FIFTH FIVE-YEAR REVIEW REPORT

FOR

HASSAYAMPA LANDFILL SUPERFUND SITE

MARICOPA COUNTY, ARIZONA

PREPARED BY

U.S. Army Corps of Engineers, Seattle District

FOR

U.S. Environmental Protection Agency

Region 9

Approved by:

ANGELES HERRERA

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Executive Summary

This is the fifth Five-Year Review of the Hassayampa Landfill Superfund Site (Site) located in Maricopa County, Arizona. The purpose of this Five-Year Review is to review information to determine if the remedy is and will continue to be protective of human health and the environment.

Maricopa County formerly operated a 47-acre municipal solid waste landfill which included a 10-acre area in the northeast portion of the landfill used for the disposal of hazardous wastes. The hazardous wastes were disposed in unlined pits in the landfill under the direction of the Arizona Department of Health Services, from April 1979 to October 1980. In 1981, under the Resource Conservation and Recovery Act Open Dump Inventory Program, Arizona Department of Health Services installed three groundwater monitoring wells at the Hassayampa Landfill. Groundwater samples collected from one of these wells was found to be contaminated with volatile organic compounds. The 10-acre portion of the 47-acre municipal landfill where hazardous wastes are known to have been disposed, as well as any areas where site-related contaminants have come to be located was designated a Superfund Site and listed on the National Priority List in July 1987. The landfill continued to accept non-hazardous wastes for disposal until 1997.

In the 1992 Record of Decision, the Environmental Protection Agency selected the remedy for the Site to remediate the groundwater and vadose zone (including soil and soil vapor above the water table) contamination. The groundwater component of the remedy includes extraction of contaminated groundwater, treatment of the water using air stripping technology, reinjection of the treated water back into the groundwater in the vicinity of the Site, and continued groundwater monitoring to measure the effectiveness of the remedy to protect long-term human health and the environment. The vadose zone component of the remedy includes capping the 10-acre hazardous waste area of the landfill using a cap that complies with the substantive capping and maintenance requirements for the Resource Conservation and Recovery Act. In addition, the vadose zone component of the selected remedy includes performing soil vapor extraction at all locations at the Site where soil vapor levels exceed cleanup standards, treat the extracted soil vapor using vapor phase carbon adsorption or catalytic oxidation technology, and implementing access and deed restrictions.

In 1994, the Hassayampa Steering Committee (composed of various companies responsible for the cleanup) implemented the remedy components including: operating the groundwater extraction and treatment system; placing a cap over the 10-acre hazardous waste disposal area; and implementing engineering and institutional controls in the form of fencing and land use restrictions.

The initial soil vapor extraction system, designed to use catalytic oxidation technology for treatment of the soil vapor, was constructed and operated intermittently between 1996 and 1998. After termination of the soil vapor extraction system in September 1998, subsequent monitoring data indicated an upward trend in the size and concentration of the vadose zone vapor plume. The Hassayampa Steering Committee installed a new soil vapor extraction system in 2006 using a proprietary cryogenic treatment technology combined with carbon polishing to treat the contaminated soil vapor. In 2009, the Environmental Protection Agency signed the Explanation of Significant Differences #1

determining that new performance standards were to be based on calculations using the State regulatory standards and Federal guidance for soil screening levels and converted to soil vapor levels at equilibrium. Due to the recent developments in the technology since the 1992 Record of Decision, the Explanation of Significant Differences #1 also allows for use of a third type of soil vapor extraction system technology that is more environmentally protective (cryogenic proprietary technology). The specific calculations used to drive the new soil vapor performance standards and revised soil vapor standards for each analyte are included in the Explanation of Significant Differences #1.

The Environmental Protection Agency updated the Site conceptual model in 2013 to acknowledge soil vapor transport, not leaching, as the principal pathway for volatile organic compounds impacting the groundwater. The Hassayampa Steering Committee conducted a pilot test in 2015 to evaluate the efficiency and cost-effectiveness of changing from the cryogenic treatment system to carbon treatment for the volatile organic compound-contaminated soil vapor. The results of the pilot test indicated that changing to the carbon treatment was feasible and the Hassayampa Steering Committee switched to the carbon treatment for soil vapor in 2016.

In May 2016, the Environmental Protection Agency signed an Explanation of Significant Differences #2 to update the soil vapor performance standards based on the vapor transport model rather than the leaching model and clarified the remedial action objectives for the Site:

Groundwater Remedial Action Objectives

- Prevent human exposure to groundwater contaminated by Site contaminants above maximum contaminant levels and, for contaminants that have no maximum contaminant levels, above Health-Based Guidance Levels established by Arizona.
- Restore groundwater throughout the Site to concentrations at or below the maximum contaminant levels and Health-Based Guidance Levels for the Site contaminants.

Soils/Soil Vapor Remedial Action Objectives

- Prevent human ingestion of, or contact with, soil or waste contaminated with Site contaminants that represent an unacceptable exposure.
- Prevent leaching or vapor transport of Site contaminants from soil and waste in the vadose zone to groundwater by attaining and maintaining soil vapor concentrations below soil vapor performance standards that are protective of the groundwater quality and will not result in degradation of groundwater at concentrations above maximum contaminant levels or health-based guidance levels at the Site boundary.

The remedy is functioning as intended. Site contaminants in groundwater continue to exceed groundwater cleanup standards and soil vapor volatile organic compound concentrations periodically exceed the current soil vapor performance standards in monitoring wells near the source area, however, the concentrations in both media are generally decreasing. The groundwater remediation system may need to be operated for decades to cleanup groundwater to beneficial uses and

optimization measures will need to be evaluated in the future. There have been no changes to Applicable or Relevant and Appropriate Requirements that effect the protectiveness of the remedy.

The remedy at the Hassayampa Landfill Superfund Site is protective of human health and the environment. The soil vapor extraction system and landfill cap are successfully preventing vapor transport of Site contaminants from the vadose zone to groundwater and the groundwater remediation system is preventing further migration of Site contaminants in groundwater. Engineering and institutional controls prevent unacceptable exposure to Site contaminants in soil and groundwater.

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List of Abbreviations and Acronyms

ARAR	applicable or relevant and appropriate requirements
bgs	below ground surface
GRS	groundwater remediation system
EPA	United States Environmental Protection Agency
lbs	pounds
Site	Hassayampa Landfill Superfund Site
SVE	Soil Vapor Extraction
SVPS	Soil Vapor Performance Standards
µg/L	micrograms per Liter
VOC	volatile organic compound

1. Introduction

The purpose of a Five-Year Review is to evaluate the implementation and performance of a remedy 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 Five-Year Review reports. In addition, Five-Year Review reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) is preparing this Five-Year Review 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 and EPA policy.

This is the fifth Five-Year Review for the Hassayampa Landfill Superfund Site (Site). The triggering action for this statutory review is the signing of the previous Five-Year Review on September 26, 2016. The Five-Year Review has been prepared because hazardous substances, pollutants, or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure.

The Site was not officially divided into separate operable units. However, two separate media remedy components were selected in the 1992 Record of Decision and implemented at the Site, one for soil vapor and one for groundwater. This review assesses the status and performance of both the groundwater and soil vapor remedies, including the landfill cap, as well as the engineering and institutional controls that are intended to address access restrictions and land use at the Site.

The Hassayampa Landfill Superfund Site Five-Year Review was led by Nadia Hollan Burke, EPA Region 9 Remedial Project Manager. Participants included Cynthia Wetmore, EPA Superfund Five-Year Review Coordinator, and from the U.S. Army Corps of Engineers: Rebecca Rule, Project Manager; Jake Williams, Project Manager; Jeff Weiss, Hydrogeologist; and Katie Richwine, Physical Scientist. The review began on November 23, 2020.

Table 1. Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Hassayampa Landfill Superfund Site		
EPA ID: AZD980735666		
Region: 9	**State:** AZ	**City/County:** Hassayampa/Maricopa County
SITE STATUS		
National Priorities List Status: Final		
Multiple Operable Units? No	**Has the site achieved construction completion?** Yes	
REVIEW STATUS		
Lead agency: EPA ***[If "Other Federal Agency", enter Agency name]*:**		
Author name (Federal or State Project Manager): Nadia Hollan Burke		
Author affiliation: EPA		
Review period: 11/23/2020 - 7/28/2021		
Date of site inspection: 7/13/2021		
Type of review: Statutory		
Review number: 5		
Triggering action date: 9/26/2016		
Due date *(five years after triggering action date)*: 9/26/2021		

1.1. Background

The Hassayampa Landfill Superfund Site (Site) is owned by Maricopa County and began operation in 1961. It is located in the southeast quarter of Section 3, Township 1 South, Range 5 West, Maricopa County, Arizona approximately 10 miles west of Buckeye, Arizona. The Site was authorized to receive unrestricted types of waste under a manifest program operated by the Arizona Department of Health Services in response to an "extreme emergency" that resulted from the Arizona Department of Health Services ban on the disposal of industrial waste at the City of Phoenix landfills. Under the manifest program, a wide range of hazardous wastes were approved for disposal at the Hassayampa Landfill. The Arizona Department of Health Services requested that Maricopa County accept hazardous waste at the Hassayampa Landfill for a 30-day period beginning on April 20, 1979. The initial 30-day period was granted several extensions that ultimately granted the Site authorization to accept hazardous waste for an 18-month period from April 20, 1979 to October 28, 1980 (EPA, 1992). The unlined pits were subsequently covered with native soil and restored to grade. Based on a review of the Arizona Department of Health Services manifests, approximately 3.4 million gallons of hazardous liquid wastes and 4,150 tons of solid wastes were disposed of in a series of five unlined disposal pits at the Site. Disposal to the municipal landfill ceased in June 1997.

The contamination at the Site is primarily associated with the known disposal pits. Pit 1 and the Special Pits area received the majority of the hazardous wastes containing volatile organic compounds such as trichloroethene, 1,1-dichloroethene, dichloromethane, 1,2-dichloropropane, tetrachloroethene, and 1,1,1-trichloroethane. Pit 1 is the primary location of the contaminant impacts to both the soil and the groundwater (highest level of soil contamination detected at 60 feet deep). Volatile organic compounds have been detected in soil and soil vapor in the unsaturated soils both above and below a basalt layer located approximately 60 feet below ground surface (bgs).

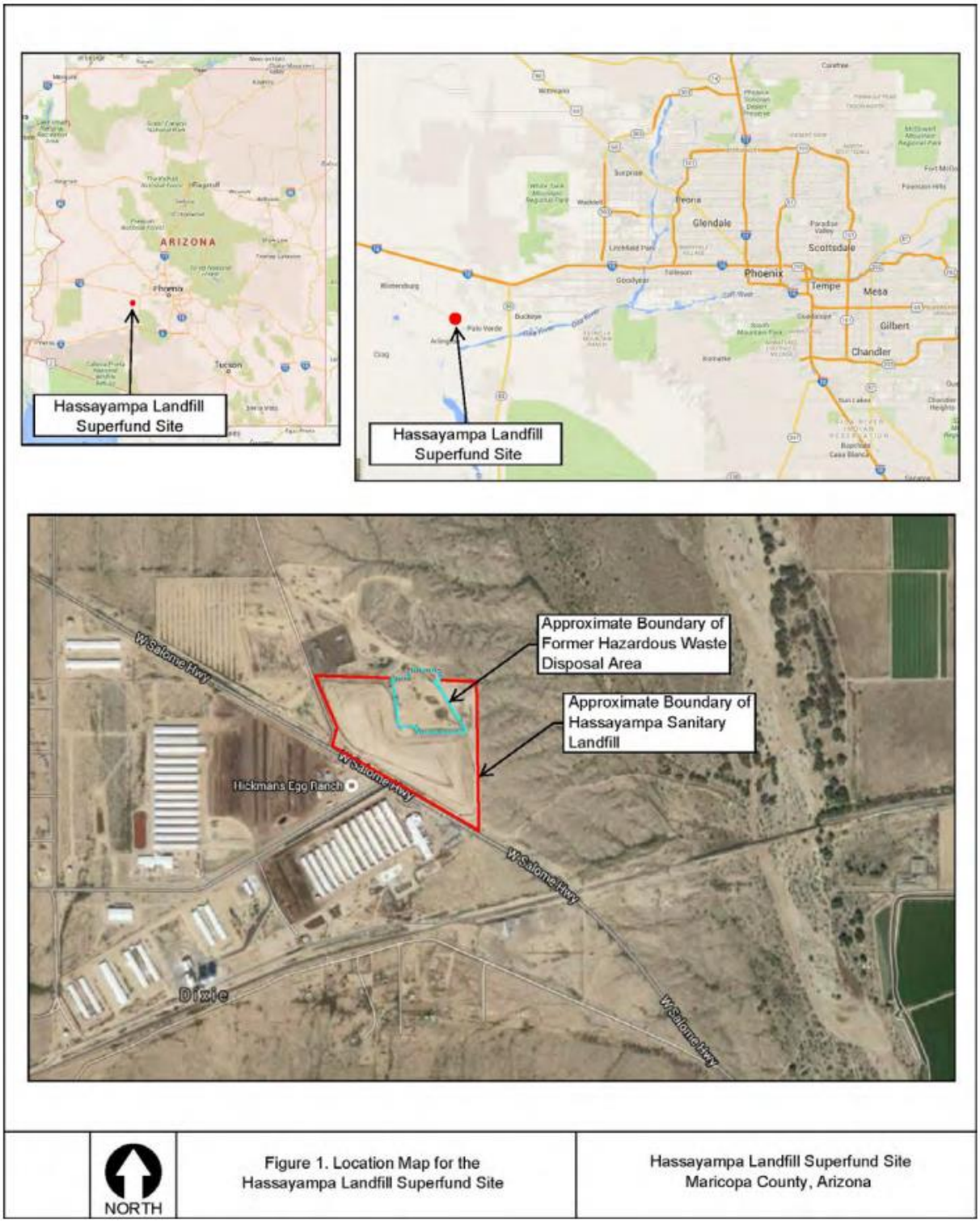
1.2. Physical Characteristics

The Site is located approximately 40 miles southwest of Phoenix and approximately three miles northeast of Arlington, in Maricopa County, Arizona (Figure 1). The Hassayampa Landfill hazardous disposal area consists of 10 acres, located within the northwest section of the former 47-acre Hassayampa Landfill operated by Maricopa County (Figure 2). The Hassayampa River is located approximately one mile east of the Site and flows completely underground in this river section. Drainage washes to the Hassayampa River are located to the east of the Site. The Site is outside the regulatory floodway of the Hassayampa River. The Gila River, Robbins Butte Wildlife Area, and Buckeye Hills Regional Park are the nearest environmentally sensitive areas, approximately three miles south of the Site.

Surrounding land use has not changed significantly since the 1992 Record of Decision was signed and includes mostly desert (undeveloped) land to the west and south with cultivated lands to the east of the Hassayampa River. Vegetation is sparse and includes creosote and salt bush high desert ecosystems. There are residential houses approximately one mile west of the Site, Hickman's Egg Ranch to the immediate southwest, and Hickman's Auto Shop to the northwest. In the last five years, Hickman's Family Farms has expanded its egg production facility, added a waste drying facility to produce fertilizer

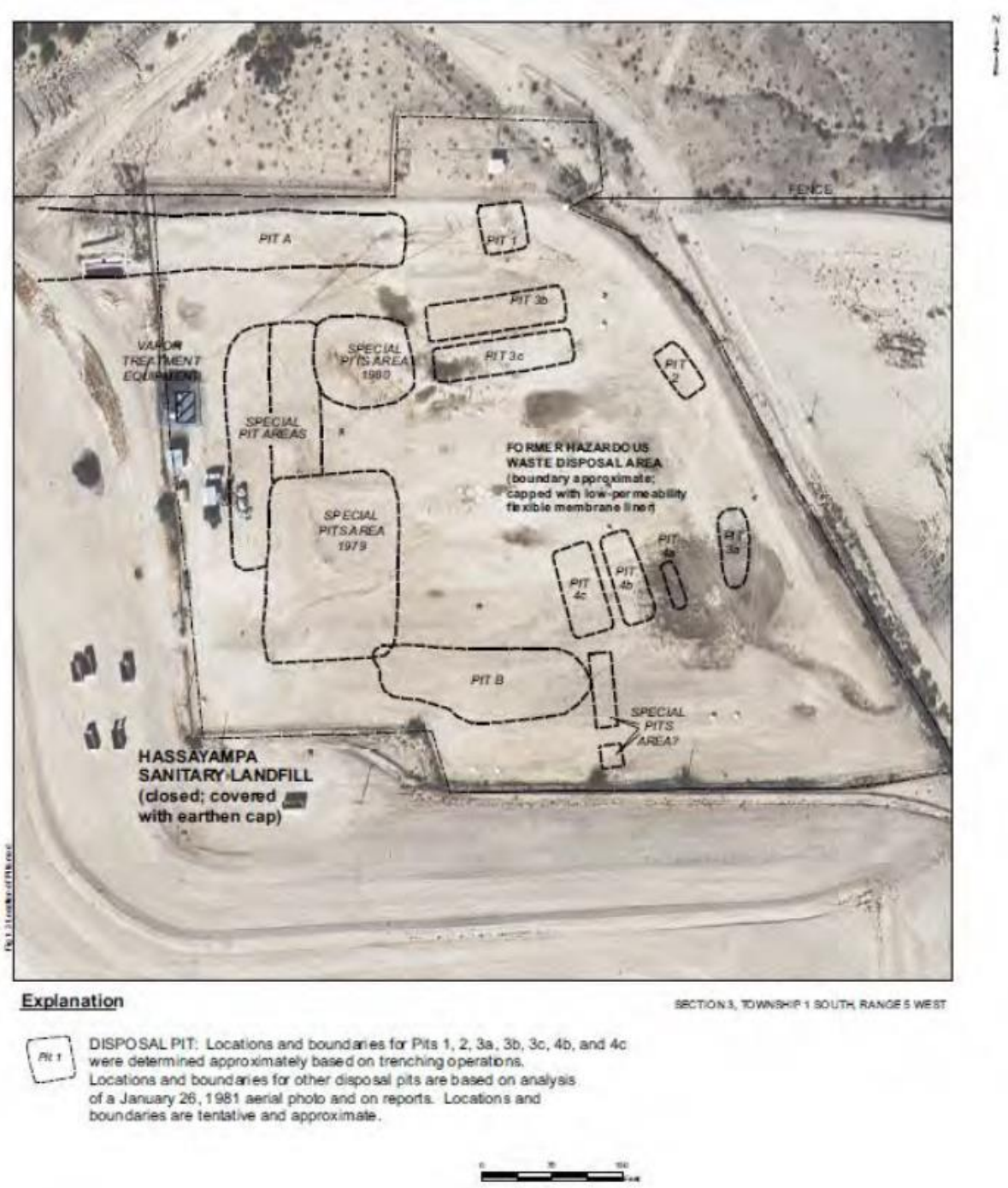
for nearby farms. In 2010, Maricopa County established a new transfer station at the closed municipal solid waste landfill northwest of the Site. The Site is secured by a fence and is not accessible to the public.

Regarding groundwater use, wells within three miles of the Site provide drinking water to approximately 350 people and irrigation for 2,800 acres of farmland. There are approximately 49 wells within a one-mile radius of the Site, 22 of which are downgradient of the Site. The nearest downgradient groundwater wells are about 2,500 yards south of the Site located on the Hickman's Egg Ranch, operated by Hickman's Family Farms. One of the wells has been installed within the last five years. These production wells are pumped from a greater depth than the contaminated groundwater aquifer at the Site.



Source: Fourth Five-Year Review for the Hassayampa Landfill Superfund Site, Figure 1, EPA, 2016.

Figure 1. Location Map

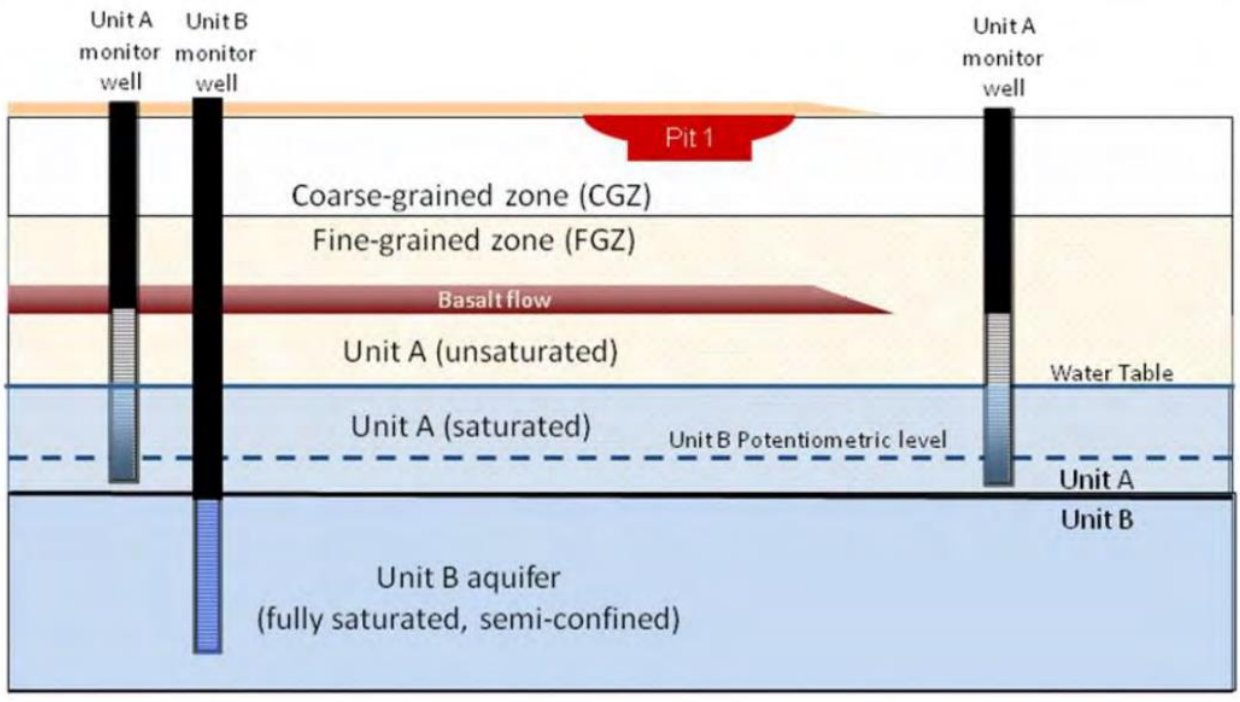


Source: Fourth Five-Year Review Report for the Hassayampa Landfill Superfund Site, Figure 3, EPA, 2016.

Figure 2. Detailed Map of the Former Disposal Pit Areas in the Northeast Corner of the Hassayampa Landfill

1.3. Hydrogeology

The Site lies within the drainage area of the Hassayampa River but is outside of the 100-year floodplain. The Hassayampa River is located approximately one mile east of the Site. The Site is located in an alluvial-filled basin, which has been influenced by the nearby river and the Arlington Mesa (Quaternary basalt flows). A regional aquifer consisting of basin-fill deposits underlies the Site and comprises the principal source of groundwater to wells in the area. The basin-fill deposits have been classified in order of increasing depth into the Upper, Middle, and Lower Alluvium units. The Upper Alluvium unit is subdivided into the Upper Alluvial Deposits Unit, Basaltic Lava-flow Unit, Unit A (fine-grained) and Unit B (coarse-grained) (Figure 3). Unit A and Unit B are both considered to be water-bearing zones within the same aquifer. There is a limited hydraulic connection between Unit A and Unit B based on the Unit B water levels not responding to pumping in Unit A and the different water quality between the two units. The regional groundwater flow direction is generally to the south-southwest in Units A and B. The groundwater flow direction in Unit A is generally to the south, and more southeast during pumping conditions. The current water table occurs at a depth of approximately 80 feet bgs in the silts and fine sands of Unit A. Unit B is composed of somewhat coarser materials than Unit A and is typically encountered at about 100 feet bgs and has a thickness of over 100 feet. Unit B is a productive aquifer in the region. Groundwater flows in Unit A are a few tens of feet per year and in Unit B are approximately 200 feet per year.



