SECOND 5-YEAR REVIEW REPORT

FOR

HASSAYAMPA LANDFILL SUPERFUND SITE

MARICOPA COUNTY, ARIZONA

September 2006

Prepared for:

Contract No.
U.S. Environmental Protection Agency
Region 9
75 Hawthorne Street
San Francisco, California 94105

Approved by: Date:

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List of Acronyms

ADEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
ADWR	Arizona Department of Water Resources
ARARs	applicable or relevant and appropriate requirements
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CGZ	course-grained zone
COPC	chemicals of potential concern
CRA	Conestoga-Rovers & Associates, Phoenix, Arizona
DEUR	Declaration of Environmental Use Restriction
FGZ	fine-grained zone
FML	flexible membrane liner
GRS	groundwater remediation system
HBGL	health based guidance level
HSC	Hassayampa Steering Committee
HWA	hazardous waste disposal area
MCL	maximum contaminant level
µg/L	micrograms per liter
NPL	National Priorities List
O&M	operation and maintenance
ROD	Record of Decision
SVE	soil vapor extraction
SVOC	semivolatile organic compound
SVTS	soil vapor treatment system
TBC	to-be-considered
UAO	Unilateral Administrative Order
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

5-Year Review Summary Form

SITE IDENTIFICATION

Site name : Hassayampa Landfill Superfund Site

EPA ID: AZD980735666 **CERCLIS ID :** 09B8

Region: 9 **State:** AZ **City/County:** Maricopa County

SITE STATUS

NPL status: ν Final ο Deleted ο Other (specify) _____

Remediation status (choose all that apply): ν Operating ν Complete

Multiple OUs? ο YES ν NO **Construction completion date:** April 1998 (Certification of Construction Completion)

Has site been put into reuse? ο YES ν NO

REVIEW STATUS

Reviewing agency: ν EPA ο State ο Tribe ο Other Federal Agency _____

Author name: Martin Zeleznik

Author title: Remedial Project Manager **Author affiliation:** USEPA Region 9

Review period: March – August 2006

Date(s) of site inspection: March 28, 2006

Type of review: ν Statutory

ο Policy οPost-SARA ο Pre-SARA ο NPL-Removal only

ο Non-NPL Remedial Action Site ο NPL State/Tribe-lead

ο Regional Discretion)

5-Year Review Summary Form (cont.)

Review number: o 1 (first) v 2 (second) o 3 (third) o Other (specify)

Triggering action:

o Actual RA Onsite Construction

o Actual RA at OU #1

v Previous 5-year Review Report

o Construction Completion

o Other (specify) _____

Triggering action date: September 28, 2001

Due date (five years after triggering action date): September 28, 2011

Issues and Recommendations:

Issue

The remedy at the site was designed and implemented assuming that the bulk of the contamination was above the laterally-extensive basalt layer. Recent studies at the site have revealed that the basalt layer does not extend beneath the whole site. Furthermore, recent data indicates the vapor concentrations beneath the basalt are significantly higher than above basalt.

Recommendation Continue the implementation of the Revised Phase I Work Plan (GSC/HA 2006) and subsequent iterations of investigation, as determined necessary.

Issue

The soil vapor performance standards which had been achieved were developed assuming that there was a laterally-extensive, low-permeability basalt layer preventing vapor movement downwards and into the aquifer. Recent information calls into question the prevention of downward migration The site-specific SESOIL vadose zone model, which was used to develop the soil vapor performance standards, may not be the most applicable analytical tool under these conditions.

Recommendation The applicability of the SESOIL model to site conditions should be reevaluated once additional physical subsurface data have been collected. If the SESOIL model is determined to be the most applicable analytical tool, then the design of the current model should be reevaluated to ensure that revised standards are protective of groundwater. Otherwise, a different analytical model should be identified and developed; along with new soil vapor performance standards. An Explanation of Significant Differences (ESD) or an amendment to the Record of Decision (ROD) will be issued if new standards are developed.

5-Year Review Summary Form (cont.)

Protectiveness Statement

The remedy at the Hassayampa Landfill Superfund Site is considered protective to the human health and the environment in the short-term, because no current exposures are occurring. The deeper Unit B groundwater has not been impacted and existing restrictions on well-drilling have not been violated. A determination about whether the remedy will be protective in the long-term will need to be deferred until additional data is collected. The new SVE system will need to be evaluated and potentially modified to demonstrate the ability to meet the revised performance standards which will ensure protection in the long term.

Executive Summary

A 5-year review of the Hassayampa Landfill Superfund Site (the site) in Maricopa County, Arizona was completed in June 2006. The 5-year review was required by statute and performed because hazardous substances, pollutants, or constituents remain at the site above levels that do not allow for unrestricted use and unlimited exposure. The triggering action for this review was the first 5-year review, which was conducted in September 2001 and finalized (with an addendum) in April 2002.

The approximately 10-acre property, currently owned by Maricopa County, was used for disposal of hazardous wastes from April 20, 1979 to October 28, 1980. Disposal of hazardous wastes was conducted under a manifest program operated by the Arizona Department of Health Services. An inventory of the information provided in the manifests indicates that approximately 3.28 million gallons of liquid hazardous wastes and approximately 4,150 tons of solid hazardous wastes were disposed of at the site during the period of operation. Disposal was conducted with approval of Arizona Department of Health Services.

The Record of Decision for the site identified two components as part of the selected remedy: a groundwater component and a vadose zone remedial component. The 5-year review evaluated these two components to ascertain whether the remedial actions remain protective of human health and the environment as originally intended by the remedy. The 5-year review process consisted of: interviews with technical participants on the remedial action; a regulatory review; a document review; and a site inspection.

The results of the 5-year review indicate that the remedy has remained protective of human health and the environment in the short term. There has been no contamination detected in Unit B groundwater. However, it has recently been determined that additional investigation is necessary to further understand the increase of contaminant levels moving off-site in the A-zone groundwater. Once available, the findings of the additional investigation must be considered in the context of the remedy to determine if adjustments are necessary to maintain protectiveness in the long term.

Given the current understanding of the hydrogeology at the site, the groundwater remediation system has proven effective at hydraulic containment and mass removal of contaminants. Approximately 181 pounds of volatile organic compounds were removed from Unit A by the groundwater remediation system from 1994 through 2005.

The cap over the former hazardous waste disposal area appears to be in good condition and appears to be meeting the design goals of preventing contact with contaminated waste, of reducing infiltration of water, and of reducing the release of volatile contaminants into the atmosphere.

The original soil vapor treatment system has not been in operation since 1998 and has been partially decommissioned. Increasing trends in soil vapor monitoring and groundwater monitoring data indicate that the vadose zone (specifically in the area of Pit 1) is likely a continued source of contamination and may not be protective of groundwater quality. In March 2006, soil vapor extraction and treatment was resumed at the site. Soil vapor is currently treated with a compression/condensation system. Once concentrations have been lowered sufficiently, vapor phase carbon will be used to treat the extracted soil vapor. New performance standards for the operation of the soil vapor extraction need to be

developed and an ESD or an amendment to the Record of Decision (ROD) is needed once sufficient data is collected from the ongoing studies.

1.0 Introduction

The United States Environmental Protection Agency (USEPA) conducted a 5-year review of the remedial actions implemented at the Hassayampa Landfill Superfund Site (the site) in Maricopa County, Arizona. This review was conducted from March to June 2006. This report documents the results of the 5-year review. This report has been prepared in accordance with USEPA's guidance document, *Comprehensive 5-year Review Guidance* (USEPA 2001).

The purpose of the five-year review is to determine whether the remedy at a site is 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 identify recommendations to address them.

The Agency is preparing this Five-Year Review report pursuant to CERCLA §121 and the National Contingency Plan (NCP). CERCLA §121 states:

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

The Agency interpreted this requirement further in the NCP; 40 CFR §300.430(f)(4)(ii) states:

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

The first 5-year review was finalized by USEPA on September 28, 2001. On April 24, 2002, USEPA submitted an addendum to the 5-year Review Report, which clarified the protectiveness statement. This is the second 5-year review report for the site. The triggering action for this review was the first 5-year review, which was signed by USEPA on September 27, 2001 (CH2M HILL 2001). Initial remedial actions at the site began in 1993; therefore, the initial 5-year review addressed an 8-year period of activity at the site.

2.0 Site Chronology

Table 2-1 provides a chronology of major events associated with the site.

Event/Document	Date(s)
• Hazardous Waste Disposal	April 20, 1979 to October 28, 1980
• National Priorities List	July 22, 1987
• Administrative Consent Order No. 88-08	February 19, 1988
– Remedial Investigation Report	April 4, 1991
– Feasibility Study Report	May 20, 1992
• Record of Decision	August 6, 1992
Unilateral Administrative Order No. 93-09	March 30, 1993
• Groundwater Pilot Study	
– Design Report	August 23, 1993
– Construction	August 20, 1993 to March 7, 1994
– Pilot Operation	March 1994 to June 1995
• Soil Cap	
– Design Report	March 17, 1994
– Construction	April 8 to June 27, 1984
– Remedial Action Report	September 25, 1995
Consent Decree No. CIV 94-1821	November 28, 1994
• Hydraulic Containment Evaluation Report	June 1, 1995
(Redesignates Groundwater Pilot Study as the Groundwater Remediation System [GRS])	July 21, 1995
• Groundwater Remediation System	
– Performance Standards Verification Plan	March 26, 1996
– Remedial Action Report	September 19, 1996
– Revised O&M Manual	December 26, 2001
– Evaluation of Dewatered Area	April 19, 2002
• Soil Venting and Treatment System (SVTS)	
– Design Report	October 13, 1995
– Addendum No. 1	October 18, 1995

– Addendum No. 2	January 16 and 22, 1996
– Construction of Soil Vapor Wells	February 28 to March 6, 1996
– Construction of SVTS	July 10 to July 29, 1996
– Performance Standards Verification Plan	May 9, 1997
– Remedial Action Report	April 30, 1998
– SVTS Shutdown	September 6, 1998
– Preliminary Close-out Report	September 30, 1997
– Completion of Remedial Action	September 15, 2000
– Resume SVTS with compression/condensation system	March 28, 2006
• Soil Vapor Sampling Plan	
• First USEPA 5-year Review Report	
– Draft Final USEPA 5-year Review Report	September 28, 2001
– Final USEPA 5-year Review Report	February 15, 2002
Addendum to Revised 5-Year Review Report	April 24, 2002
• Treatment of Soil Vapor in Non-capped Area (north)	
– Passive Venting Pilot Test (PVPT) Operation	February 8 to May 25, 2001
– Results for Passive Venting Pilot Test Report	August 27, 2001
– Design of Expanded PVPT	March 13, 2002
– Construction of Expanded PVPT	November 2002 to April 2003
– Indefinite postponement of Expanded PVPT	July 18, 2003
• Reevaluation of the Site Conceptual Model	
– Additional Investigation (wells/piezometers)	May 1, 2004
– Conduct Baro-pneumatic Testing	June 21 to June 25, 2004
– Revised Phase I Work Plan	December 8, 2005
– Estimation of Pneumatic Properties Report	January 24, 2006

3.0 Site Background

This section presents the fundamental characteristics of the site at the time of the ROD. Figure 3-1 presents a regional map showing the location of the Hassayampa Landfill. The Superfund site, as defined by the ROD, is situated in the northeastern corner of the landfill. Figure 3-2 illustrates general layout of the site and indicates the specific pit locations where hazardous wastes were disposed at the landfill.

3.1 Physical Characteristics

3.1.1 Site Description

The Hassayampa Landfill Superfund Site is located in a rural, desert area of Maricopa County, Arizona, about 40 miles west of Phoenix. The site location is in the southeast quarter of Section 3, Township 1 South, Range 5 West.

The site is located within the Hassayampa River drainage area but outside of the 100-year floodplain of the river. The drainage area is bounded on the east by the White Tank Mountains, on the south by the Buckeye Hills, and on the west by the Palo Verde Hills. The surface topography of the area is generally flat; however, approximately 0.5-mile south of the site, the plain is broken by the Arlington Mesa. The elevation of the land surface at the site is approximately 910 to 915 feet above mean sea level (USEPA 1992).

Hazardous wastes were disposed at the site in a series of five unlined disposal pits (Figure 3-2), each designated for a specific type of waste:

- Pit 1 was designated for organic and oil wastes.
- Pit 2 was designated for acids and acidic sludges.
- Pit 3 was designated for alkaline and metal sludges.
- Pit 4 was designated for pesticide and alkaline sludges.
- Special Pits Area contains isolated cells of low volume solid wastes, containerized wastes, or waste not accepted for disposal in the other pits.

Two additional pits, Pit A and Pit B, were designated for disposal of non-hazardous wastes. Pit A was reserved for cesspool and septic tank wastes. The contents of Pit B are not completely known, although it is believed to have received hydrate wastes (EMA / CRA 1991).

3.1.2 Geology/Hydrogeology

The Hassayampa area is very arid, with annual precipitation averaging 6 to 8 inches per year. The Hassayampa River is located approximately 0.5 mile east of the site; the river is an ephemeral river that flows only after a heavy rain, except where return irrigation water discharges into the drainage channel. The Arlington Mesa, a basaltic formation, lies

approximately 1.5 miles south of the site and is the point of origin for a weathered basalt unit that was believed to exist approximately 57 feet beneath the site at varying thicknesses. Evidence from recent investigations in 2006 indicates that the basalt unit does not extend under the entire site. The site is located in an alluvial-filled basin, which consists of variable lithologic sediments.

Regional hydrogeologic units at the site include, in order of increasing depth, recent alluvial deposits, basin-fill deposits, and the bedrock complex. The basin-fill deposits have been classified into the upper, middle, and lower alluvium units. The upper alluvium unit was the target of hydrogeologic investigations for the remedial investigation. The upper alluvium unit has been subdivided, in order of increasing depth, into an upper alluvial deposits unit, a basaltic lava-flow unit, and Units A and B, which are the water-bearing deposits. The upper alluvial deposits unit at the site is composed of a coarse-grained zone (CGZ) and a fine-grained zone (FGZ). The CGZ is composed of interbedded silty sand and gravelly sand, with carbonate cementation and caliche layers. The FGZ is composed of silty, clayey fine sand and sandy silt and clay, with siltstone and claystone interbeds. The CGZ ranges from 24 to 50 feet below ground surface (bgs). The depth to the top of the FGZ at the site ranges from 36 to 60 feet bgs. Thickness of the FGZ at the site ranges from 7 to 37 feet; the average thickness is about 28 feet.

The basaltic unit at the site consists primarily of basaltic lava flow rocks, which are generally weathered in the upper part of the unit and are vesicular. The upper surface of the basaltic unit is irregular, which is typical for basalt flows in the region. Thickness of the unit at the site ranges from 0 to 29 feet; average thickness is 17 feet. Depth to the top of the basaltic unit, where it exists, at the site ranges from 39 to 74 feet bgs and is quite variable. The average depth to the bottom of the basalt is more consistent and is located at about 59 feet bgs. Thickness of the unit generally decreases to the north and northeast. Data from the recent field investigations such as weathered basalt and the absence of basalt indicate that the site is located near the terminus of the basalt flow. The terminus of basalt flows typically fan out in a fingerlike mode as the result of differences in viscosity and flow of the lava.

The water bearing portions of the upper alluvial deposits at the site were subdivided into Unit A and Unit B for characterization purposes; however, the regional extent of these units is uncertain. The aquifer beneath the site is characterized as anisotropic (properties vary with direction), which is often encountered where sediments are highly heterogeneous. Generally, the sediments in the upper portion of the aquifer (Unit A, which is approximately 30 feet thick), are finer grained and less permeable than the sediments directly beneath (Unit B). Unit A consists of interbedded clays and silts; Unit B is defined by the first sandy layer and extends to the underlying Palo Verde clay. The potentiometric surface of Unit B is above the top of Unit B but lower than the potentiometric surface of Unit A. Although the groundwater flow is primarily lateral, there is a minor downward vertical component of hydraulic gradient.

3.2 Land and Resource Use

The Hassayampa Landfill is a portion of a 77-acre property owned by Maricopa County, Arizona, in which 47 acres were used for disposal of municipal and domestic solid waste. The Superfund site is the 10-acre former Hazardous Waste Disposal Area (HWA) located in

the northeast section of the 47-acre landfill. Maricopa County originally signed a 20-year lease on the parcel from the Federal Aviation Administration. After the lease expired, the parcel was transferred to Maricopa County by quitclaim deed. At the time of the August 1992 remedial action decision, the Hassayampa Landfill was used as a municipal landfill and was expected to continue operations for approximately 10 years, while the HWA was already fenced and out of service. The municipal and domestic waste portion of the Hassayampa Landfill stopped receiving waste in June 1997.

With the exception of Hickman's Egg Ranch, which is located to the south of the landfill area, adjacent land is currently undeveloped desert land with some cultivation (approximately one-sixth of the total surrounding land use). Vegetation is sparse and includes creosote and salt bushes. The first Five-Year Review report projected potential industrial growth in the area might result in increased demands on ground water. This projection was the result of reviewing plans for new power plants to be built in the area. During this Five-Year Review, we saw a large increase in residential growth in the area. The town of Buckeye, located less than ten miles to the east, is experiencing rapid residential growth. The population in the first Five-Year Review was less then 17,000 residents. Currently the population of Buckeye is over 35,000 residents. There are projections that the population of Buckeye will exceed 100,000 before the next Five-Year Review is due. Currently, one can observe an increase in small clusters of homes being built within two miles of the landfill and this trend is expected to increase over time.

A well inventory for an approximately 9-square-mile area surrounding the site was performed as part of the remedial investigation and revised as part of the 2003 Annual Monitoring Report (EMA 2004) to include well information updated through February 27, 2004 from the Arizona Department of Water Resources (ADWR) "55" well registry database. The inventory indicates that wells in the area are used for a variety of purposes, including domestic and industrial water supply, irrigation, and stock supply. The only injection well inventoried is associated with the groundwater remedy for this site.

3.3 History of Contamination

The HWA is located adjacent to a sanitary landfill. The unlined sanitary landfill operated from 1961 until June 1997 for disposal of municipal and domestic solid waste largely consisting of garbage, tree trimmings, and other plant refuse. Prior to 1979, the disposal of hazardous waste was prohibited at the landfill. However, on February 15, 1979, the Arizona Department of Health Services (ADHS) prohibited the disposal of industrial waste at all landfills within the City of Phoenix. Because no alternative waste disposal sites were available in Arizona, based on an "extreme emergency," the ADHS requested Maricopa County to accept hazardous waste at the Hassayampa Landfill for a 30-day period beginning on April 20, 1979. Following several time extensions beyond the initial 30-day time period, the disposal of hazardous wastes was again prohibited on October 28, 1980.

During the 18-month period, disposal of hazardous wastes was conducted under a manifest program operated by the ADHS. An inventory of the information provided in the manifests indicates that approximately 3.28 million gallons of liquid hazardous wastes and approximately 4,150 tons of solid hazardous wastes were disposed of at the site. The HWA

comprised of several unlined pits designated for disposal of hazardous or non-hazardous wastes. Waste types varied greatly and included heavy metals, solvents, petroleum distillates, oil, pesticides, acids, and bases.

In 1981, shortly after waste disposal in the HWA ceased, the ADHS installed three groundwater monitoring wells at the Hassayampa Landfill under the Resource Conservation and Recovery Act Open Dump Inventory Program. A groundwater sample from one of the wells was found to be contaminated with volatile organic compounds (VOCs). Later in 1981, a site inspection report was prepared for USEPA by Ecology and Environment. In 1984, ADHS conducted site inspections of the landfill. The HWA portion of the Hassayampa Landfill was added to the USEPA National Priorities List on July 22, 1987. Under the terms of Administrative Consent Order No. 88-08, and with USEPA oversight, a group of the potentially responsible parties, known as the Hassayampa Steering Committee (HSC), completed the remedial investigation in 1991 and a feasibility study in 1992.

3.4 Initial Responses

No removal actions were conducted following the determination that activity associated with the HWA— which had already stopped accepting waste— had contributed to subsurface contamination. An investigation into the volume of contaminated soil and waste that exceeds the Arizona health-based guidance levels (HBGLs) for surface soil estimated that 1,400 cubic yards were impacted. As discussed in Section 4.0, exposure to this material was prevented through the use of a cap, as well as access and deed restrictions.

3.5 Basis for Taking Action

The remedial investigation was initiated by the potentially responsible parties in 1988, with oversight provided by USEPA and the Arizona Department of Environmental Quality (ADEQ), and the final report was approved by USEPA on April 4, 1991. The objectives of the remedial investigation were to characterize physical conditions in the vicinity of the Hassayampa Landfill; characterize the nature and extent of contamination in the air, soil, soil vapor, and groundwater; and evaluate fate and transport of organic and inorganic chemicals present in groundwater associated with the landfill.

Site-related contaminants were detected in subsurface soil (including waste material), soil vapor, groundwater, and air at the site. Hazardous substances, particularly VOCs and semivolatile organic compounds (SVOCs), were detected in the soil and groundwater in concentrations above Arizona HBGLs and above federal maximum contaminant levels (MCLs) for groundwater. Ultimately, chemicals of potential concern (COPCs) that have been identified at the site include:

- 1, 1-dichloroethane
- Tetrachloroethene
- Trichloroethene
- 1, 1-dichloroethene
- 1, 2-dichloropropane
- 1, 1, 1-trichloroethane

- Trichlorotrifluoroethane (Freon 113)
- Trichlorofluoromethane (Freon 11)
- Cis-1, 2-dichloroethene
- Vinyl chloride

In addition, metals (including chromium, copper, and lead) have been detected in waste and soil at the site. However, concentrations of these metals in soil do not significantly exceed regulatory levels.

Sampling of soil vapor and ambient air was conducted to determine the impact of site conditions on air quality. Conclusions of the soil vapor sampling determined that soil vapor contaminants consist of VOCs. Conclusions of the ambient air sampling determined that, although low levels of VOCs were detected, the concentrations were well below the permissible exposure levels established by the Occupational Safety and Health Administration.

Surface sediment samples were collected from drainage channels in the vicinity of the site. Low levels of pesticides were detected in several samples; however, comparison to background sample data indicated that the detected concentrations were likely the residual effect of past agricultural activities and not those of the landfill. Onsite surface soil was not considered a medium of concern because the HWA had been covered with clean soil.

Potential pathways of contaminant exposure were evaluated during the remedial investigation. The findings indicate that air, surface water/sediment, and groundwater pathways were considered to be incomplete. Given the land uses at the time of the remedial investigation, groundwater was the only exposure pathway considered to have a potential to be complete in the future.

4.0 Remedial Actions

This section summarizes the remedial actions selected and implemented at the Hassayampa Landfill Superfund Site, as well as the O&M of each element of the remedy. The ROD for the site was signed on August 6, 1992. The selected remedy presented in the ROD addressed contamination in both groundwater and the vadose zone, which includes soil and soil vapor above the water table.

4.1 Remedy Selection

The selected remedy in the ROD addressed the threat of exposure to contaminated groundwater, soil / waste, and soil vapor and consists of:

- Access and deed restrictions.
- Surface cap.
- Groundwater extraction, treatment, reinjection, and monitoring.
- Soil vapor extraction and treatment.

A combination of these four elements addressed two primary remedy components: the groundwater component and the vadose zone component. The ROD identified a threat of exposure to groundwater contaminants as a result of future offsite migration. Further, contaminants in the vadose zone offered a potential continued source for groundwater contamination. The selected remedy allowed contaminated waste and soil to remain onsite above levels for unrestricted use.

4.1.1 Groundwater

The groundwater component of the selected remedy addressed the threat of exposure to contaminated groundwater through extraction and treatment to federal and state regulatory levels. Federal MCLs were chosen as groundwater cleanup standards (Table 4-1). Contaminants detected at the site for which no MCL exists were assigned the HBGLs proposed by the State of Arizona. The remedy requires restoration and these levels be achieved in all areas throughout the contaminated aquifer. The implementation of deed restrictions provided further protection by ensuring that drinking water wells were not installed onsite.

According to the ROD, the groundwater would be extracted, treated using air-stripping technology, and subsequently reinjected into the subsurface. Vapor-phase carbon was designated to be used for VOC adsorption in the effluent of the air stripper, should it exceed the permissible limit of 3 pounds per day. Additionally, groundwater monitoring would be conducted to evaluate the effectiveness of the remedy.

4.1.2 Vadose Zone

The vadose zone component of the remedy presented in the ROD attempted to ensure that vadose zone contaminants (soil and soil vapor combined) would not migrate to

groundwater. The selected remedy also addressed the threat of ingestion and contact with contaminated waste.

Soil vapor extraction was selected for remediation of all locations at the site where soil vapor levels exceed cleanup standards and where waste and soil contamination had been demonstrated to be a threat to groundwater quality. The extracted vapors were to be treated using vapor-phase carbon adsorption or catalytic oxidation, as determined during remedial design. The soil vapor cleanup standards were to be levels, established by USEPA, that are protective of groundwater quality. Therefore, the migration of contaminants from the vadose zone to groundwater would not result in groundwater contamination that exceeded the groundwater cleanup standards. The cleanup standards were to be determined through site-specific vadose zone analytical modeling.

A cap was constructed over the 10-acre HWA to prevent direct contact with contaminated waste and soil left in place, to reduce infiltration of water, to reduce the release of VOC vapors to the atmosphere, and to improve the efficiency of the soil vapor extraction system. At a minimum, the cap was to meet the substantive capping and maintenance requirements for Resource Conservation and Recovery Act interim status facilities as described in Title 40 of the Code of Federal Regulations Parts 265.310 and 265.117 and as described in the *USEPA Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments.*

The remedy also called for the implementation of access and deed restrictions. The perimeter fence was to be upgraded and maintained to restrict unauthorized access to the site. In addition to the installation and maintenance of the fence, long term deed restrictions were imposed to limit the future use of the site and use of the groundwater beneath the site.

