United States
Environmental Protection
Agency

Office of
Emergency and
Remedial Response

EPA/ROD/R09-92/082
August 1992

EPA

Superfund Record of Decision:

Hassayampa Landfill, AZ

NOTICE

The appendices listed in the index that are not found in this document have been removed at the request of the issuing agency. They contain material which supplement, but adds no further applicable information to the content of the document. All supplemental material is, however, contained in the administrative record for this site.

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. EPA/ROD/R09-92/082	2.	3. Recipient's Accession No.

4. Title and Subtitle SUPERFUND RECORD OF DECISION Hassayampa Landfill, AZ First Remedial Action - Final	5. Report Date 08/06/92 6.
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9. Performing Orgainization Name and Address	10. Project/Task/Work Unit No. 11. Contract(C) or Grant(G) No. (C) (G)
12. Sponsoring Organization Name and Address U.S. Environmental Protection Agency 401 M Street, S.W. Washington, D.C. 20460	13. Type of Report & Period Covered 800/000 14.

15. Supplementary Notes

PB93-964505

16. Abstract (Limit: 200 words)

The Hassayampa Landfill site is a 10-acre area of a 47-acre municipal landfill that was previously used for hazardous waste disposal. Land use in the area is predominantly desert and is sparsely cultivated. The Hassayampa Landfill lies within the Hassayampa River drainage area, but outside of the 100-year floodplain. The estimated 1,100 people who reside within a 3-mile radius of the site use the aquifer underlying the site for their drinking water. From 1961 to the present, the Maricopa County Landfill Department owned and operated the site. Waste disposed of at the landfill consisted chiefly of municipal garbage, tree trimmings, and other plant refuse. In 1979, the state requested that Hassayampa Landfill accept hazardous waste as an alternate waste disposal site during a prohibition at City of Phoenix landfills. In the 18 months that the landfill accepted hazardous waste, up to 3.28 million tons of liquid waste and approximately 4,150 tons of solid waste were deposited. The Hazardous Waste Area consisted of several unlined pits (pits 1-5) for disposal of heavy metals,

(See Attached Page)

17. Document Analysis a. Descriptors

Record of Decision - Hassayampa Landfill, AZ
First Remedial Action - Final
Contaminated Media: soil, debris, gw
Key Contaminants: VOCs, metals (chromium, lead)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 60
	20. Security Class (This Page) None	22. Price

(See ANSI-Z39.18) *See Instructions on Reverse* OPTIONAL FORM 272 (4-77) (Formerly NTIS-35) Department of Commerce

EPA/ROD/R09-92/082
Hassayampa Landfill, AZ
First Remedial Action - Final

Abstract (Continued)

solvents, petroleum distillates, oil, pesticides, acids, bases, and non-hazardous septic wastes. In 1981, under EPA guidance, a number of investigations were conducted that revealed VOC contamination in the soil and ground water. This ROD addresses the soil, debris, and ground water as the final action for the site. The primary contaminants of concern affecting the soil, debris, and ground water are VOCs and metals, including chromium and lead.

The selected remedial action for this site includes treating contamination in the vadose zone using vapor extraction at all locations where soil vapors exceed clean up levels; controlling emissions from the treatment system using either vapor phase carbon adsorption or catalytic oxidation as determined during the RD phase; installing a 10-acre cap over the soil and waste in the Hazardous Waste Area; extracting and treating contaminated ground water onsite using air stripping and, as necessary, vapor phase carbon adsorption, and reinjecting the treated water onsite or in the immediate vicinity; monitoring ground water; and implementing institutional controls including deed and ground water use restrictions, and site access restrictions such as fencing. The estimated present worth cost for this remedial action is $6,100,000, which includes an annual O&M cost of $2,213,100 for 30 years.

PERFORMANCE STANDARDS OR GOALS:

The selected remedy will comply with the federal and more stringent state standards. Soil vapor clean-up levels will be calculated based on levels that will be protective of ground-water quality. The design of the cap will be in compliance with RCRA requirements. Chemical-specific ground water clean-up goals are based on SDWA MCLs and include 1,1-DCE 7 ug/l; 1,2-DCA 5 ug/l; PCE 5 ug/l; TCE 5 ug/l; 1,2-DCE (trans) 100 ug/l; 1,2-DCE (cis) 70 ug/l; and 1,1,1-TCA 200 ug/l.

RECORD OF DECISION
HASSAYAMPA LANDFILL
SUPERFUND SITE

July 1992

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Concurrence -- Assistant Regional Administrator

Nora McGee
Assistant Regional Administrator

7-15-92
Date

Record of Decision
Hassayampa Landfill Superfund Site

Concurrence -- Water Management Division

for [signature]
Harry Serayadarian, Director
Water Management Division

13 July 92
Date

Record of Decision
Hassayampa Landfill Superfund Site

Concurrence -- Office of Regional Counsel

______________________________ (signature)
Nancy J. Marvel
Regional Counsel

7/27/92
Date

Record of Decision
Hassayampa Landfill Superfund Site

Concurrence -- Waste Programs

Laura Yoshii, Deputy Director
Waste Programs

7/10/92
Date

Record of Decision
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Concurrence -- Hazardous Waste Management Division

Keith Takata

for Jeff Zelikson, Director
Hazardous Waste Management Division

8-4-92
Date

I. DECLARATION

A. SITE NAME AND LOCATION

This Record of Decision (ROD) is written for the Hassayampa Landfill Superfund Site (the Hassayampa Landfill Site, the Site), which is located in Maricopa County, Arizona, approximately 40 miles west of Phoenix, Arizona. For purposes of this ROD, the Site shall be defined as the 10-acre area of the 47-acre municipal landfill where hazardous wastes are known to have been disposed, as well as any areas where site-related contaminants have come to be located.

B. STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for contaminated soil and groundwater at the Hassayampa Landfill Site, chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Contingency Plan (NCP). This decision document is based on the Administrative Record for the Site, the index of which is attached as Appendix C.

C. ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

D. DESCRIPTION OF THE SELECTED REMEDY

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. The groundwater component of the remedy includes extraction of contaminated groundwater, treatment of 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), reinjection of the treated water, and continued groundwater monitoring to measure the effectiveness of the remedy. Federal Maximum Contaminant Levels (MCLs) have been chosen as groundwater cleanup standards. For those contaminants detected on Site for which no MCLs exist, Health-Based Guidance Levels proposed by the State of Arizona have been selected as groundwater cleanup standards. The groundwater cleanup standards shall be met at all points within the contaminated aquifer.

The vadose zone component of the remedy includes capping the 10-acre Hazardous Waste Area of the landfill using a cap that complies with the substantive capping and maintenance requirements for 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." In addition, the vadose zone component of the selected remedy includes performing soil vapor extraction at all locations at the Site where soil vapor levels exceed cleanup standards, treating the soil vapor using vapor phase carbon adsorption or catalytic oxidation technology (to be determined during remedial design), and implementing access and deed restrictions. The soil vapor cleanup standards shall be levels that are protective of 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). The soil vapor cleanup standards will be determined through site-specific analytical modeling conducted during the remedial design stage. Additional investigation will also be performed during the remedial design stage in order to determine the extent of groundwater and soil vapor contamination.

E. STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy uses permanent solutions and alternative treatment technologies to the maximum extent practicable, and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

Because the selected remedial action allows contaminated soil to remain onsite in excess of health-based levels, a review will be conducted within five years of commencement of remedial actions to ensure that the remedy continues to provide adequate protection of human health and the environment.

Daniel W. McGovern
Regional Administrator
U.S. EPA Region 9

8·6·92
Date

II. DECISION SUMMARY

A. SITE NAME, LOCATION AND DESCRIPTION

1. LOCATION

The Hassayampa Landfill Site is located in a rural desert area approximately 40 miles west of Phoenix, Arizona. The Site is approximately three-fourths of a mile west of the Hassayampa River, one and a half miles northwest of the town of Hassayampa, three miles north of the town of Arlington, and five miles east of the Palo Verde Nuclear Generating Station. Figure 1 depicts the location of the Hassayampa Landfill Site.

The Hassayampa Landfill occupies a fenced 47-acre area located on a 77-acre parcel owned by Maricopa County. The hazardous waste area (HWA) of the landfill occupies a 10-acre area within the northeast section of the landfill. For purposes of this ROD, the Site shall be defined as the 10-acre area of the landfill where hazardous wastes are known to have been disposed, as well as any areas where site-related contaminants have come to be located.

2. LAND USE

The non-hazardous portion of the Hassayampa Landfill is still operated as a municipal landfill. Maricopa County personnel have indicated that the expected life of the non-hazardous portion of the landfill at the current rate of use is an additional ten years. The HWA is fenced and is no longer being used for landfill purposes. Approximately one-sixth of the land surrounding the landfill is cultivated, while the remaining areas are desert. Most of the cultivated land is located east of the Hassayampa River and south of the Arlington Mesa. The immediate vicinity of the landfill is sparsely vegetated. Vegetation consists mainly of creosote bush and salt bush.

3. POPULATION

Presently, the nearest residents live approximately 1,000 meters south of the HWA. Communities located within a three mile radius of the landfill include Hassayampa and Arlington. The combined 1985 census population for these two communities was 1,100 people. A growth rate of one to two percent was used to calculate a current population of 1,120 people. According to the Maricopa County Human Resources Department, a population growth of 10 to 15 percent is expected to occur over the next 20 years within a five mile radius of the Site. Several workers are employed at the non-hazardous portion of the Hassayampa Landfill.

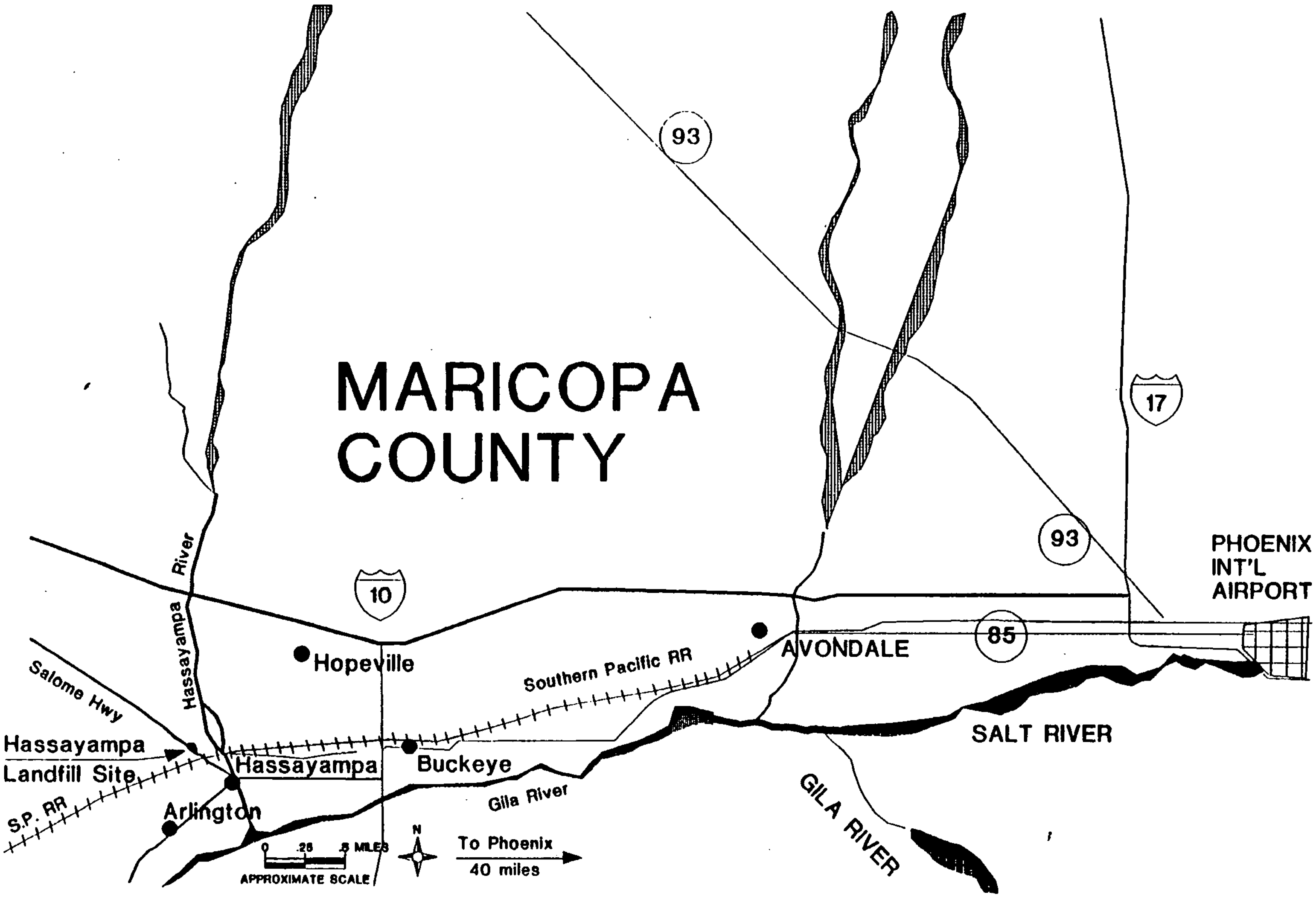

MARICOPA
COUNTY
93
17
93
10
85
PHOENIX
INT'L
AIRPORT
AVONDALE
Hopeville
Southern Pacific RR
Salome Hwy
Hassayampa River
Hassayampa
Landfill Site
Hassayampa
Buckeye
S.P. RR
Arlington
Gila River
SALT RIVER
GILA RIVER
0 .25 .5 MILES
APPROXIMATE SCALE
N
To Phoenix
40 miles

FIGURE 1

4. CLIMATE

The Site is characterized by a dry desert climate. The average precipitation at the Buckeye meteorological station (about nine miles to the east) was 7.08 inches per year, most of which occurred during a few days each year. Precipitation of 0.10 inches or more occurs on an average of 20 days per year. Records from the Buckeye station indicate the average daily maximum temperature is approximately 87° F, and the average daily minimum temperature is approximately 52° F. The average pan evaporation measured at the Salt River Valley station in Mesa (about 54 miles to the east) was about 106 inches per year.

5. TOPOGRAPHY

The Site is located on the broad southward-sloping alluvial plain of the Hassayampa River basin. The basin 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 of the alluvial plain occupied by the Site is generally flat; however, approximately one half mile south of the Site, the plain is broken by the Arlington Mesa. The HWA is currently overlain by a graded soil cover. The altitude of the land surface at the HWA is approximately 910 to 915 feet above mean sea level.

