations

AANG	Arizona Air National Guard
ADEQ	Arizona Department of Environmental Quality
AFP44	Air Force Plant #44 Raytheon Missile Systems Company
AOP	advanced oxidation process
ARAR	Applicable or Relevant and Appropriate Requirement
bgs	below ground surface
CFR	Code of Federal Regulations
CCl_4	carbon tetrachloride
COC	contaminant of concern
1,1-DCE	1,1-dichloroethylene
1,2-DCP	1,2-dichloropropane
EPA	Environmental Protection Agency
ESD	Explanation of Significant Differences
ft	foot or feet
FYR	Five-Year Review
GAC	granular activated carbon
gpm	gallons per minute
GSU	gravel subunit
GWTP	groundwater treatment plant
HiPOx	hydrogen peroxide and ozone treatment system
IC	Institutional Controls
ISCO	in-situ chemical oxidation
LUC	land use control
MCL	maximum contaminant level
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
mg/kg	milligrams per kilogram
MNA	monitored natural attenuation
NCP	National Contingency Plan
O&M	operation and maintenance
OU	operable unit
PCB	polychlorinated biphenyl
PCE	tetrachloroethylene (perchloroethylene)
PFC	perfluorinated compounds
ppbv	parts per billion by volume
PRP	Potentially Responsible Party
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
ROI	radius of influence
RRS	Remedy Required Subsites
RSL	regional screening level
Site	Tucson International Airport Area Superfund Site
SRL	soil remediation level
SVE	soil vapor extraction
SGZ	Shallow Groundwater Zone
TARP	Tucson Airport Remediation Project
TCA	1,1,1-trichloroethane
TCE	trichloroethylene
TI	Technically Impracticable
TIAA	Tucson International Airport Area
USACE	U.S. Army Corps of Engineers
Air Force	U.S. Air Force
VOC	volatile organic compound

1. Introduction

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

The U.S. Environmental Protection Agency (EPA) prepared this Five-Year Review for the Tucson International Airport Area (TIAA) Superfund Site (Site) pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act, Section 121, 40 Code of Federal Regulation Section 300.430(f)(4)(ii) of the National Contingency Plan (NCP) and EPA policy, because hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure.

This is the second FYR for this Site. The triggering action for this statutory review is the completion date of the previous FYR on September 30, 2013.

The Site currently consists of three operable units (OUs):

- OU1 Area A (western half) represents groundwater at the Tucson Airport Remediation Project (TARP) area. ("Area A")

- OU1 Area B (eastern half) represents groundwater at the following locations: Texas Instruments property (formerly Burr-Brown Corporation), the 162nd Arizona Air National Guard (AANG) Base, the former Western Capacitor property (West Cap), and the West Plume B area. ("Area B")

- OU2 represents soil and shallow groundwater at the Airport Property (including the Three Hangars Building), and soil at the AANG Base, Texas Instruments Property, and West Cap Area.

- OU3 represents soil and groundwater at U.S. Air Force (Air Force) Plant #44/Raytheon (AFP44).

This FYR addressed three of the Operable Units: OU1 (Area A and Area B), OU2, and OU3. A Focused Remedial Investigation/Feasibility Study for 1,4- dioxane-contaminated groundwater, north of Los Reales was completed in 2016. EPA is currently reviewing a draft Record of Decision (ROD) Amendment for the 1,4- dioxane-contaminated groundwater, north of Los Reales. The Air Force has the lead for remediation on AFP44 and is contributing to this FYR.

The Tucson International Airport Area Superfund Site Five-Year Review was led by Mary Aycock, Remedial Project Manager for EPA Region 9. U.S. Army Corps of Engineers (USACE) participants included Bill Gardiner, risk assessor; Kristin Addis, hydrogeologist; Alison Suess, chemist; and

Marlowe Laubach, chemical engineer. Mark Gardiner, also a member of the five-year review team, is the Project Manager of APTIM, an EPA contractor. The review began on 10/12/2017.

The Air Force has the lead for remediation on AFP44. Amec Foster Wheeler Programs, Inc. prepared a draft final Five-Year review for Air Force Plant 44. EPA has reviewed this draft and summarized key information and findings from their report in this FYR.

Table 1. Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Tucson International Airport Area Superfund Site		
EPA ID: AZD980737530		
Region: 9	**State:** AZ	**City/County:** Tucson, Pima County
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	**Has the site achieved construction completion?** No	
REVIEW STATUS		
Lead agency: EPA ***[If "Other Federal Agency", enter Agency name]*:** The Department of Defense led the review of the Air Force Plant 44 portion of the Site.		
Author name (Federal or State Project Manager): Mary Aycock		
Author affiliation: EPA Region 9		
Review period: 9/30/2013 –9/1/2018		
Date of site inspection: 3/1/2018		
Type of review: Statutory		
Review number: 2		
Triggering action date: 9/30/2013		
Due date *(five years after triggering action date)*: 9/30/2018		

1.1. *Background*

The TIAA Site is located in southeastern Arizona and encompasses sections of southwest Tucson, as well as adjoining lands south of the city (Figure 1). The Site boundaries are the Santa Cruz River on the west, Ajo Way on the north, Alvernon Way on the east, and the Hughes Access Road south of the AFP44 on the south.

The Site is divided into seven separate project areas (Figure 2), which include AFP44, TARP, the Texas Instruments property, the AANG Base, the Airport Property, the West Plume B area, and the former West-Cap. These project areas are incorporated into five OUs, as stated in Section 1 above. EPA is addressing groundwater and soil remediation efforts at TARP and the Airport Property, north of Los Reales Road, and at Texas Instruments, AANG, West Plume B, and West Cap. The Air Force is addressing groundwater remediation efforts at AFP44, south of Los Reales Road.

The groundwater and soil at the Site were contaminated by former aircraft and electronics manufacturing activities, fire drill training activities, and unlined landfills, in the 1940s – 1970. The primary contaminant of concern (COC) is trichloroethylene (TCE). Other COCs found include 1,4-dioxane, tetrachloroethylene (PCE), 1,1-dichloroethylene (1,1-DCE), chloroform, benzene, polychlorinated biphenyls, and chromium.

In the past, the companies and facilities in the Site used a variety of different chemicals in various industrial processes, including TCE as a metal degreaser and chromium in an electroplating process. Hazardous substances generated by site activities included the following: TCE, 1,1-DCE, 1,1,1-trichloroethane (TCA), and 1,4-dioxane, which was a stabilizing additive to TCA formulations. Additional wastes produced were alcohols, methyl ethyl ketone, and other solvents; used oil and lubricants; waste paint and sludges; and industrial wastewater treatment residue containing metals such as chromium, cadmium, and cyanide. The waste disposal by several aircraft and electronics facilities in the area of the Site consisted of surface discharge of waste liquids to soils onsite. The drainage areas were ponded with liquid waste runoff, which in turn provided the driving force for contaminants to infiltrate into the underlying groundwater. The flammable wastes, including solvents and fuels, were burned in unlined pits during fire-drill training. Over time, wastes migrated to the underlying saturated zone.

1.2. *Physical Characteristics*

The Site is an approximately 10-square-mile area comprised of portions of southwest Tucson and adjoining lands south of the city (Figure 1). The Site encompasses industrial, commercial, residential, and undeveloped areas, including the Tucson International Airport, AFP44, residential areas of the cities of Tucson and South Tucson, and northeastern portions of the Tohono O'odham Indian Reservation (San Xavier District).

Land use at and near the Site has been a mix of various aviation, aerospace, commercial/ industrial, and residential. The area in the immediate vicinity of the Site tends to be more commercial/industrial than areas slightly farther from the Site. The residential properties are predominantly to the west and

north, commercial/industrial properties lie predominantly to the east, and open/vacant spaces lie to the south. No major changes to land use are anticipated at this time.

Groundwater is the primary source of water for domestic, industrial, and irrigation water in the area. During the initial investigation of the site, numerous production wells and private wells located within the vicinity of the Site contained groundwater that exceeded the TCE maximum contaminant level (MCL) of 5 micrograms per liter (µg/L) (Figure 2). Production wells were either shut down or taken out of service by the city of Tucson. Some private wells remain in use, but no use of groundwater containing volatile organic compounds (VOCs) above drinking water standards is known to occur at this time.

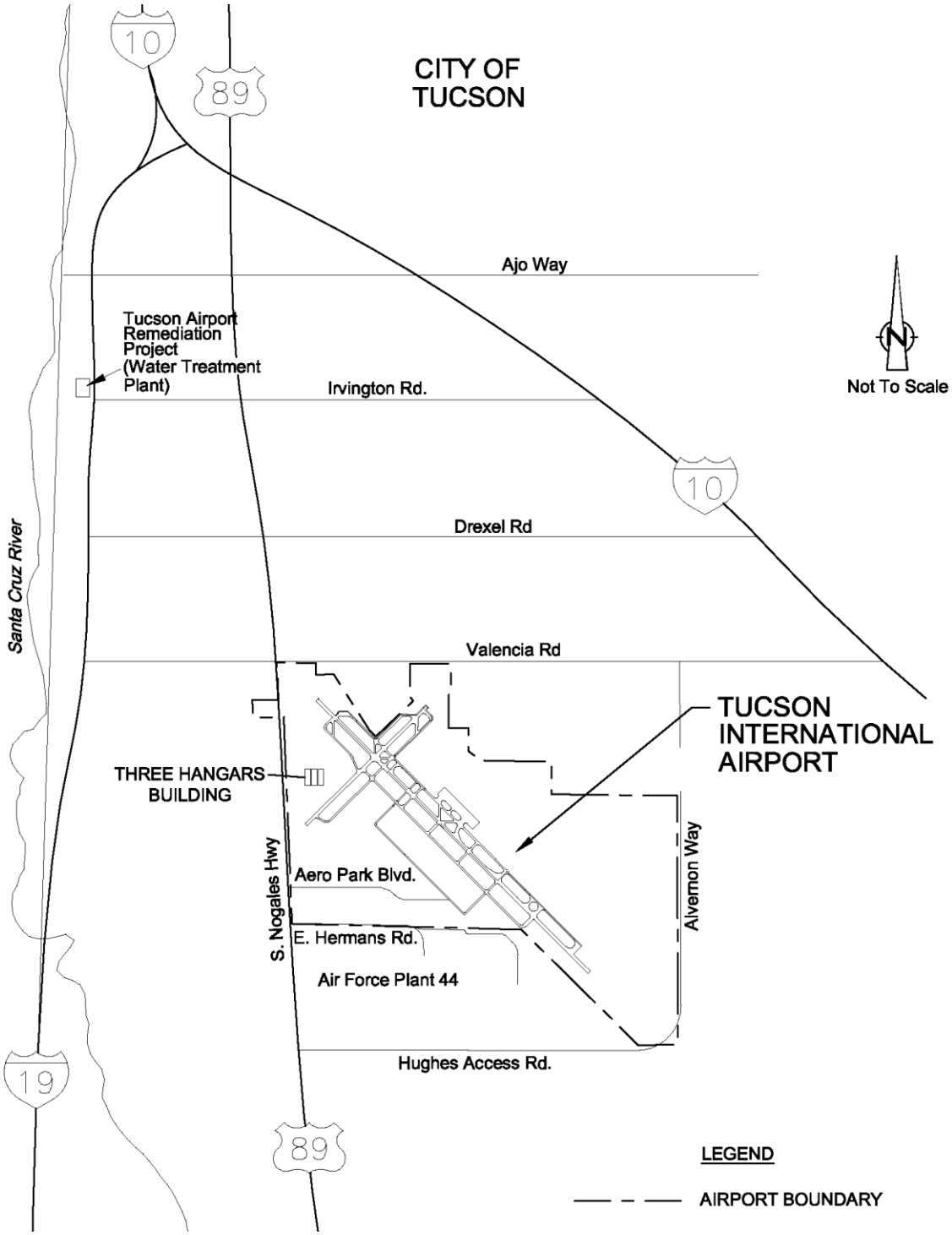


Figure 1. Location Map for the Tucson International Airport Area Superfund Site

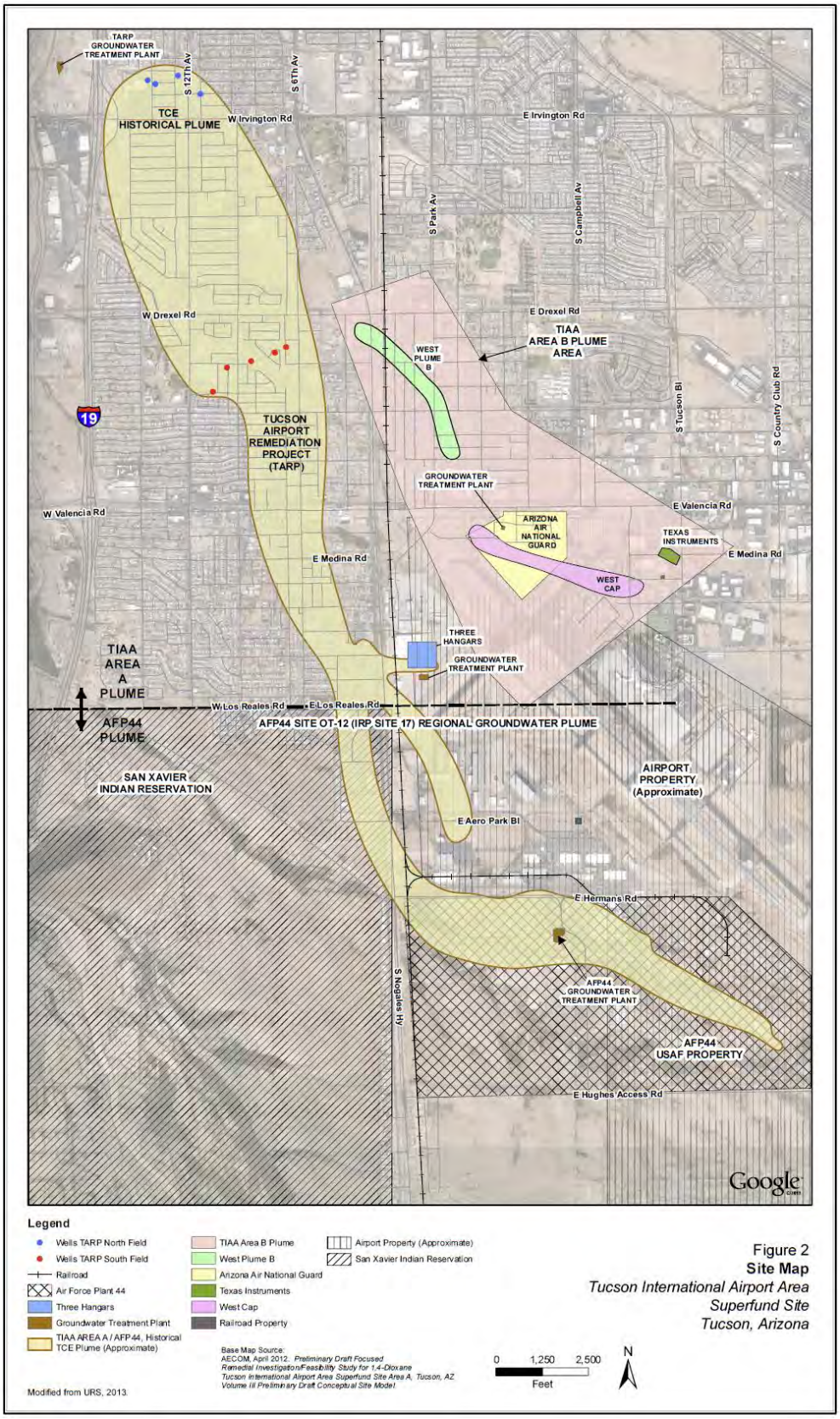


Figure 2. Detailed Map of the Tucson International Airport Area Superfund Site

1.3. *Hydrology*

The Site is located in the Tucson Basin, an alluvial valley bounded by rugged mountain ranges. The Tucson Basin runs approximately 50 miles long and 20 miles wide in an east to west direction. It is a broad, down-faulted, sediment-filled depression surrounded by mountains. The basin is bounded on the east and north by the Santa Rita, Empire, Rincon, Tanque Verde, and Santa Catalina Mountains and on the west by the Sierrita, Black, and Tucson Mountains (EPA 1988). The area was shaped by regional faulting and uplifting, which resulted in the deposition of approximately 10,000 feet of erosional basin fill material in the center of the basin. The basin fill is sub-divided into the following three formations: the Pantano Formation; the Tinaja Beds; and the Fort Lowell Formation. The Pantano Formation is the oldest, whereas the Fort Lowell Formation is the youngest, overlain by a thin veneer of stream alluvium (EPA 1988).

The Santa Cruz River runs from south to north, about one mile from the western edge of the site, and drains the basin toward the northwest. The Santa Cruz River and its tributaries are dry most of the year, and infiltration is the primary source of water to the aquifers below. A thick interconnected water-bearing unit is present basin-wide and is known as the Regional Aquifer. Groundwater flow in the Regional Aquifer is generally toward the northwest. The Regional Aquifer is composed of sand and gravel layers interbedded with thin, discontinuous clay layers of the Fort Lowell Formation.

The regional aquifer system is hydrogeologically complex because of lateral and vertical changes in conductivities of alluvial fans sediments.

1.3.1. OU1 – Area A/Area B Hydrology

The subsurface of the TARP area (OU1 Area A, north of Los Reales Road) consists primarily of alluvial sediments (unconsolidated to consolidated) to depths of at least 400 feet, overlaying bedrock. The Regional Aquifer (in the northern part of TARP) is composed mainly of coarse-grained materials. Groundwater is encountered at 200 feet below ground surface (bgs), and groundwater flow is to the north-northwest (Malcolm Pirnie/ARCADIS 2012). In general, groundwater elevations in the Regional Aquifer are increasing due to reduced reliance on groundwater (CRA 2012b) and due to the Central Arizona Recharge Project that recharges the Tucson Basin with water from the Colorado River. The rate of increase in the TARP area ranges up to about 2 feet per year (Malcolm Pirnie/ARCADIS 2012).

In the southern TARP plume area, the alluvial sediments are divided into Upper and Lower Divided Aquifers, separated by a confining clay unit. This confining unit is thinner to the north-northwest near a transition zone. The Regional Aquifer is present at the downgradient edge of the transition zone (Malcolm Pirnie/ARCADIS 2012).

The Upper Divided Aquifer is composed mainly of inter-bedded layers of sandy and clay lenses, and is approximately 70 to 120 feet thick. The groundwater flow in this region is north-northwest, and depth to groundwater is measured at 75 to 100 feet bgs. The underlying confining layer is generally encountered at depths of 160 to 190 feet bgs and ranges from 50 feet to 200 feet thick (Malcolm

Pirnie/ARCADIS 2012). In the southern portion of the TARP plume, shallow water-bearing units that exist to the east (that is, beneath the Airport Property) transition into the Upper Divided Aquifer.

The Lower Divided Aquifer is more consolidated than the Upper Divided Aquifer and is comprised of clays, clayey sands, and sand and gravel. Groundwater is encountered at 200 feet bgs. The lithologic logs indicate the Lower Divided Aquifer extends to at least 400 feet bgs (Malcolm Pirnie/ARCADIS 2012).

Area B hydrology is divided into three units below the vadose zone- the Upper Zone, the Middle Aquitard and the Lower Zone. The Upper Zone is further divided into the Upper Unit and the Lower Unit, which are separated by the Upper Aquitard. It should be emphasized that the designation of these subunits and intervening aquitards is established within each respective project area boundary. Because of heterogeneous nature of the aquifer system, subunit correlation is generally difficult between project areas where large hydrogeologic data gaps exist.

1.3.2. OU2 – Airport Property Hydrology

The Airport Property is located in the east-central portion of the Site. The stratigraphic relationship between the Shallow Groundwater Zone (SGZ), Gravel Subunit (GSU) and Regional Aquifer is presented in Figure 5. The focus of remedial actions at the Airport Property is the Upper Zone of the Upper Divided Aquifer. At the Airport Property, the Upper Zone is further divided into the following four site-specific stratigraphic units:

- Unit 1—10 feet to 15 feet of unconsolidated silt or gravelly sand.
- Unit 2—35 feet to 40 feet of consolidated layer of calcified silty fine sand.
- Unit 3—20 feet to 40 feet of unconsolidated layer of well to poorly graded silty and gravelly sand.
- Unit 4—Unit 4, primarily a clay-rich deposit, an important stratigraphic unit with respect to the SGZ remedy, is further divided into three subunits (DBS&A 1996): An Upper Unit 4 Clay, an interbedded Gravel Subunit, and a Lower Unit 4 Clay. Unit 4 is generally found from approximately 80 feet bgs to 158 feet bgs (DBS&A 1996). The Upper Unit 4 Clay is classified as plastic clay that is typically encountered at depths ranging from 80 to 100 feet bgs at an approximate elevation of 2,475 feet above mean sea level. The thickness of the Unit 4 Clay ranges from 10 to 23 feet. The clay contains stringers of interbedded sands and silts throughout its thickness. The Upper Unit 4 Clay is present beneath the entire Airport Property portion of the Site. The Gravel Subunit is considered a distinct subunit within the Unit 4 Clay and consists of channelized coarse-grained materials that are unevenly distributed across the Airport Property. The buried channel deposits (that is, paleochannels) consist primarily of sand and gravel with varying amounts of silt and clay. These buried channel deposits are difficult to remediate due to the lack of connectivity and occurrence throughout the area. Groundwater occurs at a depth of approximately 85 feet bgs within the SGZ. Groundwater flows from east to west within the SGZ near Three Hangars until it flows into the Regional Aquifer west of Nogales Highway.

The Regional Aquifer underlies Unit 4, and consists of braided channel deposits of the Paleo Santa Cruz. This unit is highly transmissive and groundwater flows to the north.

1.3.3. OU3 – AFP44 Hydrology

The AFP44 area is underlain by alluvial deposits of the distal portion of coalescing Cienega Creek alluvial fans that originate to the southeast. Distal fan sedimentation is dominated by flood processes and deposits predominantly from braided streams in shifting depositional areas. These deposits grade into fluvial deposits of the Santa Cruz River to the west of Nogales Highway. These deposits are characterized as thin to thick intervals of clay, silt, sand, and gravel. Continuity of these individual layers, especially for potential gravel-filled paleochannels, and their overall interconnectivity are uncertain from a geologic standpoint; however, groundwater behavior indicates a general connection within major units. The main aquifer unit, the Regional Aquifer, is divided into an Upper Zone and a Lower Zone that are separated by an aquitard. The aquitard between the two zones appears to provide nearly complete hydraulic separation based on water levels and aquifer response to pumping. The upper zone of the Regional Aquifer is also separated into an Upper Unit and a Lower Unit by an aquitard. The majority of the wells at AFP44 are screened in the Upper Unit, and some are screened across both the Upper Unit and Lower Unit. Groundwater recharge from the surface is minimal given the arid climate. Contaminant concentrations in groundwater differ markedly between the Upper Unit and Lower Unit, suggesting a significant level of hydraulic separation between the units. It is noted that wells that were screened across both the Upper Unit and Lower Unit may have provided conduits for contamination to move vertically downward into the Lower Unit.

The depth to groundwater is approximately 140 feet below ground surface and groundwater flows generally to the north to northwest. However, due to extractions and recharge wells (groundwater remedy), transmissive paleochannels, and subunits within the Upper and Lower Units, localized groundwater flow and magnitude will vary across the site.

2. Remedial Actions Summary

2.1. *Basis for Taking Action*

TCE was detected in groundwater at the Site in the early 1980s, with the highest concentration of TCE observed in groundwater at the Airport Property (92,000 micrograms per liter [µg/L]). The city of Tucson operated production wells for its municipal water supply near the Site, some of which had TCE detections above the MCL of 5 µg/L. Similarly, chromium detections above the MCL were found primarily in municipal wells at or adjacent to AFP44. TCE detections above the MCL of 5 µg/L were also found in some of the private wells within the vicinity of Site (EPA 1988). As a result, the primary human health risk posed was the potential for direct ingestion of contaminated groundwater.

The primary human health risk associated with soil at the Airport Property was the potential for incidental ingestion of soil or inhalation of soil gas vapors. TCE was detected in soil gas at concentrations exceeding the soil gas screening level (of 1.3 µg/L) at the Airport Property—

specifically, in the area around the Three Hangars Building. Chloroform was also detected at elevated concentrations in soil gas near the Three Hangars Building. Polychlorinated biphenyl (PCB) was detected at concentrations ranging up to 140 milligrams per kilogram (mg/kg) in soil samples collected to the west and southwest of the Three Hangars building. PCBs were also detected in sludge associated with floor drains in the Three Hangars Building and a canal drainage system located south of the Three Hangars Building at concentrations up to 1,100 mg/kg. VOC-contaminated soil extending off the Airport Property into the residential area to the west was cleaned up through a removal action in 1997.

2.2. *Remedy Selection*

2.2.1. OU1 – Area A and Area B Groundwater

OU1 consists of the contaminated groundwater plume north of Los Reales Road, and is further subdivided into Area A (TARP, in the western half) and Area B (eastern half). Area B has contaminated groundwater at several areas: the Texas Instruments property, the AANG Base, the former West Cap Area, and the West Plume B area.

In the 1988 ROD, the groundwater remedy for OU1 – Area A and Area B - included groundwater extraction and treatment of the contaminated groundwater using packed column aeration. Discharge of treated water was to be provided to the municipal potable water distribution system.

In the 1997 Explanation of Significant Differences (ESD), EPA changed the AANG Base treatment system to cascade tray air strippers and allowed reinjection of treated water. In the 2004 ROD amendment, EPA selected a remedy specifically for the West Cap Area and the West Plume B area in Area B. In 2012, EPA issued a ROD amendment to replace the previous remedy (groundwater extraction and treatment) with in-situ chemical oxidation (ISCO) injections at the West Cap Area, Texas Instruments property, and the AANG Base, and with monitored natural attenuation (MNA) at the West Plume B area. EPA also clarified the remedial action objectives (RAOs) for both Area A and Area B.

2.2.1.1 OU1 Area A (TARP)

OU1 consists of the contaminated groundwater plume north of Los Reales Road, and is further subdivided into Area A (TARP, in the western half) and Area B (eastern half).

In the 1988 ROD, the groundwater remedy for OU1 for Area A included groundwater extraction and treatment of the contaminated groundwater using packed column aeration. Discharge of treated water was to be provided to the municipal potable water distribution system. EPA selected the 1988 remedy to contain the migration of contamination and remove high levels of contamination from areas where they are currently believed to be. Groundwater monitoring was also required to verify (1) the control of contaminant migration and (2) the decrease in contaminant concentrations in the aquifer.

EPA maintained the TCE treatment level of 1.5 micrograms per liter (µg/L) in any treated water intended for direct drinking water usage. The goal of the treatment system is to treat the extracted groundwater to an overall excess cancer risk level (presumably for all contaminants combined) of 1 x 10^{-6}. The 1988 ROD further specified treatment of TCE to a concentration of 1.5 µg/L, while noting that the MCL for TCE is 5 µg/L and that "treatment will bring the levels of other contaminants well below their respective MCLs, State Action Levels, and 10^{-6} excess cancer risk concentrations." Table 2 identifies the OU1 Area A COCs and cleanup levels.

Table 2. OU1 Area A Cleanup Levels and Basis

COC	Cleanup Level (µg/L)	Basis for Cleanup Level
Benzene	5	MCL (1997 ESD)
Chloroform	100	MCL (1997 ESD)
Chromium	50	MCL (1997 ESD)
1,1-Dichloroethylene	7	MCL (1997 ESD)
trans-1,2-Dichloroethylene	100	MCL (1997 ESD)
Trichloroethylene	5	MCL (1997 ESD)

Note: The treatment level for TARP is 1.5 µg/L.

2.2.1.2 OU1 Area B (Texas Instruments Property, AANG Base, West Cap Area, West Plume B Area)

OU1 Area B consists of contaminated groundwater at several locations: the Texas Instruments property, the AANG Base, the West Cap Area, and the West Plume B area. Understanding of the nature and extent of contamination at this site has changed over time. There are four decision documents that apply to OU1 Area B: the 1988 ROD, 1997 ESD, and the 2004 and 2012 ROD Amendments.

In the 1988 ROD, the remedy included groundwater extraction and treatment. In the 1997 ESD, EPA modified the remedy at the AANG Base to allow changes to the treatment method and to reinject treated water into wells. In 2004, EPA issued a ROD Amendment and selected a remedy of groundwater extraction and treatment for groundwater contamination at the West Cap Area and the West Plume B area. EPA issued the 2004 ROD Amendment due to new information: the identification of West Plume B and the further delineation of the West-Cap groundwater plume, which includes the former West Cap Area and the AANG Base.

In 2012, EPA issued a ROD Amendment and replaced the previous remedies in OU1 Area B with a revised remedy. At the West-Cap area, Texas Instruments property, and the AANG Base, the revised remedy consists of ISCO using potassium permanganate. At West Plume B, the revised remedy consists of Monitored Natural Attenuation (MNA).

The RAOs for OU1 Areas B, as clarified by the most recent 2012 ROD amendment, are to:

- Reduce the risk of potential exposure to contaminants.

- Restore contaminated groundwater to support existing and future uses, i.e. drinking water.
- Prevent or reduce migration of groundwater contamination above maximum contaminant levels.

For groundwater in OU1 Area B, the COCs and groundwater cleanup levels were selected in 2012 ROD Amendment (Table 3). EPA maintained the TCE treatment level of 1.5 µg/L in any treated water intended for direct drinking water usage.

Table 3. OU1 Area B COCs, Cleanup Levels, and Basis

COC	Clean Up Level (µg/L)	Basis for Cleanup Level
1,1-Dichloroethylene	7	MCL (2012 ROD Amendment)
cis-1,2-Dichloroethylene	70	MCL (2012 ROD Amendment)
Tetrachloroethylene (PCE)	5	MCL (2012 ROD Amendment)
Trichloroethylene (TCE)	5	MCL (2012 ROD Amendment)
Vinyl Chloride	2	MCL (2012 ROD Amendment)

2.2.2. OU2 –Airport Property and Contaminated Soils

OU2 consists of contaminated soil and shallow groundwater at selected locations north of Los Reales Road. Three decision documents apply to this operable unit: the 1996 ROD, 1997 ROD, and 2001 ESD, which modifies the 1997 ROD. In the 1996 ROD, EPA selected the remedy for contaminated soil at an area of the AANG Base. In the 1997 ROD, EPA selected the remedy for contaminated soil and shallow groundwater at the Airport Property, which includes the Three Hangars Building, as well as contaminated soil at the Texas Instruments property and at the West-Cap area. In addition, the SGZ in OU2 contains an approximately 2-acre area called the Technical Impracticability (TI) Zone. EPA determined in the 1997 ROD that attainment of potential groundwater cleanup Applicable or Relevant and Appropriate Requirements (ARARs) would be impracticable due to the presence of dense non-aqueous phase liquids and the complexity of hydrogeology in the TI Zone. In the 2001 ESD to the 1997 ROD, EPA revised the cleanup level for PCBs to be consistent with December 1997 changes to Arizona law. In addition, the ESD included authorization for final remedial design to incorporate beneficial reuse of remediated groundwater for landscape irrigation or ornamentation. All other requirements of the 1997 ROD remained unchanged.

The RAOs described in the 1996 ROD, for the AANG Base, are to:

- Reduce transport of TCE and other VOCs from AANG Base soils to groundwater to levels protective of human health and the environment.
- Restore the underlying aquifer to drinking water quality.
- Remove TCE from Former Sludge Drying Beds soils such that the soils could not cause the groundwater to be contaminated above health-based levels.

The RAOs described in the 1997 ROD for the Airport Property, Texas Instruments property, and West Cap Area are listed by media:

- To reduce VOC vapor concentrations in soil and achieve lateral and vertical vapor containment until contaminant concentrations have been reduced such that ceasing operation of the system will not cause a water quality impact to the SGZ outside the TI Zone or to the Regional Aquifer in excess of cleanup standards (Table 4 below).
- To remove and properly dispose of all soils and sludges contaminated with PCBs in excess of cleanup standards (0.76 mg/kg, which is the Arizona soil remediation level for non-residential areas, according to Arizona Administrative Code R18-7-201.
- To formally close and cap the Tucson Airport Area landfill in accordance with Arizona Resource Conservation and Recovery Act (RCRA) Subtitle D requirements.
- To prevent migration of VOCs from the SGZ into the Regional Aquifer, or into currently clean portions of the SGZ, at levels that result in exceedances of cleanup standards (Table 4 below) and to restore the SGZ to drinking water quality wherever practicable.

The remedy components selected in the 1996 and 1997 RODs are as follows.

AANG Base

- Soil Vapor Extraction (SVE) with activated carbon treatment of off-gases.

Airport Property

- Groundwater extraction and treatment to remove VOC contamination in the SGZ, in order to restore the SGZ to cleanup levels. However, EPA determined that it is technically impracticable to restore the SGZ to cleanup levels within a defined 2-acre zone located within the SGZ referred to as the TI Zone. The shallow groundwater remedy outside the TI Zone will be operated until groundwater cleanup standards are met (Table 4 below). The remedy in the TI Zone will employ hydraulic containment to prevent migration of contamination outside of the TI Zone, and extraction will continue indefinitely in the TI Zone, unless alternative remediation technologies or processes can be developed during remedy implementation.
- SVE will be used to treat VOC-contaminated soils on Airport Property in the vicinity of the Three Hangars Area, and any other locations determined to require cleanup action after completion of soil investigations.
- Closure of the Tucson Airport Area landfill in accordance with State of Arizona RCRA Subtitle D requirements. Closure activities include: grading the landfill so that it has a smooth but sloped surface, placing and compacting a two-foot thick (minimum) cap and seeding the cap with drought-resistant vegetation to minimize erosion. A closure and post-closure monitoring program will be required in accordance with landfill closure regulations.
- Excavation and removal of pipeline sludges and soils contaminated with PCBs above 0.76 mg/kg (the State soil cleanup standard for non-residential properties).

Texas Instruments Property

- No action for soil, because the low levels of VOCs in soils at this location do not pose a risk to human health or groundwater quality.

West Cap Area

- Deferral of remedy selection until completion of ongoing soil investigations.

Table 4. OU2 COCs, Cleanup Levels, and Basis

COC	Groundwater Cleanup Level (µg/L)	Basis for Cleanup Level
1,1-Dichloroethane	5	MCL (1997 ROD)
1,1-Dichloroethylene	7	MCL (1997 ROD)
1,1,1-Trichloroethane	200	MCL (1997 ROD)
1,2-Dichloroethane	5	MCL (1997 ROD)
cis-1,2-Dichloroethylene	70	MCL (1997 ROD)
trans-1,2-Dichloroethylene	100	MCL (1997 ROD)
1,2-Dichloropropane	5	MCL (1997 ROD)
Acetone	700	ADEQ HBGL (1997 ROD)
Arsenic	50	MCL (1997 ROD)
Benzene	5	MCL (1997 ROD)
Bis(2-ethylhexyl)phthalate	6	MCL (1997 ROD)
Carbon tetrachloride	5	MCL (1997 ROD)
Chlorobenzene	100	MCL (1997 ROD)
Chloroform	100	MCL (1997 ROD)
Chloromethane	2.7	ADEQ HBGL (1997 ROD)
Chromium	100	MCL (1997 ROD)
Dichlorodifluoromethane	1400	ADEQ HBGL (1997 ROD)
Ethylbenzene	700	MCL (1997 ROD)
Lead	15	MCL (1997 ROD)
Methyl ethyl ketone	350	ADEQ HBGL (1997 ROD)
Methylene chloride	5	MCL (1997 ROD)
Nitrate (as Nitrogen)	10,000	MCL (1997 ROD)
Tetrachloroethylene	5	MCL (1997 ROD)
Toluene	1000	MCL (1997 ROD)
Trichloroethylene	5	MCL (1996 ROD, 1997 ROD)
Trichlorotrifluoroethane (Freon 113)	210,000	ADEQ HBGL (1997 ROD)
Trichlorofluoromethane [(b)]	2100	ADEQ HBGL (1997 ROD)
Trihalomethanes[(a)]	100	MCL (1997 ROD)
Xylenes	10,000	MCL (1997 ROD)
Vinyl chloride	2	MCL (1997 ROD)

(a) Trihalomethanes includes chloroform, bromodichloromethane, dibromochloromethane and tribromomethane.
ADEQ HGBL – Arizona Department of Environmental Quality Health-Based Guidance Level

(b) This COC was misspelled in the 1997 ROD as "trichlorofluoromethane (Freon 113).

2.2.3. OU3 –AFP44

OU3 consists of contaminated soil and groundwater at selected locations at the AFP44. Three decision documents apply to this operable unit: the 1985 ROD, 1997 ROD, 1998 ROD, and two ESDs.

Groundwater Remedy

In the 1985 ROD, the Air Force selected the remedy for groundwater beneath the AFB44. The remedy selected in the 1985 ROD included the following components:

- Construction of a reclamation wellfield to extract contaminated groundwater from the regional aquifer;
- Withdrawal and treatment of the extracted groundwater to remove contaminants;
- Reinjection of the treated water to the regional aquifer; and
- Monitoring of the groundwater to ensure the effectiveness of the remedial effort and to substantiate termination.

The Air Force issued Remedial Action Plan (RAP) based on the ROD in April 1986. The 1986 RAP summarized the existing RAOs for the regional groundwater emitting from AFP44. These are:

- To prevent to the maximum practicable degree any continued migration of the AFP44 plume of contaminated groundwater;
- To render groundwater contaminated by sources at AFP44 suitable for beneficial use;
- To meet applicable or relevant standards and criteria of Federal (or, where appropriate, state and local) environmental and public health laws to the maximum extent practicable;
- To achieve these results in a cost effective and timely manner; and,
- To implement a program which does not result in unwarranted drawdown impacts in the regional aquifer, which does not interfere with the performance of RA programs conducted by others in the greater TIAA vicinity, and which is consistent with the goals of the Tucson Active Management Area groundwater management plan.

The MCLs for VOCs and chromium were promulgated after both the ROD and RAP were issued. Therefore, the RAP established treatment target levels for COCs including TCE, 1,1- DCE, TCA and chromium.

The discovery of 1,4-dioxane in groundwater occurred in 2002 resulting in the Air Force conducting a technology evaluation that determined that an advanced oxidation process (AOP) system, specifically hydrogen peroxide and ozone (HiPOx™), could be used to treat both the chlorinated VOCs and 1,4-dioxane for about the same annual cost as the air stripping system. An ESD to the 1985 ROD was signed in May 2008, which identified HiPOx™ AOP to treat both the 1,4-dioxane and chlorinated VOCs in groundwater. The ESD additionally established Revised Target Treatment Levels and adopted MCLs promulgated after the 1985 ROD was signed for the COCs.

Table 5. OU3 COCs, Cleanup Levels, and Basis

COC	Groundwater Cleanup Level (µg/L)	Basis for Cleanup Level
Trichloroethylene	5	10^{-6} risk value
1,1,1-Trichloroethane	200	MCL (2008 ESD)
1,1-Dichloroethene	7	10^{-6} risk value
Chromium	100	MCL (2008 ESD)
1,4-Dioxane	3	EPA IRIS risk value

Soil Remedy

In the 1997 ROD, the Air Force selected a remedy to address contaminated soil at three specific areas on the Base: Ranch Site (Soil Site 1), FACO Landfill (Soil Site 2) and Inactive Drainage Channel Disposal Pits (Soil Site 3). The major components of the selected remedy include:

- Installation of SVE wells in contaminated soils above the water table.
- Exerting a vacuum on these wells to impose air flow through the contaminated soils, volatilizing the VOCs, and removing said VOCs.
- The vapor stream is piped to the ground surface where the VOCs are removed by a treatment system. Using either granular activated carbon (GAC) adsorption for the Ranch Site or resin adsorption for FACO Landfill and Inactive Drainage Channel Disposal Pits.

The 1997 ROD selected a cleanup level for TPH of 7,000 mg/kg for residential soils and 24,500 mg/kg for non-residential soils based chemical-specific ARARs and TBC guidance for TPH, which included the Health-Based Guidance Levels (HBGLs) established as interim standards by ADEQ and a guidance limit from an Underground Storage Tank (UST) program newsletter. Use of the non-residential HBGLs is allowed if a Voluntary Environmental Mitigation Use Restriction (VEMUR) is filed with the county recorder.

In addition to the chemical-specific ARAR for TPH, the ROD required VOC contaminant concentrations in soil to be reduced to levels that do not cause or contribute to the upper divided regional aquifer contamination in excess of each contaminant's Federal Safe Drinking Water Act MCL (or State Aquifer Water Quality Standard if there is no MCL).

The ESD revised the TPH cleanup standard to be is 4,100 mg/kg for residential soils and 18,000 mg/kg for non-residential soils for the selected RA, to be consistent with State of Arizona soil remediation levels (SRLs). Non-residential cleanup standards were selected as the applicable standards based on current and future foreseeable use. The Air Force committed to implement Land Use Controls (LUCs) in the form of a VEMUR (now replaced by Declaration of Environmental Use Restriction [DEUR]) if the land use changes.

In the 1998 ROD, the Air Force selected a remedy to address contaminated soil at three specific areas on the Base: Former Sludge Drying Bed and specific surface impoundments and the drainage ditch,

which are a part of the Inactive Drainage Channel Disposal Pits. The major components of the selected remedy include:

- Excavation of contaminated soils;
- off-site solidification/stabilization for soils containing metals in excess of action levels; and,
- Disposal of soils in a RCRA Class I landfill.

The 1998 ROD required the Air Force to remediate metals-contaminated soil to levels at or below the ADEQ SRLs (residential/unrestricted use levels) as promulgated in December 1997 for each contaminant of concern. After excavation and if additional field investigations at Former Sludge Drying Bed determined soils were likely to pose a threat to future groundwater quality, they would be remediated using SVE. SVE would be also be used to remediate the vadose zone near Building 801, located near the former sludge beds.

2.3. *Remedy Implementation*

2.3.1. OU1 – Area A and Area B Groundwater

2.3.1.1 OU1 Area A (TARP)

The TARP groundwater treatment facility is comprised of two remediation well fields: the North Well Field and the South Well Field. The combined extracted groundwater from the North Well Field and the South Well Field is conveyed to the TARP groundwater treatment facility, located northwest of the I-19/Irvington Road intersection (Figure 2). The objective of the North Well Field, which consists of four high-capacity extraction wells, is to contain the TCE plume in the Regional Aquifer. The objective of the South Well Field, which includes five low-capacity extraction wells, is to provide mass removal of TCE from the Regional Aquifer.

The TARP groundwater treatment facility began operating in 1994. It used packed column aeration to remove VOCs from the extracted groundwater and vapor-phase GAC treatment of the resulting vapor prior to discharge to the atmosphere.

In 2014, an Advanced Oxidation Process (AOP) water treatment system was incorporated into the existing groundwater treatment plant to treat for 1,4-dioxane.

2.3.1.2 OU1 Area B (Texas Instruments Property, AANG Base, West Cap Area, West Plume B Area)

In 1992, a groundwater pump and treat system for Texas Instruments property began operation. The system used air stripping technologies to remove VOCs from extracted groundwater, and water was reused in Texas Instruments' manufacturing processes.

In 1997, a groundwater pump and treat system was constructed at the AANG Base. This system also used air stripping technologies, and water was re-injected into shallow vadose zone wells.

Also in 1997, treatment at the Texas Instruments property was temporarily halted while a groundwater extraction system was built at the West Cap Area. The extraction system at the West Cap Area delivered water to the treatment system at the Texas Instruments property. In 1999, groundwater extraction and treatment resumed, treating water from both the Texas Instruments and West Cap areas.

In 2009, groundwater extraction and treatment stopped at the Texas Instruments property, West Cap Area, and the AANG Base. ISCO pilot tests, using potassium permanganate injections, were implemented at these locations during this five-year review period.

At the West Plume B area, semi-annual groundwater monitoring is ongoing, and is performed by AANG personnel.

2.3.2. OU2 – Airport Property and Contaminated Soils

AANG

The SVE system at AANG operated from April 1996 to November 1997. The system reduced the concentration of VOCs in the soil gas to a level at which groundwater would no longer be impacted.

Airport Property

The shallow groundwater remediation system includes six groundwater extraction wells pumping groundwater to the centralized treatment facility. This treatment facility uses an air stripper to remove VOCs (primarily TCE) from the extracted groundwater. The treated water is reinjected into the Regional Aquifer upgradient of the extraction system, and the air stripper off-gas is treated by vapor-phase GAC prior to discharge to the atmosphere.

Soil contamination at the Airport Property is addressed by the TI Zone SVE system. The TI Zone SVE system includes four SVE well nests connected through a pipeline to the centralized treatment facility, which treats extracted vapors through vapor-phase GAC prior to discharge to the atmosphere. Each TI Zone SVE well nest consists of two SVE wells, one well screened within Units 2 and 3, and one well screened within Unit 4.

The Tucson Airport Area landfill was capped in July 2011, and monitoring is ongoing.

The excavation and removal of pipeline sludges and soils contaminated with PCBs above 0.76 mg/kg was completed in June 2012.

West Cap Area

An SVE Pilot Treatability Study was conducted between August and December 2002. The SVE system extracted approximately 180 pounds of total VOCs from a single vapor well near Building A. The results from the treatability study concluded that TCE and PCE concentrations were significantly reduced in all soil vapor monitoring wells within the source area. This residual VOC mass in the

vadose zone within the source area was determined not to pose a significant threat to groundwater. Therefore, additional treatment of the vadose zone was not considered necessary (AANG CSM 2011).

2.3.3. OU3 – AFP44

Soils

The Air Force installed an SVE system at each of the sites that operated through 1997 at the Ranch Site, 2000 at the FACO Landfill, and 2004 at the Inactive Drainage Channel Disposal Pits. After the SVE systems were shut down, and all vapor monitoring wells sampled for four consecutive quarters. After evaluation of the data, it was concluded that no rebound of VOCs had occurred and final confirmation sampling in a centrally located soil boring should be performed. Elevated levels of TPH were observed at the Ranch Site and the FACO Landfill. However, the elevated levels were below the 1997 ROD established the Non-Residential cleanup criterion of 18,000 mg/kg as the TPH cleanup criterion.

The removal action for the Former Sludge Drying Beds sludge drying beds was performed between March and June 1997. Soil removal from Former Sludge Drying Beds involved excavation and offsite disposal of contaminated soil beneath the parking area east of Building 801 that may have been impacted by leaching from the unlined sludge drying beds. Post-excavation Phase II soil sampling for Former Sludge Drying Beds confirmed that no concentrations in remaining soil at Former Sludge Drying Beds exceeded either standard.

Groundwater

In April 1987, the Groundwater Treatment Plant (GWTP) on AFP44 was brought on line. Processes at the GWTP included extraction, treatment (using air stripping), and injection of treated groundwater into the aquifer at a maximum possible rate of approximately 5,000 gallons per minute (gpm). The wellfield configuration utilized extraction and injection wells to achieve hydraulic containment of the plume by extracting groundwater from the center of the plume and injecting it along the outside perimeter of the plume. The system was comprised of two separate piping networks: a “high chrome” system; and a “low chrome” system. Water from wells in the “high chrome” system was treated by ion exchange to remove chromium before treatment in the air strippers to remove VOCs. The ion exchange treatment system was dismantled in 1994 because chromium levels in the “high chrome” influent were consistently below applicable drinking water criteria (Raytheon 2006). The original groundwater extraction system and GWTP were taken offline in November 2008 to allow construction of the new AOP system which would address 1,4-dioxane. The AOP system was designed to treat 1,4-dioxane and other contaminants of concern at the site. The system upgrades, necessary repairs, and startup testing were completed, and the system was brought online in September 2009. The AOP system treats both 1,4-dioxane and TCE as well as other contaminants of concern.

2.3.4. Institutional Controls

Institutional controls (ICs) involve controlling exposure to contaminated media by controlling access, implementing administrative policies such as groundwater use restrictions, educating the public, and providing compliance and enforcement mechanisms. Administrative controls in place at the Site and

on the Tohono O'odham Nation in relation to the use of groundwater are expected to remain in place and prevent exposure to impacted groundwater. These ICs include requiring groundwater withdrawal permits, implementing hazardous waste training, maintaining general security, developing and implementing standard operating procedures, developing and implementing environmental regulations, and holding quarterly community meetings.

The soil underneath Building 801 cannot be fully characterized until Building 801 is demolished. Therefore, the Air Force is unable to adequately demonstrate the soil beneath Building 801 is below the ADEQ Residential SRLs. Consequently, Former Sludge Drying Beds is subject to the LUC requirements. The Air Force plans to submit an ESD to incorporate LUCs at Former Sludge Drying Beds into the 1988 ROD.

The primary ICs of the entities affected by the Site consist of the following:

- Groundwater use restrictions placed in the AFP44 lease to prevent direct human exposure where contaminants in the groundwater are at concentrations greater than groundwater cleanup levels.
- Restrictions placed in the AFP44 lease that prohibit the use of existing groundwater wells that are currently impacted or likely to be impacted by VOC contamination.
- Restrictions placed in the AFP44 lease that prohibit the installation of new wells in the contaminated portion of the aquifer.
- A policy of the TIA that prevents drilling production wells and/or using groundwater on airport property affected by the plume.
- In accordance with the City of Tucson Water Department Plan: 2000 – 2050; 2012 Update (Tucson, 2013b), the current and foreseeable future practice that the City of Tucson will provide all potable water to the entire area within and surrounding the Site.
- Arizona Revised Statues (ARS) 45, Chapter 2, Article 10, requires that a well is to be drilled by a licensed contractor, the contractor will use approved well construction methods, and a Notice of Intent to be filed with Arizona Department of Water Resources whose staff will review the Notice of Intent for proximity to the Site and confer with EPA and ADEQ before approval.
- Pima County monitors and inspects all private wells within the TCE groundwater plume footprint and provides reports to the public, EPA, and ADEQ.
- Regulations of the Tohono O'odham Nation focused on protecting the groundwater and requiring permits for new wells or expanded groundwater withdrawals from existing wells. Groundwater wells are regulated under the Tohono O'odham Nation Water Code that contains requirements for permitting and registering existing and new wells. The code contains provisions that would allow the Nation to prohibit use or installation of wells that could be affected by contamination such as the TIAA Superfund Site groundwater plume.

2.4. *Operation and Maintenance (O&M)*

2.4.1. OU1 - Area A

Treated water samples from the TARP groundwater treatment facility are collected weekly. TCE concentrations in all treated water samples during this review period were below the laboratory

reporting limit of 0.5 µg/L. Concentrations of 1,4-dioxane were also consistently below the laboratory reporting limit of 0.1 µg/L. As described in Section 2.3.1.1, treated water is delivered to the Tucson Water distribution system.

The TARP facility produced over 48.5 billion gallons of drinking water from September 1994 to August 2017. The TARP groundwater treatment system removed 5,370 pounds of TCE from the aquifer from September 1994 to August 2017. On a cumulative basis, approximately 1.1 times more TCE has been removed from the South Well Field than removed from the North Well Field since operation began in September 1994. The average flow rate at the groundwater treatment facility during the March 2017 and August 2017 performance reporting period was 4,497 gpm, approximately 89 gpm less than the prior performance reporting period (September 2016 through February 2017).

2.4.2. OU1 - Area B

No O&M is occurring at AANG, Texas Instruments, or West Cap Arizona because groundwater extraction and treatment stopped in 2009. The 2012 ROD selected ISCO at these sites. Section 2.3.1.2 provides the most current information on the occurrence of ISCO injections. After injections are performed, groundwater monitoring is conducted to evaluate ISCO effectiveness. At West Plume B, MNA is evaluated by monitoring groundwater concentrations of site COCs and MNA parameters. Groundwater monitoring results are presented in the Data Review section 4.2.2.

2.4.3. OU2 - Airport Property and Contaminated Soils

Groundwater Extraction and Treatment

The SGZ remedy includes the extraction and treatment of contaminated groundwater and reinjection of treated water into the Regional Aquifer. The groundwater extraction system includes three groundwater extraction subsystems: TI Zone SGZ extraction system, On-Airport Property SGZ extraction system, and the Off-Airport Property SGZ extraction system. The three groundwater extraction subsystems operate simultaneously to establish and maintain hydraulic containment of the groundwater in the SGZ within each of these sub-areas. The groundwater is conveyed to the central treatment facility for treatment, and is ultimately reinjected into the Regional Aquifer. The treatment process includes an equalization tank, air stripper to remove TCE, and vapor carbon treatment of air stripper off-gas.

Soil Vapor Extraction

Two SVE systems operate in OU2 (Figure 3). The TI Zone SVE is used to laterally and vertically contain VOC soil vapors in subsurface soils within the TI zone. The Remedy Required Subsites (RRS) SVE system is operated to mitigate migration of soil vapors outside of RRS and to the SGZ. Both systems are to be operated until VOC concentrations are reduced such that ceasing operations of the SVE will not cause water quality impacts to the SGZ outside the TI Zone or to the Regional Aquifer. The off-gas control for the SVE systems is required to ensure discharge standards are met. Figure 4 presents the locations of the SVE wells.

The RRS SVE, a skid-mounted unit, was initially used at SVE-7. This location met performance standards in October 2010. The unit was relocated to SVE-6 (west of Control Building No. 1) in October of 2010. The RRS SVE at SVE-6 began operation on October 26, 2010 and continued until August 29, 2013 when it was shut down due to low soil gas concentrations. The unit was then relocated to SVE-5. Remediation at RRS SVE-5 began on September 3, 2013 and continued until March 1, 2016. The RRS SVE-5 system was shut down because of asymptotic conditions. The RRS SVE-6 was brought on-line on March 6, 2016. SVE influent and GAC off-gas are sampled quarterly.

