3.3

Cave Creek Landfill Aquifer Protection Permit Application

VOLUME 1
Application
Required Attachments
Supplemental Information

Prepared for

Maricopa County
Solid Waste Management Department
February 17, 1994

Prepared by

Dames & Moore
7500 North Dreamy Draw Drive
Phoenix, Arizona 85020

DAMES & MOORE
POINTE CORPORATE CENTRE, 7500 NORTH DREAMY DRAW DRIVE, SUITE 145, PHOENIX, ARIZONA 85020
(602) 371-1110 FAX: (602) 861-7431

February 17, 1994

Mr. John Stufflebean
Maricopa County Solid Waste
Management Department
2801 West Durango Street
Phoenix, Arizona 85009

Cave Creek Landfill
Aquifer Protection Permit Application
D&M Job No. 25551-002-022

Dear Mr. Stufflebean:

Dames & Moore is pleased to submit two copies of the Cave Creek Landfill Aquifer Protection Permit Application in partial fulfillment of Contract No. SWM 1-93. The application is a revision of a draft application dated November 29, 1993 incorporating comments made by County staff as well as revisions requested by the County in a meeting with Dames & Moore on February 8, 1994. Note that your signature is required on Page 1-9 and an application fee must accompany the documents. We have not included Appendix B, Financial Capability. We understand that the County will submit Appendix B separately to ADEQ.

If you have any questions concerning this application, please do not hesitate to contact me.

REGISTERED GEOLOGIST
CERTIFICATE NO.
25059
R. DOUGLAS
BARTLETT
Date Signed 2/17/94
ARIZONA, U.S.A.

Sincerely,

DAMES & MOORE

R. Douglas Bartlett, R.G.
Project Manager

Attachment: (2) Cave Creek Landfill Aquifer Protection Permit Application

cc: A.W. Gourlay
File 25551-002-022/9.5

RDB/tc
25551002/CCAPPCVR.LTR

MARICOPA COUNTY
CAVE CREEK LANDFILL
AQUIFER PROTECTION PERMIT APPLICATION
Prepared for
Maricopa County Solid Waste
Management Department
by
DAMES & MOORE

D&M Job No. 25551-002-022
February 17, 1994

CITATION CROSS-REFERENCE TABLE
CAVE CREEK LANDFILL
AQUIFER PROTECTION PERMIT APPLICATION

Application Requirement		Submittal			
R-18-9-108 Citation	Description	APP Application Section 1.0	Required Attachments Section 2.0	Supplemental Information Section 3.0	Tables (T), Figures (F), Drawing (D), Appendices (A)
A.1-3	Name and mailing address of applicant, owner, and operator	B.1-3, C.1-5, D.1-3			
A.4	Legal description of facility location	A.1, A.3-6			AK
A.5	Expected operational life of facility			Sections 3.1.5, 3.6.5	
A.6	Other federal or state environmental permits	E.1-5			
B.1	Location map showing:				
	Facility location				F2-1
	Contiguous land area			Section 3.1.1	F2-1
	Use of adjacent properties			Section 3.1.2	F2-1
	Water well locations and details		Section 2.6		F2-1,T-2
B.2	Site plan showing:				
	Property lines			Section 3.1.1	F2-3
	Structures			Sections 3.1.3 3.1.6	F2-3
	Wells, borings, sampling points				F2-1, F2-2
	Topography				F2-1, F2-3
	Points of discharge/compliance		Section 2.6		F2-1, F2-2, F2-3
B.3	Facility design plans			Section 3.6.1	D1-D8
B.4	Characterization of discharge			Sections 3.2.4	
B.5	Description of BADCT		Section 2.5		
B.6	Demonstration of compliance with standards		Section 2.6		T4, T5
B.7	Demonstration of technical capability		Section 2.7		AA

CITATION CROSS-REFERENCE TABLE (Continued)

Application Requirement		Submittal			
R-18-9-108 Citation	Description	APP Application Section 1.0	Required Attachments Section 2.0	Supplemental Information Section 3.0	Tables (T), Figures (F), Drawing (D), Appendices (A)
B.8	Demonstration of financial capability		Section 2.8		AB
B.9	Description of enforcement actions		Section 2.9		
B.10	Demonstration of compliance with zoning		Section 2.10		AC
C.1.a	Description of geology			Section 3.2.2	F3-1, F3-2, F3-3, F3-4
C.1.b	Location of surface water bodies			Sections 3.1.2, 3.6	F2-1, F3-31
C.1.c	Characteristics of the aquifer			Sections 3.2.3, 3.2.4	F3-1, F3-2, F3-3, F3-4
C.1.d	Surface-water and ground-water flow			Sections 3.2.1, 3.6, 3.2.3	F2-1, F3-1
C.1.e	Location of 100-year floodplain			Section 3.2.1	F2-1
C.1.f	Ground-water quality			Section 3.2.3	T4, T5, T6, T7
C.1.g	Extent of soil contamination - *No known contamination*	Not applicable			
C.1.h C.1.i C.1.j	Assessment that discharge will: Leach existing soil contaminant Modify ground-water quality Modify ground-water quality			Sections 3.2.4	
C.1.k C.1.l	Discharge impact area assessment			Section 3.2.4	F3-8 to F3-23
C.1.m	Point of compliance		Section 2.6		F2-3
C.2	Proposal of:				
	Alert levels			Section 3.3.2	F3-24
	Discharge limitations				
	Monitoring plan			Section 3.3	T11, T12, T13, T14, T15
	Contingency plans			Section 3.4	F3-25
	Compliance schedule			Section 3.3.5	

CITATION CROSS-REFERENCE TABLE (Continued)

Application Requirement		Submittal			
R-18-9-108 Citation	Description	APP Application Section 1.0	Required Attachments Section 2.0	Supplemental Information Section 3.0	Tables (T), Figures (F), Drawing (D), Appendices (A)
C.2 (Cont.)	Temporary closure plan			Section 3.6	
	Closure plan			Section 3.6	
	Post-closure plan			Section 3.7	
C.3	Other information required by the Director	None requested			
D	Certification	H			

MARICOPA COUNTY
CAVE CREEK LANDFILL
AQUIFER PROTECTION PERMIT APPLICATION

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MARICOPA COUNTY
CAVE CREEK LANDFILL
AQUIFER PROTECTION PERMIT APPLICATION

1.0 AQUIFER PROTECTION PERMIT APPLICATION (ADEQ - Water Permits Unit Form APP 1 - Revised 10/17/90)

A. FACILITY DATA

1. NAME OF FACILITY

Cave Creek Landfill

2. a. DATE FACILITY BEGAN (or is expected to begin) OPERATIONS

The landfill began operation in 1984.

b. EXPECTED LIFE OF THE FACILITY

2 to 8 years

3. MAILING ADDRESS OF THE FACILITY

2801 West Durango Street
Phoenix, Arizona 85009

4. FACILITY ADDRESS

3955 East Carefree Highway
Phoenix, Arizona 85331

5. COUNTY

Maricopa

6. FACILITY LOCATION

	Township	Range	Section(s)	
a.	5N	3E	12	E ½ Section
	5N	3E	13	NE ¼, NE ¼, NE ¼

b. Latitude 33° 47' 18"

Longitude 111° 59' 48"

7. FACILITY CONTACT PERSON

John Stufflebean, P.E.

8. TELEPHONE NUMBER

(602) 506-7060

AQUIFER PROTECTION PERMIT APPLICATION
(Water Permits Unit Form APP 1 - Revised 10/17/90)

9. NATURE OF BUSINESS (FACILITY)

Municipal solid waste management and disposal

B. APPLICANT INFORMATION

1. NAME OF APPLICANT

John Stufflebean, P.E.

2. APPLICANT MAILING ADDRESS

2801 West Durango Street
Phoenix, Arizona 85009

CONSULTANT MAILING ADDRESS (OPTIONAL)

Dames & Moore
7500 North Dreamy Draw Drive, Suite 145
Phoenix, Arizona 85020

Attention: Mr. R. Douglas Bartlett, P.G.

3. TELEPHONE NUMBER OF APPLICANT

(602) 506-7060

C. OWNER INFORMATION

1. NAME OF OWNER

Maricopa County

2. OWNER MAILING ADDRESS

2801 West Durango Street
Phoenix, Arizona 85009

3. TELEPHONE NUMBER OF OWNER

(602) 506-7060

4. LAND OWNER

Maricopa County

5. LAND OWNER ADDRESS

2801 West Durango Street
Phoenix, Arizona 85009

AQUIFER PROTECTION PERMIT APPLICATION
(Water Permits Unit Form APP 1 - Revised 10/17/90)

D. OPERATOR INFORMATION

1. OPERATOR NAME

Maricopa County Solid Waste Management Department

2. OPERATOR ADDRESS

2801 West Durango Street
Phoenix, Arizona 85009

3. OPERATOR TELEPHONE NUMBER

(602) 506-7060

E. EXISTING ENVIRONMENTAL PERMITS

1. NPDES PERMITS & NUMBERS

None

2. REUSE PERMITS AND NUMBERS

None

3. RCRA PERMIT AND NUMBERS

None

4. AIR QUALITY PERMITS AND NUMBERS

None

5. SOLID WASTE PERMITS AND NUMBERS

None

AQUIFER PROTECTION PERMIT APPLICATION
(Water Permits Unit Form APP 1 - Revised 10/17/90)

G. REQUIRED ATTACHMENTS

Please indicate in the spaces provided that the appropriate attachments or information have been included. (X indicates item has been included in application)

1. LOCATION MAP

_X_ **Have you attached 2 copies of the appropriate map?**

(see Figure 2-1)

Is the following information indicated on the map?

_X_ **The facility site boundary?**

(see Figure 2-1)

_X_ **An area of at least 3 miles around the boundary?**

(see Figure 2-1)

_X_ **Location of all wells within 1/2 mile of the boundary?**

(see Figure 2-1)

_X_ **Land ownership or use of properties adjacent to the site?**

(see Figure 2-1 and Section 3.1.2)

2. SITE PLAN - TWO COPIES

_X_ **Have you included the site plan?**

(see Figure 2-3)

Is the following information indicated on the plan?

_X_ **Property lines?**

(see Figure 2-3)

_X_ **Buildings and structures?**

(see Figure 2-3)

_X_ **Location of water wells, borings or sampling points?**

(see Figure 2-3)

AQUIFER PROTECTION PERMIT APPLICATION
(Water Permits Unit Form APP 1 - Revised 10/17/90)

_X_ **Location of discharge sites?**

(see Figure 2-3)

_X_ **Topography?**

(see Figure 2-3)

_X_ **Proposed Point of Compliance?**

(see Figure 2-3)

3. FACILITY DESIGN PLANS - TWO COPIES: PROPOSED AND/OR "AS BUILT"

_X_ **Have you included the design drawings?**

(see Section 3.6.1 and Drawings 1 through 8, Closure Plan Drawings)

4. CHARACTERIZATION OF DISCHARGE

Summarize past (or anticipated) discharge practices:

a. _X_ **Have you attached analytical reports or projected data describing the chemical, biological and physical properties of the discharge described above?**

(see Section 2.4, 2.6.3 and 3.1.4)

b. **List the rates at which a discharge has or will occur.**

The Cave Creek Landfill is not observed to generate a discharge.

What is the duration and frequency of the discharge?

None

c. **List the location of each discharging facility.**
Descriptive.

Name	Latitude	Longitude
Not applicable		

AQUIFER PROTECTION PERMIT APPLICATION
(Water Permits Unit Form APP 1 - Revised 10/17/90)

5. DEMONSTRATION OF BADCT

_X_ **Indicate that you have attached a description of pollutant control methodologies for the facility and a discussion of why they meet the BADCT requirement. You may use this page if convenient.**

(see Section 2.5)

6. DEMONSTRATION OF COMPLIANCE WITH STANDARDS

_X_ **Have you indicated a proposed Point of Compliance on the appropriate site plan or map?**

(see Figure 2-2)

Is the proposed Point of Compliance for:

_X_ **Hazardous substances?**

_X_ **Non-Hazardous substances?**

Provide justification for selecting the proposed Point of Compliance.

(see Section 2.6)

7. DEMONSTRATION OF TECHNICAL CAPABILITY

a. **Who is responsible for the design of the facility?**

(see Section 2.7)

Provide the basis for the party's capability:

(see Section 2.7 and Appendix A)

b. **Who is responsible for the construction of the facility or its components?**

(see Section 2.7)

Provide the basis for the party's capability:

(see Section 2.7 and Appendix A)

AQUIFER PROTECTION PERMIT APPLICATION
(Water Permits Unit Form APP 1 - Revised 10/17/90)

c. **Who is responsible for the operation of the facility?**

Maricopa County Solid Waste Management Department

Provide the basis for the party's capability:

(see Section 2.7 and Appendix A)

8. DEMONSTRATION OF FINANCIAL CAPABILITY

Please indicate in the spaces provided that the appropriate attachments or information have been included. Please submit financial information in a form that will easily allow ADEQ to keep such information confidential.

a. **Have you included estimates for the total costs of each of the following aspects of the facility?**

- X **Construction;** (Section 2.8)
- X **Operation;** (Section 2.8)
- X **Closure;** (Section 2.8)
- X **Post-closure care;** (Section 2.8)

b. X **Have you attached the required statement from the applicant's chief financial officer that the applicant is financially capable of meeting the costs estimated in sub-section a) above?**

(see Appendix B)

c. **If the applicant is not a governmental entity, have you included one of the following?**

Not applicable (N/A). The applicant is a governmental agency.

- N/A **The most recent 10K form of the applicant;**
- N/A **A report containing all of the following:**
  - N/A **Applicant's organizational structure**
  - N/A **Description of applicant's business**
  - N/A **Applicant's net worth, describing major assets and liabilities**

AQUIFER PROTECTION PERMIT APPLICATION
(Water Permits Unit Form APP 1 - Revised 10/17/90)

N/A **Description of judgments exceeding $100,000.00 against applicant during five years prior to making this application**

N/A **Description of bankruptcy or insolvency proceedings by applicant during five years prior to making this application**

N/A **Names & dates of birth of executive officers (if applicant is a corporation)**

N/A **Evidence of a bond, insurance or trust fund**

9. ENFORCEMENT ACTIONS

Provide a brief description of any action for the enforcement of any federal or state law, rule or regulation, or county, city or local government ordinance relating to the protection of the environment, instituted against the applicant during the five years prior to making this application.

No enforcement actions have been instituted.

10. ZONING

X **Indicate that you have included evidence that the facility complies with applicable municipal or county zoning ordinances and regulations.**

(see Appendix C)

AQUIFER PROTECTION PERMIT APPLICATION
(Water Permits Unit Form APP 1 - Revised 10/17/90)

H. CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this application and all attachments and that based on my inquiry of those persons immediately responsible for obtaining the information contained in the application, I believe that the information is true, accurate and complete. I am aware that there are significant penalties for submitted false information, including the possibility of fine and imprisonment.

NAME AND OFFICIAL TITLE:

____

SIGNATURE

____

DATE SIGNED

2.0 REQUIRED ATTACHMENTS

2.1 LOCATION MAPS

Figure 2-1, "Cave Creek Landfill Well Location Map" and Figure 2-2, Areal Photograph indicate the following features:

- Topography of the area surrounding the landfill;
- Wells within a 3-mile radius of the landfill;
- Ground-water elevation contours; and
- The Cave Creek 100-year flood plain.

2.2 SITE PLAN

Figure 2-3, "Cave Creek Landfill Site Plan" is a topographic map of the existing landfill and indicates the following features:

- Existing landfill cell;
- Current disposal area;
- Proposed expansion areas;
- 200-foot buffer zone;
- On-site monitor and production wells;
- Proposed Points of Compliance; and
- Buildings and structures.

2.3 FACILITY DESIGN PLANS

(See Section 3.6.1 and Drawings 1 through 8, Closure Plan Drawings)

2.4 CHARACTERIZATION OF DISCHARGE

The Cave Creek Landfill has not been observed to generate a discharge. Additionally, little or no leachate is expected from the municipal solid waste deposited at the Landfill. A conservative infiltration rate of 0.5-inches per year has been developed for the site using the US EPA "HELP" model. The depth to ground water exceeds 600-feet below the landfill. Any potential leachate generated from the landfill would be contained within the sediments below the site. Ground-water analyses from wells at the landfill indicate that ground water has not been adversely affected by landfill operations.

2.4.1 Characterization of Refuse

The following types of wastes are accepted in the landfill. Refuse from homes and businesses, empty barrels, yard waste, mattresses, appliances, barn yard and stable waste, demolition material, clean soil, paper products, wire, non-infectious medical waste, bottled beverages, domestic animals (small pets), junk cars, boats, and trailers. Prohibited waste includes hazardous waste, fuel tanks, infectious wastes, chemical by-products, containers not properly rinsed, explosives, ammunition, shock sensitive wastes, hot coals, burning materials, industrial waste water treatment sludge, livestock, pressurized containers, and radioactive material. In the past, farm animals and pressurized tanks were accepted. Hazardous and liquid wastes have never been accepted. White goods, vegetation, tires, glass, batteries, paper, metal, and cardboard are presently received for recycling. The daily amount of material received is between 550 and 575 tons. Approximately 80 tons of this material is recycled.

2.4.2. Methods of Operation

Over the last ten years several methods of operation have been used. The trench method has been used where advantageous. Where excavation and cover materials were available the area method was used. Presently a combination of both trench and area methods are used. No records exist that specify the area, date and waste type for each method of operation. However, a waste lift of approximate 8 feet is covered daily with 1 foot of cover material.

2.5 DEMONSTRATION OF BEST AVAILABLE DEMONSTRATED CONTROL TECHNOLOGY

This section presents an evaluation of current and proposed discharge control technologies for the Cave Creek Landfill and is structured to provide a demonstration that these technologies constitute Best Available Demonstrated Control Technology (BADCT). The evaluation and demonstration are structured in accordance with guidance provided in "BADCT Guidance Document for the Landfill Category" (ADEQ, 1990).

The Cave Creek Landfill was in operation prior to August 13, 1986 and is therefore classified as an existing facility for the purposes of determining BADCT. The anticipated life of the landfill is dependent on the rate of filling, which has fluctuated significantly during the life of the facility. One or more lateral expansions of the facility after October 9, 1993 are anticipated. Current projections are that the existing and expanded capacities will be filled by the end of 1995.

Discharge control technologies which will be used in the lateral expansion cells may differ significantly from those used in the existing cells. Since the different control technologies will, in almost all instances, result in greater assurance of control effectiveness than their current equivalents, we have emphasized the current control technologies in this evaluation and demonstration; different control technologies to be used in the future cells are identified as the technologies are described and evaluated.

2.5.1 Discharge Control Technologies

The existing landfill cell will cover approximately 50 acres as of October 9, 1993. This cell does not have a synthetic liner or leachate collection system. As discussed below, the potential for leachate discharge is controlled by a combination of operation controls and site characteristics. The future landfill cells are to be constructed in accordance with the requirements of RCRA Subtitle D regulations (CFR 40 258) and meet optimal BADCT requirements. The proposed closure details, in conjunction with surface water controls and arid climatic conditions, are sufficient to isolate the waste and prevent leachate generation.

Discharge Control Technologies for Open, Existing Landfill Cells

The existing landfill cell has been operated since 1984. It is expected to be operated in conjunction with the future cells until the end of 1995 and possibly until 1999. Waste has, or will be, placed to elevations ranging between 40 feet below natural grade to 45 feet above natural grade. The northern half of the existing cell has been filled with multiple lifts to an average elevation of 1890 feet AMSL, approximately 22 feet above the original grade. The southern half of the existing cell has currently received only one or two lifts of waste and must receive several more before it approaches the elevation of the northern portion.

Discharge control in the existing cell is achieved through the following methods:

- strict controls on the type and conditions of waste accepted for disposal (see Section 2.4);

- grading of inactive portions of the cell to promote positive drainage;
- covering of inactive portions of the existing cell with approximately 12 inches of soil borrowed from the cell excavations to limit infiltration of direct precipitation; and
- control of runoff from direct precipitation adjacent to the working face to minimize potential for saturation of landfill material.

Maricopa County's waste acceptance criteria have been in place since the landfill cell was opened in 1984. The landfill accepts only residential waste, commercial and industrial waste consisting of non-hazardous solid waste, yard waste, construction and demolition debris, and white goods. Wastes that are not accepted include dewatered sewage sludge, bulk liquid waste, commercial compressed gas cylinders, RCRA hazardous waste, infectious waste, oil-field drilling fluids, and radioactive waste. Operational criteria specifically exclude waste that has the potential to introduce free liquids to the landfill. In this manner, the moisture content of the waste is minimized and the potential for leachate generation is decreased.

As in most major municipal landfills, waste is applied in lifts to minimize the area of the working face. Borrow material from the on-site excavation is used to cover areas of the inactive cell. The native soils consist of sands and gravels with varying percentages of medium to large size boulders. Laboratory gradation tests show that between 0.4 and 9.1 percent of the soil mass passes a No. 200 sieve, that the soils are generally non-plastic, and that they have recompacted hydraulic conductivities ranging between 5.1×10^{-4} and 3.7×10^{-3} centimeters per second (cm/sec). Detailed results of the geotechnical investigation and testing program are provided in Appendix F, Soil Sample Test Results.

Inactive covered surfaces are generally graded to drain to the perimeter of the cell or to areas that do not contain waste. The positive grades encourage surface water runoff and decrease potential for ponding and surface water infiltration. Some minor ponding is unavoidable due to constraints caused by access requirements, the perimeter berm, and temporary soil stockpiles. Minimizing surface water infiltration serves as a discharge control technology by minimizing the potential for leachate generation.

During waste placement, the base of the placement area is sloped away from the waste being placed to ensure that direct precipitation runs away from the waste rather than soaking into the exposed waste. During placement of the first lift, any runoff from this area is absorbed and evaporated from the upper few inches of the subgrade. During placement of subsequent lifts, runoff from the working face is absorbed in the upper few inches of the soil cover placed over the earlier lifts. In this manner, saturation of waste during placement by direct precipitation is minimized and the potential for leachate generation is controlled.

Discharge Control Technologies for Open, Future Landfill Cells

Discharge control technologies utilized in the future lateral expansion cells will include all the control technologies described in the previous section for the existing, open cells and will also consist of:

- leachate collection and removal system (LCRS) to allow removal of leachate and storm water from the lined cells and to minimize hydraulic head on the underlying liner system;
- flexible membrane liner (FML) (60 mil HDPE or equivalent) to contain any leachate and storm water within the cell and to allow removal with the LCRS; and
- 18-inch thick low permeability soil liner beneath the FML to provide suitable bedding and support and to minimize the potential for migration of any accidental leakage from the FML.

Discharge Control Technologies for Closed Landfill

The landfill closure cap will consist of the following three layers (listed from top to bottom):

- 6-inch-thick vegetative layer, consisting of fine-grained soil;
- 18-inch-thick low permeability layer to control infiltration; and
- 12-inch foundation/daily cover layer to serve as a base for placement of the low permeability layer.

The foundation layer will be similar to that used during operation of the landfill for daily cover and will be at least 12 inches thick. The purpose of this layer is to cover placed waste prior to construction of the engineered low permeability layer and to provide a smooth, firm surface for placement of the low permeability soil.

The low permeability layer will consist of 18 inches of compacted, imported silty sediments from the Cave Buttes sediment control dam. Laboratory tests on a sample of this material indicate a hydraulic conductivity value of 3.2×10^{-6} cm/sec for a sample compacted to 95 percent of maximum dry density (ASTM D698) at optimum moisture content (20 percent). The surface of the low permeability layer will slope from the center line of the landfill to the edges at an original grade of approximately eight percent.

The upper layer of the landfill cover will consist of approximately 12 inches of soil placed directly above the low permeability layer. This material will be compacted lightly to prevent erosion and allow establishment of light surface vegetation. The light cover that has established naturally on nearby areas covered with Cave Buttes sediment should be sufficient to provide dust control and to prevent erosion by wind and water.

Surface Water Control

The open landfill is protected against surface water run-on by berms constructed on all sides of the landfill. These berms range in height from 20 to 35 feet. The direction of surface water flow is from the northeast and the perimeter of the landfill drains freely in all locations with the exception of the northern portion of the eastern boundary of the existing cell. In this location, water gathers in a low area and ponds against the perimeter berm. During construction of a proposed lateral expansion in this area, surface water run-on will be permanently diverted to a ditch and around the cell.

The landfill lies outside the 100-year floodplain of Cave Creek, as shown on Figure 2-1. At its closest point, the perimeter of the landfill is 500 feet from the Cave Creek channel, making lateral infiltration of subsurface water from Cave Creek extremely unlikely. The influence of Cave Creek flow on a hypothetical release of landfill leachate was evaluated with a ground-water flow and transport model. The results, discussed in Section 3.2.4, indicate flow in Cave Creek has no influence on leachate migration from the landfill. Lateral infiltration has not been detected in the landfill excavation during periods of high river flows.

The slope of the cover on the closed landfill will direct precipitation to a series of perimeter ditches that collect run-off and transmit these waters to a detention basin. The detention basin is sized to contain the runoff from a 100-year, 24-hour storm and to empty by means of infiltration and evaporation within 48 hours.

Hierarchy of Control Technologies

Evaluation of control technologies being used at an existing landfill involves evaluation of the technologies relative to other technologies offering higher levels of control. This is accomplished by identifying the placement of existing control technologies in several control technology hierarchies provided in the "BADCT Guidance Document" (ADEQ, 1990).

The existing landfill cells have no bottom landfill liner and no leachate collection system. Therefore, the existing control technologies rank at the bottom of the respective hierarchies.

The future landfill cells will have a double liner system, consisting of an upper FML underlain by a soil liner, and a single leachate collection system. The leachate collection system will likely consist of 6 inches of granular, freely-draining material on the base of the landfill and a synthetic drainage net on the side slopes. The proposed landfill liner system ranks fourth on the published hierarchy and the proposed leachate collection system ranks fourth in its hierarchy, although it would rank first or second if the granular layer thickness was 12 inches instead of the proposed 6 inches.

Storm water from off-site will be diverted by a channel capable of withstanding a 100-year, 24-hour storm water event. Onsite storm water is directed away from the working faces and fill areas by graded slopes; however, some ponding of water following a 100-year, 24-hour storm water event is likely. Therefore, onsite storm water control ranks fourth on the referenced hierarchy. Lateral infiltration is not a concern given the distance of the landfill from Cave Creek; as such, however, protection from lateral infiltration of perennial and ephemeral water bodies is provided by natural soil and this control technology ranks third on the published hierarchy.

A hierarchy of operational practices that constitute BADCT is not provided, although a list of practices that, if enforced, constitute BADCT is provided. At the Cave Creek Landfill:

- waste for which the landfill has been designed to contain are the only ones accepted;
- hazardous wastes are excluded by use of site security and trained spotters;
- water is not discharged from the facility;
- there is no leachate generation or collection and, therefore, there is no effluent; and;

- water from dust control practices and storm water does not pond on the surface of the daily fill.

There are four hierarchies pertaining to closure of the landfill: infiltration control layer, final cover material, final cover vegetation, and final landfill surface configuration. As demonstrated in Section 3.2.4, HELP modeling has shown that net infiltration from the waste layer in the landfill is less than 0.2 inches/year. Therefore, selection of the final cover configuration has been based on materials and performance criteria. The cap infiltration control layer consists of a thick layer of compacted silt with a hydraulic conductivity less than the base of the existing landfill cell, yet greater than the hydraulic conductivity of the proposed liner in the lateral expansion cells; therefore, the barrier technology ranks third for the existing cell and seventh for the lateral expansion cells.

The proposed final cover material is 12 inches of soil, which ranks fifth on the final cover material hierarchy. The anticipated natural vegetation, already established under similar circumstances in a nearby area, is perennial, drought tolerant, low maintenance, has zero irrigation and nutrient requirements, and is shallow rooted; therefore, it ranks at the top of the hierarchy for final cover vegetation.

The final landfill surface configuration will be above-grade with a preliminary slope of approximately eight percent; therefore, the proposed closure plan ranks second in the hierarchy for final landfill surface configurations. The outer boundary of the landfill cells is formed by a compacted earth and boulder embankment that will be graded to a 3:1 slope; as this embankment has substantial thickness and contains, rather than covers the waste, it was not considered in the control technology ranking for final landfill surface configuration.

2.5.2 Site Characteristics Contributing to Discharge Control

Demonstration of the application of BADCT for the Cave Creek Landfill includes consideration of site-specific characteristics that decrease or eliminate the probability of pollutants reaching the water table. Our evaluations of the natural characteristics of this site, and supporting data, are presented in Section 3.2 of this report and as referenced in the following sections. Site characteristics play an important role in the demonstration of BADCT for this site.

Vadose Zone Characteristics

The vadose zone beneath the Cave Creek Landfill is more than 600 feet thick and is a significant component of the hydrogeologic setting of this site. Leachate potentially released from the landfill will be attenuated physically and chemically by the unsaturated gravels underlying the landfill. The degree of attenuation was evaluated for a hypothetical release of leachate using a ground-water flow and transport model. A complete discussion of the construction and input assumptions is provided in Section 3.2.4.

The results of modeling indicate that the Cave Creek Landfill will not impact local ground-water quality as a result of attenuation by the thick vadose zone beneath the landfill.

Ground-Water Depth

The depth to ground water is approximately 630 feet at the Cave Creek Landfill. Unconsolidated alluvial gravel deposits occur beneath the landfill to a depth in excess of 1,000 feet. Little or no silt and clay occur in the gravel. A complete description of the hydrogeology of the site is included in Section 3.2.

Climatic Factors

Annual precipitation in the Phoenix area averages less than 8 inches per year as measured at the Phoenix Airport (HELP model database). The EPA HELP model was used to evaluate the leachate-generation potential of the landfill given average precipitation for the Phoenix area. The results, discussed in Section 3.2.4, demonstrate that under worst-case conditions little or no leachate is generated by the landfill.

2.5.3 Discharge Control Performance

Performance for the Open Landfill

The discharge control technologies described in Section 2.5.1 minimize the potential for leachate to be generated during the period that the landfill is open. For purposes of this evaluation, the "open" phase of landfill operation refers to the period before construction of the final cover system although the waste is covered at all times by daily cover which prevents direct exposure of waste to direct precipitation.

In addition to isolating the wastes with daily and temporary cover, sound landfill operation practices constitute additional control technologies used to minimize the potential for leachate generation.

Direct measurement of leachate discharge quantity and quality is not practical because the presence of leachate has not been detected or documented elsewhere under similar conditions. The absence of observed leachate generation by operations personnel suggests that leachate generation, if it occurs, is localized, is of relatively minor quantity, and probably results from placement of waste during precipitation events.

Therefore, the expected discharge control performance of the unlined cell under open conditions is sufficient to minimize discharge and, as discussed in Section 2.5.1, effectively assure that leachate infiltration rates to the base of the unlined cell are less than or equal to 0.16 inches per year, as calculated using the HELP model (Section 3.2.4).

Performance for the Closed Landfill

The primary factor affecting the discharge control performance of the closed landfill relative to the open landfill is the landfill cap which serves to redirect water resulting from direct precipitation and to prevent infiltration of surface water to the waste by a combination of evapotranspiration and low hydraulic conductivity.

The results of HELP modeling described in Section 3.2.4 show that the net percolation rate to the subgrade is unaffected by the presence of a hypothetical absolutely impermeable cap in place of the proposed soil liner cap. Therefore, although direct measurement of discharge quantity and quality is not possible because no sections of the landfill have been closed, modeling results suggest that the proposed discharge control technologies in the landfill cover system will provide the same discharge control contribution as that which could occur using an impermeable, synthetic liner system.

2.5.4 BADCT Demonstration

This section documents the demonstration of BADCT for the existing unlined landfill cell by showing that the combination of pollutant consideration, discharge quality, discharge control technology, climatological conditions, and site characteristics (previously, depth to ground water) result in assurance that there is no reasonable probability of pollutants reaching the water table.

The demonstration focuses on the existing cell because control technologies to be implemented in the future cells will be significantly greater than the technologies used in the existing cell in terms of discharge control. Thus, it is assured that BADCT is demonstrated for the future cells if it is demonstrated for the existing unlined cell.

The results of the HELP model, presented in Section 3.2.4, were used to estimate surface water runoff, evapotranspiration, infiltration, and water storage for the various layers in the landfill system under computer-generated daily, rainfall and temperature data for an assumed 12 years of landfill operation ("open" condition) and 38 years after closure ("closed" condition).

The HELP model results can be expressed in terms of a predicted percolation rate from the bottom of the waste layer to the subgrade. The model predicts that the maximum percolation rate of 0.16-inch per year occurs in year 13, the year following closure of the landfill.

As described in Section 3.2.4, the TARGET 2DU ground-water flow and transport model results show that 50 years of assumed worst-case leachate percolation do not cause an elevation of chloride concentrations above the 13 ppm minimum background level observed in the on-site monitoring wells. The assumed leachate represents a worst-case chloride concentration (EPA, 1979) and was assumed to percolate at 0.5-inch per year, a rate three times greater than the maximum value predicted under open or closed conditions by the HELP model.

Therefore, under the worst-case conditions for the existing unlined landfill cell, BADCT application is demonstrated for this site because modeling has shown that there is no reasonable probability of pollutants reaching ground water even when extremely conservative assumptions are made regarding leachate generation and infiltration rates, and leachate quality.

2.6 DEMONSTRATION OF COMPLIANCE WITH STANDARDS

2.6.1 Points of Compliance

Two monitor wells were installed at the Cave Creek Landfill in May of 1993 (see Figure 2-3). These wells (CCMW-1 and CCMW-2) were located along the downgradient boundaries of the landfill and are therefore proposed as points of compliance. Justifications for these well locations as points of compliance include:

1) Ground water migrates beneath the landfill to the southeast under the influence of a hydraulic gradient of 0.005 feet/foot (see Section 3.2.3). Therefore, any potential leachate reaching the aquifer and dissolving in ground water would migrate to the southeast; the monitor wells are located south and east of the landfill and would detect any potential discharges to the aquifer.

2) The wells are located on the downgradient borders of the landfill property. Ground-water monitoring at these points will ensure protection of all current and reasonable future uses of the aquifer.

Latitudes and longitudes for the points of compliance (monitor wells) are listed in Table 12.

2.6.2 Existing Ground-Water Quality

Existing data suggest that background ground-water chemistry meets Aquifer Water Quality Standards and has not been affected by the Cave Creek Landfill. Water quality data collected from the one upgradient production well and two downgradient point-of-compliance monitor wells are presented in Tables 4 and 5. The upgradient production well was installed in 1982. Samples from this well have been collected by the Maricopa County Solid Waste Management Department (MCSWMD) on an intermittent basis since 1985. The downgradient monitor wells were installed during May of 1993. Samples were collected from the monitor wells in June of 1993. The monitor well analytical results show no detections of volatile or semi-volatile organic compounds. Since 1987, no volatile or semi-volatile organic compounds have been detected in samples from the production well (Table 4). Arsenic was detected at 0.10 ppm during the last sampling of the production well in July 1992. Previous arsenic concentrations were below the Aquifer Water Quality Standard. Ambient arsenic levels are discussed in Section 3.3.

2.6.3 Discharge Characterization

Characterization of discharge is discussed in detail in Section 2.4. In summary, computer modeling indicates that minimal leachate will be discharged from the Cave Creek Landfill. No impact to ground water quality is expected within the next 30 or more years. Ground-water monitoring will proceed according to the monitoring plan presented in Section 3.3. As described in the monitoring plan, quarterly sampling will be conducted for three years. At the end of this period, background concentrations will be established for the purpose of deriving Alert Levels and Aquifer Quality Limits for ongoing detection monitoring.

2.7 DEMONSTRATION OF TECHNICAL CAPABILITY

Maricopa County has been managing the operation of landfills for over 25 years. Some of the landfills presently managed by MCSWMD include Northwest Regional, Gila Bend, Hassayampa, Queen Creek, New River and Cave Creek. The MCSWMD is directed by John Stufflebean, P.E.. Mr. Stufflebean's credentials are attached in Appendix A.

Closure design was completed by Dames & Moore under the direction of Alexander Gourlay, P.E. Mr. Gourlay's credentials are attached in Appendix A.

2.8 DEMONSTRATION OF FINANCIAL CAPABILITY

Demonstration of financial capability is provided in Appendix B. Cost estimates for operations, capital improvements, closure, and post-closure are provided in Appendix O.

2.9 ENFORCEMENT ACTIONS

No enforcement actions have been instituted against Maricopa County within the past five years.

2.10 ZONING

Demonstration of proper zoning with the City of Phoenix (COP) is provided in Appendix C, a letter from the COP Zoning Administration office to the Maricopa County Solid Waste Management Department.

3.0 SUPPLEMENTAL INFORMATION

3.1 FACILITY DESCRIPTION

3.1.1 Background Information

Ownership/Name

The Cave Creek Landfill is located in the north central portion of Maricopa County within the City of Phoenix city limits. It is located approximately three miles west of Cave Creek Road and nine miles east of Interstate Highway 17. Corporate Cave Creek and the City of Scottsdale are located east of the landfill site. Further south is the Town of Paradise Valley and to the north and west is the New River area.

Responsible Authority

The responsible authority is Maricopa County Solid Waste Management Department located at 2801 West Durango Street, Phoenix, Arizona 85009. Phone number (602) 506-7060.

Location/Access

The landfill work site is located at 3955 East Carefree Highway, Phoenix, Arizona, 85383. An access road is located directly south of the Carefree Highway which leads to the landfill weigh station and entrance.

Property Description

The Cave Creek Landfill is operated on 74.71 acres of land owned by Maricopa County. The legal description of the land is provided in Appendix K.

3.1.2 Site Characteristics

Topography

The land surrounding the landfill slopes gently towards the south and west at 0.5 percent. On the north side of the landfill the land slopes toward the west and falls abruptly into the Cave

Creek Wash within 500 feet of the northwest corner. The Cave Creek Wash generally flows to the southwest but does not enter the landfill itself. The wash is approximately 18 to 22 feet lower in elevation from the west boundary of the landfill. Elevations of the landfill vary from 1,850 to 1,880 feet above sea level.

Vegetation/Wildlife

The landfill area is vegetated with Sonoran Desert community plant life. This environment is characterized by creosote bushes in the flats and Palo Verde, ironwood, and catclaw bushes lining the washes. The major cactus predominant in the area is the buckhorn species. Other common types include chain-fruit and teddy-bear cholla. Small vertebrae desert species are likely to inhabit the area. No sensitive plant or animal species are known to exist on the site.

Land Use

Scientific Archeological Services Company prepared an archeological inventory of the Cave Creek Landfill in March 1991. After a physical examination of the site nine isolated artifacts and five prehistoric Hohokam sites were found. The sites are designated AZ U:1:31 (ASM), AZ U:1:34 (ASM), AZ U:1:42 (ASM), AZ U:1:102 (ASM), and AZ U:1:103 (ASM).

Current land use is generally light residential within one mile of the landfill boundary. Approximately one-quarter mile north of the landfill is a discontinued sand and rock company. To the west, the Cave Creek Wash is located less than one-quarter of a mile away. Except for the landfill access road which is a paved all weather road, no other roads exist within one-half mile or more.

Land to the north and northeast of the landfill is owned by the Bureau of Land Management, Department of Interior. Land on the west side is primarily owned by the State of Arizona with land on the east side being privately owned and currently undeveloped.

Climate

The Cave Creek area climate is generally very arid and warm. It is also characterized by low relative humidity, low precipitation, high diurnal temperatures and breezy, dusty conditions. The landfill receives approximately 8 inches of average annual precipitation. The majority of rainfall develops in thunderstorms in the winter months of December, January and February and also in the summer months of July, August, and early September. During the summer months high temperatures average between 102 and 105 degrees and low temperatures average between 70 and 80 degrees. During the winter months high temperatures average between 65 and 75 degrees and low temperatures average between 39 and 47 degrees. Climatic data for the Cave Creek Landfill is summarized in Table 1, Climatic Summary for Cave Creek Landfill.

3.1.3 Existing Easements

Right-of-Way

Maricopa County was granted a right-of-way easement from the United States Department of the Interior, Bureau of Land Management, A-16383, for an access road to be used as an entrance to the landfill on August 12, 1981. The grant expiration date is August 12, 2011. The easement for the road measures 3,822.99 feet by 40 feet.

Electrical Easement

Electrical easement is located along the east and south sides of the across road. An Arizona Public Service 30 electrical transmission line (above ground) is located approximately 2 feet from the existing fence line. Electricity is supplied to the site to operate a production well pump and to provide power for security lighting and weigh station instrumentation.

Gas Easement

Easement for a high pressure natural gas line exists along the west and north side of the access road. Gas is supplied by the Black Mountain Gas Company and serves as a backup power source in the event of an electrical power failure.

Telephone Line

A telephone line is located along the access road. Beginning at the weigh station, the line extends east a distance of 1,320 feet.

3.1.4 Waste Sources and Quantities

Waste Sources

Maricopa County Solid Waste facilities usually receive residential and commercial waste from the local areas they serve. Hauling companies, businesses, and residents bring waste in pick-up trucks, trailers, semi's, compactor vehicles, and open type roll-off bins.

Due to recent floods of 1993, the City of Scottsdale discontinued their delivery of waste to the Tri-City Indian Reservation Landfill and are now temporarily bringing all city waste to the Cave Creek Landfill. Solid waste is received at the landfill from Paradise Valley, Phoenix, Cave Creek, Carefree, county areas of New River, areas northwest of the landfill, and the Tonto National Forest. Several Maricopa County departments including Parks and Recreation, Department of Transportation, and the Maricopa County Flood Control District also deliver waste to the landfill.

Waste Quantities

An estimated 500 tons of refuse is deposited at the landfill each day. In addition, 80 tons of recyclables including white goods and other recycled products are received daily.

3.1.5 Projected Landfill Capacity

The landfill is expected to remain open through at least 1995 and possibly to 1999.

3.1.6 Landfill Design and Construction

General

Over the last ten years several methods of operation have been practiced. Where it has been advantageous a Trench method was used. Where excavation and placement of materials were available the Area method was used. Presently a combination of both methods is used, however, due to the difficult soil conditions, preference is given to excavation and hauling soil materials to the working face. The site is regularly maintained and a scheduled litter maintenance program is utilized. The Parks and Recreation Department furnishes offenders on probation to clean wind blown papers and debris.

A permanent on-site supervisor directs the activities of the landfill and schedules personnel. Equipment consists of a D-9 bulldozer, D-7 bulldozer, dump trucks, and/or track loaders. These are used to spread and compact the waste and excavate soil. Acquisition of a compactor is planned to enhance compaction and extend the useful life of the landfill. During the landfill operation waste is evenly spread in layers of approximately 8 feet and compacted. A layer of soil is then spread over the waste as daily cover.

Support Equipment

A water truck is used for dust control and equipment maintenance in addition to fire control when necessary. A 14,000 gallon water tank supplies water for dust control and sanitary facilities. A production well continuously replenishes water to the tank. No external water source is available at this time although there is a water line along the north side of Carefree Highway serviced by a private water company. Vehicular access to the landfill is maintained by the County Department of Transportation.

Security

A four strand barbed wire security fence surrounds the landfill. The maintenance yard is secured by an 8-foot high chain link fence with barbed wire along the top rail. A security guard is scheduled during non-operating hours to provide 24-hour security.

Administrative Requirements

All vehicles used for commercial hauling are permitted by the Maricopa County Solid Waste Management Department. Vehicles are inspected at random for hazardous wastes. Small contractors and businesses wishing to deliver waste are inspected immediately. Each vehicle is identified and either weighed or measured for capacity to assess a fee for disposal in accordance with the current Maricopa County fee schedule based upon the type of waste.

Recycling

A voluntary recycling facility operates daily and is attended by County landfill personnel. The recycling area is also used to collect tires which are eventually delivered to a tire collection facility. A white goods and vegetative recycling area also exists for voluntary placement by citizens, businesses, and local town groups.

Schedule of Operation

Hours of operation are Monday through Saturday from 5:00 a.m. to 5:00 p.m. and on Sunday from 9:00 a.m. to 5:00 p.m. The landfill is usually closed on holidays.

3.2 SITE HYDROLOGY

3.2.1 Surface Water Hydrology

The Cave Creek Landfill is located 2,600 feet south of the Carefree Highway and 1,300 to 2,600 feet east of Cave Creek. The slope of the land surface in the area of the landfill is approximately 0.015 ft/ft to the southwest. Surface water features in the area include Cave Creek to the west of the landfill and two dry washes to the east of the landfill (Figures 2-1 and 2-2).

Cave Creek is an ephemeral stream that originates near the New River Mesa. Cave Creek runs in a southwesterly direction through Paradise Valley into Deer Valley and ends at the Arizona Canal Diversion Channel in northwest Phoenix. The average annual flow of Cave Creek in the area of the landfill is 2,600 acre-feet (USGS, 1991).