6. SURFACE WATER

The Hassayampa Landfill Site lies within the Hassayampa River drainage area, but outside of the 100-year floodplain of the river. The Site is located about three-quarters of a mile west of the Hassayampa River, which flows to the south. The Site is near a north-trending surface water drainage divide between the Hassayampa River and an unnamed wash to the west, which is a tributary of the Luke Wash. The Hassayampa River and the Luke Wash are ephemeral desert washes that are tributaries of the westward flowing Gila River. Presently the Gila River is perennial at its confluence with the Hassayampa River.

7. GROUNDWATER

Regional hydrogeologic units in the area of the Site include in order of increasing depth: Recent alluvial deposits, basin-fill deposits, and the bedrock complex. Groundwater levels in the vicinity of the Site generally lie below the base of the Recent alluvial deposits. However, where saturated, the Recent alluvial deposits may yield moderate quantities of groundwater to wells. The thickness of the basin-fill deposits appears to exceed 1,200 feet in the vicinity of the landfill. The basin-fill deposits comprise the principal source of groundwater to wells in the area of the Site, and are generally referred to as the regional aquifer. Within a three mile radius of the Site, 349 groundwater wells have been identified, 172 of which potentially service individual residences. These wells yield groundwater from the regional basin-fill deposits aquifer. The reported depths range from 5 feet below land surface to 250 below land surface. The nearest downgradient domestic well is about 2,500 feet south of the Site.

The basin-fill deposits have been classified in order of increasing depth into the Upper, Middle, and Lower Alluvium units. The Upper Alluvium unit beneath the Site was the target of the hydrogeologic investigations conducted at the Site. For purposes of the Remedial Investigation (RI), the Upper Alluvium unit was subdivided in order of increasing depth into the upper alluvial deposits unit, basaltic lava-flow unit, Unit A, and Unit B (Figure 2).

The upper alluvial deposits unit consists of a coarse-grained part and a fine-grained part. The average depth to the base of the coarse-grained part is about 34 feet; while the average depth to the base of the fine-grained part is about 58 feet. The basaltic lava-flow unit consists of vesicular, basaltic rock and is part of the Arlington Mesa basalt flows. This unit appears to thin and dip towards the north. The presence of contaminated groundwater in Unit A indicates that the basaltic lava-flow unit is not an impermeable unit.

The part of the Upper Alluvium unit from the base of the basaltic lava-flow unit to the top of the Middle Alluvium unit is the uppermost water-bearing part of the regional aquifer, and has been subdivided into Units A and B. There is no confining unit separating Units A and B, and Units A and B are considered to be water-bearing zones within the same aquifer. Unit A comprises the uppermost fine-grained water-bearing unit, while Unit B is the uppermost coarse-grained water bearing unit. Unit B is underlain by a silty clay. This clay has tentatively been classified as the Palo Verde Clay, and appears to comprise the basal confining unit for Unit B.

The direction of groundwater flow in Units A and B is generally to the south, although local variations in the flow direction may occur. The average depth to the water table beneath the Site is 73 feet. Water level contours and potentiometric contours for Units A and B are presented in Figures 3 and 4.

B. SITE HISTORY AND ENFORCEMENT ACTIVITIES

1. HISTORICAL ACTIVITIES

The Hassayampa Landfill is presently owned by Maricopa County and is operated by the Maricopa County Landfill Department. Maricopa County had signed a 20-year lease on the 77-acre parcel from the U.S. Federal Aviation Agency, and after the lease expired in 1963 the parcel was transferred to Maricopa County by quitclaim deed.

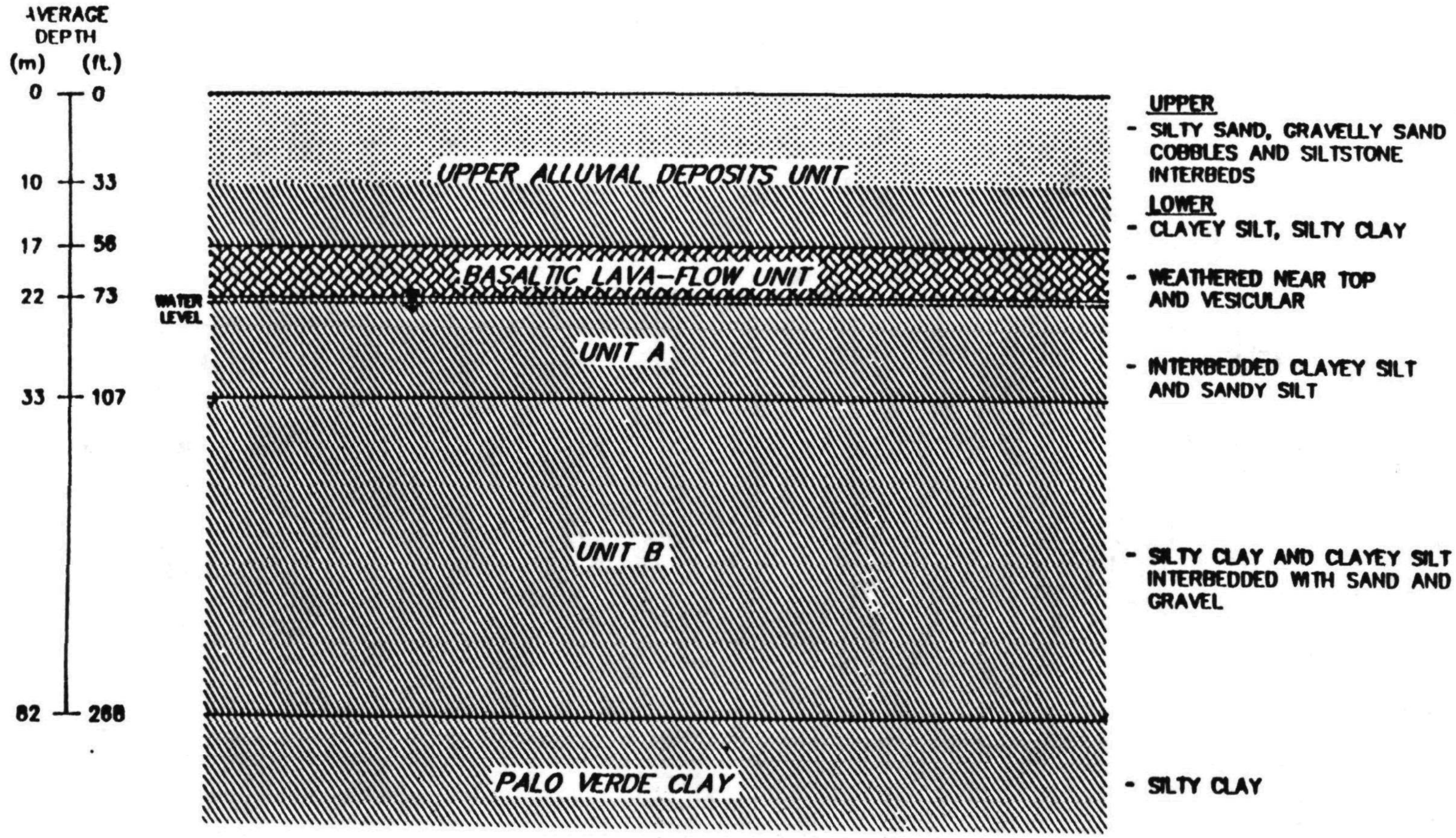


FIGURE 2

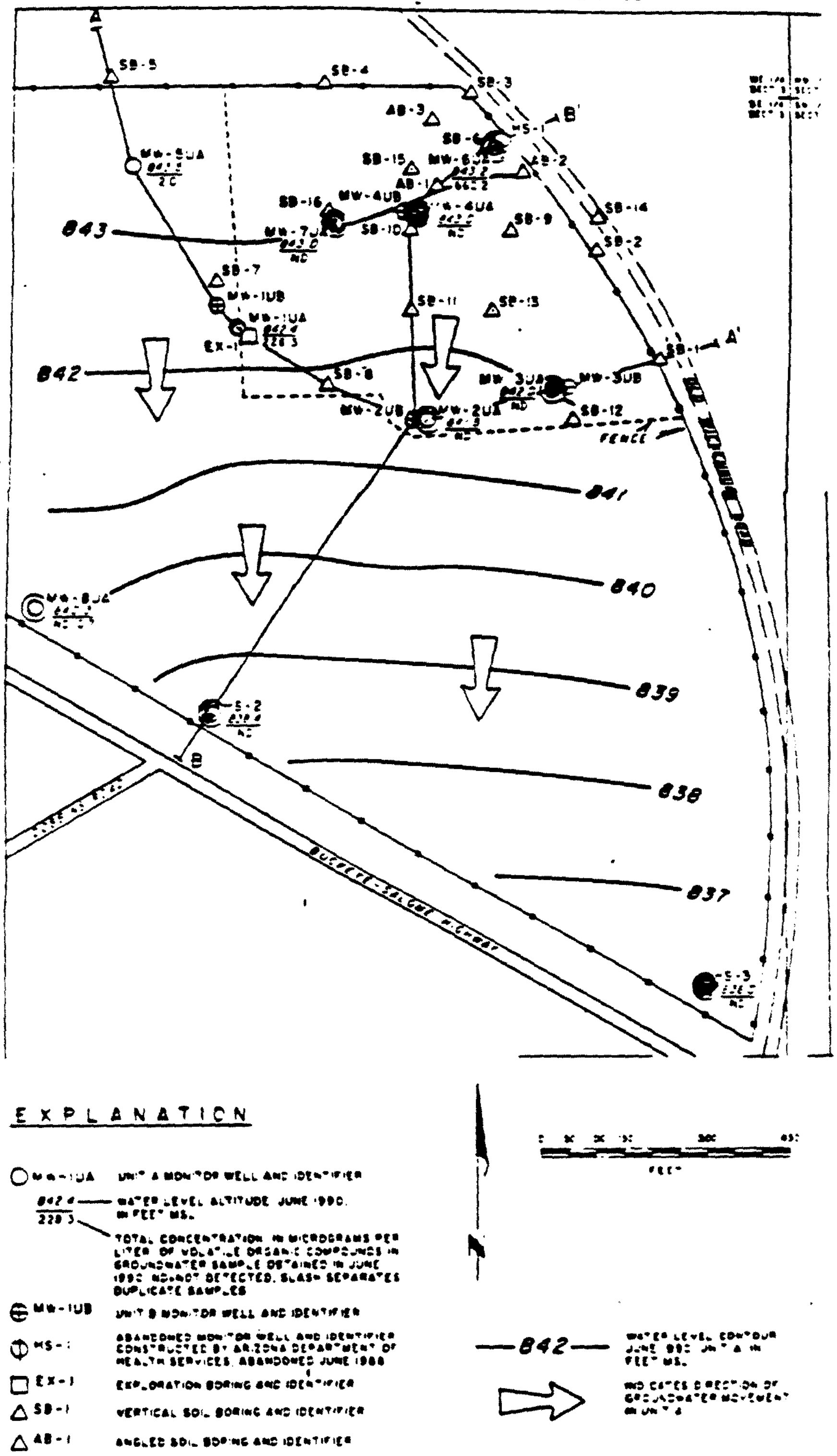
SCHEMATIC HYDROGEOLOGIC CROSS-SECTION
HASSAYAMPA LANDFILL
Maricopa County, Arizona