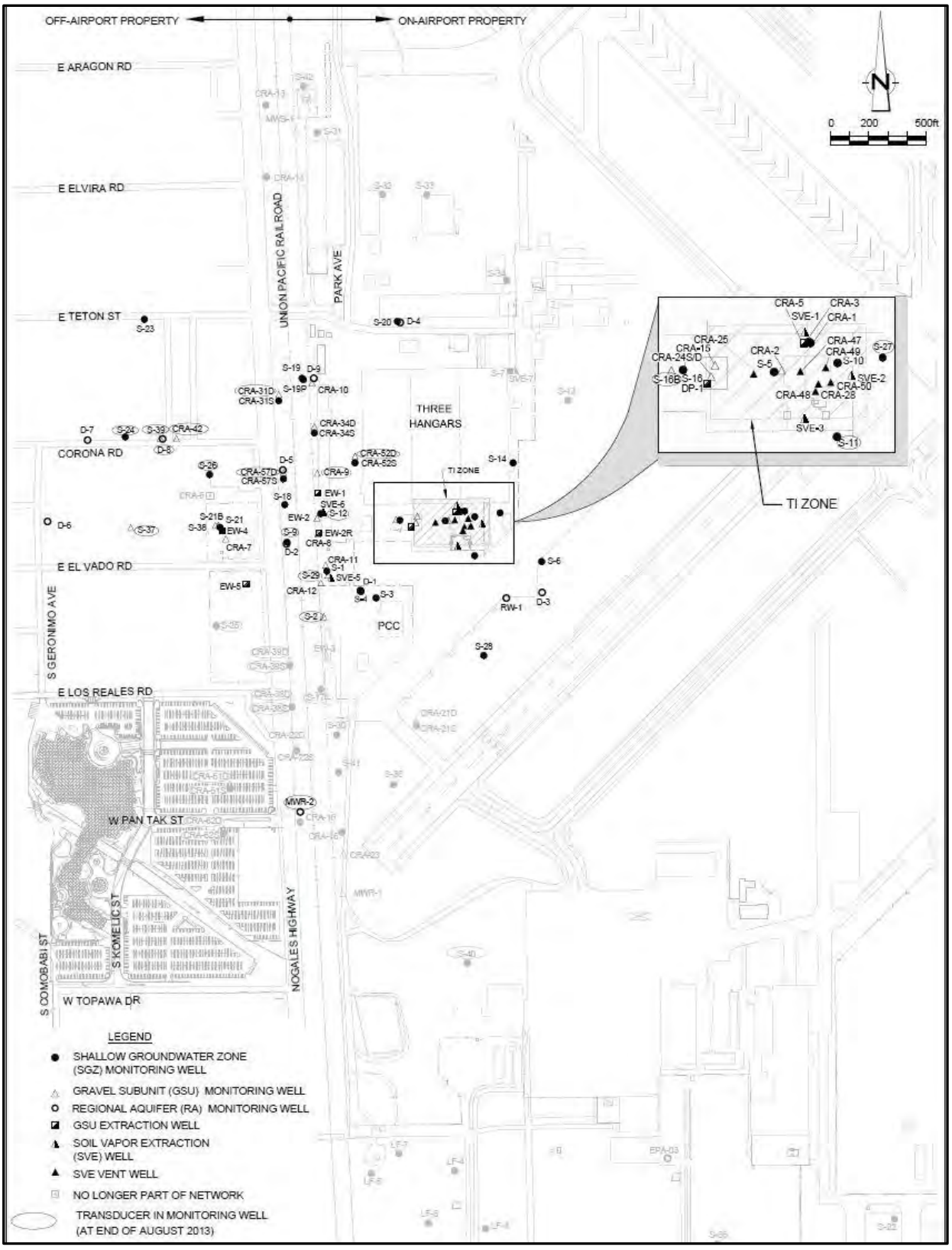


Figure 3. Soil Vapor Extraction Well Locations

2.4.4. OU3– AFP44

Soils

The soil remedies have been completed and no O&M is required.

Groundwater

The areas of the AFP44 groundwater treatment HiPOx system that require O&M are groundwater extraction and injection wells, the HiPOx system itself, and the piping and communications systems between the wells and the HiPOx system. Operation reports are submitted to EPA as part of the Annual OES Performance Metrics reports and the information is presented at the Air Force quarterly technical exchange meetings. The reports typically include: GWTP remediation operations, pumpage volumes for extraction and recharge wells, VOC removal, repairs and maintenance, influent and effluent contaminant concentrations and conclusions and recommendations regarding operations.

3. Progress Since the Last Five-Year Review

3.1. *Previous Five-Year Review Protectiveness Statement and Issues*

The protectiveness statements from the 2013 FYR for OUs 1 through 3 at the Site stated the following:

> *The remedy for OU 1 (TARP groundwater) is currently protective of human health and the environment because all exposure pathways to human health and the environment are controlled. However, the remedial action objectives written in the 1988 Record of Decision are unclear and the decision document should be substantially revised as part of any future amendments. Furthermore, the setting of the treatment goal of 1×10^{-6} excess cancer risk should be reviewed for technical feasibility to assure that long term-protectiveness can be achieved.*
>
> *A protectiveness determination of the remedy at OU 2 (Airport Property) cannot be made at this time until further information is obtained. Further information will be obtained by conducting a vapor intrusion assessment at and near the Three Hangars Building, and by investigating contamination underneath the Three Hangars Building. It is expected that these actions will take approximately two years to complete, at which time a protectiveness determination will be made. In addition, to be protective in the long term, the groundwater extraction system northwest of the Airport needs to be reassessed to ensure plume containment.*
>
> *A protectiveness determination of the remedy at OU 3 (AFP44) cannot be made at this time until further information is obtained. Further information will be obtained by conducting a vapor intrusion assessment at Building 801. In order to assure long term protectiveness, a new Record of Decision with clear remedial action objectives should be written for the site,*

and the remedy needs to be reassessed in the area of high chromium concentrations since it appears that remedial action objective of restoration will not be met.

The 2013 FYR included six issues and recommendations. Each recommendation and the current status is discussed below.

Table 6. Status of Recommendations from the 2013 FYR

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
1	1988 ROD was written with unclear RAOs and set a 1×10^{-6} excess cancer risk for cleanup which may be technically infeasible for some contaminants.	All RAOs and cleanup goals should be evaluated as part of any future ROD Amendment associated with sitewide groundwater.	Considered But Not Implemented	No ROD Amendments have been implemented at this time. Attachment #2 of the 1997 ESD clarified that the cleanup levels are MCLs not risk-based levels. A ROD amendment is currently under review for the OU 1 groundwater and will update the RAOs; in addition, the ROD amendment will include the installation and operation of a tenth extraction well.	
2	Levels of contaminants are increasing in the Off-Airport Property area northwest of the Airport Property, which suggests there is not complete capture.	Airport Property groundwater investigations in this area and remedial action(s) should be implemented, if necessary.	Ongoing	Continued groundwater monitoring of Airport Property has occurred within this five-year review period. Specific details are discussed in the Data Review section below.	
2	High levels of contaminants were found in newly drilled wells and numerous unknown drains were found inside the Three Hangars.	Airport Property should perform a subsurface investigation underneath the Three Hangars and implement appropriate actions.	Completed	The Airport Property collect soil samples, and installed a nested well pair in the southwest corner of the Three Hangars building in August 2017, and a Construction Completion Report was submitted on 01/10/18.	1/10/2018
3	Concentrations of chromium in the high chromium areas have remained high over the past five years indicating that the remedial action objective of groundwater restoration may not be achievable.	Air Force should plan for treatability studies for Chromium on AFP44 and implement appropriate actions.	Ongoing	ISB treatability studies were implemented to address COC concentrations, including chromium, in hot spots at FACO Landfill, Inactive Drainage Channel Disposal Pits, and Former Sludge Drying Beds, and were subsequently discontinued to focus groundwater extraction in higher concentration areas at Inactive Drainage Channel Disposal Pits. If EPA proposes a revised MCL	

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
				for chromium, an ion exchange pilot test will be conducted at the GWTP.	
3	There are no clear RAOs for the 1985 ROD for AFP 44 but are in the Remedial Action Plan.	Air Force should write a new ROD.	Ongoing	The Air Force has submitted the Draft-Final Proposed Plan to the regulatory agencies on March 6, 2017, and a revised document incorporating EPA comments on June 27, 2018 which is in EPA review. A Draft ROD will be prepared selecting the preferred alternative following finalization of the Proposed Plan.	
2	Soil gas and groundwater data indicates a potential for vapor intrusion at three specific areas.	An indoor air investigation should be conducted at the Three Hangars Building, the residential area nearby and Building 810.	Completed	Vapor intrusion investigations were conducted in 2015 within the Three Hangars Building and Off-Airport Property along Corona Road. Specific details of these investigations are discussed in the Section 4.2.3	March 2015

3.2. *Work Completed at the Site During this Five-Year Review Period*

3.2.1. OU1- Area A and Area B Groundwater

Area A (TARP)

In 2014, an AOP water treatment system was incorporated into the existing groundwater treatment plant. The AOP treatment system components include ultra-violet reactors, peroxide storage/feed equipment, and a GAC tank for peroxide quenching. The new system removes 1,4-dioxane, as well as other VOCs, including TCE, from water. The treated water from the TARP groundwater treatment facility is delivered to the Tucson Water Department (Tucson Water) distribution system. All nine wells are currently operational, although well R-009A was replaced with R-009B, and well R-008A was replaced with well R-008B.

Several remediation wells in the North Well Field encountered operational issues during this five-year review period, with production being greatly reduced between early 2016 through July of 2017. Gravel pack was found passing through the screens, impacting flow rates at these wells: R-009A, R-008A, R-006A, and R-007A. Three of these wells (R-009A, R-008A, and R-006A) were offline for extended periods from March 1 through August 2017. Well R-009A became a monitoring well when the replacement well, R-009B, started up on May 2017, producing approximately 1,300 gpm. A video log of R-008A revealed the well screen to be severely corroded, with significant fouling. The pumping rate in R-008A declined during the most recent reporting period covering March through August 2017, possibly indicating further fouling of the well screen. R-008A has since been replaced with new well

R-008B. The pump in Well R-006A was replaced in early 2017 after an inspection revealed severe wear on the pump impeller. Well R-007A underwent repair to line the well with a steel slot liner because gravel pack was passing through the corroded wire-wrapped screen. After repair, Well R-007A produced 1,100 gpm. The specific source of the gravel pack is not known.

Area B ISCO Pilot Tests

Full-scale ISCO injections were performed within this five-year review period. At the West Cap Area, potassium permanganate ISCO injection was performed in June 2014. Post-injection performance monitoring on a semi-annual basis has been implemented since October 2014. At the Texas Instruments property, potassium permanganate ISCO injection was performed in July 2016. Post-injection performance monitoring was performed from September 2016 to February 2017. At the AANG Base, groundwater monitoring has been performed quarterly onsite. In 2017, remedial design for a new ISCO injection was initiated.

An evaluation of the data from ISCO performance monitoring is presented in Section 4.2.2.

3.2.2. OU2 – Airport Property and Contaminated Soils

Groundwater (Airport Property)

The groundwater extraction and treatment system operated with minimal downtime within the last 5 years. The air stripper is effective in removing TCE from the groundwater. See Figure 4 for influent and effluent concentrations and quantity of TCE removed. The vapor carbon treatment is effectively removing TCE from the air stripper off-gas. Table 7 presents the vapor carbon removal efficiency. The treated air discharge performance standard is the Title 17 Pima County Air Quality Code 17.16.430, Subparagraph F, which limits discharges to 15 pounds of VOCs per day, per site. During this performance period, the maximum VOC discharge was calculated to be less than 0.05 pounds per day.

Table 7. Groundwater Treatment System Vapor Carbon Removal Efficiency

	Influent (ppbv) 5/3/2017	**Effluent (ppbv) 5/3/2017**	**Influent (ppbv) 8/1/2017**	**Effluent (ppbv) 8/1/2017**
TCE concentration	680	11	530	69
Efficiency	98.4		87.0	

During this performance period, breakthrough of VOCs in the carbon removal system occurred and the efficiency decreased. A carbon change-out was performed after the decrease in efficiency was observed, in order to continue maximum removal of contaminants in the vapor off-gas.

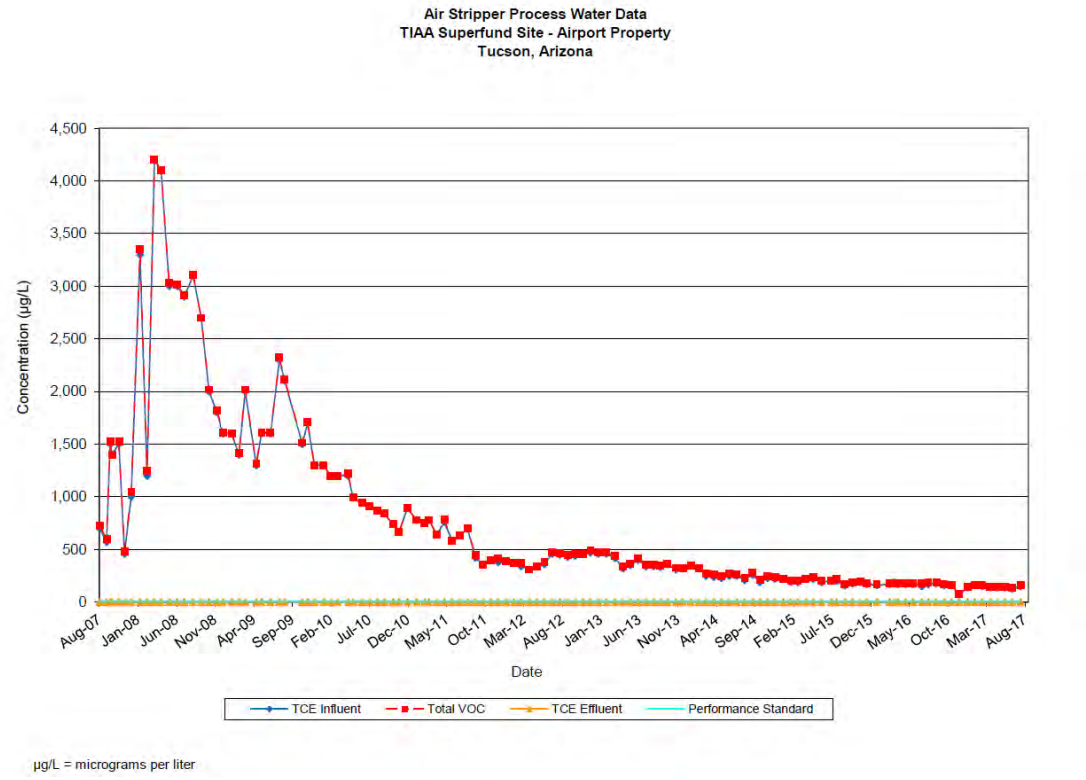


Figure 4. Airport Property Treatment System - Air Stripper Performance

Vapor Intrusion

The potentially responsible parties (PRPs) conducted vapor intrusion investigations on-airport and off-airport property in 2015. Detailed discussion of this investigation and the results are presented in Section 4.2.3.

Soil Vapor Extraction

Operational runtime at RRS SVE-6 during the March through August 2013 reporting period averaged 88 percent. Long-duration periods of downtime occurred during this reporting period due to the blower exhibiting high temperatures during summer, summer storm power outages, and disconnecting and setting up for the RRS SVE relocation from SVE-6 to SVE-5. During the latest reporting period (May through August 2017), the RRS SVE system averaged greater than 95 percent runtime, with no long-duration periods of downtime. TCE and total VOC influent concentrations decreased during the last reporting period (May through August 2017) to below the August 2013 concentrations. TCE concentrations in the off-gas during this reporting period were at non-detect levels.

Airport Property PCBs in soil

Remediation of PCBs in soil for the soil remedy of OU2 occurred between 2007 and 2011. In 2013, the PRPs produced a Construction Inspection Report providing an overview of the completed construction and remedial activities. In 2016, the PRPs produced a Remedial Action Completion Report. In 2017, EPA issued a letter certifying that the remedial action for the PCB soils remedy on the Airport Property is complete.

3.2.3. OU3 – Contamination at AFP 44

Groundwater

Improvements were made to the AFP44 Groundwater Treatment Plant to replace the ozone and oxygen generators and enclose them in an air-conditioned facility, and to bypass the unused former treatment trains associated with the packed column aeration system. Several outages including two of significant durations occurred in 2016 and 2017 leading to the subsequent improvements to the facility.

Prior to September 2016, the Groundwater Treatment Plant was in operations above 80% in 2015. However, major issues associated with degrading hydrogen peroxide as well as oxygen generator breakdowns caused the performance of the Groundwater Treatment Plant to drop below 80% operation from September 2016 through June 2017. Between January 2017 and June 2017, the average operation rate of the Groundwater Treatment Plant was 45%. Between July 2017 and September 2017, the Groundwater Treatment Plant operated above 90% and dropped to 0% from October 2017 through December 2017.

During the September 2016 to February 2017 period, the Groundwater Treatment Plant's downtime was very high due mainly to issues with degrading hydrogen peroxide effecting treatment of contaminants going through the system. In response to these downtimes, EPA and ADEQ contractors conducted a site visit and engineering inspection of the AFP44 Groundwater Treatment Plant in April 2017 to inspect the operation, maintenance, and performance of the treatment plant. As a follow up to this visit, EPA submitted a letter to Air Force on May 25, 2017 that presented findings and recommendations to improve O&M of the Groundwater Treatment Plant to potentially decrease down time. The Air Force issued a memorandum in response to the EPA's letter. In the memorandum, the Air Force proposed to develop a new O&M Manual as well as perform an assessment of the complete pump and treat system. The memorandum responding to all recommendations that was provided to the regulators for review that was approved and finalized on December 21, 2017. On September 28, 2017, the system shutdown due to catastrophic failure of oxygen generator scroll compressor and remained off through the end of December 2017. Since the oxygen generator has been the cause of many past long-term shutdowns of the Groundwater Treatment Plant, a decision was made to completely replace the oxygen generator. The replacement oxygen generator was installed in February 2018 and at the time of the site visit/inspection on February 2018, the new oxygen generator housed in an air-conditioned container was operational.

As of December 2017, a total of approximately 31.3 billion gallons have been extracted and recharged and 25,103 lbs. of VOCs have been removed from groundwater since the groundwater extraction and treatment system was started in 1987. An estimated 120 lbs. of 1,4-dioxane have been removed since startup of the AOP system in 2009. Average pumping and injection rate for the period from January 2012 through December 2017 was about 1,600 gpm. A summary of operational data of the Groundwater Treatment Plant from January 2012 through December 2017 is presented in Table 8.

Table 8. Summary of AFP44 Groundwater Treatment Operations - January 2012 to June 2017.

Period	GWTP Operational Time (Days)	GWTP Operational Time (%)	GWTP Downtime (Days)	VOCs Removed (lbs.)	Cumulative VOCs Removed Since 1987 (lbs.)	Volume of Groundwater Pumped and Injected (gallons)	Average pumping and injection rate (gpm)
January 2012 to December 2012	316	86%	50	128.3	24,408	812,276,000	1,785
January 2013 to December 2013	249	68%	116	100.9	24,508.9	591,800,786	1,650
January 2014 to December 2014	269	74%	96	93.3	24,602.2	631,498,145	1,630
January 2015 to December 2015	321	88%	44	131.2	24,733.4	603,216,936	1,305
January 2016 to June 2016	143	79%	39	191.1	24,852.5	323,686,354	1,572
July 2016 to December 2016	83.2	45%	101	186.5	25,039	189,475,791	1,581
January 2017 to December 2017	167.8	46%	197	64.0 (January 2017 to June 2017)	25,103 (January 2017 to June 2017)	407,684,823	1,687

In-situ Bioremediation pilot studies were implemented at Inactive Drainage Channel Disposal Pits and Former Sludge Drying Beds to treat soil source areas for groundwater contamination for chromium, TCE, and 1,4-dioxane.

4. Five-Year Review Process

4.1. *Community Notification and Site Interviews*

On July 25, 2018, EPA sent out a Fact Sheet in Spanish and English to all the interested parties currently on the mailing list. A total of 12,500 Fact Sheets were mailed. The Fact Sheet provided an update on activities at the Site, as well as, announcing the commencement of the FYR process for the TIAA Superfund Site. The community was invited to provide input to Mary Aycock and Viola Cooper (EPA Community Involvement Coordinator) on the remedies and the FYR process. The Fact Sheet is available in Appendix F. The FYR report will be made available to the public once it has been finalized. Copies of the document will be placed in the designated public repository at the Valencia Public Library, 202 W. Valencia Road, Tucson, Arizona 85706, and posted on the EPA's website.

During the FYR process, interviews were conducted to document any perceived problems or successes with the remedy that has been implemented to date**.** During this review, USACE conducted one interview with Mr. William Ellett of the Arizona Department of Environmental Quality (ADEQ). The results of this interview are summarized below. In addition, EPA conducted interviews with members of the public, the Unified Community Advisory Board (UCAB), the Environmental Justice Task Force. The records for these interviews are included in Appendix G.

An interview was conducted with Mr. William Ellett with ADEQ. Overall, Mr. Ellett is satisfied with the progress of the Site. OU1 Areas A and B are progressing toward meeting their remedial objectives. Mr. Ellett is concerned with OU2 and expressed his concerns that performance objectives are not being met. Mr. Ellett stated that more data on 1,4-dioxane should be collected to determine plume extent and source. Mr. Ellett noted his opinion that OU3 is progressing toward containment even though the treatment system has been down. He stated that regional water levels are rising, complicating current remedial actions at all OUs, so the assumptions made when the treatment systems were put in place may no longer be valid. Mr. Ellett indicated the rising water levels are a main concern for OU2. Ensuring that the extraction and treatments systems are reliably operating is a main component to maintaining capture. Mr. Ellett stated that all entities keep ADEQ generally well informed of activities and Site progress.

Several community members mentioned the work of the Environmental Justice Task Force. All these community members strongly opposed the discharge of water into the neighborhood and specifically identified 1,4-dioxane, perfluorinated compounds (PFC) and TCE as chemicals released in the discharge. These community members opposed the property transfer associated with the construction of the new wells and did not feel EPA kept the community informed. Two other community members echoed the same concern about EPA not keeping the community informed. The co-chair of the UCAB raised concerns about misinformation being sent to the larger community and suggested that EPA provide more community outreach.

In addition to the participants and community members described above, the City of Tucson, U.S. Geological Survey, and the University of Arizona responded positively to the progress being made at the Site. They stated that there has been substantial progress in 25 years and it will continue.

4.2. *Data Review*

4.2.1. Soil

4.2.1.1 OU2- Airport Property

SVE systems are in place to remediate the vadose zone contamination at the Airport Property (OU2). A description of the SVE systems currently operating and their performance is presented in Section 2.4.3. The Airport Property contains areas with elevated VOCs in shallow soils and within the TI zone (Figure 3). Conestoga-Rovers & Associates, consultant to Airport Property PRPs, identified eight Remedy Required Sites (RRS) identified in Table 9.

Table 9: Airport Property Remedy Required Sites

	RRS	SVE Wells
1	Former Buildings 14/15	SVE-1, SVE-2, SVE-3, SVE-4 (TI Zone SVE Wells)
2	Former Buildings 16/17	
3	Former Building 18	
4	South Portion of Hangar 2	
5	Soils beneath West Lease USTs	SVE-5
6	Former Building 25 and Adjacent Soils	SVE-6
7	North and East Sides of Hangar 1	SVE-7
8	Hangar 1	

The SVE systems treats four distinct stratigraphic units: Unit 1, 2, and 3 and Unit 4 Upper Subunit. All subsurface units are composed of recent alluvium with varying amounts of sand, silt and clay. The fine-grained alluvial sediments of Unit 4 are problematic as they retain contaminant mass which can slowly diffuse out and act as a source of groundwater contamination. The Gravel Subunit has higher permeability than surrounding Unit 4 Clays and transports contamination to the Regional Aquifer. It is important to note that the water-bearing Gravel Subunit is intermittently present in the middle of the Upper and Lower subunits of the Unit 4 Clay (Figure 5).

TCE concentrations in the SVE wells have decreased within the five-year review period from 440 parts per billion by volume (ppbv) (August 2013) to 120 ppbv (August 2017). For comparison, the TCE concentration at startup in August 2007 was 220,000 ppbv. Operational runtime near the beginning of this five-year review period (March 2013) was approximately 75 percent. Periods of downtime during this period were primarily due to studies performed in the TI Zone. During the latest reporting period (May through August 2017), the TI Zone SVE system averaged over 99 percent of operational runtime, with no long-duration periods of downtime. Off-gas concentrations for TCE through this five-year review period are below emission requirements1.

[1] Performance standard is 15 pounds of TCE per day.

Operational runtime at RRS SVE-6 during the March through August 2013 reporting period averaged 88 percent. Long-duration periods of downtime occurred during this reporting period due to the blower exhibiting high temperatures during summer, summer storm power outages, and disconnecting and setting up for the RRS SVE relocation from SVE-6 to SVE-5. During the latest reporting period (May through August 2017), the RRS SVE system averaged greater than 95 percent runtime, with no long-duration periods of downtime. TCE and total VOC influent concentrations decreased during the last reporting period (May through August 2017) to below the August 2013 concentrations. TCE concentrations in the off-gas during this reporting period were at non-detect levels.

The SVE system is functioning as designed. In general, the Radius of influence for the SVE wells captures vadose zone contamination. The northwest corner of the TI zone is not captured by the SVE system at a depth of 20 to 28 feet bgs. It is unclear that the RAOs for the TI Zone are being met based on the 1997 ROD that states that the Airport Property PRPs shall reduce VOC vapor concentrations in soil and achieve lateral and vertical vapor containment until contamination concentrations have been reduced such that ceasing operation of the system will not cause a water quality impact to the SGZ outside the TI Zone or to the Regional Aquifer in excess of cleanup standards."

Regional groundwater levels increased up to 40 feet in the last 5 years. Rising groundwater levels may impact the SVE system operation within the next 5 years if groundwater levels continue to increase at current rates.

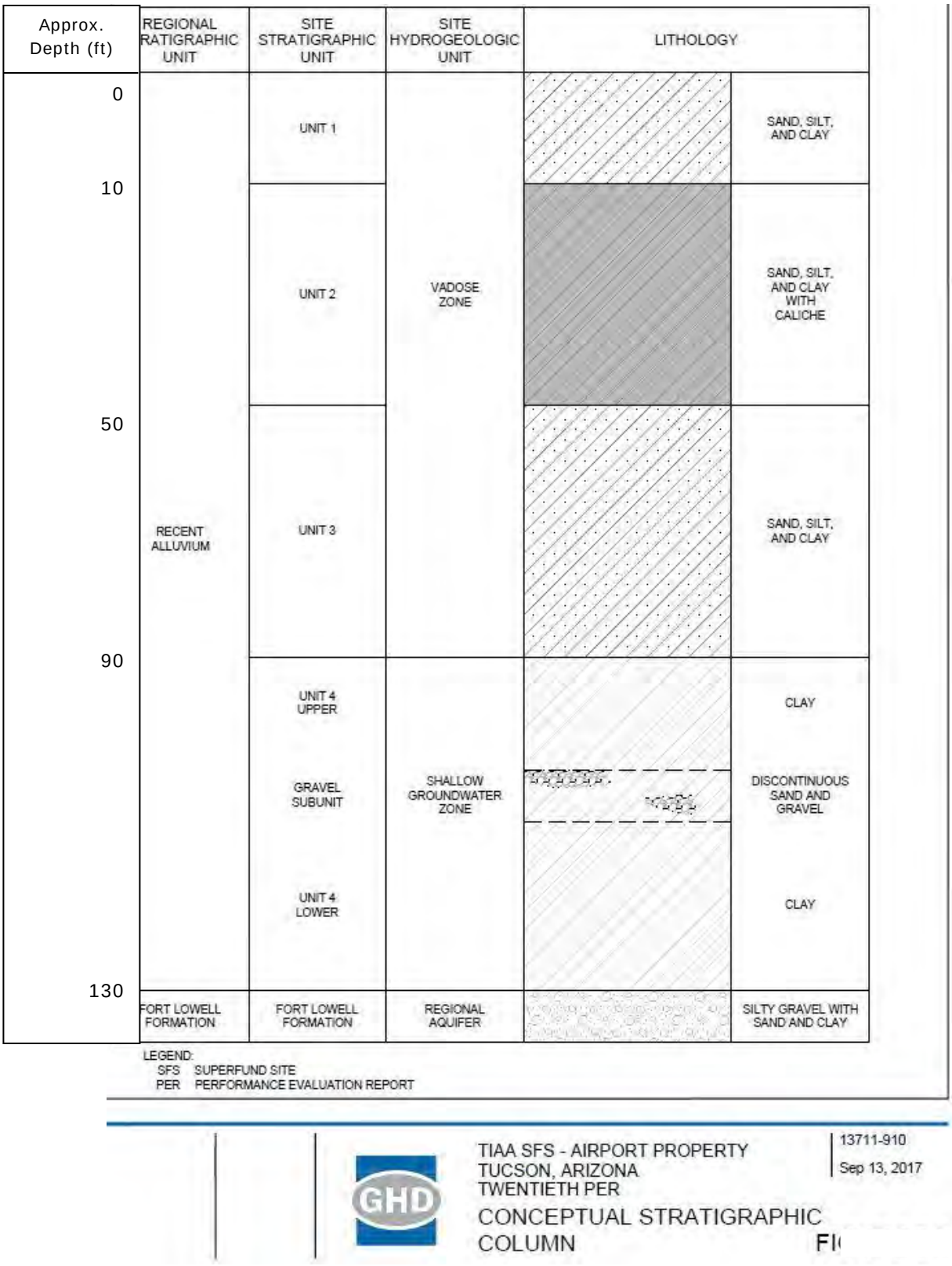


Figure 5. Stratigraphic Column Near the Three Hangars Area for the Airport Property

4.2.1.2 OU3- AFP 44

For OU3 soil at AFP44, no additional data have been generated for Ranch Site, FACO Landfill, and Inactive Drainage Channel Disposal Pits associated with the remediation of soil, as established in the 1997 ROD, during the FYR period. Currently VOCs, specifically TCE in soil have been remediated to ADEQ Non-Residential SRLs. Consequently, these sites are subject to the Land Use Covenant requirements. The Air Force is in the process of submitting an ESD to incorporate Land Use Covenants at the three sites into the 1997 ROD.

For the Former Sludge Drying Beds, data review of activities associated with the soil and soil vapor media include the Final Vapor Intrusion Study Work Plan and Technical Memorandum Vapor Intrusion Work Plan Addendum.

4.2.2. Groundwater

All sites discussed below are currently affected by regional groundwater level rise. Regional groundwater levels have risen approximately 30 to 40 feet during the last 5 years. Spikes in VOC concentrations were observed as groundwater levels rise. The impact of increasing groundwater levels on contaminant concentrations is an overall concern for the treatment systems operation at the Site.

4.2.2.1 OU1 Area A (TARP)

Carollo, consultant for TARP PRPs, prepared Semi-Annual Status Reports to document groundwater quality data, describe remedial actions and comply with ROD requirements. The ROD requirements include control of contaminant migration, aquifer remediation and treatment of extracted groundwater.

The groundwater extraction and treatment system is composed of two extraction well fields: the North Well Field designed to contain the plume, and the South Well Field designed to removed contaminant mass. The extraction wells deliver the groundwater to the TARP Water Treatment Plant. Operation and maintenance performance is discussed in Section 2.4.1.

The North Well Field has contained the TCE plume within the Regional Aquifer by maintaining hydraulic capture (Figure 6). The highest TCE concentration of 51 µg/L is observed in well WR-165A, near the North Well Field. The second highest TCE concentration of 29.7 µg/L is observed in well 410T, located along the eastern plume boundary, north of the South Well Field.

The South Well Field was successful in decreasing the concentrations of TCE and other contaminants within the plume as required by the ROD. The plume has retracted in width when comparing the 1995 to the 2017 plume extent with the exception of the area near well 410T, screened between two aquifer units and is not considered characteristic of the TCE plume (Figure 7).

USACE performed Mann-Kendall trend analysis on TCE concentrations at well 410T on data collected from November 2012 to March 2018. Increasing TCE concentrations were observed in well 410T from 2.9 µg/L (1999) to the highest concentration of 32.9 µg/L (2015). TCE concentrations have

decreased slightly since 2015 to a current TCE concentration of 25.7 µg/L (August 2018). Results from the trend analysis indicates 'no trend' in data. The consensus of opinion is that the spike of TCE observed at well 410T was possibly a slug of contamination that has passed, a possible side effect of rising groundwater levels in the area, or an unidentified local source unrelated to the TIAA site. Regardless, concentrations appear to be declining over the last several sampling events and groundwater flow direction is to the northwest in the direction of the TARP north well field where the elevated slug of TCE will be captured. Data and statistical analysis are presented in Appendix C.

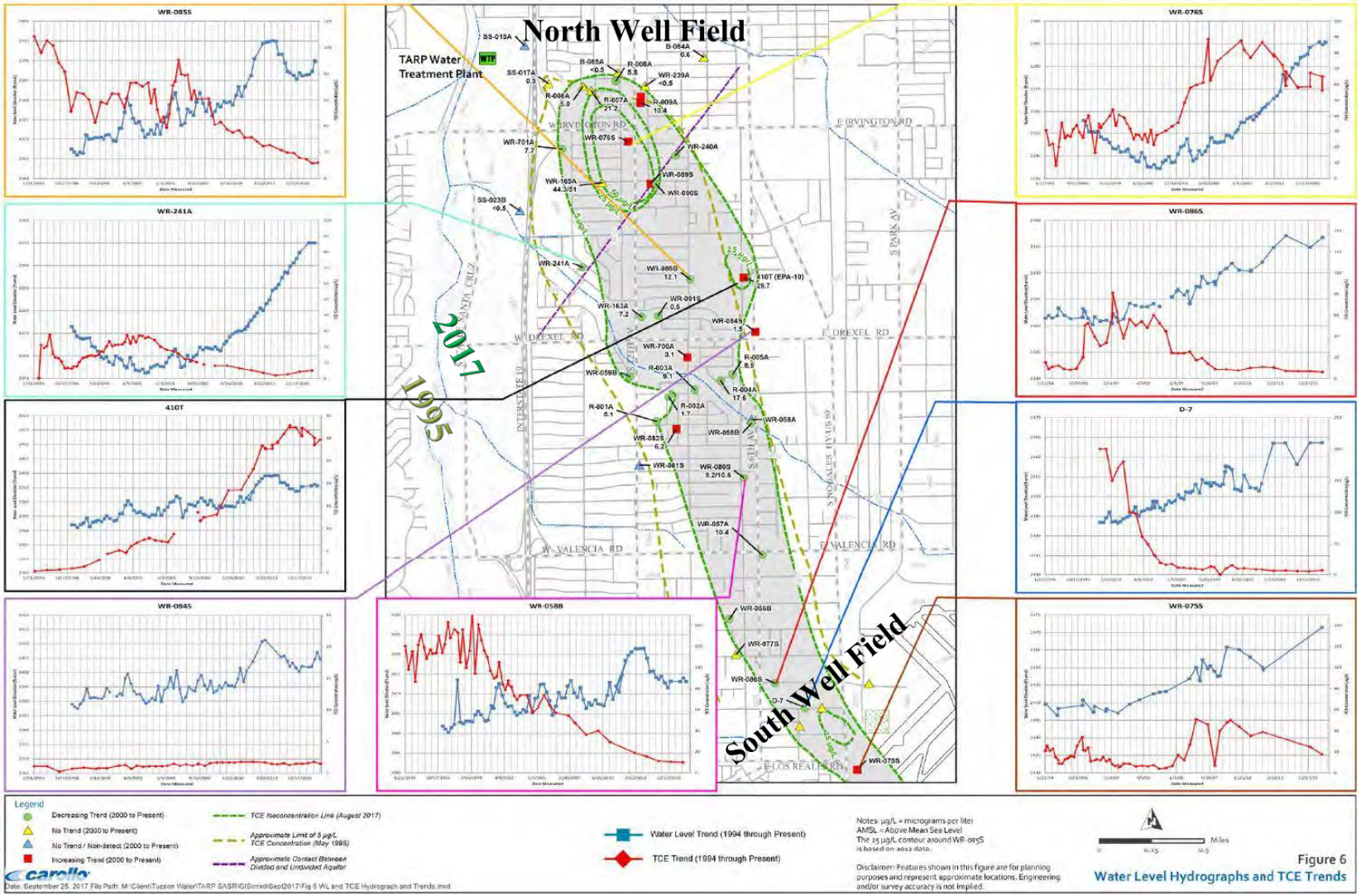


Figure 6. 2017 TCE Isocontour Map with Selected Wells Showing Their Respective Response to Regional Water Level Rise

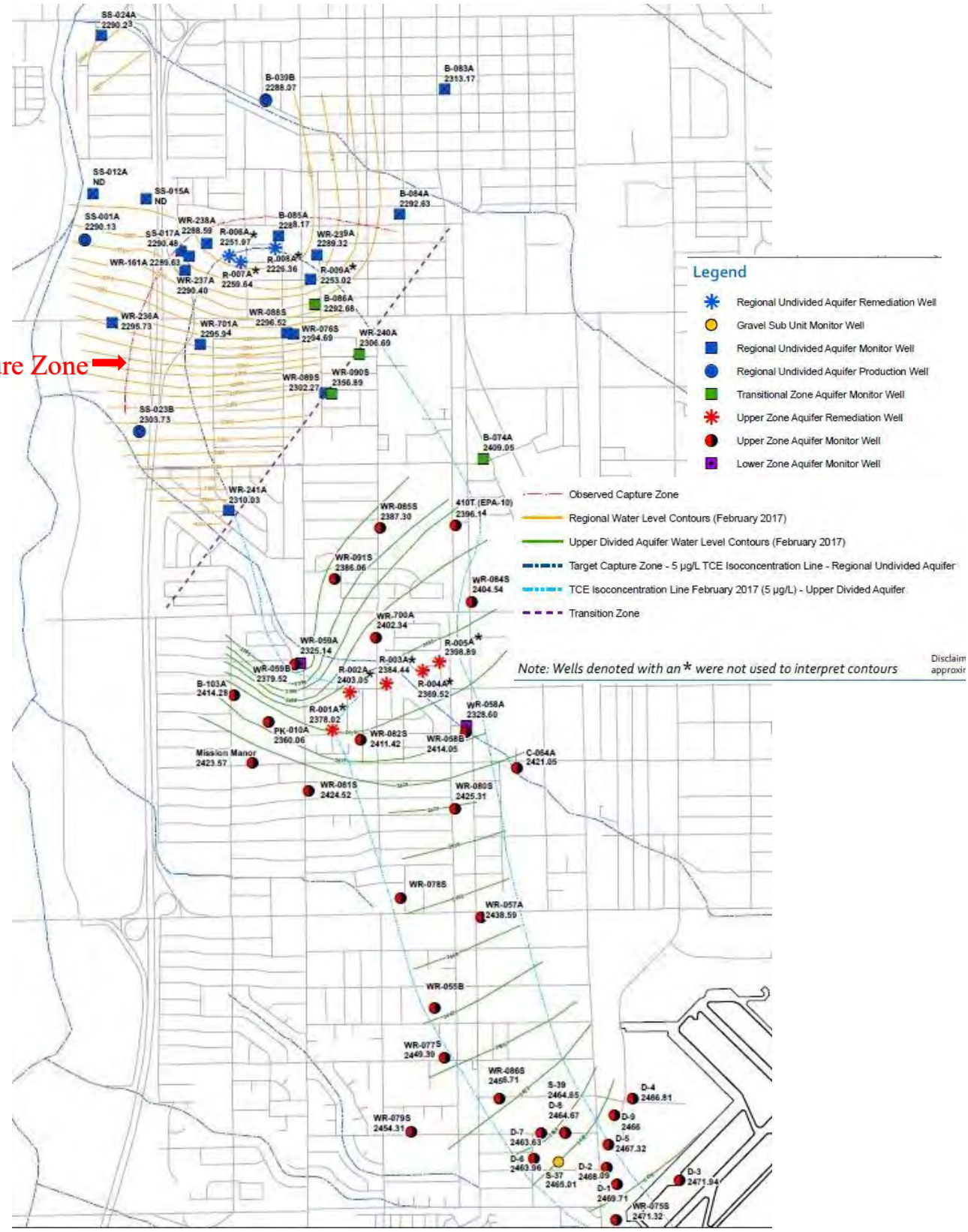


Figure 7. Equipotential Lines with Capture Zone Extent (Carollo, 2017)

4.2.2.2 OU1 Area B (Texas Instruments, West Cap, AANG and West Plume B)

EPA issued a ROD amendment in 2012 that changed the remedy from groundwater pump and treat to ISCO for all OU1 Area B sites, except West Plume B. The West Plume B remedy changed to MNA. The objective of the remedy is to treat VOC contamination present within the fine-grained sediment located directly above the groundwater (vadose zone). The VOC mass within this zone continues to act as a source of groundwater contamination. Previous remedies did not adequately address this contamination in the fine-grained sediments of the Upper Unit of the TIAA, which have lower permeability. The following OU1 Area B data analysis section is organized beginning with the upgradient site, Texas Instruments, and ending with furthest downgradient site, West Plume B.

Texas Instruments

Arcadis, a Texas Instruments consultant, performed ISCO injections using potassium permanganate in February 2016 in the target vadose zone and saturated sediment at injection wells SVMW-1 and SVE-1 (Figure 8). VOC concentrations remain above the ROD cleanup levels (Figure 9). However, the VOC concentration data are unremarkable at this point because the full effect of the ISCO treatment is typically 3 to 5 years after injection. Groundwater concentration data are presented in Appendix C.

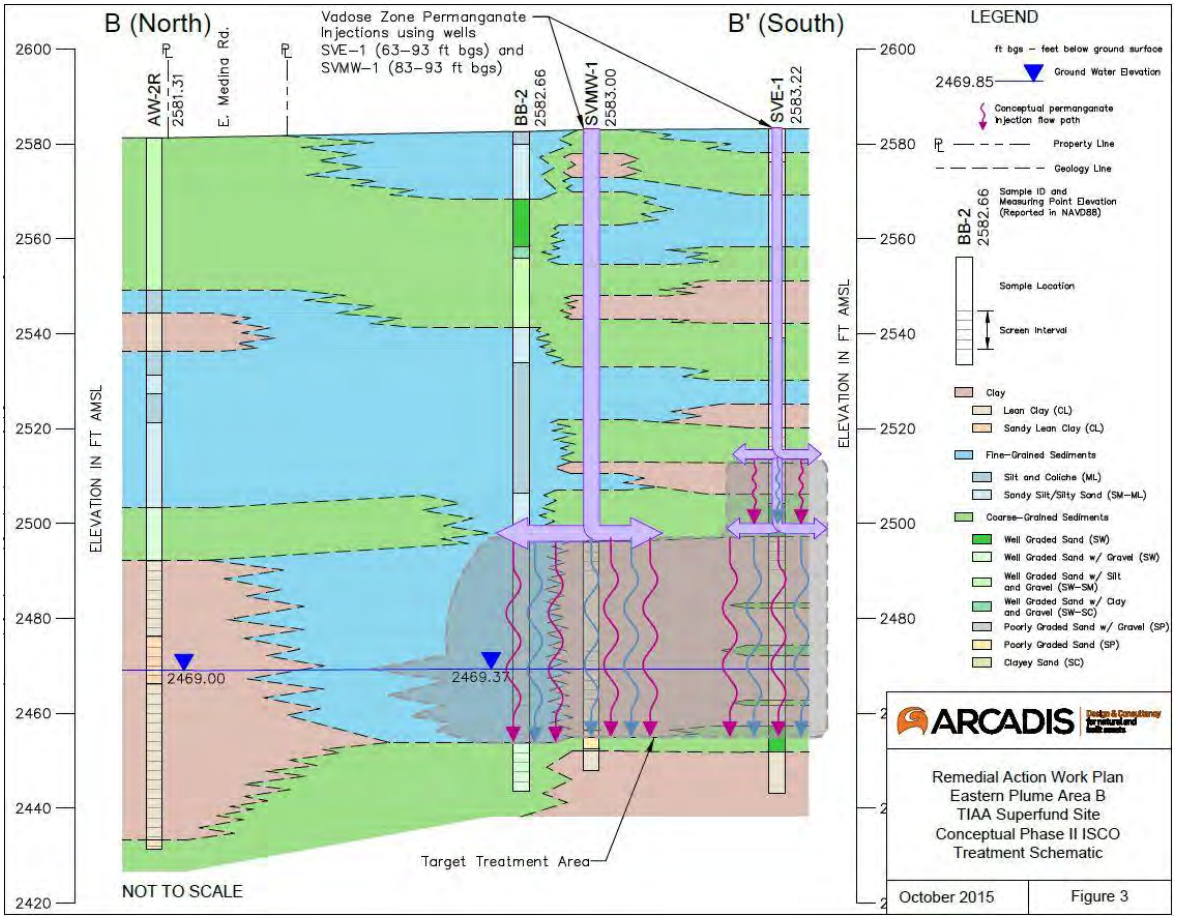


Figure 8. Conceptual Target Zone for Texas Instruments ISCO Injections

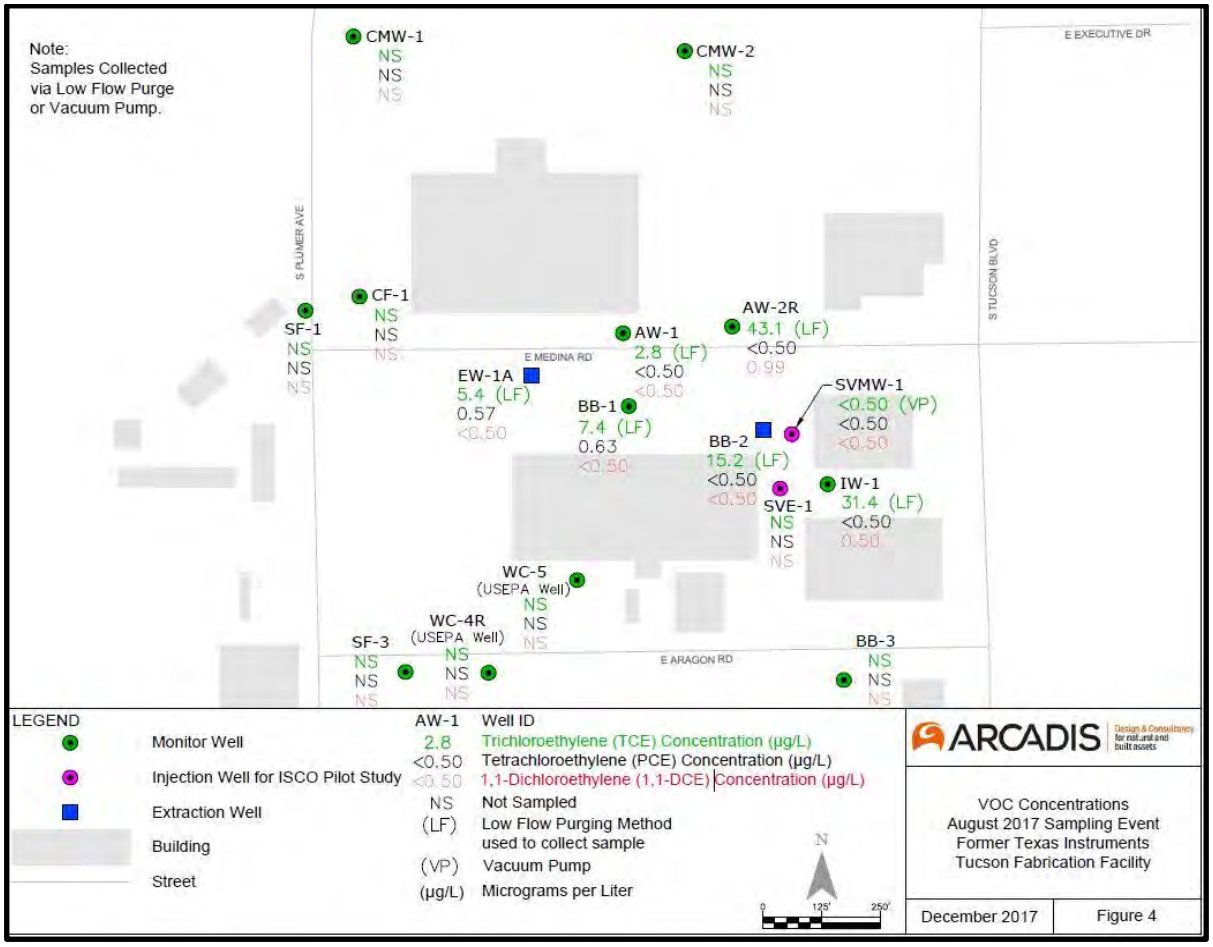


Figure 9. VOC Concentrations in August 2017 Following February 2016 ISCO Injections at Texas Instruments Property

West Cap

APTIM, consultant to EPA for Western Capacitor, performed potassium permanganate ISCO injections in 2014 within the source area, followed by performance monitoring. The ISCO treatment is effectively reducing concentrations and minimizing migration of the contaminants to the Regional Aquifer and making progress towards meeting RAOs. The TCE concentrations within the source area are decreasing following ISCO injections (Figure 10 and 11), and have achieved ROD cleanup levels just downgradient of the injection area. TCE concentrations within the western lobe, an area primarily located on Tucson International Airport between Airport Wash and Runway 3 – 12, have decreased to below the ROD cleanup levels (Figure 12 and 13).

