Div of Waste Management
and Radiation Control

OCT 30 2019

IGES®

2702 South 1030 West, Suite 10
Salt Lake City, Utah 84119
Ph: 801.270.9400 Fax: 801.270.9401

TRANSMITTAL

DSHW-2019-014268

TO: Matt Sullivan / Allan Moore
State of Utah
Department of Environmental Quality
Division of Waste Management and Radiation Control
195 North 1950 West
Salt Lake City, Utah 84116

DATE: 10/30/19
IGES JOB #: 02260-002
SENT VIA: Hand Delivered

We are delivering to you the following:

Copies	Date	Description
1	10/30/19	2019 Bayview Landfill Repermit Application (digital – thumb drive)
		Appendix A through E
		Appendix F through J
		Appendix K through O
		Appendix P through W
		Appendix X
		Permit Checklist

☒ For approval
☐ For your use
☐ As requested
☐ For your review and comment

☐ Approved as submitted
☐ Approved as noted
☐ Returned for corrections
☐ Other ______________________

☐ Resubmit
☐ Submit
☐ Return

☐ Copies for approval
☐ Copies for distribution
☐ Corrected prints

Remarks:

Matt and Allan,

The 2019 Bayview Landfill Repermit Application is included in digital format on the attached thumb drive. Please let me know if you have questions regarding this repermit application.

Thanks,
Brett

SIGNED:

2019 BAYVIEW LANDFILL
CLASS I
PERMIT RENEWAL

Prepared for:

Northern Utah Environmental Resource Agency
(NUERA)

1997 East 3500 North
Layton, Utah 84040
Tel: (801) 614-5600

October 30, 2019

ANNOTATED TABLE OF CONTENTS

Part	Title
	Introduction Includes summary of substantial changes since the last permit renewal application
I.	**General Data** Includes State of Utah Solid Waste Permit Application form
II.	**General Report** Includes general facility information required by Utah Administrative Rule R315-301 through R315-310
III.	**Technical and Engineering Report** Includes operational and technical information required by Utah Administrative Rule R315-301 through R315-310

APPENDICES

INTRODUCTION

This document presents an application to renew a permit to operate solid waste disposal facilities at the Bayview Landfill, which is owned and operated by Northern Utah Environmental Resource Agency (NUERA). Bayview Landfill is currently operated under permit number 9420R2 issued by the Utah Waste Management and Radiation Control Board.

In the ten years that have passed since the current Bayview Landfill permit was issued, several major changes have taken place at the facility. The changes to the existing operation are as follows:

- *Facility Owner* – Northern Utah Environmental Resource Agency (NUERA) purchased the Bayview Landfill operation from Southern Utah Valley Solid Waste District in 2016.

- *Additional Waste* – The waste being delivered to Bayview has increased dramatically with the facility accepting waste from North Pointe Solid Waste Special Service District (NPSWSSD).

- *New Cell* – Cell 1.5 has been added to the configuration of the Bayview Landfill. Cell 1.5 is located between the previously closed Cell 1 and the west end of Cell 2.

- *Landfill Closure Topography* – The final cover topography has changed to reflect the additional of Cell 1.5.

- *Landfill Life* – The landfill life has changed due to the additional waste being delivered from NPSWSSD, the addition of Cell 1.5, and the change in final cover geometry.

The application has been organized to follow the general outline of R315-302 and R315-310. This organization results in some duplication and repetition of information, but it is intended to simplify the review and approval of the permit application.

Part I of this document duplicates the standard form outlining general data pertaining to the site.

Part II is a general report that includes a description of the facility, and Operations Plan.

Part III is the Technical Report and includes the following:

- Geohydrological Assessment.
- Engineering Report.
- Closure Plan
- Post-Closure Care Plan
- Financial Assurance Plan

APPLICATION TO RENEW A PERMIT TO OPERATE A CLASS I LANDFILL

Bayview Landfill

PART I - GENERAL DATA

Part I General Information APPLICANT: PLEASE COMPLETE ALL SECTIONS.

***I.* Landfill Type**	☒ Class I ☐ Class V	***II.* Application Type**	☐ New Application ☒ Renewal Application	☐ Facility Expansion ☐ Modification

For Renewal Applications, Facility Expansion Applications and Modifications Enter Current Permit Number 9420R2

III. Facility Name and Location

Name of Facility
Bayview Landfill

Site Address (street or directions to site) 10800 S. State Road 68				County Utah
City		Zip Code		Telephone
Township 9 South	Range 1 West	Section(s) 17 and 18	Quarter/Quarter Section	Quarter Section

Main Gate Latitude	Degrees	40	minutes	02	seconds	00	Longitude	degrees	111	minutes	57	seconds 30

IV. Facility Owner(s) Information

Name of Facility Owner
NUERA

Address (mailing)
1997 East 3500 North

City Layton	State UT	Zip Code 84040	Telephone 801 614-5600

V. Facility Operator(s) Information

Name of Facility Operator
NUERA

Address (mailing)
1997 East 3500 North

City Layton	State UT	Zip Code 84040	Telephone 801 614-5600

VI. Property Owner(s) Information

Name of Property Owner
Utah School and Institutional Trust Lands Administration

Address (mailing)
675 East 500 South, Suite 500

City Salt Lake City	State UT	Zip Code 84102-2818	Telephone 801 538-5100

VII. Contact Information

Owner Contact Name Mark Lamoreaux	Title Landfill Manager

Address (mailing)
1997 East 3500 North

City Layton	State UT	Zip Code 84102-2818	Telephone (801) 885-4233
Email Address		Alternative Telephone (cell or other)	

Operator Contact Name Mark Lamoreaux	Title Landfill Manager

Address (mailing)
1997 East 3500 North

City Layton	State UT	Zip Code 84102-2818	Telephone (801) 885-4233
Email Address		Alternative Telephone (cell or other)	

Property Owner Contact Name Dave Ure	Title Director

Address (mailing)
675 East 500 South, Suite 500 Salt Lake City UT 84102

Part I General Information (Continued)

VIII. Waste Types (check all that apply)

☒ All non-hazardous solid waste (see R315-315-7(3) for PCB special requirements) **OR** the following specific waste types:

Waste Type	Combined Disposal Unit	Monofill Unit
☐ Municipal Waste	☐	☐
☐ Construction & Demolition	☐	☐
☐ Industrial	☐	☐
☐ Incinerator Ash	☐	☐
☐ Animals	☐	☐
☐ Asbestos	☐	☐
☐ PCB's (R315-315-7(3) only)	☐	☐
☐ Other ________________	☐	☐

IX. Facility Area

Facility Area.. 660 acres

Disposal Area.. 67 acres

Design Capacity

Years.. 15

Cubic Yards.. 10,280,000

Tons.. 7,710,000

X. Fee and Application Documents

Indicate Documents Attached To This Application

☐ Application Fee: Amount $

☒ Facility Map or Maps
☒ Ground Water Report
☒ Facility Legal Description
☒ Closure Design
☒ Plan of Operation
☒ Cost Estimates
☒ Waste Description
☒ Financial Assurance

Class V Special Requirements

☐ Documents required by UCA 19-6-108(9) and (10)

I HEREBY CERTIFY THAT THIS INFORMATION AND ALL ATTACHED PAGES ARE CORRECT AND COMPLETE.

Signature of Authorized Owner Representative Rodger D Harper	Title OdM Chairman	Date 10/29/19
Name typed or printed Rodger D Harper	Address 2000 W 200 South, Lindon, UT 84042	
Email Address rodger.WP@gmail.com	Alternative Telephone (cell or other)	801-225-8538- x203
Signature of Authorized Land Owner Representative (if applicable)	Title	Date
Name typed or printed	Address	
Email Address	Alternative Telephone (cell or other)	
Signature of Authorized Operator Representative (if applicable)	Title	Date
Name typed or printed	Address	
Email Address	Alternative Telephone (cell or other)	

City	State	Zip Code	Telephone

APPLICATION TO RENEW A PERMIT TO
OPERATE A CLASS I LANDFILL

Bayview Landfill

PART II - GENERAL REPORT

The permit information has been updated from previous permits to reflect the change in landfill ownership to NUERA, modification to landfill life due to the additional waste stream from NPSWSSD, the addition of Cell 1.5 and the changes to the final cover contours due to the Cell 1.5 addition. Portions of the text and associated appendices that do not require modifications have been left as originally presented in previous permit applications. The previous 2009 permit renewal application by HDR is included as Appendix X.

TABLE OF CONTENTS: PART II – GENERAL REPORT

SECTION 1 – FACILITY DESCRIPTION

1.1 LOCATION

The Bayview Landfill site is located in the Goshen Valley approximately 2 to 3 miles west of Goshen Bay, the southwestern-most portion of Utah Lake. The Goshen Valley slopes upward away from the lake toward the East Tintic Mountains some 7 miles southwest of the lake. The landfill site similarly slopes with an approximate 150-foot rise from the eastern to the western boundaries of Section 17. The eastern boundary of the landfill site is approximately 120 feet above the water elevation of Utah Lake.

The Bayview Landfill is located in Sections 17 and 18, T9S, R1W approximately 6 miles north of Elberta, Utah, and directly west of State Highway 68. The landfill property includes all 640-acres of Section 17, and a 20-acre parcel in Section 18. All solid waste disposal activities are planned within the Section 17 parcel; the 20-acre Section 18 parcel houses a culinary well, a water storage tank, and an upgradient monitoring well associated with the landfill operations. Appendix A – Location Map & USGS Quad presents the location of Bayview Landfill and surrounding areas as well as location of the landfill presented on the most recent USGS Quad.

1.2 GENERAL BACKGROUND INFORMATION

The Bayview Landfill was located, permitted, designed, and constructed by Provo City Corporation during 1989. The City received a Conditional Use Permit for the landfill site through the Utah County Board of Adjustment.

The Southern Utah Valley Solid Waste District was formed in 1989 to own and operate solid waste facilities for the cities of Provo, Salem, Spanish Fork, Springville, Mapleton, and Goshen, Utah. It assumed the existing and previously permitted landfill operations from the City of Provo in 1990.

The 660 – acre Bayview Landfill started operations in Cell 1 in 1990 with Cell 1 being active from 1990 until it was fully capped in 2005. Cell 2 development started while Cell 1 was operational with Cell 2 beginning to accept waste in February 2005. Cell 2 is operationally broken into individual Stages moving generally from west to east. Cell 2 is the current operational area of the Bayview Landfill.

The District added a compost facility at the Bayview Landfill in 2004. The compost facility has processed a combination of yard waste and biosolids and is jointly permitted through the State of Utah Division of Waste Management and Radiation Control (DWMRC) and the Division of Water Quality. The compost operation is not operated continually, but on an as needed basis.

In 2016, Northern Utah Environmental Resource Agency (NUERA) purchased Bayview Landfill from the Southern Utah Valley Solid Waste District. NUERA members planning to utilize the Bayview Landfill include South Utah Valley Solid Waste District, North Pointe Solid Waste Special Service District, Trans-Jordan Cities, and Wasatch Integrated Waste Management District. In addition to a permit issued by the DWMRC, Bayview operates under a Utah County Conditional Use Permit (CUP). A copy of the most current CUP documents are included as Appendix B.

1.3 AREAS SERVED BY THE FACILITY

The current service area for the Bayview Landfill includes the cities of Provo, Salem, Spanish Fork, Springville, Mapleton, Goshen, and the communities in southern Utah County. Most of the waste in southern Utah County is transferred to Bayview Landfill via the Southern Utah County Solid Waste District's transfer station. Additionally, since the operations have changed to NUERA, waste from northern Utah County is being transferred through North Point Solid Waste Special Service District transfer station. Future waste is anticipated from Wasatch Integrated Waste Management District and Trans-Jordan Cities once construction of their transfer stations is complete. Waste is not accepted from direct haulers.

1.4 WASTE TYPES

The Bayview Landfill accepts wastes transfer stations in Springville (Southern Utah County Solid Waste District), Lindon (North Pointe Solid Waste Special Service District), and a city-owned transfer station in Goshen. The individual transfer stations provide record keeping, screening and processing of incoming wastes, and shipping of the solid wastes to the Bayview Landfill. The transfer stations accept residential and commercial solid wastes, including yard wastes, but generally do not accept construction debris (C&D) wastes. The transfer stations also do not accept regulated hazardous wastes. The waste screening operation is outlined in each of the transfer station's operating plans.

Yard wastes arriving at the transfer stations may either be segregated for composting or commingled and compacted with the residential and commercial wastes for processing and disposal. Transfer station personnel make these decisions based on whether the compost operation is active, the quantity and ease of separation of the yard wastes, and the workload at the specific moment in time.

The landfill will occasionally receive special waste (bulky waste and dead animals) directly at the landfill under special arrangements with the waste generator. Bulky waste is crushed and moved to the working face and is buried so that the potential for liner damage is avoided and so that large materials are not easily uncovered by operations at a later date. Dead animals are immediately covered with at least two (2) feet of material to minimize odors and to prevent the attraction from insects, rodents, and other animals. The wastes accepted at the transfer stations are, loaded into over-the-road vehicles, and transported to the landfill for disposal. When transfer station staff observe recyclable materials, and when there is time to easily and safely remove the recyclable materials, they will segregate these materials into on-site dumpsters for recycling.

Appendix C – Annual Report includes the most recent operational data for the Bayview Landfill. The Annual Report presents a summary of the types and volumes of wastes processed at the Bayview Landfill. Daily tonnage is approximately 1,000 tons per day.

1.5 LANDFILL EQUIPMENT

All equipment operating at the landfill is owned and operated by Bayview Landfill. The following equipment is available for use at the landfill:

- Caterpillar D8T
- Caterpillar 836 Compactor
- Caterpillar 636 Scrappers
- John Deere Loader

- John Deere Grader
- Kenworth Water Truck
- Off-Road Water Wagon

Any other equipment necessary for the operations of the landfill are rented as necessary. During periods of major overhaul or extended breakdown, replacement equipment is rented locally.

1.6 LANDFILL PERSONNEL

Currently, daily operations at Bayview landfill is accomplished with approximately 10 people (1 manager, 8 operators, and 1 attendant). The following describes the responsibilities for the on-site personnel at the landfill:

Landfill Manager (Manager) – The Manager is responsible for all day-to-day landfill activities. Daily responsibilities include road maintenance, general site access and site safety. The Manager is also responsible for all persons working or visiting the landfill. Additional responsibilities include the maintenance and oversight of the groundwater monitoring, and daily, intermediate, and final cover. The Manager is responsible for the landfill meeting all DWMRC permit requirements. The Manager conducts regular facility inspections and monitors all landfill activities. The Manager is responsible for all operational documentation including the preparation of the annual reports to DWMRC.

The Landfill Manager reports to the NUERA Operations and Maintenance (O&M) committee and ultimately to the NUERA Board of Directors.

Equipment Operators (Operators) – The Operators are responsible for all day-to-day activities at the landfill. These responsibilities include; waste acceptance, waste placement, traffic control, safe operation and maintenance of all equipment, visual inspection of incoming waste, waste screening operations and general construction as it pertains to landfill operations.

Landfill Attendants (Attendants) – The Attendants are responsible for the secondary screening of all incoming waste. The Attendants track all incoming waste and updates landfill records as required. The Attendants are also responsible for all transactions at the scale house and assist the Manager in the preparation of the annual landfill reports.

SECTION 2 - LEGAL DESCRIPTION AND PROOF OF OWNERSHIP

All properties used for the disposal of waste and supporting functions are owned by Trust Lands Administration, State of Utah School and Institutional Trust Lands Administration (SITLA).

2.1 LEGAL DESCRIPTION

The Bayview Landfill operation is conducted on the following parcels of land:

Parcel “A” – SW ¼ NW ¼ Section 17, T9S R1W
Parcel “B” – That portion of Section 17, T9S, R1W not described in Parcel “A”
Parcel “C” – S ½ of the SE ¼ of the NE ¼ Section 18 T9S, R1W

The use of this land was conveyed by the Utah Trust Lands Administration to the Provo City Corporation for a term of 51-years under Special Use Lease Agreement No. 498. Appendix D – Lease Agreements presents lease agreements. The term of this lease agreement extends through the year 2035 and has a clause for extension of the lease beyond the 51-year period.

SECTION 3 – OPERATIONS PLAN

This Operations Plan has been written to address the requirements of UAC R315-302-2 and briefly describes the operations of the Bayview Landfill. The purpose of the Plan of Operation is to provide the Manager and operating personnel with standard procedures for day-to-day operation of the landfill.

The primary function of the Bayview Landfill is currently to provide for the responsible disposal of MSW wastes generated by the citizens of Utah County. Future landfill operations will accommodate MSW wastes from other NUERA member entities participating in the Bayview Landfill project. The landfill is operated in accordance with the UAC R315-301 through 320.

3.1 SCHEDULE OF CONSTRUCTION

Landfill Cell 1 - Stage 1, the first landfill half-cell, was excavated in 1988. The soils excavated from this half-cell were used to construct portions of the screening berms on the eastern and northern boundaries of the site. The geomembrane lining system for this half- cell was installed during the fall of 1989. Essentially, the construction consisted of: excavating the native soils, compacting the exposed soils to 95% of optimum density (Standard Proctor), installing a geotextile to cushion the overlying geomembrane from underlying soils, installing a 40-mil HDPE geomembrane liner, installing a geotextile to absorb side slope tensile stresses and to transmit leachate, and placing the protective soil cover. Provo City Corporation and design personnel (HDR Engineering, Inc.) provided construction quality assurance observation during the installation of the geosynthetics and during the placement of protective cover soils. Stage 2 of Cell 1 was similarly constructed except that a 60-mil geomembrane was used.

Cell 2 Stage 1 was constructed in early 2004 and provided approximately 5 years of operational life. Cell 2 Stage 2 has been operational since approximately 2009 and is currently serving as the operational area of the landfill.

Currently operations at the Bayview Landfill are associated with Cell #2 Stage 2. All landfill operations consist of the importing, compacting, and covering of wastes with soil. Operations will be modified to accommodate the construction of a new lined landfill cell located between closed Cell 1 and the previously filled Cell 2 operations, the new cell will be identified as Cell 1.5. Appendix E – General Arrangement shows the locations of the landfill cells with regard to surrounding site features.

Cell 1.5 will be filled once construction is complete in the summer of 2020. Once Cell 1.5 starts operation, Cell 2 Stage 3 will be prepared for liner construction in 2022 with Cell 2 Stage 4 slated for liner construction in 2025 or 2026 depending on waste processed at the landfill.

Soil is utilized as the primary cover material on the working faces. Soil excavated in preparation for future cells is utilized as daily and intermediate cover soils.

3.2 WASTE STREAM MANAGEMENT - DESCRIPTION OF HANDLING PROCEDURES

3.2.1 Waste Acceptance

A waste control program designed to detect and deter attempts to dispose of hazardous and other unacceptable wastes will continue to be implemented at the Bayview Landfill in conjunction with the screening operation of the associated transfer stations. The program is designed to protect the health and safety of employees, customers, and the general public, as well as to protect against the contamination of the environment. The landfill is not open for private hauler or citizen self-hauled wastes.

The following procedures are practiced at the Bayview Landfill to deter disposal of hazardous and unacceptable waste. All waste entering are pre-screened for unacceptable materials by transfer station personnel prior to transfer of wastes. The operations at the individual transfer stations are not described in this Operations Plan.

3.2.2 Waste Disposal

Transfer trailers entering the site will be directed by landfill operations personnel to the working face, where the driver will be instructed to discharge the load. Landfill equipment operators will push the solid waste up the working face using a compactor. The waste will be placed in lifts with a loose thickness of 2 - 3 feet. After the waste has been placed in loose lifts, the operator will run the compactor over all portions of the lift at least two times parallel with the slope (up slope), and at least one time across the slope. There may be times in operating the landfill when pushing uphill may be impractical or poor practice (i.e., when the first lift of waste is placed on protective cover soil.) Equipment operators will also maintain the working face so that it is as small as practical to allow for efficient unloading of transfer trucks, placement and compaction of solid wastes, and minimize the use of cover soils.

3.2.3 Placement of Cover Soils

Cover soils or other approved material will be placed over solid wastes to minimize the potential for nuisance conditions, fire, and disease vector contact with solid wastes. Nuisance conditions include odor generation and air discharges; blowing of plastic and paper wastes; and other conditions that impair the use of adjoining properties.

At the end of each working day, the landfill operators will cover all solid wastes received during that day with daily cover. The daily cover will consist of a minimum of 6 inches of soil excavated from other portions of the landfill site. Daily cover will be placed to minimize the nuisance, fire, and disease vector potential attributable to each day's waste placement.

Whenever a portion of the landfill cell will remain in an inactive condition for an extended period, landfill operators will place an intermediate cover over the inactive portion. The intermediate cover will reduce the potential for wind and water-induced erosion of the cover and reduce the production of leachate and contact stormwater within the landfill cell. The intermediate cover will consist of an additional 6-inches ofsoil.

3.2.4 Special Wastes

3.2.4.1 Used Oil and Batteries

Used oil and batteries will not be accepted at the Bayview Landfill.

3.2.4.2 Bulky Wastes

White goods are not accepted at the Bayview Landfill. Some white goods may be included in wastes transferred through the associated transfer stations.

3.2.4.3 Tires

Tires are not accepted at Bayview Landfill. Some tires may be included in wastes transferred through the associated transfer stations.

3.2.4.4 Dead Animals

Dead animals are accepted at the Bayview Landfill when included in wastes from associated transfer stations.

3.2.4.5 Asbestos Waste

Asbestos wastes are not accepted at Bayview Landfill.

3.2.4.6 Grease Pit and Animal Waste By-Products

Grease pit and animal wastes are not accepted at Bayview Landfill.

3.3 WASTE INSPECTION

3.3.1 Landfill Spotting

Landfill spotting is not utilized at Bayview since the waste has been screened at the transfer stations and Bayview is a commercial operation.

3.3.2 Random Waste Screening

In addition to the random screenings performed at the transfer stations, random inspections of incoming loads are conducted at the landfill according to the schedule established by the landfill management. If frequent violations are detected, additional random checks are scheduled at the discretion of the landfill management.

If a suspicious or unknown waste is encountered, the operator proceeds with the waste screening as follows:

- The driver of the vehicle containing the suspect material is directed to the waste screening area
- The waste screening form is completed
- Protective gear is worn (leather gloves, steel-toed boots, goggles, coveralls, and hard hat)
- The suspect material is spread out with the loader or hand tools and visually examined
- Suspicious marking or materials, like the ones listed below, are investigated further:
  - Containers labeled hazardous
  - Material with unusual amounts of moisture
  - Biomedical (red bag) waste
  - Unidentified powders, smoke, or vapors
  - Liquids, sludges, pastes, or slurries
  - Asbestos or asbestos contaminated materials
  - Batteries
  - Other wastes not accepted by the landfill

The landfill management is called if unstable wastes that cannot be handled safely or radioactive wastes are discovered or suspected. Specific attention will be paid to minimize the disposal of liquids by screening for liquid containers larger than household size, sludge containing free liquids, or any waste containing free liquids. The forms utilized by landfill personnel to record waste screening activities are included in Appendix F.

3.3.3 Removal of Hazardous or Prohibited Waste

Should hazardous or prohibited wastes be discovered during random waste screening or during tipping, the waste is removed from the landfill as follows:

The transfer station where the waste originated will be notified of the prohibited waste and be asked to perform additional waste screening to minimize the likelihood of a repeat event. The landfill management will arrange to have the waste transported to the proper disposal site and then work with the transfer station to determine the responsibility for associated disposal costs. The landfill management will also contact the State of Utah DWMRC about the incident.

A record of the removal of all hazardous or prohibited wastes is kept in the site operational records.

3.3.4 Hazardous or Prohibited Waste Discovered After the Fact

If Hazardous or prohibited wastes are discovered in the landfill, the following procedure is used to remove them:

- Access to the area is restricted
- The landfill management is immediately notified
- The operator will remove the waste from the working face if it is safe to do so
- The waste is isolated in a secure area of the landfill and the area cordoned off
- The Utah County Fire Department is notified
- The Utah County Health Department is also notified

The DWMRC, the transfer station, and the generator (if known) are notified within 24-hours of the discovery. The generator (if known) is responsible for the proper cleanup, transportation, and disposal of the waste.

3.3.5 Notification Procedures

The following agencies and people are contacted if any hazardous materials are discovered at the landfill:

Mark Lamoreaux, Landfill Manager	(801) 885-4233
Utah County Health Department	(801) 851-7095
Director, DWMRC	(801) 536-0200
Utah County Fire Department	(801) 851-4141

3.4 FACILITY MONITORING AND INSPECTION

3.4.1 Groundwater

The Bayview Landfill has a DWMRC approved groundwater monitoring plan and will continue to follow the plan. This plan includes sampling and analysis plans for the monitoring of groundwater at the landfill. Appendix G includes a copy of the Groundwater Monitoring Report which details the groundwater sampling and analysis procedures.

3.4.2 Surface Water

Surface water management structure have been previously designed, installed and are currently operating as designed. Calculations of the anticipated run-on and run-off volumes are shown in Appendix H. Run-off from the final cover will be managed by a combination of berms and ditches. The berms will be placed to divert the water around the active area to culverts and a settling pond. Landfill staff will inspect the drainage system monthly. Temporary repairs will be made to any observed deficiencies until permanent repairs can be scheduled. Bayview staff or a licensed general contractor will repair drainage facilities as required.

The Bayview Landfill has an approved Multi-Sector General Permit for Storm Water Discharges Associated with Industrial Activity, Coverage No. UTR000000. A copy of the Storm Water Pollution Prevention Plan is included in Appendix I.

3.4.3 Leachate Collection

The Bayview Landfill has a leachate collection and management system that has been designed, largely constructed and is currently in service. The leachate generation calculations are presented in Appendix J – Leachate Generation Calculations. Appendix K – Engineering Drawings presents the details of the previously designed and constructed leachate system. Appendix K also presents additional details of the liner system and general engineering features previously designed and constructed at the Bayview Landfill.

3.4.4 Landfill Gas

Bayview staff began a landfill gas monitoring program by conducting an initial surface survey for combustible gases, and by purchasing a combustible gas indicator (CGI). During the initial survey, no measurable combustible gases were detected on the site, and landfill gas monitoring stations were established for future monitoring events.

The Bayview staff will continue to conduct combustible gas monitoring at the established stations on a quarterly basis. Landfill staff will coordinate the gas monitoring events with groundwater monitoring events and will arrange for interpretation of the monitoring results if combustible gases are detected at any station.

If methane releases are detected in excess of 25 percent of the LEL, in the landfill building or more than 100 percent of LEL at the property boundary, the procedure outlined in the "Explosive Gases" section is followed.

The Bayview Landfill has a Title V Operating Permit issued from the Division of Air Quality. A copy of the most current Annual Title V Compliance Reports is included in Appendix L – Annual Title V Compliance Reports.

3.4.5 General Inspections and Quarterly Inspection

Routine inspections are necessary to prevent system malfunctions, facility deterioration, operator errors, and discharges that may cause or lead to release of wastes to the environment or a threat to human health. Operators are responsible for conducting and recording routine inspections of the landfill facilities according to the following schedule:

Operators perform pre-operational inspections of all equipment daily. A post-operational inspection is performed at the end of each shift while equipment is cooling down.

All equipment is on a regular maintenance schedule. A logbook is maintained on each piece of equipment and any repairs and comments concerning the inspection are contained in the log. Oil samples are pulled when each machine is serviced, and results are recorded in the machine log.

Facility inspections are completed on a quarterly basis. Any needed corrective action items are recorded, and the Operators complete needed repairs. If a problem is of an urgent nature, the problem is corrected immediately.

Scale maintenance is performed annually at a minimum. If specific problems arise before scheduled maintenance, scale maintenance is done as required. The scale is certified on an annual basis.

The quarterly inspection is performed by a team of qualified landfill employees and is intended to asses the condition of the following area of the landfill. This include dust control activities, cover condition, waste control, perimeter fence, run-off/ run-on system, roads, buildings, groundwater monitoring wells, compost area, tipping face, and general site conditions. The forms utilized by landfill personnel to record general and quarterly inspection activities are included in Appendix F.

3.5 CONTIGENCY AND CORRECTIVE ACTION PLANS

The following sections outline procedures to be followed in case of fire, explosion, groundwater contamination, release of explosive gases, or failure of the storm water management system.

The Utah County Fire Department is contacted in all cases where hazardous materials or materials contaminated with PCB's are suspected to be involved.

3.5.1 Fire

The potential for fire is a concern in all landfills. The likelihood of a fire is lower at the Bayview Landfill since nearly all of the waste is transferred through transfer stations. Bayview Landfill staff follows a waste handling procedure to minimize the potential for a landfill fire. If any load comes to the landfill on fire, the driver of the vehicle is directed to an area away from the working face. The burning waste is unloaded, spread out, and immediately covered with sufficient amounts of soil to smother the fire. Once the burning waste cools and is deemed safe, the material is then incorporated into the working face. Some loads coming to the landfill may be on fire but not detected until after being unloaded at the working face. If a load of waste that is on fire is unloaded at the working face, the load of waste is immediately removed from the working face, spread out, and covered with soil.