CRA

2141-26/11/91-10-0

Figure 3

Water-Level Contours for Unit A

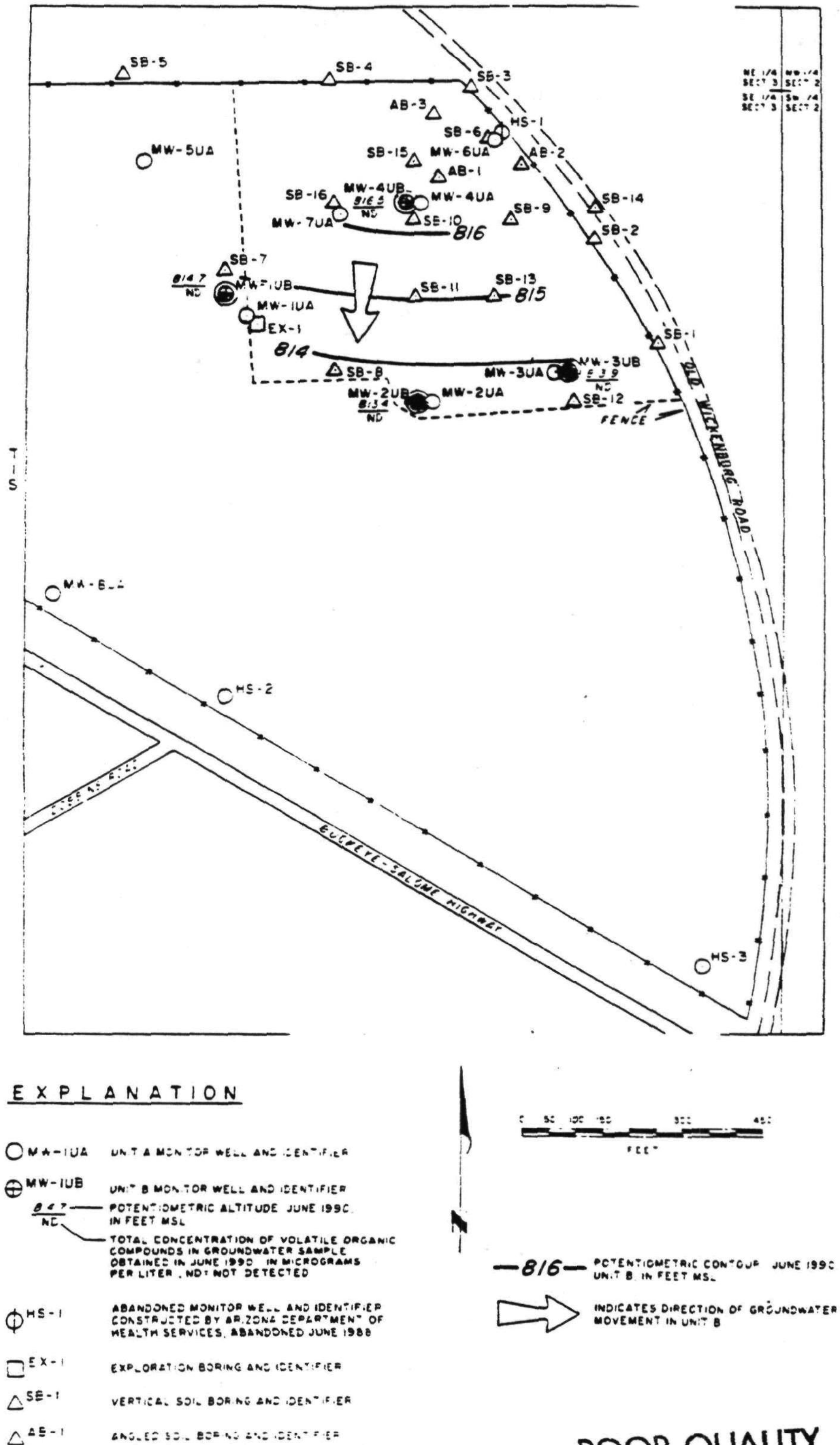


POOR QUALITY ORIGINAL

POOR QUALITY ORIGINAL

Figure 4

Potentiometric Contours for Unit B



POOR QUALITY ORIGINAL

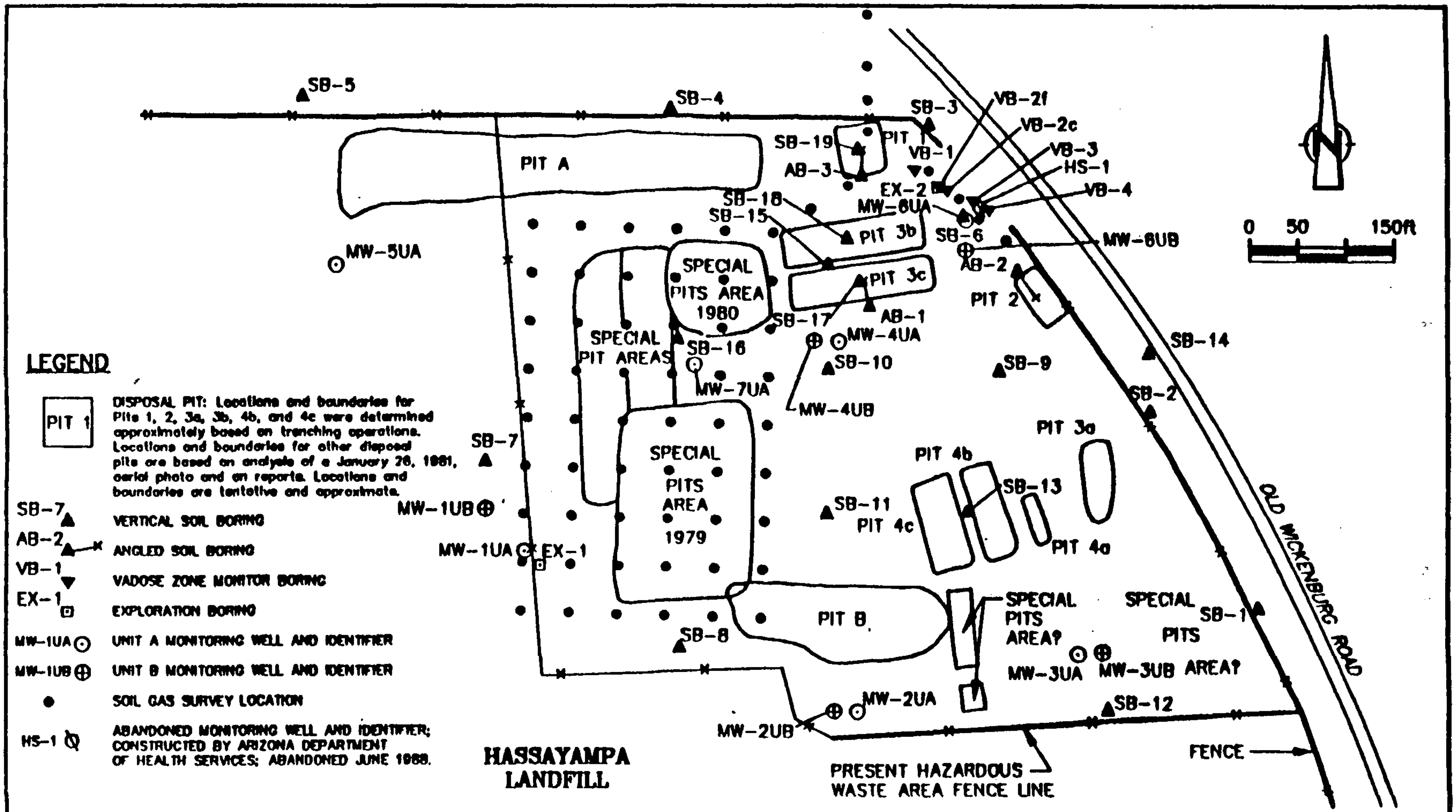
Disposal of municipal and domestic waste began at the landfill in 1961 and has continued to the present. According to a 1977 report prepared for the Arizona Department of Health Services (ADHS), the types of waste disposed at the landfill were unrestricted but consisted chiefly of garbage, rubbish, tree trimmings, and other plant refuse. In that report, it was stated that the Hassayampa Landfill was not suitable for the disposal of hazardous waste. Based on this report, Maricopa County prohibited the disposal of hazardous waste at the landfill.

On February 15, 1979, ADHS prohibited disposal of industrial waste at the City of Phoenix's landfills. Because no alternate waste disposal sites were available in Arizona, ADHS characterized the situation as an "extreme emergency." Consequently, ADHS requested that Maricopa County accept hazardous waste at the Hassayampa Landfill for a 30-day period beginning on April 20, 1979. After the initial 30-day period, several time extensions for hazardous waste disposal at the landfill were granted. On October 28, 1980, the disposal of hazardous waste at the Hassayampa Landfill was prohibited.

During the 18-month period from April 20, 1979 to October 28, 1980, disposal of hazardous waste at the landfill was conducted under a manifest program operated by ADHS. An inventory performed by ADHS indicated that a wide range of hazardous wastes consisting of up to 3.28 million gallons of liquid waste and up to 4,150 tons of solid waste were approved by ADHS for disposal at the landfill. However, an inventory conducted by consultants for the potentially responsible parties (PRPs), indicated that the amount of hazardous waste approved by ADHS for disposal consisted of up to 3.44 million gallons of liquid waste and up to 3,710 tons of solid waste.

The hazardous waste area was composed of several unlined pits that were designated for disposal of hazardous or nonhazardous wastes. Pits 1, 2, 3 (including 3a, 3b, and 3c), 4 (including 4a, 4b, and 4c), and the Special Pits were designated for disposal of hazardous waste (Figure 5). The waste types varied greatly and included heavy metals, solvents, petroleum distillates, oil, pesticides, acids, and bases. Specific pits were designated to receive certain types of waste, but it is not clear that this practice was always followed. The designated waste types, the actual received waste types, and the quantities for each pit, as reported in the RI report, are presented in Table 1.

Pits A and B were designated for the disposal of non-hazardous waste. Although Pit A was intended for cesspool and septic tank wastes, other substances (whitish grey sludge, black oily liquid, and pesticide containers) were also disposed (Ecology and Environment, 1981). The contents of Pit B were not well defined. It should be noted that the wastes disposed in Pits A and B were



REFERENCE:
INFORMATION FOR BASE MAP
FROM ERROL L. MONTGOMERY
AND ASSOCIATES INC.

CRA

FIGURE 5

RI MONITORING LOCATIONS
HASSAYAMPA LANDFILL
Maricopa County, Arizona

2141(10)-MAY 4/92-REV.2 (P-18)

TABLE 1

SUMMARY OF WASTES APPROVED FOR DISPOSAL
HASSAYAMPA FEASIBILITY STUDY

		Quantity Reported in the Liquid Waste Evaluation Report (CRA AND M&A, 1991)		*Quantity Reported by Arizona Department of Health Services (1985)*	
Pit(s)	*Waste Type Designated*	*Liquid Waste (gallons)*	*Solid Waste (tons)*	*Liquid Waste (gallons)*	*Solid Waste (tons)*
Special Pit	Incompatible Hazardous Waste	174,183	2,123	134,578	308.64
Pit 1	Organics & Oils	373,755	5.0	360,805	0
Pit 2	Acids & Acid Sludges	110,930	0.1	125,597	0.1
Pits 3a, b and c	Alkaline & Metallic Sludges	1,368,991	7.3	1,362,636	24.5
Pits 4a, b and c	Pesticides & Akaline Sludges	1,407,467	1,600	1,295,022.2	3,816.46
	Total	3,435,326	3,735.4	3,278,638.2	4,149.7

Notes:

The waste amounts are determined from an analysis of ADHS approved waste manifests.

The difference between these estimates is explained in the Liquid Waste Evaluation Report (M&A and CRA, 1991). These differences are attributed to the different solid waste volume reported by ADHS. This solid waste difference, if converted to liquid waste, would reduce the difference in liquid volumes to three percent.

not recorded under the manifest system.

2. SITE DISCOVERY

In 1981, under the Resource Conservation and Recovery Act (RCRA) Open Dump Inventory Program, ADHS installed three groundwater monitoring wells at the Hassayampa Landfill. Groundwater samples collected from one of these wells was found to be contaminated with volatile organic compounds (VOCs). Also in 1981, Ecology and Environment prepared a site inspection report for the U.S. Environmental Protection Agency (EPA). In 1984, ADHS conducted site inspections of the landfill. The Site was added to EPA National Priorities List in July 1987.

3. SITE INVESTIGATIONS

The major preliminary investigation reports prepared for the Site are summarized below:

- Hydrogeologic Conditions and Waste Disposal at the Hassayampa, Casa Grande, and Somerton Landfills, Arizona (Schmidt and Scott, 1977);

- The Hassayampa Landfill Hazardous Waste Disposal Site: Disposal Analysis (April 20, 1979 - October 28, 1980) (ADHS, 1980);

- Site Inspection Report on Hassayampa Landfill, Hassayampa, Arizona (Ecology and Environment, 1981);

- Geotechnical Evaluation of the Influence of Hassayampa Landfill Hazardous Wastes on the PVNGS Conveyance Pipeline (Ertec Western, 1982);

- Open Dump Inventory of Hassayampa Landfill, Groundwater Criterion (ADHS, 1982);

- Hassayampa Landfill Site Inspection Report (ADHS, 1985);

- Results of Preliminary Hydrogeological Investigations, Hassayampa Landfill, Maricopa County, Arizona (Montgomery and Associates, 1987).

The Remedial Investigation for the Site was conducted by the PRPs, with oversight provided by EPA and the Arizona Department of Environmental Quality (ADEQ). The Remedial Investigation was initiated in 1988, and the Remedial Investigation report was approved by EPA on April 4, 1991. A Risk Assessment report was completed by EPA on September 12, 1991. The Feasibility Study report, which was completed by the PRPs, was approved by EPA on May 20, 1992.

4. ENFORCEMENT ACTIVITIES

Significant enforcement activities conducted at the Site are summarized in Table 2.

C. HIGHLIGHTS OF COMMUNITY PARTICIPATION

As described below, EPA has satisfied the public participation requirements of CERCLA Section 113(k)(2)(B) and 117. EPA currently maintains Hassayampa Landfill Site information repositories at the Buckeye Library in Buckeye, Arizona and at the EPA Region 9 office in San Francisco. The EPA Region 9 office and the Buckeye Library maintain copies of the entire Administrative Record File. EPA also maintains a computerized Hassayampa Landfill Site mailing list, currently with over 500 addresses. Furthermore, EPA conducted a public meeting and accepted comments on the Proposed Plan and RI/FS. EPA has prepared a Responsiveness Summary (Appendix B) which summarizes EPA's responses to public comments received on the RI/FS and Proposed Plan.

A chronological list of community relations activities conducted by EPA for the Hassayampa Landfill Site is provided in Table 3.

D. SCOPE AND ROLE OF THIS DECISION DOCUMENT WITHIN THE SITE STRATEGY

This ROD selects remedial measures for vadose zone contamination (including soil and soil vapor above the water table) and groundwater contamination at the Hassayampa Landfill Site. The remedial measures selected under this ROD constitute a final remedy for the Site.

Sufficient information currently exists to select a remedy for the Site. However, additional investigation will be conducted during the remedial design phase in order to define the extent of groundwater and soil vapor contamination. This additional investigation is not expected to affect the remedy selected for the Site. As necessary, the remedial design will be modified to reflect the additional data collected.

E. SUMMARY OF SITE CHARACTERISTICS

1. CONTAMINANTS OF CONCERN

Waste and Soil Contamination
Site-related contaminants have been detected in soil, soil vapor, groundwater, and air at the Site.

Soil borings drilled through the disposal pits indicate that the base of these pits (which have since been filled) range in depth from 6 to 20 feet below land surface. Consolidated, moist,

TABLE 2 ENFORCEMENT ACTIVITIES - HASSAYAMPA LANDFILL SITE	
DATE	**ACTIVITY**
1/87	EPA completes Potentially Responsible Party (PRP) Search
2/2/87	General Notice/Information Request letters sent to 8 PRPs
4/17/87	General Notice/Information Request letters sent to 78 PRPs
5/7/87	General Notice/Information Request letters sent to 20 PRPs
6/24/87	Special Notice letters sent to all previously identified PRPs
1/11/88	Remedial Investigation/Feasibility (RI/FS) Consent Order signed by EPA and PRPs
11/19/91	General Notice letter sent to one previously unidentified PRP

TABLE 3 COMMUNITY RELATIONS ACTIVITIES HASSAYAMPA LANDFILL SITE	
1987	Community Relations Plan for the site was completed
1/92	EPA issued a Fact Sheet summarizing results of the Remedial Investigation and Risk Assessment and outlining future site activities.
5/29/92	The Administrative Record for the Site was sent to the Buckeye Library.
6/1/92	A public notice was published in the Buckeye Valley News announcing the availability of the Proposed Planand the Administrative Record and announcing the dates of the public comment period and public meeting.
6/28/92	EPA issued the Proposed Plan Fact Sheet which explained the results of the RI/FS, described EPA's preferred plan for cleaning up the Site, and announced the dates of the public comment period and public meeting.
6/1/92-6/30/92	Public comment period for the RI/FS and Proposed Plan
6/11/92	EPA conducted a public meeting during which the Proposed Plan was presented and comments were accepted.

colored material encountered within the pits is referred to herein as waste material. Waste samples were collected from Pits 1, 2, 3a, 3c, 4b, and 4c. Soil samples were also collected from beneath Pits 1, 2, 3b, 3c, 4b, 4c. No waste or soil samples were collected from the Special Pits area due to the scattered nature of these pits. Instead soil vapor sampling was performed in the Special Pits area. Vadose zone monitoring borings were also installed at several locations and soil vapor samples were obtained. Figure 5 shows the location of soil borings, vadose zone monitoring borings, and soil vapor samples taken at the Site.

Volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) have been detected in waste and soil within the hazardous waste area. The concentrations of contaminants in waste and soil were compared with Health-Based Guidelines Levels (HBGLs) for surface soil developed by ADHS. The HBGLs are derived from calculations based on ingestion of soil. The HBGLs have not been promulgated. The only pit which contains waste contaminants at concentrations in excess of their HBGLs is Pit 1, which contains tetrachloroethane and trichloroethene at levels in excess of their respective HBGLs (Table 4). Similarly, the only pit which is underlain by soil contaminants at concentrations in excess of their HBGLs is Pit 1, which has 1,1-dichloroethene, dichloromethane, 1,2-dichloropropane, tetrachloroethene, 1,1,1-trichloroethane, and trichloroethene present at levels in excess of their HBGLs (Table 4). It should be noted that the highest level of soil contamination was detected in the deepest sample taken beneath Pit 1(about 60 feet). This sample was taken immediately above the basaltic lava-flow unit.

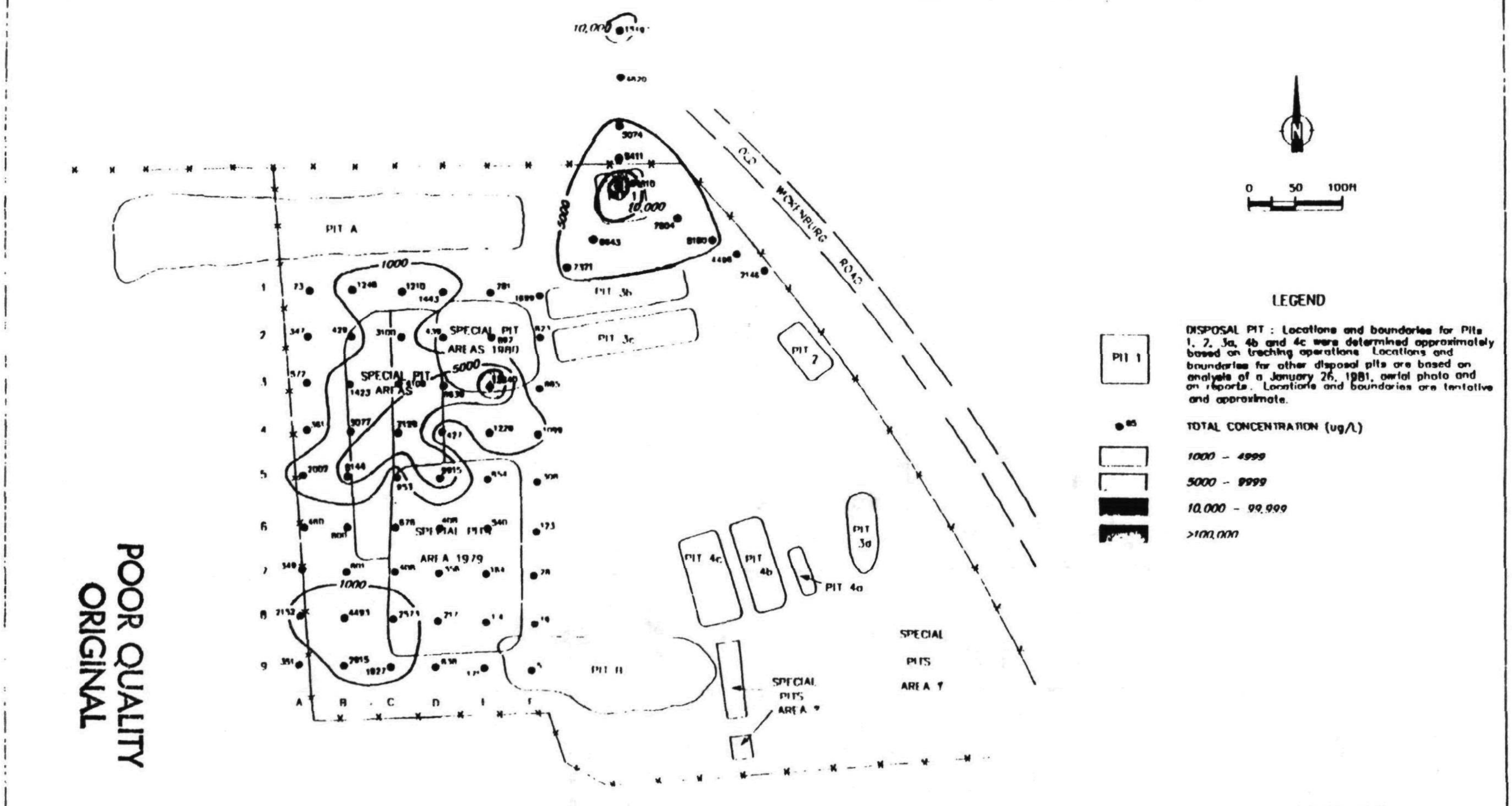
Waste and soil contaminant concentrations were also compared to Toxicity Characteristic Leaching Procedure (TCLP) levels and Extraction Procedure Toxicity (EP Tox) levels. The TCLP test was designed to determine the mobility of organic and inorganic analytes, and is one of the criteria used to determine whether a material is a hazardous waste. The EP Tox test preceded the TCLP test and has since been replaced by the TCLP test. The TCLP levels for organics were exceeded only by waste from Pit 1, where levels of 1,1-dichloroethene, trichloroethene, and tetrachloroethene exceeded the TCLP levels. All inorganic waste and soil concentrations were below the TCLP and EP Tox levels with the exception of two compounds. Chromium was detected in waste from Pit 2 at a concentration of 9.9 mg/l (compared to EP Tox level of 5 mg/l) and lead was detected in waste from Pit 3c at a concentration of 11.5 mg/l (compared to EP Tox level of 5 mg/l).

Soil Vapor Contamination
Based on the results of soil vapor surveys, several areas of soil vapor contamination have been identified (Figure 6). The soil

TABLE 4

Comparison of Waste and Soil Concentrations for Pit 1 to Health-Based Guidance Levels

CHEMICAL	PIT 1-MAXIMUM WASTE CONCENTRATION (PPM)	PIT 1-MAXIMUM SOIL CONCENTRATION (PPM)	HEALTH-BASED GUIDANCE LEVEL (PPM)
benzene	ND	1	--
o,p-dichlorobenzene	97	22	1,500
1,1-dichloroethane	ND	47	--
1,1-dichloroethene	30	1630	140
dichloromethane	16	990	94
1,2-dichloropropane	ND	207	12
dimethylbenzenes (total xylenes)	77	350	200,000
acetone	ND	2540	14,000
ethylbenzene	ND	57	14,000
toluene	25	510	20,000
methyl ethyl ketone	ND	405	3,400
tetrachloroethene	541	600	14
1,1,1-trichloroethane	914	23,000	4,000
1,1,2-trichloroethane	13	20	60
trichloroethene	107	590	64
trichlorotrifluoroethane	20	12,000	4,200,000



BASE MAP SOURCE : ERROL L. MONTGOMERY AND ASSOCIATES

FIGURE 6

TOTAL SOIL GAS CONCENTRATIONS
HASSAYAMPA LANDFILL
Maricopa County, Arizona

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vapor contaminants consist of volatile organic compounds (VOCs) including 1,1-dichlorethene, tetrachlorethene, 1,1,1-trichloroethane, trichloroethene, and trichlorotrifluoroethane. The area in the vicinity of Pit 1 contains the highest levels of soil vapor contamination. Soil vapor contamination also exists in an area north of Pit 1, extending beyond the boundaries of the HWA. Investigation of the extent of soil vapor contamination north of Pit 1 is ongoing and will continue during the remedial design phase. Elevated levels of soil vapor contamination have also been identified in the central and southwest portions of the Special Pits area.

Groundwater
As mentioned previously, two water-bearing units beneath the Site were identified and investigated. The direction of groundwater flow in both units is generally to the south, although local variations in the flow direction may occur. Water level contours and potentiometric contours for Units A and B are presented in Figures 3 and 4), while hydraulic parameters for both units are identified below.

UNIT	**GRADIENT**	**TRANSMISSIVITY gpd/ft**	**CONDUCTIVITY (gpd/ft^2)**
Unit A	0.005	2,000	100
Unit B	0.008	5,000	140

Analytical results for routine constituents indicate that the chemical quality of groundwater in Unit A is consistent with chemical quality of groundwater in shallow aquifers in the landfill area, and that chemical quality of groundwater in Unit B is generally better than that of Unit A.

Volatile organic compounds were detected and confirmed in groundwater samples obtained from Unit A monitor wells MW-1UA, MW-4UA, MW-5UA, MW-6UA, MW-7UA, and from abandoned ADHS well HS-1 (see Figure 3 for well locations). The compounds detected in groundwater from Unit A are presented in Table A-1. Eight of these chemicals have been detected at levels in excess of the selected cleanup standards (see Section I - The Selected Remedy for a discussion of cleanup standards). The approximate target zone for groundwater remedial action is presented in Figure 7. It must be stressed that this target zone does not correspond to a groundwater plume, but merely represents a contiguous area within which are located the monitoring wells that have yielded contaminated groundwater from Unit A. The boundaries of the contaminant plume will be further defined during the remedial design phase. To date, no significant contamination has been detected in groundwater from Unit B.

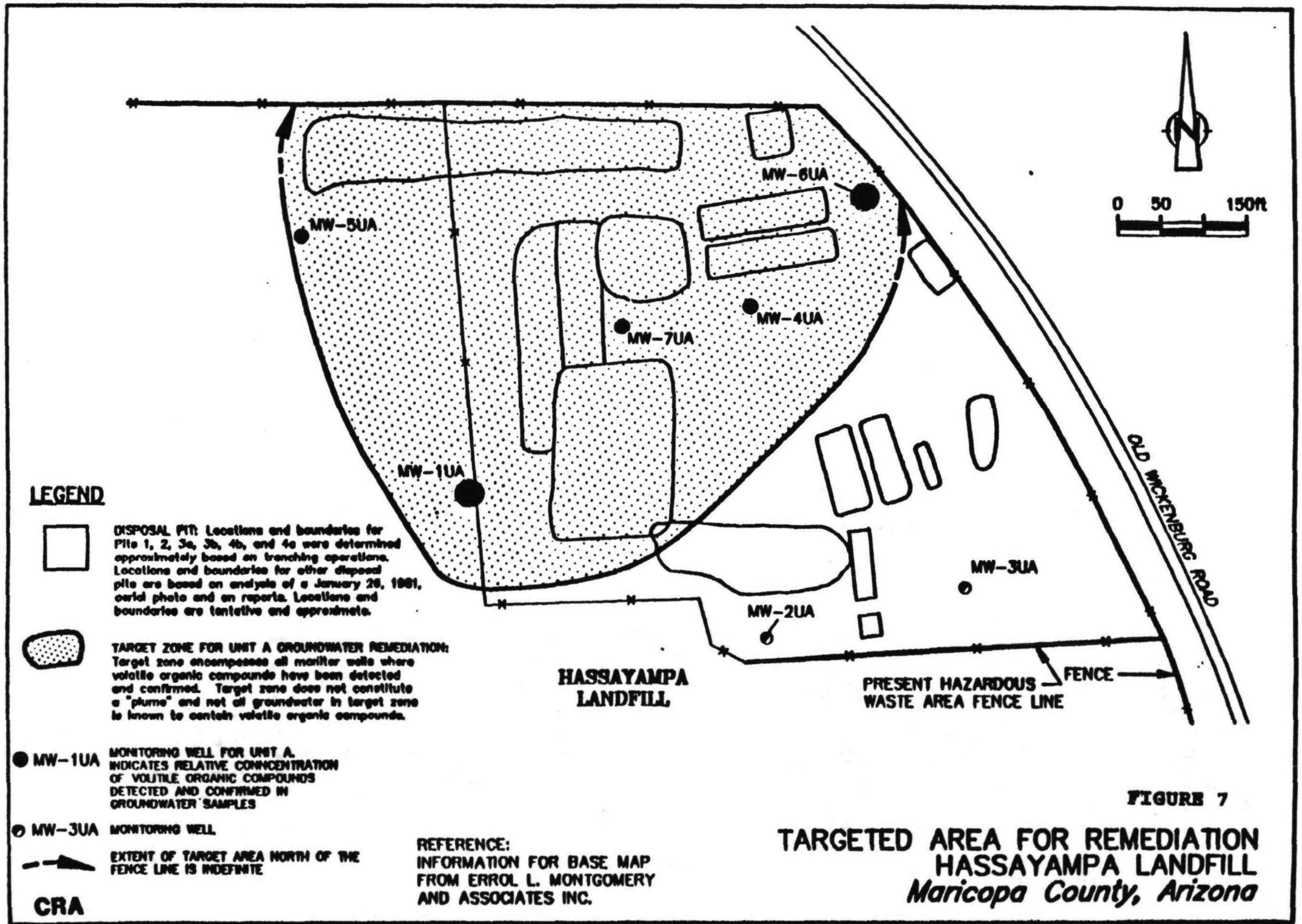

FIGURE 7

TARGETED AREA FOR REMEDIATION
HASSAYAMPA LANDFILL
Maricopa County, Arizona

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Air
Air sampling using Tenax tubes was conducted to determine the impact of Site conditions on air quality. The results of this sampling event are presented in Table 5. Generally, only relatively low levels of VOCs were detected in the air samples. Exposure by workers to VOCs in air is regulated under the Permissible Exposure Levels (PELs) established by the Occupational Safety and Health Administration (OSHA). The levels of VOCs detected in air at the Site are well below the PELs. Caution should be used in interpreting the sampling results as being representative of annual average conditions, because these results may vary with different meteorological conditions.

Soil cover in the HWA consists of a reddish-brown to brown silty sand which ranges from two to eight feet in thickness. The soil cover appears to effectively retard the release of gas from buried waste materials in the pits.

Surface Sediment
Surface sediment samples were collected from drainage channels in the vicinity of the Site. Low levels of pesticides were detected in several samples; however, pesticides were also detected in a background sample at similar concentrations suggesting that the Site is not the source of this contamination. The presence of these pesticides may be the residual effect of past agricultural activities.