The Federal Emergency Management Agency (FEMA) conducts floodplain delineation studies on a recurring basis to determine flood insurance rates. FEMA uses the flow with a one percent probability of occurrence in any one year to establish the flood insurance rate maps. This flow is known as the 100-year flood flow. Figure 2-1 illustrates the 100-year flood near the Cave Creek Landfill boundary as identified by FEMA in their latest Flood Insurance Rate Map (dated April 15, 1988). The Cave Creek Landfill is not located within this boundary.

Two dry washes intersect the landfill (Figure 2-2). Each drains toward the Cave Creek to the southwest. Berms placed around the landfill have caused diversion of flow in the washes. Diversion channels will be used to control flooding and washout. Control of surface drainage is discussed in Section 3.6.

3.2.2 Subsurface Geology

The Cave Creek Landfill is located in the East Salt River Valley sub-basin of the Phoenix Active Management Area (Reeter and Remick, 1986). The following discussion of the geology in the vicinity of the Cave Creek Landfill was derived from available published literature, the USGS, U.S. Bureau of Reclamation, and available drilling reports.

Stratigraphic units in the area of Cave Creek Landfill consist of a thick sequence of alluvial and lacustrine valley deposits which have been subdivided by the U.S. Bureau of Reclamation (1976) into the lower conglomerate unit (LCU), the middle fine grained unit (MFU), and the upper alluvial unit (UAU). Although ground water is produced from all three units in this area, this report principally addresses the upper portion of the UAU, the unit most likely to be impacted by landfill operations.

In the vicinity of the Cave Creek Landfill, the regional ground-water table occurs at a depth greater than 600 feet. Therefore, the unsaturated thickness (vadose zone) of the UAU beneath this site is significant. Water migrating vertically downward through the vadose zone is strongly influenced (physically and chemically) by the unsaturated UAU formation. In general, water will migrate more slowly through unsaturated alluvium than saturated aquifer and will chemically react with the formation matrix. A more detailed discussion of this process is provided in Section 3.2.4.

The water bearing formation of the UAU consists of unconsolidated and semiconsolidated alluvial deposits (Figures 3-2, 3-3, and 3-4). Reeter and Remick (1986) suggest that although ground water in the UAU is usually unconfined, confined and perched conditions can exist locally. No perched aquifers have been identified in the vicinity of the Cave Creek Landfill.

Site Stratigraphy

The thicknesses of the UAU, MFU, and LCU alluvial formations in the Paradise Valley area are estimated to be 1,100, 2,000, and 2,000 feet respectively (Bureau of Reclamation, 1976). The UAU was described by the Bureau of Reclamation (1976) as follows:

"The UAU is comprised of unconsolidated, relatively fresh to slightly weathered detritus of all igneous and metamorphic rock types. It also includes reworked older alluvial materials. Much of the material along the axial portion of many of the basins is primarily fine-grained, with the coarser material occurring as near-surface deposits."

Dames & Moore on behalf of Maricopa County installed two monitor wells at the Cave Creek Landfill in May 1993. CCMW-1 and CCMW-2 were drilled to 740 and 720 feet, respectively using the air rotary drilling method. Well Completion Diagrams are shown on Figures 3-4 and 3-5. The locations of the monitor wells are shown on Figures 2-1 and 2-3. The alluvium drilled during installation of the wells included coarse gravel with numerous boulders and cobbles making collection of undisturbed soil samples difficult. Six undisturbed samples were, however, obtained.

Three in situ soil samples each were collected from depths ranging from 10 to 30.5 feet in well CCMW-1 and three samples from 30 to 51.6 feet in well CCMW-2 (Table 8). The grain size fraction less than 200 mesh ranged between 0.4 to 6.6 percent in CCMW-1 and from 7.4 to 9.1 percent in CCMW-2. The moisture content was 11.3 percent by dry weight in one sample from CCMW-1 and ranged between 7.4 and 20.1 percent by dry weight in samples from CCMW-2. Total organic carbon was less than 0.2 percent in all samples.

Although only six undisturbed soil samples were collected and all were from shallow depths, drill cuttings from deeper intervals appeared to have properties consistent with the laboratory-tested samples. No significant silt or clay horizons were encountered. Figure 3-4 illustrates the lithologies encountered in well CCMW-1 and CCMW-2. Alluvial gravels and sands with little or no silt and clay dominate the lithologies encountered in CCMW-1 and CCMW-2 and agree well with the lithologies encountered within the upper 700 feet of City of Phoenix (COP) Wells 280 and 281 located about 1 mile southeast of the landfill.

Subsurface lithologic data were obtained by the COP in 1990 and 1991 during installation of the two production wells COP Wells 280 and 281. James M. Montgomery Consulting Engineering, Inc., of Phoenix, Arizona was contracted by the COP to perform pre-construction and construction monitoring services for the installation of the wells. Reports written by J.M. Montgomery describing the well installation, pumping tests, water quality, soil descriptions and geophysical logging were obtained from the COP (J.M. Montgomery 1990 and 1991). The locations of Wells 280 and 281 are indicated on Figure 2-1. Well 280 was drilled to 2,141 feet below ground surface (bgs) and Well 281 was drilled 1,649 feet bgs. The descriptions of the soils encountered in Well 280 as described by J.M. Montgomery were as follows:

- "The cuttings collected during drilling were comprised primarily of alluvial clays, silt, sands, and gravels derived from igneous, volcanic and metamorphic source rocks. All cuttings samples were poorly sorted and individual clasts generally exhibited poor to moderate roundness.

- Most drill cuttings samples from Well 280 displayed a strong reaction to a 10% solution of hydrochloric acid, implying the presence of calcium carbonate. Calcium carbonate cement in the form of surficial coatings on individual clasts and as interstitial cement was evident in many of the sample cuttings.

- Very fine to coarse-grained sands and gravels and varying amounts of clay were predominant from the surface to a depth of about 900 feet. Calcium carbonate coatings on clasts were common in this interval. The interval from this depth to about 1,575 feet was characterized by coarser-grained material and very little clay. While calcium carbonate grain coatings generally diminished in this interval, interstitial calcium carbonate cement increased in abundance, resulting in increased consolidation. Below 1,575 feet, the cuttings suggested a varying degree of consolidation with an increase in clay content toward the bottom."

The subsurface lithology encountered in Well 281 was described by J.M. Montgomery (1991) as follows:

- "The cuttings during drilling were composed primarily of alluvial clays, silts, sands and gravels derived from igneous, volcanic and metamorphic source rocks. All cuttings samples were poorly sorted and individual grains generally exhibited poor to moderate roundness.

- Fine to medium-grained sands with varying amounts of clay and gravel were predominant from the surface to a depth of about 735 feet. Below this depth, the sediments were more stratified with generally 35-65 foot intervals of predominantly coarse-grained pebbly sands alternating with generally 35-75 foot intervals of predominantly fine-grained clayey and silty sands. Varying amounts of clay were ubiquitous below 735 feet.

- Most samples displayed a strong response to a 10% solution of hydrochloric acid, implying the presence of calcium carbonate cement. Little direct evidence of cement was apparent in most of the cuttings; however, this may be due to the drilling method used."

The most favorable water producing strata from COP Wells 280 and 281 are from a depth of 670 feet to about 1,200 ft and 740 feet to about 930 feet, respectively (Figure 3-3).

Figure 3-1 illustrates the locations of two cross sections, A-A' and B-B'. Cross section A-A' is oriented north-south and is shown in Figure 3-2. Section A-A' shows the relationship between the water table and the bedrock to the north.

Section B-B' is shown in Figure 3-3 and depicts the relationship between lithologies, as represented using the Unified Soil Classification designations encountered in COP Wells 280 and 281. The water table is shown in relation to the lithologies.

The sands and gravels underlying the Cave Creek landfill are widespread through the area. It is unlikely that a clay or silt horizon of any significant thickness occurs under the landfill.

3.2.3 Ground-Water Hydrology

Ground-Water Movement

Ground-water elevations were measured in monitor wells CCMW-1 and CCMW-2 and in the production well at the north end of the landfill in August 1993. Water levels also were obtained by the COP from Wells 280 and 281 in July 1993. These data were used to construct a water table elevation contour map depicted in Figure 2-1. Based on the measured water level elevations, ground water in the vicinity of the Cave Creek Landfill flows to the south-southeast.

It should be noted that water levels measured in the COP production wells were taken approximately one-half hour after shut down of the well pumps. It is not known whether the wells had fully recovered. Water level elevations measured in January 1991 in Wells 280 and 281 were within one foot of each other. A water level elevation contour map drawn from the January 1991 data results in ground-water flow toward the southeast. As shown on Figure 2-1, in July 1993, the water level in Well 280 was about 21 feet lower than the water level measured in Well 281 yielding a ground-water flow direction toward the south-southeast. It is not known whether this difference is due to unrecovered drawdown caused by pumping or due to regional seasonal variations in flow directions. Interpretation of water levels obtained from CCMW-1 and CCMW-2 concur with the south-southeast ground-water flow direction implied by the COP production-well data.

The hydraulic gradient measured in July-August 1993 is about 0.005 ft/ft. Temporal variations in water levels could not be evaluated due to a lack of historical water levels for wells in this area. Seasonal variations in water levels may occur due to seasonal pumping from the COP and City of Scottsdale production wells.

Hydraulic Properties

An aquifer test was conducted at monitor well CCMW-2 in July 1993. The test was conducted by pumping the well using the dedicated sampling pump. The pump yielded a maximum flow rate of 3 gpm. The net drawdown was about 0.2 feet and is shown graphically in Figure 3-7. The drawdown reached steady state after five minutes of pumping. Note the initial drawdown reached a maximum of about 0.5 feet and then slowly declined. This was caused by an increase in pumping rate before the 600 foot column of water had developed above the pump. As the head pressure built on the pump, the pumping rate slowly decreased to 3 gpm, the rate at which water discharged from the riser pipe after filling. Water level data collected during the aquifer test is shown in Appendix G.

The test was evaluated using the Theim-Dupuit steady state equation for flow from a well, resulting in a calculated hydraulic conductivity of about 19 ft/day. Calculations used to derive this value are included on Figure 3-7. This number agrees well with a value of about 10 ft/day measured at downgradient COP Wells 280 and 281 (James M. Montgomery & Associates, Inc., 1990 and 1991) and with hydraulic conductivity tests conducted on soil samples collected from the CCMW-1 boring.

Aquifer tests performed during construction of COP Wells 280 and 281 indicate that the transmissivity of the aquifer in this area ranges from about 25,000 gallons/day/foot (gpd/ft) in Well 281 to about 69,000 gpd/ft in Well 280 (James M. Montgomery & Associates, Inc., 1990 and 1991). The test intervals ranged in length from 690 to 640 feet for Wells 280 and 281, respectively yielding hydraulic conductivity values ranging from about 5 to 14 feet per day. Based on this data and the Cave Creek Landfill monitor well data, an average hydraulic conductivity value of 15 feet per day can be assumed for the area.

Hydraulic conductivity tests were conducted on undisturbed samples from monitor wells CCMW-1 and CCMW-2. The results are included in Table 8. The measured hydraulic conductivity from one sample collected at CCMW-1 was 10.5 ft/day. The measured hydraulic conductivity of three samples collected at CCMW-2 ranged from 1.4 to 1.8 ft/day. The measurement of hydraulic parameters is scale-dependent (Dagan, 1986). Laboratory tests tend to yield values of hydraulic conductivity that are smaller than values measured from pumping tests. Therefore, the hydraulic conductivity implied by the laboratory tests is likely to be larger than 2 feet/day.

The discharge velocity (Darcy velocity) of ground water is the product of the hydraulic conductivity and the hydraulic gradient. Since the hydraulic gradient in the vicinity of the Cave Creek Landfill facility is approximately 0.005 (ft/ft) and the average hydraulic conductivity is 15 ft/day, the estimated ground-water discharge velocity is about 0.075 ft/day. If an effective porosity of 20 percent is assumed (Fetter, 1980), the average particle velocity (i.e. the velocity at which a water or dissolved contaminant molecule may migrate in the aquifer) would be approximately 0.38 ft/day.

In the vadose zone, the flow velocity of water is dependent on the matric suction potential (negative suction head) and the relative hydraulic conductivity which is, in turn, dependent on the soil moisture content. When a soil is saturated, all of the pores transmit water. In the unsaturated zone large pores readily drain creating suction and leaving partially saturated small pores as the only pathways for water movement. A water or contaminant molecule must take a more tortuous path through the unsaturated aquifer relative to the path it would take in the same aquifer if it was saturated thus, increasing the travel time. In coarse grained sands and gravels, like those characteristic of alluvium below the Cave Creek Landfill, pore spaces are large and therefore the relative hydraulic conductivity is considerably smaller at low moisture contents. Conversely, in a clayey or silty formation, the relative hydraulic conductivity may equal or exceed the saturated hydraulic conductivity, even at low moisture content (Hillel, 1982). Water flow velocity in the unsaturated zone is difficult to quantify because the flow rate varies depending on the water content of soil. Numerical flow modeling can solve the complex multi-variable unsaturated flow equations to describe unsaturated zone flow and transport.

A vertical-plane ground-water flow and transport model was developed to evaluate flow through the unsaturated zone. The assumptions incorporated into the model and the interpretation of the results are discussed in Section 3.2.4, Discharge Impact Area.

The large thickness of the vadose zone at this site is an important consideration when assessing the discharge potential of the landfill. It has been demonstrated that unsaturated sediment is effective at removing organic and inorganic contaminants from leachate. The influence of the vadose zone on treatment of secondary wastewater effluent was investigated by Dr. Herman Bouwer of the U.S. Water Conservation Service and reported in Bouwer et al. (1984), Bouwer and Rice (1984), and Bouwer and Chase (1984). The studies, conducted using wastewater effluent from the 23rd Avenue Wastewater Treatment Plant, showed that the vadose zone was effective at decreasing concentrations of nitrate, total dissolved solids, phosphate, fluoride, and metals such as zinc, copper, cadmium, and lead. This study was conducted in an area adjacent to the Salt River where the depth to ground water was about 20 feet. With 600 feet of vadose zone beneath the Cave Creek Landfill, the effectiveness of contaminant removal could be significantly higher.

Ground-Water Quality

There are several sources for ground-water quality data in the vicinity of the Cave Creek Landfill including the Cave Creek Landfill Production Well, the Cave Creek Landfill Monitor Wells, and the City of Phoenix Production Wells.

The production well at the Cave Creek Landfill was installed in 1982. The production well lies upgradient of the landfill near the weigh station. Samples from the well have been collected on an intermittent basis since 1985. Analytical results are summarized in Table 3.

Since 1985, 11 separate sampling events have occurred at the production well. The ground-water samples have been analyzed for a variety of compounds including volatile and semi-volatile organic compounds, phenols, pesticides and herbicides, metals, radionuclides, and ions and indicators.

Initial sampling of the production well in September 1985 resulted in detections of methylene chloride (53.9 ppb), trichloroethylene (TCE) (9.8 ppb), and toluene (8.2 ppb). TCE and toluene were not detected in subsequent sampling events. Methylene chloride, a common laboratory contaminant, was detected in concentrations less than the MCL (5.0 ppb) through 1986. No detections of methylene chloride have been observed after 1986. Benzene and tetrachloroethylene (PCE) have been detected in concentrations less than the MCLs during sampling events conducted through October 1987. Benzene was detected at a concentration of 2.3 ppb during the August 1986 sampling event. PCE was detected at 3.3 ppb in December 1985 and again at 4.3 ppb in October 1987. No detections of any volatile or semi-volatile organic compounds have occurred in production well samples since October 1987.

With the exception of arsenic, metal concentrations above MCLs have not been observed in any of the production well samples. Arsenic was detected at 0.10 ppm (MCL=0.05 ppm) during the July 1992 sampling event. Other parameters from the well, such as pH, TDS, chloride, fluoride and nitrate, indicate good water quality and correspond with results from the monitor well samples.

Two monitor wells (CCMW-1 and CCMW-2) were installed at the Cave Creek Landfill in May 1993. Ground-water samples were collected from each of the wells in June 1993. Analytical results are summarized in Table 5. The samples were analyzed for the following constituents: volatile and semi-volatile organic compounds, phenols, pesticides and herbicides, metals, and ions and indicators. Analytical results show that no MCLs were exceeded in either monitor well. Non-metal inorganic parameters indicate good water quality.

Two COP production wells lie within 1.5 miles downgradient of the Cave Creek Landfill. Wells COP 280 and COP 281 were sampled in June - September 1990 and August - September 1990, respectively. Analytical results are summarized in Tables 6 and 7.

Water quality analyses of the two COP wells correlate well with analyses from the Cave Creek Landfill wells. In Well 280, arsenic was detected in excess of the MCL in one sample. No detections for volatile or semi-volatile organic compounds were observed in either well. Total dissolved solids (TDS) analyses show concentrations in the 290 to 350 ppm range for both wells with the exception of one sample from Well 281 with a concentration of 560 ppm for TDS. The values for TDS correlate well with the Cave Creek well TDS data which range from 300 to 330 ppm.

3.2.4 Discharge Impact Area Assessment

The Discharge Impact Area (DIA) is defined as the "potential areal extent of pollutant migration, as projected on the land surface as a result of a discharge from a facility" (A.R.S. 49-201). A landfill can potentially generate leachate as precipitation infiltrates into landfill refuse mobilizing inorganic and organic contaminants. Leachate generation has not been observed in association with the Cave Creek Landfill. However, a hypothetical release from the landfill has been evaluated using a ground water flow and transport model. The results, discussed below, indicate that the Cave Creek Landfill will not impact ground water. Only the unsaturated zone beneath the landfill would be affected by a leachate release. Therefore, the DIA is proposed to coincide with the landfill boundaries (Figure 2-3). The following discussion provides a summary of computer modeling used to justify the DIA boundaries.

Ground-Water Model Development

The unsaturated (vadose) zone underlying the Cave Creek Landfill is greater than 600 feet thick and is therefore a significant component of the hydrogeologic system at this site. A vertical plane flow and transport model capable of simulating unsaturated flow was used to evaluate the influence of the unsaturated zone on the transport time for a hypothetical release of landfill leachate to the water table. Dames & Moore used a proprietary code known as TARGET 2DU to simulate unsaturated flow. TARGET 2DU is a vertically integrated finite difference model capable of simulating flow and transport in variably saturated porous media. ADEQ is a licensed user of the TARGET 2DU code. The mathematical formulation and assumptions are provided in the documentation supplied with the model.

A vertical plane model was developed to represent vertical flow through the unsaturated zone to the water table. The model extends from just west of Cave Creek 10,800 feet southeast to just east of Cave Creek Road (Figure 3-8). The bottom of the model was placed about 50 feet below the water table coincident with the saturated screened interval lengths in monitor wells CCMW-1 and CCMW-2. The finite difference mesh includes 131 cells in the horizontal direction ranging from 50 to 200 feet long and 80 cells vertically, each 10 feet thick for a total of 10,480 calculation cells. Figure 3-9 illustrates the finite-difference mesh used for the model.

Hydraulic properties for the alluvium used in the model are tabulated in Table 9 and were derived from laboratory and field measurements and published literature. Unsaturated zone flow calculations require the input of coefficients used to describe the relationship between the degree of saturation, the relative hydraulic conductivity and the moisture content. These relationships are described using "characteristic curves" for specific materials. The values of these coefficients were derived from published literature and correspond to a "typical sand" (Van Genuchten, et al., 1977). Sand and gravel deposits drain quickly as compared to clay and silt-bearing materials. The typical sand characteristic curves are believed to best represent the material underlying the Cave Creek Landfill.

The value of hydraulic conductivity (15 ft/day) was derived from interpretation of aquifer tests (Section 3.2.3). The porosity (28 percent) was derived from laboratory testing (Table 8).

Fixed head cells were used to establish the position of the water table at the up and downgradient model boundaries. Hydraulic heads along the bottom of the model were also fixed to allow flow from the bottom of the model domain and thereby avoid a curved water table surface. The result is a flat, sloping water table surface across the model domain. The upper model boundary was lined with fixed-infiltration cells. Two infiltration cell types were used: a cell representing natural infiltration, and a cell that includes concentrations of a leachate contaminant designed to simulate landfill leachate.

HELP Model Simulations

The infiltration rate assumed for the model was 0.5 inches per year. The percolation of water from the bottom of the Cave Creek Landfill was estimated utilizing the Hydrologic Evaluation of Landfill Performance (HELP) model. The climatological data from the Phoenix Sky Harbor airport is included in the HELP data base. Using the Phoenix monthly average of temperature and rainfall, 50 years of precipitation data were simulated using the simulation option of HELP. The simulated precipitation data were then used to predict percolation from the landfill over a period of 50 years.

A cross section of the landfill is shown on Figure 3-9. The final cover was assumed to be absent for the first 12 years of simulated percolation (1984 to 1996). Input parameters for the HELP model are given in Table 10. The landfill was characterized as open for the first 12 years of simulation. At the end of 12 years the final cover was added for two subsequent simulations over a period of 20 years each. The final soil moisture for each period of time was used as the initial soil moisture for the following period. These "initial" moisture contents are shown in Table 10 for each period of HELP simulation.

The initial soil moistures for the garbage and daily cover layers were selected on the basis of available data. For the garbage layer, moisture data were based on samples collected from borings in the 19th Avenue Landfill in Phoenix, Arizona (Dames & Moore, 1988). From the data, it was estimated that the moisture content of garbage at the 19th Avenue Landfill is 23 percent. This agrees with moisture content of garbage reported in the literature (Emcon Associates, 1982).

Other parameters for the garbage layer were based on the default soil type 18 in the HELP model data base.

For the daily cover, the initial moisture content and saturated conductivity were based on data from several onsite soil borings (Table 8). Other soil parameters used for the daily cover are summarized in Table 9.

Soil parameters for the closure cap are based on design considerations. It is assumed that during compaction the moisture content will be brought to about 20 percent. With compaction, the conductivity of the infiltration control layer should meet the minimum required conductivity of 1 x 10^{-5} cm/sec. Other parameters for the final cover are summarized in Table 9.

HELP Model Results

The outputs for the HELP model simulation are reproduced in Appendix H. The predicted percolation rates are shown on Figure 3-8 for 50 years of simulation. The HELP model predicts that the maximum percolation rate from the bottom of the garbage would be about 0.16 inch per year which is predicted to occur in year 13. Thereafter, the percolation rate is predicted to decrease steadily to 0.12 inch per year.

The percolation rate that is predicted after the closure cap is in place is due almost entirely to drainage of water present in the garbage at the time of closure. This is demonstrated by comparing the percolation rates predicted for the closure cap in place with predicted percolation rates that would occur if an impermeable cap were substituted for the actual closure cap. The results between the two cases are identical as compared below.

	Average Percolation (in/year)	
	Years 13-32	Years 33-50
With Closure Cap	0.15	0.13
With Impermeable Cap	0.15	0.13

The above comparison indicates that, with the closure cap as planned, percolation from the garbage layer is due almost entirely to gravity drainage. Over time therefore, the percolation from the garbage layer is expected to progressively diminished and will not be affected by precipitation.

Based on the results of HELP modeling, the value of 0.5 inches per year used in the ground-water modeling is a conservative estimate of leachate generation potential from the Cave Creek Landfill. The value of 0.5 inches per year represents about 6 percent of the average annual precipitation in this area (about 8 inches per year).

Cave Creek Simulation

Cave Creek is an intermittent stream, flowing only during storm events. Initial model simulations assumed no flow in the Cave Creek. A sensitivity analysis was done to evaluate the influence of Cave Creek on leachate migration from the landfill. Cave Creek was simulated using an infiltration rate equivalent to the average hydraulic conductivity of the alluvium (15 ft/day) and a hydraulic gradient of 1.0 for a period of three months. The results are discussed below in "Ground-Water Model Results".

Starting Conditions

The flow model was run assuming steady state conditions. This assumption is valid because hydraulic conditions in the vadose zone are relatively unchanged by fluctuations in the water table. Seasonal variations in the water table elevation were assumed to be insignificant over the 50 year period of simulation. Transport calculations were performed transiently.

Figure 3-12 illustrates the assumptions incorporated for the starting conditions used for the base case simulation of leachate migration from the landfill. The model was run for a period of 50 years, from 1984 when the landfill was opened to 2034, about 40 years in the future. Closure of this landfill is expected within about 2 years. Ground water monitoring is required for 30 years after closure of the landfill (40 CFR 258.61), therefore, the simulated period of 50 years extends several years beyond the required monitoring period and results in a worst-case prediction of contaminant migration potential from the landfill.

A leachate concentration of 5,475 ppm of chloride was assumed to be generated from the landfill. Chloride is commonly associated with landfills and is a good indicator of leachate generation. Chloride is a non-reactive, mobile ion and is therefore a good compound to estimate the worst-case migration potential of leachate. Most other metals and organic compounds are reactive with alluvial materials, particularly when clay or silt is present. The concentration of 5,475 ppm represents the maximum value reported by the EPA (1988) for landfill leachate. Chloride has a secondary drinking water standard of 250 ppm. The minimum concentration of chloride in ground water measured in monitor wells at the Cave Creek Landfill is 13 ppm. Therefore, the model predictions have been compared to a background value of 13 ppm chloride to evaluate the potential impact on ground-water quality.

The longitudinal and transverse dispersivity was set to 100 feet and 10 feet, respectively based on an evaluation of measured dispersivities by Gelhar, et al., (1992).

The results of the modeling are discussed in the following section.

Ground-Water Model Results

Figures 3-13 through 3-16 illustrate the predicted concentration of chloride after 5, 10, 30, and 50 years of leachate migration. Note that the figures have a vertical exaggeration of 10. These results indicate that, under worst-case conditions, the landfill, does not generate a concentration of chloride in ground water that exceeds the background concentration of 13 ppm after 50 years of continuous leachate generation.

The influence of Cave Creek on leachate migration was investigated by simulating flow in Cave Creek for three months. A three month continuous flow in Cave Creek would represent an unusually wet winter such as the 1992-1993 winter season. Figures 3-17 through 3-26 illustrate the predicted "plume" of clean water migrating downward from Cave Creek after three months of flow (Figure 3-17), three months after the flow had ceased (Figure 3-18), nine months after the flow (Figure 3-19), and five years after the flow (Figure 3-20). The results indicate that Cave Creek has no influence on the potential for leachate generation from the landfill.

Lateral migration and/or the development of a perched aquifer is not expected to occur in this area due to the lack of significant silt or clay horizons that could act as an aquitard.

Sensitivity Analyses

Sensitivity analyses were used to test the predictions of the model to variations in parameters such as hydraulic conductivity, infiltration rate, and dispersivity. The results were used to rank the sensitivity of input assumptions. For each input parameter, the value was increased and decreased over a hydrogeologically reasonable range and run to simulate 50 years of leachate generation.

The hydraulic conductivity of the alluvium was increased and decreased by a factor of 2 (from 7.5 to 30 feet per day). The results, presented on Figure 3-21 indicate that variation of hydraulic conductivity has no influence on the model predictions. This result is expected for unsaturated zone flow because the transport velocity of a contaminant in the unsaturated zone is dependent on the relative hydraulic conductivity and degree of saturation which are themselves dependent on the moisture content (see Section 3.2.3 for a detailed discussion). Variation of hydraulic conductivity would only influence flow and transport time in the saturated aquifer. It is concluded that the model is not sensitive to the value of hydraulic conductivity used in the model as long as no contamination migrates to the saturated aquifer.

Figure 3-22 illustrates the results of sensitivity analyses conducted by varying the infiltration rate. The infiltration rate is a key input parameter. The results show that the travel distance of a contaminant is directly proportional to the infiltration rate. In this case, however, even doubling the infiltration rate by a factor of 2 does not cause the model to predict an impact at the water table.

The dispersivity is an input parameter used to simulate advective dispersion of a contaminant as the contaminant moves through the unsaturated zone. Dispersivity values are typically derived from published sources because they are difficult to measure in the field. Dispersivity ranges over several orders of magnitude and is scale dependent. In this model, longitudinal and transverse dispersivity were established as 100 and 10 feet, respectively based on published data provided by Gelhar, et al. (1992). The sensitivity of dispersivity was tested by increasing and decreasing these values by a factor of 2. The results are presented on Figure 3-23. Dispersivity is slightly less sensitive to variation than the infiltration rate. Doubling the dispersivity does not result in a contaminant impact to ground water.

Based on the modeling results, the DIA boundary has been established as the boundaries of the landfill (see Figure 2-3) because only the vadose zone under the landfill is potentially influenced by leachate migration.

3.3 MONITORING PLAN

3.3.1 Introduction

This monitoring plan provides specific methods for Cave Creek Landfill ground-water sampling and analyses. The details in this plan conform to the requirements set forth in USEPA Subtitle D regulations, *EPA Criteria for Municipal Solid Waste Landfills* (40 CFR 258; 56 FR 51016, October 9, 1991; Amended at 57 FR 28627, June 26, 1992); *ADEQ Aquifer Protection Permits Application Guidance Manual* (modified September 11, 1992); and *ADEQ Guidance Document*

I, Establishing Ambient Groundwater Quality and Groundwater Levels for Aquifer Protection Permit Facility (June 1993).

Ground-water sampling will be conducted on a regular basis at three onsite wells. Initially, an Ambient Aquifer Quality Determination Program will be conducted to assess background ground-water quality in the area of the landfill. Sampling will then continue with a Detection Monitoring Program. If necessary, additional ground-water sampling may take place as part of an Assessment Monitoring Program and a Corrective Measures Program. These latter two programs are discussed in the Contingency Plan (Section 3.4).

This monitoring plan addresses ground-water sampling of the upgradient production well and two downgradient monitor wells. The two downgradient wells, CCMW-1 and CCMW-2, define points of compliance. Sections 3.3.2 and 3.3.3 present the details of the Ambient Aquifer Quality Determination Program and the Detection Monitoring Program, respectively. Section 3.3.4 is the field sampling plan providing information on sample collection handling, preservation, and custody procedures; field documentation requirements; and quality assurance and quality control measures.

3.3.2 Ambient Aquifer Quality Determination

The Ambient Aquifer Quality Determination Program will consist of 12 quarterly ground-water sampling events. Samples will be collected and analyzed according to the protocol presented in Section 3.3.4. For each sampling event, Maricopa County will submit a report to ADEQ. The report will present the analytical data sheets received from the laboratory (to include the date the analysis was complete, the individual who performed the analysis, the analytical method used to perform the analysis, the analytical result, and the reporting limit of the analytical method), and an assessment of the direction of ground-water flow based on water-level measurements performed at the time of sampling.

During the first, fifth, and ninth quarterly sampling events, the samples collected from the three on-site wells will be analyzed for the full list of parameters presented in US EPA Subtitle D Appendix I. For the remaining nine events, samples from the three wells will be analyzed for the 15 Appendix I inorganics plus the Appendix I organics previously detected during the annual events. Table 11 shows the Appendix I analytes, the practical quantitation limits listed by EPA, and Arizona Aquifer Water Quality Standards. Table 11 also presents a list of supplemental (not listed in Appendix I) inorganics analyses that will be included in each of the 12 Ambient

Determination Program events. Following the 12 sampling events, Alert Levels (AL) and Aquifer Quality Limits (AQLs) will be established according to the protocol presented in Figure 3-24. The calculated AL and AQL values will be presented to ADEQ in the report submitted for the twelfth and final sampling event of the Ambient Determination Program.

3.3.3 Detection Monitoring Program

Once the ALs and AQLs have been established, semi-annual samples will be collected from the three wells for full Appendix I analyses plus supplemental inorganic analyses (see Table 11). The samples will be collected and analyzed according to the protocol presented in Section 3.3.4. A report will be submitted to ADEQ for each semi-annual sampling event. Each report will include the analytical data sheets and an assessment of ground-water flow directions as described in Section 3.3.2.

Upon receipt of the analytical results, Maricopa County will perform an initial review of the data to determine if any detections have exceeded an AL or AQL. If an AL or AQL is exceeded, a verification sample(s) will be collected as soon as possible. The results of each verification analysis will be evaluated according to the flow chart presented as Figure 3-25. This evaluation will determine if the Detection Monitoring Program is to continue, or if the Assessment Monitoring Program or Corrective Measures Program is to begin. These latter two programs are discussed in the Contingency Plan (Section 3.4).

3.3.4 Field Sampling Plan

This plan describes the procedures that Maricopa County, contractor and subcontractors will take to assure that appropriate and high quality ground-water quality information is obtained. The information presented in this section applies to the collection of ground-water samples from the upgradient production and downgradient monitor wells during the Ambient Aquifer Quality Determination Program (Section 3.3.2) the Detection Monitoring Program (Section 3.3.3), the Post-Closure Monitoring Program (Section 3.7.4), and if required, during the Assessment Monitoring Program (Section 3.4.1) and any corrective measures program (Section 3.4.2). Table 12 presents the well construction details for the three wells including total depths, screened intervals, and pump settings.

Sample Preservation, Containers, and Holding Times

Table 13 lists the required preservatives and containers, recommended holding times for each group of analytes. Appendix J presents Appendix II analyte groups that are applicable only if the Assessment Monitoring Program is implemented (Section 3.4.1). Sample containers provided by the analytical laboratory will be clean virgin bottleware. Stick-on labels will be affixed to all containers. These labels will indicate any preservative added to the containers by the laboratory.

Sample Handling and Storage

In the field each sample container will be marked with the well name, date, and time of sample collection. After being filled, each container will be dried with paper towels, sealed with chain-of-custody seals, and placed in a cooler on ice in preparation for delivery to the laboratory. Samples for volatile organic analysis will be securely packed in plastic bubble bags.

Upon receipt of the samples, the laboratory will immediately notify Maricopa County if conditions or problems are identified that require immediate resolution. Such conditions include container breakage, missing or improper chain-of-custody, holding times exceedances, large (pea-size or larger) air bubbles in VOC containers, missing or improper sample labeling, or frozen samples. If any of these conditions are evident, resampling may be necessary. The laboratory will not proceed with sample analysis until directed to do so by Maricopa County.

Sample Custody

For each ground-water sample collected, an entry will be made on a chain-of-custody form supplied by the laboratory. The information to be recorded includes the sampling date and time, sample identification number, matrix sampled, requested analytes and methods, preservatives, and sampler(s) name. Sampling team members will maintain custody of the sample until they are relinquished to laboratory personnel or sample courier. The chain-of-custody form will accompany the samples from the time of collection until they are received by the laboratory. Each party in possession of the samples (except a professional courier service) will sign the chain-of-custody form signifying receipt. A copy of the original completed form will be provided by the laboratory along with the report of results. If a professional courier service delivers the samples to the laboratory, the chain-of-custody form will be placed in a plastic bag and shipped with samples inside the cooler. After the samples, ice, and chain-of-custody forms are packed in the coolers, custody seals will be placed on the lid of each cooler before the cooler is relinquished to the professional courier service. Custody seals provide assurance that the samples are not tampered with during transportation to the laboratory. The seals will be signed and dated by the sample team member that prepared the package. Upon receipt, the laboratory will inspect the condition of the custody seals and report the information on the chain-of-custody form.

Field Quality Control Samples

Trip Blank - A trip blank is provided by the laboratory and accompanies the sample containers throughout the collection activity; it is not opened until analysis. It consists of a sample of analyte-free water supplied by the laboratory in VOC vials. One trip blank will accompany each shipment containing VOC samples. Trip blanks will be analyzed for VOCs only.

Field Duplicate - One field duplicate sample will be collected every other sampling event. The duplicate sample will be collected in a manner that produces two samples with a high degree of homogeneity; i.e., the sampler will alternate filling primary sample bottles and the duplicate sample bottles. Bottles will only be filled half-way until all primary and duplicate bottles have received a portion of sample. The bottles will then be completely filled by alternating between primary and duplicate sample bottles. Field duplicates will be labeled by prefacing the well name with "FD" (e.g. FD CCMW-1) and will be analyzed in the same manner as the associated primary sample.

Documentation

Information will be recorded on chain-of-custody forms (discussed above), Sample Collection Record sheets, Daily Field Report forms, and instrument Calibration notebooks. An example of a Sample Collection Record Sheet is shown in Appendix I. Copies of these forms will be submitted to ADEQ as part of the report prepared for each sampling event. The Daily Field Report forms are used to record pertinent data that are not included in the chain-of-custody form or the Sample Collection Record sheets. A notebook will be maintained for each (conductivity meter), (pH meter), and water-level probe to record calibration, maintenance, and repair activities, and to document any correction factors (for electronic water-level probes) that must be included in the measurement calculations.

Production Well Sampling

The production well is located approximately 100-feet west of the Cave Creek Landfill weigh station (see Figures 2-1 and 2-3). The well head is contained in an above ground steel box. The well is operated on a daily basis to provide water for landfill operations. The amount of water to be purged from the production well prior to collecting a sample will be 1,500 gallons; required purge volumes will not be calculated on an event-by-event basis because the well is regularly purged during daily operation. Fifteen hundred gallons equals three times the volume of water standing in the well during static (nonpumping) conditions given a conservatively high static water level of 630 feet below ground surface. Considering an approximate flow rate of 20 gpm (there is no flow meter on the discharge pipe), the pump must be operated for a minimum of 75 minutes prior to sample collection. This purge water will be contained in the on-site 14,000 gallon holding tank for use in regular landfill operation. If the pump has been operated for at least 70 minutes by the time the sampling team arrives for sample collection, the sample will be collected immediately according to the procedures and protocols listed below, and a single set of pH, specific conductance and temperature measurements will be performed. If the well has not been pumping continuously for 70 minutes the sampling team will allow the pump to operate for the additional required time while performing pH, specific conductance, and temperature measurements at 20-minute intervals. After 70 minutes of purging, the ground-water sample will be collected as follows:

1) Turn off the production well pump.

2) Unthread and remove the plastic "vacuum breaker" from the 1.5-inch discharge pipe coupling on top of the well seal.

3) Thread the sampling valve into the 1.5-inch discharge pipe coupling.

4) Start the production well pump.

5) Open the sampling valve and purge 1 gallon of water through the sampling barb to clear any built-up pressure in the valve. Collect this purge water in 5-gallon bucket or other appropriate container.

6) Adjust the sampling valve so that the water exits the sampling barb in a slow, smooth stream.

7) Fill the required sample containers (see Table 13) beginning with the VOC containers. Samples for metal analyses will not be field filtered.

8) Turn off the pump.

9) Unthread and remove the sampling valve from the 1.5-inch discharge pipe coupling on top of the well seal immediately after turning off the pump.

10) After waiting at least 30 minutes, insert an electronic water-level probe into the discharge pipe and to the nearest 0.5-foot, measure the depth to water below the top of the discharge pipe coupling.

11) Remove the water-level probe and rinse with deionized water.

12) Thread the plastic "vacuum breaker" into the 1.5-inch discharge pipe coupling.

If the pump is not operating at the time the sampling team arrives for sample collection, the following protocol will be followed:

1) Unthread and remove the plastic "vacuum breaker" from the 1.5-inch discharge pipe coupling on top of the well seal.

2) Insert an electric water-level probe into the discharge pipe and to the nearest 0.5-foot, measure the depth to water below the top of the discharge pipe coupling.

3) Remove the water level probe and rinse with deionized water.

4) Thread the sampling valve into the 1.5-inch discharge pipe coupling.

5) Start the production well pump and operate for 70 minutes.

6) Perform steps 5-7 listed above.

7) Turn off the pump.

8) Immediately unthread and remove the sample valve and replace with the plastic "vacuum breaker".

Monitor Well Sampling

Monitor well CCMW-1 is located along the eastern boundary of the landfill approximately 2,000 feet south of the weigh station. Monitor well CCMW-2 is located in the buffer zone directly south of the landfill (see Figures 2-1 and 2-3). Both wells are secured in above ground steel boxes. The following list outlines procedures and protocols for collecting ground-water samples from the monitor wells.

1) Unlock and open the steel well box. If desired, unhinge and remove the box for easier access.

2) Unthread the sampling valve from the 1-inch discharge pipe coupling on top of the well seal.

3) Insert an electronic water-level probe into the discharge pipe and to the nearest 0.5-foot, measure the depth to water below the top of the discharge pipe coupling.

4) Remove the water-level probe and rinse with deionized water.

5) Thread the sampling valve back into the discharge pipe coupling.

6) Calculate the required purge volume and document the calculations on the Sample Collection Record sheet.

   Required Purge Volume (gallons) = three well volumes = 3 x [Well Radius (ft)]^2 $\times$ π $\times$ [Total Well Depth -Depth to Water] $\times$ 7.48.

For example:

Total Well Depth = 700 feet
Depth to Water = 620 feet
Well Radius = 6 inches = 0.25 feet

Required Purge Volume = $3 \times (0.25)^2 \times \pi \times (700\text{-}620) \times 7.48 = 352$ gal

7) Connect the pump's power cord to a generator. The pump motor requires a generator with 250 volt, single phase capacity. Smaller generators (6.5-kilowatt and less) may not provide sufficient power for the pump motor. A 15-kilowatt generator will provide adequate power. When connecting the power cord directly to the generator (no plug), only use the red and black leads. The yellow/green lead is not used.

8) Start the generator and purge the required volume while measuring pH, specific conductance and temperature. Purge volumes will be measured by observing the purge flow rate and then calculating the amount of pumping time necessary to meet the total purge volume. Based on existing water-quality data, it is appropriate to discharge the purge water onto the ground surface during the Ambient Determination Program and the Detection Monitoring Program. If an Assessment Monitoring Program or Corrective Measures Program is implemented, purge water will be contained and handled in an appropriate manner as approved by ADEQ.

9) Specific conductance, pH, and temperature measurements will be performed according to the following schedule:

- First set of measurements - upon pump start-up
- Second set of measurements - after one-third required volume has been purged
- Third set of measurements - after two-thirds required volume has been purged
- Fourth set of measurements - after required volume has been purged

10) Fill the required sample container (see Table 13) beginning with the VOC containers. Samples for metal analyses will not be field filtered.

3.3.5 Compliance Schedule

As discussed in Section 2.4 and 3.2, the Cave Creek Landfill is not expected to produce any discharge that will affect aquifer water quality. Furthermore, existing water-quality data suggest that background ground-water chemistry may currently meet Aquifer Water Quality Standards. Maricopa County will maintain the Monitoring Plan schedule as described in Section 3.3.2 and 3.3.3 to characterize ambient ground-water chemistry, to establish Alert Levels and Aquifer Quality Limits, and to verify that the Cave Creek Landfill will not adversely impact ground-water chemistry.

3.4 CONTINGENCY PLAN

Maricopa County will begin an Assessment Monitoring Program or Corrective Measures Program as determined from Figure 3-25. The details presented in this Contingency Plan for these two Programs are in conformance with the requirements set forth in the USEPA Subtitle D regulations (1991), ADEQ Aquifer Protection Permit Application Guidance Manual (1991), and the ADEQ Technical Guidance Document I (1993). All ground-water sampling discussed in this Contingency Plan will be conducted according to the protocols set forth in Section 3.3.4.

3.4.1 Assessment Monitoring Program

Maricopa County will begin the Assessment Monitoring Program as determined by Figure 3-25. ADEQ will be notified within 14 days of receiving an analytical report verifying an exceedance of an Alert Level. Within 90 days of verification ground-water samples will be collected from each of the three on-site wells for analysis of the full list of US EPA Subtitle D Appendix II constituents as presented in Appendix J. Additional components of the Assessment Monitoring Program are as follows:

1) Collect annual samples for the full list of Appendix II constituents.

2) Perform eight monthly sampling events to establish Alert Levels and Aquifer Quality Limits for each detected Appendix II constituent not found on the Appendix I list.

3) Collect semiannual samples for the full list of Appendix I analytes plus the site-specific (previously detected) Appendix II constituents.

In order to meet the requirements of the Assessment Monitoring Plan the sampling schedule shown on Table 15 will be implemented. This schedule will be followed until one of two findings are encountered: 1) all Appendix I and site-specific Appendix II concentrations are below Alert Levels for two consecutive sampling events, in which case the Detection Monitoring Program will be reimplemented; or 2) one or more verified concentrations exceed an Aquifer Quality limit, in which case a Corrective Measures Program will be implemented (Section 3.4.2) if the conditions on Figure 3-25 are satisfied.

3.4.2 Corrective Measures Program

Maricopa County will begin a Corrective Measures Program as determined by Figure 3-25. ADEQ will be notified within 14 days of receiving an analytical report verifying an exceedance of an Aquifer Quality Limit. Within 90 days of receiving the verification report, a proposal will be presented to ADEQ discussing the need for installation of additional monitoring wells, downgradient property owners will be notified of the verified exceedance(s), and an assessment of corrective measures will begin. The assessment of corrective measures will be performed according to the protocols described in the US EPA Subtitle D regulations. The Assessment Monitoring Program will continue during the period of time that corrective measures are being assessed. Prior to selection and implementation of a remedy, the results of the corrective measures assessment will be discussed at a public meeting with interested and affected parties. After the public meeting, a remedy will be selected and the corrective measure will be implemented according to the protocols described in the US EPA Subtitle D regulations.