Source: Fourth Five-Year Report for the Hassayampa Landfill Superfund Site, Figure 4, EPA, 2016.

Figure 3. Conceptual Site Stratigraphy of the Upper Alluvium Unit Showing Pit 1, Relationship of the Buried Basalt Flow and Units A and B.

The shallow subsurface at the Site includes two general zones in the zone of unsaturated soils (vadose zone): an upper coarse-grained zone and a lower fine-grained zone (Hargis + Associates, Inc., and Geosyntec Consultants 2013). The coarse-grained zone generally extends from ground surface to approximately 30 feet bgs. The fine-grained zone extends from approximately 30 to 60 feet bgs and consists predominately of silts and fine sands. Beneath the fined-grained zone, at approximately 60 feet bgs, there is a basaltic lava flow unit approximately 20 feet thick which tapers out or is not present at the northern end of the Site. This basalt flow originated from Arlington Mesa to the south. An unsaturated zone, approximately 10 feet thick, lies beneath the basalt unit.

2. Remedial Actions Summary

2.1. Basis for Taking Action

The unlined waste pits received volatile organic compounds, heavy metals, solvents, pesticides, petroleum distillates, oil, acids, bases, cesspool and septic tank wastes, and lime wastes which contaminated the soil. Affected media at the Site include soil, groundwater, soil vapor, and air. The human health and ecological risk assessments summarized in the Record of Decision found that while risk for ecological receptors was low, significant health risks may exist for individuals who ingest the contaminated groundwater, contact hazardous wastes present in several of the trenches and pits, and/or breathe air on or near the Site. Risks were significant for all residential and occupational exposure scenarios. The basis for taking action was due to the threat of exposure to groundwater contaminants as a result of future off-Site migration of contaminated groundwater, and the threat of exposure to contaminated waste and soil under the residential and commercial/industrial scenarios.

2.2. Remedy Selection

Several decision documents that establish and clarify the selected remedy for the Site have been issued over the years. Table 2 summarizes the content of these decision documents.

Table 2. Summary of Decision Documents.

Decision Document	Date	Summary
Record of Decision	August 1992	Selected the remedies for cleanup of groundwater and soil vapor in the vadose zone at the Site.
Explanation of Significant Differences #1	December 2009	Established revised soil vapor performance standards based on a leaching model.
Explanation of Significant Differences #2	May 2016	Revised the soil vapor performance standards based on a vapor transport model and established the remedial action objectives for the Site.

EPA issued a Record of Decision for the soil and groundwater Site contaminants on August 6, 1992. The remedy selected by EPA in the 1992 Record of Decision includes:

- Groundwater extraction, treatment, reinjection, and monitoring;
- Soil vapor extraction and treatment;
- A multi-layer cap with a geomembrane liner over the 10-acre hazardous waste disposal area; and
- Deed and access restrictions.

For groundwater cleanup standards, EPA selected the federal drinking water standards for contaminants with drinking water standards. For those contaminants for which drinking water standards had not been established, EPA selected proposed federal drinking water standards or Health Based Guidance Levels developed by Arizona Department of Health Services. Groundwater cleanup standards established in the Record of Decision are summarized in Table 3.

Table 3. Record of Decision Groundwater Cleanup Standards.

Compound	Cleanup Standards (**µg/L**)	Basis for Cleanup Level
Benzene	5	Federal MCL
Dichlorodifluoromethane (Freon 12)	1,400	State Health-Based Guidance Level
1,1-Dichloroethene	7	Federal MCL
1,1-Dichloroethane	No cleanup standard selected	N/A
1,1,1-Trichloroethane	200	Federal MCL
1,2-Dichloroethane	5	Federal MCL
1,2-Dichloroethene (cis)	70	Federal MCL
1,2-Dichloroethene (trans)	100	Federal MCL
1,2-Dichloropropane	5	Federal MCL
Acetone	700	State Health-Based Guidance Level
Chlorobenzene	100	Federal MCL
Trichlorofluoromethane (Freon 11)	2,100	State Health-Based Guidance Level
Trichlorotrifluoroethane (Freon 113)	210,000	State Health-Based Guidance Level
Methyl ethyl ketone (2-butanone)	170	State Health-Based Guidance Level
Dichloromethane (methylene chloride)	5	Proposed Federal MCL
Tetrachloroethene	5	Federal MCL
Toluene	1,000	Federal MCL
Trihalomethanes (total)	100*	Federal MCL
Trichloroethene	5	Federal MCL
Chromium (total)	50	Federal MCL
Xylenes (total)	10,000	Federal MCL
Vinyl chloride	2	Federal MCL

*The current federal MCL for total trihalomethanes is 80 µg/L; N/A – no standard available; µg/L = micrograms per liter MCL = National Primary Drinking Water Standard expressed as the Maximum Contaminant Limit

For soil vapor cleanup standards, EPA required that soil vapor performance standards be established using site-specific modeling. Soil vapor performance standards were established in a 1996 Soil Vapor Performance Verification Plan. EPA revised the soil vapor performance standards in its 2009 Explanation of Significant Difference #1 and again in its 2016 Explanation of Significant Difference #2.

In December 2009, EPA signed an Explanation of Significant Difference #1 to update the soil vapor remedy and the soil vapor performance standards. In the Explanation of Significant Difference #1, EPA modified the soil vapor treatment technology for the soil vapor extraction and treatment system from thermal oxidation to a proprietary cryogenic treatment system. As described in the Explanation of Significant Difference #1, EPA allowed carbon treatment to be used if determined feasible and revised the soil vapor performance standards that were based on equilibrium soil vapor concentrations to result in corresponding soil screening levels.

In May 2016, EPA issued an Explanation of Significant Difference #2 which established new soil vapor performance standards based on the Soil Vapor Extraction Endstate Tool modeling to calculate performance standards which would be protective of groundwater (Table 4). As described in the Explanation of Significant Difference #2, EPA established the remedial action objectives for the Site which are consistent with the intent of the 1992 Record of Decision.

EPA did not expressly identify remedial action objectives in the Record of Decision; however, EPA clarified in the 2016 Explanation of Significant Difference #2, that the remedial action objectives for the Site are the following:

Groundwater remedial action objectives

- Prevent human exposure to groundwater contaminated by Site contaminants above maximum contaminant levels and, for contaminants that have no maximum contaminant levels, above Health-Based Guidance Levels established by Arizona.

- Restore groundwater throughout the Site to concentrations at or below the maximum contaminant levels and Health-Based Guidance Levels for Site contaminants.

Soils/Soil Vapor remedial action objectives

- Prevent human ingestion of or contact with soil or waste contaminated with Site contaminants that represents an unacceptable exposure.

- Prevent leaching or vapor transport of Site contaminants from soil and waste in the vadose zone to groundwater by attaining and maintaining soil vapor concentrations below soil vapor performance standards that are protective of groundwater quality and will not result in degradation of groundwater at concentrations above groundwater cleanup values at the Site boundary.

Table 4. Soil Vapor Performance Standards from the Explanation of Significant Difference #2.

Volatile Organic Compound	Soil Vapor Performance Standards (µg/L)
Acetone	10
Benzene	14
2-Butanone (MEK)	4
Chlorobenzene	287
Dichlorodifluoromethane (Freon 12)	184,658
1,1-Dichloroethene	148
1,2-Dichloroethane	4
1,2-Dichloropropane	10
Cis-1,2-Dichloroethene	184
Trans-1,2-Dichloroethene	5
Dichloromethane (methylene chloride)	10
Tetrachloroethene	117
1,1,1-Trichloroethane	3,070
Toluene	3,873
Trichloroethene	38
Trichlorofluoromethane (Freon 11)	188,370
Trichlorotrifluoroethane (Freon 113)	3,289,020
Xylenes	43,476
Vinyl Chloride	90

µg/L = micrograms per liter

2.3. Remedy Implementation

The Hassayampa Steering Committee implemented the remedy pursuant to the Administrative Consent Order (EPA, 1988), the EPA 1992 Record of Decision, the Administrative Order (EPA, 1993), the Consent Decree, the EPA 2009 Explanation of Significant Difference #1, and the EPA 2016 Explanation of Significant Difference #2.

In 1994, the Hassayampa Steering Committee (composed of the companies responsible for implementing the remedy) completed construction of the Site Remedy including: a groundwater extraction and treatment system that includes a building with an air stripper treatment unit, four extraction wells and one injection well; 29 monitoring wells to monitor the effectiveness of the treatment system; a multi-layer membrane and soil cap meeting the requirements of Subtitle C of the Resource Conservation and Recovery Act to prevent erosion and infiltration of contaminants into the groundwater; and a 6-foot-high two-inch mesh chain link fence with locking gates and barbed wire to encompass the perimeter of the Site to restrict access, with signs identifying the Site as a hazardous waste site every 100-feet. Additionally, an environmental covenant between Maricopa County and the Arizona Department of Environmental Quality was executed that requires all future use of the property to remain as a landfill pursuant to Arizona Revised Statutes (A.R.S.) 49-771. The environmental covenant restricts all excavation, grading, drilling, or mining at the Site except as approved by the Arizona Department of Environmental Quality.

In 1996, the initial soil vapor extraction and treatment system was constructed. The system consisted of a catalytic oxidation technology (also known as a regenerative thermal oxidation system) for treatment of the soil vapor from 22 soil vapor monitoring/extraction wells. This system was shut down in 1999 and replaced in 2006 with another system which was further modified in 2016. Details regarding the system changes are discussed in Section 2.4.

2.4. System Operations/Operation and Maintenance, and Optimization

Operation and maintenance activities, monitoring, and investigations at the Site are conducted in accordance with the 2017 Performance Monitoring and Verification Plan for Soil Vapor and Groundwater and the Consolidated Operations and Maintenance Manual for the Hassayampa Landfill Superfund Site and prior versions as applicable.

Groundwater Remediation System

The groundwater remediation system consists of four Unit A extraction wells EW-01UA through EW-04UA; an air stripper and associated piping, pumps, and controls; one Unit B injection well (IW-01UB); 20 Unit A groundwater monitor wells, including wells MW-01UA through MW-14UA and MW-16UA through MW-21UAR, and nine Unit B groundwater monitor wells, including wells MW-01UB through MW-04UB, MW-06UB, MW-09UB, MW-10UB, MW-15UB, and MW-21UB (Figure 4).

Site inspections are performed monthly (by Geosyntec and Hargis+Associates on behalf of the Hassayampa Steering Committee), to verify all systems are in working order and to perform any needed preventative maintenance. Influent sampling is conducted annually, and effluent sampling is conducted monthly after treatment in the air stripper. Total discharge of volatile organic compounds to the atmosphere is calculated to ensure compliance with emissions criteria by determining the total mass removed by the air stripper based on the groundwater influent and effluent concentration data. Operating extraction wells are sampled quarterly, and non-operating extraction wells are sampled annually. Annual maintenance is also conducted on the system, including dismantling the air stripper, manual scraping and cleaning during disassembly, an acid bath, rinsing, and reassembly. Most monitoring wells are sampled on a quarterly basis and a few are sampled semi-annually or annually. The sampling schedule is modified as needed depending on the location of the wells and the results.

Soil Vapor Extraction System

The Hassayampa Steering Committee operated the first soil vapor extraction system intermittently between 1996 to September 1998. In March 1999, the thermal oxidation treatment system was shut down after it failed several compliance tests for destruction efficiency (contaminant destruction) the previous year. Approximately 3,700 pounds of volatile organic compound contaminants were removed from the subsurface soils between 1996 and 1998.

Data collected in 2005 indicated the need for further soil vapor extraction treatment at the Site after the system had been shut off for 7 years. The Hassayampa Steering Committee began an investigation to further characterize the migration of subsurface soil vapors at the Site and in 2006, the Hassayampa

Steering Committee installed a replacement soil vapor extraction system with a proprietary cryogenic technology and carbon treatment to remove the volatile organic compound contaminant vapors from the system. During a subsequent 2007 investigation, significant upward trends in the concentrations of the volatile organic compounds in the vadose zone soil vapor plume were detected. There was unexpected contamination of groundwater in an up-gradient groundwater monitoring well (MW-11UA) due to vapor migration. Therefore, additional soil vapor monitoring wells were installed, and 3 groundwater wells were temporarily converted to soil vapor extraction wells. In 2011 these groundwater wells were returned to use as soil vapor/groundwater monitoring wells.

In 2015, the Hassayampa Steering Committee conducted a pilot test to evaluate the feasibility of changing to vapor-phase granulated activated carbon to treat the soil vapor, rather than the cryogenic treatment system. The results of the pilot test indicated that switching to carbon treatment would be more cost effective than continuing to operate the cryogenic system. In January 2016, the Hassayampa Steering Committee dismantled the cryogenic treatment system, and installed a full-scale vapor phase granular activated carbon soil vapor extraction treatment system in May 2016 and began its operation in August 2016. The Performance Monitoring and Verification Plan for the new system was submitted on March 21, 2017 and approved by EPA on March 24, 2017. A Consolidated Operations and Maintenance Manual was completed in August 2017.

Currently, the soil vapor extraction system is periodically turned off to determine if cleanup levels have been met based on the selected criteria (rebound tests). If the criteria are not met, the system is re-started. See Section 3.1 Work Completed at the Site During this Five-Year Review Period for more information.

Flow rates from individual extraction wells are evaluated approximately weekly as a part of operation and maintenance activities by collecting measurements of Pitot tube differential pressures and applied well head vacuums. Volatile organic compound concentrations of the extracted vapors are evaluated at each extraction well. Annual and semiannual soil vapor monitoring are conducted in October and April, respectively. The 2,000-pound vapor granular activated carbon vessels are replaced as needed as determined by the sampling results, typically occuring on an annual basis. Condensate is removed and sent off-site as needed. Influent and effluent samples are collected monthly from the soil vapor extraction system during operation. System emissions calculations are performed if any month shows a removal efficiency below the target of 90%. The system will be shut down if volatile organic compounds and hazardous air pollutants are above 9 lbs/day and 6 lbs/day respectively, or if system exhaust exceeds 100 parts per million by volume.

Soil Cap

The monitoring program for the cap includes inspection of the cap monthly, annually, and following severe rainstorm events. Repairs are performed as needed based on the inspections.

Deed and Access Restrictions

The covenant restricting land use to a landfill remains recorded with the County and does not require any monitoring. The site security fence is inspected and repaired if necessary.

3. Previous Five-Year Review Protectiveness Statement and Issues

The protectiveness statement from the 2016 Five-Year Review for the Hassayampa Landfill Superfund Site stated the following:

The remedy at the Site is protective of human health and the environment. Concentrations of Contaminant of Potential Concerns (COPCs) are decreasing, but the groundwater cleanup standards and the 2016 SVPS have not yet been achieved. Currently, there are no environmental exposure pathways that result in unacceptable risks. The SVE system is successfully preventing vapor transport of COPCs from the vadose zone to groundwater and the groundwater remediation system is preventing further migration of COPCs in groundwater. Engineering and institutional controls prevent unacceptable exposure to COPCs in soil and groundwater.

The 2016 Five-Year Review did not identify any issues or recommendations.

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

Site inspection and maintenance occurred monthly. Personnel were not on-Site daily, however, alarms were triggered if system failures occur as operations are automated and with sensors with preprogramed shutdown thresholds. Occasional power outages have occurred on the Site resulting in system shutdowns due to weather and scheduled maintenance. The contractors have been responsive to shutdowns and have restarted the system and communicated issues to the EPA and ADEQ in a timely manner.

Over the last 5 years, the Hassayampa Steering Committee contractors have met approximately semi-annually which typically include site visits by project managers to evaluate site and system conditions. Semi-annual meetings with EPA and ADEQ personnel and contractors have been held to provide updates of on-going work at the Site, review plans for upcoming work and to review and discuss the results of sampling events.

Groundwater Remediation System

The groundwater remediation system operated approximately 98% of the time during this five-year review period and was offline during power outages, low airflow alarms, maintenance for routine mechanical issues, such as pump failures, or annual maintenance. These issues are accounted for in annual planning and there are strategies in place to address them quickly and minimize downtime in the event they occur. Even though the system has been performing well overall, it is aging, and increased maintenance issues are expected in the future. The remaining life span of the system and its components should be evaluated to ensure minimal downtime will continue.

During this reporting period, only extraction wells EW-03UA and EW-04UA were in operation. Extraction wells EW-01UA and EW-02UA are have been in stand-by mode since mid-2010 as the wells are not needed to maintain capture of affected groundwater. Water samples from the monitoring wells

(typically 2 biennially, 14 annually, 9 semiannually, 5 quarterly, 2 non-operating extraction wells annually), 2 operating extraction wells quarterly, and quarterly air stripper influent and monthly effluent were collected.

Approximately 3.4 gallons per minute are pulled by the two extraction wells for treatment. The volume of groundwater (in gallons) that was pumped and treated was approximately 1.8 million, 1.7 million, 1.5 million, 1.6 million and 1.8 million in 2016, 2017, 2018, 2019, and 2020, respectively. Approximately 400 pounds of volatile organic compound chemicals were removed from the groundwater Unit A from 1994 through 2020 (3 pounds in 2020). Groundwater remediation system performance monitoring results are further discussed in the Data Review Section 4.2.1 Groundwater.

The system water effluent samples have all be non-detect over the last five years except for acetone in 2016, which was not a confirmed result. On average, volatile organic carbon mass in the air stripper emissions were 0.012 lb/day in 2016, 0.010 lb/day in 2017, 0.007 lb/day in 2018, 0.006 in 2019, and 0.008 lb/day in 2020.

Soil Vapor Extraction System

Several planned shutdowns and restarts for the soil vapor extraction system for rebound testing occurred during the Five-Year Review period. The soil vapor extraction system first shut down on September 11, 2017 to begin the initial rebound testing program, and following three months of rebound testing, the Vapor-phase Granular Activated Carbon soil vapor extraction system was restarted on January 15, 2018. The system was shut down on July 9, 2018, and after three months the system was restarted on November 20, 2018. A third round of rebound testing began on July 8, 2019, and after nine months, the Vapor-phase Granular Activated Carbon soil vapor extraction system was restarted on June 2, 2020. The system has remained operational through the remainder of the 2020 reporting period. The Hassayampa Steering Committee performed soil vapor monitoring during 2020 which included: sampling of selected Fine-Grained Zone and sub-basalt vapor monitoring wells for fixed laboratory analysis of volatile organic compound chemicals as part of the combined semiannual and 9-month soil vapor extraction rebound testing sampling events in April 2020; and sampling of select Course-Grained Zone, Fine-Grained Zone and sub-basalt vapor monitor wells for fixed laboratory analysis of volatile organic compound chemicals as part of the annual sampling event in October 2020.

The 2,000-pound vapor granular activated carbon vessels were replaced with new carbon in 2016, 2017, 2018, 2019, and 2020. The spent carbon was shipped off-site for disposal. Condensate that collected in the condensate storage vessel was not removed from the Site in 2020 but was removed and shipped off-site for disposal in 2016, 2017, 2018, and 2019. The spent carbon and condensate wastes were profiled and sent to a hazardous waste facility if required. Influent and effluent samples were collected monthly from January through July in 2017, 2018, and 2019 and June through December 2020 from the soil vapor extraction system.

The total mass volatile organic compound chemicals removed from the vadose zone during the reporting period was 3,275 pounds, 813 pounds, 588 pounds, 345 pounds, and 540 pounds in 2016, 2017, 2020, 2018, 2019, and 2020, respectively. Since soil vapor extraction activities were resumed in March 2006, a

total of approximately 223,880 pounds (over 111 tons) of volatile organic compound chemicals have been recovered. Soil vapor extraction system monthly removal efficiencies were calculated to be between 47.98-99.99+% in 2016, 62-99+% in 2017, 29-99.9+% in 2018, 2-99.9+% in 2019, and 80-99.9+% in 2020. System emissions calculations of were performed when removal efficiency was below 90%. Emissions were all well below the emissions requirements of 9 lbs/day for volatile organic compounds (maximum of 1.61 lbs/day in December 2018) and 6 lbs/day for hazardous air pollutants, except for December 2018 at 12.48 lbs/day of hazardous air pollutants. In October 2020 there was a slight exceedance of the shutdown criteria of 100 parts per million by volume in the exhaust, so the system was shut down until the carbon was replaced. The calculated emissions for that month were determined to be 0.38 lbs/day of volatile organic compounds and 0.54 lbs/day hazardous air pollutants.

Soil Cap

Routine inspections of the cap were performed according to the maintenance requirements to ensure the integrity of the cap such as to identify potential damage by erosion and monitor rodent control measures. Minor recurring erosion issues were identified near the main gate of the Site in 2020. As in the past, this issue has been addressed in a reasonable timeframe by the County who assists the Hassayampa Steering Committee with minor repairs. These areas of recurring erosion are related to runoff from the adjacent closed municipal solid waste landfill area during major rain events and efforts to find a permanent solution are ongoing. Pest control was conducted monthly for the Site, and additional measures were taken if needed to address periodic rodent activity.

Deed and Access Restrictions

The land use restriction remains in place and no land use changes have been observed. No issues have been reported regarding the site security fence.

4. Five-Year Review Process

4.1. Community Notification and Site Interviews

4.1.1. Five-Year Review Public Notice

EPA issued a public notice in the *West Valley View*, on March 10, 2021, stating that EPA was conducting a Five-Year Review and inviting the public to submit any comments to the EPA (Appendix F). No comments were received. The results of the review and the report will be made available at http://www.epa.gov/superfund/hassayampalandfill and the following Site information repositories:

Arizona Department of Environmental Quality
1110 W. Washington Street
Phoenix, Arizona 85007
(602) 771-4380
http://azdeq.gov/records-center

EPA Superfund Records Center
75 Hawthorne Street
Room 3110
San Francisco, California, 94105
(415) 947-8000

4.1.2. Site Interviews

During the Five-Year Review process, interviews were conducted to document any perceived problems or successes with the remedy that has been implemented to date (Appendix G). The results of these interviews with the Hassayampa Steering Committee Project Manager, the Hassayampa Steering Committee consultant Geosyntec (Principal Engineer and Project Manager), the Hassayampa Steering Committee Project Manager, the Hassayampa Steering Committee consultant Hargis and Associates Senior Hydrogeologist, U.S. Army Corps of Engineers Geologists, Maricopa County Risk Control and Loss Prevention Manager, CALIBRE Systems, Inc a consultant to the Arizona Department of Environmental Quality, the Project Manager, former Project Manager, and Unit Manager for the Arizona Department of Environmental Quality are summarized below.

All interviewees felt that the project is progressing as expected and that communication among all parties is ongoing and beneficial. They indicated that the groundwater and vapor plumes are contained and decreasing in size while removing volatile organic compounds from groundwater and soil vapor.

The Senior Hydrogeologist at Hargis+Associates stated "Off-Site, down-gradient migration of Site-related constituents has been prevented, the vertical migration potential of contaminants in groundwater is low, and the remedy at the Site has been operated and maintained in a manner that has been and remains protective of human health and the environment. The soil vapor system has been successful in decreasing soil vapor concentrations to below the Soil Vapor Performance Standards during operation and has been undergoing a series of rebound tests to evaluate how much longer it will continue to be needed. Groundwater concentrations are decreasing in all wells except those located between the source area (Pit 1) and the extraction wells." Hargis performs monthly Site inspections and operation and maintenance on Site components per the schedule approved in the operation and maintenance manual. Monthly inspections include cap condition, security, well conditions, groundwater recovery system operation/condition, etc. Hargis completes more thorough inspections annually, including teardown and cleaning of the groundwater recovery system and they conduct groundwater sampling.