The Utah County Fire Department is called if it appears that landfill personnel and equipment cannot contain any fire at the landfill. The Utah County Fire Department is also called if a fire is burning below the landfill surface or is difficult to reach or isolate.

In case of fire, the Manager and DWMRC Director are notified immediately. A written report detailing the event is placed in the operating record within seven days, including any corrective action taken.

3.5.2 Loaded Vehicle Fires

In the event that a transport vehicle enters the landfill site carrying a burning or smoldering load of waste, landfill operations personnel will take the following actions:

- Direct the vehicle to a designated section of the landfill away from the working face.
- Direct the driver to deposit his load and to clear the area as quickly as possible.
- Access to the area is restricted
- The landfill management is immediately notified
- Immediately cover the burning waste with sufficient soil to completely smother the fire. Allow the waste to cool for several days, or longer if necessary.
- If necessary, spray equipment and the transfer vehicle with water to cool the equipment while working the fire. This will not be necessary if the equipment is pushing or dumping soil on the burning wastes in front of the advancing equipment.
- If landfill operations personnel cannot control the fire, the Utah County Fire Department will be contacted.
- Notify the UDEQ immediately and provide written documentation within 14 days of the fire.

3.5.3 Working Face/Below Cover Fire

In the event of a working face fire or a fire below cover, landfill operations personnel will take the following actions:

- Evacuate all non-essential personnel from the area of the fire. Non-essential personnel would include transfer truck drivers, attendants, and visitors.
- Isolate the burning material from other wastes to the extent possible. Use compactor blades and dozers to move the burning materials away from other wastes; this may not be possible if the fire is below cover soil.

- Immediately cover the burning waste with sufficient soil to completely smother the fire. Allow the waste to cool for several days, or longer if necessary.
- If landfill operations personnel cannot control the fire, the Utah County Fire Department will be contacted.
- Notify the UDEQ immediately and provide written documentation within 14 days of the fire.

3.5.4 Release of Explosive Gases

Methane gas generation and concentration is not anticipated to be a problem at the Bayview Landfill. However, due to the production of methane in all landfills, landfill gas levels are monitored quarterly. If a concentration of methane is detected in excess of 25 percent of LEL in a landfill building, 100 percent LEL at the property boundary, or over 100 parts per million in an off-site building, the following procedure is followed:

- Landfill operations cease immediately. The landfill is evacuated if personnel or buildings may be threatened
- If gas is detected in a building, the doors and windows are opened to allow the gas to escape
- If off-site buildings or structures appear to be threatened, the Utah County Fire Department is called, the property evacuated, and the property owners notified
- The Manager is called. The release is monitored, and a temporary corrective action implemented as soon as possible. Permanent corrective action is completed as soon as practicable

The DWMRC is notified immediately and a written report submitted within 14 days of detecting the release. The gas levels detected, and a description of the steps taken to protect human health are placed in the operating record within seven days of detection. A remediation plan for the methane gas release will be placed in the operating record within 60 days of detection and the Executive Secretary is notified that the plan has been implemented.

3.5.5 Explosion

In the event that an explosion should occur at the landfill or in any structure associated with the landfill, landfill operations personnel will take the following actions:

- Immediately evacuate the area surrounding the explosion, including any adjacent buildings. Shut down and abandon any equipment near the explosion that is hot and may provide an ignition source for additional explosions.
- Account for all personnel. Contact the Utah County Fire Department and the emergency dispatcher (911). Contact the Landfill Manager.
- Restrict the explosion area to any entry until emergency response personnel clear the area.
- Notify the DWMRC immediately and provide written documentation within 14 days of the explosion.

If the explosion is the result of methane gas, the gas levels detected, and a description of the steps taken to protect human health is placed in the operating record within seven days of detection. A remediation plan for the methane gas release will be placed in the operating record within 60 days of detection and the Executive Secretary is notified that the plan has been implemented.

3.5.6 Failure of Run-On/Run-Off Containment

The purpose of the run-on/run-off control systems is to manage the stormwater falling in or near the landfill. Water is diverted away from the landfill using a series of ditches, berms, and roads. These structures are inspected on a regular basis and repaired as needed. All stormwaters falling or flowing near the active landfill cell are prevented from flowing into the active area by diversion berms and ditches.

If the run-on system fails, temporary measures such as temporary berms, ditches, or other methods are used to divert water from the active landfill cell.

If a run-off ditch or berm fails, temporary berms or ditches will be constructed until a permanent run-off structure can be constructed.

Any temporary berms or other structures will be checked at least every 2 hours during working hours of the landfill. Permanent improvements or repairs will be made as soon as practicable.

The Manager is notified immediately if a failure of either of the run-on or run-off systems is discovered. The event will be fully documented in the operating record, including corrective action within 14 days.

3.5.7 Groundwater Contamination

If groundwater contamination is ever suspected, studies to confirm contamination will be conducted and the extent of contamination documented. This program may include the installation of additional groundwater monitoring wells. The groundwater monitoring program may be updated, and corrective action taken as deemed necessary, with the approval of the Executive Secretary.

3.6 CONTINGENCY PLAN FOR ALTERNATIVE WASTE HANDLING

Landfill operations have been adapted for wet weather by constructing an all-weather, asphalt-paved roadway from the site entrance to the active cell. The site soils, including those used as daily cover, consist primarily of sands and gravels. In the semi-arid climate of the Bayview Landfill site, experience has shown that precipitation has little effect on the operations of the landfill, especially given the nature of the cover soils. The Bayview management team does not believe that alternate waste handling plans are necessary for this site with respect to wet weather operations.

All reasonable caution and prudence will be exercised to not dispose of wastes during any unreasonable weather conditions. If unforeseen weather conditions occur, the manager, or his designee, will be informed and will coordinate any changes in operations. The manager will consider the system-wide requirements (including transfer station requirements) in determining what changes, if any, need to be made in operations at the landfill to accommodate any disruption in waste handling procedures.

In the event of a landfill tipper malfunction, wastes will be diverted to other area landfills that utilize tippers in their operation until the malfunctioning tipper can be repaired or replaced.

3.7 MAINTENANCE PLAN

3.7.1 Groundwater Monitoring Wells and Leachate System

The landfill personnel will conduct quarterly inspection which includes the assessment of the groundwater monitoring wells and the groundwater/leachate collection system.

3.7.2 Gas Monitoring System

Gas monitoring locations will be maintained on a routine basis. Weeds will be removed from the vicinity of each monitoring location at least every 3 months, approximately 2 weeks prior to each scheduled sampling event.

3.8 DISEASE AND VECTOR CONTROL

The vectors encountered at the Bayview Landfill are flies, birds, mosquitoes, rodents, skunks, and snakes. The program for controlling these vectors is as follows:

3.8.1 Insects

Eliminating breeding areas is essential in the control of insects. Bayview Landfill minimizes the breeding areas by covering the waste daily and maintaining surfaces to reduce ponded water.

3.8.2 Rodents

Reducing potential food sources minimizes rodent populations at the landfill. The potential food sources are minimized by properly applying daily cover.

In the event of a significant increase in the number of rodents at the landfill, a professional exterminator will be contacted. The exterminator would then establish an appropriate protocol for pest control in accordance with all county, state and federal regulations. Since the bulk of the waste delivered to the Bayview Landfill is through a transfer station the problems with rodents should be minimal.

3.8.3 Birds

As with rodent control, the primary method of controlling birds is to control the conditions favorable to their existence. The following methods will be used as needed:

- Minimizing the size of the working face. This is the most effective method of controlling birds since it reduces the area available for feeding. More frequent cover and higher degrees of compaction of the wastes may also serve to minimize the opportunities for feeding.
- Minimizing the accumulation of water in depressions, ponds, or other features near the active working face. The lack of water makes a landfill a less attractive feeding area for birds.
- Use of noise or other frightening techniques. These techniques offer short-term reductions in the numbers of birds feeding at a landfill.

If the primary methods do not produce satisfactory results, a destructive method of control may need to be implemented. Destructive methods may cause harm or death to some birds, and authorization must be obtained from local officials prior to implementing a destructive program.

3.8.4 Fugitive Dust

The roads leading to the landfill are paved with secondary site access provided via a maintained gravel access road. Some construction activities and daily traffic produce a certain amount of dust. Landfill activities compounded by the occasional high wind present a periodic fugitive dust problem. If the dust problem elevates above the “minimum avoidable dust level”, the landfill applies water to problem areas.

The landfill has a water tank truck and is used to suppress the dust. Water is applied to the gravel roads leading to all landfill facilities and to the tipping face. The water is applied as often as needed to control the dust.

3.8.5 Litter Control

The use of the extensive litter fencing at Bayview Landfill minimizes the problem with litter control. Due to the nature of landfilling operations, litter control is still an ongoing challenge. Landfill personnel perform routine litter cleanup to keep the landfill and surrounding properties clear of windblown debris.

Whenever possible, the working face is placed down wind so that blowing litter is worked into the landfill face. During windy conditions, landfill personnel minimize the spreading of the waste to reduce the amount of windblown debris.

3.9 RECYCLING

The primary location for recycling will be the transfer stations. These locations are best suited for separating recyclable materials, and separation will be difficult or impossible after the wastes have been loaded into over-the-road trucks. The landfill operations personnel may segregate tires, large and bulky wooden wastes, and similar materials upon receipt at the landfill; however, this recycling activity is considered secondary to recycling at the transfer stations.

3.10 TRAINING PROGRAM

As part of the initial training of new employees, Bayview Landfill Operations Plan is required reading. All landfill personnel are required to review the approved permit annually.

All personnel associated with the operation of the landfill receive training annually. Training typically includes Solid Waste Association of North America (SWANA) courses with certificates of completion are kept in personnel files. Regular safety and equipment maintenance training sessions are held to ensure that employees are aware of the latest technologies and that good safety practices are used at all times.

3.11 RECORDKEEPING

A daily operating record is maintained as part of a permanent record on the following items:

- Number of loads entering the landfill and types of wastes received
- Deviations from the approved Plan of Operation
- Number of waste inspections conducted
- Amount and type of cover material used
- Dust control

- Personnel training and notification procedures
- Landfill gas-monitoring results

3.12 SUBMITTAL OF ANNUAL REPORT

The Bayview Manager will submit a copy of its solid waste facility annual report to the Executive Secretary by March 1 of each year for the most recent calendar or fiscal year of facility operation. The annual report will include facility activities during the previous year and will include, at a minimum, the following:

- Name and address of facility
- Calendar or fiscal year covered by the annual report
- Facility type and status
- Annual quantity, in tons or volume, in cubic yards of solid waste handled for each disposal facility, including applicable recycling facilities
- Annual update of required financial assurances mechanism pursuant to Utah Administrative Code R315-309
- Ground water monitoring results
- Explosive gas monitoring results
- And an annual training report

A copy of the latest Annual Report is presented in Appendix C.

3.13 INSPECTIONS

The Manager, or his/her designee, inspects the facility to minimize malfunctions and deterioration, operator errors, and discharges that may cause or lead to the release of wastes to the environment or to a threat to human health. These inspections are conducted on a quarterly basis, at a minimum. An inspection log is kept as part of the operating record. This log includes at least the date and time of inspection, the printed name and handwritten signature of the inspector, a notation of observations made, and the date and nature of any repairs or corrective actions. Inspection records are available to the Executive Secretary or an authorized representative upon request.

3.14 RECORDING WITH COUNTY RECORDER

Plats and other data, as required by the County Recorder, will be recorded with the Utah County Recorder as part of the record of title no later than 60 days after certification of closure.

3.15 STATE AND LOCAL REQUIREMENTS

The Bayview Landfill maintains and will continue to maintain compliance with all applicable state and local requirements including zoning, fire protection, water pollution prevention, air pollution prevention, and nuisance control.

3.16 SAFETY

Landfill personnel are required to participate in an ongoing safety program. This program complies with the Occupational Safety and Health Administration (OSHA), and the National Institute of Occupational Safety and Health (NIOSH) regulations as applicable. This program is designed to make the site and equipment as secure as possible and to educate landfill personnel about safe work practices.

NUERA trains all of the landfill employees in First Aid, CPR, accident investigation, drug and alcohol policy, lockout and tagout, confined space entry, blood born pathogen, hazard communication, defensive driving, spill prevention control and counter measure, hazardous waste, and commercial driving license requirements.

3.17 EMERGENCY PROCEDURES

In the event of an accident or any other emergency situation, the Operator will notify the Manager and proceeds as directed. The emergency telephone numbers are:

Mark Lamoreaux, Landfill Manager	(801) 885-4233
Utah County Health Department	(801) 851-7095
Director, DWMRC	(801) 536-0200
Utah County Fire Department	(801) 851-4141

APPLICATION TO RENEW A PERMIT TO
OPERATE A CLASS I LANDFILL

Bayview Landfill

PART III - TECHNICAL REPORT

The permit information has been updated from previous permits to reflect the change in landfill ownership to NUERA, modification to landfill life due to the additional waste stream from NPSWSSD, the addition of Cell 1.5 and the changes to the final cover contours due to the Cell 1.5 addition. Portions of the text and associated appendices that do not require modifications have been left as originally presented in previous permit applications. The previous 2009 permit renewal application by HDR is included as Appendix X.

TABLE OF CONTENTS: PART III – TECHNICAL REPORT

SECTION 1 – INTRODUCTION & MAPS

This Part 3 – Technical and Engineering Report presents information on geology, hydrology, location restrictions, engineering design, closure, post-closure, and financial assurance for the Bayview Landfill.

Appendix A contains the Location Map and the latest USGS Quad information. Appendix E presents the General Arrangement of the Bayview Landfill and associated structures.

SECTION 2 - GEOHYDROLOGICAL ASSESSMENT

2.1 GENERAL

Several studies are available in the public and nonpublic arenas that describe the geology and hydrogeology of the region and the site. The hydrogeology of the Goshen Valley has been described by Dustin (1978) and Cordova (1970). These studies also describe the general geology of the area including the Bayview Landfill site. Two hydrogeological investigations were commissioned by Provo City Corporation during the original permitting of the site in the 1980s (Chen and Associates, 1980; Rollin, Brown, and Gunnell [RBG], 1983). These investigations provided shallow geological data specific to the landfill site.

During litigation regarding permitting of the site, several parties (Hintze and Fuhriman, 1983; Environmental Science and Engineering, 1986; and Danzberger, 1986) re-evaluated and re-interpreted the data presented in the Dustin, Cordova, Chen, and RBG studies, and re-interpreted site-specific geologic and hydrogeologic data. These re-evaluations presented no new data, and do not contribute to the understanding of the site.

During 1986 and 1987, the Utah County Planning Commission evaluated the Bayview Landfill site seismicity. This evaluation included on-site trenching to determine whether lineaments present on the site represented the surface expression of geologic faults. The Planning Commission's geologist concluded that the lineaments were not related to faults or seismic activities at the site (Robison, 1987).

During the original construction of the Bayview Landfill in 1989, the contractor drilled and installed 12 monitoring wells. Six of these wells are deep wells (170 to 310 feet below ground surface) that provide geological data from regions deeper than earlier Provo studies. Three additional deep monitoring wells have been installed since the Bayview Landfill began operating. These wells serve as compliance monitoring wells and also provide hydrogeological data specific to the site. Groundwater monitoring has been ongoing at the site with evaluations submitted annually to the DWMRC. The Groundwater Monitoring Report is included as Appendix G. Boring logs for monitoring wells are included as Appendix M.

During 1993, the U.S. Geological Survey (U.S.G.S.) conducted an evaluation of the aquifers in Utah and Goshen Valleys. A summary of selected data collected during this evaluation has been published as Utah Hydrologic Data Report No. 50, and is attached to this permit application as Appendix N.

2.2 GEOLOGY

2.2.1 Stratigraphy

The Bayview Landfill site is located in Goshen Valley between the East Tintic Mountains and Utah Lake. The Goshen Valley is bounded on the north by the Lake Mountains, on the west by the Mosida Hills and the East Tintic Mountains, on the south by Long Ridge, and on the east by Utah Lake and West Mountain. The site lies on the eastern slope of the East Tintic Mountains as the slope approaches Utah Lake. The terrain in the vicinity of the landfill site slopes toward the lake at approximately 2.5%; the terrain is steeper to the west and shallower to the east of the site.

The Goshen Valley is underlain by a thick sequence of consolidated and unconsolidated sediments overlying sedimentary Paleozoic limestone and dolomitic basement rock. The surficial materials at the site consist of heterogeneous deposits of gravel, sand, silt, and clay laid down in Lake Bonneville. These deposits were derived from erosion of the East Tintic Mountains, and were dropped into the lake as beach, bar, and spit deposits along the fluctuating shoreline. The materials are poorly to moderately well sorted and are derived from a mixture of Paleozoic sedimentary (limestone and quartzite) and Tertiary volcanic outcrops. In some places, these lake sediments are overlain by beach and dune sands representing Lake Bonneville shoreline and Quaternary deposits, respectively. The western portion of the landfill site exhibits dune and beach sand deposits.

Two other Pleistocene deposits underlie the Lake Bonneville Group sediments: the Terrace gravel, and the Older Alluvium. The Terrace gravel consists of gravel and sand benches and contains an aquifer referred to as the Upper Pleistocene aquifer. The Older Alluvium consists of cemented gravel and sand (fanglomerate) and contains an aquifer referred to as the Lower Pleistocene aquifer. Miocene latites and conglomerates reportedly underlie the Pleistocene deposits; the conglomerates reportedly consist of cobbles and boulders in a sandy matrix. It does not appear that the deep monitoring wells constructed at the Bayview Landfill site penetrate into the Lower Pleistocene aquifer.

2.2.2 Instability and Seismicity

No unstable slopes or subsidence areas have been mapped in the vicinity of the Bayview Landfill site. However, the Utah County Planning Commission has not prepared landslide, unstable area, or subsidence maps for this portion of the county. To the best recollection of Commission personnel, the Planning Commission has received no reports of landslides or subsidence. The site is relatively flat and is not subject to steep cuts that would create slope stability problems. There does not appear to be any surface observable evidence that the site is located in a floe type land stability problem area.

Numerous faults traverse the Goshen Valley. Most of these faults are believed to be inactive; however, more than 25 earthquake epicenters have been plotted within approximately 5 miles of the landfill site. These epicenters include one with a reported intensity of VII on the Modified Mercalli Intensity Scale, and several with reported intensities of IV or V (U.S.G.S, 1986). The Utah County Planning Commission has not prepared seismicity maps for this portion of the county. The International Building Code (IBC) – 2015 classifies the site as a Seismic Design Category D. This classification places the Bayview Landfill site in a seismic impact zone as defined under the Utah Solid Waste Management Rules.

2.3 HYDROLOGY

2.3.1 Surface Water

Three surface water channels cross the landfill site. Appendix E – General Arrangement presents the location of the channels with regard to site features. These surface water channels flow ephemerally from watersheds west of the landfill site. The northern and central channels originate about 2 miles west of the site in Section 14. Each of these channels has a drainage basin of less than 1,000 acres. The southern channel originates less than 1 mile west of the site in Section 18 and has a drainage basin of less than 200 acres.

The northern and central channels have cut gullies approximately 5 feet deep and 30 feet wide through the dune sands on the steep, western portion of the landfill site. These channels decrease in size to less than 3 feet in depth and less than 10 feet in width on the eastern portion of the site. The southern channel is only 1 to 2 feet in depth.

The drainage channels appear to be completely dry during most years. These channels carry water only during storm events and during spring run-off from the foothills west of the site. The sandy nature of the area and of the channel bottoms allows water to infiltrate into subsoils during storm events with a more frequent return period.

2.3.2 Aquifers

Previous studies (Cordova, 1980; Dustin, 1978) have defined four aquifers underlying the Goshen Valley; however, not all of these aquifers appear to be present at the Bayview Landfill site (Brook, 1994; Carpenter, 1994a). As identified in previous reports, the uppermost aquifer, the water table aquifer, is contained in the Lake Bonneville group, and is commonly found at depths of less than 25 feet below ground level (bgl). The second aquifer, the Upper Pleistocene aquifer, is contained in a sand and gravel deposit, the Terrace gravel, at depths of 150 to 300 feet bgl in the Goshen Valley. The Upper Pleistocene aquifer reportedly ranges from 75 to 100 feet in thickness. The Upper and Lower Pleistocene aquifers are separated by a 50 to 100-feet thick cemented sand and gravel confining layer. This confining layer is thought to partially separate the two Pleistocene aquifers. The Lower Pleistocene aquifer is reported to vary in thickness from 25 to 175 feet. The third aquifer, the Tertiary aquifer, is reportedly found at 200 to 500 feet bgl; its thickness is unknown but may exceed 1,500 feet in the Goshen Valley.

Eight shallow soil borings, six shallow monitoring wells, and six deep monitoring wells indicate that the Lake Bonneville group water table aquifer is not present at the site (Carpenter, 1994a). The six shallow monitoring wells are constructed with a 20-foot screen and a 1-foot sump below 49 feet of casing. The wells contain dedicated pumps mounted at 65 feet bgl. Boring logs are attached to this permit application as Appendix M. All of the shallow wells have contained small amounts of water during most sampling events; however, none of the wells have contained sufficient water to allow purging or sampling. The water in these wells is believed to be condensation within the well, rather than perched groundwater (Carpenter, 1994a). The nine deep monitoring wells appear to be screened in the Upper Pleistocene aquifer (Carpenter, 1994a).

The nine deep monitoring wells do not appear to have penetrated through the Upper

Pleistocene aquifer into the Lower Pleistocene aquifer. Boring logs for these wells are presented in Appendix M. This aquifer is the uppermost usable aquifer in the immediate vicinity of the landfill site. The landfill culinary well appears to be screened in the Lower Pleistocene aquifer (Carpenter, 1994a). The well log indicates that the partially confining layer between Upper and Lower Pleistocene aquifers is not present at the site. This is consistent with the interpretation of the U.S. Geological Survey for this portion of the Goshen Valley (Brook, 1994). The Upper and Lower Pleistocene aquifers appear to represent a single, water table (unconfined) aquifer in the vicinity of the Bayview Landfill.

2.3.3 Water Rights

The Utah Department of Natural Resources Water Rights Division lists only one active water right within 2,000 feet of the Bayview Landfill site boundary. This active water right is the culinary water well for the landfill. This well is located upgradient of the site and is screened in the Lower Pleistocene aquifer. The nearest well not associated with the Bayview Landfill is a well 2,400 feet north of the northeast corner of the landfill. Appendix O presents the results of the Utah DNR Water Rights search.

2.3.4 Groundwater Flow

The previous studies indicate that groundwater flow enters the Goshen Valley from the south through Current Creek Gap, and from the northwest through the Mosida Hills. These groundwater flows converge near the Bayview Landfill site. The groundwater underlying the site is expected to flow northeast toward Utah

Lake. Cordova (1970) estimated transmissivity of the Pleistocene aquifer to be between 50,000 and 300,000 gallons per day per foot (gpd/ft). Earthfax (1984) estimated the velocity of groundwater flow north of Elberta to be 24 feet per year (ft/yr).

In April 1994, Carpenter issued a report on the results of the Bayview Landfill background monitoring program (Carpenter, 1994b). This report provided an assessment of the background water quality and flow direction in the immediate vicinity of the landfill. This report stated that the groundwater flow at the site moves northeasterly toward Utah Lake, and estimated the velocity of this flow at 1.8 ft/yr. The discrepancy between the published values and the apparent velocity of groundwater at the site is unexplained. However, this does not seem to be important since the upper aquifer is more than 100 feet below the bottom of the landfill.

2.3.5 Groundwater Chemistry

The uppermost aquifer (the Upper Pleistocene aquifer) underlying the Bayview Landfill site is classified as a Class II aquifer. Appendix G – Groundwater Monitoring Report contains the groundwater monitoring plan for the landfill. Statistical analyses of groundwater monitoring data have been completed semi-annually since the completion of background sampling in 1993. Statistical analysis results are submitted with the Landfill Annual Reports.

SECTION 3 – ENGINEERING REPORT

3.1 LOCATION STANDARDS

In accordance with the Subtitle D criteria, DWMRC has adopted specific location standards. *The location standards are for new landfills or lateral expansions of existing landfills. Since the Bayview Landfill is not new or a lateral expansion, the location standards are not applicable.* The location standards information is presented for informational purposes. The Utah location standards for Municipal Solid Waste Landfills (MSWLFs), as presented in the Solid Waste Permitting and Management Rules (R315-302), are outlined below.

1 — Land Use Compatibility

- Not to be located within 1000 feet of parks and protected areas
- Not to be located in an ecologically and scientifically significant area
- Not to be located on prime or unique farmland
- Not to be located within ¼ mile of existing dwellings, incompatible or historical structures, unless allowed by local land use planning or zoning
- Not to be located within 5,000 feet of airport runways
- Not to be located on archeological sites

2 — Geologic Hazards

- Proximity to a Holocene Fault
- Considerations for constructing in a seismic impact zone
- Consideration given to unstable areas

3 — Surface Water

- Will not affect public water system
- Will not affect existing lakes, reservoirs and ponds
- Cannot be located in a floodplain unless certain criteria are met

4 —Wetlands

- Not allowed unless:
- Alternative location has been denied previously
- Will not violate state water quality standard or Clean Water Act
- Will not jeopardize threatened or endangered species

Will not cause or contribute to significant degradation of the wetlands

5 — Groundwater

Groundwater/landfill cell separation
Sole source aquifer
Groundwater quality
Source protection areas

The following sections present the Utah location standards for landfills and discuss Bayview Landfill's compliance with those requirements.

3.1.1 Land Use Compatibility

The Bayview Landfill is not known to be out of compliance with any element of the land use compatibility standard. However, the landfill has been designated as "exempt" in past permit documents due to its status as an existing landfill not seeking lateral expansion.

The Bayview Landfill is not located within any of these restriction zones. The land use directly adjacent to the landfill is primarily agricultural. The nearest residence is located more than 1 mile north of the site boundary, and the nearest town, Elberta, is located approximately 5.5 miles south of the site. The nearest airport is located approximately 17 miles from the site. No parks, ecologically significant areas, prime farmland, or archeological sites are known to exist near the site. The Bayview Landfill site is surrounded on the north and west by land zoned mining and grazing (MEG I), and on the south and east by land zoned agricultural (AI). The landfill is not inconsistent with these planned land uses. In any case, the site was permitted by the Utah County Board of Adjustment under a Conditional Use Permit, and therefore, is consistent with the local zoning and land use planning. Appendix B – Utah County Conditional Use Permit contains the most recent local permitting documents.

3.1.2 Geologic Hazards

The Utah State Regulations indicate "No new facility or lateral expansion of an existing facility shall be located in a subsidence area, a dam failure flood area, above an underground mine, above a salt dome, above a salt bed, or on or adjacent to geologic features which could compromise the structural integrity of the facility".

The Bayview Landfill has been designated as exempt from this regulation due to its status as an existing landfill not seeking lateral expansion. However, the landfill is not known to be located in a subsidence area, a dam failure flood area, above an underground mine, above a salt dome, or above a salt bed as mentioned in the Utah State Regulations.

3.1.2.1 Fault Areas

The Bayview Landfill site does not include known Holocene faults, and all solid waste containment will occur more than 200 feet from the property boundary. A trenching study was conducted to determine whether apparent lineaments represented the surface expression of faults. This study concluded that the lineaments were not related to faults. Appendix P – Lineament Study presents the results of the trenching study.

3.1.2.2 Seismic Impact Zone

Historic seismic records indicate that more than 25 earthquake events have occurred with epicenters within approximately 5 miles of the Bayview Landfill site. These earthquake events have occurred south, southwest, and southeast of the site.

The Bayview Landfill site has been determined to be in a seismic impact zone. Design for Cell 2 has been analyzed considering seismic activity and has been found to be stable with an adequate factor of safety. Appendix Q – Seismic Analysis presents the results of the seismic analysis for the Bayview Landfill structures.

Seismic stability analyses have been conducted to demonstrate that the proposed landfill components can resist the maximum horizontal acceleration expected at the site. These analyses were conducted in accordance with the State of Utah Administrative Rules and EPA guidance presented in RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Facilities, (EPA, 1995).

The landfill components considered in these analyses included: linear systems, leachate collection and delivery systems, the leachate collection and run-on/run-off control systems and the final cover.

The scope of the analyses included a review of regional and local soils, geology and seismic selection of the design earthquake and the site-specific earthquake acceleration; static and pseudo-static stability analyses for each landfill component: and evaluation of stability and potential deformations for each. landfill component.