4.2 Remedy Implementation

This section will describe the implementation and subsequent performance of the groundwater and vadose zone components of the remedy individually. The locations of the groundwater monitoring, extraction, and injection wells are presented on Figure 4-1. The layout of the soil vapor wells, piping, and treatment system is presented on Figure 3-2.

4.2.1 Groundwater Component Implementation and Performance

4.2.1.1 Implementation

Under the terms of the Unilateral Administrative Order (UAO), the HSC was responsible for designing and implementing a pilot study for extraction and treatment of groundwater. A pilot-scale pump-and-treat system was constructed in late 1993 and early 1994 and began operating in March 1994 (CRA / EMA 1993). Contaminated groundwater was pumped from four groundwater extraction wells to a building (hereafter referred to as the treatment facility)—located on the west side of the former hazardous waste disposal area—to remove VOCs through an air-stripping treatment system. The treated water was then pumped to an injection well, approximately 500 feet west of the HWA, for reinjection.

In 1995, the groundwater pilot study was re-designated as a full-scale groundwater remediation system (GRS), as discussed in the Hydraulic Containment Evaluation Report

(EMA / CRA 1995). The GRS extracts groundwater from the contaminated, uppermost water-bearing zone, referred to as Unit A, using four extraction wells (EW-1UA, EW-2UA, EW-3UA, and EW-4UA). The extracted groundwater is then treated and injected into the deeper, more permeable portion of the aquifer, referred to as Unit B, via injection well IW-1UB. An evaluation was conducted to determine the appropriate location for the injection well (CRA / EMA 1993), and potential well sites were considered at locations at the site, as well as locations in each direction around the site. Locations north and west were believed to have the greatest remedial advantage, and because the current west location was chosen because it is owned by Maricopa County. The design called for injection into Unit B because that unit was believed to have the capacity to handle the estimated injection rate.

The design of the extraction and monitoring well network of the GRS has been optimized as recently as 2006, with the addition of groundwater monitoring wells MW-18UA and MW-19UA. The GRS consists of the following components:

- Eighteen Unit A groundwater monitoring wells (MW-1UA though MW-14UA and MW-16UA through MW-19UA).
- Four Unit A extraction wells (EX-1UA through EX-4UA).
- Eight Unit B groundwater monitoring wells (MW-1UB through MW-4UB, MW-6UB, MW-9UB, MW-10UB, and MW-15UB).
- The groundwater treatment system, which includes the air stripper and associated piping, pumps, and controls.
- One Unit B injection well (IW-1UB, for injection of the treated water).

A groundwater monitoring program was established as part of the procedures for GRS O&M (CRA / EMA 2001). The monitoring program includes the following components:

- Measurement of groundwater levels at the Unit A extraction wells, Unit B injection well, Unit A and Unit B monitoring wells, and private domestic well (C-1-5)10abd2 (owned by nearby resident Ed Robinson [ADWR registration no. 55-518966]).
- Measurement of pumping rates for the extraction wells and injection rate for the injection well.
- Collection of water samples from the monitoring wells, extraction wells, and air stripper influent and effluent.
- Remote monitoring of selected GRS operations via an autodialer, which with automatically places telephone calls to appropriate personnel to report system alarm conditions.

All groundwater and treatment system water samples collected as part of the monitoring program are analyzed for VOCs using USEPA Method 8260B. As part of the annual comprehensive sampling, GRS influent and effluent samples are analyzed for the total analyte list, which includes inorganic compounds, SVOCs, organochlorine pesticides, and polychlorinated biphyenyls, in addition to VOCs. Groundwater data are compared to the performance standards identified in the Groundwater Performance Standards Verification Plan (CRA / EMA 1996).

4.2.1.2 Performance

The GRS generally has been in constant operation since its implementation in 1994. System downtime has been limited to maintenance, minor system malfunctions, and, from 2003 to present, scheduled 2-week shutdown periods during the spring to allow for aquifer recovery in the target remediation zone. In 2005, the O&M cost for the GRS was approximately $25,270. In 2004, the O&M cost for the GRS was $23,600. It is difficult to derive the O&M cost for 2001-2003 due to a change of contractors and different accounting methods. Nevertheless, it is not believed that the O&M cost was significantly different and should average to be $24,400 per year. We do anticipate that there will be a significant increase in O&M cost in 2006 due to the additional field studies being implemented.

During the time period from 1994 through 2005, the GRS has removed a total of approximately 181 pounds of VOCs from Unit A. The total average pumping rate from the four Unit A extraction wells, when operating, is approximately 5.8 gallons per minute. There is no empirical evidence from groundwater monitoring that indicates the contamination in Unit A has reached the groundwater in Unit B.

Vadose Zone Component Implementation and Performance

4.2.1.3 Implementation

The soil vapor component of the remedy included deed and access restrictions at the site. The ROD required that long-term deed restrictions be imposed, restricting future land use of the property and groundwater beneath the site. The Consent Decree, signed in 1994 by the HSC, required that the Owner place a copy of the decree on file with the Recorder's Office in Maricopa County. In addition, each deed, title, or other instrument conveying an interest in the property shall reference the recorded location of the Consent Decree and any restrictions applicable to the property under it.

The site owner, Maricopa County, recorded the Consent Decree, as required, on January 4, 1995, imposing the deed restrictions. In addition, a restrictive covenant was recorded for the Hassayampa Landfill, which encompasses the Site, in 1994. The restrictive covenant was recorded pursuant to A.R.S. 49-771, which requires the recording of a restrictive covenant for solid waste landfills before they can be allowed to operate. The covenant prohibits the filling, grading, excavating, drilling or mining of the property covered by the covenant without the approval of the Arizona Department of Environmental Quality. Because the property covered by the covenant includes the Site, the covenant prohibits such uses of the Site as well and is functioning as an institutional control for the Site.

Access controls at the site included a 6-foot-high, chain-link perimeter fence constructed in June 1994. Gates were installed adjacent to the Treatment Facility and south of the northwest corner of the site. Signage, including warning signs and a phone number for contacting USEPA, has been installed on the perimeter fence.

Under the terms of the UAO, the HSC was responsible for designing and implementing a soil cap to entirely cover the HWA. A substantive change to the conceptual design of the cap, as presented in the UAO, was approved by USEPA prior to construction. The design change involved the use of an engineered flexible membrane liner (FML) system, based on USEPA's concerns about the integrity and permeability of a soil cap. The design change was

meant to produce a lower hydraulic conductivity and to ensure a higher level of quality control than may have been available with a soil cap.

The cap was constructed from April through June 1994 and is still in place. According to the Remedial Action Report-Construction of Soil Cap (CRA / EMA 1995) and associated inspection reports documenting the construction of the soil cap, the design consisted of (from bottom to top) an existing soil layer; a soil bedding layer; the FML, which was approximately 10 acres in area and manufactured of 40-mil HDPE; a drainage layer; filter fabric; a soil cover; and a top vegetative cover layer. The drainage layer, which lies above the FML, is made of sand. The soil cover consisted of backfill material compacted to 95 percent standard Proctor density using vibratory rollers, with the application of water as an aid to compaction. Protrusions through the cap at well vaults were fitted with prefabricated boots, which were heat-welded to a skirt and then welded to the liner. Each boot was additionally secured with a stainless-steel belt at the point where the structure exits the sub grade.

Design documents for the soil vapor treatment system (SVTS) were prepared in 1995, and construction was started in February 1996. Remediation of the vadose zone was designed to occur by extracting soil vapor from a series of vapor extraction wells drilled into both fine- and coarse-grained soils above the basalt unit in areas where vadose zone conditions were believed to be a threat to groundwater quality. The extracted soil vapor would then be treated with technology designed for a minimum of 90-percent destruction efficiency of organic vapors. The ROD originally specified that the soil vapors would be treated using either vapor-phase carbon adsorption or catalytic oxidation, as determined during remedial design. However, based on findings during the design phase, including concerns about catalyst fouling associated with chlorinated compounds in soil vapor, the HSC proposed thermal oxidation for treatment of soil vapors. The thermal oxidation system was designed to use the solvents in the influent air stream as a fuel source. The preheated VOC-laden soil vapor would enter the combustion chamber, where the burner would heat the vapors to the desired oxidation temperature (1,400 degrees Fahrenheit), with the desired retention time. Remaining fuel source requirements would be provided by propane fuel (CRA / EMA 1998). USEPA approved the Soil Venting Design Report on January 22, 1996.

The system was started up on July 29, 1996; system commissioning was completed in July 1997. According to construction documentation, during its period of operation, the SVTS consisted of:

- Eleven soil vapor monitoring / extraction wells drilled into the coarse-grained, upper vadose zone (wells SP1 through SP-6, W-1, P-1, VB-2c. NW-2, and NE-1).
- Eleven SVME wells drilled into the fine-grained, lower vadose zone (wells SP-1 through SP-6, W-1, P-1, VB-2f, NW-2, and NE-1).
- Piping to the SVTS treatment unit.
- The SVTS treatment unit itself, which consisted of a thermal oxidation system designed with a 600 standard cubic-feet-per-minute flow capacity and an organic destruction efficiency of at least 90 percent.
- Eight dual-completion passive injection wells (V-1 through V-8).

- One dual-completion active injection well (V-9).
- Eight dual-completion, vadose zone piezometers (PZ-1 through PZ-8).
- Twelve soil-vapor monitoring wells (SP-7, SP-8, P-3, SE-1, N-1 through N-3, NW-1, NE-3, VB-1, VB-3, and VB-4).
- A condensate removal system.

As described in the following sub-section, the SVTS ceased operation in September 1998.

Soil vapor performance standards were originally developed in 1994 by employing a vadose zone transport model, SESOIL, as a basis to compare soil vapor monitoring data as these data relate to the protection of groundwater. Demonstration of compliance monitoring, as defined in the Soil Vapor Sampling Plan (EMA 2000), began in 2000, when it was determined that the SVTS would not be restarted because the soil vapor performance standards had been met across the majority of the site.

4.2.1.4 Performance

Between the initial startup in 1996 and July 1997, significant operational problems occurred, including the breakdown of mechanical components, unreliable water supply, problems with storage capacity of wastewater, caustic ash buildup in the heat exchanger, and quench/scrubber packing failure. Several changes were made to the initial design of the SVTS during construction and startup. In 1998, additional operational problems arose involving condensate collection at several locations along one of the extensions of the soil vapor lines, partially blocking vapor flow from the vapor wells. USEPA requested that the HSC begin periodic sampling of the condensate as a condition for condensate commingling with SVTS wastewater. In addition, USEPA requested that HSC assess and mitigate condensate buildup within the header piping. A Condensate Evaluation and Management Plan was submitted later that year, and a condensate collection system was constructed thereafter.

The SVTS was operational from July 1997 until its shutdown in September 1998, which was caused by a lightning strike. During this time, the system ran sporadically; however, system uptime had increased to 90 percent prior to the September 1998 shut down. The SVTS subsequently failed to meet the required vapor destruction efficiency of 90 percent. Although necessary repairs were made, the unit remained shutdown while USEPA evaluated the potential for formation of dioxins and furans as a by product from combustion via thermal oxidation. During this evaluation, it was agreed that residual concentrations of COPCs in the vadose zone should be re evaluated to determine the progress of the SVTS toward achieving the soil vapor performance standards. Soil vapor samples were obtained and the vadose zone transport model, SESOIL, which was used to project potential impacts to groundwater and was updated and rerun. The results indicated that the soil vapor performance standards were met in the capped area of the site, but the results also indicated that a small part of the non-capped area of the site, located north of the Pit 1 capped area, contained two COPCs in soil vapor at concentrations that exceed the soil vapor performance standards. Because the performance standards were met for most of the site, full-scale SVTS operations were not resumed; however, a soil vapor passive venting system was designed to address the uncapped area.

Demonstration of compliance monitoring consisted of a series of four semiannual soil vapor sampling events and six quarterly landfill gas monitoring events, which commenced in spring 2000 and were completed in fall 2001. Based on the results of the four semiannual sampling events, the monitoring frequency was adjusted to a long term schedule, which consists of soil vapor sampling and landfill gas monitoring for selected vapor wells at 1-year intervals for a 5-year period. The long-term soil vapor monitoring comprised an additional component to the Consent Decree scope of work for the site.

A soil vapor passive venting pilot test was conducted from February to May 2001 to evaluate the feasibility of passive venting as a means to decrease residual concentrations of VOCs in the soil vapor north of the Pit 1 capped area. In April 2003, based on the pilot test, the system was expanded and comprised two separate but equivalent extraction and monitoring systems: one for vapor wells constructed within the FGZ and one for those constructed in the CGZ. USEPA ultimately determined that the soil passive venting system should not be run without off-gas treatment, and the system was never fully implemented. Due to the fact that the SVTS was shut down in 1998, there are no O & M costs to review to assess performance.

5.0 Progress Since Last 5-year Review

The following section presents the protectiveness statements and recommendations included in the final version of the First 5-year Review Report (CH2M HILL 2001) and an evaluation on follow-up actions completed since the last 5-year review.

5.1 Protectiveness Statements From the Previous 5-year Review

The Five-Year Review Report (CH2M HILL 2001) presents the protectiveness statement as follows:

> *The results of the five-year review indicate that the groundwater remedy and the soil cap portion of the vadose zone remedy have remained protective of human health and the environment. However, a protectiveness determination of the soil-vapor treatment portion of the vadose zone remedy cannot be made at this time. Further evaluation of the current soil-vapor performance standards is necessary to determine whether they are protective of groundwater. It is expected that this evaluation will take approximately six months to complete, at which time the protectiveness determination will be made.*
>
> *The GRS has proven effective at hydraulic containment and mass removal of contaminants. Routine monitoring of groundwater indicates that lateral hydraulic containment is occurring. In addition, approximately 48 pounds of VOCs were removed by the system from 1994 through early 2001. There have been several incidents of non-compliance related to maintenance problems, but overall it appears that the effectiveness of the GRS is adequate and generally functioning as intended by the design.*
>
> *The cap over the former hazardous waste disposal area was found to be in good condition and meeting the design goals of providing a barrier to prevent contact with contaminated waste, reducing the infiltration of water, and reducing the release of VOCs into the atmosphere.*
>
> *USEPA is currently evaluating the effectiveness of the soil-vapor performance standards. Use of the SESOIL model for determining the soil-vapor performance standards was approved in 1996. However, ADEQ has recently questioned the applicability of the SESOIL model to the site, and correspondingly the protectiveness of the soil-vapor performance standards. ADEQ will submit a letter to USEPA documenting its concerns with the use of the SESOIL model at this site. The HSC will be given an opportunity to respond to ADEQ's concerns before USEPA will then make a final determination of the appropriateness of using the SESOIL model at this site to determine the soil-vapor performance standards.*
>
> *Following a determination of the protectiveness of soil-vapor performance standards, the ongoing evaluation of attainment of the soil-vapor performance standards will be completed. The SVTS, which has not operated since March 1999, may resume operation if current contaminant levels in the vadose zone are found to pose a threat to groundwater, according*

to the agreed to performance standards. While the SVTS has not been operating, the landfill cap has remained protective as a barrier, and the GRS has maintained hydraulic containment and mass removal.

CERCLA requires ongoing 5-year reviews of the site remedy to assure that protectiveness is not compromised. The next review will be conducted within 5 years of the completion of the final 5-year Review Report.

A protectiveness statement for the vadose zone remedy could not be made in the 5-year Review Report due to ADEQ concerns regarding the protectiveness of the soil vapor performance standards. After review of ADEQ's concerns and the existing site data, USEPA concluded that the soil vapor performance standards were protective of groundwater and, therefore, the soil vapor extraction and treatment portion of the remedy was protective. An addendum to the 5-year Review Report (USEPA 2002) was issued and supplemented the above protectiveness statement as follows:

The soil vapor extraction and treatment portion of the vadose zone remedy at the Hassayampa Landfill Superfund site is protective of human health and the environment. The protectiveness of the other remedies at the Hassayampa Landfill are documented in the 5-year Review Report.

5.2 Status of Recommendations and Follow-up Actions from Last Review

Table 5-1 summarizes the status of recommendations that were made during the last 5-year review (CH2M HILL 2001) and presents the status of follow-up actions for those recommendations.

6.0 5-year Review Process

This section presents the activities performed during the 5-year review process and a summary of the findings. The 5-year review consisted of a review of relevant documents and data, a site inspection, and interviews.

6.1 Administrative Components of the 5-year Review Process

The Hassayampa Landfill 5-year review was led by Martin Zeleznik, USEPA's Remedial Project Manager for the site. CH2M HILL provided technical support to USEPA for the review.

This 5-year review of the site involved:

- A review of relevant documents, including annual monitoring reports, additional investigation reports, and administrative documents.
- A review of federal and state applicable or relevant and appropriate requirements (ARARs) cited in the ROD for this site.
- A review of institutional controls cited in the ROD for this site.
- A review of risk assessment studies.
- A site inspection.
- Interviews.

6.2 Community Notification and Involvement

A public notice was placed in four local newspapers and the paper of record, The Arizona Republic, on January 4, 2006 informing the public of the beginning of the Hassayampa Five-Year Review process. The notice also extended an invitation to an open house which was held on January 11, 2006 in Buckeye, Arizona. The purpose of the open house was to provide a forum for the USEPA to inform all potentially interested parties of the current site activities and of the 5-year review process. We also used the public notification process to inform the public of the operation of a new SVTS at the site. No significant comments or concerns were raised at this open house. The final 5-year review report will be placed in the Hassayampa Landfill Superfund Site information repositories, and a fact sheet will be prepared to inform the public of the findings of this 5-year review. The public will be able to submit to the USEPA any comments or concerns about the remedy to date.

6.3 Documents Review

As a part of the 5-year review process, CH2M HILL conducted a brief review of numerous documents related to site activities. The documents chosen for review ranged in publication

date from 1991 to January 2006. Appendix A provides a list of the documents reviewed as part of this report.

6.4 Data Reviewed

The following section presents a summary and evaluation of data for groundwater, groundwater remediation system operation, and soil vapor samples collected at the site over the past 5 years. Data presented in the Annual Monitoring Reports from 2001 through 2005 were reviewed and compared to previous years as necessary. The annual reports are referenced as follows:

- 2001 Annual Monitoring Report – M&A, 2002
- 2002 Annual Monitoring Report - M&A, 2003
- 2003 Annual Monitoring Report - M&A, 2004
- 2004 Annual Monitoring Report – H&A, 2005
- 2005 Annual Monitoring Report – H&A – 2006

6.4.1 Groundwater Monitoring

6.4.1.1 Groundwater Level Monitoring

Groundwater level measurements have been obtained at the site both manually and with down-hole pressure transducers equipped with data loggers. The groundwater level data are used to evaluate the effectiveness of the GRS as it relates to hydraulic containment of the contaminated groundwater and to identify changes in hydraulic conditions caused by external basin-wide activity. Groundwater level contours for Unit A and Unit B wells are provided on Figures 6-1 and 6-2, respectively. The data used to create the contours are from the October 2005 semiannual monitoring event.

Since groundwater extraction began at the site in March 1994 to present, onsite groundwater levels in Unit A have decreased approximately 4 to 8 feet, with the majority of drawdown occurring during the first year of extraction. Over the past 5 years, groundwater level data collected while the GRS was operational indicate lowered Unit A groundwater levels have remained relatively unchanged. Unit B groundwater potentiometric surface elevations fluctuate seasonally with regional groundwater demand and do not appear to be effected by Unit A groundwater extraction.

When groundwater is not being extracted from Unit A, horizontal migration direction is generally to the southwest at a gradient of 0.01. However, cones of depression, which dictate the onsite groundwater migration direction, exist in Unit A due to groundwater extraction. Onsite horizontal hydraulic gradients in Unit A generally decrease with increasing distance from the extraction wells. In February 2003, Unit A extraction was stopped for a two-week period. During this time, Unit A water levels rebounded as much as 6.95 feet near extraction wells. Interpretation of the recovery data indicates that the GRS is effectively containing lateral groundwater migration over the majority of the target zone for groundwater remediation. The target remediation zone is composed of a contiguous area that encompasses all wells where VOCs have been detected and confirmed at concentrations that exceed the groundwater performance standards. In Unit B, horizontal groundwater migration is to the south at a gradient of 0.0045.

At paired wells, the groundwater potentiometric surface in Unit B is approximately 10 to 15 feet lower than water levels in Unit A, indicating a minor downward vertical hydraulic gradient. Over time, the potentiometric surface for Unit B has been lowering due to increased demands on the regional aquifer.

6.4.1.2 Groundwater Quality Monitoring

Groundwater samples for laboratory analysis are collected semiannually from monitoring wells and extraction wells, in accordance with the GRS O&M Manual (CRA / EMA 2001) and the Groundwater Performance Standards Verification Plan (CRA / EMA 1996). In addition, in December 2003, USEPA requested that select Unit A monitoring wells be sampled quarterly for 1 year. All samples collected are analyzed for VOCs using USEPA Method 8260B. A summary of groundwater sample collection from 2001 through 2005 is provided in Table 6-1.

Groundwater beneath the site in Unit A is contaminated with VOCs. VOCs have not been detected in any groundwater samples obtained from Unit B. Groundwater contaminant concentrations are compared to the groundwater performance standards as established in the Groundwater Performance Standards Verification Plan (CRA / EMA 1996). COPCs detected at concentrations greater than the groundwater performance standards in October 2005 (the most recent comprehensive sampling event) include: 1,1-dichloroethene, 1,2-dichloropropane, tetrachloroethene, and trichloroethene. Unit A groundwater wells that contain the highest concentrations of COPCs above performance standards are located in the vicinity of former Pits 1, 3b, and 3c. The lateral extent of contaminated groundwater appears to be delineated; however, concentration trends in select Unit A wells have been increasing over the past 5 years. Specific Unit A monitoring wells with generally increasing COPC concentration trends include: MW-01UA, MW-04UA, MW-06UA, MW-07UA, MW-11UA, MW-12UA, and MW-14UA. Extraction wells EW-3UA and EW-04UA also exhibit increasing COPC concentration trends.

The lack of contaminants in the Unit B wells is significant as it indicates that although there are increasing levels of contaminants in Unit A wells, there is no threat to public health at the present time.

6.4.2 Groundwater Remediation System

The GRS has been in operation at the site since March 1994. Over the past 5 years, the GRS has operated approximately 91 percent of the total time. During this period, system downtime has been attributed to:

- Routine maintenance and inspections.
- System malfunction and / or alarm conditions.
- Two-week upper aquifer recharge events – Spring of 2003, 2004, and 2005.
- Baro-pneumatic testing – June 2004.

Over the 5-year period, the GRS has been extracting groundwater from four wells screened in Unit A at an average rate of 5.5 gallons per minute, when operating. The total volume of water pumped over the same period is approximately 14,184,000 gallons or, an average of

approximately 2,836,800 gallons per year. A total of approximately 181 pounds of VOCs were removed from Unit A by the GRS from 1994 through 2005. The rate of mass removal over the last 5 years has ranged from approximately 0.044 to 0.107 pounds per day (lbs / day). Mass removed by the GRS is vented to the atmosphere without vapor-phase treatment and, at these rates, has been within the action-specific performance criteria, which are not to exceed 3 lbs / day for uncontrolled discharge of VOCs to the atmosphere.

The air stripper influent and effluent water has been sampled for laboratory analysis in accordance with the schedule identified in the GRS O&M Manual (CRA / EMA 2001). In addition to the standard analyses, 1,4-dioxane was analyzed during select sampling events during 2002 and 2003 and all samples were non-detect. Concentrations of total VOCs detected in influent samples collected over the last 5 years ranged from 497 micrograms per liter (µg / L) to 1,255 µg / L. No SVOC, pesticide, or polychlorinated biphenyl compounds were detected in any of the influent samples. No COPCs were detected in any of the effluent samples at concentrations above the groundwater performance standards. All treated groundwater was injected in the Unit B at injection well IW-01UB.

6.4.3 Soil Vapor Monitoring

The SVTS has not been operated since September 6, 1998. However, soil vapor extraction and treatment was resumed in March 2006 as planned in the Revised Phase I Work Plan (GSC / HA 2006). A summary of soil vapor samples collected for laboratory analysis from 2001 through 2005 is provided in Table 6-2.

Soil vapor within the FGZ and CGZ units beneath the capped and uncapped area of the site is impacted with VOCs. Total VOC concentration distribution (October 2005) for the CGZ and FGZ are presented on Figures 6-3 and 6-4, respectively. Performance criteria, developed through site-specific modeling (SESOIL), to which the soil vapor contaminant concentrations are compared, have been set aside pending potential revision. In general, despite some concentration data variability over the past 5 years, the distribution of total VOCs in both the FGZ and CGZ units has increased since the shut down of the SVTS, though the concentrations are still lower than before the implementation of the SVTS. Additional monitoring locations, specifically in the vicinity of former Pit 1 and in areas to the east, have been added over time and allow for a more detailed interpretation of the extent and distribution of contamination. Due to increasing trends in the Unit A groundwater and soil vapor contaminant concentrations, soil vapor extraction activities were restarted in March 2006 as part of a field investigation. Data from monitoring points above and below the basalt unit will be used to evaluate the effectiveness of the SVTS design. At a minimum, new performance standards need to be developed to assure the shut down of the SVTS will remain protective of ground water.

Landfill gases (methane, carbon dioxide, and oxygen) are monitored across the site in the FGZ and CGZ and have remained consistent over the past 5 years. Field monitoring data indicate relatively large concentrations of methane and carbon dioxide and small concentrations of oxygen in the Special Pits area and in the Pit 1 area. Cells of the former sanitary landfill are located adjacent to the Special Pits area to the west and the south and are interpreted to be the source of methane in this area. Laboratory confirmation samples collected from the Pit 1 area do not confirm the presence of methane in the vadose zone. The field monitoring detections of methane in the Pit 1 area are interpreted to be false positives

due to a large sensitivity of the field instrument to relatively small concentrations of other low-carbon alkanes. Carbon dioxide and oxygen concentrations across the remainder of the site are consistent with normal atmospheric conditions.