3.5 LANDFILL LATERAL EXPANSION DESIGN

3.5.1 Existing Landfill Status

Prior to October 9, 1993, the existing landfill will include approximately 30.8 acres of completed or partially completed fill, to the limits as indicated on Drawing 3 of the Closure Plan Drawings. This will leave approximately 22 acres of the dedicated landfill area to be expanded and closed in accordance with the requirements of Subtitle D. The total landfill area upon closure will be 52.9 acres.

The existing landfill is shown on Drawing 2, which indicates topographically the extent of placement of unclosed municipal solid waste (MSW) and the extent of excavation of those areas planned for future MSW placement. Excavated materials have been utilized for the construction of berms and for daily cover material. All MSW placed each day is covered at the end of each working day.

As described in Section 2.4, fill has been placed by using both trench and area fill methods in the past. Current operations utilize the conventional area fill method.

To date the northwesterly quadrant of the landfill, shown as Cell "A" on Drawing 3, has been substantially completed and will be raised to its final closure grade by early 1994. The northerly portion of Cell "A" is readily accessible, is well drained and for these reasons will be reserved primarily for wet weather operations during the remaining period of operation.

Current operations have extended into the area shown as Cell "B" on Drawing 3. Cell "B" is functionally an extension of Cell "A" inasmuch as the two areas are contiguous with no separating berm. The southerly line of Cell "B" represents the planned extension of fill operations prior to the effective date of Subtitle D.

The combined footprint of Cells "A" and "B" represents the extent of fill operations anticipated as of October 9, 1993.

Cell "C", as shown on Drawing 3 is partially excavated at this time, and the Cell "C" containment berm is partially constructed. Cell "C" will be prepared in anticipation of full compliance with Subtitle "D" and ADEQ guidelines relating thereto.

Cell "D" has not been excavated and is planned as the final cell to be opened at the Cave Creek Landfill.

3.5.2 Lateral Expansion Plan

The lateral expansion plan will be initiated as of October 9, 1993, from the point of furthest extent of the existing landfill footprint as of that date. It is planned that the line of furthest expansion of the footprint, as of that date will be the line separating Cell "C" from Cell "D", as shown on Drawing 3. Upon the completion of Cell "C" MSW placement, the lateral expansion will extend into Cell "D", the completion of which will initiate the final closure of the Cave Creek Landfill.

3.5.3 Lateral Expansion Design

The transition to lateral expansion following October 9, 1993 will be initiated by placement of a composite liner, consisting of a flexible membrane liner overlying a compacted low permeability soil liner, in Cell "C" in accordance with Maricopa County policy to comply with CFR 258.40 (a)(2). This policy represents a conservative design policy decision by the County which exceeds the optional requirement of CFR 258.40 (a)(1), compliance to which has been demonstrated as a result of monitoring the performance of the existing landfill. This monitoring and related hydrogeologic and climatologic evaluation has been discussed in Section 3.2. Modeling indicates there will be no measurable water quality impact on the aquifer or detection of landfill related discharge or any other moisture discharge to potentially impacted soils of the vadose zone in the immediate downgradient vicinity of the landfill.

The other change in landfill design criteria relating to Subtitle D compliance involves a transition to 2:1 and 3:1 cell interior side slopes in order to accommodate the composite liner. Details and typical cross sections depicting the lateral expansion design are shown on Drawings 6 and 7.

3.6 LANDFILL CLOSURE DESIGN

The closure design provides an engineered plan for minimizing possible future threats to public health and safety, and to the environment. The closure design has been developed to be compatible with local topography and surface drainage, local climatology, and the planned post-closure land use of the site. The closure design incorporates the following design objectives:

- Elimination of potential leachate production attributable to precipitation infiltration through the landfill;
- Conformation to regulatory grading requirements;
- Minimization of potential threats to the integrity of the final cover and the associated potential of environmental releases from erosion and gullying, slope failure, physical disturbance, or surface water drainage control capacity exceedance by short duration precipitation events with a 100-year return period;
- Minimization of potential soil loss from the final cover;

- Maintenance of sufficient environmental monitoring and control systems to adequately ensure protection of public safety and the environment;
- Compatibility of sequential stages in partial closure design with final closure design; and
- Minimization of post-closure maintenance requirements in an economic manner.

Drawing 3 shows all pertinent site characteristics. Included on this site map are property boundaries, site acreage, limits of filling, access barriers, local topography, site drainage, 100 year flood, structures, surrounding land use, regional geology, surface hydrology, ground water wells, roads, and utilities.

The Cave Creek landfill is a non-discharging facility and all closure activities focus on possible discharge prevention rather than on actual discharge management. The landfill is expected to remain in operation for approximately two to six more years. The only waste material that is expected to be removed from the facility is operational waste, stockpiled prohibited waste, and recyclable material. These wastes are not, as yet, defined so specific details about characteristics, quantities, and disposal technologies and destinations will be developed at closure. All wastes removed from the site will be disposed of in accordance with the appropriate regulations.

3.6.1 Closure Design Drawings

Closure design drawings which are included herein are designated as follows:

Drawing No.	Description
1	Title Sheet - Includes a location map for the landfill;
2	Existing Site Conditions - Includes the most recent topographic mapping of the landfill as of (July 1993);
3	Closure Grading & Drainage Plan - Depicts the final cover grading plan and slopes, the proposed drainage control plan, and references details for grading and drainage. Ground-water monitoring wells and security fencing are also presented;

4 Closure Site Plan - Depicts the proposed drainage control plan for the compatible grading and drainage of all waste management facilities at the landfill;

5 Off-Site Drainage Map - Depicts off-site drainage plan, and references details of drainage control features;

6 Sections and Details - Depicts sections of the Landfill, and includes ground surface profiles for existing conditions, anticipated conditions at the time of closure construction, and final cover profiles;

7 Sections and Details - Depicts the details of construction items, including typical interior and drainage ditches and general notes.

8 Sections and Details - Depicts the details of construction items, including typical interior and drainage ditches and general notes.

3.6.2 Final Cover

The final cover profile is summarized below.

Infiltration Control Layer

The infiltration control layer will be placed immediately above the final fill lift and its daily cover of site excavated material and will consist of a minimum of 18 inches of compacted reservoir sediment imported from Cave Buttes flood control reservoirs. This material has been representatively tested to a hydraulic conductivity level of 3×10^{-6} cm/sec. The infiltration layer will be compacted to 90 percent of dry density at optimum moisture content for placement and compaction purposes. The infiltration control layer will be exposed to solar dehydration following compaction and prior to placement of the erosion control layer.

Core sampling of this material on September 7, 1993 indicates a field moisture capacity at 1/3 Bar of 21.1 percent as native uncompacted material. Field moisture content on this date was measured following significant localized precipitation within 10 days prior to sampling and indicated the following:

Sample Depth (inches)	% Moisture (by weight)	% of Field Moisture Capacity
8	10.7	50.7
15	5.9	28.0
22	8.4	39.8
30	7.1	33.6

This in-situ infiltration observation of the proposed infiltration control layer material in a naturally deposited, uncompacted state indicates a moisture content well below the field capacity, which indicates there is no free moisture available to induce deeper percolation. Compacted placement of this material will further improve its infiltration control potential.

It is also significant that the site of the above in-situ infiltration observation is in the bottom of the reservoir at a location which was subjected to relatively deep inundation during the storms earlier this year.

These observations yield the equivalent of negative infiltrometer test. This result, together with the results of the HELP modeling described in Section 3.2.4, provide a conclusive basis for design compliance with the provisions of 40 CFR 258.60 (b)(1) requiring that the infiltration control layer provide a reduction in infiltration which is equivalent to the composite liner proposed, and as described on Drawing 8. This is based on the conclusion that the planned design will provide zero infiltration at the cap as well as zero exfiltration at the liner.

Erosion Control Layer

The erosion control layer will be placed immediately over the infiltration control layer, following an adequate period of compactive moisture dehydration of the infiltration layer to a level not greater than 30 percent of moisture capacity. The erosion layer shall consist of approximately 12 inches of vegetative soil consisting of material imported from the organically enriched soils upstream from the upper Cave Buttes Reservoir. This soil may be blended with screened fines available on site to provide a reasonably well drained blend of topsoil which will support a vigorous growth of native plants and grasses conducive to maximizing moisture retention during precipitation events and which will optimize evapotranspiration potential, as well as providing erosion control of the infiltrative barrier.

Leachate Generation Potential Analysis

A leachate generation potential analysis for the final cover design was performed using the Hydrologic Evaluation of Landfill Performance (HELP) Version 2 simulation model. The HELP model was developed by P. Schroeder et al., (1988), and endorsed by the United States Environmental Protection Agency.

The results of this analysis indicates zero cover infiltration potential and confirms the field observation and testing data indicative of a no-discharge landfill. See Section 3.2.4 for a detailed description of the HELP modeling.

Anticipated Settlement

The placement of compacted fill required for the closure will cause some settlement of the fill material. An estimate of this settlement has been performed using data obtained, as well as information gathered from a review of the preliminary grading plan.

Based on available information, it is expected that the settlement of the compacted fill and native ground will be minimal, and therefore not a design consideration. Differential settlement of previously-placed waste may cause depressions in the ground surface, which could cause ponding of surficial runoff water. The need for periodic maintenance consisting of regrading or filling depressed areas should be anticipated. Differential settlement resulting from the range in thicknesses of placed waste between the edge of the cell and center of the cell will tend to cause an overall flattening of the final cover slope; the constructed final cover slope of eight percent will be sufficient to accomodate any flattening while still providing sufficient slope to ensure surface water runoff.

Additional monitoring should be performed as soon as any final cover materials are placed to measure the actual amounts and rates of settlements which occur under the weight of new fill materials. The results of the settlement monitoring from the initial closure phase should be applied to subsequent phases to minimize the requirement for periodic maintenance and regrading.

Vegetation and Slope Protection

The final cover of the Landfill will be stabilized by establishing native vegetation on the topsoil of the erosion control topsoil layer, final grade. The plant species selected for the final cover are compatible with the moisture retention characteristics of the vegetated soil layer, and the climatology in the vicinity of the site. Final cover vegetation must also be tolerant or resistant to site-specific conditions, require minimum irrigation and maintenance, and be persistent and hardy. Establishment and maintenance of a vegetative cover on the closed landfill surface will be completed after the upper soil cover has been placed and any nutrient amendments added. No permanent irrigation of the vegetative cover will be provided. The erosion control layer design incorporates an added erosion control feature, providing for placement of interceptor downdrain ditches to prevent rill or gully formation.

The U.S. Department of Agriculture, Soil Conservation Service, Phoenix Field Office and the Arizona Department of Transportation were consulted in the development of the seed mix and seeding application technique. The plant species adapted to the climatic conditions at the site and which can be reseed with little or no maintenance required after establishment include: Tufted grama grass (*Aristida glabrata*), wild oat (*Avena fatua*), Carolina canary grass (*Phalaris caroliniana*), bottlebrush squirreltail) (*Eylmus alymoidas*), foxtail brome (*Bromus ruben*), red grama grass (*Bouteloua trifida*), and feather fingergrass (*Chloris virgata*).

The final surface of the landfill soil cover will be planted with drought resistant, native vegetation. The vegetation established on the site surface will provide erosion mitigation and dust control.

The topsoil should be disked and 250 lbs/acre of ammonium phosphate (16-20-0, nitrogen, phosphorus, potassium, with 21% sulfur as sulfate) should be incorporated into the topsoil. Seeds will be planted during late October into the soil at the rates that are recommended in Appendix L. Temporary irrigation may be required to establish vegetative cover if winter rainfall is inadequate to establish the seedlings. Irrigation can be accomplished by a number of methods, utilizing portable sprinkler pipe or through surface application of water. Irrigation will be managed so that standing surface water is minimized and excess leachate is not generated.

3.6.3 Surface Water Drainage Control

The surface water drainage control facilities have been designed to carry the 100-year, 24-hour storm water volumes in accordance with drainage requirements as defined by Maricopa County standardized drainage requirements. Objectives considered in the design of the surface water drainage controls included:

- Minimization of potential ponding, infiltration, inundation, erosion, slope failure, washout, and overtopping under 100-year, 24-hour storm water volumes as derived.

- Minimization of surface runoff velocities through the utilization of lateral collection facilities, interception and diversion structures.

Other considerations in the design of the surface water drainage controls included:

- Compatibility of the drainage control system with the planned sequential partial closure of the site.

- Compatibility of the drainage control system with final grading drainage patterns.

- Compatibility with drainage facilities on adjacent properties.

- Compatibility of the drainage control system with the drainage pattern of the surrounding area.

- Use of no underdrains in the design of the drainage control system.

3.6.4 Structures Removal and Environmental Control Systems Decommissioning

The following section details the structure removal and environmental control systems decommissioning tasks necessary for closure construction.

Structures Removal and Abandonment

The existing structures associated with the daily operation of the Cave Creek Landfill will be removed and relocated to another site. Those structures required to house post closure maintenance equipment and supplies will remain on site.

Structures to be removed and relocated include:

- Miscellaneous sheds, tanks, recycling bins, and related improvements.

Structures to remain include:

- Tool shed
- Small Fuel Tank
- Scale
- Scale house and office (to be converted to Transfer Station).

Environmental Control Systems

Currently, a landfill gas monitoring system is being formulated. Gas monitoring locations will be placed around the perimeter of the landfill in roughly 400-foot intervals. Gas monitoring will be completed on a quarterly basis with a gas monitoring probe. The existing ground-water monitoring wells will remain in place and will be protected and secured. No water quality control systems are in place at this time, and none are expected to be required.

3.6.5 Closure Management

Closure of the Landfill will be conducted in accordance with the approved Final Closure and Post-Closure Maintenance Plan (Final Plan). No closure activities can proceed until the Final Plan is approved by all involved regulatory agencies, in accordance with all statutory and regulatory provisions relating to the closure of landfills. Deviations in scope and schedule from the Final Plan will be limited to reasonably unexpected events. Maricopa County will notify ADEQ of any deviations in scope and schedule within a reasonable period of time of becoming aware of the needed change. The accepted Final Plan will not be changed without approval by all involved administering regulatory agencies. Closure management of the site will be administered by Maricopa County.

Time-Frame for Closure

The planned time frame for closure of the Landfill is based on remaining waste disposal area, waste disposal methods, and waste loadings.

Projected Closure Horizon

As presented in Section 3.1 of this document, the projected remaining landfill life, based on available capacity, historical loadings, and current waste disposal techniques is two years, or through 1995.

Partial Closure

An interim, low permeability cover to provide positive surface drainage, is placed periodically over filled areas in order to eliminate the potential production of leachate from precipitation infiltration through the Landfill. Maricopa County will implement closure to the extent feasible as site operation progresses. Following approval of the Final Plan, Maricopa County will complete final cover placement, final grading, and revegetation activities consistent with the closure of the entire site over completed portions of the landfill.

Notification of Closure

Maricopa County will notify the ADEQ of landfill closure no more than ten working days following receipt of the last shipment of waste at the landfill site.

The County will begin implementation of closure activities within a reasonable time following final receipt of waste at the Landfill, and following final approval of a Final Plan by all agencies exercising jurisdiction over the closure of landfills. Placement of the final cover will occur within 18 months of receipt of the final shipment of waste to the Landfill. Should unforeseen events prevent adherence to the planned time frames, the County will notify all concerned agencies of the delay and will propose an alternate schedule for Landfill closure. Unforeseen events may also necessitate revisions to the approved Final Plans to ensure effective Plan implementation. Should this occur, proposed revisions will be submitted to the appropriate regulatory agencies for approval prior to implementation of any activities in the proposed revisions.

Construction Quality Assurance Plan

The purpose of the Construction Quality Assurance (CQA) plan is to verify that materials, construction methods used in final cover placement, and testing procedures are in accordance with the intent and purpose of the Plan. The results of the CQA program will be summarized in a CQA Summary Report addressing construction requirements and testing during each phase of the final cover construction. Details of the CQA Program are provided in Appendix N.

Construction processes are subdivided into the following for CQA reporting purposes:

- Preconstruction Materials Testing;
- Final Cover Placement Construction;
- Drainage Facilities; and
- Vegetative Cover.

A closure Final Documentation Report (FDR) will be submitted to the ADEQ. This report will contain the following information:

- A general description of the closure activities and significant related events;
- Construction record drawings;
- Construction quality assurance test results;
- A detailed description and discussion of all deviations from the approved closure plan, drawings, specifications, and approved revisions; and
- As-built descriptions of all environmental containment, monitoring, control, collection and recovery systems to remain at the Landfill during the post-closure maintenance period as well as any changes in the operational requirements of such systems to the extent that they deviate from those set forth in the approved Final Plan.

An as-built topographic map of the completed final grades will be produced as described for periodic settlement reported in Section 3.6.2 of this document and accompany the FDR. The FDR shall be a self-standing document and contain all subordinate reports.

The Final Documentation Report will also contain a certification that the information presented is accurate and a professional opinion as to whether the closure meets the requirements and intent of the approved closure plan and associated construction documents. The original closure construction documents will be stored and maintained in a protected, accessible location throughout the post-closure maintenance period. Supplemental documentation to support the Final Documentation Report will be retained by the County and will be furnished to the ADEQ upon request.

Engineer's Closure Cost Estimate

A cost estimate for the closure plan outlined herein has been prepared and is presented in Appendix O. Note that approximately 65 percent of the closure costs outlined below have been represented in capital improvements.

(1) Costs for structure removal and abandonment

(2) Costs for environmental control system decommissioning

(3) Costs for the final cover, including:

- Types and quantities of materials;
- Material acquisition;
- Material placement and grading; and
- Material compaction.

(4) Costs for geomembranes, including:

- Types and quantities of materials;
- Material acquisition;
- Material placement; and
- Installation inspection.

(5) Costs for construction quality assurance, including:

- Preparation of the CQAR;
- Inspection;
- Testing;

- Administration;
- Record keeping; and
- Reporting.

(6) Costs for revegetation of the final cover, including labor and materials costs for:

- Soil preparation;
- Planting;
- Fertilizing; and
- Establishment irrigation.

(7) Costs for drainage control systems and facilities, including:

- Design;
- Materials; and
- Installation.

(8) Costs for implementing site security measures, including:

- Securing environmental control systems;
- Fencing; and
- Signage.

The cost estimate does not include the following scope:

(1) Costs for gas monitoring system installation.

(2) Costs for gas control system installation.

(3) Costs for leachate control measures. Costs for leachate control measures for the Landfill are not provided. No leachate discharge is projected.

(4) Costs for the installation of a groundwater monitoring system. No additional groundwater monitoring wells are proposed for the site at this time. Accordingly, costs for groundwater monitoring system installation for the Landfill are not provided.

The current costs for the closure of the Landfill, incorporating the above scope and considerations, is estimated to be approximately $732,140 in 1993 dollars. The cost estimate has been increased by a 10 percent contingency for unforeseen cost overruns. This cost represents an accurate estimate for closure considering site conditions which would make closure most expensive.

This closure cost estimate should be revised during subsequent amendments or revision of this Plan to reflect any increase or decrease in closure costs which result from the amendment or revision. This estimated closure cost must be increased if there is an increase in the maximum extent of closure boundaries delineated in this Plan, or if there is an increase in monitoring associated with closure construction.

The closure cost estimate should be updated to accommodate changes in regulations and for inflationary effects at the time that the amended or revised plan is submitted.

3.7 POST-CLOSURE INSPECTION, MONITORING, AND REPORTING PROGRAMS

The purposes of the post-closure inspection, monitoring and reporting programs are to provide a detailed plan for the inspection of facilities and systems planned to be retained, and environmental monitoring of surface and subsurface environments at the Landfill during the post-closure maintenance period. Post-closure inspection, monitoring and reporting programs for the Landfill will be conducted, at a minimum, in accordance with a monitoring and reporting program specified by ADEQ and anticipated to be set forth in future amendments thereto, and will continue throughout the post-closure maintenance period. No modifications to the approved post-closure inspection, monitoring, and reporting programs will be made without the approval of the ADEQ.

3.7.1 Post-Closure Inspection and Reporting Program

A post-closure inspection program will be instituted at the site. This program will provide for:

Annual post-closure inspections which will include inspection of the following:

- Final grading;
- Infiltration control layer;
- Erosion control layer;

- Cover vegetation;
- Drainage control systems;
- Groundwater monitoring systems;
- Nuisance control measures including litter, vector, and fire control; and
- Security measures including signing, site access restrictions, and structures.

Annual post-closure inspection documentation will include inspection notes and laboratory reports including QA documentation for any samples which may be taken during the inspection. The inspection report will summarize areas of the Landfill in need of maintenance. Maintenance if required, will commence within 90 days following the date of inspection.

Post-closure inspection of the closed Landfill will continue on an annual basis for 30 years, or until it is determined by appropriate regulatory authority that the Landfill does not pose a threat to human health or to the environment. The proposed post-closure inspection program will continue until written permission to discontinue the program is granted by the ADEQ.

3.7.2 Post-Closure Landfill Gas Monitoring Program

A post-closure landfill gas monitoring program is currently being developed for the Landfill.

3.7.3 Post-Closure Vadose Zone Monitoring

A vadose zone monitoring program is currently not required for the Landfill and it is not anticipated that one will be implemented for the purpose of post-closure monitoring.

3.7.4 Post-Closure Ground-Water Monitoring

The proposed groundwater Detection Monitoring Program is discussed in Section 3.3.3. The post-closure monitoring program will be similar to the proposed groundwater Detection Monitoring Program. Ground-water quality monitoring may be discontinued following several years of negative results, if authorized by ADEQ. The groundwater monitoring well locations are indicated on Figures 2-1 and 2-3.

3.7.5 Self-Monitoring Reporting

Self-monitoring reports are proposed to be submitted to the ADEQ annually for review. The reports will describe the current site conditions observed during the periodic site inspections, actions that were performed, the results of the groundwater quality monitoring program, and recommendations.

3.7.6 Post-Closure Management

The purpose of the proposed post-closure management program is to provide a detailed plan for the maintenance of systems and facilities planned to be retained at the Landfill during the post-closure maintenance period. Objectives of the post-closure management program include:

- Minimize the potential for events which could cause a threat to public health and safety or to the environment;
- Minimize the cost and extent of the required post-closure maintenance activities;
- Provide and maintain an accurate estimate of the costs.

Post-Closure Land Use

The post-closure land use for the Landfill will likely be non-irrigated open space. No grazing or other agricultural activities are planned on the Landfill site following closure. At present, no structures are planned to be constructed on the Landfill.

Post-Closure Security

Details of site-access limitations, signing, and environmental and control systems protective measures at the Landfill proposed for the post-closure maintenance period are described in the following sections:

- **Site Access Limitations**

Current site access constraints are shown on Drawing 3. The Landfill will be provided with a 6-foot high chain-link fencing surrounding the entire perimeter at the time of closure. Site access limitations will be minimally implemented within 10 days of final waste receipt. A lockable gate will control entry into the closed Landfill. This gate will remain securely locked throughout the post-closure maintenance period. Keys to locks on these gates will be provided to the ADEQ, as well as local emergency response personnel, following closure.

- **Signage**

Signing proposed to be provided at the landfill perimeter includes the following:

- One sign will be posted at the main entrance to the Landfill, advising of landfill closure and indicating where the Plan for the Landfill may be viewed will be posted within 10 days of final receipt of waste at the facility. This sign will also provide a local or toll-free telephone number for notification in case of an emergency;
- Signs which read "NO TRESPASSING" and warn of the potential hazards of the closed landfill will be optionally posted every 250 feet along the Landfill perimeter fencing, and at all gates which provide access to the closed Landfill.

All signs provided will be written in Spanish, in addition to plain English language, and minimally be visible at a distance of 25-feet during daylight hours.

Environmental Monitoring and Control Systems Protection

All groundwater monitoring wells will be provided with locking caps or locking protective structures. These measures attempt to minimize the possibility of tampering with the wells, and the associated compromise of the integrity and representative accuracy of samples obtained from these wells. Locking of groundwater monitoring well protective structures will be maintained throughout the post-closure maintenance period of the Landfill. A single key will provide access to all groundwater monitoring wells, and a copy of this key will be provided to the ADEQ.

Post-Closure Maintenance Program

The purpose of the post-closure maintenance program is to maintain the integrity and effectiveness of the final cover, and site monitoring and control systems throughout the post-closure maintenance period. The post-closure maintenance program for the Landfill will continue, and associated post-closure financial assurance mechanisms described in Section 3.7.7 of this document will be maintained, for 30 years, or until it is demonstrated that the Landfill no longer poses a threat to the environment. No modifications to the post-closure maintenance program will be made without the approval of the ADEQ. Modifications to the post-closure maintenance program will be proposed if the following conditions exist:

- If the proposed modifications are to enhance environmental control at the Landfill; and
- If the proposed modifications are to reduce the amount of necessary environmental control, provided that documentation that the current level of control is no longer necessary is furnished by Maricopa County and the ADEQ concurs and approves such documentation.

The proposed post-closure maintenance program will continue until written permission to discontinue the program is granted by the ADEQ.

Maintenance activities will commence within 90 days following final approval of the PIR. Maintenance activities will be carried out by qualified personnel.

Annual post-closure maintenance programs will include the maintenance of the following:

- Final grading;
- Final cover;
- Drainage control systems;
- Drainage collection and holding facilities;
- Vegetative cover;
- Groundwater monitoring systems;
- Security measures; and
- Vector and nuisance control.

Final Cover and Grading Maintenance Program

A final cover maintenance program will be instituted at the Landfill. This program will include:

(1) Maintaining the final cover and, if warranted, correct the effects of landfill settlement.

(2) Maintaining the vegetated cover and, if warranted, correct the effects of erosion or vegetation desiccation.

No periodic post-closure irrigation program is planned for the Landfill. Other than as may be needed for initial establishment of vegetative cover.

If ponding is noted on-site during the annual inspection, settled areas will be regraded and reseeded to compensate for local differential settlements. Borrow materials for maintenance and repair will be sourced as set forth in Section 3.6.2 of this document. Procedures and processes for final cover maintenance and repair will be in accordance with the approved Final Plan.

Drainage Control Systems and Facilities Maintenance

A drainage control systems and facilities maintenance program will be instituted at the site. This program will include:

(1) Correcting differential settlement effects along drainage ways to provide proper runoff control; and
(2) Keeping drainage ditches clear and cleaned of accumulated debris or blockages.

Materials for correcting any differential settlement will be obtained from the borrow source identified in Section 3.5.2 of this document.

Environmental Monitoring and Control Systems Maintenance Program

An environmental monitoring and control systems maintenance program will be instituted at the site, and will include:

- Maintaining existing Groundwater Monitoring Systems.

No vadose zone monitoring is currently proposed for the Landfill. Accordingly, no vadose zone monitoring system maintenance program is planned.

A landfill gas monitoring system is currently being developed for at the Landfill. If a gas control system is determined to be necessary as indicated by future gas monitoring, a program for its maintenance will be provided.

Security and Plant Facilities Maintenance

Post-closure maintenance of security and plant facilities will include the regular repair of fences, signing, vandalism, and repairs to survey monuments.

Post-Closure Maintenance Cost Estimate

A post-closure maintenance cost estimate has been developed for the Landfill to provide an accurate projection of anticipated costs for materials, equipment, labor, and administration necessary for a third party to inspect, monitor, and maintain the systems and facilities as described in this Plan. The post-closure maintenance cost estimate is presented in Appendix O, and includes the following scope of projected inspection and maintenance costs:

- Costs for routine inspections of the final cover and grading and the costs for maintaining the integrity of the final cover, and, if warranted, correcting the effects of differential landfill settlement, subsidence, or erosion, including material acquisition, labor, and material placement costs.
- Costs for routine inspections of the drainage control systems and, if warranted, to remove blockages, including costs for the repair of levees, dikes, and berms.
- Costs for routine inspections and for maintenance of the vegetative cover, including costs for fertilization, irrigation, and irrigation system maintenance.
- Costs for scheduled groundwater monitoring, including sampling, equipment, laboratory analysis, reporting and costs for routine inspections of the groundwater monitoring system.
- Costs for scheduled inspection of site security measures;
- Costs for scheduled vector and nuisance control; and
- Costs for a gas monitoring program.

No vadose zone monitoring system is currently proposed at the Landfill. Accordingly, vadose zone monitoring system inspections and maintenance will not be conducted, and no cost estimate for these activities.

The proposed annual post-closure maintenance program is currently estimated to cost $101,820 annually. This annual cost must be multiplied by 30 years to determine the total amount for the financial assurance mechanisms. The resultant projected cost for the post-closure maintenance period is estimated to be $3,054,600 in 1993 dollars.

This post-closure maintenance cost estimate should be revised during subsequent amendments or revisions of this Plan to reflect any increase or decrease in post-closure costs which result from the amendment or revision. This estimated closure cost must be increased if there is an increase in the frequencies of post closure inspection, or if there is an increase in the frequency or parameters of post-closure environmental monitoring programs.

The post-closure cost estimate should be updated for inflationary effects at the time that the amended or revised plan is submitted.

3.7.7 Financial Assurance

ADEQ guidelines require that the County be responsible for establishing a demonstration of financial responsibility to provide funding for the costs for the closure and post-closure maintenance of the site.

These costs are currently estimated to be:

1)	For closure activities as presented in Appendix O of this document	$732,140
2)	For post-closure maintenance activities as presented in Appendix O of this document	$3,054,600
	TOTAL	**$3,786,740**

The amount of financial assurance mechanisms should be adjusted to reflect any increase or decrease in post-closure costs which result from the amendment or revision of this Plan, as well as be updated for inflationary effects at the time that the amended or revised plan is submitted. Documentation of any change in the amount or mechanism of financial assurance should be provided concurrent with the submittal of an amended or revised Plan, and include documentation of the cancellation of previous financial assurance mechanisms.

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TABLE 1

CLIMATIC SUMMARY FOR CAVE CREEK LANDFILL

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Temperature													
Absolute max temp (F)	88	92	100	105	113	122	118	110	118	107	93	88	122
Avg. max temp (F)	65.2	69.7	74.5	83.1	92.4	102.3	105.0	102.3	98.2	87.7	74.3	66.4	85.1
Avg. temp (F)	52.3	56.1	60.6	68.0	77.0	86.5	92.3	89.9	84.6	73.4	60.6	53.3	71.2
Avg. min temp (F)	39.4	42.5	46.7	53.0	61.5	70.6	79.5	77.5	70.9	59.1	46.9	40.2	57.3
Absolute min temp (F)	17	22	25	32	40	50	61	60	47	34	25	22	17
Humidity													
0500 (%)	66	60	56	43	35	31	45	51	50	51	58	66	51
1700 (%)	32	27	24	16	13	11	20	23	23	23	27	34	23
Precipitation													
Max (in)	2.41	2.23	4.16	2.10	1.06	1.70	5.15	5.56	4.23	4.40	3.04	3.98	5.56
Avg (in)	0.73	0.59	0.81	0.27	0.14	0.17	0.74	1.02	0.64	0.63	0.54	0.83	7.11
Min (in)	0	0	0	0	0	0	0	0	0	0	0	0	0
Surface													
Avg sfc wnd dir	E	E	E	E	E	E	E	E	E	E	E	E	E
Avg wnd spd (kts)	5.3	5.9	6.7	7.0	7.1	6.8	7.2	6.7	6.3	5.8	5.4	5.1	6.3
Max wnd spd (kts)	32	25	32	28	35	31	35	35	35	28	24	26	35
Sky Condition													
Sky cover (tenths)	4.7	4.5	4.3	3.4	2.6	1.9	3.7	3.2	2.3	2.7	3.4	4.1	3.4
Thunderstorms													
Avg number days	0.3	0.5	0.8	0.7	0.9	1.0	6.3	7.2	3.5	1.3	0.5	0.7	23.7

Data obtained from NOAA Atlas for Phoenix, Arizona.

TABLE 2

LIST OF WELLS WITHIN A 3-MILE RADIUS OF THE CAVE CREEK LANDFILL

Well # of Figure 1	ADWR		Owner	Total Well Depth (ft.)	Casing Diameter (in.)	Date Completed	Use
	Registration No	Legal Description					
1	55-601159	A(6-4)32abb	Goodman, G.J.	335	8	12/78	D
2	55-611757	A(6-4)32abd	Omundson, R.T.	320	6	1976	D
3	55-614064	A(6-4)32bad	Arizona State Land Dept	80	10	1944	UNK
4	55-805152	A(6-4)32bad	Arizona State Land Dept	UNK	12	UNK	J
5	55-518286	A(6-4)32caa	Flach & Soich	85	8	07/29/88	DJ
6	55-625150	A(6-4)32caa	Schubert, G.J.	106	12	10/45	DJ
7	55-625151	A(6-4)32caa	Schubert, G.J.	50	10	UNK	DJ
8	55-514411	A(6-4)32cab	Williams, Richard	340	8	11/29/86	D
9	55-506269	A(6-4)32ccc	David K.	175	6	09/12/83	D
10	55-506822	A(6-4)32ccc	Bowles, B.W.	140	8	12/15/83	DA
11	55-801126	A(6-4)32ccc	Bowles, et.al.	38	8	UNK	D
12	55-805321	A(6-3)34aaa	Bechtold, Phillip	600	UNK	12/01/71	DA
13	55-518165	A(6-3)34abb	Lares, Christopher	620	8	07/11/87	D
14	55-524131	A(6-3)34acc	Seely, Diane	785	8	04/15/89	D
15	55-502005	A(6-3)34acd	Beeskau, G.	820	8	02/26/82	D
16	55-521091	A(6-3)34bcc	Olson, John	695	8	05/10/88	D
17	55-523180	A(6-3)34bcd	Smith, Gary	710	8	02/03/89	D
18	55-531883	A(6-3)34bcd	Sones, James	715	UNK	05/30/91	D
19	55-524416	A(6-3)34bdd	Hoyt, Robert, et.al.	720	8	05/14/89	D
20	55-521687	A(6-3)34cab	Lawrence Family Trust	719	8	08/04/88	D
21	55-800842	A(6-3)34cac	Love Acres Association	700	8	12/79	D
22	55-636555	A(6-3)34daa	Perez, Raul M., Sr.	685	8	03/19/78	D
23	55-087362	A(6-3)34bab	Barton, B.	700	6	1981	D
24	55-517023	A(6-3)34dbb	Babbin, Stewart	700	8	03/20/87	D
25	55-530471	A(6-3)34ddd	Meeker, Rae Ellen	835	9	05/25/91	D
26	55-519950	A(6-3)35acc	Desert Foothills	915	8	01/09/88	JC

TABLE 2 (Continued)

Well # of Figure 1	ADWR		Owner	Total Well Depth (ft.)	Casing Diameter (in.)	Date Completed	Use
	Registration No	Legal Description					
27	55-513379	A(6-3)35bab	Beard, Harold	550	8	02/20/86	D
28	55-520855	A(6-3)35bac	Lopez, Ron	600	8	04/16/88	D
29	55-532262	A(6-3)35bbb	Emmett, James T. Jr.	738	8	10/16/91	D
30	55-638089	A(6-3)35bca	Stevens, H.	665	6	02/09/75	D
31	55-509150	A(6-3)35bcd	Mullens, C.	780	9	10/04/84	D
32	55-802504	A(6-3)35bcd	Silva, Irma	672	5	02/15/78	D
33	55-804560	A(6-3)35bcd	Ogden, Linda	200	8	10/22/84	D
34	55-628045	A(6-3)35bdb	Williams, L.E.	685	9	06/15/74	ADF
35	55-518430	A(6-3)35cbc	Combs, Jasper	400	8	08/10/87	D
36	55-528864	A(6-3)35cbc	Borders, Timothy	800	9	08/27/90	D
37	55-531151	A(6-3)35cdb	Cable, Robert	800	8	03/30/91	D
38	55-532341	A(6-3)35cdd	Fautin, Jim	795	9	07/26/91	D
39	55-804220	A(6-3)35dad	Ansick, Paul R. Jr.	1,000	6	UNK	AD
40	55-614030	A(5-3)01ccb	Arizona State Land Dept.	79	9	UNK	UNK
41	55-503913	A(5-3)12add	Arizona State Land Dept.	820	10	10/08/82	D
42	55-614031	A(5-3)22cbc	Arizona State Land Dept.	430	6	1949	D
43	55-518305	A(5-4)05bab	Johnson	535	8	06/25/87	D
44	55-638749	A(5-4)05bab	Flowers, J.L.	462	8	01/28/77	D
45	55-510670	A(5-4)05bac	Johnson, J.	520	7	05/13/85	D
46	55-640160	A(5-4)05caa	Hatcher, N.	875	10	UNK	D
47	55-507675	A(5-4)05cab	Johnson, J. Jr.	600	6	04/28/84	D
48	55-518167	A(5-4)05dcb	Winter, Frances	851	8	08/27/87	D
49	55-800785	A(5-4)05dcc	Formon, E.M.	997	8	1966	D
50	55-530868	A(5-4)06add	Joy Ridge, inc.	800	6	02/15/91	D
51	55-634474	A(5-4)07aad	Veres	980	6	1930	
52	55-600029	A(5-4)08dbd	City of Phoenix (COP 279)	1,100	10	02/61	D
53	55-524559	A(5-4)08dcc	City of Phoenix (COP 281)	1,400	13	09/25/90	E
54	55-602536	A(5-4)09ab	Carefree Black Mountain	1,400	8	01/81	D
55	55-600030	A(5-4)17bcd	City of Phoenix (COP 278)	864	14	12/18/69	D
56	55-527549	A(5-4)19acb	City of Phoenix (COP 280)	1,490	19	09/24/90	E

TABLE 2 (Continued)

Well # of Figure 1	ADWR Registration No	ADWR Legal Description	Owner	Total Well Depth (ft.)	Casing Diameter (in.)	Date Completed	Use
57	55-518789	A(5-4)21bbb	City of Scottsdale (COS 65)	1,698	30	10/23/87	E
58	55-522909	A(5-4)21cab	Kezele, Joseph M.	1,060	8	12/06/88	D
59	55-635121	A(5-4)21cbb	Holbrook	200	8	11/29/73	D
60	55-633464	A(5-4)28bac	Councilman	200	6	1971	D
61	55-633735	A(5-4)28bcd	Perkins	NA	NA	NA	D
62	55-638933	A(5-4)28ddd	Olson	850	8	1974	D
63	55-638272	A(5-4)29acc	Nolte, et al.	825	8	01/19/73	DJ
64	55-603807	A(5-4)30bad	City of Phoenix (COP 276)	1,157	16	02/24/78	F
65	55-800775	A(5-4)30cab	Short	600	8	06/66	ADJ
66	55-516342	A(5-4)30dcc	Albert, George & E.	820	8	11/19/87	D
67	55-636545	A(5-4)31ac	Holgerson, Rex	632	8	NA	D
68	55-532698	A(5-4)31aca	Holgerson, Rex	820	8	9/12/91	D
69	55-511808	A(5-4)31dba	Saffer, Russell Dean	700	7	08/01/85	D
70	55-600117	A(5-4)33daa	Ironwood Water Co.	993	6	03/62	D
71	55-600115	A(5-4)33dcd	Ironwood Water Co.	1,555	16	01/73	D

Note: Data obtained from the ADWR Well Registry Report dated 5/11/92.
Legend: A = Irrigation; D = Domestic; E = Municipal; F = Industrial; J = Stock; NA = Not Available; UNK = Unknown

TABLE 3

WATER LEVEL DATA FOR WELLS WITHIN A 3-MILE RADIUS OF CAVE CREEK LANDFILL

ADWR Identification No.	Map No. from Figure 1	Date Measured	Elevation of Land Surface (ft.)	Elevation of Water Level (ft.)	Depth to Water (ft.)
A(5-3)12add	41	10/92	1879.0	1240.0	639.0
		08/09/93		1243.5	635.5
A(5-3)22cbc	42	04/77	1680.0	1280.00	400.00
A(5-4)5dcc2	49	04/27/83	2000.0	1305.30	694.70
		01/02/85		1294.50	705.50
		11/20/91		1242.70	757.30
A(5-4)7aad1	51	06/46	1950.0	1280.00	670.00
		04/26/83		1276.80	673.20
		01/02/85		1272.50	677.50
A(5-4)8dcc	53	01/91	2000.0	1222.0	778.00
		07/93		1221.0	779.00
A(5-4)19acb	56	01/91	1900.0	1221.0	679.00
		07/93		1200.0	700.00
A(5-4)17bcd2	55	01/10/85	1955.0	1248.60	706.40
		03/06/86		1245.20	709.80
A(5-4)28bbb	?	11/60	1978.0	1248.00	730.00
A(5-4)28ddd	62	02/07/75	1995.0	1245.70	749.30
		01/08/76		1245.40	749.60
		01/25/78		1243.50	751.50
A(5-4)29dcd	?	03/24/46	1900.0	1274.00	626.00
A(5-4)30ddc	?	11/05/91	2261.0	2245.20	15.80

TABLE 3 (Continued)

ADWR Identification No.	Map No. from Figure 1	Date Measured	Elevation of Land Surface (ft.)	Elevation of Water Level (ft.)	Depth to Water (ft.)
A(5-4)30bac	64	04/26/83	1837.0	1224.50	612.50
		01/10/85		1221.30	615.70
		06/18/85		1217.90	619.10
		12/06/85		1218.50	618.50
		05/28/86		1213.50	623.50
A(6-3)35dca	?	09/07/82	1905.0	1349.90	555.10
A(6-3)35dab	?	05/09/74	1900.0	1232.00	668.00
A(6-4)32dad	?	11/11/91	1980.0	1589.30	390.70
A(6-4)32caa	5,6,7	11/16/76	1970.0	1923.80	46.20
		04/27/83		1958.22	11.78
		01/02/85		1957.00	13.00

Note: Water level information obtained from the ADWR/GWSI files and from correspondence with COP.