The results of these analyses are presented in Appendix Q and indicate the following:

- The Bayview Landfill site is located in a Seismic Impact Zone. Both deterministic and probabilistic methods indicate a peak bedrock acceleration of 0.5g. The dense granular soils offer little amplification or attenuation of the bedrock acceleration through the overlying soil column.

- The cut and fill slopes and run-on/run-off structures have adequate static factor of safety and indicate minimal permanent deformations (U < 1 cm) in response to the design seismic event.

- The side slope liner and leachate collection/recovery system will require a geosynthetic reinforcement to increase the static factor of safety and limit permanent deformations in response to the design seismic event.

- The closure cap system has an adequate static factor of safety and indicates acceptable permanent deformation (U < 1 cm) in response to the design seismic event. No reinforcement is required for the final cover.

These demonstration analyses indicate that the proposed Bayview landfill components are designed to resist the "maximum horizontal acceleration" at the site.

3.1.2.3 Unstable Areas

The owner or operator of a landfill must consider several factors when determining whether an area is unstable. In guidance document R315-302, these factors are listed as; 1) soil conditions that may result in significant differential settling, 2) geologic or geomorphic features and 3) human-made features or events, both surface and subsurface.

Based on the site location, local geology and subsurface conditions, the Bayview Landfill is not located within a known unstable area as defined in the regulations.

3.1.3. Surface Water

The Utah Solid Waste Permitting and Management Rules state that no municipal solid waste landfill shall be located within a public water system watershed, a floodplain, or a wetland without specific approval of the Executive Secretary. The Bayview Landfill site is not located within a public water system watershed or 100-year floodplain. Three surface water drainage features cross the site from west to east. The Landfill Master Plan provides that the three drainage areas will be improved to divert run-on from the active landfill cells. Calculations for run-on and run-off ditches can be found in Appendix H.

3.1.4 Wetlands

The site drainage features do not contain vegetation that is characteristic of wetlands areas nor has any other wetland areas have been identified on the site.

3.1.5 Groundwater

The Utah Solid Waste Permitting and Management Rules state that no municipal solid waste landfill shall be located within the following restriction zones:

- Within 5 feet of the historical high groundwater elevation.
- Within 100 feet vertically (50 feet for high total dissolved solids [TDS between 1,000 and 3,000 mg/I] aquifers) of an aquifer that could be used for drinking water unless constructed with a composite liner system.
- Over an aquifer designated as a sole source aquifer or a 1B aquifer.
- In a drinking water source protection area.

The Bayview Landfill is not located within a sole source or 1B aquifer, or in a drinking water source protection area. Landfill cells will not be constructed within 5 feet of the historical high groundwater elevation. The shallowest groundwater at the site, the Upper Pleistocene aquifer is located more than 100 feet below the bottom of the proposed liner system. A composite liner system consisting of a geosynthetic clay liner (GCL) and an HDPE geomembrane is proposed for the bottom of all landfill cells.

3.2 ESTIMATED FACILITY LIFE

The current operational area of the Bayview Landfill is Cell 2 Stage 2. Details of the landfill life analysis are contained in Appendix R – Landfill Life. Cell 1.5 will be constructed in the summer of 2020 and start to receive waste in the fall of 2020. The active waste area will then move back to Cell 2. Cell 2 will be filled to capacity sometime between 2032 and 2034 depending on the amount of waste delivered to the landfill.

3.3 LANDFILL MODIFICATIONS

This permit application includes provisions for changes in the landfill configuration and changes in the final cover geometry. The changes in configuration is to accommodate an additional landfill cell located between Cell 1 and Cell 2, the name of the new Cell is Cell 1.5. The addition of Cell 1.5 will allow for a modification in final cover topography to enhance surface water diversion, accommodate long-term landfill settlement, and provide additional solid waste disposal capacity. The location of Cell 1.5 is presented on the General Arrangement drawing in Appendix E.

3.4 ENGINEERING DESIGN

In 1987, HDR prepared a Landfill Master Plan (HDR, 1987) to guide development of the site over its active life.

The Master Plan was updated in 2002 (HDR) to show a combined Cell 2 and 3, and to increase excavation depths in this new Cell 2. A 2008 Cell 2 Master Plan modified Cell 2 - Stage 2 base grades to drain the western two-thirds down at 2% to the north and east, and the eastern third down at 2% to the southeast and modified the leachate drainage plan to accommodate the new grades. Excavation depths remain more than I00 feet above the uppermost aquifer. An additional leachate evaporation pond was designed to collect leachate and stormwater from Cells 1 and 2 only. The General Arrangement is attached to this permit application as Appendix E.

After all Stages of Cell 2 reach final contours and the final cap is in place in approximately 2032 to 2034 depending on actual MSW densities, long-term monitoring of the final cover and groundwater monitoring wells will continue for the 30-year post-closure care period. The final cover contours for the Bayview Landfill are presented in Appendix S – Final Cover.

3.4.1 Landfill Cell 2 – Stage 2, Stage 3, and Stage 4

Stage 2 of Landfill Cell 2 consisted of a 15-acre, geosynthetic clay and HDPE- lined area located in the E l/2 of the NW l/4 of Section 17. The excavation for this cell stage began in 2004 with Stage 2 nearing completion. The excavated soils have been used for liner protection, daily cover, or stockpiled. The stockpiled soil will be used for daily cover and intermediate cover for the rest of the Cell 2 Stages.

Generally, excavation side slopes of all Cell 2 Stages will be constructed on a 4:1 (H:V) slope. The excavation bottom slopes are graded at 2% north to south and 2.5% west to east, so that leachate drains to the northeast. The excavation has been constructed with a leachate collection trench along the eastern edge of the excavation bottom. The leachate collection swale is graded at a 2.0% slope down from south to north toward a sump at the north edge of Stage 2.

The liner system for Cell 2 - Stage 2 and future Stages consists of the following components (from bottom to top):

- A 12- to 20-ounce non-woven, needle punched polypropylene geotextile. The excavation specification will allow 4-inches minus material to remain on the surface of the excavation. A heavy geotextile will provide puncture resistance for the overlying geomembrane. Alternately, a sand cushion may be used in lieu of, or to reduce the required weight of, the geotextile cushion.
- A bentonite impregnated geotextile (geosynthetic clay liner - GCL). The GCL provides an additional barrier to leachate and landfill gas migration.
- A 60-mil textured HDPE flexible membrane liner.
- A woven reinforced geotextile. This high strength geotextile will provide the tensile strength necessary to resist the sliding forces generated on a 4:1 slopes (where applicable) by the 2-foot-thick soil protective layer.
- A 12- to 16-ounce non-woven geotextile placed on top of the HDPE liner (of the floor of the excavation) to provide protection to the HDPE liner.
- A 2-foot thick protective cover layer. This soil layer will protect the geotextile, HDPE and GCL during placement of the first lift of solid waste. It is also intended to provide a pathway for leachate movement above the HDPE toward the leachate collection and removal system. If beneficial, a drain net material

will be incorporated on top of the HDPE to facilitate leachate movement and to protect the HDPE liner.

3.5 MONITORING SYSTEM DESIGN

3.5.1 Groundwater Monitoring

The Bayview Landfill has a DWMRC approved groundwater monitoring plan and will continue to follow the plan. This plan includes sampling and analysis plans for the monitoring of groundwater at the landfill. Appendix G – Groundwater Monitoring Report details the groundwater sampling and analysis procedures.

3.5.2 Surface Water Controls

The Bayview Landfill site and its vicinity generally drain from west to southeast. Stormwater originating west of the site is routed through three existing surface water channels. See General Arrangement drawing in Appendix E.

Stormwater originating on-site is managed as either non-contact or contact stormwater depending on its source. Non-contact stormwater is water falling on unimproved portions of the site, or on improved portions of the site having no contact with solid waste (e.g., the maintenance building vicinity) or on the final cover of Cell 1. Run-on control structures divert this water from the active landfill cell and stormwater/leachate pond and route this water into the existing surface water channels. Contact stormwater is water falling onto the active landfill cell. Run-off control structures divert water falling on the active landfill cell into the leachate collection system. Ultimately, contact stormwater is stored and evaporated in the evaporation pond. Neither leachate nor contact stormwater are discharged from the site.

Analyses have been conducted for run-on and run-off control systems around Cell 2. These analyses were conducted for a 25-year storm event and the associated time of concentration that produced peak flow. The analyses, (Appendix H – Run-on / Runoff Calculations), indicate that a triangular ditch, nominally 1 foot deep, provides adequate flow capacity. This ditch geometry was constructed concurrent with the initial Cell 2 construction.

3.5.3 Leachate Management

In its current design, runoff and leachate from Cell 1 and Cell 2 report to the dual lined leachate pond northeast of Cell 2. Leachate from the compost facility (when utilized) are contained in the Compost Tea Collection Pond. Sizing calculations for the leachate pond are found in Appendix J – Leachate Generation Calculations.

The leachate pond liner system consists of the following layers (from bottom to top):

- A 16-ounce non-woven geotextile.
- A 60-mil HDPE geomembrane.
- A geonet, sandwiched between two layers of non-woven geotextile.
- A UV-resistant, 60-mil HDPE geomembrane, textured on side slopes.
- A 6-inch layer of sand (bottom and the 10:1 sideslope only) as a cushion layer beneath the soil cement to protect the 60-mil HDPE geomembrane.
- An 8-inch layer of soil cement (bottom and the 10:1 sideslope only). The cement will allow the landfill personnel to enter the pond and remove accumulated sediment using a front-end loader.

The leachate pond also has a leak detection system between the lower 60-mil HDPE geomembrane and the sandwiched geonet/geotextile layer. The geonet will convey any fluid that leaks through the primary liner to a gravel-filled sump with an 8" perforated HDPE pipe. The pipe extends up a 4:1 sideslope as a solid-wall pipe and terminates at a manhole structure where a portable water level meter and, if needed, a pump can be lowered down to check for leaks in the primary evaporation pond liner.

3.5.3.1 Modeling

Since the leachate generation calculations were done for the October 2003 Permit Application, no modifications have been made to the landfill that affect the amount of leachate generated or the performance of the leachate collection system. Because of this, the Hydrologic Evaluation of Landfill Performance (HELP) model, hydraulic head calculations, and calculations for the flow capacity of the leachate collection pipe used for the 2003 Permit Application are still valid and are included in Appendix T – Flow Capacity of the Leachate Collection Pipe.

Analyses have been conducted to evaluate the sizing and capacity of the proposed leachate evaporation pond for the combination of contact stormwater run-off from the contributing cell area and leachate generation from all of Cell I and Cell 2. Only stormwater from the largest stage in Cell 2 (Stage 3) was considered in the stormwater runoff calculations because the stages will be developed in sequence, with each stage receiving intermediate cover when it reaches capacity, thereby reducing contact stormwater runoff. The 25-year, 24-hour storm event was used to compute run-off. The results of the analysis, presented in Appendix H – Run-on / Runoff Calculations, indicate the leachate evaporation pond is sized adequately to contain the leachate generated from Cell 1 and Cell 2 and the contaminated stormwater run-off from the equivalent area of Cell 2- Stage 3. The addition of Cell 1.5 will have little effect on the amount of leachate generated.

3.5.4 Landfill Gas Collection

Bayview Landfill has an active gas collection system, details of the landfill gas collection system is presented in Appendix U – Bayview Landfill LFG Gas Collection System. The landfill gas collection system will be modified to accommodate the construction of Cell 1.5. A construction package detailing the landfill gas collection modifications will be submitted to the DWMRC for review and approval prior to construction of any gas collection system modifications.

SECTION 4 – CLOSURE PLAN

4.1 GENERAL

Closure of the existing Bayview Landfill will proceed from the west to east. Closure started with Cell 1 and will proceeded over the areas of Cell 1.5 and ultimately through the Cell 2 area. The drawings in Appendix S show the final cover topography and closure phases for the landfill.

4.2 CELL 1 AREA

The final cover of Cell 1 area was completed in 2008. An alternate final cover consisting of 34 inches of on-site, olive-brown silty sand was used to close Cell 1. A seed mix similar to that shown on the table below was used to establish vegetation during 2009. Final contours for western half Cell 1 (Phase A cover) is presented in Appendix S – Final Cover. The eastern side slopes of Cell 1 will be covered as Cell 1.5 is filled. The side slopes of the landfill were constructed at a 4:I (H:V) slope, with the top slope being approximately 5%.

Seed Mix for Bayview Landfill

%Mix	Type of Grass
0.50%	Sand Drop Seed
1.50%	Alkali Sacaton
3.50%	Blue Grama
17.50%	Blue Bunch Wheat Grass
17.50%	Indian Rice Grass
3.00%	Sandberg Blue Grass
4.00%	Sheep Fescue
16.25%	Slender Wheat Grass
16.25%	Stream Bank Wheat Grass
20.00%	Western Wheat Grass
100.00%	Total

The final capping system used for Cell 1 varies from the standard design in the Utah Administrative Code at R315-303-3(4). However, based on modeling performed for the

2003 permit application, the approved cap is equivalent to the standard design in preventing infiltration. A copy of this analysis is included in Appendix V – Closure Cap Equivalency.

4.3 CELL 1.5 AREA

Cell 1.5 area will be constructed between the existing closed Cell 1 (Phase A) and the western side of the Cell 2 landfill operations. Cell 1.5 area will be developed utilizing the same liner and cover components identified in Cell 1 and Cell 2.

4.4 CELL 2 AREA

Landfill Cell 2 is the active landfill area at Bayview. Landfill Cell 2 is not expected to reach capacity until sometime between 2032 and 2034 depending on density and amount of waste delivered annually to the facility.

The same alternate final capping system as used for Cell 1 area will be used for Cell 2 area (Phase B through Phase F) when final contours are reached. In general, this capping system consists of the following layers from the bottom up:

- 6 inches of intermediate cover placed over the daily cover to provide a 12-inch cushion of soil between the solid waste and the barrier layer;
- 34-inches of evaporative cap constructed from the olive-brown silty sand available on-site. The top six inches of this evaporative cap will be capable of supporting vegetative growth by amending the soil with compost to aid in initial seed germination.

Landfill personnel will inspect the completed cap weekly until vegetation is established, and monthly thereafter to ensure that damage to the capping system is detected and repaired early. The vegetation on the landfill cap will be maintained to blend into the surrounding semi-arid landscape.

Landfill personnel will also inspect the completed cap to determine that the final contours are maintained, and that the flow of stormwater is unimpeded. Areas in which excessive settlement or erosion of 1 inch has occurred, as evidenced by the exposure of the blue top survey stakes, will be regraded, mulched, and seeded as specified above.

A seed mix similar to that utilized in the Cell 1 area (Phase A) final cover will be used to establish vegetation. Projected final contours for the Cell 2 (Phase B through Phase F) are presented in Appendix S – Final Cover. The side slopes of the final cover above Cell 2 will be constructed at a 4:1 (H:V) slope, with a top slope of approximately 5%.

4.5 CLOSURE PROCEDURES

Closure activities for each phase of the landfill will take place in accordance with the following procedures:

4.5.1 Submittal of Plans, Specifications, and QA/QC Plan

Four months before the intended closure of each of the phases of landfilling, a design package consisting of drawings, construction specifications, and a QA/QC plan will be submitted to the DWMRC. The DWMRC will have approximately 60 days to review and comment on the adequacy of the drawings, specifications and quality assurance/quality control measure envisioned for the construction. Comments from DWMRC will be incorporated into a final "bid" package for the cover construction.

4.5.2 Formal Notification

The Executive Secretary of the DWMRC will be notified of the intent to implement the closure plan in whole or part, 60 days prior to the date projected for construction.

4.5.3 Additional Closure Activities

Additional closure activities to close each of the landfill phases are as follows:

- Regrading of all lower side slopes where current slopes are steeper than 4 horizontal to 1 vertical.
- Regrading top of the landfill slopes to no less than 5%.
- Finalization (including DWMRC comments) of the final cover design package. Final Cover design package will include, at a minimum, plans, construction specifications, and QA/QC protocols to guide the construction of the final cover.
- Bidding and construction of final cover.
- Construction of run-off control structures as needed.

- Preparation of As-Built Drawings.
- Vegetation of the final cover soils.
- Inspection of final cover construction by Owner, Engineer (engineer of record) and DWMRC personnel.
- Preparation of Certificate of Closure by a Utah registered Professional Engineer.
- Submittal of required documents to the State DWMRC and to the Utah County Recorder's office.

4.6 CLOSURE COSTS

The most recent closure cost estimates are presented in Appendix C – Annual Report.

SECTION 5 – POST-CLOSURE PLAN

5.1 GENERAL

Post-closure care for Cell 1 of the Bayview Landfill will consist of long-term maintenance of the closure cap and ongoing sampling of the groundwater monitoring wells and gas monitoring stations to ensure that the landfill cell has been closed in accordance with regulations. The post-closure care period will be 30 years unless unexpected environmental contamination or continued subsidence occurs, or a shorter period if it can be proven that it no longer presents a threat to human health or the environment.

The most recent analysis of annual post-closure costs is provided in Appendix C – Annual Report.

5.2 POST-CLOSURE PLAN

The Post-Closure activities will include the following work:

5.2.1 Changes to Record of Title

A Plat Map and Statement of Fact concerning the location of the landfill shall be recorded with the Utah County recorder not later than 60 days after certification of final closure. The recorded document will restrict future land use.

5.2.2 Monitoring and Maintenance Plan

Semi-annual groundwater and quarterly landfill gas monitoring will occur throughout the post-closure period. This frequency will be increased if data indicate that contamination may have occurred. The post-closure monitoring frequency will revert to the original schedule if the more frequent monitoring demonstrates that contamination, if present, is not attributable to the landfill.

Collection and treatment of leachate generated in Cell 1, Cell 1.5, and Cell 2 will be provided by the dual-lined evaporation pond constructed directly north and upstream of the existing evaporation pond. The original evaporation pond will provide stormwater and process water runoff containment for the adjacent biosolids compost facility (when or if composting operations are performed). These leachate collection and treatment systems will be inspected as part of the ongoing activities for other landfill cells during the post-closure period for Cell 1, Cell 1.5, and Cell 2. Since the Bayview Landfill has no planned surface water discharge, no surface water monitoring will be required during the post-closure period.

The table below provides a schedule for conducting inspections and maintenance and for recording these routine activities. Landfill personnel will be responsible for conducting the inspections, scheduling maintenance, and recording these activities on the forms provided in Appendix F.

Frequency of Inspection / Maintenance of Facilities During Post-Closure Care

Landfill Facility	Inspection or Maintenance	Frequency
Landfill Cell	Closure cap integrity. Cell perimeter fence integrity.	Quarterly
Stormwater / Leachate Pond	Perimeter fence integrity. Water depth. Liner system integrity.	Quarterly
Other Appurtenances	Entrance gate integrity. Perimeter fence integrity. Monitoring station integrity. Berm integrity. Run-on and Run-off Control Systems.	Quarterly

The above activities will be carried out as part of the ongoing operations during the active life of the site. They will be expanded to include the entire site at final landfill closure and will continue throughout the post-closure monitoring period.

A written summary of the activities performed during each inspection will be maintained. NEURA will retain the right of entry to the closed landfill, maintain all right-of-way’s, and conduct maintenance and/or remediation activities as needed. The landfill will be inspected on a quarterly basis for the following conditions:

- Integrity of the final cover (including erosion, subsidence, seeps and settlement);
- Loss of vegetative cover or growth of undesirable plant species;
- Visible debris, litter, and waste;
- Condition of access roads, gates, and fences;
- Integrity of on-site structures;
- Integrity of groundwater monitoring system;
- Integrity of methane monitoring system;
- Integrity of drainage features;
- Integrity of the leachate collection system;

The final cover will be inspected for erosion or other maintenance problems. Any problems detected during routine site inspections will be corrected as soon as practicable. All eroded areas will be recovered with suitable soil to establish erosion control and infiltration layers, as well as positive drainage to maintain the integrity of the final cover. All bare areas in the final cover will be re-vegetated as necessary.

The need for final cover system repairs due to differential settlement or subsidence will be determined based on an evaluation of whether the final cover in the affected area has been impaired. Any areas where the integrity of the final cover has been compromised will be repaired as necessary.

Eroded areas in drainage ditches will be repaired and re-graded. Sediment buildup will be removed from areas where flow is restricted. Temporary stormwater control structures will be constructed and maintained as needed.

The leachate collection system will be maintained and operated as needed to minimize leachate head on the liner. The NUERA may seek the approval of the DWMRC to cease leachate extraction and treatment if it can demonstrate that leachate generation has diminished and no longer poses a threat to human health and environment.

These activities have been initiated on Cell l (Phase A) and will be expanded to all closed areas at the appropriate times.

5.2.3 Closure and Post-Closure Contact

The Landfill Manager of the Bayview Landfill will be the contact person for the Closure period of the landfill. A caretaker position will be created and serve as the point of contact during the Post-Closure care period. The Landfill Manager of the Bayview Landfill can be reached at (801) 885-4233. The caretaker contact information will be provided to the DWMRC once that position has been filled.

SECTION 6 – POST-CLOSURE LAND USE

NUERA will design a post-closure land use plan to be implemented at the landfill within 5 years prior to the end of the landfill's life. NUERA will select an end use for the landfill consistent with good landfilling practices. The final land use selected for the landfill will be based upon maintaining a functional landfill cover. Typical end uses range from recycling operations (which complement existing operations) to recreational activities. Since the closure of the site will be dozens of years away and with the potential development options that could occur in this area, it is not currently possible to establish a land use plan that will be consistent with surrounding land uses and the needs of NUERA.

SECTION 7 – FINANCIAL ASSURANCE & CLOSURE/POST CLOSURE COSTS

7.1 GENERAL

The most up-to-date financial assurance documents are provided in the latest Annual Report Submitted to the State of Utah, DWMRC . The Annual Report is included in Appendix C.

7.2 FINANCIAL ASSURANCE PLAN

The Financial Assurance Plan for the Bayview Landfill is presented in Appendix W – Financial Assurance Plan.

7.3 CLOSURE/POST CLOSURE COSTS

The latest Closure / Post Closure Costs are presented in Appendix C – Annual Report.

SECTION 8 – REFERENCES

HDR Engineering, Inc, 2009, *SUVSWD Bayview Class I Landfill Permit Application.*

Attachment X – Application for a Permit to Operate a Class I Landfill (HDR 2009) presents the last permit renewal application.

Application Checklist

I. Facility General Information	
Description of Item	Location In Document
Ia. Information Required for All Class I and V Landfills	
Completed Part I General information Form	Part I
General description of the facility (R315-310-3(1)(b))	Part II Section 1
Legal description of property (R315-310-3(1)(c))	Part II Section 2
Proof of ownership, lease agreement, or other mechanism (R315-310-3(1)(c))	Part II Section 2
Area served by the facility including population (R315-310-3(1)(d))	Part II Section 1.3
If the permit application is for a class I landfill a demonstration that the landfill is not a commercial facility	Part II Section 1.2
Waste type and anticipated daily volume (R315-310-3(1)(d))	Part II Section 1.4 Appendix C
Ib. Information Required for All New Or Laterally Expanding Class I and V Landfills	Not Applicable
Intended schedule of construction (R315-302-2(2)(a))	Not Applicable
Name and address of all property owners within 1000 feet of the facility boundary (R315-310-3(2)(a)(i))	Not Applicable
Documentation that a notice of intent to apply for a permit has been sent to all property owners listed above (R315-310-3(2)(ii))	Not Applicable
Name of the local government with jurisdiction over the facility site (R315-310-3(2)(iii))	Not Applicable
Ic. Location Standards for All New Or Laterally Expanding Class I and V Landfills (R315-302-1)	Not Applicable
Documentation that the facility has met the historical survey requirement of R315-302-1(2)(f)	Not Applicable
Land use compatibility (R315-302-1(2)(a))	Not Applicable
Maps showing the existing land use, topography, residences, parks, monuments, recreation areas or wilderness areas within 1000 feet of the site boundary	Not Applicable
Certifications that no ecologically or scientifically significant areas or endangered species are present in site area	Not Applicable
List of airports within five miles of facility and distance to each	Not Applicable
Geology (R315-302-1(2)(b))	Not Applicable
Geologic maps showing significant geologic features, faults, and unstable areas	Not Applicable
Maps showing site soils	Not Applicable
Surface water (R315-302-1(2)(c))	Not Applicable
Magnitude of 24 hour 25 year and 100 year storm events	Not Applicable
Average annual rainfall	Not Applicable

***I.* Facility General Information**	
Description of Item	Location In Document
Maximum elevation of flood waters proximate to the facility	Not Applicable
Maximum elevation of flood water from 100 year flood for waters proximate to the facility	Not Applicable
Wetlands (R315-302-1(2)(d))	Not Applicable
Ground water (R315-302-1(2)(e))	Not Applicable
***Id.* Plan of Operations Requirements for All Class I And V Landfills (R315-310-3(1)(e) and R315-302-2(2))**	
Forms and other information as required in R315-302-2(3) including a description of on-site waste handling procedures and an example of the form that will be used to record the weights or volumes of waste received (R315-302-2(2)(b) And R315-310-3(1)(f))	Part II Section 3
Schedule for conducting inspections and monitoring, and examples of the forms that will be used to record the results of the inspections and monitoring (R315-302-2(2)(c), R315-302-2(5)(a), and R315-310-3(1)(g))	Part II Section 3.4.5
Contingency plans in the event of a fire or explosion (R315-302-2(2)(d))	Part II Section 3.5
Corrective action programs to be initiated if ground water is contaminated (R315-302-2(2)(e))	Part II Section 3.5.7
Contingency plans for other releases, e.g. explosive gases or failure of run-off collection system (R315-302-2(2)(f))	Part II Section 3.5.5 Section 3.5.6
Plan to control fugitive dust generated from roads, construction, general operations, and covering the waste (R315-302-2(2)(g))	Part II Section 3.8.4
Plan for litter control and collection (R315-302-2(2)(h))	Part II Section 3.8.5
Description of maintenance of installed equipment (R315-302-2(2)(i))	Part II Section 3.7
Procedures for excluding the receipt of prohibited hazardous or PCB containing wastes (R315-302-2(2)(j))	Part II Section 3.3
Procedures for controlling disease vectors (R315-302-2(2)(k))	Part II Section 3.8
A plan for alternative waste handling (R315-302-2(2)(l))	Part II Section 3.6
A general training plan for site operations (R315-302-2(2)(o))	Part II Section 3.10
Any recycling programs planned at the facility (R315-303-4(6))	Part II Section 3.9
Closure and post-closure care Plan (R315-302-2(2)(m))	Part III Section 4 Part III Section 5
Procedures for the handling of special wastes (R315-315)	Part II Section 3.2.4
Plans and operation procedures to minimize liquids (R315-303-3(1))	Part II Section 3.3.2
Plans and procedures to address the requirements of R315-303-3(7)(c) through (i) and R315-303-4	Part III Section 4 Appendix V
Any other site-specific information pertaining to the plan of operation required by the Director (R315-302-2(2)(p))	Part II Section 3