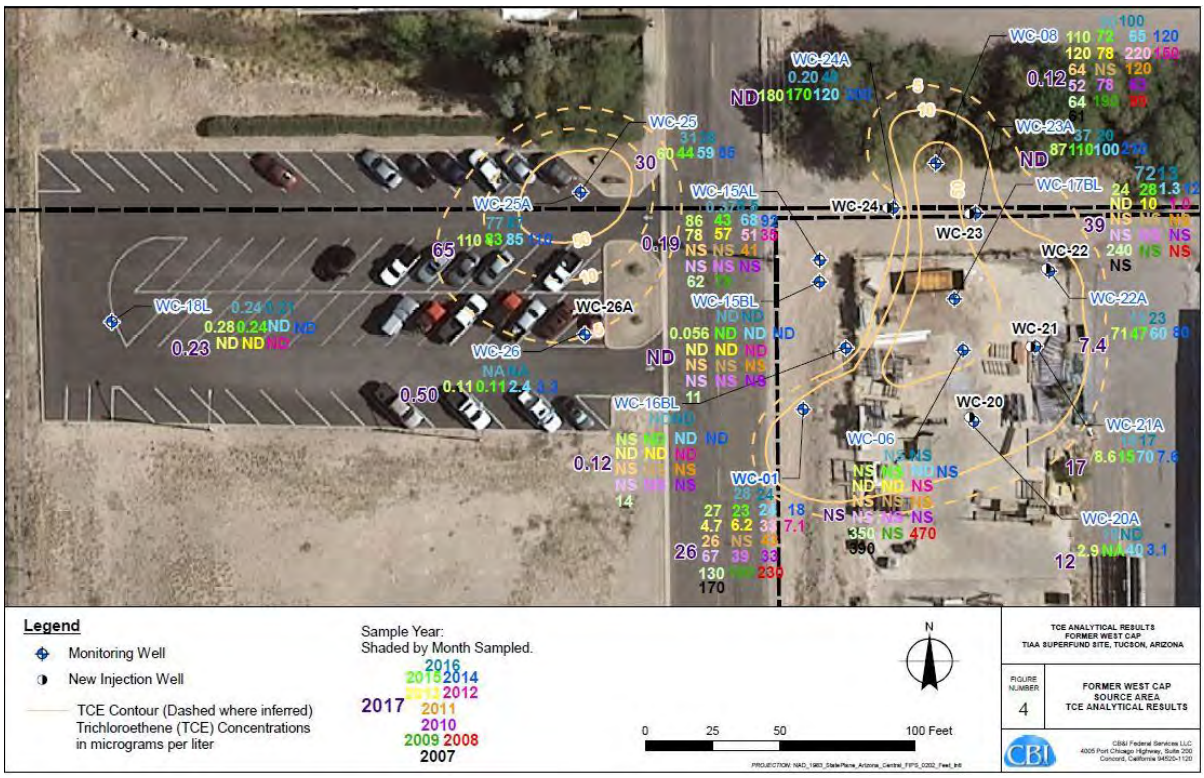


Figure 10. TCE Concentration Data and Plume Location for the West Cap Source Area

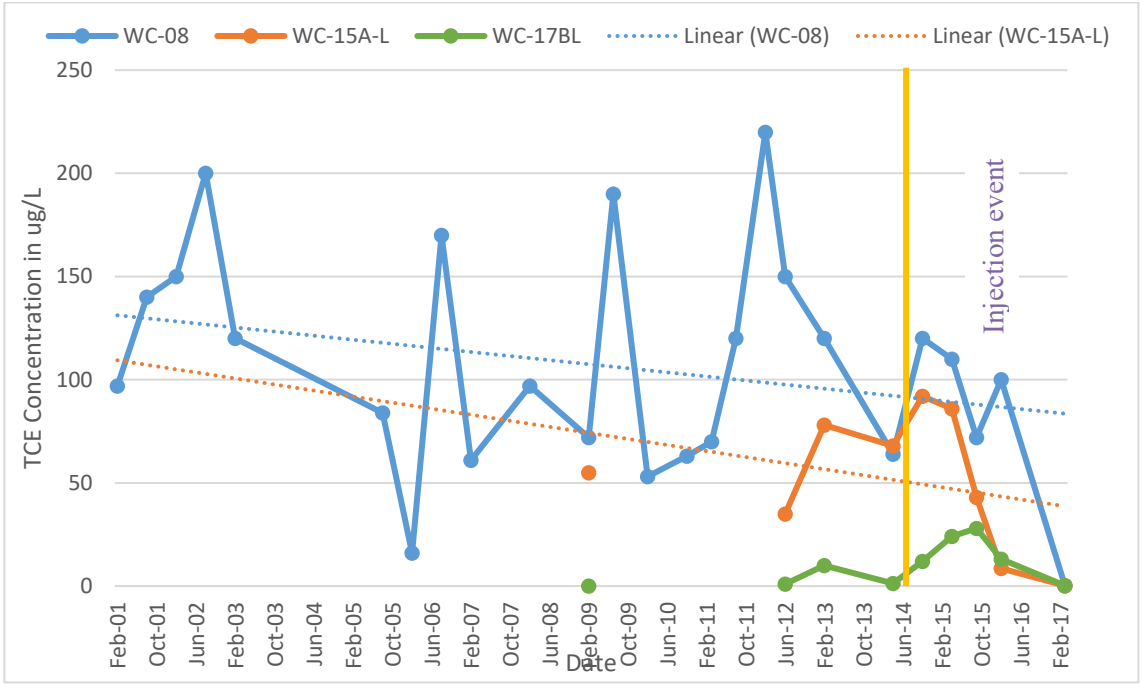


Figure 11. West Cap Source Area TCE Concentrations Versus Time

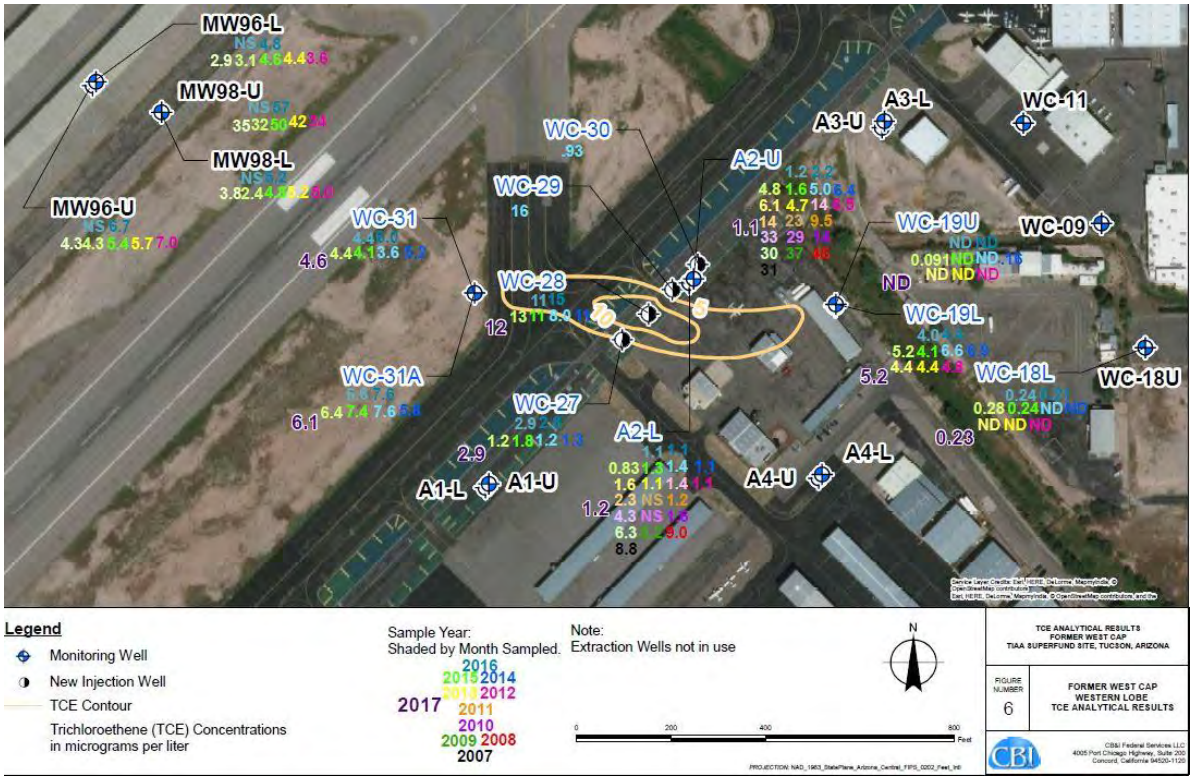


Figure 12. TCE Concentration Data and Plume Location for the West Cap Western Lobe Area

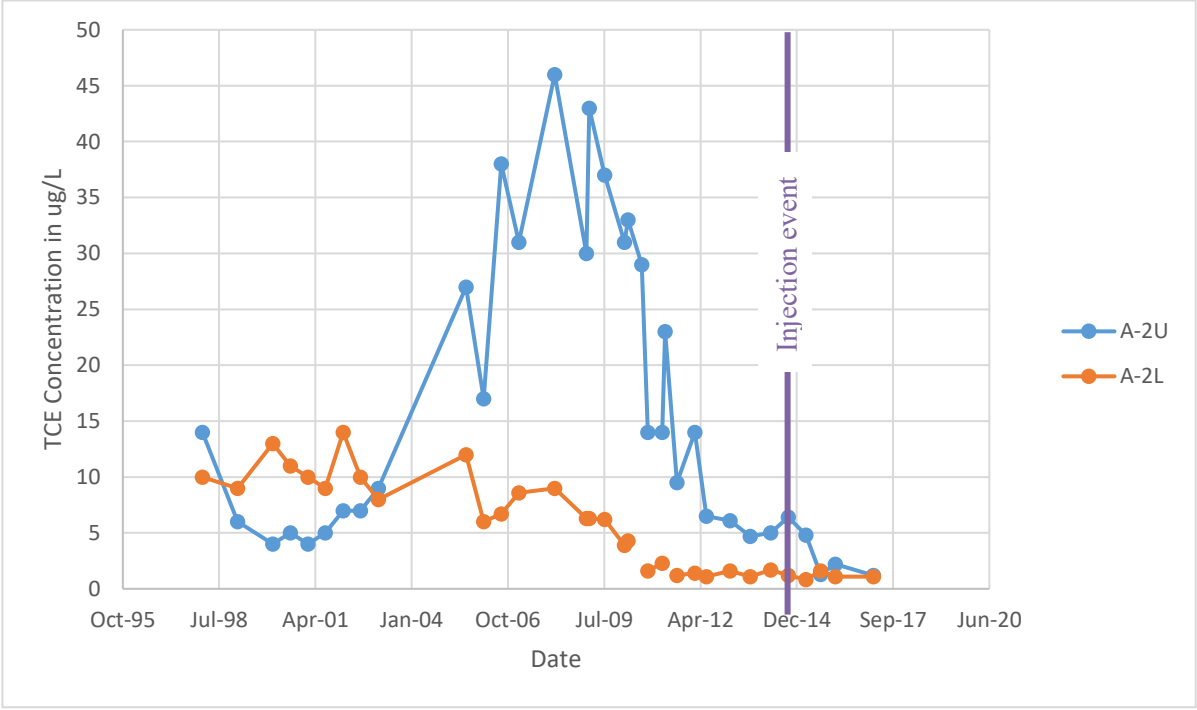


Figure 13. West Cap Western Lobe TCE Concentrations Versus Time

AANG

The AANG is located downgradient of the Texas Instruments and West Cap sites. An ISCO pilot study was performed between 2009 and 2010. Since these injections, groundwater concentrations are monitored to observe the trends in VOCs and dissolved metals. The AANG also conducts monitoring for the West Plume B site. Groundwater flow direction for both Upper and Lower Subunit of the Upper Zone Regional Aquifer is to the northwest at an approximate gradient of 0.003 foot/foot (ft/ft). TCE exceeds the ROD cleanup level of 5 µg/L for portions of the Upper and Lower Aquifers (Figures 14 and 15).

USACE performed Mann-Kendall trend analysis on three groundwater monitoring well pairs for the upper and lower subunit of the upper aquifer. Wells MW100-U,-L and MW101-U,-L are located at the downgradient portion of the property. MW103-U,-L is located off-property. The upper subunit wells are screened from approximately 87 ft to 97 ft bgs. The lower subunit wells are screened from approximately 130 ft to 150 ft bgs. It is important to note that the current depth to water for both upper and lower subunit wells ranged from 77 ft to 79 ft bgs.

Results of the Mann-Kendall trend analysis illustrate 5 of 6 wells with increasing TCE concentration trends for on and off-property wells in the Upper and Lower Subunits. However, concentrations were not detected above the contingency plan trigger value of 10 µg/L described in the 2012 Record of Decision Amendment. Increasing concentrations of TCE are attributed to a change in the sampling methodology for the site. Recent sampling events have been conducted using passive diffusion bags instead of low-flow pumping. During two rounds of sampling, select wells were sampled using PDB in addition to low-flow sampling, and PDB results were generally higher. A small contribution to increasing concentrations may also be attributable to rising water levels. For wells on the eastern side of the Base with increasing TCE, the trend is attributed to a slug of elevated TCE observed just outside the eastern Base boundary; the AANG is in the process of implementing an ISCO remedial action at that area to address that concern.

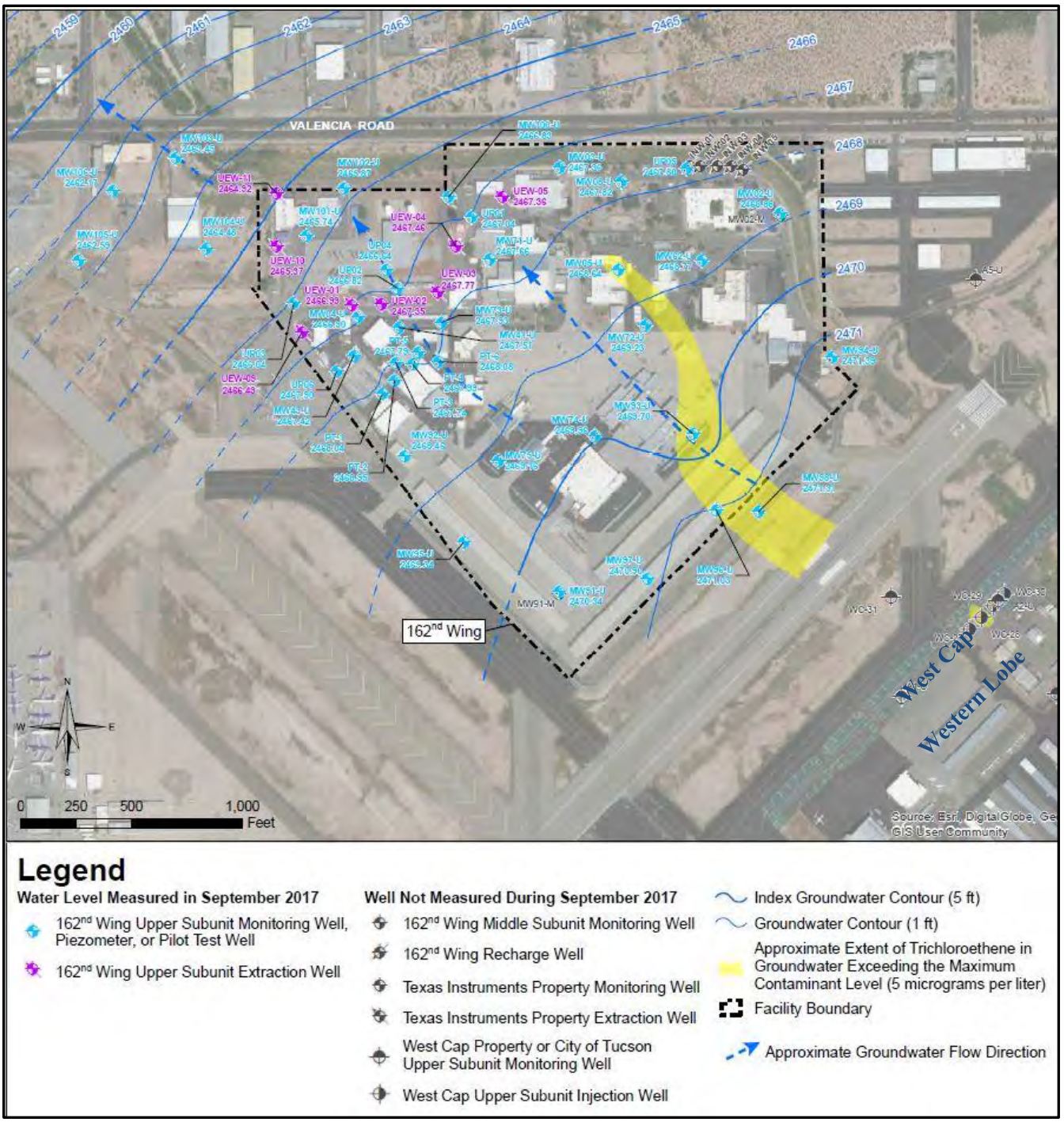


Figure 14. AANG Groundwater Gradient and TCE Plume in the Upper Aquifer Subunit

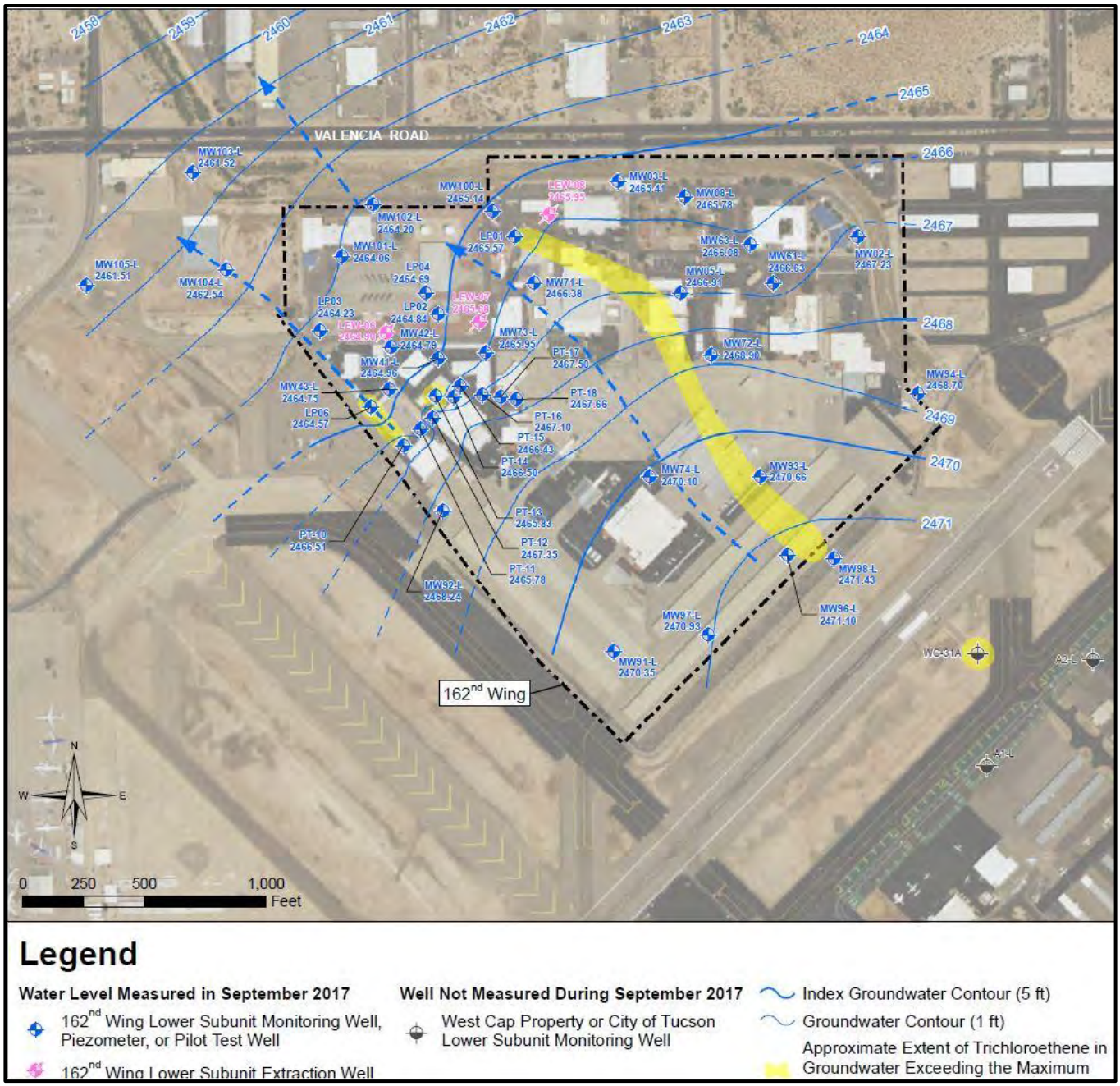


Figure 15. AANG Groundwater Gradient and TCE Plume in the Lower Aquifer Subunit

West Plume B

The West Plume B groundwater plume appears to be stable and is not migrating vertically or horizontally. USACE performed Mann-Kendall statistics on two monitoring wells: one located at the downgradient end of the plume in the shallow aquifer (WPB-11), and one located at mid-plume (WPB-13) at a deeper screened interval than the downgradient well to identify any vertical migration of TCE. TCE concentrations have decreased steadily at in the downgradient well since the selection of

MNA remedy. The results from Mann-Kendall analysis at mid-plume well show no trend in concentration. However, TCE degradation products are detected at this well, suggesting that natural attenuation is occurring within the plume. Results of the Mann-Kendall analysis are presented in Appendix C.

4.2.2.3 OU2 – Airport and Contaminated Soils

Airport Property

Based on the following data analysis, the Airport Property is not completely meeting the required groundwater RAO that prevents migration of contaminants into the Regional Aquifer and into clean portions of the Shallow Groundwater Zone.

The operation of the three groundwater extraction systems and natural aquifer conditions (confining pressures) result in the upward head gradient that prevents downward migration of contaminants into the Regional Aquifer for the RRS and TI Zone areas with the exception of the areas near the transition zone into the Regional Aquifer at S-39 area, located along E. Corona Rd, west of the Site.

Horizontal capture throughout most of the TI Zone and RRS areas (Figures 16 and 17) is meeting RAOs with the exception of the area near CRA-67D, near the intersection of S Nogales Hwy and E. Corona Rd., on the western boundary of the airport. The groundwater flow direction is concentric around most of the existing six extraction wells where a majority of the contamination is extracted, treated and reinjected into the aquifer. TCE concentrations in well CRA-67D are not declining in relation to other nearby wells based on Mann-Kendall analysis (discussed further in Appendix C). It is important to note that although this well is designated as GSU, it may be geologically isolated from the extraction system due to the natural irregularity of stream deposition. This area of concern is not influenced by the extraction systems (Figures 18 and 19).

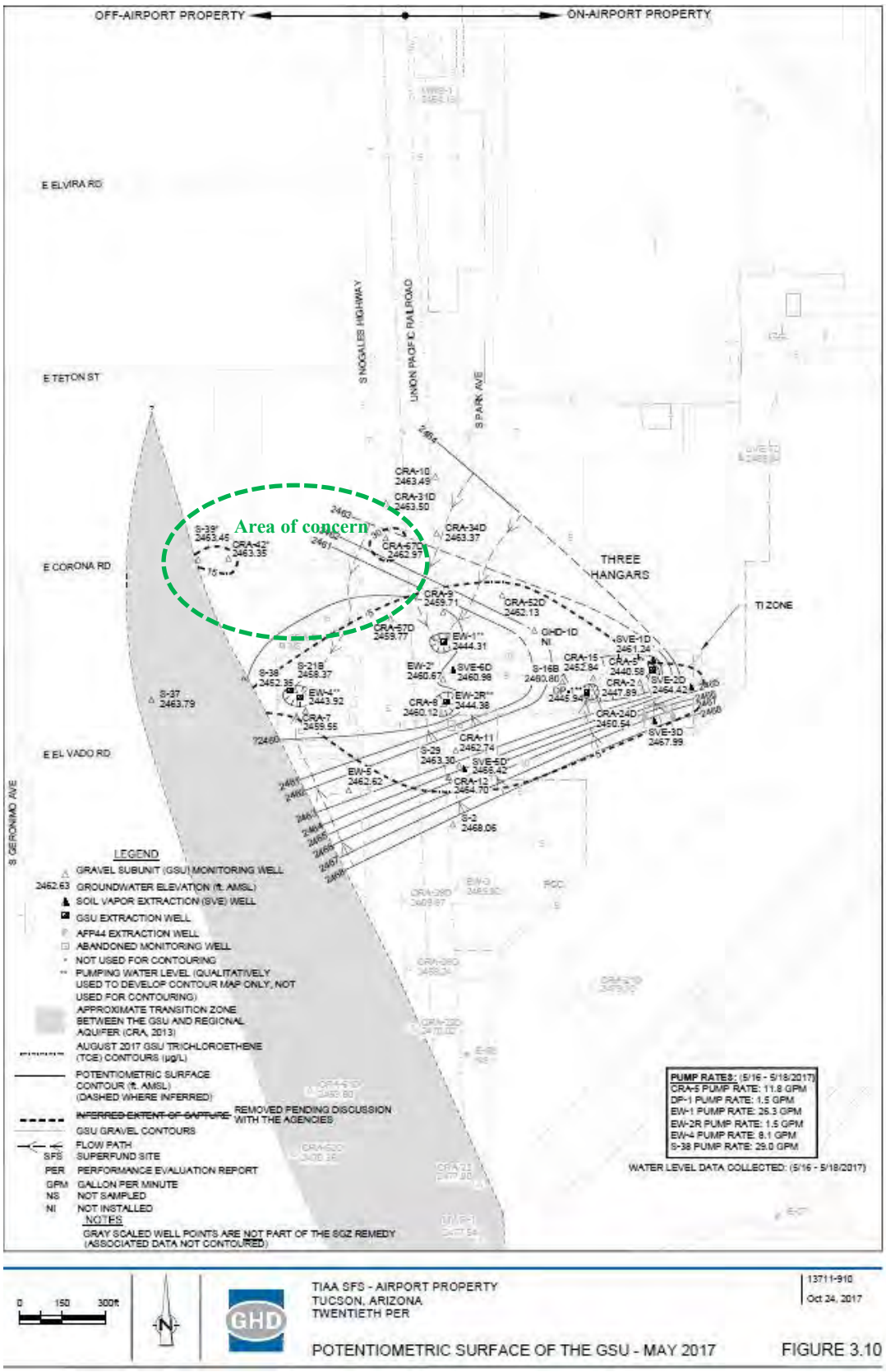


Figure 16. SGZ Hydraulic Contours and Flow Patterns in May 2017

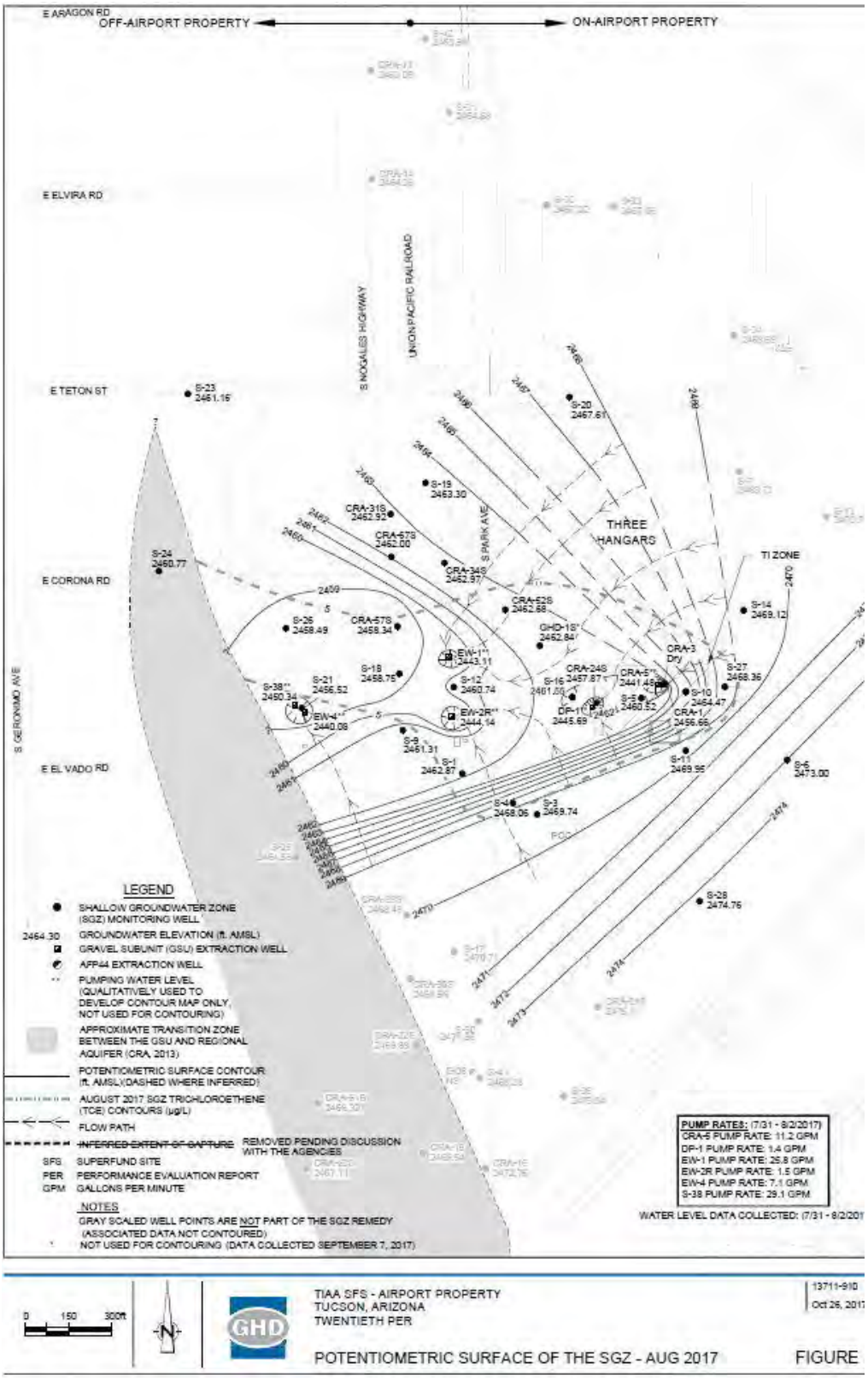


Figure 17. SGZ Hydraulic Contours and Flow Patterns in August 2017

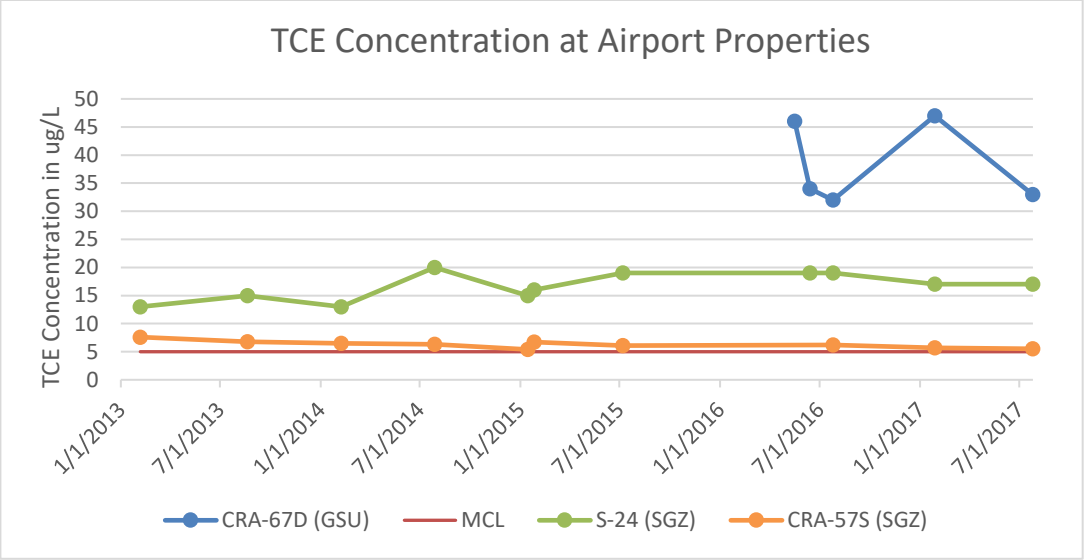


Figure 18. TCE Concentrations for SGZ and GSU wells at Airport Property

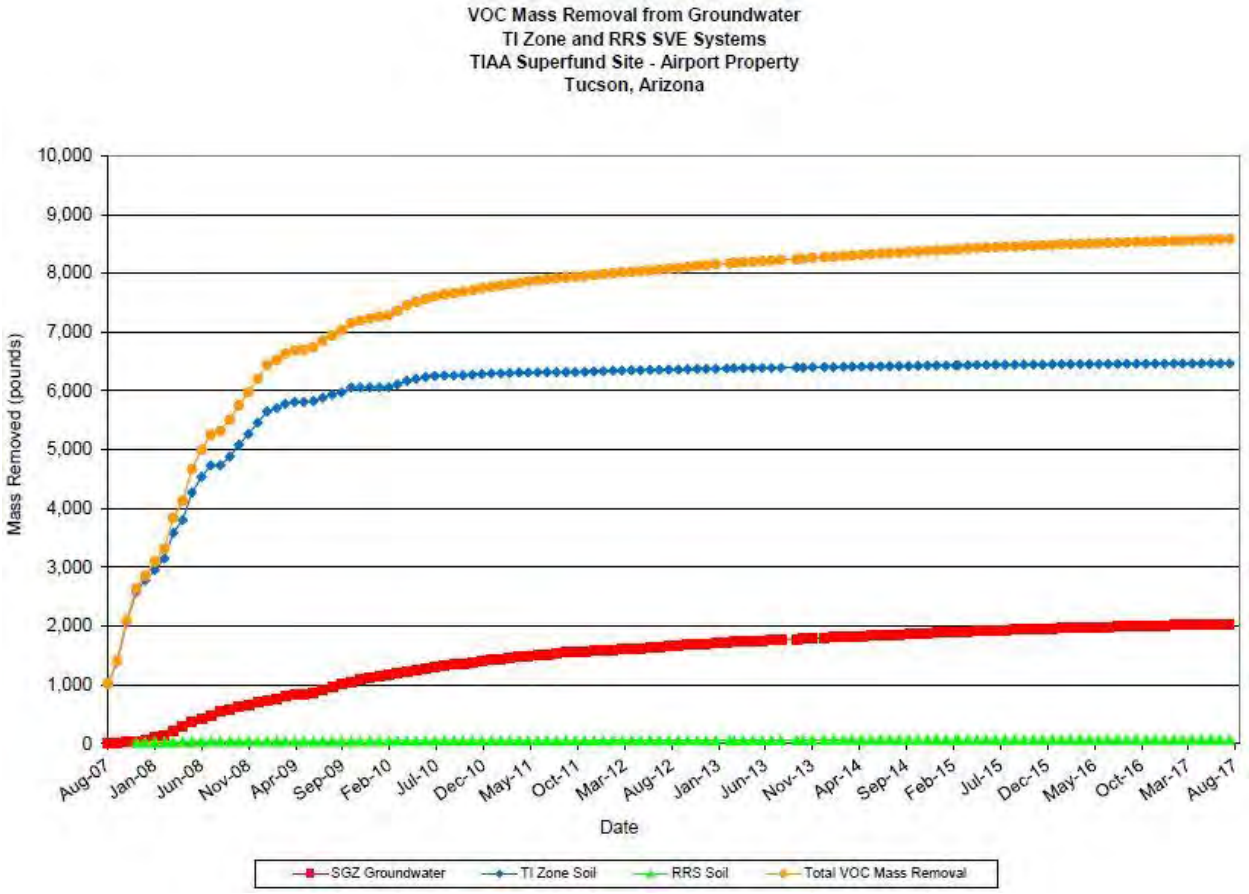


Figure 19. VOC Mass Removal for All Three Extraction Systems Operating at Airport Property (Red curve)

4.2.2.4 OU3 – AFP44

TCE concentrations in many wells at or near the edge of the Upper Zone, Upper Unit plume boundary (peripheral wells) are stable or decreasing, other wells show an extension of the TCE plume from the previous sampling events in a northwest trending direction. This increase in the TCE plume footprint in the area between Hermans Road and Los Reales Road is attributed to the significant period of downtime for the GWTP in late 2016 and early 2017. However, water level data for the Upper Zone, Upper Unit obtained in April – May 2017 demonstrate re-establishment of containment of the Upper Zone, Upper Unit TCE contamination within the AFP44 site after the GWTP came back on line in March 2017. Based on historical trends, TCE concentrations are anticipated to decline accordingly. Steady TCE concentrations were observed in most of the Upper Zone, Lower Unit peripheral wells north of Hermans Road, but concentrations in peripheral wells along the south and west edge of the plume increased. Similar to the Upper Zone, Upper Unit, these data trends suggest that the Upper Zone, Lower Unit plume expanded somewhat between previous and current reporting periods, this condition is anticipated to be a short-term response to the GWTF being down for significant periods of time during the reporting period.

The areas in the Upper Zone, Upper Unit and Upper Zone, Lower Unit where 1,4-dioxane and chromium exceed associated treatment goals and/or regulatory standards are encompassed by, and are smaller than, the TCE plumes in these subunits. Therefore, hydraulic capture of these COCs is also occurring at the site. The distribution of 1,4-dioxane is generally similar to the previous sampling events. The distribution of total chromium in the Upper Zone, Upper Unit changed somewhat from previous reporting periods. The localized hot spot area still exists near Former Sludge Drying Beds, and an additional hot spot near FACO Landfill was observed

The metric used by the Air Force to demonstrate plume containment was the geometric mean of the measured concentrations of COCs in µg/L from samples collected from four consecutive sampling events at three boundary locations (AFP44 Boundary Wells in the Upper Zone, Upper Unit and Upper Zone, Lower Unit; Nogales Highway Wells Between Hermans Road and Los Reales Road; and Los Reales Road Boundary Wells in the Upper Zone, Lower Unit) within the two subunits. Typically, when comparing the trend of the COC concentrations in these boundary wells to the baseline (2009 through 2014), there was a steady decrease of COCs shown in wells with the exception of the sampling events that were collected after the Groundwater Treatment Plant had been inoperable for approximately 3 months. Shutdown of the groundwater remedial system during this period may have resulted in some migration of the COC plumes within the respective boundaries. However, as demonstrated in the past shutdowns, plume containment is anticipated to occur very quickly once the Groundwater Treatment Plant is in full operation. During the next five years the Air Force expects to establish full capture of the TCE and 1,4-dioxane plumes at Herman's Road, which is one mile south of Los Reales Road, thus cutting off the largest source of contamination to the Area A plume.

Data indicate that from the initial operation of the groundwater extraction and treatment plant in 1986, overall, the VOC plume is decreasing in width and in length. As of June 2016, a total of approximately 30.7 billion gallons have been extracted and recharged and 24,852 lbs. of VOCs have been removed from groundwater since the groundwater extraction and treatment system was started in 1987. The

average pumping and injection rate for the period from July 2015 through June 2016 was about 1,650 gpm, with a resultant VOC mass removal of 196 lbs. Weekly monitoring of the influent and effluent streams of the Groundwater Treatment Plant continues to indicate that the AOP system is effectively treating 1,4-dioxane and TCE in the extracted groundwater.

Convergent groundwater flow patterns in the Upper Zone, Upper Unit and Upper Zone, Lower Unit (UZLU) provide hydraulic capture of the area where TCE concentrations exceed the MCL of 5 µg/L (Figure 20). The complex pattern of extraction and injection that occurs at the site results in multiple coalescing capture zones that encompass the area where TCE exceeds the MCL. The direction of groundwater movement throughout the TCE plume areas in the Upper Zone, Upper Unit and Upper Zone, Lower Unit is toward extraction wells tied into treatment. The areas in the Upper Zone, Upper Unit and Upper Zone, Lower Unit where 1,4-dioxane and chromium exceed associated treatment goals and/or regulatory standards are encompassed by, and are smaller than, the TCE plumes in these subunits. Therefore, hydraulic capture of these COCs is also occurring at the site (URS, 2018e).

Further supporting plume containment, between July 2012 and June 2016, monitoring wells at or near the edge of the Upper Zone, Upper Unit and Upper Zone, Lower Unit plume boundary (peripheral wells) generally exhibit stable or decreasing trends in TCE and 1,4-dioxane concentrations when compared to the previous year's or previous sampling event. These data trends generally support a demonstration of containment of the zone of Upper Zone, Upper Unit and Upper Zone, Lower Unit TCE and 1,4-dioxane contamination at the site. However, during significant outages of the Groundwater Treatment Plant, loss of capture, at least on a temporary basis, has occurred particularly for the Upper Zone, Lower Unit. These outages were discussed previously in Section 3.2.3. In addition, it has been observed that being able to demonstrate capture in the immediate vicinity around Los Reales Road has been hampered by the lack of an adequate number of monitoring wells in the best locations that would confirm the COC concentrations at Los Reales Road and provide proof of capture.

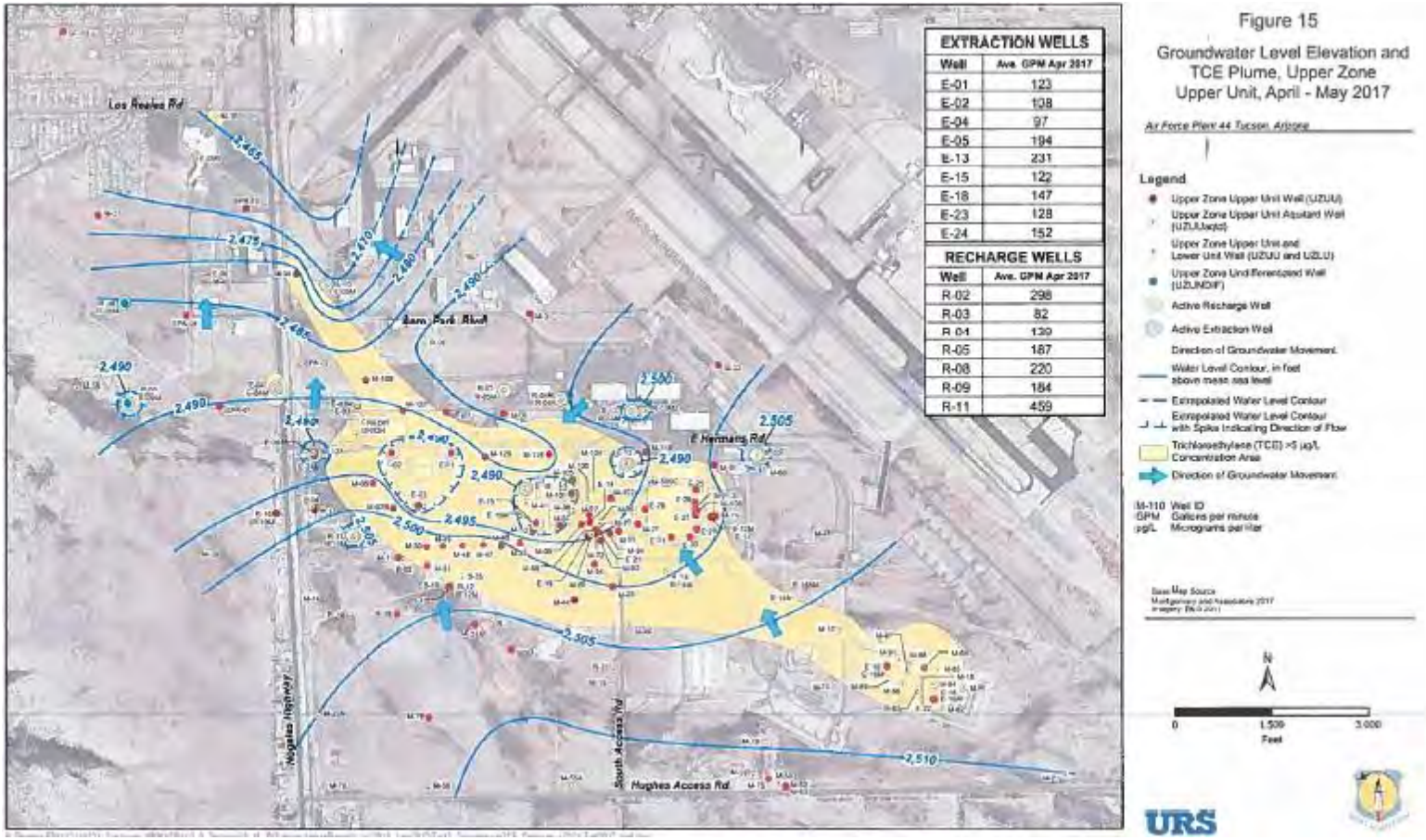


Figure 20. AFP 44 Monitoring Wells, Upper Zone, Upper Unit

4.2.3. Vapor Intrusion

4.2.3.1 OU2 – Airport Property

The Airport Property, as directed by EPA, conducted an indoor air investigation of the Three Hangars Building. The investigation focused on the southern portion of the building, which overlies the SGZ groundwater plume (Figure 21).

Seven passive samplers were placed inside of the building to measure indoor air concentrations. One sampler was placed outside to measure ambient air concentrations. The passive samplers were installed along existing chain link fence at each of the three locations within the open hangar areas (Hangars 1, 2, and 3). The remaining four samples were located within areas leased by building tenants. Within the four tenant locations, the passive samplers were installed along a wall at a location that would minimize impact to the tenant's operations. The passive sampler for the ambient air sample was placed outside on the southern building wall of the metal storage building located approximately 100 feet southeast of the southeast corner of the Three Hangars Building. This location was selected as an appropriate upwind location after reviewing the prevailing wind direction at the airport. All passive samplers were installed at a height of approximately 5 feet above ground level at each location. The passive samplers were left in place for 1 week prior to analysis. Figure 18 presents the air sampling locations at the Three Hangars Building.

The only contaminant detected in all eight samples was carbon tetrachloride (CCl_4). The highest concentration was 0.78 micrograms per cubic meter (µg/m^3), located in a storage room, and the lowest concentration was 0.38 µg/m^3, which occurred at two locations. The CCl_4 concentration in the ambient air sample was 0.46 µg/m^3. No detections of chloroform, 1,1-DCE, TCE, or vinyl chloride were present in any of the indoor or ambient air samples. The CCl_4 detections are all below the industrial indoor air regional screening level (RSL) of 2 µg/m^3. The analytical results are presented in Table 10.

Table 10. On-Airport Property Indoor Air Investigation Results

Sample Location	CCl_4 (µg/m^3)	Chloroform (µg/m^3)	1,1-DCE (µg/m^3)	TCE (µg/m^3)	Vinyl Chloride (µg/m^3)
SS-01	0.39	ND (0.14)	ND (0.55)	ND (0.15)	ND (0.46)
SS-02	0.40	ND (0.14)	ND (0.55)	ND (0.15)	ND (0.46)
SS-03	0.38	ND (0.14)	ND (0.55)	ND (0.15)	ND (0.46)
SS-04	0.61	ND (0.14)	ND (0.55)	ND (0.15)	ND (0.46)
SS-05	0.39	ND (0.14)	ND (0.55)	ND (0.15)	ND (0.46)
SS-06	0.78	ND (0.14)	ND (0.55)	ND (0.15)	ND (0.46)

Sample Location	CCl_4 ($\mu g/m^3$)	Chloroform ($\mu g/m^3$)	1,1-DCE ($\mu g/m^3$)	TCE ($\mu g/m^3$)	Vinyl Chloride ($\mu g/m^3$)
SS-07[2]	0.46	ND (0.07)	ND (0.27)	ND (0.8)	ND (0.23)
SS-08	0.38	ND (0.14)	ND (0.54)	ND (0.15)	ND (0.46)
EPA RSL[1]	2.0	0.53	880	3.0	2.8

1 – EPA regional screening level for industrial air

2 – Ambient air sample

ND – not detected; reporting limit denoted in parentheses.

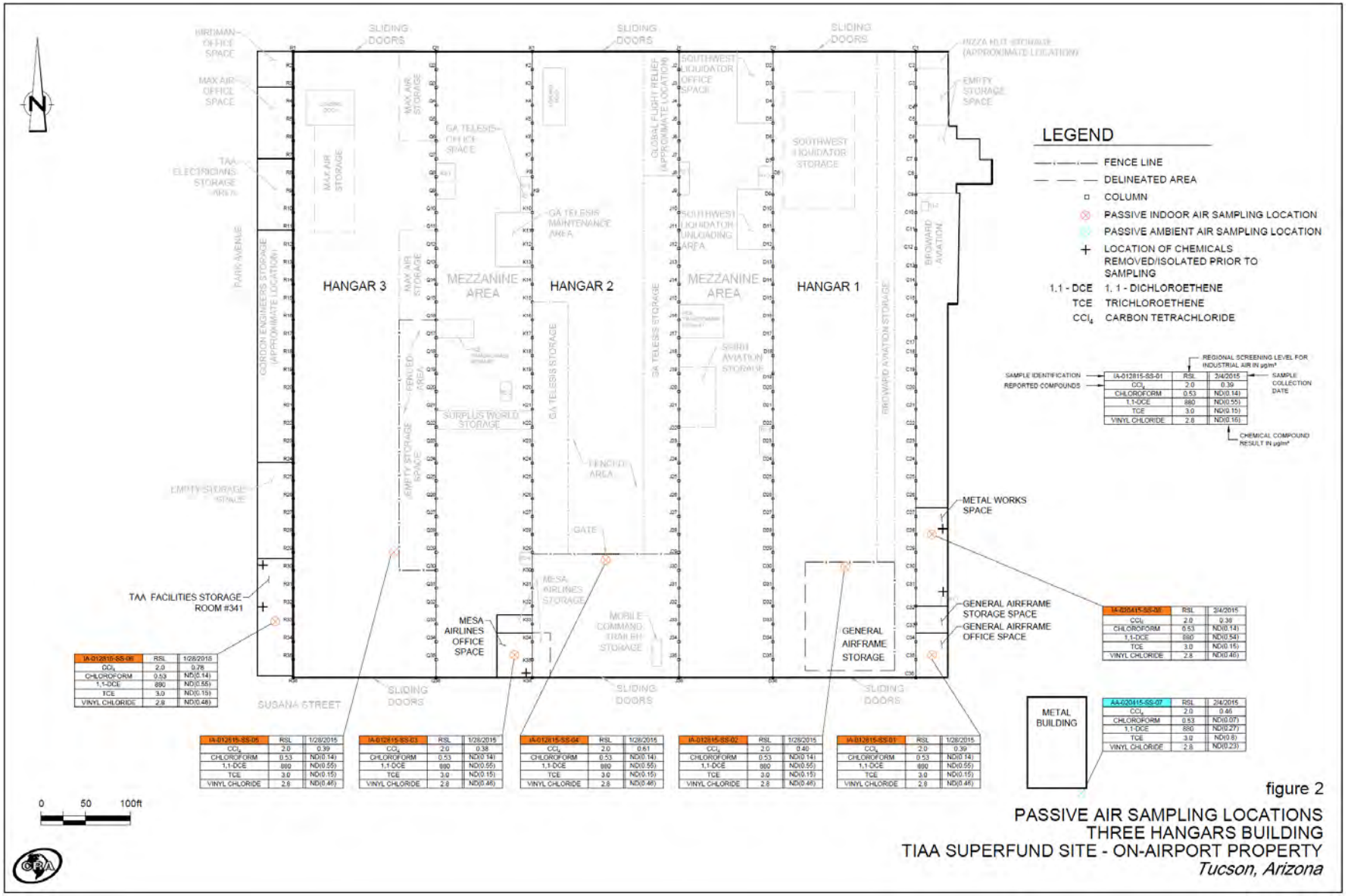


Figure 21. On-Airport Property Air Sampling Locations

Off-Airport Property (OU2)

The Airport Property, under direction of EPA, also conducted a vapor intrusion investigation off the airport property along Corona Road. Six soil borings (SG-1 through SG-6) were installed to depths ranging from 10 to 15 feet bgs (Figure 19). Soil gas probes were installed in each of the borings. Soil gas sampling occurred within a minimum of 48 hours after installation of the soil gas probes using a 1-liter SUMMA canister. The samples were analyzed by EPA Method TO-17 for the following contaminants: cis-DCE, TCE, vinyl chloride, and 1,2-dichloropropane (1,2-DCP).

Cis-DCE and TCE were the only contaminants detected. Cis-1,2-DCE was detected at SG-1 and SG-4 at concentrations of 3.2 and 4.4 µg/m^3, respectively. TCE was detected at SG-1, SG-3, and SG-4 at concentrations of 36, 13, and 56 µg/m^3, respectively. Vinyl chloride and 1,2-DCP were not detected in any of the seven soil gas samples analyzed from six locations.

Table 11. Off-Airport Property Soil Gas Investigation Results

Sample Location	Cis-1,2-DCE (µg/m^3)	TCE (µg/m^3)	Vinyl Chloride (µg/m^3)	1,2-DCP (µg/m^3)
SG-1	3.2	36	ND (1.0)	ND (1.8)
SG-2	ND (1.7)	ND (2.3)	ND (1.1)	ND (2.0)
SG-3	ND (3.0)	13	ND (2.0)	ND (3.5)
SG-4	4.4	56	ND (1.0)	ND (1.8)
SG-5	ND (2.1)	ND (2.9)	ND (1.4)	ND (2.5)
SG-6	ND (1.6)	ND (2.2)	ND (1.0)	ND (1.9)
SGHHSL (µg/m^3)	27,000	210	74	120

ND – not detected; reporting limit denoted in parentheses.
SGHHSL – Soil Gas Human Health Screening Level (residential)

Analytical results were compared to the residential Soil Gas Human Health Screening Levels developed in 2014 by EPA for the Motorola 52nd Street Superfund Site. 1,2-DCP did not have a Soil Gas Human Health Screening Levels, so the contractor for the PRPs developed a site-specific residential Soil Gas Human Health Screening Levels by dividing the EPA residential RSL by the residential soil gas attenuation factor of 0.0023. The detected chemicals were lower than Soil Gas Human Health Screening Levels.

4.2.3.2 OU3 – AF 44

Building 801

In November 2014, four indoor air samples, three sub-slab vapor sample and one ambient air sample from within or around Building 801. Only one indoor air sample measured a concentration of TCE greater than the ambient air concentration. The area of interest where the TCE was detected (east side of the interior of Building 801 approximately center to the building) is the area adjacent to a former plating shop that manufactured printed wiring boards and contained other metal finishing operations that used solvents (URS, 2017c). However, the corresponding sub-slab concentration to this indoor air sample detected TCE at levels below the 2014 industrial EPA Soil Gas Human Health Screening Levels (SGHHSLs) for Arizona Superfund Sites of 2,500 µg/m3. The indoor air sample concentration (6.5 µg/m3) exceeded the June 2017 EPA RSL for industrial indoor air (3.0 µg/m3) which incorporates recent toxicity data considering sensitive receptors. However, the sample was collected in the basement of Building 801 with infrequent worker occupation.

Table 12. Building 801 Indoor Air Investigation Results

Sample Location/ Media	TCA µg/m^3	PCE µg/m^3	TCE µg/m^3
Indoor Air Location 1	0.71	0.044	6.4
Indoor Air Location 2	0.025	0.026	.025
Indoor Air Location 3	0.021	0.075	.054
Indoor Air Location 4	0.013	0.081	.029
Ambient Air	2.1	0.29	0.10
Sub-slab Location 1	32700	.28	236
Sub-slab Location 4	2.6	0.16	0.42

Subsequently, the Air Force is conducting Soil Vapor Intrusion study to evaluate the nature, extent, and potential health risk, associated with SVI into indoor air from subsurface impacts at AFP44 Building 801. In the summer of 2017, a total of 50 soil vapor samples and five duplicate samples were collected and analyzed for select VOCs based on the compounds that have historically been detected in soil vapor at Former Sludge Drying Beds. The highest TCE concentrations on site were observed at SVP-15 at a depth of 7 feet (29,900 µg/m3), at SVP-16 at a depth of 7 feet (68,300 µg/m^3 and 77,900 µg/m^3), at SVP-17 at a depth of 14 feet (24,000 µg/m^3), at SVP- 18 at a depth of 12 feet (6,340 µg/m^3), and at SVP-19 at a depth of 15 feet (2,640 µg/m^3), all of which exceed the 2014 industrial EPA Soil Gas Human Health Screening Levels for Arizona Superfund Sites (2,500 µg/m^3) (EPA, 2014). A supplemental soil vapor intrusion assessment is on-going.

4.3. *Site Inspection*

EPA contractor Mark Gardiner with APTIM conducted site inspections for each subarea of the Site throughout the month of March 2018, except for OU3. Ms. Rachel Peterson conducted the site inspections for OU3 on February 27, 2018. The following table presents the subareas inspected, date inspected, and who was present at the site inspection.