TABLE 4

ANALYTICAL RESULTS
FOR THE CAVE CREEK LANDFILL PRODUCTION WELL

Constituents	MCL (SMCL)	Sample Event													
		09/19/85	11/18/85	12/06/85	07/16/86	08/04/86	06/08/87	06/10/87	10/23/87	05/25/88	03/19/90	02/25/91	11/20/91	08/14/91	07/22/92
PURGEABLE ORGANIC COMPOUNDS (ppb)															
Acrolein	ND	<10	<10	a	a	a	a	a	<0.5	<1.0	a	a	a	a	a
Acrylonitrile	ND	<10	<10	a	a	a	a	a	<0.5	<1.0	a	a	a	a	a
Benzene	5.0	<4.4	<4.4	<1	a	2.3/b	a	a	<0.5	<1.0	<0.5	a	<1.0	<1.0	<1.0
Bromodichloromethane	100	<2.2	<2.2	<1	a	a	a	a	<0.5	<1.0	<0.5	a	<1.0	<1.0	<1.0
Bromoform	100	<4.7	<4.7	<1	a	a	a	a	<0.5	<1.0	<0.5	a	<1.0	<1.0	<1.0
Bromomethane	ND	<10	<10	<1	a	a	a	a	<0.5	<1.0	<0.5	a	<1.0	<1.0	<1.0
Carbon tetrachloride	5.0	<2.8	<2.8	<1	a	a	a	a	<0.5	<1.0	<0.5	a	<1.0	<1.0	<0.5
Chlorobenzene	100	<6.0	<6.0	<1	a	a	a	a	<0.5	<1.0	<0.5	a	<1.0	<1.0	<1.0
Chloroethane	ND	<10	<10	<1	a	a	a	a	<0.5	<1.0	<0.5	a	<1.0	<1.0	<1.0
2-Chloroethylvinyl ether	ND	<10	<10	<1	a	a	a	a	<0.5	<1.0	<0.5	a	<1.0	<1.0	<15
Chloroform	100	<1.6	<1.6	<1	a	a	a	a	<0.5	<1.0	<0.5	a	<1.0	<1.0	<0.5
Chloromethane	ND	<10	<10	<1	a	a	a	a	<0.5	<1.0	<0.5	a	<1.0	<1.0	<1.0
Dibromomethane	ND	a	a	a	a	a	a	a	a	a	a	a	a	a	<1.0
Dichlorodifluoromethane	ND	a	a	a	a	a	a	a	a	a	a	a	<1.0	<1.0	<1.0
Dibromochloromethane	100	<3.1	<3.1	<1	a	a	a	a	<0.5	<1.0	<0.5	a	<1.0	<1.0	<1.0
1,2-Dichlorobenzene (o)	600 (10)*	<10	<10	<1	a	a	a	a	<0.5	<1.0	<0.5	a	<1.0	<1.0	<1.0
1,3-Dichlorobenzene (m)	600	<10	<10	<1	a	a	a	a	<0.5	<1.0	<0.5	a	<1.0	<1.0	<1.0
1,4-Dichlorobenzene (p)	75 (5)*	<10	<10	<1	a	a	a	a	<0.5	<1.0	<0.5	a	<1.0	<1.0	<1.0

TABLE 4 (Continued)

Constituents	MCL (SMCL)	Sample Event													
		09/19/85	11/18/85	12/06/85	07/16/86	08/04/86	06/08/87	06/10/87	10/23/87	05/25/88	03/19/90	02/25/91	11/20/91	08/14/91	07/22/92
1,1-Dichloroethane	ND	<4.7	<4.7	<1	a	a	a	a	<0.5	<1.0	<0.5	a	<1.0	<1.0	<0.5
1,2-Dichloroethane	5.0	<2.8	<2.8	<1	a	a	a	a	<0.5	<1.0	<0.5	a	<1.0	<1.0	<0.5
1,1-Dichloroethene	7.0	<2.8	<2.8	<1	a	a	a	a	<0.5	<1.0	<0.5	a	<1.0	<1.0	<0.5
trans-1,2-Dichloroethene	100	<1.6	<1.6	<1	a	a	a	a	<0.5	<1.0	<0.5	a	<1.0	<1.0	<1.0
1,2-Dichloropropane	5.0	<6.0	<6.0	<1	a	a	a	a	<0.5	<1.0	<0.5	a	<1.0	<1.0	<0.5
cis-1,3-Dichloropropene	ND	<10	<10	<1	a	a	a	a	<0.5	<1.0	<0.5	a	<1.0	<1.0	<0.5
trans-1,3-Dichloropropene	ND	<5.0	<5.0	<1	a	a	a	a	<0.5	<1.0	<0.5	a	<1.0	<1.0	<1.0
Ethylbenzene	700 (30)*	<7.2	<7.2	<1	a	a	a	a	<0.5	<1.0	<0.5	a	<1.0	<1.0	<1.0
Methylene chloride	5.0	53.9/2.8	<2.8	2.6/b	2.9/b	1.4/b	<1	<1	<0.5	<1.0	<0.5	a	<1.0	<1.0	<5.0
1,1,2,2-Tetrachloroethane	ND	<6.9	<6.9	<1	a	a	b	b	<0.5	<1.0	<0.5	a	<1.0	<1.0	<0.5
1,1,2,2-Tetrachloroethene	ND	a	a	a	a	a	a	a	a	a	a	a	a	a	<0.5
Tetrachloroethene	5.0	<4.1	<4.1	3.3/b	<1	a	<1	<1	4.3/b	<1.0	<0.5	a	<1.0	<1.0	a
Toluene	10^3 (40)*	8.2/6.0	<6.0	<1	<1	a	<1	<1	<0.5	<1.0	<0.5	a	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	200	<3.8	<3.8	<1	a	a	b	b	<0.5	<1.0	<0.5	a	<1.0	<1.0	<0.5
1,1,2-Trichloroethane	5.0	<5.0	<5.0	<1	a	a	b	b	<0.5	<1.0	<0.5	a	<1.0	<1.0	<0.5
Trichloroethene	5.0	9.8/1.9	<1.9	<1	<1	a	<1	<1	<0.5	<1.0	<0.5	a	<1.0	<1.0	<0.5
Trichlorofluoromethane	ND	<10	<10	a	a	a	a	a	a	<1.0	a	a	<1.0	<1.0	<1.0
Vinyl chloride	2.0	<10	<10	<1	b	b	b	b	<0.5	<1.0	<0.5	a	<1.0	<1.0	<2.0
Xylenes	10^4 (20)*	a	a	a	a	a	a	a	a	a	a	a	<1.0	<1.0	<0.3

TABLE 4 (Continued)

Constituents	MCL (SMCL)	Sample Event													
		09/19/85	11/18/85	12/06/85	07/16/86	08/04/86	06/08/87	06/10/87	10/23/87	05/25/88	03/19/90	02/25/91	11/20/91	08/14/91	07/22/92
BASE/NEUTRAL EXTRACTABLE ORGANIC COMPOUNDS (ppb)															
Acenaphthene	ND	<1.9	a	a	a	a	a	a	a	a	a	a	a	a	a
Acenaphthylene	ND	<3.5	a	a	a	a	a	a	a	a	a	a	a	a	a
Anthracene	ND	<1.9	a	a	a	a	a	a	a	a	a	a	a	a	a
Benzo (a) anthracene	0.1*	<7.8	a	a	a	a	a	a	a	a	a	a	a	a	a
Benzo (b) fluoranthene	0.2*	<4.8	a	a	a	a	a	a	a	a	a	a	a	a	a
Benzo (k) fluoranthene	0.2*	<2.5	a	a	a	a	a	a	a	a	a	a	a	a	a
Benzo (a) pyrene	0.2	<2.5	a	a	a	a	a	a	a	a	a	a	a	a	a
Benzo (ghi) perylene	ND	<4.1	a	a	a	a	a	a	a	a	a	a	a	a	a
Benzyl butyl phthalate	100*	<2.5	a	a	a	a	a	a	a	a	a	a	a	a	a
Bis (2-chloroethyl) ether	ND	<5.7	a	a	a	a	a	a	a	a	a	a	a	a	a
Bis (2-chloroethoxy) methane	ND	<5.3	a	a	a	a	a	a	a	a	a	a	a	a	a
Bis (2-ethylhexyl) phthalate	ND	<2.5	a	a	a	a	a	a	a	a	a	a	a	a	a
Bis (2-chloroisopropyl) ether	ND	<5.7	a	a	a	a	a	a	a	a	a	a	a	a	a
4-Bromophenyl phenyl ether	ND	<1.9	a	a	a	a	a	a	a	a	a	a	a	a	a
2-Chloronaphthalene	ND	<1.9	a	a	a	a	a	a	a	a	a	a	a	a	a
4-Chlorophenyl phenyl ether	ND	<4.2	a	a	a	a	a	a	a	a	a	a	a	a	a
Chrysene	0.2*	<2.5	a	a	a	a	a	a	a	a	a	a	a	a	a
Dibenzo (a,h) anthracene	0.3*	<2.5	a	a	a	a	a	a	a	a	a	a	a	a	a
Di-n-butylphthalate	ND	<2.5	a	a	a	a	a	a	a	a	a	a	a	a	a
1,2-Dichlororbenzene	600 (10)*	<1.9	a	a	a	a	a	a	a	a	a	a	a	a	a
1,3-Dichlorobenzene	600	<1.9	a	a	a	a	a	a	a	a	a	a	a	a	a
1,4-Dichlorobenzene	75 (5)*	<4.4	a	a	a	a	a	a	a	a	a	a	a	a	a

TABLE 4 (Continued)

Constituents	MCL (SMCL)	Sample Event													
		09/19/85	11/18/85	12/06/85	07/16/86	08/04/86	06/08/87	06/10/87	10/23/87	05/25/88	03/19/90	02/25/91	11/20/91	08/14/91	07/22/92
3,3-Dichlorobenzidine	ND	<16.5	a	a	a	a	a	a	a	a	a	a	a	a	a
Diethyl phthalate	ND	<22	a	a	a	a	a	a	a	a	a	a	a	a	a
Dimethyl phthalate	ND	<1.6	a	a	a	a	a	a	a	a	a	a	a	a	a
2,4-Dinitrotoluene	ND	<5.7	a	a	a	a	a	a	a	a	a	a	a	a	a
2,6-Dinitrotoluene	ND	<1.9	a	a	a	a	a	a	a	a	a	a	a	a	a
Di-n-octylphthalate	ND	<2.5	a	a	a	a	a	a	a	a	a	a	a	a	a
Fluorantene	ND	<2.2	a	a	a	a	a	a	a	a	a	a	a	a	a
Fluorene	ND	<1.9	a	a	a	a	a	a	a	a	a	a	a	a	a
Hexachlorobenzene	1.0	<1.9	a	a	a	a	a	a	a	a	a	a	a	a	a
Hexachlorobutadiene	ND	<0.9	a	a	a	a	a	a	a	a	a	a	a	a	a
Hexachloroethane	ND	<1.6	a	a	a	a	a	a	a	a	a	a	a	a	a
Indeno (1,2,3-cd) pyrene	0.4*	<3.7	a	a	a	a	a	a	a	a	a	a	a	a	a
Isophorone	ND	<2.2	a	a	a	a	a	a	a	a	a	a	a	a	a
Naphthalene	ND	<1.6	a	a	a	a	a	a	a	a	a	a	a	a	a
Nitrobenzene	ND	<1.9	a	a	a	a	a	a	a	a	a	a	a	a	a
N-Nitrosodi-n-prypylamine	ND	<10	a	a	a	a	a	a	a	a	a	a	a	a	a
Phenanthrene	ND	<5.4	a	a	a	a	a	a	a	a	a	a	a	a	a
Pyrene	ND	<1.9	a	a	a	a	a	a	a	a	a	a	a	a	a
1,2,4-Trichlorobenzene	70	<1.9	a	a	a	a	a	a	a	a	a	a	a	a	a

TABLE 4 (Continued)

Constituents	MCL (SMCL)	Sample Event													
		09/19/85	11/18/85	12/06/85	07/16/86	08/04/86	06/08/87	06/10/87	10/23/87	05/25/88	03/19/90	02/25/91	11/20/91	08/14/91	07/22/92
PHENOLS (ppb)															
4-Chloro-3-methylphenol	ND	<3.0	a	a	a	a	a	a	a	a	a	a	a	a	a
2-Chlorophenol	ND	<3.3	a	a	a	a	a	a	a	a	a	a	a	a	a
2,4-Dichlorophenol	ND	<2.7	a	a	a	a	a	a	a	a	a	a	a	a	a
2,4-Dimethylphenol	ND	<2.7	a	a	a	a	a	a	a	a	a	a	a	a	a
2,4-Dinitrophenol	ND	<42	a	a	a	a	a	a	a	a	a	a	a	a	a
2-Methyl-4,6-dinitrophenol	ND	<24	a	a	a	a	a	a	a	a	a	a	a	a	a
2-Nitrophenol	ND	<3.6	a	a	a	a	a	a	a	a	a	a	a	a	a
4-Nitrophenol	ND	<2.4	a	a	a	a	a	a	a	a	a	a	a	a	a
Pentachlorophenol	1.0	<3.6	a	a	a	a	a	a	a	a	a	a	a	a	a
Phenol	ND	<1.5	a	a	a	a	a	a	a	a	a	a	a	a	a
2,4,6-Trichlorophenol	ND	<2.7	a	a	a	a	a	a	a	a	a	a	a	a	a
PESTICIDES/HERBICIDES (ppb)															
Aldrin	ND	<1.9	a	a	a	a	a	a	a	a	a	a	a	a	a
B- BHC	ND	<4.2	a	a	a	a	a	a	a	a	a	a	a	a	a
D- BHC	ND	<3.1	a	a	a	a	a	a	a	a	a	a	a	a	a
Chlordane	2.0	<10	a	a	a	a	a	a	a	a	a	a	a	a	a
4,4'-DDD	ND	<2.8	a	a	a	a	a	a	a	a	a	a	a	a	a
4,4'-DDE	ND	<5.6	a	a	a	a	a	a	a	a	a	a	a	a	a
4,4'-DDT	ND	<4.7	a	a	a	a	a	a	a	a	a	a	a	a	a
Dieldrin	ND	<2.5	a	a	a	a	a	a	a	a	a	a	a	a	a
Endosulfan sulfate	ND	<5.6	a	a	a	a	a	a	a	a	a	a	a	a	a
Endrin aldehyde	ND	<15	a	a	a	a	a	a	a	a	a	a	a	a	a
Heptachlor	0.40	<1.9	a	a	a	a	a	a	a	a	a	a	a	a	a

TABLE 4 (Continued)

Constituents	MCL (SMCL)	Sample Event													
		09/19/85	11/18/85	12/06/85	07/16/86	08/04/86	06/08/87	06/10/87	10/23/87	05/25/88	03/19/90	02/25/91	11/20/91	08/14/91	07/22/92
Heptachlor epoxide	0.20	<2.2	a	a	a	a	a	a	a	a	a	a	a	a	a
PCB-1016	0.50	<50	a	a	a	a	a	a	a	a	a	a	a	a	a
PCB-1221	0.50	<30	a	a	a	a	a	a	a	a	a	a	a	a	a
PCB-1232	0.50	<50	a	a	a	a	a	a	a	a	a	a	a	a	a
PCB-1242	0.50	<50	a	a	a	a	a	a	a	a	a	a	a	a	a
PCB-1248	0.50	<50	a	a	a	a	a	a	a	a	a	a	a	a	a
PCB-1254	0.50	<36	a	a	a	a	a	a	a	a	a	a	a	a	a
PCB-1260	0.50	<50	a	a	a	a	a	a	a	a	a	a	a	a	a
Toxaphene	3.0	<50	a	a	a	a	a	a	a	a	<1.0	a	<1.0	a	<5.0
Endrin	2.0	a	a	a	a	a	a	a	a	a	<0.1	a	<0.1	a	<0.2
Lindane	0.20	a	a	a	a	a	a	a	a	a	<1.0	a	<1.0	a	<4.0
Methoxychlor	40	a	a	a	a	a	a	a	a	a	<1.0	a	<1.0	a	<100
2,4-D	70	a	a	a	a	a	a	a	a	a	<1.0	a	<1.0	a	<100
2,4,5-TP (Silvex)	50	a	a	a	a	a	a	a	a	a	<1.0	a	<1.0	a	<10
METALS (ppm)															
Aluminum	(0.05-0.2)	a	a	a	a	a	a	a	a	<0.01	<0.1	a	<0.10	<0.1	0.08/b
Antimony	0.006	a	a	a	a	a	a	a	a	<0.02	<0.01	a	<0.02	<0.02	<0.05
Arsenic	0.05	a	a	a	a	a	a	a	0.01/b	0.013/b	<0.01	<0.2	<0.01	<0.01	0.10/b
Barium	2.0	a	a	a	a	a	a	a	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.05
Beryllium	0.004	a	a	a	a	a	a	a	<0.01	<0.01	<0.01	a	<0.01	a	<0.05
Boron	ND	a	a	a	a	a	a	a	<0.005	0.05/b	a	a	a	<0.01	a
Cadmium	0.005	a	a	a	a	a	a	a	a	<0.005	<0.005	<0.02	<0.005	<0.005	<0.01
Chromium	0.1	a	a	a	a	a	a	a	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05
Cobalt	ND	a	a	a	a	a	a	a	<0.05	0.01	<0.01	a	<0.01	<0.01	<0.05

TABLE 4 (Continued)

Constituents	MCL (SMCL)	Sample Event													
		09/19/85	11/18/85	12/06/85	07/16/86	08/04/86	06/08/87	06/10/87	10/23/87	05/25/88	03/19/90	02/25/91	11/20/91	08/14/91	07/22/92
Copper	TT (1.0)	a	a	a	a	a	a	a	<0.05	<0.05	a	a	a	a	a
Iron	(0.3)	a	a	a	a	a	a	a	.0.32/b	<0.1	<0.1	a	<0.5	<0.1	<0.05
Lead	TT	a	a	a	a	a	a	a	<0.02	<0.01	<0.005	<0.2	<0.005	<0.002	<0.05
Lithium	ND	a	a	a	a	a	a	a	a	<0.05	a	a	a	a	a
Magnesium	ND	a	a	a	a	a	a	a	a	22/b	a	a	a	a	a
Manganese	0.05	a	a	a	a	a	a	a	<0.05	<0.05	<0.05	a	<0.05	<0.005	<0.05
Mercury	0.002	a	a	a	a	a	a	a	<0.001	<0.001	<0.001	<0.05	<0.001	<0.001	<0.001
Molybdenum	ND	a	a	a	a	a	a	a	a	<0.05	a	a	a	a	a
Nickel	0.1	a	a	a	a	a	a	a	a	<0.05	<0.05	a	<0.1	<0.5	<0.5
Selenium	0.05	a	a	a	a	a	a	a	<0.005	<0.005	<0.005	<0.1	<0.005	<0.005	<0.005
Silver	(0.1)	a	a	a	a	a	a	a	<0.02	<0.02	<0.02	<0.2	<0.02	<0.02	<0.05
Thallium	0.002	a	a	a	a	a	a	a	<0.01	<0.01	<0.01	a	<0.02	<0.01	<0.10
Tin	ND	a	a	a	a	a	a	a	<0.04	<0.01	<0.02	a	<0.02	<0.02	0.15/b
Vanadium	ND	a	a	a	a	a	a	a	<0.05	<0.05	<0.05	a	<0.05	<0.05	<0.05
Zinc	(5.0)	a	a	a	a	a	a	a	0.16/b	0.15/b	0.10/b	a	0.24/b	0.21/b	0.1/b
NON-METAL INORGANICS (ppm unless otherwise noted)															
pH (S.U.)	(6.5-8.5)	a	a	a	a	a	a	a	a	8.0/b	7.4/b	8.3/b	7.1/b	7.3/b	7.5/b
TDS	(500)	a	a	a	a	a	a	a	a	310/b	330/b	a	310/b	310/b	320/b
Alkalinity	ND	a	a	a	a	a	a	a	a	230/b	a	a	a	a	a
Ammonia-N	ND	a	a	a	a	a	a	a	a	<0.1	a	a	a	a	a
Calcium	ND	a	a	a	a	a	a	a	a	49/b	a	a	a	a	a
Chloride	(250)	a	a	a	a	a	a	a	a	16/b	16/b	a	16/b	16/b	17/b
Fluoride	4.0 (2.0)*	a	a	a	a	a	a	a	a	0.4/b	0.4/b	a	0.33/b	0.5/b	0.41/b

TABLE 4 (Continued)

Constituents	MCL (SMCL)	Sample Event													
		09/19/85	11/18/85	12/06/85	07/16/86	08/04/86	06/08/87	06/10/87	10/23/87	05/25/88	03/19/90	02/25/91	11/20/91	08/14/91	07/22/92
Nitrate-N	10	a	a	a	a	a	a	a	a	2.0/b	1.8/b	a	1/4.b	1.3/b	0.96/b
Phosphate-P, Ortho	ND	a	a	a	a	a	a	a	a	<0.01	a	a	a	a	a
Phosphate-P, Total	ND	a	a	a	a	a	a	a	a	<0.01	a	a	a	a	a
Silica	ND	a	a	a	a	a	a	a	a	41/b	a	a	a	a	a
Sodium	ND	a	a	a	a	a	a	a	a	33/b	a	a	a	a	a
Sulfate	(250)	a	a	a	a	a	a	a	a	22/b	25/b	a	26/b	27/b	21/b
Total Kjeldahl Nitrogen (TKN)	ND	a	a	a	a	a	a	a	a	0.02	a	a	a	a	a
Total Nitrogen	ND	a	a	a	a	a	a	a	a	2.0/b	a	a	a	a	a
Total Organic Carbon (TOC)	ND	a	a	a	a	a	a	a	a	0.58/b	a	a	a	a	a
Fecal Coliform Bacteria	ND	a	a	a	a	a	a	a	a	<2	a	a	a	a	a
RADIONUCLIDES (pCi/litre)															
Gross Alpha	15	a	a	a	a	a	a	a	a	<2	a	a	a	a	a

Notes:
[Result/Detection Limit]
< = less than practical quanitation limit or PQL
a = not analyzed
b = detection limit not listed
* = proposed
MCL = maximum contaminant level
SMCL = secondary maximum contaminant level
ND = no MCL or SMCL determined

References
Arizona Department of Environmental Quality, 1992, Human Health-Based Guidance Levels for the Ingestion of Contaminants in Drinking Water and Soil.
Maricopa County Solid Waste Management Division files.
United States Environmental Protection Agency Region 9, 1992, Drinking Water Standards and Health Advisories Table.
United States Environmental Protection Agency, Office of Water, 1993, Drinking Water Regulations and Health Advisories.

TABLE 5

ANALYTICAL RESULTS FOR THE CAVE CREEK LANDFILL MONITOR WELLS

Constituents	MCL (SMCL)	Well CCMW-1 Sample Event 06/14/93	Well CCMW-1 Sample Event 06/22/93	Well CCMW-2 Sample Event 06/14/93	Well CCMW-2 Sample Event 06/22/93
PURGEABLE ORGANIC COMPOUNDS (ppb)					
Acetone	ND	<20	a	<20	a
Acrolein	ND	a	a	a	a
Acrylonitrile	ND	a	a	a	a
Benzene	5.0	<2.0	<1.0	<2.0	<1.0
Bromodichloromethane	100	<2.0	<1.0	<2.0	<1.0
Bromobenzene	ND	<2.0	a	<2.0	a
Bromochloromethane	ND	<2.0	a	<2.0	a
Bromoform	100	<5.0	<1.0	<5.0	<1.0
Bromomethane	ND	<5.0	<1.0	<5.0	<1.0
Carbon tetrachloride	5.0	<2.0	<0.5	<2.0	<0.5
Chlorobenzene	100	<2.0	<1.0	<2.0	<1.0
Chloroethane	ND	<2.0	<1.0	<2.0	<1.0
2-Chloroethylvinyl ether	ND	a	<15	a	<15
Chloroform	100	<2.0	<0.5	<2.0	<0.5
Chloromethane	ND	<2.0	<1.0	<2.0	<1.0
2-chlorotoluene	ND	<2.0	a	<2.0	a
4-chlorotoluene	ND	<2.0	a	<2.0	a
Dibromomethane	ND	<2.0	<1.0	<2.0	<1.0
Dichlorodifluoromethane	ND	<5.0	<1.0	<5.0	<1.0
Dibromochloromethane	100	<2.0	<1.0	<2.0	<1.0
1,2-Dibromoethane	ND	<5.0	a	<5.0	a
1,2-Dichlorobenzene (o)	600 (10)*	<2.0	<1.0	<2.0	<1.0

TABLE 5 (Continued)

Constituents	MCL (SMCL)	Well CCMW-1 Sample Event 06/14/93	Well CCMW-1 Sample Event 06/22/93	Well CCMW-2 Sample Event 06/14/93	Well CCMW-2 Sample Event 06/22/93
1,3-Dichlorobenzene (m)	600	<2.0	<1.0	<2.0	<1.0
1,4-Dichlorobenzene (p)	75 (5)*	<2.0	<1.0	<2.0	<1.0
1,1-Dichloroethane	ND	<2.0	<0.5	<2.0	<0.5
1,2-Dichloroethane	5.0	<2.0	<0.5	<2.0	<0.5
1,1-Dichloroethene	7.0	<2.0	<0.5	<2.0	<0.5
cis-1,2-Dichloroethene	70	<2.0	a	<2.0	a
trans-1,2-Dichloroethene	100	<2.0	<1.0	<2.0	<1.0
1,2-Dichloropropane	5.0	<2.0	<0.5	<2.0	<0.5
1,3-Dichloropropane	ND	<2.0	a	<2.0	a
2,2-Dichloropropane	ND	<2.0	a	<2.0	a
1,1-Dichloropropene	ND	<2.0	a	<2.0	a
cis-1,3-Dichloropropene	ND	a	<0.5	a	<0.5
trans-1,3-Dichloropropene	ND	a	<1.0	a	<1.0
Diethyl ether	ND	<100	a	<100	a
Ethylbenzene	700 (30)*	<2.0	<1.0	<2.0	<1.0
Hexachlorobutadiene	ND	<2.0	a	<2.0	a
2-hexanone	ND	<10	a	<10	a
Isopropylbenzene	ND	<2.0	a	<2.0	a
4-Isopropyltoluene	ND	<2.0	a	<2.0	a
Methyl Ethyl Ketone	ND	<20	a	<20	a
Methyl iso-Butyl Ketone	ND	<20	a	<20	a
Methyl tert-Butyl Ether	ND	<20	a	<20	a
Methylene chloride	5.0	<2.0	<5.0	<2.0	<5.0
Naphthalene	ND	<5.0	a	<5.0	a
1,1,1,2-Tetrachloroethane	ND	<2.0	a	<2.0	a
1,1,2,2-Tetrachloroethane	ND	<2.0	<0.5	<2.0	<0.5

TABLE 5 (Continued)

Constituents	MCL (SMCL)	Well CCMW-1 Sample Event		Well CCMW-2 Sample Event	
		06/14/93	06/22/93	06/14/93	06/22/93
1,1,2,2-Tetrachloroethene	ND	a	<0.5	a	<0.5
Tetrachloroethene	5.0	<2.0	a	<2.0	a
Toluene	10^3 (40)*	<2.0	<1.0	<2.0	<1.0
1,1,1-Trichloroethane	200	<2.0	<0.5	<2.0	<0.5
1,1,2-Trichloroethane	5.0	<2.0	<0.5	<2.0	<0.5
Trichloroethene	5.0	<2.0	<0.5	<2.0	<0.5
1,2,3-Trichlorobenzene	ND	<2.0	a	<2.0	a
1,2,4-Trichlorobenzene	70	<2.0	a	<2.0	a
1,2,4-Trimethylbenzene	ND	<2.0	a	<2.0	a
1,3,5-Trimethylbenzene	ND	<2.0	a	<2.0	a
1,2,3-Trichloropropane	ND	<2.0	a	<2.0	a
Trichlorofluoromethane	ND	<5.0	<1.0	<5.0	<1.0
1,1,2-Trichloro-1,2,2-Trifluoro Ethane	ND	<2.0	a	<2.0	a
Vinyl chloride	2.0	<5.0	<2.0	<5.0	<2.0
m-Xylene	ND	<2.0	a	<2.0	a
o-Xylene	ND	<2.0	a	<2.0	a
p-Xylene	ND	<2.0	a	<2.0	a
Total Xylenes	10^4 (20)*	a	<0.3	a	<0.3
PHENOLS (ppb)					
4-Chloro-3-methylphenol	ND	a	<20	a	<20
2-Chlorophenol	ND	a	<10	a	<10
2,4-Dichlorophenol	ND	a	<10	a	<10
2,4-Dimethylphenol	ND	a	<20	a	<20
2,4-Dinitrophenol	ND	a	<50	a	<50
2-Methyl-4,6-dinitrophenol	ND	a	<30	a	<30
2-Nitrophenol	ND	a	<10	a	<10

TABLE 5 (Continued)

Constituents	MCL (SMCL)	Well CCMW-1 Sample Event		Well CCMW-2 Sample Event	
		06/14/93	06/22/93	06/14/93	06/22/93
4-Nitrophenol	ND	a	<50	a	<50
Pentachlorophenol	1.0	a	<15	a	<15
Phenol	ND	a	<10	a	<10
2,4,6-Trichlorophenol	ND	a	<10	a	<10
PESTICIDES/HERBICIDES (ppb)					
Toxaphene	3.0	a	<2.5	a	<2.5
Endrin	2.0	a	<0.1	a	<0.1
Lindane	0.20	a	<2	a	<2
Methoxychlor	40	a	<50	a	<50
2,4-D	70	a	<50	a	<50
2,4,5-TP (Silvex)	50	a	<5	a	<5
METALS (ppm)					
Aluminum	(0.05-0.2)	a	0.13	a	0.14/0.05
Antimony	0.006	a	<0.05	a	<0.05
Arsenic	0.05	a	<0.05	a	<0.05
Barium	2.0	a	<0.05	a	<0.05
Beryllium	0.004	a	<0.05	a	<0.05
Cadmium	0.005	a	<0.01	a	<0.01
Chromium	0.1	a	<0.05	a	<0.05
Cobalt	ND	a	<0.05	a	<0.05
Iron	(0.3)	a	<0.05	a	1.2/0.05
Lead	TT	a	<0.05	a	<0.05
Manganese	(0.05)	a	0.06/0.05	a	0.08/0.05
Mercury	0.002	a	<0.001	a	<0.001
Nickel	0.1	a	<0.05	a	<0.05
Selenium	0.05	a	<0.01	a	<0.01
Silver	(0.1)	a	<0.05	a	<0.05

TABLE 5 (Continued)

Constituents	MCL (SMCL)	Well CCMW-1 Sample Event 06/14/93	Well CCMW-1 Sample Event 06/22/93	Well CCMW-2 Sample Event 06/14/93	Well CCMW-2 Sample Event 06/22/93
Thallium	(0.002)	a	<0.10	a	<0.10
Tin	ND	a	<0.05	a	<0.05
Vanadium	ND	a	<0.05	a	<0.05
Zinc	(5.0)	a	2.0/0.05	a	2.2/0.05
NON-METAL INORGANICS (ppm unless otherwise noted)					
pH (S.U.)	(6.5-8.5)	7.96/1.0	a	7.69/1.0	a
Electrical Conductivity (μmho/cm)	ND	480/0.5	a	2300/0.5	a
TDS	(500)	330/5	a	300/5	a
Alkalinity	ND	250/2.0	a	240/2.0	a
Chloride	(250)	13/1.0	a	20/1.0	a
Fluoride	4.0 (2.0)*	0.49/0.10	a	0.42/0.10	a
Nitrate-N	10	2.0/0.50	<0.50	1.8/0.50	<0.50
Sulfate	(250)	20/5.0	a	20/5.0	a
Total Kjeldahl Nitrogen	ND	<0.1	a	<0.1	a
Total Organic Halogens	ND	<0.05	a	<0.05	a
Chemical Oxygen Demand	ND	<5	a	6/5	a
Total Organic Carbon	ND	3.8/1.0	a	1.9/1.0	a

TABLE 5 (Continued)

Constituents	MCL (SMCL)	Well CCMW-1		Well CCMW-2	
		Sample Event		Sample Event	
		06/14/93	06/22/93	06/14/93	06/22/93

Notes:

[Result/Detection Limit]

< = less than practical quanitation limit or PQL
a = not analyzed
* = proposed
MCL = maximum contaminant level
SMCL = secondary maximum contaminant level
ND = no MCL or SMCL determined

<u>References</u>

Arizona Department of Environmental Quality, 1992, Human Health-Based Guidance Levels for the Ingestion of Contaminants in Drinking Water and Soil.

Maricopa County Solid Waste Management Division files.

United States Environmental Protection Agency Region 9, 1992, Drinking Water Standards and Health Advisories Table.

United States Environmental Protection Agency, Office of Water, 1993, Drinking Water Regulations and Health Advisories.

TABLE 6

ANALYTICAL RESULTS FOR COP WELL 280 (AUGUST - SEPTEMBER, 1990)

Constituent	Units	MCL[a] (SMCL[b])	Sample 280-1000	Sample 280-1120	Sample 280-1445	Sample 280-1645	Sample 280-1840	Final Sample 280-0
pH	units	(6.5-8.5)	7.6	7.8	7.9	8.1	8.3	7.6
Arsenic	(mg/l)	0.05	0.016	0.011	0.016	0.049	0.12	0.014
Barium	(mg/l)	1.0	<0.5	<0.5	<0.5	<0.5	<0.05	<0.5
Cadmium	(mg/l)	0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium	(mg/l)	0.05	<0.01	<0.01	0.018	0.032	0.011	0.011
Fluoride	(mg/l)	4.0	0.6	0.6	0.6	0.8	1.1	0.4
Lead	(mg/l)	0.05	<0.002	<0.002	<0.002	0.0066	0.0073	<0.002
Mercury	(mg/l)	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nitrates-N	(mg/l)	10.0	1.3	1.7	1.2	1.3	1.2	1.3
Selenium	(mg/l)	0.01	<0.005	<0.005	<0.005	<0.005	<0.005	0.005
Silver	(mg/l)	0.05	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Alkalinity	(mg/l)		200	190	200	200	230	220
Calcium	(mg/l)		34	30	22	12	8.8	38
Chloride	(mg/l)	(250)	24	26	20	20	22	12
Copper	(mg/l)	(1.0)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Hardness	(mg/l)		180	170	130	60	41	210
Iron	(mg/l)	(0.3)	<0.1	<0.1	0.56	0.42	0.68	0.11
Magnesium	(mg/l)		24	23	18	7.3	4.7	29
Manganese	(mg/l)	(0.05)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Note: Information for this table was obtained from James M. Montgomery, C.O.P. Well report January 1991

TABLE 6 (Continued)

Constituent	Units	MCL[a] (SMCL[b])	Sample 280-1000	Sample 280-1120	Sample 280-1445	Sample 280-1645	Sample 280-1840	Final Sample 280-0
Sodium	(mg/l)		38	39	54	93	120	34
Sulfate	(mg/l)	(250)	20	21	15	20	26	18
Total Dissolved Solids @ 180° C	(mg/l)	(500)	310	310	290	300	350	310
Zinc	(mg/l)	(5.0)	<0.05	<0.05	<0.05	0.12	0.095	<0.05
Total coliform bacteria (number of tubes positive out of five)		(>2)						1
Temperature (field)	°C		27.8	28.3	28.9	28.9	31.1	26.7
Langelier Index			+.03	-0.3	+0.3	+0.1	+0.7	-0.1
p-Dichlorobenzene	(mg/l)	0.075	<0.0005				<0.0005	<0.0005
Vinyl Chloride	(mg/l)	0.002	<0.0005				<0.0005	<0.0005
1,1-Dichloroethylene	(mg/l)	0.007	<0.0005				<0.0005	<0.0005
1,2-Dichloroethane	(mg/l)	0.005	<0.0005				<0.0005	<0.0005
1,1,1-Trichlorethane	(mg/l)	0.2	<0.0005				<0.0005	<0.0005
Carbon Tetrachloride	(mg/l)	0.005	<0.0005				<0.0005	<0.0005
Trichloroethylene (TCE)	(mg/l)	0.005	<0.0005				<0.0005	<0.0005
Benzene	(mg/l)	0.005	<0.0005				<0.0005	<0.0005
Chloromethane	(mg/l)		<0.0005				<0.0005	<0.0005
Dichlorodifluoromethane	(mg/l)		<0.0005				<0.0005	<0.0005
Bromomethane	(mg/l)		<0.0005				<0.0005	<0.0005
Chloroethane	(mg/l)		<0.0005				<0.0005	<0.0005
Fluorotrichloromethane	(mg/l)		<0.0005				<0.0005	<0.0005
1,3-Dichloropropene	(mg/l)		<0.0005				<0.0005	<0.0005

Note: Information for this table was obtained from James M. Montgomery, C.O.P. Well report January 1991

TABLE 6 (Continued)

Constituent	Units	MCL[a] (SMCL[b])	Sample 280-1000	Sample 280-1120	Sample 280-1445	Sample 280-1645	Sample 280-1840	Final Sample 280-0
cis-1,2-Dichloroethylene	(mg/l)		<0.0005				<0.0005	<0.0005
Dibromomethane	(mg/l)		<0.0005				<0.0005	<0.0005
1,1-Dichloropropene	(mg/l)		<0.0005				<0.0005	<0.0005
1,3-Dichloropropane	(mg/l)		<0.0005				<0.0005	<0.0005
1,2,3-Trichloropropane	(mg/l)		<0.0005				<0.0005	<0.0005
2,2-Dichloropropane	(mg/l)		<0.0005				<0.0005	<0.0005
Chloroform	(mg/l)		<0.0005				<0.0005	<0.0005
Bromoform	(mg/l)		<0.0005				<0.0005	<0.0005
Bromodichloromethane	(mg/l)		<0.0005				<0.0005	<0.0005
Chlorodibromomethane	(mg/l)		<0.0005				<0.0005	<0.0005
Dibromochloropropane (DBCP)	(mg/l)		<0.00002				<0.00002	<0.00002
Ethylene Dibrommide (EDB)	(mg/l)		<0.00001				<0.00001	<0.00001
Dichloromethane	(mg/l)		<0.0005				<0.0005	<0.0005
O-Chlorotoluene	(mg/l)		<0.0005				<0.0005	<0.0005
p-Chlorotoluene	(mg/l)		<0.0005				<0.0005	<0.0005
m-Dichlorobenzene	(mg/l)		<0.0005				<0.0005	<0.0005
O-Dichlorobenzene	(mg/l)		<0.0005				<0.0005	<0.0005
1,1-Dichloroethane	(mg/l)		<0.0005				<0.0005	<0.0005
trans-1,2-Dichloroethylene	(mg/l)		<0.0005				<0.0005	<0.0005
1,2-Dichloropropane	(mg/l)		<0.0005				<0.0005	<0.0005
1,1,2-Trichloroethane	(mg/l)		<0.0005				<0.0005	<0.0005

Note: Information for this table was obtained from James M. Montgomery, C.O.P. Well report January 1991

TABLE 6 (Continued)

Constituent	Units	MCL[a] (SMCL[b])	Sample 280-1000	Sample 280-1120	Sample 280-1445	Sample 280-1645	Sample 280-1840	Final Sample 280-0
1,1,1,2-Tetrachloroethane	(mg/l)		<0.0005				<0.0005	<0.0005
Tetrachloroethylene	(mg/l)		<0.0005				<0.0005	<0.0005
Chlorobenzene	(mg/l)		<0.0005				<0.0005	<0.0005
Toluene	(mg/l)		<0.0005				<0.0005	<0.0005
Ehtylbenzene	(mg/l)		<0.0005				<0.0005	<0.0005
Bromobenzene	(mg/l)		<0.0005				<0.0005	<0.0005
m-Xylene	(mg/l)		<0.0005				<0.0005	<0.0005
Styrene	(mg/l)		<0.0005				<0.0005	<0.0005
o-Xylene	(mg/l)		<0.0005				<0.0005	<0.0005
p-Xylene	(mg/l)		<0.0005				<0.0005	<0.0005
Endrin	(mg/l)	0.0002	<0.0001				<0.0001	<0.0001
Lindane	(mg/l)	0.004	<0.001				<0.001	<0.001
Methoxychlor	(mg/l)	0.1	<0.01				<0.01	<0.01
Toxaphene	(mg/l)	0.005	<0.001				<0.001	<0.001
2,4-D	(mg/l)	0.1	<0.01				<0.01	<0.01
1,4,5-TP Silvex	(mg/l)	0.01	<0.001				<0.001	<0.001
Gross Alpha	pCi/liter	15					4±3	2±1

a Primary Maximum Contaminant Level
b Secondary Maximum Contaminant Level

Note: Information for this table was obtained from James M. Montgomery, C.O.P. Well report January 1991

TABLE 7

ANALYTICAL RESULTS FOR COP WELL NO. 281
(JUNE - SEPTEMBER, 1990)

Constituent	Units	MCL[a] (SMCL[b])	Sample 281-1080	Sample 281-1280	Sample 281-1360	Sample 281-1490	Sample 281-1590	Sample 281-1649	Final Sample 281-0
pH	units	(6.5-8.5)	8.1	8.0	8.1	8.1	8.2	8.0	7.8
Arsenic	(mg/l)	0.05	<0.01	<0.01	<0.01	<0.01	0.010	<0.01	<0.01
Barium	(mg/l)	1.0	1.3	1.9	0.92	1.2	1.9	1.2	<0.5
Cadmium	(mg/l)	0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium	(mg/l)	0.05	<0.01	<0.01	0.01	0.01	0.01	0.01	0.34
Fluoride	(mg/l)	4.0	0.6	0.7	0.7	0.7	0.7	0.7	0.6
Lead	(mg/l)	0.05	<0.0025	<0.002	<0.002	0.0030	0.0030	0.002	<0.002
Mercury	(mg/l)	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nitrates-N	(mg/l)	10.0	1.2	1.2	0.8	1.0	0.9	1.0	2.5
Selenium	(mg/l)	0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005
Silver	(mg/l)	0.05	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Alkalinity	(mg/l)		200	190	190	210	200	210	260
Calcium	(mg/l)		39	32	30	33	28	31	91
Chloride	(mg/l)	(250)	34	34	32	32	28	36	11
Copper	(mg/l)	(1.0)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Hardness	(mg/l)		170	140	150	160	140	160	330
Iron	(mg/l)	(0.3)	0.72	0.43	0.12	0.93	1.2	0.10	1.4
Magnesium	(mg/l)		18	16	18	19	18	19	25
Manganese	(mg/l)	(0.05)	0.10	<0.05	<0.05	0.13	0.11	<0.05	<0.05

Note: Information for this table was obtained from James M. Montgomery, C.O.P. Well report January 1991

TABLE 7 (Continued)

Constituent	Units	MCL[a] (SMCL[b])	Sample 281-1080	Sample 281-1280	Sample 281-1360	Sample 281-1490	Sample 281-1590	Sample 281-1649	Final Sample 281-0
Sodium	(mg/l)		55	52	50	49	51	53	75
Sulfate	(mg/l)	(250)	35	32	32	33	32	29	32
Total Dissolved Solids @ 180° C	(mg/l)	(500)	320	310	320	320	290	320	560
Zinc	(mg/l)	(5.0)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total coliform bacteria (number of tubes positive out of five)		(>2)							0
Temperature (field)	°C		26.1			25.6			32.3
Langelier Index			+1.0			+0.6			+1.3
p-Dichlorobenzene	(mg/l)	0.075	<0.0005			<0.0005			<0.0005
Vinyl Chloride	(mg/l)	0.002	<0.0005			<0.0005			<0.0005
1,1-Dichloroethylene	(mg/l)	0.007	<0.0005			<0.0005			<0.0005
1,2-Dichloroethane	(mg/l)	0.005	<0.0005			<0.0005			<0.0005
1,1,1-Trichlorethane	(mg/l)	0.2	<0.0005			<0.0005			<0.0005
Carbon Tetrachloride	(mg/l)	0.005	<0.0005			<0.0005			<0.0005
Trichloroethylene (TCE)	(mg/l)	0.005	<0.0005			<0.0005			<0.0005
Benzene	(mg/l)	0.005	<0.0005			<0.0005			<0.0005
Chloromethane	(mg/l)		<0.0005			<0.0005			<0.0005
Dichlorodifluoromethane	(mg/l)		<0.0005			<0.0005			<0.0005
Bromomethane	(mg/l)		<0.0005			<0.0005			<0.0005
Chloroethane	(mg/l)		<0.0005			<0.0005			<0.0005
Fluorotrichloromethane	(mg/l)		<0.0005			<0.0005			<0.0005
1,3-Dichloropropene	(mg/l)		<0.0005			<0.0005			<0.0005

Note: Information for this table was obtained from James M. Montgomery, C.O.P. Well report January 1991

TABLE 7 (Continued)

Constituent	Units	MCL[a] (SMCL[b])	Sample 281-1080	Sample 281-1280	Sample 281-1360	Sample 281-1490	Sample 281-1590	Sample 281-1649	Final Sample 281-0
cis-1,2-Dichloroethylene	(mg/l)		<0.0005			<0.0005			<0.0005
Dibromomethane	(mg/l)		<0.0005			<0.0005			<0.0005
1,1-Dichloropropene	(mg/l)		<0.0005			<0.0005			<0.0005
1,3-Dichloropropane	(mg/l)		<0.0005			<0.0005			<0.0005
1,2,3-Trichloropropane	(mg/l)		<0.0005			<0.0005			<0.0005
2,2-Dichloropropane	(mg/l)		<0.0005			<0.0005			<0.0005
Chloroform	(mg/l)		<0.0005			<0.0005			<0.056
Bromoform	(mg/l)		<0.0005			<0.0005			0.0017
Bromodichloromethane	(mg/l)		<0.0005			<0.0005			0.0076
Chlorodibromomethane	(mg/l)		<0.0005			<0.0005			0.0033
Dibromochloropropane (DBCP)	(mg/l)		<0.00002			<0.00002			*
Ethylene Dibrommide (EDB)	(mg/l)		<0.00001			<0.00001			*
Dichloromethane	(mg/l)		<0.0005			<0.0005			<0.0005
O-Chlorotoluene	(mg/l)		<0.0005			<0.0005			<0.0005
p-Chlorotoluene	(mg/l)		<0.0005			<0.0005			<0.0005
m-Dichlorobenzene	(mg/l)		<0.0005			<0.0005			<0.0005
O-Dichlorobenzene	(mg/l)		<0.0005			<0.0005			<0.0005
1,1-Dichloroethane	(mg/l)		<0.0005			<0.0005			<0.0005
trans-1,2-Dichloroethylene	(mg/l)		<0.0005			<0.0005			<0.0005
1,2-Dichloropropane	(mg/l)		<0.0005			<0.0005			<0.0005
1,1,2-Trichloroethane	(mg/l)		<0.0005			<0.0005			<0.0005

Note: Information for this table was obtained from James M. Montgomery, C.O.P. Well report January 1991

TABLE 7 (Continued)

Constituent	Units	MCL[a] (SMCL[b])	Sample 281-1080	Sample 281-1280	Sample 281-1360	Sample 281-1490	Sample 281-1590	Sample 281-1649	Final Sample 281-0
1,1,1,2-Tetrachloroethane	(mg/l)		<0.0005			<0.0005			<0.0005
Tetrachloroethylene	(mg/l)		<0.0005			<0.0005			<0.0005
Chlorobenzene	(mg/l)		<0.0005			<0.0005			<0.0005
Toluene	(mg/l)		<0.0005			<0.0005			<0.0005
Ehtylbenzene	(mg/l)		<0.0005			<0.0005			<0.0005
Bromobenzene	(mg/l)		<0.0005			<0.0005			<0.0005
m-Xylene	(mg/l)		<0.0005			<0.0005			<0.0005
Styrene	(mg/l)		<0.0005			<0.0005			<0.0005
o-Xylene	(mg/l)		<0.0005			<0.0005			<0.0005
p-Xylene	(mg/l)		<0.0005			<0.0005			<0.0005
Endrin	(mg/l)	0.0002	<0.0001			<0.0001			<0.0001
Lindane	(mg/l)	0.004	<0.001			<0.001			<0.001
Methoxychlor	(mg/l)	0.1	<0.01			<0.01			<0.01
Toxaphene	(mg/l)	0.005	<0.001			<0.001			<0.001
2,4-D	(mg/l)	0.1	<0.01			<0.01			<0.01
1,4,5-TP Silvex	(mg/l)	0.01	<0.001			<0.001			<0.001
Gross Alpha	pCi/liter	15	3±2			7±4			<2
Radium 226/228	pCi/liter	5				1.6			

* unable to analyze due to matrix interference (chlorine)
a Primary Maximum Contaminant Level
b Secondary Maximum Contaminant Level

Note: Information for this table was obtained from James M. Montgomery, C.O.P. Well report January 1991

TABLE 8

ANALYTICAL RESULTS FOR THE CAVE CREEK LANDFILL SOIL SAMPLES

Well I.D.	Sample Depth (ft)	Sieve (-200, % finer by weight)	Moisture Content (% dry wt.)	Moist Density (PCF)	Dry Density (PCF)	Permea-bility * (cm/sec)	Permea-bility * (ft/day)	Porosity (%)	Total Organic Carbon (%)
CCMW-1	10-14	6.6	11.3	128.2	115.3	3.7×10^{-3}	10.5	28	0.14
	20-22 comb.	1.4	N/A	N/A	N/A	N/A	N/A	N/A	0.05
	30-30.5	0.4	N/A	N/A	N/A	N/A	N/A	N/A	0.02
CCMW-2	30-33	7.8	20.1	120.14	100.5	6.4×10^{-4}	1.8	33	0.14
	40-43	9.1	10.1	119.5	108.5	5.9×10^{-4}	1.7	27	0.01
	50-51.6	7.4	7.4	121.9	113.6	5.1×10^{-4}	1.4	24	0.04

* - Recompacted to original moist density.
N/A - No analysis, insufficient sample.