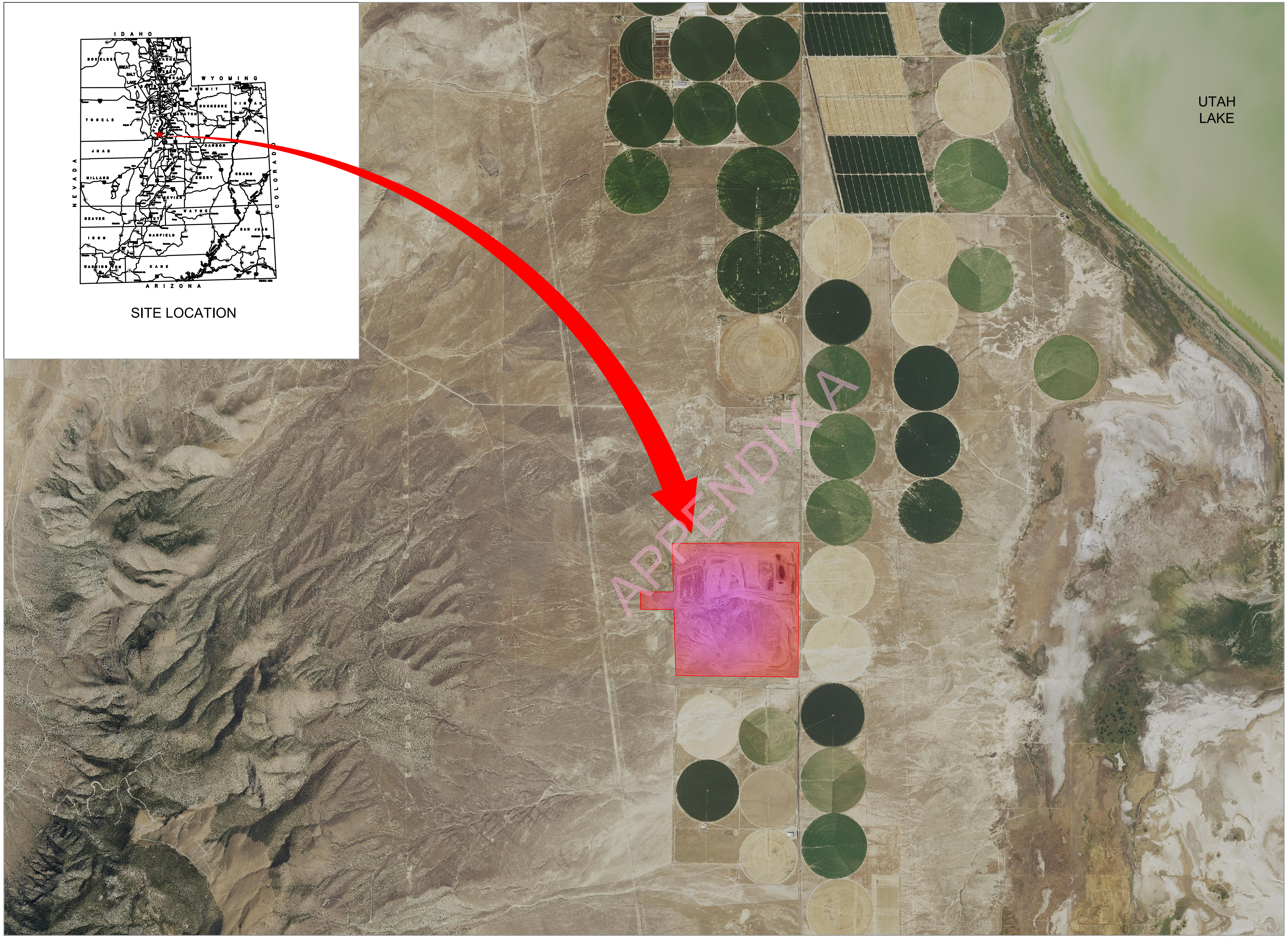
I. **Facility General Information**	
Description of Item	Location In Document
Ie. Special Requirements for New Or Laterally Expanding Class V Landfill (R315-310-3(3))	Not Applicable
Submit information required by the *Utah Solid and Hazardous Waste Act* Subsections 19-6-108(9) and 19-6-108(10) (R315-310-3(2)(a))	Not Applicable
Note the following information must be provided following issuance of the permit but prior to Director approval to take waste for a new Class V facility.	Not Applicable
Approval from the local government within which the solid waste facility sits	Not Applicable
Approval from the Legislature and the Governor	Not Applicable

II **Facility Technical Information**	
Description of Item	Location In Document
IIa. Maps for All Class I and V Landfills	
Topographic map drawn to the required scale with contours showing the boundaries of the landfill unit, ground water monitoring well locations, gas monitoring points, and the borrow and fill areas (R315-310-4(2)(a)(i))	Appendix E
Most recent U.S. Geological Survey topographic map, 7-1/2 minute series, showing the waste facility boundary; the property boundary; surface drainage channels; any existing utilities and structures within one-fourth mile of the site; and the direction of the prevailing winds (R315-310-4(2)(a)(ii))	Appendix A
IIb. Geohydrological Assessment for All Class I and V Landfills (R315-310-4(2)(b))	
Local and regional geology and hydrology including faults, unstable slopes and subsidence areas on site (R315-310-4(2)(b)(i))	Part III Section 2
Evaluation of bedrock and soil types and properties including permeability rates (R315-310-4(2)(b)(ii))	Part III Section 2
Depth to ground water (R315-310-4(2)(b)(iii))	Part III Section 2
Direction and estimated flow rate of ground water (R315-310-4(2)(b)(iv))	Part III Section 2.3.4
Quantity, location, and construction of any private or public wells on-site or within 2,000 feet of the facility boundary (R315-310-4(2)(b)(v))	Part III Section 2.3.3 Appendix O
Tabulation of all water rights for ground water and surface water on-site and within 2,000 feet of the facility boundary (R315-310-4(2)(b)(vi))	Part III Section 2.3.3 Appendix O
Identification and description of all surface waters on-site and within one mile of the facility boundary (R315-310-4(2)(b)(vii))	Part III Section 2.3
Background ground water and surface water quality assessment and, for an existing facility, identification of impacts upon the ground water and surface water from leachate discharges (R315-310-4(2)(b)(viii))	Part III Section 2
Ground Water Monitoring (R315-303-3(7)(b) and R315-308)	Part III Section 3.5
Statistical method to be used (R315-308-2(8))	Appendix G

***II* Facility Technical Information**	
Description of Item	Location In Document
Calculation of site water balance (R315-310-4(2)(b)(ix))	Part II Section 3.4.3
IIc. Engineering Report - Plans, Specifications, And Calculations for All Class I and V Landfills	
Documentation that the facility will meet all of the performance standards of R315-303-2	Part III Section 3.5
Engineering reports required to meet the location standards of R315-302-1 including documentation of any demonstration or exemption made for any location standard (R315-310-4(2)(c)(i))	Part III Section 3.1
Anticipated facility life and the basis for calculating the facility's life (R315-310-4(2)(c)(ii))	Part III Section 3.2
Cell design to include liner design, cover design, fill methods, elevation of final cover including plans and drawings signed and sealed by a professional engineer registered in the State of Utah (R315-303-3(3), R315-303-3(6) and (7)(a), R315-310-3(1)(b) and R315-310-4(2)(c)(iii))	Part III Section 3.4.3 Appendix K
Leachate collection system design and calculations showing system meets the requirements of R315-303-3(2)	Part II Section 3.4.3 Appendix J
Equipment requirements and availability (R315-310-4(2)(c)(iii))	Part II Section 1.5
Identification of borrow sources for daily and final cover and for soil liners (R315-310-4(2)(c)(iv))	Part III Section 4 Appendix V
Run-On and run-off diversion designs (R315-303-3(1)(c), (d) and (e))	Part II Section 3.4.2 Appendix H
Leachate collection, treatment, and disposal and documentation to show that any treatment system is being or has been reviewed by the Division of Water Quality (R315-310-4(2)(c)(v) and R315-310-3(1)(i))	Part II Section 3.4.3 Appendix J and U
Ground water monitoring plan that meets the requirements of Rule R315-308 including well locations, design, and construction (R315-310-4(2)(b)(x) and R315-310-4(2)(c)(vi))	Part II Section 3.4.1 Appendix G
Landfill gas monitoring and control plan that meets the requirements of Subsection R315-303-3(5) (R315-310-4(2)(c)(vii))	Part II Section 3.4.4 Part III Section 3.5.4 Appendix U
Slope stability analysis for static and under the anticipated seismic event for the facility (R315-310-4(2)(b)(i) and R315-302-1(2)(b)(ii))	Part III Section 3.1.2.2 Appendix Q
Design and location of run-on and run-off control systems (R315-310-4(2)(c)(viii))	Part II Section 3.4.2 Appendix H and Appendix E
IId. Closure Plan for All Class I and V Landfills (R315-310-3(1)(h))	
Closure Plan (R315-302-3(2) and (3))	Part III Section 4
Closure schedule (R315-310-4(2)(d)(i))	Part III Section 4
Design of final cover (R315-303-3(4) and R315-310-4(2)(c)(iii))	Part III Section 4 Appendix V
Capacity of site in volume and tonnage (R315-310-4(2)(d)(ii))	Part III Section 3.2 Appendix R

***II* Facility Technical Information**	
Description of Item	Location In Document
Final inspection by regulatory agencies (R315-310-4(2)(d)(iii))	Part III Section 4.5.2
IIe. Post-Closure Care Plan for All Class I and V Landfills (R315-310-3(1)(h))	
Post-Closure Plan (R315-302-3(5) and (6))	Part III Section 5
Site monitoring of landfill gases, ground water, and surface water, if required (R315-310-4(2)(e)(i))	Part III Section 5.2.2
Changes to record of title, land use, and zoning restrictions (R315-310-4(2)(e)(v))	Part III Section 5.2.1
Maintenance activities to maintain cover and run-on/run-off control systems (R315-310-4(2)(e)(iii))	Part III Section 5.2.2
List the name, address, and telephone number of the person or office to contact about the facility during the post-closure care period (R315-310-4(2)(e)(vi))	Part III Section 5.2.3
IIf. Financial Assurance for All Class I and V Landfills (R315-310-3(1)(j))	
Identification of closure costs including cost calculations (R315-310-4(2)(d)(iv)) and (R315-302-2(2)(n))	Part III Section 7 Appendix C Appendix W
Identification of post-closure care costs including cost calculations (R315-310-4(2)(e)(iv))	Part III Section 7 Appendix C Appendix W
Identification of the financial assurance mechanism that meets the requirements of Rule R315-309 and the date that the mechanism will become effective (R315-309-1(1))	Part III Section 7 Appendix C Appendix W

APPENDIX A – LOCATION MAP & USGS QUAD



REFERENCE:
ADAPTED FROM MAP
PROVIDED BY CLIENT.

Northern Utah Environmental Resource Agency
Bayview Landfill
10804 South State Route 68
Elberta, Utah

CONSULTANTS

IGES
ideas for a changing world

2702 South 1030 West, Suite 10
Salt Lake City, Utah 84119
(801)270-9400 (T)
(801)270-9401 (F)

NOTES:

MARK	DATE	DESCRIPTION
	10/21/19	DRAFT

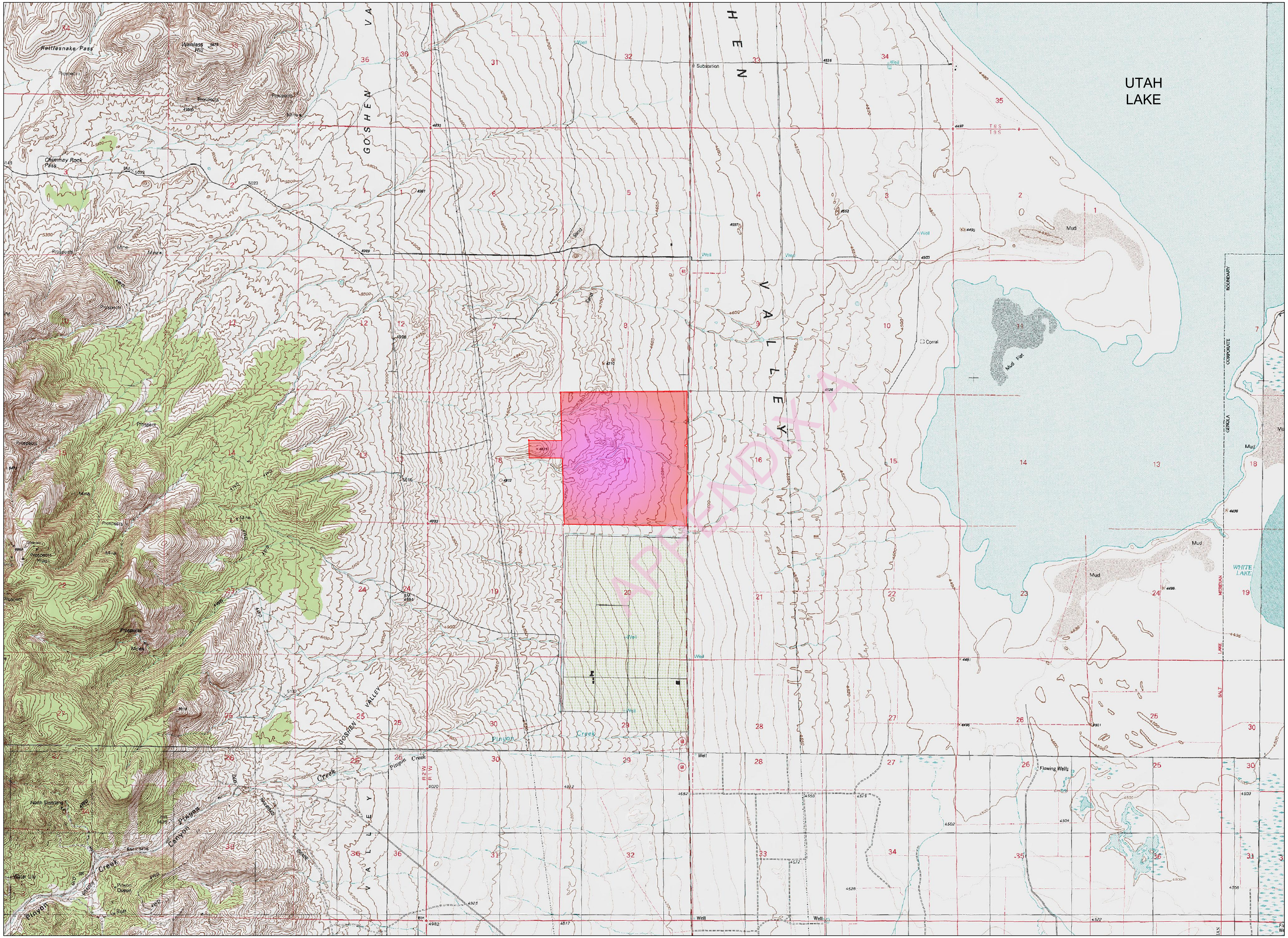
ISSUE:

PROJECT NO.: *02260-002*
CAD DWG FILE: *02260\Bayview\Location Map.dwg*
DRAWN BY: *JAH*
DESIGNED BY: *BDM*
CHECKED BY: *BDM*
COPYRIGHT: *IGES 2019*

SHEET TITLE

BAYVIEW LANDFILL PERMIT
SITE LOCATION MAP

-



REFERENCE:
ADAPTED FROM MAP
PROVIDED BY CLIENT.

Northern Utah Environmental Resource Agency
Bayview Landfill
10804 South State Route 68
Elberta, Utah

CONSULTANTS

IGES
ideas for a changing world

2702 South 1030 West, Suite 10
Salt Lake City, Utah 84119
(801)270-9400 (T)
(801)270-9401 (F)

NOTES:

MARK	DATE	DESCRIPTION
	10/21/19	DRAFT

ISSUE:

PROJECT NO.: *02260–002*
CAD DWG FILE: *02260\Bayview\Location Map.dwg*
DRAWN BY: *JAH*
DESIGNED BY: *BDM*
CHECKED BY: *BDM*
COPYRIGHT: *IGES 2019*

SHEET TITLE

BAYVIEW LANDFILL PERMIT
USGS
MAP

-

APPENDIX B – UTAH COUNTY CONDITIONAL USE PERMIT

ENT 119954:2018 PG 1 of 2
JEFFERY SMITH
UTAH COUNTY RECORDER
2018 Dec 20 10:16 am FEE 0.00 BY MA
RECORDED FOR UC COMMUNITY DEVELOPMENT

Pursuant to Utah County Ordinance No. 2000-08, the following decision of the Utah County Board of Adjustment is recorded relative to the subject property.

ACTION BY BOARD OF ADJUSTMENT
ACTION TAKEN ON DECEMBER 6, 2018

Appeal No. 1576

Applicant: Northern Utah Environmental Resource Agency

CONDITIONAL USE

When the Board of Adjustment acts under its power to hear and decide requests for conditional use, the Board shall comply with all the rules and standards of the Utah County Land Use Ordinance as found in Section 7-20.

The request of Northern Utah Environmental Resource Agency for an amendment of condition(s) of approval for existing Bayview Landfill to allow additional entities within the applicant's agency to utilize the landfill in the M&G-1, Mining and Grazing zone located at approximately 10804 South 12800 West (State Route 68), Section 17, T9S R1W, Elberta area of Utah County is **granted** based on the following motion:

Motion that the Utah County Board of Adjustment **approve**, with Staff Findings located in the Staff Report, as amended by legal counsel, of the request to amend condition 18 of the original conditional use permit established through Appeal #653, Appeal #981, and Appeal #1034 for the existing Bayview Landfill in the M&G-1 Zone of Utah County, to allow certain current members of Northern Utah Environmental Resource Agency (specifically Wasatch Integrated Waste Management District, Trans-Jordan Cities, South Utah Valley Solid Waste District, and North Pointe Solid Waste Special Service District) to utilize the landfill, subject to the following minimum finding and conditions:

1. That the Board finds the conditional use meets the standards found in Section 7-20-C(1) through (7) of the Utah County Land Use Ordinance;
2. That continued use of the property for a landfill meet all applicable requirements of the Utah State Department of Environmental Quality;
3. That any increase in truck traffic to and from the landfill meet all applicable requirements of the Utah State Department of Transportation related to access from State Route 68;
4. That all applicable conditions of previous approvals for the existing landfill be met.

The decision of the Utah County Board of Adjustment may be appealed to the Fourth District Court within 30 days from the date this Action Report is filed with the Utah County Recorder.

Vote Record:	**AYE**	**NAY**	**ABSTAINED**
Jim Dain	**X**		
Samuel M Otterstrom	**X**		
Thomas V Sakievich	**X**		

I, Joshua Ivie, certify the voting record shown above to be true and correct, and a copy of this Action Report was recorded and filed in the Utah County Community Development Department on the 20th day of December, 2018.

Joshua Ivie, Secretary
UTAH COUNTY BOARD OF ADJUSTMENT

UTAH COUNTY, UTAH
SECRETARY
BOARD OF ADJUSTMENT

EXHIBIT A
61:013:0001
SEC 17, TOWNSHIP 9 S, RANGE 1 W, SLB&M.

APPENDIX C – 2018 ANNUAL REPORT

Div of Waste Management
and Radiation Control

FEB 28 2019

DSHW-2019-002365

LANDFILL ANNUAL REPORT

For Calendar year 2018

Administrative Information (Please enter all the information requested below - type or print legibly)

Facility Name: Bayview Landfill
Facility Mailing Address: 10800 South Highway 68
(Number & Street, Box and/or Route)
City: Elberta Zip Code: 84626
County: Utah Permit No.: 9420R1

Owner

Name: Northern Utah Environmental Resource Agency (NUERA)
Phone No.:(801) 885-4233
Mailing Address: 1997 East 3500 North
(Number & Street, Box and/or Route)
City: Layton State: Utah Zip Code: 84040
Contact's Name: Mark Lamoreaux Title: Manager
Contact's Mailing Address: 1997 East 3500 North, Layton, UT 84040
Phone No.:(801) 885-4233 Contact's Email: mlamoreaux@northernutahera.org

Operator *(Complete this section only if the operator is not an employee of the Owner shown above)*

Name: Phone No.:( )
Mailing Address:
(Number & Street, Box and/or Route)
City: State:Utah Zip Code:
Contact's Name: Title:
Contact's Mailing Address:
Phone No.:( ) Contact's Email Address:

Facility Type and Status

X Class I
☐ Class II
☐ Class IIIa
☐ Class IIIb
☐ Class IVa
☐ Class IVb
☐ Class V
☐ Class VI

Facility operates separate cells for C/D and municipal waste. Yes ☐ No ☐
If facility was permanently closed during the year enter date closed:

Annual Disposal

Total tons received at facility for disposal:

Waste Type	Waste Origin		Total	Measurement	
	In-State	Out-of-State		Tons	Cubic Yards
Municipal	270,966.07		270,966.07	X	☐
Industrial				☐	☐
C/D[1]				☐	☐

[1] C/D waste includes all waste going to a Class IV or VI landfill cell

Conversion Factor Used

X None ☐ From rules ☐ Site Specific Conversion (please list):

Recycling

Material Recycled:____________________ Tons ☐ Cubic Yds. ☐
(Material recycled should not be included in disposed tons reported. Report compost on separate form. Circle tons or yards)

Utah Disposal Fee

Disposal Fee Required to be Paid to State Yes ☐ No ☐ (If yes please show fees paid below)

Municipal	$ 33,000	C/D	$
Industrial	$	Annual	$ 33,000

(Municipal, Industrial and C/D are fees paid by Commercial Facilities. Annual fee is paid by facilities operated by a municipality)

Landfill Capacity

Current Landfill Remaining Capacity
Tons:__________ Cubic Yards:__________
Years: 70+ Acres:__________

Acres Currently Open: 43 Acres Acres Currently Closed: 32 Acres

Financial Assurance

Current Closure Cost Estimate: $ 1,504,312
Current Post-Closure Cost Estimate: $ 1,275,800
Current Amount or Balance in Mechanism: $ 1,292,952 / 929,306
(If facility permit has been renewed if balance does not equal or exceed total for closure and post-closure care please contact the Division)
Current Financial Assurance Mechanism: LOCAL GOV TEST / ESCROW
(ie. Bond, Trust Fund, Corporate or government Test etc.)
Mechanism Holder and Account Number: PTIF 7814
(ie. Name of Bond Company, Bank etc Account number)

Financial Assurance: Each facility must recalculate the cost of closure and post-closure care to account for inflation and design changes each year. The inflation factor can be found on the Division web page. Facilities that are using a trust account should include a copy of the most recent account statement.

Note Facilities using "Local Government Financial Test" or the "Corporate Financial Test" must provide the information required in R315-309-8(4) or R315-309-9(3) each year.

Other Reports and Information

Ground Water Monitoring: Class I and V landfills only. Check if exempt ☐
(PREVIOUSLY SUBMITTED)
Explosive Gas Monitoring: Class I, II and V landfills only. Check if exempt ☐

Training Report: A report of all training programs or procedures completed by facility personnel during the year.

Does the facility have a landfill gas collection system Yes ☐ No X If yes please briefly describe use of gas, e.g., flared or used for electricity generation. __________

Signature: ____________________ **Date: February 20, 2019**
Signature should be by an executive officer, general partner, proprietor, elected official, or a duly authorized representative. A duly authorized representative must meet the requirements of the solid waste rules (UAC R315-310-2(4)(d)).

Print name: Mark Lamoreaux Title: Manager

APPENDIX C

Explosive Gas Monitoring

South Utah Valley Solid Waste District
Bayview Landfill
Quarterly Landfill Gas Monitoring Results

1 Quarter 1

Date 3/21/18

Time 10:45 AM

Weather Cloudy / cool / sprinkles

Temperature 44°
Wind - SE 5 mph

Sample Collector Steve / Kade

Monitoring Device Calibrated Prior to sampling. Yes [✓ No] 102 Days to Calibrate

Monitoring Device Used: PhD Plus Multi Gas Detector Max XT II

	Monitoring Location	Measured %LEL	Internal Action Limit Half Regulatory Limit %LEL	Regulator Action Limit %LEL
Maintenance Shop Outside	✓	0	12	25
Office Lunch Room Inside	✓	0	12	25
North Boundary	✓	0	50	100
South Boundary	✓	0	50	100
East Boundary Leachate Pond	✓	0	50	100
West Boundary Pump House	✓	0	50	100

Gas Sample Collector: If measured %LEL equals or exceeds internal action limit, contact landfill supervisor.

Landfill Supervisor: If measured %LEL equals or exceeds regulatory action limit, notify the State Director, in compliance with 40 CFR 258.23c.

Comments: Cloudy / cool / sprinkles

Samples Collected By Steve Dansie / Kade Eva

South Utah Valley Solid Waste District
Bayview Landfill
Quarterly Landfill Gas Monitoring Results

2 Quarter 2

Date 5/30/18

Time 1:15 PM

Weather Cloudy/WArm Temperature 82°

Sample Collector Steve/Kade

Monitoring Device Calibrated Prior to sampling Yes [✓ No] 32 Days to Calibrate

Monitoring Device Used: PhD Plus Multi Gas Detector MAX XT II

	Monitoring Location	Measured %LEL	Internal Action Limit Half Regulatory Limit %LEL	Regulator Action Limit %LEL
Maintenance Shop Outside	✓	0	12	25
Office Lunch Room Inside	✓	0	12	25
North Boundary	✓	0	50	100
South Boundary	✓	0	50	100
East Boundary Leachate Pond	✓	0	50	100
West Boundary Pump House	✓	0	50	100

Gas Sample Collector: If measured %LEL equals or exceeds internal action limit, contact landfill supervisor.

Landfill Supervisor: If measured %LEL equals or exceeds regulatory action limit, notify the State Director, in compliance with 40 CFR 258.23c.

Comments: Cloudy/Warm

Samples Collected By Steve Dansie/Kade

South Utah Valley Solid Waste District
Bayview Landfill
Quarterly Landfill Gas Monitoring Results

3 Quarter

Date 8/30/18

Time 2:15 PM

Weather Cloudy Breeze Temperature 86°

Sample Collector Steve /KADE

Monitoring Device Calibrated Prior to sampling [✓ Yes] No 180 DAYS to Recalibrate

Monitoring Device Used: PhD Plus Multi Gas Detector MAX XT II

	Monitoring Location	Measured %LEL	Internal Action Limit Half Regulatory Limit %LEL	Regulator Action Limit %LEL
Maintenance Shop Outside		0	12	25
Office Lunch Room Inside		0	12	25
North Boundary		0	50	100
South Boundary		0	50	100
East Boundary Leachate Pond		0	50	100
West Boundary Pump House		0	50	100

Gas Sample Collector: If measured %LEL equals or exceeds internal action limit, contact landfill supervisor.

Landfill Supervisor: If measured %LEL equals or exceeds regulatory action limit, notify the State Director, in compliance with 40 CFR 258.23c.

Comments:

Samples Collected By Steve D. / KADE E.

South Utah Valley Solid Waste District
Bayview Landfill
Quarterly Landfill Gas Monitoring Results

4 Quarter

Date 12/4/18

Time 11:00 AM

Weather Partly Cloudy Cold Temperature 20°

Sample Collector Steve / Kade - Mark L

Monitoring Device Calibrated Prior to sampling. [✓ Yes] No 84 Days to Calibration

Monitoring Device Used: PhD Plus Multi Gas Detector Max XT II

	Monitoring Location	Measured %LEL	Internal Action Limit Half Regulatory Limit %LEL	Regulator Action Limit %LEL
Maintenance Shop Outside		0	12	25
Office Lunch Room Inside		0	12	25
North Boundary		0	50	100
South Boundary		0	50	100
East Boundary Leachate Pond		0	50	100
West Boundary Pump House		0	50	100

Gas Sample Collector: If measured %LEL equals or exceeds internal action limit, contact landfill supervisor.

Landfill Supervisor: If measured %LEL equals or exceeds regulatory action limit, notify the State Director, in compliance with 40 CFR 258.23c.