Table 13. Site Inspection

Subarea Inspected	Date inspected	Inspection Participants
TARP	March 15, 2018	Mark Gardiner, APTIM Project Manager, EPA Contractor Chad Lapora, Tucson Water, TARP Project Coordinator Robert Hacketthal, Tucson Water, TARP Treatment Plant Operator
Texas Instruments	March 29, 2018	Mark Gardiner, APTIM Project Manager
AANG	March 8, 2018	Mark Gardiner, APTIM Project Manager Eder Delgadillo, AANG Environmental Coordinator
West Cap	March 2, 2018	Mark Gardiner, APTIM Project Manager
West Plume B	March 2, 2018	Mark Gardiner, APTIM Project Manager
Airport Property	March 7, 2018	Mark Gardiner, APTIM Project Manager Peter Schwartz, GHD Project Manager Mike Freid, GHD O&M Manager Tim Fish, GHC Treatment Plant Operator
AFP44	February 27, 2018	Rachel Peterson, Amec Foster Wheeler, AF Contractor George Warner, AFCEC AFP44 Remedial Project Manager Mr. John Kim, Senior Project Manager and Principal Engineer, AECOM

The purpose of the inspections was to assess the protectiveness of the remedy. A summary of each subarea inspection is presented below. Site inspection trip reports for OU1 and OU2 with photos are presented in Appendix H.

4.3.1. OU1 Area A

The site visit to TARP included inspection of the AOP facility, the original packed column aeration treatment facility, and two remediation wells (R-009B and R-008A). Participants also visited a vacant lot within the North Well Field where a potential new remediation well will be located. The treatment plant was offline at the time of the site inspection to address ongoing challenge. One challenge is the ongoing problem of gravel in raw water into the AOP from the remediation wells. Tucson Water believes that gravel in the pipelines from the North Well Field is due to the previous failure of the well screen in remediation well R-009A. This well has since been replaced by well R-009B. Remediation well R-008A has been taken out of service and drilling of replacement well R-008B has been completed. Tucson Water plans to replace all nine remediation wells, which are 20 to 25 years old. Tucson Water is also planning to add a tenth remediation well in the North Well Field to assist in

removing contaminant mass more quickly. Maintaining containment during well replacement is a noted challenge.

4.3.2. OU1 Area B

Texas Instruments Property

The site inspection included visiting the original TCE storage area near the injection wells used in the 2009 and 2016 ISCO injections. No current active remediation activity is occurring at the Texas Instruments facility. Ongoing groundwater semi-annual monitoring is occurring to evaluate the 2016 ISCO injection performance. The site is secured with a wall, gate, and roving security guards. The facility is occupied by non-manufacturing businesses. No concerns were noted during the time of the site inspection.

AANG Base

The site inspection included the visiting the 2009 ISCO pilot study area, airplane wash rack, areas of planned ISCO injections on the eastern Base boundary, and areas where the AANG Base is conducting a preliminary site investigation for PFCs. The entire Base is enclosed within secure fencing and access gates and military patrols, except for the flight line, which is enclosed by the Tucson International Airport fence. No concerns were noted at the time of the site inspection. The AANG Base is planning ISCO injections in 2018.

West Cap Area

The site inspection included visiting the source area, the parking lot across from the source area, and the western lobe. The source area is enclosed within a fence and maintained by the current property occupant, who owns and operates a glass manufacturing facility on the site. The western lobe is within the high security area of the Tucson International Airport. No concerns were noted at the time of the site inspection.

West Plume B Area

The site inspection included visiting several monitoring wells and typical residential neighborhoods within and near the boundary of the groundwater plume. This subarea is primary residential with some light commercial facilities at the northwest end of the plume. There is no active remedy for the West Plume B area. No concerns were noted at the time of the site inspection. The monitoring wells are in good condition.

4.3.3. OU2 – Airport Property and Contaminated Soils

The site inspection included visiting the groundwater treatment plant, the Three Hangars Building area, the closed landfill, the former Samsonite Building area (ISCO injection location), SVE system locations, and the On- and Off-Airport Property extraction wells and control stations. All facilities in OU2 are within fenced areas with limited access. No issues of concern were noted at the time of the

site inspection. The treatment plant was operating normally and there have been no significant unplanned operation outages. The landfill cap is in good condition and is well maintained.

Additional concerns to monitor in the future include TCE contaminant migration and rising regional water levels. Two new well clusters were installed in 2016 and 2017 to address TCE contamination under the southwest corner of Hangar 3 and along the western Airport Property boundary. Elevated concentrations of TCE were discovered at the new western boundary wells. Rising regional water levels have little impact at this point on the eastern portion of the Airport Property (in the immediate vicinity of the Three Hangars Building and the source area). However, at the Off-Airport Property further to the west, rising regional water levels have begun to impact some wells. The Airport Property SGZ extraction wells have not been impacted by rising water levels at this time.

4.3.4. OU3- AFB 44

Soil

There were no issues identified during the inspection of the four previous remediated soil areas at the Ranch Site, the Faco Landfill, Inactive Drainage Channel Disposal Pits and Former Sludge Drying Beds. No signage was present to identify specific soil area, although signage was posted identifying groundwater monitoring wells. No issues regarding physical conditions of this site were noted. No active remediation was being conducted associated with the soil remedies.

Groundwater

The GWTP is located within a secondary secured fence within the secured AFP44 facility. On-site documents are stored in an office within the GWTP along with spare parts, tools, and supplies. The GWTP, the groundwater extraction wells, HiPOx™ AOP and oxygen generator system, and associated piping were visually inspected. The GWTP was operational at the time of the site inspection. The equipment generally appeared in good condition. Monitoring, extraction and injection wells associated with the groundwater remedy appeared to be in good condition at the surface.

5. Technical Assessment

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

Overall, the remedies at the TIAA Superfund Site are functioning as intended. The groundwater treatment systems at Area A (OU1) and at AFP44 (OU3) continue to extract and treat contaminated groundwater and thereby making progress towards restoring the aquifer to existing and future uses. Both groundwater treatment systems have had some difficulties in achieving complete capture, but work is underway to address those issues. The groundwater remedies of ISCO and MNA for the Area B groundwater (OU1) are showing progress in reducing the concentration within the plumes. The Soil remedies have been successfully implemented and completed at the AFP 44.

OU1

Area A. The TARP groundwater treatment facility is functioning as designed. Groundwater is treated to meet drinking water criteria for distribution. Pumping rates in the North Well Field were reduced between 2016 and 2017 because of pump failures in four remediation wells. Gravel pack was observed bypassing the well screens, impacting the pumps. Three of the four impacted wells have been repaired or replaced. The fourth well is scheduled for replacement soon. Capture within the Regional Aquifer is occurring. In general, the TCE plume has reduced in width since system startup and the South Well Field is removing mass effectively.

Although the remedy for the groundwater, north of Reales Road, did not address the contaminant 1,4-dioxane, the City of Tucson upgrade its treatment plant to add an AOP unit to address it. EPA completed a Remedial Investigation/Feasibility Study in 2016, and a draft ROD Amendment is currently under review by EPA.

Area B. Two areas in Area B received ISCO injections during this review period: Texas Instruments in February 2016 and West-Cap in 2014. Performance monitoring after the 2016 ISCO injections at Texas Instruments shows no meaningful trends at this time. Insufficient time has passed to evaluate the performance of the ISCO remedy at the Texas Instruments Site. Based on performance monitoring at the West Cap area, TCE concentrations are decreasing within the source area. TCE concentrations in downgradient wells are below cleanup levels. Pilot test ISCO injections were implemented in 2009 and 2010 at the AANG property. Evaluation of the performance monitoring results from these injections shows increasing TCE concentrations, but these concentrations are still below the trigger concentration of 10 µg/L. MNA at the West Plume B area is functioning as intended. Concentrations of TCE are decreasing or stable.

OU2

Airport Groundwater. The groundwater extraction systems used to remove contaminant mass is reaching asymptotic conditions in groundwater outside of the TI Zone. Horizontal capture is occurring throughout most of the site with the exception of the area near the intersection of S Nogales Hwy and E. Corona Rd., off-airport property. Rising groundwater levels are potentially altering groundwater flow patterns, which may impact the ability to maintain capture and decrease contaminant concentrations at the Site.

Airport SVE: The SVE systems put in place functions as designed. TCE contaminant mass in the vadose zone is decreasing. However, TCE contaminant mass removal reached asymptotic conditions within each of the SVE areas. Regional groundwater levels are increasing, which may impact SVE effectiveness in the future. There is also a need to evaluate SVE optimization and whether to continue SVE activities.

OU3

Soils: At the Ranch Site, FACO Landfill, and Inactive Drainage Channel Disposal Pits, removal actions and SVE were conducted from 1997 through 2004 and are completed.

The soil removal action for the Former Sludge Drying beds was performed between March and June 1997. Post-excavation soil sampling for Former Sludge Drying Beds confirmed that no concentrations in remaining soil at Former Sludge Drying Beds exceeded ADEQ Residential SRLs. Operation of the DPE system at Former Sludge Drying Beds began in September 1995 and operations and periodic sampling continued through June 2004 when the system was shut down for four quarters of post-remedial monitoring. The soil underneath Building 801 cannot be fully characterized until Building 801 is demolished. Therefore, the Air Force is unable to adequately demonstrate the soil beneath Building 801 is below the Arizona Residential SRLs. Consequently, Former Sludge Drying Beds site subject to Land Use Control requirements. The Air Force plans to submit an ESD to incorporate Land Use Covenant at Former Sludge Drying Beds into the 1988 ROD.

Groundwater: The remedy for Regional Groundwater Beneath AFP44 continues to operate and function as designed. In 2009, it was updated with the installation of the AOP system as specified in the ESD. It is successfully remediating all COCs, including 1,4-dioxane. Several groundwater treatment plant outages in 2016 and 2017 led the Air Force to upgrade several components of the AOP system, including replacement of the oxygen and ozone generators and enclosing them in an air-conditioned structure.

Additional ISB treatability studies were implemented to address COC concentrations, including chromium, in hot spots at FACO Landfill, Inactive Drainage Channel Disposal Pits, and Former Sludge Drying Beds. Based on recommendations made in the AFCEC Critical Path Analysis / Critical Site Investigation, the path forward activities identified were to discontinue any additional ISB injections at FACO Landfill, Inactive Drainage Channel Disposal Pits and Former Sludge Drying Beds (including the additional gas injections at Former Sludge Drying Beds) and focus groundwater extraction in higher concentration areas at Inactive Drainage Channel Disposal Pits. The Air Force has submitted a draft-final proposed plan to revise the preferred groundwater remedy at Site OT012 as Optimized Pump and Treat System, ISB Hot Spot Treatment and Long-Term Monitoring with Monitored Natural Attenuation.

5.2. *Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?*

There are no human health or ecological routes of exposure or receptors that have been newly identified or changed in a way that could affect the protectiveness of the remedy. There were no changes to ARARs that affect protectiveness. An ARARs assessment is provided in Appendix D. Toxicity information has changed for 1,4-dioxane. EPA established a health advisory level of 0.35 µg/L for 1,4-dioxane based on residential lifetime exposure risk of 10^{-6}. Air Force is currently preparing a proposed plan to address 1,4-dioxane. There are no other changes to toxicity data.

The Site is progressing as expected towards meeting the RAOs for all OUs, with the exemption of plume control at OU 2 (Airport Property). Data indicates that the system may not have full control on the western boundary of the Airport Property. Shutdown of the groundwater treatment plant at AFP 44 during this five-year period may have resulted in some migration of the contaminant plumes within the respective boundaries. However, as demonstrated in the past shutdowns, plume containment is anticipated to occur very quickly once the groundwater treatment plant is in full operation.

Vapor intrusion concerns in OU2 were addressed in the 2015 investigations. Results from this investigation indicate that the vapor intrusion pathway is currently not a concern for buildings overlying the plume as long as building construction features remain the same into the future. Future FYRs should look at building construction and use conditions to assure that vapor intrusion exposures remain the same.

Vapor intrusion in Building 801 at OU3 was investigated starting in 2014. Indoor air samples were below ambient air concentrations, with the exception of one indoor air sample in adjacent to a former plating shop that manufactured printed wiring boards and contained other metal finishing operations that used solvents. The corresponding sub-slab concentration was below screening levels. However, multiple soil gas samples in and around the building containing elevated levels of TCE. Vapor intrusion studies are ongoing.

PFCs are substances present in various materials, including aqueous film-forming foam used in fire-fighting foam. There is a known association between PFCs and the operational history of the Site. Recently, on August 20th, TARP notified EPA that PFCs had been detected in the Southern wellfield at OU1 at about 30 parts per trillion (ppt), which is below its health advisory guidance level of 70 ppt. The treatment plant was immediately shut down pending further evaluation. In addition, an investigation of whether PFCs have impacted Site groundwater and soil at OU3 is currently underway.

Impacted groundwater is considered the only medium of concern with respect to human exposure. The Site is progressing as expected towards meeting the RAOs for the Regional Groundwater Beneath AFP44 site. Institutional and Governmental controls are in place preventing exposure to contaminated water while clean-up is occurring.

5.3. *Question C: Has any other information come to light that could call into question the protectiveness of the remedy?*

PFCs are substances present in various materials, including aqueous film-forming foam used in fire-fighting foam. There is a known association between PFCs and the operational history of the Site. An investigation of whether PFCs have impacted Site groundwater and soil at OU3 is currently underway.

No other information has come to light that could call into question the protectiveness of the remedy.

6. Issues/Recommendations

Table 14. Issues and Recommendations Identified in the Five-Year Review

Issues and Recommendations Identified in the Five-Year Review:				
OU(s): OU1, OU2, OU3	**Issue Category: Changed Site Conditions**			
	Issue: Rising regional groundwater levels may impact remedies within the next five years			
	Recommendation: Continue to monitor groundwater levels and evaluate next steps if remedies are impacted by rising water levels.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA	9/1/2022
OU(s): OU1, OU2, OU3	**Issue Category: Monitoring**			
	Issue: Based on the operational history of the Site, PFCs may be present.			
	Recommendation: Perform an investigation to determine extent of PFCs			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Affect Current Protectiveness**	**Affect Future Protectiveness**	**Affect Current Protectiveness**
No	Yes	No	Yes	No
OU(s): OU2 – Airport Property	**Issue Category: Remedy Performance**			
	Issue: Increasing TCE concentrations indicate full capture of the TCE plume may not be occurring.			
	Recommendation: Evaluate Site conditions to determine the cause of TCE contaminant increase and evaluate the existing remedial action to determine whether to optimize the existing system or pursue alternative remedial technologies.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA	9/1/2020
OU(s): OU3	**Issue Category: Institutional Controls**			
	Issue: Soil on the AFP 44 property was remediated to industrial levels, and the remedy did not include any Land Use Restrictions to prevent uses other than industrial			
	Recommendation: Prepare an ESD to include Land Use Restrictions the remedy for these sites.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**

No	Yes	PRP	EPA	12/1/2020
OU(s): OU3	**Issue Category: Remedy Performance**			
	Issue: Soil gas and groundwater data indicates a potential for vapor intrusion at Former Sludge Drying Beds.			
	Recommendation: Conduct an indoor air investigation at Building 801 for TCE.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA	12/31/2018
OU(s): OU3	**Issue Category: Remedy Performance**			
	Issue: Concentrations of chromium in the high chromium areas have remained high over the past five years indicating that with the current remedy, the RAO of groundwater restoration to the MCL may not be achievable.			
	Recommendation: Consider modifying the ROD to reflect the alternative treatment technology for TCE and 1,4-dioxane, and plan for treatability studies for chromium on AFP44. Implement appropriate actions based on whether a revised MCL for chromium is promulgated.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA	12/31/2020

6.1. *Other Findings*

The following additional recommendations were identified during the FYR to improve performance of the remedy, but which do not affect current and/or future protectiveness:

- Regional groundwater levels are rising which may impact the future functions of the SVE and groundwater extraction and treatment systems. Continue to monitor groundwater levels and evaluate next steps if remedies are impacted by rising water levels.
- The plume near well 410T in OU1 Area A is not fully defined. Determine the plume extent east of this well.
- Additional groundwater monitoring well or wells may be needed in the vicinity both north and south of Los Reales Road to better determine capture of the groundwater plume at or south of Los Reales Road.
- Replacement of extraction wells that are screened across multiple zones is recommended.
- Ensure that remediation wells in OU3 are continually operating to the required pumping rates to maintain capture of the plume south of Los Reales Road.

- Documents in the information repository at the local public library are not organized to be searchable by the public. In addition, project documents are not provided on-line. Recommend organizing project documents at the information repository and providing them on-line.

7. Protectiveness Statement

Table 15. Protectiveness Statement

Protectiveness Statement(s)		
Operable Unit: OU1	*Protectiveness Determination:* Short-term Protective	*Planned Addendum Completion Date:* Click here to enter a date
Protectiveness Statement: The remedy at OU1 currently protects of human health and the environment. Contaminant containment is occurring and the groundwater treatment systems are operating to treat contaminated groundwater to below MCLs and to reduce groundwater contaminant concentrations. However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure protectiveness: re-evaluate the operation of the remedy, if groundwater levels continue to rise; and investigate the extent of PFCs in groundwater.		
Operable Unit: OU2	*Protectiveness Determination:* Short-term Protective	*Planned Addendum Completion Date:* Click here to enter a date
Protectiveness Statement: The remedy at OU2 currently protects human health and the environment because contamination in the vadose zone is decreasing via SVE, reducing transport to groundwater. However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure protectiveness: evaluate site conditions and groundwater extraction treatment systems to determine whether to optimize the existing extraction and treatment systems or evaluate alternative remedial technologies; re-evaluate the operation of the remedy, if groundwater levels continue to rise; and investigate the possible presence of PFCs in groundwater.		
Operable Unit: OU3	*Protectiveness Determination:* Short-term Protective	*Planned Addendum Completion Date:* Click here to enter a date
Protectiveness Statement: The remedy at OU3 currently protects human health and the environment because treated groundwater meets drinking water standards and regional screening levels, and there is no exposure pathway for human health or the environment. However, in order for the remedy to be protective in the long-term, the following actions need to be taken to ensure protectiveness: prepare an ESD to include Land Use Restrictions the remedy for these sites; consider alternative technology for high chromium area; complete the indoor air investigation at Building 801; re-evaluate the operation of the remedy, if groundwater levels continue to rise; and investigate the extent of PFCs in groundwater.		

8. Next Review

The next five-year review report for the Tucson International Airport Area Superfund Site is required 5 years from the completion date of this review.

Appendix A: List of Documents Reviewed

AANG 1995. Remedial Investigation Report, Vols I-IV. June 1995.

AANG 1996. Record of Decision for Site 5 Soils, 162nd Fighter Wing, Arizona Air National Guard, Tucson International Airport Superfund Site. August 1996.

AANG 2011. Environmental Restoration Program, Final Conceptual Site Model Report. July 2011.

AANG 2013. Environmental Restoration Program, Revised Final Quarterly Groundwater Monitoring Report, January through March 2013. April 2013.

Amec Foster Wheeler Programs, Inc. 2018, Five-Year review of Five Sites at Air Force Plant 44, Tucson, Arizona. August 10, 2018

Arizona Department of Health Services, 1985. Results of the Tucson Airport Area Remedial Investigation Phase I, Vols I-III. November 1985.

APTIM Federal Services (APTIM) 2017. Summary of Well Installation, Development, Baseline Sampling, Remedial Action, and Performance Monitoring, Former Western Capacitor Site, Tucson International Area Superfund Site, Tucson, AZ. October 25, 2017.

APTIM 2017. Draft Construction Summary Report: In-Situ Chemical Oxidation, Former Western Capacitor Facility, Tucson International Airport Area Superfund Site, Tucson, Arizona. October 2017.

ARCADIS U.S., Inc. (ARCADIS) 2015. June 2015 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. July 10, 2015.

ARCADIS 2015. July 2015 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. August 10, 2015.

ARCADIS 2015. August 2015 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. September 10, 2015.

ARCADIS 2015. Revised Remedial Action Work Plan Eastern Plume Area B – Tucson International Airport Area Superfund Site. October 2, 2015.

ARCADIS 2015. September 2015 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. October 9, 2015.

ARCADIS 2015. October 2015 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. November 10, 2015.

ARCADIS 2015. November 2015 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. December 10, 2015.

ARCADIS 2016. December 2015 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. January 8, 2016.

ARCADIS 2016. January 2016 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. February 10, 2016.

ARCADIS 2016. February 2016 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. March 10, 2016.

ARCADIS 2016. March 2016 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. April 8, 2016.

ARCADIS 2016. Revised Sampling and Analysis Plan for the Remedial Action at the Eastern Plume Area B – Tucson International Airport Area Superfund Site. April 2016.

ARCADIS 2016. Revised Work Plan for Implementation of the In-Situ Chemical Oxidation Remedy. April 2016.

ARCADIS 2016. April 2016 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. May 10, 2016.

ARCADIS 2016. May 2016 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. June 10, 2016.

ARCADIS 2016. June 2016 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. July 8, 2016.

ARCADIS 2016. July 2016 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. August 10, 2016.

ARCADIS 2016. August 2016 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. September 9, 2016.

ARCADIS 2016. September 2016 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. October 10, 2016.

ARCADIS 2016. October 2016 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. November 10, 2016.

ARCADIS 2016. November 2016 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. December 9, 2016.

ARCADIS 2017. December 2016 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. January 10, 2017.

ARCADIS 2017. Revised October 2016 Semi-Annual Report; Former Texas Instruments Tucson Fabrication Facility. January 11, 2017.

ARCADIS 2017. January 2017 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. February 10, 2017.

ARCADIS 2017. February 2017 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. March 10, 2017.

ARCADIS 2017. March 2017 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. April 10, 2017.

ARCADIS 2017. April 2017 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. May 10, 2017.

ARCADIS 2017. May 2017 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. June 9, 2017.

ARCADIS 2017. Hexavalent Chromium Analysis Alternative Evaluation; Former Texas Instruments Tucson Fabrication Facility. June 28, 2017.

ARCADIS 2017. June 2017 Monthly Progress Report, Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B. July 10, 2017.

ARCADIS 2017. Revised September 2016 Through February 2017 Semi-Annual Report; Former Texas Instruments Tucson Fabrication Facility. August 25, 2017.

ARCADIS 2017. Response to Comments Regarding the Hexavalent Chromium Analysis Alternative Evaluation, Former Texas Instruments Tucson Fabrication Facility, Tucson, Arizona. August 25, 2017.

ARCADIS 2017. Third Quarter 2017 Progress Report: Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B, Tucson, Arizona. October 10, 2017.

ARCADIS 2017. March 2017 through August 2017 Semi-Annual Report; Former Texas Instruments Tucson Fabrication Facility. December 8, 2017.

ARCADIS 2018. Fourth Quarter 2017 Progress Report: Former Texas Instruments Tucson Fabrication Facility, Tucson International Airport Area Superfund Site, Eastern Plume Area B, Tucson, Arizona. January 10, 2018.

ARCADIS 2018. Response to Comments Regarding the March 2017 Through August 2017 Semi-Annual Report; Former Texas Instruments Tucson Fabrication Facility. February 7, 2018.

Black & Veach 1983. Report on the Installation of Ground Water Monitoring Wells near the Tucson International Airport, Tucson, Arizona. June 6, 1983.

Carollo 2017. TARP: Tucson International Airport Area Groundwater Remediation Project, Semi-Annual Status Report, September 2016 through February 2017. October 2017.

Carollo 2018. TARP: Tucson International Airport Area Groundwater Remediation Project, Semi-Annual Status Report, March 2017 through August 2017. January 2018.

CB&I Federal Services (CB&I) 2017. Summary of Well Installation, Development, and Baseline Sampling Event in Preparation for Remedial Action, Western Capacitor Site, Tucson International Area Superfund Site, Tucson, AZ. August 26, 2014.

CB&I 2014. Evaluation of Trichloroethene Data in the Vicinity of Well A-2U, Western Lobe of Western Capacitor Site, Tucson International Airport Area Superfund Site, Tucson, AZ. June 27, 2014.

CH2MHILL 2011. Tucson International Airport Area Superfund Site – Area B: Focused Feasibility Study. October 2011.

CH2MHILL 2013. Former West-Cap Facility In-Situ Chemical Oxidation (ISCO) Final Design. August 23, 2013.

CRA 2004. Pilot Test Work Plan, SGZ Remediation, Samsonite Building Area. August 2, 2004.

Conestoga-Rovers & Associates (CRA) 2013. Construction Inspection Report – Polychlorinated biphenyl (PCB) Remedy, TIAA Superfund Site, Airport Property. July 2013.

CRA 2013. Twelfth Performance Evaluation Report – Airport Property. November 2013.

CRA 2015. Construction Completion Letter Report for the Off-Property Vapor Intrusion Investigation along Corona Road. March 13, 2015.

CRA 2015. Construction Completion Letter Report for On-Airport Property Vapor Intrusion Investigation within the Three Hangars Building. March 26, 2015.

Desert Earth Engineering 1992. Geotechnical Engineering Investigation on Tucson Airport Remedial Project (TARP) Treatment Plant, Tucson, Arizona. February 7, 1992.

Dames & Moore 1999. Capture Evaluation Report: January through June 1999, Remedial Well Field Operation, Tucson International Airport Area Remediation Project. October 26, 1999.

EGC, Inc. (EGC) 2015. Focused Baseline Human Health Risk Assessment; Focused Remedial Investigation and Feasibility Study of 1,4-Dioxane North of Los Reales Road, Tucson International Airport Area Superfund Site Area A, Tucson, Arizona. September 2015.

U.S. Environmental Protection Agency (EPA) 1988. Record of Decision for Groundwater Remediation, North of Los Reales Road. August 1988.

EPA 1994. Tucson International Airport Area Superfund Site, Tucson Airport Remediation Project (TARP) Consent Decree, Civil Action No. 90-57 TUC-RMB, as modified EPA Approval of TARP Final Start-up Plan. August 26, 1994.

EPA 1996. Record of Decision for Site 5 Soils, 162nd Fighter Wing, Arizona Air National Guard, Tucson International Airport Superfund Site. August 1996.

EPA 1997. Explanation of Significant Differences for the Record of Decision, Tucson International Airport Area (Areas A and B Groundwater OU). February 7, 1997.

EPA 1997. Record of Decision, Tucson International Airport Area, OU2, Airport Property (Soils and Shallow Groundwater Zone), Burr-Brown Property (Soils), Former West Cap Property (Soils). September 1997.

EPA 2001. Explanation of Significant Difference for the Record of Decision, Tucson International Airport Area OU2. April 2001.

EPA 2004. Record of Decision Amendment for Tucson International Airport Area, Former West Cap and West Plume B Areas, Areas A and B Groundwater OU. September 2004.

EPA 2011. Proposed Plan: Tucson International Airport Area Superfund Site, Area B. October 2011.

EPA 2012. Record of Decision Amendment for Tucson International Airport Superfund Site, Area B. April 2012.

EPA 2013. First Five-Year Review for Tucson International Airport Area Superfund Site. September 30, 2013.

EPA 2015. Revised Limited Risk Assessment for 1,4-Dioxane and Trichloroethylene in Groundwater at the Tucson International Airport Area Superfund Site. September 2015.

EPA 2015. Unified Focused Human Health Risk Assessment; Focused Remedial Investigation and Feasibility Study for 1,4-Dioxane North of Los Reales Road, Tucson International Airport Area Superfund Site Area A, Tucson, Arizona. November 2015.

EPA 2016. Focused Remedial Investigation and Feasibility Study for 1,4-Dioxane North of Los Reales Road; Volumes I-III. January 2016.

EPA 2017. Proposed Plan: Superfund Site Area A, North of Los Reales Road, Tucson International Airport Area, Tucson, Arizona. March 2017.

EPA 2017. EPA Certification of Completion of Remedial Action for the PCB Soils Remedy, Airport Property, Tucson International Airport Area Superfund Site, Tucson, Arizona. July 6, 2017.

EPA 2017. PCB Remedy Pre-Certification Meeting and Inspection, Three Hangars Area, Airport Property, Tucson International Airport Area Superfund Site, Tucson, Arizona. July 27, 2016.

GHD Services, Inc. (GHD) 2016. In Situ Chemical Oxidation Pilot Test Status Report – Samsonite Building Area. January 8, 2016.

GHD 2016. Remedial Action Completion Report – PCB Soils Remedy. September 6, 2016.

GHD 2016. Construction Completion Letter Report for Soil Borings and SGZ and GSU Groundwater Monitoring Wells, CRA 67S/D Along the Airport Property Boundary, SGZ Remedy. November 11, 2016.

GHD 2016. Eighteenth Performance Evaluation Report – SGZ Remedy & SVE Remedy. November 15, 2016.

GHD 2017. Semi Annual Status Report: Investigation of Nature and Extent of TCE and PCE in the S-17 Area and CCl4 Investigation in the West End of Runway 3 Area. April 10, 2017.

GHD 2017. Nineteenth Performance Evaluation Report – SGZ Remedy & SVE Remedy. May 15, 2017.

GHD 2017. Twentieth Performance Evaluation Report – SGZ Remedy & SVE Remedy. November 15, 2017.

TT 2017. Final Groundwater Monitoring Report for the 3rd Quarter 2016, Environmental Restoration Program, 162nd Wing, Arizona Air National Guard, Tucson. February 20, 2017.

Tetra Tech, Inc. (TT) 2017. Final Groundwater Monitoring Report for the 1st Quarter 2017, Environmental Restoration Program, 162nd Wing, Arizona Air National Guard, Tucson. September 28, 2017.

Tetra Tech, Inc. (TT) 2017. Final Groundwater Monitoring Report for the 2nd Quarter 2017, Environmental Restoration Program, 162nd Wing, Arizona Air National Guard, Tucson. November 17, 2017.

TT 2018. Draft Final Groundwater Monitoring Report for the 3rd Quarter 2017, Environmental Restoration Program, 162nd Wing, Arizona Air National Guard, Tucson. January 26, 2018.

Malcom Pirnie, Inc., 1986. Feasibility Study for Ground Water Remediation in the Tucson Airport Area. February 1986.

Malcom Pirnie 1992. Tucson International Airport Area Groundwater Remediation Project (TARP): Piping, Plant, and Equipment (PPE) Design Analysis Report, Vols I-II. February 1992.

Malcom Pirnie 2006. TARP: Tucson International Airport Area Groundwater Remediation Project, Field Operations Plan for Groundwater Remedial Action, North of Los Reales Road in Area A. November 2006.

Malcom Pirnie 2010. TARP: Tucson International Airport Area Groundwater Remediation Project, Operations & Maintenance Plan. January 2010.

URS, 2017c. Final Vapor Intrusion Study Work Plan, Installation Restoration Program Site WP005, Building 801, Air Force Plant 44, Tucson, Arizona. June 2017.

URS, 2018e. Draft Annual Optimized Exit Strategy Performance Metrics July 2016 to June 2017, OT012 South of Los Reales Road Regional Groundwater Plume, Air Force Plant 44, Arizona, April 2018.

Appendix B: Site Chronology

Event	Date
Airport Property—Industrial use and disposal of metals, chlorinated solvents and other hazardous wastes began.	1942
AFP44—Hughes Missile Systems Company and/or its subsidiaries have operated the AFP44 plant since construction.	1951-1997
AFP44—A groundwater sample from a municipal supply well indicated elevated levels of chromium. Residents complained of foul-smelling water.	1952
AFP44—A well at AFP44 was closed by the state because of high levels of chromium.	1976
AFP44—Under EPA direction, the Air Force and its subcontractor, Hughes Aircraft Company, conducted an investigation and verified trichloroethylene (TCE) contamination at the AFP44 facility and north of the AFP44 facility.	1981
TIAA Superfund Site was listed on "Expanded Eligibility List," a Preliminary National Priorities List (NPL).	July 23, 1982
TIAA Superfund Site proposed for inclusion on the Final NPL.	December 30, 1982
Final NPL listing of TIAA.	September 8, 1983
Air Force issues ROD/Remedial Action Plan for Air Plant 44 but this was signed before the Superfund law was amended in 1987	1986
Tucson Airport Remediation Project (TARP), Airport Property, and AFP44—The Arizona Department of Health Services (ADHS) completed the remedial investigation (RI) for the area north of Los Reales Road. The Arizona Department of Water Resources (ADWR) conducted a feasibility study (FS). The Air Force issued a ROD for regional groundwater at AFP44.	1985
AFP44—The Air Force Remedial Action (RA) Plan for the area south of Los Reales Road was released.	April 1986
EPA sent general notice letters to the potentially responsible parties (PRPs) officially notifying them of their potential liability for groundwater remedy north of Los Reales Road.	August and September 1987
AFP44—U.S. Air Force began operation of a groundwater pump-and-treat system to address contamination at the AFP44 Facility. Groundwater remediation includes extracting groundwater, treatment for removal of hexavalent chromium (ion exchange) and volatile organic compounds (VOCs; packed column aeration with partial control of emissions using vapor-phase granular activated carbon [GAC]), and re-injecting treated water into the aquifer.	1987
The draft "Feasibility Study for Groundwater Remediation in the Tucson Airport Area" report was released for public review and comment.	March 3, 1988
TARP ROD signed by EPA to treat the groundwater north of Los Reales Road by pumping and treating the contaminated groundwater followed by discharging the treated water to the municipal water distribution system.	July 25, 1988
TARP—EPA and the Settling Parties entered a Consent Decree for the TARP.	June 1991
EPA issued a Unilateral Order (UAO; Docket No. 92-09, July 9, 1992) to Tucson Airport Authority, City of Tucson, General Dynamics Corporation, and McDonnell Douglas Corporation, for performance of a RI/FS of the TIAA Superfund Site.	August 25, 1992
Texas Instruments (formerly Burr-Brown) began operation of a groundwater pump and treat system to address the contamination at its facility.	1992

Event	Date
162nd AANG—EPA and the National Guard Bureau signed a Federal Facilities Agreement (FFA).	1993
TARP—The TARP treatment plant began operation.	September 1994
AFP44—Excavation of contaminated soils (cadmium, chromium, and lead).	1995
Airport Property—RI was completed. RI characterized extent of contamination in soil and shallow groundwater zone.	1996
Airport Property—Daniel B. Stephens & Associates (DBS&A) completed the RI of the shallow groundwater zone and vadose zone.	April 1995 – April 1996
OU2 – ROD issued; selected remedy of SVE for contaminated soil at AANG.	August 1996
Airport Property—DBS&A completed RI report for EPA submittal.	October 31, 1996
AFP44—Raytheon purchased/merged with Hughes Electronics and assumed operation of AFP44, a Government Owned Contractor Operated facility.	1997
Airport Property—Excavation of PCB-contaminated soil (El Vado Residential Neighborhood and Three Hangars Area).	March – May 1997
Airport Property—EPA approved RI report submitted by DBS&A.	May 2, 1997
Airport Property—Conestoga-Rovers and Associates (CRA) prepared an FS and submitted to EPA to identify remedial technologies that may be applicable to the site, and was approved by EPA on July 10, 1997.	June 10, 1997
Formation of Unified Community Advisory Board	September 1997
Airport Property—EPA issued a ROD for the selected RA.	September 30, 1997
Airport Property—A Consent Decree was signed between EPA and the PRPs for the cleanup.	February 2000
TARP and AFP44—1,4-dioxane was discovered in groundwater.	March – April 2002
West-Cap Arizona—A SVE Pilot Treatability Study was conducted; extracting approximately 180 pounds of total VOCs from a single vapor well near Building A. TCE and PCE concentrations were significantly reduced such that additional treatment of the vadose zone was not necessary.	August – December 2002
Airport Property—Five extraction wells were installed in gravel subunits to cut off the shallow groundwater zone from the TARP plume.	2002
TARP—EPA asked Tucson Water and TARP representatives to begin RI/FS to evaluate available remedial technologies to address 1,4-dioxane contamination.	2004
Airport Property—1,4-dioxane was detected at up to 36 micrograms per liter (µg/L).	2004
Airport Property—The final Shallow Groundwater Zone remedy and soil vapor extraction (SVE) remedy design report (100% Design) (Final Report) and RA work plan were submitted to EPA.	July 25, 2004
Airport Property—EPA approved the final Shallow Groundwater Zone remedy and SVE remedy design report (100% Design; Final Report) and RA work plan.	September 3, 2004
Airport Property—Proposal submitted to characterize carbon tetrachloride in the Shallow Groundwater Zone at West End of Runway 3.	2005
Airport Property—In situ chemical oxidation using potassium permanganate ($KMnO_4$) to treat dichloroethylene (1,1-DCE) concentration at Samsonite Building Area.	2006
AFP44—EPA issued an Safe Drinking Water Act Order to the Air Force and Raytheon to design, build, and operate advanced oxidation treatment plant at AFP44 to treat TCE and 1,4-dioxane.	July 13, 2007

Event	Date
Airport Property—EPA provided an "Operational and Functional Determination" for the Shallow Groundwater Zone remedy and SVE remedy and routine operation commenced.	October 29, 2007
AFP44—Air Force completed Phase I Focused RI to address 1,4-dioxane contamination north of Los Reales Road.	2008
AFP44—The Air Force submitted to EPA a Phase II Focused RI of 1,4-dioxane work plan, which includes the TARP area. Tucson Water completed a technical memorandum identifying ultraviolet (UV) light–peroxide advanced oxidation processes were the best available technologies for 1,4-dioxane treatment.	2009
AFP44—Advanced oxidation treatment systems operational. The treatment system was designed to remove 1,4-dioxane but also effectively remove VOCs.	September 2009
TARP—Tucson Water conducted pilot testing of ozone-peroxide and UV light–peroxide advanced oxidation treatment for 1,4-dioxane and concluded that UV light–peroxide is the preferred technology. AFP44—Air Force conducted Phase II Focused RI.	2010
OU2 – Tucson Airport Area Landfill capped.	July 2011
Federal Facilities Agreement for Air Force Plant 44 signed	September 2011
OU1 Area B – ROD Amendment revises the remedy. At the West Cap Area, Texas Instruments property, and AANG Base, the revised remedy consists of In-Situ Chemical Oxidation (ISCO) using potassium permanganate. At West Plume B, the revised remedy consists of Monitored Natural Attenuation (MNA).	April 2012
OU2 – Pipeline sludges contaminated with PCBs above 0.76 mg/kg were excavated and removed.	June 2012
First FYR	2013
OU1 Area A – Advanced Oxidation Process (AOP) water treatment system incorporated to the existing system at TARP. The AOP system removes 1,4-dioxane, as well as other VOCs, including TCE, from water. The treated water from the TARP groundwater treatment facility is delivered to the Tucson Water Department (Tucson Water) distribution system.	2014
At West Cap Area, potassium permanganate ISCO injection was performed in June 2014. Post-injection performance monitoring on a semi-annual basis has been implemented since October 2014.	2014
In 2015, a vapor intrusion investigation was completed in the neighborhood immediately west of the Airport Property Three Hangars area. Results showed that vapor intrusion was not a significant health concern.	2015
OU1 Area A – Proposed Plan issued for TARP ROD Amendment.	March 2017
At Texas Instruments (formerly Burr-Brown) property, potassium permanganate ISCO injection was performed in July 2016. Post-injection performance monitoring was performed from September 2016 to February 2017, and long-term monitoring on a semi-annual basis is ongoing.	July 2017
Second FYR	2018
Groundwater sampling—All project areas	Ongoing

Appendix C: Data Review and Analysis

Appendix C Data Review

USACE performed this data review of the soil and groundwater remedies for OU1 and OU2 using data and other relevant information. The appendix presents data, maps and calculations used to support the conclusions discussed in Section 4 to determine if the remedies are successful in achieving performance standards.

Amec Foster Wheeler Programs, Inc. prepared the final Five-Year review on Air Force Plant 44 for the Air Force. Details for Data Review and Analysis for OU3 can be found in the *Five-Year review of Five Sites at Air Force Plant 44, Tucson, Arizona. August 10, 2018*

Soils

OU 2 Airport Property SVE System

GHD, Airport Property consultant, conducted a soil vapor monitoring program to analyze the progress and performance of the SVE system at the eight identified RRS, discussed in Section 4.2.1. GHD sampled air from soil vapor observation wells to confirm the removal of TCE and other VOC contaminants within the vadose zone. In addition, GHD installed three soil vapor observation wells at greater distance from the TI Zone to provide additional data to determine the radius of influence of the SVE system.

GHD calculated the radius of influence (ROI) at each of the four vapor probes installed at various depths within the sand pack for each observation well. Observation well construction details are presented in Table C-1 below.

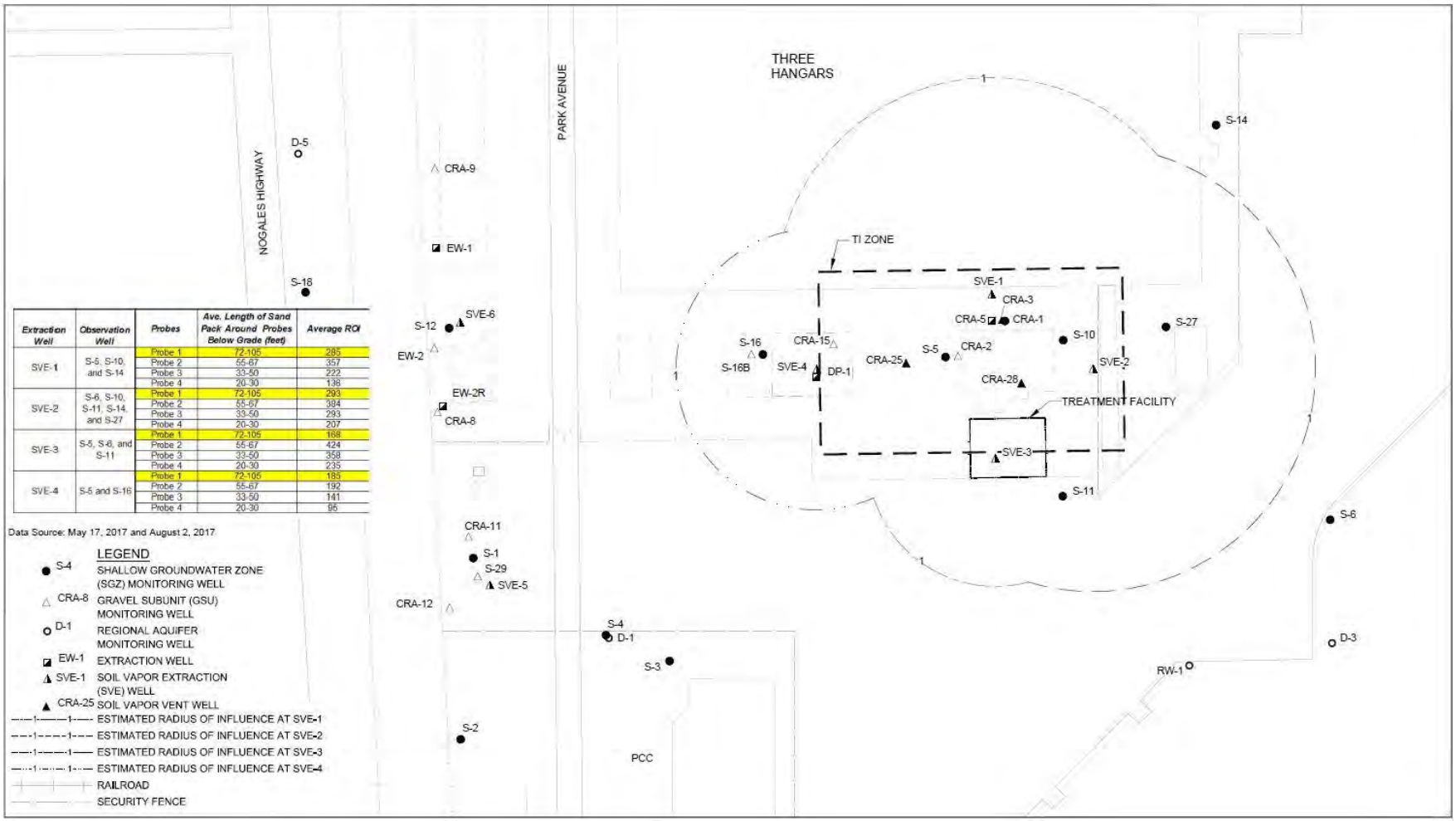
A small area of the TI zone is not captured in the ROI. However, since the VOCs migrate downward before encountering the regional groundwater, the VOC contamination will be captured by the deeper intervals of the SVE system. The calculated ROI for each of the combined SVE well capture zones within the TI zone are presented in Figures C-1 to C-4. The complete ROI extends past the TCE contour of µg/L (Figures C-1 to C-3). The calculated ROI for Probe 4 reading at each of the SVE wells (Figure C-4).

All four SVE extraction wells sampled result in a gradual decline of TCE concentrations over time. The VOC mass removal for each SVE system from 2010 to 2017 is presented in Figure C-5.

Table C-1. Observation Well Construction

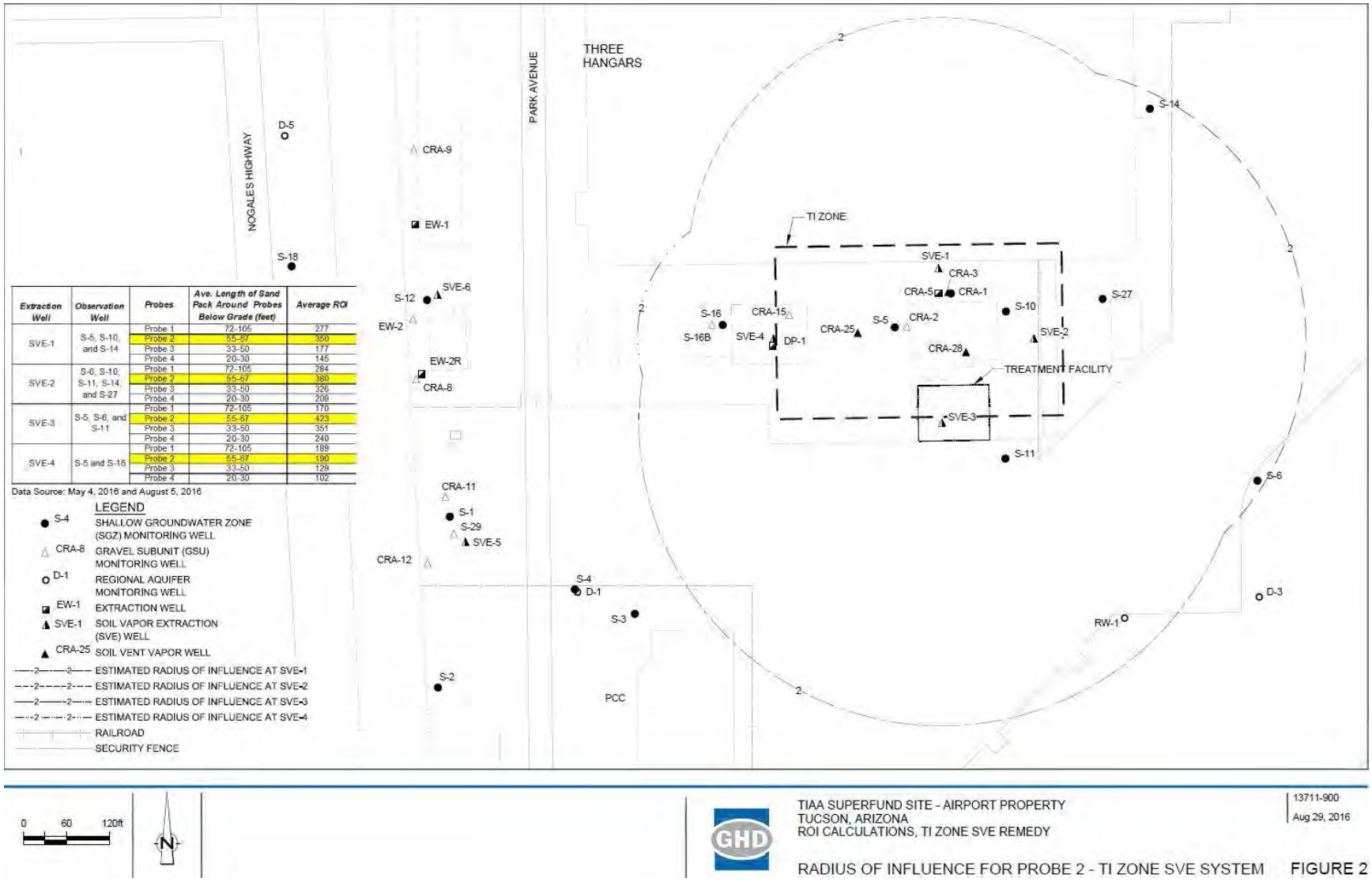
Observation Wells	Depth of Observation Wells (feet)	Observation Well Diameter (inches)	Screened Interval Below Grade (feet)	Probe Identification	Type of Probe	Length of Sand Pack Around Probes-Below Grade (feet)
S-5	103.6	4	88.2-98.2	5 4 3 2 1	HDPE, 0.25-inch O.D.	5 22.6-27.2 42.5-47.5 62.5-67.35 72.5-77.5
S-6	103.0	2	87.2-97.2	5 4 3 2 1	HDPE, 0.25-inch O.D.	5 22.5-27.7 40.1-46.3 56.7-62.3 81.8-103.0
S-10	103.5	2	88-98	5 4 3 2 1	HDPE, 0.25-inch O.D.	5 20.6-25.5 32.9-38.4 57.3-62.5 78.7-103.5
S-11	100.9	2	85-95	5 4 3 2 1	HDPE, 0.25-inch O.D.	5 20.6-25.7 45.2-49.7 61.5-66.75 79.6-100.9
S-14	105.8	2	87.2-102.2	5 4 3 2 1	HDPE, 0.25-inch O.D.	5 25.3-30.2 40.3-45.6 58.6-63.6 74.0-105.8
S-16	104.1	2	88.2-98.2	5 4 3 2 1	HDPE, 0.25-inch O.D.	5 20.4-25.5 35.4-40.3 55.3-60.3 77.5-104.1
S-27	118.8	2	87.1-102.1	5 4 3 2 1	HDPE, 0.25-inch O.D.	5 21.4-26.5 40.4-44.8 57.6-62.7 77.2-82.7

Note: O.D.-Outer Diameter



Extraction Well	Observation Well	Probes	Ave. Length of Sand Pack Around Probes Below Grade (feet)	Average ROI
SVE-1	S-5, S-10, and S-14	Probe 1	72-105	285
		Probe 2	55-67	357
		Probe 3	33-50	222
		Probe 4	20-30	138
SVE-2	S-6, S-10, S-11, S-14, and S-27	Probe 1	72-105	293
		Probe 2	55-67	384
		Probe 3	33-50	293
		Probe 4	20-30	207
SVE-3	S-5, S-6, and S-11	Probe 1	72-105	168
		Probe 2	55-67	424
		Probe 3	33-50	358
		Probe 4	20-30	235
SVE-4	S-5 and S-16	Probe 1	72-105	185
		Probe 2	55-67	192
		Probe 3	33-50	141
		Probe 4	20-30	96

Figure C-1. Radius of Influence for Probe 1 (72ft to 105ft bgs) at the SVE Wells Within the TI Zone



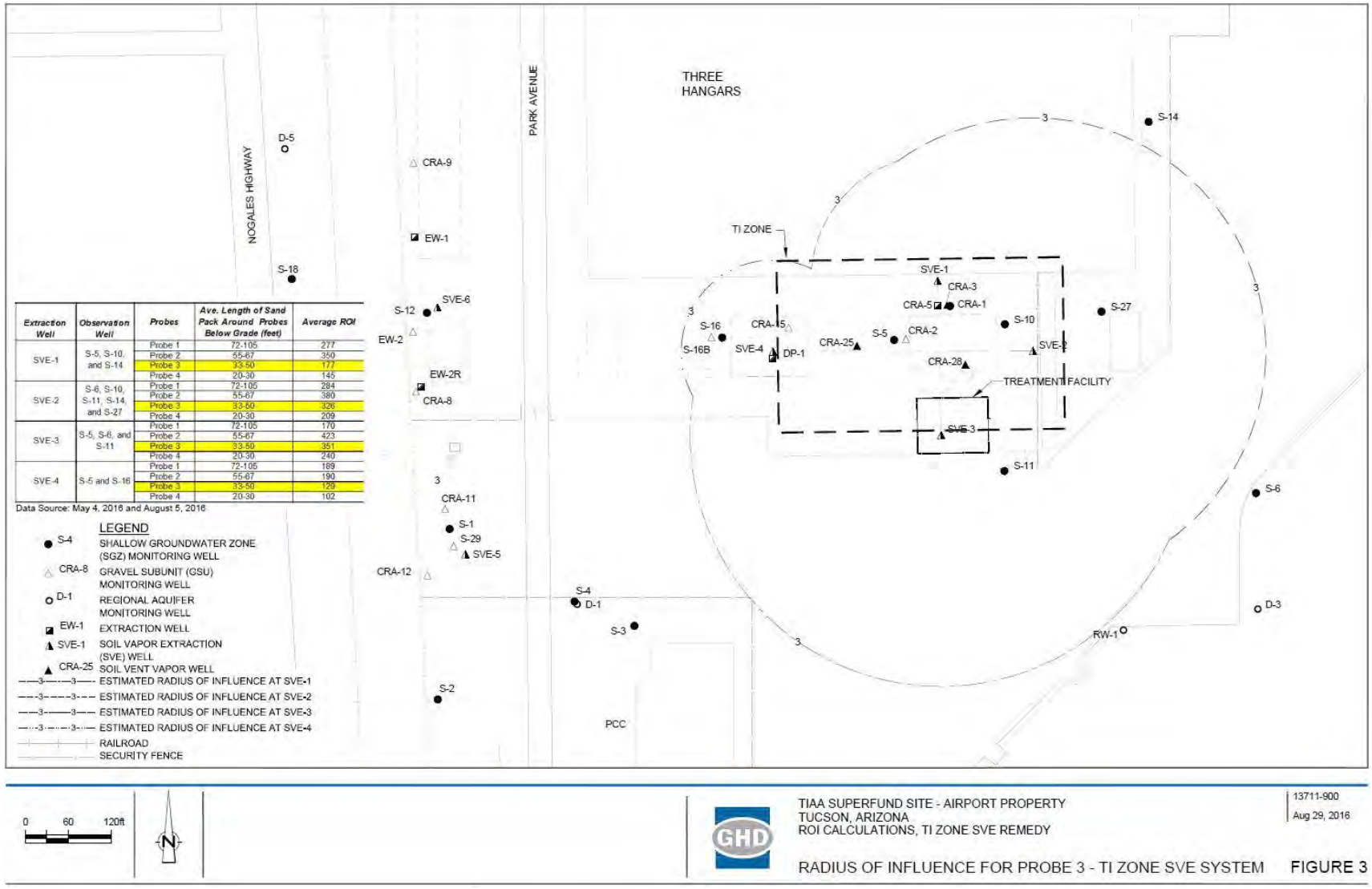
Extraction Well	Observation Well	Probes	Ave. Length of Sand Pack Around Probes Below Grade (feet)	Average ROI
SVE-1	S-5, S-10, and S-14	Probe 1	72-105	277
		Probe 2	55-67	350
		Probe 3	33-50	177
		Probe 4	20-30	145
SVE-2	S-6, S-10, S-11, S-14, and S-27	Probe 1	72-105	284
		Probe 2	55-67	380
		Probe 3	33-50	326
		Probe 4	20-30	209
SVE-3	S-5, S-6, and S-11	Probe 1	72-105	170
		Probe 2	55-67	423
		Probe 3	33-50	351
		Probe 4	20-30	240
SVE-4	S-5 and S-16	Probe 1	72-105	189
		Probe 2	55-67	190
		Probe 3	33-50	128
		Probe 4	20-30	102