TABLE 9

TARGET MODEL INPUT FOR CAVE CREEK LANDFILL

Parameter	Input
Horizontal Hydraulic Conductivity (ft/day)	15[a]
Vertical Hydraulic Conductivity (ft/day)	15[a]
Porosity (unitless)	0.28[b]
Longitudinal Dispersivity (ft)	100.0[c]
Transverse Dispersivity (ft)	10.0[c]
Source Data	Chloride concentration remains constant at 5,475 ppm[d]
Infiltration Rate	0.5 inches/year[e]

Notes:
[a] Aquifer test results see Section 3.1.4
[b] Measured (see Table 7)
[c] Gelhar et al. 1992
[d] EPA 1979
[e] Estimated based on HELP model results

TABLE 10

HELP MODEL INPUT FOR CAVE CREEK LANDFILL

	Garbage	Daily Cover	Infiltration[1] Control Layer	Erosion[1] Control Layer
Thickness (in)	960	12	18	6
Porosity (v/v)	0.52	0.30	0.30	0.30
Field Capacity (v/v)	0.29	0.20	0.2	0.2
Wilting Point (v/v)	0.14	0.08	0.15	0.15
Saturated K (cm/sec)	2.0×10^{-4}	5.3×10^{-3}	1×10^{-5} [4]	5×10^{-5}
Area (ft^2)	N/A	2,000,000	2,000,000	2,000,000
SCS Curve No	N/A	95	N/A	95[3]
Runoff Fraction	N/A	0	N/A	N/A

[1] Compacted
[2] For open landfill years 1-12
[3] For closed landfill year 13-52
[4] Set to 1.0×10^{-10} cm/sec for simulation with impermeable cap

HELP Simulation Period (years)	Initial H_20 Content			
	Garbage	Daily Cover	Infiltration Control Layer	Erosion Control Layer
0-12	0.23	0.08	N/A	N/A
13-32	0.2405[1]	0.1028[1]	.15	.15
33-50[2]	0.2401[2]	0.0932[2]	0.2054[2]	0.1748[2]

[1] Based on water content after 12 years
[2] Based on water content 20 years after closure cap construction

TABLE 11

CAVE CREEK LANDFILL
PROPOSED DETECTION MONITORING ANALYSES

Constituent*	EPA Method	PQL**	AWQS***
Appendix I Organics		**ppb**	**ppb**
acetone	8260	100	700
acrylonitrile	8260	200	0.07
benzene	8260	5	5
bromochloromethane	8260	5	ND
bromodichloromethane	8260	5	100
bromoform	8260	5.0	MCL 100
carbon disulfide	8260	100	HBGL 700
carbon tetrachloride	8260	10	MCL 5
chlorobenzene	8260	5	MCL 100
chloroethane	8260	10	ND
chloroform	8260	5	MCL 100
dibromochloromethane	8260	5	MCL 100
1,2-dibromo-3-chloropropane	8260	25	MCL 0.03
1,2-dibromoethane	8260	5.0	ND
1,2-dichlorobenzene	8260	5	MCL 600
1,4-dichlorobenzene	8260	5	MCL 75
trans-1,4-dichloro-2-butene	8260	5	ND
1,1-dichloroethane	8260	5	ND
1,2-dichloroethane	8260	5	MCL 5
1,1-dichloroethene	8260	5	MCL 7
cis-1,2-dichloroethene	8260	5	MCL 70
trans-1,2-dichloroethene	8260	5	MCL 100
1,2-dichloropropane	8260	5	MCL 5
cis-1,3-dichloropropene	8260	10	ND
trans-1,3-dichloropropene	8260	10	MCL 100
ethylbenzene	8260	5	MCL 700

TABLE 11 (Continued)

Constituent*	EPA Method	PQL**	AWQS***
2-hexanone	8260	50	ND
methyl bromide	8260	5	HBGL 9.8
methyl chloride	8260	5	2.8
methylene bromide	8260	10	ND
methylene chloride	8260	10	MCL 5
methyl ethyl ketone	8260	100	HBGL 350
methyl iodide	8260	10	ND
methyl isobutyl ketone	8260	100	ND
styrene	8260	10	HBGL 140
1,1,1,2-tetrachloroethane	8260	5	MCL 21
1,1,2,2-tetrachloroethane	8260	5	MCL 0.18
tetrachloroethene	8260	5	MCL 5
toluene	8260	5	MCL 1000
1,1,1-trichloroethane	8260	5	MCL 200
1,1,2-trichloroethane	8260	5	MCL 5
trichloroethene	8260	5	MCL 5
trichlorofluoromethane	8260	5	HBGL 2100
1,2,3-trichloropropane	8260	15	HBGL 42
vinyl acetate	8260	50	ND
vinyl chloride	8260	10	2
xylenes	8260	5	MCL 10,000
Appendix I Inorganics			
antimony	200.7	0.05	MCL 0.006
arsenic	200.7	0.05	MCL 0.05
barium	200.7	0.05	MCL 2.0
beryllium	200.7	0.05	MCL 0.004
cadmium	200.7	0.05	MCL 0.005
chromium	200.7	0.05	MCL 0.1
cobalt	200.7	0.05	ND

TABLE 11 (Continued)

Constituent*	EPA Method	PQL**	AWQS***
copper	200.7	0.05	TT
lead	200.7	0.05	TT
nickel	200.7	0.05	MCL 0.1
selenium	200.7	0.05	MCL 0.05
silver	200.7	0.05	SMCL 0.1 HBGL 0.05
thallium	200.7	0.10	MCL 0.002
vanadium	200.7	0.05	HBGL 0.049
zinc	200.7	0.05	SMCL 5 HBGL 1.4
Supplemental Inorganics			
pH	150.1	-	-
electrical conductivity	2510-B	-	-
TDS	2540-C	-	-
alkalinity	2320-B	-	-
chloride	300.0	-	-
fluoride	4500-F-C	-	-
nitrate-N	300.0	-	-
sulfate	300.0	-	-

* Organics and metals formulated from 40 CFR 258 Appendix I.
** PQL Practical Quantitative Limit based on 40 CFR 258 Appendix II data.
*** MCL Maximum Concentration Level, USEPA
SMCL Secondary Maximum Concentration Level, USEPA
HBGL Health Based Guidance Level of Drinking Water, ADHS, ADEQ
TT Treatment Technology
ND No MCL, SMCL, or HBGL determined

References

Arizona Department of Environmental Quality, 1992, Human Health-Based Guidance Levels for the Ingestion of Contaminants in Drinking Water and Soil.
United States Environmental Protection Agency, Region 9, 1992, Drinking Water Standards and Health Advisories Table
United States Environmental Protection Agency, Office of Water, 1993, Drinking Water Regulations and Health Advisories

TABLE 12

CAVE CREEK LANDFILL WELL INFORMATION

Well/Pump Installation	Upgradient Production Well	Downgradient Points of Compliance	
		CCMW-1	CCMW-2
ADWR Registration No.	55-503913	55-538298	55-538299
ADWR Legal Description	A(5-3)12add	A(5-4)7ddd	A(5-4)7ddd
Latitude	30° 47' 32"	30° 47' 10"	30° 47' 03"
Longitude	111° 59' 47"	111° 59' 44"	111° 59' 48"
Total Depth	825 ft	700 ft	680 ft
Casing Diameter/Type	8-inch/steel	6-inch/steel	6-inch/steel
Screened Interval	750-825 ft	640-700 ft	620-680 ft
Depth to Water	635.5 ft (08/09/93)	642 ft (6/14,22/93)	621 ft (6/14,22/93)
Measurement Point *	Top of discharge pipe coupling on top of well seal	Top of discharge pipe coupling on top of well seal	Top of discharge pipe coupling on top of well seal
Measurement Point Elevation	1878.24 ft	1878.79 ft	1854.07 ft
Pump Make	Grunfos	Jacuzzi	Jacuzzi
Pump Motor	5.0 HP (three wire)	Franklin 1.5 HP (two wire)	Franklin 1.5 HP (two wire)
Pump Power Req's	460 V three phase	250 V single phase	250 V single phase
Pump Depth	750 ft	695 ft	675 ft
Pump Discharge	1.5-inch steel	1-inch steel	1-inch steel
Typical Flow Rate	~ 20 gpm	2.8-3.0 gpm	2.8-3.0 gpm

* Note: There are no sounding tubes installed in the wells. Depth to water measurements are collected through the discharge pipe.

TABLE 13

SUMMARY OF CONTAINERS, PRESERVATIVES, AND HOLDING TIMES FOR DETECTION MONITORING

Sample Container	Preservation	Parameters	Methods	Recommended Maximum Holding Times
Appendix I Organics				
3 x 40 ml glass (VOA) with Teflon-lined septa	4 deg C, HCl to pH <2	Volatile Organics	8260	14 days
Appendix I Inorganics				
1 x 1 liter plastic bottle	4 deg; HNO_3 to pH <2	Metals	200.7	7 days until extraction; 40 days after extraction
Supplemental Inorganics				
1 x 1 liter plastic bottle	4 deg C	Non-Metal Inorganics	150.1, 2510-B, 2540-C, 2320-B, 4500-F-C	7 days until extraction 40 days after extraction

TABLE 14

SUMMARY OF CONTAINERS, PRESERVATIVES, AND HOLDING TIMES FOR ASSESSMENT MONITORING

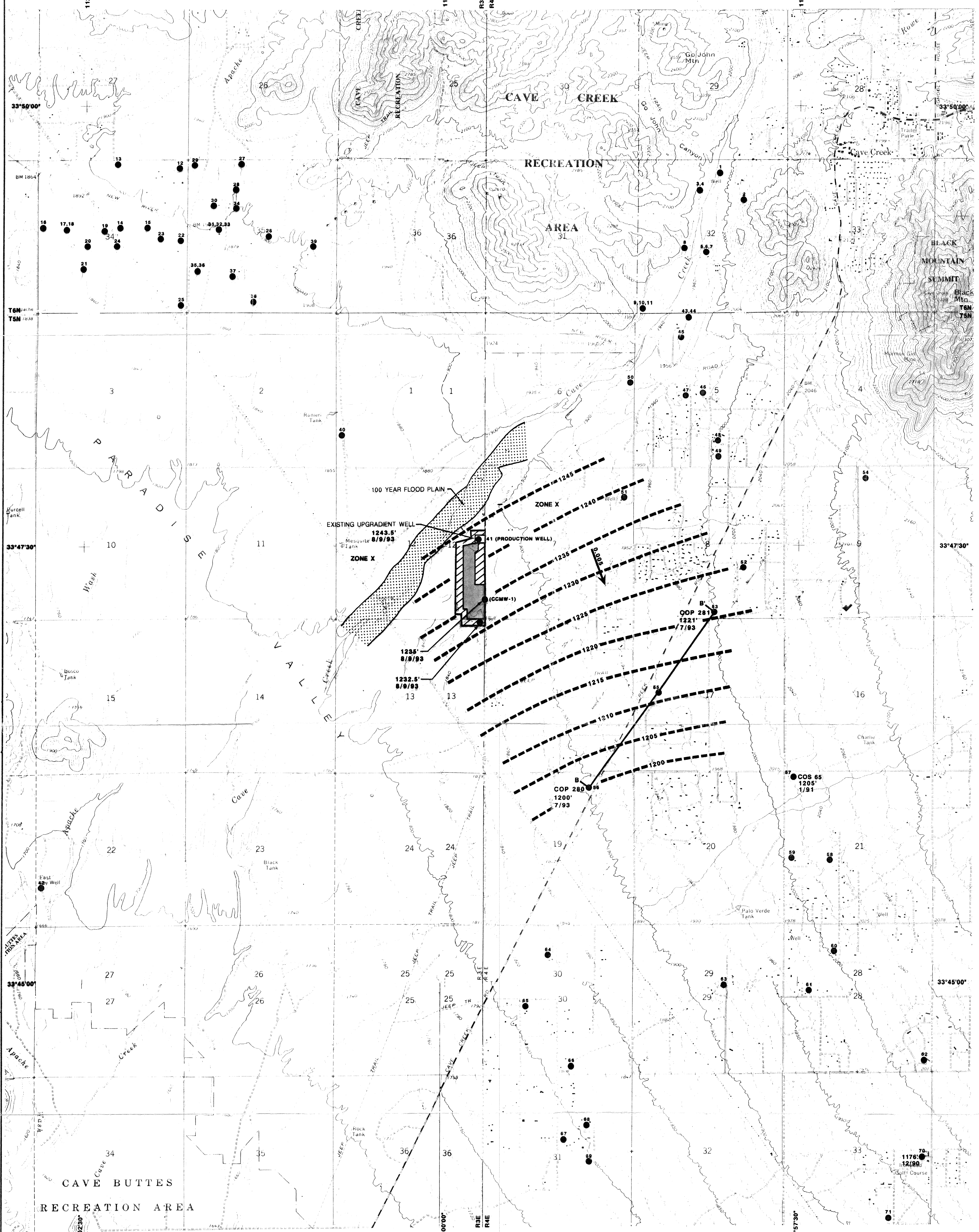
Sample Container	Preservation	Parameters	Methods	Recommended Maximum Holding Times
Liquid Samples				
3 x 40 ml glass (VOA) with Teflon-lined septa	4 deg C, HCl to pH <2	Volatile Organics	8240,8015	14 days
2 x 1 liter amber glass with Teflon-lined caps	4 deg C	Semivolatile Organics	8270	7 days until extraction 40 days after extraction
2 x 1 liter amber glass with Teflon-lined caps	4 deg C	Chlorinated Pesticides and PCBs	8080	7 days until extraction 40 days after extraction
2 x 1 liter amber glass with Teflon-lined caps	4 deg C	Herbicides	8150	7 days until extraction 40 days after extraction
1 x 1000 ml polyethylene	4 deg C; HNO3 to pH <2	Metals/ICP + GFAA	6010, 7060, 742, 7740, 7841	6 months
		Mercury	7470	28 days
1 x 500 ml polyethylene	4 deg C; NaOH to pH >12	Cyanide	9010	14 days
1 x 500 ml amber glass	4 deg C; NaOH to pH >9; Zn $(C_2H_3O_2)_2$	Total Sulfide	9030	7 days
1 x 1 liter glass with Teflon-lined caps	4 deg C; H2SO4 to pH <2	Phenol	9066	28 days
2 x 1 liter amber glass with Teflon-lined caps	4 deg C	Organophosphorus Pesticides	8140	7 days until extraction; 40 days after extraction

TABLE 15

ASSESSMENT MONITORING PROGRAM SCHEDULE

Months After Verification of AL Exceedance	Analyte List
1	Full A2
2	SSA2
3	SSA2
4	SSA2
5	SSA2
6	SSA2
7	Full A1 plus SSA2
8	SSA2
13	Full A2
19	Full A1 plus SSA2
25	Full A2
31	Full A1 plus SSA2

Continue semiannual sampling alternating between Full A2 and Full A1 plus SSA2.
A1 40 CFR 258 Appendix 1 Constituents for Detection Monitoring
A2 40 CFR 258 Appendix 2 Constituents for Assessment Monitoring
SSA2 Site Specific Appendix 2 Constituents



●[40] LOCATION OF WELL BASED ON ADWR REGISTRATION REPORT

1221' WATER LEVEL ELEVATION (FEET AMSL)
1/91 DATE OF WATER LEVEL MEASUREMENT

● COP 280 CITY OF PHOENIX WELL LOCATION AND NUMBER

● COS 65 CITY OF SCOTTSDALE WELL LOCATION AND NUMBER

0.003 → DIRECTION OF GROUND WATER FLOW AND GRADIENT (FT/FT)

— 1230 — GROUND WATER LEVEL CONTOUR

PREFERRED MONITOR WELL LOCATION

○ ALTERNATIVE MONITOR WELL LOCATION

ZONE X 500 YEAR FLOOD PLAIN

FUTURE LANDFILL EXPANSION AREA

APPROXIMATE
0 1500 3000
SCALE IN FEET

TABLE 1

LIST OF WELLS WITHIN A 3-MILE RADIUS OF THE CAVE CREEK LANDFILL

Well # of Figure 1	ADWR Registration No	ADWR Legal Description	Owner	Total Well Depth (ft.)	Casing Diameter (in.)	Date Completed	Use
1	55-601159	A(6-4)32abb	Goodman, G.J.	335	8	12/78	D
2	55-611757	A(6-4)32abd	Omundson, R.T.	320	6	1976	D
3	55-614064	A(6-4)32bad	Arizona State Land Dept	80	10	1944	UNK
4	55-805152	A(6-4)32bad	Arizona State Land Dept	UNK	12	UNK	J
5	55-518286	A(6-4)32caa	Flach & Soich	85	8	07/29/88	DJ
6	55-625150	A(6-4)32caa	Schubert, G.J.	106	12	10/45	DJ
7	55-625151	A(6-4)32caa	Schubert, G.J.	50	10	UNK	DJ
8	55-514411	A(6-4)32cab	Williams, Richard	340	8	11/29/86	D
9	55-506269	A(6-4)32ccc	David K.	175	6	09/12/83	D
10	55-506822	A(6-4)32ccc	Bowles, B.W.	140	8	12/15/83	DA
11	55-801126	A(6-4)32ccc	Bowles, et.al.	38	8	UNK	D
12	55-805321	A(6-3)34aaa	Bechtold, Phillip	600	UNK	12/01/71	DA
13	55-518165	A(6-3)34abb	Lares, Christopher	620	8	07/11/87	D
14	55-524131	A(6-3)34acc	Seely, Diane	785	8	04/15/89	D
15	55-502005	A(6-3)34acd	Beeskau, G.	820	8	02/26/82	D
16	55-521091	A(6-3)34bcc	Olson, John	695	8	05/10/88	D
17	55-523180	A(6-3)34bcd	Smith, Gary	710	8	02/03/89	D
18	55-531883	A(6-3)34bcd	Sones, James	715	UNK	05/30/91	D
19	55-524416	A(6-3)34bdd	Hoyt, Robert, et.al.	720	8	05/14/89	D
20	55-521687	A(6-3)34cab	Lawrence Family Trust	719	8	08/04/88	D
21	55-800842	A(6-3)34cac	Love Acres Association	700	8	12/79	D
22	55-636555	A(6-3)34daa	Perez, Raul M., Sr.	685	8	03/19/78	D
23	55-087362	A(6-3)34bab	Barton, B.	700	6	1981	D
24	55-517023	A(6-3)34dbb	Babbin, Stewart	700	8	03/20/87	D
25	55-530471	A(6-3)34ddd	Meeker, Rae Ellen	835	9	05/25/91	D
26	55-519950	A(6-3)35acc	Desert Foothills	915	8	01/09/88	JC
27	55-513379	A(6-3)35bab	Beard, Harold	550	8	02/20/86	D
28	55-520855	A(6-3)35bac	Lopez, Ron	600	8	04/16/88	D
29	55-532262	A(6-3)35bbb	Emmett, James T. Jr.	738	8	10/16/91	D
30	55-638089	A(6-3)35bca	Stevens, H.	665	6	02/09/75	D
31	55-509150	A(6-3)35bcd	Mullens, C.	780	9	10/04/84	D
32	55-802504	A(6-3)35bcd	Silva, Irma	672	5	02/15/78	D
33	55-804560	A(6-3)35bcd	Ogden, Linda	200	8	10/22/84	D
34	55-628045	A(6-3)35bdb	Williams, L.E.	685	9	06/15/74	ADF
35	55-518430	A(6-3)35cbc	Combs, Jasper	400	8	08/10/87	D
36	55-528864	A(6-3)35cbc	Borders, Timothy	800	9	08/27/90	D
37	55-531151	A(6-3)35cdb	Cable, Robert	800	8	03/30/91	D
38	55-532341	A(6-3)35cdd	Fautin, Jim	795	9	07/26/91	D
39	55-804220	A(6-3)35dad	Ansick, Paul R. Jr.	1,000	6	UNK	AD
40	55-614030	A(5-3)01ccb	Arizona State Land Dept.	79	9	UNK	UNK
41	55-503913	A(5-3)12add	Arizona State Land Dept.	820	10	10/08/82	D
42	55-614031	A(5-3)22cbc	Arizona State Land Dept.	430	6	1949	D
43	55-518305	A(5-4)05bab	Johnson	535	8	06/25/87	D
44	55-638749	A(5-4)05bab	Flowers, J.L.	462	8	01/28/77	D
45	55-510670	A(5-4)05bac	Johnson, J.	520	7	05/13/85	D
46	55-640160	A(5-4)05caa	Hatcher, N.	875	10	UNK	D
47	55-507675	A(5-4)05cab	Johnson, J. Jr.	600	6	04/28/84	D
48	55-518167	A(5-4)05dcb	Winter, Frances	851	8	08/27/87	D
49	55-800785	A(5-4)05dcc	Formon, E.M.	997	8	1966	D
50	55-530868	A(5-4)06add	Joy Ridge, inc.	800	6	02/15/91	D
51	55-634474	A(5-4)07aad	Veres	980	6	1930	
52	55-600029	A(5-4)08dbd	City of Phoenix (COP 279)	1,100	10	02/61	D
53	55-524559	A(5-4)08dcc	City of Phoenix (COP 281)	1,400	13	09/25/90	E
54	55-602536	A(5-4)09ab	Carefree Black Mountain	1,400	8	01/81	D
55	55-600030	A(5-4)17bcd	City of Phoenix (COP 278)	864	14	12/18/69	D
56	55-527549	A(5-4)19acb	City of Phoenix (COP 280)	1,490	19	09/24/90	E
57	55-518789	A(5-4)21bbb	City of Scottsdale (COS 65)	1,698	30	10/23/87	E
58	55-522909	A(5-4)21cab	Kezele, Joseph M.	1,060	8	12/06/88	D
59	55-635121	A(5-4)21cbb	Holbrook	200	8	11/29/73	D
60	55-633464	A(5-4)28bac	Councilman	200	6	1971	D
61	55-633735	A(5-4)28bcd	Perkins	NA	NA	NA	D
62	55-638933	A(5-4)28ddd	Olson	850	8	1974	D
63	55-638272	A(5-4)29acc	Nolte, et al.	825	8	01/19/73	DJ
64	55-603807	A(5-4)30bad	City of Phoenix (COP 276)	1,157	16	02/24/78	F
65	55-800775	A(5-4)30cab	Short	600	8	06/66	ADJ
66	55-516342	A(5-4)30dcc	Albert, George & E.	820	8	11/19/87	D
67	55-636545	A(5-4)31ac	Holgerson, Rex	632	8	NA	D
68	55-532698	A(5-4)31aca	Holgerson, Rex	820	8	9/12/91	D
69	55-511808	A(5-4)31dba	Saffer, Russell Dean	700	7	08/01/85	D
70	55-600117	A(5-4)33daa	Ironwood Water Co.	993	6	03/62	D
71	55-600115	A(5-4)33dcd	Ironwood Water Co.	1,555	16	01/73	D

Note: Data obtained from the ADWR Well Registry Report dated 5/11/92.
Legend: A = Irrigation, D = Domestic, E = Municipal, F = Industrial, J = Stock, NA = Not Available, UNK = Unknown

REFERENCES TITLE	REVISIONS NO.	BY	DATE	DESCRIPTION
USGS CAVE CREEK QUADRANGLE REVISED 1981	△			
USGS CURRYS CORNER QUADRANGLE REVISED 1982	△			
USGS NEW RIVER SE QUADRANGLE REVISED 1981	△			
USGS UNION HILLS QUADRANGLE REVISED 1981	△			
FIRM PANELS 795 AND 815 OF 4350 (9/29/89)	△			

CAVE CREEK LANDFILL BOUNDARY AND TOPOGRAPHIC SURVEY (6/23/92)

SCALE: 1"=1500'	DATE
DESIGNED BY:	
DRAWN BY:	
CHECKED BY:	
APPROVED BY:	
CLIENT APPROVAL BY:	

Dames & Moore

MARICOPA COUNTY

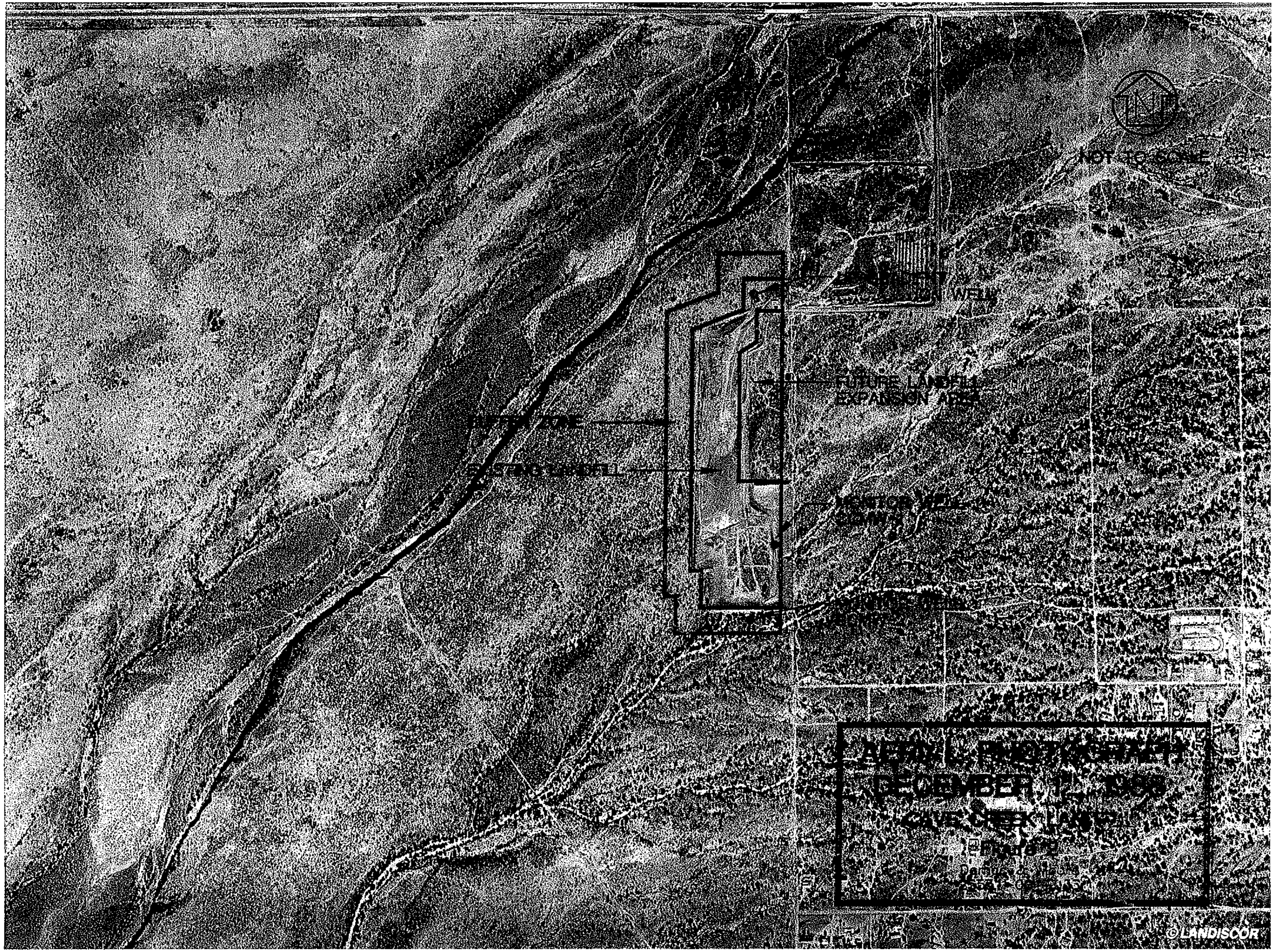
CAVE CREEK LANDFILL
WELL LOCATION MAP

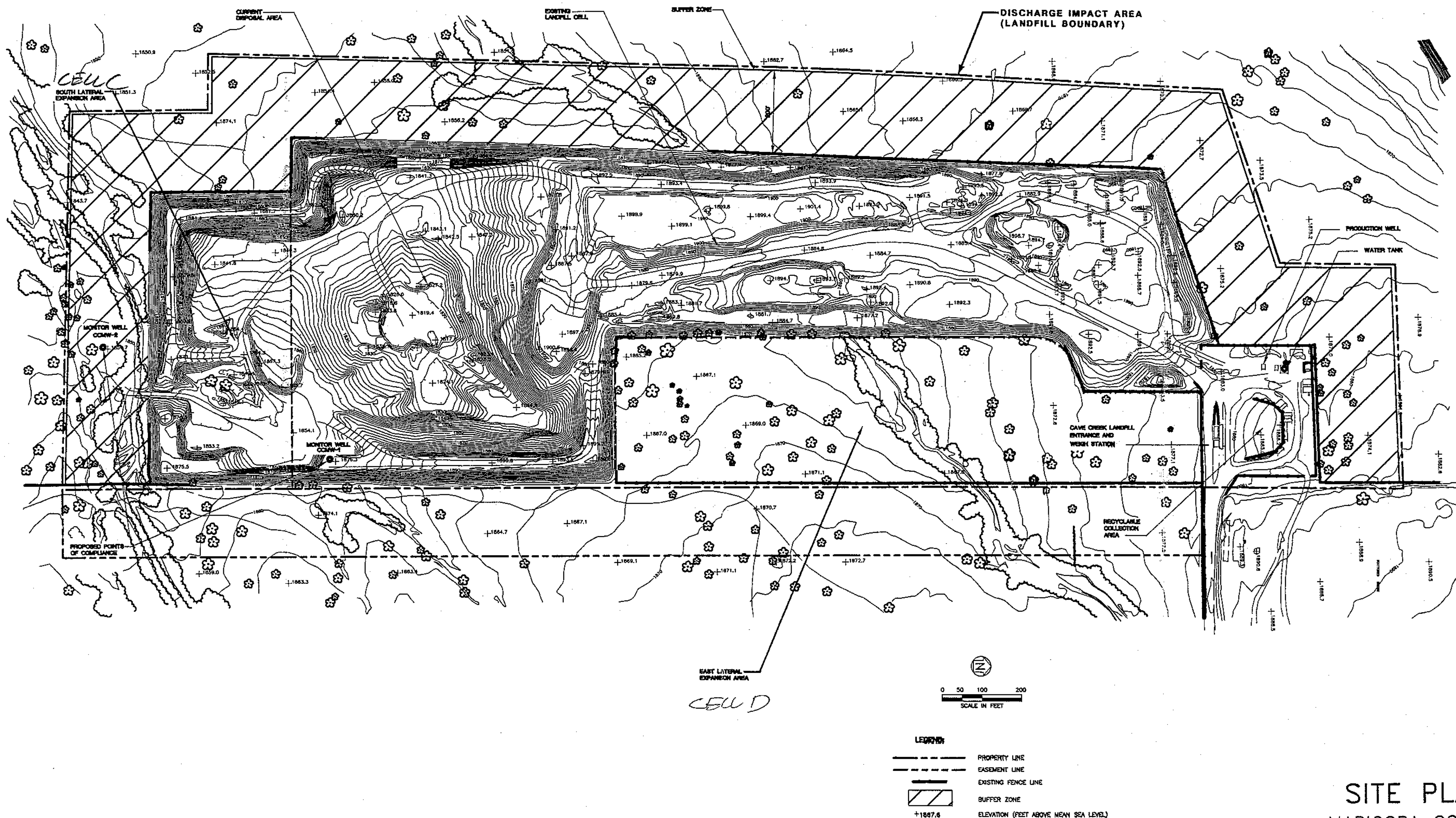
PRELIMINARY GROUND WATER CONTOUR MAP

JOB NO. 25551-001-033

FIGURE NO. 2-1

REV.

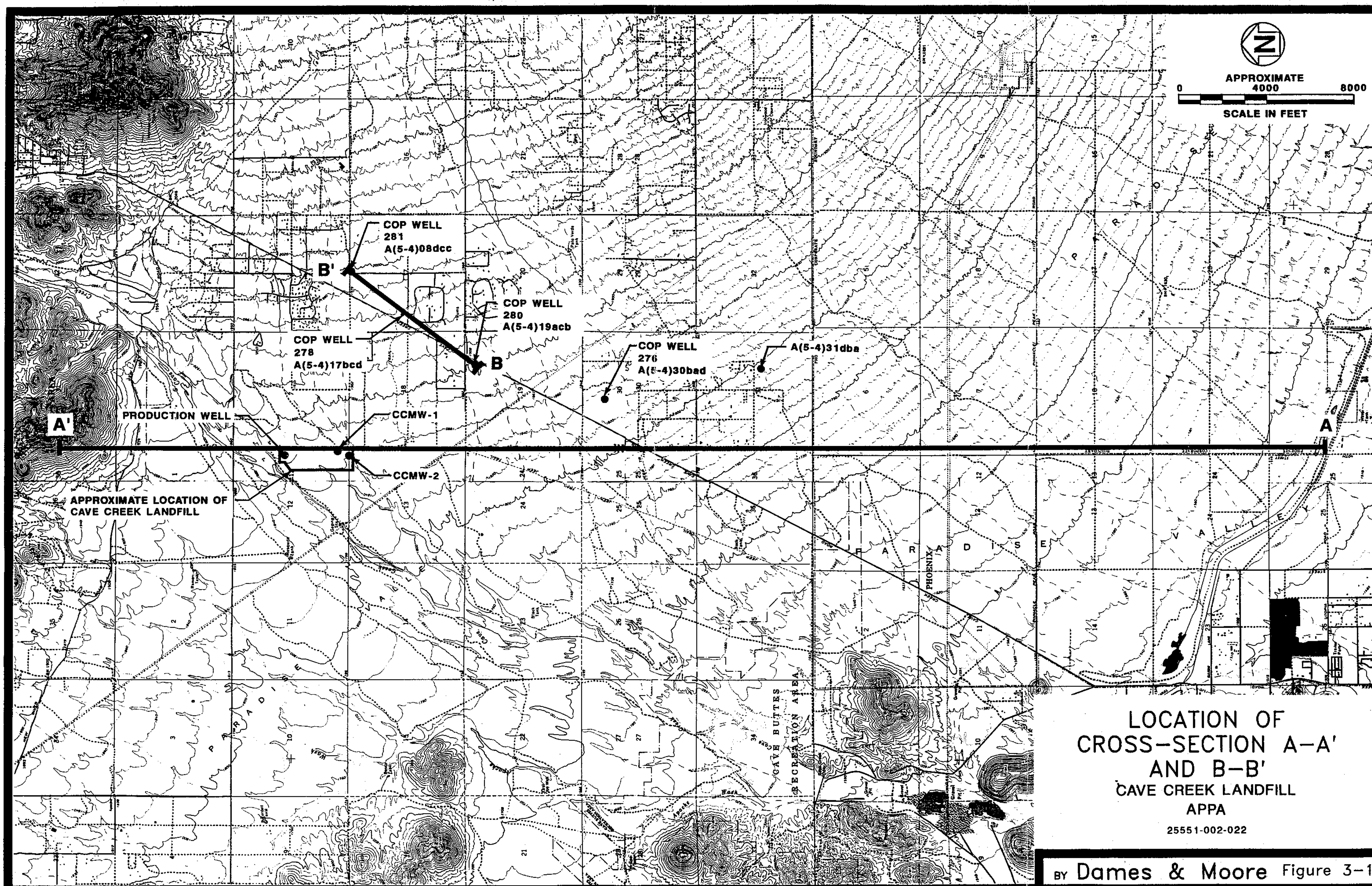

NOT TO SCALE
FUTURE LANDFILL
EXPANSION AREA
AERIAL PHOTOGRAPH
DECEMBER
CAVE CREEK
© LANDISCOR



SITE PLAN
MARICOPA COUNTY
CAVE CREEK LANDFILL
APPA

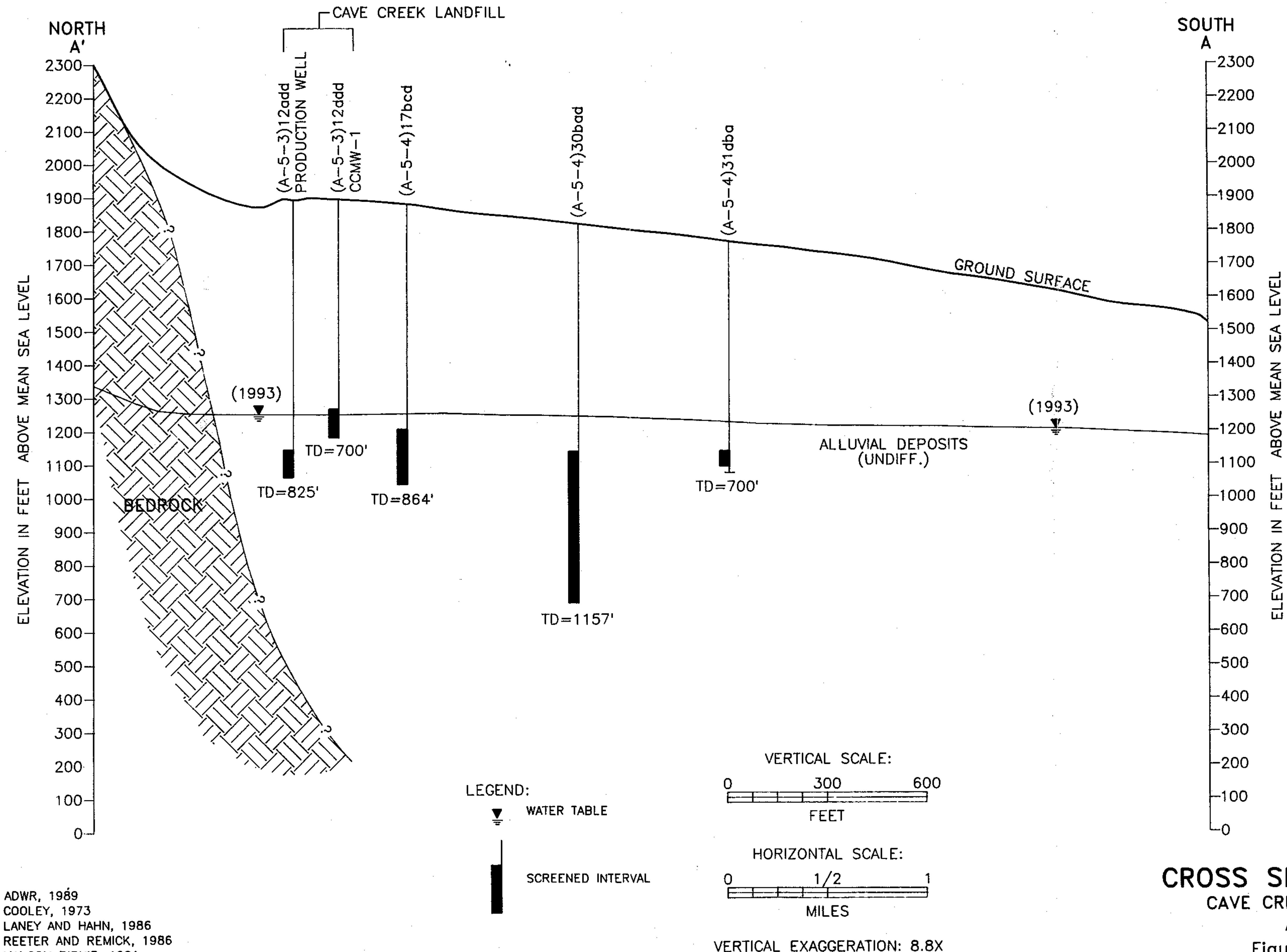
Figure 2-3

DAMES & MOORE
25551-002-022



LOCATION OF CROSS-SECTION A-A' AND B-B'
CAVE CREEK LANDFILL
APPA
25551-002-022

BY Dames & Moore Figure 3-1



REFERENCE: ADWR, 1989
COOLEY, 1973
LANEY AND HAHN, 1986
REETER AND REMICK, 1986
MALCOM PIRNIE, 1991

CROSS SECTION A-A'