The Principal Engineer and the Project Manager with Geosyntec stated the following "Groundwater and soil vapor conditions are frequently monitored to demonstrate contaminant containment and steady progress towards remedial goals. Through operation of the soil vapor extraction system, soil vapor data have exhibited significant declines, where the magnitude and extent of volatile organic compounds in soil vapor have been dramatically reduced in comparison to conditions in 2006 when soil vapor extraction system was restarted. Per the Agency approved Performance Monitoring and Verification Plan, soil vapor volatile organic compounds concentrations in the Pit 1 source area have been reduced to levels that support rebound testing and possible shutdown. Reductions in soil vapor volatile organic compounds concentrations have resulted in commensurate declines in influent volatile organic compounds concentrations to groundwater remediation system. These data trends continue to support the Conceptual Site Model for the Site that was jointly prepared with the Agencies."

According to the Arizona Department of Environmental Quality (ADEQ) current and former Project Managers and current Unit Manager, monitoring data indicates that impacts to groundwater are limited to

a few on-Site wells and vapor concentrations are below the soil vapor performance standards. The SVE system was shut down for rebound testing on several occasions. The system was restarted a few months later after sampling indicated an increase of chemical concentrations (for several contaminants) over the performance standards. The age of the groundwater system has resulted in increased equipment malfunctions causing system shutdowns. They also stated that "Within the next 5 years Groundwater Remediation System equipment nearing end of life should be replaced…" This was further echoed by the Unit Manager who stated that the age of the system does have the potential to increase maintenance costs as made evident by the reported equipment failures and malfunctions. They noted that countermeasures should be discussed to reduce the frequency of power outages, especially during the summer monsoon season.

4.2. Data Review

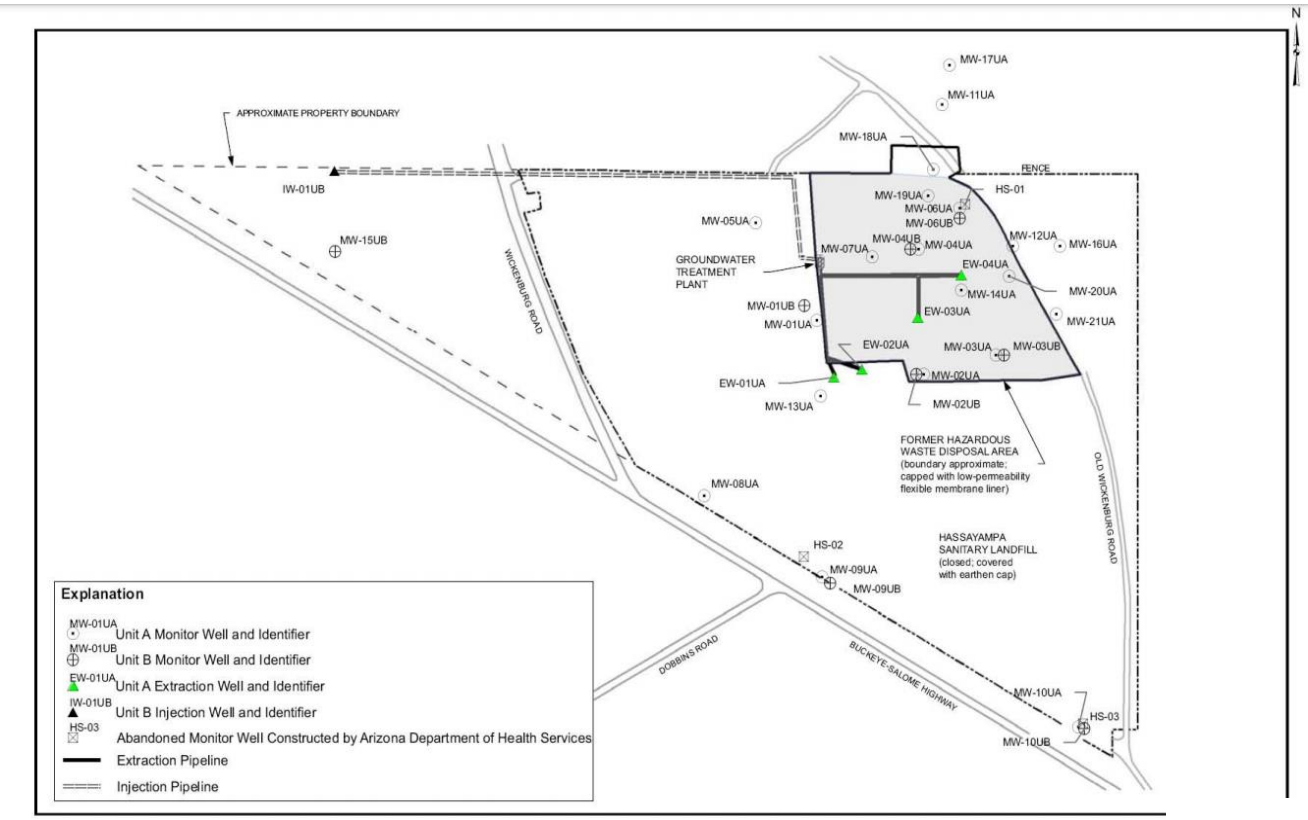
4.2.1. Groundwater

Groundwater contamination at the Site is primarily located near Pit 1 (Figure 2) and decreases in concentration moving away from Pit 1. The aquifer has two units, the shallower Unit A and a deeper Unit B. The contamination is located in Unit A. Comparison of water level elevations from paired wells completed in Units A and B indicated that water level elevations in Unit A monitor wells are, on average, about 18 feet higher than water level elevations in monitor wells completed in Unit B. These data suggest that a downward vertical gradient exists between these two units. However, based on data collected to date, while there is evidence that some migration of contaminants has occurred from Unit A to Unit B such as intermittent detections of 1,1-dichloroethane (1,1-DCA) in MW-01UB, it is not occurring at concentrations above the groundwater performance standards. While the gradient between aquifer Unit A and Unit B is downward, the pump and treat system reduces the vertical gradient reducing the potential for vertical migration between the aquifer units. The pump and treat system located in Unit A is primarily used for containment and to depress the water table beneath Pit 1. If the pump and treat system was turned off, the groundwater levels would increase and saturate contaminated soil and mobilize contaminants into the groundwater. Appendix C includes a summary of the groundwater exceedances during the reporting period and results of the Mann-Kendall analysis.

4.2.1.1 Hydraulic Capture

Containment of groundwater contamination was determined by groundwater gradients, down gradient wells with no detections and results of a recovery test. Groundwater in the A Unit flows to the southeast across the Site except near the extraction wells where groundwater flows towards the extraction wells. The wells with concentrations exceeding cleanup levels are within the capture zone and down gradient wells have been non-detect during the reporting period (Figure 5). An aquifer recovery test was conducted in 2019 to evaluate contaminant migration with the pump and treat system off. The recovery test was planned for one year; however, the extraction wells were turned back on after one month due to groundwater flow direction near MW-12UA shifting from southwest to a more southeasterly flow which had the potential to allow contamination to migrate off site. The groundwater gradient during pumping compared to the results of the recovery test confirmed the pump and treat system is creating hydraulic capture.

Two monitoring wells (MW-6UA and MW-19UA) located between Pit 1 and the extraction wells had increasing trends during this five-year review period. The greatest increase in concentration was at MW-06UA which had 1,1-DCE increase from 1,700 µg/L in April 2015 to 4,340 µg/L in July 2020. The reason for the increasing tends is not completely understood however it may be caused by groundwater contamination migrating from Pit 1 towards the extraction wells. The wells with increasing trends are within the capture zone so the contamination is expected to be removed by the pump and treat system. The plume migration will continue to be monitored to ensure it does not migrate past the extraction wells.



Source: Third Five-Year Review Report for the Hassayampa Landfill Superfund Site, Figure 2, EPA, 2011.

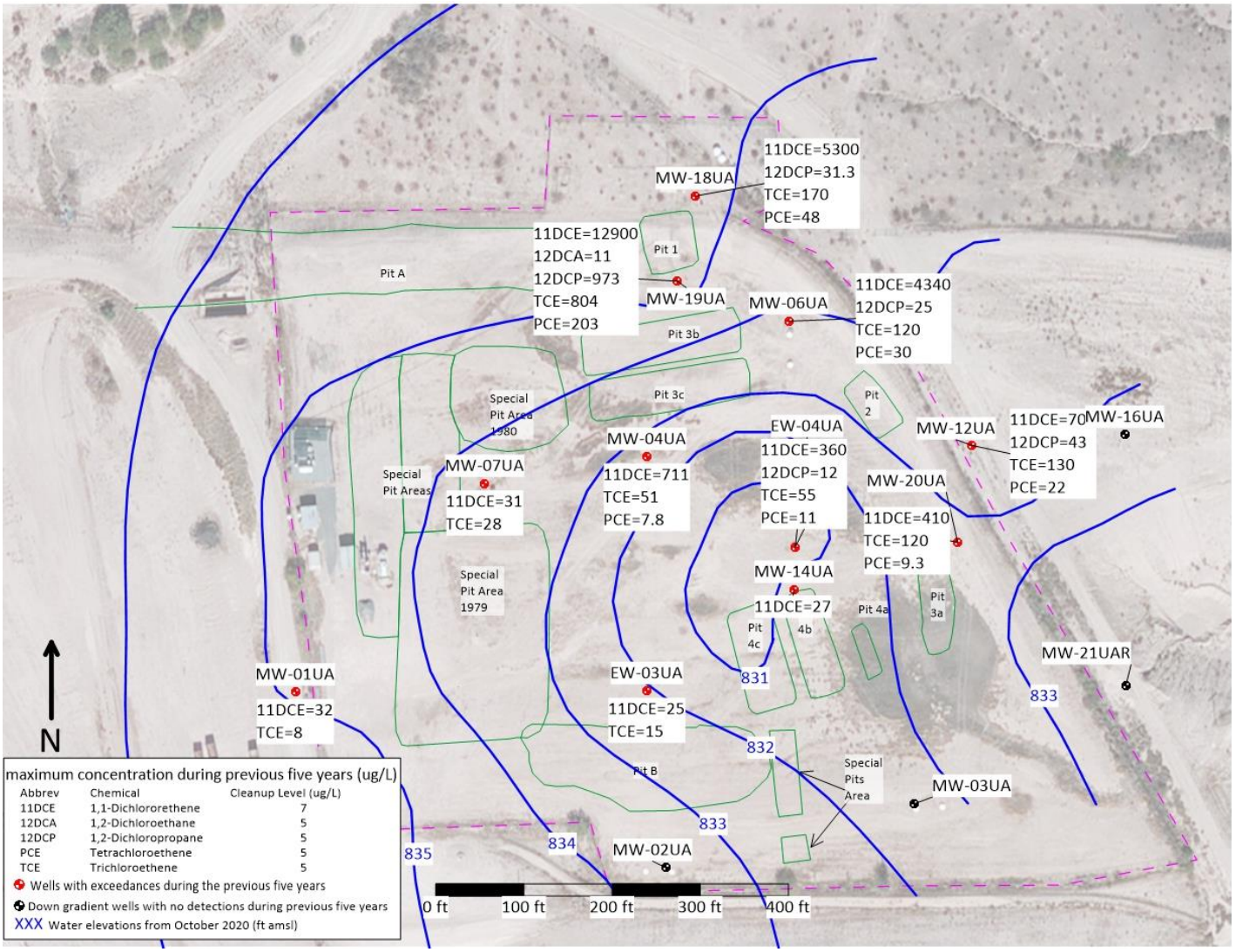
Figure 4 Monitoring and Extraction Well Locations

4.2.1.2 Groundwater Restoration

Restoring groundwater to beneficial use is not likely to occur in a reasonable time frame based on the high concentrations of contaminants in groundwater (129,000 µg/L of 1,1-DCE at MW-19UA) and the slow removal rate (approximately 3.4 pounds per year) of contaminants by the pump and treat system (Figure 6). The mass of contaminants removed from groundwater by the groundwater remediation system is calculated as the product of influent volume and average total concentrations of contaminants. The contaminant mass removal rate from groundwater has reached asymptotic levels (Figure 6) so the pump treat system is doing little to restore the aquifer to beneficial use.

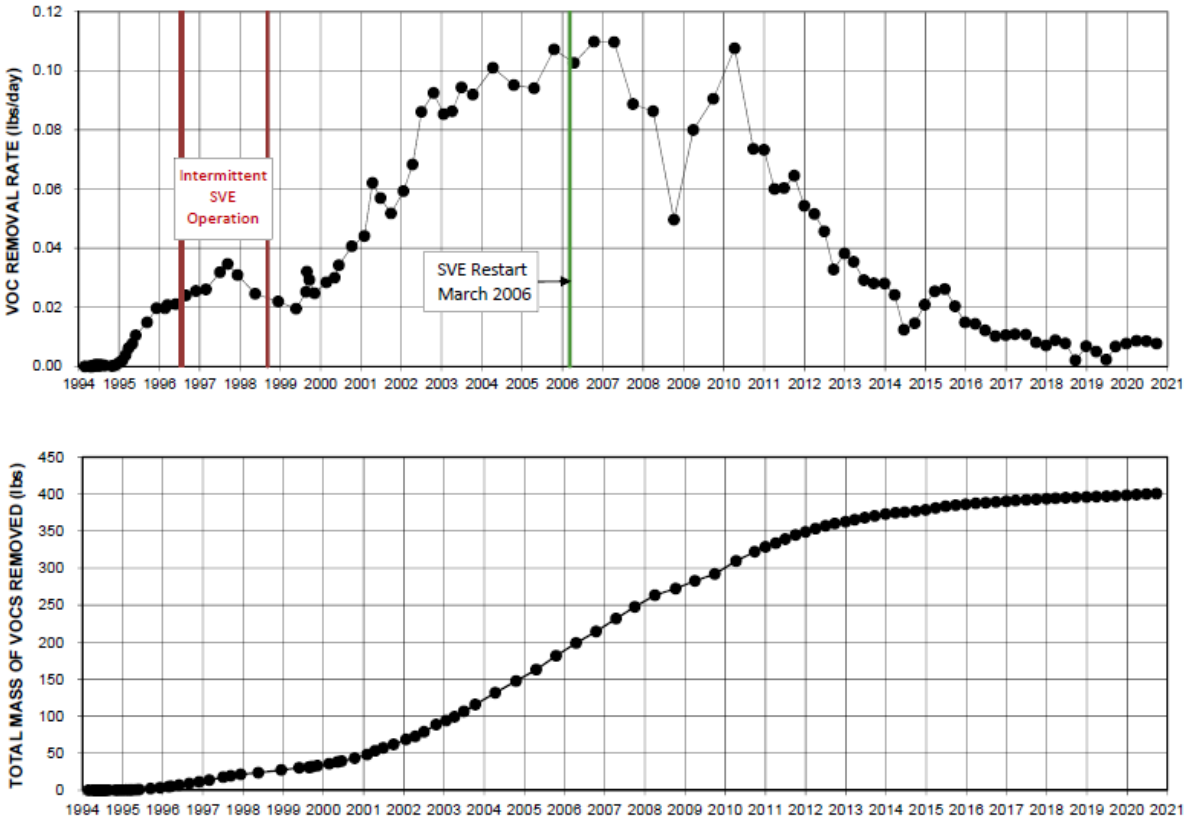
The primary source of contamination in groundwater was vapor phase contaminants leaching into groundwater. The soil vapor extraction system is now removing the vapor phase as a source of contamination, however high concentrations of contaminants in the groundwater will remain. The estimated time to cleanup groundwater is between several decades to greater than 100 years. USACE estimated the cleanup time using the extraction rate of the pump and treat system, the estimated pore volume of the area of influence of the pump and treat systems and the number of pore volumes that need to be pumped out to reduce the concentration of 1,1-DCE from 129,000 to 7 µg/L.

Groundwater contaminant mass would need to be removed at a higher rate than the current pump and treat system to achieve cleanup in a reasonable time frame. When it is determined that the soil vapor extraction system has met the soil vapor performance standards then treatment of groundwater in the source area should be evaluated to decrease the time to cleanup. The second Five-Year Review included a source area analysis that provided potential methods for optimizing treatment in the source area.



Source: Adapted by USACE from Figure 7 of the 2020 Annual Groundwater Monitoring Report, Hargis + Associates, Inc., 2021.

Figure 5. Maximum Groundwater Exceedances from 2015 through 2020 (units in µg/L)



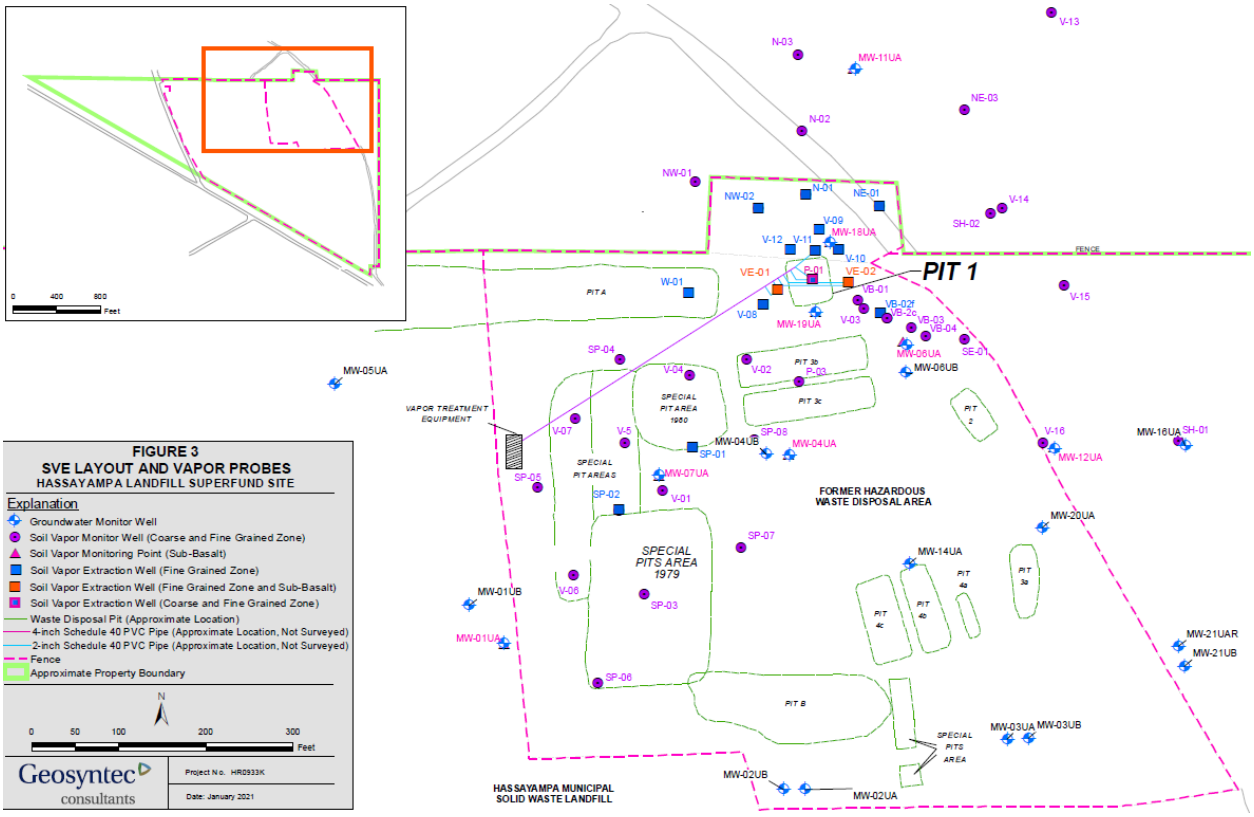
Source: Figure 12 from the 2020 Annual Monitoring Report, Hargis + Associates, Inc., 2021.

Figure 6. Groundwater Pump and Treat Mass Removal

4.2.2. Soil Vapor

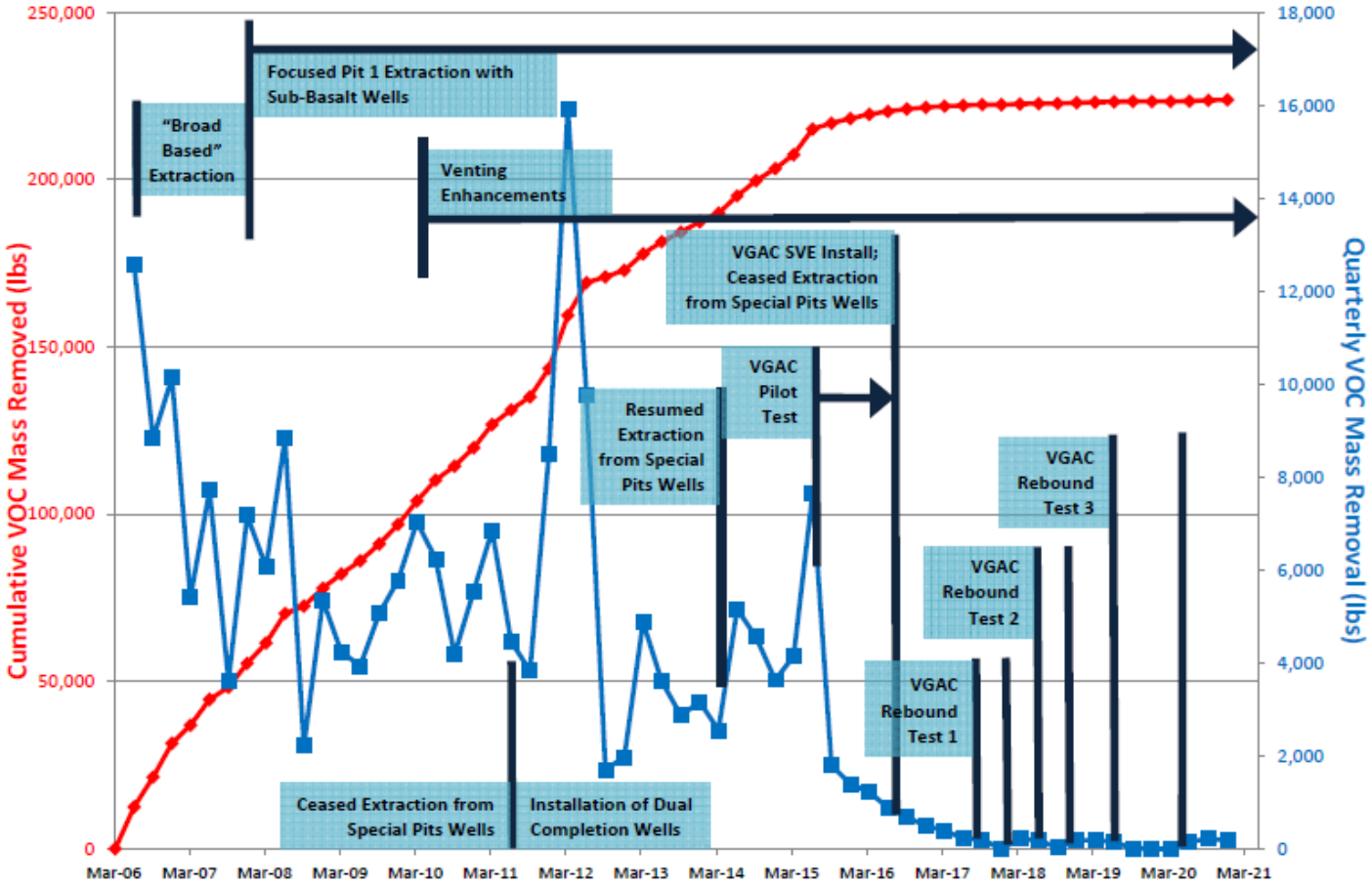
Soil vapor at the Site is a source of contamination for groundwater and the removal of the soil vapors has decreased volatile organic compound concentrations in groundwater. Since 2006, the soil vapor extraction system (Figure 7) (11 fine-grained zone extraction wells, 1 coarse-grained zone extraction well, 2 dual completion wells) has removed over 200,000 pounds of volatile organic compounds (Figure 8). Soil vapor performance standards (Table 4) were developed to determine the concentration of soil vapor that would not cause groundwater concentrations to exceed cleanup levels. The soil vapor performance standards are compared to the arithmetic mean of the concentrations from eight wells near Pit 1 (Table 5). During the reporting period the most soil vapor performance standards exceedances were for 1,2-Dichloroporpane which exceeded the soil vapor performance standards six out of the fifteen times it was sampled for during the reporting period. All soil vapor performance standards exceedances, since 2017, have occurred when the soil vapor extraction system has been off for rebound tests. Three rebound tests have been completed for the soil vapor extraction system during the reporting period. The first two rebound tests completed in 2017 and 2018 lasted three months and the soil vapor performance standards

were exceeded at the end of the three months. The third rebound test in 2019 lasted nine months and soil vapor performance standards were not exceeded until the end of the test at nine months. Based on the decrease in concentrations at the soil vapor monitoring wells and the longer timeframes for the soil vapor concentrations to exceed standards during shutdown periods, the soil vapor extraction system is close to meeting the soil vapor performance standards.