Comments: ______________________

Samples Collected By Steve / Kade / Mark L

APPENDIX C

Training Reports

SUV SWD

Northern Utah Environmental Resource Agency
(NUERA)

BayView Facility

Training Roster

Subject : Air/Bloodborne Pathogens Location: Facility Breakroom Date: 02/15/2018

Instructor(s): Merlin A. Pacheco ☒ Monthly Safety ☐ Specialized ☐ Certification ☐ Re-Certification

	(Sign) NAME	(Print)		(Sign) NAME	(Print)
1		KADE J EVA	11		
2		Steve Dansie	12		
3		Mike Schuhmann	13		
4		Don Perry	14		
5		Jeff Morrison	15		
6		Michael A. Torres	16		
7	Mark W. Phillips	Mark Phillips	17		
8		Jessie T. Larsen	18		
9	William [illegible]	William [illegible]	19		
10			20		

Instructor/Safety Signature:

Start Time: 0730 / 1005 End Time: 0945 / 1120 Total Hrs: 1.2hr / 1.4hr

Comments:
[LONG VERSION OF BBP PPT]

SUV SWD

Northern Utah Environmental Resource Agency
(NUERA)

BayView Facility

Training Roster

Subject : Forklift Operations - Classroom

Location: Break Room

Date: 03/15/2018

Instructor(s): Merlin A. Pacheco

☒ Monthly Safety ☐ Specialized ☐ Certification ☐ Re-Certification

	NAME (Sign)	NAME (Print)		NAME (Sign)	NAME (Print)
1	William	Isaacson	11		
2	Jesse T. L	Jesse T. Larsen	12	[redacted]	
3		KADE J EVA	13		
4	Mark W. Phillips	Mark Phillips	14		
5		Mike Schuhmann	15		
6		Michael A. Torres	16		
7	Steve Dansie	Steve Dansie	17		
8			18		
9			19		
10			20		

Instructor/Safety Signature:

Start Time: ~~0702~~ 0836 End Time: ~~0756~~ 0938 Total Hrs: ~~0.9hr~~ 1.0hr

Comments:
- Basic Principles of Lifting c̄ load equip. - FEL, Fork Lift, hand truck
  - Lift triangle
  - Load center
  - Center of Gravity
  - Safe Load ht. carry
  - Pedistrian Responsibility

APPENDIX C

SUV SWD

Northern Utah Environmental Resource Agency
(NUERA)

BayView Facility

Training Roster

Subject : Annual OSHA Respiratory
Location: Facility Breakroom
Date: 04/19/2018

Instructor(s): Merlin A. Pacheco

☒ Monthly Safety ☐ Specialized ☐ Certification ☐ Re-Certification

	NAME (Sign)	NAME (Print)		NAME (Sign)	NAME (Print)
1✓	Kade	KADE J Eur	11		
2✓		Jessie T Larsen	12		
3✓		Jeff Morrison	13		
4✓	William Isaacson		14		
5✓	Steve Dansie	Steve Dansie	15		
6✓	Mark W. Phillips	mark Phillips	16		
7✓		Michael A. Torres	17		
8	Don Perry	Don Perry	18		
9			19		
10			20		

Instructor/Safety Signature:

Start Time: 0737 End Time: 0845 Total Hrs: 1.2 hr

~~Start Time: End Time: Total Hrs:~~ MP

Comments:

SUV SWD

Northern Utah Environmental Resource Agency
(NUERA)

BayView Facility

Training Roster

Subject : NUERA Agency Report Form Location: Break Room Date: 05/17/2018

Instructor(s): Merlin A. Pacheco ☐ Monthly Safety ☐ Specialized ☐ Certification ☐ Re-Certification

	(Sign) NAME (Print)			(Sign) NAME (Print)	
1		Jeff Merrin	11		
2	William Isaacson		12		
3		Jesse T. Larsen	13		
4		Michael A. Torres.	14		
5		KADE J EVA	15		
6	Mark W. Phillips	Mark Phillips	16		
7		Don Perry	17		
8	Steve Dansie	Steve Dansie	18		
9	Stacy Tuckett	Stacy Tuckett	19		
10			20		

Instructor/Safety Signature:

Start Time: 0730 End Time: 0835 Total Hrs: 1.0h
Start Time: 0907 End Time: 1012 Total Hrs: 1.0h

Comments:

SUV SWD

Northern Utah Environmental Resource Agency
(NUERA)

BayView Facility

Training Roster

Subject : OSHA Lockout/Tagout Location: Facility Breakroom Date: 06/21/2018

Instructor(s): Merlin A. Pacheco ☒ Monthly Safety ☐ Specialized ☐ Certification ☐ Re-Certification

	(Sign) NAME	(Print)		(Sign) NAME	(Print)
1		KADE S EVA	11		
2	William Isaacson		12		
3		Michael H. Torres	13		
4	Mark W. Phillips	Mark Phillips	14		
5	Steve Dawson	Steve Dassie	15		
6		Dan Perry	16		
7		Jeff Morrison	17		
8	Jessie T. L	Jessie T. Larsen	18		
9			19		
10			20		

Instructor/Safety Signature:

A Start Time: 0730 End Time: 0830 Total Hrs: 1.0hr
B Start Time: 0911 End Time: 1000 Total Hrs: 0.8hr

Comments: - Presented

SUV SWD
Northern Utah Environmental Resource Agency
(NUERA)
Bay View Facility
Training Roster

Subject : Fire Prevention/Fire Extinguisher
Location: Facility Break Room
Date: 07/19/2018

Instructor(s): Merlin A. Pacheco

☒ Monthly Safety ☐ Specialized ☐ Certification ☐ Re-Certification

	NAME (Sign)	NAME (Print)		NAME (Sign)	NAME (Print)
1		KADE J EWA	11		
2		Dan Perry	12		
3	Stacy Tuckett	Stacy Tuckett	13		
4	Jesse T. L	Jesse T. Larsen	14		
5	Mark W. Phillips	Mark Phillips	15		
6		Steve Dansie	16		
7			17		
8			18		
9			19		
10			20		

Instructor/Safety Signature:

Start Time: 0808 End Time: 0908 Total Hrs: 1.0hr
Start Time: 0920 End Time: 1025 Total Hrs: 1.0hr

Comments:

ecture conducted covering:

- 3 Components of Fire Tetrahedron/Fire Triangle – with emphasis on management of FUEL sources at Landfill/Transfer Stations
- The 5 fire extinguisher classifications [A,B,C,D, K] with associated/relevant information
- Decision Points-When to Fight a Fire
  - Flame below waist
  - Clear escape route at back
  - Fire does not involve explosives
  - Comfortable with knowledge/skill of fire extinguisher
- Acronym "Pull Pin – Aim Nozzle, Squeeze Handle, Sweep From Side to Side with associated/relevant information
- Live Fire/Extinguisher Exercise using Facility and HHV contributed FE's

SUV SWD

Northern Utah Environmental Resource Agency
(NUERA)

Bay View Facility

Training Roster

Subject : First Aid/CPR Review

Location: Break Room

Date: 08/16/2018

Instructor(s): Merlin A. Pacheco

☐ Monthly Safety ☐ Specialized ☐ Certification ☐ Re-Certification

	(Sign) NAME	(Print)		(Sign) NAME	(Print)
1		Jessie T. Larsen	11		
2		JEFF MORRISON	12		
3		Steve Dansie	13		
4		Don Perry	14		
5	William [illegible]		15		
6	Mark W. Phillips	Mark Phillips	16		
7		KADE JEUA	17		
8			18		
9			19		
10			20		

Instructor/Safety Signature:

Start Time: 0800 End Time: 0915 Total Hrs: 1.1hr
Start Time: 0945 End Time: 1046 Total Hrs: 1.0hr

Comments:

SUV SWD

Northern Utah Environmental Resource Agency
(NUERA)

Bay View Facility

Training Roster

Subject : HHW Basic Chemistry/Incompatibilities Location: Break Room Date: 09/20/2018

Instructor(s): Merlin A. Pacheco ☒ Monthly Safety ☐ Specialized ☐ Certification ☐ Re-Certification

(Sign) NAME (Print)	(Sign) NAME (Print)
1	11
2 SEE ATTACHED SIGNATURE SHEET	12
3	13
4	14
5	15
6	16
7	17
8	18
9	19
10	20

Instructor/Safety Signature:

Start Time: 0820 End Time: 0912 Total Hrs: 0.9 hr
Start Time: 1020 End Time: 1050 Total Hrs: 0.5 hr

Comments:

Subject: HAZMAT HHW Basic Chemistry/Incompatibilities
Instructor: Merlin A. Pacheco
Location: Break Room
Date 09/20/18

1 Jeff Morrison
2 Wade J Eva
3 Jesse T L Jesse T. Larsen Start 0820 hrs
4 William Isaacsen End 0912 hrs
5 Steve Dansie Steve Dansie
6
7
8
9
10

start 1020
End 1050

SUV SWD

Northern Utah Environmental Resource Agency
(NUERA)

Bay View Facility

Training Roster

Subject : Executive Level Safety Orientation Location: Area Office Date: 11/05/2018

Instructor(s): Merlin A. Pacheco ☐ Monthly Safety ☒ Specialized ☐ Certification ☐ Re-Certification

	(Sign) NAME	(Print)		(Sign) NAME	(Print)
1		Mark Lamoreaux	11		
2			12		
3			13		
4			14		
5			15		
6			16		
7			17		
8			18		
9			19		
10			20		

Instructor/Safety Signature:

Start Time: 0700 End Time: 1007 Total Hrs: ____

~~Start Time: ____ End Time: ____ Total Hrs: ____~~ MP

Comments:

SUV SWD

Northern Utah Environmental Resource Agency
(NUERA)

Bay View Facility

Training Roster

Subject : SWANA Based Spotter/Operator Training Location: Break Room Date: 11/15/2018

Instructor(s): Merlin A. Pacheco ☒ Monthly Safety ☐ Specialized ☐ Certification ☐ Re-Certification

	(Sign)	NAME (Print)		(Sign)	NAME (Print)
1	Brent Shaw	Brent Shaw	11		
2	Mark W. Phillips	Mark Phillips	12		
3	Jonathan Lamb	Jonathan Lamb	13		
4	Steve Dansie	Steve Dansie	14		
5	William Isaacson	William Isaacson	15		
6		KADE J ELA	16		
7			17		
8			18		
9			19		
10			20		

Instructor/Safety Signature:

Start Time: 08:10 End Time: 0850 Total Hrs: 1.4hr
Start Time: 0845 End Time: 1150 Total Hrs: 1.1hr

Comments:

Northern Utah Environmental Resource Agency
(NUERA)

Bay View Facility

Training Roster

Subject : New Hire Safety Orientation Location: Facility Break Room Date: 11/20/2018

Instructor(s): Merlin A. Pacheco ☐ Monthly Safety ☐ Specialized ☐ Certification ☐ Re-Certification

	NAME (Sign)	NAME (Print)		NAME (Sign)	NAME (Print)
Ⓐ 1	Brent Shaw	Brent Shaw	11		
B HAZ COM (0830) 2	Jonathan Lamb	Jonathan Lamb	12		
3			13		
4			14		
5			15		
6			16		
7			17		
8			18		
9			19		
10			20		

Instructor/Safety Signature:

A Start Time: 0784 End Time: 1025 Total Hrs: ______
B 0830 1112

Comments:

Solid Waste Training Institute

789 E 80 N
Kaysville, UT 84037
Phone (801) 773-3155 Fax (801)773-3156

Invoice

Date	Invoice #
1/3/2019	3193

Bill To
Nuera Bayview Landfill 6800 UT 68 Elberta, UT 84626

P.O. No.	Terms	Project

Quantity	Description	Rate	Amount
	Landfill Personnel Training December 2018 Attendees: Steve Dansic, Don Perry, Kade Eva, William Isaacson	200.00	200.00

OK To pay
Please code To
Training

Total	$200.00

UASD

CERTIFICATE OF COMPLETION

This certificate is awarded to

Mark Lamoreaux

in recognition of successful completion of the

UTAH ASSOCIATION OF SPECIAL DISTRICTS PERSONNEL & BOARD MEMBER TRAINING

Presented on this 9th day of November, 2018
during the 30th Annual UASD Convention

Voneene J. Jorgensen

Voneene J. Jorgensen, Chair

Trimble
DIMENSIONS

NOVEMBER 5-7, 2018
THE VENETIAN | LAS VEGAS

Terry Ficklin
tficklin@suvswd.org
Northern Utah Environmental
Resource Agency
P.O. Box 900
Layton, UT 84041
US

Event	Trimble Dimensions 2018
Order Date	09/27/2018
Invoice #	4520
Payment Method	Credit Card

Item	**Unit Cost**	**Quantity**	**Total**
Full Registration - Government	$900.00	1	$900.00
		Total	$900.00
		Balance Due	$0.00

32LBPFJB

Perdium - sunday to thur

Miles to Las Vegas
361 miles one way -

fuzzy_porky@yahoo.com

1-866-708-3213

APPENDIX C

Financial Assurance

2018 Financial Assurance Calculation - unaudited financials

Estimated
Closure Costs
HDR 8/9/2016

	2016	2017	2018
Inflation Adjustment per DWMRC		1.018	1.02389
Total Closure Costs	$ 1,443,234	$ 1,469,212	$ 1,504,312
Post Closure Care Costs	$ 1,224,000	$ 1,246,032	$ 1,275,800
Total Closure and Post Closure Care Costs (2016)	$ 2,667,234		
Adjusted Total Closure and Post Closure Care Costs		$ 2,715,244	$ 2,780,111

Local Government Test 2018

a)	no outstanding bonds		
b)			
	(i) financial ratio grater than 0.05		1.05 yes
	$ 3,111,213.00	cash plus marketable securities	
	$ 2,964,618.00	total expenditures	
	(ii) annual debt service to total expenditures less than 0.2		
	$ -	annual debt service	0 yes
	$ 2,964,618.00	total expenditures	
(c)	audited financial statements		NO
(d)	reference in financial statements		
	maximum assurance		$ 1,292,952
	$ 3,006,866	total annual revenue	
	43%	percent	
	Required by Escrow		$ 1,374,282

2/27/2019

STATEMENT OF ACCOUNT

PTIF

UTAH PUBLIC TREASURERS' INVESTMENT FUND

David Damschen, Utah State Treasurer, Fund Manager
PO Box 142315
350 N State Street, Suite 180
Salt Lake City, Utah 84114-2315
Local Call (801) 538-1042 Toll Free (800) 395-7665
www.treasurer.utah.gov

ESC NUERA BAYVIEW FINANCIAL
NATHAN RICH
PO BOX 900
LAYTON UTAH 84041

Account	**Account Period**
7814	December 01, 2018 through December 31, 2018

Summary

Beginning Balance	$ 467,451.15	Average Daily Balance	$ 779,064.05
Deposits	$ 461,855.05	Interest Earned	$ 1,855.05
Withdrawals	$ 0.00	360 Day Rate	2.7652
Ending Balance	$ 929,306.20	365 Day Rate	2.8036

Date	Activity	Deposits	Withdrawals	Balance
12/01/2018	FORWARD BALANCE	$ 0.00	$ 0.00	$ 467,451.15
12/11/2018	annual p	$ 460,000.00	$ 0.00	$ 927,451.15
12/31/2018	REINVESTMENT	$ 1,855.05	$ 0.00	$ 929,306.20
12/31/2018	ENDING BALANCE	$ 0.00	$ 0.00	$ 929,306.20

1896

State of Utah

GARY R HERBERT
Governor

SPENCER J. COX
Lieutenant Governor

Department of
Environmental Quality

Alan Matheson
Executive Director

DIVISION OF WASTE MANAGEMENT
AND RADIATION CONTROL
Scott T. Anderson
Director

April 4, 2017

Bob Stevenson, Board Chairman
Northern Utah Environmental Resource Agency
P.O. Box 900
Layton, UT 84041

RE: Financial Assurance
Bayview Landfill

Dear Mr. Stevenson:

The Division of Waste Management and Radiation Control has completed its review of the documents from the Northern Utah Environmental Resource Agency (NUERA) addressing closure and post-closure cost estimates and changes to financial assurance for the Bayview Landfill in Utah County now owned by NUERA.

The financial assurance mechanisms chosen by NUERA are a trust fund through the Utah Public Treasurers' Investment Fund (PTIF) in the amount of $1,827,444.00 and a Local Government Financial Test in the amount of $839,790.00. Your proposed actions regarding the two financial assurance mechanisms are as follows:

1) Four annual payments of $456,861.00 shall be made to the PTIF beginning in 2017 with the last payment in 2020, for a total of $1,827,444.00, and
2) The Local Government Financial Test for 839,790.00 shall be completed and sent to the Director by July 15, 2017 for review.

Recognizing that payments to the PTIF will be made over four years, funds currently held by the South Utah Valley Solid Waste District for Bayview Landfill will be released upon receipt of documentation that the 2017 PTIF payment of 456,861.00 has been made and upon approval of the Local Government Financial Test.

(Over)

195 North 1950 West • Salt Lake City, UT
Mailing Address: P O. Box 144880 • Salt Lake City, UT 84114-4880
Telephone (801) 536-0200 • Fax (801) 536-0222 • T D.D. (801) 903-3978
www.deq.utah.gov
Printed on 100% recycled paper

If you have any questions, please call Matt Sullivan at (801) 536-0241.

Sincerely,

Scott T. Anderson, Director
Division of Waste Management and Radiation Control

STA/MBS/jr

c: Ralph Clegg, EHS, MPA, Director, Utah County Health Department
Bryce C. Larsen, MPA, LEHS, Environmental Health Director, Utah County Health Department
Nathan Rich, NUERA Secretary
Terry Ficklin, NUERA

Bayview Landfill
Closure and Post Closure Care Cost Estimate
(2016 Dollars)

COST ESTIMATE FOR LANDFILL CLOSURE

Landfill Units	Area (Acres)
Cell 1 (Closed)	0
Cell #2 - Stage 1	20
Cell #2 - Stage 2	23
Total	**43**

	Item	Unit	Unit Cost (2016$)	Quantity	Cost
1.0	**Engineering/Management**				
1.01	Topo Survey and Control	LS	$20,000	1	$20,000
1.02	Topo Survey Final	LS	$10,000	1	$10,000
1.03	Engineer Site Visits	HR	$200	40	$8,000
1.04	Construction Plans and Specifications	LS	$100,000	1	$100,000
1.05	Bidding and Award	LS	$10,000	1	$10,000
1.06	Quality Control Testing	LS	$35,000	1	$35,000
1.07	Construction Management/Quality Assurance	LS	$75,000	1	$75,000
1.08	Closure Report/As-Builts	LS	$25,000	1	$25,000
1.09	SWPPP preparation, UPDES and other permits	LS	$15,000	1	$15,000
			Subtotal		$298,000
			Contingency	10%	$29,800
			Engineering Subtotal		**$327,800**

2.0	**Construction**		**Unit Cost (2016$)**	**Quantity**	**Cost**
2.01	Mobilization/Demobilization	LS	$50,000	1	$50,000
2.02	Waste Grading [(1)]	CY	$3.00	10,500	$31,500
2.03	Finish Grading Intermediate Cover [(2)]	SY	$0.75	208,120	$156,090
2.04	Final Cover, 34" On-site Soil, Placement/ Grading [(2) (5) (6)]	CY	$2.75	196,970	$541,668
2.05	Seeding	ACRE	$1,000.00	43	$43,000
2.06	Final Cover Runoff/Erosion Controls	LF	$3.00	5,000	$15,000
2.07	Leachate Collection [(3)]	LF	$60.00	0	$0
2.08	Silt Fence/Erosion Control [(4)]	LS	$20,000	1	$20,000
2.09	Dust Control	LS	$15,000	1	$15,000
2.10	Gas Collection System [(7)]	ACRE	$25,000.00	0	$0
			Subtotal		$872,258
			Contingency	20%	$174,452
			Construction Subtotal		**$1,046,709**

Summary		
1. Engineering		$327,800
2. Construction		$1,046,709
3. Legal	5%	$68,725
Total Closure Costs (2016$)		**$1,443,234**

Assumptions/Notes:

1 Assumes a portion of waste needs minor regrading to create stable side slopes, 1' foot across 15% of area.

2 Estimate assumes closure of Cell #2 Stages 1 and 2 with an alternative final cover similar to the one approved for Cell 1.

3. Leachate collection system was constructed with Cell 2 Stage 2 and no additional improvements are necessary

4. No existing drainage channel protections, permanent culverts, or storm drainage piping are required.

5 Assumes final cover soil is hauled from stockpile/excavation areas near Bayview and no extra compactive effort is needed.

6. Assumes topsoil is available onsite.

7. Active landfill gas collection system (LFGCS) for Cell 2 is not required at this time. LFGCS for Cell 1 will be constructed by a 3rd party under contract. SUVSWD will require that the 3rd party provide a separate financial assurance plan for the long-term maintance, decommissioning, and post-closure care.

Bayview Landfill
Closure and Post Closure Care Cost Estimate
(2016 Dollars)

COST ESTIMATE FOR LANDFILL POST-CLOSURE CARE

	Item	Unit	Unit Cost (2016$)	Quantity	Cost
1.0	**ENGINEERING**				
1.1	Post Closure Plan Review	LUMP	$10,000	1	$10,000
1.3	Budget for Corrective Action Plans & Specs	LUMP	$50,000	1	$50,000
2.0	**ENVIRONMENTAL MONITORING**				
2.1	Site Inspections (Quarterly)	PER QUARTER	$1,000	120	$120,000
2.2	Groundwater Monitoring (1)	PER YEAR	$18,000	30	$540,000
2.3	Landfill Gas Monitoring (2)	PER YEAR	$5,000	30	$150,000
3.0	**MAINTENANCE COSTS**				
3.1	Final Cover Maintenance (3)	PER YEAR	$4,000	30	$120,000
3.2	Fix Fences and Gates	PER YEAR	$500	30	$15,000
3.3	SWPPP Updates, UPDES and other permit renewals	PER YEAR	$500	30	$15,000
4.0	**LEACHATE DISPOSAL**				
4.1	Collection, testing, disposal (5)	PER YEAR	$10,000	0	$0
			Subtotal		$1,020,000
			Contingency	20%	$204,000
			Total Post-Closure Care (2016$)		$1,224,000

Closure Cost Estimate (previous page)	**$**	**1,443,234**
Total Closure & Post Closure Care	**$**	**2,667,234**

Assumptions/Notes:

1. Includes groundwater sampling, laboratory analysis, statistical analysis, and reporting
2. Monitoring and reporting only Maintenance and/or decommissioning of a LFGCS installed by a 3rd party for Cell 1 is covered under a seperate financial assurance mechanism
3. Includes Cell 1 and Cell 2 and assumes repairing eroded final cover material with on site material and adding compost and seeding.
4. Includes power to run existing leachate pumps.
5. Leachate is retained on site, no testing or dipsosal is required.

Northern Utah Environmental Resource Agency

Statement of Net Assets as of
December 31, 2018

ASSETS		**NUERA 2018**
Cash & Cash Equivalents		
Petty Cash	**$**	**397**
PTIF 7814 Escrow Closure & Post Closure Bayview	**$**	**929,306**
PTIF 8392 Account Bayview	**$**	**1,267,302**
Wells Fargo Checking Account Admin	**$**	**28,109**
Wells Fargo Checking Account Bayview	**$**	**827,479** +
Wells Fargo Checking Account Safety	**$**	**58,619**
Total Cash & Cash Equivalents	**$**	**3,111,213** ✓
Accounts Receivable	**$**	**485,094**
Fixed Assets		
Equipment and Vehicles	**$**	**845,981**
Land Improvements	**$**	**734,677**
Bayview Landfill Purchase	**$**	**5,750,000**
Accumulated Depreciation		**(1,928,898)**
Total Fixed Assets	**$**	**5,401,760**
Other Assets		
N/R Safety from Bayview	**$**	**216**
Prepaid - Bayview Expenses	**$**	**56,730**
Deferred Outlflows of Resources Related to Pensions	**$**	**204,176**
Total Other Assets	**$**	**261,123**
TOTAL ASSETS	**$**	**9,259,190**
Liabilities		
Accounts Payable	**$**	**243,626**
WF Credit Card	**$**	**3,585**
Fuelman Credit Card	**$**	**238**
Bayview N/P to Safety	**$**	**-**
Payroll Accruals	**$**	**99,955**
Bayview Closure and Post Closure Liability	**$**	**2,250,027**
Net Pension Liability	**$**	**144,389**
Deferred Inflows of Resources Related to Pensions	**$**	**94,528**
Total Liabilities	**$**	**2,836,349**
Net Assets		
Net Investment in Capital Assets	**$**	**5,401,760**
Unreserved Net Assets	**$**	**1,021,081**
Total Net Assets		**6,422,841**
TOTAL LIABILITIES & NET ASSETS	**$**	**9,259,190**

Northern Utah Environmental Resource Agency

2018 Nuera Bayview Statement of Revenue and Expenses and Changes in Net Assets and Budget Comparison

Participants: Wasatch Integrated Waste Management, South Utah Valley Solid Waste District, Trans-Jordan Cities, North Pointe Solid Waste

January Through December 2018

APPENDIX C

	Nuera 2018	Annual Budget	*Percent of Annual Budget*	Favorable/ (Unfavorable) YTD
Operating Revenue:				
Bayview Project (Solid Waste Tonnage Fees)	$ 2,877,202	$ 2,766,750	*104%*	$ 110,452
FGM Product Sold	$ 2,163			
Fees & Fines	-	$ -		
Recycling Revenue	$ -	$ -		
Total Operating Revenue	$ 2,879,366	$ 2,766,750	*104%*	$ 110,452
Operating Expenses:				
Payroll	$ 619,421	$ 696,981	*89%*	$ 77,560
Supplies	$ 294,873	$ 306,150	*96%*	$ 11,277
Utilities	$ 16,542	$ 19,200	*86%*	$ 2,658
Repairs & Maintenance	$ 167,717	$ 196,000	*86%*	$ 28,283
Travel and Training	$ 2,359	$ 7,500	*31%*	$ 5,141
Property & Equipment Insurance	$ 54,371	$ 90,000	*60%*	$ 35,629
Professional Services	$ 174,737	$ 316,300	*55%*	$ 141,563
License & Fees	$ 73,504	$ 63,000	*117%*	$ (10,504)
Closure/Post Closure Expense	$ -	$ 100,000	*0%*	$ 100,000
Land Rent	$ 213,386	$ 175,400	*122%*	$ (37,986)
Administrative Operating Expense	$ 54	$ 2,000	*3%*	$ 1,946
Contingency (Other)	$ -	$ 25,000	*0%*	$ 25,000
Depreciation Expense	$ - 1,040,121	$ 978,424	*106%*	$ (61,697)
	4			
Total Operating Expenses	$ 2,657,084	$ 2,975,955	*89%*	$ 318,871
Total Operating Income (loss)	$ 222,282	$ (209,205)		
Nonoperating Revenues (Expenses):				
Contributions (Intergovernmental)	$ -	$ -		
Interest Income-PTIF Account	$ 49,973	$ 2,477		$ 47,496
Interest Income-Wells Fargo Checking	$ 139	$ -		$ 139
Expense Reimbursements	$ 1,162	$ -		$ 1,162
Total Nonoperating Income (loss)	$ 51,274	$ 2,477		
Change in Net Position	$ 273,556	$ (206,728)		
Capital Expenses (See Detailed Summary)	$ + 1,347,655	$ 1,347,655	*100%*	$ 0
	2,964,618			Total Favorable/ (Unfavorable)
Revenue	$ 2,930,640	$ 2,769,227	*106%*	159,249
Fund Transfer	$ 1,074,099	$ 1,349,228		
Total Sources	$ 4,004,739	$ 4,118,455		
Total Expenses	$ 4,004,739	$ 4,323,610	*93%*	$ 318,871

APPENDIX D – SPECIAL USE LEASE AGREEMENTS

APPENDIX B

Special Use Lease Agreement

SUVSWD Bayview Class I Landfill
Permit Application

January 6, 1984

Dale

Provo City Corporation
359 West Center Street
Provo, Utah 84601

RE: SULA #49

Gentlemen:

Enclosed please find two copies of the above referenced special use lease. Please sign both copies have your signature notarized and return both copies to this office, at which time we will send you the fully executed original for your file and reference.

Thank you.

Sincerely,

RBW

Richard B. Wilcox
LAND SPECIALIST

RBW:jcl

Enclosures (2)

Note - paragraph 6 has been added to the lease.

RECEIVED
JAN 10 1984
PROVO CITY MAYOR

APPENDIX D

SPECIAL USE LEASE AGREEMENT NO. 498

School Fund

The STATE OF UTAH, acting by and through the DIVISION OF STATE LANDS, LESSOR, hereby leases to Provo City Corporation, LESSEE, 359 West Center Street, Provo, Utah 84601, the following described tract of State land in Utah County, Utah , to-wit:

Parcel "A":

Township 9 South, Range 1 West, SLB&M
Section 17: SW¼NW¼

Containing 40 acres, more or less.

Parcel "B":

Township 9 South, Range 1 West, SLB&M
Section 17: That portion of the section ot described by Parcel "A".

Containing 600 acres, more or less.

TO HAVE AND TO HOLD for a term of 51 years, beginning as of January 1, 1984, subject to any and all existing valid rights in said land and subject also to the following terms and conditions. LESSOR and LESSEE enter into this Special Use Lease Agreement for the purpose that LESSEE develop the land in the manner hereinafter described and consistent with the principles and objectives of land development expressed and implicit in the Enabling Act of Utah (Act of July 16, 1894, Ch. 138, 28 Stat. 107) and Article X of the Constitution of the State of Utah.

1. The subject tract shall be used by LESSEE for the purpose of constructing and maintaining a sanitary landfill, including all improvements reasonably associated therewith. All improvements constructed on the subject tract shall comply with the applicable provisions of the Uniform Building Code, Current Edition, International Conference of Building Officials.

2. LESSEE shall pay, to the LESSOR as rental, for the subject tract, the sum of $1,000.00 per year until LESSEE commences construction of the sanitary landfill on the subject property, after which the annual rate shall be $40.00 per acre per annum for that portion of the subject property which is currently being used as the sanitary landfill proper (Parcel A). The sanitary landfill proper is that portion of the subject tract enclosed by a fence and which is used for sanitary landfill purposes. The fee for that portion of the subject property which is not currently being used as the sanitary landfill proper is $10.00 per acre per annum (Parcel B). The annual lease fee, based on th above rates is $7600.00 per annum. LESSOR acknowledges the receipt of $1,020.00 which is payment of this rental for the year January 1, 1984 through December 31, 1984 plus the $20.00

application fee. Should construction on the sanitary landfill commence during the 1984 rental year, or any other subsequent rental year, the lease rates will be prorated according to the rates as outlined above. Failure to pay the rental for a period of one month from the date such rent is due shall work a forfeiture of the lease upon expiration of thirty (30) days written notice by LESSOR to LESSEE, requiring performance, if payment shall not be made within said thirty (30) day period.

3. LESSEE agrees that LESSOR shall have the right to adjust the annual rentals as provided for in Paragraph 2 at the end of each five (5) year period as LESSOR shall deem to be reasonably necessary in the best interest of the State.

LESSEE also agrees that at the end of five (5) years from the date of this lease, and, if necessary, for each two (2) year period thereafter, LESSEE has not developed the land as proposed in Paragraph (1), LESSEE shall then be required to appear before the Board of State Lands and show that it has exercised due diligence toward development of the land. If LESSEE fails to show due diligence, then LESSEE agrees that LESSOR may at its option, terminate this lease agreement as to any or all the land leased hereunder. In the event LESSOR so terminates, LESSEE 's interest in the land shall revert to the State.