Data Source: May 4, 2016 and August 5, 2016

LEGEND

- S-4 SHALLOW GROUNDWATER ZONE (SGZ) MONITORING WELL
- CRA-8 GRAVEL SUBUNIT (GSU) MONITORING WELL
- D-1 REGIONAL AQUIFER MONITORING WELL
- EW-1 EXTRACTION WELL
- SVE-1 SOIL VAPOR EXTRACTION (SVE) WELL
- CRA-25 SOIL VENT VAPOR WELL
- ESTIMATED RADIUS OF INFLUENCE AT SVE-1
- ESTIMATED RADIUS OF INFLUENCE AT SVE-2
- ESTIMATED RADIUS OF INFLUENCE AT SVE-3
- ESTIMATED RADIUS OF INFLUENCE AT SVE-4
- RAILROAD
- SECURITY FENCE

Figure C-2. Radius of Influence for Probe 2 (Approximately 56 ft to 67 ft bgs) at the SVE Wells Within the TI Zone



Extraction Well	Observation Well	Probes	Ave. Length of Sand Pack Around Probes Below Grade (feet)	Average ROI
SVE-1	S-5, S-10, and S-14	Probe 1	72-105	277
		Probe 2	55-67	350
		Probe 3	33-50	177
		Probe 4	20-30	145
SVE-2	S-6, S-10, S-11, S-14, and S-27	Probe 1	72-105	284
		Probe 2	55-67	380
		Probe 3	33-50	326
		Probe 4	20-30	209
SVE-3	S-5, S-6, and S-11	Probe 1	72-105	170
		Probe 2	55-67	423
		Probe 3	33-50	351
		Probe 4	20-30	240
SVE-4	S-5 and S-16	Probe 1	72-105	189
		Probe 2	55-67	190
		Probe 3	33-50	129
		Probe 4	20-30	102

Figure C-3. Radius of Influence for Probe 3 (approximately 33 ft to 50 ft bgs) at the SVE Wells Within the TI Zone

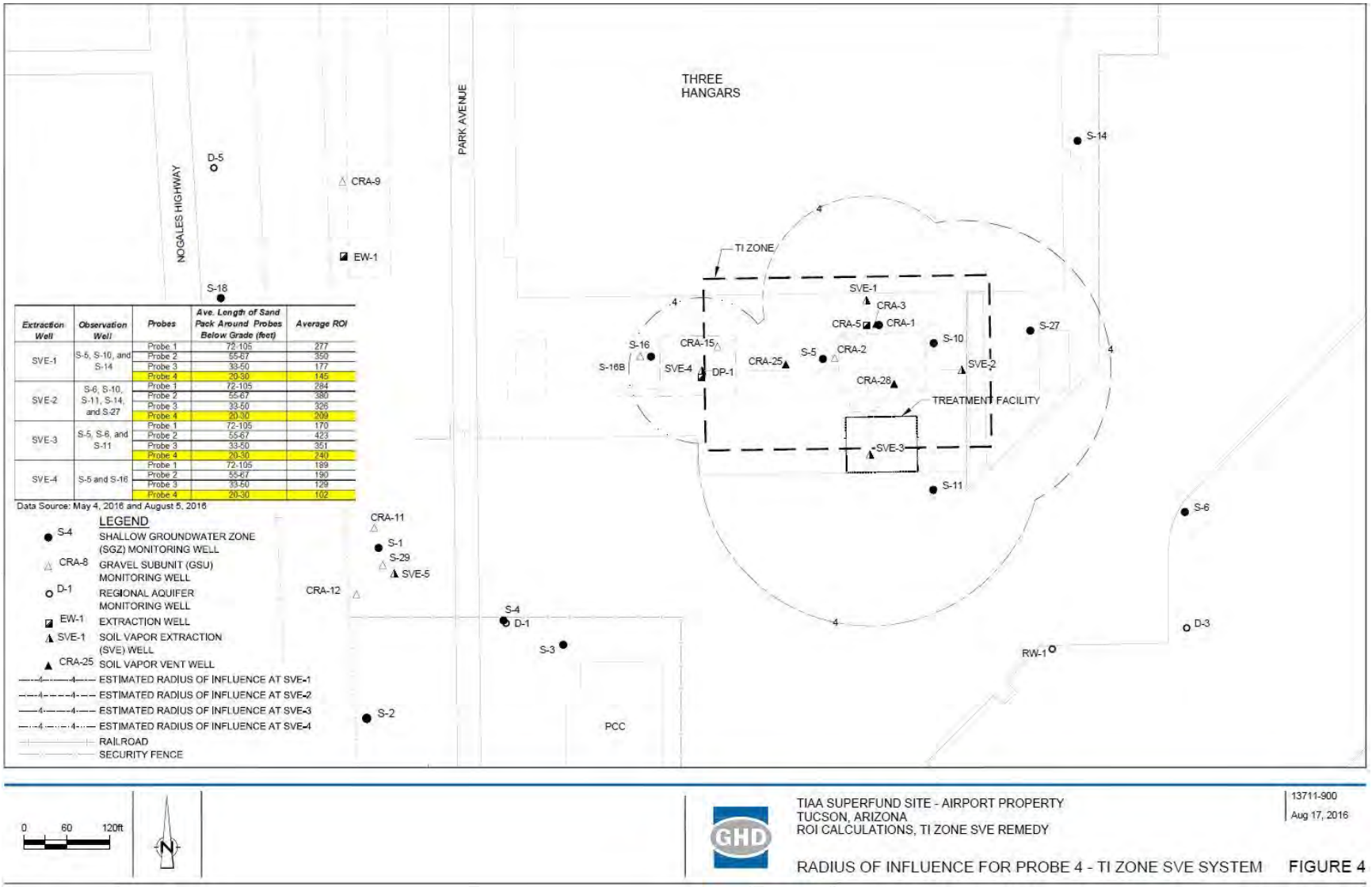


Figure C-4. Radius of Influence for Probe 4 (Approximately 20 ft to 28 ft bgs) at the SVE Wells Within the TI Zone

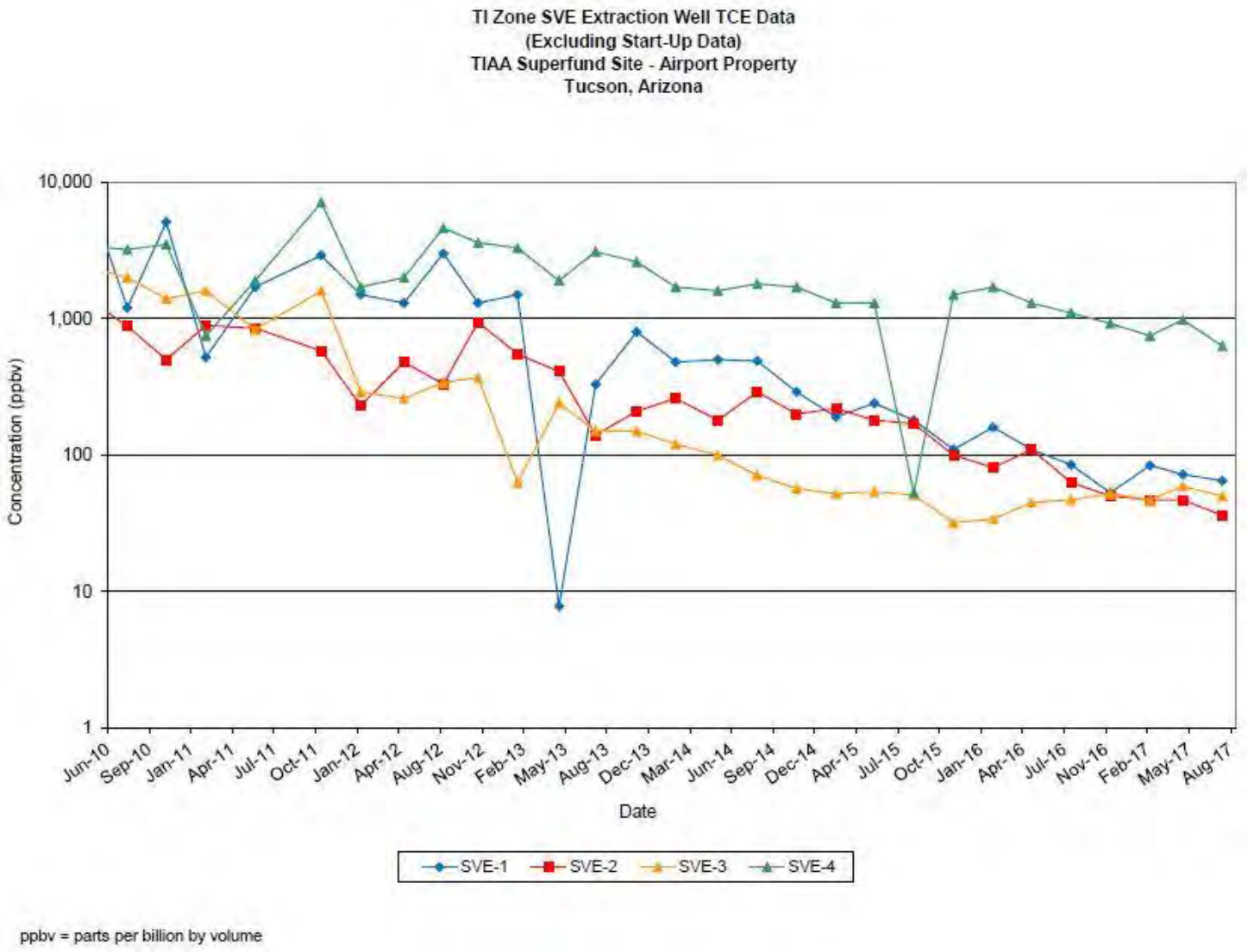


Figure C-5. TCE Concentrations Within the TI Zone Sampled from the SVE Extraction Wells

Groundwater

USACE reviewed data provided by the PRPs for each of the respective subsites discussed below. The purpose of the data review is to determine if the remedy selected is successful in achieving performance standards and RAOs determined in the respective RODs.

All sites discussed below are currently affected by regional groundwater rise. Regional groundwater levels have risen approximately 30 to 40 feet during the last 5 years, as illustrated in Figure C-6. The PRPs have observed an increase in VOC concentrations as water levels increase at some locations. The impact of increasing groundwater levels on contaminant concentrations is an overall concern for the long-term protectiveness of the Site and may impact the effectiveness of some remedial technologies. All PRPs are aware of this issue and are monitoring trends within each respective area.

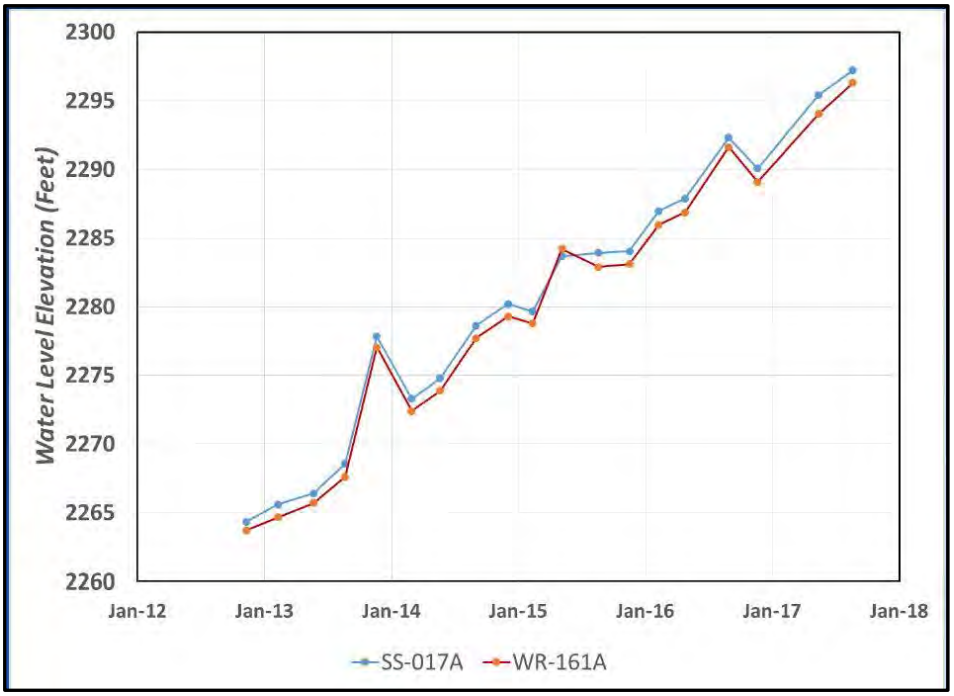


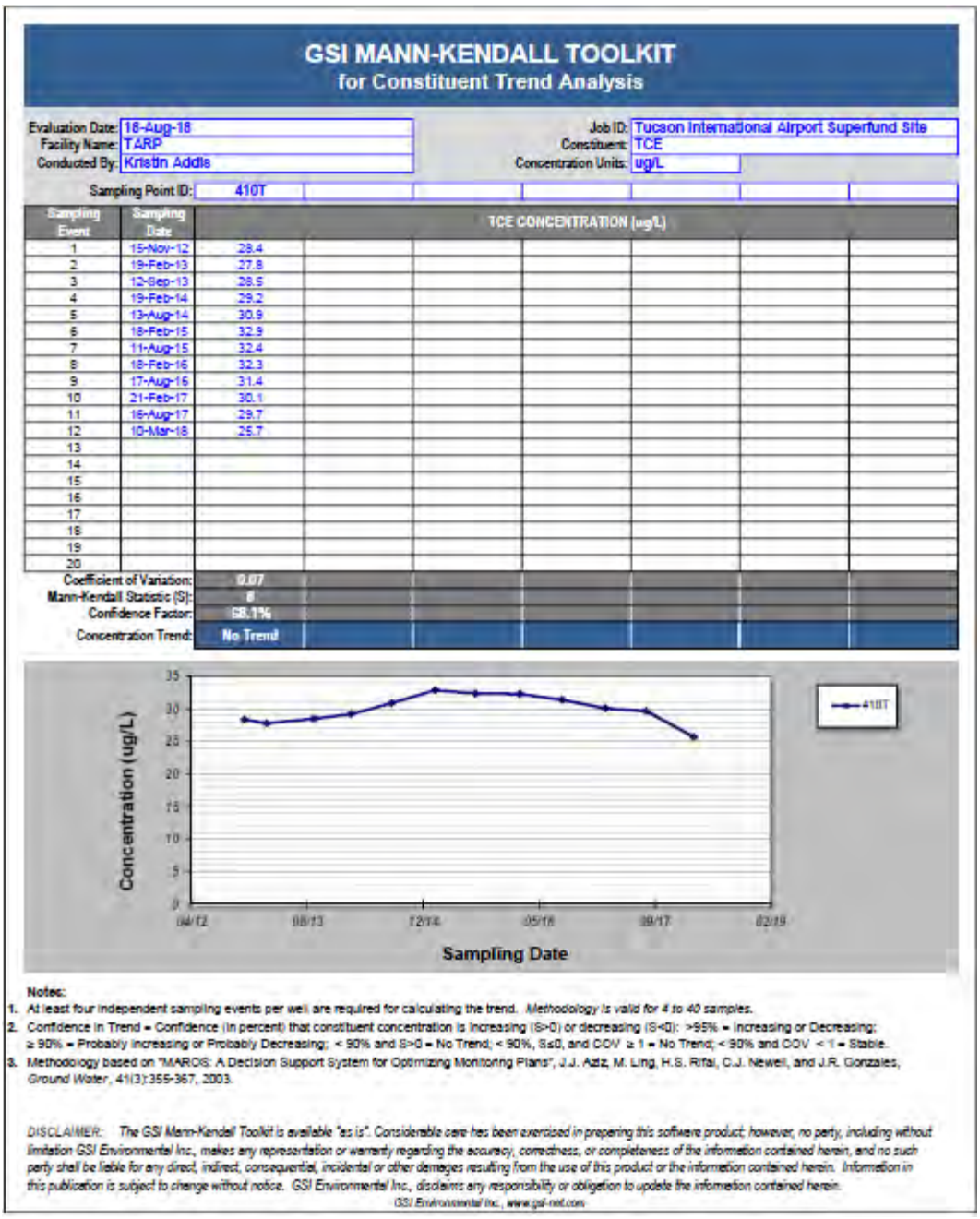
Figure C-6. Representative Wells Showing the Increase in Water Levels from 2013 to 2017

OU1 Area A TARP

The TARP extraction wells fields are functioning as designed. The groundwater extraction and treatment system designed to remove VOCs is composed of two extraction well fields: the North Well Field and the South Well Field. The North Well Field is designed to contain the plume, while the South Well Field is designed to removed contaminant mass. One area of concern is the containment along the eastern plume boundary near well 410T.

USACE performed Mann Kendall trend analysis on well 410T and found that it is a potential concern due to increasing TCE concentrations since 1999 (Figure C-7). The resulting statistics suggest that the trend probably increasing in the last 5 years, however due to the variability within the data set, the concentrations are stable within the last five-year period. Well 410T has a positive correlation to water levels since 1996 with TCE concentrations have increased with increasing groundwater elevation (Figure C-8). However, it is important to note that the peak concentration of 32.9 μg/L occurred in 2015.

The construction of well 410T is problematic because the well is screened over multiple water-bearing units (Figure C-9). However, based on plume maps and wells downgradient of 410T, it does appear that the plume is not increasing in width downgradient of well 410T.



GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date: 16-Aug-18
Facility Name: TARP
Conducted By: Kristin Addis
Job ID: Tucson International Airport Superfund Site
Constituent: TCE
Concentration Units: ug/L
Sampling Point ID: 410T

Sampling Event	Sampling Date	TCE CONCENTRATION (ug/L)
1	15-Nov-12	28.4
2	19-Feb-13	27.8
3	12-Sep-13	28.5
4	19-Feb-14	29.2
5	13-Aug-14	30.9
6	18-Feb-15	32.9
7	11-Aug-15	32.4
8	18-Feb-16	32.3
9	17-Aug-16	31.4
10	21-Feb-17	30.1
11	16-Aug-17	29.7
12	10-Mar-18	25.7
13		
14		
15		
16		
17		
18		
19		
20		

Coefficient of Variation: 0.07
Mann-Kendall Statistic (S): 8
Confidence Factor: 68.1%
Concentration Trend: No Trend

Notes:
1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
3. Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

DISCLAIMER: The GSI Mann-Kendall Toolkit is available "as is". Considerable care has been exercised in preparing this software product; however, no party, including without limitation GSI Environmental Inc., makes any representation or warranty regarding the accuracy, correctness, or completeness of the information contained herein, and no such party shall be liable for any direct, indirect, consequential, incidental or other damages resulting from the use of this product or the information contained herein. Information in this publication is subject to change without notice. GSI Environmental Inc., disclaims any responsibility or obligation to update the information contained herein.

Figure C-7. Mann-Kendall Data and the Resulting Concentration Trend

Figure C-8. Well 410T Illustrating the Relationship Between Water Levels and TCE Concentrations.

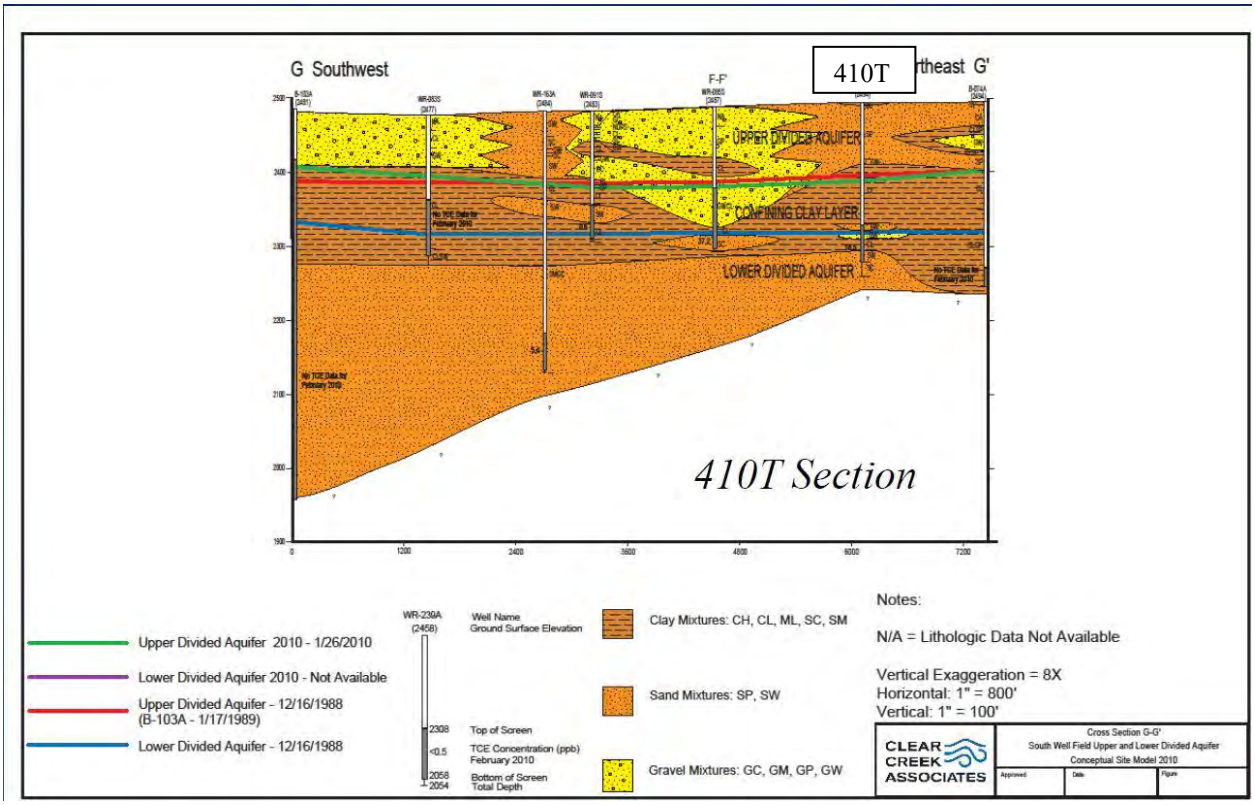


Figure C-9. Well 410T Screened Across Unit 4 Gravel Aquifer and Lower Divided Aquifer

OU1 Area B

EPA issued a ROD amendment in 2012 that changed the remedy from groundwater pump and treat to ISCO for all OU1 Area B sites, except West Plume B. The West Plume B remedy changed to MNA. The objective of the remedy is to treat VOC contamination present within the fine-grained sediment located directly above the groundwater (vadose zone). The VOC mass continues to act as a source of groundwater contamination. The following OU1 Area B data analysis section is organized in the same order as Section 4.2.2.2 beginning with upgradient site, Texas Instruments, and ending with furthest down gradient site, West Plume B.

Texas Instruments

The Texas Instruments Site is located on the eastern part of Plume B, just south of the West Cap Site. Groundwater generally flows to the north at the gradient of approximately 0.0045 ft/ft (Figure C-10). Arcadis performed ISCO injection in 2016 and the Site data will not be effectively evaluated until 3 to 5 years after injections are complete. Arcadis collected groundwater samples during baseline sampling, PDB sampling and post injection sampling (Table C-2).

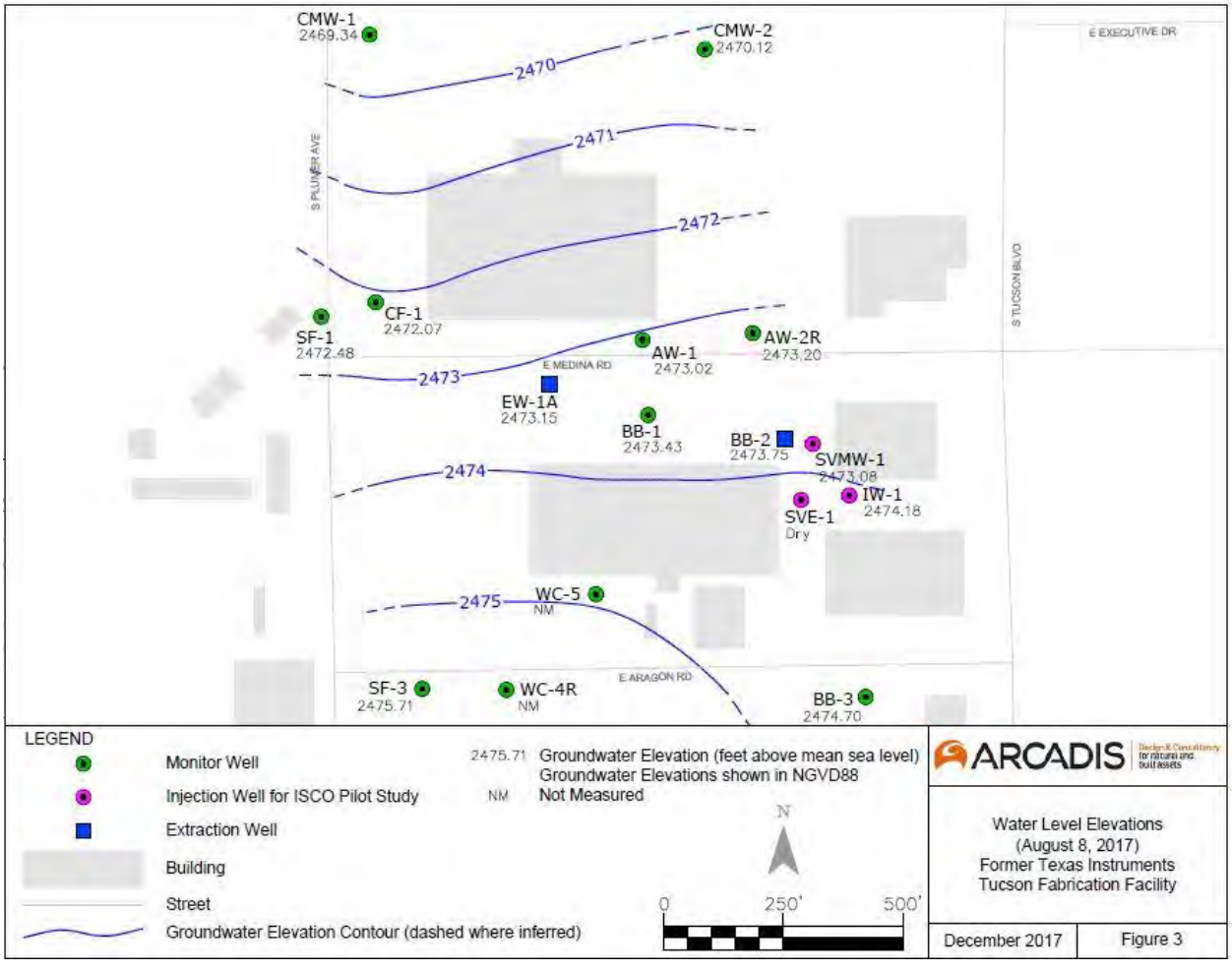


Figure C-10. Groundwater elevations at the Texas Instruments Site in August 2017.

Table C-2. Analytical Data for Texas Instruments ISCO Injection

Location ID	Sample Date	Event	Sample Method	Sample Type	TCE (µg/L)	PCE (µg/L)	1,1-DCE (µg/L)	CR 6 Total (µg/L)	Cr Total (µg/L)	CR 6 Dissolved (µg/L)	Cr Dissolved (µg/L)	Cr 6[1] (µg/L)
					AWQS/MCL							
					5	5	5	NE	100	NE	NE	NE
AW-1	2/17/2016	Baseline	Low Flow	N	9.2	< 0.50	< 0.50	7.2	8.5	7.3	7.9	NS
	12/12/2016	Week 16	Bailer	N	3.1	< 0.50	< 0.50	1.2	< 4.0	1.2	< 4.0	NS
	2/27/2017	Week 28	Low Flow	N	2.7	< 0.50	< 0.50	1.3 B4	< 4.0	1.4	< 4.0	NS
	8/8/2017	Long Term Event 1	Low Flow	N	2.8	< 0.50	< 0.50	NS	< 4.0	NS	< 4.0	1.27 J
AW-2R	2/17/2016	Baseline	Low Flow	N	24.4	< 0.50	< 0.50	0.61	< 4.0	0.60	< 4.0	NS
	12/13/2016	Week 16	Bailer	N	43.2 B7	< 0.50	1.0	0.53	< 4.0	0.56	< 4.0	NS
	2/27/2017	Week 28	Low Flow	N	39.6	< 0.50	0.83	0.5 B4	< 4.0	0.53	< 4.0	NS
	8/8/2017	Long Term Event 1	Low Flow	N	43.1	< 0.50	0.99	NS	< 4.0	NS	< 4.0	0.564 J
BB-1	2/17/2016	Baseline	Low Flow	N	7.3	< 0.50	< 0.50	0.59	< 4.0	0.59	< 4.0	NS
	12/12/216	Week 16	Bailer	N	5.6	< 0.50	< 0.50	1.1	< 4.0	0.84	< 4.0	NS
	2/28/2017	Week 28	Low Flow	N	6.2	< 0.50	< 0.50	0.85 B4	< 4.0	0.86	< 4.0	NS
	8/9/2017	Long Term Event 1	Low Flow	N	7.4	0.63	< 0.50	NS	< 4.0	NS	< 4.0	0.529 J
BB-2	2/17/2016	Baseline	Low Flow	N	13.6	< 0.50	< 0.50	11	12.3	11	10.8	NS
	2/17/2016	Baseline	Low Flow	FD	13.5	< 0.50	< 0.50	11	12.5	11	10.8	NS
	3/16/2016	PDB	PDB	PDB (120 ft)	20.7	< 0.50	< 0.50	NA	NA	NA	NA	NS
	3/16/2016	PDB	PDB	PDB (124 ft)	17.7	< 0.50	< 0.50	NA	NA	NA	NA	NS
	3/16/2016	PDB	PDB	PDB (130 ft)	15.6	< 0.50	< 0.50	NA	NA	NA	NA	NS
	8/19/2016	End of Injection	Bailer	N	13.8	< 0.50	< 0.50	20	22.6	20	24.9	NS
	8/19/2016	End of Injection	Bailer	FD	16.2	< 0.50	< 0.50	20	23.1	20	21	NS
	9/6/2016	Week 2	Bailer	N	26.1	< 0.50	0.51	12 M2 J	21.2	12	< 2.0 U	NS
	9/6/2016	Week 2	Bailer	FD	26.1	< 0.50	0.53	12 J	19.1	12	< 2.0 U	NS
	10/6/2016	Week 6	Bailer	N	23.3	< 0.50	< 0.50	13	16	12	13.8	NS
	10/6/2016	Week 6	Bailer	FD	28.5 J	< 0.50	< 0.50	12	15.2	12	11.9	NS
	12/13/2016	Week 16	Bailer	N	22.2 B7	< 0.50	< 0.50	16	25.6 J	15	15.2	NS
	12/13/2016	Week 16	Bailer	FD	22.1 B7	< 0.50	< 0.50	16	36.2 J	15	14.2	NS
	2/28/2017	Week 28	Low Flow	N	3.5	< 0.50	< 0.50	NS	64.5	NS	59.6	NS
	2/28/2017	Week 28	Low Flow	FD	3.5	< 0.50	< 0.50	NS	63.2	NS	61.1	NS
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Bold faced type indicates an exceedance of the applicable Arizona Aquifer Water Quality Standards (AWQS) and/or United States Environmental Protection Agency Maximum Contaminant Level (MCL).
1 - Samples analyzed by EMAX Laboratories Inc. in accordance with method SW7199LL.
1,1-DCE - 1,1-Dichloroethene
B4 - Target analyte detected in blank at or above method acceptance criteria
B7 - Target analyte detected in method blank at or above method reporting limit. Concentration found in the sample was 10 times above the concentration found in the method blank.
CR 6 - Hexavalent Chromium
D1 - Sample required dilution.
FD - Field Duplicate
J - The compound was positively identified; however, the associated numerical value is an estimated concentration only.
MI - Matrix Interference. Sample was collected and submitted to Eurofins Eaton Analytical (Eurofins). However, due to matrix interference, the sample was not analyzed
M1 - Matrix spike recovery was high; the associated blank spike recovery was acceptable.
M2 - Matrix spike recovery was low; the associated blank spike recovery was acceptable.
N - Normal sample
NA - No sample available for Hexavalent Chromium analysis
NE - Not established
NS - Not sampled
PCE - Tetrachloroethene
PDB - Passive diffusion bag sample
TCE - Trichloroethene
U - Analyte considered non-detect at the listed value due to associated blank contamination
UB - Analyte considered non-detect at the listed value due to associated blank contamination.
UJ - The compound was not detected above the reported sample quantitation limit. However, the reported limit is approximate and may or may not represent the actual limit of quantitation.
µg/L - Micrograms per liter

Table C-2 continued. Analytical Data for Texas Instruments ISCO Injection

CMW-2	2/17/2016	Baseline	Low Flow	N	< 0.50	< 0.50	< 0.50	0.22 UB	99.6	0.21 UB	< 4.0 U	NS
EW-1A	2/16/2016	Baseline	Low Flow	N	< 0.50	< 0.50	< 0.50	0.086 UB	< 4.0 U	0.078 UB	< 4.0 U	NS
	12/12/2016	Week 16	Bailer	N	3.5	< 0.50	< 0.50	0.051	424	0.099	< 4.0 U	NS
	2/27/2017	Week 28	Low Flow	N	4.7	< 0.50	< 0.50	< 0.02 U	9.6	< 0.02 U	< 4.0 U	NS
	8/8/2017	Long Term Event 1	Low Flow	N	**5.4**	0.57	< 0.50	NS	20.3	NS	< 4.0 U	< 0.05 UJ
IW-1	2/18/2016	Baseline	Low Flow	N	**13.3**	< 0.50	< 0.50	28	29.7	28	33.8	NS
	2/18/2016	Baseline	Low Flow	FD	**13.1**	< 0.50	< 0.50	28	30.3	27	30.5	NS
	3/17/2016	PDB	PDB	PDB (116 ft)	**45.3**	< 0.50	0.69	NA	NA	NA	NA	NS
	3/17/2016	PDB	PDB	DUP PDB (116 ft)	**47.0**	< 0.50	0.71	NA	NA	NA	NA	NS
	3/17/2016	PDB	PDB	PDB (125 ft)	**7.9**	< 0.50	< 0.50	NA	NA	NA	NA	NS
	3/17/2016	PDB	PDB	PDB (135 ft)	**7.9**	< 0.50	< 0.50	NA	NA	NA	NA	NS
	12/13/2016	Week 16	Bailer	N	48.1 B7	.58	< 0.50	160	162 J	160	218 J	NS
	2/28/2017	Week 28	Low Flow	N	20.3	< 0.50	< 0.50	63 B4	77.3	53	60.3	NS
	2/28/2017	Week 28	Low Flow	FD	NS	NS	NS	71 B4	NA	50 M1	NA	NS
	8/9/2017	Long Term Event 1	Low Flow	N	**31.4**	< 0.50	0.50	NS	54.9	NS	59.0	52.3 J
SF-1	2/16/2016	Baseline	3 Volume Purge	N	0.71	1.1	< 0.50	0.45	< 4.0 U	0.46	< 4.0 U	NS
SF-3	2/16/2016	Baseline	3 Volume Purge	N	3.5	3.3	< 0.50	0.38	< 4.0 U	0.39	< 4.0 U	NS
SVMW-1 [110-120]	2/18/2016	Baseline	Bailer	N	**21.8**	< 0.50	< 0.50	NA	NA	NA	NA	NS
	3/16/2016	PDB	PDB	PDB (112 ft)	1.6	< 0.50	< 0.50	NA	NA	NA	NA	NS
	8/19/2016	End of Injection	Bailer	N	< 0.50	< 0.50	< 0.50	NA	NA	NA	NA	NS
	9/19/2016	Week 2	Evacuation Pump	N	< 0.50	< 0.50	< 0.50	MI	826	MI	715	NS
	9/19/2016	Week 2	Evacuation Pump	FD	< 0.50	< 0.50	< 0.50	NA	NA	NA	NA	NS
	10/6/2016	Week 6	Evacuation Pump	N	< 0.50	< 0.50	< 0.50	MI	760	MI	751	NS
	12/13/2016	Week 16	Evacuation Pump	N	< 0.50	< 0.50	< 0.50	NS	733	NS	832	NS
	2/28/2017	Week 28	Evacuation Pump	N	< 0.50	< 0.50	< 0.50	NS	1240	NS	1100	NS
	8/9/2017	Long Term Event 1	Evacuation Pump	N	< 0.50	< 0.50	< 0.50	NS	1340 D1	NS	1250	NS

Bold faced type indicates an exceedance of the applicable Arizona Aquifer Water Quality Standards (AWQS) and/or United States Environmental Protection Agency Maximum Contaminant Level (MCL).
1 - Samples analyzed by EMAX Laboratories Inc. in accordance with method SW7199LL.
1,1-DCE - 1,1-Dichloroethene
B4 - Target analyte detected in blank at or above method acceptance criteria
B7 - Target analyte detected in method blank at or above method reporting limit. Concentration found in the sample was 10 times above the concentration found in the method blank.
CR 6 - Hexavalent Chromium
D1 - Sample required dilution.
FD - Field Duplicate
J - The compound was positively identified; however, the associated numerical value is an estimated concentration only.
MI - Matrix interference. Sample was collected and submitted to Eurofins Eaton Analytical (Eurofins). However, due to matrix interference, the sample was not analyzed
M1 - Matrix spike recovery was high; the associated blank spike recovery was acceptable.
M2 - Matrix spike recovery was low; the associated blank spike recovery was acceptable.
N - Normal sample
NA - No sample available for Hexavalent Chromium analysis
NE - Not established
NS - Not sampled
PCE - Tetrachloroethene
PDB - Passive diffusion bag sample
TCE - Trichloroethene
U - Analyte considered non-detect at the listed value due to associated blank contamination
UB - Analyte considered non-detect at the listed value due to associated blank contamination.
UJ - The compound was not detected above the reported sample quantitation limit. However, the reported limit is approximate and may or may not represent the actual limit of quantitation.
µg/L - Micrograms per liter

West Cap

Table C-3 – Baseline Sampling Event in 2014

Well ID	Water Level	VOC	VOC Date	Time	Sample Type	KP results (mg/L)	Metals Sample	Metals Sample Collection Date	Time	Notes
TIAA Property										
A2-U	97.11	Y9FM1	4/16/2014	11:28	REG	N/A	N/A	N/A	N/A	
A2-L	97.08	Y9FM2	4/16/2014	11:40	FD	N/A	N/A	N/A	N/A	Y9FM3=FD
WC-19U	98.55	Y9FM4	4/16/2014	11:50	REG	N/A	N/A	N/A	N/A	
WC-19L	98.48	Y9FM5	4/16/2014	11:55	REG	N/A	N/A	N/A	N/A	
WC-25	104.61	Y9FN3	5/1/2014	7:00	REG	3.8	MY9FN3	5/1/2014	7:00	
WC-25A	104.33	Y9FN4	5/1/2014	9:40	REG	2.2	MY9FN4	5/1/2014	9:40	
WC-26	104.55	Y9FN5	5/2/2014	6:20	REG	0	MY9FN5	5/2/2014	6:20	
WC-26A	104.42	N/A	N/A	N/A	MS/MSD	N/A	MY9FN6	5/2/2014	12:45	
WC-27	96.32	Y9FM8	4/29/2014	7:14	FD	2.6	MY9FM8	4/29/2014	7:14	Y9FM9=FD
WC-28	97.14	Y9FN0	4/29/2014	11:20	REG	0	MY9FN0	4/29/2014	11:20	
WC-29	96.95	Y9FN1	4/30/2014	7:25	MS/MSD	2.9	MY9FN1	4/30/2014	7:25	
WC-30	96.89	Y9FN2	4/30/2014	13:00	REG	2.3	MY9FN2	4/30/2014	13:00	
WC-31	96.01	Y9FM6	4/28/2014	8:15	REG	4.7	MY9FM6	4/28/2014	8:15	
WC-31A	95.93	Y9FM7	4/28/2014	12:30	REG	0.0	MY9FM7	4/28/2014	12:30	
Source Area										
WC-1	105.3	Y9FL8	4/15/2014	14:16	REG	N/A	N/A	N/A		
WC-6	108.54	Y9FL4	4/15/2014	13:19	REG	27.1	N/A	N/A		
WC-8	103.85	Y9FL2	4/15/2014	7:30	FD	5.4	MY9FL2	4/15/2014	7:30	Y9FL3=FD
WC-15A-L	104.25	Y9FL9	4/15/2014	13:56	REG	0.9	N/A	N/A	N/A	
WC-15B-L	104.8	Y9FL7	4/15/2014	14:07	REG	0.2	N/A	N/A	N/A	
WC-16A-L	106.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
WC-16B-L	107.01	Y9FL6	4/15/2014	13:40	REG	1.6/3.6	N/A	N/A	N/A	Split bailer; half clear half purple
WC-17A-L	108.58	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
WC-17B-U	Dry									
WC-17B-L	108.69	Y9FL5	4/15/2014	13:30	REG	0	N/A	N/A	N/A	
WC-18U	Dry									
WC-18L	104.44	Y9FM0	4/16/2014	7:14	REG	4.4	MY9FM0	4/16/2014	7:14	
WC-20A	108.59	Y9FN7	5/5/2014	8:30	REG	3.2	MY9FN7	5/5/2014	8:30	
WC-21A	108.57	Y9FN8	5/5/2014	12:15	MS/MSD	0	MY9FN8	5/5/2014	12:15	
WC-22A	108.62	Y9FP0	5/6/2014	7:15	FD	0	MY9FP0	5/6/2014	7:15	Y9FN9=FD
WC-23A	103.87	Y9FP1	5/6/2014	9:40	REG	1.9	MY9FP1	5/6/2014	9:40	
WC-24A	104	Y9FP2	5/7/2014	7:20	REG	1.2	MY9FP2	5/7/2014	7:20	

Notes:

1. Purple shading indicates the presence of visible permanganate.
2. KP = Potassium Permanganate; colorimetric field test for manganese, results presented as KP.
3. FD = Field Duplicate.
5. mg/L = milligrams per
6. N/A = Not Applicable

4. MS/MSD = Matrix Spike/Matrix Spike Duplicate.

The West Cap area is located east of AANG and north of Texas Instruments site. Groundwater flow is generally in the westerly direction towards AANG. The objective of ISCO is to inject potassium permanganate into the fine-grained sediments in the subsurface that are opined to provide a continual source of TCE to the shallow groundwater. The baseline sampling data is presented in Table 3.

The following graphs are a series of TCE concentration versus time plots for the source area (Figure C-11a) and the Western Lobe data versus time since injection (Figure C-11b).

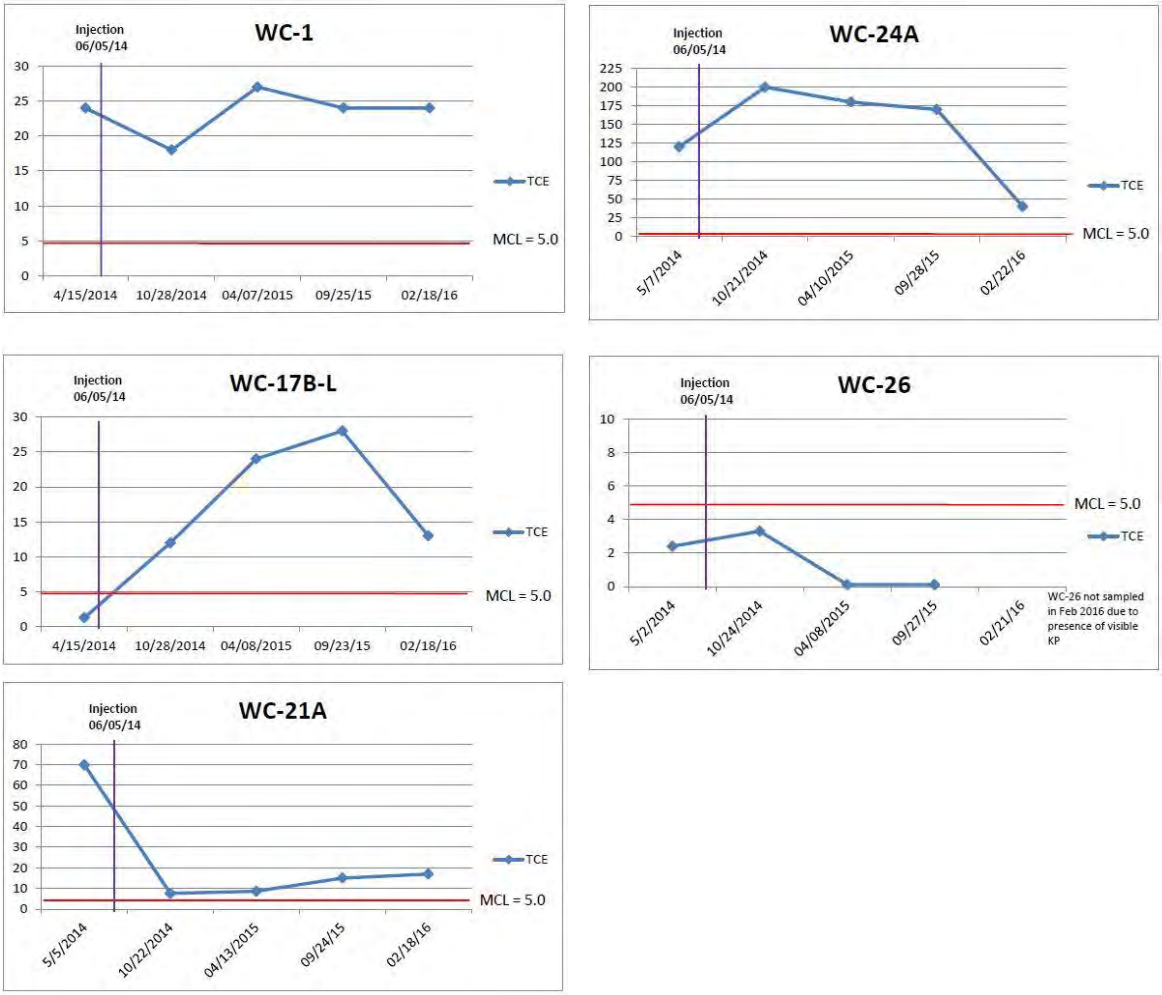


Figure C-11a. Time-Series Plots for the Source Area

Results for each individual well are varied at this point in time. Well WC-17B-L is located in the area with the highest TCE concentrations. The TCE increased following ISCO injections, suggesting that TCE was released from the fine-grained sediment. However, this result is localized and inconclusive at this point in time. Time series plots are presented for the West-Cap source area wells, located at the West- Cap Property (See Section 4.2).

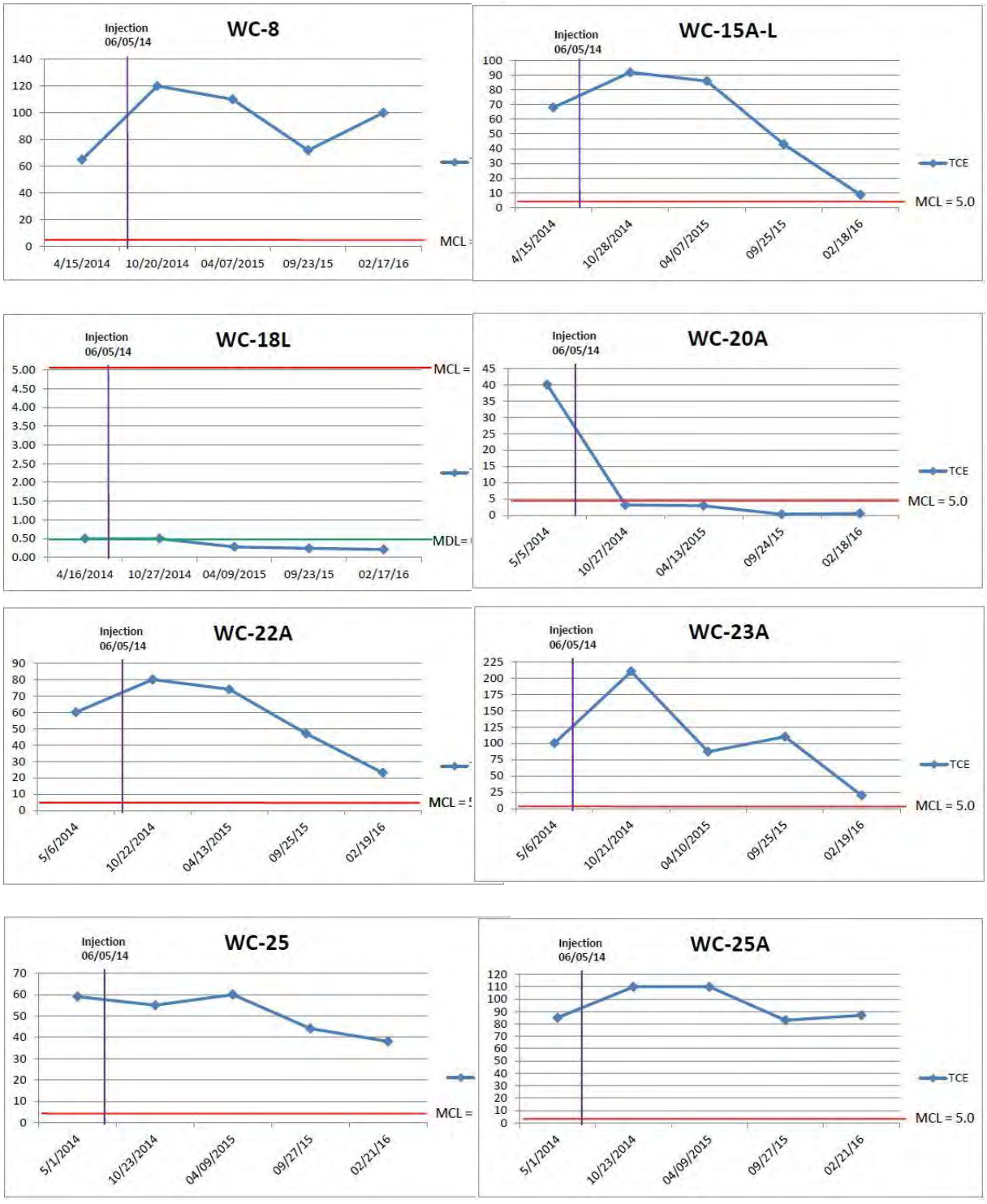


Figure C-11a continued. Time-Series plots for the Source Area

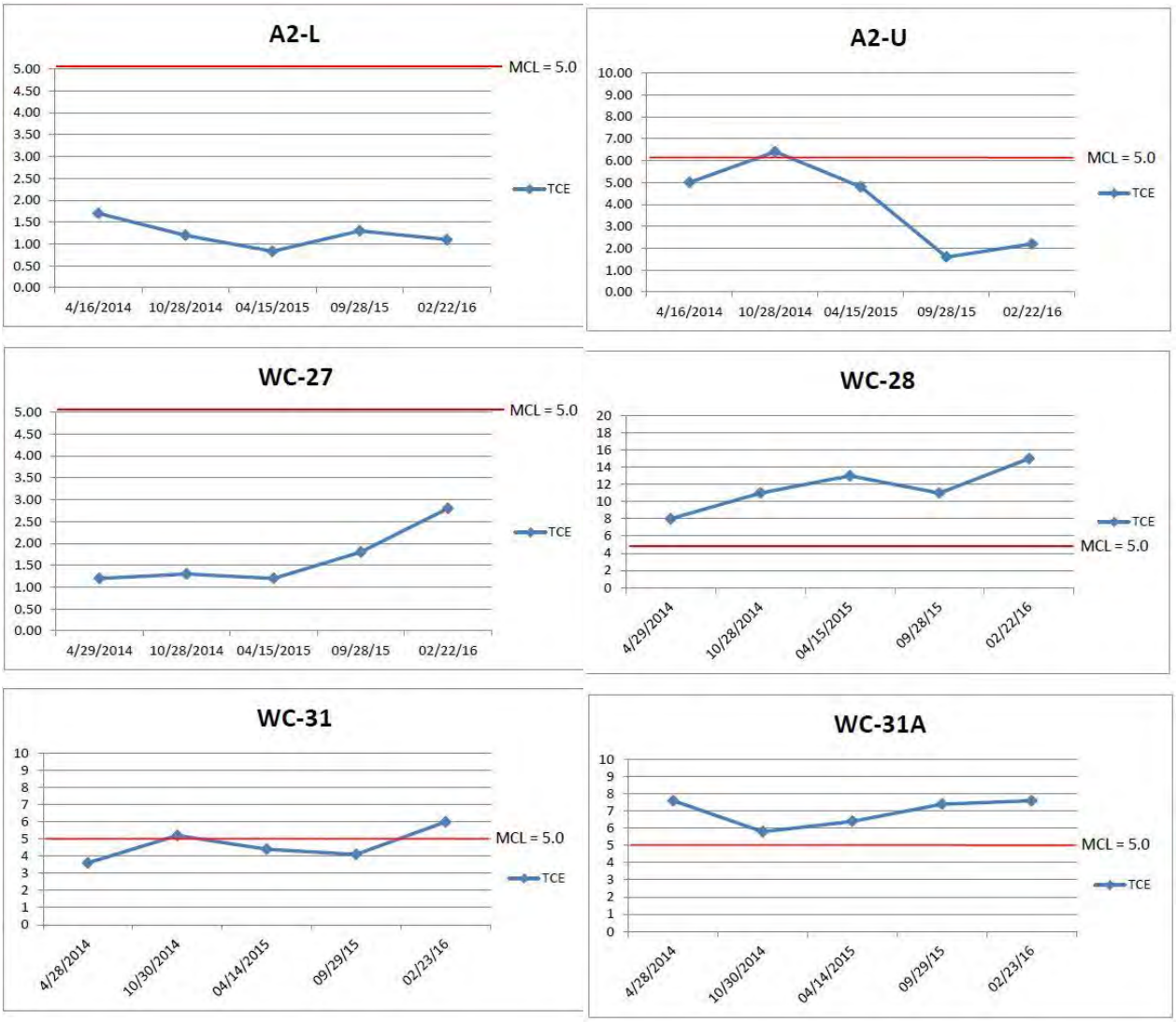


Figure C-11b. Time-Series Plots for the West Cap, Western Lobe, Downgradient from ISCO Treatment

It does not appear that the TCE plume has migrated to the down gradient wells. Wells in the lower aquifer (A2-L, WC-27 and WC-31) are below the MCL of 5 µg/L, with the exception of two samples at WC-31 collected in 2014 and 2016. Wells in the Upper Aquifer (A2-U, WC-28, WC-31A) result in concentration above the MCL of 5 µg/L, with the exception of well A2-U. Time series plots presented for the Western Lobe wells are located at the western edge of the property (See Section 4.2). USACE agrees with the PRPs request to wait on further injection and continue to evaluate the effectiveness of ISCO injections.