Source: Figure 3 from the 2020 Annual Monitoring Report, Geosyntec consultants, 2021.

Figure 7 Location of Soil Vapor Extraction Wells



Source: Figure 14 from the 2020 Annual Monitoring Report, Hargis + Associates, Inc., 2021.

Figure 8. Soil Vapor Extraction (SVE) System Mass Removal

Table 5. Soil Vapor Exceedance During the Reporting Period

	1,2-DCP	DMK	MC	MEK	TCE
SVPS	***10***	***10***	***10***	***4***	***38***
4/15/2015	19.6	21.4	9.9	9.9	43.7
10/14/2015	16.4	50.9	9.4	8.6	37.3
4/13/2016	10.9	21.9	4.8	3.7	21.8
10/12/2016	7.7	13.0	4.9	1.4	11.5
4/11/2017	8.5	8.5	5.0	1.3	17.1
10/11/2017	9.5	9.0	3.9	3.2	16.8
12/12/2017	14.0	3.4	8.1	1.3	20.4
4/23/2018	5.8	4.8	2.3	1.1	11.4
8/9/2018	5.9	6.1	2.6	0.3	8.3
10/9/2018	10.5	4.6	5.5	0.6	21.0
4/17/2019	2.9	2.6	1.0	0.1	3.5
8/8/2019	7.6	2.9	2.8	0.4	12.0
10/8/2019	9.1	2.1	5.7	0.3	17.5
4/14/2020	10.5	2.6	12.4	0.3	12.8
10/14/2020	2.7	3.9	2.5	0.3	5.9

Arithmetic mean of concentrations from eight wells near Pit 1
Wells used: MW-18UA, MW-19UA, P-01-FINE, V-11-FINE, VE-01-FINE, VE-01-SB, VE-02-FINE, VE-02-SB
Highlighted cells are SVPS exceedances

SVPS= Soil Vapor Performance Standards
12DCP= 1,2-Dichloropropane
DMK= Acetone
MC= Methylene Chloride
MEK= Methylethylketone
TCE= Trichloroethene

4.3. Site Inspection

On October 20th and 21st, 2020, Matthew Masten, USACE, conducted a site inspection on behalf of EPA to oversee the annual groundwater treatment system maintenance. Hassayampa Steering Committee contractors Jeffery Menken, Michael Hall and Daniel Hall of Hargis+ Associates were also in attendance. The visit included contractor visual observation of overall site conditions, update on the current status of the remedy, and inspection of the disassembly and cleaning of the air stripper system. The trays, chutes, and pans from the air stripper were removed for cleaning and inspected for pitting and leaks. No remarkable damage was noted. Once all the scale was removed, the air stripper was reassembled. The system appeared to be in good functional shape, with no leaks.

On July 13, 2021, Mr. Masten conducted the Five-Year Review Site inspection on behalf of EPA. Natalie Romanoff, the Arizona Department of Environmental Quality Project Manager and Hassayampa Steering Committee contractors were also in attendance. They visually inspected the landfill site. No erosion problems were noted near the gate or on the cap. The site appeared to be in good shape overall. The vegetation was notably well maintained and mowed down compared to the previous year. Lack of monsoon moisture in the summer likely played a factor.

5. Technical Assessment

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

Yes, the remedy is functioning as intended as the groundwater remediation system, soil vapor extraction system, landfill cap, and institutional controls are functioning according to the decision documents. In addition, decreasing site contaminant trends and the effective capture and control of them are occurring. The Hassayampa Steering Committee conducts quarterly, semi-annual, and annual monitoring; maintains logs for the groundwater remediation system and soil vapor extraction treatment systems; and ensures compliance with the Record of Decision.

The groundwater remediation system and the soil vapor extraction system are equipped with alarm notifications systems and provide real-time notification if unexpected operational failure occurs such as due to power outages. Systems are brought back online in a timely fashion and downtime has not impacted the effectiveness of the remedial systems.

Groundwater Remediation System

The groundwater remediation system is functioning successfully to ensure volatile organic compound contamination is being captured and controlled at and in the immediate vicinity of the Site. Capture of contaminated groundwater in Unit A appears to be maintained by the extraction system. Concentrations are decreasing except for wells MW-06UA and MW-19UA located between Pit 1 and the extraction wells. The overall decreasing trends indicate the systems are functioning as intended, and the increases between Pit 1 and extraction wells are likely do to contaminant migration from the source area towards the extraction wells, which is a desired outcome of remediation. Additionally, Unit A groundwater is being captured by the groundwater extraction wells limiting contaminant flows between Unit A and Unit B, so vertical migration of contaminants in Unit A to Unit B groundwater does not appear to be occurring. Unit B groundwater contaminant concentrations are below groundwater cleanup standards. Additionally, emissions from the air stripper are all below regulatory standards.

However, the pump and treat system removes a relatively small amount of mass from the Site compared to the vapor extraction system and has a minimal impact on the overall mass at the Site. The pump and treat system will need to be operated indefinitely for several decades to over 100 years to cleanup groundwater to beneficial use. The second Five-Year Review included a source area evaluation that provided a brief evaluation of available methods for cleaning up groundwater in the source area. Additional groundwater treatment in the source area should be re-evaluated after the soil vapor extraction system meets the soil vapor performance standards in the vadose zone. This is anticipated to occur prior to the next Five-Year Review. Additionally, various components of the pump and treatment will likely require replacement as the system ages.

Soil Vapor Extraction System

The soil vapor extraction system, which restarted in 2006, is functioning as intended. During soil vapor extraction operation, only nine wells had concentrations that exceed the standards, and concentrations of contaminants in the vadose zone are decreasing. The soil vapor volatile organic compound concentrations are below the soil vapor performance standards in monitoring wells near the source area (Pit 1). 1,2-Dichloropropane and Methylethylketone exceeded soil vapor standards in April 2020 but were below the standards in October 2020. While the system has been shut down and re-started numerous times to assess the rebound of contaminants, the soil vapor extraction system shutdown and restart cycles are a tool to determine if the soil vapor concentrations will remain below the performance standards and not an indication of remedy performance issues. There has been one shut down in October 2020 due to exceedances in air emissions however, typically the emissions are well below standards. One other instance of effluent above the hazardous air pollutants occurred in December 2018. These isolated instances of emissions exceedances do not indicate a significant issue with remedial performance.

Soil Cap

The multilayer landfill cap has been effective in containing the waste and contaminants and prevents human exposure to the contaminants at the Site. Any necessary repairs have been addressed within a reasonable timeframe, and rodent control measures are on-going to ensure damage is prevented and/or mitigated.

Deed and Access Restrictions

The 1994 covenant restricting use of the Site to a landfill remains in place, and Maricopa County complies with its requirements. No Site security issues were identified during the reporting period, and the Site fence is intact.

5.2. Question B: Are the exposure assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives Used at the Time of Remedy Selection Still Valid?

Yes, the exposure assumptions are still valid. Contamination has not migrated off-site to any nearby production wells, and site access is restricted so potential exposure pathways are not complete. There have been no revisions to applicable or relevant and appropriate requirements that affect the protectiveness of the remedy at the Site (Appendix D). The contaminants that do not have Federal criteria and only State Health Based criteria are evaluated in Appendix E (Toxicity Analysis). EPA's acceptable toxicity risk ranges are still met by the remedial goals. EPA updates target cancer risk and target hazard quotients (non-cancer risks) risks on a regular basis and changes noted in Appendix E do not affect protectiveness. Given the current understanding that landfills have been a source of Per- and polyfluoroalkyl substances (PFAS) contamination at other locations, the current sampling program should include sampling and analysis for PFAS to ensure that the Hassayampa landfill is also not a source. However, the current groundwater extraction system is currently controlling migration of the Site contaminants, so there is no possible exposure if PFAS is detected.

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

No additional information has come to light that would affect the protectiveness of the remedy. The Site is listed in the 2019 Government Accountability Office Superfund Climate Change report (https://www.gao.gov/products/GAO-20-73) as an area which could potentially be impacted by other flood hazards and is not in an area with direct flood susceptibility (GAO, 2019). The report utilizes the Federal Emergency Management Agency's national flood hazard layer with data relevant as of 2018. Should uncontrolled flooding occur, it may increase the contaminated groundwater concentrations as a result of soil vapor contaminant movement. The report indicates that the Site is not in a wildfire hazard zone.

6. Issues/Recommendations

There are no issues or recommendations identified in the Five-Year Review.

6.1. *Other Findings*

The following are recommendations to improve management of the operations and maintenance but do not affect current and/or future protectiveness:

- Determine total mass of volatile organic compounds in groundwater and estimate an approximate timeframe towards achieving restoration of aquifer to drinking water standards. Depending on the estimated timeframe for groundwater restoration a treatment strategy for groundwater in the source area should be re-evaluated for options to decrease the time to achieve cleanup standards. Additionally, groundwater remediation system equipment is aging, and should be evaluated for replacement in coordination with any optimization efforts.

- A permanent solution to the areas of recurring erosion from runoff from the adjacent closed municipal solid waste landfill area during major rain events should be developed.

- Countermeasures should be identified to reduce the frequency of power outages, especially during the summer monsoon season.

- The groundwater sampling plan should be modified to include Per- and polyfluoroalkyl substances to determine if these constituents are present.

7. Protectiveness Statement

Table 6. Protectiveness Statement

Sitewide Protectiveness Statement
Protectiveness Determination: Click here to enter a date Protective
Protectiveness Statement: The remedy at the Hassayampa Landfill Superfund Site is protective of human health and the environment. The groundwater remediation system is preventing further migration of Site contaminants in groundwater and the soil vapor extraction system and soil cap is successfully preventing vapor transport of Site contaminants from the vadose zone to groundwater. Engineering and institutional controls prevent unacceptable exposure to Site contaminants in soil and groundwater.

8. Next Review

The next Five-Year Review report for the Hassayampa Landfill Superfund Site is required five years from the completion date of this review.

Appendix A: List of Documents Reviewed

Conestoga-Rovers Associates (CRA) and Errol L. Montgomery & Associates, Inc., (M&A), 1996. Groundwater Performance Standards Verification Plan, Hassayampa Landfill, Maricopa County, Arizona. Revised April 24

EPA. 1988. Administrative Consent Order, EPA Docket No. 88-08, Hassayampa Landfill. March 1.

EPA. 1992. Record of Decision, Hassayampa Landfill Superfund Site, Maricopa County, Arizona, August 6

EPA. 1993. Administrative Order for Remedial Design Activities, EPA Docket No. 93-09, Hassayampa Landfill Superfund Site. March 30

EPA. 1994. Consent Decree CIV 94-1821 PHX RCB. Filed November 28, 1994

EPA. 2009. Explanation of Significant Differences #1, Hassayampa Landfill Superfund Site, Maricopa County, Arizona, December 23

EPA. 2016. Explanation of Significant Differences #2, Hassayampa Landfill Superfund Site, Maricopa County, Arizona, May 17

EPA. 2016. Fourth Five-Year Review Report for Hassayampa Landfill Superfund Site Maricopa County, Arizona, September 26

Geosyntec Consultants. 2016. Full-Scale Carbon Pilot Tests Summary Report and Soil Vapor Treatment System Transition Plan, Hassayampa Superfund Site, Maricopa County, Arizona. June 10

Geosyntec and Hargis + Associates, Inc. 2017a. Performance Monitoring and Verification Plan for Soil Vapor and Groundwater. Hassayampa Landfill Superfund Site. March 21

Geosyntec and Hargis + Associates, Inc. 2017b. Consolidated Operations and Maintenance Manual for the Hassayampa Landfill Superfund Site. August 9

Geosyntec and Hargis + Associates, Inc. 2017c. 2016 Annual Monitoring Report, Hassayampa Landfill EPA Superfund Site. January 31

Geosyntec and Hargis + Associates, Inc. 2020. 2019 Annual Monitoring Report, Hassayampa Landfill EPA Superfund Site. January 31

Hargis + Associates. 2021. 2020 Annual Monitoring Report Hassayampa Landfill Superfund Site, Maricopa County, Arizona. January

Hargis + Associates, 2020. 2019 Annual Monitoring Report, Hassayampa Landfill Superfund Site, Maricopa County, Arizona, January 31

Hargis + Associates. 2019. 2018 Annual Monitoring Report, Hassayampa Landfill Superfund Site, Maricopa County, Arizona, January 31

Hargis + Associates. 2018. 2017 Annual Monitoring Report, Hassayampa Landfill Superfund Site, Maricopa County, Arizona, January 31

Hargis + Associates. 2017. 2016 Annual Monitoring Report, Hassayampa Landfill Superfund Site, Maricopa County, Arizona, January 31

Hargis + Associates. 2013. Site Conceptual Model (Contaminant Fate and Transport) for Hassayampa Landfill Superfund Site, April 30

Appendix B: Site Chronology

Event	Date
Hazardous Waste Disposal (liquids and solid waste in the 10-acre Hazardous Waste Disposal Area of the Landfill)	April 20, 1979 to October 28, 1980
Site listed on the National Priorities List by EPA	July 22, 1987
Administrative Consent Order No. 88-08 to conduct the Remedial Investigation/Feasibility Study	February 19,1988
Remedial Investigation Report	April 4, 1991
Results from Vadose Zone Monitor Borings, Hazardous Waste Area	August 30, 1991
Feasibility Study Report	May 20, 1992
Record of Decision	August 6, 1992
Administrative Order No. 93-09 to design and implement remedy	March 30, 1993
Consent Decree No. CIV 94-1821 for remedy	November 28, 1994
Groundwater Pilot Study	August 1993 to June 1995
Soil Cap Design and Construction	March 1994 to September 1995
Hydraulic Containment Evaluation Report, Established Groundwater Remediation System	June 1, 1995
Soil Venting and Treatment System, Design and Construction	October 1995 to July 1996
Groundwater Remediation System began to operate	March 1996
Construction Completed	September 30, 1997
Soil Venting and Treatment System Shutdown	September 6, 1998
First Five-Year Review Report	September 28, 2001
Groundwater Remediation System, Revised Operation and Maintenance Manual	December 26, 2001
Addendum to First Five-Year Review Report	April 24, 2002
Treatment of Soil Vapor in Non-Capped Area (North), Passive Venting Pilot Test	February 2001 to July 2003
Passive Venting Pilot Test Postponement of Expanded System	July 18, 2003
Re-evaluation of Site Conceptual Model, Additional Investigation	May 2004 to January 2006
Site Conceptual Model, Estimation of Pneumatic Properties Report	January 24, 2006
Soil Vapor Extraction System redesign and start-up	March 2006
Second Five-Year Review Report	September 22, 2006
Groundwater Remediation System, Proposed Site Pilot Test: 6-Month Shutdown of 2 Extraction Wells	June 3, 2009
Summary of Soil Vapor Extraction Remedy Component	October 2, 2009
Explanation of Significant Difference #1	December 23, 2009
Groundwater Remediation System, Optimization 6-Month Pilot Test Results and July 2010 Study	March 29, 2010
Third Five-Year Report	September 30, 2011
EPA determined the Site is Ready for Reuse and Redevelopment	September 26, 2012
Consolidated Operations and Maintenance Manual	April 4, 2013
Site Conceptual Model (Contaminant Fate and Transport)	April 30, 2013
Explanation of Significant Differences #2	May 17, 2016

Event	Date
Full-Scale Carbon Pilot Tests Summary Report and Soil Vapor Treatment System Transition Plan	June 10, 2016
Fourth Five-Year Report	September 26, 2016
Performance Monitoring and Verification Plan for Soil Vapor and Groundwater. Hassayampa Landfill Superfund Site	March 21, 2017
Consolidated Operations and Maintenance Manual for the Hassayampa Landfill Superfund Site	August 9, 2017
Workplan to Perform One-Year Aquifer Recovery Testing	July 10, 2019

Appendix C: Data Review

This appendix provides a summary of the groundwater and soil vapor contamination detected at the Site during the reporting period. Section 4.2 provides a description of how the data relates to the remedial action objectives in the Record of Decision.

Groundwater

Groundwater contamination at the Site is primarily contained on Site within the Unit A (shallower) aquifer. Table C-1 provides a summary of the detections in groundwater during the reporting period and Figure 4 shows the locations of the wells. During the reporting period, 12 wells had groundwater contaminant exceedances. The most frequently detected chemical was 1,1-Dichloroethene which was detected in 12 wells and had a maximum concentration of 129,000 µg/L (cleanup level 7 µg/L) at MW-19UA. Mann-Kendall trend analysis was completed using data from wells that exceeded cleanup levels and had at least four detections during the reporting period. A summary of the Mann-Kendall results is included in Table C-1 and the figures with all of the results are included in this appendix. The only wells with increasing contaminant trends during the reporting period were MW-06UA and MW-19UA. The wells are the closest downgradient of Pit 1 and within the containment of the groundwater extraction system. All of the other wells and the influent concentrations had declining or stable concentrations during the reporting period indicating the Site contamination overall is decreasing.

Table C-1. Summary of Groundwater Exceedance Between 2015 and 2020

Well	1,1-Dichloroethene			1,2-Dichloroethane			1,2-Dichloropropane			Trichloroethene			Tetrachloroethene			Benzene		
Cleanup Standard	*7*			*5*			*5*			*5*			*5*			*5*		
	Max (µg/L)	*Exc*	*MK*	Max (µg/L)	*Exc*	*MK*	Max (µg/L)	*Exc*	*MK*	Max (µg/L)	*Exc*	*MK*	Max (µg/L)	*Exc*	*MK*	Max (µg/L)	*Exc*	*MK*
EW-02UA	**7.5**	*1*	*S*															
EW-03UA	**25**	*22*	*S*							**15**	*22*	*D*						
EW-04UA	**360**	*24*	*D*				**12**	*13*	*D*	**55**	*24*	*D*	**11**	*6*	*D*			
MW-01UA	**32**	*3*	*S*							**8**	*2*	*NT*						
MW-04UA	**711**	*24*	*NT*							**51**	*23*	*S*	**7.8**	*17*	*NT*			
MW-06UA	**4340**	*25*	***I***				**25**	*10*	***I***	**120**	*25*	***I***	**30**	*24*	***I***			
MW-07UA	**31**	*6*	*NT*							**28**	*6*	*NT*						
MW-12UA	**700**	*6*	*S*				**43**	*7*	*D*	**130**	*7*	*PD*	**22**	*7*	*PD*			
MW-14UA	**27**	*6*	*D*															
MW-18UA	**5300**	*25*	*D*				**31.3**	*21*	*S*	**170**	*25*	*D*	**48**	*23*	*D*			
MW-19UA	**12900**	*25*	***I***	**11**	*12*	*D*	**973**	*25*	*PD*	**804**	*25*	*NT*	**203**	*25*	***I***	**8.3**	*11*	*NT*
MW-20UA	**410**	*12*	*D*							**120**	*12*	*D*	**9.3**	*9*	*D*			
INFLUENT	**240**	*24*	*D*				**8.5**	*6*	*D*	**41**	*24*	*D*	**7.7**	*4*	*D*			

Exc= number of exceedances between 2015 and 2020

Max=maximum concentration between 2015 and 2020

µg/L=micro grams per liter

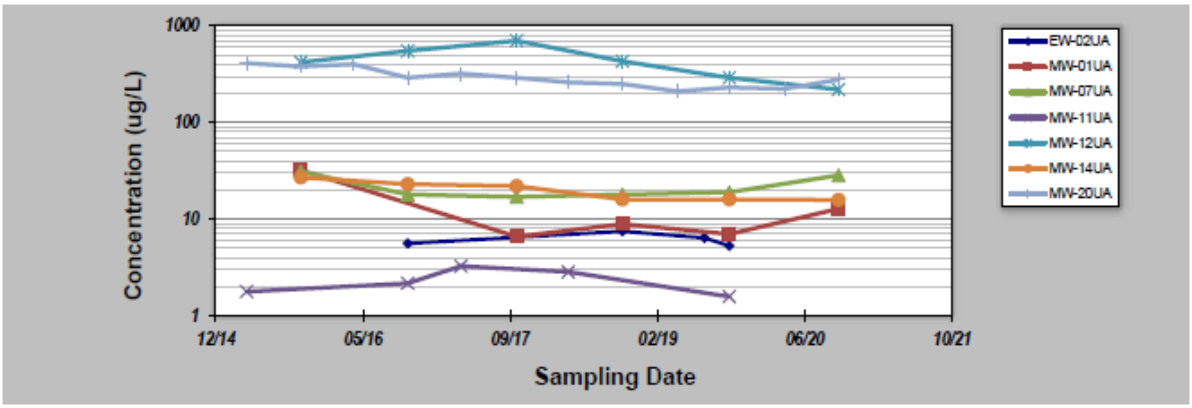
MK=results of Mann-Kendall trend analysis

S=stable, D=decreasing, PD=probably decreasing, NT=no trend, I=increasing,

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date: 1-Mar-21
Facility Name: Hassyampa Landfill
Conducted By: Jeffrey Weiss
Job ID:
Constituent: 11DCE
Concentration Units: ug/L

Sampling Point ID:	EW-02UA	MW-01UA	MW-07UA	MW-11UA	MW-12UA	MW-14UA	MW-20UA
Sampling Event	Sampling Date	11DCE CONCENTRATION (ug/L)						
1	11-Apr-15				1.78			410
2	12-Oct-15		32	31		420	27	380
3	9-Apr-16							400
4	9-Oct-16	5.6		18	2.17	550	23	290
5	8-Apr-17				3.27			320
6	14-Oct-17		6.6	17		700	22	290
7	7-Apr-18				2.85			260
8	8-Oct-18	7.5	8.9	18		430	16	250
9	13-Apr-19							210
10	13-Jul-19	6.4						
11	6-Oct-19	5.3	7	19	1.58	290	16	230
12	11-Apr-20							223
13	11-Oct-20		12.8	28.4		219	15.8	277
14								
15								
16								
17								
18								
19								
20								
Coefficient of Variation:		0.16	0.79	0.28	0.31	0.40	0.24	0.23
Mann-Kendall Statistic (S):		-2	0	2	0	-7	-14	-47
Confidence Factor:		62.5%	40.8%	57.0%	40.8%	86.4%	99.6%	>99.9%
Concentration Trend:		Stable	Stable	No Trend	Stable	Stable	Decreasing	Decreasing



Notes:

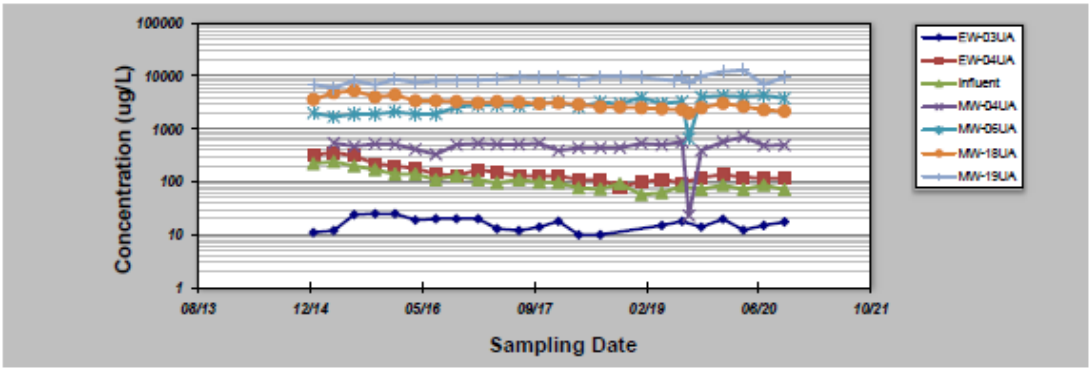
1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably 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.