4. LESSEE, in exercising the privileges granted by this lease, shall comply with the provisions of all valid Federal, State, County, and Municipal laws, ordinances, and regulations which are applicable to the subject tract and operations covered by this lease.

5. LESSEE shall take reasonable precautions to protect, in place, all public land survey monuments and private property corners.

6. LESSEE shall be bound by all of the provisions, conditions, and prohibitions of Chapter 14 of Title 73, Utah Code Annotated (1953) as amended. No waste or by-products shall be discharged which contain any substance in concentrations which will result in substantial harm to fish and wildlife, or to human water supplies. Storage facilites for materials capable of causing water pollution, if accidentally discharged, shall be located so as to prevent any spillage into waters, or channels leading into water, that would result in substantial harm to fish and wildlife or to human water supplies.

7. LESSEE agrees to permit LESSOR free and unrestricted access to and upon the subject tract at all reasonable times for all lawful and proper purposes not inconsistent with the intent of this lease or with the reasonable exercise and enjoyment by the LESSEE of the rights and privileges granted herein.

8. It is hereby understood and agreed that all treasure-trove and all articles of antiquity in or upon the subject lands are and shall remain the property of the State of Utah. LESSEE shall report any discovery of a "site" or "Specimen" to the Division of State History in compliance with the provisions of Section 63-18-27, Utah Code Annotated (1953), as amended.

9. LESSEE may relinquish or surrender this lease at any time during the term hereof by giving LESSOR one year's advance written notice, and by paying all rentals due to the effective date of such relinquishment or surrender; provided, all accounts are in good standing and all terms and conditions have been performed by LESSEE. The relinquishment or surrender shall become effective upon written acceptance thereof by LESSOR.

10. This lease may be terminated by LESSOR upon breach of any conditions hereof. If LESSOR determines that the LESSEE, its assigns or successors in interest have breached any conditions of this lease, LESSOR shall notify the breaching party (parties) in writing by certified mail, return receipt requested, specifying the particular breach. The breaching party (parties) shall have thirty (30) days from the date of such notice, or such longer period as may reasonably be required under the circumstances, to correct such breach. If breaching party (parties) fails (fail) to correct such breach within such period, LESSOR may terminate this lease upon thirty (30) days notice; provided, however, such termination shall not release breaching party (parties) from liability for damage prior to such termination.

11. This lease is made pursuant to the provisions of all applicable laws and subject to the rules and regulations of the departments and agencies of the State of Utah presently in effect and to such laws, rules and regulations as may be hereafter promulgated by the State.

12. It is understood that the LESSEE will use the subject lands as a sanitary landfill and consistent with such a use, the LESSEE shal maintain the subject lands in a reasonable state of repair, orderliness, neatness, sanitation and safety. In no event shall the condition of the subject lands be less than that required by law and applicable regulations.

13. LESSEE shall have the right to remove any improvements and any personal property placed on the lands by LESSEE, provided that the same shall be removed within sixty (60) days after the expiration of the term of this lease, provided that the LESSEE shall properly restore any damage caused thereby to the subject tract or any improvements remaining thereon; provided further, that LESSOR shall have the option to retain without compensation to LESSEE any and all underground pipes or facilities for water and sewer now on the premises or subsequently installed thereon by LESSEE.

14. LESSEE assumes liability for and agrees to indemnify LESSOR for and against any and all liability (including attorney's fees) of any nature imposed upon, incurred by, or asserted against LESSOR which in any way relates to or arises out of the activity or presence upon the premises of LESSEE, its servants, employees, agents, sublessees, assignees or invitees.

15. LESSEE shall not assign this lease, in whole or in part, nor sublease the leased premises, nor allow unauthorized or commercial use of the premises without obtaining the prior written consent of LESSOR.

16. LESSOR expressly reserves the right to lease said lands to third parties for mineral exploration and/or development purposes together with the right to grant the mineral lessee reasonable access by ingress and egress to and from the mineral estate through the surface estate in connection with mineral exploration and/or development, but without damage to improvements made by LESSEE. Provided, however, that the rights reserved by this paragraph and any rights conveyed by the LESSOR to a mineral lessee shall in no event be inconsistent with the construction or maintenance of a sanitary landfill.

17. LESSOR claims title in fee simple, but does not warrant to LESSEE the validity of title to the leased premises. LESSEE shall have no claim from damages or refund against the LESSOR for any claimed failure or deficiency of LESSOR's title to said lands or for interference by any third party.

18. If LESSEE shall initiate or establish any water right on the leased premises, such right shall become an appurtenance of the leased premises. LESSEE agrees that any existing application to appropriate water on said State land shall be transferred to the Division of State Lands after the application has been completed, without any cost to the State. It is expressly understood and agreed that this lease does not confer any rights upon LESSEE to use any water presently developed on the subject lands.

19. LESSEE shall at all times observe reasonable precautions to prevent fire on the leased premises and shall comply with all applicable laws and regulations of any governmental agency having jurisdiction. In the event of a fire on the leased premises proximately caused by LESSEE, its servants, employees, agents, sublessees, assignees or licensees which necessitates suppression action by the State Forester, LESSEE agrees to reimburse LESSOR for the cost of such fire suppression action.

20. LESSEE shall comply with any and all valid sanitation and pollution regulations prescribed by any governmental agency having jurisdiction; and the LESSEE agrees to indemnify LESSOR for any damage which LESSOR may suffer which arises out of the improper or unlawful disposal of refuse associated with said land.

21. LESSEE may fence the leased premises at his own expense, but if there is no fence erected, LESSEE shall have no right of action against any other State grazing permittee by reason of a trespass upon the leased premises.

22. In the event of any breach of this agreement, the party at fault shall pay all costs of enforcing the same, including reasonable attorney's fees.

23. Any notice contemplated herein to be served upon LESSEE shall be in writing and shall be deemed sufficient if deposited in the United States mail, postage prepaid and certified or registered, and addressed as follows:

Provo City Corporation
359 West Center Street
Provo, Utah 84601

or at any such other address as LESSEE may from time to time designate by written notice to LESSOR.

24. The provisions hereof shall inure to and be binding upon the successors and assigns of LESSEE.

25. IN WITNESS WHEREOF, the Director of the Utah Division of State Lands has executed this instrument as of the ____________ day of ______________, 1983, by authority of a resolution of the Board of State Lands, dated January 20, 1982.

LESSOR: STATE OF UTAH
DIVISION OF STATE LANDS
3100 State Office Building
Salt Lake City, Utah 84114

By: ____________________________
RALPH A. MILES, Director

ATTORNEY GENERALS OFFICE
APPROVED AS TO FORM
By

LESSEE:

By: ____________________________

STATE OF UTAH)
: ss.
COUNTY OF SALT LAKE)

On the ________ day of ______________, 1983, personally appeared before me Ralph A. Miles, who being by me duly sworn did say that he is the Director of the Division of State Lands of the State of Utah, and that said instrument was signed in behalf of said Board by resolution of the Board, and said Ralph A. Miles acknowledged to me that said Board executed the same in behalf of the State of Utah.

Given under my hand and seal this ________ day of ____________, 1983.

____
Notary Public, residing at:

My Commission Expires:

26.

STATE OF UTAH)
: ss.
COUNTY OF)

On the ________ day of _______________, 1983, personally appeared before me _______________________________________, who being by me duly sworn did say that he is the ____________________________ of Provo City Corporation, and said ________________________________ acknowledged to me that said City executed the same.

Given under my hand and seal this __________ day of _______________, 1983.

____
Notary Public, residing at:

My Commission Expires:

AMENDMENT

TO

SPECIAL USE LEASE AGREEMENT NO. 498

The STATE OF UTAH, acting by and through the DIVISION OF STATE LANDS & FORESTRY, LESSOR, and Provo City Corporation, LESSEE, hereby agree to amend Special Use Lease Agreement No. 489, as follows:

The leased premises shall include, in addition to Parcel "A" and Parcel "B" as described in SULA No. 498, Parcel "C" which is a tract of State land in Utah County, Utah, to-wit:

Township 9 South, Range 1 West, SLB&M
Section 18: S2SE4NE4

Containing 20 acres

1. Parcel "C" shall be used by LESSEE for the purpose of constructing and maintaining a water well and water tank to be used in conjuction with a sanitary landfill including improvements reasonably associated . All improvements constructed on the subject tract shall comply with the applicable provisions of the Uniform Building Code, Current Edition, International Conference of Building Officials.

2. LESSEE shall pay, to the LESSOR as rental, for the subject tract the sum of $1000.00 per year until LESSEE commences construction of the sanitary landfill on the subject property, after which the annual rate shall be $40.00 per acre per annum for that portion of subject property which is currently being used as the sanitary landfill proper (Parcel A). The sanitary landfill proper is that portion of the subject tract enclosed by a fence which is used for sanitary landfill purposes. The fee for that portion of the subject property which is not currently being used as the sanitary landfill proper is $10.00 per acre per annum (Parcel B). The fee for that portion of the subject property which is used for the water well and water tank site (Parcel C) will be $600.00 per year. The annual lease fee, based on the above rates is $8,200.00 per annum.

3. IN WITNESS WHEREOF, the Director of the Utah Division of State Lands and Forestry has executed this instrument as of the 14th day of JAN., 1987, by authority of a resolution of the Board of State Lands, dated January 20, 1982.

LESSOR: STATE OF UTAH
DIVISION OF STATE LANDS AND FORESTRY
3 Triad Center, Suite 400
355 West North Temple
Salt Lake City, Utah 84180

By: Ralph A. Miles
RALPH A. MILES, Director

APPROVED AS TO FORM:
DAVID L. WILKINSON
ATTORNEY GENERAL

BY: David Christensen

LESSEE: Provo City Corporation
359 West Center
Provo City, UT 84601

By: Joseph A. Jenkins

STATE OF UTAH)
: ss.
COUNTY OF SALT LAKE)

On the 14th day of January, 1987, personally appeared before me Ralph A. Miles, who being by me duly sworn did say that he is the Director of the Division of State Lands and Forestry of the State of Utah, and that said instrument was signed in behalf of said Board by resolution of the Board, and said Ralph A. Miles acknowledged to me that said Board executed the same in behalf of the State of Utah.

Given under my hand and seal this 14th day of January, 1987.

Jan C. Lucas
Notary Public, residing at: S.L.C.

My Commission Expires: 4-16-90

4.

STATE OF UTAH)
: ss.
COUNTY OF)

On the 31 day of Dec., 1986, personally appeared before me Joseph A. Jenkins, who being by me duly sworn did say that he is the Mayor of Provo City, and said Joseph A. Jenkins acknowledged to me that said company executed the same.

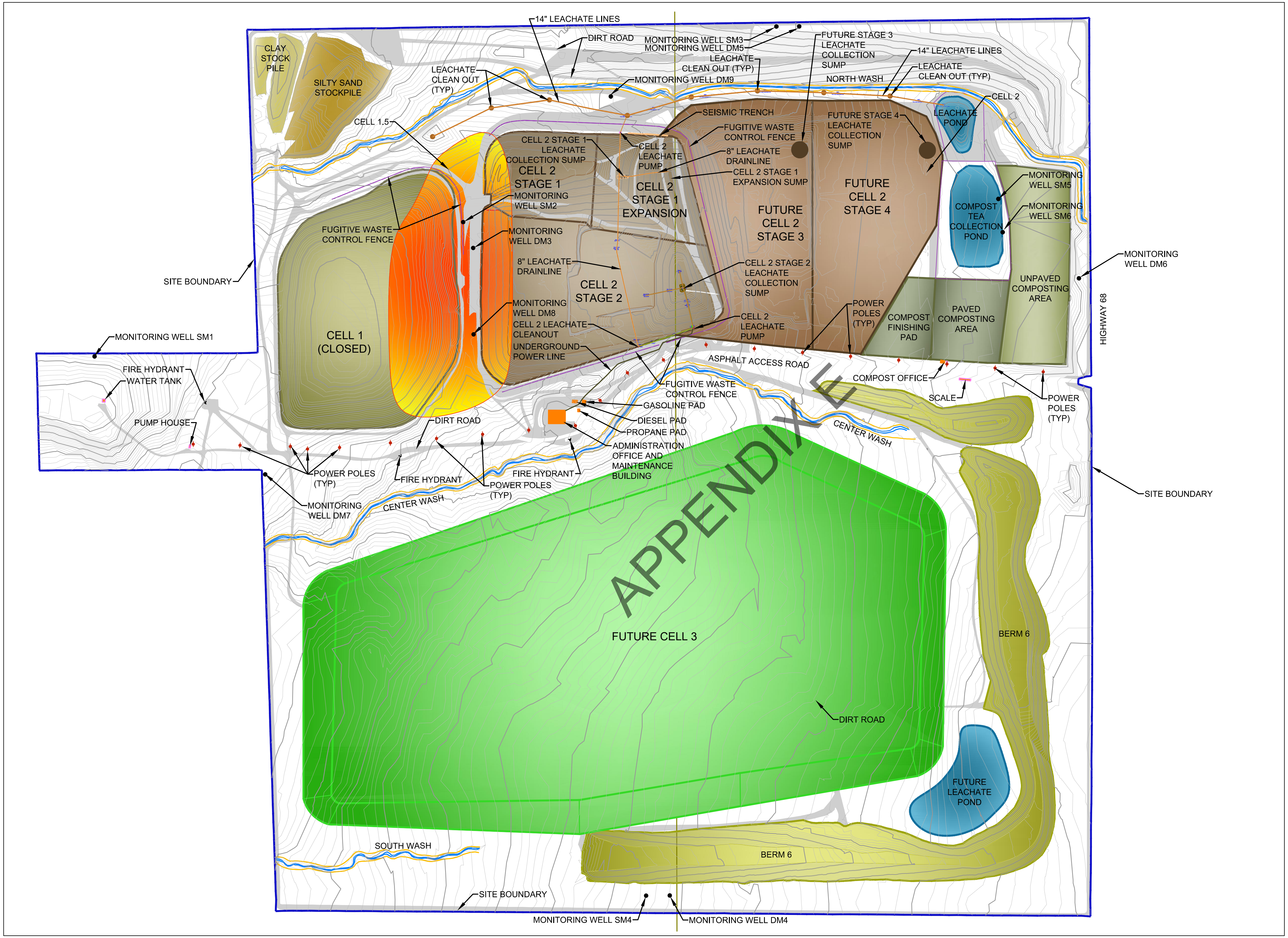
Given under my hand and seal this 31 day of Dec., 1986.

Dean Eklund
Notary Public, residing at:

My Commission Expires:
12-10-90

APPENDIX E – GENERAL ARRNAGEMENT

APPENDIX E



REFERENCE:
ADAPTED FROM MAP
PROVIDED BY CLIENT.

0 150 300 600 900
SCALE IN FEET

Northern Utah Environmental Resource Agency
Bayview Landfill
10804 South State Route 68
Elberta, Utah

CONSULTANTS

IGES
ideas for a changing world

2702 South 1030 West, Suite 10
Salt Lake City, Utah 84119
(801)270-9400 (T)
(801)270-9401 (F)

NOTES:

MARK	DATE	DESCRIPTION
	10/21/19	DRAFT

ISSUE:

PROJECT NO.: 02260–002
CAD DWG FILE: 02260\Bayview\Location Map.dwg
DRAWN BY: JAH
DESIGNED BY: BDM
CHECKED BY: BDM

SHEET TITLE

BAYVIEW LANDFILL PERMIT
GENERAL ARRANGEMENT

-

APPENDIX F – LANDFILL FORMS

	Machine												Machine									
Date	836K	836H	836G	623 Old	623 New	D8R	D8T	Grader	WW	WT Kenwo	B Dodge	F350	Loader	W Dodge	Tipper	LGT Plants	Ranger	Welder	F150	F350 old	Misc	Misc
3-Sep																						
4-Sep																						
5-Sep																						
6-Sep																						
7-Sep																						
8-Sep																						
9-Sep																						
10-Sep																						
11-Sep																						
12-Sep																						
13-Sep																						
14-Sep																						
15-Sep																						
16-Sep																						
17-Sep																						
18-Sep																						
19-Sep																						
20-Sep																						
21-Sep																						
22-Sep																						
23-Sep																						
24-Sep																						
25-Sep																						
26-Sep																						
27-Sep																						
28-Sep																						
29-Sep																						
30-Sep																						

APPENDIX F

Machine

Loader	W Dodge	Tipper	LGT Plants	Ranger	Welder	F150	F350 old	Misc	Misc

	Machine														
Date	836K	DEF	836H	836G	623 Old	623 New	D8R	D8T	DEF	Grader	WW	WT Kenworth	B Dodge	F350	MISC
3-Sep															
4-Sep															
5-Sep															
6-Sep															
7-Sep															
8-Sep															
9-Sep															
10-Sep															
11-Sep															
12-Sep															
13-Sep															
14-Sep															
15-Sep															
16-Sep															
17-Sep															
18-Sep															
19-Sep															
20-Sep															
21-Sep															
22-Sep															
23-Sep															
24-Sep															
25-Sep															
26-Sep															
27-Sep															
28-Sep															
29-Sep															
30-Sep															

South Utah Valley Solid Waste District
Bayview Landfill
Quarterly Landfill Gas Monitoring Results

_____ Quarter _____

Date __________

Time __________

Weather ____ Temperature __________

Sample Collector ______________

Monitoring Device Calibrated Prior to sampling Yes No

Monitoring Device Used: PhD Plus Multi Gas Detector

	Monitoring Location	Measured %LEL	Internal Action Limit Half Regulatory Limit %LEL	Regulator Action Limit %LEL
Maintenance Shop Outside			12	25
Office Lunch Room Inside			12	25
North Boundary			50	100
South Boundary			50	100
East Boundary Leachate Pond			50	100
West Boundary Pump House			50	100

Gas Sample Collector: If measured %LEL equals or exceeds internal action limit, contact landfill supervisor.

Landfill Supervisor: If measured %LEL equals or exceeds regulatory action limit, notify the State Director, in compliance with 40 CFR 258.23c.

Comments: ____

____

Samples Collected By ________________

Weekly Visual Inspection and Maintenance Report

Person Conducting Inspection:	
Date (MM/DD/YY)	

GOOD HOUSEKEEPING

Instructions: As necessary, review section 5.3, Good Housekeeping: Mark "Y" (yes) or"N" (no) as appropriate. For each "N", note question number and corrective action(s) in the space below

	Y		N	1	Is the maintenance building orderly and neat
	Y		N	2	Is there adequate space in the work areas? Are work areas free of clutter?
	Y		N	3	Are equipment, materials, and tools stored properly?
	Y		N	4	Are materials properly labeled and stored?
	Y		N	5	Is the material inventory up to date?
	Y		N	6	Are employees receiving regular training?
	Y		N	7	Is there evidence of drips or leaks from equipment or machery on site?
	Y		N	8	are outside areas orderly and neat?
	Y		N	9	Are roads, walkways, and other passageways easily accessible, safe, and free of protruding objects, materials, or equipment?
	Y		N	10	Is blown litter collected regulary?

No:	**Corrective Action(s)**

Preventive Maintenance

Instructions: As necessary, review section 5.4, preventive maintenance. As appropriate, inspect each facility feature for leaks, spills, signs of errosion, proper operation, etc. Indicate the type of test or observation: "V" for visual observation, "O" for other (if other, indicate type of test, e.g., pump ooperation). Note Condition as "S" (satisfactory) or "N" (not satisfactory) For each "N", include comments the corrective action(s) taken, such as maintenance performed.

Facility Feature	**Type of Observation or Test**	**Condition**	**Comments (Corrective action, etc)**
Active Landfill Working Face	V O	S N	
Leachate Conveyance Piping and Equipment	V O	S N	
Leachate Pond	V O	S N	
Landfill Slopes	V O	S N	
Berms	V O	S N	
Drainage Channels	V O	S N	
Culverts	V O	S N	
Outfalls	V O	S N	
Structural BMP's (Silt Fence, Straw Bales, etc.)	V O	S N	
Vegetative Cover	V O	S N	
Newly Graded Areas	V O	S N	
Heavy Equipment	V O	S N	
Storage Areas	V O	S N	
AST's	V O	S N	
Secondary	V O	S N	
Previous Spill & Leak Areas	V O	S N	

STATE OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF AIR QUALITY
VISIBLE EMISSION OBSERVATION FORM

Page _1_ of ____

APPENDIX F

Type of Inspection: Initial ( ) Partial Initial ( ) Stack Test ( ) CEM ( ) Annual ( ) Followup ( ) Surveillance ( ) Complaint ( )

Source Name: ____________________

Street Address: ____________________

City/County: ____________________

Phone: ____________________

AIRS ID: ____________________

____

Facility: ____________________

Equipment: ____________________

Control Equipment: ____________________

____

Emission Point: ____________________

____

Height of Discharge Relative in Observer: ____________________

Distance from Observer: ____________________

Condensed Water Vapor Present? Y / N

Attached ☐ Detached ☐

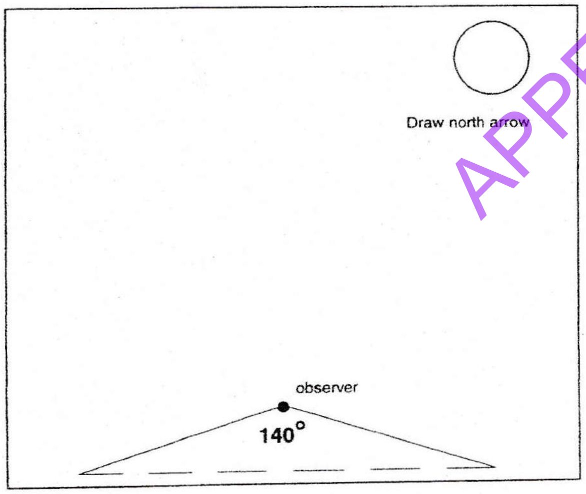
Length of Condensed Water Vapor Plume: ____________________

Background: ____________________

Sky Conditions: Clear ☐ Partly Cloudy ☐ Overcast ☐

Wind Direction: __________ Wind Speed: ______ mph

Ambient Temp: ______ ° F RH: ______ %



Sun ⊕

Wind ►

Emission Point with Plume ○═

Observation Point X

Observer's Signature: ____________________

Affiliation: State of Utah, Department of Environmental Quality
Division of Air Quality

I Have Received a Copy of These Observations: ____________________

SIGNATURE: ____________________

Printed Name: ____________________

Title: ____________________

Distribution: white-file; canary-EPA; pink-inspector; gold-owner/operator

Observation Date: ____________________

Start Time: __________ Stop Time: __________

min \ sec	0	15	30	45
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

Average Opacity for Highest Six-Minute Period: __________

Comments: ____________________

APPENDIX G – GROUNDWATER MONITORING REPORT

APPENDIX F

District's Groundwater Quality Report

SUVSWD Bayview Class I Landfill
Permit Application

Appendix F: District's Groundwater Monitoring Report

SUVSWD Bayview Class I Landfill
Permit Application

Prepared for
Bayview Landfill
South Utah Valley Solid Waste District
Springville, Utah

Prepared by
HDR Engineering, Inc.
3995 South 700 East, Suite 100
Salt Lake City, UT 84107

March 2009

Contents

Figures

Attachments

1.0 Introduction

The Bayview Landfill is located in southwestern Utah County about 6 miles north of Elberta and 3 miles west of Goshen Bay of Utah Lake. The Bayview Landfill is underlain by unconsolidated deposits of the Provo Formation, Lake Bonneville Group, of the Pleistocene age. These deposits consist of poorly sorted, homogeneous matrix of silt, clay, sand, and gravel. Groundwater occurs under unconfined conditions in the shallow Pleistocene Aquifer and moves in a northeast direction from the East Tintic Mountains towards Utah Lake. The hydraulic gradient is very flat (0.02%) and the estimated velocity is 1.8 feet per year. The groundwater surface is at an approximate elevation of 4500 feet (Carpenter 1994).

2.0 Monitoring System

The existing groundwater monitoring system for the site consists of nine deep monitoring wells, DMW-1 through DMW-9. Wells DMW-1 and DMW-7 provide upgradient background data for Cells 1 and 2. DMW-4 is on the southern boundary upgradient of parts of Cells 6 and 7. Wells DMW-3 and DMW-8 are compliance monitoring wells for Cell 1. Well DMW-6 is east of the existing leachate basin. The remaining wells, DMW-2, DMW-5, and DMW-9 are located along the property boundary north of Cells 1 and 2. See Figure F-1 (Monitoring Wells). The locations of the monitoring wells shown in this figure are approximate; this figure is intended to present the general location relative to the landfill cells.

DMW-9 serves as a compliance well, and is within 500 feet hydraulically downgradient, for Cell #2. As shown in Figure F-1, two future compliance-monitoring wells may be installed along the northern boundary of Cell #2. The location of these two wells will be determined after future stages of Cell #2 are designed. Figure F-2 shows a typical design of a groundwater monitoring well.

The groundwater monitoring system also includes six shallow groundwater-monitoring wells, SMW-1 through SMW-6. None of the six shallow monitoring wells have contained water sufficient to either purge or sample on any sampling event, and these wells are not included in the discussion that follows.

3.0 Groundwater Sampling Program

The sampling program began in March of 1991 in monitoring wells DMW-1 through DMW-6 as part of the initial landfill development process. Data from nine sampling events, from March 1991 to June 1992, was used to established background water quality in these wells. Wells DMW-7 and DMW-8 were installed in late 1999 with background samples collected quarterly through 2001. DMW-9 was installed in 2004 with background water quality being collected during semi-annual sampling events.

In accordance with Utah Administrative Code Rule 315-308-2, groundwater samples are collected from all deep wells and submitted for laboratory analysis on a semi-annual basis. The samples collected are analyzed for the parameters listed in Utah Administrative Code Rule 315-308-4 (constituents for detection monitoring). When possible, laboratory detection limits will be set one order of magnitude below the groundwater protection standards listed in Rule 315-308-4. Attachment 1 (Groundwater Monitoring Plan for Bayview Municipal Solid

Waste Landfill) provides more information on sampling procedures and monitored constituents.

The statistical analysis approach selected to analyze the ground water data uses intra-well methods consisting of control charts and prediction limits. The purpose of this analysis is to determine if there are any statistically significant changes in the compliance data relative to background pollutant concentrations. These methods compare monitoring results to values established during background water quality data collection for each well. Reports summarizing statistical analysis of semi-annual ground water sampling are prepared and submitted to the Division of Solid and Hazardous Waste annually. These reports disclose any statistically significant changes in the water quality.

4.0 Groundwater Quality

Laboratory analyses of background samples collected March 1991 to June 1992 show no prior contamination of the groundwater by inorganic chemicals, volatile organic chemicals (VOC), or synthetic organic chemicals. (Carpenter 1994)

Laboratory analyses have never detected VOCs in groundwater samples so no statistical analysis has been needed.

As mentioned, reports summarizing the statistical analysis are submitted to the Division of Solid and Hazardous Waste annually. These reports disclose any statistically significant changes in ground water quality. Analysis of ground water laboratory results has shown very few statistically significant changes in the data from compliance monitoring wells. Additional analysis of statistically significant increases in pollutant concentration eliminated the need for any corrective action. In most cases the pollutant concentrations that were found to be statistically significant increases when conducting an intra-well analysis were found to be similar to background concentrations in other upgradient and compliance monitoring wells. Analysis of results from subsequent sampling events showed that the ground water pollutant concentrations were again near background levels, indicating that the landfill was not likely the source of the increased pollutant concentration. Other statistically significant increases were attributed to laboratory error and a change in laboratory detection limits.