F. SUMMARY OF SITE RISKS

1. HUMAN HEALTH RISKS

The human health assessment consists of several steps including identification of Contaminants of Potential Concern (COPCs), exposure assessment, toxicity assessment, and risk characterization.

a. Chemicals of Potential Concern

For the most part, all chemicals found to be present at the Site during the RI were identified as COPCs in the Risk Assessment report. However, the list of COPCs was narrowed down based on the following criteria:

- Common laboratory contaminants were removed from further evaluation if the Site sample concentrations were less than ten times the maximum amount detected in any blank. For all other chemicals, if the Site contaminant concentrations were less than five times the maximum amount detected in any blank, the chemicals were removed from further evaluation;

- Chemicals that were judged to be present at background

TABLE 5

SUMMARY OF MONITORING DATA FOR AIR COPCs (concentrations in ug/m3)

STATION	Acetone	Benzene (a)	Carbon Tetrachl.	Chloro-methane	DBCM	1,1-DCA	1,1-DCE	1,2-DCP	Ethyl Benzene	Methylene Chloride	PCE	Toluene	1,1,1-TCA	TCE	TCFM	Xylenes (m,p-)	Xylenes (o-)
A2		3.20 J	0.60 J	0.49 J	0.67	0.80	2.38 J			91.00 J	0.62	19.00	13.00 J	0.57	3.60	0.86	
B2		3.70 J	0.70 J				0.85			71.00 J		15.00		1.10	2.05 J	0.90	
C2		1.20								12.00							
E2	34.00 J	4.50 J	0.80 J						0.71	141.00 J		95.00			6.10 J	1.90	0.57
F2		4.70 J	0.71 J	0.61 J						91.00 J		26.00			1.90 J	0.91	
G2		5.10 J	0.77 J						0.56	112.00 J		72.00	4.49 J		2.51 J	1.70	0.56
H2		4.40 J	0.61 J	0.85 J						96.00 J		0.80					
I2		2.89 J	0.74 J	0.74 J			1.10		0.58	116.00 J		30.00			1.42 J		
J2			1.30 J		1.60	1.40	4.90 J	0.47		204.00 J	1.50	20.00	46.50 J	1.60	1.10 J	0.57	
MEAN (b)	34.00	3.71	0.78	0.67	1.14	1.10	2.31	0.47	0.62	103.78	1.06	34.73	21.33	1.09	2.67	1.14	0.57
MAXIMUM	34.00	5.10	1.30	0.85	1.60	1.40	4.90	0.47	0.71	204.00	1.50	95.00	46.50	1.60	6.10	1.90	0.57
STD (c)	0.00	1.19	0.21	0.14	0.47	0.30	1.61	0.00	0.07	48.91	0.44	29.84	18.13	0.42	1.59	0.48	0.00
SAMPLE SI	1	8	8	4	2	2	4	1	3	9	2	8	3	3	7	6	2
95% UCL (d)	34.00	4.40	0.90	0.78	1.68	1.45	3.63	0.47	0.68	130.60	1.57	52.08	38.55	1.49	3.66	1.46	0.57

Source: Montgomery, 1991 (Table I-8)

NOTES: [shaded box] = Statistical summary

DBCM: Dibromochloromethane
1,1-DCA: 1,1-Dichloroethane
1,1-DCE: 1,1-Dichloroethene
1,2-DCP: 1,2-Dichloropropane
PCE: Tetrachloroethene
1,1,1-TCA: 1,1,1-Trichloroethane
TCE: Trichloroethene
TCFM: Trichlorofluoromethane

(a) J, as a validation data qualifier, indicates an estimated quantity.

(b) Blank spaces indicate that the compound was not detected or its presence could be attributed to laboratory contamination.

(b) Arithmetic mean or average. Positively detected values were averaged only. One-half of the sample quantitation limit (SQL) for non-detects was not assumed.

(c) Sample standard deviation.

(d) One-sided 95% upper confidence limit = (average) + [Z of 0.95 or 1.645 x [(standard deviation) / (sample size)^1/2]], where "^" means "to the power of."

concentrations were eliminated from further evaluation; and

- With the exception of trichlorofluoroethane (Freon 113), tentatively identified compounds (TICs) were not considered COPCs. Freon 113 was retained due to the large volumes (approximately 10,384 gallons) thought to have been disposed at the Site.

COPCs were identified by environmental medium - subsurface soil (including waste material), groundwater, and air. Onsite surface soil is not considered a medium of concern because the HWA has been covered with clean soil. No COPCs were identified in surface sediments in the vicinity of the landfill.

The specific COPCs identified for subsurface soil, groundwater, and air are presented in Table 6. Vinyl chloride was identified as a COPC even though it was not detected in groundwater at the Site. This decision was based on the fact that vinyl chloride is a potent carcinogen, and is a potential breakdown product of VOCs that were identified at the Site.

b. Exposure Assessment

The objective of exposure assessment is to estimate the types and magnitudes of exposure to COPCs associated with the Site. As part of this process, pathways of current and future exposure are identified. There are several pathways by which individuals could be exposed to contaminants disposed in the HWA. These pathways were evaluated under current land-use and future land-use scenarios.

Under the current land-use scenario, the nearest offsite residence is about 1,000 meters south of the HWA. If contaminated groundwater is allowed to continue 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. Exposure of workers to VOCs at the landfill was not evaluated by the Risk Assessment. However, the concentrations of VOCs to which landfill workers are expected to be exposed are well below Permissible Exposure Levels (PELs) established by the Occupational Safety and Health Administration (OSHA). The following exposure routes were evaluated under the current-use scenario:

- Ingestion of VOCs in contaminated groundwater migrating offsite;
- Inhalation of VOCs in contaminated groundwater migrating offsite; and
- Inhalation of VOCs released from the Site to air.

TABLE 6
CHEMICALS OF POTENTIAL CONCERN BY MEDIUM

CHEMICAL OF POTENTIAL CONCERN	MEDIUM OF POTENTIAL CONCERN		
	SOIL	GROUNDWATER	AIR
acetone			X
benzene			X
carbon tetrachloride			X
chloromethane			X
chromium	X		
copper	X		
dibromochloromethane			X
1,2-dichlorobenzene	X		
1,4-dichlorobenzene	X		
1,1-dichloroethane		X	X
1,1-dichlorothene	X	X	X
1,2-dichloroethene		X	
1,2-dichloropropane		X	X
ethylbenezene			X
lead	X		
methylene chloride			X
tetrachloroethene	X	X	X
toluene	X	X	X
1,1,1-trichloroethane	X	X	X
trichloroethene		X	X
Freon 11		X	X
Freon 113	X	X	
xylene	X		X
vinyl chloride		X	

Under the future-use scenario, exposed populations are assumed to be present onsite and domestic wells are assumed to be installed onsite. Potentially exposed populations evaluated included both residential and industrial users. Although residential and industrial use of the landfill seems unlikely in the near future, it is not unrealistic to assume that such use could occur in the more distant future. The following exposure routes were evaluated under the future use scenario for both onsite residential and onsite industrial populations:

- Ingestion of contaminated soil;
- Ingestion of VOCs in groundwater;
- Inhalation of VOCs in groundwater, particularly via showering (residential only); and
- Inhalation of VOCs released from the Site to air.

Exposure intake parameter values were based on standard assumptions and best professional judgement. It should be noted that under all scenarios, it was assumed that the exposed individuals were adults. The only scenario under which children would demonstrate significantly different behavioral patterns which would affect their exposure was onsite residential (ingestion of soil). However, as explained later, this exposure pathway was not evaluated quantitatively.

c. Toxicity Assessment

Both carcinogenic and non-carcinogenic chemicals have been identified in soil and groundwater at the Hassayampa Landfill Site. Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting non-carcinogenic effects. The RfD is an estimate, with an uncertainty of approximately an order of magnitude, of a lifetime daily exposure for the entire population (including sensitive individuals) that is expected to be without appreciable risk of deleterious effects. Estimated intake of chemicals from environmental media (e.g. the amount of a chemical ingested from contaminated drinking water) can be compared to RfDs. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g. to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse non-carcinogenic effects to occur.

For chemicals classified by EPA as proven or probable human carcinogens, risk was evaluated using cancer potency factors (CPFs) which have been developed by EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. CPFs were multiplied by the estimated intake of the potential carcinogen to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term upper-bound reflects the conservative estimate of the risks calculated from the CPF. Use of this approach makes underestimation of the actual cancer risks highly unlikely.

EPA's Region 9 office has generated guidance for calculating toxicity values for chemicals considered to be "possible human carcinogens," such as 1,1-dichlorothene (1,1-DCE). EPA Region 9 has proposed developing a modified RfD for 1,1-DCE rather than using its CPF. The modified RfD is calculated by dividing its oral RfD by a safety factor of 10.

d. Risk Characterization

The risk characterization step of the risk assessment process combines the information from the previous steps to determine if an excess health risk is present at the Site. Excess lifetime cancer risks are determined by multiplying the intake levels by the CPFs. These risks are probabilities that are generally expressed in scientific notation (e.g. 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} indicates that, as a plausible upper-bound, an individual has a one in one million chance of developing cancer as a result of a site exposure to a carcinogen over a seventy year lifetime under the specific exposure conditions at a site. As is stated in the National Contingency Plan (NCP)(40 C.F.R. Section 300.430 (e)), "For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper-bound lifetime cancer risk to an individual of between 10^{-4} and 10^{-6}."

Potential concern for the non-carcinogenic effect of a single contaminant in a single medium is expressed as a hazard quotient (HQ), which is the ratio of the estimated intake derived from the contaminant concentrations in a given medium to the contaminant's reference dose. By adding the HQs for all contaminants within a medium or across all media to which a given population is exposed, the hazard index (HI) can be generated. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media. An HI in excess of one is generally regarded by EPA as representing an unacceptable lifetime, non-carcinogenic human health risk.

As discussed previously, 1,1-DCE is classified as a "possible human carcinogen," reflecting the fact that there is only limited evidence available suggesting that this substance is a human carcinogen. Thus, in accordance with EPA Region 9 guidance, carcinogenic risk for 1,1-DCE was evaluated differently than for other carcinogens. The evaluation of 1,1-DCE's carcinogenicity is analogous to the calculation for the non-carcinogenic contaminants described above. A cancer hazard index (CHI) in excess of one is regarded by EPA Region 9 as representing an unacceptable lifetime human health risk.

The results of the risk characterization step are summarized in Table 7. This table presents both typical and reasonable maximum exposure (RME) risks calculated for the current offsite residential, future onsite residential, and future onsite commercial or industrial scenarios. The typical (or average) exposure risk is based on exposure to mean contaminant levels and mean values for contact and intake variables, including exposure frequency and duration. The RME risk is based on exposure to a concentration defined as the 95 percent upper confidence limit of the arithmetic mean concentration and 90 to 95 percent percentile values for contact and intake variables.

For a current offsite receptor located at a distance of a thousand meters downwind and downgradient from the site, the risk associated with VOCs in air does not appear significant (HI and CHI are less than one and carcinogenic risk is less than 10^{-6}). For the groundwater pathways, the carcinogenic and non-carcinogenic risk levels are below the benchmarks of 10^{-6} and one, suggesting there is no significant health threat. However, the CHI for 1,1-DCE is nearly four times the acceptable level of one (under both average and RME conditions), suggesting that continued migration of contaminated groundwater could result in unacceptable health risks.*

Under the future onsite residential scenario, the risk associated with ingestion and contact with onsite waste and soil was not evaluated quantitatively and was not summed with the other pathways evaluated, since only limited data from the pits was available at the time of writing the Risk Assessment. However, due to the presence of chromium, lead, and copper and high levels of VOCs and SVOCs in several of the pits, it was assumed that exposure to waste and soil would result in unacceptable health risks for onsite residents (termed significant risk in Table 7). Risk associated with inhalation of ambient air exceeded the acceptable benchmarks of 10^{-6} (average and RME conditions) and 1 (RME conditions only) for carcinogenic risk and CHI, suggesting unacceptable health risks for onsite residents. Finally, the CHI associated with ingestion of groundwater and inhalation of VOCs in groundwater also exceeded 1 (average and RME conditions), again suggesting unacceptable health risks for onsite residents.* Since the total risk calculated for the future onsite residential scenario does not include exposure to waste and soil within the

* If carcinogenic risk for 1,1-DCE had been evaluated using the traditional approach, the RME risk due to ingestion of groundwater and inhalation of VOCs in groundwater under the current offsite residential scenario would have been $1X10^{-3}$ excess cancers. Similarly, under the future onsite residential scenario, the RME risk would have been $2X10^{-3}$ excess cancers. Thus, carcinogenic risk under both of these scenarios exceeds the acceptable risk range of 10^{-4} to 10^{-6} excess cancers, suggesting that continued migration of contaminated groundwater could result in unacceptable health risks.

TABLE 7

SUMMARY OF ESTIMATED RISKS - CURRENT AND FUTURE LAND USES

Exposure Scenario	Average Exposure: Excess Cancer Risk	Average Exposure: CHI for 1,1-DCE	Average Exposure: Noncarcinogenic HI	Reasonable Maximum Exposure: Excess Cancer Risk	Reasonable Maximum Exposure: CHI for 1,1-DCE	Reasonable Maximum Exposure: Noncarcinogenic HI
I. CURRENT OFF-SITE RESIDENTIAL						
"Actual"[a]						
a. Inhalation of Ambient Air	8E-08	2.9E-03	2.4E-03	3E-07	4.5E-03	3.0E-03
Total	8E-08	2.9E-03	2.4E-03	3E-07	4.5E-03	3.0E-03
Potential						
a. Ingestion of Ground Water	1E-07	1.9	2.0E-01	4E-07	1.9	2.0E-01
b. Inhalation of VOCs in Ground Water	7E-08	1.9	1.9E-01	2E-07	1.9	1.9E-01
c. Inhalation of Ambient Air	8E-08	2.9E-03	2.4E-03	3E-07	4.5E-03	3.0E-03
Total	2E-07	3.8	3.9E-01	9E-07	3.8	3.9E-01
II. FUTURE ON-SITE RESIDENTIAL						
Potential						
a. Ingestion of Ground Water	2E-07	1.8	1.9E-01	7E-07	3.2	3.2E-01
b. Inhalation of VOCs in Ground Water	1E-07	1.8	1.9E-01	4E-07	3.2	3.2E-01
c. Inhalation of Ambient Air	2E-05	7.0E-01	5.9E-01	8E-05	1.1	7.3E-01
d. Exposure to Wastes Below Soil Cover	Significant Risk			Significant Risk		
Total	2E-05[b]	4.3[b]	9.7E-01[b]	8E-05[b]	7.5[b]	1.3[b]
III. FUTURE ON-SITE COMMERCIAL/INDUSTRIAL						
Potential						
a. Ingestion of Ground Water	7E-08	6.5E-01	6.7E-02	2E-07	1.1	1.2E-01
b. Inhalation of Ambient Air	1E-05	5.0E-01	4.2E-01	5E-05	7.9E-01	5.2E-01
c. Exposure to Wastes Below Soil Cover	Significant Risk			Significant Risk		
Total	1E-05[b]	1.2[b]	5E-01[b]	5E-05[b]	1.9[b]	6.4E-01[b]

Notes:

[a] "Actual" refers to currently complete exposure pathways. Risk numbers are estimates.