Figure C-1. 1,1-DCE concentration trends from 7 of the 13 wells in the A-zone aquifer with exceedances during the reporting period.

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date: 1-Mar-21
Facility Name: Hassyampa Landfill
Conducted By: Jeffrey Weiss
Job ID:
Constituent: 11DCE
Concentration Units: ug/L

Sampling Point ID:	EW-03UA	EW-04UA	Influent	MW-04UA	MW-06UA	MW-18UA	MW-19UA
Sampling Event	Sampling Date	11DCE CONCENTRATION (ug/L)					
1	10-Jan-15	11	320	220		2000	3600	6900
2	11-Apr-15	12	360	240	540	1700	4800	6000
3	11-Jul-15	24	310	200	470	1900	5300	8100
4	12-Oct-15	25	220	170	520	1900	4000	6800
5	9-Jan-16	25	200	140	510	2100	4400	8500
6	9-Apr-16	19	180	140	410	1900	3400	7500
7	9-Jul-16	20	140	110	330	1900	3400	8000
8	9-Oct-16	20	130	130	500	2500	3300	8200
9	14-Jan-17	20	170	110	530	2800	3100	8300
10	8-Apr-17	13	150	96	510	2800	3300	8600
11	15-Jul-17	12	130	110	510	2700	3200	9500
12	14-Oct-17	14	130	98	530	3000	3000	9400
13	7-Jan-18	18	130	97	390	3200	3100	9300
14	7-Apr-18	10	110	76	440	2600	2900	8300
15	13-Jul-18	10	110	73	440	3200	2600	9700
16	8-Oct-18		80	92	440	3000	2600	9800
17	12-Jan-19		99	57	530	3900	2500	9500
18	13-Apr-19	15	110	62	500	3000	2400	
19	8-Jun-19							8100
20	13-Jul-19	18	96	83	570	3300	2300	9400
21	12-Aug-19				23	650	2000	7400
22	6-Oct-19	14	120	72	390	4000	2500	9900
23	11-Jan-20	19.7	138	87.2	569	4280	3040	12100
24	11-Apr-20	12.3	121	71.8	711	4050	2650	12900
25	11-Jul-20	15	118	86.5	487	4340	2290	6860
26	11-Oct-20	17.5	114	71.5	492	3770	2160	9450
27								
28								
29								
30								
Coefficient of Variation:		0.28	0.47	0.45	0.26	0.33	0.26	0.18
Mann-Kendall Statistic (S):		-42	-177	-210	3	198	-235	140
Confidence Factor:		87.5%	>99.9%	>99.9%	52.0%	>99.9%	>99.9%	>99.9%
Concentration Trend:		Stable	Decreasing	Decreasing	No Trend	Increasing	Decreasing	Increasing



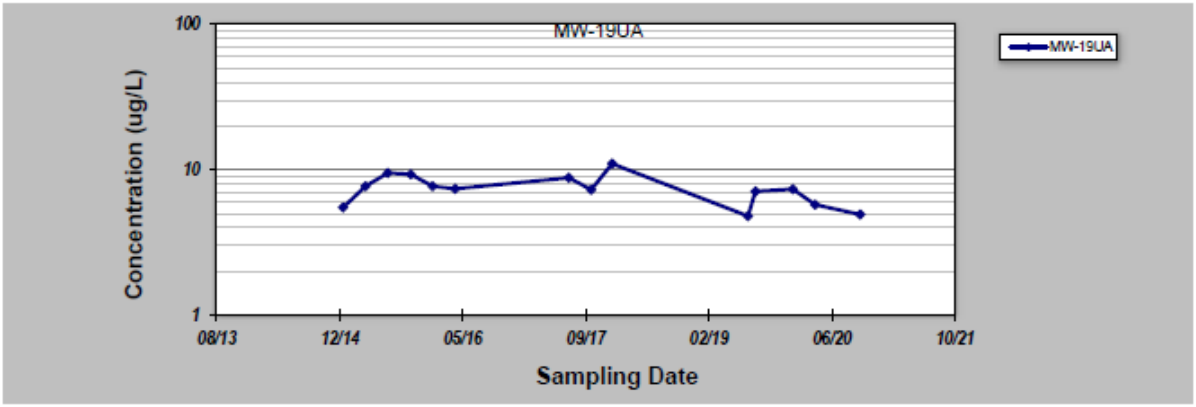
Notes:
1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 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.

Figure C-2. 1,1-DCE concentration trends from 7 of the 13 wells in the A-zone aquifer with exceedances during the reporting period. Two out of the 13 had increasing trends during the reporting period.

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date:	1-Mar-21	Job ID:	
Facility Name:	Hassyampa Landfill	Constituent:	12DCA
Conducted By:	Jeffrey Weiss	Concentration Units:	ug/L
Sampling Point ID:	MW-19UA		

Sampling Event	Sampling Date	12DCA CONCENTRATION (ug/L)
1	10-Jan-15	5.5
2	11-Apr-15	7.7
3	11-Jul-15	9.5
4	12-Oct-15	9.3
5	9-Jan-16	7.7
6	9-Apr-16	7.4
7	15-Jul-17	8.8
8	14-Oct-17	7.3
9	7-Jan-18	11
10	13-Jul-19	4.8
11	12-Aug-19	7.1
12	11-Jan-20	7.36
13	11-Apr-20	5.75
14	11-Oct-20	4.92
15		
16		
17		
18		
19		
20		
Coefficient of Variation:		0.24
Mann-Kendall Statistic (S):		-32
Confidence Factor:		95.5%
Concentration Trend:		Decreasing



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.

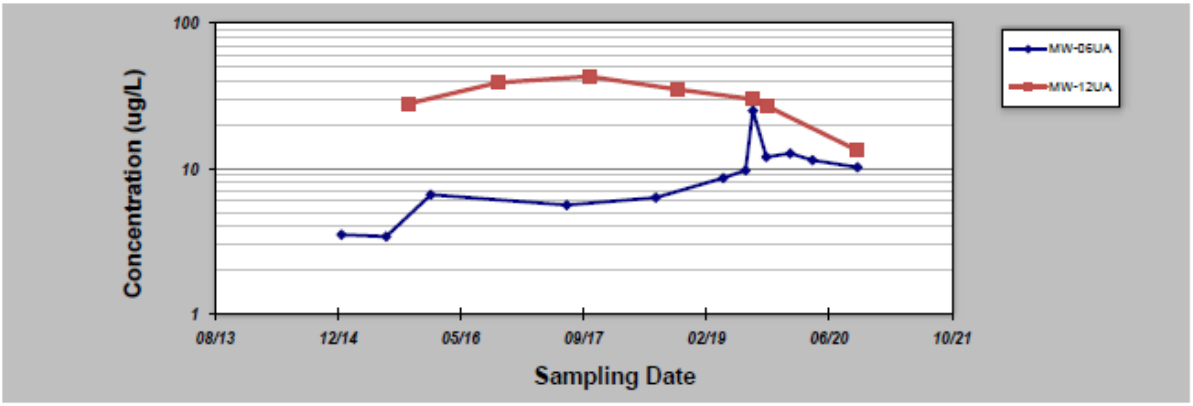
Figure C-3. 1,2-DCA concentration trend from the one well with exceedances during the reporting period.

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date:	1-Mar-21	Job ID:	
Facility Name:	Hassyampa Landfill	Constituent:	12DCP
Conducted By:	Jeffrey Weiss	Concentration Units:	ug/L

Sampling Point ID:	MW-06UA	MW-12UA

Sampling Event	Sampling Date	12DCP CONCENTRATION (ug/L)	
1	10-Jan-15	3.5	
2	11-Jul-15	3.4	
3	12-Oct-15		28
4	9-Jan-16	6.6	
5	9-Oct-16		39
6	15-Jul-17	5.6	
7	14-Oct-17		43
8	13-Jul-18	6.3	
9	8-Oct-18		35
10	13-Apr-19	8.6	
11	13-Jul-19	9.7	
12	12-Aug-19	25	30
13	6-Oct-19	12	27
14	11-Jan-20	12.7	
15	11-Apr-20	11.4	
16	11-Oct-20	10.2	13.3
17			
18			
19			
20			
Coefficient of Variation:		0.60	0.31
Mann-Kendall Statistic (S):		42	-11
Confidence Factor:		99.8%	93.2%
Concentration Trend:		Increasing	Prob. Decreasing



Notes:

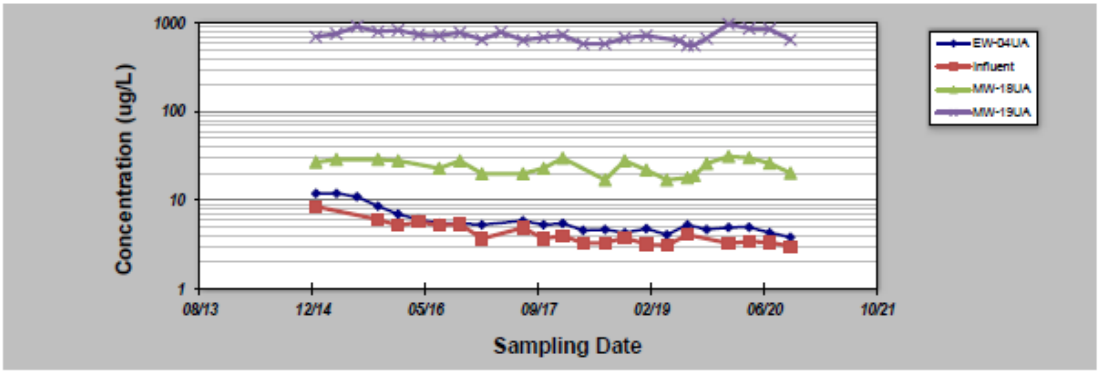
1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably 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.

Figure C-4. 1,2-DCP concentration trend from the two of the five well with exceedances during the reporting period. The wells are plotted on separate sheets because of different sampling intervals.

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date: 1-Mar-21
Facility Name: Hassyampa Landfill
Conducted By: Jeffrey Weiss
Job ID:
Constituent: 12DCP
Concentration Units: ug/L

Sampling Point ID:	EW-04UA	Influent	MW-18UA	MW-19UA			
Sampling Event	Sampling Date	12DCP CONCENTRATION (ug/L)						
1	10-Jan-15	12	8.5	27	700			
2	11-Apr-15	12		29	760			
3	11-Jul-15	11			910			
4	12-Oct-15	8.6	6.1	29	800			
5	9-Jan-16	7	5.2	28	830			
6	9-Apr-16	6.1	5.7		740			
7	9-Jul-16	5.5	5.2	23	720			
8	9-Oct-16	5.5	5.4	28	780			
9	14-Jan-17	5.3	3.7	20	650			
10	8-Apr-17				790			
11	15-Jul-17	5.9	4.9	20	640			
12	14-Oct-17	5.3	3.7	23	690			
13	7-Jan-18	5.5	4	30	730			
14	7-Apr-18	4.6	3.3		580			
15	13-Jul-18	4.7	3.3	17	580			
16	8-Oct-18	4.3	3.8	28	680			
17	12-Jan-19	4.8	3.2	22	720			
18	13-Apr-19	4.1	3.1	17				
19	8-Jun-19				630			
20	13-Jul-19	5.3	4.1	18	560			
21	12-Aug-19			19	560			
22	6-Oct-19	4.7		26	670			
23	11-Jan-20	4.96	3.29	31.3	973			
24	11-Apr-20	4.98	3.43	30.1	865			
25	11-Jul-20	4.32	3.37	26.2	854			
26	11-Oct-20	3.84	3.03	20.3	646			
27								
28								
29								
30								
Coefficient of Variation:		0.40	0.32	0.19	0.15			
Mann-Kendall Statistic (S):		-181	-127	-25	-69			
Confidence Factor:		>99.9%	>99.9%	76.3%	94.4%			
Concentration Trend:		Decreasing	Decreasing	Stable	Prob. Decreasing			



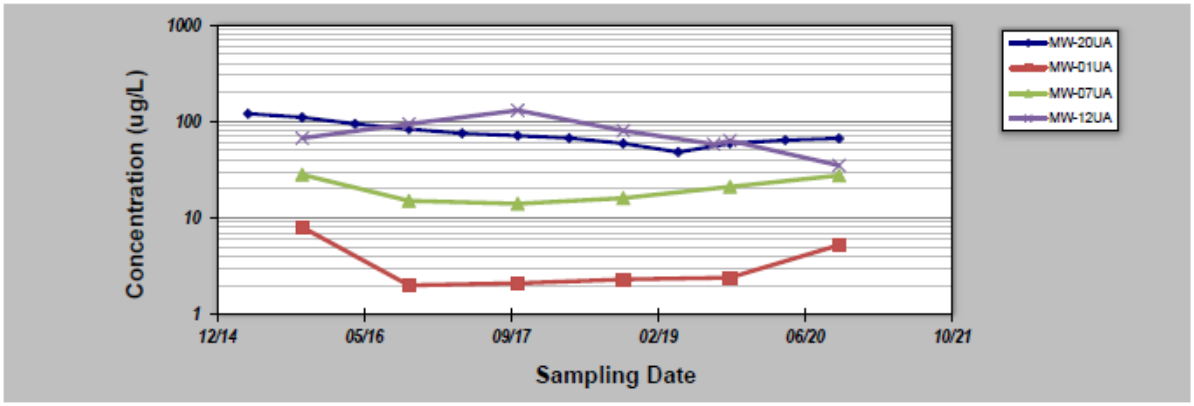
Notes:
1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 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.

Figure C-5. 1,2-DCP concentration trend from the three of the five well with exceedances during the reporting period. The wells are plotted on separate sheets because of different sampling intervals.

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date:	1-Mar-21	Job ID:	
Facility Name:	Hassyampa Landfill	Constituent:	TCE
Conducted By:	Jeffrey Weiss	Concentration Units:	ug/L

Sampling Point ID:	MW-20UA	MW-01UA	MW-07UA	MW-12UA			
Sampling Event	Sampling Date	TCE CONCENTRATION (ug/L)						
1	11-Apr-15	120						
2	12-Oct-15	110	8	28	67			
3	9-Apr-16	94						
4	9-Oct-16	83	2	15	94			
5	8-Apr-17	75						
6	14-Oct-17	71	2.1	14	130			
7	7-Apr-18	67						
8	8-Oct-18	59	2.3	16	80			
9	13-Apr-19	48						
10	12-Aug-19				58			
11	6-Oct-19	59	2.4	21	63			
12	11-Apr-20	63.9						
13	11-Oct-20	66.5	5.22	27.5	34.9			
14								
15								
16								
17								
18								
19								
20								
Coefficient of Variation:		0.28	0.67	0.31	0.40			
Mann-Kendall Statistic (S):		-49	5	3	-11			
Confidence Factor:		>99.9%	76.5%	64.0%	93.2%			
Concentration Trend:		Decreasing	No Trend	No Trend	Prob. Decreasing			



Notes:

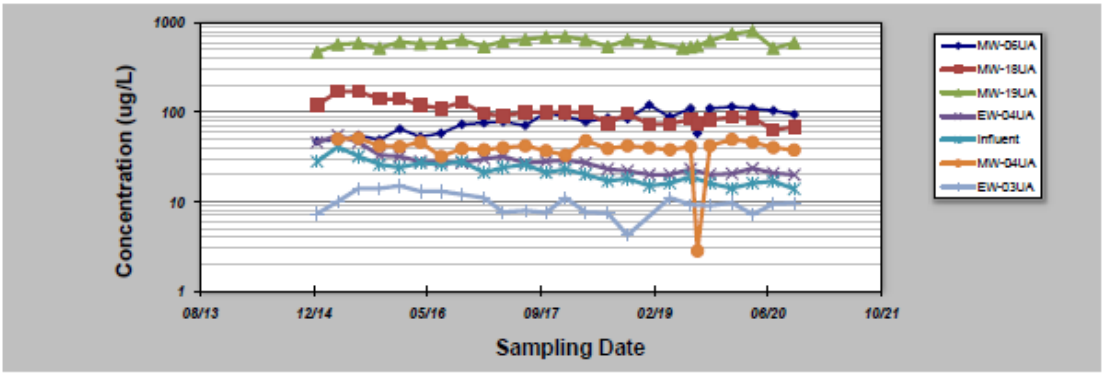
1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably 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.

Figure C-6. TCE concentration trend from four of the ten wells with exceedances during the reporting period.

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date: 1-Mar-21
Facility Name: Hassyampa Landfill
Conducted By: Jeffrey Weiss
Job ID:
Constituent: TCE
Concentration Units: ug/L

Sampling Point ID:	MW-06UA	MW-18UA	MW-19UA	EW-04UA	Influent	MW-04UA	EW-03UA
Sampling Event	Sampling Date	TCE CONCENTRATION (ug/L)						
1	10-Jan-15	47	120	470	46	28		7.3
2	11-Apr-15	49	170	570	55	41	50	10
3	11-Jul-15	55	170	590	46	32	51	14
4	12-Oct-15	49	140	520	33	26	42	14
5	9-Jan-16	65	140	610	32	24	41	15
6	9-Apr-16	53	120	580	28	27	46	13
7	9-Jul-16	58	110	590	28	26	32	13
8	9-Oct-16	73	130	640	27	28	39	12
9	14-Jan-17	76	96	540	30	21	38	11
10	8-Apr-17	78	91	620	32	24	40	7.6
11	15-Jul-17	71	100	650	27	26	42	7.9
12	14-Oct-17	99	100	690	28	21	37	7.5
13	7-Jan-18	90	100	700	29	23	33	11
14	7-Apr-18	78	99	640	27	20	48	7.6
15	13-Jul-18	86	75	540	23	17	39	7.4
16	8-Oct-18	84	96	640	22	18	42	4.2
17	12-Jan-19	120	73	610	20	15	40	
18	13-Apr-19	88	74		20	16	38	11
19	8-Jun-19			520				
20	13-Jul-19	110	83	530	23	19	41	9.2
21	12-Aug-19	58	75	550			2.8	
22	6-Oct-19	110	82	630	20	16	42	9
23	11-Jan-20	115	87.9	750	20.5	14.1	49.5	9.67
24	11-Apr-20	110	86.6	804	23.5	16	46.1	7.18
25	11-Jul-20	104	63	519	20.8	16.9	40.2	9.41
26	11-Oct-20	94.2	68.4	593	19.9	13.8	37.7	9.57
27								
28								
29								
30								
Coefficient of Variation:		0.28	0.29	0.13	0.32	0.30	0.23	0.27
Mann-Kendall Statistic (S):		198	-212	55	-200	-209	-34	-83
Confidence Factor:		>99.9%	>99.9%	89.5%	>99.9%	>99.9%	79.1%	98.5%
Concentration Trend:		Increasing	Decreasing	No Trend	Decreasing	Decreasing	Stable	Decreasing



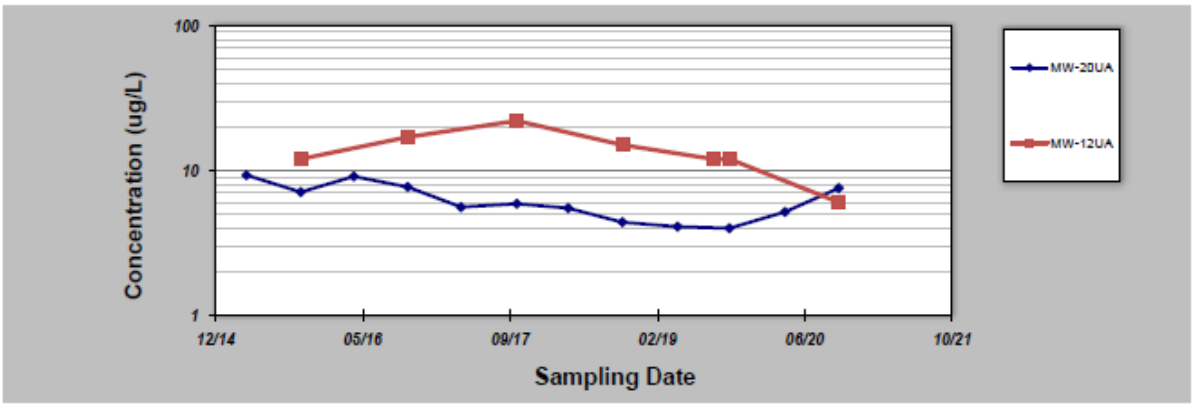
Notes:
1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 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.

Figure C-7. TCE concentration trend from six of the ten wells with exceedances during the reporting period.

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date:	1-Mar-21	Job ID:	
Facility Name:	Hassyampa Landfill	Constituent:	PCE
Conducted By:	Jeffrey Weiss	Concentration Units:	ug/L

Sampling Point ID:	MW-20UA	MW-12UA
Sampling Event	Sampling Date	PCE CONCENTRATION (ug/L)
1	11-Apr-15	9.3	
2	12-Oct-15	7.1	12
3	9-Apr-16	9.1	
4	9-Oct-16	7.7	17
5	8-Apr-17	5.6	
6	14-Oct-17	5.9	22
7	7-Jan-18		
8	7-Apr-18	5.5	
9	8-Oct-18	4.4	15
10	13-Apr-19	4.1	
11	12-Aug-19		12
12	6-Oct-19	4	12
13	11-Apr-20	5.18	
14	11-Oct-20	7.56	6.04
15			
16			
17			
18			
19			
20			
Coefficient of Variation:	0.29	0.36
Mann-Kendall Statistic (S):	-38	-10
Confidence Factor:	99.6%	90.7%
Concentration Trend:	Decreasing	Prob. Decreasing



Notes:

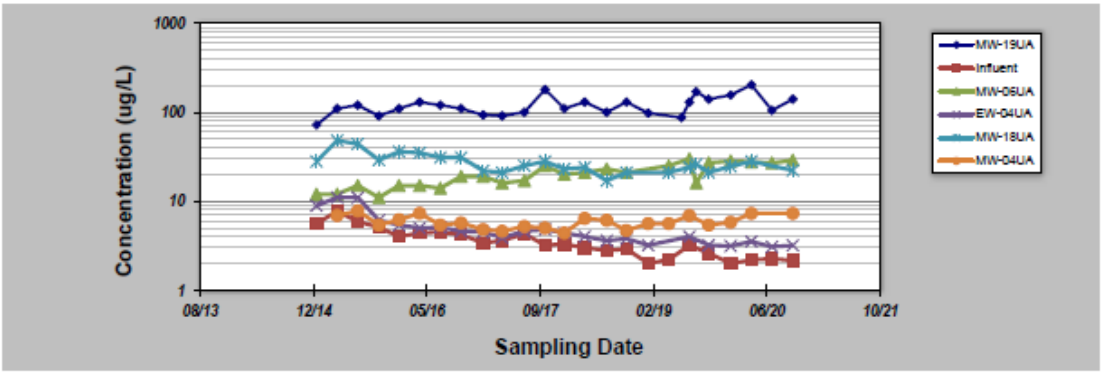
1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably 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.