AANG

USACE performed Mann-Kendall trend analysis on three groundwater monitoring well pairs for the Upper and Lower Subunit of the Upper Aquifer. Wells MW100-U,-L and MW101-U,-L are located on-property at the downgradient portion of the property (Figure C-12). MW103-U,-L is located off-

property. The upper subunit wells are screened from approximately 87 ft to 97 ft bgs. The lower subunit wells are screened from approximately 130 ft to 150 ft bgs. It is important to note that the current depth to water for both upper and lower subunit wells ranged from 77ft to 79 ft bgs.

Results of the Mann-Kendall trend analysis illustrates 5 of 6 wells with increasing trends of TCE for both on- and off-property wells in the upper and lower subunits (Figure C-13). However, concentrations were not detected above the contingency plan trigger value of 10 µg/L described in the 2012 ROD Amendment. The well with the highest concentration and increasing trend was MW103-U, located off-property within the lower subunit.

Based on Mann-Kendall results from the AANG lower subunit off-property well MW103-L, additional lower subunit wells in the West Plume B area should be monitored more frequently to monitor the lower aquifer subunit.

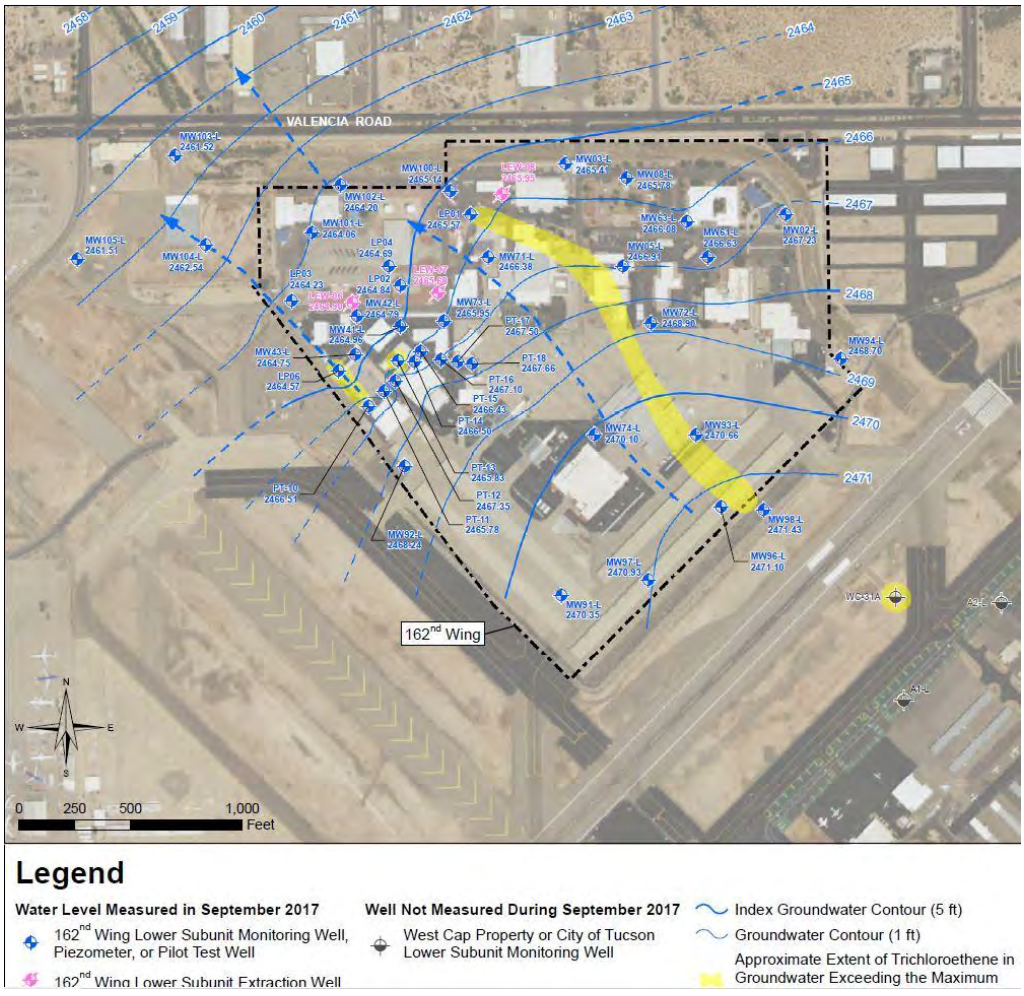
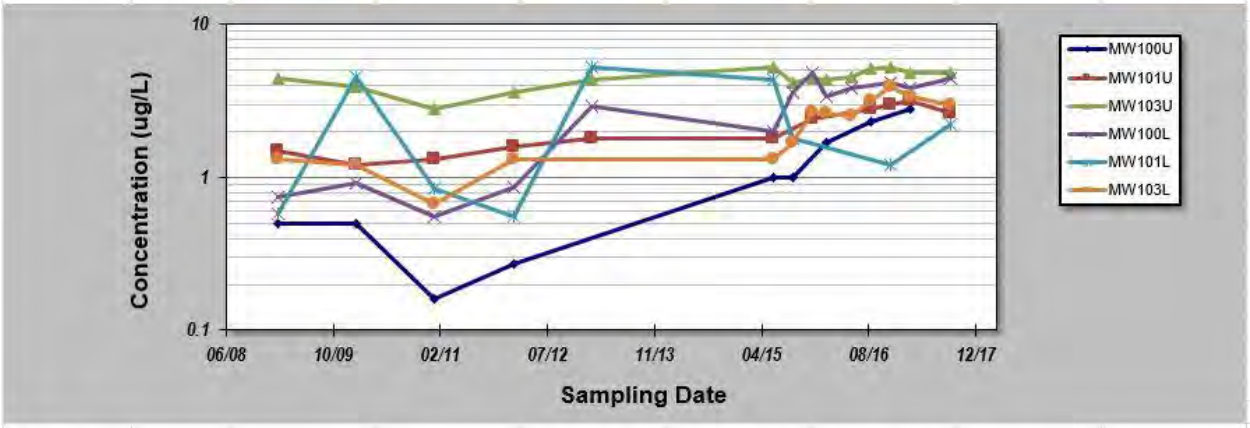


Figure C-12. Analytical Data for the AANG September 2017.

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date:	16-Mar-18	Job ID:	Tucson International Airport Superfund Site
Facility Name:	AANG	Constituent:	TCE
Conducted By:	Kristin Addis	Concentration Units:	ug/L

Sampling Point ID:	MW100U	MW101U	MW103U	MW100L	MW101L	MW103L
Sampling Event	Sampling Date	TCE CONCENTRATION (ug/L)					
1	1-Feb-09	0.5	1.5	4.4	0.75	0.58	1.3
2	1-Feb-10	0.5	1.2	3.9	0.92	4.5	1.2
3	1-Feb-11	0.16	1.3	2.8	0.56	0.85	0.67
4	1-Feb-12	0.27	1.6	3.6	0.86	0.56	1.3
5	1-Feb-13		1.8	4.3	2.9	5.3	
6	1-Jun-15	1	1.8	5.2	2	4.3	1.3
7	1-Sep-15	1		4.2	3.6	1.8	1.7
8	1-Dec-15		2.4	4.4	4.8		2.7
9	1-Feb-16	1.7		4.3	3.4		2.6
10	1-Jun-16			4.5	3.8		2.5
11	1-Sep-16	2.3	2.8	5.1			3.2
12	1-Dec-16		3	5.2	4.2	1.2	3.9
13	1-Mar-17	2.8	3.2	4.8	3.8		3.4
14	1-Sep-17		2.6	4.8	4.4	2.2	3
15							
16							
17							
18							
19							
20							
Coefficient of Variation:		0.82	0.34	0.15	0.56	0.78	0.46
Mann-Kendall Statistic (S):		26	44	45	55	4	55
Confidence Factor:		99.7%	>99.9%	99.3%	>99.9%	61.9%	>99.9%
Concentration Trend:		Increasing	Increasing	Increasing	Increasing	No Trend	Increasing



Notes:

At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*

Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.

Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

Figure C-13. Mann-Kendall Statistic for the AANG

West Plume B

This data review evaluates the effectiveness for the West Plume B MNA remedy. EPA defines the West Plume B TCE groundwater contamination as the plume that extends northwest from the AANG property to approximately Drexel Road and Nogales Highway.

USACE performed Mann-Kendall statistics on two monitoring wells to evaluate the remedy: WPB-11 and WPB-13. WPB-11 is located at the downgradient end of the plume in the shallow aquifer. WPB-13 is located at mid-plume at a deeper screened interval than WPB-11 to identify any vertical migration of TCE. Mann-Kendall results indicate that the West Plume B TCE plume appears to be stable and is not migrating vertically or horizontally. Breakdown products are observed in the analytical results, suggesting that natural attenuation is occurring within the plume.

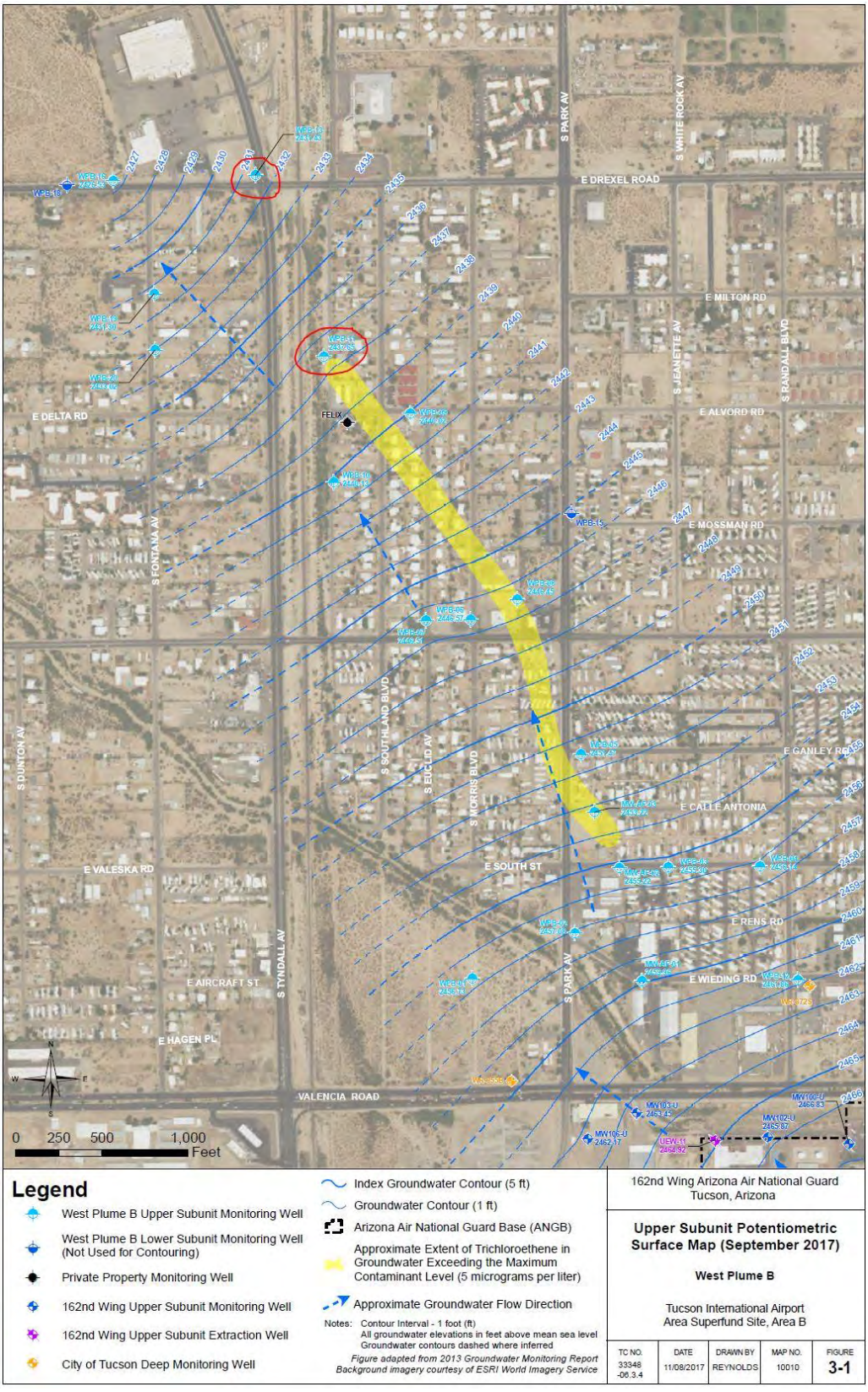


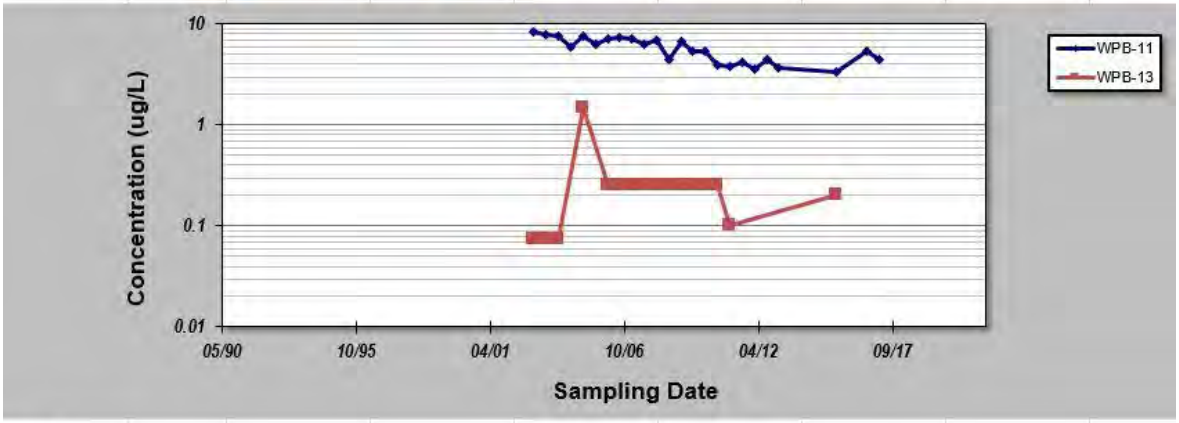
Figure C-14. West Plume B,

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date:	14-Mar-18	Job ID:	West Plume B - MNA area
Facility Name:	Tucson International Airport	Constituent:	TCE
Conducted By:	Kristin Addis	Concentration Units:	ug/L

Sampling Point ID:	WPB-11	WPB-13

Sampling Event	Sampling Date	TCE CONCENTRATION (ug/L)	
1	1-Feb-03	8.4	0.075
2	1-Aug-03	7.8	0.075
3	1-Feb-04	7.6	0.075
4	1-Aug-04	6	
5	1-Feb-05	7.7	1.5
6	1-Aug-05	6.3	
7	1-Feb-06	7.1	0.25
8	1-Aug-06	7.3	0.25
9	1-Feb-07	7.2	0.25
10	1-Aug-07	6.2	0.25
11	1-Feb-08	6.9	0.25
12	1-Aug-08	4.5	0.25
13	1-Feb-09	6.8	0.25
14	1-Aug-09	5.3	0.25
15	1-Feb-10	5.3	0.25
16	1-Aug-10	3.9	0.25
17	1-Feb-11	3.8	0.1
18	1-Aug-11	4.2	
19	1-Feb-12	3.6	
20	1-Aug-12	4.4	
21	1-Feb-13	3.7	
22	1-Jun-15	3.4	0.2
23	1-Sep-16	5.4	
24	1-Mar-17	4.4	
25			
Coefficient of Variation:		0.28	1.18
Mann-Kendall Statistic (S):		-186	8
Confidence Factor:		>99.9%	62.2%
Concentration Trend:		Decreasing	No Trend



Notes:

At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*

Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.

Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

Figure C-15. Mann-Kendall Data and Statistical Parameters for West Plume B MNA Remedy

Table C-4. Groundwater Analytical Results for AANG for September 2017

162nd Wing, Arizona Air National Guard
Tucson International Airport Superfund Site
Tucson, Arizona

Monitoring Well ID	Sample ID	Collection Date	Volatile Organic Compounds (µg/L)										Dissolved Metals (µg/L)				Hexavalent Chromium (mg/L)
			1,2-dichloroethane	1,2-dichloroethene, total	acetone	bromodichloromethane	chloromethane	cis-1,2-dichloroethene	methylene chloride	tetrachloroethene (PCE)	toluene	trichloroethene (TCE)	cadmium	chromium	lead	selenium	chromium, hexavalent
		USEPA MCL	0.5	--	--	80[1]	--	6	5	5	1,000	5	5	100	15[2]	50	--
UEW-01	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
UEW-02	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
UEW-03	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
UEW-04	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
UEW-05	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
LEW-06	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
LEW-07	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
LEW-08	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
UEW-09	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
UEW-10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
UEW-11	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
UP01	UP01-17-03	11-Sep-17	0.40 U	0.20 U	6.4 U	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.46 J q	0.21 J q	NS	NS	NS	NS	NS
LP01	LP01-17-03	11-Sep-17	0.40 U	0.20 U	6.4 U	0.40 U	0.30 J q	0.40 U	0.80 U	0.40 U	0.40 U	5.0	NS	NS	NS	NS	NS
LP01	LP01-17-03_FD	11-Sep-17	0.40 U	0.20 U	6.4 U	0.40 U	0.33 J q	0.40 U	0.80 U	0.40 U	0.40 U	5.0	NS	NS	NS	NS	NS
UP02	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
LP02	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
UP03	UP03-17-03	08-Sep-17	0.40 U	0.20 U	6.4 U	0.40 U	0.80 U	0.40 U	0.75 U k	0.40 U	0.40 U	3.7	NS	NS	NS	NS	NS
LP03	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
UP04	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
LP04	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
UP05	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
UP06	UP06-17-03	08-Sep-17	0.40 U	0.20 U	3.2 U k	0.40 U	0.80 U	0.40 U	1.2 U k	0.40 U	0.40 U	4.9	NS	NS	NS	NS	NS
LP06	LP06-17-03	08-Sep-17	0.40 U	0.20 U	2.6 U k	0.40 U	0.80 U	0.40 U	1.1 U k	0.40 U	0.40 U	7.6	NS	NS	NS	NS	NS
MW02-L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW02-M	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW02-U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW03-L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW03-U	MW03-U-17-03	08-Sep-17	0.40 U	0.20 U	3.7 U k	0.40 U	0.80 U	0.40 U	0.63 U k	0.40 U	0.40 U	0.40 U	NS	NS	NS	NS	NS
MW04-U	MW04-U-17-03	21-Sep-17	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.8 U	39	10 U	19 U	0.044
MW04-U	MW04-U-17-03_FD	21-Sep-17	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.83 J f,q	40	3.0 J f,q	5.8 J f,q	0.040
MW05-L	MW05-L-17-03	07-Sep-17	0.40 U	0.20 U	3.3 U k	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	4.2	NS	NS	NS	NS	NS

Table C-4 continued. Groundwater Analytical Results for AANG for September 2017

September 2017 Groundwater Analytical Results
162nd Wing, Arizona Air National Guard
Tucson International Airport Superfund Site
Tucson, Arizona

Monitoring Well ID	Sample ID	Collection Date	Volatile Organic Compounds (µg/L)										Dissolved Metals (µg/L)				Hexavalent Chromium (mg/L)
			1,2-dichloroethane	1,2-dichloroethene, total	acetone	bromodichloromethane	chloromethane	cis-1,2-dichloroethene	methylene chloride	tetrachloroethene (PCE)	toluene	trichloroethene (TCE)	cadmium	chromium	lead	selenium	chromium, hexavalent
		USEPA MCL	0.5	--	--	80[1]	--	6	5	5	1,000	5	5	100	15[2]	50	--
MW05-U	MW05-U-17-03	07-Sep-17	0.40 U	0.20 U	3.1 U k	0.40 U	0.80 U	0.40 U	0.80 U	0.34 J q	0.40 U	8.9	NS	NS	NS	NS	NS
MW08-L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW08-U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW41-L	MW41-L-17-03	08-Sep-17	0.40 U	0.20 U	2.8 U k	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	3.0	NS	NS	NS	NS	NS
MW41-U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW42-L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW43-L	MW43-L-17-03	07-Sep-17	0.40 U	0.20 U	5.3 U k	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	4.4	1.8 U	41	10 U	19 U	0.050
MW43-U	MW43-U-17-03	08-Sep-17	0.40 U	0.20 U	6.2 U k	0.40 U	0.80 U	0.40 U	0.82 U k	0.40 U	0.40 U	3.4	NS	NS	NS	NS	NS
MW61-L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW62-U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW63-L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW71-L	MW71-L-17-03	08-Sep-17	0.40 U	0.20 U	5.8 U k	0.40 U	0.80 U	0.40 U	0.40 U k	0.40 U	0.40 U	2.8	NS	NS	NS	NS	NS
MW71-U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW72-L	MW72-L-17-03	07-Sep-17	0.40 U	0.20 U	4.5 U k	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	4.1	NS	NS	NS	NS	NS
MW72-U	MW72-U-17-03	07-Sep-17	0.40 U	0.20 U	3.0 U k	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	3.8	NS	NS	NS	NS	NS
MW73-L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW73-U	MW73-U-17-03	08-Sep-17	0.40 U	0.20 U	5.0 U k	0.40 U	0.80 U	0.40 U	0.98 UJ a,k,d	0.40 U	0.40 U	4.8	NS	NS	NS	NS	NS
MW74-L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW74-U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW75-U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW91-L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW91-M	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW91-U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW92-L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW92-U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW93-L	MW93-L-17-03	11-Sep-17	0.40 U	0.20 U	6.2 U k	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	5.6	NS	NS	NS	NS	NS
MW93-U	MW93-U-17-03	11-Sep-17	0.40 U	0.20 U	7.2 J f,q	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	12	NS	NS	NS	NS	NS
MW93-U	MW93-U-17-03_FD	11-Sep-17	0.40 U	0.20 U	6.4 U	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	12	NS	NS	NS	NS	NS
MW94-L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW94-U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW95-U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table C-4 continued. Groundwater Analytical Results for AANG for September 2017

162nd Wing, Arizona Air National Guard
Tucson International Airport Superfund Site
Tucson, Arizona

Monitoring Well ID	Sample ID	Collection Date	Volatile Organic Compounds (µg/L)										Dissolved Metals (µg/L)				Hexavalent Chromium (mg/L)
			1,2-dichloroethane	1,2-dichloroethene, total	acetone	bromodichloromethane	chloromethane	cis-1,2-dichloroethene	methylene chloride	tetrachloroethene (PCE)	toluene	trichloroethene (TCE)	cadmium	chromium	lead	selenium	chromium, hexavalent
		USEPA MCL	0.5	--	--	80[1]	--	6	5	5	1,000	5	5	100	15[2]	50	--
MW96-L	MW96-L-17-03	11-Sep-17	0.40 U	0.20 U	6.4 U	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	4.3	NS	NS	NS	NS	NS
MW96-U	MW96-U-17-03	11-Sep-17	0.40 U	0.20 U	3.2 U k	0.40 U	0.80 U	0.40 U	0.61 UJ a,k,d	0.40 U	0.40 U	5.8	NS	NS	NS	NS	NS
MW97-L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW97-U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW98-L	MW98-L-17-03	11-Sep-17	0.40 U	0.20 U	4.7 U k	0.40 U	0.80 U	0.40 U	0.51 UJ a,k,d	0.40 U	0.40 U	4.3	NS	NS	NS	NS	NS
MW98-U	MW98-U-17-03	11-Sep-17	0.40 U	0.20 U	3.9 U k	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	49	NS	NS	NS	NS	NS
MW100-L	MW100-L-17-03	08-Sep-17	0.40 U	0.20 U	4.2 U k	0.40 U	0.80 U	0.40 U	0.71 U k	0.40 U	0.40 U	4.4	NS	NS	NS	NS	NS
MW100-U	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW101-L	MW101-L-17-03	08-Sep-17	0.40 U	0.20 U	2.8 U k	0.40 U	0.80 U	0.40 U	1.9 J q	0.40 U	0.40 U	2.2	NS	NS	NS	NS	NS
MW101-U	MW101-U-17-03	08-Sep-17	0.40 U	0.20 U	6.4 U	0.40 U	0.80 U	0.40 U	0.79 U k	0.40 U	0.40 U	2.6	NS	NS	NS	NS	NS
MW102-L	MW102-L-17-03	08-Sep-17	0.40 U	0.20 U	6.4 U	0.40 U	0.80 U	0.40 U	0.68 U k	0.40 U	0.40 U	3.3	NS	NS	NS	NS	NS
MW102-U	MW102-U-17-03	08-Sep-17	0.40 U	0.20 U	2.5 UJ k, b	1.6 J+ b	0.80 U	0.40 U	0.95 UJ a,k,b,d	0.40 U	0.40 U	2.4 J+ b	NS	NS	NS	NS	NS
MW103-L	MW103-L-17-03	07-Sep-17	0.40 U	0.20 U	3.8 U k	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	3.0	NS	NS	NS	NS	NS
MW103-U	MW103-U-17-03	07-Sep-17	0.40 U	0.20 U	4.4 U k	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	4.7	NS	NS	NS	NS	NS
MW103-U	MW103-U-17-03_FD	07-Sep-17	0.40 U	0.20 U	4.2 U k	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	4.8	NS	NS	NS	NS	NS
MW104-L	MW104-L-17-03	11-Sep-17	0.40 U	0.20 U	5.6 U k	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	3.8	NS	NS	NS	NS	NS
MW104-U	MW104-U-17-03	11-Sep-17	0.40 U	0.20 U	4.5 U k	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	4.4	NS	NS	NS	NS	NS
MW105-L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW105-U	MW105-U-17-03	11-Sep-17	0.40 U	0.20 U	3.5 U k	0.40 U	0.80 U	0.40 U	0.63 UJ a,k,d	0.40 U	0.40 U	1.2	NS	NS	NS	NS	NS
MW106-U	MW106-U-17-03	07-Sep-17	0.40 U	0.20 U	4.4 U k	0.25 U k	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	0.93 J q	NS	NS	NS	NS	NS
PT-1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PT-2	PT-2-17-03	21-Sep-17	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.84 J q	240	5.2 J q	8.5 J q	0.013 J q
PT-3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PT-4	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PT-5	PT-5-17-03	21-Sep-17	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.84 J q	400	15	190 U	4.0 U
PT-6	PT-6-17-03	11-Sep-17	0.40 U	0.20 U	6.4 U	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	3.8	NS	NS	NS	NS	NS
PT-10	PT-10-17-03	12-Sep-17	0.40 U	0.20 U	5.2 U k	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	6.6	NS	NS	NS	NS	NS
PT-11	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PT-12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PT-13	PT-13-17-03	12-Sep-17	0.40 U	0.20 U	8.1 J q	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	11	NS	NS	NS	NS	NS
PT-14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table C-4 continued. Groundwater Analytical Results for AANG for September 2017

Monitoring Well ID	Sample ID	Collection Date	Volatile Organic Compounds (µg/L)										Dissolved Metals (µg/L)				Hexavalent Chromium (mg/L)
			1,2-dichloroethane	1,2-dichloroethene, total	acetone	bromodichloromethane	chloromethane	cis-1,2-dichloroethene	methylene chloride	tetrachloroethene (PCE)	toluene	trichloroethene (TCE)	cadmium	chromium	lead	selenium	chromium, hexavalent
		USEPA MCL	0.5	--	--	80[1]	--	6	5	5	1,000	5	5	100	15[2]	50	--
PT-15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PT-16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PT-17	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PT-18	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
WPB-1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
WPB-2	WPB-2-17-03	05-Sep-17	0.40 U	0.20 U	6.4 U	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	1.3	NS	NS	NS	NS	NS
WPB-3	WPB-3-17-03	05-Sep-17	0.40 U	0.20 U	6.4 U	0.40 U	0.80 U	0.40 U	0.80 U	0.25 J q	0.40 U	0.43 J q	NS	NS	NS	NS	NS
WPB-4	WPB-4-17-03	05-Sep-17	0.40 U	0.20 U	6.4 U	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	3.7	NS	NS	NS	NS	NS
WPB-5	WPB-5-17-03	05-Sep-17	0.40 U	0.20 U	2.5 U h	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	2.6	NS	NS	NS	NS	NS
WPB-6	WPB-6-17-03	06-Sep-17	0.40 U	0.20 U	6.4 U	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	0.92 J q	NS	NS	NS	NS	NS
WPB-7	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
WPB-8	WPB-8-17-03	06-Sep-17	0.40 U	0.31 J q	4.0 U h	0.40 U	0.80 U	0.31 J q	0.80 U	0.40 U	0.40 U	5.8	NS	NS	NS	NS	NS
WPB-8	WPB-8-17-03_FD	06-Sep-17	0.40 U	0.30 J q	3.9 U h	0.40 U	0.80 U	0.30 J q	0.80 U	0.40 U	0.40 U	5.8	NS	NS	NS	NS	NS
WPB-9	WPB-9-17-03	06-Sep-17	0.40 U	0.20 U	1.9 U h	0.22 U h	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	2.5	NS	NS	NS	NS	NS
WPB-10	WPB-10-17-03	06-Sep-17	0.40 U	0.20 U	6.4 U	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	1.7	NS	NS	NS	NS	NS
WPB-11	WPB-11-17-03	06-Sep-17	0.40 U	0.25 J q	6.4 U	0.40 U	0.80 U	0.25 J q	0.80 U	0.40 U	0.40 U	4.8	NS	NS	NS	NS	NS
WPB-12	WPB-12-17-03	05-Sep-17	0.40 U	0.20 U	7.1 J q	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	0.40 U	NS	NS	NS	NS	NS
WPB-13	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
WPB-15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
WPB-16	WPB-16-17-03	06-Sep-17	0.40 U	0.20 U	2.2 U h	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	0.40 U	NS	NS	NS	NS	NS
WPB-18	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
WPB-19	WPB-19-17-03	06-Sep-17	0.31 J q	0.15 J q	6.4 U	0.40 U	0.80 U	0.15 J q	0.80 U	0.40 U	0.40 U	2.7	NS	NS	NS	NS	NS
WPB-20	WPB-20-17-03	06-Sep-17	0.77 J q	0.20 U	3.3 U h	0.40 U	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	1.6	NS	NS	NS	NS	NS
Felix Well	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-AF-01	MW-AF-01-17-03	05-Sep-17	0.40 U	0.20 U	12	0.32 U h	0.80 U	0.40 U	0.80 U	0.40 U	0.40 U	1.6	NS	NS	NS	NS	NS
MW-AF-02	MW-AF-02-17-03	05-Sep-17	0.40 U	0.21 J q	6.4 U	0.40 U	0.80 U	0.21 J q	0.80 U	0.40 U	0.40 U	3.4	NS	NS	NS	NS	NS
MW-AF-03	MW-AF-03-17-03	05-Sep-17	0.40 U	0.49 J q	6.4 U	0.40 U	0.80 U	0.49 J q	0.80 U	0.40 U	0.40 U	8.6	NS	NS	NS	NS	NS

Table C-4 continued. Groundwater Analytical Results for AANG for September 2017

Notes:

- Indicates result is equal to or greater than the respective USEPA MCL.
(1) - For total trihalomethanes (sum of bromoform, bromodichloromethane, chloroform, and dibromochloromethane).
(2) - Federal Action Level
— - no MCL available
J - The analyte was positively identified and the result is usable; however, the analyte concentration is an estimated value.
U - The analyte was not detected above the Limit of Detection (LOD).
UJ - The analyte was not detected above the LOD; however, the LOD is uncertain and may be elevated above normal levels.
+/- - Plus or minus sign after the qualifier indicates a potential positive or negative bias of the sample result because of issues identified by the qualifier and comments.
a - The analyte was found in the method blank.
b - The surrogate spike recovery was outside quality control criteria
d - The laboratory control sample recovery was outside control limits.
f - The duplicate/replicate sample's relative percent difference was outside the control limit.
k - The analyte was found in a field blank.
q - The analyte detection was below the LOQ.
FD - duplicate sample
LOD - limit of detection
LOQ - limit of quantitation
MCL - Maximum Contaminant Level (USEPA 2009)
µg/L - micrograms per liter
NS - not sampled
USEPA - United States Environmental Protection Agency

OU2 - Airport Property

The OU2 remedy consists of the Airport Property shallow groundwater remediation remedy and the TI Zone remedy. The following data analysis reviews effectiveness of the SGZ remedy to prevent migration into the Regional Aquifer. GHD collects performance sampling on a semi-annual and annual basis to monitor the remedy effectiveness (Table C-4).

Table C-4. Airport Property Groundwater Monitoring Program.

Sampling Frequency	**SGZ**	**GSU**	**Regional Aquifer**
Semi-Annual	37	27	10
Annual	52	38	12

Site Hydrogeology

The performance of the remedy relies on the effectiveness of the extraction systems and its ability to limit migration of contaminants into the Regional Aquifer. The stratigraphic units for the Airport Property are simplified into five units, (Table C-5).

Table C-5. Stratigraphic and Hydrogeologic units for at the Airport Property Site

Stratigraphic Unit	***Hydrogeologic Unit***	***Hydrogeologic Subunit***
Unit 1	Vadose Zone	(see Section 4 Soils for details on SVE remedy within the vadose zone)
Unit 2		
Unit 3		
Unit 4	SGZ	Upper SGZ (Upper Unit 4 Clay)
		Gravel Subunit (GSU)
		Lower Unit 4 Clay
Fort Lowell Formation/ Upper Tinaja Beds	Regional Aquifer	Upper Divided Aquifer
		Lower Divided Aquifer

The Airport Property is composed of two water-bearing units, the SGZ (including the Gravel Subunit [GSU]) and the Regional Aquifer. The SGZ includes groundwater in both the Upper Unit 4 and the GSU. The GSU was deposited as loosely connected paleochannels composed of mainly of gravel interbeds within the clay aquitard. Due to limited permeability of the clay, the permeable GSU exhibits characteristics of a confined aquifer, with varying degrees of upward pressure. The SGZ is hydraulically connected to the GSU and groundwater flows in the westerly direction. Due to the complex depositional environment of alluvial fan deposits and paleochannels, some GSUs, while connected to the surrounding SGZ may not be hydraulically connected to other GSU wells. The SGZ/GSU transitions to the west into the Regional Aquifer.

EPA conducted statistical analysis for TCE concentration trends on select wells throughout the Airport Property Site (Figure C-16). GHD's interpretation of the subsurface provides a general representation through the remedial area illustrating the geology, well placement, and well screen intervals with relation to SGZ, GSU and Regional Aquifer (Figure C-17).

The groundwater extraction systems capture the majority of the TCE contamination, with the exception of one area off-property near CRA 67D. The transition zone from the SGZ into the Regional Aquifer and the SGZ.

USACE reviewed TCE concentration and water elevation over time to determine whether contaminant capture is occurring. Of the four on-property wells evaluated, two wells (CRA-8 and CRA-9) have decreasing TCE concentrations, and two wells (D-2 and D-3) have increasing TCE concentrations. Two off-property wells (S-24 and S-37) evaluated have increasing TCE concentrations. One off-property well (D-6) evaluated has fluctuating TCE concentrations.

USACE reviewed time series plots presented in (Figures C-18 through C-24) for the following wells: CRA-9, CRA-8, S-24, S-37, D-2, D-3 and D-6. Four wells are located on-property (CRA-9, CRA-8, D-2, and D-3) and three are located off-property (S-24, S-37 and D-6). CRA-8 and CRA-9 are located adjacent to extraction wells. TCE concentrations in these wells are decreasing over time, while the water elevation increases. TCE concentrations in D-2, located on-property, are increasing with increasing water elevations versus time. D-3 is located upgradient to the SGZ source area. There is an increasing trend in TCE in this well, suggesting there is TCE mass moving onto the property from another source area. D-6 is located off-property in the Regional Aquifer and shows fluctuations of TCE concentrations, while water elevations increase following SGA extraction system startup. Because D-6 is located in the Regional Aquifer, it is not within the ROI of the SGZ extraction system. Nevertheless, this well is downgradient of the Airport Property and it is influenced by upgradient influences from the Regional Aquifer (AFP44). S-24 is located off-property. Following SGZ extraction system startup, TCE concentrations and water levels have increased. S-37 is located off-property. Following SGZ extraction system startup, water elevation has increased and TCE concentrations decreased.

If the remedy is effective throughout the Site, other wells downgradient of the extraction systems should result in similar trends of TCE. This is not what is observed downgradient, or within the wells within the Regional Aquifer, or with the upgradient well, D-3. There are several factors that may be contributing to the increases in TCE trends:

- Water elevation increases from the Regional Aquifer may be mobilizing TCE in the recently saturated sediments on Unit 4 in the transition zone.
- TCE mass may be affecting the TCE trends within the Airport Property as water elevations (2457ft elevation) increase.
- The extraction systems may not have adequate capture due to the complexity of the subsurface.
- Additional TCE may be transported from the Regional Aquifer from upgradient sources (AFP44).

Based on the reasoning stated above and due to the complexity of the Airport Property subsurface, it is unclear that the current remedy is functioning as designed.

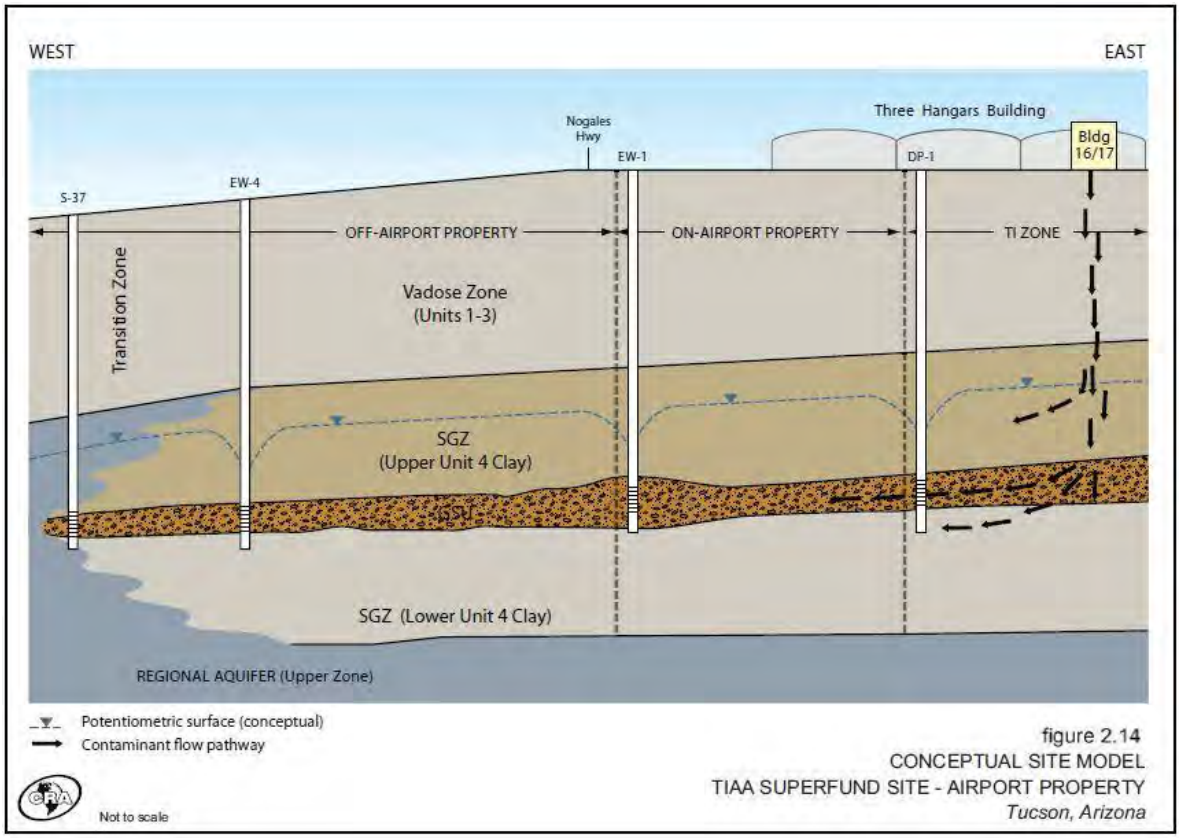


Figure C-15. Conceptual Site Model for the Airport Property Site

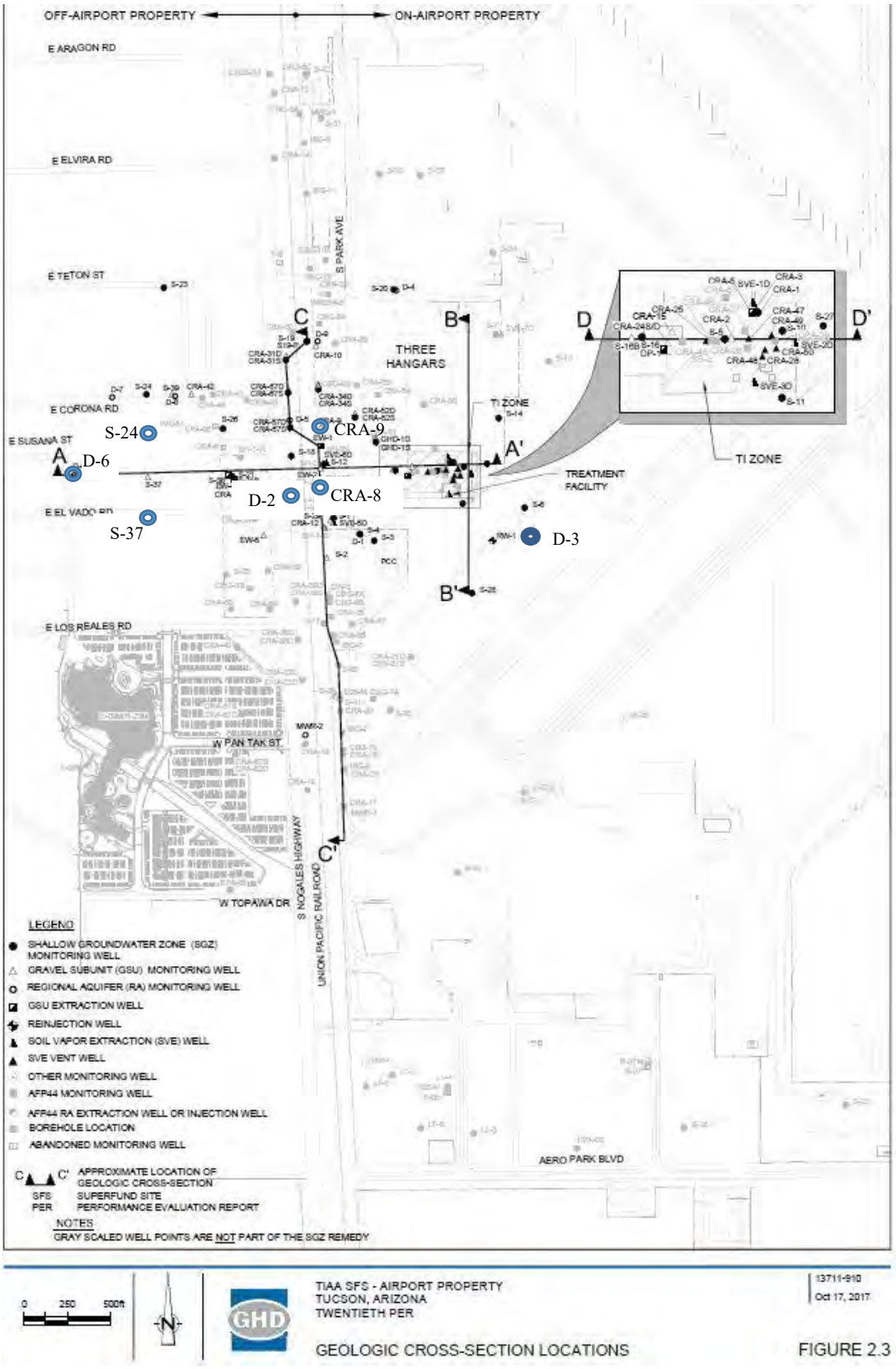


Figure C-16. Site Map for the Airport Property Site

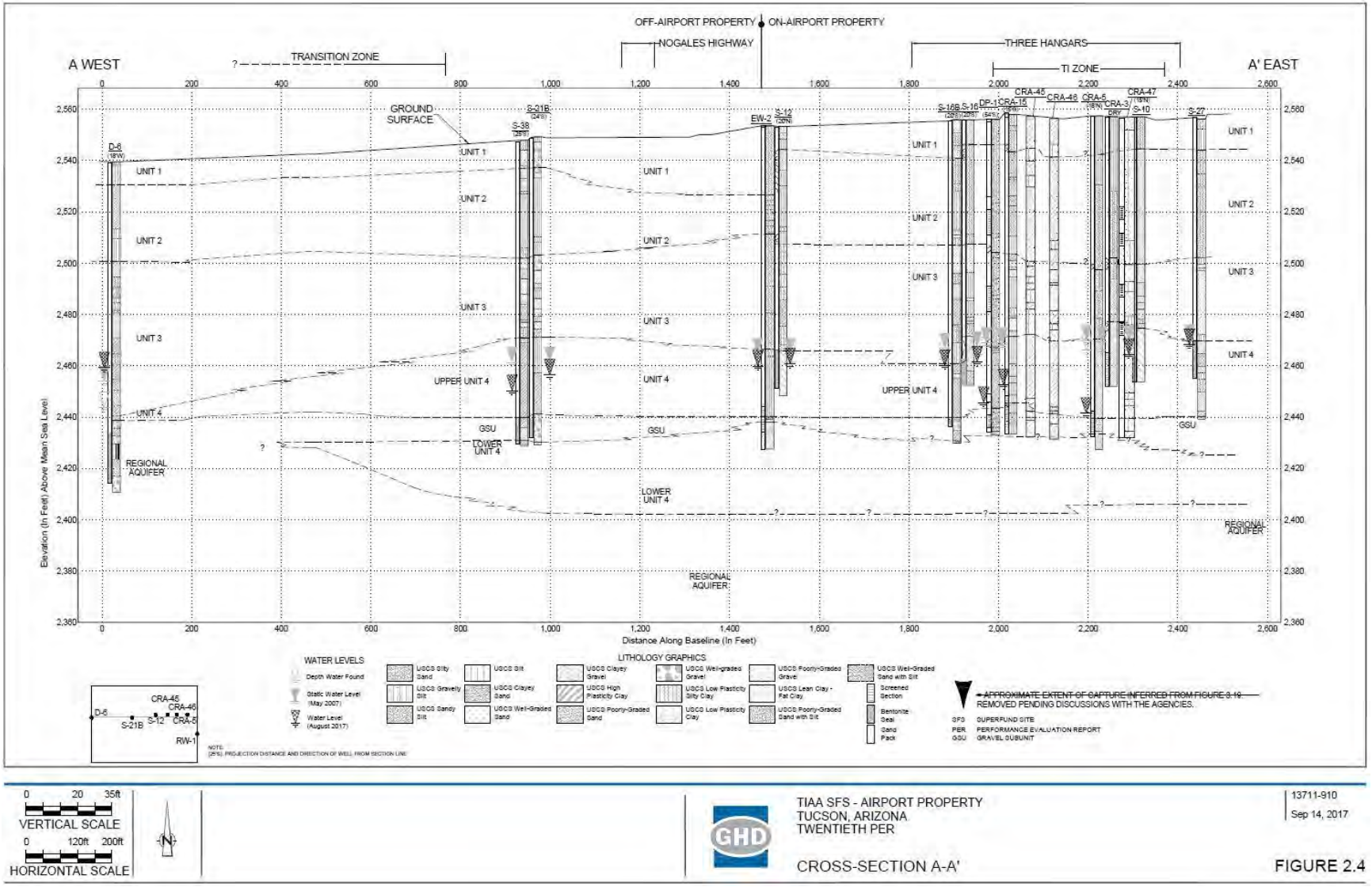


Figure C-17. Cross Section at Airport Property Illustrating the Water-Bearing Units of the SGZ and the Transition into the Regional Aquifer