6.5 Site Inspection

Representatives of USEPA, the HSC, and CH2M HILL performed a site inspection on March 28, 2006. This inspection coincided with the restart of the SVE system at the site. A summary of the inspection findings is presented below. A site inspection checklist and photos taken during the inspection are provided in Appendices B and C, respectively.

Conditions during the inspection were warm with mostly cloudy skies and short periods of light rain. The site was secured with adequate fencing and signage, both of which were in good condition. The GRS building, which is also used as a central area for document storage and site safety materials storage, was secure and in good condition. A visitors log was maintained at the GRS building.

The cap appeared to be in good condition. The general topography of the capped area is flat and was not engineered with any benching or letdown channels. Areas of sparse vegetation (mostly seasonal grasses) were observed across the capped area but concentrated in the surface drainage channel. There was no indication of erosion in the surface drainage channel, which contained cobbles for energy mitigation where the channel leaves the cap to the southeast. Surface water discharges into a small collection channel located immediately outside the site fence and then into lower lying areas to the southeast. Minor indications of erosion were observed at one location on the southern perimeter of the site. The eroded area was less than 1 foot deep and approximately 3 feet long. The monitoring and repair of erosion features is ongoing and focused after rain events. The cover is penetrated by several groundwater and soil vapor wells. A very small portion of cover material was visible at one well location, though it does not pose an immediate threat to the integrity of the cover.

The GRS, including the groundwater monitoring and extraction wells, was functioning and appeared in good condition. All wells were adequately protected at the ground surface. All GRS components in the GRS building including electrical panels, remediation equipment, and influent/effluent conveyance infrastructure were well-labeled and appeared to be in safe, working condition. Applicable O&M plans, health and safety and contingency plans, and daily access/visitor log records were available onsite for review.

The inactive soil vapor remediation equipment and associated infrastructure is onsite and in its original location. However, new, now-active soil vapor extraction equipment has been installed recently. A lined and bermed secondary containment area has been built directly north of the GRS building and houses the soil-vapor-condensing equipment and associated product and water containment vessels. Additionally, blowers and compressors for the new system are located directly north of the bermed area, and a soil vapor conveyance piping array is located directly north of the Pit 1 area.

Overall, the various components of the remedy appear to be functioning as designed and appear to be well maintained.

6.6 Interviews

Interview summary forms are provided in Appendix D. Both community and technical interviews were attempted; however, only technical interviews were obtained. Interviews were obtained from:

- Benjamin Costello / HSC Project Manager – interview conducted in person and through email correspondence.
- Hugh Rieck, former hydrogeologist for Arizona Department of Environmental Quality was responsible for technical review of the Hassayampa Landfill site from 2001-March, 2006. He is currently employed as a geologist at the Army Corps of Engineers, Hazardous, Toxics, and Radioactive Waste Center of Expertise in Omaha, Nebraska.
- Frank Corkhill / ADWR Supervisor of the Hydrology Division Technical Support Section – interview conducted through email correspondence.

Additionally, through conversation during the site inspection, Alex Heirman, Site O&M Technician Lead with Hargis and Associates, provided valuable input to the report but was not formally interviewed.

As the HSC Project Manager, Mr. Costello's interview reflects his site knowledge. He states that the site has been operated and maintained in a manner that has been and remains protective of human health and the environment. Mr. Costello also discussed the HSC's work in cooperation with USEPA and ADEQ to develop and implement a detailed work plan to further refine the understanding of the conceptual site model.

Mr. Rieck's position and continuity of assignment to the site allowed him to offer more specific observations in his interview. He discussed his early concerns during the Remedial Investigation phase of the project and the data trends seen in recent years. He is encouraged that real progress is being made with these new studies which he believes may be related to the change of contractors assigned to the site. In addition to his suggestion to continue the existing studies to refine the conceptual site model, he believes there may be some changes needed to the remedial design. He also suggests that more thought should be given to an aggressive remedial action that includes thermal absorption or in situ chemical oxidation.

Mr. Corkhill provided input regarding the ADWR's current understanding of projected water use in the Hassayampa sub-basin, in which the site is located. Mr. Corkhill mentioned the population in the area is projected to increase substantially over the next 30 years leading to a major increase in groundwater demand. This demand is expected to lower the water tables across the region and potentially alter the groundwater hydraulics at the site. However, efforts to quantify the estimated future groundwater demand and the effects of the demand are in progress and should be available in the near future.

7.0 Technical Assessment

This section evaluates the functioning of the remedy as intended, the current status of assumptions, and new information affecting the remedy.

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

The review of the documents, monitoring data, ARARs, the site risk assessment, results of the site inspection, and site interviews indicates that the remedy is functioning as intended by the ROD but at a minimum, the performance standards developed for the soil vapor extraction system need to be revised. It is anticipated that an Explanation of Significant Difference (ESD) will be needed to revise the performance standards and more data is needed to evaluate the effectiveness of the remedial design.

The Five-Year Review process has led to the conclusion that the access and deed restrictions that have been implemented for the site have been effective. A detailed review of the institutional controls is presented in Appendix E. Drinking water wells have not been installed at the site. The site is adequately secured with fencing that is in good repair and aside from isolated incidents of forced entry, has restricted access to the site. The site is well-marked with signage posted on the perimeter fence that identifies the area as a Superfund Site and presents the instructions for visitation. The existing cap is effective in preventing direct exposure to buried waste and site-related contaminants. Further, the presence of the cap limits the downward migration of onsite contaminants due to the infiltration of rainfall. The cap has been adequately maintained.

The GRS is functioning as intended by the ROD. Groundwater containing contaminant concentrations that exceed the GRS performance standards does not appear to be migrating offsite. Analysis of groundwater elevation contours indicates cones of depression in the Unit A water table focused at the groundwater extraction locations. The analysis of groundwater quality data indicates that the downward migration of contaminants from Unit A to Unit B has not occurred. The GRS has consistently met the action-specific performance standards for air and water discharge. Groundwater monitoring has been conducted in accordance with the GRS O&M manual. Further, additional groundwater monitoring has been conducted as deemed necessary by the HSC, USEPA, and ADEQ to accurately evaluate groundwater contaminant concentration trends at the site.

Until recently, the soil vapor extraction and treatment element of remedial action at the site, which had been shut down and moved into a monitoring without extraction phase, was thought to have functioned as intended in the ROD. However, increasing trends in soil vapor and Unit A groundwater contaminant concentrations post shut-down indicate that residual contaminant mass in the vadose zone is likely impacting soil vapor, and potentially groundwater, at the site. The SVE system has been restarted at the site while the original soil clean-up standards and the applicability of the site-specific vadose zone analytical model (SESOIL) used to develop the soil vapor performance standards will be reevaluated.

More data is needed to determine if the current remedial design is effective in removing vapor concentrations found beneath the basalt.

7.2 Question B: Are the assumptions used at the time of selection still valid?

Regulatory Review

The site ARARs (as established in the ROD and reviewed in the previous 5-year review) were evaluated for changes or updates that effect the protectiveness of the selected remedies (Appendix F). The basis of ARARs are laws and regulations applicable to the site location, remedy actions, and COPCs. The COPCs include VOCs, SVOCs, and metals.

There were no changes to ARARs.

Assumptions in the Human Health Risk Assessment

In an effort to determine whether the remedy at the site remains protective of human health, changes in site conditions, exposure pathways, and toxicity values since selection of the site remedy were evaluated (Appendix G).

Changes in Site Conditions

Monitoring data from the last several years indicate upward trends in both the size and concentration of the vadose zone vapor plume. In addition, VOC concentrations in several groundwater wells have been increasing over the last few years. Due to increasing trends in groundwater and soil vapor contaminant concentrations, soil vapor extraction activities were restarted in February 2006. Resumed extraction of soil vapor is expected to reduce VOC concentrations in the vadose zone, therefore reducing the potential impact to groundwater.

Changes in Exposure Pathways

While exposure to VOC vapors from migration to indoor air has become more of a concern in recent years, this pathway is very unlikely at the site because there are currently no buildings at the site except the GRS Building, which is unoccupied. The ROD required that long-term deed restrictions be imposed, restricting future land use of the property and groundwater beneath the site.

Changes in Toxicity Values

There have been a number of changes to the toxicity values for specific constituents of concern in soil and groundwater at the site since the final baseline risk assessment was submitted in 1991. These changes would have only impacted conditions as they existed at the site prior to remediation. Post-remediation site conditions eliminated or reduced the exposure pathways, effectively negating the impact of the change in toxicity factors. Therefore, these changes do not affect the protectiveness of the remedy.

In 2001, U.S. EPA released a draft toxicity evaluation for TCE following the current cancer guidelines and incorporating current data and physiological/biochemical understanding.

This review concluded TCE was "highly likely to produce cancer in humans." With this determination, a range of cancer slope factors were developed, some of which would result in more stringent cleanup levels than the current MCL. This toxicity evaluation is under review by several external scientific panels. This issue will need to be updated in subsequent 5 year reviews.

Assumptions Used in Selecting the Remedy

At the time of the ROD, it was assumed that, because a laterally extensive, significantly low permeability boundary (basalt) existed above the Unit A groundwater, the primary mechanism of Unit A groundwater contamination was vapor-phase transport. However, recent site investigations have shown that the basalt is not as laterally extensive beneath the site as originally assumed. Therefore, if sufficient aqueous phase liquids and/or dense non-aqueous-phase liquids migrated through or past the lateral extent of the basalt, residual contaminant mass may be present on top, within, or below the unit. Therefore, the design of the remedy selected may need to be revised to include a deeper target area for vapor extraction, or other modifications, to comply with the remedial action objectives in the ROD.

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

There have not been any natural disasters, such as weather-related or seismic incidents, in recent years that would affect or compromise the protectiveness of the remedy.

There are no exposure pathways from site contaminants to ecological receptors.

The area of Maricopa County up gradient of the site is expected to see rapid residential development over the next 30 years. The increased development is expected to have a direct effect on groundwater demand in the area.

The increased development in the area may also have an impact on land value and may increase the likelihood of a property transfer. When the original ROD was signed, the Hassayampa Landfill was in a remote area and there was little concern about a property transfer. A restrictive covenant has been recorded and is effective as a use restriction for the property. Prior to the next five-year review report, EPA will consider whether execution and recordation of a Declaration of Environmental Use Restriction (DEUR) would enhance the protectiveness of the remedy.

8.0 Issues and Recommendations

Two issues were identified while conducting the 5-year review for the Hassayampa Landfill Superfund Site.

8.1.1 Issue

The remedy at the site was designed and implemented assuming that the bulk of the contamination was above the laterally-extensive basalt layer. Recent studies at the site have revealed that the basalt layer does not extend beneath the whole site. Furthermore, recent data indicates the vapor concentrations beneath the basalt are significantly higher than above the basalt.

8.1.2 Recommendation

Continue the implementation of the Revised Phase I Work Plan (GSC / HA 2006) and subsequent iterations of investigation, as determined necessary.

8.1.3 Issue

The soil vapor performance standards were developed assuming that there was a laterally-extensive, low-permeability basalt preventing vapor movement downwards. Recent information calls into question the effectiveness of this layer for prevention of downward migration. The site-specific SESOIL vadose zone model, which was used to develop the soil vapor performance standards, may not be the most applicable analytical tool under these conditions.

8.1.4 Recommendation

The applicability of the SESOIL model to site conditions should be reevaluated once additional physical subsurface data have been collected. If the SESOIL model is determined to be the most applicable analytical tool, then the design of the current model should be reevaluated to ensure the standards are protective of groundwater. Otherwise, a different analytical model should be identified, and new soil vapor performance standards should be developed. An Explanation of Significant Differences (ESD) or an amendment to the Record of Decision (ROD) will be issued if new standards are developed.

TABLE 8-1
Summary Table - Issues, Recommendations and Follow-Up Actions
Second 5-year Review Report for the Hassayampa Landfill Superfund Site, Maricopa County, Arizona

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
Current design and implementation of SVE remedy may not be designed to capture all soil vapor mass.	Continue with implementation of Revised Phase I Work Plan and subsequent iterations of investigation, as determined necessary.	HSC	USEPA	Summer 2007	N	Def
Soil vapor performance standards may not be protective of Unit A groundwater.	Continue with implementation of Revised Phase I Work Plan and subsequent iterations of investigation, as determined necessary by USEPA. Following revised definition of the conceptual site model, reevaluate standards and revise as necessary.	HSC	USEPA	Fall 2008	N	Def

9.0 Protectiveness Statement

The remedy at the Hassayampa Landfill Superfund Site is considered protective to human health and the environment in the short-term, because no current exposures are occurring. The Unit B groundwater has not been impacted and there are restrictions on well-drilling and future property use in place that would prevent usage. Existing institutional controls to prevent access to the property and use of groundwater have not been violated. However, a determination about whether the remedy will be protective in the long-term will need to be deferred until additional data is collected which will lead to changes in the performance standards for operation of the soil vapor extraction system and may lead to changes to the remedial design.

10.0 Next 5-Year Review

The next 5-year review should be performed in 2011. A report to document the results of that review shall be completed by September 30, 2011.

11.0 References

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Tables

Table 4-1
Groundwater Performance Standards
Second Five-Year Review Report, Hassayampa Landfill Superfund Site, Maricopa County, Arizona

Compound	Performance Standard (μg/L)
acetone	700
benzene	5
methylethyl ketone	170
chlorobenzene	100
dichlorofluoromethane	1,400
1,2-dichloromethane	5
1,1-dichloroethene	7
1,2-dichloroethene (cis)	70
1,2-dichloroethene (trans)	100
dichloromethane	5
1,2-dichloropropane	5
tetrachloroethene	5
toluene	1,000
1,1,1-trichloroethane	200
trichloroethene	5
trichlorofluoromethane (Freon 11)	2,100
trichlorotrifluoroethane (Freon 113)	210,000
vinyl chloride	2
xylenes	10,000
chromium	50

Note:

μg/L - micrograms per liter

TABLE 5-1
Actions Taken Since Previous 5-Year Review
Second Five-Year Review Report, Hassayampa Landfill Superfund Site, Maricopa County, Arizona

AREA OF DEFICIENCY FROM PREVIOUS REVIEW	RECOMMENDATION FROM PREVIOUS REVIEW	FOLLOW UP ACTION	RESPON-SIBLE PARTY	OVERSIGHT AGENCY	TARGET COMPLETION DATE (MILESTONE)	ACTION TAKEN AND OUTCOME	DATE OF ACTION
Effluent treatment monitoring protectiveness	Maintain the current monthly monitoring of treated effluent from the GRS	Prepare a schedule for monthly monitoring and submit an addendum to the GPS O&M Manual which reflects the new schedule	HSC	EPA	December 28, 2001	Revised GRS O&M Manual submitted to EPA. Document contains appropriate schedule.	December 26, 2001
Groundwater Treatment System O&M	Continue to conduct annual disassembly, inspection, and cleaning of the air stripper unit	Prepare a schedule for annual disassembly, cleaning and inspection and submit an addendum to the GPS O&M Manual which reflects the new schedule	HSC	EPA	December 28, 2001	Revised GRS O&M Manual submitted to EPA. Document contains appropriate schedule.	December 26, 2001
GPS O&M	Update the Groundwater Pilot Study Operation and Maintenance Manual (GPS O&M Manual) to address equipment modifications and changes to sampling frequency	Submit an addendum to the GPS O&M Manual	HSC	EPA	December 28, 2001	Revised GRS O&M Manual submitted to EPA. Document contains appropriate schedule.	December 26, 2001
Vapor zone clean-up goals	Determine achievement of soil vapor cleanup goals in the FML capped area	Complete verification sampling in accordance with the requirements of the *Soil Vapor Performance Standards Verification Plan*	HSC	EPA	January 2002	-Demonstration of Compliance sampling was completed. -Addendum to final Five-Year Review Report included a revised protectiveness statement indicating that soil vapor performance standards were protective of human health and the environment. -Soil Vapor Analysis Report (M&A, 2001) indicated performance standards were met in the capped area.	-Compliance sampling was completed in Fall 2001. - Addendum to final Five-Year Review Report issued April 24, 2001. - Soil Vapor Analysis Report submitted (M&A, 2001) September 27, 2001.

TABLE 5-1
Actions Taken Since Previous 5-Year Review
Second Five-Year Review Report, Hassayampa Landfill Superfund Site, Maricopa County, Arizona

AREA OF DEFICIENCY FROM PREVIOUS REVIEW	RECOMMENDATION FROM PREVIOUS REVIEW	FOLLOW UP ACTION	RESPON-SIBLE PARTY	OVERSIGHT AGENCY	TARGET COMPLETION DATE (MILESTONE)	ACTION TAKEN AND OUTCOME	DATE OF ACTION
Remediation of uncapped and Pit 1 area	Complete evaluation of remedial options for uncapped and Pit 1 polygon area	Submit final proposal for remedial action	HSC	EPA	A date was to be determined by EPA after final determination on protectiveness of vadose zone performance standards.	- Soil Vapor Analysis Report (M&A, 2001) indicated that dichloromethane and 1,1-DCE exceeded soil vapor performance standards in the non-capped portion of Pit 1. - Soil Vapor Passive Venting Pilot Test (PVPT) was conducted to evaluate remedial feasibility. - Expanded PVPT implemented	- Soil Vapor Analysis Report submitted (M&A, 2001) September 27, 2001. - PVPT implemented from February to May 2001 - Expanded PVPT implemented in November 2001
Soil Vapor O&M	Update the *Operations and Maintenance Manual Soil Venting and Treatment System* to address new or modified equipment and changes to sampling frequency	Submit an addendum to the O&M Manual for the SVTS	HSC	EPA	A date will be determined by EPA if decision is made to resume operation of the SVTS	- No action taken. Operation of the SVTS was not resumed.	N/A
Access Controls	Update and/or correct information on signage on the perimeter fencing	The HSC should propose a plan to update signage on perimeter fencing	HSC	EPA	A proposed date should be submitted at the completion of the final Five-Year Review	- Signage has been updated to clearly identify the site as a hazardous waste superfund site and states visitation instructions.	
Groundwater remediation effectiveness	Estimation of mass of VOCs in groundwater	The HSC has estimated the mass of VOCs in the groundwater, and should intermittently update this calculation in the annual reports	HSC	EPA	Annual Reports	- The calculation is updated in each annual report.	- Annual reports from 2001 through present (2005).
Characterization of dewatered Unit A	Evaluate dewatered area of Unit A	Submit evaluation of VOCs in dewatered area of Unit A	HSC	EPA	December 15, 2001	- The GRS is shut down for a two week period in the Spring to allow Unit A groundwater recovery to flush the dewatered area.	- Spring 2003 to present (2005)
Protectiveness of vadose zone clean-up standards in context of the five-year review process	Evaluate appropriateness of SESOIL model	Submit memorandum explaining concerns with use of SESOIL at the site.	ADEQ	EPA	October 17, 2001	- Addendum to the first 5-Year Review stated that the vadose zone remedy and the associated soil vapor performance standards developed using the SESOIL model are protective of groundwater.	- Addendum to final Five-Year Review Report issued April 24, 2001.
Appropriateness of using SESOIL model at site	To be determined	Final determination on protectiveness of vadose zone clean-up standards	EPA	EPA	March 29, 2002	- In progress.	- The Phase II Work Plan for re-evaluation of the conceptual site model will evaluate the data collected during Phase I and reevaluate the appropriateness of the SESOIL model.

Table 6-1
Summary of Groundwater Sample Collection: 2001 through 2005
Second 5-Year Review Report, Hassayampa Landfill Superfund Site, Maricopa County, Arizona

	Jan-01	Feb-01	Mar-01	Apr-01	May-01	Jun-01	Jul-01	Aug-01	Sep-01	Oct-01	Nov-01	Dec-01	Jan-02	Feb-02	Mar-02	Apr-02	May-02	Jun-02	Jul-02	Aug-02
MW-01UA				VOC						VOC						VOC				
MW-02UA				VOC						VOC						VOC				
MW-03UA				VOC						VOC						VOC				
MW-04UA				VOC												VOC				
MW-05UA				VOC												VOC				
MW-06UA				VOC												VOC				
MW-07UA				VOC												VOC				
MW-08UA				VOC						VOC						VOC				
MW-09UA				VOC						VOC						VOC				
MW-10UA				VOC						VOC						VOC				
MW-11UA				VOC						VOC						VOC				
MW-12UA				VOC			VOC			VOC						VOC				
MW-13UA				VOC						VOC						VOC				
MW-14UA				VOC			VOC			VOC						VOC				
MW-16UA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-17UA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-18UA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-19UA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EX-01UA				VOC						VOC						VOC				
EX-02UA				VOC						VOC						VOC				
EX-03UA				VOC						VOC						VOC				
EX-04UA				VOC			VOC			VOC						VOC				
MW-01UB				VOC						VOC						VOC				
MW-02UB				VOC						VOC						VOC				
MW-03UB				VOC						VOC						VOC				
MW-04UB				VOC												VOC				
MW-06UB				VOC												VOC				
MW-09UB				VOC						VOC						VOC				
MW-10UB				VOC												VOC				
MW-15UB				VOC												VOC, INORG				
IW-01UB																				
GRS influent		VOC		VOC			VOC			VOC, TAL			VOC			VOC			VOC	
GRS effluent	VOC	VOC	VOC	VOC	VOC		VOC	VOC	VOC	VOC, TAL	VOC	VOC	VOC	VOC	VOC	VOC	VOC	VOC	VOC	VOC

Notes:

CM - Acrolein, acrylontirile, and 2-chloroethyl vinyl ether
DX - 1,4-dioxane
INORG - nitrate, antimaony, arsenic, chromium, and lead
TAL - SVOC by EPA Method 8270C, OCP by EPA Method 8081A, PCB by EPA Method 8082, common constituents, trace constituents, cyanide, and nitrate
VOC - EPA Method 8260B

Table 6-1
Summary of Groundwater Sample Collection: 2001 through 2005
Second 5-Year Review Report, Hassayampa Landfill Superfund Site, Maricopa County, Arizona

	Sep-02	Oct-02	Nov-02	Dec-02	Jan-03	Feb-03	Mar-03	Apr-03	May-03	Jun-03	Jul-03	Aug-03	Sep-03	Oct-03	Nov-03	Dec-03	Jan-04	Feb-04	Mar-04	Apr-04
MW-01UA		VOC						VOC												VOC
MW-02UA		VOC						VOC												VOC
MW-03UA		VOC						VOC												VOC
MW-04UA		VOC			VOC			VOC			VOC			VOC						VOC
MW-05UA		VOC						VOC												VOC
MW-06UA		VOC			VOC			VOC			VOC			VOC						VOC
MW-07UA		VOC			VOC			VOC			VOC			VOC						VOC
MW-08UA		VOC						VOC						VOC						VOC, CM
MW-09UA		VOC						VOC						VOC						VOC, CM
MW-10UA		VOC						VOC						VOC						VOC, CM
MW-11UA		VOC			VOC			VOC			VOC			VOC						VOC, CM
MW-12UA		VOC						VOC												VOC
MW-13UA		VOC						VOC												VOC
MW-14UA		VOC						VOC												VOC
MW-16UA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-17UA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-18UA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-19UA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EX-01UA		VOC						VOC						VOC						VOC
EX-02UA		VOC						VOC						VOC						VOC
EX-03UA		VOC			VOC			VOC			VOC			VOC						VOC
EX-04UA		VOC			VOC			VOC			VOC			VOC						VOC
MW-01UB		VOC						VOC												VOC
MW-02UB		VOC						VOC												VOC
MW-03UB		VOC						VOC												VOC
MW-04UB								VOC												VOC
MW-06UB								VOC												VOC
MW-09UB		VOC						VOC												VOC
MW-10UB								VOC												VOC
MW-15UB								VOC, INORG												VOC, INORG
IW-01UB																				
GRS influent		VOC, TAL	DX		VOC			VOC			VOC			TAL						VOC
GRS effluent	VOC	VOC, TAL	VOC	VOC	VOC	VOC	VOC	VOC	VOC	VOC	VOC	VOC	VOC	TAL	VOC	VOC	VOC	VOC	VOC	VOC

Notes:

CM - Acrolein, acrylontirile, and 2-chloroethyl vinyl ether
DX - 1,4-dioxane
INORG - nitrate, antimaony, arsenic, chromium, and lead
TAL - SVOC by EPA Method 8270C, OCP by EPA Method 8081A, PCB by EPA Method 8082, common constituents, trace constituents, cyanide, and nitrate
VOC - EPA Method 8260B

Table 6-1
Summary of Groundwater Sample Collection: 2001 through 2005
Second 5-Year Review Report, Hassayampa Landfill Superfund Site, Maricopa County, Arizona

	May-04	Jun-04	Jul-04	Aug-04	Sep-04	Oct-04	Nov-04	Dec-04	Jan-05	Feb-05	Mar-05	Apr-05	May-05	Jun-05	Jul-05	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05
MW-01UA						VOC						VOC						VOC		
MW-02UA						VOC						VOC						VOC		
MW-03UA						VOC						VOC						VOC		
MW-04UA						VOC						VOC						VOC		
MW-05UA												VOC								
MW-06UA						VOC						VOC						VOC		
MW-07UA						VOC						VOC						VOC		
MW-08UA						VOC, CM						VOC, CM						VOC, CM		
MW-09UA						VOC, CM						VOC, CM						VOC, CM		
MW-10UA						VOC, CM						VOC, CM						VOC, CM		
MW-11UA						VOC, CM						VOC, CM						VOC, CM		
MW-12UA						VOC						VOC						VOC		
MW-13UA						VOC						VOC						VOC		
MW-14UA						VOC						VOC						VOC		
MW-16UA	VOC		VOC			VOC						VOC						VOC		
MW-17UA	VOC		VOC			VOC						VOC						VOC		
MW-18UA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-19UA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EX-01UA						VOC						VOC						VOC		
EX-02UA						VOC						VOC						VOC		
EX-03UA						VOC						VOC						VOC		
EX-04UA						VOC						VOC						VOC		
MW-01UB						VOC						VOC						VOC		
MW-02UB						VOC						VOC						VOC		
MW-03UB						VOC						VOC						VOC		
MW-04UB												VOC								
MW-06UB												VOC								
MW-09UB						VOC						VOC						VOC		
MW-10UB												VOC								
MW-15UB												VOC, INORG								
IW-01UB																				
GRS influent			VOC			VOC, TAL			VOC			VOC			VOC			VOC, TAL		
GRS effluent	VOC	VOC	VOC	VOC	VOC	VOC, TAL	VOC	VOC	VOC	VOC	VOC	VOC	VOC	VOC	VOC	VOC	VOC	VOC, TAL	VOC	VOC