CAVE CREEK LANDFILL

APPA

Figure 3-2

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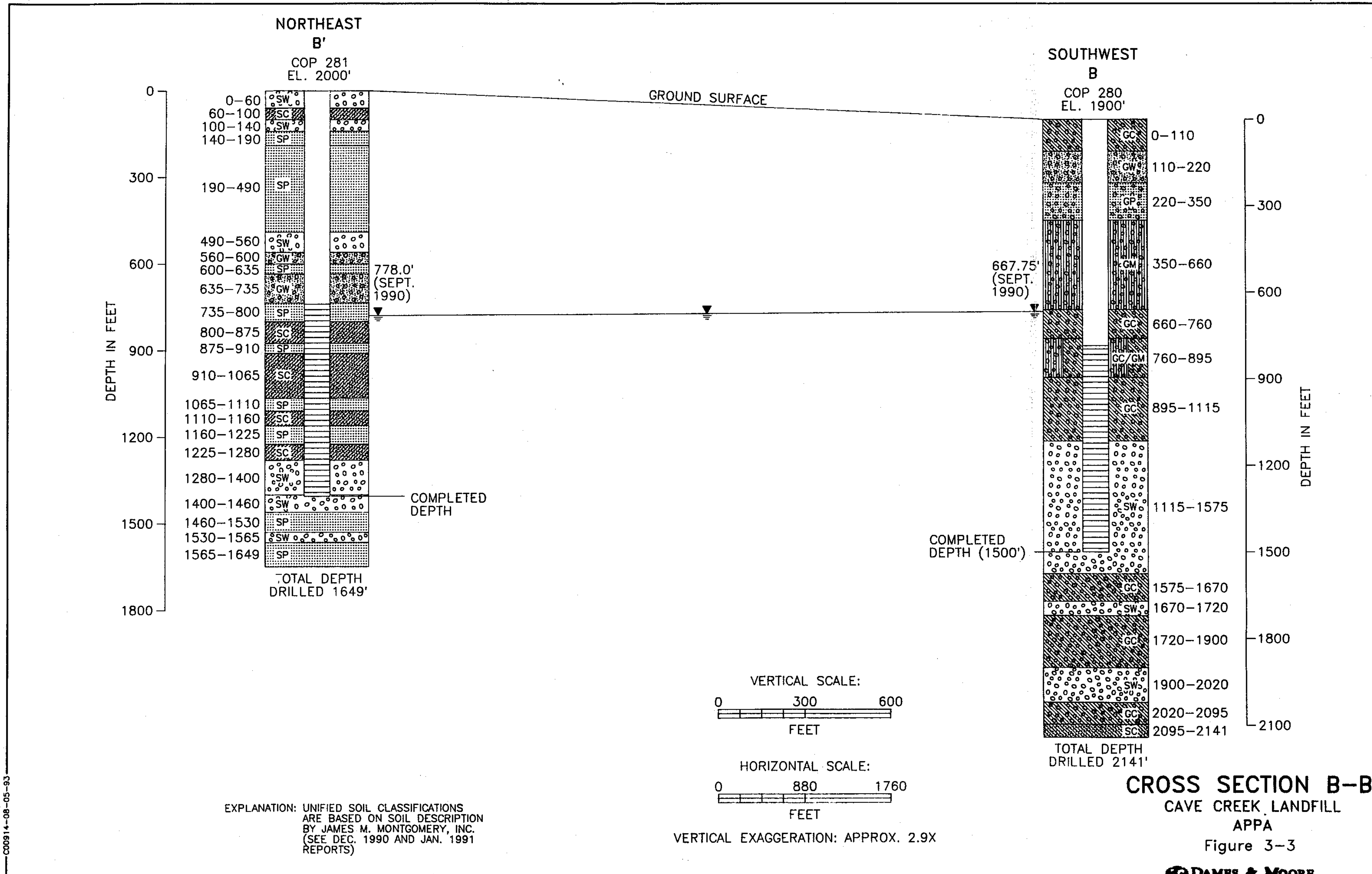
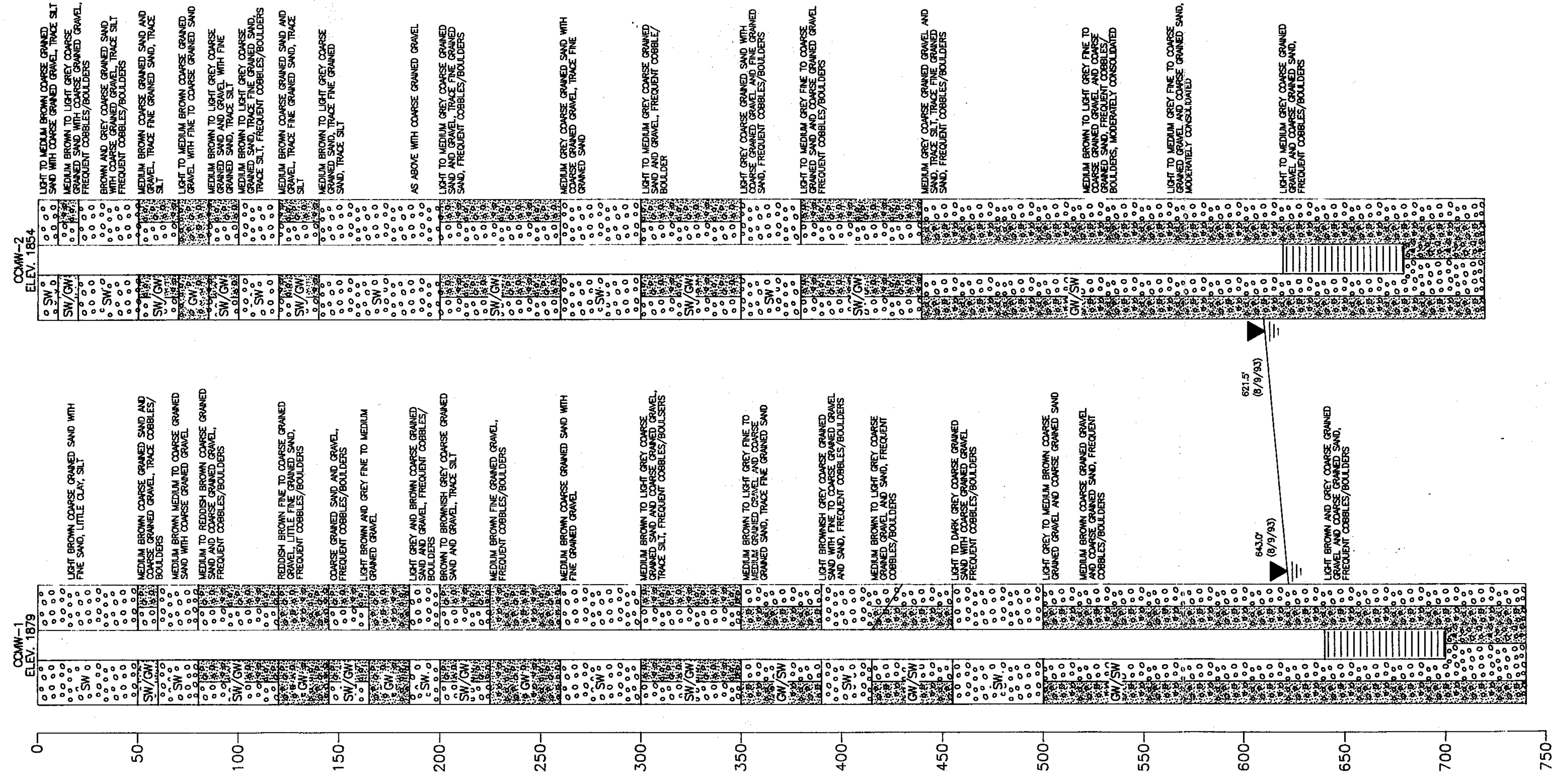
25551-001-033

C00913-08-05-93


NORTHEAST
B'
COP 281
EL. 2000'
SOUTHWEST
B
COP 280
EL. 1900'
GROUND SURFACE
DEPTH IN FEET
0
300
600
900
1200
1500
1800
2100
0-60 SW
60-100 SC
100-140 SW
140-190 SP
190-490 SP
490-560 SW
560-600 GW
600-635 SP
635-735 GW
735-800 SP
800-875 SC
875-910 SP
910-1065 SC
1065-1110 SP
1110-1160 SC
1160-1225 SP
1225-1280 SC
1280-1400 SW
1400-1460 SW
1460-1530 SP
1530-1565 SW
1565-1649 SP
778.0' (SEPT. 1990)
COMPLETED DEPTH
TOTAL DEPTH DRILLED 1649'
0-110 GC
110-220 GW
220-350 GP
350-660 GM
660-760 GC
760-895 GC/GM
895-1115 GC
1115-1575 SW
1575-1670 GC
1670-1720 SW
1720-1900 GC
1900-2020 SW
2020-2095 GC
2095-2141 SC
667.75' (SEPT. 1990)
COMPLETED DEPTH (1500')
TOTAL DEPTH DRILLED 2141'
VERTICAL SCALE:
0 300 600
FEET
HORIZONTAL SCALE:
0 880 1760
FEET
VERTICAL EXAGGERATION: APPROX. 2.9X
EXPLANATION: UNIFIED SOIL CLASSIFICATIONS ARE BASED ON SOIL DESCRIPTION BY JAMES M. MONTGOMERY, INC. (SEE DEC. 1990 AND JAN. 1991 REPORTS)
CROSS SECTION B-B'
CAVE CREEK LANDFILL
APPA
Figure 3-3
DAMES & MOORE
25551-001-033
C00914-08-05-93



STRATIGRAPHY OF WELLS CCMW-1 AND CCMW-2

CAVE CREEK LANDFILL

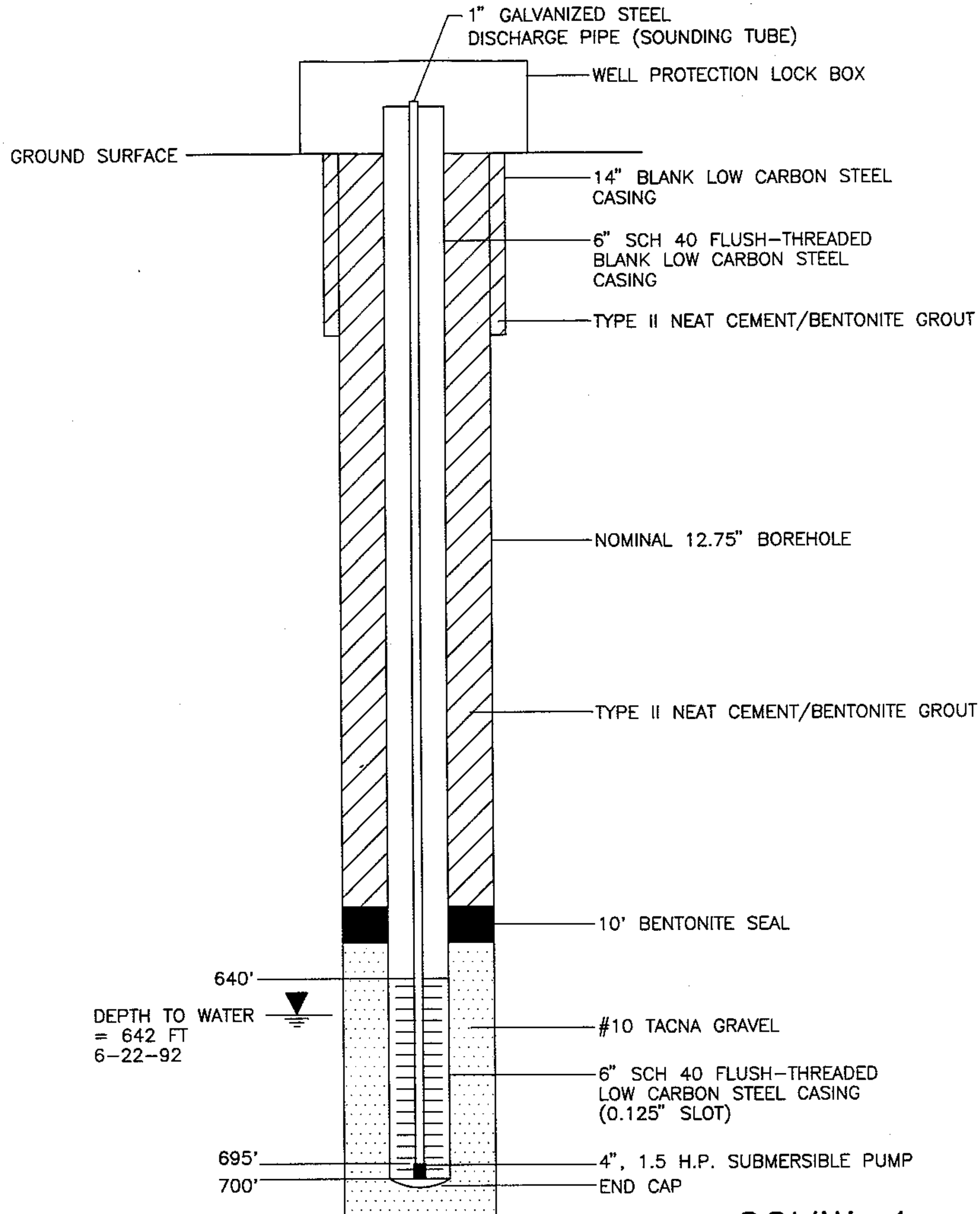
APPA

Figure 3-4

DAMES & MOORE

25551-001-033

C00913-08-05-93



CCMW-1 MONITOR WELL COMPLETION DIAGRAM

CAVE CREEK LANDFILL

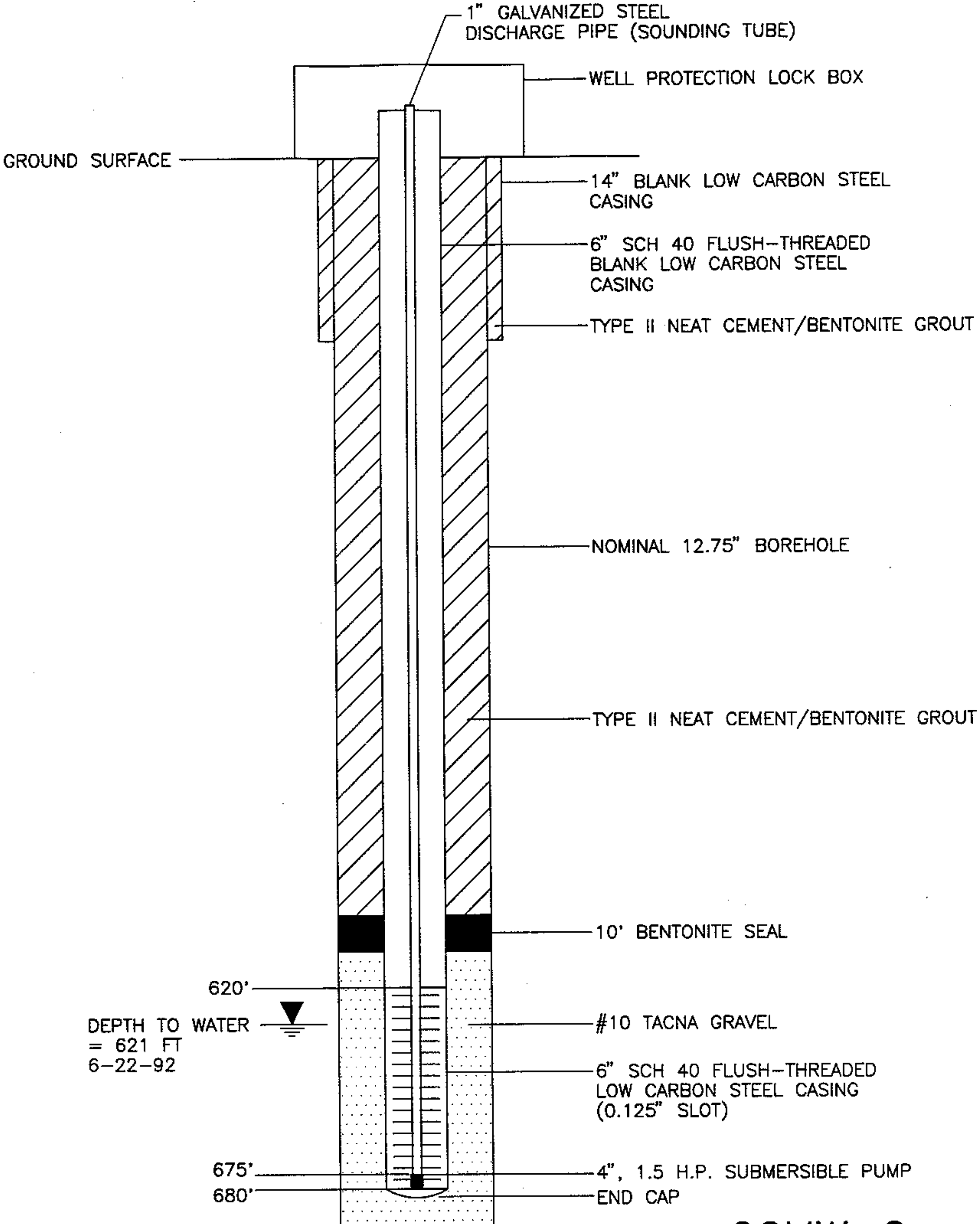
APPA

Figure 3-5

A00877-07-22-93

DAMES & MOORE

25551-002-033



CCMW-2
MONITOR WELL
COMPLETION DIAGRAM

CAVE CREEK LANDFILL

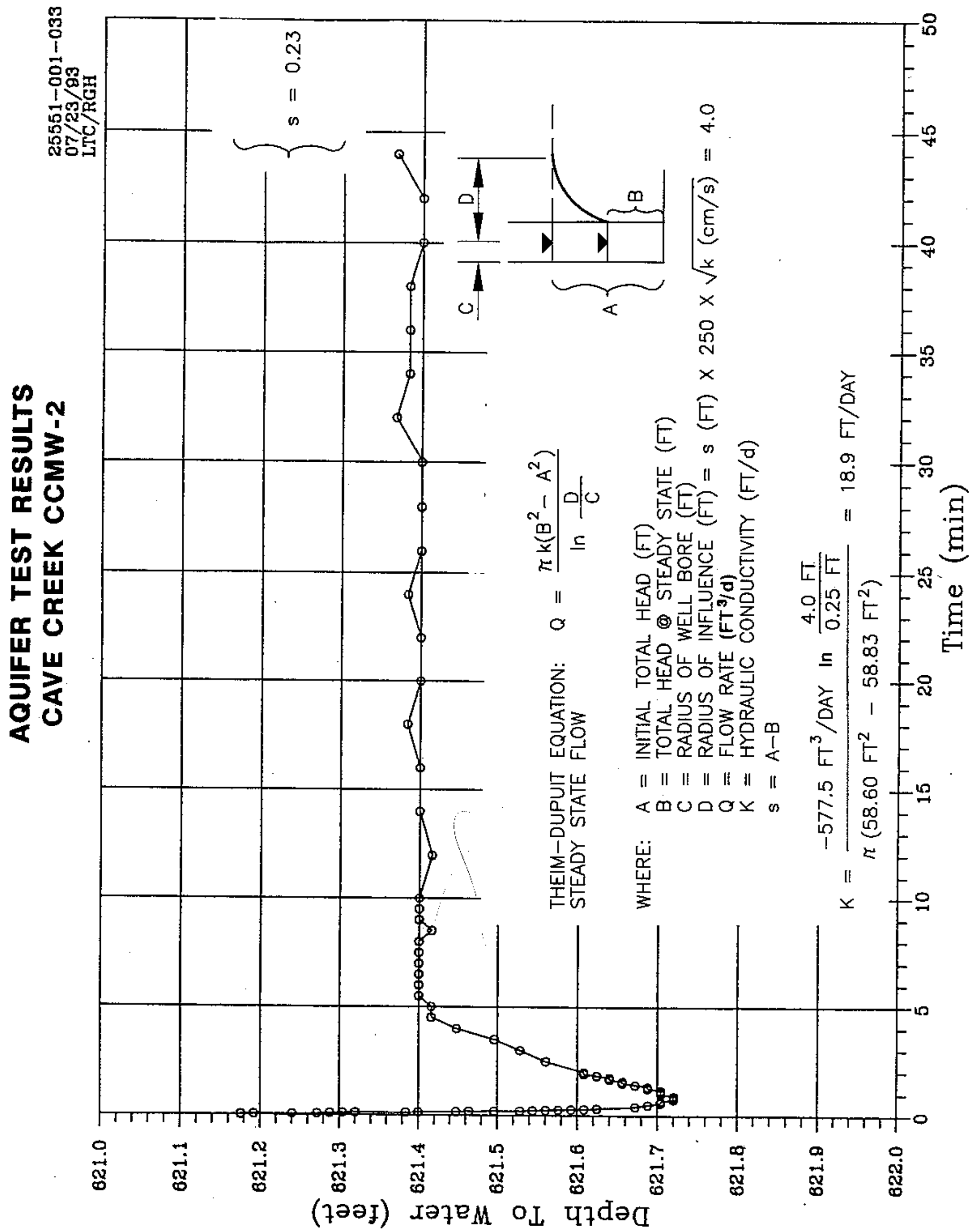
APPA

Figure 3-6

DAMES & MOORE

25551-002-033

A00878-07-22-93



AQUIFER TEST RESULTS MW-2 TEST 1

CAVE CREEK LANDFILL

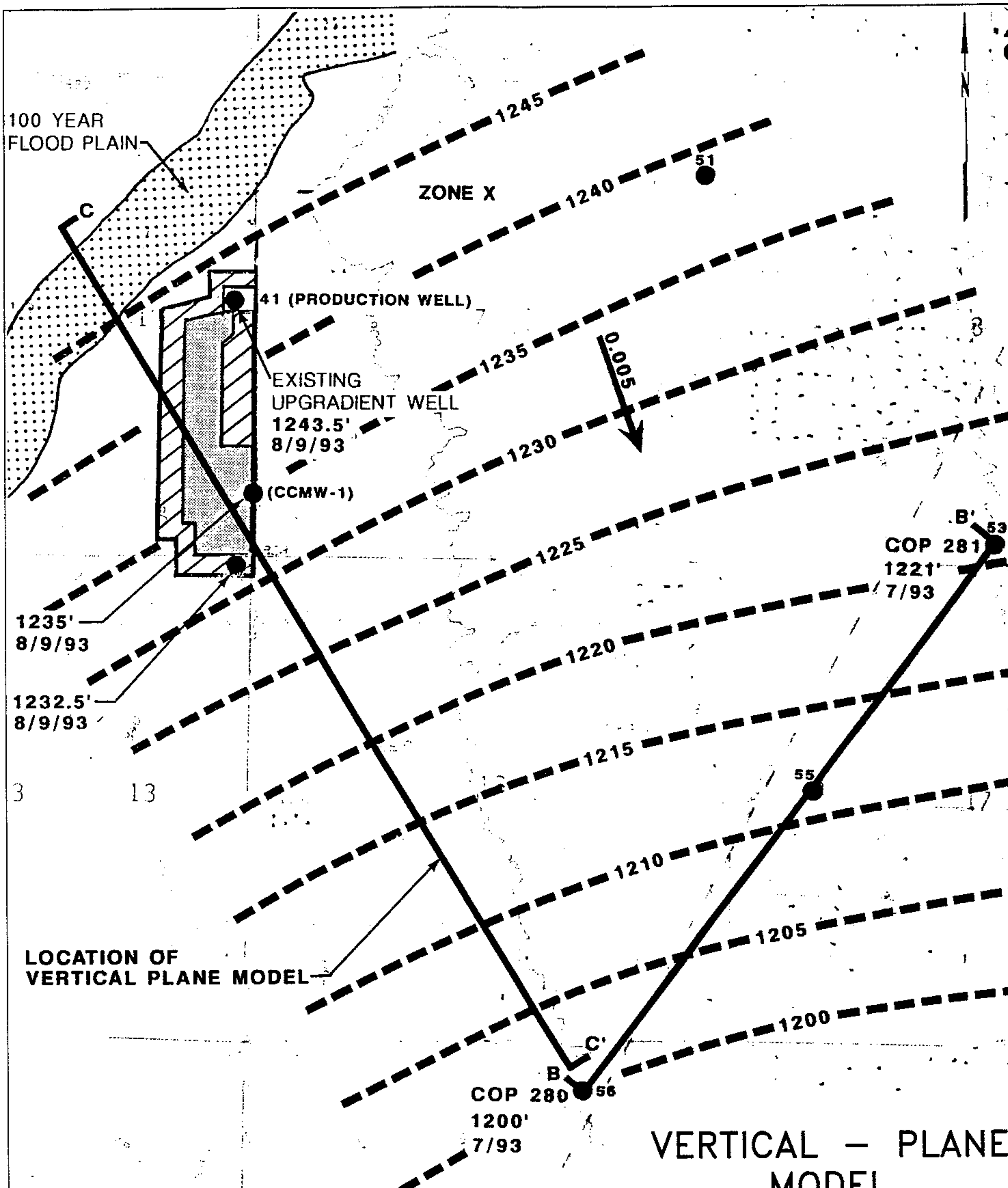
APPA

Figure **3-7**

DAMES & MOORE

25551-002-022

A01019-09-08-93



VERTICAL – PLANE MODEL LOCATION MAP

CAVE CREEK LANDFILL

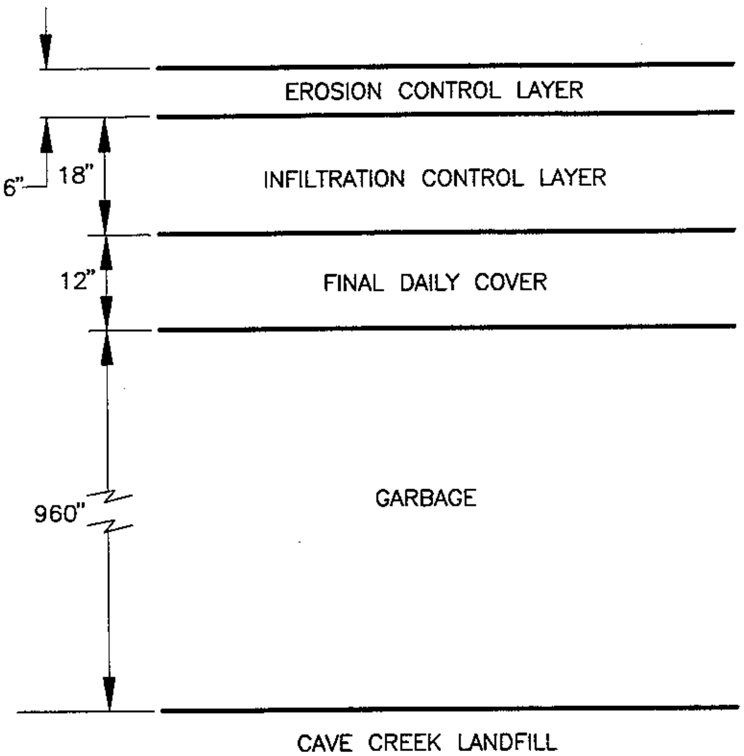
APPA

Figure 3-8

A00974-09-03-93

DAMES & MOORE

25551-002-022



CAVE CREEK LANDFILL CROSS SECTION FOR HELP MODEL

CAVE CREEK LANDFILL

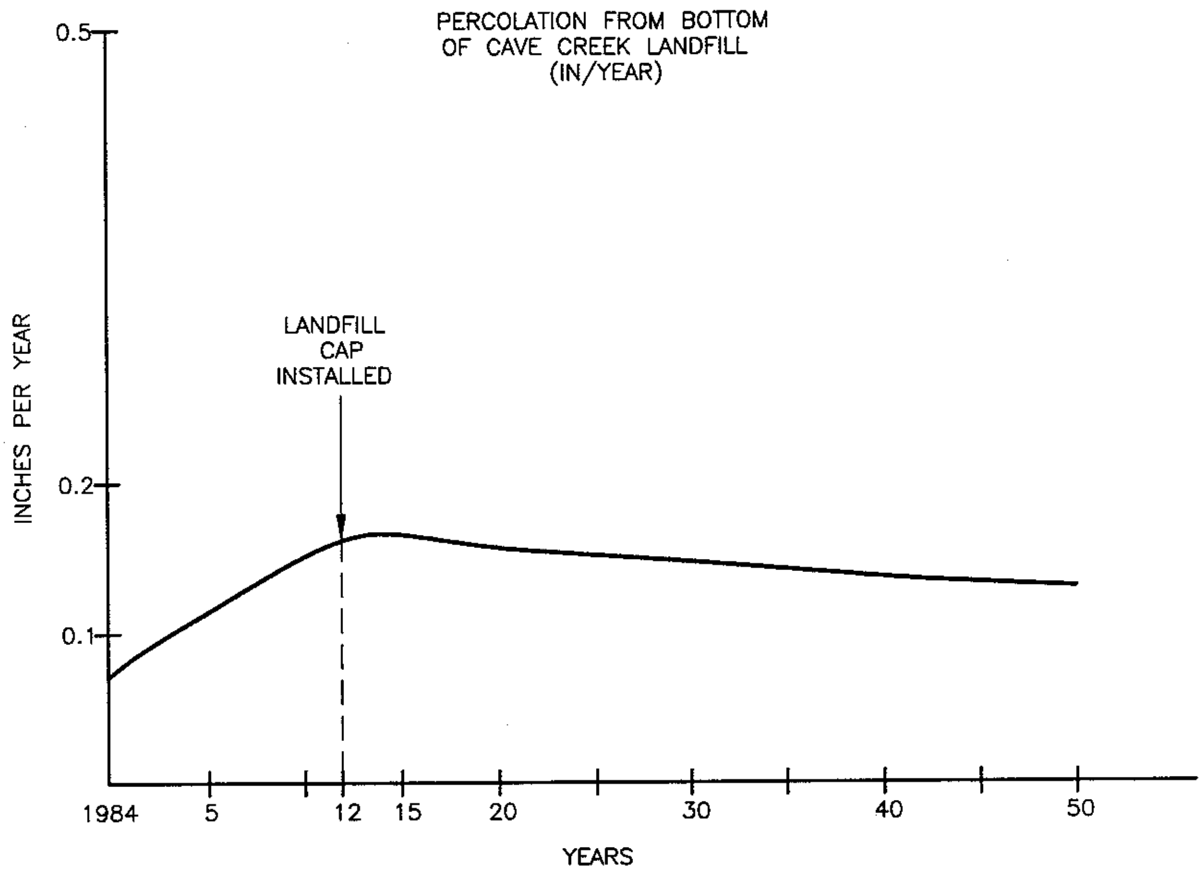
APPA

Figure 3-9

DAMES & MOORE

25551-002-022

A00975-09-03-93



CAVE CREEK LANDFILL PREDICTED PERCOLATION RATE

CAVE CREEK LANDFILL

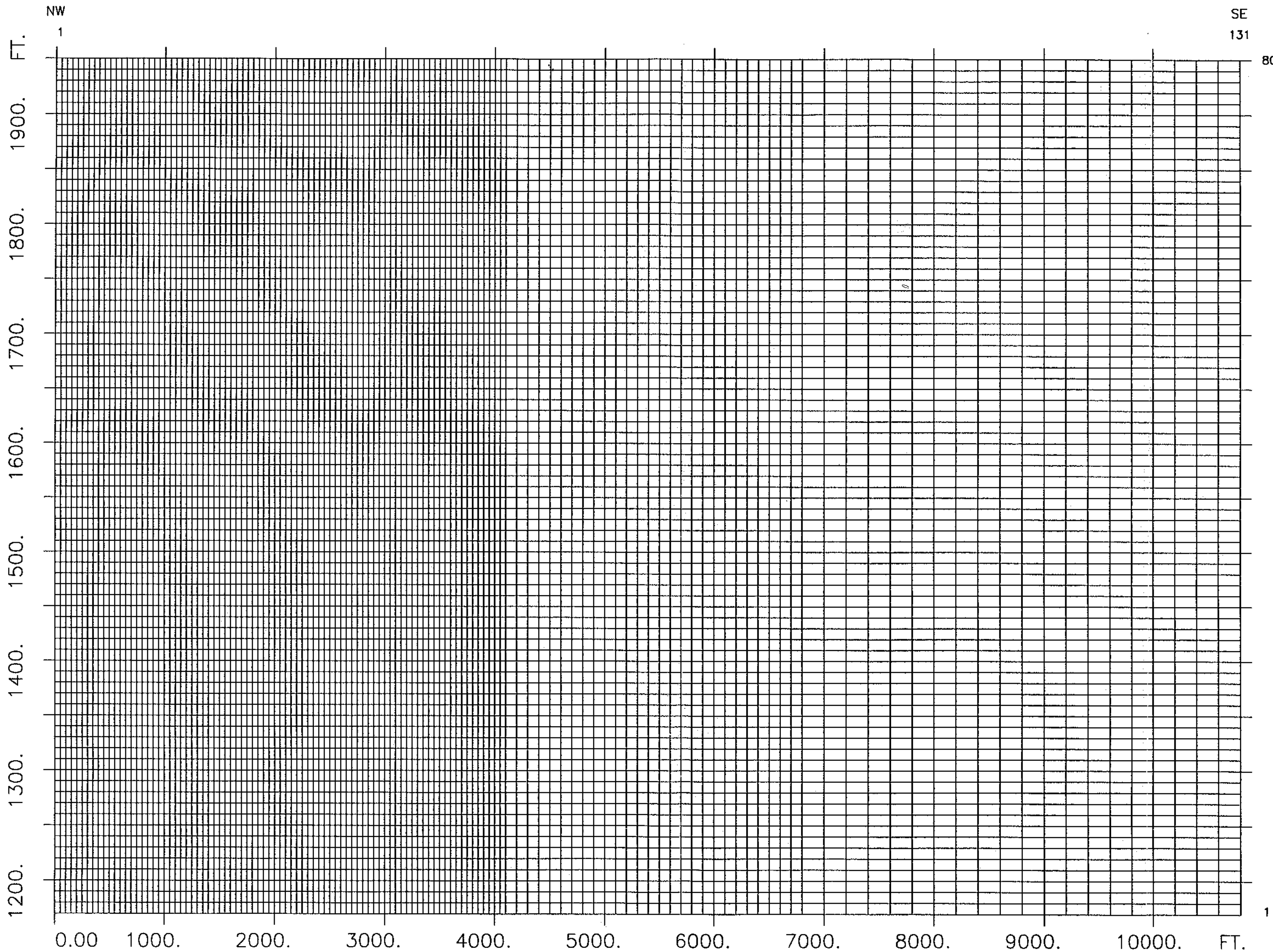
APPA

Figure 3-10

DAMES & MOORE

25551-002-022

A00976-09-03-93



FINITE–DIFFERENCE MESH

CAVE CREEK LANDFILL

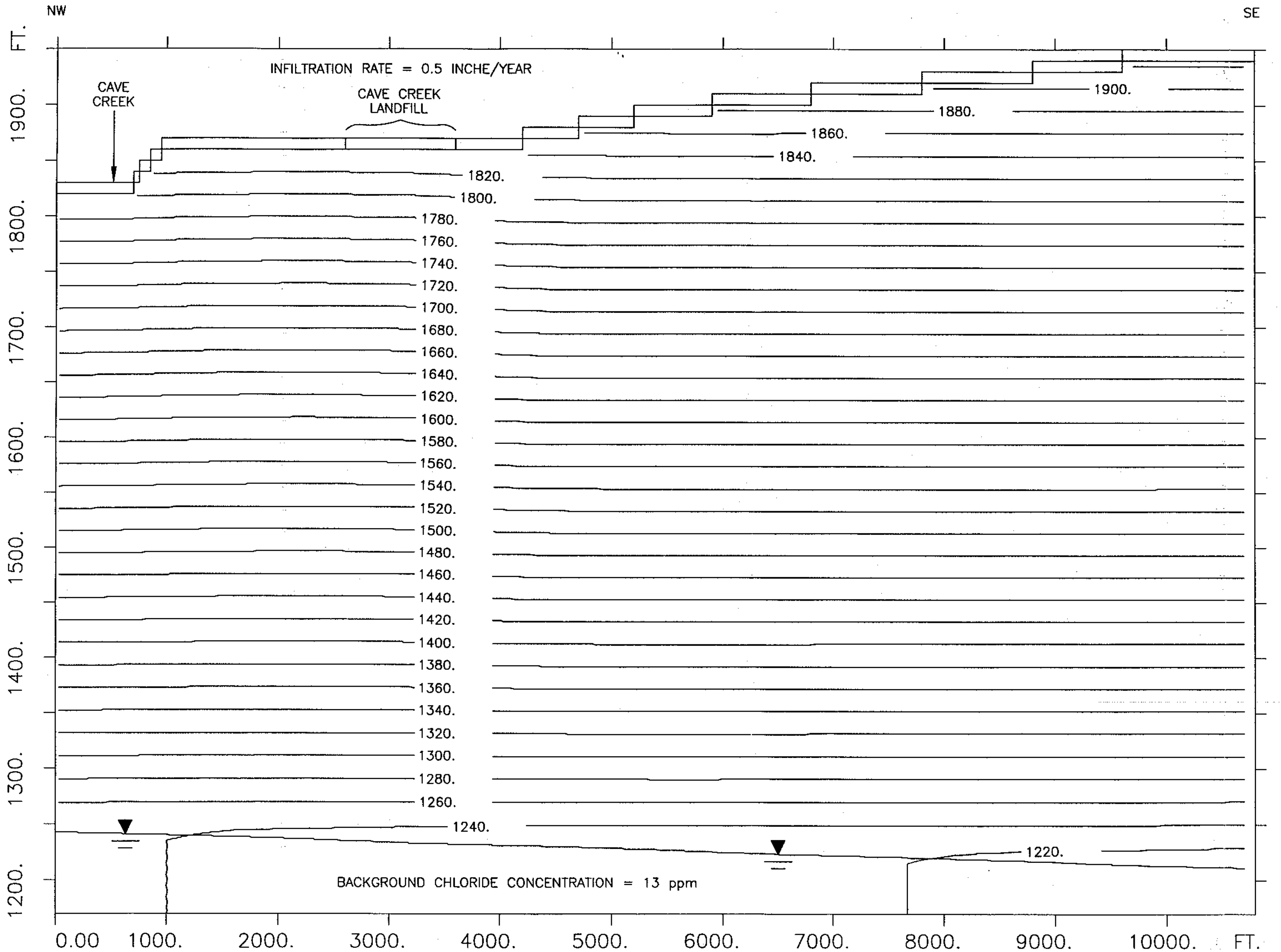
APPA

Figure 3-11

DAMES & MOORE

25551-002-022

A00984-09-08-93



ALLUVIAL PROPERTY ASSUMPTIONS

HYDRAULIC CONDUCTIVITY (HORIZONTAL = VERTICAL) = 15 FT/DAY

POROSITY = 0.28

CHARACTERISTIC CURVE FOR "TYPICAL SAND"