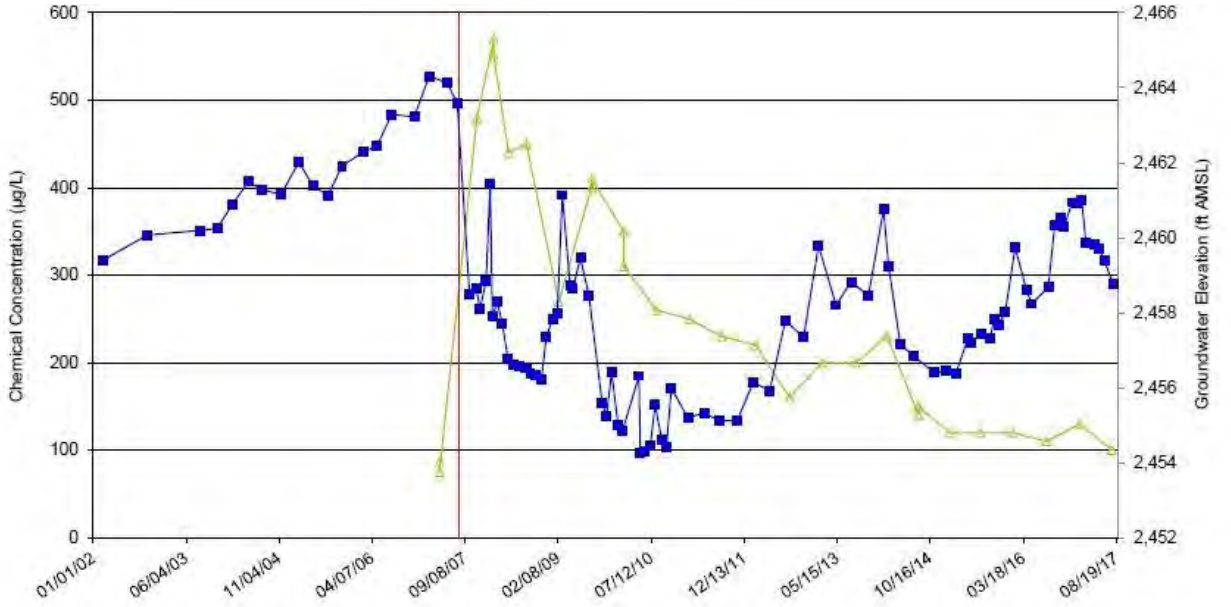


Figure C-18. Groundwater Elevations and TCE Concentrations at CRA-9

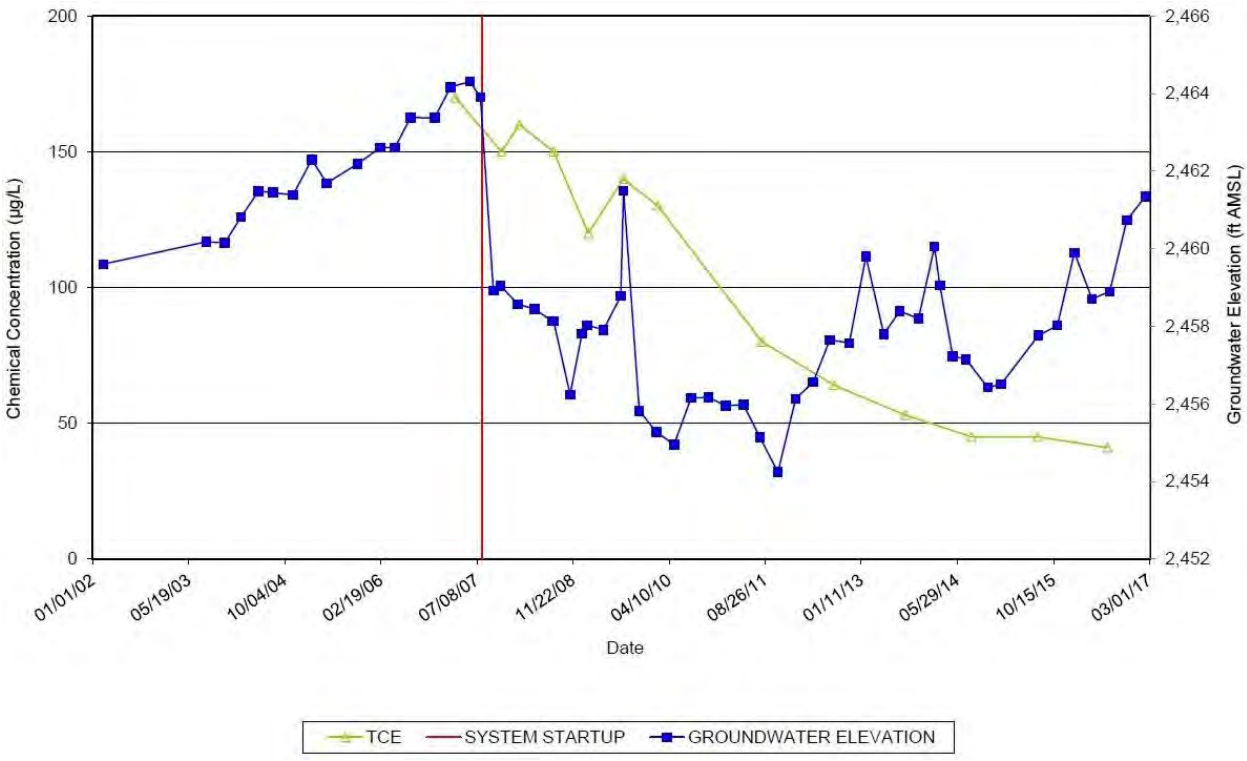


Figure C-19. Groundwater Elevations and TCE Concentrations at CRA-8

Figure C-20. Groundwater Elevations and TCE Concentrations at S-24

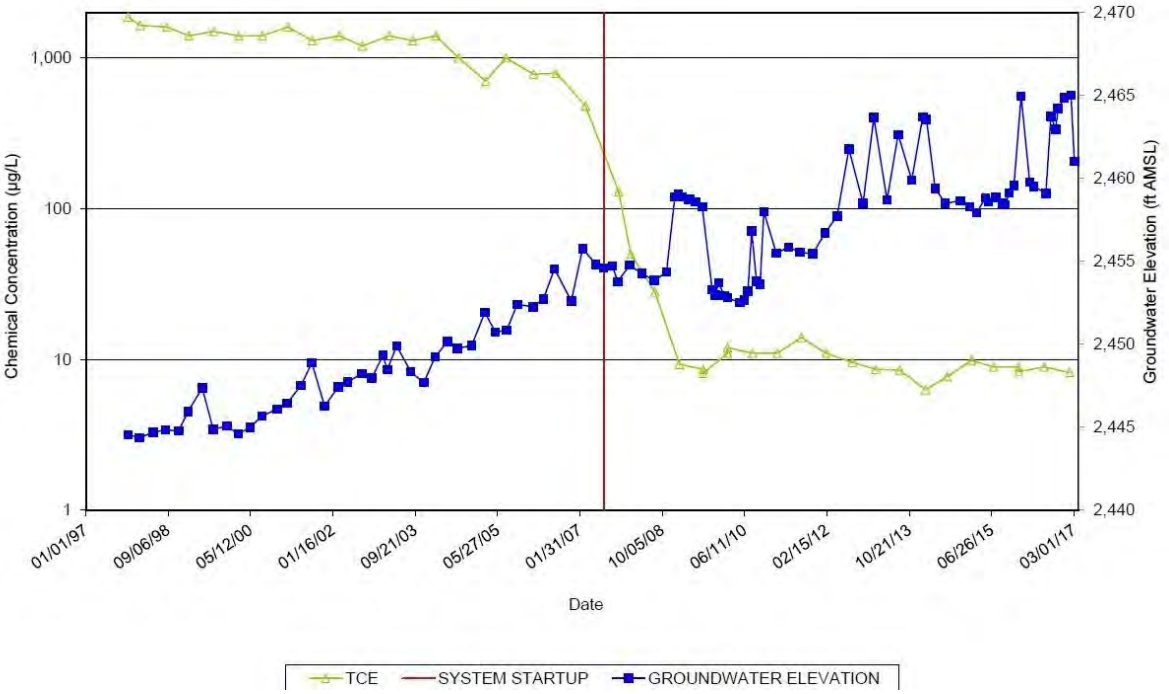


Figure C-21. Groundwater Elevations and TCE Concentrations at S-37

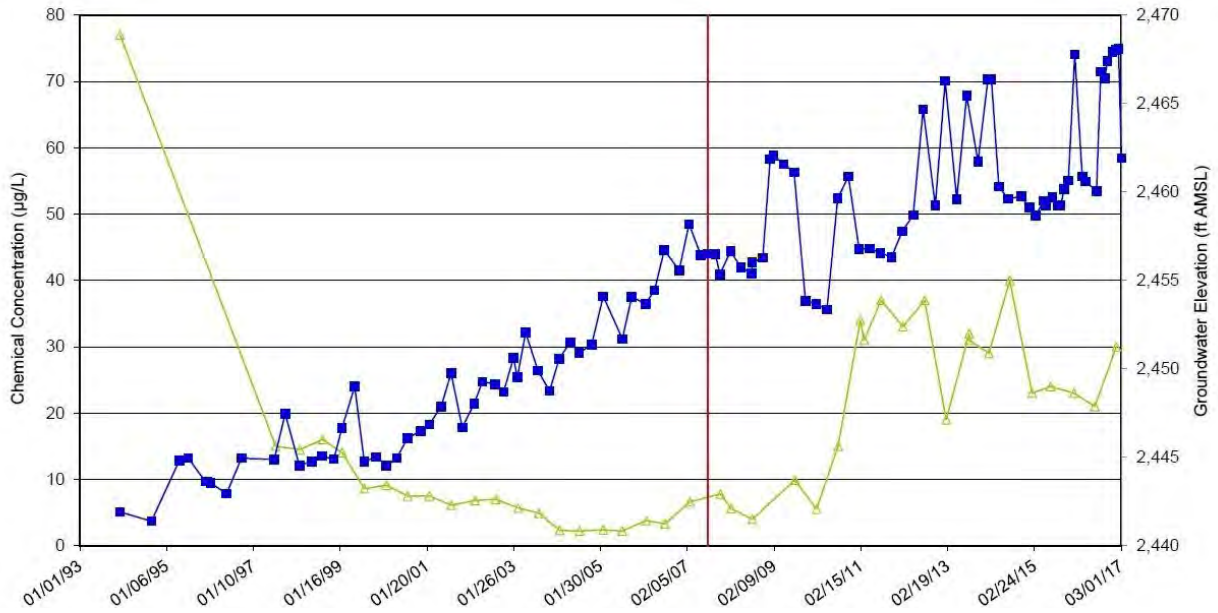


Figure C-22. Groundwater Elevations and TCE Concentrations at D-2

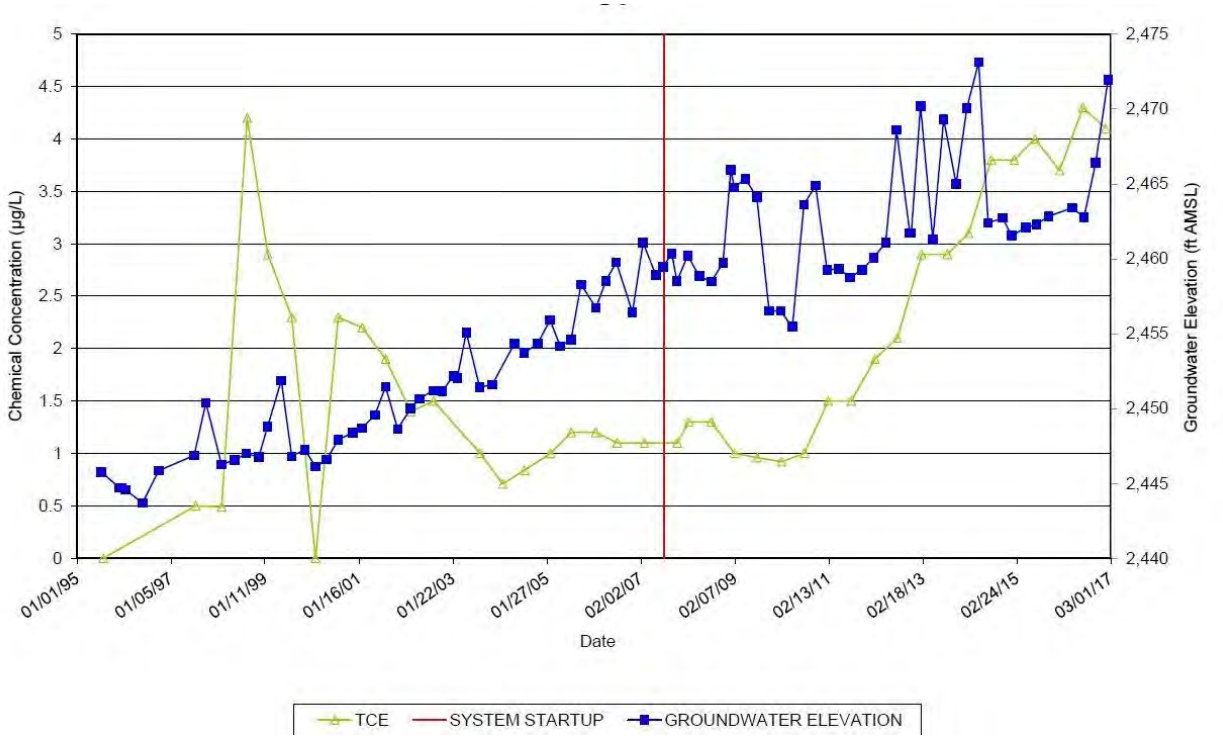


Figure C-23. Groundwater Elevations and TCE Concentrations at D-3, Upgradient of TI Zone

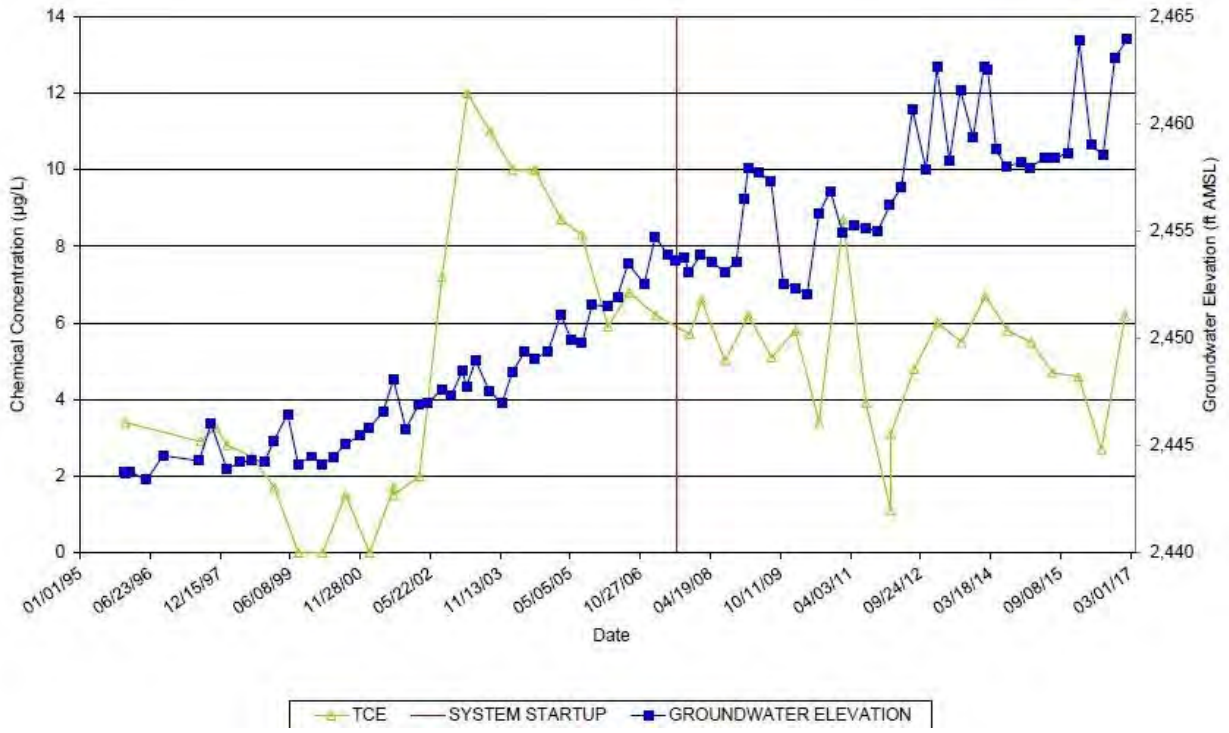


Figure C-24. Groundwater Elevations and TCE Concentrations at D-6

Appendix D: ARAR Assessment

Amec Foster Wheeler Programs, Inc. prepared the final Five-Year review on Air Force Plant 44 for the Air Force. Details for OU3 ARAR assessment can be found in the *Five-Year review of Five Sites at Air Force Plant 44, Tucson, Arizona. August 10, 2018*

USACE completed the ARAR assessment for OU1 and OU2.

Section 121 (d)(2)(A) of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) specifies that Superfund remedial actions 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, remedial action, location, or other circumstance at a CERCLA site.

Changes (if any) in ARARs are evaluated to determine if the changes affect the protectiveness of the remedy. Each ARAR and any change to the applicable standard or criterion are discussed below.

The major statutes and regulations that contribute to the list of potential chemical-specific ARARs are the Clean Water Act (CWA), the Safe Drinking Water Act (SDWA), the Arizona Water Quality Standards (A.A.C Title 18, Chapter 11), and the Arizona Soil Remediation Levels (A.A.C, Title 18, Chapter 7). In 2008, federal MCLs were incorporated by reference into A.A.C. Title 18, Chapter 4. If an Arizona Water Quality Standard (AWQS) does not exist for a specific compound, the ADEQ Human Health-Based Guidance Levels for Contaminants in Drinking Water (HBGL) are To Be Considered (TBC) standards. While the HBGLs are not promulgated and are not, therefore, ARARs, they were taken into consideration during the development of remedial alternatives.

OU1 Area A consists of groundwater at the Tucson Airport Remediation Project (TARP). There are two decision documents that apply to chemical-specific ARARs for OU1 Area B: the 1988 ROD and 1997 ESD. In Attachment #2 of the 1997 ESD, EPA clarified that cleanup levels are MCLs for all Site contaminants. Changes have occurred to the chemical-specific ARARs; the MCL for chloroform (as total trihalomethanes) has become more stringent, and the MCLs for chromium and trans-1,2-dichloroethylene have become less stringent. In OU1 Area A, chloroform is detected in groundwater at concentrations well below the MCL, so protectiveness of the remedy is not affected. Chemical-specific ARARs identified in the selected remedy within the decision documents for the groundwater at OU1 Area A and considered for this FYR for continued groundwater treatment and monitoring are listed in Table D-1.

Table D-1. Summary of Groundwater ARARs for OU1 Area A

Contaminant of Concern	1988 ROD/ 1997 ESD Cleanup Standard (µg/L)	Basis	Current Regulations (µg/L)		ARARs Changed?
			State – MCL	Federal – MCL	
Benzene	5	State	5	5	No changes
Chloroform	100	Federal	**80**[a]	**80**[a]	More stringent MCL
Chromium	50	Federal	**100**	**100**	Less stringent MCL
1,1-Dichloroethylene (1,1-DCE)	7	Federal	7	7	No changes
trans-1,2-Dichloroethylene (trans-1,2-DCE)	70	State	**100**	**100**	Less stringent MCL
Trichloroethylene (TCE)	5	Federal	5	5	No changes

a – MCL shown is for Total Trihalomethanes, a class of chemicals that includes chloroform.

Bolded entries indicate changes to state and/or federal MCLs since the 1996 ROD.

OU1 Area B consists of groundwater at several locations: the Texas Instruments property (formerly Burr-Brown Corporation property), the 162nd Fighter Group Arizona Air National Guard (AANG) Base, the former West-Cap area, and the West Plume B area. There are four decision documents that apply to chemical-specific ARARs for OU1 Area B: the 1988 ROD, 1997 ESD, 2004 and 2012 ROD Amendments. In the most recent decision document, the 2012 ROD Amendment, EPA updated the COCs and cleanup levels at OU1 Area B. No changes have occurred to the chemical-specific ARARs since the 2012 ROD Amendment. Chemical-specific ARARs identified in the selected remedy within the decision documents for the groundwater at OU1 Area B and considered for this FYR for continued groundwater treatment and monitoring are listed in Table D-2.

Table D-2. Summary of Groundwater ARARs for OU1 Area B

Contaminant of Concern	2012 ROD Amendment Cleanup Standard (µg/L)	Basis	Current Regulations (µg/L)		ARARs Changed?
			State – MCL	Federal – MCL	
1,1-Dichloroethylene (1,1-DCE)	7	State	7	7	No changes
cis-1,2-Dichloroethylene (cis-1,2-DCE)	70	Federal	70	70	No changes
Tetrachloroethylene (PCE)	5	Federal	5	5	No changes
Trichloroethylene (TCE)	5	State	5	5	No changes
Vinyl chloride	2	Federal	2	2	No changes

OU2 consists of soil and shallow groundwater at several locations: the Texas Instruments property (formerly Burr-Brown Corporation property), the 162nd Fighter Group Arizona Air National Guard (AANG) Base, and the former West Cap Area. There is one decision documents that applies to chemical-specific groundwater ARARs for OU2: the 1997 ROD. (The 1996 ROD and 2001 ESD apply to soil actions only.) Changes have occurred to the chemical-specific ARARs; the MCL for chloroform (as total trihalomethanes), total trihalomethanes, and arsenic have become more stringent. From the November 2017 performance evaluation report, concentrations of chloroform and trihalomethanes were greater than the current MCLs. However, the RAOs are being met. Samples are

not analyzed for metals. Chemical-specific ARARs identified in the selected remedy within the decision documents for the groundwater at OU2 and considered for this FYR for continued groundwater treatment and monitoring are listed in Table D-3.

Table D-3. Summary of Groundwater ARAR Changes for OU2

Contaminant of Concern	1997 ROD Cleanup Standard (µg/L)	Basis	Current Regulations (µg/L)		ARARs Changed?
			State – MCL	Federal – MCL	
1,1-Dichloroethane	5	State [a]	--	--	No changes
1,1-Dichloroethylene	7	Federal	7	7	No changes
1,1,1-Trichloroethane	200	Federal	200	200	No changes
1,2-Dichloroethane	5	Federal	5	5	No changes
cis-1,2-Dichloroethylene	70	Federal	70	70	No changes
trans-1,2-Dichloroethylene	100	Federal	100	100	No changes
1,2-Dichloropropane	5	Federal	5	5	No changes
Acetone	700	State [a]	--	--	No MCL
Arsenic	50	Federal	**10**	**10**	More stringent MCL
Benzene	5	Federal	5	5	No changes
Bis(2-ethylhexyl)phthalate[b]	6	Federal	6	6	No changes
Carbon tetrachloride	5	Federal	5	5	No changes
Chlorobenzene	100	Federal	100	100	No changes
Chloroform	100	Federal	**80**[c]	**80**[c]	More stringent MCL
Chloromethane	2.7	State [a]	--	--	No MCL
Chromium	100	Federal	100	100	No changes
Dichlorodifluoromethane (Freon 12)	1400	State [a]	--	--	No MCL
Ethylbenzene	700	Federal	700	700	No changes
Lead[d]	15	Federal	15 50b	15	No changes
Methyl ethyl ketone	350	State	?	--	No MCL
Methylene chloride[e]	5	Federal	5	5	No changes
Nitrate (as Nitrogen)	10,000	Federal	10,000	10,000	No changes
Tetrachloroethylene	5	Federal	5	5	No changes
Toluene	1000	Federal	1000	1000	No changes
Trichloroethylene	5	Federal	5	5	No changes
Trichlorotrifluoroethane (Freon 113)[f]	210,000	State [a]	--	--	No MCL
Trichlorofluoromethane (Freon 12)	2100	State [a]	--	--	No MCL
Trihalomethanes	100	Federal	**80**	**80**	More stringent MCL
Xylenes	10,000	Federal	10,000	10,000	No changes
Vinyl chloride	2	Federal	2	2	No changes

a – The clean-up level was based on the ADEQ Human Health-Based Guidance Levels for Contaminants in Drinking Water (HBGL). HBGLs are not promulgated, but were considered during development of remedial alternatives.

b – Also called di(2-ethylhexyl) phthalate.

c – MCL shown is for Total Trihalomethanes, a class of chemicals that includes chloroform.

d – Lead is federally regulated by a treatment technique that requires systems to control the corrosiveness of their water. If more than 10% of tap water samples exceed the action level, water systems must take additional steps. For lead, the action level is 15 µg/L.

e – Also called dichloromethane.

f- This COC was misspelled in the 1997 ROD as "trichlorofluoromethane (Freon 113).

Bolded entries indicate changes to state and/or federal MCLs since the 1996 ROD.

Federal and state laws and regulations, other than the chemical-specific ARARs that have been promulgated or changed over the past five years, are described in Table D-4. ARARs identified in the decision documents that are no longer pertinent to the current remedy phase are not included in the table. There have been no revisions to laws and regulations that affect the protectiveness of the remedy.

The following ARARs have not changed since the last Five Year Review and therefore do not affect protectiveness:

- Federal Aviation Administration Rules. AC 150/5210-24 (replaced AC 150/5380-5B effective November 2010). (2004 ROD Amendment for Areas A and B).
- Federal Aviation Administration Rules. AC 150/5300-13. (1997 ROD for OU2)
- National Historic Preservation Act, Section 106, 16 U.S.C. §§470 et seq.; 36 Code of Federal Regulations (CFR) Parts 65 and 800. (1997 ROD for OU2, 2012 ROD Amendment for OU1 Area B)
- Arizona Administrative Code §R18-5-501 (section recodified from §R18-4-501, effective January 2004). (2004 ROD Amendment for OU1 Area A and B)
- Archeological Discoveries, Historic Preservation. 41 Arizona Revised Statutes (ARS) §§841-847, 865. (1997 ROD for OU2, 2012 ROD Amendment for OU1)
- Arizona Aquifer Water Quality Standards. R18-11-405, R18-11-406. (1997 ROD for OU2)
- Arizona Water Quality Standards, ARS 49-224. (2004 ROD Amendment for OU1)
- Arizona Remedial Action Requirements. ARS 49-282.06(A)(2). (1997 ROD for OU2)
- Arizona Groundwater Management Act, ARS 45-454.01 (Also includes 45-494, 45-495, 45-496, 45-600, 45-605). (1997 ROD for OU2)
- Safe Drinking Water Act, 42 U.S.C. §300f et seq.; 40 CFR 144.12-144.16. (2004 ROD Amendment for OU1, 2012 ROD Amendment for OU1)
- Safe Drinking Water Act, 42 U.S.C. §300f et seq.; 40 CFR 144.24, 146. (1997 ROD for OU2, 2012 ROD Amendment for OU1)
- Office of Solid Waste and Emergency Response (OSWER) Directive 9355.0-28, Emissions from Air Strippers. (1997 ROD for OU2)
- EPA Office of Solid Waste, RCA Groundwater Monitoring; Draft Technical Guidance, Nov., 1992 (EPA/530-R93-001)

Table D-4. Summary of ARAR Changes

Requirement and Citation	Document	Description	Effect on Protectiveness	Comments	Amendment Date
Federal Aviation Administration Rules AC 150/5370-2G.	1997 ROD for OU2	Restricts emissions that may cause a navigational hazard near airports	The change to this advisory do not affect protectiveness.	Applicable to emission from operation of air strippers, thermal desorption, excavation, construction or any other types of emissions.	December 2017 (Advisory circular updated)
Federal Aviation Administration Rules AC/70/7460-1L.	1997 ROD for OU2	Establishes marking and lighting requirements for construction equipment or permanent structures near airports.	The change to this advisory do not affect protectiveness.	Applicable to construction equipment and equipment or permanent structures near airports.	December 2015 (Advisory circular updated)
Endangered Species Act 16 United States Code (U.S.C.) §1531 50 CFR Parts 200 and 402.	1997 ROD for OU2	Establishes procedures for determining presence of endangered species and protecting their habitats.	The change to this regulation does not affect protectiveness.	No endangered species have been identified at the SVE sites and plug-in sites. If any native plants or species are identified as endangered or threatened, construction or other remedial activities will be mitigated to avoid affecting such species or its habitat.	February 2016 (Part 402), December 2015 (Part 200)
Federal RCRA Subtitle C; 42 USC §6921 et seq, (RCRA Subtitle C); ARS §49-921 et seq. 40 CFR Part 261 and R18-8-261	1997 ROD for OU2	Establishes criteria for identifying hazardous waste subject to Subtitle C treatment, storage, and disposal requirements.	The change to this regulation does not affect protectiveness.	Requires determination as to whether treatment residuals (e.g. spent carbon from the SVE system) or drilling wastes are classified as hazardous waste.	November 2016 (40 CFR Part 261), September 2015 (R18-8-261)

Requirement and Citation	Document	Description	Effect on Protectiveness	Comments	Amendment Date
RCRA Subtitle C; ARS §49-921 et seq. 49 CFR Section 262.11 and R18-8-262.	1st Five Year Review, 2012 ROD Amendment for OU1 Area B	Regulation of waste from construction and operation of remedial action requires waste generators to determine whether wastes are hazardous wastes and establishes procedures for such determinations.	This law affects the regulation of waste from remedial activities and does not affect protectiveness.	These requirements are applicable to management of waste materials generated as a result of construction of the selected remedial action or operation of any groundwater treatment units.	November 2016 (40 CFR Part 262.11), September 2015 (R18-8-262)
RCRA Subtitle C; ARS §49-921 et seq. 40 CFR Part 264 Subpart X, and R18-8-264.	1997 ROD for OU2	Establishes narrative criteria for regulating miscellaneous treatment units.	The change to this regulation does not affect protectiveness.	Location, design, construction, operation, maintenance, and closure of the SVE system, including any on-site disposal, must comply with the substantive portions of the narrative criteria.	November 2016 (40 CFR Part 264), September 2015 (R18-8-264)
RCRA Subtitle C; ARS §49-921 et seq. 40 CFR Part 264 Subpart AA and BB, and R18-8-264	1997 ROD for OU2	Regulates emissions from process vents associated with solvent extraction.	The change to this regulation does not affect protectiveness.	Emissions from the SVE treatment system must comply with these subparts.	November 2016 (40 CFR Part 264), September 2015 (R18-8-264)
Clean Air Act 42 U.S.C. §§ 7401- 7671q 40 CFR Part 61.	1997 ROD for OU2	Controls air emissions of VOCs and gaseous contaminants. (Note: Only applies if the equipment is in service of a liquid that contains at least 10% volatile hazardous air pollutant, such as TCE.)	The change to this regulation does not affect protectiveness.	Requires reduction of VOC emissions from product accumulator vessels. Also requires leak detection and repair programs.	January 2017

Requirement and Citation	Document	Description	Effect on Protectiveness	Comments	Amendment Date
RCRA Subtitle C; ARS §49-921 et seq. 40 CFR Part 264.1(j)(2-6)(10-12), and R18-8-264.1(j)(2-6)(10-12). Note: 40 CFR Part 264 incorporated by reference into R18-8-264; there is no longer a standalone R18-8-264.1(j)(2-6)(10-12).	2004 ROD Amendment for Area A and B	Requirements for remediation waste management sites.	The change to this regulation does not affect protectiveness.	Requires waste analysis, inspection requirements, personnel training requirements, and contingency and emergency plans.	November 2016 (40 CFR Part 264), September 2015 (R18-8-264)
RCRA Subtitle C; ARS §49-921 et seq. 40 CFR Part 264.18(a & b), and R18-8-264.18(a & b). Note: 40 CFR Part 264 incorporated by reference into R18-8-264; there is no longer a standalone R18-8-264.18(a & b).	2004 ROD Amendment for Area A and B	Location standards.	The change to this regulation does not affect protectiveness.	Requirements for and/or prohibition of treatment, storage, or disposal facilities in a floodplain or fault.	November 2016 (40 CFR Part 264), September 2015 (R18-8-264)

Requirement and Citation	Document	Description	Effect on Protectiveness	Comments	Amendment Date
RCRA Subtitle C; ARS §49-921 et seq. 40 CFR Part 264, Subpart G, Sections 264.111(a & b) and 264.114, and R18-8-264.111(a & b) and 264.114. Note: 40 CFR Part 264 incorporated by reference into R18-8-264; there is no longer a standalone R18-8-264.111(a & b) and 264.114	2004 ROD Amendment for Area A and B	Closure performance standards and requirements.	The change to this regulation does not affect protectiveness.	Closure performance standards and requirements.	November 2016 (40 CFR Part 264), September 2015 (R18-8-264)
RCRA Subtitle C; ARS §49-921 et seq. 40 CFR Part 264 Subpart I, and R18-8-264.170 et seq. Note: 40 CFR Part 264 incorporated by reference into R18-8-264; there is no longer a standalone R18-8-264.170.	1997 ROD for OU2, 2004 ROD Amendment for Area A and B	Establishes requirements for containers holding RCRA hazardous waste for treatment, storage or disposal including condition, management, and inspection of containers, container compatibility with wastes and design and operation of container storage areas.	The change to this regulation does not affect protectiveness.	Containers storing treatment system waste (including RCRA wastewater from the SVE air/water separator and GAC carbon), sludges or soil must comply with substantive provisions.	November 2016 (40 CFR Part 264), September 2015 (R18-8-264)

Requirement and Citation	Document	Description	Effect on Protectiveness	Comments	Amendment Date
RCRA Subtitle C; ARS §49-921 et seq. 40 CFR Part 264 Subpart J, and R18-8-264.190 et seq. Note: 40 CFR Part 264 incorporated by reference into R18-8-264; there is no longer a standalone R18-8-264.190.	1997 ROD for OU2, 2004 ROD Amendment for Area A and B	Establishes requirements for tank systems used to store or treat hazardous waste, including design and installation, containment and detection of releases, operating requirements, inspections, responses to leaks or spills and closure and post-closure.	The change to this regulation does not affect protectiveness.	Tanks used for treatment or storage must comply with substantive provisions.	November 2016 (40 CFR Part 264), September 2015 (R18-8-264)
RCRA Subtitle C; ARS §49-921 et seq. 40 CFR Part 264.601, and R18-8-264.601 et seq. Note: 40 CFR Part 264 incorporated by reference into R18-8-264; there is no longer a standalone R18-8-264.601.	2004 ROD Amendment for Area A and B	Miscellaneous treatment unit requirements.	The change to this regulation does not affect protectiveness.	Requirements for owners and operators of miscellaneous treatment units.	November 2016 (40 CFR Part 264), September 2015 (R18-8-264)
RCRA Subtitle C; ARS §49-921 et seq. 40 CFR 262.34	1st Five Year Review	Regulates temporary accumulation of hazardous waste on-site. Specifies procedure for accumulation of hazardous waste on-site for certain amounts of hazardous waste and for certain time periods under generator status.	The change to this regulation does not affect protectiveness.	These requirements are applicable to management of waste materials generated as a result of construction of the remedial action and operation of any of the groundwater treatment plants if the waste materials generated are hazardous wastes.	November 2016 (40 CFR Part 262.34)

Requirement and Citation	Document	Description	Effect on Protectiveness	Comments	Amendment Date
Federal Clean Air Act, 42 U.S.C. §§7401 et seq. Pima County Bureau of Air Pollution Control Rules and Regulations, Title 17 Pima County Air Quality Code, 17.16.430, Subparagraph F	1st Five Year Review, 2004 ROD Amendment for OU1 Area A and B	Requires reasonably available control equipment from a stationary source that emits VOCs.	The change to the U.S.C. does not affect protectiveness.	The change was not related to the remedy; the change was related to motor vehicle and motor vehicle engine compliance testing and certification.	2015 Amendment to 42 U.S.C. §7525. No changes to Title 17 Pima County Air Quality Code, 17.16.430, Subparagraph F.
Resource Conservation and Recovery Act (RCRA) Subtitle C; ARS §49-921 et seq. 40 CFR part 264 Subpart CC, and R18-8-164 et seq.	1997 ROD for OU2	Establishes air emission standards for tanks and containers.	The change to this regulation does not affect protectiveness.	Relevant and appropriate if remedy employs on-site treatment.	November 2016 (40 CFR Part 264), September 2015 (R18-8-264)
RCRA Subtitle D 40 CFR Part 257	1997 ROD for OU2	Establishes criteria for determining whether a solid waste disposal facility poses a threat to human health and the environment.	The change to this regulation does not affect protectiveness.	Includes groundwater monitoring and post-closure care requirements.	November 2016 (40 CFR Part 257)

Requirement and Citation	Document	Description	Effect on Protectiveness	Comments	Amendment Date
Federal Safe Drinking Water Act, 42 U.S.C. Sec. 300g-1, 40 CFR 141.161 40 CFR Part 141 (Subparts B, C, G), Federal Primary Drinking Water Standards-MCLs	1997 ROD for OU2, 2004 ROD Amendment for OU1 Area A and B	MCLs were established as health-based drinking water standards to protect public health from contamination that may be found in drinking water from public water systems. The NCP, 40 CFR §300.430(e)(2), provides that remedial actions generally must attain MCLs and non-zero MCLGs where groundwater is a source or potential source of drinking water.	The change to this regulation does not affect protectiveness.	Updates to analytical procedures and minor corrections have been made, but MCLs have not changed.	February 2014
Arizona Surface Water Quality Standards ARS 49-222 R18-11-101 et seq	1st Five Year Review	Regulates discharges to surface water through narrative and numerical standards.	Numerical standards are not more protective than MCLs, except for di-(2-ethylhexyl)phthalate, for which MCL = 6 µg/L, and Surface Water Quality Standard of 6 µg/L for water serving as a domestic water source (DWS), but 3 µg/L for water serving as a source of fish consumption (FC). However, the water does not serve as a source of FC, so protectiveness is not affected.	Discharges from treatment must comply with narrative and numeric Arizona State Water Quality Standards for Surface Waters if treated water is discharged to surface water.	August 2016 (Supp. 16-4)

Requirement and Citation	Document	Description	Effect on Protectiveness	Comments	Amendment Date
RCRA Subtitle C; ARS §49-921 et seq. 40 CFR 262.34	1st Five Year Review	Regulates temporary accumulation of hazardous waste onsite. Specifies procedure for accumulation of hazardous waste on-site for certain amounts of hazardous waste and for certain time periods under generator status.	The change to this regulation does not affect protectiveness.	These requirements are applicable to management of waste materials generated as a result of construction of the remedial action and operation of any of the groundwater treatment plants if the waste materials generated are hazardous wastes.	November 2016 (40 CFR Part 262)

Appendix E. Toxicity Assessment Memo

Amec Foster Wheeler Programs, Inc. prepared the final Five-Year review on Air Force Plant 44 for the Air Force. Toxicity Assessment for OU3 can be found in the *Five-Year review of Five Sites at Air Force Plant 44, Tucson, Arizona, August 10, 2018.*

EPA completed the Toxicity Assessment for OU1 and OU2.

MEMORANDUM August 2018

Subject: Tucson International Airport Area Superfund Site, Second Five Year Review, Protectiveness with Respect to changes in Toxicity Values.

From: Daniel Stralka, Ph.D.

Regional Toxicologist

For: Five Year Review report.

Revisions to toxicity assessments for site-related contaminants may call into question the protectiveness of cleanup levels established in the Record of Decision (ROD) for a Superfund site. Thus, it is appropriate during a site's Five-Year Review (FYR) to re-evaluate protectiveness for contaminants where risk-based cleanup levels were chosen in the ROD.

Cleanup levels at Superfund sites are typically set to either Applicable or Relevant and Appropriate Requirements (ARARs), such as drinking water Maximum Contaminant Goals (MCLs). When an ARAR is not available for a contaminant, the NCP directs EPA to set a cleanup level that is "protective of human health and the environment", usually based on the risk assessment for the site.

While ARARs are "frozen" at the time of the ROD, risk-based cleanup levels should be re-evaluated considering any revisions to underlying toxicity assessments, to ensure continued protectiveness. If a Superfund site remedy is intended to meet a site-specific, risk-based cleanup level, the FYR guidance requires EPA to assess whether toxicity or other contaminant characteristics used to determine the original cleanup level have changed and whether it remains protective considering the change(s).

This review addresses three of the five operable units, OUs 1, 2 and 3. OU1 is divided into Area A (western half) and Area B (eastern half). OU1 Area A includes the Tucson Airport Remediation Project (TARP) area. OU1 Area B includes the following locations: Texas Instruments property, the 162nd Arizona Air National Guard (AANG) Base, the West Cap area, and the West Plume B area. OU2 includes the Airport property (including the Three Hangars Building). OU3 is the Air Force Plant #44/Raytheon (APF44). The Air Force has the lead for remediation on AFP44. Details for OU3 ARAR assessment can be found in the *Five-Year review of Five Sites at Air Force Plant 44, Tucson, Arizona, August 10, 2018.*

Appendix D address changes to ARARs and MCLs that pertain to the COCs for each OU. There have been several changes to MCLs over the last five years that will not substantially affect the protectiveness of the remedies. However, there are several chemicals that did not have promulgated levels that were chosen based on risk evaluation.

Table 1. OU1 Area B Groundwater Cleanup Levels, and Basis

COC	Clean Up Level (µg/L)	Basis for Cleanup Level
1,1-Dichloroethylene	7	MCL (2012 ROD Amendment)
cis-1,2-Dichloroethylene	70	MCL (2012 ROD Amendment)
Tetrachloroethylene (PCE)	5	MCL (2012 ROD Amendment)
Trichloroethylene (TCE)	5	MCL (2012 ROD Amendment)
Vinyl Chloride	2	MCL (2012 ROD Amendment)

Table 2. OU2 Groundwater Cleanup Levels, and Basis

COC	Groundwater Cleanup Level (µg/L)	Basis for Cleanup Level
1,1-Dichloroethane	5	MCL (1997 ROD)
1,1-Dichloroethylene	7	MCL (1997 ROD)
1,1,1-Trichloroethane	200	MCL(1997 ROD)
1,2-Dichloroethane	5	MCL (1997 ROD)
cis-1,2-Dichloroethylene	70	MCL (1997 ROD)
trans-1,2-Dichloroethylene	100	MCL (1997 ROD)
1,2-Dichloropropane	5	MCL (1997 ROD)
Acetone	700	ADEQ HBGL (1997 ROD)
Arsenic	50	MCL (1997 ROD)
Benzene	5	MCL (1997 ROD)
Bis(2-ethylhexyl)phthalate	6	MCL (1997 ROD)
Carbon tetrachloride	5	MCL (1997 ROD)

COC	Groundwater Cleanup Level (µg/L)	Basis for Cleanup Level
Chlorobenzene	100	MCL (1997 ROD)
Chloroform	100	MCL (1997 ROD)
Chloromethane	2.7	ADEQ HBGL (1997 ROD)
Chromium	100	MCL (1997 ROD)
Dichlorodifluoromethane (Freon 12)	1400	ADEQ HBGL (1997 ROD)
Ethylbenzene	700	MCL (1997 ROD)
Lead	15	MCL (1997 ROD)
Methyl ethyl ketone	350	ADEQ HBGL (1997 ROD)
Methylene chloride	5	MCL (1997 ROD)
Nitrate (as Nitrogen)	10,000	MCL (1997 ROD)
Tetrachloroethylene	5	MCL (1997 ROD)
Toluene	1000	MCL (1997 ROD)
Trichloroethylene	5	MCL (1996 ROD, 1997 ROD)
Trichlorotrifluoroethane (Freon 13)	210,000	ADEQ HBGL (1997 ROD)
Trichlorofluoromethane (Freon 11)	2100	ADEQ HBGL (1997 ROD)
Trihalomethanes[(a)]	100	MCL (1997 ROD)
Xylenes	10,000	MCL (1997 ROD)
Vinyl chloride	2	MCL (1997 ROD)

(a) Trihalomethanes includes chloroform, bromodichloromethane, dibromochloromethane and tribromomethane.
ADEQ HGBL – Arizona Department of Environmental Quality Health-Based Guidance Level

(b) The ROD misspelled some Freon compound names. The table has been revised to reflect the proper name.

The majority of the cleanup levels were selected based on their respective MCL, and are addressed in the ARAR Review Appendix D. For those few chemicals that were not MCL driven, the following has the comparison to the 2018 Regional Screening Levels for drinking water. ADEQ has not updated the HBGL since 1997.

Table 3. Cleanup Levels Comparison the Current Regional Screening Levels.

Chemical	Groundwater Cleanup Level (µg/L)	Drinking Water RSL 2018	Within EPA's acceptable risk range?
Acetone	700	14,000	yes
Chloromethane	2.7	190	yes
Dichlorodifluoromethane	1400	200 (non-cancer)	no
Methyl ethyl ketone	350	5600	yes
Trichlorofluoromethane (Freon 11)	2100	5,200	yes
Trichlorotrifluoroethane	210,000	10,000 (non-cancer)	no

The Groundwater Cleanup Levels for dichlorodifluoromethane and trichlorotrifluoroethane are above EPA's non-cancer acceptable risk level. However, a review of groundwater data between March 2016 and August 2017 demonstrated that their current concentrations are below their respective Drinking Water RSL. All results were non-detect. Therefore, the remedy remains protective with respect to the toxicity of the cleanup levels.

Appendix F: Fact Sheet

Appendix G: Interview Forms

Amec Foster Wheeler Programs, Inc. prepared the final Five-Year review on Air Force Plant 44 for the Air Force. Details for OU3. Interviews for OU3 can be found in the *Five-Year review of Five Sites at Air Force Plant 44, Tucson, Arizona, August 10, 2018.*

USACE completed the interviews for OU1 and OU2.

Five-Year Review Interview Record				
Site:	Tucson International Airport Area		**EPA ID No:**	AZD980737530
Interview Type: Teleconference Date: 27 March 2018 Time: 0900 PDT				
Interviewers				
Name			**Title**	**Organization**
Kristen Addis			Hydrogeologist	USACE
Marlowe Laubach			Chemical Engineer	USACE
Interviewees				
Name	**Organization**	**Title**	**Telephone**	**Email**
Bill Ellett	ADEQ			
Summary of Conversation				

ATTENDEES:
USACE: Kris Addis and Marlowe Laubach
EPA: Mary Aycock
State: Bill Ellet
APTIM: Mark Gardiner

1) What is your overall impression of the project?
There's been a lot of progress made over the 20 years I've been on the project. I feel that the project is on the right path to cleanup, but it will still take a long time.

2) Is the remedy functioning as expected? How well is the remedy performing at OU1, OU2, and OU3? For OU1, do you believe that the ISCO injections are effective and MNA is remaining protective at West Plume B? For OU2, do you believe that the SVE and SGZ treatment is effective? For OU3, is the containment remedy effective?

OU1 A– The City's long-term plan is to replace all the extraction wells, which is the weak link in the TARP system. It works well when the [extraction] wells are working. The city of Tuscon planning on putting in a 10th well.

OU1B – All this working well. The new remedy for ISCO. At the AANG property, the ISCO pilot test was successful and they are planning to do more. This [additional ISCO] will likely wrap up that site. At the West Cap site; this is a less straight forward. Still analyzing data for this [ISCO performance.] At Texas Instrument property, the jury is still out on how this will work.

OU2 – This OU is the biggest concern for the entire site; it is not considered protective at this point. They are not meeting performance objectives. Recently found a paleochannel that's not connected to the extraction system. Not enough 1,4-dioxane data collected over the years to see how it's [1.4.-dioxane plume] changing. Not a lot of site wide sampling to determine the source of the 1,4-dioxane. Regional water levels are rising. This is complicating matters. The assumptions made when that treatment system was first implemented may not be valid.

OU3 – I feel pretty good about this OU. The Air Force (AF) is proactive in modifying (optimizing) the treatment; trying to pull the plume back to their property line. I do not believe that the AF is not cutting off this plume, yet. They've made progress towards this but they're are not there yet. The AOP treatment plant has been down a lot in the last year and half. EPA and

ADEQ did an engineering review and provided suggestions for improvements. The AOP is now back up. The AF needs to establish complete capture and cut-off the AF44 plume from the rest of the plume and ensure reliability of the treatment plant.

3) Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office? If so, please provide the purpose and results.
Yes. I have monthly conference calls with EPA. For the AF44 treatment plant performed a joint inspection with EPA and provided an engineering review of the system. The state (ADEQ) contractor collects split samples (mostly on the AF site), making new maps (almost ready to publish), and sends comment letters to EPA. ADEQ go to all the meetings. ADEQ plays a pretty active role at this site, since I've been involved.

4) 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.
I get several calls a year from concerned citizens; general questions typically. Sometimes they ask for a document and I send it to them. I receive emails from concerned citizens; forwarded to legal. Not aware of any NOVs issued at the site.

5) Do you feel well informed about the site's activities and progress?
Yes. EPA and ADEQ works pretty well together. EPA values ADEQ our opinion.

6) Have there been unexpected O&M difficulties at the site in the last five years? If so, please give details.
The treatment system at AF44 has a lot of downtime over the last year and a half. They recently replaced the oxygen generator. The AF needs to perform a detailed capture analysis when the treatment system was down.

The AOP treatment at TARP has been down because of the gravel pack entering the extraction wells. City is planning to replace all the wells. ADEQ is in agreement with this approach.

The key is to have minimal downtime possible; these treatment systems are an important piece to the remediation of the site.

7) Have there been opportunities to optimize O&M or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.
Minimized the frequency of sampling. Most sites have biannual sampling (Feb and August). We've cut back the number of wells to streamline efforts and costs.

The plan by Tucson water to add another extraction well. This will potentially expand the well field in the long-run resulting in quicker remediation. No cost analysis yet performed on the addition of a new extraction well.

At AF44, extraction has focused on the most concentrated well and minimizing extracting clean water. The AF has been the testing ground for new technologies; they were the first ones to implement SVE, ISCO; hydraulic fracture.

8) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
No. I Would love to see an MCL for 1,4-dioxane.

9) Do you have any comments, suggestions, or recommendations regarding the project?
In this Five-Year Review, I would like to see a thorough review of new technologies. For example, the TI Zone on the Airport Property with thick clay. I would like to discussion to consider of other technologies for that TI zone (e.g. thermal; hydraulic fracturing.)

I'm pretty happy with how things are going. AF will establish full capture in the source zone and make their treatment system more reliable.

Only real concern at the site is the Airport Property.

Additional Site-Specific Questions
[If needed]

Five-Year Review Interview Record			
Site:	Tucson International Airport Area	**EPA ID No:**	AZD980737530

Interview Type: Interview

Date: 06 September 2018
Time: 1500 AZT

Interviewers

Name	Title	Organization
Mark Gardiner	Contractor Project Manager	APTIM Federal Services, LLC

Interviewees

Name	Organization	Title	Telephone	Email
Jeff Biggs	Tucson Water	Administrator, Strategic Initiatives Division		

Summary of Conversation

1) What is your overall impression of the project?

After being involved for 17 years, very satisfied. I look at the two plume maps we presented at the July 2018 UCAB meeting that show how the concentrations of contaminants are down and the size of the plume is considerably smaller. Positive progress continues, with Tucson Water, help from ADEQ and EPA, and the community. With the pending ROD Amendment that will incorporate 1,4-dioxane will see even more improvement and cost recovery.

2) What effects have site operations had on the surrounding community?

In general, the effects are positive, once the community members have the facts and understand how much work is being done. We try to give them factual information that is easy to digest.

3) Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.

Yes. I am aware of community members that have concerns regarding the cleanup and the exposure to water and vapor, but those few individuals in the community have been given the facts and accurate data. In some cases a few individuals do not accept the information as being factual.

With respect to communication w/ community, Tucson Water has conducted numerous and significant outreach in English and Spanish with the public, attended and presented at UCABs, and held open houses.

4) 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.

No.

5) Do you feel well informed about the site's activities and progress?

Yes.

6) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

No. Being involved with this site over the last 17 years, I feel that the core group that manages and operates the facilities have accomplished a lot in this time.

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

Nothing significant that couldn't be dealt with as they occurred.

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

Optimization occurred as needed over the years, both for O&M as well as sampling. In addition Tucson Water is designing an additional extraction well to supplement the North Well Field with the intent to speed up remediation.

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

There are health advisories for 1,4-dioxane that have been lowered over time, and that is also becoming the case for perfluorinated compounds. As health advisories get lowered it impacts the remedy until there are MCLs for emerging contaminants. Because the treated water from TARP is served, it is very different than if the water is disposed.

Additional Site-Specific Questions

[If needed]

Five-Year Review Interview Record			
Site:	Tucson International Airport Area	**EPA ID No:**	AZD980737530

Interview Type: Interview

Date: 06 September 2018
Time: 1500 AZT

Interviewers

Name	Title	Organization
Mark Gardiner	Contractor Project Manager	APTIM Federal Services, LLC

Interviewees

Name	Organization	Title	Telephone	Email
Chad Lapora	Tucson Water	Environmental & Regulatory Compliance Supervisor		

Summary of Conversation

1) What is your overall impression of the project?

Good. The site didn't get contaminated overnight, and it's not going to get cleaned up overnight. There has been substantial progress in 25 years, and it will continue. Tucson Water has been receptive to dealing with new threats as they arise, whether dioxane and moving ahead to construct the AOP, or moving ahead to look at perfluorinated compounds. This site is a work in progress. The remedy is working. The original remedy was to treat for TCE, so there was nothing in the guidance dealing with dioxane or PFC. We are dealing with that now working with the agencies and the community and consultants. The plume is contained, concentrations are down, and we are addressing emerging contaminants as they occur.

2) What effects have site operations had on the surrounding community?

Positive, from a health perspective. From the very beginning, in the 80s, when TCE was discovered the production wells were shut down and clean water brought in, the exposure to TCE was removed. By doing the cleanup, concentrations of contaminants have been lowered and exposures removed.

3) Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.

Yes.

4) 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.

No.

5) Do you feel well informed about the site's activities and progress?

Yes

6) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

No. We just need to keep doing what we are doing and responding to new threats if they occur; Tucson Water is planning to install a tenth remediation well to add to the North Well Field which should work to clean up the plume quicker.

Additional Site-Specific Questions

[If needed]

Five-Year Review Interview Record			
Site:	Tucson International Airport Area	**EPA ID No:**	AZD980737530

Interview Type: Written Questionnaire

Date: 6 September 2018
Time: N/A

Interviewers

Name	Title	Organization
Mark Gardiner	Contractor Project Manager	APTIM Federal Services, LLC

Interviewees

Name	Organization	Title	Telephone	Email
Fred Tillman	USGS	Research Hydrologist		

Summary of Conversation

1) What is your overall impression of the project?

The TIAA groundwater and source zone treatment activities, as well as management actions such as eliminating the use of certain chemicals, have had tremendous success in bringing down concentrations of contaminants of concern in the area, particularly TCE. Unfortunately, the time to achieve full cleanup of organics in groundwater can be painfully slow. This is not unique to TIAA and is seen at similar sites throughout the world.

2) What effects have site operations had on the surrounding community?

I cannot speak to effects from the TARP treatment facility on nearby neighborhoods. I can say that the numerous monitoring wells in the area and the nine TARP treatment wells have a very small footprint in the community, often being unrecognizable if you didn't know they were there.

3) Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.

At the UCAB meetings, community members and the board have expressed concern about people exposed to groundwater contamination by drinking water from private wells. Recently, some community members have taken issue with the sale of property by the City of Tucson near the TARP treatment facility, thinking (I believe) that the property surrounding the plant was necessary as some sort of protection buffer for the nearby residences.

4) 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.

I have seen graffiti painted on some monitoring well vault covers of in the area. Similarly, on fenced property owned by Tucson Water for three monitoring wells, there is evidence of trespassing (e.g., liquor bottles, "Whippits" CO_2 cartridges).

5) Do you feel well informed about the site's activities and progress?

I do, but I'm a scientist that has worked at the site for 12 years. I find the UCAB meetings a great place to hear about what's happening at all the different parts of the site.

6) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

It's a difficult task to keep the affected community informed of activities and progress, while not stirring up unfounded fears. Pump-and-treat is just a very slow process that will take many decades to reach the desired cleanup goals. While some source areas may see benefit from new-ish technologies (e.g., ISCO, fracking), for the most part, it just takes a tremendous amount of time and sustained effort.