[b] Risk values presented do not account for exposure to wastes below the soil cover. Risks associated with exposure to these wastes are deemed unacceptable since the soil meets the criteria of hazardous waste.

pits (for reasons described above), the total risk values presented in Table 7 for this scenario represent minimum valuesand are expected to be significantly higher. Still, the total lrisk exceeded the 10^{-6} benchmark (average and RME), CHI of 1 (average and RME), and HI of 1 (RME).

Similarly, under the future onsite commercial or industrial scenario the risk associated with exposure to waste and soil was not evaluated quantitatively, but was assumed to be significant and indicative of unacceptable health risks for future workers in the HWA. The carcinogenic risk associated with inhalation of ambient air (average and RME) also exceeded the benchmark of 10^{-6}, indicating unacceptable health risks for future workers in the HWA. Again, as described above, the total risk calculated for the future onsite commercial/industrial scenario does not include exposure to waste and soil within the pits, and the total risk values presented in Table 7 for this scenario represent a minimum value and are expected to be significantly higher. Still, the total risk exceeded the 10^{-6} benchmark (average and RME) and CHI of 1 (average and RME).

Due to the threat of exposure to groundwater contaminants as a result of future offsite migration of contaminated groundwater, and the threat of exposure to contaminated waste and soil under the residential and commercial/industrial scenarios; actual or threatened releases of hazardous substances from this Site may present an imminent and substantial endangerment to public health or welfare.

2. ENVIRONMENTAL EVALUATION

The ephemeral Hassayampa river (which drains to the south) and associated riparian habitat, is located about 3/4 mile east of the landfill. Although the Hassayampa Landfill is located within the drainage area of this river, the landfill is located outside of the projected 100-year floodplain of the river.

The Arizona Game and Fish Department (AGFD) identified the Gambel's Quail, Mourning Dove, and Jack Rabbit as the most likely game species in the area and noted that interspersed stands of larger trees may be used by migratory birds. The U.S. Fish and Wildlife Service (USFWS) indicated that no listed or proposed threatened or endangered species or biological resources would likely be affected by contamination at the Site. USFWS did indicate that a candidate category 1 species, the Lowland Leopard Frog, may be found in the vicinity of the Site.

Under current Site conditions, there is no information to suggest that ecological receptors may presently be exposed to Site contamination. The HWA is covered by clean soil and the perimeter is bermed to prevent erosion and offsite drainage. Although contaminated groundwater appears to be migrating south, the nearest perennial surface water body where groundwater might discharge is the Gila River, which is more than 2 miles from the Site.

With the understanding that the HWA is covered with soil, AGFD concludes that the likelihood of exposure to wildlife seems low. AGFD did identify wetland and riparian habitat and associated species along the Gila River that might be affected if groundwater contamination were to migrate that distance. Groundwater modeling performed in the Risk Assessment indicates that this scenario is unlikely. There are no wetlands or riparian habitat within the boundaries of the Site.

G. DESCRIPTION OF ALTERNATIVES

EPA initially considered a wide range of technologies and alternatives for remediation of the vadose zone (including soil and soil vapor above the water table) and for remediation of groundwater. The alternatives which survived the screening process and were evaluated in the detailed analysis are described below. For all of the alternatives except for the No Action Alternative, two groundwater options were evaluated. Since these two groundwater options are common to all of the alternatives except No Action, the groundwater options will be discussed first.

The cost of each of the alternatives evaluated is presented in Table 8.

1. GROUNDWATER

EPA evaluated two groundwater options for the Site. These two options were identical with the exception that the treatment systems differed. Both options consisted of groundwater extraction, groundwater treatment, reinjection of the treated water, and continued groundwater monitoring. The two treatment options considered were air stripping and ultra-violet (UV) oxidation.

Under these options, groundwater would be extracted from Unit A using several extraction wells. Calculations performed in the Feasibility Study suggest that four to five extraction wells operating at five gallons per minute would achieve ARARs in Unit A within a maximum of 20 to 30 years. However, the exact number of extraction wells, well locations, and pumping rates would be

TABLE 8
COST OF REMEDIAL ALTERNATIVES

ALTERNATIVE	ESTIMATED COST			
	CAPITAL COST	ANNUAL COST	PRESENT WORTH OF ANNUAL COST*	TOTAL PRESENT WORTH*
Alternative 1 No Action	$0	$0	$0	$0
Alternative 2 Access/Deed Restrictions Cap Groundwater Extraction/ Treatment/Reinjection	Option A $1,531,300 Option B $2,012,300	 $347,500 $485,000	 $2,213,100 $4,865,100	 $3,744,000 $6,877,000
Alternative 3 Access/Deed Restrictions Cap Soil Vapor Extraction/ Treatment Groundwater Extraction/ Treatment/Reinjection/ Monitoring	Option A $3,878,300 Option B 4,359,300	 $347,500 $490,500	 $2,213,100 $4,865,100	 $6,091,400 $9,224,400
Alternative 4 Access/Deed Restrictions Cap Soil Vapor Extraction/ Treatment Removal/Soil Washing Pit 1 Groundwater Extraction/ Treatment/Reinjection/ Monitoring	Option A $4,980,300 Option B 5,461,300	 $347,500 $485,500	 $2,213,100 $4,865,100	 $7,193,000 $10,325,000

Option A refers to a groundwater treatment system using air stripping.
Option B refers to a groundwater treatment system using UV oxidation.
* Present worth costs are estimated based on a 30-year operating period.

determined during remedial design.

The extracted groundwater would be treated through air stripping or UV oxidation. Air stripping involves the transfer of VOCs dissolved in water to a stream of air flowing counter-current to a stream of water over a bed of packing material.

Contaminants which have been transferred to the air stream, can be discharged directly to the atmosphere or treated prior to discharge. Calculations performed in the Feasibility Study suggest that uncontrolled VOC air emissions from the air stripper would be 1.3 lbs/day, which is substantially below the Maricopa County guideline of 3 lbs/day and the EPA guideline of 15 lbs/day. Nevertheless, vapor phase carbon adsorption would be required to treat air emissions from the air stripper if total VOC emissions at the Site exceed the Maricopa County guideline. UV oxidation uses ultraviolet light and an oxidant (typically hydrogen peroxide or ozone) to destroy organic contaminants. Water and a small amount of chloride salts and carbon dioxide are produced as by-products, but there are no substantial air emissions from the process.

The treated groundwater would be reinjected, either onsite or in the immediate vicinity of the Site. The Feasibility Study indicated that one injection well screened in Unit B and located to the west of the hazardous waste area would be the most advantageous scenario. However, the number of injection wells, the location of the injection wells, depth of the injection wells, and injection rates would be determined during remedial design.

Continued groundwater monitoring would be performed to monitor and ensure the effectiveness of the remedy. The number of monitoring wells and frequency of sampling would have to be sufficient to monitor the effectiveness of the remedy. Additional investigation would be performed during remedial design to characterize the extent of groundwater and soil vapor contamination.

2. VADOSE ZONE

The following alternatives were evaluated for remediation of the vadose zone (including soil and soil vapor above the water table).

Alternative 1 - No Action.

Under this alternative no additional action would be taken at the Site following the RI/FS. Continued monitoring would be required at the Site, although the cost estimate for this alternative does not reflect the cost of performing such monitoring. EPA is required to carry a No Action alternative through the final detailed analyses.

Alternative 2 - Access & Deed Restrictions, Cap, Groundwater Extraction/Treatment/Reinjection/Monitoring.

Under this alternative the perimeter fence would be upgraded and maintained to restrict unauthorized access to the Site. Long-term deed restrictions would also be imposed, thereby restricting future use of the Site. These restrictions would include (1) access limitations (including a requirement that a fence be maintained around the Site) and (2) use limitations restricting future use of the Site and restricting use of groundwater beneath the Site.

This alternative would also include the construction of a cap over the hazardous waste area. The purpose of this cap would be to prevent direct contact with contaminated waste and soil left in place, to reduce infiltration of water, and to reduce the release of VOC vapors to the atmosphere. At a minimum, this cap would have to meet the substantive requirements of a RCRA cap for 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" (EPA/530-SW-89-047). The construction details and design requirements of this cap would be determined during remedial design.

As described previously, this alternative would also include groundwater extraction, groundwater treatment, reinjection of treated water, and continued groundwater monitoring to ensure the effectiveness of the remedy.

Alternative 3 - Access & Deed Restrictions, Cap, Soil Vapor Extraction/Treatment, Groundwater Extraction/Treatment/ Reinjection/Monitoring.

This alternative is identical to Alternative 2 with the exception that it also includes soil vapor extraction and treatment of the extracted soil vapors. Soil vapor extraction would involve the installation of extraction vents in order to remove VOCs and SVOCs from the vadose zone. These vents would be installed within waste and soil in areas where waste and soil contamination has been demonstrated to be a threat to groundwater and where soil vapor has been identified as being present in excess of the soil vapor cleanup standards (see Section I - The Selected Remedy for a discussion of soil vapor cleanup standards). A vacuum system would be applied to the vents in order to induce air flow through the soil, causing the VOCs and SVOCs present in the waste and soil to volatilize into the air stream. Water in the air stream would be condensed, separated from the air stream, and transferred to a water treatment system. The contaminated air stream would then flow through an air and vapor treatment system consisting of either a vapor phase carbon adsorption unit or a catalytic oxidation system (catalytic oxidation is essentially a thermal incinerator which uses a catalyst to promote the oxidation of VOCs). The specific soil vapor treatment system would be selected during remedial design.

Alternative 4 - Access & Deed Restrictions, Cap, Soil Vapor Extraction/Treatment, Excavation/Soil Washing, Groundwater Extraction/Treatment/Reinjection/Monitoring.

This alternative is identical to Alternative 3, except that it also includes excavation of approximately 1,400 cubic yards of waste from Pit 1, soil washing, and replacement of the treated material. Waste that is present at levels in excess of the Arizona Health-Based Guidance Levels for surface soil would be excavated using standard excavation equipment. The excavated waste would then be treated using a soil washing process. Soil washing involves contacting the waste with water to partition the contaminants from the solid phase to the liquid phase. Excavated wastes would be slurried with water to remove contaminants from the wastes and pumped through a filter press to separate the solids from the wastes. The contaminated water would then be collected for treatment, while the decontaminated soils would be backfilled into Pit 1.

H. SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

Each of the alternatives described in the preceding section was evaluated according to the nine criteria defined below. Each criterion is discussed in detail on the pages that follow this list.

Threshold Criteria

Overall protection of human health and the environment. Addresses whether the alternative can adequately protect human health and the environment, in both the short and long-term, from contaminants present at the Site.

Compliance with ARARs. Addresses whether the alternative will meet all Federal and State environmental laws that are applicable or relevant and appropriate requirements (ARARs) or provide grounds for invoking a waiver of the ARAR.

Primary Balancing Criteria

Long-term effectiveness and permanence. Refers to the long-term effectiveness and permanence afforded by the alternative along with the degree of certainty that the alternative will prove successful.

Reduction of toxicity, mobility, or volume through treatment. Refers to the degree to which the alternative reduces toxicity, mobility, or volume of the Site contaminants through treatment and reduces inherent hazards posed by the Site.

Short-term effectiveness. Refers to the short-term risks posed to the community, the potential impact on workers, and the potential environmental impact during implementation of the alternative.

Implementability. Refers to the ease or difficulty of implementing the alternative by considering technical feasibility, administrative feasibility, and availability of materials and services.

Cost. Includes capital costs, annual operating and maintenance costs (O & M costs), and net present value of O & M costs.

Modifying Criteria

State acceptance. Indicates whether the State concurs with, opposes, or has no comment on the preferred alternative.

Community acceptance. Indicates whether the community agrees with, opposes, or has no comment on the preferred alternative.

COMPARATIVE ANALYSIS

Overall Protection of Human Health and the Environment

Alternative 1 is not protective of human health and the environment since no action is taken to prevent future exposure to contaminated groundwater. In addition, future land use could result in direct exposure to waste material and contaminated soil.

Alternatives 2, 3, and 4 attain similar levels of protection of human health and the environment by preventing exposure to contaminated groundwater through groundwater extraction and treatment. In addition, these alternatives prevent contact with waste material and contaminated soil through the use of a cap and access and deed restrictions.

Alternatives 3 and 4 attain a slightly greater level of protection as compared to Alternative 2, since they use soil vapor extraction to reduce soil vapor contamination to levels that are protective of groundwater quality. This reduces the chances of exposure to the soil vapor contaminants through exposure to groundwater. Similarly, Alternative 4 attains a slightly greater level of protection as compared to Alternative 3, since contaminated waste from Pit 1 would be excavated and treated. This provides additional protection in the unlikely event that deed and access restrictions and the cap fail to prevent direct contact with the waste material. The two groundwater treatment options considered, air stripping and UV oxidation, attain similar levels of protection of human health and the environment.

Compliance with ARARs

Alternative 1 does not comply with ARARs since it would not meet the groundwater cleanup standards. Alternatives 2, 3, and 4 all meet ARARs. Under these alternatives, it is estimated that groundwater cleanup standards would be met in a maximum of 20-30 years. However, since Alternatives 3 and 4 use soil vapor extraction to prevent vadose zone contaminants from continuing to contaminate groundwater, it is possible that these two alternatives could attain the groundwater cleanup standards more quickly than Alternative 2.

The two groundwater treatment options considered would both meet the groundwater cleanup standards. It is expected that emissions from the air stripper and the soil vapor extraction system would meet Federal and County guidelines. In the event that these guidelines are exceeded, vapor-phase carbon will be required in order to comply with these standards.

ADEQ Health-Based Guidance Levels for surface soil have been identified as TBCs for Alternative 4, which involves excavation and treatment of contaminated waste and soil. Under this alternative, contaminated waste and soil would be excavated and treated to the ADEQ HBGLS. Alternatives 2 and 3 meet the ADEQ HBGLS for surface soil indirectly by preventing exposure to contaminated waste and soil through the use of access and deed restrictions and a cap.

Long-Term Effectiveness and Permanence

Since Alternative 1 does not involve remediation at the Site, it does not provide long-term protection.