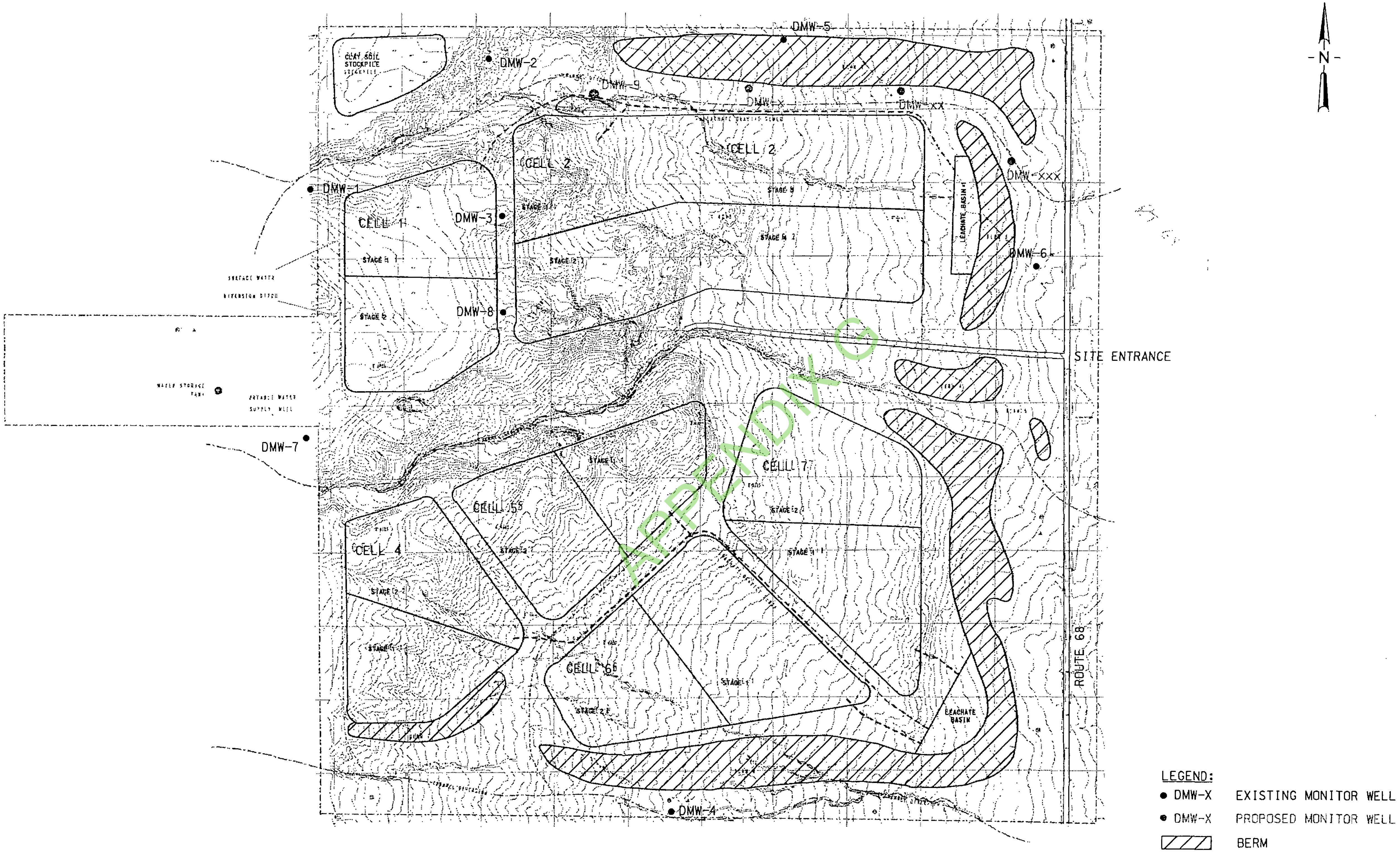
Historic changes in the laboratory detection limits may have resulted in the reporting of statistically significant changes for many constituents. In the event of a constituent not being detected, the statistical analysis used one-half of the laboratory detection limit as the actual concentration. The detection limit may have been greater than the projected limit value (above which would constitute a statistical change) calculated from background data. The result is a statistically significant change being reported even though a constituent was not detected by laboratory analysis. The laboratory detection limits will be set at or below the groundwater protection standards listed in R315-308-4 for all future analysis.

5.0 References

Carpenter, Carl, CGWP No. 361. 1994. Quality of Groundwater at the Bayview Landfill Site, Elberta, Utah, April 1994.

1

Figures



User:
Project number: 00000000002830
Filename: \Springville-SUVSWD\Bayview Design Files\v7\bayview.dgn
Date plotted: 12/30/2003 3:37 pm

HDR ENGINEERING INC.
SALT LAKE CITY, UTAH

DESIGN ____ CHECK ____
DRAWN ____ CHECK ____
QUANT. ____ CHECK ____
APPROVAL RECOMM. ____ DATE ____
APPROVED ____ DATE ____

BAYVIEW LANDFILL

SUVSWD

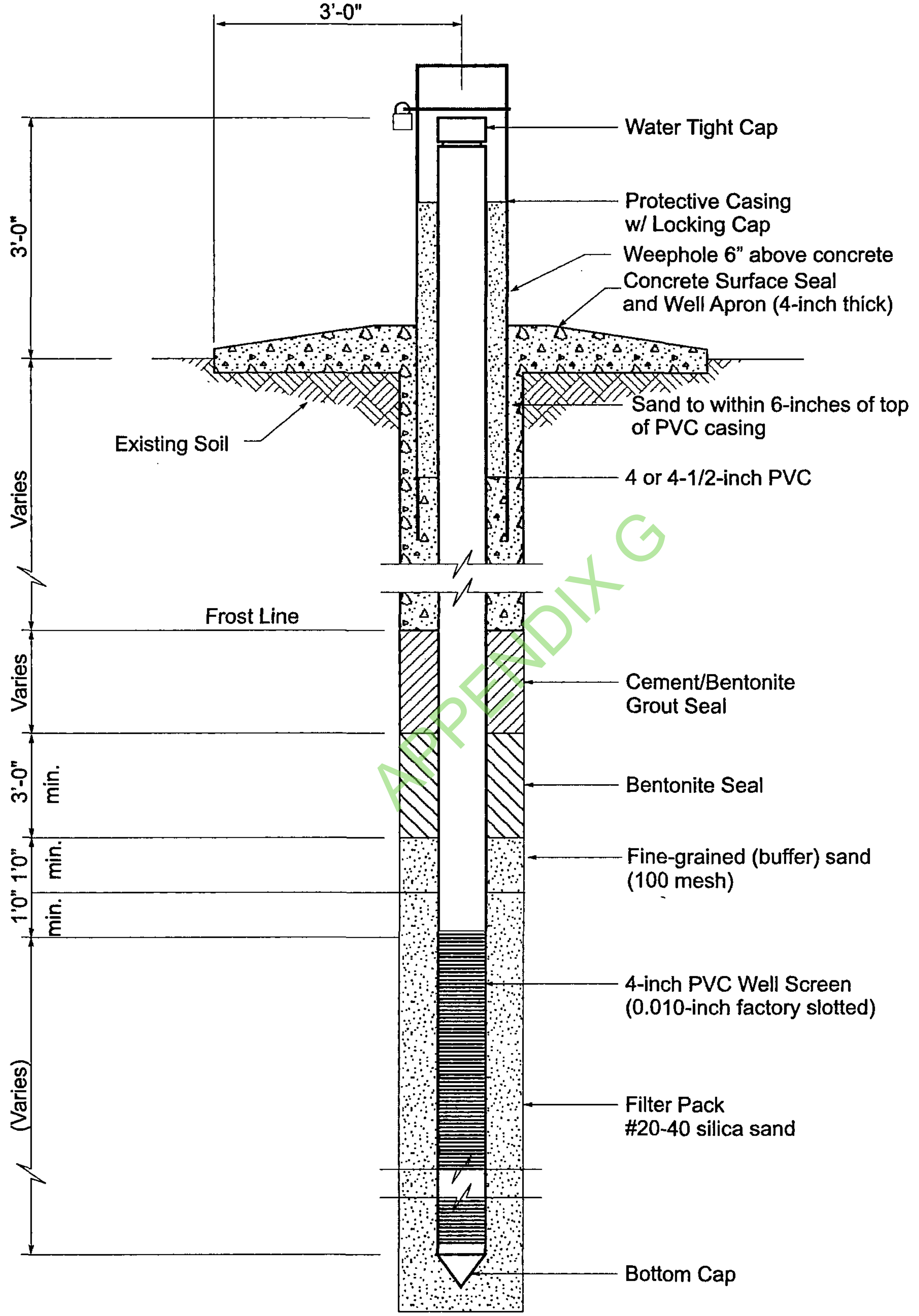
Figure F1-
Monitoing Wells

SALT LAKE
COUNTY

DWG. NO.

DATE: December 2003

HDR



HDR Engineering, Inc.

Typical Monitoring Well

Date
Jan. 2004

Figure
F-2

2/2001

Attachment F-1

District's Groundwater Monitoring Plan

GROUNDWATER MONITORING PLAN

FOR

BAYVIEW MUNICIPAL SOLID WASTE LANDFILL

SOUTH UTAH VALLEY SOLID WASTE DISTRICT

SPRINGVILLE, UTAH

Prepared by:

HDR Engineering, Inc.
3995 South 700 East, Suite 100
Salt Lake City, Utah 84107
(801) 281-8892

Submitted
January 1999

Revised
July 2003

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF TABLES

APPENDICES

1.0 INTRODUCTION

This groundwater monitoring plan (GMP) addresses the groundwater monitoring and sampling program at the South Utah Valley Solid Waste District's Bayview Landfill in Elberta, Utah. The GMP is required by the Utah Department of Environmental Quality (UDEQ) Municipal Solid Waste Regulations (R315-308-2) and will meet the requirements of the Federal US EPA Regulations under Subtitle D of the Resource Conservation and Recovery Act (RCRA).

1.1 Groundwater Monitoring System

The groundwater monitoring system for the site consists of eight deep monitoring wells, DMW-1 through DMW-8. Wells DMW-1 and DMW-7 serve as the upgradient or background wells for the first three cells, which are scheduled for development during the next 25 to 50 years. DMW-3 and DMW-8 are downgradient or compliance wells for Cell 1, and DMW-6 is downgradient of Leachate Basin 1. The remaining wells serve as property boundary wells; DMW-2 and DMW-5 are on the northern boundary downgradient from parts of Cells 1 and 2; and DMW-4 is on the southern boundary upgradient of parts of Cells 6 and 7.

The groundwater monitoring system also includes six shallow groundwater monitoring wells, SMW-1 through SMW-6. None of the six shallow monitoring wells has contained water sufficient to either purge or sample on any sampling event, and these wells are not included in the follow discussion.

Additional monitoring wells may be added to the system as information becomes available indicating the necessity to meet the requirements of the regulations. New wells may also be added to the system as new cells or leachate basins are designed and constructed.

1.2 Well Construction

Well construction records, including drilling logs, are presented in Appendix E of the Bayview Landfill Permit. Generally, wells have been constructed of 4- or 4½ -inch diameter PVC pipe with a 20-foot screened interval and a 1-foot silt sump. Table 1 provides information on wells DMW-1 through DMW-8, including total depth and approximately depth to groundwater for each of the deep monitoring wells.

Table 1. Monitoring well data for the Bayview Landfill.

Well	**Screened Interval**		**Water Depth (ft.)**		
Designation	**Top**	**Bottom**	**Drilling** [1]	**Monitoring** [2]	**Variation** [3]
DMW-1	280	300	265	242	1.5
DMW-2	270	278	236	232	7.5
DMW-3	245	308	245	245	2.0
DMW-4	175	195	175	174	2.5
DMW-5	189	210	178	172	20.0
DMW-6	145	166	139	137	2.0
DMW-7	243	295	NA	265	NA
DMW-8	225	270	NA		
DMW-9	225	270	NA		

1. Drilling means the depth at which water was reported during drilling.
2. Monitoring is an approximate average depth to groundwater as measured during monitoring events.
3. Variation is the approximate ranges of values observed during monitoring events.

2.0 GROUNDWATER ELEVATION MONITORING

2.1 Well Inspections

During each monitoring event, the wells will be inspected for damage to the well casing, protective cover, lock, well cap, and concrete pad. In addition, the ground surface around the well pads will be inspected for erosion. If any problems are discovered, they will be repaired or replaced as soon as practicable.

2.2 Monitoring Procedures

Groundwater level measurements will be collected using either an electric well sounder marked in 1-foot increments. A measuring tape will be used to determine the distance between 1-foot markings, with measurements recorded to the nearest ½-inch (0.04-foot) increment. For each monitoring event the total well depth will be measured to evaluate whether the casing has silted up. Water levels in the monitor wells will be measured prior to purging or sampling to minimize the potential effects of these activities the water levels across the site. The groundwater level measurement will be recorded to the nearest 0.04 foot from the top of the monitor well casing. Water level measurements will always be referenced to the survey mark on the well casing. When a measurement is collected, the measuring device will be raised and lowered several times to be sure the correct measurement is read off the tape measure. Water level measurements collected for each monitoring event will be converted to elevations (nearest 0.04 foot) and submitted with the groundwater sampling report. The survey data for each monitoring well will be referenced to the benchmark established for the landfill.

2.3 Protocol for Water-Level Measurements and Instrumentation

During each monitoring event, the current water level readings will be compared to the readings from the previous monitoring event in order to avoid discrepancies. If an obvious discrepancy is encountered, the water level will be measured again to ensure the measurement was recorded correctly.

Prior to collecting water level measurements, the measuring device will be checked for damage, including bends or kinks in the tape. To maintain consistency and precision, and to the degree possible, the same measuring device will be used during each monitoring event. Also once each year, the tape will be checked against a calibrated tape measure to verify its accuracy.

Prior to conducting the well purging activities, the pH and conductivity meters will be calibrated. Calibration of the instruments will be in accordance with the manufacturer's procedures for the particular instrument. At a minimum, the pH meter will be calibrated using standard calibration solutions as recommended by the manufacturer. The conductivity meter will be calibrated using standard solutions as recommended or supplied by the manufacturer. The same instrumentation will be used for each monitoring event.

3.0 DECONTAMINATION PROCEDURES

Prior to beginning each sampling event and between wells, all non-dedicated equipment including the water level measuring device will be decontaminated thoroughly to minimize the potential for cross contamination. The decontamination procedures will consist of thoroughly flushing the equipment with potable water three times followed by a final rinse with deionized water. Decontamination of larger items, such as dedicated pumps removed for repair, will be accomplished by steam cleaning. If steam cleaning is necessary, then a container will be used to collect the rinsate water to prevent the water from coming into contact with the ground. Purge and decontamination water will be stored in closed top drums and stored in a designated area on site until analytical data is complete. The drums will be typically labeled with the well identification number, date of collection, and contents of drums. The disposal of the water will be based on analytical results: contaminated water will be discharged into the leachate basin; uncontaminated water will be discharged to the ground adjacent to the well from which it came.

4.0 GROUNDWATER SAMPLE COLLECTION

4.1 Well Purging Procedures

Prior to each sampling event, the groundwater level in each well and the total well depth will be measured as described in Section 2.2. During the purging activities, disposable latex gloves will be worn by the sampling team and changed between wells. To purge a well temperature, conductivity, and pH will be continuously measured. Once all these parameters stabilize, indicating stagnant water has been replaced by formation water, purging will be considered complete. If a well dewaters prior to achieving the stabile water quality parameters, it will be allowed to recharge before sampling.

The method of well purging for this site consists of using a dedicated submersible pump system for each well where the discharge rate can be regulated for sampling. The pump intake will be placed within the screened section of the well casing. For wells that sustain continuous pumping without dewatering, the discharge rate on the pump will be set to allow minimal drawdown in the well. This procedure will minimize any cascading effects that may volatilize constituents in the groundwater entering the well casing and will also minimize agitating sediment collected in the bottom of the well. If the main pump system fails, temporary portable pumps will be used as backups. If portable pumps are needed, the intake will be gently lowered into the upper most portion of the water column to minimize agitating any residual sediment that has collected in the bottom of the well. If a portable pump is used for more than one well, then proper cleaning of the pump is necessary to minimize the potential of cross contamination (refer to Section 3.0).

During the purging operations, a record of the climatic conditions, condition of the wells and surrounding ground surface, field collected water quality, color, odors, water level, depth of well and purge rate will be recorded. The information will be recorded in indelible ink, will be stored either on site at the landfill office or at the District's office in Springville, and will become part of the site operating record for the landfill.

4.2 Groundwater Collection and Handling Procedures

During groundwater collection disposable latex gloves will be worn, and changed between wells to minimize cross contamination of samples and to reduce the possibility of coming into contact with groundwater containing contaminants. Prior to collecting a groundwater sample the monitor wells will be purged of groundwater as described in Section 4.1. Purge water will be handled as discussed in Section 4.5. The monitor wells will be sampled in the same order they are purged. Samples will be collected within 24-hours following purging. If sufficient recharge does not occur within 7 days following purging, then the well will be considered dry and a sample will not be collected. The District will follow the laboratory's QA/QC protocols regarding sampling containers, preservation, and holding times.

The samples will be collected off the pump discharge. The pump discharge will be regulated at the time of sampling to maintain as slow discharge rate as possible (typically 0.1 liter per minute) to minimize cascading and volatilization as the sample containers are being filled. Once the discharge rate is set for sampling, it will be maintained at that rate for several minutes so that the sample collected will not be from the period of time when the pump was operating at a higher discharge rate, and to ensure that air has been adequate purged from the discharge line. The sample containers will be held as close to the pump discharge as possible without touching to minimize the loss of volatiles. The containers for the VOCs will be tilted slightly to allow the water to gently run down the inside wall of the container.

Following the filling of each sample container, they will be labeled with the well number, date and time collected, preservatives used, analyses to be run, and the sampler's initials. The 40-milliliter vials will be placed in zip-locked plastic bags. The sample containers for each well will include as a minimum two-40 milliliter VOA glass vials with Teflon® septa screw caps for volatile organic constituents (VOC), and other bottles as provided by the laboratory. Sample containers for VOCs will be completely filled and sealed carefully to prevent air bubbles. If an air bubble is present, then the sample will be discarded and the sample will be collected again. All other sample containers will be filled as completely as possible.

Once the samples have been properly sealed and labeled as described above, they will be recorded on a Chain-of-Custody (COC) form, signed and dated by the sampling technician(s). An example of a typical COC is presented in Appendix 2. The COC will accompany the samples to the laboratory. The samples will be placed in a plastic ice chest (similar to an Igloo ice chest) with ice or a re-freezable type product to maintain a temperature as close to 4^0C as possible until the analyses are performed. Dry ice is not permitted due to the potential of freezing the samples and breaking the containers. Precautions will be taken to secure the samples in the ice chest to prevent them from breaking during transport. The samples will be delivered to the laboratory within 24-hours after collection, therefore it will not be necessary to preserve the samples in the field, except samples collected for dissolved constituent analyses. Any samples, other than the samples collected for dissolved constituent analyses, requiring preservatives will be collected in pre-preserved containers supplied by the laboratory.

4.2.1 Detection Monitoring Sampling Frequency

The sampling schedule for Detection Monitoring consists of collecting samples from each monitor well for the Detection Monitoring Constituents on a semi-annual basis after background data has been established. Any changes to the frequency and/or number and type of constituents for Detection Monitoring must be approved by the Executive Secretary prior to implementing the change. The schedule for establishing background data will be discussed in Section 5.5.

4.3 Quality Assurance and Quality Control Samples

To provide screening of field procedures, additional samples will be collected. Trip blank samples will be prepared by the laboratory and will accompany the empty sample containers and collected samples to and from the laboratory. The trip will consist of filling four-40 milliliter VOA vials (two sets each) with deionized and laboratory-grade water, respectively. The purpose of the trip blank is to assess whether any of the sample containers or collected samples has been contaminated before or during sampling, and during transport to the laboratory. At least one trip blank will be prepared for each day of sampling or for every container transported to the laboratory. The QA/QC samples will be collected and handled in a similar fashion as the other samples and will be analyzed for VOCs.

At the discretion of the District or direction of UDEQ, blind field duplicate samples will be collected to assess the precision of the sampling and laboratory methods. The blind duplicate samples will be collected from well(s) with typically the highest concentrations of contaminants. When a blind sample is collected, it will be handled in a similar fashion as the other samples, but will be labeled in such a manner that the laboratory does not know it is a duplicate sample for QA/QC purposes.

4.4 Weather Protocol

Sampling of the monitor wells will not be permitted during inclement weather, thunderstorms; to the extent possible, monitor wells will not be sampled during periods when the temperature drops below freezing. Caution should be taken when the temperature exceeds 100 ^{0}F. If contamination is detected, the District will develop a health and safety plan for further ground water monitoring activities. While in the field, personnel engaged in the monitoring program shall adhere to this health and safety protocol.

4.5 Purge Water Handling Procedures

Purge and decontamination water will be collected in closable drums and stored on site for subsequent disposal. The analytical data will be reviewed to determine the proper disposal procedures. If needed, the UDEQ can be consulted to assist in assessing proper disposal procedures.

5.0 ANALYTICAL TESTING

5.1 Laboratory Performing the Analyses

The analytical laboratory selected to perform the required analyses will be licensed and certified by the State of Utah. At a minimum the selected laboratory will apply quality control procedures in accordance with EPA SW-846, Test Methods for Evaluating Solid Waste, Third Edition, November 1986 as revised December 1987.

5.2 Laboratory Procedures

The laboratory will follow appropriate QA/QC protocol developed as part of its licensing and certification. At a minimum, upon receipt of the samples by the laboratory, the sample lot will be verified with the information on the COC, Appendix 2. If there is a discrepancy with the samples, the responsible party that collected the samples will be notified and the problem will be resolved before the analyses are performed. The COC will be signed and dated by the designated receiving personnel at the laboratory. The COC will remain with the laboratory until the analyses are completed, then will be attached to the completed laboratory report. For samples that require overnight transport to the laboratory, the COC will be signed; including date and time received by the transporter. The COC will be attached to the sample container(s) and delivered to the laboratory and a copy of the bill of lading will be supplied by the transporter. After the analyses is completed and the laboratory report finalized, the complete COC with the bill of lading or receipt if sent by certified mail will be attached to the laboratory report. The laboratory will keep a copy of the COC and laboratory results for a period of at least three years.

5.3 Laboratory Quality Assurance and Quality Control Samples

The laboratory will adhere to its QA/QC plan developed as part of its licensing and certification. If possible, the laboratory will be required to achieve detection limits (DLs) that are at least one order of magnitude below the maximum contaminant levels (MCLs) for a constituent for which an MCL has been promulgated.

5.4 Constituents to be Analyzed and Test Methods

As specified in the UDEQ (R315-308-2) and Subtitle D (40 CFR 258.53) regulations, the groundwater monitoring program at all MSWLFs shall consist of detection monitoring that includes specific constituents. The constituents to be tested for during the detection-monitoring program are listed in Table 2. Approved testing methods, as described in 5.1, will be used for all constituents. The laboratory DLs will be below the MCLs for each of the constituents. If a change in the analytical method is needed, then the Executive Secretary will be notified in writing. The Executive Secretary shall approve of the change prior to implementing the change. All samples will be analyzed within the required holding times for the particular analyses. The laboratory will report the CAS number for each constituent analyzed.

TABLE 2

Background/Detection Monitoring Constituents

Inorganic Constituents
Ammonia (7664-41-7)
Carbonate/Bicarbonate
Calcium
Chemical Oxygen Demand (COD)
Chlorides
Iron (7439-89-6)
Magnesium
Manganese (7439-96-5)
Nitrate (as N)
pH
Potassium
Sodium
Sulfate
Total Dissolved Solids (TDS)
Total Organic Carbon (TOC)

Heavy Metals
Antimony (7440-36-0)
Arsenic (7440-38-2)
Barium (7440-39-3)
Beryllium (7440-41-7)
Cadmium (7440-43-9)
Chromium
Cobalt (7440-48-4)
Copper (7440-50-8)
Lead
Mercury (7439-97-6
Nickel (7440-02-0)
Selenium (7782-49-2)
Silver (7440-22-4)
Thallium
Vanadium (7440-62-2)
Zinc (7440-66-6)

VOCs

Acetone (67-64-1)
Acrylonitrile (107-13-1)
Benzene (71-43-2)
Bromochloromethane (74-97-5)
Bromodichloromethane (75-27-4)
Bromoform (75-25-2)
Carbon disulfide (75-15-0)
Carbon tetrachloride (56-23-5)
Chlorobenzene (108-90-7)
Chloroethane (75-00-3)
Chloroform (67-66-3)
Dibromochloromethane (124-48-1)
1,2-Dibromo-3-chloropropane (96-12-8)
1,2-Dibromoethane (106-93-4)
1,2-Dichlorobenzene, ortho (95-50-1)
1,4-Dichlorobenzene, para (106-46-7)
trans-1,4-Dichloro-2-butene (110-57-6)
1,1-Dichloroethane (75-34-3)
1,2-Dichloroethane (107-06-2)
1,1-Dichloroethylene (75-35-4)
cis-1,2-Dichloroethylene (156-59-2)
trans-1,2-Dichloroethylene (156-60-5)
1,2-Dichloropropane (78-87-5)

cis-1,3-Dichloropropene (100061-01-5)
trans-1,3-Dichloropropene (10061-02-6)
Ethylbenzene (100-41-4)
2-Hexanone (591-78-6)
Methyl bromide (74-83-9)
Methyl chloride (74-87-3)
Methylene bromide (74-95-3)
Methylene chloride (75-09-2)
Methyl ethyl ketone; MEK (78-93-3)
Methyl iodide (74-88-4)
4-Methyl-2-pentanone (108-10-1)
Styrene (100-42-5)
1,1,1,2-Tetrachloroethane (630-20-6)
1,1,2,2-Tetrachloroethane (79-34-5)
Tetrachloroethylene (127-18-4)
Toluene (108-88-3)
1,1,1-Trichloroethane (71-55-6)
1,1,2-Trichloroethane (79-00-5)
Trichloroethylene (79-01-6)
Trichlorofluoromethane; CFC-11 (75-69-4)
1,2,3-Trichloropropane (96-18-4)
Vinyl acetate (108-05-4)
Vinyl chloride (75-01-4)
Xylenes (1330-20-7)

Note: The CAS Number if appropriate) is listed in parentheses. These parameters were taken from UAC R315-308-2, and should be verified at least annually.

5.5 Establishment of Background Data

As specified in the UDEQ regulations (R315-308-2 (4)(a)) and Subtitle D (40 CFR 258.53) regulations, background data for the Detection Monitoring Constituents was established. The monitoring wells were installed, and background data were collected prior to the effective date of these regulations. The background sampling was performed from March 1991 to June 1992 from deep monitoring wells DMW-1 through DMW-6 with more than eight samples collected from each of these wells. Monitoring wells DMW-7 and DMW-8 were installed during 1996, background sampling was conducted the eight background samples on these two wells during 1999 and 2000 by collecting a sample from each well on a quarterly basis.

The District plans to install new monitoring wells adjacent to each new landfill cell as the cells are developed. Background data on new wells will adhere to the protocols outlined in the cited regulations.

6.0 STATISTICAL METHOD TO EVALUATE ANALYTICAL DATA

After each sampling event the groundwater monitoring data will be evaluated to determine if statistically significant changes from background values exist for each constituent listed in Table 2. The statistical analyses will be performed in accordance with R315-308-2 (7). To perform the statistical methods with some degree of confidence, a minimum of eight statistically independent samples will be collected from each monitor well during the background-monitoring period. Based on the available statistical methods cited in the regulations, the preferred method selected for this site is an intra-well comparison with a control chart such as a Shewert-CUSUM control chart. This procedure is the preferred method because of its relative ease to implement and because it is especially applicable to sites where no groundwater contamination exists. The analytical data may also be analyzed using Prediction Limits (PL) with the PLs determined based on background data collected.

7.0 REPORTING REQUIREMENTS

Upon completion of each Detection Monitoring sampling event, the analytical data will be summarized in a report. The report will be submitted with the District's annual report unless more immediate notification is required. Any statistically significant change observed from the background data will be reported in writing to UDEQ within 60 days following a sampling event. Only statistically significant changes (SSC) detected in the compliance wells (downgradient wells) will be reported to the UDEQ.

When a SSC has been determined, the owner/operator within 14 days of receipt of the sample analysis results will enter this information into the operating record and notify the Executive Secretary of the finding in writing. The notification must indicate what constituents have shown SSC. In addition, immediately resample all monitoring wells for the constituents listed in Table 3. If an SSC is still present after resampling, the owner/operator must notify the Executive Secretary in writing within seven days of receipt of the sample results. However, if the SSC change from the background data is believed to be caused by a source other than the landfill, then the owner/operator can prepare a report that explains the cause of the significant change. This report must be prepared and certified by a qualified groundwater scientist and submitted to the Executive Secretary within 90 days after the sampling event for approval. If the Executive Secretary approves the report, then the landfill may return to Detection Monitoring. If the Executive Secretary believes a satisfactory explanation is not given, the Assessment Monitoring Program will be implemented at the direction of the Executive Secretary. The Assessment Monitoring Program shall be implemented in accordance with R315-308-2 (11)

Attachment F-2

Recording Forms

GROUNDWATER MONITORING PROGRAM
BAYVIEW MUNICIPAL SOLID WASTE LANDFILL
SOUTH UTAH VALLEY SOLID WASTE DISTRICT

DATE: 20-Dec-00

SAMPLED BY: Craig Hoffman

RECORDED BY: Craig Hoffman

WEATHER:

Well Number	Depth of Well (feet)	Depth to Water (feet)	Temp. C_X__ F___	pH	Conductivity	Comments
DMW1	300					
DMW2	278					
DMW3	308					
DMW4	195					
DMW5	210					
DMW6	168					
DMW7	293					
DMW8	270					

Attachment F-3

Typical Chain of Custody

TO :
Address :

Chain of Custody Log Form

COC / SL # :

Page ____ of ____

Client :
Address :

Quote # :

ID :
PO # :
Contact :
Phone :

Date :
Turnaround :
Job # :

Sampled By :

Report To :
Address :

Invoice To :

Sample ID	Date / Time	MATRIX	Preservatives				Analyses														Comments
			Cool < 4°C																		

Relinquished By	Date	Time	Received By	Date	Time	Temperature	Airbill #

APPENDIX H – RUNON – RUNOFF CALCULATIONS

APPENDIX M

Runon-Runoff Calculations

SUVSWD Bayview Class I Landfill
Permit Application

APPENDIX M

RUN-ON / RUN-OFF CALCULATIONS

SUVSWD Bayview
Class I Landfill Permit Application

Submitted March 2009

Prepared By:

HDR ENGINEERING, INC.