Notes:

CM - Acrolein, acrylontirile, and 2-chloroethyl vinyl ether
DX - 1,4-dioxane
INORG - nitrate, antimaony, arsenic, chromium, and lead
TAL - SVOC by EPA Method 8270C, OCP by EPA Method 8081A, PCB by EPA Method 8082, common constituents, trace constituents, cyanide, and nitrate
VOC - EPA Method 8260B

Table 6-2
Summary of Laboratory Soil Vapor Sample Collection: 2001 through 2005
Second 5-Year Review Report, Hassayampa Landfill Superfund Site, Maricopa County, Arizona

	Jan-01	Feb-01	Mar-01	Apr-01	May-01	Jun-01	Jul-01	Aug-01	Sep-01	Oct-01	Nov-01	Dec-01	Jan-02	Feb-02	Mar-02	Apr-02	May-02	Jun-02	Jul-02	Aug-02	Sep-02	Oct-02	Nov-02	Dec-02	Jan-03	Feb-03	Mar-03	Apr-03	May-03	Jun-03
SP-1*				VOC						VOC												VOC								
SP-2*				VOC						VOC												LF, VOC								
SP-3*	LF (F), AK (F)			VOC			LF (C), AK (C)			VOC																				
SP-4*				VOC						VOC												VOC								
SP-5*	LF (C), AK (C)			LF (F), VOC						LF (F), VOC																				
SP-6*				VOC						VOC												VOC								
SP-7																														
SP-8																														
N-1				VOC						VOC												VOC								
N-2				VOC						VOC												VOC								
N-3				VOC						VOC																				
NW-1				VOC						VOC												VOC								
NW-2*				VOC			LF (F), AK (F), VOC			VOC												VOC								
NE-1*				VOC						VOC												VOC								
NE-2																														
NE-3				VOC						VOC																				
W-1*				VOC						VOC																				
P-1*	LF (F), AK (F)			VOC			LF (C), AK (C)			VOC												LF, VOC								
P-2																														
P-3																						LF, VOC								
PZ-1*																														
PZ-2*																														
PZ-3*																														
PZ-4*																														
PZ-5*																														
PZ-6*																														
PZ-7*																														
PZ-8*																														
SE-1				VOC						VOC												VOC								
V-1*																														
V-2*																														
V-3*																														
V-4*																														
V-5*																														
V-6*																														
V-7*																														
V-8*																														
V-9*	LF (F), AK (F)			LF (C), VOC						LF (C), VOC												LF, VOC								
V-10*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--							VOC	
V-11*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--							VOC	
V-12*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--							VOC	
V-13*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
V-14*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
V-15*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
V-16*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
VB-1																														
VB-2c				VOC						VOC												VOC								
VB-2f				LF, VOC						LF, VOC																				
VB-3																														
VB-4																														

Notes:

AK - alkanes with carbon chains C1 through C6+ by EPA method TO-3
LF - methane, carbon dioxinde, and oxygen by ASTM method D1946
VOC - VOC by EPA Method TO-15
(F) - fine grained zone only
(C) - coarse grained zone only
* indicates dual completion (fine grained zone and coarse grained zone)

Table 6-2
Summary of Laboratory Soil Vapor Sample Collection: 2001 through 2005
Second 5-Year Review Report, Hassayampa Landfill Superfund Site, Maricopa County, Arizona

	Jul-03	Aug-03	Sep-03	Oct-03	Nov-03	Dec-03	Jan-04	Feb-04	Mar-04	Apr-04	May-04	Jun-04	Jul-04	Aug-04	Sep-04	Oct-04	Nov-04	Dec-04	Jan-05	Feb-05	Mar-05	Apr-05	May-05	Jun-05	Jul-05	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05
SP-1*				VOC													LF (F), VOC											VOC		
SP-2*				VOC													VOC											LF (C), VOC		
SP-3*				VOC													VOC											LF (F), VOC		
SP-4*				VOC													LF (F), VOC											VOC		
SP-5*																	LF (F), VOC											VOC		
SP-6*				LF (F), VOC													LF (F), VOC											VOC		
SP-7																	LF, VOC											VOC		
SP-8																	VOC											VOC		
N-1				VOC													LF, VOC											VOC		
N-2				VOC													VOC											VOC		
N-3				VOC													VOC											VOC		
NW-1				VOC													VOC											VOC		
NW-2*				LF (F), VOC													VOC											VOC		
NE-1*				VOC													VOC											VOC		
NE-2																												LF		
NE-3				VOC													VOC											VOC		
W-1*																	LF (F), VOC											VOC		
P-1*				LF (F), VOC													VOC											VOC		
P-2																														
P-3				VOC													LF, VOC											VOC		
PZ-1*																														
PZ-2*																														
PZ-3*																														
PZ-4*																														
PZ-5*																														
PZ-6*																														
PZ-7*																														
PZ-8*																														
SE-1				VOC													VOC											VOC		
V-1*																														
V-2*																														
V-3*																														
V-4*																														
V-5*																														
V-6*																														
V-7*																														
V-8*																														
V-9*				VOC													VOC											VOC		
V-10*				VOC													VOC											VOC		
V-11*				LF (F), VOC													VOC											VOC		
V-12*				VOC													VOC											VOC		
V-13*	--	--	--	--	--	--	--	--	--	--						VOC	VOC										LF (F), VOC		
V-14*	--	--	--	--	--	--	--	--	--	--						VOC	VOC										VOC		
V-15*	--	--	--	--	--	--	--	--	--	--						VOC	VOC										VOC		
V-16*	--	--	--	--	--	--	--	--	--	--						VOC	VOC										LF (F), VOC		
VB-1																														
VB-2c				VOC													VOC											LF, VOC		
VB-2f				VOC													VOC											VOC		
VB-3																														
VB-4																														

Notes:

AK - alkanes with carbon chains C1 through C6+ by EPA method TO-3
LF - methane, carbon dioxinde, and oxygen by ASTM method D1946
VOC - VOC by EPA Method TO-15
(F) - fine grained zone only
(C) - coarse grained zone only
* indicates dual completion (fine grained zone and coarse grained zone)

Figures

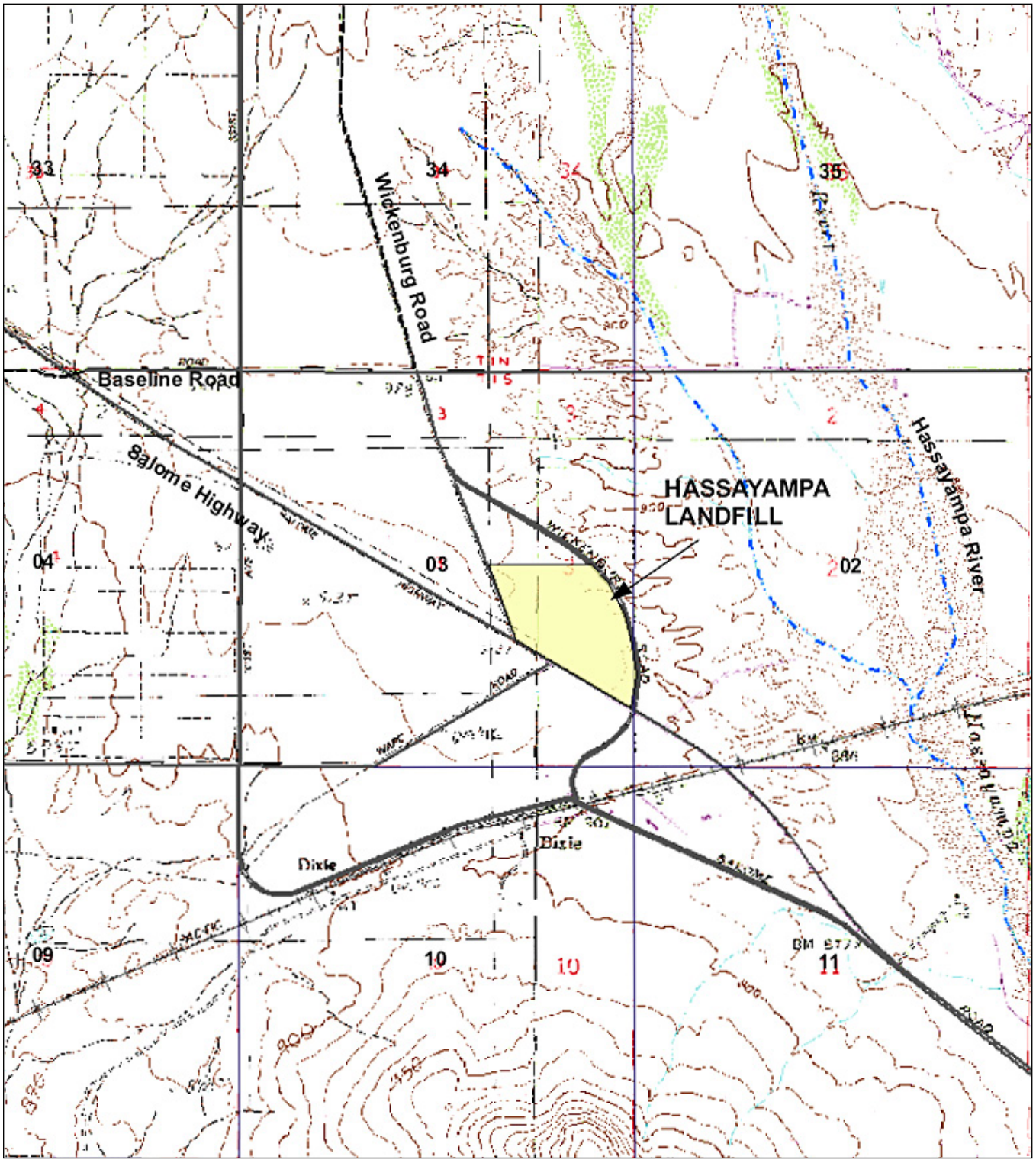


FIGURE 3-1
SITE LOCATION MAP
HASSAYAMPA FIVE-YEAR REVIEW REPORT
MARICOPA COUNTY, ARIZONA

Source: *Geosyntec Consultants* and *Hargis + Associates, Inc.*, December 2005.

CH2MHILL

ES062006011BAO_Fig3-1.ai_061206_ll

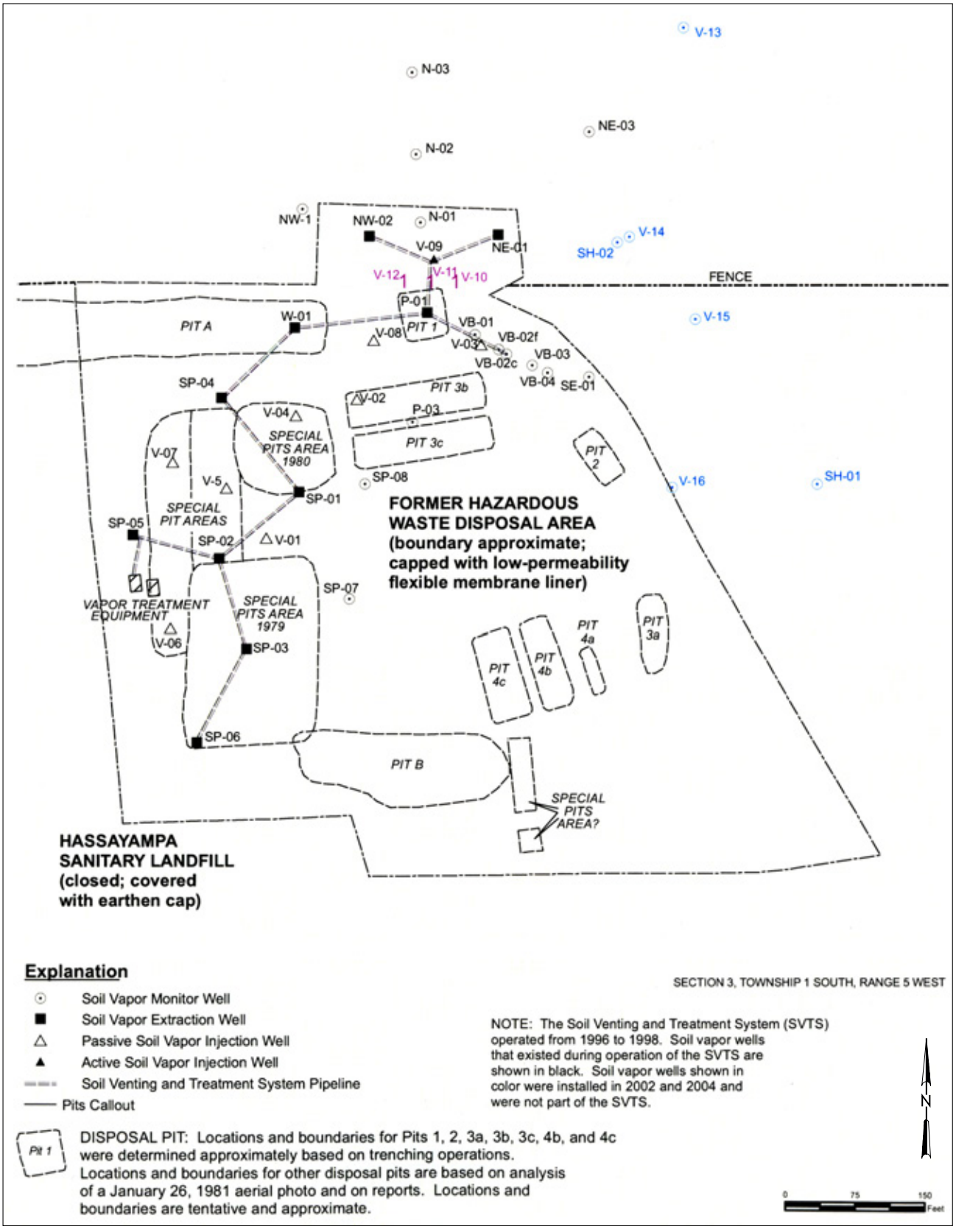


FIGURE 3-2
SITE MAP WITH LOCATION OF SOIL VENTING AND TREATMENT SYSTEM ELEMENTS
HASSAYAMPA FIVE-YEAR REVIEW REPORT
MARICOPA COUNTY, ARIZONA

Source: *Hargis + Associates, Inc.*, March 10, 2006.

CH2MHILL

ES062006011BAO_Fig3-2.ai_061206_ll

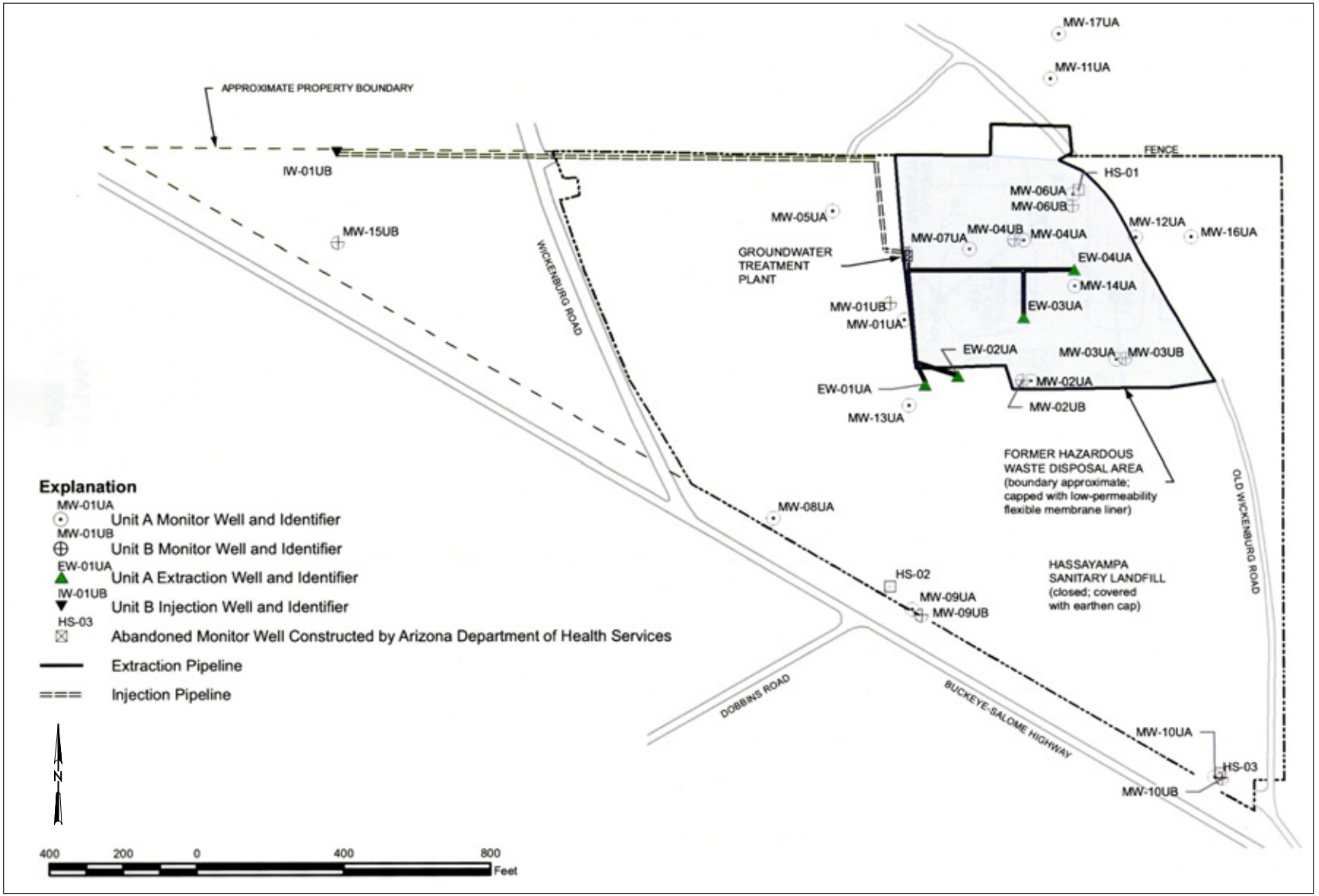


FIGURE 4-1
LOCATION MAP FOR GROUNDWATER WELLS
HASSAYAMPA FIVE-YEAR REVIEW REPORT
MARICOPA COUNTY, ARIZONA

Source: *Hargis + Associates, Inc.*, March 10, 2006.

CH2MHILL

ES062006011BAO_Fig4-1.ai_061206_ll

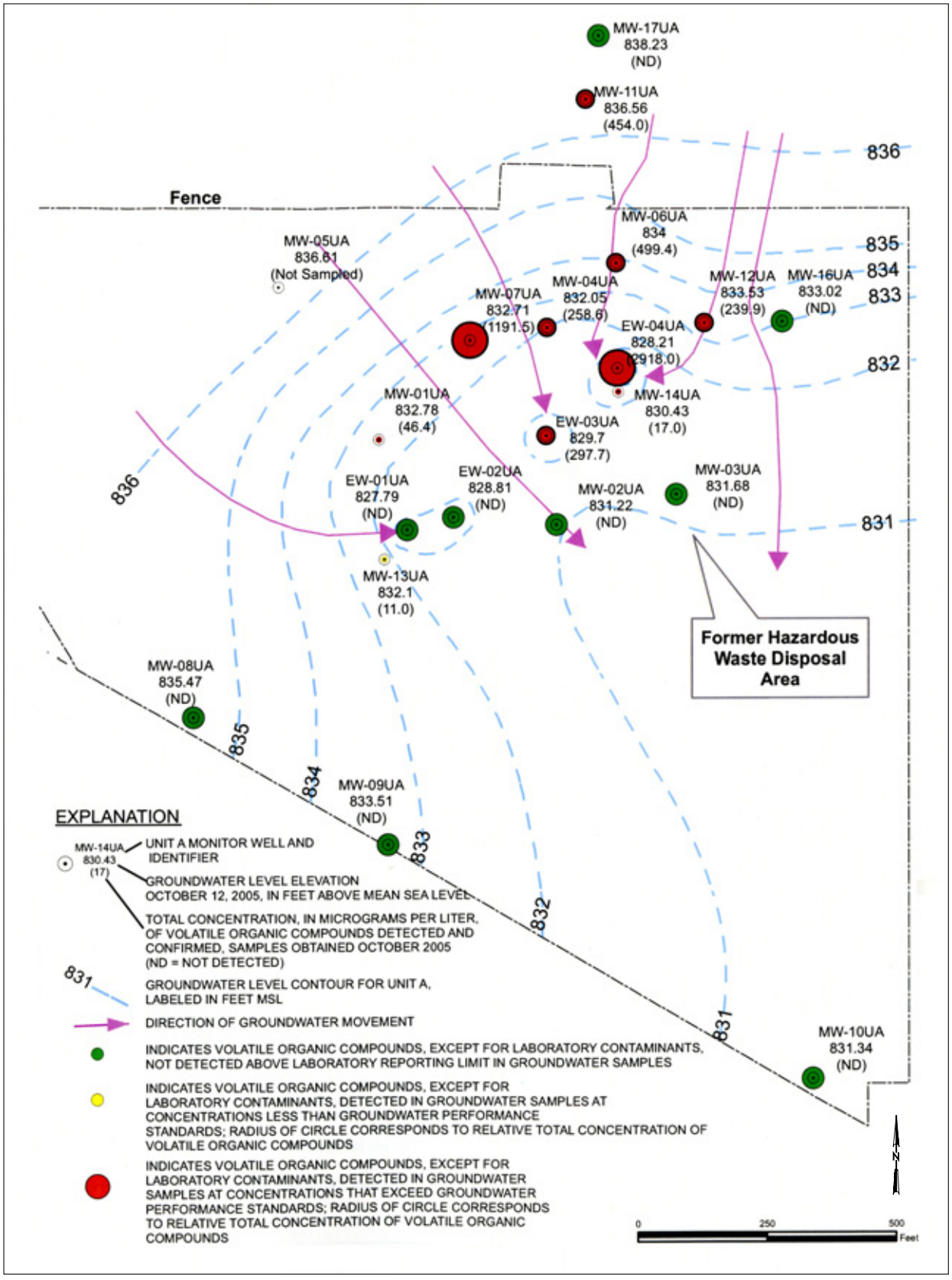


FIGURE 6-1
UNIT A GROUNDWATER LEVEL CONTOURS AND VOC DISTRIBUTION
HASSAYAMPA FIVE-YEAR REVIEW REPORT
MARICOPA COUNTY, ARIZONA

Source: *Hargis + Associates, Inc.*, March 10, 2006.

CH2MHILL

ES062006011BAO_Fig6-1.ai_061206_ll

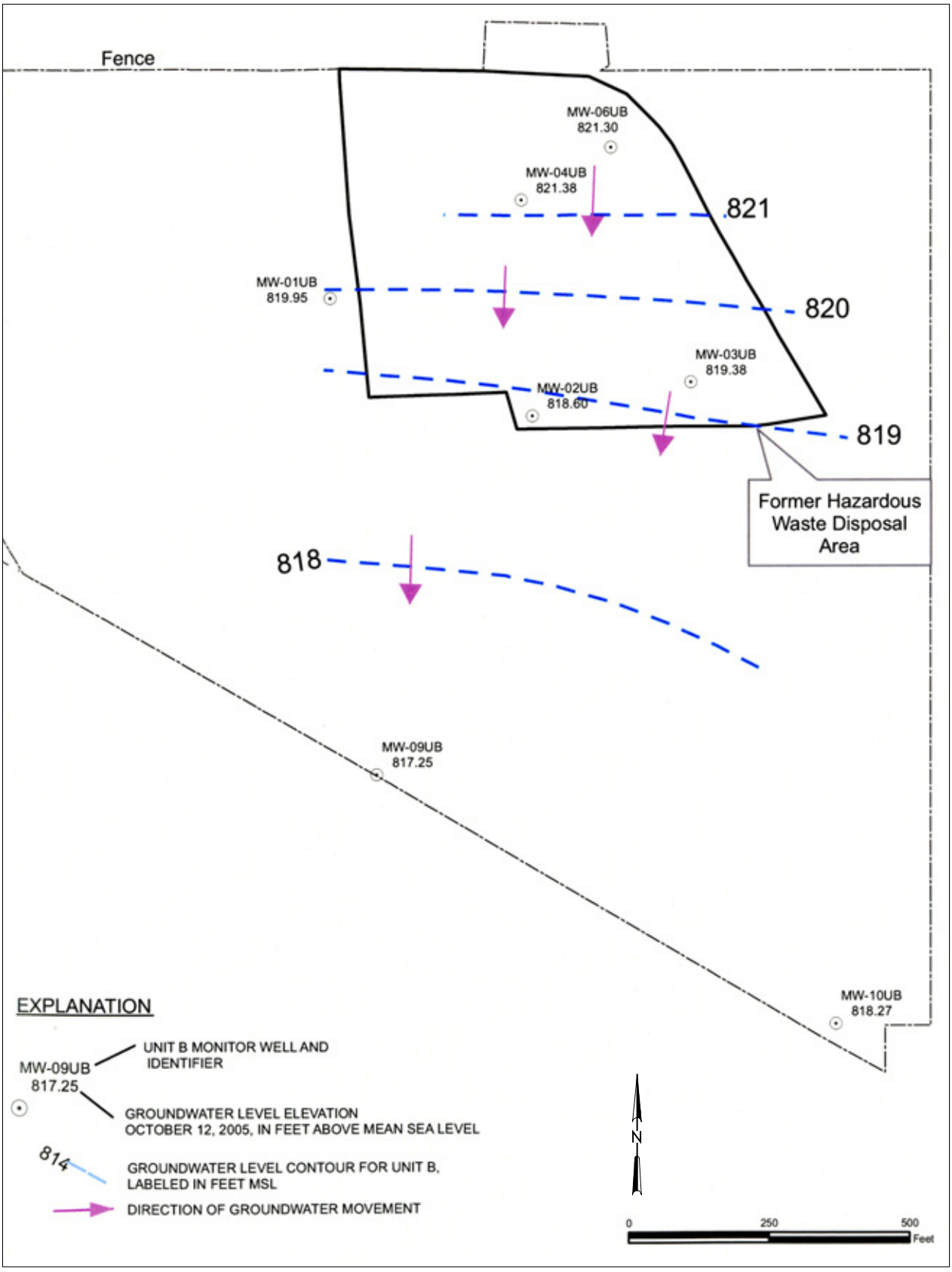


FIGURE 6-2
UNIT B GROUNDWATER LEVEL CONTOURS
HASSAYAMPA FIVE-YEAR REVIEW REPORT
MARICOPA COUNTY, ARIZONA

Source: *Hargis + Associates, Inc.*, March 10, 2006.