Alternatives 2, 3, and 4 provide similar long-term effectiveness with respect to groundwater by extracting and treating contaminated groundwater. However, Alternatives 3 and 4 provide greater long-term effectiveness with respect to groundwater as compared to Alternative 2, because Alternatives 3 and 4 use soil vapor extraction to prevent vadose zone contamination from being a continuing source of groundwater contamination. Both of the groundwater treatment options, air stripping and UV oxidation, are considered permanent remedies.

Alternatives 2, 3, and 4 use a cap and access and deed restrictions to attain long-term effectiveness and permanence with respect to soil contamination. Through the use of soil vapor extraction, Alternative 3 attains a greater level of long-term effectiveness than Alternative 2. Alternative 4 provides a slightly greater level of long-term effectiveness since it also includes excavation and soil washing. However, since the volume of soil to be excavated and treated is relatively small (1,400 cubic yards), the added long-term effectiveness is limited.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternative 1 does not involve any treatment and would not result in a reduction of toxicity, mobility, or volume.

Alternatives 2, 3, and 4 all attain a significant reduction in mobility and volume of groundwater contaminants through the use of groundwater extraction and treatment. Alternatives 2, 3, and 4 would also result in a reduction in mobility of vadose zone contamination through the use of a cap. The cap would limit the amount of infiltration, and would thereby reduce migration of vadose contamination to groundwater. Of the two groundwater treatment options considered, UV oxidation attains a greater reduction of toxicity, mobility and volume as compared to air stripping.

Alternatives 3 and 4 attain a greater reduction in mobility and volume of vadose zone contamination as compared to Alternative 2, since Alternatives 3 and 4 include the use of soil vapor extraction to treat vadose zone contamination. Alternative 4 attains a slightly greater reduction in mobility and volume as compared to Alternative 3, since Alternative 4 includes soil washing of waste material in Pit 1.

Short-Term Effectiveness

Since water supply wells in the vicinity of the Site have not yet been impacted by site-related chemicals and since access to the Site is currently restricted, there are few short-term risks associated with the Site. Alternative 4, which includes removal of contaminated waste, could potentially pose some short-term risk to remedial workers during implementation; however, this risk could be eliminated through proper engineering, safety, and management practices.

Implementability

All of the alternatives are readily implementable. Alternative 1 is the most readily implementable since it involves no action. Alternatives 2, 3, and 4 rely on demonstrated technologies and proven and effective methods and equipment. Of the groundwater treatment technologies evaluated (which are identical for Alternatives 2, 3, and 4), air stripping would be easier to implement than UV oxidation, since UV oxidation would require a treatability study prior to implementation.

Cost

Table 8 presents a cost comparison of the four alternatives. Alternative 1 has no additional costs since there would be no action taken at the Site. The costs of Alternatives 2, 3, and 4 increase progressively. A cost sensitivity analysis performed in the feasibility study indicated that the net present worth of Alternative 4 remains significantly higher than the other alternatives irrespective of operating life. Although the groundwater component of the remedy is identical for Alternatives 2, 3, and 4, the cost of the two groundwater treatment technologies considered for these alternatives differs substantially. The cost of UV oxidation is significantly more expensive than the cost of air stripping.

State Acceptance

The State of Arizona, through both the Department of Environmental Quality and the Department of Water Resources, has participated in the RI/FS process. Both agencies have assisted in the development of ARARs and the remedy selection process. Since Alternative 1 is not protective of human health and the environment, this alternative would not be acceptable to either agency. Since Alternative 2 does not include soil vapor extraction and there is potential for continuing contamination of groundwater by soil vapor, this alternative would not be acceptable to either agency. Both Alternatives 3 and 4 would be acceptable to the two agencies.

Community Acceptance

Since Alternative 1 is not protective of human health and the environment, this alternative would not be acceptable to the community. Several community members have expressed a preference for treatment of contaminated soil gas, and as a result it is unlikely that Alternative 2 would be acceptable to the community. Alternatives 3 and 4 generally appear acceptable to the community; although several community members have expressed a preference for Alternative 4 since this alternative includes excavation and treatment of contaminated soil. Finally, several community members expressed a concern over the time required to reach the groundwater cleanup standards under Alternatives 2, 3, and 4.

I. THE SELECTED REMEDY

Alternative 3 is the selected remedy for the Hassayampa Landfill Superfund Site. The selected remedy includes vadose zone (including soil and soil vapor above the water table) remediation and groundwater remediation. Table 9 provides an estimate of the

TABLE 9
ESTIMATED COST OF THE SELECTED REMEDY
HASSAYAMPA LANDFILL SUPERFUND SITE

Remedial Component	*Description*		*Estimated Cost* *Capital Cost*	*Annual Cost*	*Present Worth of Annual Cost*	*Total Present Worth*
B1	Deed and Access Restrictions		$ 7,300	$ 500	$ 9,600	$ 17,000
B2	Cap		466,000	5,000	97,500	563,000
B8 & B9	Soil Vapor Extraction		2,347,000	Nil	Nil	2,347,000
B10, B11 & B12	Groundwater extraction, treatment, reinjection and monitoring					
	a) air stripping treatment		1,058,000	342,000	2,106,000	3,164,000
	b) UV oxidation treatment		1,539,000	480,000	4,758,000	6,297,000
	TOTAL	a)	3,878,300	347,500	2,213,100	6,091,400
		b)	4,359,300	490,500	4,865,100	9,224,400

TOTAL IMPLEMENTATION COST	a)	$	6,091,400
		($	6,100,000 rounded)
	b)	$	9,224,500
		($	9,200,000 rounded)

cost of the selected remedy with respect to the vadose zone and groundwater components.

GROUNDWATER

The groundwater component of the remedy includes extraction of contaminated groundwater, treatment of the water using air stripping, reinjection of the treated water, and continued groundwater monitoring to measure the effectiveness of the remedy. The number, location, and pumping rates of the extraction wells will be determined during the remedial design stage. To date, groundwater contamination has been restricted to Unit A, so it is anticipated that contaminated groundwater will only be extracted from this unit. In the event that groundwater contamination is identified in Unit B, then groundwater will also be extracted from Unit B.

Air stripping, rather than UV oxidation, was selected as the groundwater treatment technology. Both technologies are capable of attaining the selected cleanup standards; however, air stripping is significantly less expensive. It is anticipated that combined air emissions from the air stripper and SVE system at the Site will meet the Federal VOC guideline of 15 pounds per day and the Maricopa County VOC guideline of 3 pounds per day. In the event that these guidelines are exceeded, vapor phase carbon adsorption will be added to the air stripper (the selected remedy already calls for emissions controls to be placed on the SVE system). The treated water meeting the groundwater cleanup standards will be reinjected onsite or in the immediate vicinity of the Site. The number, location, depth, and injection rates of the reinjection well(s) will be determined during remedial design.

Continued groundwater monitoring will be performed to ensure the effectiveness of the remedy. The number of monitoring wells and frequency of sampling will have to be sufficient to measure the effectiveness of the remedy.

Federal MCLs have been selected as groundwater cleanup standards for the Site (Appendix A). The groundwater cleanup standards shall be met at all points within the contaminated aquifer. For the chemicals detected at the Site, the ADEQ MCLs and non-zero MCLGs are identical to the Federal MCLs, and, therefore, were not selected as cleanup standards. For those chemicals for which MCLs do not exist, ADEQ HBGLs have been selected as cleanup standards. There was one chemical, 1,1-dichloroethane, for which no ARARs or TBCs exist; however, this chemical is present at concentrations below risk-based levels. As a result, no groundwater cleanup standard was selected for this chemical.

VADOSE ZONE

The vadose zone component of the remedy includes installation of a cap over the 10-acre Hazardous Waste Area, soil vapor extraction and treatment, and access and deed restrictions. The purpose of the cap is 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. The design and construction details of the cap will be determined during remedial design; however, at a minimum the cap must meet 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" (EPA/530-SW-89-047).

The vadose zone component of the remedy also includes performing soil vapor extraction at all locations at the Site where soil vapor levels exceed cleanup standards, and where waste and soil contamination has been demonstrated to be a threat to groundwater quality. While the specific areas of the Site which require soil vapor extraction will be determined by EPA during the remedial design, EPA presently expects these areas to include Pit 1, the area of soil vapor contamination north of Pit 1, and several portions of the Special Pits area. The location, number, and construction details of the soil vapor extraction vents will be determined during remedial design. The soil vapors will be treated using vapor phase carbon adsorption or catalytic oxidation, as determined during remedial design. The soil vapor cleanup standards will be levels, established by EPA, that are protective of 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), as determined by site-specific analytical modeling.

The selected remedy also includes implementation of access and deed restrictions at the Site. The perimeter fence will be upgraded and maintained to restrict unauthorized access to the Site. Long-term deed restrictions will also be imposed, thereby restricting future use of the Site. These restrictions will include (1) access limitations (including a requirement that a fence be maintained around the Site) and (2) use limitations (restricting future use of the Site and restricting use of groundwater beneath the Site).

Additional investigation will be performed during remedial design to define the extent of groundwater and soil vapor contamination at and in the vicinity of the Site.

The selected remedy for the Site allows contaminated waste and soil to remain onsite. As described in Section II-E of this ROD, "Summary of Site Characteristics," Pit 1 was the only location where contaminants in waste or soil exceeded ADEQs proposed HBGLs or EPA's TCLP or EP Tox levels for organic chemicals. There were two pits which had minor exceedences of EP Tox levels for inorganic chemicals. It should be noted that the HBGLs have not been promulgated and that the TCLP levels were not necessarily intended to be used as cleanup standards. Through the use of access and deed restrictions and a cap, the selected remedy will prevent direct contact with contaminated waste and soil. Through the use of soil vapor extraction, the selected remedy will limit the migration of vadose zone contaminants to groundwater.

EPA believes that the selected remedy provides the best balance of tradeoffs with respect to the nine criteria. While Alternative 4 may provide a slight increase in protection of human health and the environment and reduction of toxicity, mobility or volume through treatment; EPA does not believe that these marginal benefits are necessary or justify the additional costs.

J. STATUTORY DETERMINATIONS

Under its legal authorities, EPA's primary responsibility at Superfund sites is to undertake remedial actions that achieve adequate protection of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences that EPA must consider when evaluating remedial alternatives for a Superfund site. Section 121 of CERCLA specifies that when complete, a selected remedial action must comply with ARARs established under Federal and State environmental laws unless a statutory waiver is justified. The selected remedy also must be cost effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, Section 121 of CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedy meets these statutory requirements.

1. PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Threats to human health and the environment posed by the Site include ingestion of contaminated groundwater, inhalation of VOCs in groundwater, and ingestion and contact with contaminated waste and soil. The selected remedy addresses the threat of exposure to contaminated groundwater through the extraction of contaminated groundwater and treatment to Federal and State regulatory levels. The selected remedy requires that these levels be met throughout the contaminated aquifer. The implementation of deed restrictions will provide further protection by ensuring that drinking water wells are not installed onsite.

By requiring soil vapor extraction to levels that are protective of groundwater quality, the selected remedy ensures that vadose zone contaminants (soil and soil vapor) will not migrate to groundwater. The selected remedy addresses the threat of ingestion and contact with contaminated waste and soil through the use of access and deed restrictions and a cap. The cap will also minimize infiltration and limit the migration of vadose zone contamination to groundwater.

2. COMPLIANCE WITH ARARS

The selected remedy will comply with all Federal and more stringent State ARARs identified in Appendix A. In addition, the selected remedy will comply with TBCs identified in Appendix A.

3. COST-EFFECTIVENESS

The selected remedy is cost-effective in addressing the risks posed by the Site. Section 300.430(f)(ii)(D) of the NCP states that once a remedial action satisfies the threshold criteria (overall protection of human health and the environment and compliance with ARARs), cost-effectiveness is determined by evaluating the following three balancing criteria: long-term effectiveness and permanence; reduction of toxicity, mobility or volume through treatment; and short-term effectiveness.

The selected remedy provides the best overall effectiveness at the lowest cost. Alternatives 3 and 4 attain a similarly high level of overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; and short-term effectiveness. Alternative 4 would provide a slightly greater reduction of toxicity, mobility or volume through treatment; however, EPA does not believe this slight reduction merits the significant increase in cost.

The groundwater treatment technology selected for the Site also provides the best overall effectiveness at the lowest cost. Two groundwater treatment technologies, air stripping and UV oxidation, were evaluated as part of Alternatives 2, 3, and 4. Air stripping (which is a component of the selected remedy) provides a similar level of protection and treatment at substantially less cost than UV oxidation.

4. UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES OR RESOURCE RECOVERY TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

EPA has determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be used at the Site in a practicable manner. The selected remedy provides the best balance of trade-offs in terms of long-term effectiveness and permanence, reduction in toxicity, mobility or volume through treatment, short-term effectiveness, implementability, and cost, while also considering State and community acceptance.

The selected remedy will result in a reduction in the volume and mobility of groundwater contaminants through groundwater extraction, treatment, and reinjection. Continued groundwater monitoring will be performed to ensure that the remedy is protective of human health and the environment. The selected remedy uses soil vapor extraction and treatment to prevent vadose zone contamination from continuing to contaminate groundwater. Additionally, a cap will be used to prevent contact with contaminated waste and soil and to further limit the migration of vadose zone contamination to groundwater.

5. PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The selected remedy satisfies the statutory preference for remedies that employ treatment as a principal element. By treating the contaminated groundwater using air stripping, the treated water can be returned to its beneficial use through reinjection. By performing soil vapor extraction and treatment, vadose zone contamination will be prevented from continuing to contaminate groundwater.

The selected remedy does allow a relatively small volume of contaminated soil (1,400 cubic yards) which exceeds ADEQ Health-Based Guidance Levels to remain onsite. By requiring access and deed restrictions and a cap, the selected remedy will prevent exposure to these contaminants. EPA does not believe that treatment of this contaminated soil is necessary or worth the additional cost.

K. SIGNIFICANT CHANGES

There are no significant differences between the remedy identified in the Proposed Plan and the remedy selected in the Record of Decision.

APPENDIX A
ARARs AND OTHER CRITERIA FOR THE SELECTED REMEDY AT THE HASSAYAMPA LANDFILL SITE

This appendix identifies ARARs and other criteria to be considered (TBCs) for the selected remedy for the Hassayampa Landfill Site. The selected remedy shall meet the requirements of the ARARs identified below. Furthermore, unless otherwise indicated, the selected remedy shall also meet the requirements of the TBCs identified below.