Figure C-8. PCE concentration trend from two of the seven wells with exceedances during the reporting period.

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date: 1-Mar-21
Facility Name: Hassyampa Landfill
Conducted By: Jeffrey Weiss
Job ID:
Constituent: PCE
Concentration Units: ug/L

Sampling Point ID:	MW-19UA	Influent	MW-06UA	EW-04UA	MW-18UA	MW-04UA	
Sampling Event	Sampling Date	PCE CONCENTRATION (ug/L)						
1	10-Jan-15	72	5.6	12	8.9	28		
2	11-Apr-15	110	7.7	12	11	48	6.9	
3	11-Jul-15	120	5.9	15	11	44	7.8	
4	12-Oct-15	91	5.1	11	6.1	29	5.4	
5	9-Jan-16	110	4	15	5.4	36	6.2	
6	9-Apr-16	130	4.4	15	5	35	7.3	
7	9-Jul-16	120	4.5	14	5.1	31	5.4	
8	9-Oct-16	110	4.2	19	4.6	31	5.7	
9	14-Jan-17	93	3.4	19	4.5	22	4.8	
10	8-Apr-17	91	3.6	16	3.9	21	4.6	
11	15-Jul-17	100	4.3	17	4.6	25	5.2	
12	14-Oct-17	180	3.2	25	4.8	28	5	
13	7-Jan-18	110	3.3	20	4.4	23	4.4	
14	7-Apr-18	130	3	21	4	24	6.4	
15	13-Jul-18	100	2.8	23	3.6	17	6.1	
16	8-Oct-18	130	2.9	21	3.8	21	4.7	
17	12-Jan-19	98	2		3.2		5.6	
18	13-Apr-19		2.2	25		21	5.6	
19	8-Jun-19	87						
20	13-Jul-19	130	3.2	30	4	24	6.9	
21	12-Aug-19	170		16		26		
22	6-Oct-19	140	2.6	27	3.2	21	5.4	
23	11-Jan-20	156	2	28.3	3.14	24.6	5.79	
24	11-Apr-20	203	2.18	27.7	3.52	28	7.29	
25	11-Jul-20	105	2.26	26.9	3.08			
26	11-Oct-20	140	2.15	28.9	3.18	22.2	7.28	
27								
28								
29								
30								
Coefficient of Variation:		0.26	0.40	0.30	0.46	0.27	0.17	
Mann-Kendall Statistic (S):		96	-216	200	-207	-110	2	
Confidence Factor:		98.7%	>99.9%	>99.9%	>99.9%	99.9%	51.1%	
Concentration Trend:		Increasing	Decreasing	Increasing	Decreasing	Decreasing	No Trend	



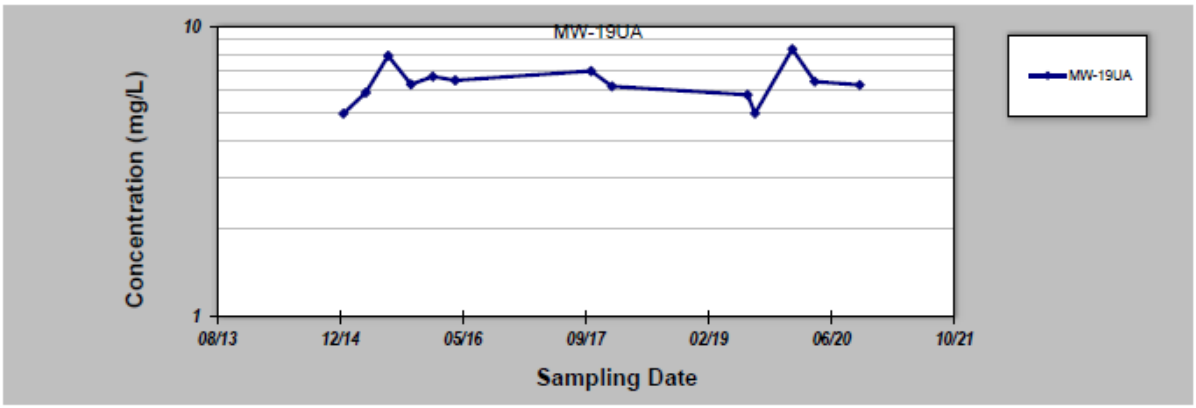
Notes:
1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 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.

Figure C-9. PCE concentration trend from five of the seven wells with exceedances during the reporting period.

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date:	1-Mar-21	Job ID:	
Facility Name:	Hassyampa Landfill	Constituent:	BZ
Conducted By:	Jeffrey Weiss	Concentration Units:	mg/L
Sampling Point ID:	MW-19UA		

Sampling Event	Sampling Date	BZ CONCENTRATION (mg/L)
1	10-Jan-15	5
2	11-Apr-15	5.9
3	11-Jul-15	7.9
4	12-Oct-15	6.3
5	9-Jan-16	6.7
6	9-Apr-16	6.5
7	14-Oct-17	7
8	7-Jan-18	6.2
9	13-Jul-19	5.8
10	12-Aug-19	5
11	11-Jan-20	8.33
12	11-Apr-20	6.44
13	11-Oct-20	6.27
14		
15		
16		
17		
18		
19		
20		
Coefficient of Variation:		0.15
Mann-Kendall Statistic (S):		3
Confidence Factor:		54.8%
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.

Figure C-10. Benzene concentration trend the one well with exceedances during the reporting period.

Appendix D: Applicable or Relevant and Appropriate Requirements Assessment

Section 121 (d)(2)(A) of Comprehensive Environmental Response, Compensation, and Liability Act 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 Comprehensive Environmental Response, Compensation, and Liability Act 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.

Chemical-specific ARARs identified in the 1992 Record of Decision for groundwater were evaluated (Table D-1). There have been no changes to groundwater chemical specific ARARs in the last five years. Site contaminants identified in Table D-1 that do not have any state or Federal regulations are toxicity based and are evaluated in the Toxicity Analysis (Appendix E).

Table D-1. Summary of Groundwater Chemical-Specific ARAR Changes

Chemical	1992 ROD Cleanup Levels (µg/L)	Basis for Cleanup Level	Current Regulations (µg/L)		ARARs More or Less Stringent than Cleanup Levels?
			State [if applicable]	Federal	
Benzene	5	Federal MCL	5	5	No changes
Dichlorodifluoromethane (Freon 12)	1,400	State HBGL	N/A	N/A	N/A
1,1-Dichloroethene	7	Federal MCL	7	7	No changes
1,1-Dichloroethane	N/A	No cleanup standard selected	N/A	N/A	N/A
1,1,1-Trichloroethane	200	Federal MCL	200	200	No changes
1,2-Dichloroethane	5	Federal MCL	5	5	No changes
Cis-1,2-Dichloroethene	70	Federal MCL	70	70	No changes
Trans-1,2-Dichloroethene	100	Federal MCL	100	100	No changes
1,2-Dichloropropane	5	Federal MCL	5	5	No changes
Acetone	700	State HBGL	N/A	N/A	N/A
Chlorobenzene	100	Federal MCL	N/A	100	No changes
Trichlorofluoromethane (Freon 11)	2,100	State HBGL	N/A	N/A	N/A
Trichlorotrifluoroethane (Freon 113)	210,000	State HBGL	N/A	N/A	N/A
Methyl Ethyl Ketone	170	State HBGL	N/A	N/A	N/A

Chemical	1992 ROD Cleanup Levels (µg/L)	Basis for Cleanup Level	Current Regulations (µg/L)		ARARs More or Less Stringent than Cleanup Levels?
			State [if applicable]	Federal	
Dichloromethane	5	Proposed Federal MCL	5	5	No changes
Tetrachloroethene	5	Federal MCL	5	5	No changes
Toluene	1,000	Federal MCL	1,000	1,000	No changes
Trihalomethanes	100	Federal MCL	80	80	No changes
Trichloroethene	5	Federal MCL	5	5	No changes
Chromium (total)	50	Federal MCL	N/A	50	No changes
Xylenes (total)	10,000	Federal MCL	10,000	10,000	No changes
Vinyl chloride	2	Federal MCL	2	2	No changes

HBGL=Health Based Guidelines

Federal and State laws and regulations other than the chemical-specific ARARs discussed in Table D-1 that have been promulgated or changed since the 1992 Record of Decision are described in Table D-2. There have been no revisions to laws or regulations that affect the protectiveness of the remedy.

The following action- or location-specific ARARs have not changed in the past five years, and therefore do not affect protectiveness:

- Safe Drinking Water Act (42 USC 300f)
- Endangered Species Act (16 USC 1531 et seq.; 50 CFR 200 and 402)
- National Archeological and Historic Preservation Act (16 USC 469; 36 CFR Part 79)
- National Environmental Policy Act (NEPA) Floodplain Management Procedures (40 CFR 6 Appendix A; Executive Order 11988)
- Fish and Wildlife Coordination Act (40 CFR 6.302)
- Protection of Riparian Areas (Executive Order No. 91-06 of the governor's office of Arizona)
- RCRA standards for miscellaneous units (e.g., air strippers) (40 CFR 264, Subpart X)
- Clean Air Act (42 USC 7401; 40 CFR 50-99)
- Installation permits to make alterations to machinery (49 ARS 480)
- Land Disposal Restrictions (LDRs) (40 CFR 268, Subpart D)
- Requirements for capping and cap maintenance of Hazardous Waste TSD Facilities (40 CFR, 265.310 and 265.117)
- Underground injection of treated groundwater (UIC Permit) (40 CFR 144-146)
- Arizona Aquifer Protection Permit (APP) (49 ARS 242-249, and AAC R18-9-102 to R18-9-403)
- RCRA Hazardous Waste Management System (40 CFR Part 260)
- Groundwater Monitoring (40 CFR 265 Subpart F)
- Arizona Health-Based Guidance Levels (HBGLs) set by Arizona Department of Health Services
- Control of volatile organic compounds and gaseous contaminants (Maricopa County rules 320 and 330)
- Control of emissions from air strippers exceeding 3 pounds/hour (EPA OSWER Directive 9355.0-28)

Table D-2. Summary of ARAR Changes for Site in the Past Five Years

Requirement and Citation	Document	Description	Effect on Protectiveness	Comments	Recent Amendment Date
Fish and Wildlife Coordination Act (16 USC 661)	1992 ROD	Game, Fur-bearing animals, and fish	Changes do not affect protectiveness.	Pub. L. 116–9 inserted section catchline, designated existing provisions as subsec. (b), inserted heading, and added subsec. (a).	2019
RCRA TSDF standards for control of volatile organic compounds (40 CFR 264, subparts AA and BB)	1992 ROD	Air Emission Standards for Process Vents and Equipment Leaks	Changes do not affect protectiveness.	Edits to Notes	Subpart AA revised in 2017 Subpart BB revised in 2019
Underground injection of treated groundwater (UIC Permit) (40 CFR 147)	1992 ROD	State, Tribal and EPA administered underground injection control programs	Changes do not affect protectiveness.	Subpart ZZ changes to State of WY injection wells.	2020
RCRA Hazardous Waste Management System (40 CFR Part 260)	1992 ROD	Hazardous Waste Management System	Changes do not affect protectiveness	Edits to 260.11	2020
Use and management of containers (40 CFR 264.170-264-179)	1992 ROD	Standards for owners and operators of hazardous waste treatment, storage, and disposal facilities	Changes do not affect protectiveness	Edit to the purpose and scope section	2020
Maricopa County Rule 210	1992 ROD	Describes title V permit requirements, application procedures for new title V sources, and application procedures for modifications to existing title V sources.	Changes do not affect protectiveness.	Adopted December 11,2019	2019
Arizona Aquifer Protection Permit (APP) (49 ARS 241 and 250 and AAC R18-9-101)	1992 ROD	Aquifer Protection Permit	Changes do not affect protectiveness.	49 ARS 241 has been taken out of the regulation 49 ARS 250: exemption for class V wells AAC R18-9-101: Amended by final expedited rulemaking at 25 A.A.R. 3060	49 ARS 241: January 29, 2021 49 ARS 250: January 29, 2021 AAC R18-9-101: September 23, 2019

Appendix E. Toxicity Assessment

Chemical-specific applicable or relevant and appropriate requirements identified in the 1992 Record of Decision for groundwater were evaluated (Table E-1). EPA adopted Regional Screening Levels as screening levels for residential and commercial worker risk exposures. EPA's Integrated Risk Information System updates toxicity values used by EPA in risk assessment when newer scientific information becomes available, and the most recent update available for the Five-Year Review was in May 2021.

Changes have occurred to some Regional Screening Levels since the 1992 Record of Decision (Table E-1). All changes fall within EPA's generally acceptable risk range of 1×10^{-4} to 1×10^{-6} as discussed in the National Oil and Hazardous Substances Contingency Plan, so the changes do not affect protectiveness.

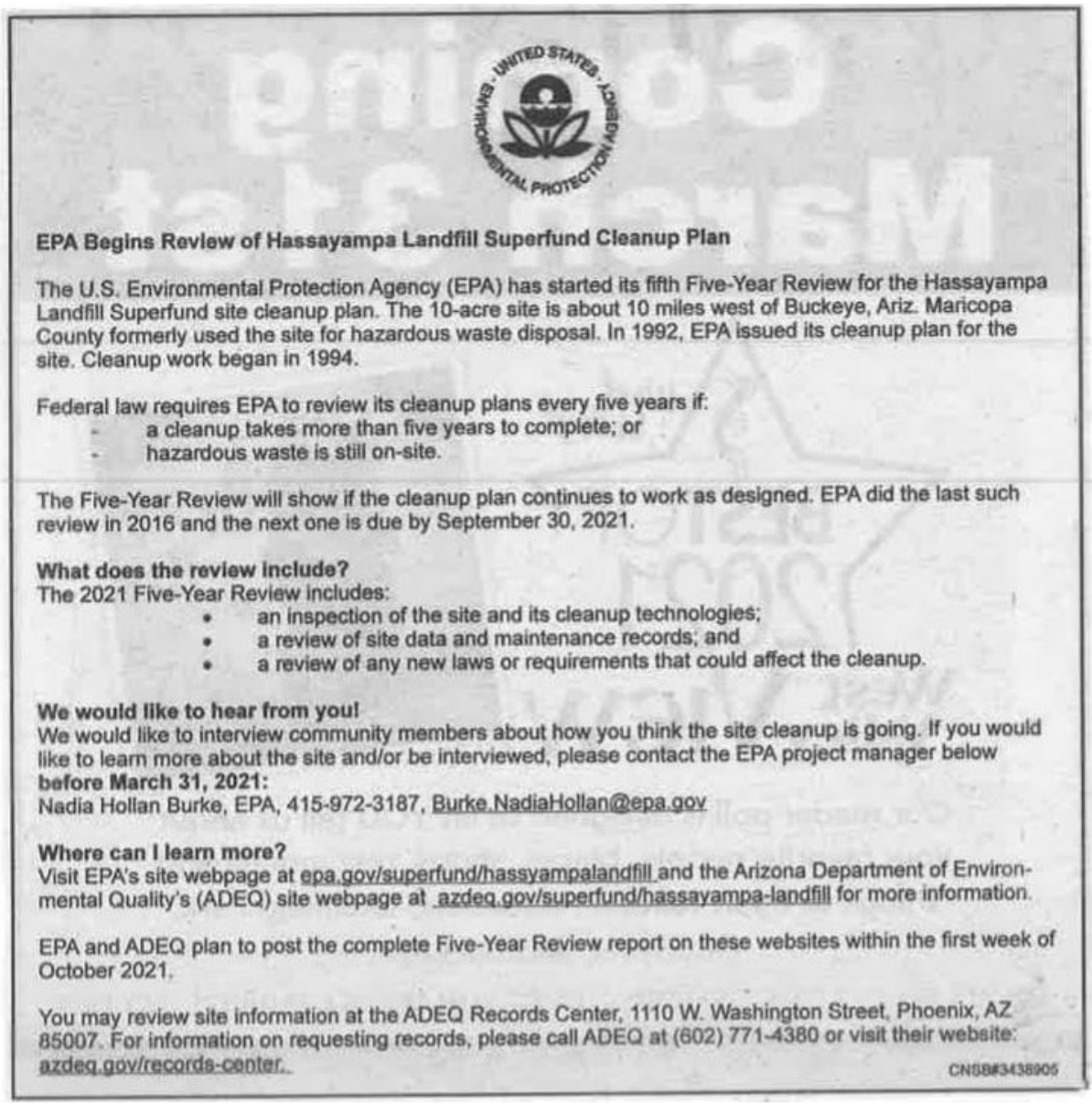
Table E-1. Comparison of Tap Water RSL to Record of Decision Cleanup Standards

Chemical	Hassayampa Groundwater Cleanup Standard (µg/L)	Basis for Cleanup Level	Current Tap Water RSL (µg/L) c = cancer n = noncancer	RSLs More or Less Stringent than Cleanup Levels?
Dichlorodifluoromethane (Freon 12)	1,400	Based on non-cancer hazard index of 1	200 (n)	More stringent
1,1-Dichloroethane	No cleanup standard selected		2.8 (c)	N/A
Acetone	700	Based on non-cancer hazard index of 1	14,000 (n)	Less stringent
Trichlorofluoromethane (Freon 11)	2,100	Based on non-cancer hazard index of 1	5,200 (n)	Less stringent
Trichlorotrifluoroethane (Freon 113) aka 1,1,2-trichloro-1,2,2-trifluoroethane	210,000	Based on non-cancer hazard index of 1	10,000(n)	More stringent
Methyl Ethyl Ketone	170	Based on non-cancer hazard index of 1	5,600 (n)	Less stringent

c = cancer, n = noncancer, RSL = Regional Screening Level

While the current tap water regional screening level for dichlorodifluoromethane is significantly less than the cleanup standard, a review of sampling results during the reporting period found all samples reported as non-detect. All sample results for Trichlorotrifluoroethane were below the regional screening level for this reporting period.

Appendix F: Public Notice



EPA Begins Review of Hassayampa Landfill Superfund Cleanup Plan

The U.S. Environmental Protection Agency (EPA) has started its fifth Five-Year Review for the Hassayampa Landfill Superfund site cleanup plan. The 10-acre site is about 10 miles west of Buckeye, Ariz. Maricopa County formerly used the site for hazardous waste disposal. In 1992, EPA issued its cleanup plan for the site. Cleanup work began in 1994.

Federal law requires EPA to review its cleanup plans every five years if:

- a cleanup takes more than five years to complete; or
- hazardous waste is still on-site.

The Five-Year Review will show if the cleanup plan continues to work as designed. EPA did the last such review in 2016 and the next one is due by September 30, 2021.

What does the review include?
The 2021 Five-Year Review includes:

- an inspection of the site and its cleanup technologies;
- a review of site data and maintenance records; and
- a review of any new laws or requirements that could affect the cleanup.

We would like to hear from you!
We would like to interview community members about how you think the site cleanup is going. If you would like to learn more about the site and/or be interviewed, please contact the EPA project manager below **before March 31, 2021:**
Nadia Hollan Burke, EPA, 415-972-3187, Burke.NadiaHollan@epa.gov

Where can I learn more?
Visit EPA's site webpage at epa.gov/superfund/hassyampalandfill and the Arizona Department of Environmental Quality's (ADEQ) site webpage at azdeq.gov/superfund/hassayampa-landfill for more information.

EPA and ADEQ plan to post the complete Five-Year Review report on these websites within the first week of October 2021.

You may review site information at the ADEQ Records Center, 1110 W. Washington Street, Phoenix, AZ 85007. For information on requesting records, please call ADEQ at (602) 771-4380 or visit their website: azdeq.gov/records-center.

CNSB#3438905

Appendix G: Interview Forms

Five-Year Review Interview Record			
Site:	Hassayampa Landfill	**EPA ID No:**	AZD980735666
Interview Type: Filling-in Interview Record Location of Visit: N/A Date: February 8, 2021 Time: N/A			

Interviewers		
Name	**Title**	**Organization**

Interviewees				
Name	**Organization**	**Title**	**Telephone**	**Email**
Dave Becker	USACE	Geologist		
Hugh Rieck	USACE	Geologist		

Summary of Conversation

1)What is your overall impression of the project?
The project is relatively stable. There are no known exposures, nor are any imminent. Progress is being made on vadose zone remediation by the soil vapor extraction and treatment, but groundwater extraction and treatment to contain groundwater contamination on-site will be on-going for decades (if not centuries) under the current approach. The relationship between the agencies and the HSC is constructive.
2) Is the remedy functioning as expected? How well is the remedy performing?
The remedy is generally functioning as intended, though progress toward the goal of restoration of groundwater is not occurring at an appreciable rate, and in some cases, groundwater concentrations in a few wells near the Pit 1 source area have increased in the last three years for unknown reasons. However, data from the second half of 2020 may suggest the trend may not persist.
3) What does the monitoring data show? Is contaminant containment occurring?
The monitoring data indicate the groundwater plume in Unit A is generally contained by the extraction system; and contamination has not migrated downward to Unit B, nor is it expected to do so. Soil vapor concentrations have generally and substantially declined except near SP-1 (and this is not considered a direct risk to the groundwater as the contaminants are predominantly degradable hydrocarbons, e.g., xylenes, and the detections are separated from the water table by a thick basalt layer and the site is capped). There have been some detections of contaminants in wells south of the municipal landfill, that are not suspected of being related to the Superfund site. Again, the increased concentrations of some VOCs in groundwater near the Pit 1 source area during the last 3 years or so are difficult to explain and require additional discussion.
4) Please describe the frequency of site inspections and maintenance visit activities in the last five years.
Our understanding is the site is inspected every month, and personnel respond to alarm conditions on the equipment. Detailed inspection and air stripper cleaning are conducted at least annually, though there may be more frequent cleaning done, if necessary. USACE provides oversight of the annual cleaning, usually conducted in October of each year.
5) Have there been any significant changes in the Operations & Maintenance requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.
There have been adjustments in the sampling of soil gas to support the updated soil vapor extraction decision logic, with an emphasis on monitoring points near Pit 1. There has been a permanent change from the GEO condensation treatment to carbon adsorption. This has reduced O&M effort (and cost). There have been some minor modifications to the groundwater sampling program that would be described in the Annual Reports.
6) Have there been unexpected Operations & Maintenance difficulties or costs at the site in the last five years? If so, please give details.
No, nothing unexpected.
7) Have there been opportunities to optimize Operations & Maintenance or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.
Yes, modifications to the sampling program are typically proposed in the Annual Report and evaluated by the agencies. Any apparent O&M issues are raised by the HSC and discussed with the agencies to identify approaches for improvement that are reliable, cost-effective, and green. The transition to vapor-phase carbon for SVE effluent treatment in 2016 is a good example.
8) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
No.
9) Are you aware of any changes in the nearby land use in the last five years?
The operations at the Hickman Egg Operations appear to have expanded over the last several years including facilities northwest of the site.
10) Are you aware of any vandalism at the site in the last five years?
Not that has been reported to the agencies.
11) Do you have any comments, suggestions, or recommendations regarding the project?
None, other than what is contained in the responses above.