CH2MHILL

ES062006011BAO_Fig6-2.ai_061206_ll

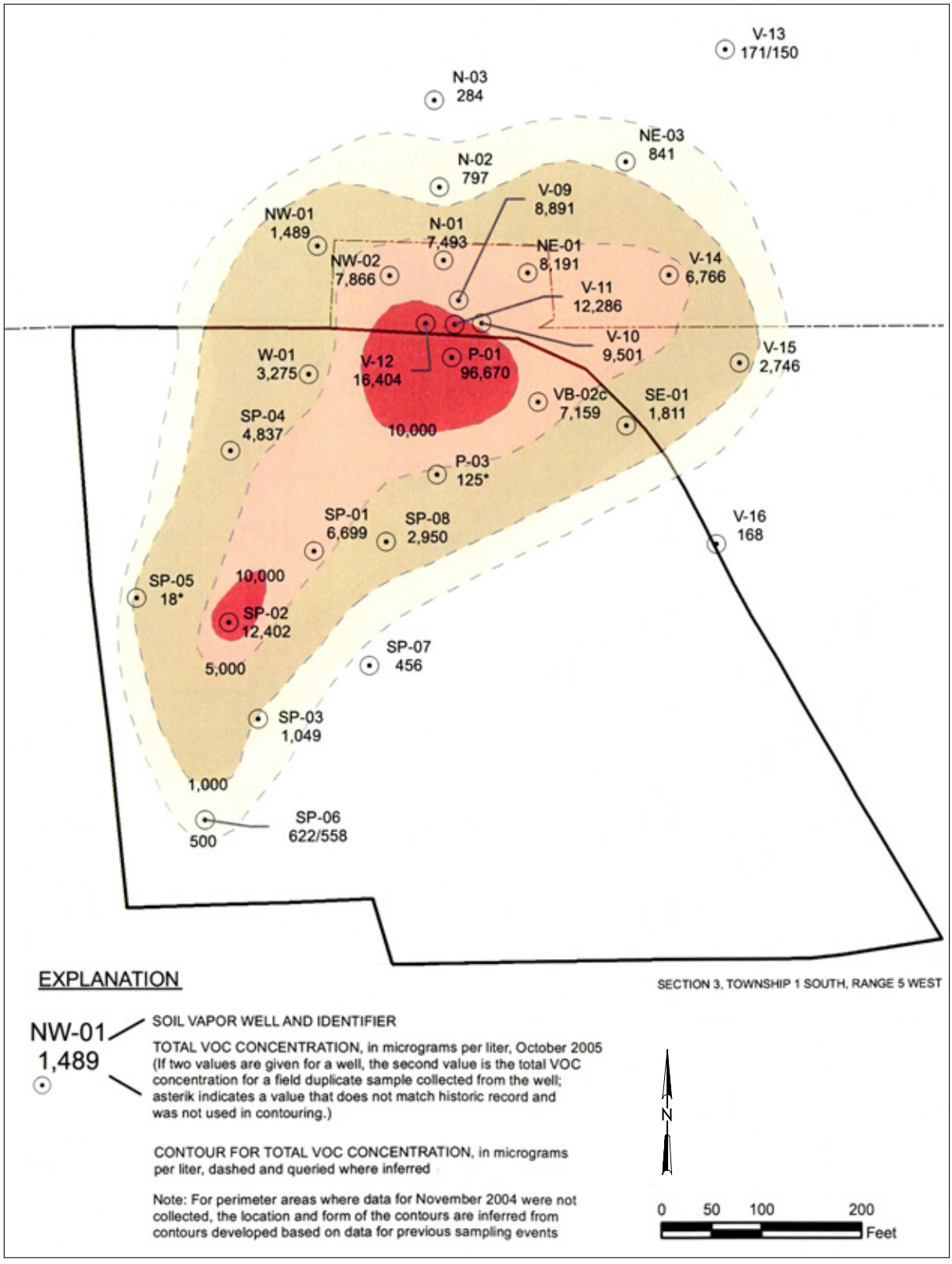


FIGURE 6-3
TOTAL VOC CONCENTRATION DISTRIBUTION IN THE COARSE-GRAINED ZONE
HASSAYAMPA FIVE-YEAR REVIEW REPORT
MARICOPA COUNTY, ARIZONA

Source: *Hargis + Associates, Inc.*, March 10, 2006.

CH2MHILL

ES062006011BAO_Fig6-3.ai_061306_ll

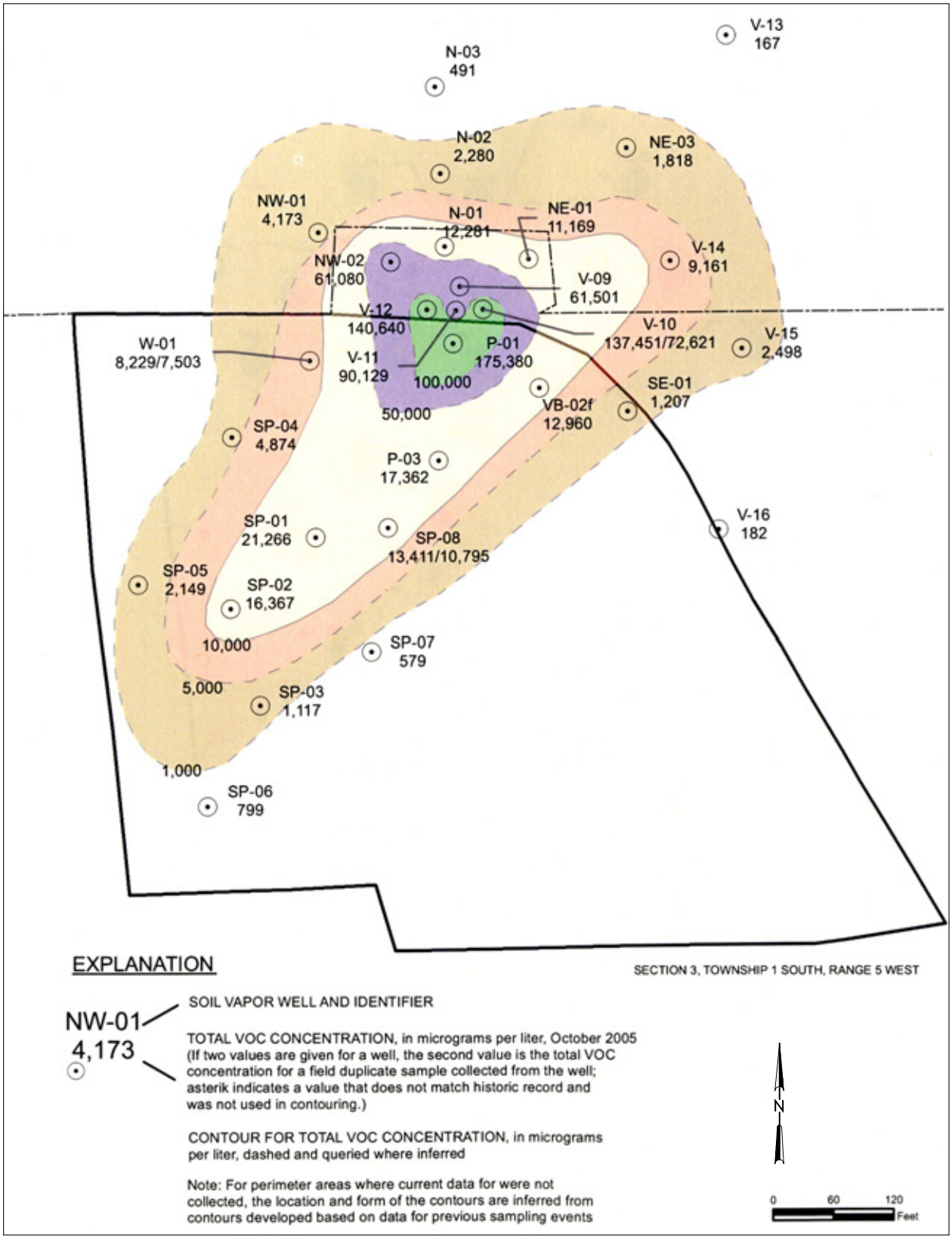


FIGURE 6-4
TOTAL VOC CONCENTRATION DISTRIBUTION IN THE FINE-GRAINED ZONE
HASSAYAMPA FIVE-YEAR REVIEW REPORT
MARICOPA COUNTY, ARIZONA

Source: *Hargis + Associates, Inc.*, March 10, 2006.

CH2MHILL

ES062006011BAO_Fig6-4.ai_061306_ll

Appendix A
Documents Reviewed

CH2M HILL. 2001. Five-Year Review Report for Hassayampa Landfill Superfund Site, Maricopa County, Arizona.

Conestoga-Rovers & Associates and E.L. Montgomery Associates, Inc (CRA and EMA). 1993. *Design Report – Groundwater Pilot Study, Hassayampa Landfill Maricopa County, Arizona.* September 21.

EMA and CRA. 1995. *Hydraulic Containment Evaluation Report*. January 17.

CRA and EMA. 1995. *Operation and Maintenance Manual, soil cap, Former Hazardous Waste Disposal Area, Hassayampa Landfill, Maricopa County, Arizona*. May 1995.

CRA and EMA. 1995. *Remedial Action Report, Construction of Soil Cap Hassayampa Landfill, Maricopa County, Arizona.* August.

CRA and EMA. 1996. *Groundwater Performance Standards Verification Plan, Hassayampa Landfill, Maricopa County, Arizona.* April 24.

CRA and EMA. 1996. *Soil Vapor Performance Standards Verification Plan Hassayampa Landfill, Maricopa County, Arizona.* August.

CRA and EMA. 2001. *GRS Operations and Maintenance, Volume, Hassayampa Landfill EPA Superfund Site, Maricopa County, Arizona.* December 26.

E.L. Montgomery & Associates, Inc. (EMA). 2000. *Re-evaluation of Potential Impact to Groundwater Resulting from Residual Contaminants of Potential Concern in Soil Vapor, Hassayampa Landfill EPA Superfund Site, Maricopa County, Arizona.* May 18.

EMA. 2002. *Annual Monitoring Report No. 7 for 2001, Hassayampa Landfill EPA Superfund Site, Maricopa County, Arizona.* April 1.

EMA. 2003. *Annual Monitoring Report No. 8 for 2002, Hassayampa Landfill EPA Superfund Site, Maricopa County, Arizona.* March 31.

EMA. 2004. *Annual Monitoring Report No. 9 for 2003, Hassayampa Landfill EPA Superfund Site, Maricopa County, Arizona.* March 30.

E.L. Montgomery & Associates and Conestoga-Rovers & Associates (EMA and CRA). 1991. *Final Remedial Investigation Report for Former Hazardous Waste Disposal Area at Hassayampa Landfill, Maricopa County, Arizona, Volume I.* February 7.

ERA and CRA. 1994. *Additional Investigation Report, Hassayampa Landfill Superfund Site, Maricopa County, Arizona.* February 7.

GeoSyntec Consultants and Hargis and Associates (GSC and HA) 2006. *Revised Phase 1 Work Plan, Hassayampa Superfund Site Maricopa County, Arizona.* December 8.

Hargis and Associates, Inc (HA). 2005. *2004 Annual Groundwater Monitoring Report, Hassayampa Landfill EPA Superfund Site, Maricopa County, Arizona.* June 20.

HA. 2006. *2005 Annual Groundwater Monitoring Report, Hassayampa Landfill EPA Superfund Site, Maricopa County, Arizona.* March 10.

Hydro Geo Chem, Inc. 2006. *Estimation of Pneumatic Properties at the Hassayampa Site Using A Three-Dimensional Numerical Model.* January 24.

U.S. Environmental Protection Agency (USEPA). 1998. Consent Order, Hassayampa Landfill. March 1.

USEPA. 1992. *Record of Decision – Hassayampa Landfill Superfund Site.* August 6.

USEPA. 1993. Administrative Order No. 93-09, Hassayampa Landfill Superfund Site. March 30.

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

USEPA. 2001. *Comprehensive Five-Year Review Guidance.* June 2001.

USEPA. 2002. Addendum to the Five-Year Review Report. April 24.

USEPA. No Date. *Hassayampa Landfill Community Relations Plan.*

Appendix B
Five-Year Review Site Inspection Checklist

TABLE B-1
Site Inspection Team Roster, Site Inspection- March 28, 2006
Second 5-year Review Report for the Hassayampa Landfill Superfund Site, Maricopa County, Arizona

Name	Title	Affiliation
Martin Zeleznik	Remedial Project Manager	United States Environmental Protection Agency Region 9
Ben Costello	Project Manager – Hassayampa Steering Committee	Nationwide Environmental Services
Alex Heirman	Site O&M Manager	Hargis and Associates
Michael Cavaliere	Task Manager	E2 Consulting Engineers, subcontracted by CH2M HILL Bay Area (Oakland) Office

Five-Year Review Site Inspection Checklist
Hassayampa Landfill Superfund Site

I. SITE INFORMATION	
Site name: Hassayampa Landfill	**Date of inspection:** 03/28/2006
Location and Region: Maricopa County, AZ, Region IX	**EPA ID:** AZD980735666
Agency, office, or company leading the five-year review: EPA Region IX	**Weather/temperature:** Mostly cloudy, 70's, moments of light rain

Remedy Includes: (Check all that apply)

- ☒ Landfill cover/containment
- ☒ Access controls
- ☒ Institutional controls
- ☒ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☒ Other (explain) Soil Vapor Extraction/Treatment

Attachments: Inspection team roster attached Site map attached [in report]

II. INTERVIEWS (Check all that apply)

1. **O&M site manager**

Name	Title	Date
Alex Heirman Hargis	O&M Technical Lead	03/28/06

(Interviewed) **Phone No.** (602) 942-9691

Problems, suggestions:

Plans to update PLC software. Should automatically reset/reboot when there is a power Failure. Currently, system fails to automatically restart, requires hand.

NOTE: All referenced attachments can be found in Five-Year Review Report.

2. **O&M staff**

Name Title Date

Interviewed Phone No.

Problems, suggestions

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

Agency

Contact

Name Title Date Phone No.

Problems; suggestions

Agency

Contact

Name Title Date Phone No.

Problems; suggestions

4. **Other interviews** (optional)

III. ONSITE DOCUMENTS AND RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

O&M manual	Readily available	(Up to date)
As-built drawings	(Readily available)	Up to date
Maintenance logs	Readily available	Up to date

Remarks:

2. **Site-Specific Health and Safety Plan** (Readily available) (Up to date)

Contingency plan/emergency response plan Readily available Up to date

Remarks: _____.

3. **O&M and OSHA Training Records** Readily available Up to date (N/A)

Remarks:

4.	**Permits and Service Agreements**			
	Air discharge permit	Readily available	Up to date	(N/A)
	Effluent discharge	Readily available	Up to date	(N/A)
	Waste disposal, POTW	Readily available	Up to date	(N/A)
	Other permits _____	Readily available	Up to date	N/A
	Remarks:			
5.	**Gas Generation Records**	Readily available	Up to date	(N/A)
	Remarks:			
6.	**Settlement Monument Records**	Readily available	Up to date	(N/A)
	Remarks:			
7.	**Groundwater Monitoring Records**	Readily available	Up to date	(N/A)
	Remarks:			
8.	**Leachate Extraction Records**	Readily available	Up to date	(N/A)
	Remarks:			
9.	**Discharge Compliance Records**			
	Air	Readily available	Up to date	(N/A)
	Water (effluent)	Readily available	Up to date	(N/A)
	Remarks:			
10.	**Daily Access/Security Logs**	(Readily available)	(Up to date)	
	Remarks:			

IV. O&M COSTS

1.	**O&M Organization**	
	State in-house	Contractor for State
	PRP in-house	(Contractor for PRP)
	Other	

2. **O&M Cost Records**
Readily available Up to date
Funding mechanism/agreement in place NA
Original O&M cost estimate_____ Breakdown attached

Total annual cost by year for review period if available

Date	Date	Total cost	
From	To		Breakdown attached
Date	Date	Total cost	
From	To		Breakdown attached
Date	Date	Total cost	

3. **Unanticipated or Unusually High O&M Costs During Review Period**
Describe costs and reasons:
None

V. ACCESS AND INSTITUTIONAL CONTROLS Applicable

A. Fencing

1. **Fencing** (Location shown on site map) (Gates secured) N/A
Remarks:

B. Other Access Restrictions

1. **Signs and other security measures** Location shown on site map N/A
Remarks: Signs posted at various locations along fence line identifying site as hazardous waste area, identifying site as Superfund Site, and identifying site visitation instructions.

C. Institutional Controls

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented — Yes (No) N/A
Site conditions imply ICs not being fully enforced — Yes (No) N/A

Type of monitoring (e.g., self-reporting, drive by)
Frequency
Responsible party/agency _____

Contact

Name	Title	Date	Phone No.

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

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

2. **Adequacy** (ICs are adequate) ICs are inadequate N/A
Remarks:

D. General

1. **Vandalism/trespassing** Location shown on site map (No vandalism evident)
Remarks: Site has been broken into on several occasions (cut fence, force entry into the GRS building). However, fence is promptly repaired/building is repaired. Fence and building are in appropriate state of repair at time of inspection

2. **Land use changes onsite** N/A
Remarks:
None

3. **Land use changes offsite** N/A
Remarks:
None

VI. GENERAL SITE CONDITIONS

A. Roads (Applicable)

1. **Roads** (Location shown on site map) (Roads adequate) N/A
Remarks:
Site access road are in good repair (unpaved).

B. Other Site Conditions

Remarks:
New SVE system (including a burmed/lined containment area) has been build in the northeastern portion of the site. No cap damage or future drainage/erosion pathways appear to have been created.

VII. LANDFILL COVERS Not Applicable

A. Landfill Surface

1. **Settlement** (Low spots) Location shown on site map (Settlement not evident)
Areal extent_____ Depth
Remarks:
Engineered surface drainage pathways exist (not shown on site maps).

2. **Cracks** Location shown on site map Cracking not evident
Lengths 3'- 4' Widths 6" – 12" Depth 6"- 8"
Remarks: Minor erosion "cracks" exist at 2-3 locations on site. Monitoring & repair of erosion features are ongoing and focused after rain events.

3. **Erosion** Location shown on site map Erosion not evident
Areal extent_____ Depth
Remarks: Engineered drainage pathways contain rip-rap gravel to prevent erosion in the area it leaves site (highest energy), which is to the southeast

4. **Holes** Location shown on site map (Holes not evident)
Areal extent_____ Depth
Remarks:

5. **Vegetative Cover** Grass Cover properly established (No signs of stress)
Trees/Shrubs (indicate size and locations on a diagram)
Remarks: There is no engineered vegetative cover. However, sparse scrub/grass exists across the site, Specifically in low-lying areas were water likely collects.

6. **Alternative Cover** (armored rock, concrete, etc.) N/A
Remarks: As mentioned in Box #3, rock is used to dissipate energy where surface drainage leaves the site.

7. **Bulges** Location shown on site map (Bulges not evident)
Areal extent_____ Height
Remarks:

8. **Wet Area/Water Damage** (Wet areas/water damage not evident)
Wet areas Location shown on site map Areal extent
Ponding Location shown on site map Areal extent
Seeps Location shown on site map Areal extent
Soft subgrade Location shown on site map Areal extent
Remarks:

9. **Slope Instability** Slides Location shown on site map (No evidence of slope instability)
Areal extent
Remarks:

B. Benches Applicable (N/A)

(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

General site topography is flat.

1. **Flows Bypass Bench** Location shown on site map (N/A or okay)
Remarks:

2. **Bench Breached** Location shown on site map (N/A or okay)
Remarks:

3. Bench Overtopped Location shown on site map (N/A or okay)
Remarks:

C. Letdown Channels Applicable (N/A)

(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

General site topography is flat.

1. **Settlement** Location shown on site map (No evidence of settlement)
Areal extent_____ Depth
Remarks:

2. **Material Degradation** Location shown on site map (No evidence of degradation)
Material type_____ Areal extent
Remarks:

3. **Erosion** Location shown on site map (No evidence of erosion)
Areal extent_____ Depth
Remarks:_____

4. **Undercutting** Location shown on site map (No evidence of undercutting)
Areal extent_____ Depth
Remarks:

5. **Obstruction** Type_____ (No obstruction)
Location shown on site map Areal extent
Size
Remarks:

6. **Excessive Vegetative Growth** Type
(No evidence of excessive growth)
(Vegetation in channels does not obstruct flow)
Location shown on site map Areal extent
Remarks:
Surface drainage pathway is not obstructed, though contains vegetation at site border.

D. Cover Penetrations (Applicable) N/A

1. **Gas Vents** Active Passive
Properly secured/located Functioning Routinely sampled Good condition
Evidence of leakage at penetration
Remarks:
None

2. **Gas Monitoring Probes**
(Properly secured/located) (Functioning) (Routinely sampled) (Good condition)
Evidence of leakage at penetration
Remarks:

3. **Monitoring Wells** (within surface area of landfill)
(Properly secured/located) (Functioning) (Routinely sampled) (Good condition)
Evidence of leakage at penetration
Remarks:

4. **Leachate Extraction Wells**
Properly secured/located Functioning Routinely sampled Good condition
Evidence of leakage at penetration Needs O&M (N/A)
Remarks:

5. **Settlement Monuments** Located Routinely surveyed (N/A)
Remarks:

E. Gas Collection and Treatment Applicable N/A

1. **Gas Treatment Facilities**
(Flaring) Thermal destruction (Collection for reuse)
(Good condition) Needs O&M
Remarks: The existing thermal oxidation system is not in working condition. A condensate collection system is currently in use.

2. **Gas Collection Wells, Manifolds and Piping**
(Good condition) Needs O&M
Remarks:
Collection system is new.

3. **Gas Treatment Facilities** (e.g., gas monitoring of adjacent homes or buildings)
(Good condition) Needs O&M N/A
Remarks:
Collection system is new.

F. Cover Drainage Layer Applicable N/A

1. **Outlet Pipes Inspected** Functioning (N/A)
Remarks:

2. **Outlet Rock Inspected** (Functioning) N/A
Remarks:

G. Detention/Sedimentation Ponds Applicable (N/A)

1. **Siltation** Areal extent_____ Depth_____ N/A
Siltation not evident
Remarks:

2. **Erosion** Areal extent_____ Depth
Erosion not evident
Remarks:
N/A

3. **Outlet Works** Functioning (N/A)
Remarks:

4. **Dam** Functioning (N/A)
Remarks:

H. Retaining Walls Applicable (N/A)

1. **Deformations** Location shown on site map Deformation not evident
   Horizontal displacement_____ Vertical displacement
   Rotational displacement_____
   Remarks:

2. Degradation Location shown on site map Degradation not evident
   Remarks:

I. Perimeter Ditches/Off-Site Discharge Applicable (N/A)

1. **Siltation** Location shown on site map Siltation not evident
   Areal extent_____ Depth
   Remarks:

2. **Vegetative Growth** Location shown on site map N/A
   Vegetation does not impede flow
   Areal extent_____ Type
   Remarks:

3. **Erosion** Location shown on site map Erosion not evident
   Areal extent_____ Depth
   Remarks:

4. **Discharge Structure** Functioning N/A
   Remarks:

VIII. VERTICAL BARRIER WALLS (Not Applicable)

1. **Settlement** Location shown on site map Settlement not evident
   Areal extent_____ Depth
   Remarks:

2. **Performance Monitoring** Type of monitoring
   Performance not monitored
   Frequency_____ Evidence of breaching
   Head differential
   Remarks:

IX. GROUNDWATER/SURFACE WATER REMEDIES Applicable

A. Groundwater Extraction Wells, Pumps, and Pipelines Applicable

1. **Pumps, Wellhead Plumbing, and Electrical**
   (Good condition) (All required wells located) Needs O&M N/A
   Remarks:
   Well vaults are locked.

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
   (Good condition) Needs O&M
   Remarks:

3. **Spare Parts and Equipment**
   Readily available Good condition Requires upgrade Needs to be provided
   Remarks:
   System downtime due to parts failure has not been a problem. Most parts not stocked on site.

B. Surface Water Collection Structures, Pumps, and Pipelines Not Applicable

1. **Collection Structures, Pumps, and Electrical**
   Good condition Needs O&M
   Remarks:

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
   Good condition Needs O&M
   Remarks:

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

C. Treatment System Applicable

1. **Treatment Train** (Check components that apply)

Metals removal Oil/water separation Bioremediation
Air stripping Carbon adsorbers
Filters
Additive (e.g., chelation agent, flocculent)
Good condition Needs O&M
Sampling ports properly marked and functional
Sampling/maintenance log displayed and up to date
Equipment properly identified

Remarks:

2. **Electrical Enclosures and Panels** (properly rated and functional)

N/A Good condition Needs O&M

Remarks:

3. **Tanks, Vaults, Storage Vessels**

Remarks: Storage vessels for SVTS are properly labeled and secondary containment is provided. Vessels are new.