A00986-09-08-93

STEADY STATE FLOW MODEL STARTING CONDITIONS

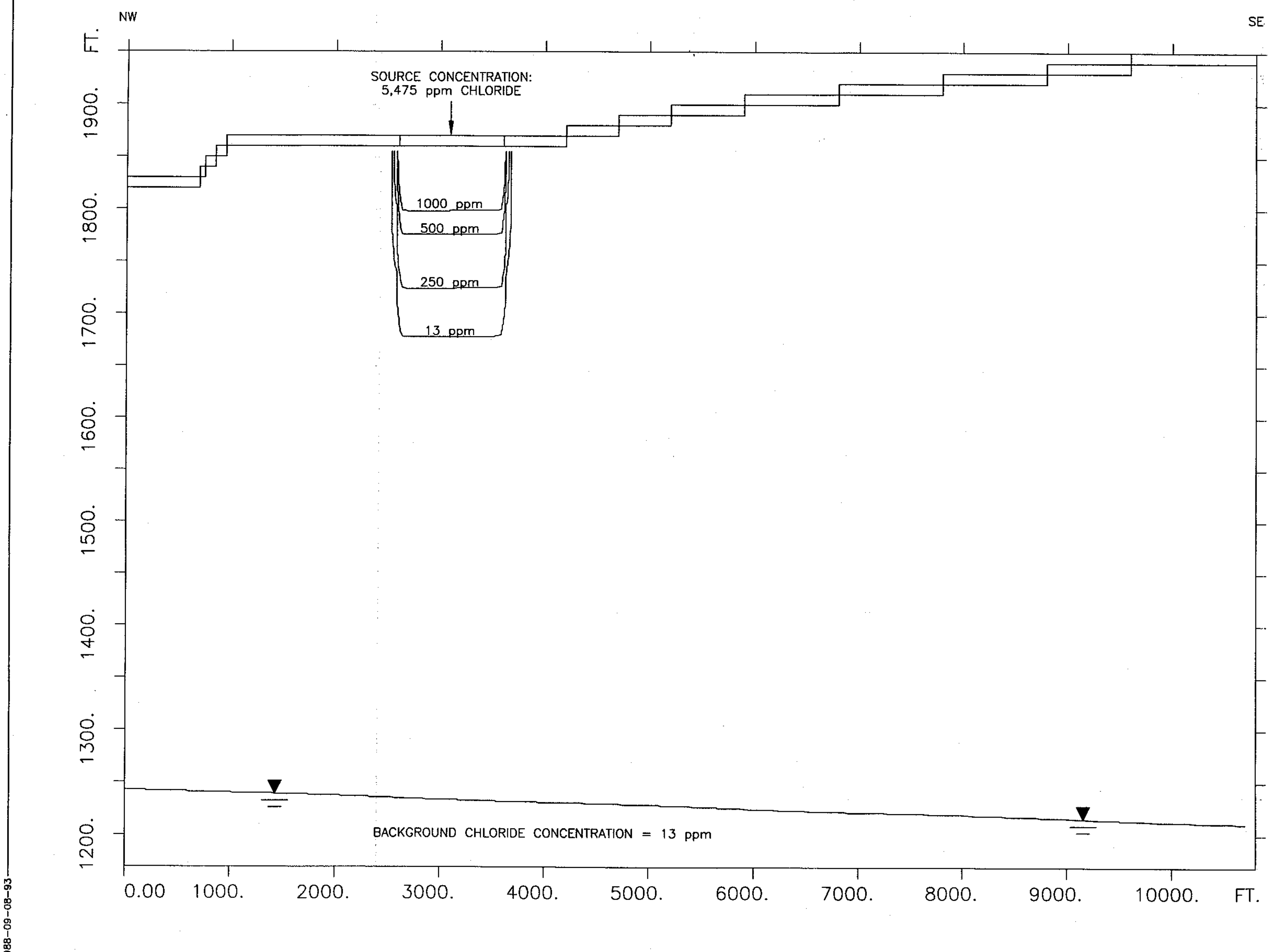
CAVE CREEK LANDFILL

APPA

Figure 3-12

DAMES & MOORE

25551-002-022



TRANSPORT ASSUMPTIONS

LONGITUDINAL DISPERSIVITY = 100 FEET

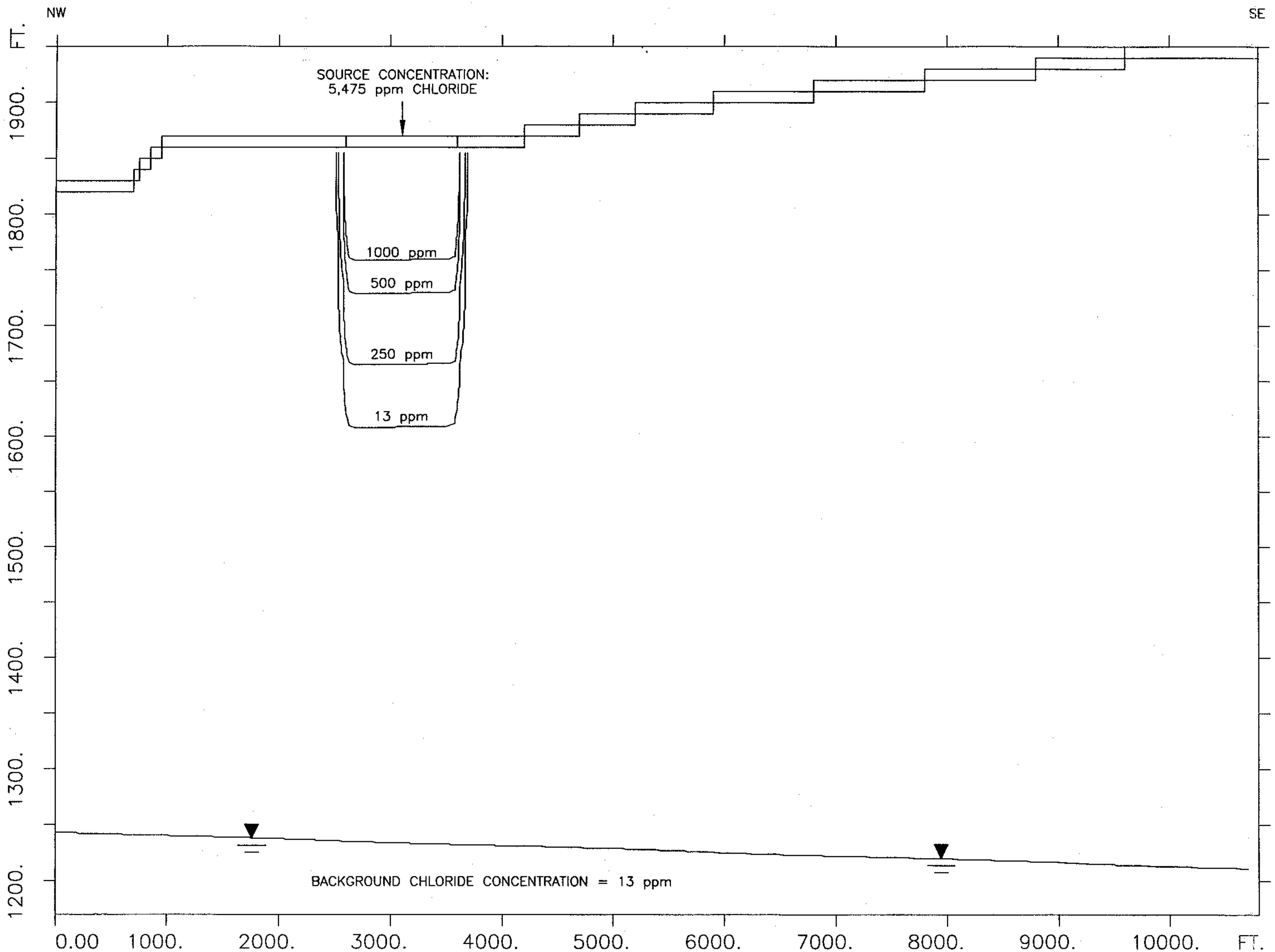
TRANSVERSE DISPERSIVITY = 10 FEET

NO RETARDATION
SIMULATION PERIOD = 5 YEARS

PREDICTED CHLORIDE CONCENTRATIONS AFTER 5 YEARS

CAVE CREEK LANDFILL
APPA
Figure **3-13**

DAMES & MOORE
25551-002-022



TRANSPORT ASSUMPTIONS

LONGITUDINAL DISPERSIVITY = 100 FEET

TRANSVERSE DISPERSIVITY = 10 FEET

NO RETARDATION
SIMULATION PERIOD = 10 YEARS

PREDICTED CHLORIDE CONCENTRATIONS AFTER 10 YEARS

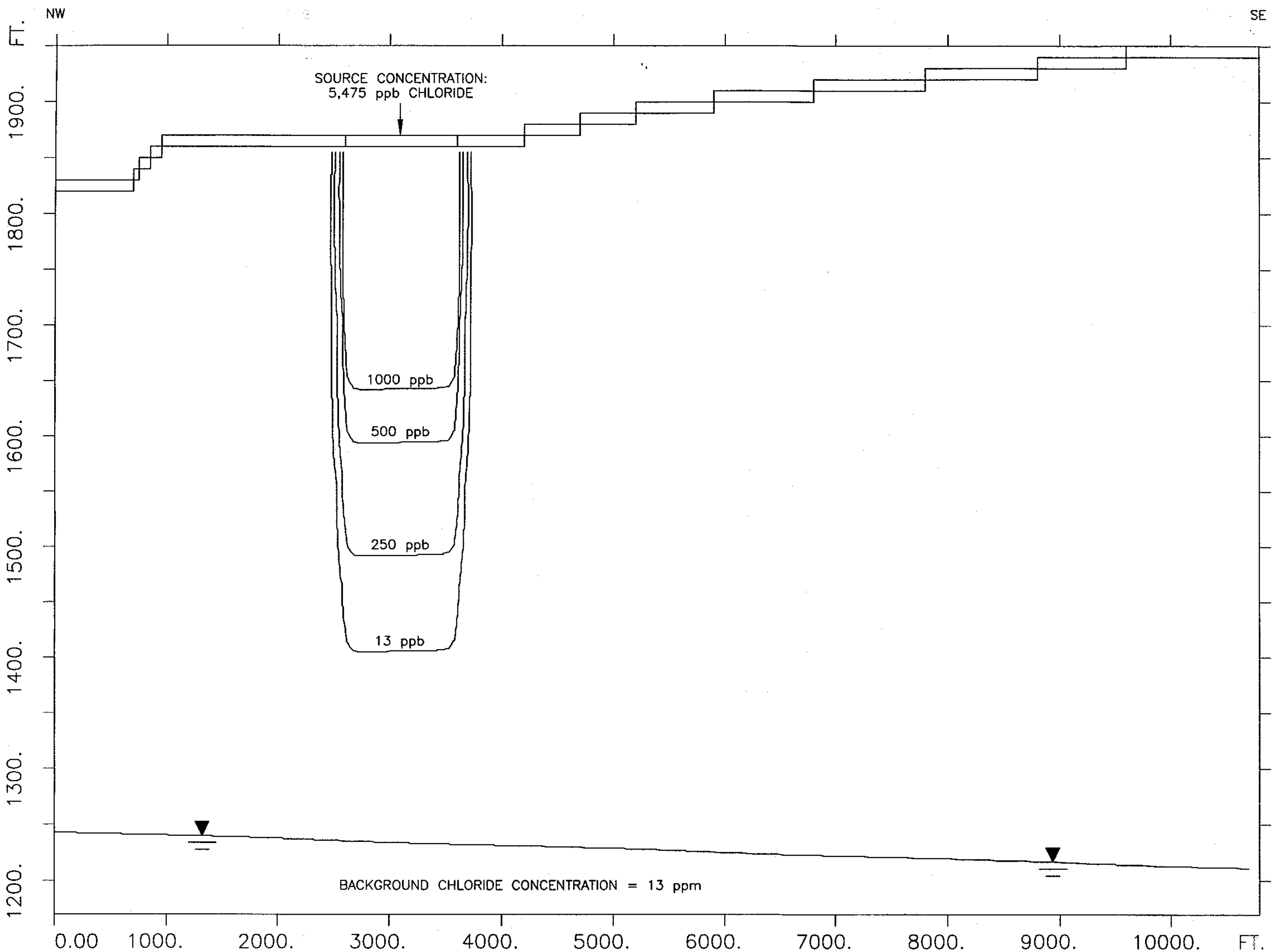
CAVE CREEK LANDFILL

APPA

Figure **3-14**

DAMES & MOORE
25551-002-022

A00990-09-08-93



TRANSPORT ASSUMPTIONS

LONGITUDINAL DISPERSIVITY = 100 FEET

TRANSVERSE DISPERSIVITY = 10 FEET

NO RETARDATION
SIMULATION PERIOD = 30 YEARS

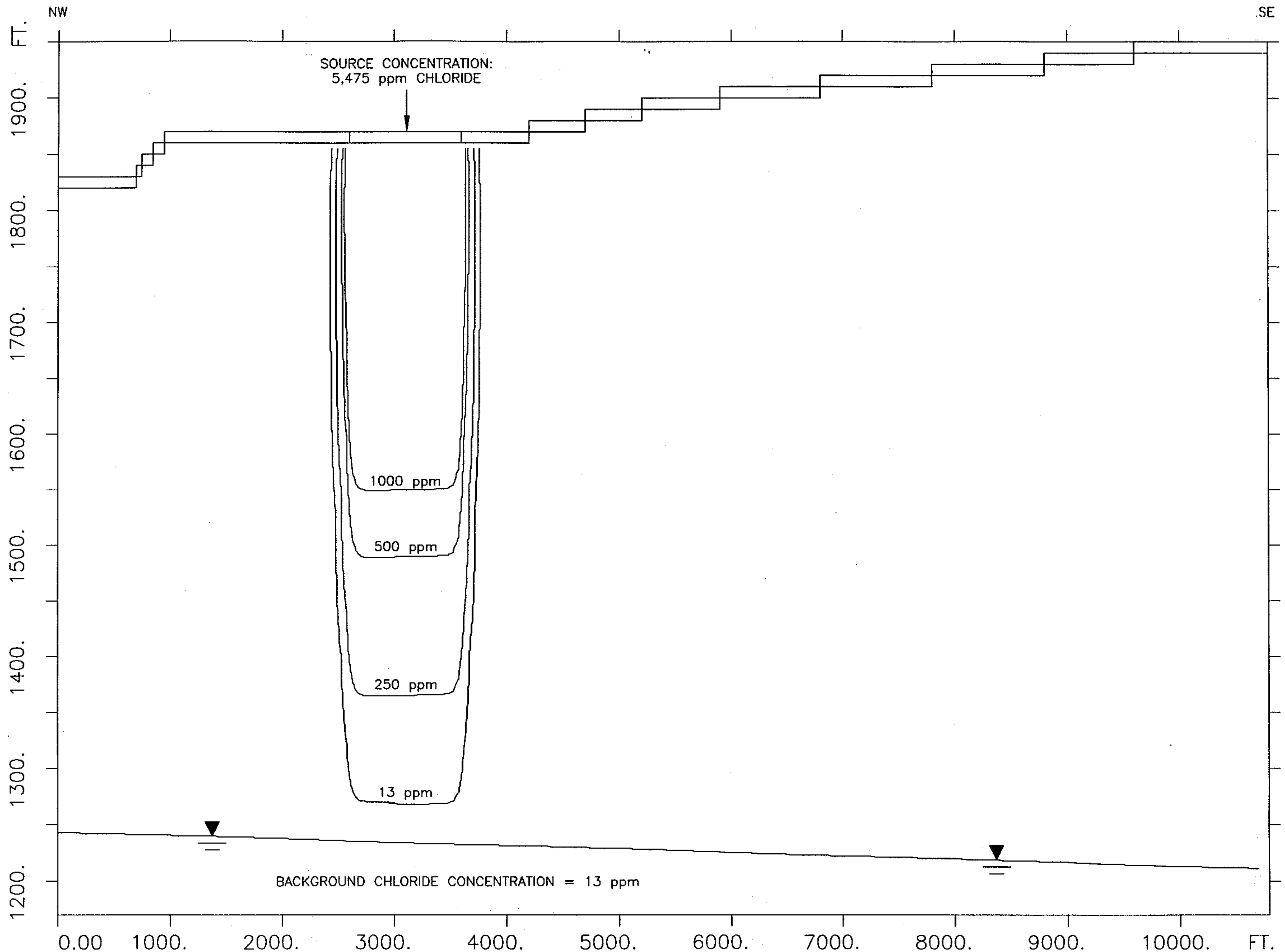
PREDICTED CHLORIDE CONCENTRATION AFTER 30 YEARS

CAVE CREEK LANDFILL
APPA

Figure **3-15**

DAMES & MOORE
25551-002-022

A00996-09-08-93



TRANSPORT ASSUMPTIONS

LONGITUDINAL DISPERSIVITY = 100 FEET

TRANSVERSE DISPERSIVITY = 10 FEET

NO RETARDATION
SIMULATION PERIOD = 50 YEARS

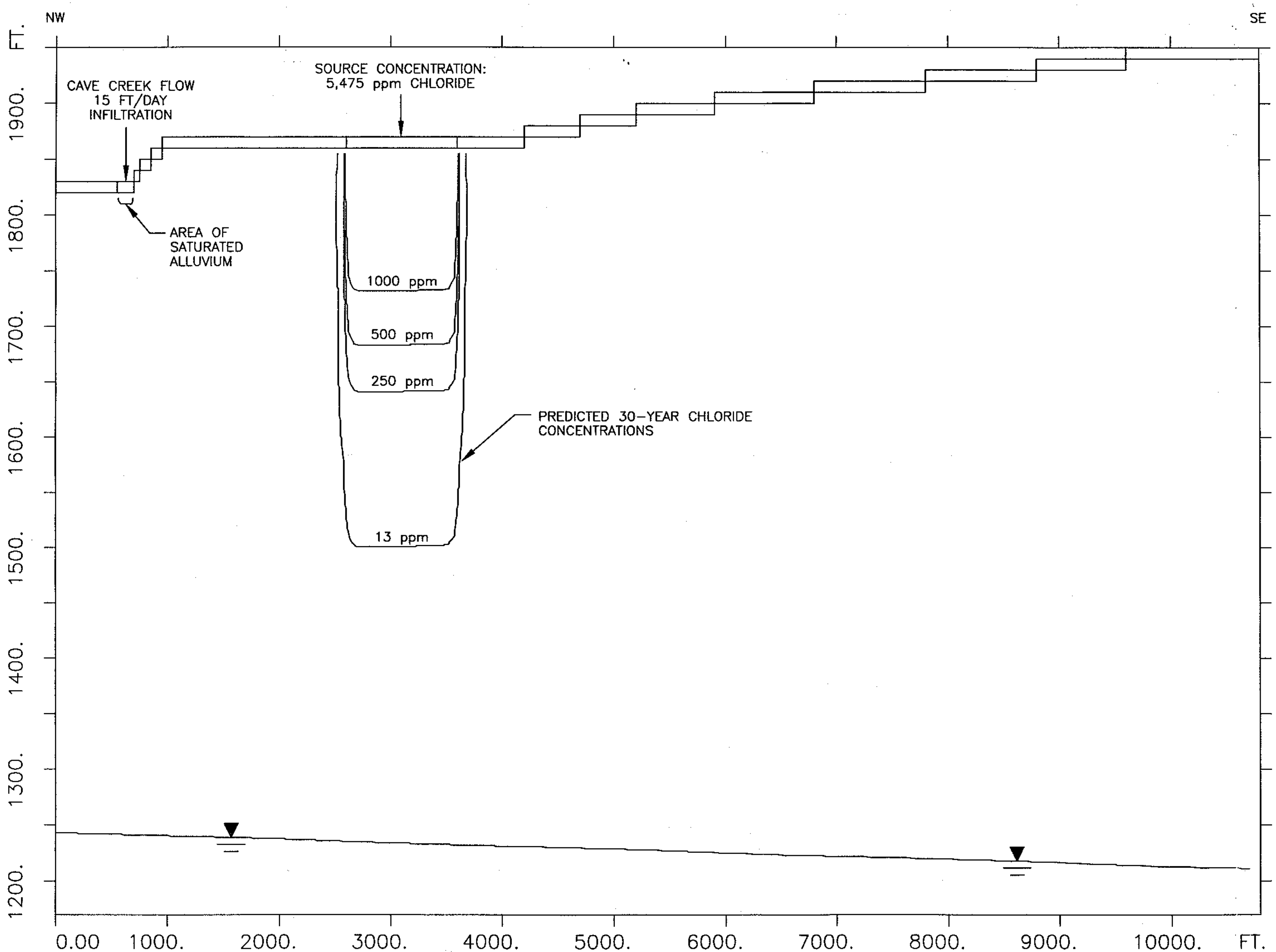
A00998-09-08-93

PREDICTED CHLORINE CONCENTRATION AFTER 50 YEARS

CAVE CREEK LANDFILL
APPA

Figure **3-16**

DAMES & MOORE
25551-002-022



A00993-09-08-93

CAVE CREEK FLOW SIMULATION 3 MONTHS OF FLOW

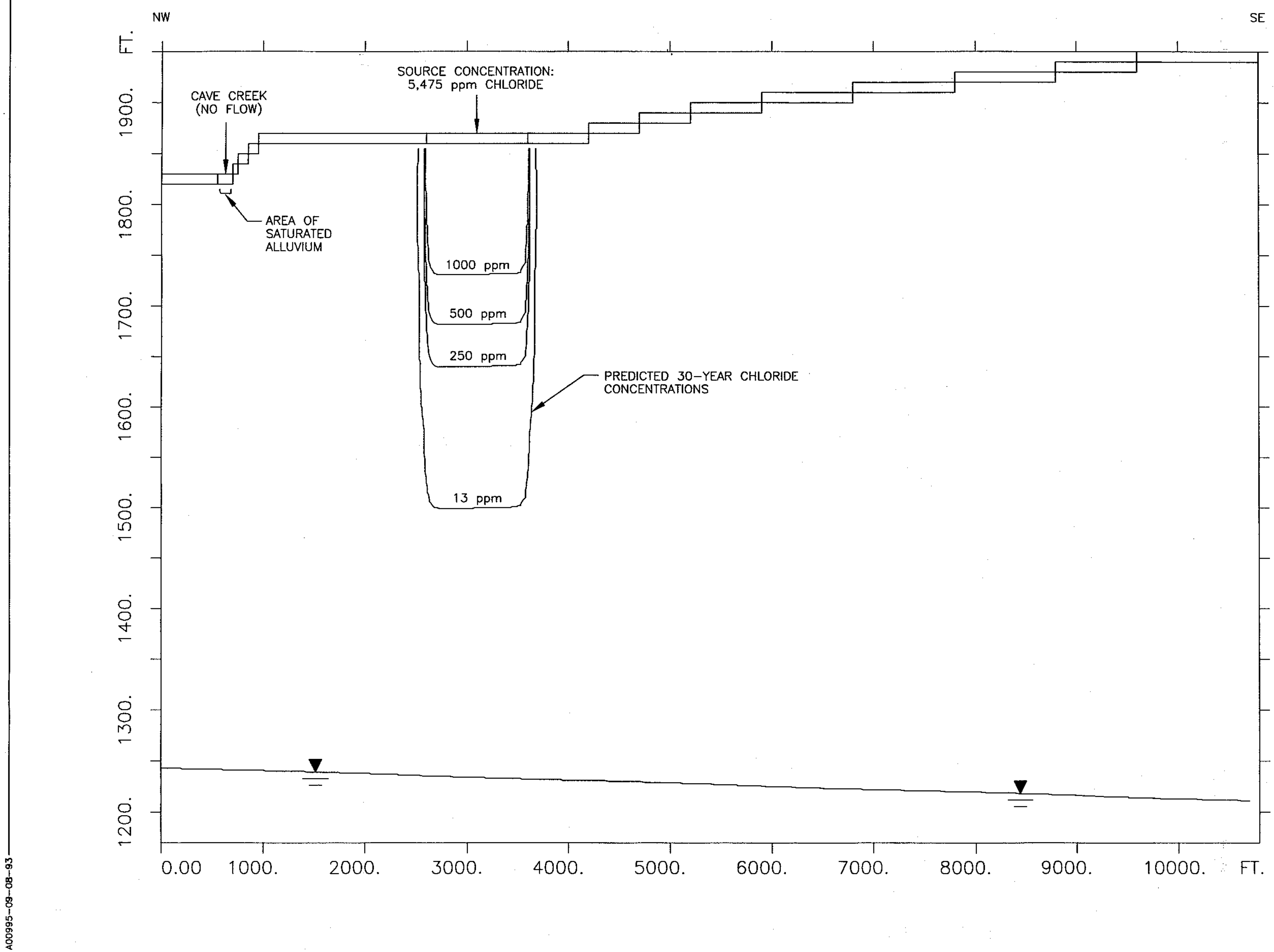
CAVE CREEK LANDFILL

APPA

Figure 3-17

DAMES & MOORE

25551-002-022



CAVE CREEK FLOW SIMULATION 3 MONTHS AFTER FLOW

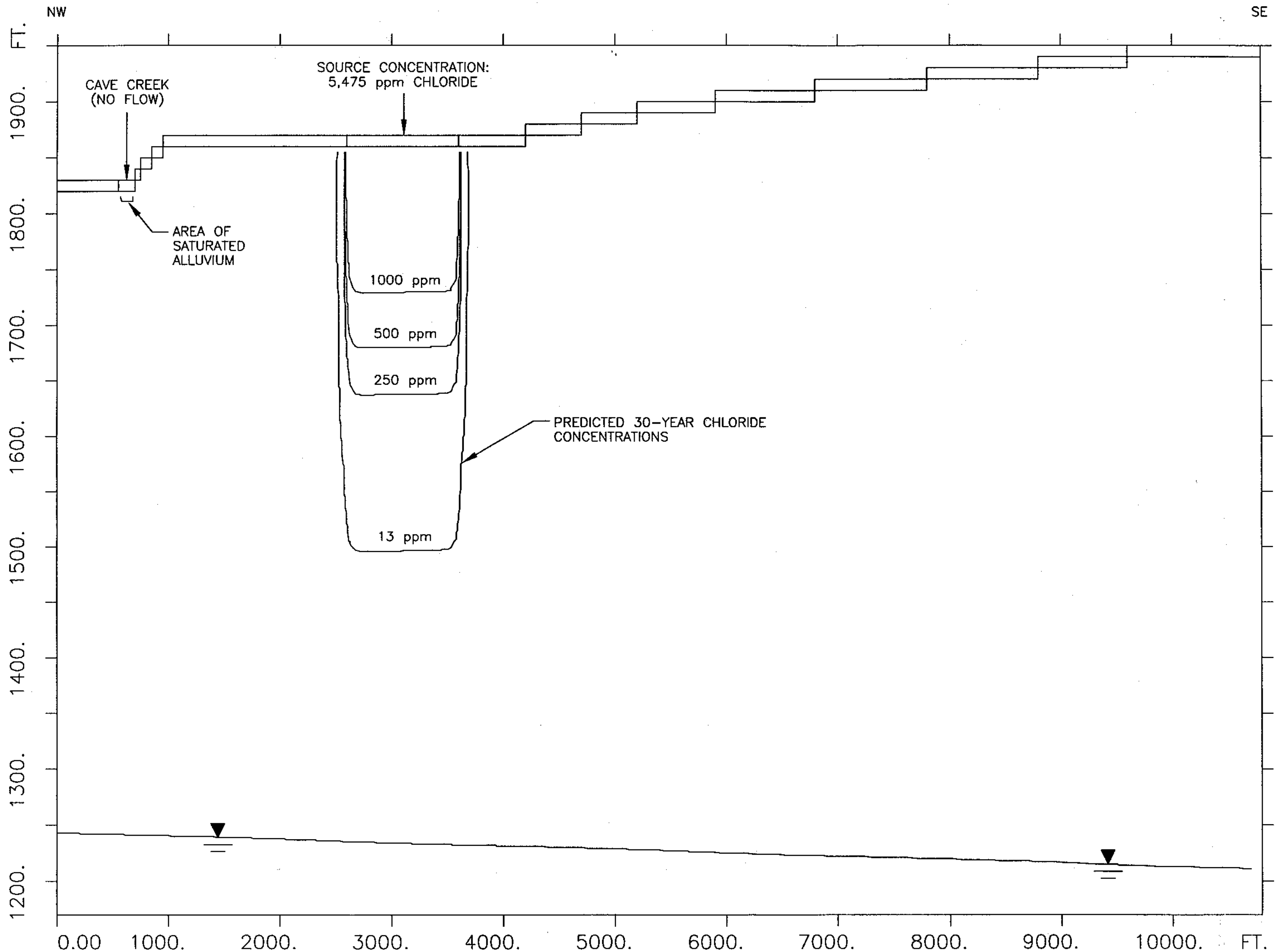
CAVE CREEK LANDFILL

APPA

Figure **3-18**

DAMES & MOORE

25551-002-022



A01000-09-08-93

CAVE CREEK FLOW SIMULATION 9 MONTHS AFTER FLOW

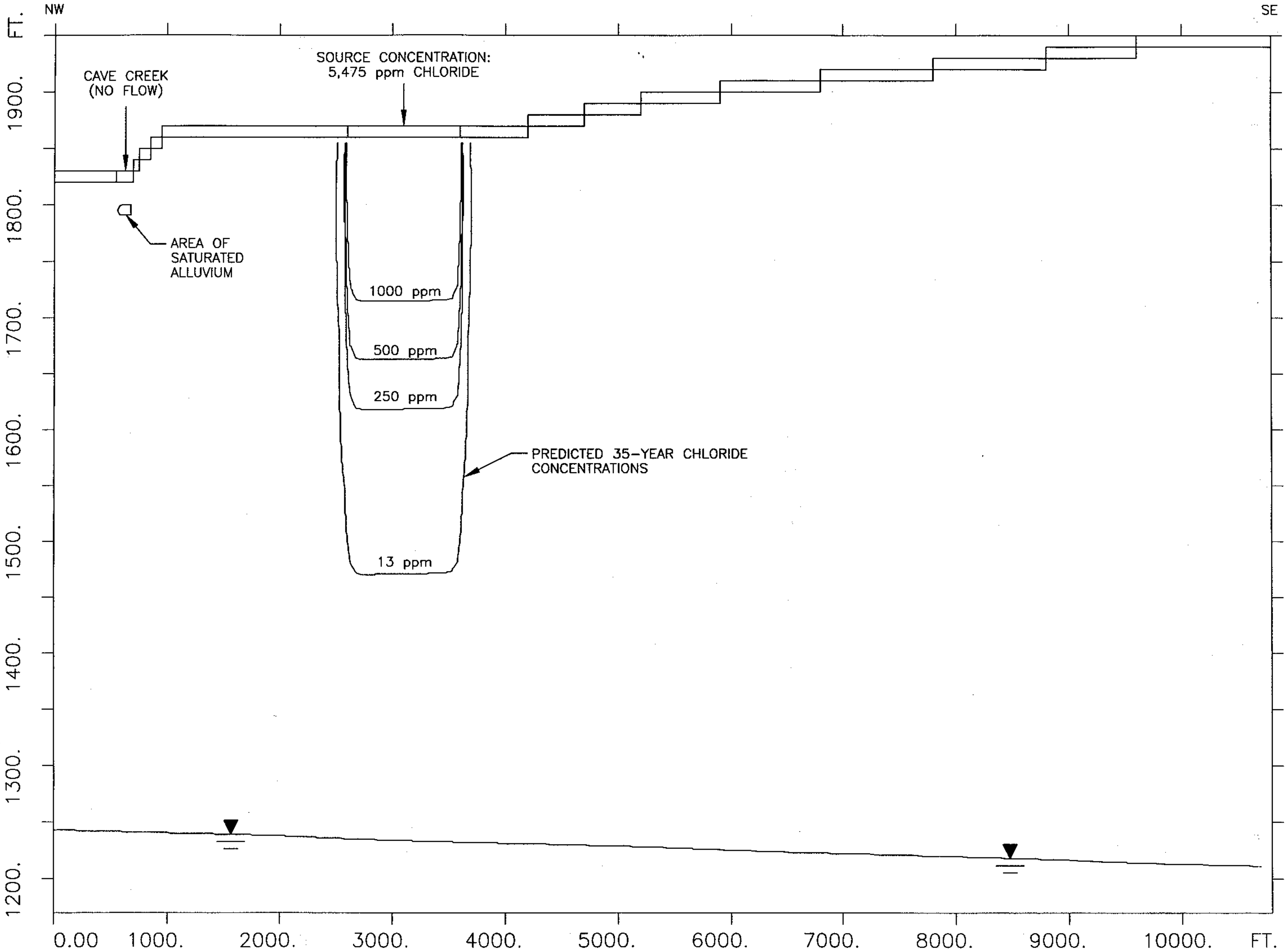
CAVE CREEK LANDFILL

APPA

Figure **3-19**

DAMES & MOORE

25551-002-022



A01002-09-08-93

CAVE CREEK FLOW SIMULATION 5 YEARS AFTER FLOW

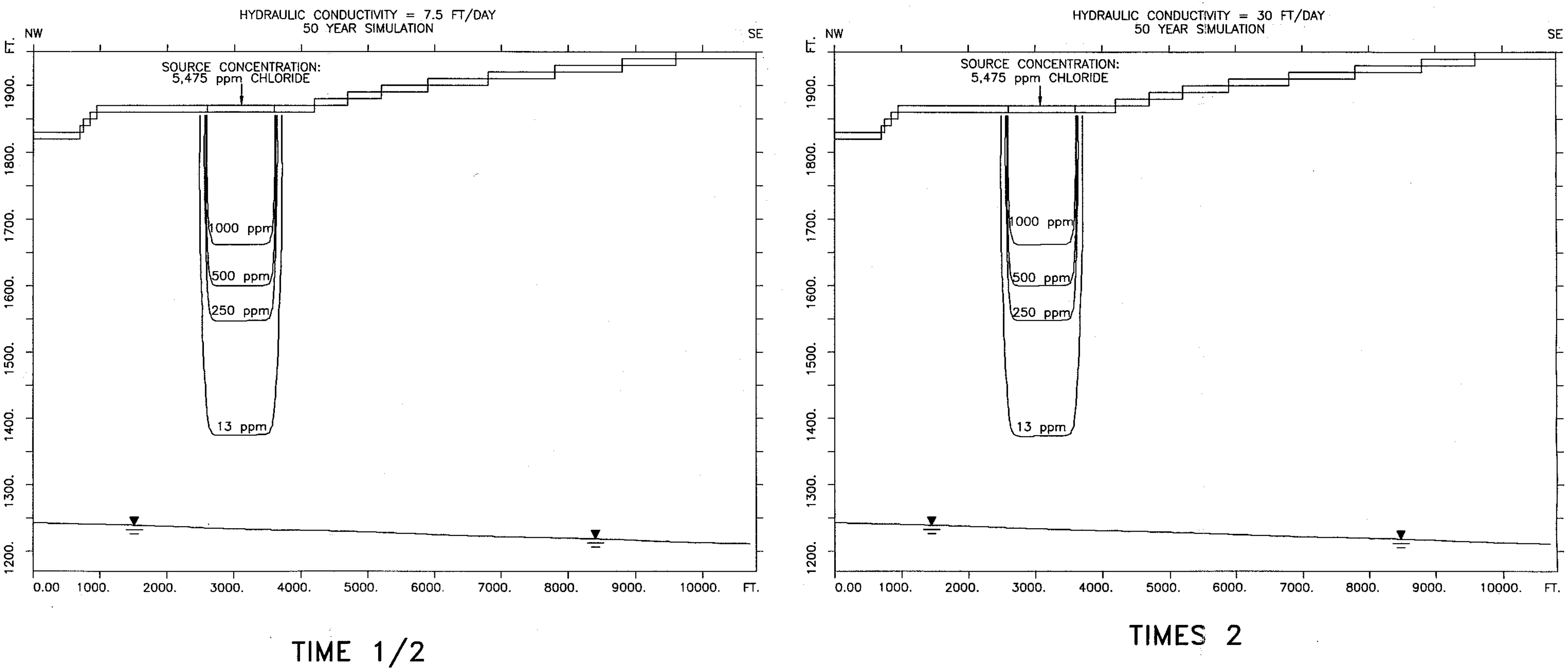
CAVE CREEK LANDFILL

APPA

Figure **3-20**

DAMES & MOORE

25551-002-022



A01004-09-08-93

SENSITIVITY ANALYSIS HYDRAULIC CONDUCTIVITY

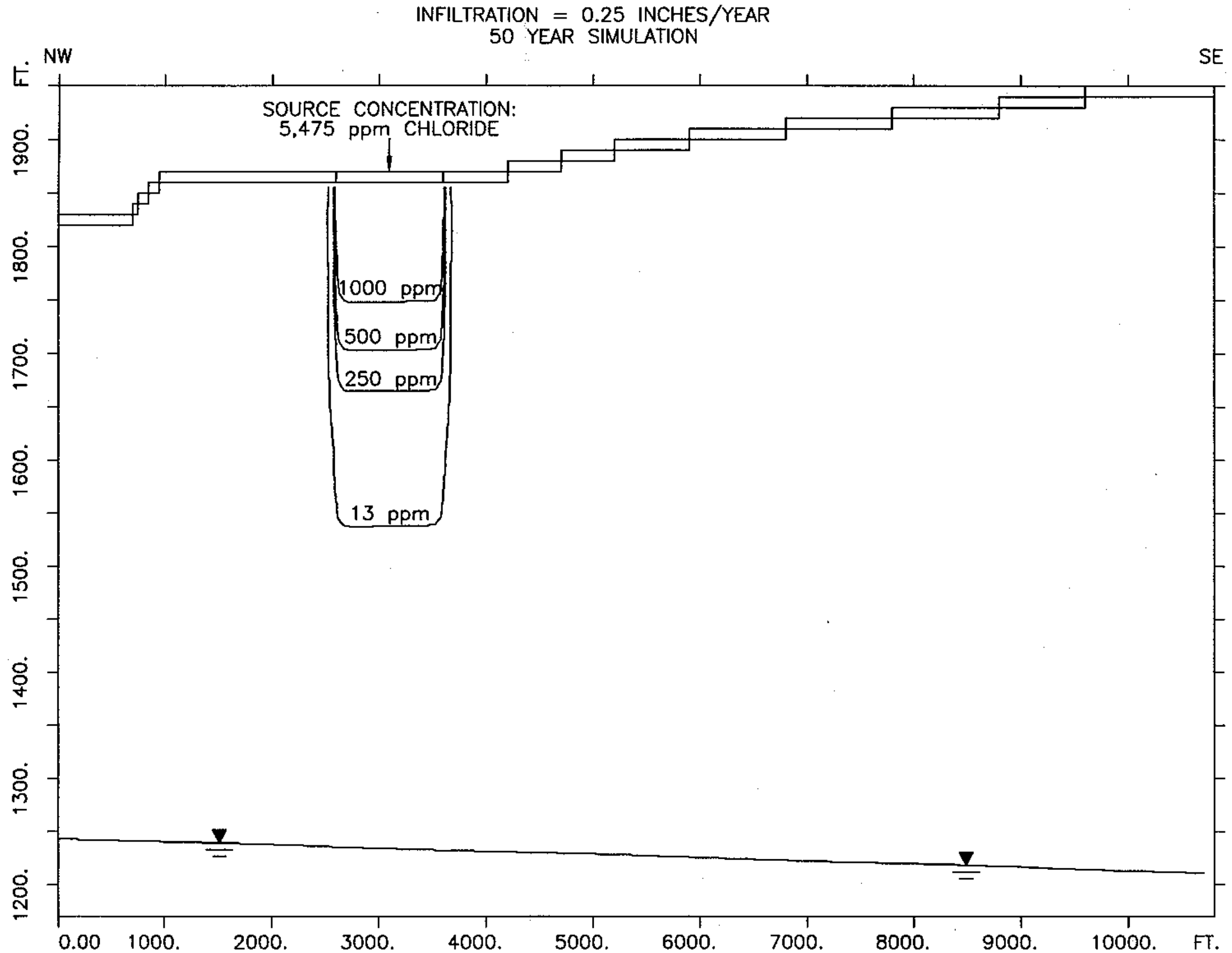
CAVE CREEK LANDFILL

APPA

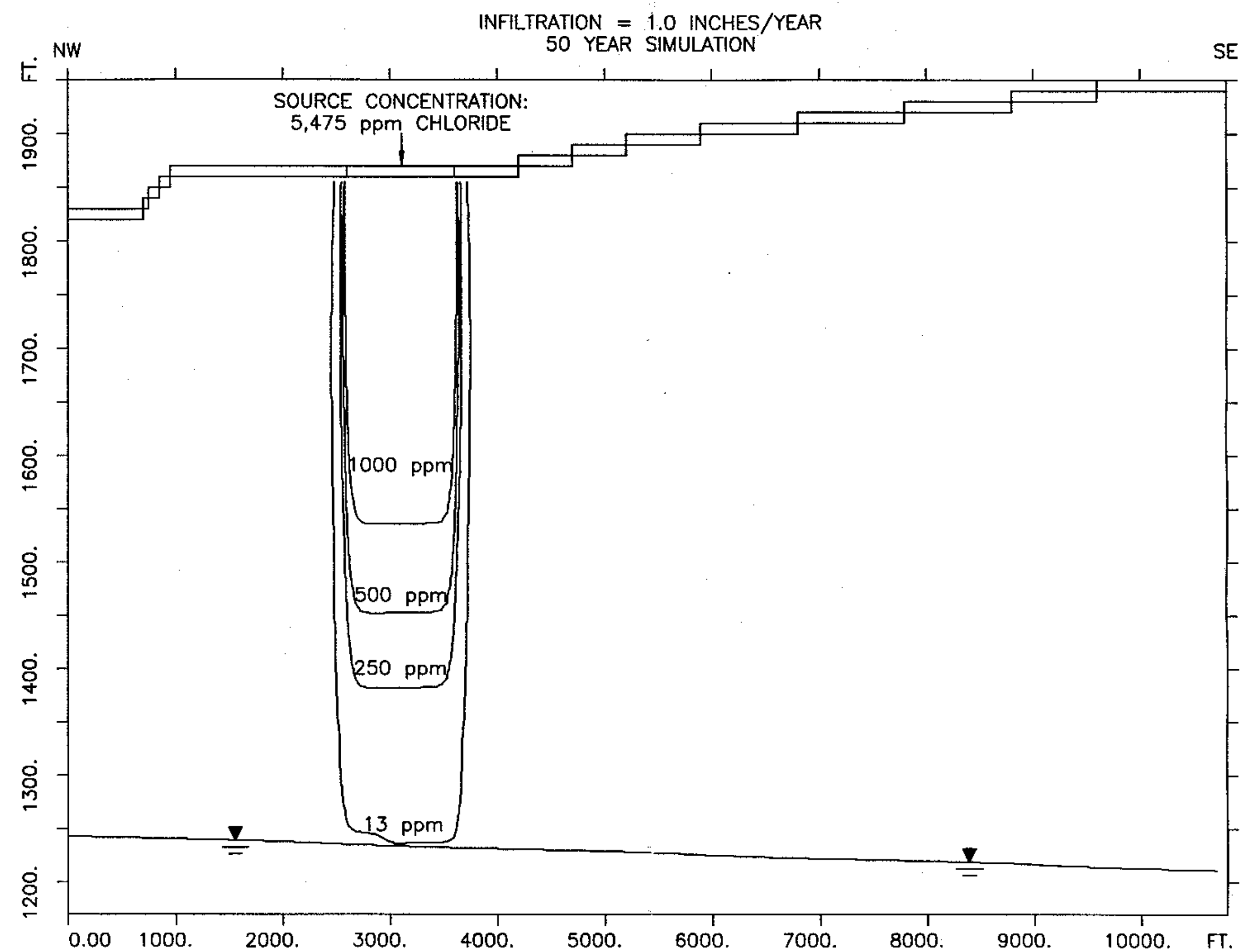
Figure 3-21

DAMES & MOORE

25551-002-022



TIMES 1/2



TIMES 2

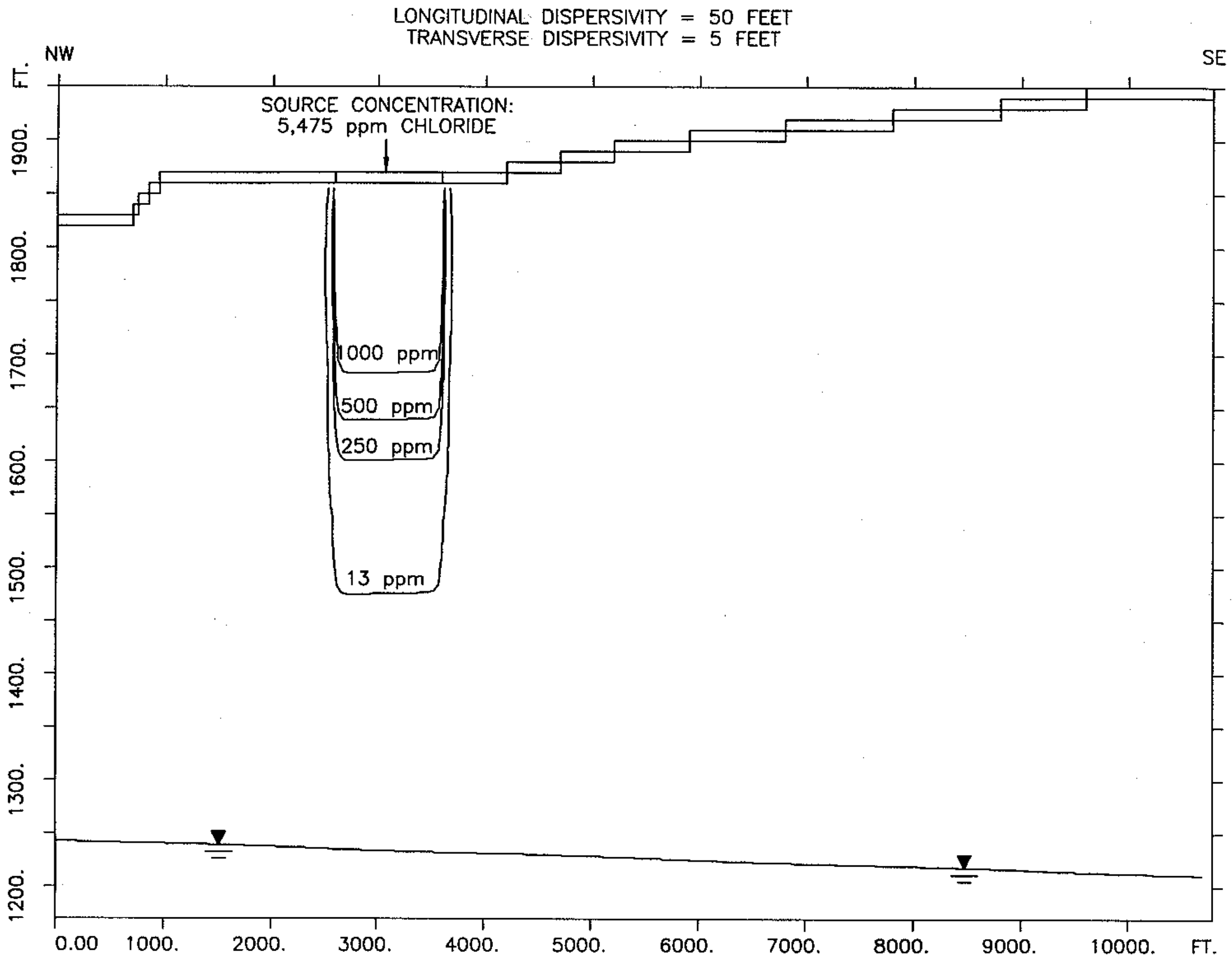
A01008-09-08-93

SENSITIVITY ANALYSIS
INFILTRATION

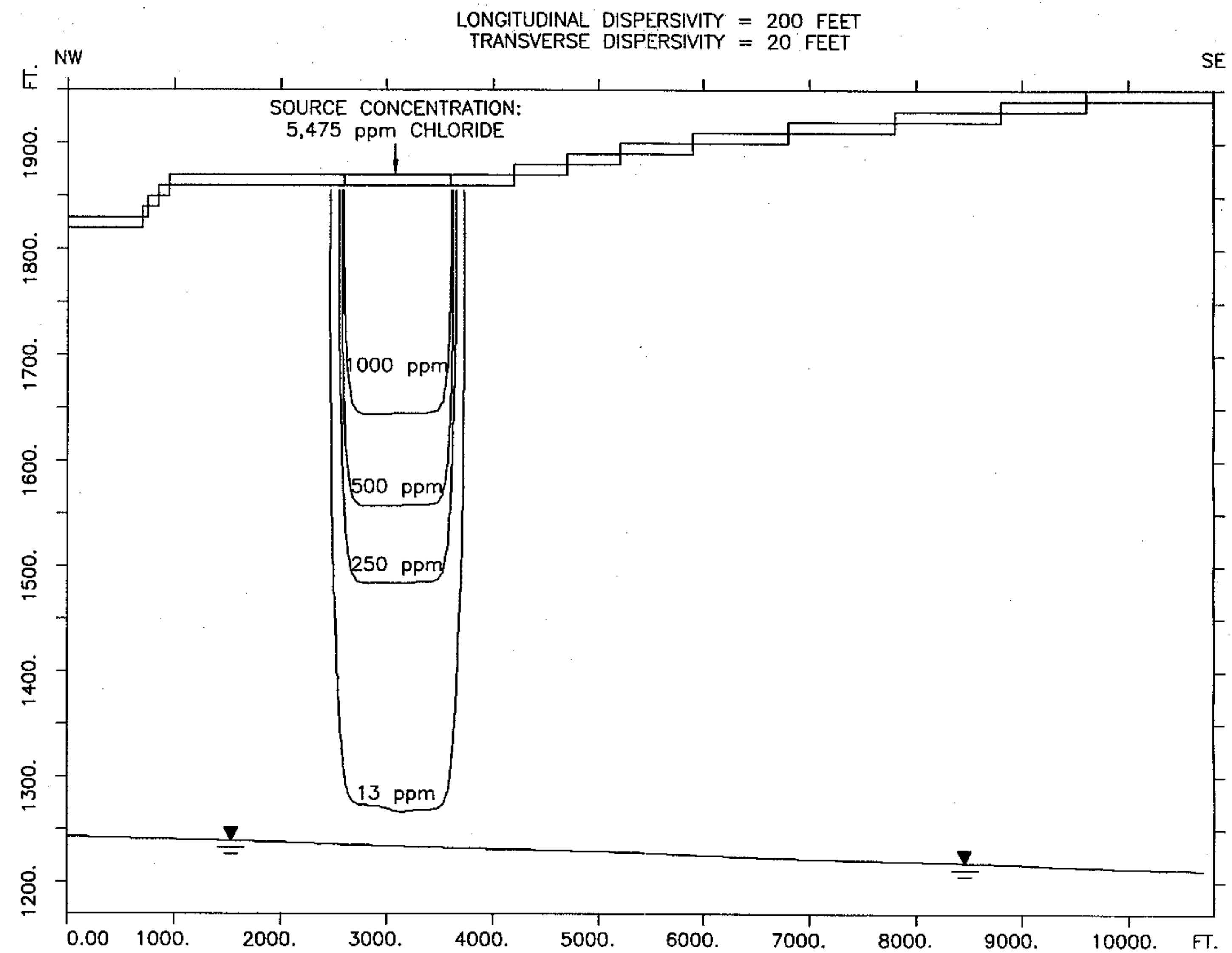
CAVE CREEK LANDFILL
APPA

Figure 3-22

DAMES & MOORE
25551-002-022



TIMES 1/2



TIMES 2

A01012-09-08-93

SENSITIVITY ANALYSIS
DISPERSIVITY

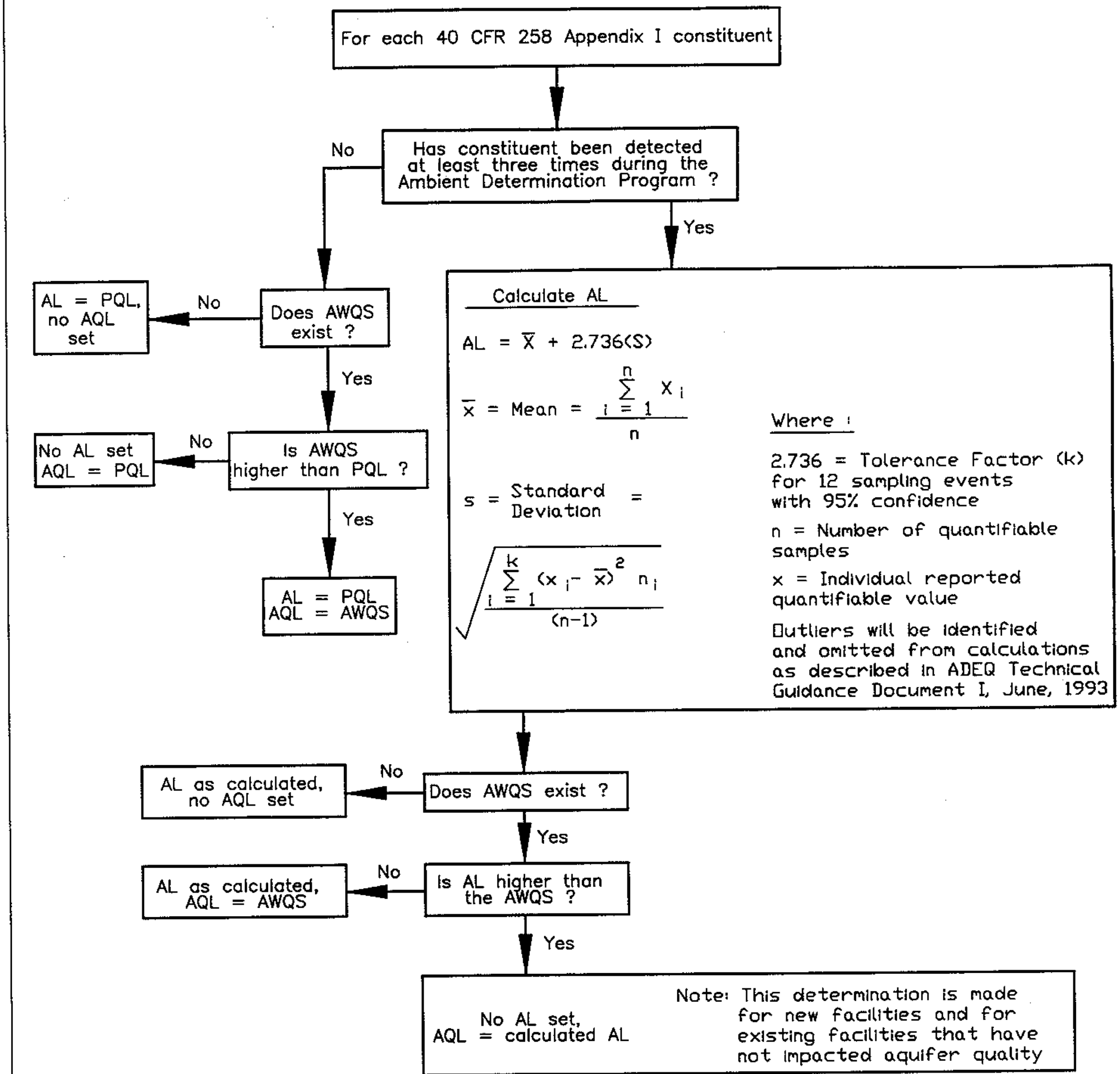
CAVE CREEK LANDFILL

APPA

Figure **3-23**

DAMES & MOORE

25551-002-022



AL = Alert Level

AQL = Aquifer Quality Limit

AWQS = Aquifer Water Quality Standard, set as the USEPA Primary or Secondary MCL, or the Health-Based Guidance Level if no MCL exists