CHEMICAL-SPECIFIC ARARs AND TBCs

Table A-1 presents chemical-specific ARARs and TBCs for water arranged by chemical compound. The Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs) are based on human consumption of water for drinking, cooking, bathing, etc. Economic considerations and technical feasibility of treatment processes are included in the justification for these levels. MCLs are applicable to drinking water at the tap pursuant to the SDWA, and are ARAR for treated water when the end use is drinking water. Pursuant to 40 C.F.R. 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 or may be used as drinking water.

ADEQ Aquifer Water Quality Standards (ADEQ MCLs), established pursuant to A.R.S. Section 49-223 are identical to SDWA MCLs for the compounds detected in groundwater at the Hassayampa Landfill Site. Since ADEQ MCLs are not more stringent than the SDWA MCLs, these ADEQ standards are not ARARs and are not included in Table A-1.

ADEQ 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. ADEQ HGBLs were selected as cleanup standards only for chemicals for which no SDWA MCL or MCLGs existed.

Federal Health Advisories, which are criteria developed by either EPA's Office of Drinking Water Health Advisory Program or the National Academy of Sciences (NAS), were considered at the Site. The Federal Health Advisories are based on NAS-suggested Non-Adverse Response Levels (SNARLs) at which no known or anticipated adverse human health effects would occur, given an adequate margin of safety. These Federal Health Advisories were not selected as cleanup standards, since they were less stringent than the SDWA MCLs and ADEQ Health-Based Guidance Levels (HBGLs).

LOCATION-SPECIFIC ARARs

Table A-2 identifies location-specific ARARs and TBCs for the Hassayampa Landfill Site. Location-specific ARARs are concerned with the area in which the Site is located. Actions may be required to preserve or protect aspects of the environment or cultural resources of the area that may be threatened by the existence of the Site, or by remedial actions to be undertaken at the Site.

ACTION-SPECIFIC ARARs

Table A-3 identifies action-specific ARARs for the Hassayampa Landfill Site. The actions included in Table A-3 are components of the selected remedy.

ADDITIONAL STATE ARARs and TBCs

Arizona Revised Statute Section 49-224 is applicable or relevant and appropriate at the Hassayampa Landfill Site. A.R.S. Section 49-224 classifies all Arizona aquifers as drinking water aquifers. Section 45-454.01 of the Arizona Groundwater Management Act (GMA) (A.R.S. Sections 45-454.01), is also applicable or relevant and appropriate to the Site. All offsite uses of treated groundwater are subject to state law outside the context of the Superfund action. However, for activities conducted onsite, the substantive portions of the provisions referenced within Section 45-454.01 of the GMA shall be applicable or relevant and appropriate.

While the State of Arizona has cited 49 A.R.S. Section 282(D)(2) as an ARAR, EPA has not identified this Arizona law as an ARAR since it does not establish groundwater cleanup standards that are more stringent than the federal cleanup standards selected for the Hassayampa Landfill Site. Like Section 300.430(a)(iii) of the National Contingency Plan, 49 A.R.S. Section 282(D)(2) evinces an intent that remedial actions shall, to the extent practicable, provide for the control, management, or cleanup of hazardous substances so as to allow the maximum beneficial use of the waters of the State. The maximum beneficial use of groundwater in Arizona appears to be "drinking water protected use," which is defined as the protection and maintenance of aquifer quality for human consumption. See Ariz. Admin. Comp. R. 18-11-501; 49 A.R.S. Section 224 (which classifies all aquifers in Arizona as drinking water aquifers). Under 49 A.R.S. Section 223, aquifer water quality standards are established as primary maximum contaminant levels, which are the groundwater cleanup standards selected in this ROD in accordance with CERCLA Section 121(d).

TABLE A-1 - HASSAYAMPA LANDFILL SITE
GROUNDWATER CLEANUP STANDARDS, CHEMICAL SPECIFIC ARARS AND REQUIREMENTS TO BE CONSIDERED
CONCENTRATIONS IN PARTS PER BILLION (ppb)

Compound(A)	Maximum Concentration Detected	Selected Cleanup Standard	Applicable or Relevant and Appropriate		Other Criteria To Be Considered							
			SDWA MCL	SDWA MCLG	SDWA Proposed MCL	SDWA Proposed MCLG	1-day 10 kg	10-day 10kg	longer term 10 kg	longer term 70 kg	life-time 70 kg	ADEQ HBGL
benzene	.6	5	5	0			200	200	NA	NA	NA	
dichlorodifluoromethane	.35	1400	NA	NA	NA	NA	40000	40000	9000	30000	1000	1400
1,1-dichloroethene	2000	7	7	7			2000	1000	1000	4000	7	7
1,1-dichloroethane	27	N/A	NA	NA	NA	NA	NA	NA	NA	NA	NA	
1,1,1-trichloroethane	1500	200	200	200			100000	40000	40000	100000	200	200
1,2-dichloroethane	800	5	5	0			700	700	700	2600	N/A	.38
1,2-dichlorothene(cis)	160	70	70	70			4000	3000	3000	11000	70	
1,2-dichloroethene (trans)	160	100	100	100			20000	2000	2000	6000	100	100
1,2-dichloropropane	4	5	5	0			NA	90	NA	NA	NA	.56
acetone	19	700	NA	NA	NA	NA	NA	NA	NA	NA	NA	700
chlorobenzene	13	100	100	100			2000	2000	2000	7000	100	100
trichlorofluoromethane (Freon 11)	190	2100	NA	NA	NA	NA	7000	7000	3000	10000	200	2100
trichlorotrifluoroethane (Freon 113)	610	210000	NA	NA	NA	NA	NA	NA	NA	NA	NA	210000
methyl ethyl ketone	40	170	NA	NA	NA	NA	80000	8000	3000	9000	200	170
dichloromethane	15	5	NA	NA	5	0	10000	2000	NA	NA	NA	
tetrachloroethene	25	5	5	0			2000	2000	1000	5000	N/A	.67
toluene	15	1000	1000	1000			20000	2000	2000	7000	1000	2000
trihalomethanes(B)	63	100	100	NA								
trichloroethene	115	5	5	0			NA	NA	NA	NA	NA	
chromium(total)	40	50	100	100			1400	1400	240	840	170	100
xylenes(total)	1	10000	10000	10000			40000	40000	10000	100000	10000	
vinyl chloride(C)	ND	2	2	0			3000	3000	10	50	NA	

Notes:
Shaded Areas=Chemicals for which the maximum concentration exceeds the cleanup standard
(A) Compounds listed were detected and confirmed in groundwater samples taken during the RI and supplementary field investigations
(B) The sum of trihalomethanes MCL=100 (includes chloroform, bromodichloromethane, dibromochloromethane, and tribromomethane
(C) Vinyl Chloride has never been detected in groundwater samples as the site, but has been detected in soil gas samples
MCL=Maximum Contaminant Level
MCLG=Maximum Contaminant Level Goal
SDWA=Safe Drinking Water Act
N/A=No Standard Available
U.S. EPA Health Advisories
1-day/10kg=Concentration of compound in drinking water that could pose a risk if consumed by a 10 kg child for 1 day
10-day/10kg=Concentration of compound in drinking water that could pose a risk if consumed by a 10 kg child for 10 days
Longer Term/10kg=Concentration of compound in drinking water that could pose a risk if consumed by a 10 kg child for more than 10 days
Longer Term/70kg=Concentration of compound in drinking water that could pose a risk if consumed by a 70 kg adult for more than 70 days
Lifetime/10kg=Concentration of compound in drinking water that could pose a risk if consumed by a 70 kg adult for a lifetime

Table A-2
Location-Specific ARARs and Other Criteria for the Hassayampa Landfill Site

Location	Requirement	Prerequisite(s)	Citation	ARAR	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 Flood-plains (40 CFR 6, Appendix A)	ARAR	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 floodplains. If newly constructed facilities are to be located in a floodplain, accepted floodproofing 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. The Hassayampa Landfill is located outside of the 100-year floodplain of the Hassayampa River, but may still be located within the floodplain of the river.
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	ARAR	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 depends	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	ARAR	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	ARAR	This act requires coordination with the Department of Fish and Wildlife prior to any action that would alter a body of the United States. 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 selected 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.91-6 of the Govenorof AZ	ARAR	The landfill lies within the drainage area of the Hassayampa River, a riparian area as defined inExecutive Order 91-06 of the State of Arizona.

Table A-3
Action-Specific ARARs and Other Criteria for the Hassayampa Landfill Site

Action	Requirements	Prerequisites	Citation	ARAR	Comments
Container Storage (Onsite)	Containers of hazardous waste must be:	RCRA hazardous waste (listed or characteristic) held for a temporary period before treatment, disposal, or storage elsewhere, (40 CFR 264.10) in a container (i.e., any portable device in which a material is stored, transported, disposed of, or handled).	40 CFR 264-171 (R18-18-264.170, et seq.)	ARAR	These requirements are applicable or relevant and appropriate for any contaminated soil or ground water or treatment system waste that might be containerized and stored onsite prior to treatment or final disposal.
	• Maintained in good condition				
	• Compatible with hazardous waste to be stored*		40 CFR 264.172	ARAR	
	• Closed during storage (except to add or remove waste)		40 CFR 264.173	ARAR	
	Inspect container storage areas weekly for deterioration.		40 CFR 264.174	ARAR	
	Place containers on a sloped, crack-free base, and protect from contact with accumulated liquid. Provide containment system with a capacity of 10 percent of the volume of containers of free liquids.		40 CFR 264.175	ARAR	
	Remove spilled or leaked waste in a timely manner to prevent overflow of the containment system.				
	Keep containers of ignitable or reactive waste at least 50 feet from the facility's property line.		40 CFR 264.176	ARAR	
	Keep incompatible materials separate. Separate incompatible materials stored near each other by a dike or other barrier.		40 CFR 264.177	ARAR	
	At closure, remove all hazardous waste and residues from the containment system, and decontaminate or remove all containers, liners.		40 CFR 264.178	ARAR	

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Action-Specific ARARs and Other Criteria for the Hassayampa Landfill Site

Action	Requirements	Prerequisites	Citation	ARAR	Comments
Treatment	RCRA Standards for control of VOCs	Emissions of VOCs or gaseous contaminants	40 CFR 265 Subparts AA and BB	ARAR	This standard requires reduction of VOC emissions from process vents. Process vents include air strippers. The standard also sets emissions standards for equipment leaks.
	Control of VOCs and gaseous contaminants	Emissions of VOCs or gaseous contaminants	Maricopa County Rules 210, 320, 330	TBC	Maricopa County's January 1991 guidelines for implementing rule 210 require VOC emission controls for remediation site where uncontrolled VOC air emissions would exceed 3 lb/day. The air emission controls must have an overall efficiency of at least 90%. These criteria are selected as the air emission standards at Hassayampa based on considerations of the potential aggregate impacts of the air stripping and SVE systems.
	Control of air emissions from air strippers exceeding 3 lb/hr, 15 lb/day, or a potential rate of 10 tons/year total VOCs because VOCs are ozone precursors	Actual emission rate of 3 lb/hr, 15 lb/day or a potential rate of 10 tons/year	EPA OSWER Directive #9355.0-28 (June, 1989)	TBC	This guidance on the control of air emissions from air strippers used at Superfund sites is a TBC for the site. This policy evinces a need to control VOC emissions from sites which exceed 15 lb/day of total VOCs from air stripping and other vented extraction techniques (e.g. SVE).
	Standards for miscellaneous units require new miscellaneous units to satisfy environmental performance standards.	Treatment of hazardous wastes in units not regulated elsewhere under RCRA (e.g., air strippers).	40 CFR 264 (Subpart X)	ARAR	Air stripping towers and SVE units are considered miscellaneous units. Therefore the substantive requirements are relevant and appropriate
	Treatment of wastes subject to ban on land disposal must attain levels achievable by best demonstrated available treatment technologies (BDAT) for each hazardous constituent in each listed waste.	Treatment of LDR waste.	40 CFR 268 (Subpart D)	ARAR	The substantive portions of these requirements are applicable to the disposal of any Hassayampa site wastes that can be defined as restricted hazardous wastes (ie. drill cuttings).
	Remedial actions must comply with the substantive requirements of the CAA and its related programs, including the EPA-approved SIP		40 CFR 50-99	ARAR	The Clean Air Act (CAA) regulations define air quality management programs used to achieve the CAA goals. The State of AZ is responsible for the State Implementation Plan (SIP) which describes how the air quality programs will be implemented.
	Installation permits must be obtained to make alterations to machinery which may cause or contribute to air pollution	An alteration to machinery which may cause or contribute to air pollution	49 A.R.S. 480	ARAR	The substantive requirements of the Air Pollution Control Rules and Regulations for groundwater and soil treatment facilities are applicable to the site.

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Action-Specific ARARs and Other Criteria for the Hassayampa Landfill Site

Action	Requirements	Prerequisites	Citation	ARAR	Comments
Capping	At final closure of a landfill or cell, the landfill must be capped or maintained in accordance with 40 CFR 265.310 and 265.117.	Closure of a RCRA interim status landfill	40 CFR 265.310 and 265.117 EPA Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments (EPA/530-SW-89-047)	ARAR TBC	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. Furthermore, 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 these regulations and in the guidance document.
Underground injection of treated groundwater	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 which may result in violations of MCLs or adversely affect health. Compliance with the UIC program includeds (1) meeting MCLs for all constituents reinjected, (2) submitting inventory information, (3) obtaining a permit if the point of injection is offsite.	Action involving underground injection	40 CFR Parts 144-147	ARAR	Reinjection 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 reinjection of treated groundwater onsite. Offsite reinjection will have to comply with the procedural and substantive portions of these regulations.
	Any person who discharges to an aquifer must obtain an Aquifer Protection permit from ADEQ	Discharge to an aquifer	49 A.R.S. 241-246	ARAR	The substantive requirements of the permit must be met for onsite reinjection.
Ground-Water Well Installation, Development, Testing, and Sampling	Any nonwaste material (e.g., ground water or soil) that contains a listed hazardous waste must be managed as if it were a hazardous waste.	Nonwaste material containing listed hazardous waste	RCRA "continued in" principle	ARAR	Contaminated soil and groundwater containing a listed hazardous waste must be managed as a hazardous waste. The "contained in" principle will not apply to groundwater treated to MCLs and ADEQ HBGLs at the site.
Ground-Water Monitoring	Ground-water monitoring at new or existing RCRA disposal units.	Creation of a new disposal unit, remedial actions at an existing RCRA unit or disposal of RCRA hazardous waste	40 CFR, Subpart F	ARAR	The groundwater monitoring requirements contained in 40 C.F.R. Section 265 Subpart F are relevant and appropriate for the site.