4. **Discharge Structure and Appurtenances**

Good condition Needs O&M

Remarks:

5. **Treatment Building(s) – support building**

N/A Good condition (especially roof and doorways) Needs repair
Chemicals and equipment properly stored

Remarks:

6. Monitoring Wells (pump and treatment remedy)

Properly secured/locked Functioning Routinely sampled Good condition
All required wells located Needs O&M N/A

Remarks:

D. Monitored Natural Attenuation Not Applicable

1. **Monitoring Wells** (natural attenuation remedy)

Properly secured/locked Functioning Routinely sampled Good condition
All required wells located Needs O&M

Remarks:

_____

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

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

No issues. Remedy elements for plume containment, treatment (soil vapor and groundwater) appear in good condition and are properly functioning.

B. Adequacy of O&M

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

O&M procedures appear adequate. According to O&M Manager, GRS Control software may require a minor upgrade to allow automatic system restarts following power failures. This doe not effect current or long term protectiveness due to remote alarm system when shutdowns occur. Mr. Heirman has the software and is planning to install soon.

C.	Early Indicators of Potential Remedy Failure
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of .unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. No early indicators of remedy failure identified.

D.	Opportunities for Optimization
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. See Section B regarding GRS software upgrade.

Appendix C
Site Inspection Photographs

Image: Signage near Site entrance

FIGURE APPENDIX C-1
HASSAYAMPA FIVE-YEAR REVIEW REPORT
MARICOPA COUNTY, ARIZONA

CH2MHILL

Image: GRS Building

FIGURE APPENDIX C-2
HASSAYAMPA FIVE-YEAR REVIEW REPORT
MARICOPA COUNTY, ARIZONA

CH2MHILL

Image: Air stripper located inside GRS building

FIGURE APPENDIX C-3
HASSAYAMPA FIVE-YEAR REVIEW REPORT
MARICOPA COUNTY, ARIZONA

CH2MHILL

Image: Partially decommissioned former SVTS

FIGURE APPENDIX C-4
HASSAYAMPA FIVE-YEAR REVIEW REPORT
MARICOPA COUNTY, ARIZONA

CH2MHILL

Image: New SVTS located within bermed and lined secondary containment area

FIGURE APPENDIX C-5
HASSAYAMPA FIVE-YEAR REVIEW REPORT
MARICOPA COUNTY, ARIZONA

CH2MHILL

Image: View across capped area, from east to west, along surface drainage channel

FIGURE APPENDIX C-6
HASSAYAMPA FIVE-YEAR REVIEW REPORT
MARICOPA COUNTY, ARIZONA

CH2MHILL

Image: Minor surface soil erosion along southeast perimeter of capped area

FIGURE APPENDIX C-7
HASSAYAMPA FIVE-YEAR REVIEW REPORT
MARICOPA COUNTY, ARIZONA

CH2MHILL

Image: Minor exposure of cap material at well location

FIGURE APPENDIX C-8
HASSAYAMPA FIVE-YEAR REVIEW REPORT
MARICOPA COUNTY, ARIZONA

CH2MHILL

Appendix D
Interview Summary Forms

Five-Year Review Interview Record			Interviewee: Benjamin Costello		
Site Name		**EPA ID No.**		**Date of Interview**	**Interview Method via**
Hassayampa Landfill Maricopa County, AZ		AZD980735666			Phone ☐ Fax/email ☐ In person ☐
Interview Contacts	**Organization**	**Phone**	**Email**	**Address**	
Martin Zeleznik	US EPA, Region 9	(415) 972-3543	zeleznik.martin@epa.gov	75 Hawthorne Street San Francisco, CA 94105	
Mike Cavaliere	CH2M HILL/SFO, as rep of EPA	(510) 587-7753	mcavalie@ch2m.com	155 Grand Ave, Suite 1000 Oakland, CA 94612	

Interview Questions

1. **What is your current role as it relates to the site? What is your overall impression of the work conducted at the site to date? (general sentiment)**

Response: 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, down-gradient 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. The HSC has recently re-started a portion of the SVE system to control, at a minimum, VOCs in the vadose zone soil gas.

2. **Have any problems been encountered which required, or will require changes to this remedial design or ROD?**

Response: There are no changes to the remedial design or the Record of Decision (ROD) contemplated at this time. Changes in Site conditions have caused the HSC, with EPA's approval, to reverse a previous decision to cease operation of the soil vapor recovery (SVE) system. In March 2006, a portion of the inactive SVE system was placed back into operation.

3. What does the monitoring data show? Are there any trends that show contaminant levels are decreasing? Have any new or emerging COCs been identified? If so, have they impacted the effectiveness of the remedy?

Response:

Since 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 has indicated an upward trend in soil gas VOC concentrations in the vicinity of the Pit 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 is expected to adequately control VOCs in the vadose zone soil gas and, possibly, reduce VOC concentrations in ground water.

The monitoring data indicates that the concentrations of VOCs in ground water within the upper aquifer (Unit A) located just beneath the basalt layer have been trending upward in a number of monitoring and ground water recovery wells within the capture zone of the ground water pump and treat system; VOC concentrations at the monitoring points down-gradient of the capture zone of the ground water pump and treat system have remained relatively constant. These increasing data tends in the Unit A aquifer are believed to be, primarily, a function of the increased VOC concentrations in the overlying vadose zone. Therefore, the HSC's resumption of SVE operations should also serve to correct these trends.

The monitoring data indicates that the ground water quality of the lower aquifer (Unit B) located just beneath the basalt layer and below Unit A has been and remains unaffected by site-related constituents both within the capture zone of the ground water pump and treat system and at all monitoring points down-gradient of the capture zone of the ground water pump and treat system. To date, VOCs have not been detected in ground water samples collected from the lower (Unit B) aquifer.

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

4. Have there been routine communications or activities (site visits, inspections, reporting activities, etc) conducted by your office regarding the site? If so please give purpose and results.

Response:

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 insure that routine site inspections are performed, routine and non-routine maintenance items are preformed, the Site is maintained in an operational status; and the routine quarterly and annual reports are filed with both EPA and ADEQ. I frequently visit the site personally to oversee operational and investigative work. I frequently meet with EPA and ADEQ personnel to provide updates of on-going work at the Site, review plans for upcoming work and to review and discuss the results of every sampling event.

The HSC's contractors conduct: monthly site inspections in addition to responding to any alarm conditions from the ground water pump & treat system and now the restarted SVE

system; quarterly ground water 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 quarterly reports or separate incident reports, as needed.

We have been meeting with EPA and ADEQ personnel via face-to-face meetings and conference calls on a monthly basis or more frequently. Two of the HSC's contractors and I provided logistical and technical support to and participated in EPA's 5-Year Review Open House public meeting in Buckeye, Arizona on January 11, 2006.

The HSC has worked in concert with EPA to develop and obtain approval of a detailed work plan for evaluating the conceptual model for the Hassayampa Site and to conduct a baro-pneumatic test of the site scale vertical air permeability of the basalt layer beneath the Hassayampa Site. The development, approval and implementation of these work efforts have resulted in frequent meetings and Site visits with EPA and ADEQ personnel. The results of all of this work, both completed and on-going have been provided to EPA in routine and special reports; including frequent telephone, and electronic mail (e-mail) communication.

5. Would you say that O&M and/or sampling efforts have been optimized? Please describe how improved efficiency has or has not occurred.

Response:

Two years ago the HSC changed O&M contractors. The new contractor has worked diligently to optimize the ground water pump and treat system. As a result, the efficiency and up-time of the ground water 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 the maximize, to the extent practical, applicability of efficacy of alternate ground water sample acquisition techniques, such as passive diffusion bags. As a result sampling efficiency and, therefore, cost efficiencies to obtain ground water samples have improved. The HSC believes that over time this will result in more consistent ground water data.

On the vapor side, the HSC has re-started portions of the inactive SVE system. This re-start included a kick-off field visit with EPA and ADEQ personnel to literally "flip the switch." The new system is using select wells from the prior SVE system, to focus the remediation where it is needed most, and is using a significantly more effective off-gas treatment system. The new system, a condensate/compression unit, has significantly better uptime than the previous off-gas treatment system (thermal adsorption) and is removing larger quantities of residual mass.

6. Are you aware of any institutional controls, site access controls, new ordinances in place, changes in actual or projected land use, complaints being filed or unusual activities at the site? If so, please describe in detail.

Response:

I am not aware of any changes in Site-related institutional controls, site access controls, new ordinances in place, complaints being filed or any unusual activities at the Site. There have not been any changes in actual or projected land use on the Hassayampa site. Signs have been erected on the Hickman Egg Ranch property, to the west of the Hassayampa Site, indicating that additional egg production facilities may be constructed on a previously undeveloped parcel of land owned by the Hickman Egg Ranch. This prospective change in land use of property well west of the Hassayampa Site will not be threatened by remedial operations at the Hassayampa Site and is expected to have no impact on the operation and maintenance activities at the Hassayampa Site. Mr. Glen Hickman attended the 5-Year Review Open House in Buckeye, Arizona and spoke with EPA and ADEQ representatives to discuss the planned expansion of the Hickman Egg Ranch.

7. Do you have any comments, suggestions, or recommendations regarding the site?

Response: No. The project appears to be on track with the remedy proceeding as anticipated.

Five-Year Review Interview Record			Interviewee: Hugh Rieck		
Site Name		**EPA ID No.**		**Date of Interview**	**Interview Method via**
Hassayampa Landfill Maricopa County, AZ		AZD980735666		31 May 2006	Phone ☐ Fax/email ☐ In person ☐
Interview Contacts	**Organization**	**Phone**	**Email**	**Address**	
Martin Zeleznik	US EPA, Region 9	(415) 972-3543	zeleznik.martin@epa.gov	75 Hawthorne Street San Francisco, CA 94105	
Mike Cavaliere	CH2M HILL/SFO, as rep of EPA	(510) 587-7753	mcavalie@ch2m.com	155 Grand Ave, Suite 1000 Oakland, CA 94612	

Interview Questions

1. **What is your current role as it relates to the site? What is your overall impression of the work conducted at the site to date? (general sentiment)**

Response: I am a former Arizona Department of Environmental Quality hydrologist / geologist and was responsible for technical review of site monitoring data and reports, and provided technical support to ADEQ project management from May 2001 through March 2006. I am currently a geologist with the US Army Corps of Engineers, Hazardous Toxic and Radioactive Waste Center of Expertise in Omaha, NE.

Some aspects of basic investigation conducted at the site through about 1998 were sound. However, the site was incompletely characterized. Significant data gaps, particularly regarding 1) the likely mass and distribution of VOC contaminants in the subsurface, and 2) the geologic properties of the subsurface materials controlling contaminant migration, remained at the end of the RI. These data gaps were ignored or dismissed as irrelevant. Refusals to obtain critical data allowed a specious conceptual site model to be perpetuated. Aside from a period of problematic SVE in the late 1990s, no meaningful source remediation was attempted at the site until March 2006. Historical monitoring was incomplete. Implementation of the remedial actions stipulated in the ROD was inadequate. Acknowledgment of the deteriorating site conditions by late 2004, and recognition of the long term failure of the remedy implementation and the clear prospect of indefinite and increasing future expenses, resulted in new consultants taking over the work. The acknowledgment of previous shortcomings and the new technical perspective is the first step in moving the site toward successful long term management and remediation.

2. Have any problems been encountered which required, or will require changes to this remedial design or ROD?

Response: The cornerstone components of the selected remedy of for the site, SVE and groundwater containment remain sound. However, the degree and extent of VOC contamination and the difficulty of containment was not understood at the time of the ROD. Groundwater performance standards of the ROD (MCLs at all points within the aquifer) are unachievable at this site. Realistic groundwater cleanup goals should be defined.

The existing soil vapor performance standards, developed to be protective of groundwater, were based on inappropriate modeling studies and the clearly flawed previous conceptual site model. New soil vapor performance standards should be developed. Performance measures should include not only soil vapor concentrations at the water table, but also be linked to the demonstrated effect on groundwater contaminant concentrations. The recognition that the highest VOC concentrations in the main source area occur beneath the basalt layer may require expansion of the remedial design of the SVE system.

The SVE treatment technology specified in the ROD has never been implemented. At a minimum, an ESD should be provided to address the issue.

3. What does the monitoring data show? Are there any trends that show contaminant levels are decreasing? Have any new or emerging COCs been identified? If so, have they impacted the effectiveness of the remedy?

Response: As of March 2006, monitoring data continued to show increasing VOC contaminant concentrations in all sampled media. Vapor phase contaminants are laterally more extensive than ever, and vapor concentrations at the water table beneath the source area (never sampled before 2006) are the highest reported from any location at the site. Groundwater VOC concentrations continue to increase at an accelerating rate.

4. Have there been routine communications or activities (site visits, inspections, reporting activities, etc) conducted by your office regarding the site? If so please give purpose and results.

Response: Since 2001, ADEQ has provided numerous technical reviews, site visits, and repeated written and verbal recommendations and requests for additional investigations to the EPA to fill data gaps, resolve technical issues, and move the site toward meaningful remediation. By late 2004, it could no longer be denied that contamination was spreading at an accelerating rate, implementation of the remedy had failed to meet objectives, and that no long term exit strategy existed. In 2006, some of the ADEQ suggestions were being implemented (*e.g.* resuming SVE, investigating contaminant distribution below the basalt, *etc.*)

5. Would you say that O&M and/or sampling efforts have been optimized? Please

describe how improved efficiency has or has not occurred.

Response: No. Operations and Maintenance continue to change as new characterization and monitoring data from new wells and sampling methods are acquired. Significant modifications to the SVE well configuration are likely to be required to remediate soil and groundwater beneath the basalt layer. The current groundwater containment well network may need to be expanded. Additional data and analysis are still required to re-design a final remedy. Whether or not contaminant migration and adequate mass reduction can be achieved using only the current infrastructure is uncertain.

6. Are you aware of any institutional controls, site access controls, new ordinances in place, changes in actual or projected land use, complaints being filed or unusual activities at the site? If so, please describe in detail.

Response: Changes in projected land use upgradient of the site over the next decade can be expected to make long term containment of VOC contamination in site groundwater much more difficult. Construction has begun on very large housing developments in the Hassayampa River valley upgradient of the site. Regional groundwater is planned as the primary source of water for these communities and regional water levels can be expected to drop as a result of large scale pumping. The regional "unit B" water bearing zone is locally confined beneath the contaminated sediments of the "unit A" zone at the site. A drop of only 5 to 10 feet in the potentiometric level of the unit B zone beneath the site will cause the contaminated groundwater of the "unit A" zone to become perched. The greatly increased downward hydraulic gradient is very likely to cause a loss of vertical containment of contaminants at the site. Without a new multi-well groundwater extraction and containment system in the unit B aquifer, contaminants may begin moving rapidly off site in the regional aquifer. Lowered potentiometric level of the unit B aquifer is likely to present significantly more costly and difficult site management problems.

7. Do you have any comments, suggestions, or recommendations regarding the site?
Response:

Without more aggressive remedial action, such as thermal desorption or *in situ* chemical oxidation, the site will require groundwater containment and SVE for long time. The level of active containment may be able to be reduced as the release of VOC contaminants becomes more of a diffusion limited rate.

Performance monitoring and site progress should continue to be carefully reviewed.

Five-Year Review Interview Record			Interviewee: Frank Corkhill – ADWR Hydrology Division	
Site Name		**EPA ID No.**	**Date of Interview**	**Interview Method via**
Hassayampa Landfill Maricopa County, AZ		AZD980735666	5/1/06	Phone ☐ Fax/email x☐ In person ☐
Interview Contacts	**Organization**	**Phone**	**Email**	**Address**
Martin Zeleznik	US EPA, Region 9	(415) 972-3543	zeleznik.martin@epa.gov	75 Hawthorne Street San Francisco, CA 94105
Mike Cavaliere	CH2M HILL/SFO, as rep of EPA	(510) 587-7753	mcavalie@ch2m.com	155 Grand Ave, Suite 1000 Oakland, CA 94612

Interview Questions

1. **What is your current role at the Department of Water Resources as it relates to the activities near the site?**

Response: I am the supervisor of the Hydrology Division Technical Support Section which includes the WQARF, Groundwater modeling, and GIS sections. The WQARF unit reviews well permit applications for construction methods to prevent vertical cross-contamination and also reviews well permit applications that require well impact analysis for well interference and water quality concerns. The groundwater modeling unit has been working closely with the Department's Water Management Division and Assured Water Supply section with regard to development and review of some Assured Water Supply applications and hydrologic models in the Hassayampa basin area.

2. **Have there been routine activities (permits, inquiries, review of residential and**

industrial development plans) conducted by your office in the area near site? If so please give a summary of activities.

Response: Yes the Department has received several dozen AWS certificate or physical availability study applications in the Hassayampa sub-basin over the last two to four years. Likewise the Department has processed a growing number of well permit applications in the area last several years in the area. The Town of Buckeye has greatly expanded its city limits and municipal water provider area to the north and east of the landfill over the last few years. There are numerous developments planned within 5 miles of the landfill.

3. **Are you aware of any institutional controls, new ordinances in place, changes in actual or projected land use, complaints being filed or unusual activities near the site being implemented or proposed? If so, please describe.**

Response: As indicated above, major new development is planned for almost all areas of the Hassayampa sub-basin, from the Morristown area to the north to the Arlington area to the south. Future growth may bring some new ordinances from the Town of Buckeye on water reuse, and all state statutes and rules regarding well permitting, groundwater recharge and assured water supply also apply.

4. **Have any problems been encountered or anticipated with the changes in the water table which may affect the area near the site?**

Response: A consultant for a group of major developers in the area is working on a groundwater model of the Hassayampa sub-basin that will be used to simulate future planned growth in the area. Based on the projected increase in population, which is projected to be 500,000 people or more in the Hassayampa sub-basin within the next 30 years, there will be a major increase in groundwater demand and anticipated lowering of water tables over the regional area (that will likely include the area of the landfill).

5. **Would you say that projected demands on the aquifers in the area will increase in the future in a normal or accelerated rate? Please describe how the demands in the last five years will compare to those expected in the next five years?**

Response: Groundwater demands will be accelerated. Projected demands may almost triple current water use in the sub-basin area over thw next 20 to 30 years. Approved and pending requests for additional groundwater water supplies to support new developments in the area are in the 200,000 AF/year range. The next 5 years will see increased demands; however the long-term development plans call for phased in growth over about a thirty year period.

6. Do you have any comments or expectations for the potential changes in the water table that may affect the groundwater treatment operations at the site?

Response: I would expect water levels to drop in the area of the site due to the planned new development. At this time I have no idea how much things may change, however the previously mentioned groundwater modeling of the area should be available in the near future and provide new insight into the potential range of decline. Based on my limited knowledge of the landfill treatment operation I would anticipate that such a lowering could potentially effect the clean up and containment, as I recall there was concern expressed a few years ago by the landfill's consultant about the potential effects of a new well that was permitted at the Hickman Egg ranch just a little to the southwest of the landfill. It seems likely that the cumulative impacts of all the new development in the area could eventually effect groundwater levels and flow directions far more than the Hickman well. Whether this would create a problem for the containment and treatment operation now used at the landfill, I do not know.

Appendix E
Institution Controls Review

Hassayampa Landfill Superfund Site 5-Year Review

Institutional Controls Evaluation

PREPARED FOR: Martin Zeleznik

United States Environmental Protection Agency (USEPA), Region IX

PREPARED BY: CH2M HILL

DATE: June 22, 2006

PROJECT NUMBER : 341212

Institutional controls are non-engineering instruments such as administrative and/or legal controls that minimize the potential for human exposure to contamination by limiting land or resource use. This technical memorandum summarizes the results of an evaluation of institutional controls for the Hassayampa Landfill Superfund Site (the Site) located in Maricopa County, Arizona.

A Record of Decision (ROD) was issued for the Site in July 1992. (USEPA 1992) The remedy was separated into a groundwater component and a vadose zone component. Institutional Controls (ICs) of access and deed restrictions were included as part of the vadose zone remedy. It should be noted that actual access controls such as fences and signage are considered physical controls and should be categorized as engineering controls. Therefore, the only true ICs from the ROD are the deed restrictions.

The ROD provided that "Long-term deed restrictions will also be imposed, thereby restricting future use of the Site. These restrictions will include … use limitations (restricting future use of the Site and restricting use of groundwater beneath the Site)."

In addition, a Consent Decree Case No. 94-1821, signed in 1994 by the Hassayampa Steering Committee, required that the owner of the property place a copy of the decree on file with the Maricopa County Recorder's Office and required that the owner record a notice of obligation to provide access to EPA. (USEPA 2000)

This is the second five-year review for the Site since the ROD was issued in 1992. The first five-year review, completed in November 2000, did not identify deficiencies in the implementation of the remedy's IC component. As part of this five year review, a preliminary title report was obtained for the Site. The preliminary title report identifies the site as Assessor's Parcel Number 401-30-004B. The title report, included as Attachment 1, shows that the consent decree was recorded as required.

The title report also shows that a restrictive covenant was recorded for the Hassayampa Landfill, which encompasses the Site, in 1994. The restrictive covenant was recorded pursuant to A.R.S. 49-771, which requires the recording of a restrictive covenant for solid waste landfills before they can be allowed to operate. The covenant prohibits the filling, grading, excavating, drilling or mining of the property covered by the covenant without the

approval of the Arizona Department of Environmental Quality. Because the property covered by the covenant includes the Site, the covenant prohibits such uses of the Site as well and is functioning as an institutional control for the Site.

The title report is included as Attachment 1. A copy of the restrictive covenant is included as Attachment 2. Also attached is a parcel map, Attachment 3.

Deficiencies and Recommendations

The 1994 recordation of a restrictive covenant for the Hassayampa Landfill imposes an effective use restriction for the Site. Because the Site is owned by Maricopa County and transfer is unlikely, the existing restrictive covenant is protective. An inspection of the site was made on March 26, 2006 and no obvious violations of the institutional controls described in the ROD were observed. Before the next five-year review, EPA will consider whether execution and recordation of a Declaration of Environmental Use Restriction under Arizona Revised Statutes Section 49-152 would increase protectiveness of the existing ICs.

References

United States Environmental Protection Agency (USEPA) 2000. Draft Final *Five-Year Review Report for Hassayampa Landfill Superfund Site*.November, 2000.

United States Environmental Protection Agency (USEPA). 1992. *EPA Superfund Record of Decision for Hassayampa Landfill Superfund Site.*

Attachment 1
Preliminary Title Report

No. 4708428

SPECIAL REPORT

SCHEDULE A

1. This report is for informational purposes only and is not to be considered as a commitment to issue any form of Title Insurance Policy. This report is for the sole use and benefit of the parties set forth in Number 2 below and liability is hereby limited to the amount of the fee paid.

   This report was prepared from only those items of public record shown in the title plant indices of the issuing company to show the condition of title as reflected by same. Those items to which the hereinafter described land is subject are set forth in Schedule B, Part Two. No attempt has been made to reflect the condition of title relating to the items set forth in Schedule B, Part One.

2. For the use and benefit of:

   CH2MHILL

3. The Title to the fee estate in the land described herein is at this date hereof vested in:

   Maricopa County, a political subdivision of the State of Arizona

4. The land referred to in this report is situated in Maricopa County, Arizona, and is described as:

SEE EXHIBIT "A" ATTACHED HEREIN

Search made to June 6, 2006 at 7:30 A.M.

FIRST AMERICAN TITLE INSURANCE COMPANY

By: Kenneth Smith/dmf/ssl (602)685-7672

EXHIBIT "A"

THAT PORTION OF THE SOUTH ONE-HALF OF SECTION 3, TOWNSHIP 1 SOUTH, RANGE 5 WEST, GILA AND SALT RIVER BASE AND MERIDIAN, MARICOPA COUNTY, ARIZONA, LYING NORTHERLY OF THE HASSAYAMPA-SALOME HIGHWAY.

SCHEDULE B

PART ONE:

1. Taxes or assessments which are not shown as existing liens by the records of any taxing authority that levies taxes or assessments on real property or by the public records.

   Proceedings by a public agency which may result in taxes or assessments, or notices of such proceedings, whether or not shown by the records of such agency or by the public records.

2. Any facts, rights, interests or claims which are not shown by the public records but which could be ascertained by an inspection of the land or by making inquiry of persons in possession thereof.

3. Easements, liens, or encumbrances, or claims thereof, which are not shown by the public records.

4. Discrepancies, conflicts in boundary lines, shortage in area, encroachments, or any other facts which a correct survey would disclose, and which are not shown by the public records.

5. (a) Unpatented mining claims; (b) reservations or exceptions in patents or in Acts authorizing the issuance thereof; (c) water rights, claims or title to water; whether or not the aforementioned matters excepted are shown by the public records.

6. Any lien, or right to a lien, for services, labor or material heretofore or hereafter furnished, imposed by law and not shown by the public records.

7. Lack of a right of access to and from the land.

SCHEDULE B

(All recording data refers to records in the office of the County Recorder in the County in which the land is situated.)

EXCEPTIONS:

1. NOTE: The subject property is currently assessed as "tax exempt". Upon conveyance, the subject property may lose its "tax exempt" status.

2. Conditions subsequent set forth in instrument recorded November 7, 1963 in Docket 4800, Page 312.

3. Right of re-entry in favor of the United States of America, as set forth in instrument recorded November 7, 1963 in Docket 4800, Page 312.

4. Right of Way for highway purposes, recorded in Docket 4878, Page 180.

5. All matters as set forth in Agreement, recorded July 19, 1973 as Docket 10230, Page 936.

6. All matters as set forth in Agreement, recorded October 18, 1973 as Docket 10359, Page 1149.

7. An easement for pipeline and incidental purposes, recorded in Docket 14992, Page 4, which instrument was assigned as 1990-085360 of Official Records.