PQL = Practical Quantitation Limit

ESTABLISHMENT OF ALERT LEVELS AND AQUIFER QUALITY LIMITS

CAVE CREEK LANDFILL

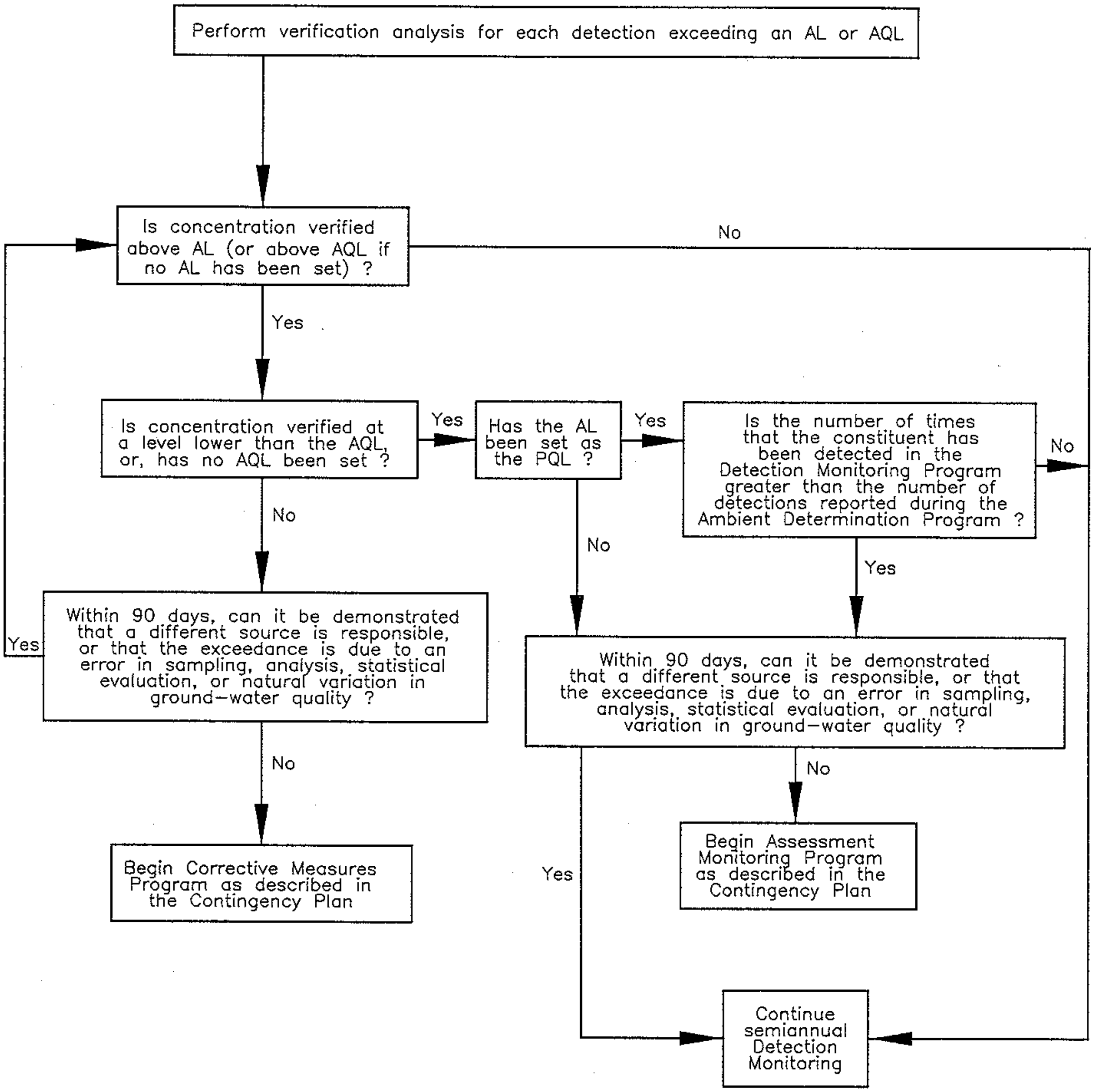
APPA

Figure 3-24

DAMES & MOORE

25551-002-022

A00973-09-02-93



AL = Alert Level

AQL = Aquifer Quality Limit

PQL = Practical Quantitation Limit

EVALUATION OF DETECTION MONITORING DATA

CAVE CREEK LANDFILL

APPA

Figure 3-25

DAMES & MOORE

25551-002-022

A00972-09-02-93

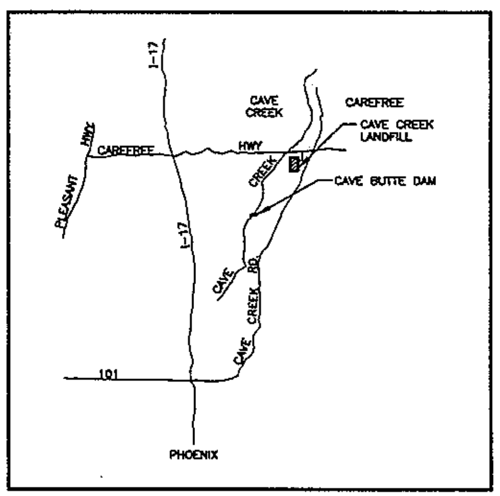
CAVE CREEK LANDFILL

PERMIT

DRAWINGS

MARICOPA COUNTY
ARIZONA

NOVEMBER 1993

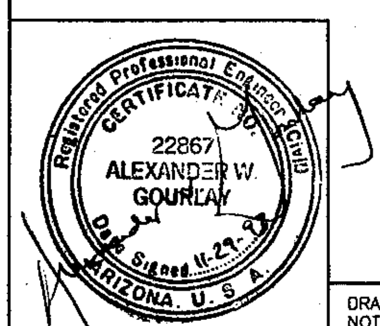


VICINITY MAP
N.T.S.

DRAWING NO.	DRAWING INDEX
1	TITLE SHEET
2	EXISTING SITE CONDITIONS
3	CLOSURE GRADING AND DRAINAGE PLAN
4	CLOSURE SITE PLAN
5	OFF-SITE DRAINAGE MAP
6	SECTIONS AND DETAILS
7	SECTIONS AND DETAILS
8	SECTIONS AND DETAILS

KEY

A / 3 | 8 — SECTION A
APPEARS ON SHEET 8 AND IS REFERENCED ON SHEET 3



DRAWINGS ARE FOR PERMITTING ONLY–
NOT FOR CONSTRUCTION USE

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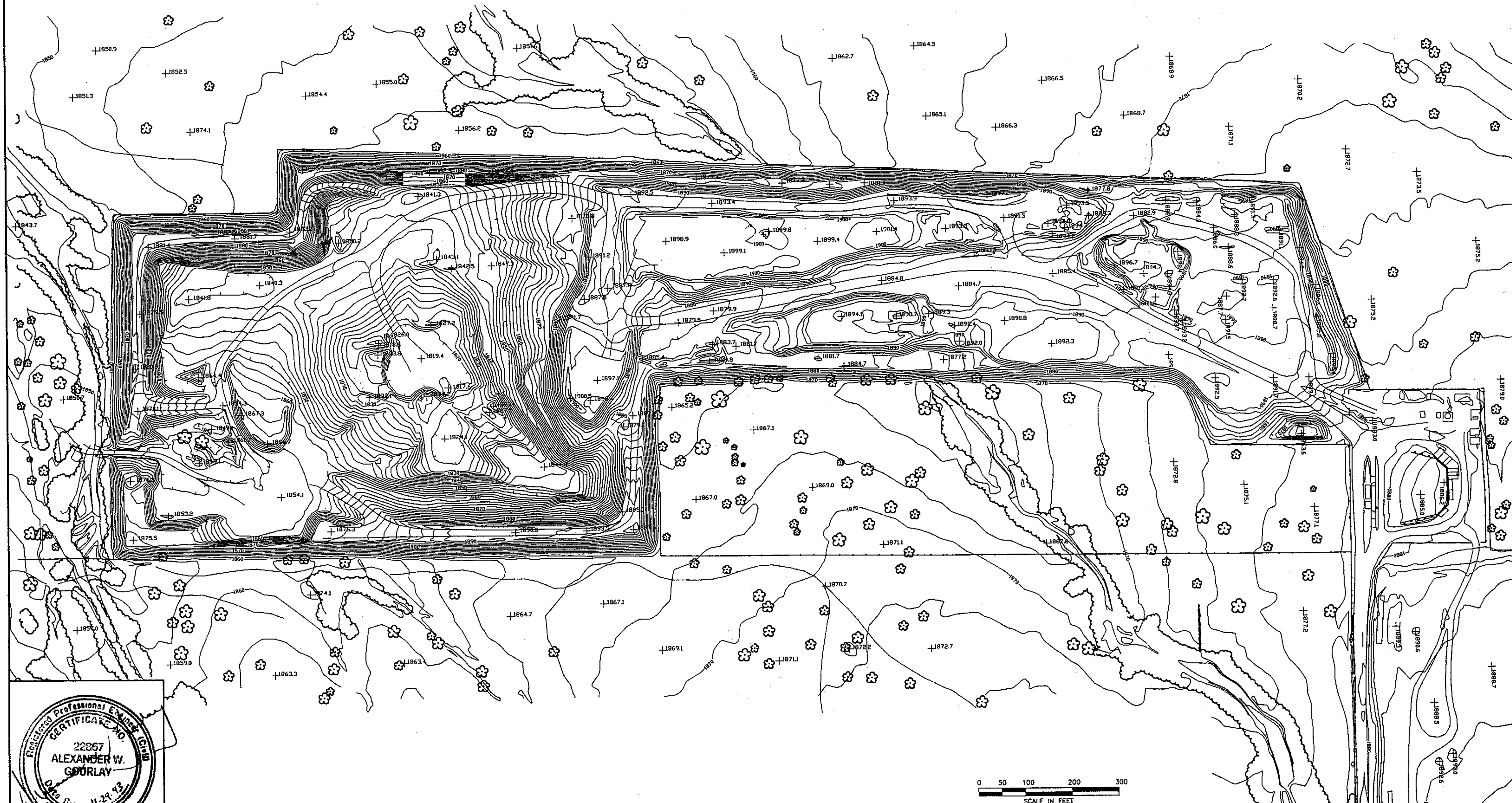
	△				△			
	△				△			
	△				△			
	△				△			

SCALE: AS SHOWN		DATE
DESIGNED BY:	BHC	9-21-93
DRAWN BY:	JBH	9-21-93
CHECKED BY:	AWG	9-21-93
APPROVED BY:	AWG	9-21-93
CLIENT APPROVAL BY:		

DAMES & MOORE

CAVE CREEK LANDFILL
TITLE SHEET
JOB NO. 25551-001-022
DRAWING NO. 1
REV. 0



DRAWINGS ARE FOR PERMITTING ONLY-NOT FOR CONSTRUCTION USE

REFERENCES
TITLE
1. BASE TOPOGRAPHY BY AERIAL MAPPING CO. PHOENIX, ARIZONA JULY 1993

REVISIONS			
NO.	BY	DATE	DESCRIPTION
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REVISIONS			
NO.	BY	DATE	DESCRIPTION
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CHECKED BY:	AWG	9-21-93
APPROVED BY:	AWG	9-21-93
CLIENT APPROVAL BY:		

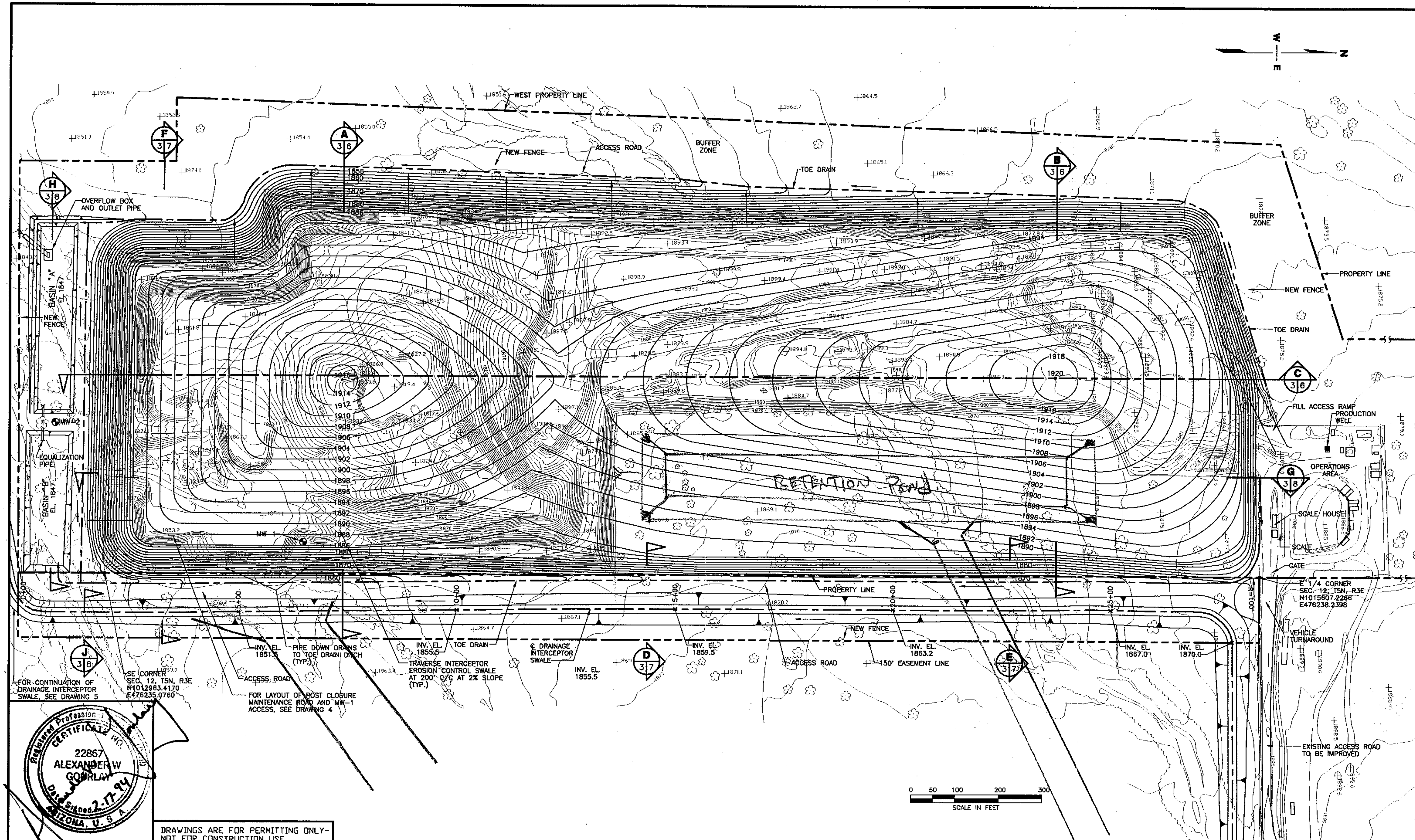
DAMES & MOORE

CAVE CREEK LANDFILL

EXISTING SITE CONDITIONS

JOB NO. 25551-001-022

DRAWING NO. 2 REV. 0



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REFERENCES TITLE
1. BASE TOPOGRAPHY BY AERIAL MAPPING CO. PHOENIX, ARIZONA JULY 1993

NO.	BY	DATE	REVISIONS DESCRIPTION
1	CJK	2-94	REVISED TO ADD FINAL COVER SLOPE

SCALE: AS SHOWN		DATE
DESIGNED BY:	BHC	9-21-93
DRAWN BY:	JBH	9-21-93
CHECKED BY:	AWG	9-21-93
APPROVED BY:	AWG	9-21-93
CLIENT APPROVAL BY:		

DAMES & MOORE

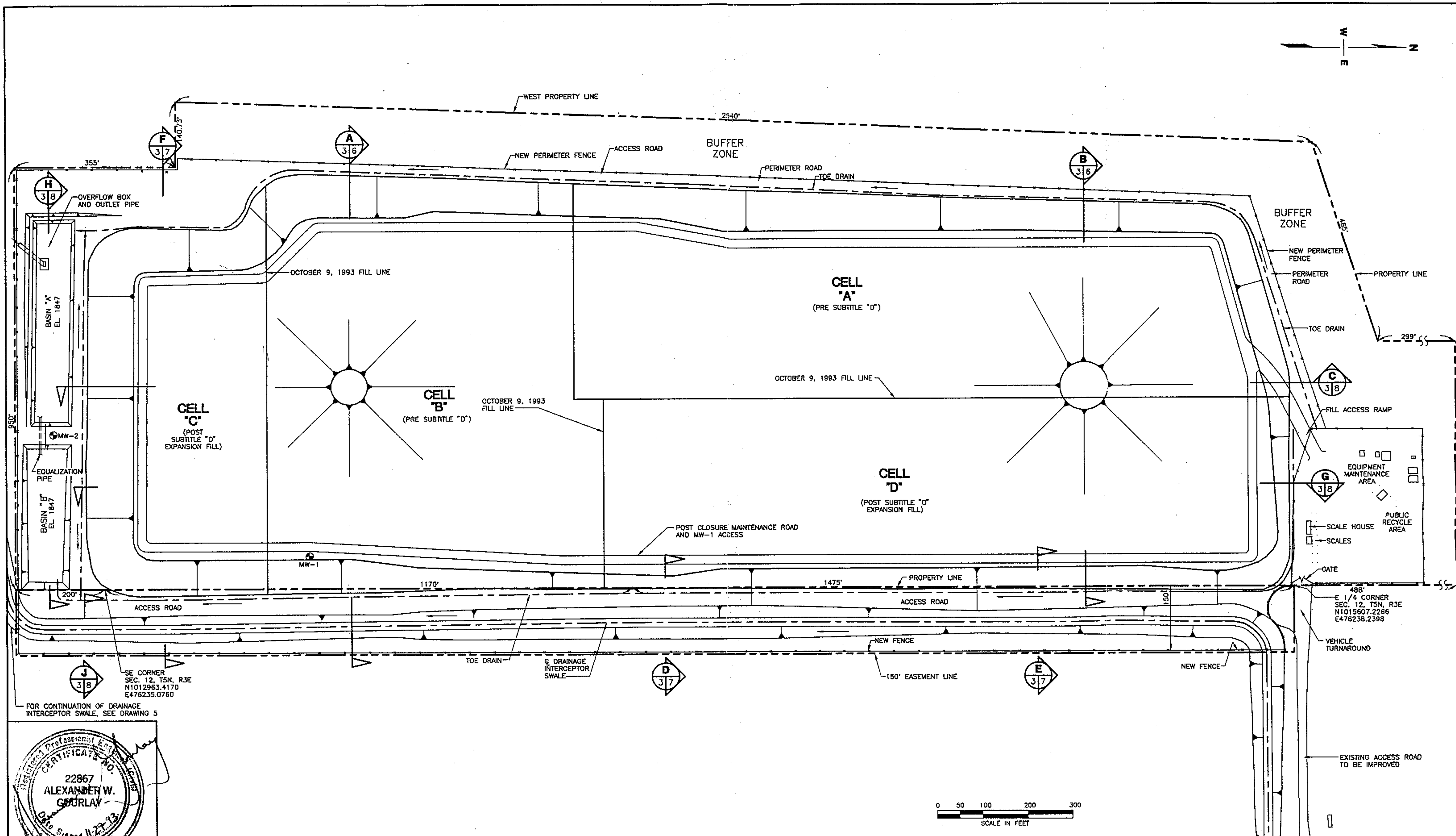
CAVE CREEK LANDFILL

CLOSURE GRADING AND DRAINAGE PLAN

JOB NO. 25551-001-022

DRAWING NO. 3 REV. 1

DWG-3



DRAWINGS ARE FOR PERMITTING ONLY-NOT FOR CONSTRUCTION USE

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DESIGNED BY:	BHC	9-21-93
DRAWN BY:	JBH	9-21-93
CHECKED BY:	AWG	9-21-93
APPROVED BY:	AWG	9-21-93
CLIENT APPROVAL BY:		

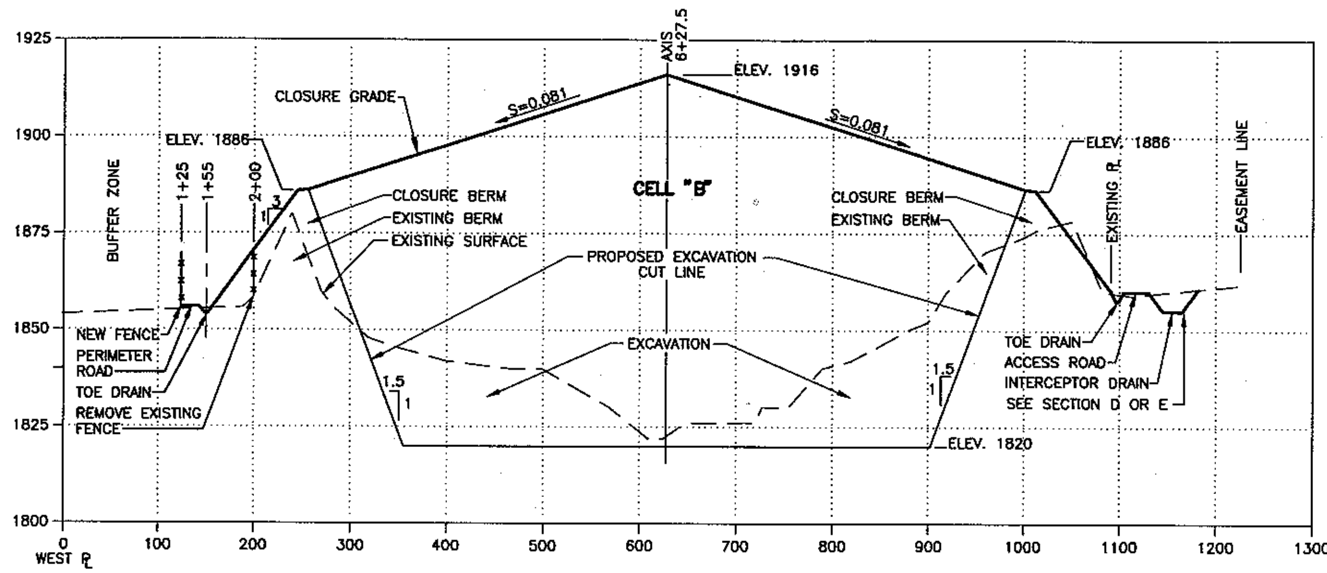
DAMES & MOORE

CAVE CREEK LANDFILL

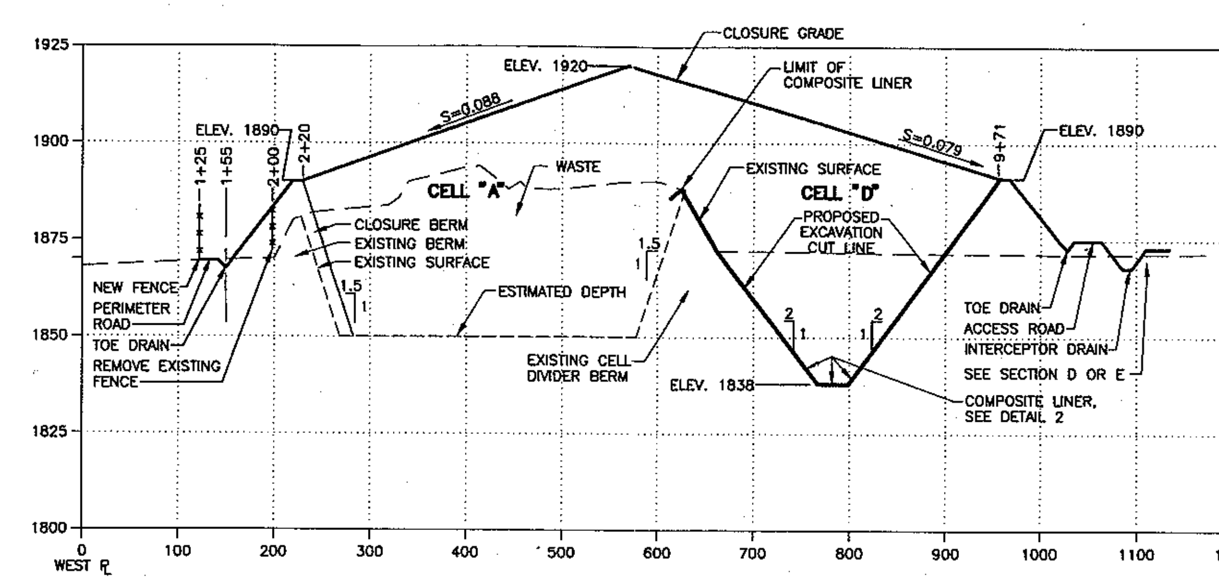
CLOSURE SITE PLAN

JOB NO. 25551-001-022

DRAWING NO. 4 REV. 0



SECTION A 3|6



SECTION B 3|6

HORIZONTAL SCALE

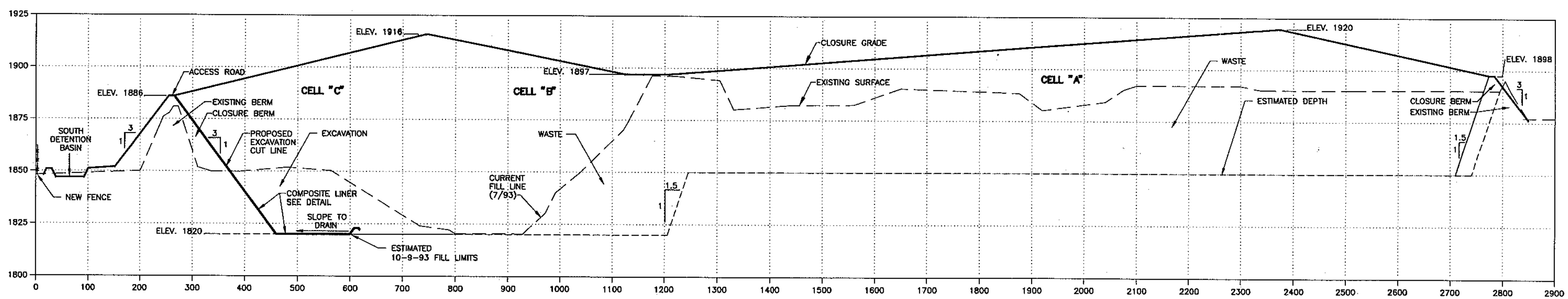
0 50 100 200 300

IN FEET

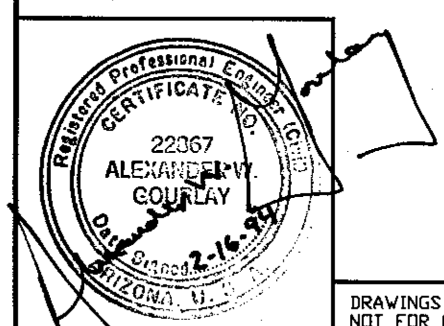
VERTICAL SCALE

0 12.5 25 50 75

IN FEET



SECTION C 3|6



DRAWINGS ARE FOR PERMITTING ONLY-
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REFERENCES	REVISIONS				REVISIONS			
TITLE	NO.	BY	DATE	DESCRIPTION	NO.	BY	DATE	DESCRIPTION
	△	CIK	2-94	CELL D EXCAVATION SLOPES; EXPANSION CELL LINER LOCATION; AND FINAL COVER SLOPE	△			
	△				△			
	△				△			
	△				△			
	△				△			

SCALE: AS SHOWN	DATE
DESIGNED BY: BHC	9-21-93
DRAWN BY: JBH	9-21-93
CHECKED BY: AWG	9-21-93
APPROVED BY: AWG	9-21-93
CLIENT APPROVAL BY:	

DAMES & MOORE

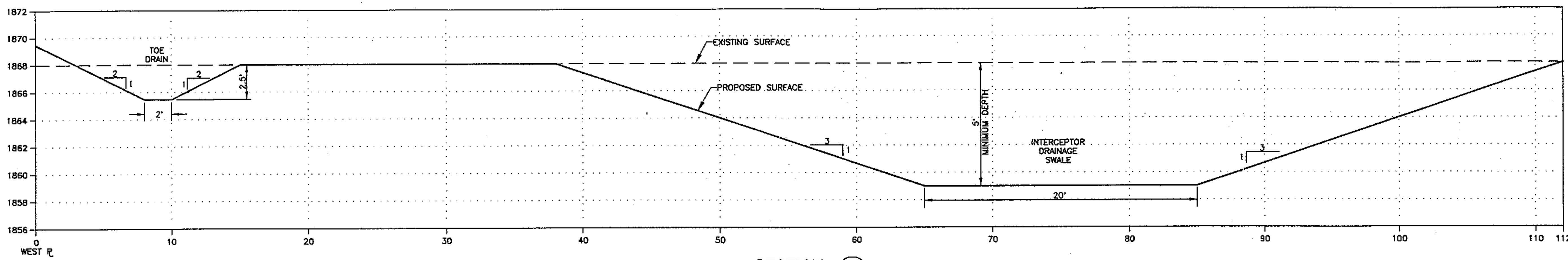
CAVE CREEK LANDFILL

SECTIONS AND DETAILS

JOB NO. 25551-001-022

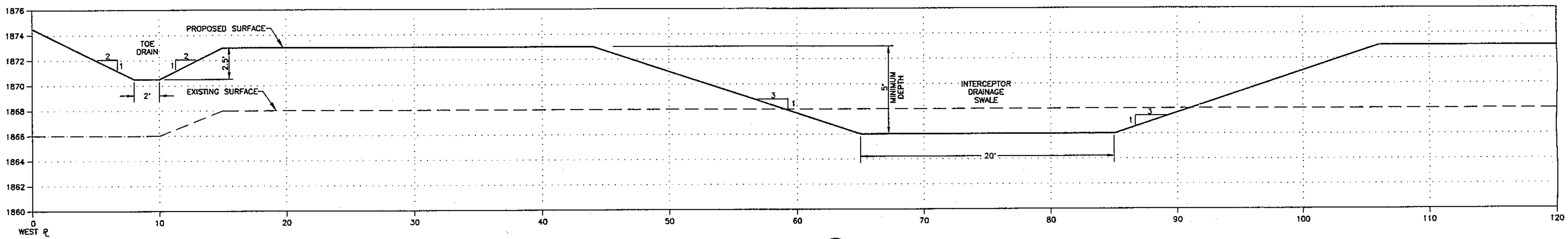
DRAWING NO. 6 REV. 1

DWG-6



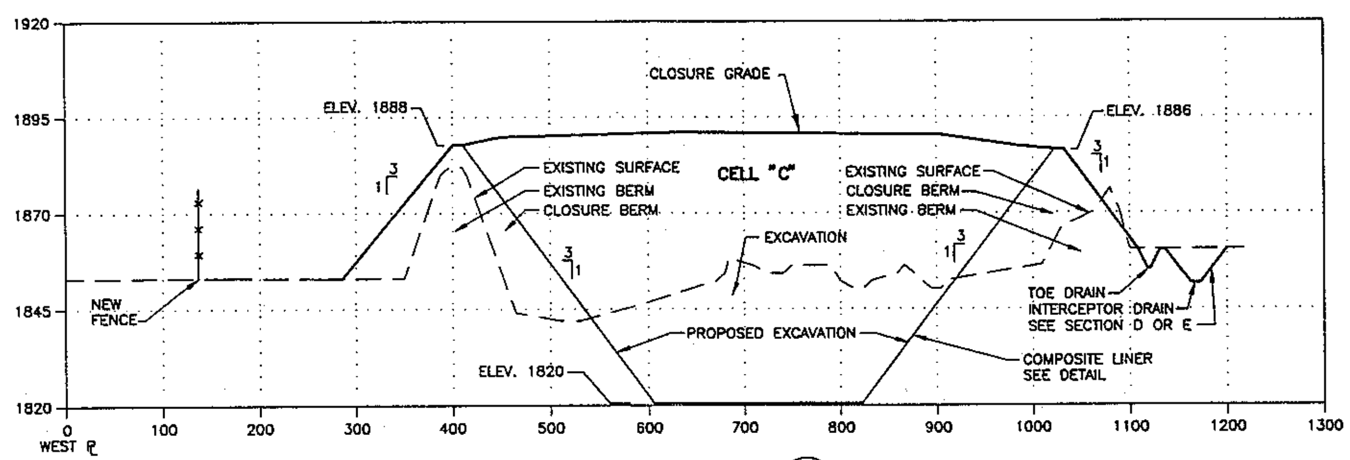
SECTION D 3|7

0 2 4 8 12
SCALE IN FEET



SECTION E 3|7

0 2 4 8 12
SCALE IN FEET



SECTION F 3|7

HORIZONTAL SCALE
0 50 100 200 300
IN FEET

VERTICAL SCALE
0 12.5 25 50 75
IN FEET

Registered Professional Engineer (Civil)
CERTIFICATE NO. 22857
ALEXANDER W. GOURLAY
ARIZONA, U.S.A.

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REFERENCES TITLE	REVISIONS NO.	BY	DATE	DESCRIPTION	REVISIONS NO.	BY	DATE	DESCRIPTION
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	△				△			
	△				△			
	△				△			
	△				△			

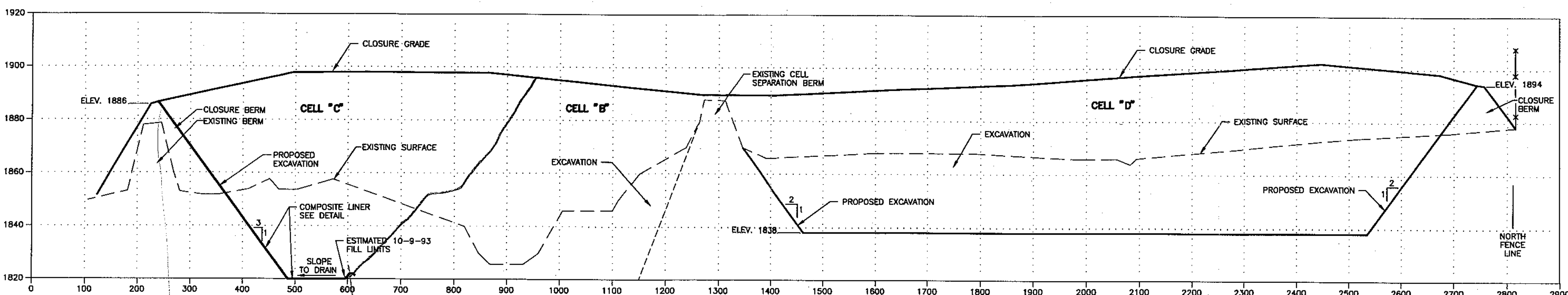
		DATE
SCALE:	AS SHOWN	
DESIGNED BY:	BHC	9-21-93
DRAWN BY:	JBH	9-21-93
CHECKED BY:	AWG	9-21-93
APPROVED BY:	AWG	9-21-93
CLIENT APPROVAL BY:		

DAMES & MOORE

CAVE CREEK LANDFILL

SECTIONS AND DETAILS

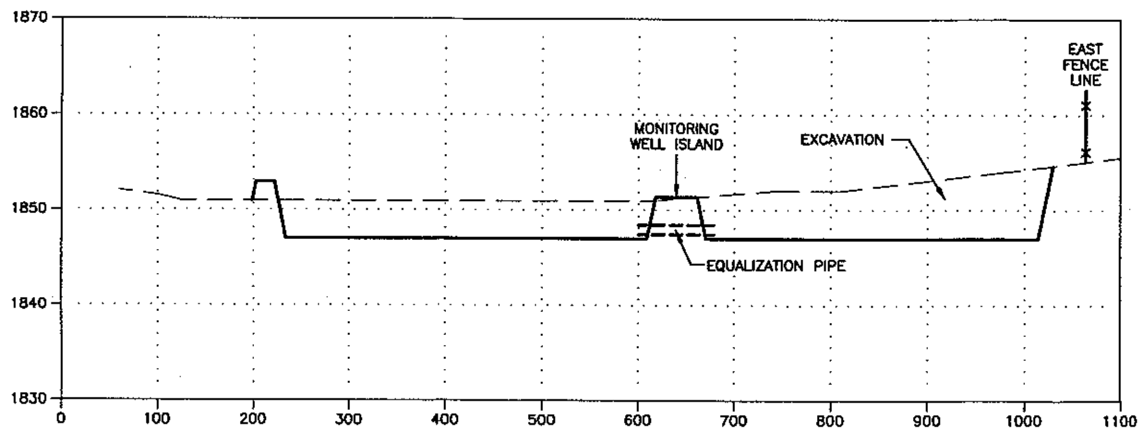
JOB NO. 25551-001-022
DRAWING NO. 7
REV. 0



SECTION G 3|8

HORIZONTAL SCALE 0 50 100 200 300 IN FEET

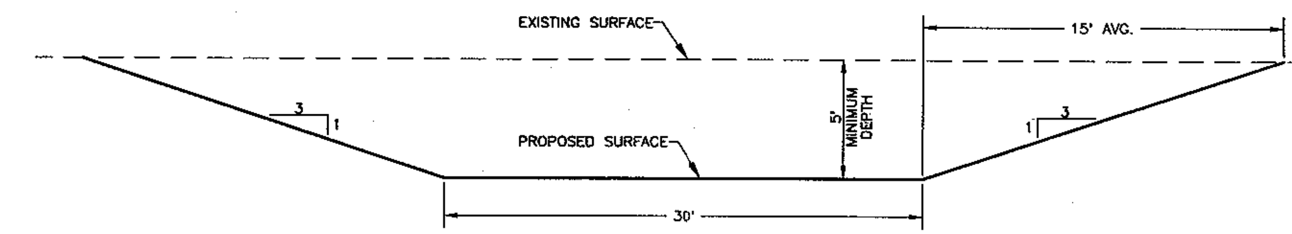
VERTICAL SCALE 0 10 20 40 60 IN FEET



SECTION H 3|8

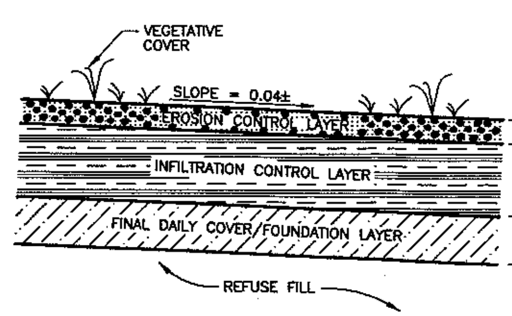
HORIZONTAL SCALE 0 50 100 200 300 IN FEET

VERTICAL SCALE 0 5 10 20 30 IN FEET



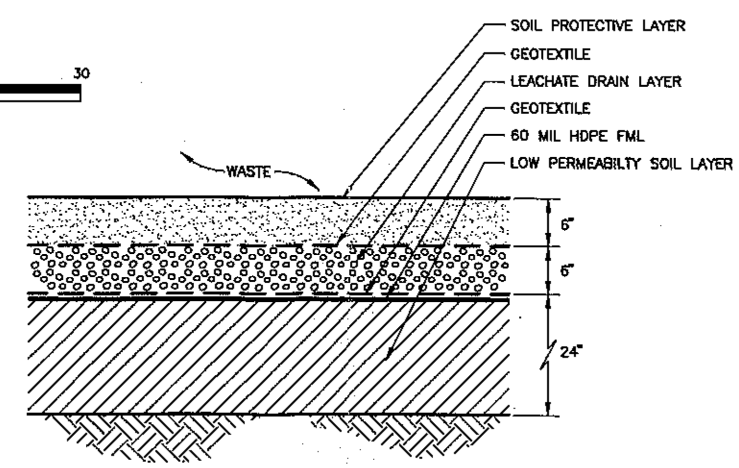
SECTION J 3|8

N.T.S.



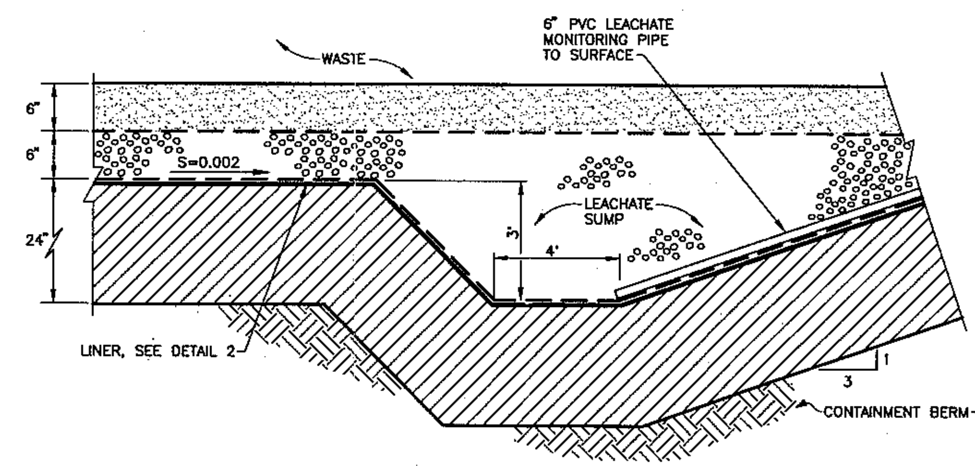
FINAL COVER DETAIL 1 -|8

NTS



BOTTOM LINER DETAIL 2 -|8

SCALE 0 0.5 1 2 3 IN FEET



NOTE: EXTRACTION PUMP AND PIPE NOT SHOWN

LEACHATE COLLECTION SUMP

SCALE 0 0.5 1 2 3 IN FEET

Registered Professional Engineer (Civil) CERTIFICATE NO. 22867 ALEXANDER W. GOURLAY Date Signed 2-16-94 ARIZONA, U.S.A.

DRAWINGS ARE FOR PERMITTING ONLY- NOT FOR CONSTRUCTION USE

REFERENCES TITLE

REVISIONS

NO.	BY	DATE	DESCRIPTION
△	CIK	2-94	CELL D EXCAVATION SLOPES; EXPANSION CELL LINER LOCATION; AND FINAL COVER SLOPE
△			
△			
△			
△			

REVISIONS

NO.	BY	DATE	DESCRIPTION
△			
△			
△			
△			
△			

SCALE: AS SHOWN		DATE
DESIGNED BY:	BHC	9-21-93
DRAWN BY:	JBH	9-21-93
CHECKED BY:	AWG	9-21-93
APPROVED BY:	AWG	9-21-93
CLIENT APPROVAL BY:		

DAMES & MOORE

CAVE CREEK LANDFILL

SECTIONS AND DETAILS

JOB NO. 25551-001-022

DRAWING NO. 8 REV. 1

DWG-8