Additional Site-Specific Questions

[f needed]

Five-Year Review Interview Record

Site:	Tucson International Airport Area	EPA ID No:	AZD980737530

Interview Type: Written Questionnaire

Date: 28 August 2018
Time: N/A

Interviewers

Name	Title	Organization
Viola Cooper	Community Involvement Coordinator	USEPA

Interviewees

Name	Organization	Title	Telephone	Email
Yolanda Herrera	UCAB	Community Co-Chair		

Summary of Conversation

1) What is your overall impression of the project?
I think for those that are familiar with the clean up and have been involved or following the progress are somewhat satisfied. Sadly, all the misinformation getting out into the public is creating mistrust and fear. Two steps forward ten backward. What we tend to hear is the question, "when will this clean up be complete?"

2) What effects have site operations had on the surrounding community?
I think new activity tends to have more community awareness and in turn more questions and possibly more participation and interaction and interest in UCAB meetings.

3) Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.
Yes of late I am aware of an increase in community concerns due to misinformation, signs and fliers informing people they are living above a toxic area. I think many of us are working on accurate information to quell the increasing distrust, something the City of Tucson, EPA and other government agencies have tried to rebuild over the last two decades. I think Tucson Water is trying to be more proactive in community outreach and tours of all their facilities.

4) 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.
No, I am not aware of any negative incidents outside of the posted signs and fliers being distributed in the community. However CE Rose was recently vandalized and I questioned if maybe the negative signs may have angered some members of the public and so this was "their" effort to bring more attention to their misguided efforts of attention.

5) Do you feel well informed about the site's activities and progress?
Personally I do as the Community Co-chair for the Unified Community Advisory Board - UCAB. I do always ask to be kept informed in any activities/visited/communications with the EPA and Tucson Water including our elected officials. This does not always happen.

6) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?
I think more community outreach w/correct information needs to be kept on the forefront in English and Spanish. I think we need to keep both the Tucson and Sunnyside Districts informed, at the table and involved as well as all surrounding neighborhoods. Maybe increase our presence at tabling events and creating our own such as poster sessions. Share more of the successes.

Additional Site-Specific Questions

[If needed]

Five-Year Review Interview Record			
Site:	Tucson International Airport Area	**EPA ID No:**	AZD980737530

Interview Type: Written Questionnaire

Date: 09/06/18
Time: N/A

Interviewers

Name	Title	Organization
Mary Aycock	Remedial Project Manager	USEPA

Interviewees

Name	Organization	Title	Telephone	Email
Carole Maluf	UCAB	Member, and Past President of Barrio Nopal Neighborhood		

Summary of Conversation

1) What is your overall impression of the project?

So far so good.

2) What effects have site operations had on the surrounding community?

None that I know of.

3) Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.

No.

4) 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.

No.

5) Do you feel well informed about the site's activities and progress?

Yes.

6) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

No.

Additional Site-Specific Questions

[If needed]

Five-Year Review Interview Record			
Site:	Tucson International Airport Area	**EPA ID No:**	AZD980737530

Interview Type: Written Questionnaire

Date: 21 August 2018
Time: N/A

Interviewers

Name	Title	Organization
Viola Cooper	Community Involvement Coordinator	USEPA

Interviewees

Name	Organization	Title	Telephone	Email
Joseph Cordero	Community Member			

Summary of Conversation

1) What is your overall impression of the project?
Very poor and not properly communicating with the entire Southside of Tucson.

2) What effects have site operations had on the surrounding community?
Noisy, more POLLUTION, more DISEASE/AILMENTS, and CONTAMINATION.

3) Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.
Yes, that the new well is behind the old Fry's Shopping Center (I-19/Irvington).

4) 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.
Water discharges into the community, including TCE, PFOs, and Dioxane.

5) Do you feel well informed about the site's activities and progress?
No.

6) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?
The EPA is acting inhumane and that's unacceptable for what they are doing to the children, pregnant moms, elderly, and the southside community of Tucson. It was brought to our attention at the weekly meetings, and Tucson newspaper report, that houses north of Irvington were being sold. Proposals for a new well to replace connections to the TCE Super-Fund Site and one of several major project areas on location that are hazards to small businesses, and the community were being built at the TCE Super-Fund Site. If this is the case, we would like to express proposals of the development. We are expressing our options to this proposal of sale and it is immoral and unacceptable to us, family, neighbors, children and community, to be put in this position. Where we play, shop, and in the area with potential and unhealthy hazards. And Further, it is very disturbing that the City of Tucson can be so irresponsible and to be a party to this ongoing transaction, on which our party will arise. Environmental Justice Task Force (EJTF) will be holding a community meeting on September 15, 2018, with our fellow residents to advise them on what the EPA and City of Tucson plan on doing for the community. In respect to the community's proposals, we hope the discussed transactions between us, EPA, and the City will become a reality. Thank you for your concern in this matter.

Additional Site-Specific Questions

[If needed]

Five-Year Review Interview Record			
Site:	Tucson International Airport Area	**EPA ID No:**	AZD980737530

Interview Type: Written Questionnaire

Date: 21 August 2018
Time: N/A

Interviewers

Name	Title	Organization
Viola Cooper	Community Involvement Coordinator	USEPA

Interviewees

Name	Organization	Title	Telephone	Email
Anthony DeSoto	Community Member			

Summary of Conversation

1) What is your overall impression of the project?
Very poor.

2) What effects have site operations had on the surrounding community?
Noisy, more POLLUTION, more ILLNESSES, and CONTAMINATION

3) Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.
Yes, going into a new well at the old Fry's Shopping Center (I-19/Irvington).

4) 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.

Water discharges into the community, including TCE, PFOs, and Dioxane.

5) Do you feel well informed about the site's activities and progress?
No.

6) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?
The EPA is acting inhumane and that's unacceptable for what they are doing to the children, pregnant moms, elderly, and the southside community of Tucson. It was brought to our attention at the weekly meetings, and Tucson newspaper report, that houses north of Irvington were being sold. Proposals for a new well to replace connections to the TCE Super-Fund Site and one of several major project areas on location that are hazards to small businesses, and the community were being built at the TCE Super-Fund Site. If this is the case, we would like to express proposals of the development. We are expressing our options to this proposal of sale and it is immoral and unacceptable to us, family, neighbors, children and community, to be put in this position. Where we play, shop, and in the area with potential and unhealthy hazards. And Further, it is very disturbing that the City of Tucson can be so irresponsible and to be a party to this ongoing transaction, on which our party will arise. Environmental Justice Task Force (EJTF) will be holding a community meeting on September 15, 2018, with our fellow residents to advise them on what the EPA and City of Tucson plan on doing for the community. In respect to the community's proposals, we hope the discussed transactions between us, EPA, and the City will become a reality. Thank you for your concern in this matter.

Additional Site-Specific Questions

[If needed]

Five-Year Review Interview Record			
Site:	Tucson International Airport Area	**EPA ID No:**	AZD980737530

Interview Type: Written Questionnaire

Date: 23 August 2018
Time: N/A

Interviewers

Name	Title	Organization
Viola Cooper	Community Involvement Coordinator	USEPA

Interviewees

Name	Organization	Title	Telephone	Email
Mary Granillo	Community Member			

Summary of Conversation

1) What is your overall impression of the project?
It is very unselfish and in moral of the poor job are they doing in our area.

2) What effects have site operations had on the surrounding community?
The noise was so disturbing to the community and businesses with more polluting in the air.

3) Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.
Yes it is very unjustable the way they discharge the water in our streets and into our yards and releasing more chemicals that make human get more illnesses.

4) 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.
We want them to test the soil, water, blood testing and also test all the hotspots in the community due to T.C.E., 1.4 Dioxin, and now P.F.O.

5) Do you feel well informed about the site's activities and progress?
We do not know about the wells until 2 days prior when the city started working on the new wells. I did not even understand what they were doing.

6) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?
This I unacceptable to all the community and what they did to us where our children, live,play,learn and grow up and worst of all they call our community the gutter who gave them the right to do this to our community.

Additional Site-Specific Questions

[If needed]

Five-Year Review Interview Record			
Site:	Tucson International Airport Area	**EPA ID No:**	AZD980737530

Interview Type: Written Questionnaire

Date: 22 September 2018
Time: N/A

Interviewers

Name	Title	Organization
Viola Cooper	Community Involvement Coordinator	USEPA

Interviewees

Name	Organization	Title	Telephone	Email
Ludyvina Martinez	Community Member			

Summary of Conversation

1) What is your overall impression of the project?
Extremely very poor.

2) What effects have site operations had on the surrounding community?
Health Care & Treatment Inequality, Astounding Amounts of Diseases including cancers, autoimmune, skin rashes, etc. More Toxic Pollution in our neighborhoods, homes, schools, and small businesses, property value and sales have been dramatically affected.

3) Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.
Yes, the agency has not sent out postal service mass mail to affected community and nearby homes, schools, and businesses, about the site discharges, new construction, new management, health risks, and has not provided the community victims, with technical advice, updates, including past and current emergency response, contingency plans, accidental and//or incidental releases, of untreated water, documents, data, sampling, has not been consistent with community victims, project coordination and make available to public an accelerated schedules and work plan with specific, dates for conducting remedial action in accordance with all scope of work at the AFP # 44. TARP WTF.

4) 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.
Yes, the last year the agency failed to explain about TARP,WTF, rapidly discharged of untreated water have been discharged into our neighborhoods, and why a new construction was being done in conjunction to TARP Superfund wells, around our C.E. Rose, and Mission Manor, Challenger community, the agency also failed to provide community with these incidences that can put our children healthy at risk.

5) Do you feel well informed about the site's activities and progress?
No

6) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?
Yes,
Comment: The EPA should put safety first before Industry, we demand government transparency, and safe clean, water, air, land.
Comment: EPA, this is inhumane, unacceptable, and immoral to us that EPA has allowed this new construction or development in the area that presents a potential health hazard, to our families, friends, neighbors, and particularly our children who are put in this position where they play, pray, learn, live, shop.
Comment: It is disturbing to us, the EPA Administration, would be so irresponsible as to be a party to the transaction out of which these several projects would arise.
Recommendation: Please keep us informed about the site and all its activities, especially about new discovery of evidence, including the discovery of all accidental, and accidental releases of untreated water impacting, or affecting public water services, rivers, frogs, people, washes, arroyos, all emergency responses, main water breaks, from the site seven major project management areas.
Recommendations: Be consist with community and begin implementation on scope of work, about pfaos. Including implement a plan of relocation, and compensation to all affected residents or home and business owners who choose to be relocated and compensated.

Additional Site-Specific Questions

Five-Year Review Interview Record			
Site:	Tucson International Airport Area	**EPA ID No:**	AZD980737530

Interview Type: Written Questionnaire

Date: September 10, 2018
Time: N/A

Interviewers

Name	Title	Organization
Mark Gardiner	Contractor Project Manager	APTIM Federal Services

Interviewees

Name	Organization	Title	Telephone	Email
Denise Moreno Ramirez	UA	Ph.D. Candidate		

Summary of Conversation

1) What is your overall impression of the project?

It seems that the project has progressed when it comes to the remedial component. Obviously, the sensitivity of technology will determine future contaminants that will be discovered (e.g., 1,4-dioxane) or maximum contaminant levels decrease. The consulting companies should consider hiring science communicators to transfer science information. It is its own discipline and if these win contracts, they need to make a concerted effort to do a good job in this area as they do in the science/remediation component. One of the responsible parties should also make sure to provide food and beverages and community members should not have to pay for this expense (especially since community members don't get paid to attend).

2) What effects have site operations had on the surrounding community?

Site operations have caused stress and trauma to community members that grew up with the contamination. They are symbols of tainted environments and the associated health concerns. Current populations that are not aware of the issues may not have this same adverse reaction.

3) Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.

Please refer to current newspaper articles that document community concerns (if they are founded or unfounded they are still concerns that should be documented). I believe the majority of the community is not aware of the Superfund site and therefore have no concerns. Currently population of southern metropolitan Tucson is primarily Mexican and not the Mexican-American families that populated the area in the 1960s.

4) 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.

No

5) Do you feel well informed about the site's activities and progress?
Yes

6) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

Not at this time.

Additional Site-Specific Questions

[If needed]

Five-Year Review Interview Record			
Site:	Tucson International Airport Area	**EPA ID No:**	AZD980737530

Interview Type: Written Questionnaire

Date: 18 August 2018
Time: N/A

Interviewers

Name	Title	Organization
Viola Cooper	Community Involvement Coordinator	USEPA

Interviewees

Name	Organization	Title	Telephone	Email
Irene Robles	Community Member			

Summary of Conversation

1) What is your overall impression of the project?
I was unaware of this Superfund project. I really am grateful and relief that clean-up has been and is on-going for our community. I believed that the contamination clean-up was of the past.

2) What effects have site operations had on the surrounding community?
Most of my relatives and acquaintances use bottled water for cooking and drinking. We are unaware of site operations. In my opinion information needs to be given to us continuously. This is my first time I have known about this project.

3) Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.
I have been unaware of site, operations, and administration.

4) 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.
I am unaware of any unlawful issues to sites.

5) Do you feel well informed about the site's activities and progress?
This is the very first time to be informed of any project monitoring our water except for Tucson water company's inserts in the statement.

6) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?
I would like to be informed concerning your projects and operations. I am sure my community would appreciate a very valuable concern. Once again, thank to you and this project for giving me peace of mind.

Additional Site-Specific Questions

[If needed]

Five-Year Review Interview Record			
Site:	Tucson International Airport Area	**EPA ID No:**	AZD980737530

Interview Type: Written Questionnaire

Date: 28 August 2018
Time: N/A

Interviewers

Name	Title	Organization
Viola Cooper	Community Involvement Coordinator	USEPA

Interviewees

Name	Organization	Title	Telephone	Email
Stella Saenz	Community Member			

Summary of Conversation

1) What is your overall impression of the project?
I am writing to you from E.J.T.F. About the five-year review about 4000 to 5000 people living in this area. It was brought to our weekly attention at our meeting and newspaper report. That the E.P.A. and the City of Tucson purchase property. It is our understanding that property after the sales to this property is purpose development extracted for new wells to replace an old wells connected to a well Superfund one of several major project areas on location that is casual close to peoples, homes, school, and businesses hot spot area T.C.E. treatment facility. If this is the case we will like express our strongest preposition to our development we are expressing proposition to this opposed to that now it is in moral to us that our families, friends, neighbors particularly our children could ever be place in this position live, play, learn, and shop an area that presents a health hazards. Furthermore, it is very disburden to us the E.P.A and the City of Tucson would be so irresponsible as to be a party to transaction out of which this project would arise. The next T.J.T.F. meeting will be on September 15, 2018 with our residents at that time we would like to advise our residents and the city E.P.A. have it" s again been protect respective to this transaction and project to become a reality. Thank you for your consideration for this matter.

I am extremely very upset with all the poor work done in my area.

2) What effects have site operations had on the surrounding community?
With all the work going on it was very disturbing for the resident in the area and bringing more pollution to the community.

3) Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.
Yes I can not believe how much water was being discharge in our community polluting our air more that what it is already.

4) 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.
Discharging the water in our community was in moral especially because they were discharging 1.4 Dioxin and we did not even know about the P.F.O.'s. I believe it is the polluters responsibility to test our soil in our homes and schools and do blood testing on people who want this services.

5) Do you feel well informed about the site's activities and progress?
We were never advise about new wells in our area until 2 days right before the city started to work on the wells. That was not enough time for the community to oppose the new in our areas.

6) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?
This is in moral for the health of the people and worst of all for our children and for all the people who have died and are continuing dying due to so many types of different illnesses.

Additional Site-Specific Questions

[If needed]

Appendix H: Site Inspection and Photographs from Site Inspection Visit

Trip Report
Tucson International Airport Area Superfund Site Remediation Program (TARP)
Tucson, Arizona

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1. INTRODUCTION

a. Date of Visit: 15 March 2018

b. Location: W. Irvington Road and I-19, Tucson, AZ

c. Purpose: A site visit was conducted to visually inspect and document the conditions of the remedy, the site, and the surrounding area for inclusion into the Five-Year Review Report.

d. Participants:

Chad Lapora	Tucson Water, TARP Project Coordinator	(520) 837-2435
Robert Hacketthal	Tucson Water, TARP Treatment Plant Operator	
Mark Gardiner	APTIM Federal Services, Project Manager	(520) 448-5025

2. SUMMARY

A site visit to the Tucson Area Remediation Project (TARP) portion of the Tucson International Airport Area (TIAA) Superfund Site was conducted on 15 March 2018. AANG is part of groundwater Operable Unit (OU) 1, located in Area A at the site. The site visit included visiting the Advanced Oxidation Process (AOP) facility, the original Packed Column Aeration (PCA) treatment system at the facility, two current remediation well locations (R-009B and R-008A), and a vacant lot for a potential new remediation well location in the North Well Field south of Irvington Road.

The AOP and PCA facilities are enclosed in a secure walled compound with electronic gated entry. All remediation wells are located within walled gated compounds with remote sensing capabilities.

The current status of the TARP facility is ongoing groundwater extraction, treatment, and discharge to the Tucson Water drinking water supply system.

3. DISCUSSION

On 15 March 2018 Mark Gardiner visited the site, arriving at 0900 AZT. The weather was partly cloudy and cool, breezy, temperature approximately 60 degrees F.

Since the last Five Year Review, the AOP facility was constructed and began operation in January 2014. The AOP facility is an ultraviolet (UV) – peroxide system. The AOP treats both TCE and 1,4-Dioxane to non-detect levels. The PCA is currently still in operation and water treated by the AOP is sent to the PCA plant prior to discharge because it is required under the

current Record of Decision and Consent Decree. Once an ongoing ROD Amendment for Area A is finalized, it is anticipated that the PCA plant will be decommissioned.

The GWTP plant was not operating at the time of the site visit; however, the facility has an excellent track record of operation on a general basis. Several issues were being addressed on the day of the visit. An ongoing problem that Tucson Water has been investigating is the appearance of amounts of gravel in raw water coming to the AOP from the remediation wells significant enough to cause concern for the UV lamps inside the reactors. Tucson Water has had to frequently take the reactors offline separately from each other to clean out sand and gravel. A photograph of some of the gravel is provided in this report. The gravel is well-graded and appears to be standard filter pack material. After study, Tucson Water believes that it is gravel that is in the piping lines coming from the North Well Field due to the failure previously of the well screen in remediation well R-009A. This well has since been replaced with R-009B. A camera study of the piping runs and a cleanout project is underway currently. Once complete, the AOP facility will be brought back online. Studies of groundwater data and modeling performed after previous outages suggests there should be no long-term loss of capture of the plume. In addition, remediation well R-008A has been taken out of service and drilling of a replacement well R-008B is underway. Eventually all the remediation wells in the North Well Field will require replacement, and Tucson Water has this built into their capital projects plan for the next several years.

During normal operations, the remediation system has a demonstrated capture of the northern most extent of the groundwater plume by the North Well Field, and continued mass removal of TCE by the South Well Field wells.

The system is efficient and will be more so upon retirement of the PCA portion of the treatment plant. Tucson Water is proposing a potential enhancement to the system by adding a tenth remediation well as part of the North Well Field, which is being evaluated currently by the regulatory agencies and the site PRPs. A tenth well could remove more contaminant mass more quickly.

A potential problem that could affect the protectiveness of the remedy is the replacement of the aging remediation wells. Tucson Water has a plan to continue replacement of the wells, and is currently working on the second of four North Well Field wells to replace. The wells are 20 to 25 years old and constructed of galvanized riser and wire-wrapped screen. A sudden failure of a well prior to replacement would require shutting the well down, and the lead time for a new well to get drilled, installed, and equipped can be several months. Tucson Water has been handling this very well so far, and as noted previously, sampling and modeling data after previous outages has demonstrated that recapture of the plume is relatively quick.

Rising regional water levels has not affected the TARP system to date. The remediation wells, particularly the North Well Field wells, are large capacity producing between 1,000 and 1,300 gallons per minute (gpm) volumes of water and are screened over large intervals. The wells in the South Well Field are smaller capacity wells in the 300 gpm range and continue to perform mass removal. Over time, as a remaining slug of elevated TCE migrates north from the area

around the West End of Runway 3 on Airport Property, an evaluation of the South Well Field efficacy may be required. It will likely be several years before this occurs.

The site visit ended at approximately 1130 AZT.

4. ACTIONS

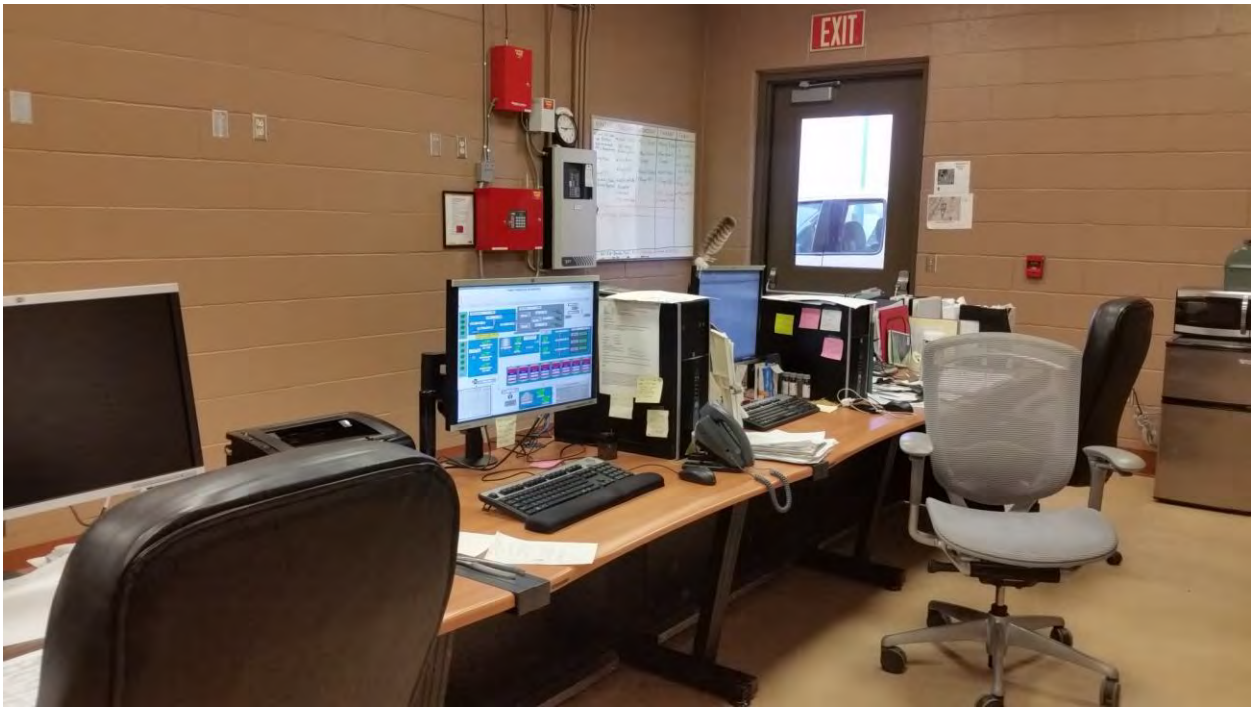
The USACE will incorporate information obtained from the site visit into the Five Year Review report.

Mark Gardiner
APTIM Project Manager
Tucson, AZ

Site Visit Photos

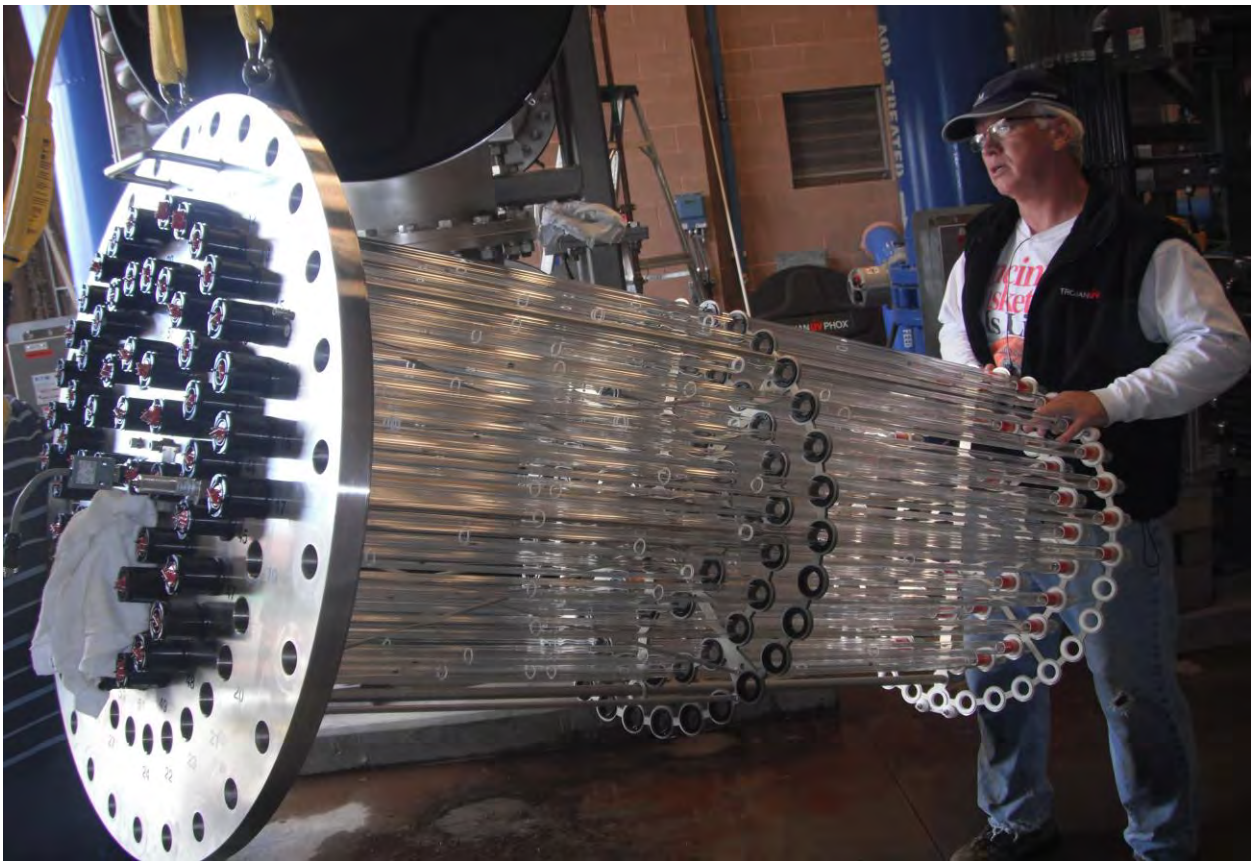
View to the North of the AOP treatment facility, peroxide GAC contactors to the west.

View to the South/Southwest of the PCA and GAC quenchers; this system proposed for retirement.



TARP AOP control room.

TARP AOP reactor trains.



TARP AOP UV lamps from one reactor.

Gravel removed from TARP AOP treatment trains presumed to be coming from the piping system due to the past failure of the R-009A well screen.

View to the North of gated entry to remediation well R-009B.

View to the North of walled compound with R-009B well and control panel.

View to the South of remediation well R-008A; well taken out of service and surface piping removed in preparation for replacing the well with R-008B (due to poor condition of the well).

View to the East of vacant lot South of Irvington Road for potential tenth remediation well to support the North Well Field.

Trip Report
Airport Property, Tucson International Airport Area Superfund Site
Tucson, Arizona

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1. INTRODUCTION

a. Date of Visit: 07 March 2018

b. Location: Tucson International Airport, Tucson, AZ

c. Purpose: A site visit was conducted to visually inspect and document the conditions of the remedy, the site, and the surrounding area for inclusion into the Five-Year Review Report.

d. Participants:

Peter Schwarz	GHD, Project Manager	(520) 623-9221
Mike Freid	GHD, O&M Manager	
Tim Fish	GHD, Treatment Plant Operator	
Mark Gardiner	APTIM Federal Services, Project Manager	(520) 448-5025

2. SUMMARY

A site visit to the Airport Property portion of the Tucson International Airport Area (TIAA) Superfund Site was conducted on 07 March 2018. Airport Property is Operable Unit 2, soil and shallow groundwater zone (SGZ) remedy. The site visit included visiting the Groundwater Treatment Plant (GWTP), Three Hangars building area (which includes the hangars, the completed PCB remedy, and the Technical Impracticability [TI] Zone south of the hangars), the closed Landfill, Former Samsonite Building area, and On- and Off-Airport Property extraction wells and control stations.

All facilities are within fenced areas with limited access.

The current status at OU-2 is as follows: The PCB remedy has been completed and was certified by EPA in July 2017; the TAA Landfill was closed and certified by EPA in September 2013 and is in O&M phase; the SGZ groundwater remedy is ongoing; treatment at the Former Samsonite Building area included an in-situ chemical oxidation (ISCO) injection of potassium permanganate (KP) and is being monitored for performance on a semi-annual basis.

3. DISCUSSION

On 07 March 2018 Mark Gardiner visited the site, arriving at 1030 AZT. The weather was sunny and warm, breezy, temperature approximately 78 degrees F.

No issues of concern were noted at the time of the site visit. The GWTP was operating normally and there have been no significant unplanned outages of operations; outages for planned maintenance have been brief and normal. As noted in the Summary section of this report, the

PCB remedy was completed since the last Five Year Review, and the Landfill cap was installed and the remedy certified about the time of completion of the last Five Year Review. The SVE remedy continues to operate primarily in the TI zone. The Landfill cap is in good condition and well maintained with native local desert vegetation.

Two new well clusters were installed as part of the SGZ remedy in 2016 and 2017 to address EPA and ADEQ concerns for TCE contamination under the southwest corner of Hangar 3 and along the western Airport Property boundary west of Three Hangars. Elevated TCE was discovered particularly at the new western boundary wells. Ongoing discussions with the PRPs have been taking place to determine if what is being observed represents a new paleochannel of contamination migration; if so, this will have an impact on the protectiveness of the remedy. At this time, it appears that the new well area along the western property boundary needs to be incorporated into the extraction network to ensure capture of the contamination. In addition, the possibility of additional remedial action may be needed in the area around what is known as the West End of Runway 3 on Airport Property. Elevated TCE exists in this area that likely is not being captured by the Airport Property remedial action. This TCE will most likely end up migrating north/northwest to ultimately be captured by the Tucson Area Remediation Project south well field if not otherwise captured sooner.

Rising regional water levels has little impact at this point on the eastern parts of the Airport Property site, in the immediate vicinity of Three Hangars and the source area. However, further to the west off Airport Property, rising regional water levels have begun to impact some wells, and evaluation of the impact is currently ongoing. Reclassification of some wells that previously were considered to be either SGZ or Groundwater Subunit wells to wells that represent regional water levels will be required, and the installation of additional monitoring wells will likely be necessary. The Airport Property SGZ extraction wells have not been impacted by rising water levels at this time.

The site visit ended at approximately 1230 AZT.

4. ACTIONS

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

Mark Gardiner
APTIM Project Manager
Tucson, AZ

Site Visit Photos

View to the South/Southeast of the north side of Three Hangars.

View to North/Northwest of part of SVE system (left) and On-Airport Property extraction well control room.

View to the North of inside of Hangar 2 at Three Hangars building.

SVE-6 extraction well.

EW-2R groundwater extraction well.

View to West of the Groundwater Treatment Plant and TI zone located between the hangars and the GWTP.

View to the North/Northwest of GWTP facilities.

View to the North of GWTP facilities.

View to the North/Northeast of GWTP facility control room.

View to the South of the GWTP facility.

View to West/Southwest on North end of Former Samsonite Building ISCO area.

View to the West of TAA Landfill gate and entrance.

View to the West/Northwest of TAA Landfill.

LF-5 monitoring well at TAA Landfill.

View to the North of drainage along the Eastern edge of TAA Landfill.

View to the North of AFP 44 extraction wells E-5 and E-5M, located at TAA Landfill.

View to the North of gate and entry into Off-Airport Property extraction and monitoring wells West of Nogales Highway and Three Hangars.

View to the North/Northeast of Off-Airport Property extraction and monitoring wells West of Nogales Highway and Three Hangars.

View to the East towards Airport Property GWTP area from Off-Airport Property extraction well area; horizontal drilling under Nogales Highway and railroad tracks was performed for the extraction piping system.

Trip Report
Arizona Air National Guard, Tucson International Airport Area Superfund Site
Tucson, Arizona

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1. INTRODUCTION

a. Date of Visit: 08 March 2018

b. Location: Arizona Air National Guard Base, Tucson International Airport, Tucson, AZ

c. Purpose: A site visit was conducted to visually inspect and document the conditions of the remedy, the site, and the surrounding area for inclusion into the Five-Year Review Report.

d. Participants:

Eder Delgadillo	162nd Fighter Wing, AANG, Env. Coordinator	(520) 419-7952
Mark Gardiner	APTIM Federal Services, Project Manager	(520) 448-5025

2. SUMMARY

A site visit to the Arizona Air National Guard (AANG) Base portion of the Tucson International Airport Area (TIAA) Superfund Site was conducted on 08 March 2018. AANG is part of groundwater Operable Unit (OU) 1, located in Area B at the site. The site visit included visiting the area where an in-situ chemical oxidation (ISCO) injection of potassium permanganate (KP) was performed as a pilot study in 2009, airplane wash rack, areas where the AANG is currently conducting a preliminary site investigation for perfluorinated compounds, and an area along the eastern Base boundary where an ISCO injection is planned.

The entire Base is enclosed within secure fencing and military patrols and access gates, with the exception of the flight line which is enclosed by the Tucson International Airport fence.

The current status of the AANG site is ongoing groundwater monitoring for TCE, an ongoing preliminary site investigation for the presence of perfluorinated compounds at historically suspected use areas on base, and the planning phase for a KP injection along the eastern upgradient boundary of the Base anticipated for implementation during the Summer of 2018.

3. DISCUSSION

On 08 March 2018, Mark Gardiner visited the site, arriving at 1215 AZT. The weather was sunny and warm, light breeze, temperature approximately 85 degrees F.

No issues of concern were noted at the time of the site visit. As noted in the Summary section of this report, there is a preliminary site investigation for perfluorinated compounds initiated recently and since the last Five Year Review. In addition, a planned ISCO injection that was being programmed at the time of the last Five Year Review is now being planned for implementation during the Summer of 2018. This is designed to treat a slug of TCE that is migrating onto Base property. One well on Base property to the west of the boundary has a

recently slightly increasing trend of TCE concentration that is approaching 10 ug/L. The previous pump and treat remedy and the 2009 ISCO pilot study on Base have been successful in cutting off the TCE plume from migrating to the north/northwest towards the current West Plume B (WPB) and treating the original AANG source area. The new ISCO implementation on the eastern Base boundary should treat the TCE at that area and prevent further need for remedial action on Base. If successful, there is no reason to believe the remedy will not be functional and protective.

A subsite of the AANG area known as Airplane Wash Rack was previously investigated and closed; the date of this activity could not be determined during the site visit.

Regional rising water levels have had little impact at the AANG area of the site. There have been slight rises in water levels over the past 2 to 3 years; however, the rise is much more pronounced further to the west of this area.

There is no evidence that the AANG or WPB parts of Area B are contributing any VOC contamination to Area A and the TARP system.

The site visit ended at approximately 1400 AZT.

4. ACTIONS

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

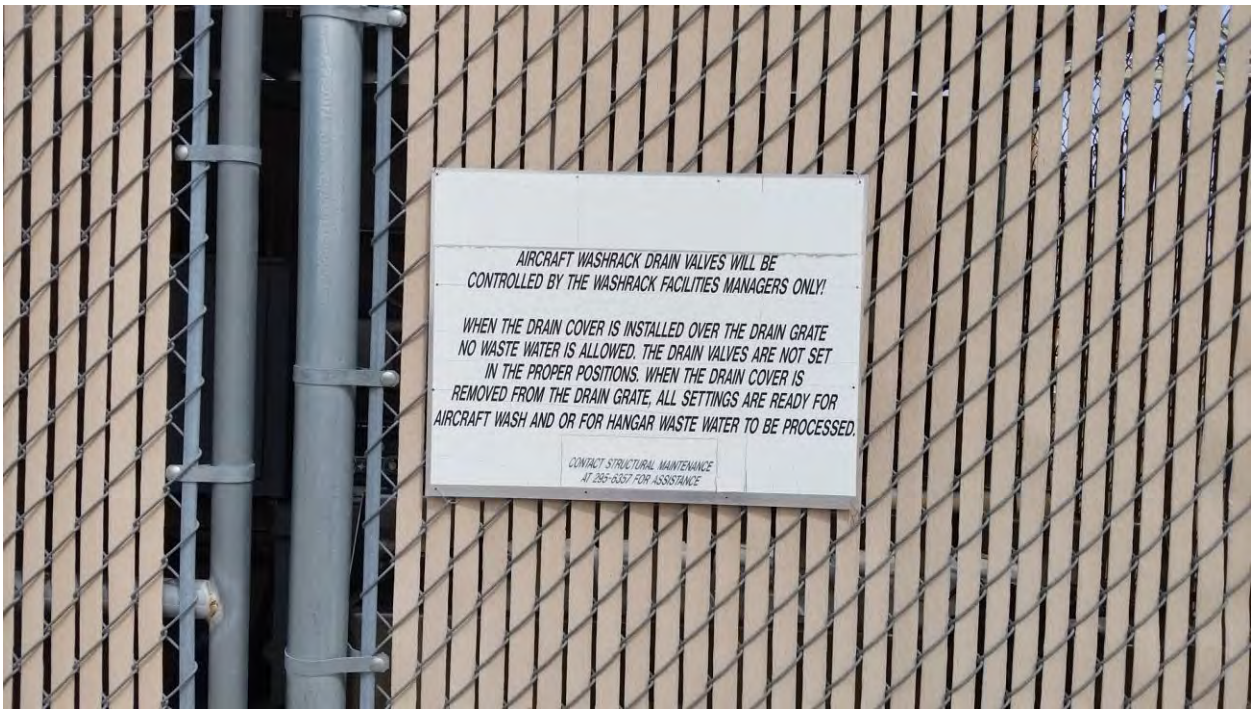
Mark Gardiner
APTIM Project Manager
Tucson, AZ

Site Visit Photos

View to the East/Southeast of monitoring well PT-5 and Building 34, in the vicinity of the 2009 ISCO Pilot Study.

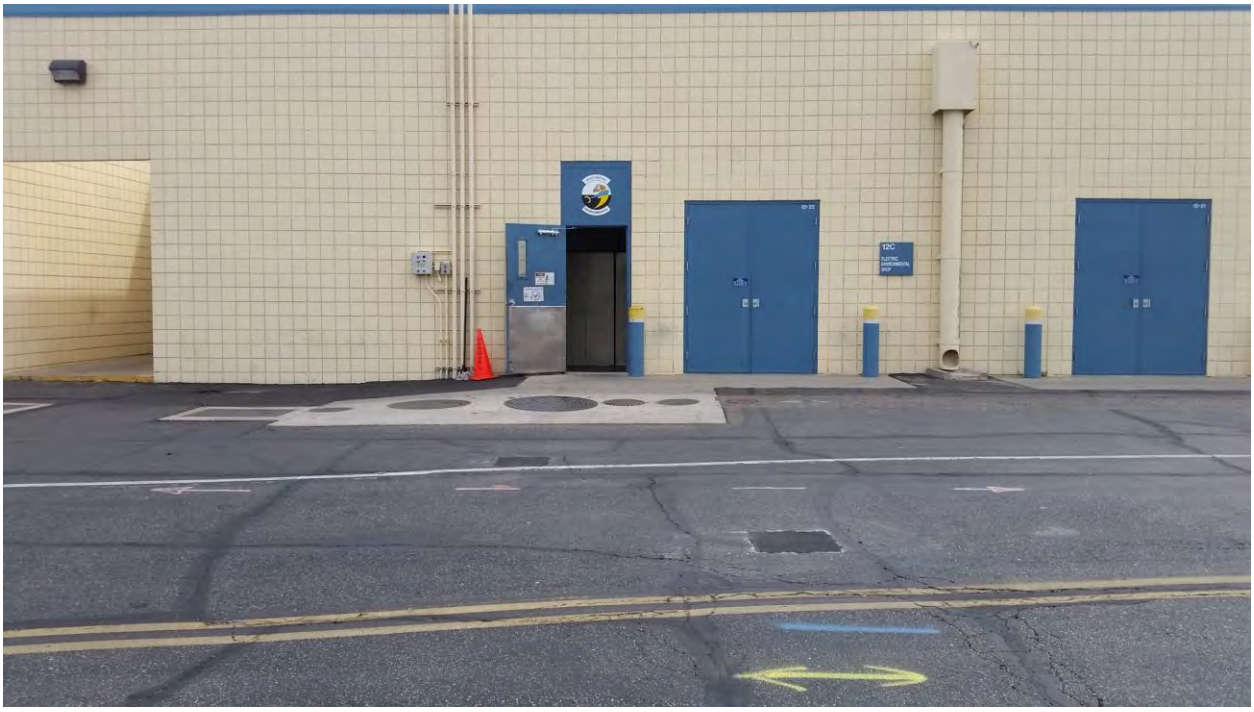
View to the West of Aircraft Wash Rack.

View to the Northeast of valve system at the wash rack; controls storm water runoff to storm drains versus aircraft wash water to the wash rack pretreatment unit prior to discharge to storm drain.



View to the North of gate and fence housing the wash rack pretreatment unit.

MW-75U typical monitoring well on AANG property.



View to East of former AFFF facility with two soil boring locations in the foreground as part of the perfluorinated compounds investigation.

View to the East of monitoring wells MW-98U and MW-98L along flight line to the east, looking towards West Cap Western Lobe across the runway. The planned ISCO injection will take place west of these wells.

View to the East toward West Cap Western Lobe and wells MW-98U/L from aircraft parking apron.

Trip Report
West Plume B, Tucson International Airport Area Superfund Site
Tucson, Arizona

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1. INTRODUCTION

a. Date of Visit: 02 March 2018

b. Location: North of E. Valencia Road Extending Northwest to E. Drexel Road

c. Purpose: A site visit was conducted to visually inspect and document the conditions of the remedy, the site, and the surrounding area for inclusion into the Five-Year Review Report.

d. Participants:

Mark Gardiner	APTIM Federal Services, Project Manager	(520) 448-5025

2. SUMMARY

A site visit to the West Plume B (WPB) area of the Tucson International Airport Area (TIAA) Superfund Site was conducted on 02 March 2018. WPB is part of groundwater Operable Unit (OU) 1, located in Area B at the site. The site visit was conducted by Mark Gardiner, a contractor to EPA. The site visit included visiting the locations of select monitoring wells and typical residential neighborhoods within and near the boundary of the groundwater plume at the site. The WPB area is primarily residential with some light commercial facilities along S. Park Avenue and along E. Drexel Road at the northwest end of the plume.

WPB is a portion of the TIAA site that is currently in a long-term groundwater monitoring phase. There is no active remedy for WPB. Currently, monitoring wells associated with WPB are monitored on a semi-annual basis by the Arizona Air National Guard. The last groundwater sampling event for WPB wells took place in March 2018.

3. DISCUSSION

On 02 March 2018 Mark Gardiner visited the WPB area, arriving at 1430 AZT. The weather was sunny and warm, light breeze, temperature approximately 80 degrees F.

No issues of concern were noted at the site during the visit. The remedial action is ongoing and operating as intended. TCE concentrations continue to trend generally downward. One well in the southern portion of the WPB area has a TCE concentration of approximately 8 ug/L based on the most recent semi-annual sampling event.

The AANG contractor TetraTech was contacted regarding the status of wells and well security in the WPB area. The wells are in good condition and new Torguer rubber gasket J-plug caps were installed on all the wells in the sampling program two years ago. In addition, AF bolts were added to lock traffic box lids which require a special tool to loosen. These can be seen in the

photograph of monitoring well WPB-02 attached to this report. It was noted that there are no locks on the well caps under the traffic lids; consideration should be given to adding locks, although TetraTech noted that there has been no evidence of any tampering of the wells between monitoring events.

The site visit ended at approximately 1430 AZT.

4. ACTIONS

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

Mark Gardiner
Project Manager
Tucson, AZ

Site Visit Photos

Typical monitoring well at south end of WPB, well WPB-02 at intersection of S. Park and E. Wielding.

View to the North/Northwest from well WPB-02 at intersection of S. Park and E. Wielding.

View to the North/Northwest of typical residential area of WPB towards the Northwest end of the plume.

View to the South/Southeast of typical residential area from the Northwest end of WPB back towards the Airport.

Trip Report
Former Western Capacitor, Tucson International Airport Area Superfund Site
Tucson, Arizona

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1. INTRODUCTION

a. Date of Visit: 02 March 2018

b. Location: 2207 E. Elvira Rd, Tucson, AZ, 85756

c. Purpose: A site visit was conducted to visually inspect and document the conditions of the remedy, the site, and the surrounding area for inclusion into the Five-Year Review Report.

d. Participants:

Mark Gardiner	APTIM Federal Services, Project Manager	(520) 448-5025

2. SUMMARY

A site visit to the Former Western Capacitor (West Cap) portion of the Tucson International Airport Area (TIAA) Superfund Site was conducted on 02 March 2018. West Cap is part of groundwater Operable Unit (OU) 1, located in Area B at the site. The site visit included visiting the Source Area located at the corner of E. Elvira and S. Plumer roads, a parking lot across the street to the west from the Source Area, and the portion of the site known as the Western Lobe located on Airport Property inside the Tucson International Airport (TIA) fence west of the Source Area.

The Source Area is secure within a fence and maintained by the current company (Glaz-Tech) that owns and operates a glass manufacturing facility on the property. The Western Lobe portion of the site is within the high security area of the TIA. The Source Area original concrete pad has a significant amount of equipment and debris owned by the glass company, but it does not interfere with the remedial action at the site.

The current status of the West Cap site is groundwater monitoring to determine whether the in-situ chemical oxidation (ISCO) injection of potassium permanganate (KP) remedial action that took place in June 2014 is operation and functional. The most recent groundwater sampling event took place the week of 12 March 2018 by APTIM Federal Services, EPA's contractor currently for the site.

3. DISCUSSION

On 02 March 2018 Mark Gardiner visited the site, arriving at 1300 AZT. The weather was sunny and warm, light breeze, temperature approximately 80 degrees F.

No issues of concern were noted at the site during the visit. The remedial action is ongoing and operating as intended. Concentrations of TCE have been declining at the site since the ISCO injection in June 2014. At the north end of the Source Area TCE concentrations declined from

180 to 200 micrograms per liter immediately following injection to approaching non-detect in the September 2017 event. However, TCE concentrations at WC-01, just west of the injection target zone and west of the concrete pad have declined but have recently persisted in the 20 ug/L range. Data from the March 2018 event will be evaluated to determine if TCE concentrations continue to decline at WC-01. Rising regional water levels have not had a significant impact at this portion of the TIAA site.

The site visit ended at approximately 1430 AZT.

4. ACTIONS

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

Mark Gardiner
Project Manager
Tucson, AZ

Site Visit Photos

Typical nested injection and monitoring well at north end of concrete pad at Source Area.

View to the North towards North end of Source Area pad.

View to the West at North end of Source Area pad.

View to the East towards North end of Source Area pad and Glaz-Tech facility.

View to the West from Source Area towards Western Lobe.

View to the East from Western Lobe towards Source Area.

View to the West from Western Lobe well WC-28 towards Taxiway D and Arizona Air National Guard Base.

View to the South of row of monitoring and injection wells at Western Lobe.

View to the East/Southeast of Airport Wash along Western Lobe towards Source Area.

View to the East toward Source Area from Western Lobe in vicinity of monitoring well WC-18.

Trip Report
Former Texas Instruments, Tucson International Airport Area Superfund Site
Tucson, Arizona

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1. INTRODUCTION

a. Date of Visit: 29 March 2018

b. Location: 2380 E. Medina Road, Tucson, Arizona, 85756

c. Purpose: A site visit was conducted to visually inspect and document the conditions of the remedy, the site, and the surrounding area for inclusion into the Five-Year Review Report.

d. Participants:

Mark Gardiner	APTIM Federal Services, Project Manager	(520) 448-5025

2. SUMMARY

A site visit to the Former Texas Instruments (TI) (Former Burr Brown) portion of the Tucson International Airport Area (TIAA) Superfund Site was conducted on 29 March 2018. TI is part of groundwater Operable Unit (OU) 1, located in Area B at the site. The site visit included the original TCE storage area and the vicinity of injection wells utilized during the 2009 in-situ chemical oxidation (ISCO) injection and the 2016 additional ISCO injection.

There is no current active remedy taking place at the TI facility. The site is secure with a wall and gate, and roving security guards. Access is controlled by building leasing management. The facility is now occupied by VXI Global Solutions (a call center), Arizona Department of Economic Security, and other businesses. There is no manufacturing activity on the property. The parking lot is walled where the majority of the wells are located and remedial action activities occurred.

The current status of the TI site is ongoing groundwater semi-annual monitoring of the performance of the ISCO injection from Summer 2016.

3. DISCUSSION

On 29 March 2018 Mark Gardiner visited the site, arriving at 1000 AZT. The weather was clear and warm, breezy, temperature approximately 80 degrees F.

No issues of concern were noted at the time of the site visit. Since the last Five Year Review, an ISCO injection of potassium permanganate (KP) was performed during the summer of 2016. Since that time, groundwater monitoring to evaluate the performance of the remedial action has been taking place. Sampling was initially on a quarterly basis and is now being performed on a semi-annual basis. Recent data from the performance monitoring indicates KP is migrating as intended out of the injection area into the target treatment zone and beginning to reach through clay units into the upper water-bearing zone. Additional semi-annual events are programmed. It

may require another one to two years of monitoring to determine if the remedy is operational and functional. In the meantime, monitoring indicates that the extent of TCE contamination greater than 5 ug/L is limited to the area around the source and target treatment zone and is not migrating off site.

Rising regional water levels has not affected the remedial action or distribution of TCE at the site to date. Rising water levels are more pronounced in the Area A portion of TIAA, and less so in Area B. At this time rising water levels in the shallow zone where TCE is elevated at the TI site has been minimal, and is not expected to significantly impact the remedy.

The site visit ended at approximately 1100 AZT.

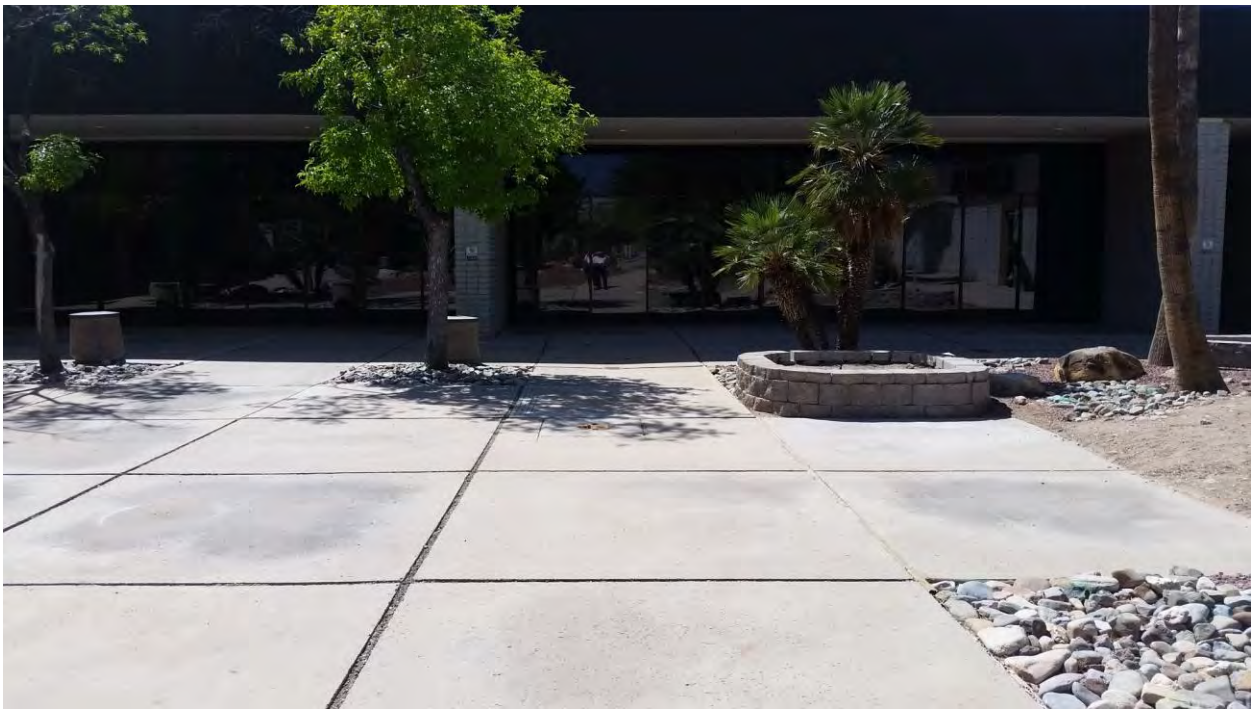
4. ACTIONS

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

Mark Gardiner
APTIM Project Manager
Tucson, AZ

Site Visit Photos

View to the South of entrance to courtyard where original TCE storage area was located and well SVE-1 utilized in the 2016 ISCO injection.



View to the West inside the courtyard towards well SVE-1 and the original TCE storage Area.

Well SVE-1 in the courtyard near the original TCE storage area.

View to the East from near SVE-1 towards the location of original injection well IW-1.