8. An easement for electric lines and incidental purposes, recorded as 1993-0711635 of Official Records.

9. Covenant running with the land recorded as 1994-0696822 of Official Records.

10. All matters set forth in that certain Consent Decree, being United States District Court Case No. 94-1821 regarding the Hassayampa Landfill, recorded January 4, 1995 as 1995-0003649 of Official Records.

11. All matters as set forth in Notice of Obligation to Provide Access, recorded January 17, 1995 as 1995-0026178 of Official Records.

12. The interest of any and all party defendants recited in Consent Decree, being United States District Court Case No. 94-1821 regarding the Hassayampa Landfill, recorded January 4, 1995 as 1995-0003649 of Official Records.

End of Schedule B

The First American Corporation

PRIVACY POLICY

We Are Committed to Safeguarding Customer Information

In order to better serve your needs now and in the future, we may ask you to provide us with certain information. We understand that you may be concerned about what we will do with such information - particularly any personal or financial information. We agree that you have a right to know how we will utilize the personal information you provide to us. Therefore, together with our parent company, The First American Corporation, we have adopted this Privacy Policy to govern the use and handling of your personal information.

Applicability

This Privacy Policy governs our use of the information which you provide to us. It does not govern the manner in which we may use information we have obtained from any other source, such as information obtained from public records or from another person or entity. First American has also adopted broader guidelines that govern our use of personal information regardless of its source. First American calls these guidelines its *Fair Information Values*, a copy of which can be found on our web site at www.firstam.com.

Types of Information

Depending upon which of our services you are utilizing, the types of nonpublic personal information that we may collect include:

- Information we receive from you on applications, forms and in other communications to us, whether in writing, in person, by telephone or any other means;
- Information about your transactions with us, our affiliated companies, or others; and
- Information we receive from a consumer reporting agency.

Use of Information

We request information from you for our own legitimate business purposes and not for the benefit of any nonaffiliated party. Therefore, we will not release your information to nonaffiliated parties except: (1) as necessary for us to provide the product or service you have requested of us; or (2) as permitted by law. We may, however, store such information indefinitely, including the period after which any customer relationship has ceased. Such information may be used for any internal purpose, such as quality control efforts or customer analysis. We may also provide all of the types of nonpublic personal information listed above to one or more of our affiliated companies. Such affiliated companies include financial services providers, such as title insurers, property and casualty insurers, and trust and investment advisory companies, or companies involved in real estate services, such as appraisal companies, home warranty companies, and escrow companies. Furthermore, we may also provide all information we collect, as described above, to companies that perform marketing services on our behalf, on behalf of our affiliated companies, or to other financial institutions with whom we or our affiliated companies have joint marketing agreements.

Former Customers

Even if you are no longer our customer, our Privacy Policy will continue to apply.

Confidentiality and Security

We will use our best efforts to ensure that no unauthorized parties have access to any of your information. We restrict access to nonpublic personal information about you to those individuals and entities who need to know that information to provide products and services to you. We will use our best efforts to train and oversee our employees and agents to ensure that your information will be handled responsibly and in accordance with this Privacy Policy and First American's *Fair Information Values*. We currently maintain physical, electronic, and procedural safeguards that comply with federal regulations to guard your nonpublic personal information.

Attachment 2
Deed Restriction

RECORDED AT THE REQUEST OF:
Maricopa County Board of Supervisors

WHEN RECORDED RETURN TO:
Maricopa County Solid Waste
Management Department

RESTRICTIVE COVENANT

Hassayampa Landfill

Maricopa County, the undersigned owner of the real property described on Exhibit "A" attached hereto and by this reference incorporated herein (the "Property"), hereby acknowledges that the Property has been and will be used as a solid waste landfill. Pursuant to A.R.S. 49-771, the County hereby covenants and agrees that its agents, employees, heirs, successors, lessees, executors, administrators or assigns, will not engage in filling, grading, excavating, drilling or mining the property during the operating life of the solid waste landfill, or after its closure, without the approval of the Director of the Arizona Department of Environmental Quality, or any successor official or agency as provided by law, unless provided for in the approved facility closure or post closure plan.

This agreement constitutes a mutual covenant running with the land and all successors in interest, heirs, lessees, executors, administrators or assigns shall be deemed parties to this agreement to the same effect as the original signers, and all subsequent deeds or other instruments conveying any title to the Property or any portion thereof shall be made expressly subject to this restrictive covenant; provided, however, that this agreement shall automatically terminate if A.R.S. 49-771 is revoked or revised in such a manner as to eliminate the restrictive covenant requirement.

IN WITNESS WHEREOF, each party to this agreement has caused it to be executed on the dates indicated below.

Dated this 10th day of August, 1994

ACCEPTED:
MARICOPA COUNTY BOARD OF SUPERVISORS

By _____
Chairman of the Board

Date 8/10/94

_____
John E. Stufflebean, P.E.
Director

ATTEST:

_____
Clerk of the Board of Supervisors

(Arizona Department of Environmental Quality Acceptance on reverse side)

The foregoing restrictive covenant is accepted this 19th day of September, 1993.

Edward Z. Fox, Director
Arizona Department of Environmental Quality

STATE OF ARIZONA)
)ss.
COUNTY OF MARICOPA)

The foregoing instrument was acknowledged before me this 19th day of September, 19 93 by Edward Z. Fox, Director, Arizona Department of Environmental Quality.

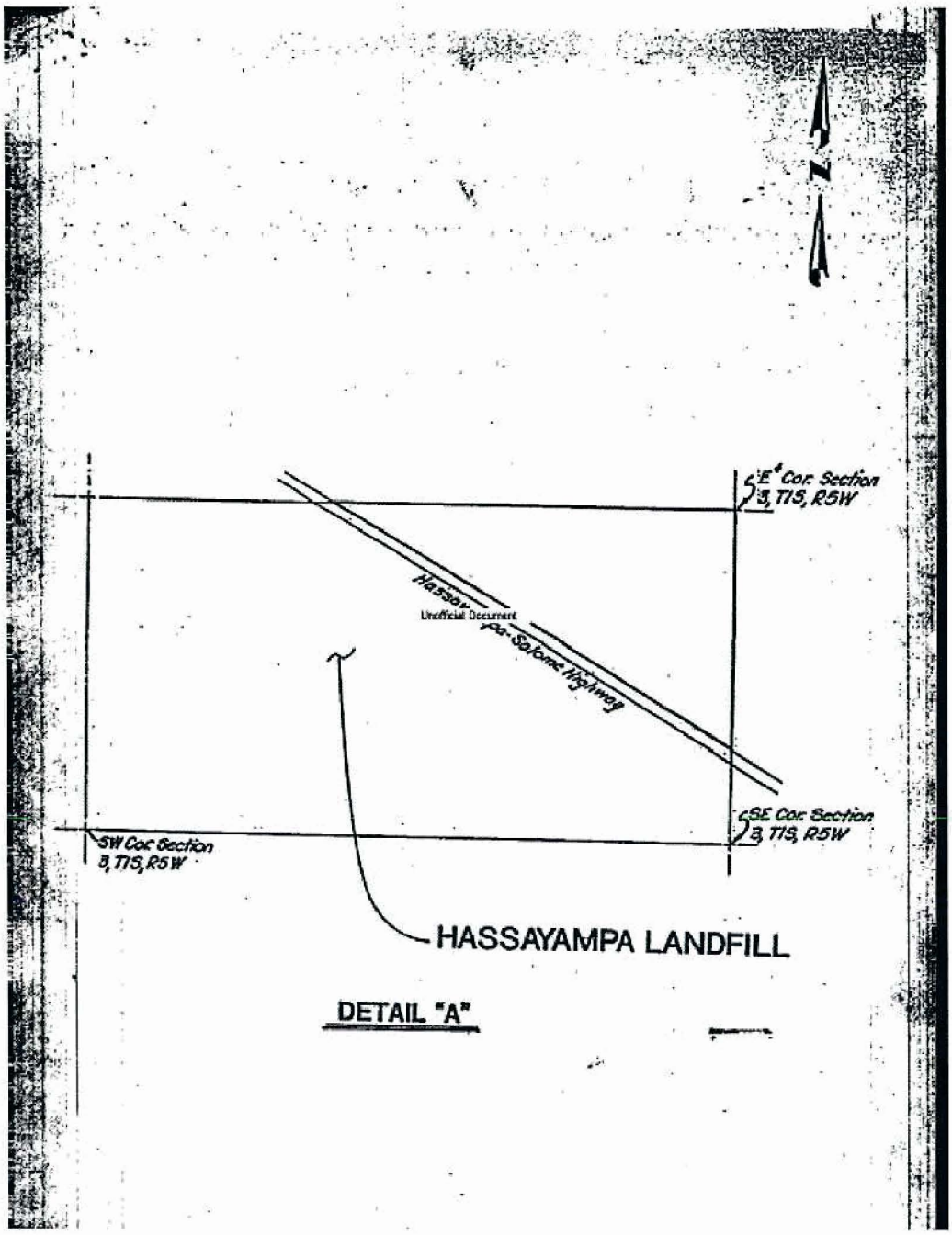
My Commission Expires April 19, 1996

Notary Public (signature)

HASSAYAMPA LANDFILL
LEGAL DESCRIPTION

EXHIBIT "A"

That portion of the South one-half (S1/2) of Section Three (3), Township One (1) South, Range Five (5) West of the Gila and Salt River Base and Meridian, Maricopa County, Arizona, lying Northerly of the Hassayampa Salome Highway.


N
SE Cor. Section 3, T1S, R5W
Hassayampa-Salome Highway
Unofficial Document
SW Cor. Section 3, T1S, R5W
HASSAYAMPA LANDFILL

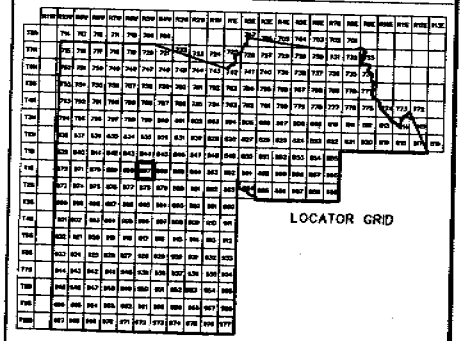
DETAIL "A"

Attachment 3
Parcel Map

MARICOPA COUNTY
OFFICIAL PARCEL MAP
STATE OF ARIZONA

SECTION 03 T01S R05W

MAP ID = 867 - 03 - 00 - 00
(PARCEL MAP NUMBER · SECTION NUMBER · TOWNSHIP NUMBER · TOWNSHIP ALPHA)

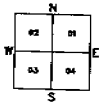


LOCATOR GRID

SECTION

06	05	04	03	02	01
07	08	09	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

1/4 SECTION



1/4 1/4 SECTION

ASSESSOR BOOKS & MAPS WITHIN THIS AREA
BOOK 401 MAP 30

SUBDIVISIONS

SCALE: 1" = 400'

Maricopa County Assessor G.I.S.

MAP GENERATION DATE: 4-28-2005

MARICOPA COUNTY ASSESSOR'S OFFICE
301 W. JEFFERSON ST.
PHOENIX, AZ 85003
www.maricopa.gov/assessor

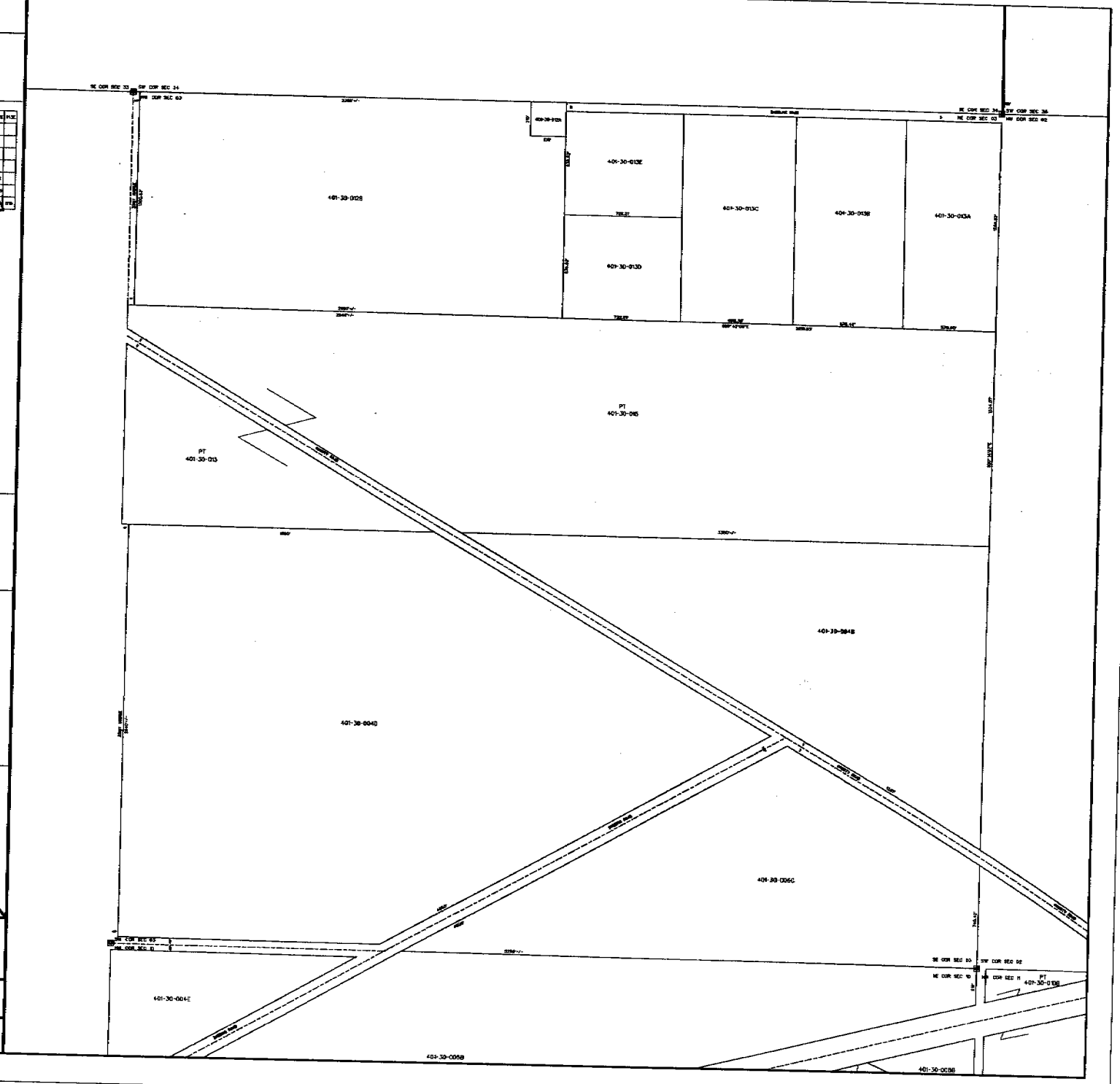
LEGEND:

- Subdivision Boundary Line
- Subdivision Boundary Corner
- Street Centerline
- Street Centerline Marker
- Section Corner Marker
- Indicates change in original boundary
- Parcel Boundary Line
- Parcel Split Line
- 123-45-678A Parcel Number
- Parcel Boundary Tie-In

REVISION INFORMATION IS LOCATED ON A SEPARATE DOCUMENT

Disclaimer - Indemnification

Requestor/Purchaser understands and agrees that Maricopa County does not guarantee the accuracy of the data and information requested and hereby expressly disclaims any responsibility for the truth, and all errors, validity, liability, accuracy, inadequacy or any such data and information. The parcel lines on maps are for illustration purposes only and are not intended to be used as a survey product.



Appendix F
ARARs Review

Hassayampa Landfill Superfund Site 5-Year Review

Applicable or Relevant and Appropriate Requirements (ARARs) Evaluation

PREPARED FOR: Martin Zeleznik
United States Environmental Protection Agency, Region IX

PREPARED BY: CH2M HILL

DATE: August 2, 2006

PROJECT NUMBER: 341212

This technical memorandum presents an evaluation of the Applicable or Relevant and Appropriate Requirements (ARARs) at the Hassayampa Landfill Superfund Site (site).

Purpose of ARARs Review

The purpose of an ARARs review is to determine whether laws, regulations, or guidance promulgated since approval of site decision documents alter the remedy's protectiveness of human health and the environment.

ARARs are established in the site decision documents: Record of Decisions (RODs). Changes to ARARs, where necessary, can be memorialized in ROD Amendments or Explanation of Significant Differences (ESDs).

The preamble to the National Contingency Plan (NCP) states that remedy selection decisions are not to be reopened unless new or modified requirements call into question the protectiveness of the selected remedy (55 CFR 8757, March 8, 1990). This is interpreted to mean generally that ARARs are frozen at the time of remedy approval, unless updated by additional decision documents.

ARARs Background

Section 121(d) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires that remedial actions implemented at CERCLA sites are carried out in compliance with any Federal or more stringent State environmental standards, requirements, criteria, or limitations that are determined to be ARARs.

CERCLA response actions are exempted by law from the requirement to obtain Federal, State or local permits related to any activities conducted completely on-site. However, this does not remove the requirement to meet the substantive provisions of permitting regulations that are ARARs.

Applicable. Applicable requirements are cleanup standards, criteria, or limitations promulgated under federal or state law that specifically address the situation at a CERCLA site. A requirement is applicable if the jurisdictional prerequisites of the environmental

standard show a direct correspondence when objectively compared with the conditions at the site.

Relevant and appropriate. If a requirement is not legally applicable, the requirement is evaluated to determine whether it is relevant and appropriate. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not applicable, address problems or situations sufficiently similar to the circumstances of the proposed response action and are well suited to the conditions of the site. The criteria for determining relevance and appropriateness are listed in 40 CFR 300.400(g) (2).

To be considered (TBC). TBC criteria are requirements that may not meet the definition of an ARAR, but still may be useful in determining whether to take action at a site or to what degree action is necessary. TBC criteria, as defined in 40 CFR 300.400(g) (3), are non-promulgated advisories or guidance issued by federal or state government that are not legally binding but may provide useful information or recommended procedures for remedial action. Although TBC criteria do not have the status of ARARs, they are considered together with ARARs to establish the required level of cleanup for protection of human health and the environment.

Pursuant to USEPA guidance, ARARs generally are classified into three categories: chemical-specific, location-specific, and action-specific requirements. These categories of ARARs are identified below:

- **Action-specific ARARs** are requirements that apply to specific actions that may be associated with site remediation. Action-specific ARARs often define acceptable handling, treatment, and disposal procedures for hazardous substances. These requirements are triggered by the particular remedial activities that are selected to accomplish a remedy. Examples of action-specific ARARs include requirements applicable to landfill closure, wastewater discharge, hazardous waste disposal, and emissions of air pollutants.

- **Chemical-specific ARARs** include those laws and regulations that regulate the release to the environment of materials possessing certain chemical or physical characteristics or containing specified chemical compounds. These requirements generally set health- or risk-based concentration limits or discharge limits for specific hazardous substances.

- **Location-specific ARARs** are those requirements that relate to the geographical or physical location of the site, rather than the nature of the contaminants or the proposed site remedial actions. These requirements may limit the placement of remedial action, and may impose additional constraints on the cleanup action. For example, location-specific ARARs may refer to activities in the vicinity of wetlands, floodplains, endangered species habitat, and areas of historical or cultural significance.

Hassayampa Landfill Background

The Hassayampa Landfill Superfund Site (site) is located approximately 40 miles west of Phoenix and approximately eight miles west of Buckeye, in Maricopa County, Arizona. The Superfund site is a 10-acre portion of a 77-acre property owned by Maricopa County. The

County began operating Hassayampa Landfill as a municipal landfill beginning in 1961. During an 18 month period from April 20, 1979 to October 28, 1980, hazardous wastes were disposed in unlined pits in a 10-acre area in the northeast section of the landfill. A wide range of hazardous wastes were disposed at this 10-acre portion of the Hassayampa Landfill, including up to 3.28 million gallons of liquid wastes and 4,150 tons of solid wastes. The landfill pits were covered with native soil and restored to grade at the end of the 18-month period. Disposal to the municipal landfill ceased in June, 1997.

The site was placed on the National Priorities List (NPL) July 22, 1987, and the United States Environmental Protection Agency (USEPA) assumed lead agency status. Groundwater and vadose zone contaminated by hazardous substances are the primary concerns at the site. Drinking water and irrigation water is extracted from private wells within 3 miles of the site.

The USEPA determined that remedial actions were necessary in the following site decision document:

- Record of Decision (ROD), issued August 6, 1992

The selected remedy for the Hassayampa Landfill site includes remediation of groundwater and vadose zone (including soil and soil vapor above the water table) contamination:

- Extract contaminated groundwater
- Treat the water using air stripping technology (vapor phase carbon adsorption will be performed as necessary to meet Federal, State, and County regulations pertaining to air emissions).
- Re-inject the treated water.
- Continued groundwater monitoring to measure the effectiveness of the remedy.
- Cap the 10-acre Hazardous Waste Area of the landfill using a cap that complies with the substantive capping and maintenance requirements for Resource Conservation and Recovery Act (RCRA) Interim Status facilities as described in 40 CFR Parts 265.310 and 265.117, and as described in the "EPA Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments."
- Perform soil vapor extraction at all locations at the site where soil vapor levels exceed cleanup standards.
- Treat soil vapor using vapor phase carbon adsorption or catalytic oxidation technology.
- Implement access and deed restrictions.

The following chemicals of concern (COCs) at the site were identified in the ROD and are listed on the EPA Superfund Web site (http://cfpub.epa.gov/supercpad/cursites/ccontinfo.cfm?id=0900677).

- 1,1,1-trichloroethane
- 1,1-dichloroethane
- 1,1-dichloroethene
- 1,2-dichlorobenzene
- 1,2-dichloropropane
- 1,4-dichlorobenzene
- cis-1,2-dichloroethene
- trans-1,2-dichloroethene
- chlorinated fluorocarbon (Freon 113)
- chromium
- copper
- dichloromethane
- lead, inorganic
- perchloroethylene
- toluene
- trichloroethene
- trichlorofluoromethane (Freon 11)
- vinyl chloride
- xylene

The ROD identified Maximum Contaminant Levels (MCLs) in drinking water as groundwater cleanup standards for the site.

Hassayampa Landfill Site ARARs Review

The following three tables list the ARARs established in the above-referenced decision documents, summarize the requirement for each ARAR, cite the regulatory basis for each ARAR, state the evaluated status of each ARAR, and comment on regulatory changes for each ARAR where applicable.

Table 1 contains action–specific ARARs, Table 2 contains chemical–specific ARARs, and Table 3 contains location-specific ARARs. The tables provide the applicable requirements and citation for each established ARAR; and describe whether any updates have occurred for each ARAR since the previous 5-Year Review. Current versions of the Arizona Administrative Code (AAC), the Arizona Revised Statutes (ARS), and the Code of Federal Regulations (CFR) were consulted (via the internet or in hardcopy) to review pertinent updates of laws, regulations, or guidance.

Action-specific ARARs and TBCs

Table 1 presents the action-specific ARARs and TBCs for the site. Actions identified in the ROD include:

- groundwater extraction and treatment
- vadose zone extraction and treatment
- underground injection
- construction of the landfill cap
- construction of wells

The Arizona Aquifer Protection Permit Program (AAC, Title 18, Chapter 9, Article 1) was reviewed with regard to the re-injection of treated groundwater in the drinking water aquifer at the site. This program is composed of several permits required for compliance, but CERCLA response actions generally are not subject to procedural permit requirements, as stated at 42 USC Section 9621(e). Therefore, the permit program is not an ARAR or TBC. However, the site is required to comply with the substantive requirements of the program.

The review of action-specific ARARs indicates that the injected water from the Groundwater Remediation System (GRS) does not meet MCLs for nitrates. Re-injection was approved by EPA because investigations conducted by Hassayampa Steering Committee (HSC) during the Remedial Investigation (RI) indicated that nitrate concentrations in Unit B exceeded those in the Unit A groundwater at five of seven paired wells sampled at the time. Reportedly, nitrate concentrations, detected in Unit A and B monitoring wells, are not unusual in groundwater in the Hassayampa regional area, and were not considered to be the result of waste disposal operations at the site. As stated at Section 104(a)(3), CERCLA remedial actions do not provide direct remediation for naturally occurring substances where the substances are naturally found. Furthermore, assuming that the nitrates are not naturally occurring, because they may be the result of agricultural discharges, re-injection of Unit A groundwater to Unit B does not further degrade the quality of the aquifer and meets the requirements of Underground Injection Control (UIC) Program under Part C of the Safe Drinking Water Act.

In addition, it was concluded that the general groundwater quality should not prohibit injecting Unit A groundwater into Unit B. Laboratory results indicate that chloride, sulfate, nitrate, and total dissolved solids in Unit B were higher than most of the sampled locations in Unit A. Injecting Unit A groundwater into Unit B would not further degrade groundwater at the point of compliance and therefore complies with the substantive requirements of the Arizona Aquifer Protection Permit Program

Chemical-specific ARARs and TBCs

Table 2 presents the chemical-specific ARARs and TBCs for the site. Hazardous substances, particularly volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs), were detected in the soil and groundwater in concentrations above Federal MCLs

for groundwater.

The ROD specified MCLs in drinking water as groundwater cleanup standards for the site. Based on the Safe Drinking Water Act (SDWA), and pursuant to 40 CFR Section 300.430(e)(2)(i)(B), MCLs and non-zero Maximum Contaminant Level Goals (MCLGs) are relevant and appropriate as in-situ aquifer standards for groundwater that is used, or may be used, as drinking water.

Arizona Department of Environmental Quality (ADEQ) Aquifer Water Quality Standards (ADEQ MCLs), established pursuant to ACC, Title 49 (ARS) Section 49-223, are identical to MCLs for the compounds detected in groundwater at the site. Since ADEQ MCLs are not more stringent than the Federal MCLs, the ADEQ standards are not ARARs.