Additional Site-Specific Questions

None

Five-Year Review Interview Record			
Site:	Hassayampa Landfill Superfund Site	**EPA ID No:**	AZD980735666

Interview Type: Filling-in Interview Record
Location of Visit: N/A
Date: February 11, 2021
Time: N/A

Interviewers

Name	Title	Organization

Interviewees

Name	Organization	Title	Telephone	Email
Tim Little	Maricopa County	Risk Control and Loss Prevention Mgr.		

Summary of Conversation

1) What is your overall impression of the project?
I am the representative to the Hassayampa Steering Committee (HSC) for Maricopa County. I believe the project is well organized, well managed, and is making steady progress towards resolution.
2) Is the remedy functioning as expected? How well is the remedy performing?
The remedy is performing according to predictions.
3) What does the monitoring data show? Is contaminant containment occurring?
Data shows steady progress in the removal of contaminants from soil vapor and from groundwater.
4) Please describe the frequency of site inspections and maintenance visit activities in the last five years.
Staff from the Maricopa County Environmental Services Department, Waste Resources and Recycling Department are on site quarterly for purposes of sampling. Maricopa Risk Management staff in on site twice per year and additionally if circumstances require.
5) Have there been any significant changes in the Operations & Maintenance requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.
To the best of my knowledge, there have been no significant changes in the last 5 years.
6) Have there been unexpected Operations & Maintenance difficulties or costs at the site in the last five years? If so, please give details.
Other than reports of occasional minor issues, there have been no reports of significant issues.
7) Have there been opportunities to optimize Operations & Maintenance or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.
With the length of time this project has been underway, I believe that maximum efficiencies have been achieved.
8) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
No.
9) Are you aware of any changes in the nearby land use in the last five years?
There are no land use changes in the vicinity.
10) Are you aware of any vandalism at the site in the last five years?
None that I am aware of.
11) Do you have any comments, suggestions, or recommendations regarding the project?
Maricopa County is satisfied with the remediation activities, the progress being made, the overall management of the project and the communications received regarding the project. No suggestions or recommendations at this time.

Additional Site-Specific Questions

None

Five-Year Review Interview Record			
Site:	Hassayampa Landfill	**EPA ID No:**	AZD980735666

Interview Type: Filling-in Interview Record
Location of Visit: N/A
Date: February 23, 2021
Time: N/A

Interviewers

Name	Title	Organization

Interviewees

Name	Organization	Title	Telephone	Email
Colin Wagoner	CALIBRE Systems, Inc.	Consultant to ADEQ		

Summary of Conversation

1) What is your overall impression of the project?
The project is running smoothly. The groundwater remediation system (GRS) is effectively containing the plume and removing small amounts of volatile organic compounds (VOCs). The soil vapor extraction system is removing significantly larger quantities of VOCs. The reporting and communications are timely and clear.
2) Is the remedy functioning as expected? How well is the remedy performing?
Yes, the remedy is preforming as expected. The GRS is effectively containing the groundwater plume onsite. The vapor plume is decreasing in size due to ongoing operation of the SVE system.
3) What does the monitoring data show? Is contaminant containment occurring?
VOCs in groundwater are localized to a few wells. VOCs in soil vapor are decreasing in size.
4) Please describe the frequency of site inspections and maintenance visit activities in the last five years.
I have not been to the site.
5) Have there been any significant changes in the Operations & Maintenance requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.
The O&M requirements have not generally changed. There have been ongoing efforts to turn off the SVE system but to-date the concentrations of one or more compounds have rebounded and the system has been restarted.
6) Have there been unexpected Operations & Maintenance difficulties or costs at the site in the last five years? If so, please give details.
There have been occasional short shutdowns due to power outages or equipment malfunctions, but contractors have dealt with these in a timely manner.
7) Have there been opportunities to optimize Operations & Maintenance or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.
The HSC has conducted several SVE rebound tests over the last few years in an attempt to justify turning off that system. In each case, the soil vapor concentrations have rebounded. Should the current (or subsequent) rebound tests prove successful, the operating costs will undoubtedly decrease.
8) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
Not to my knowledge.
9) Are you aware of any changes in the nearby land use in the last five years?
Not to my knowledge.
10) Are you aware of any vandalism at the site in the last five years?
Not to my knowledge.
11) Do you have any comments, suggestions, or recommendations regarding the project?
O&M seems routine. The groundwater data suggest that the GRS will need to be operated indefinitely. If the SVE system can be shut down, efforts to reduce reporting costs should be considered.

Additional Site-Specific Questions

None

Five-Year Review Interview Record

Site:	Hassayampa Landfill	EPA ID No:	AZD980735666

Interview Type: Filling-in Interview Record
Location of Visit: N/A
Date: February 25, 2021
Time: N/A

Interviewers

Name	Title	Organization

Interviewees

Name	Organization	Title	Telephone	Email
Natalie Romanoff	Arizona Department of Environmental Quality	Project Manager		

Summary of Conversation

1) What is your overall impression of the project?
The project is progressing as expected. Communication among all parties is ongoing and beneficial. The remedy is effectively containing and removing VOCs from the groundwater and soil.

2) Is the remedy functioning as expected? How well is the remedy performing?
The remedy is functioning and performing as expected. Groundwater and vapor plumes are contained and decreasing in size.

3) What does the monitoring data show? Is contaminant containment occurring?
Impacts to groundwater are limited to a few onsite wells and the vapor concentrations are below the Soil Vapor Performance Standards (SVPS). The SVE system was shut down during rebound testing and restarted after several months of monitoring due to increasing concentrations for several contaminates of concern.

4) Please describe the frequency of site inspections and maintenance visit activities in the last five years.
Shortly after my onset as Project Manager, ADEQ staff performed one site visit in May 2020. During the last year, field activities were limited by the agency in response to COVID-19 infection numbers.

5) Have there been any significant changes in the Operations & Maintenance requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.
Equipment malfunctions occasionally occur and result in system shutdowns. The contractor is timely in their responsiveness to the equipment failure minimizing the shutdown times and ensuring the protectiveness of the remedy.

6) Have there been unexpected Operations & Maintenance difficulties or costs at the site in the last five years? If so, please give details.
Periodic power outages at the site have caused system shutdowns. However, the contractor responded to the outages, restarted the system, and communicated issues in a timely manner. The age of the system has resulted in increased equipment malfunctions causing system shutdowns. The contractor is very responsive to repairing and restarting the system in a timely manner.

7) Have there been opportunities to optimize Operations & Maintenance or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.
Yes, rebound testing occurred on the SVE system. However, after several months of monitoring during the rebound test period several VOC concentrations increased to SVPS. These increases lead to the decision to restart the system and perform rebound testing again at a future date.

8) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
No.

9) Are you aware of any changes in the nearby land use in the last five years?
No.

10) Are you aware of any vandalism at the site in the last five years?
No.

11) Do you have any comments, suggestions, or recommendations regarding the project?
The remediation systems are kept in good working condition due to routine and regular maintenance. However, the age of the system does have the potential to increase maintenance costs, as made evident by the reported equipment failures and malfunctions. Within the next 5 years Groundwater Remediation System equipment nearing the end of life should be replaced and rebound testing of the SVE system should be reattempted.
Concerning the power outages, countermeasures should be discussed to reduce the frequency, especially during the summer monsoon season.

Additional Site-Specific Questions
None

Five-Year Review Interview Record			
Site:	Hassayampa Landfill	**EPA ID No:**	AZD980735666
Interview Type: Filling-in Interview Record Location of Visit: N/A Date: February 23, 2021 Time: N/A			

Interviewers		
Name	**Title**	**Organization**

Interviewees				
Name	**Organization**	**Title**	**Telephone**	**Email**
Adam King	Geosyntec	Principal Engineer		

Summary of Conversation

1) What is your overall impression of the project?
I have been working on the project since 2009. In 2006 the SVE system was restarted and was aggressively operated targeting areas of the Site with the highest concentrations of VOCs, resulting in removal of over 110-tons of mass to date. Since the development and Agency approval of the soil vapor performance standards (SVPS), three rounds of rebound testing of the SVE system have been conducted indicating that permanent shut down of the SVE remedy may be possible in the near future. The aggressive mass removal efforts will serve to maintain protectiveness over the long term. At the same time frame the groundwater recovery system (GRS) has also been relatively continuously operated providing containment of VOCs in groundwater with some additional mass removal.

The HSC has also worked closely with the Agencies over the last 15 years to address questions or concerns that have arisen. The HSC has more recently worked with the Agencies to finalize performance standards and operational protocols contained in the performance monitoring and verification plan (PMVP) to guide later operation and eventual shutdown of the SVE and GRS remedies. In summary, site conditions are understood, the remedies are operating as intended and plans have been developed and approved to guide future operation of the SVE and GRS systems.

2) Is the remedy functioning as expected? How well is the remedy performing?
Both the GRS and SVE remedies are functioning as designed and expected. Capture of VOC affected groundwater has been maintained by the GRS. The operational configuration of the SVE system has also been transitioned to carbon for off-gas treatment due to the declining influent concentrations and mass removal rates that were experienced in 2015. Since initially achieving soil vapor performance standards (SVPSs) which supported conducting rebound testing, the operation of the carbon based SVE system is currently being focused on controlling concentration rebound in the Pit 1 area. Previous Agency questions regarding capture of VOC affected groundwater along the eastern side of the Site as well as potential vertical migration to Unit B have also been addressed.

3) What does the monitoring data show? Is contaminant containment occurring?
Groundwater and soil vapor conditions are frequently monitored to demonstrate contaminant containment and steady progress towards remedial goals. Through operation of the SVE system, soil vapor data have exhibited significant declines, where the magnitude and extent of the VOCs in soil vapor have been dramatically reduced in comparison to conditions in 2006 when SVE was restarted. Per the Agency approved PMVP, soil vapor VOC concentrations in the Pit 1 source area have been reduced to levels that support rebound testing and possible shutdown. Reductions in soil vapor VOC concentrations have resulted in commensurate declines in influent VOC concentrations to GRS. These data trends continue to support the Conceptual Site Model (CSM) for the Site that was jointly prepared with the Agencies. Earlier Agency questions with respect to contaminant of VOC affected groundwater were addressed with the replacement of monitoring well MW-21UA and installation of MW-21UB. The underlying Unit B groundwater continues to be regularly monitored.

4) Please describe the frequency of site inspections and maintenance visit activities in the last five years.
The Hassayampa Site does not have personnel on-Site continuously performing O&M. The SVE and GRS operations are automated and equipped with sensors and preprogramed shutdown thresholds. Systems also include telemetry to notify the appropriate O&M contractor in event of any upset condition so that timely corrective measures can be implemented. Over the last 5 years, the contractors have met approximately semi-annually which typically include site visits by project managers to evaluate site and system conditions. Semi-annual meetings with EPA and ADEQ personnel and contractors have also been held to provide updates of on-going work at the Site, review plans for upcoming work and to review and discuss the results of sampling events. Conference calls and net-meetings with EPA and ADEQ personnel are also held as needed or requested to provide updates of on-going work at the Site, resolve questions and review plans for upcoming work.

Over the past 5-years, groundwater related site activities have included monthly inspections in addition to responding to any alarm conditions from the GRS and quarterly groundwater monitoring activities. Beginning in 2016, the full-scale granular activated carbon (GAC) system was initiated for extraction and off-gas treatment of VOCs in soil vapor. The switch to the GAC SVE system included some changes in the O&M performed for the SVE system. Soil vapor monitoring is also performed semi-annually following an approximate 1-week shutdown of the SVE system (non-extracting conditions). Per the Agency approved PMVP, rebound testing have been completed to date. All of the data from O&M visits, inspections and sampling events are submitted to Agencies in the routine semi-annual and annual reports for the Site.

5) Have there been any significant changes in the Operations & Maintenance requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.
Except for SVE system rebound testing initiated in 2017 and a groundwater recovery test in 2020, there have not been any significant changes in the O&M requirements or maintenance schedules in the last 5 years. The groundwater sampling program still includes additional analyses for nitrates and 1,4-dioxane as requested by EPA. Reductions in sampling frequencies at a number of soil vapor and groundwater points based upon statistical evaluations of trends as reported in the 2020 Annual Report have been implemented with approval of the Agencies. The significant mass removal from the vadose zone of over 110-tons has resulted in a commensurate decline in influent VOC mass to the GRS which results in an increase in the protectiveness over the long term.

6) Have there been unexpected Operations & Maintenance difficulties or costs at the site in the last five years? If so, please give details.
There have not been any unexpected difficulties with O&M of the systems that could not be addressed with replacement parts or repairs to elements such as pumps, level controls, belts, etc.

7) Have there been opportunities to optimize Operations & Maintenance or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.
Due to declining influent concentrations, a full-scale pilot test of an air phase granulated activated carbon off gas treatment system was successfully implemented in 2015 and was made full scale in 2016. As a result, operating costs, including energy costs have been reduced due to a change from the cryogenic treatment system and carbon consumption has steadily declined.
8) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
No.
9) Are you aware of any changes in the nearby land use in the last five years?
Hickman's Family Farms expanded its egg production facility and added a waste drying facility to produce fertilizer for nearby farms and a new deep groundwater well. There have been no other significant land use changes since the last 5-year review.
10) Are you aware of any vandalism at the site in the last five years?
As a result of the HSC's combination of well-maintained security fencing and nightly patrols there have been no vandalism at the site in the last five years.
11) Do you have any comments, suggestions, or recommendations regarding the project?
Both the SVE and GRS remedies are operating as designed. The SVE system has been highly effective at removing VOC mass from the vadose zone and has been showing signs of asymptotic mass removal. This condition is supported by initially achieving SVPSs in 2017 which supported rebound testing of the SVE system. As of the 2020 Annual report, a third rebound test of the SVE system has been completed, where rebound testing should be maintained to support eventual shutdown of the active SVE remedy, which will save costs and reduce energy consumption. The SVPSs which are used to guide rebound testing were developed throughout the 5-year review period, resulting in containment of VOC affected groundwater and some mass removal. Efforts should continue to maintain consistent GRS operation and containment of VOCs in groundwater per the PMVP.

Additional Site-Specific Questions
None

Five-Year Review Interview Record			
Site:	Hassayampa Landfill	**EPA ID No:**	AZD980735666

Interview Type: Filling-in Interview Record
Location of Visit: N/A
Date: February 10, 2021
Time: N/A

Interviewers		
Name	**Title**	**Organization**

Interviewees				
Name	**Organization**	**Title**	**Telephone**	**Email**
Ben Costello	HSC/NES	Project Manager		

Summary of Conversation

1) What is your overall impression of the project?
I am the Project Manager for the Hassayampa Steering Committee (HSC) the PRP group responsible for implementing the remedial action at the Hassayampa Landfill Site.

To date, the work at the Hassayampa Site has successfully controlled any off-Site, downgradient migration of Site-related constituents. The remedy at the Hassayampa Site has been operated and maintained in a manner that has been and remains protective of human health and the environment. In 2006, the HSC re-started and has operated almost continuously a portion of the SVE system to control, at a minimum, VOCs in the vadose zone soil gas. The work performed over the last 15-years to optimize the SVE and groundwater recovery system (GRS) remedy components at the Hassayampa site will be detailed later. Over 110-tons of VOCs have been removed from the Site and sent off-Site for disposal. The HSC maintains very good relationships with its few Site neighbors.
2) Is the remedy functioning as expected? How well is the remedy performing?
The remedy is functioning as designed and as expected and is protective of human health and the environment. During the last 5-years, no problems have been encountered at the Site that would require any changes to the remedial design. The GRS and SVE remedy components combined with security fencing and patrols, the flexible membrane liner cap and an extensive robust soil vapor and groundwater monitoring program have insured that the remedy at the Hassayampa Site remains protective of

human health and the environment.

3) What does the monitoring data show? Is contaminant containment occurring?

Contaminant containment is occurring. When operation of the SVE system ceased in 1998, the soil vapor monitoring data for the vadose zone above the basalt layer beneath the Hassayampa Site indicated an upward trend on soil gas VOC concentrations in the vicinity of the Put 1 area of the Hassayampa Site. Largely based on these data, a portion of the SVE system was restarted in March 2006. The restarted SVE system has more than adequately controlled VOCs in the vadose zone soil gas and has contributed to a reduction in VOC concentrations in portions of the Site groundwater.

The monitoring data indicates that the concentrations of VOCs in groundwater within the upper aquifer (Unit A) located just beneath the basalt layer have been trending downward in a number of monitoring and groundwater recovery wells within the capture zone of the groundwater pump and treat system; VOC concentrations at the monitoring points down-gradient of the capture zone of the groundwater pump and treat system have remained non-detect. These decreasing data trends in the Unit A aquifer are believed to be primarily, a function of the decreased VOC concentrations in the overlying vadose zone as a result of the HSC's resumption of aggressive SVE operations.

The monitoring data indicates that the groundwater quality of the lower aquifer (Unit B) located just beneath Unit A has been and remains unaffected by Site-related constituents both within the capture zone of the groundwater pump and treat system and at all monitoring points downgradient of the capture zone of the groundwater pump and treat system. To date, VOCs have not been detected above Performance Standards in groundwater samples collected from the lower (Unit B) aquifer.

No new chemicals of concern (COCs) have been identified in soil, soil gas or groundwater.

4) Please describe the frequency of site inspections and maintenance visit activities in the last five years.

The Hassayampa site does not have personnel on-Site continuously performing O&M. All of the SVE and GRS operations are automated and equipped with sensors and shutoff interlocks to deal with any upset conditions and are linked to telemetry to notify the appropriate O&M contractor in event of any upset conditions. I manage the overall operation and maintenance of the remedy at the Hassayampa Site as well as the ongoing work to review and evaluate the current conceptual model for the Site. As a result, I am responsible to ensure that routine site inspections are preformed, routine and non-routine maintenance items are performed, the Site is maintained in an operational status; and the routine quarterly and annual reports are filed with both EPA and ADEQ. As necessary, I visit the site to personally observe operational and investigative work. I meet approximately semi-annually, at a minimum, with EPA and ADEQ personnel and contractors face-to-face to provide updates of ongoing work at the Site, review plans for upcoming work and to review and discuss the results of every sampling event. I have had conference calls and net-meetings with EPA and ADEQ personnel to provide frequent telephone conversations and correspond via e-mail and letters with EPA and ADEQ personnel and contractors to provide updates of on-going work at the Site, work on 5-year review issues, review plans for upcoming work and to review and discuss the results of every sampling event.

Over the past 5 years the HSC's contractors conduct: monthly site inspections in addition to responding to any alarm conditions from the groundwater pump & treat system and bi-weekly inspection of the SVE system; quarterly groundwater and soil vapor sampling; and other Site-related inspection, maintenance and monitoring activities on an as needed basis. All of the data from these visits and inspections are conveyed to EPA in the routine semi-annual reports or, if needed, separate incident reports.

As needed, I have responded, via telephone conversations, correspondence and in-person meetings, to inquiries from actual Site neighbors (e.g., Hickman's Family Farms and inquiries from individuals contemplating purchasing property in the vicinity of the Site). When asked, the HSC has shared its knowledge of the local and regional hydrogeology and its groundwater water level and water quality data bases with its neighbors.

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

Except for SVE system rebound testing and a groundwater recovery test in 2020, there have not been any significant changes in the O&M requirements or maintenance schedules in the last five years. Sampling routines still include additional analyses for nitrates and 1,4-dioxane as requested by EPA, the addition of several wells, and reductions in sampling frequencies at a number of soil vapor and groundwater points based upon statistical evaluations of trends as reported in the 2020 Annual Report. If anything, there has been an increase in the protectiveness of the remedy given the mass of VOCs removed from the source area.

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

While the Site has experienced routine O&M mechanical issues, there have not been any unexpected O&M difficulties at the site in the last 5-years.

7) Have there been opportunities to optimize Operations & Maintenance or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.

The efficiency and up-time of the groundwater pump and treat system have improved and the need for call-out response to alarm or upset conditions has decreased.

The HSC has been working with EPA and ADEQ to maximize, to the extent practical, applicability of efficacy of alternate groundwater sample acquisition techniques, such as passive diffusion bags. As a result, sampling efficiency and, therefore, cost efficiencies to obtain groundwater samples have improved. The HSC believes that over time this will result in more consistent groundwater data.

On the soil vapor side, since March 2006 the HSC has successfully re-started and operated portions of the SVE system using the GEO cryogenic off-gas treatment system. In August 2015, a full-scale pilot test of an air phase granulated activated carbon off gas treatment system was successfully implemented and, as a result, installation of a permanent air phase granular activated carbon off gas treatment system was completed.

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

No.

9) Are you aware of any changes in the nearby land use in the last five years?

Hickman's Family Farms has increased to size of its egg production facility and added a waste drying facility and a new deep groundwater well. There have been no other land use changes.

10) Are you aware of any vandalism at the site in the last five years?

As a result of the HSC's combination of well-maintained security fencing and nightly patrols there has been no vandalism at the site in the last five years.

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

The project is on track with the remedy proceeding as anticipated. There has been nothing in the data collected over the lasts 5-years to indicate DNAPL in contact with groundwater or the presences pf significant DNAPL concentrations in the vadose zone near the groundwater table. The HSC has, at EPA's request, examined a number of methods that were posed as possibly optimizing or accelerating clean-up (i.e., more aggressive source area treatments) but none have been practical or cost effective. MW-21UB was added to the groundwater monitoring network to improve the long-term verification of conditions in Unit B and serve as a background well for nitrate. MW-21UB and its paired well MW-21UAR serve to document capture and verify that there is no downward migration of site-related contamination in that area. The data from MW-21UB and all of the other nitrate data collected by the HS when combined with all of the available regional nitrate data solidly confirm that any nitrate in the treated water going to the injection well has no potential to impact public health. The CSM, O&M Plan and the QAPP are updated, the SVPSs have been revised and the updated performance monitoring requirements have been redesigned to take into consideration and effects soil vapor will have on meeting site closure requirements and the remote possibility that any residual, non-mobile DNAPL might have an effect on meeting Site closure requirements.

Additional Site-Specific Questions
None

Five-Year Review Interview Record			
Site:	Hassayampa Landfill	**EPA ID No:**	AZD980735666

Interview Type: Filling-in Interview Record
Location of Visit: N/A
Date: February 10, 2021
Time: N/A

Interviewers		
Name	**Title**	**Organization**

Interviewees				
Name	**Organization**	**Title**	**Telephone**	**Email**
Jeff Menken	Hargis + Associates, Inc.	Senior Hydrogeologist		

Summary of Conversation

1) What is your overall impression of the project?

My overall impression is that the project is successful. Off-Site, down-gradient migration of Site-related constituents has been prevented, the vertical migration potential of contaminants in groundwater is low, and the remedy at the Site has been operated and maintained in a manner that has been and remains protective of human health and the environment. The soil vapor system has been successful in decreasing soil vapor concentrations to below the Soil Vapor Performance Standards (SVPSs) during operation and has been undergoing a series of rebound tests to evaluate how much longer it will continue to be needed. Groundwater concentrations are decreasing in all wells except those located between the source area (Pit 1) and the extraction wells.

2) Is the remedy functioning as expected? How well is the remedy performing?
The remedy is performing as expected, all affected groundwater is captured, and soil vapor concentrations have been reduced to below SVPSs during SVE operation. Soil vapor rebound testing to-date has resulted in slow, minimal increases of soil vapor concentrations and testing completed in 2019/2020 indicated soil vapor concentrations remained below SVPSs for 9 months without SVE operation. A 2019 groundwater recovery test that allowed re-saturation of the vadose zone identified no groundwater concentration increases resulting from re-saturation. This is in sharp contrast to the 200% to 500% groundwater concentration increases documented when Pit 1 area vadose zone soils were re-saturated as part of SVE operations between 2007 and 2012. The 2019 results, along with low soil vapor concentrations in sub-basalt soil vapor monitoring wells, indicate the soil vapor extraction system has significantly reduced the Pit 1 vadose zone residual mass. As a result, groundwater concentrations in MW-18UA (north of Pit 1) are decreasing as are those across the Site except for in wells between Pit 1 and the extraction wells.

3) What does the monitoring data show? Is contaminant containment occurring?
The monitoring data indicate that containment of affected groundwater has been maintained. Data also indicate that soil vapor concentrations are now de-minimis and groundwater concentrations are declining apart from the areas between Pit 1 and the extraction wells. This is to be expected as the plume migrates towards the pumping wells. Unit B groundwater remains unaffected by VOCs.

No new chemicals of concern (COCs) have been identified in soil, soil gas or groundwater. Nitrate is routinely detected in groundwater samples above the EPA MCL, however nitrate concentrations in both Unit A and Unit B groundwater samples have been proven to have historically been below background concentrations of this chemical and for that reason nitrate is not considered a site-related contaminant. Similarly, total chromium has occasionally been reported above the groundwater performance standards (GWPSs) in upgradient Unit A monitor well MW-11UA. These have also been shown to be related to background conditions. Additional analyses for 1,4-dioxane have also been performed. 1,4-dioxane has only been detected in groundwater samples at Pit 1 area wells (MW-18UA and MW-19UA) at very low concentrations that attenuate before they reach downgradient wells. Since this compound would be expected to be at significantly higher concentrations if it were present in groundwater (based on concentrations of other VOCs) and at other sample locations, it is not considered to be a significant contaminant in Site groundwater.

4) Please describe the frequency of site inspections and maintenance visit activities in the last five years.
The Hassayampa Site is remote, and no continuous O&M presence is maintained. Instead, SVE and GRS operations are remotely monitored with systems that automatically communicate alarm conditions. Hargis performs monthly Site inspections and O&M on Site components per the schedule approved in the O&M manual. Monthly inspections include cap condition, security, well conditions, GRS operation/condition, etc. More thorough inspections are completed by Hargis annually, including teardown and cleaning of the GRS. Hargis also conducts quarterly groundwater sampling.

During operation, photoionization detector and vacuum readings are collected for the SVE system on a weekly basis by either Hargis or Geosyntec. Other O&M activities are performed as needed. The systems typically maintain an operational up-time of greater than 95%.

5) Have there been any significant changes in the Operations & Maintenance requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.
No significant changes to the GRS or Site O&M have occurred over the last 5 years. The O&M requirements for the SVE system are dependent upon operation as it is occasionally off for rebound testing. Sampling routines have been adjusted occasionally either in response to agency requests or following agency discussions and approval.

6) Have there been unexpected Operations & Maintenance difficulties or costs at the site in the last five years? If so, please give details.
No O&M difficulties have been encountered in the last 5 years that significantly impacted the Site remedy. While the Site has experienced routine O&M mechanical issues (e.g., power outages, pump failures, etc.) such issues are accounted for in annual planning and strategies are in place to address them quickly and minimize downtime in the event they occur.

7) Have there been opportunities to optimize Operations & Maintenance or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.
Optimization of the systems is an ongoing process that is formally addressed in each Annual Report. Over the last 5 years several O&M changes have been performed to increase work efficiency such as installing a more rugged pitot tube and a lighter GRS exhaust stack, but no major changes have been made to the GRS.

The cryogenic SVE treatment system was replaced in 2016 by a vapor phases granular activated carbon SVE system which has operated since. This system has proven effective at treating soil vapor concentrations at a lower cost.

Sampling efforts are reviewed at least annually to identify opportunities to increase efficiency and several changes to the lists of wells monitored and monitoring frequencies have been made, including those associated with the revised Performance Monitoring and Verification Plan approved in 2017. No additional changes have been requested recently.

8) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
No.

9) Are you aware of any changes in the nearby land use in the last five years?

I am not aware of any land use changes since 2015 other than some expansion to Hickman's Egg Ranch operations northwest of the Site at Baseline Road and 331st Avenue.

10) Are you aware of any vandalism at the site in the last five years?

No. The only significant unexpected damage to the Site in the last 5 years has been due to weather-related causes (for example loss of a storage shed due to high winds) and did not significantly impact the remedy.

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

Based on site data the project appears to be on track and is progressing as expected. Recent recommendations have included potential additional SVE rebound testing. No additional recommendations have been made or are pending at this time.

Additional Site-Specific Questions
None

Five-Year Review Interview Record			
Site:	Hassayampa Landfill	**EPA ID No:**	AZD980735666

Interview Type: Filling-in Interview Record

Location of Visit: N/A

Date: February 23, 2021

Time: N/A

Interviewers		
Name	**Title**	**Organization**

Interviewees				
Name	**Organization**	**Title**	**Telephone**	**Email**
Michael Reardon	Geosyntec	Project Manager		

Summary of Conversation

1) What is your overall impression of the project?

I have been working on the project since Geosyntec's initial involvement in 2005. In 2006 the SVE system was restarted and was aggressively operated targeting areas of the Site with the highest concentrations of VOCs, resulting in removal of over 110-tons of mass to date. Since the development and Agency approval of the soil vapor performance standards (SVPSs), three rounds of rebound testing of SVE system has been conducted indicating that permanent shut down of the SVE remedy may be possible in the near future. The aggressive mass removal efforts will serve to maintain protectiveness over the long term. In the same time frame the groundwater recovery system (GRS) has also been relatively continuously operated providing containment of VOCs in groundwater with some additional mass removal.

The HSC has also worked closely with the Agencies over the last 15 years to address questions or concerns that have arisen. The HSC has more recently worked with the Agencies to finalize performance standards and operational protocols contained in the performance monitoring and verification plan (PMVP) to guide later operation and eventual shutdown of the SVE and GRS remedies. In summary, site conditions are understood, the remedies are operating as intended and plans have been developed and approved to guide future operation of the SVE and GRS systems.

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

Both the GRS and SVE remedies are functioning as designed and expected. Capture of VOC affected groundwater has been maintained by the GRS. The operational configuration of the SVE system has also been transitioned to carbon for off-gas treatment due to the declining influent concentrations and mass removal rates that were experienced in 2015. Since initially achieving soil vapor performance standards (SVPSs) which supported conducting rebound testing, the operation of the carbon based SVE system is currently being focused on controlling concentration rebound in the Pit 1 area. Previous Agency questions regarding capture of VOC affected groundwater along the eastern side of the Site as well as potential vertical migration to Unit B have also been addressed.

3) What does the monitoring data show? Is contaminant containment occurring?

Groundwater and soil vapor conditions are frequently monitored to demonstrate contaminant containment and steady progress towards remedial goals. Through operation of the SVE system, soil vapor data have exhibited significant declines, where the magnitude and extent of VOCs in soil vapor have been dramatically reduced in comparison to conditions in 2006 when SVE was restarted. Per the Agency approved PMVP, soil vapor VOC concentrations in the Pit 1 source area have been reduced to levels that support rebound testing and possible shutdown. Reductions in soil vapor VOC concentrations have resulted in commensurate declines in influent VOC concentrations to GRS. These data trends continue to support the Conceptual Site Model (CSM) for the Site that was jointly prepared with the Agencies. Earlier Agency questions with respect to contaminant of VOC affected groundwater were addressed with the replacement of monitoring well MW-21UA and installation of MW-21UB. The underlying Unit B groundwater continues to be regularly monitored.

4) Please describe the frequency of site inspections and maintenance visit activities in the last five years.
The Hassayampa Site does not have personnel on-Site continuously performing O&M. The SVE and GRS operations are automated and equipped with sensors and preprogramed shutdown thresholds. Systems also include telemetry to notify the appropriate O&M contractor in event of any upset condition so that timely corrective measures can be implemented. Over the last 5 years, the contractors have met approximately semi-annually which typically include site visits by project managers to evaluate site and system conditions. Semi-annual meetings with EPA and ADEQ personnel and contractors have also been held to provide updates of on-going work at the Site, review plans for upcoming work and to review and discuss the results of sampling events. Conference calls and net-meetings with EPA and ADEQ personnel are also held as needed or requested to provide updates of on-going work at the Site, resolve questions and review plans for upcoming work.

Over the past 5 years, groundwater related site activities have included monthly inspections in addition to responding to any alarm conditions from the GRS and quarterly groundwater monitoring activities. Beginning in 2016, the full-scale granular activated carbon (GAC) system was initiated for extraction and off-gas treatment of VOCs in soil vapor. The switch to the GAC SVE system included some changes in the O&M performed for the SVE system. Soil vapor monitoring is also performed semi-annually following an approximately 1-week shutdown of the SVE system (non-extracting conditions). Per the Agency approved PMVP, rebound testing of the SVE system was also initiated in 2017 and three rounds of rebound testing have been completed to date. All of the data from O&M visits, inspections and sampling events are submitted to Agencies in the routine semi-annual and annual reports for the Site.

5) Have there been any significant changes in the Operations & Maintenance requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.
Except for SVE system rebound testing initiated in 2017 and a groundwater recovery test in 2020, there have not been any significant changes in the O&M requirements or maintenance schedules in the last 5 years. The groundwater sampling program still includes additional analyses for nitrates and 1,4-dioxane as requested by EPA. Reductions in sampling frequencies at a number of soil vapor and groundwater points based upon statistical evaluations of trends as reported in the 2020 Annual Report have been implemented with approval of the Agencies. The significant mass removal from the vadose zone of over 110-tons has resulted in a commensurate decline in influent VOC mass to the GRS which results in an increase in the protectiveness over the long term.

6) Have there been unexpected Operations & Maintenance difficulties or costs at the site in the last five years? If so, please give details.
There have not been any unexpected difficulties with O&M of the systems that could not be addressed with replacement parts or repairs to elements such as pumps, level controls, belts, etc.

7) Have there been opportunities to optimize Operations & Maintenance or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.
Due to declining influent concentrations, a full-scale pilot test of an air phase granulated activated carbon off gas treatment system was successfully implemented in 2015 and was made full scale in 2016. As a result, operating costs, including energy costs have been reduced due to a change from the cryogenic treatment system and carbon consumption has steadily declined.

8) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
No.

9) Are you aware of any changes in the nearby land use in the last five years?
Hickman's Family Farms expanded its egg production facility and added a waste drying facility to produce fertilizer for nearby farms and a new deep groundwater well. There have been no other significant land use changes since the last 5-yr. review.

10) Are you aware of any vandalism at the site in the last five years?
As a result of the HSC's combination of well-maintained security fencing and nightly patrols there has been no vandalism at the site in the last five years.

11) Do you have any comments, suggestions, or recommendations regarding the project?
Both the SVE and GRS remedies are operating as designed. The SVE system has been highly effective at removing VOC mass from the vadose zone and has been showing signs of asymptotic mass removal. This condition is supported by initially achieving SVPSs in 2017 which supported rebound testing of the SVE system. As of the 2020 Annual report, a third rebound test of the SVE has been completed, where rebound sampling data supported shutdown of the SVE system for 9-months. The focus on rebound testing should be maintained to support eventual shutdown of the active SVE remedy, which will save costs and reduce energy consumption. The SVPSs which are used to guide rebound testing were developed to be protective of groundwater at the Site. The GRS has been consistently operated throughout the 5-yr. review period, resulting in containment of VOC affected groundwater and some mass removal. Efforts should continue to maintain consistent GRS operation and containment of VOCs in groundwater per the PMVP.

Additional Site-Specific Questions
None

Five-Year Review Interview Record

Site:	Hassayampa Landfill	EPA ID No:	AZD980735666

Interview Type: Filling-in Interview Record
Location of Visit: N/A
Date: March 2, 2021
Time: N/A

Interviewers

Name	Title	Organization

Interviewees

Name	Organization	Title	Telephone	Email
Karin Harker	ADEQ	Unit Manager (former Project Manager)		

Summary of Conversation

1) What is your overall impression of the project?
The project is progressing as expected. Any issues that arise are communicated and addressed in a timely manner.
2) Is the remedy functioning as expected? How well is the remedy performing?
The remedy is functioning and performing as expected.
3) What does the monitoring data show? Is contaminant containment occurring?
Impacts to groundwater are limited to a few onsite wells and the vapor concentrations are below the Soil Vapor Performance Standards (SVPS). The SVE system was shut down during rebound testing and restarted after several months of monitoring due to increasing concentrations for several contaminates of concern.
4) Please describe the frequency of site inspections and maintenance visit activities in the last five years.
Site was transferred early 2019 for a limited period during my role as the ADEQ Project Manager. During that time there was no visit activities performed. However, ADEQ did performed one site visit in the new role as Unit Manager with the newly assigned Project Manager in May 2020. The frequency of site inspections and maintenance visit activities for ADEQ has been limited over the last five years but appears regularly frequent for the Hassayampa Steering Committee and consultants.
5) Have there been any significant changes in the Operations & Maintenance requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.
Equipment malfunctions occasionally occur and result in system shutdowns. The contractor is timely in their responsiveness to the equipment failure minimizing the shutdown times and ensuring the protectiveness of the remedy.
6) Have there been unexpected Operations & Maintenance difficulties or costs at the site in the last five years? If so, please give details.
Periodic power outages at the site have cause system shutdowns. However, the contractor responded to the outages, restarted the system, and communicated issues in a timely manner. The age of the system has resulted in increased equipment malfunctions causing system shutdowns. The contractor is very responsive to repairing and restarting the system in a timely manner.
7) Have there been opportunities to optimize Operations & Maintenance or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.
Yes, rebound testing occurred on the SVE system. However, after several months of monitoring during the rebound test period several VOC concentrations increased to SVPS. These increases lead to the decision to restart the system and perform rebound testing again at a future date.
8) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
Not to my knowledge
9) Are you aware of any changes in the nearby land use in the last five years?
Not to my knowledge
10) Are you aware of any vandalism at the site in the last five years?
Not to my knowledge
11) Do you have any comments, suggestions, or recommendations regarding the project?
The remediation systems are kept in good working condition due to routine and regular maintenance. However, the age of the system does have the potential to increase maintenance costs, as made evident by the reported equipment failures and malfunctions. Within the next 5 years Groundwater Remediation System equipment nearing end of life should be replaced and rebound testing of the SVE system should be reattempted.

Concerning the power outages, countermeasures should be discussed to reduce the frequency, especially during the summer monsoon season.

Additional Site-Specific Questions

None

Five-Year Review Interview Record			
Site:	Hassayampa Landfill	**EPA ID No:**	AZD980735666

Interview Type: Filling-in Interview Record
Location of Visit: N/A
Date: March 3, 2021
Time: N/A

Interviewers

Name	Title	Organization

Interviewees

Name	Organization	Title	Telephone	Email
Brett McDaniel	ADEQ	Former Project Manager		

Summary of Conversation

1) What is your overall impression of the project?
The project is progressing as expected. Communication among all parties is ongoing and beneficial. The RP is actively and aggressively seeking the most effective and efficient remedy solutions for the site.

2) Is the remedy functioning as expected? How well is the remedy performing?
The remedy is functioning and performing as expected. Groundwater and vapor plumes are contained and decreasing in size.

3) What does the monitoring data show? Is contaminant containment occurring?
Impacts to groundwater are limited to a few onsite wells and the vapor concentrations are below the Soil Vapor Performance Standards (SVPS). The SVE system was shut down for rebound testing and promptly restarted after several months of monitoring due to increasing concentrations for several contaminates of concern. Based on these results, it appears that several iterations of SVE system shutdown and restart are necessary.

4) Please describe the frequency of site inspections and maintenance visit activities in the last five years.
The RP has efficiently performed site visits for maintenance. Any unexpected maintenance or repairs are promptly remedied. Shortly after my onset as Project Manager, ADEQ staff performed one site visit in October 2018. Remedial equipment and monitoring assets appeared in good condition.

5) Have there been any significant changes in the Operations & Maintenance requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.
Operation of the remedial system was (rebound) tested for transitioned from full-time to periodic operation to allow for rebound and more efficient recovery of COCs. Results suggested fairly rapid rebound and system returned to full-time operation. Equipment malfunctions occasionally occur and result in system shutdowns. The contractor is timely in their responsiveness to the equipment failure minimizing the shutdown times and ensuring the protectiveness of the remedy.

6) Have there been unexpected Operations & Maintenance difficulties or costs at the site in the last five years? If so, please give details.
Periodic power outages at the site have cause system shutdowns. However, the contractor responded to the outages, restarted the system, and communicated issues in a timely manner. The age of the system has resulted in increased equipment malfunctions causing system shutdowns. The contractor is very responsive to repairing and restarting the system in a timely manner.

7) Have there been opportunities to optimize Operations & Maintenance or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.
Yes, rebound testing occurred on the SVE system. However, after several months of monitoring during the rebound test period several VOC concentrations increased to SVPS. These increases lead to the decision to restart the system and perform rebound testing again at a future date.

8) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
No.

9) Are you aware of any changes in the nearby land use in the last five years?
No.

10) Are you aware of any vandalism at the site in the last five years?
No.

11) Do you have any comments, suggestions, or recommendations regarding the project?
The remediation systems are kept in good working condition due to routine and regular maintenance. However, the age of the system does have the potential to increase maintenance costs, as made evident by the reported equipment failures and malfunctions. Within the next 5 years Groundwater Remediation System equipment nearing end of life should be replaced and rebound testing of the SVE system should be reattempted.

Concerning the power outages, countermeasures should be discussed to reduce the frequency, especially during the summer monsoon season.

System equipment tolerances should be evaluated for increases in summertime temperatures. Equipment upgrades or cooling mechanisms may be needed to safeguard equipment and visiting personnel within the next 5 years.
Additional Site-Specific Questions
None

Appendix H: Site Inspection Report and Photos

Hassayampa Landfill

a. Date of Visit: 13 July 2021

b. Location: 40 miles west of Phoenix, 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:

Matthew Masten	US Army Corps of Engineers, Env. Engineer	602-230-6873
Jim Davis	Senior Project Manager, Hargis + Associates	520-727-7130
Mike Hall	Lead Field Tech, Hargis + Associates	
Daniel Hall	Field Tech, Hargis + Associates	
Branden Selleh	Field Tech, Hargis + Associates	
Natalie Romanoff	Project Manager, ADEQ	602-771-0956

A site visit to the Hassayampa Landfill Superfund Site was conducted on 13 July 2021. The inspection included visual observation of overall site conditions and inspection of various components of the remedy. The participants received an overview of the site and the remedial history. The inspection evaluated the landfill cap, the groundwater treatment system, soil vapor extraction system, groundwater and gas extraction wells.

On 13 July 2021, Mr. Masten arrived at the Hassayampa Landfill Superfund Site at 0700 hrs. The weather was partly cloudy, calm, and approximately 90 degrees Fahrenheit. The participants first toured the groundwater treatment system located in the on-site building. Since the previous Five-Year Review, an effluent check valve was replaced on the groundwater treatment system, the air stripper tray sight glass is now clear PVC and the data logger has been replaced. Mr. Mike Hall indicated that the air blower motor is scheduled to be replaced in October 2021. Mr. Hall confirmed that the aerator trays are being manually descaled yearly. The O&M manual and Health and Safety plans were all in place. No other

major changes or issues with the air stripper were noted; the system appears to be in good condition and functioning normally.

Mr. Hall indicated that his team is focusing on housekeeping throughout the site and plans on disposing of miscellaneous unneeded/discarded equipment and supplies. Mr. Hall noted that a rattlesnake was discovered inside the system building the previous Saturday. He contacted personnel from the Palo Verde Generating Station, who voluntarily came and relocated the snake. No rodent damage was noted in the building. Mr. Hall confirmed that Orkin pest control regularly comes on site to maintain rodent traps. Mr. Hall explained that Hargis personnel had trapped approximately 10 rodents near MW-2, and they have not returned.

The team next inspected the Vapor Phase Granular Activated Carbon vessels for the SVE system. The SVE system was not operating, as a rebound test was currently underway. The system is run by Geosyntec, but Hargis and Associates has performed the environmental sampling. Mr. Hall noted that the tubing for the GAC vessels has been replaced as necessary and painted to prevent sun damage. He stated that the system has condensation issues in the wintertime and the lines must be drained as needed. Geosyntec performs the maintenance on the system. Minor animal burrowing was noted in the berm that surrounds the SVE control system, blower and condensation tank; no other issues were noted.

The team next walked the rest of the Hassayampa landfill site, inspecting the SVE above-ground piping, source area wells, and the landfill cap itself. The piping was found to be in good condition. The unused piping manifold noted in the previous Five-Year Review has been dismantled and removed. Representative vapor and monitoring wells (V-11, MW-19UA, MW-6UA) were inspected. All wells were found to be secured and in good shape. The landfill cap was noted to be in good shape overall. Vegetation was sparse due to recent dry conditions. Minor erosion damage was noted down gradient from the main gate. A low spot in the adjacent county road causes runoff to flow eastward across the site and also towards county well MW-10A. This erosion damage did not appear to affect the protectiveness of the remedy. Gravel has been spread in this area to help alleviate the erosion issue. This minor erosion appears to be the only site maintenance issue. Mr. Hall said this is checked monthly, and there is an on-site stockpile of gravel if more is needed to be placed.

The fence on the perimeter of the site was in good condition and is inspected monthly. No evidence of vandalism was noticed; Mr. Hall said he was not aware of any trespassing issues. A security guard, shared with the nearby Hickman Egg farm, patrols nightly.

Mr. Masten inspected extraction well vaults outside the fence line. The well vault settling issue at extraction well EW-01UA, noted in the previous Five-Year Review, has been fixed. However, the well vault for EW-02UA has a similar issue due to erosion and settling. The well vault lid will not completely close. It was noted that these wells were not currently in use. All other wells and vaults appeared to be in good condition.

Mr. Hall explained that the site has occasional phone line communication issues during stormy weather. This affects the data logger for the ground water treatment system. When this occurs, he is notified, and CenturyLink (the local phone company) will repair the issue.

The formerly used thermal oxidation system was noted to still be on site. Mr. Masten was informed that there was no current plan to remove the system. Inquiries made to companies to scrap the equipment have been unsuccessful. It is currently cost prohibitive to remove, manifest and properly dispose of the system.

The team met at the parking area and then proceeded to inspect the injection well west of the site. The well vault was found to be secured and the well was in good working order. Mr. Masten departed the site at 1100 hrs.

All components of the remedial action for the Hassayampa Landfill appear to be in good condition and are currently operating as intended.

Matthew Masten, P.E.

Environmental Engineer

US Army Corps of Engineers, LA District

Photo 9 – Air stripper system

Photo 10 – Extraction well flowrate gauges

Photo 11 – Air stripper trays

Photo 12 – Clear PVC sight glass on air stripper trays

Photo 13 – View of replaced effluent check valve (center right of photo)

Photo 14 – View of VGAC vessels

Photo 15 – VGAC system, and condensation tank

Photo 16 – View of SVE system above ground piping, facing east

Photo 17 – Site of former piping manifold, facing north

Photo 18 – Well V-11

Photo 19 – Well MW-19UA with hanging passive diffusion bag

Photo 20 – Well MW-6UA

Photo 21 – Extraction well EW-4UA

Photo 22 – Extraction well EW-2UA, showing partially closed lid

Photo 23 –Overview of site facing northwest, towards treatment system

Photo 24 – Entrance gate, facing southwest

Photo 25- Gravel placed over minor erosion area, downgradient of main gate, facing east

26- View towards main gate, facing west, showing minor erosion

27- Formerly used thermal oxidation system

Photo 28- Secured doors to ground water treatment system building

Photo 29- Injection well west of site