ADEQ Health Based Guidance Levels (HBGLs) for groundwater are TBCs for the site. The HBGLs are derived from calculations based on ingestion of groundwater. The HBGLs have not been promulgated. However, ADEQ HBGLs were selected in the ROD as cleanup standards for chemicals for which no Federal MCLs or MCLGs existed.

The groundwater cleanup standards were specified to be met at all points within the contaminated aquifer. In addition, the ROD specified that soil vapor cleanup standards would be defined as levels that protect groundwater quality (meaning that the migration of contaminants from the vadose zone to groundwater will not result in groundwater contamination that exceeds the groundwater cleanup standards).

Location-specific ARARs and TBCs

Table 3 presents location-specific ARARs and TBCs for the site. The table shows that revisions in the state and federal regulations did not affect the location-specific ARARs and TBCs in the ROD.

The Arizona Aquifer Protection Permit Program (AAC Title 18, Chapter 9, Article 1) was reviewed with regard to the re-injection of treated groundwater in the drinking water aquifer at the site. This program is composed of several permits required for compliance, but CERCLA response actions generally are not subject to procedural permit requirements, as stated at 42 USC Section 9621(e). Therefore, the permit program is not an ARAR or TBC; however, substantive requirements of the program are TBC.

TABLE 1
Action-Specific ARARs

Action	Requirement	Citation	Origin	Determination	Status	Comments
Treatment	RCRA Standards for control of VOCs or gaseous contaminants.	40 CFR 265 Subparts AA and BB	ROD	Applicable	No Change	This standard requires reduction of VOC emissions from process vents. Process vents include air strippers. The standard also sets emissions standards for equipment leaks.
Treatment	Control of VOCs and gaseous contaminants under the delegated federal air program.	Maricopa County Rules 200, 210, 220, 241, 320, 330, and 370	ROD identified as TBC; 2001 5-Year review identified as ARAR	Applicable	No Change	Maricopa County rules require VOC emission controls where uncontrolled VOC air emissions would exceed 3 pounds per day. The air emission controls must have an overall efficiency of at least 90 percent. These criteria are selected as the air emission standards at the site based on considerations of the potential aggregate impacts of the air stripping and SVE systems.
Treatment	Control of air emissions from air strippers exceeding 3 pounds per hour, 15 pounds per day, or a potential rate of 10 tons per year total VOCs, because VOCs are ozone precursors.	EPA OSWER Directive No. 9355.0-28 (June 1989)	ROD	TBC	No Change	This policy is in place to control VOC emissions from sites which exceed 15 pounds per day of total VOCs from air stripping and other vented extraction techniques (e.g., SVE).
Treatment	Treatment of hazardous wastes in units not regulated elsewhere under RCRA (e.g., air strippers). Standards for miscellaneous units to satisfy environmental performance standards.	40 CFR 264 Subpart X	ROD	Applicable	No Change	Air stripping towers and SVE units are considered miscellaneous units. Therefore, the substantive requirements are relevant and appropriate.
Treatment	Treatment of wastes subject to ban on land disposal must attain levels achievable by best demonstrated available treatment technologies for each hazardous constituent in each listed waste.	40 CFR 268 Subpart D	ROD	Applicable	No Change	The substantive portions of these requirements are applicable to the disposal of any Hassayampa site wastes that can be defined as restricted hazardous wastes (i.e., drill cuttings).
Treatment	Remedial actions must comply with the substantive requirements of the CAA and its related programs, including the EPA-approved State Implementation Plan.	40 CFR 50-99	ROD	Applicable	No Change	CAA regulations define air quality management programs used to achieve the CAA goals. The State of AZ is responsible for the SIP, which describes how the air quality programs will be implemented.
Treatment	Installation permits must be obtained to make alterations to machinery that may cause or contribute to air pollution. An alteration to machinery that may cause or contribute to air pollution.	A.R.S. 49-480	ROD	Applicable	No Change	The substantive requirements of the Air Pollution Control Rules and Regulations for groundwater and soil treatment facilities are applicable to the site.

TABLE 1
Action-Specific ARARs

Action	Requirement	Citation	Origin	Determination	Status	Comments
Cap Construction	At final closure of a landfill or cell, the landfill must be capped or maintained in accordance with 40 CFR 265.310 and 265.177.	40 CFR 265.310 and 265.117.	ROD	Applicable	No Change	Although the site is not a RCRA Interim status facility, the closure and post-closure care regulations contained in 40 CFR 265.310 and 265.117 are relevant and appropriate.
Cap Construction	At final closure of a landfill or cell, the landfill must be capped or maintained in accordance with 40 CFR 265.310 and 265.177.	EPA Technical Guidance Documents: Final Covers on Hazardous Waste Landfills and Surface Impoundment (EPA/530-SW-89-047)	2001 5-Year review identified as TBC	TBC	No Change	The capping and maintenance requirements described in the "EPA Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments" are TBCs. The cap at the site will comply with the substantive design and maintenance requirements specified in the 40 CFR 265.310 and 265.117 regulations and in the guidance document.
Underground injection	This regulation sets standards for types of underground injection wells. The UIC program prohibits activities that allow movement of contaminants into underground sources of drinking water that may result in violations of MCLs or adversely affect health. Compliance with the UIC program includes (1) No injection activity shall result in endangerment of underground sources of drinking water, (2) submitting inventory information, (3) obtaining a permit if the point of injection is offsite.	40 CFR Parts 144-147	ROD	Applicable	No Change	Re-injection of treated groundwater at the site shall comply with these regulations. While a permit is not required for onsite CERCLA actions, the substantive requirements would apply for re-injection of treated groundwater onsite. Offsite re-injection will have to comply with the procedural and substantive portions of these regulations.
Underground injection	Any person who discharges to an aquifer must obtain an Aquifer Protection Permit from ADEQ.	ARS 49-241 to 49-246	ROD	Applicable	No Change	CERCLA response actions generally are not subject to procedural permit requirements, as stated at 42 USC Section 9621(e). However, the substantive requirements of the permit must be met for onsite re-injection. Best available control technology required, and must not cause a water quality violation or further degrade the aquifer at the point of compliance.
Groundwater well installation, development, testing, and sampling	Any non-waste material (e.g., groundwater or soil) that contains a listed hazardous waste must be managed as if it were a hazardous waste.	40 CFR 261.3; EPA "contained in" policy of defining "hazardous waste"	ROD	Applicable	No Change	The "contained in" principle will not apply to groundwater treated to MCLs and ADEQ HBGLs at the site.

TABLE 1
Action-Specific ARARs

Action	Requirement	Citation	Origin	Determination	Status	Comments
Groundwater monitoring	Groundwater monitoring at new or existing RCRA disposal units.	40 CFR, Subpart F	ROD	Applicable	No Change	The groundwater monitoring requirements contained in 40 CFR, Section 265, Subpart F are relevant and appropriate for the site.
Container storage (onsite)	Containers of hazardous waste must be maintained in good condition, compatible with hazardous waste to be stored, and closed during storage (except to add or remove waste).	40 CFR 264.171-173 (R18-18-264.170, et seq.).	ROD	Applicable	No Change	These requirements are applicable or relevant and appropriate for any contaminated soil or groundwater or treatment system waste that might be contained and stored onsite prior to treatment or final disposal.
Container storage (onsite)	Inspect container storage areas weekly for deterioration. Provide containment system with a capacity of 10 percent of the volume of containers of free liquids.	40 CFR 264.174.	ROD	Applicable	No Change	Place containers on a sloped, crack-free base, and protect from contact with accumulated liquid.
Container storage (onsite)	Remove spilled or leaked waste in a timely manner to prevent overflow of the containment system.	40 CFR 264.175.	ROD	Applicable	No Change	Maintain containment system clear of waste.
Container storage (onsite)	Keep containers of ignitable or reactive waste at least 50 feet from the facility's property line.	40 CFR 264.176.	ROD	Applicable	No Change	Store containers of ignitable or reactive waste at least 50 feet from the facility's property line.
Container storage (onsite)	Keep incompatible materials separate.	40 CFR 264.177.	ROD	Applicable	No Change	Separate incompatible materials stored near each other by a dike or other barrier.
Container storage (onsite)	At closure, remove all hazardous waste and residues from the containment system, and decontaminate or remove all containers, liners.	40 CFR 264.178.	ROD	Applicable	No Change	Applicable at closure.

TABLE 1
Action-Specific ARARs

Action	Requirement	Citation	Origin	Determination	Status	Comments

Notes:

ADEQ = Arizona Department of Environmental Quality

ARS = Arizona Revised Statutes

CFR = Code of Federal Regulations

EPA = U. S. Environmental Protection Agency

HBGLs = Health Based Guidance Levels

MCLs = Maximum Contaminant Levels

OSWER = EPA Office of Solid Waste Emergency Response

RCRA = Resource Conservation and Recovery Act

SDWA = Safe Drinking Water Act

SIP = AZ State Implementation Plan

SVE = Soil Vapor Extraction

UIC = Underground Injection Control

USC = United States Code

VOCs = Volatile Organic Compounds

TABLE 2
Chemical-Specific ARARs

Contaminant	Requirement	Citation	Origin	Determination	Status	Comments
Chemicals of Concern (COCs)	MCLs are applicable to drinking water at the tap pursuant to the SDWA and the AAC.	SDWA; 40 CFR Section 300.430(e)(2)(i)(B) AAC Title 18, Chapter 4	ROD	Applicable	No Change (i.e., MCLs and MCLGs remain applicable as aquifer standards	MCLs and non-zero MCLGs are relevant and appropriate as in-situ aquifer standards for groundwater that is or may be used as drinking water.
1,1,1-trichloroethane	MCL = 0.2 mg/L	MCLG = 0.20 mg/L				
1,1-dichloroethane	MCL = NA	MCLG = NA				
1,1-dichloroethene	MCL = 0.007 mg/L	MCLG = 0.007 mg/L				
1,2-dichlorobenzene	MCL = NA	MCLG = NA				
1,2-dichloropropane	MCL = 0.005 mg/L	MCLG = 0 mg/L				
trans -1,2-dichloroethene	MCL = 0.1 mg/L	MCLG = 0.1 mg/L				
1,4-dichlorobenzene	MCL = NA	MCLG = NA				
chlorinated fluorocarbon (Freon 113)	MCL = NA	MCLG = NA				
chromium (total)	MCL = 0.1 mg/L	MCLG = 0.1 mg/L				
cis-1,2-dichloroethene	MCL = 0.07 mg/L	MCLG = 0.07 mg/L				
copper	MCL = 1.3 mg/L	MCLG = 1.3 mg/L				
dichloromethane	MCL = 0.005 mg/L	MCLG = 0 mg/L				
lead, inorganic	MCL = 0.015 mg/L	MCLG = 0 mg/L				
perchloroethylene	MCL = NA	MCLG = NA				
toluene	MCL = 1 mg/L	MCLG = 1 mg/L				
trichloroethene	MCL = 0.005 mg/L	MCLG = 0 mg/L				
trichlorofluoromethane (Freon 11)	MCL = NA	MCLG = NA				

TABLE 2
Chemical-Specific ARARs

Contaminant	Requirement	Citation	Origin	Determination	Status	Comments
vinyl chloride	MCL = 0.002 mg/L	MCLG = 0 mg/L				
xylene	MCL = 10 mg/L	MCLG = 10 mg/L				
COCs	ADEQ HBGLs are state drinking water risk-based levels as measured at the tap.	HBGLs are not promulgated, and were developed by the Arizona OEH as risk-based guidance.	ROD	TBC	No Change	HBGLs have not been promulgated; however, ADEQ HBGLs were selected in the ROD as cleanup standards for chemicals for which no Federal MCLs or MCLGs exist.

Notes:

AAC = Arizona Administrative Code

ADEQ = Arizona Department of Environmental Quality

CFR = Code of Federal Regulations

COCs = Chemicals of Concern

EPA = U. S. Environmental Protection Agency

HBGLs = Health Based Guidance Levels

MCLs = Maximum Contaminant Levels (http://www.epa.gov/safewater/mcl.html#mcls)

MCLGs = Maximum Contaminant Level Goals

mg/L = milligrams per Liter

NA = Not Applicable (no MCL or MCLG established by EPA)

OEH = Arizona Office of Environmental Health

SDWA = Safe Drinking Water Act

TABLE 3
Location-Specific ARARs

Location	Requirement	Citation	Origin	Determination	Status	Comments
Within floodplain	Action to avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial values. Action that will occur in a floodplain (i.e., lowlands, and relatively flat areas adjoining inland and coastal waters and other flood-prone areas).	Executive Order 11988, Protection of Floodplains (40 CFR 6, Appendix A).	ROD	Applicable	No Change	Federal agencies are directed to ensure that planning programs and budget requests reflect consideration of flood-plain management, including the restoration and preservation of such land as natural undeveloped flood plains. If newly constructed facilities are to be located in a floodplain, accepted flood-proofing and other flood control measures shall be undertaken to achieve flood protection. Whenever practical, structures shall be elevated above the base flood level rather than filling land. As part of any Federal plan or action, the potential for restoring and preserving floodplains so their natural beneficial values can be realized must be considered.
Within area where action may cause irreparable harm, loss, or destruction of significant artifacts.	Action to recover and preserve artifacts. Alteration of terrain that threatens significant scientific, prehistoric, historic, or archaeological data.	National Archaeological and Historical Preservation Act (16 USC Section 469); 36 CFR Part 65.	ROD	Applicable	No Change	No artifacts are known to have been found in the vicinity of the site. If artifacts are identified at the site, this requirement will be applicable.
Critical habitat upon which endangered species or threatened species depend.	Action to conserve endangered species or threatened species, including consultation with the Department of the Interior. Determination of endangered species or threatened species.	Endangered Species Act of 1973 (16 USC 1531 et seq.); 50 CFR Part 200, 50 CFR Part 402.	ROD	Applicable	No Change	No endangered or threatened species have been identified at the site. If such species are identified at the site, this requirement will be applicable.
Area affecting stream or river.	Action to protect fish or wildlife. Diversion, channeling, or other activity that modifies a stream or river and affects fish or wildlife.	Fish and Wildlife Coordination Act (16 USC 661 et seq.); 40 CFR 6.302.	ROD	Applicable	No Change	This act requires coordination with the Department of Fish and Wildlife prior to any action that would alter a body of water of the United States. No activity is expected in the vicinity of Hassayampa River, and the selected remedy is not expected to affect the river or associated riparian habitat and wetlands. This requirement will be applicable if the remedy will impact the river.
Riparian area.	Requires ADEQ to consider protection of riparian areas in its decision making. Impact on riparian areas.	Executive Order No. 91-06 of the Governor of AZ.	ROD	Applicable	No Change	The landfill lies within the drainage area of the Hassayampa River, a riparian area as defined in Executive Order 91-06 of the State of Arizona. No activity is expected in the vicinity of the river, and the selected remedy is not expected to affect the river or associated riparian habitat and wetlands. This requirement will be applicable if the remedy will impact the river.

TABLE 3
Location-Specific ARARs

Location	Requirement	Citation	Origin	Determination	Status	Comments
Drinking water aquifer	The Arizona Aquifer Protection Permit Program is composed of several permits required for aquifer protection compliance.	AAC, Title 18, Chapter 9, Article 1	2001 5-Year review identified as TBC	TBC	No change	CERCLA response actions generally are not subject to procedural permit requirements, as stated at 42 USC Section 9621(e). Therefore, substantive requirements of the program are TBC.

Notes:

AAC = Arizona Administrative Code

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act

CFR = Code of Federal Regulations

ESA = Endangered Species Act of 1973

FR = Federal Register

USC = United States Code

USFWS = U.S. Fish and Wildlife Service

Hassayampa Landfill Site ARARs Summary

The Hassayampa Landfill site ARARs (as established in the ROD, and reviewed in the previous 5-Year Review) were evaluated for changes or updates that effect the protectiveness of the selected remedies. The basis of ARARs are laws and regulations applicable to the site location, remedy actions, and COCs. The COCs include VOCs, SVOCs and metals.

The site is located is located approximately 40 miles west of Phoenix and approximately three miles north of Arlington, in Maricopa County, Arizona. The remedy actions determined in the 1992 ROD include:

- Extract and treat contaminated groundwater.
- Re-inject treated water.
- Continue groundwater monitoring to measure the effectiveness of the remedy.
- Cap the 10-acre Hazardous Waste Area of the landfill.
- Extract and treat contaminated soil vapor.
- Implement access and deed restrictions.

The Hassayampa Landfill site is a CERCLA Superfund Site, and was placed on the NPL in 1987. CERCLA response actions are exempted by law from the requirement to obtain Federal, State or local permits related to any activities conducted completely on-site. However, this does not remove the requirement to meet the substantive provisions of permitting regulations that are ARARs.

Hassayampa Landfill site ARARs were evaluated and detailed in Tables 1 through 3. There

were no changes to existing action-specific, chemical-specific, nor location-specific ARARs. No substantive changes were made to the regulations on which ARARs are based, that affect the protectiveness of the remedy.

TBC criteria, as defined in 40 CFR 300.400(g)(3), are non-promulgated advisories or guidance issued by federal or state government that are not legally binding but may provide useful information or recommended procedures for remedial action. There were no changes to existing TBC criteria for the Hassayampa Landfill site. No substantive changes were made to the regulations on which TBC criteria are based, that effect the protectiveness of the remedy.

Appendix G
Toxicology Review

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

Memorandum

DATE: 8 August 2006

FROM: Ned Black, Ph.D.
Regional CERCLA Ecologist, SFD-8-4

TO: Martin Zeleznik, Remedial Project Manager, SFD-8-2
Cynthia Wetmore, Regional CERCLA Engineer, SFD-8-4

SUBJECT: Review of draft Second 5-Year Review Report for the Hassayampa Landfill Superfund Site, Maricopa County, Arizona

I have reviewed the draft Second 5-Year Review Report for the Hassayampa Landfill Superfund Site (EPA ID: AZD980735666, CERCLIS ID: 09B8). From the description of the original remedy and landfill cap, as well as the report from the Site Inspection on March 28, 2006, I conclude there are no complete exposure pathways from the landfill contaminants to any ecological receptors in the area. This conclusion is contingent upon continued maintenance of the integrity of the landfill cap. As such, the remedy at the Hassayampa Landfill can be characterized as protective of the environment.

Hassayampa Landfill Superfund Site 5-Year Review

Risk Assessment and Toxicology Analysis

PREPARED FOR: Cynthia Wetmore
Martin Zeleznik
United States Environmental Protection Agency, Region IX

PREPARED BY: CH2M HILL

DATE: June 22, 2006

PROJECT NUMBER: 341212

This technical memorandum presents a risk assessment and toxicology analysis to support the five-year review of the Hassayampa Landfill Superfund Site in Maricopa County, Arizona.

In an effort to determine whether the remedy at the Hassayampa Landfill remains protective of human health, this section discusses changes in site conditions, changes in exposure pathways and changes in toxicity values, since selection of the Site remedy. A baseline risk assessment for the site was prepared by the PRC Environmental Management, Inc. (1991), which was reviewed as part of this evaluation.

Changes in Site Conditions

The Hassayampa Landfill Superfund Site is located in a rural, desert area of Maricopa County, Arizona. The land is currently owned and operated by Maricopa County. Surrounding land use includes mostly undeveloped desert land with some cultivation (approximately one-sixth of the total surrounding land use). Vegetation is sparse and includes creosote and salt bushes. During the site inspection, which was performed in March 2006, it was noted that the site was secured with adequate fencing and signage, both of which were in good condition. Also, the cap appeared to be in good condition.

According to the Arizona Department of Water Resources (ADWR), residential development in areas upgradient of the site is projected to increase substantially in upcoming years. Currently, there have been no changes in site conditions that would impact the protectiveness of the remedy. However, the Hassayampa Steering Committee (HSC) and USEPA should maintain an open dialogue with ADWR regarding the projections of residential development. Further, the results of the current investigation into a basin-wide estimate for future groundwater demand, and the effects of the demand on the basin should be reviewed by HSC and USEPA with respect to site conditions.

Changes in Exposure Pathways

Under the current land-use scenario, the nearest offsite residence is about 1,000 meters south of the Hazardous Waste Area. If contaminated groundwater is allowed to migrate, residents

at this location could be exposed to site-related contaminants through the use of domestic wells. Since the prevailing wind direction is from the northeast about 50 percent of the time, the residents at this location could also be exposed to site-related contaminants via inhalation. In the 1991 Baseline Risk Assessment for the Former Hazardous Waste Area of the Hassayampa Landfill, the following exposure routes were evaluated under current-use scenario:

- Ingestion of VOCs in contaminated groundwater migrating offsite;
- Inhalation of VOCs in contaminated groundwater migrating offsite;
- Inhalation of VOCs released from the site into the air.

While exposure to VOC vapors from migration to indoor air has become more of a concern in recent years, this pathway is very unlikely at the Hassayampa Landfill because currently there are no buildings (except the GRS Building which is unoccupied) at the site and in the future the soil vapor component of the remedy included deed and access restrictions at the Site. The ROD required that long-term deed restrictions be imposed, restricting future land use of the property and groundwater beneath the Site.

Changes in Toxicity Values

There have been a number of changes to the toxicity values for specific constituents of concern in soil and groundwater at the Hassayampa Landfill Superfund Site since the final baseline risk assessment was submitted in 1991. Table 1 provides a direct comparison between the 1991 toxicity values and current EPA Region 9 values. The chemicals listed are compiled from Tables 4-1 and 4-2 of the baseline risk assessment.

Revisions to the toxicity values for (acetone, carbon tetrachloride, 1,2-dichlorobenzene, 1,1-dichloroethene, 1,1,1-trichloroethane, and trichlorofluoromethane) indicate a lower risk from exposure to these chemicals than previously considered. On the other hand, evaluation of the toxicity values for PCE and TCE, as well as other chemicals, is ongoing and may indicate higher risks from exposure than previously considered.

The greatest uncertainty with toxicological changes for the Site is associated with TCE. In August 2001, U.S. EPA's Office of Research and Development (ORD) released the draft "Trichloroethylene Health Risk Assessment: Synthesis and Characterization" ("TCE Health Risk Assessment") for external peer review. The draft TCE Health Risk Assessment takes into account recent scientific studies of the health risks posed by TCE. According to the draft TCE Health Risk Assessment, for those who have increased susceptibility and/or higher background exposures, TCE could pose a higher risk through inhalation than previously considered. The draft TCE Health Risk Assessment is available on-line at: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=23249.

The Science Advisory Board, a team of outside experts convened by U.S. EPA, reviewed the draft TCE Health Risk Assessment in 2002. The Science Advisory Board's review of the draft TCE Health Risk Assessment is available at: http://www.epa.gov/sab/pdf/ehc03002.pdf.

U. S. EPA's ORD and Office of Solid Waste and Emergency Response have requested additional external peer review of the draft TCE Health Risk Assessment by the National

Academy of Sciences. Consequently, review of the toxicity value for TCE may continue for a number of years. This issue will need to be updated in subsequent five-year reviews.

References

PRC Environmental Management, Inc. 1991. Baseline Risk Assessment for the Former Hazardous Waste Area. Final Report. September 13.

Table 1
Direct Comparison Between the 1991 Toxicity Values used in the Baseline Risk Assessment and Current Region 9 Values

Chemical	Ingestion Exposure				Inhalation Exposure			
	RfDo mg/kg/day		SFo $(mg/kg/day)^{-1}$		RfDi mg/kg/day		SFi $(mg/kg/day)^{-1}$	
	Table 4-1*	Region 9#	Table 4-2*	Region 9#	Table 4-1*	Region 9#	Table 4-2*	Region 9#
Acetone	0.1	0.9	None	None	None	**0.9**	None	None
Benzene	None	**0.004**	0.029	**0.055**	None	**0.008571**	0.029	0.0273
Carbon Tetrachloride	0.0007	0.0007	0.13	0.13	None	**0.0007**	0.13	0.053
Chloromethane	None	**0.026**	0.013	None	None	**0.026**	0.0063	None
Dibromochloroethane	0.02	0.02	0.084	0.084	0.02	0.02	None	**0.084**
1,2-Dichlorobenzene	0.09	0.09	None	None	0.04	0.057	None	None
1,4-Dichlorobenzene	None	**0.03**	0.024	0.024	0.2	0.23	None	**0.022**
1,1-Dichloroethane	0.1	0.1	None	None	0.1	0.14	None	None
1,1-Dichloroethene	0.009	0.05	0.6	None	None	**0.057**	1.2	None
Cis-1,2-Dichloroethene	0.01	0.01	None	None	None	**0.01**	None	None
Trans-1,2-Dichloroethene	0.02	0.02	None	None	None	**0.02**	None	None
1,2-Dichloropropane	None	**0.0011**	0.068	0.068	None	**0.0011**	None	**0.068**
Ethylbenzene	0.1	0.1	None	None	0.3	**0.29**	None	None
Methylene chloride	0.06	0.06	0.0075	0.0075	0.9	**0.86**	0.0016	0.0016
Tetrachloroethene	0.01	0.01	0.051	**0.54**	None	**0.01**	0.0018	**0.21**
Toluene	0.2	**0.1**	None	None	0.6	**0.11**	None	None
1,1,1-Trichloroethane	0.09	0.28	None	None	0.3	0.63	None	None
Trichloroethene	None	**0.0003**	0.011	**0.013/0.4^**	None	**0.01**	0.017	0.007/0.4^
Trichlorofluoromethane	0.3	0.3	None	None	0.2	0.2	None	None
Trichlorofluoroethane	3	30	None	None	30	**8.6**	None	None
Vinyl chloride	None	**0.003**	1.9	1.5	None	**0.0286**	0.29	0.031
Xylene, m-	2	**0.2**	None	None	0.2	**0.029**	None	None
Xylene, o-	2	**0.2**	None	None	0.2	**0.029**	None	None

Notes:

* From Tables 4-1 and 4-2 of Baseline Risk Assessment for the Former Hazardous Waste Area.

\# Toxicity values as they appear on the October 2004 Region 9 Table of Preliminary Remediation Goals.

^ Slope factors provided for trichloroethene are from Cal EPA (first value) and NCEA (second value).