INTRODUCTION

The run-on/run-off calculations were performed to determine the size of drainage ditches required to control run-on and run-off flows. The run-on/run-off peak flows were calculated using the Rational Method:

$$Q = CiA$$

where Q = Run-off flow (ft^3/sec)
C = Run-off Coefficient
i = rainfall intensity (in/hr)
A = Area contributing to run-off (acres)

The run-off coefficient, C, was multiplied by the run-off coefficient adjustment factor, C_f, of 1.1 to adjust the rational method for a recurrence interval of 25 years.

Once the run-on/run-off flows were calculated, the capacity of the ditch designed to carry the run-on/run-off was calculated using Manning's Equation:

$$Q = \frac{1.49}{n} AR^{2/3} S^{1/2}$$

where Q = Maximum capacity of ditch (ft^3/sec)
n = Manning's roughness coefficient
A = Cross-sectional area of ditch (ft^2)
R = Hydraulic radius (A/wetted perimeter) (ft)
S = slope of ditch (ft/ft)

If the capacity of the ditch exceeds the run-on/run-off flow, then the ditch is adequate.

The first set of calculations shown in Appendix M, Attachment 1 is for the run-on from Cell 1 onto Cell 2 and from Cell 2 onto Cell 1. The map on page 4 of Attachment M-1 shows the portion of Cell 1 that is directed towards Cell 2 and the portion of Cell 2 that will be directed to Cell 1 after closure with final cover in place. The ditch that will be constructed to go between Cell 1 and Cell 2 will direct the run-on to the north and south to existing drainage channels. The final cover on Cell 1 and Cell 2 will be overlaid with short grass prairie, which has a Manning's roughness coefficient, n, of 0.15. This was considered to be cultivated land on a rural catchment, so a value of 0.30 was chosen as the basic factor for the run-off coefficient, *C*.

The second set of calculations shown in Appendix M, Attachment 2 is for the run-off from the areas of Stage 1 and Stage 2 in Cell 2 prior to installation of the final cap. The calculations were done for the design of drainage ditches which will be constructed around the perimeter of Stages 1 and 2. The run-off was calculated as if Cell 2 were filled to capacity prior to installation of the final cap as a worst-case scenario so that the ditches can be constructed as Cell 2 is filled and will not need to be redesigned. A Manning's roughness coefficient of 0.027 (earth with weeds) was used for the channel design and a run-off coefficient (C-value) of 0.30 was used for run-off calculations (undeveloped land). Because the diversion ditches around Stages 1 and 2 will not continue around Stages 3 and 4 until these stages are constructed, the ditches will outfall to the sump in Stage 2.

APPENDIX M

ATTACHMENT 1:

REQUIRED CAPACITY OF DRAINAGE DITCH FOR RUN-OFF

Job No.
No.

HDR Computation

HDR

oject Bayview Landfill
Computed
Date 5/03
Subject
Checked
Date
Task
Sheet 1
Of 21

Determine Peak Discharge to Drainage Ditches

$$Q = CiA$$

Based on the portion of Cell 1 and the proposed Cell 2 that will be draining into the ditch between them in the Northern direction, the maximum area that will be contributing to the ditch in either direction is 18.4 acres. (see page 1a)

Run-off Coefficient of Drainage Area, c.

Based on Ref. 1, a runoff coefficient of drainage area for cultivated land is 0.30. This is multiplied by a frequency factor of 1.1 for a recurrence interval of 25 years, so the coefficient of drainage, C, is 0.33.

Rainfall intensity, i

To determine rainfall intensity, time of concentration, t_c, is required.

Sheet Flow (Overland flow)

$$T_c = \frac{0.007(nL)^{0.8}}{P_2^{0.5} S^{0.4}}$$

n = Manning's roughness coefficient
L = Flow length (total < 300')
P_2 = 2-Year 24-hour Precipitation
S = Land Slope

REF. 1

pg. 2/21

Table 5.6-3: Runoff coefficient adjustment factors for Rational Method

Recurrence Interval (years)	C_f
25	1.1
50	1.2
100	1.25

The Rational formula now becomes Equation 5.6-4.

$$Q = \frac{CC_f IA}{360} \quad \text{5.6-4}$$

5.6.6 Procedure for Rational Method

The general procedure for estimating the peak discharge for a watershed using the Rational Method is as follows:

(1) Determine the watershed area in hectares.

(2) With consideration for future characteristics of the watershed, determine the time of concentration as defined in Section 5.5.

(3) Assure consistency with the assumptions and limitations for application of the Rational Method.

(4) According to the locality in Texas and the design frequency, extract the rainfall IDF coefficients e, b, and d values from the list shown in Appendix 5-2.

(5) Using Equation 5.6-2, calculate rainfall intensity.

(6) With consideration for future characteristics of the watershed, select or develop appropriate runoff coefficients for the watershed. Where the watershed comprises more than one characteristic, C values for each area segment must be estimated individually. A weighted C value then may be estimated using Equation 5.6-5.

$$C = \frac{\sum_{n=1}^{m} C_n A_n}{\sum_{n=1}^{m} A_n} \quad \text{5.6-5}$$

where:

C = weighted runoff coefficient
n = nth subarea
m = number of subareas
C_n = runoff coefficient for n^{th} subarea

HDR Computation

Project Bayview Landfill | Computed | Date 5/03

Subject | Checked | Date

Task | Sheet 3 | Of 21

Using Planix 6 (see page 4)

Drainage Areas

Northward Flow in Ditch

Cell 1

$$A_{1,N} = 24.85 \text{ in}^2 \left(\frac{120^2 \text{ ft}^2}{1 \text{ in}^2} \right) = 8.215 \text{ acres}$$

Cell 2

$$A_{2,N} = 13.24 \text{ in}^2 \left(\frac{150^2 \text{ ft}^2}{1 \text{ in}^2} \right) = 6.84 \text{ acres}$$

$$A_{3,N} = 3.65 \text{ in}^2 \left(\frac{200^2 \text{ ft}^2}{1 \text{ in}^2} \right) = 3.35 \text{ acres}$$

Total = 18.4 acres

Southward Flow in Ditch

Cell 1

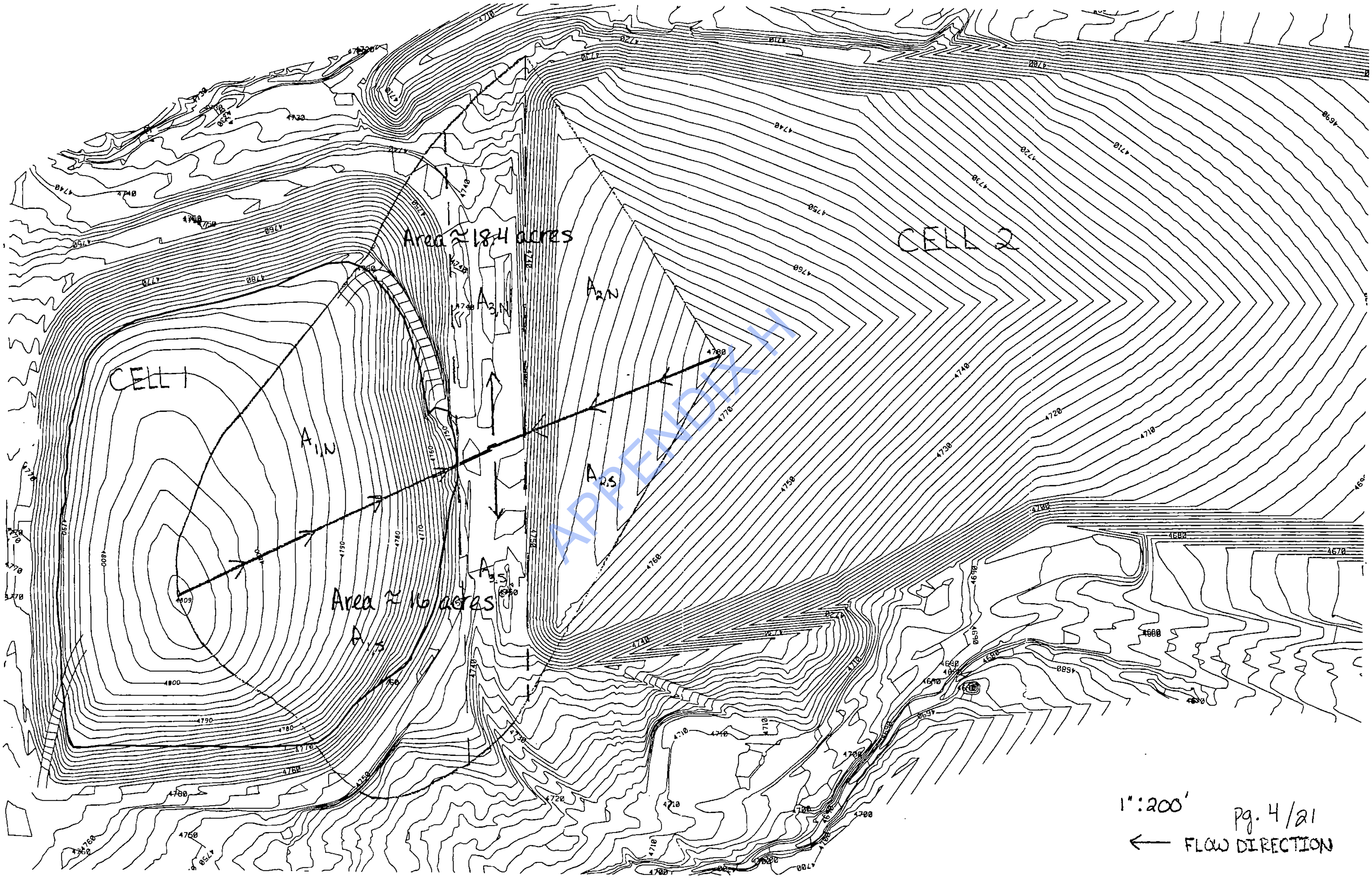
$$A_{1,S} = 27.48 \text{ in}^2 \left(\frac{120^2 \text{ ft}^2}{1 \text{ in}^2} \right) = 9.08 \text{ acres}$$

Cell 2

$$A_{2,S} = 8.56 \text{ in}^2 \left(\frac{150^2 \text{ ft}^2}{1 \text{ in}^2} \right) = 4.4215 \text{ acres}$$

$$A_{3,S} = 2.713 \text{ in}^2 \left(\frac{200^2 \text{ ft}^2}{1 \text{ in}^2} \right) = 2.49 \text{ acres}$$

Total = 16 acres



1" : 200'

← FLOW DIRECTION

Job No.

No.

HDR Computation

HDR

Project Bayview Landfill

Computed

Date 5/03

Subject

Checked

Date

Task

Sheet 5

Of 211

Surface description - Short grass prairie

$n = 0.15$

$L = 300'$

$P_2 = 1''$

$S = 4\%$

$$T_c = \frac{0.007(0.15 * 300')^{0.8}}{(1'')^{.5}(.04)^{.4}} = .53$$

Shallow concentrated flow (swale flow)

Surface description - Short grass prairie

$L_{,1} = 276'$

$S_{,1} = 6.5\%$

$V =$ Average velocity $= 4.1$ ft/s (from REF. 2) (using $S = .065$ for unpaved soil)

$$T_{c,1} = \frac{L}{3600V} = \frac{276'}{3600(4.1 \text{ ft/s})} = .019$$

$L_{,2} = 156'$

$S_{,2} = 18.8\%$

$V = 7$ ft/sec (from REF. 2 using $S = .188$ for unpaved soil)

$$T_{c,2} = \frac{L}{3600V} = \frac{156'}{3600(7 \text{ ft/s})} = .0062$$

Channel Slope

$S = 1\%$ $\therefore V = 1.6$ ft/sec from Ref. 2

Assuming average velocity for a channel is similar to average velocity for shallow concentrated flow

Job No. No.

HDR Computation

Project Bayview Landfill Computed Date 5/03
Subject Checked Date
Task Sheet 6 Of 21

Channel Flow (continued)

$$T_c = \frac{L}{3600V} = \frac{1050 \text{ ft}}{3600(1.6 \text{ ft/s})} = .18$$

$$T_{c,TOTAL} = .53 + .019 + .0062 + .18 = .735 \text{ hr}\left(\frac{60 \text{ min}}{1 \text{ hr}}\right) = 44.11 \text{ min}$$

(for runoff from Cell 1)

Based on REF. 3, 2-year and 100-year 1-hour storm is estimated as:

$$Y_2 = 0.005 + 0.852[X_1(X_1/X_2)]$$

$$Y_{100} = 0.322 + 0.789[X_3(X_3/X_4)]$$

Y_2 = 2-yr 1-hr estimated value
Y_{100} = 100-yr 1-hr estimated value
X_1 = 2-yr 6-hr value from precipitation-frequency maps
X_2 = 2-yr 24-hr value from precipitation-frequency maps
X_3 = 100-yr 6-hr value from precipitation-frequency maps
X_4 = 100-yr 24-hr value from precipitation-frequency maps

X_1 = 0.7 in (see 2-yr 6-hr precipitation-frequency map)(p.12)
X_2 = 1.0 in (see 2-yr 24-hr precipitation-frequency map)(p.9)
X_3 = 1.8 in (see 100-yr 6 hr precipitation-frequency map)(p.13)
X_4 = 2.6 in (see 100-yr 24-hr precipitation-frequency map)(p.14)

$$Y_2 = 0.005 + 0.852[0.7(0.7/1.0)] = .4225 \text{ inches}$$

$$Y_{100} = 0.322 + 0.789[1.8(1.8/2.6)] = 1.305 \text{ inches}$$

pg. 7/21

REF. 1

TABLE 12.5 RATIONAL RUNOFF COEFFICIENT

a. Urban Catchments

General Description	*C*	Surface	
City	0.7–0.9	Asphalt paving	0.7–0.9
Suburban business	0.5–0.7	Roofs	0.7–0.9
Industrial	0.5–0.9	Lawn heavy soil	
		>7° slope	0.25–0.35
Residential multiunits	0.6–0.7	2–7°	0.18–0.22
Housing estates	0.4–0.6	<2°	0.13–0.17
Bungalows	0.3–0.5	Lawn sandy soil	
		>7°	0.15–0.2
Parks, cemeteries	0.1–0.3	2–7°	0.10–0.15
		<2°	0.05–0.10

b. Rural Catchments (less than 10 km^2)

Ground Cover	Basic Factor	Corrections: Add or Subtract
Bare surface	0.40	Slope < 5%: −0.05
Grassland	0.35	Slope > 10%: +0.05
Cultivated land	0.30	Recurrence interval < 20 yr: −0.05
Timber	0.18	Recurrence interval > 50 yr: +0.05
		Mean annual precipitation < 600 mm: −0.03
		Mean annual precipitation > 900 mm: +0.03

Table 3-1.—Roughness coefficients (Manning's n) for sheet flow

REF. 2

Surface description	n[1]
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses[2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods:[3]	
Light underbrush	0.40
Dense underbrush	0.80

---

[1] The n values are a composite of information compiled by Engman (1986).

[2] Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.

[3] When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

pg. 8/21

REF. 2

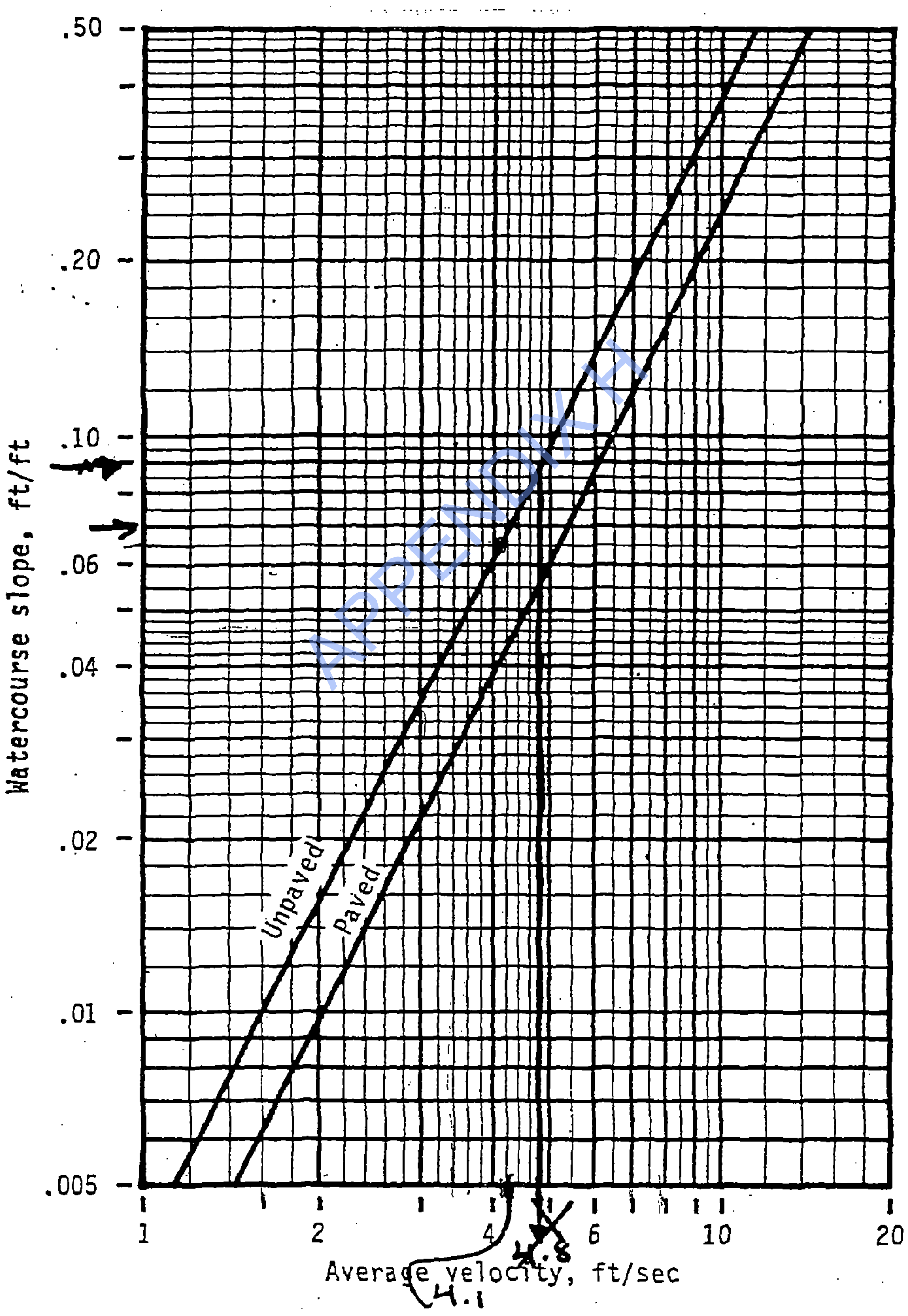
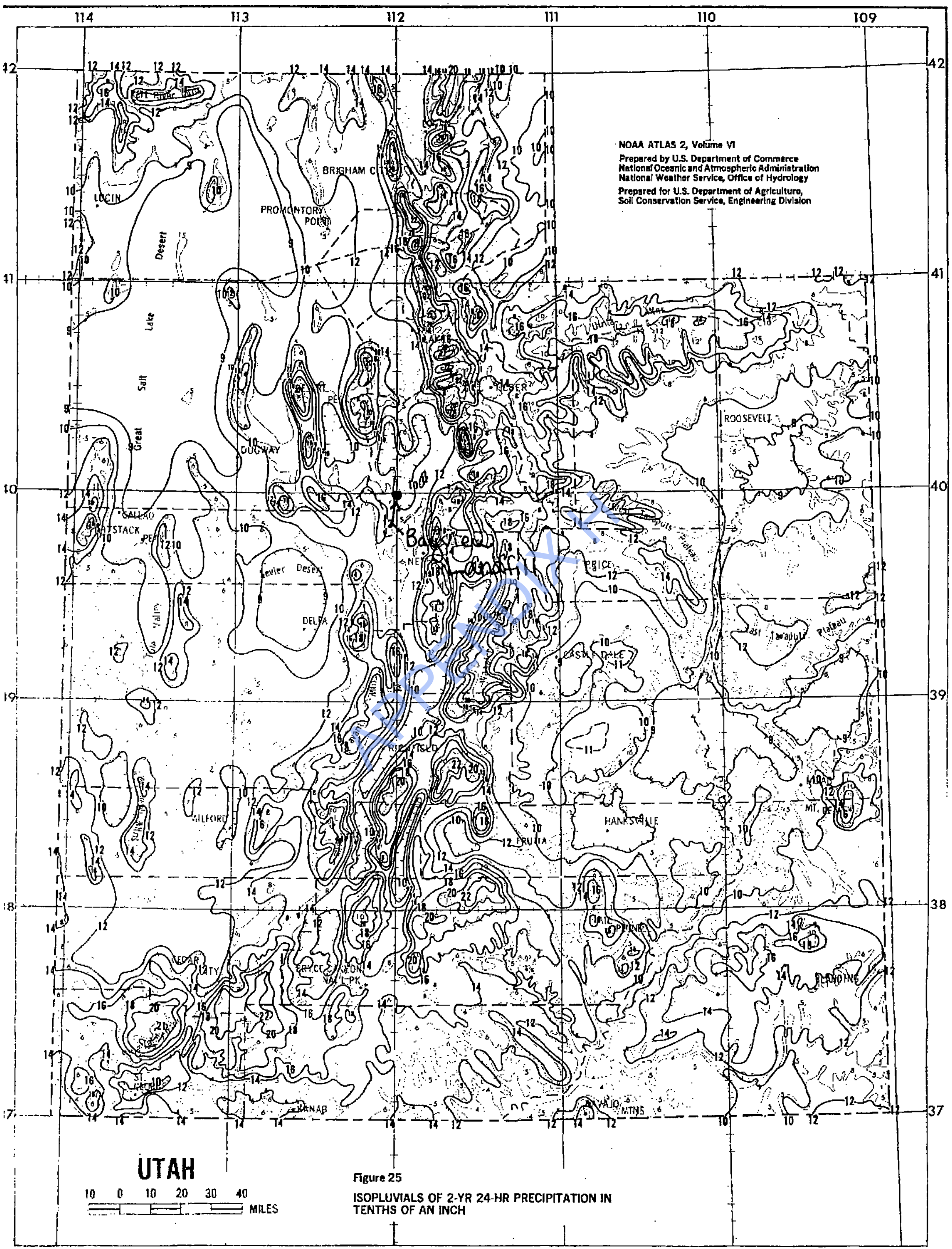


Figure 3-1.—Average velocities for estimating travel time for shallow concentrated flow.



NOAA ATLAS 2, Volume VI
Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

Figure 25

ISOPLUVIALS OF 2-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

REF. 3
pg. 9/21

Region of applicability*	Equation	Corr. coeff.	No. of stations	Mean of computed stn. values (inches)	Standard error of estimate (inches)
Utah south of the Unitas east of Wasatch, and east and south of Boulder and Pine Valley Mountains (1)	$Y_2 = -0.011 + 0.942[(X_1)(X_1/X_2)]$	0.95	86	0.72	0.085
	$Y_{100} = 0.494 + 0.755[(X_3)(X_3/X_4)]$	.90	85	1.96	.290
Most of western Utah (2)	$Y_2 = 0.005 + 0.852[(X_1)(X_1/X_2)]$	.89	65	0.41	.047
	$Y_{100} = 0.322 + 0.789[(X_3)(X_3/X_4)]$	.87	65	1.25	.196
Northeast and northwest corners of Utah (3)	$Y_2 = 0.019 + 0.711[(X_1)(X_1/X_2)] + 0.001Z$	.82	98	0.40	.031
	$Y_{100} = 0.338 + 0.670[(X_3)(X_3/X_4)] + 0.001Z$	.80	79	1.04	.141

* Numbers in parentheses refer to geographic regions shown in figure 18. See text for more complete description.

List of variables

Y_2 = 2-yr 1-hr estimated value
Y_{100} = 100-yr 1-hr estimated value
X_1 = 2-yr 6-hr value from precipitation-frequency maps
X_2 = 2-yr 24-hr value from precipitation-frequency maps
X_3 = 100-yr 6-hr value from precipitation-frequency maps
X_4 = 100-yr 24-hr value from precipitation-frequency maps
Z = point elevation in hundreds of feet

REF.3

p.10/21

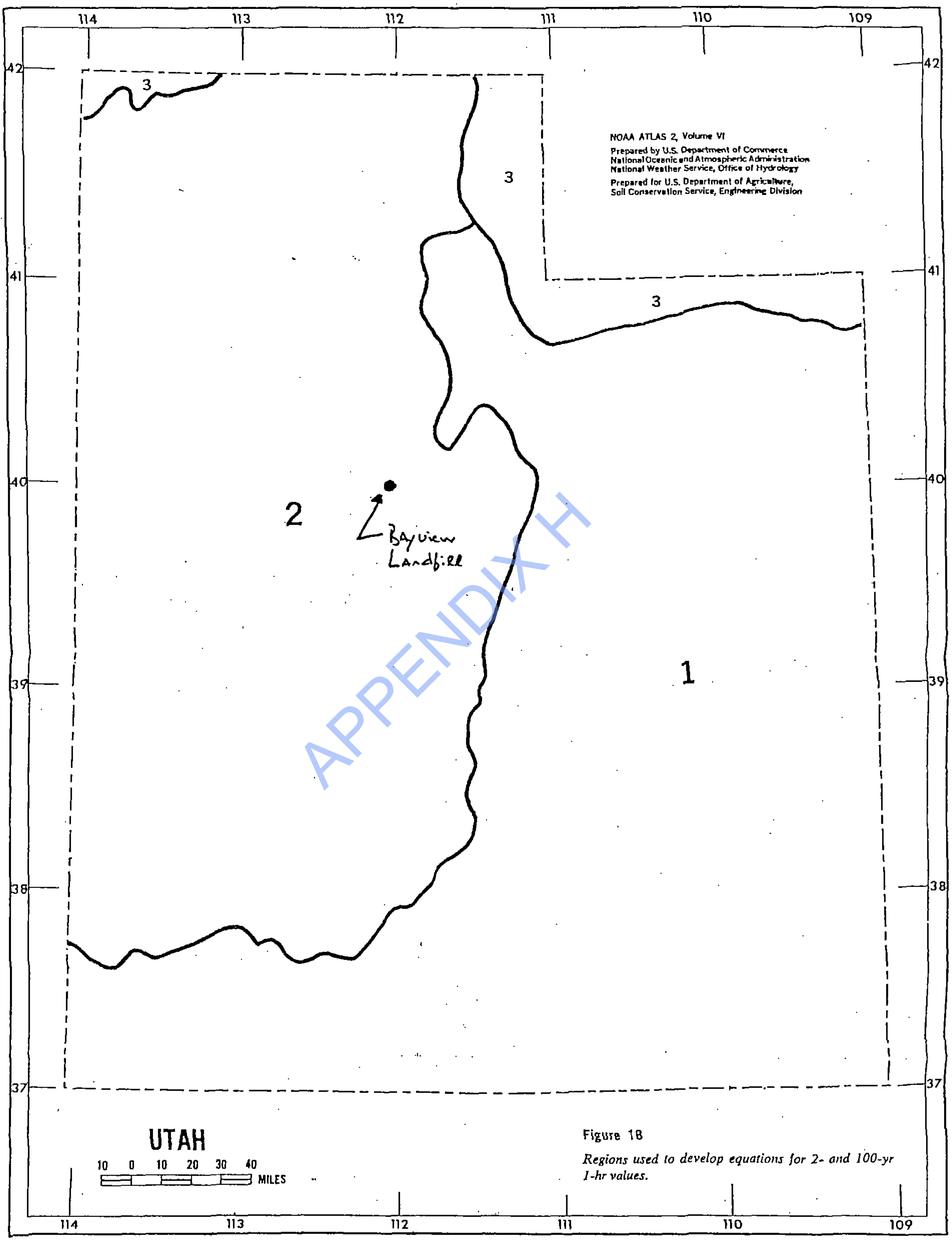
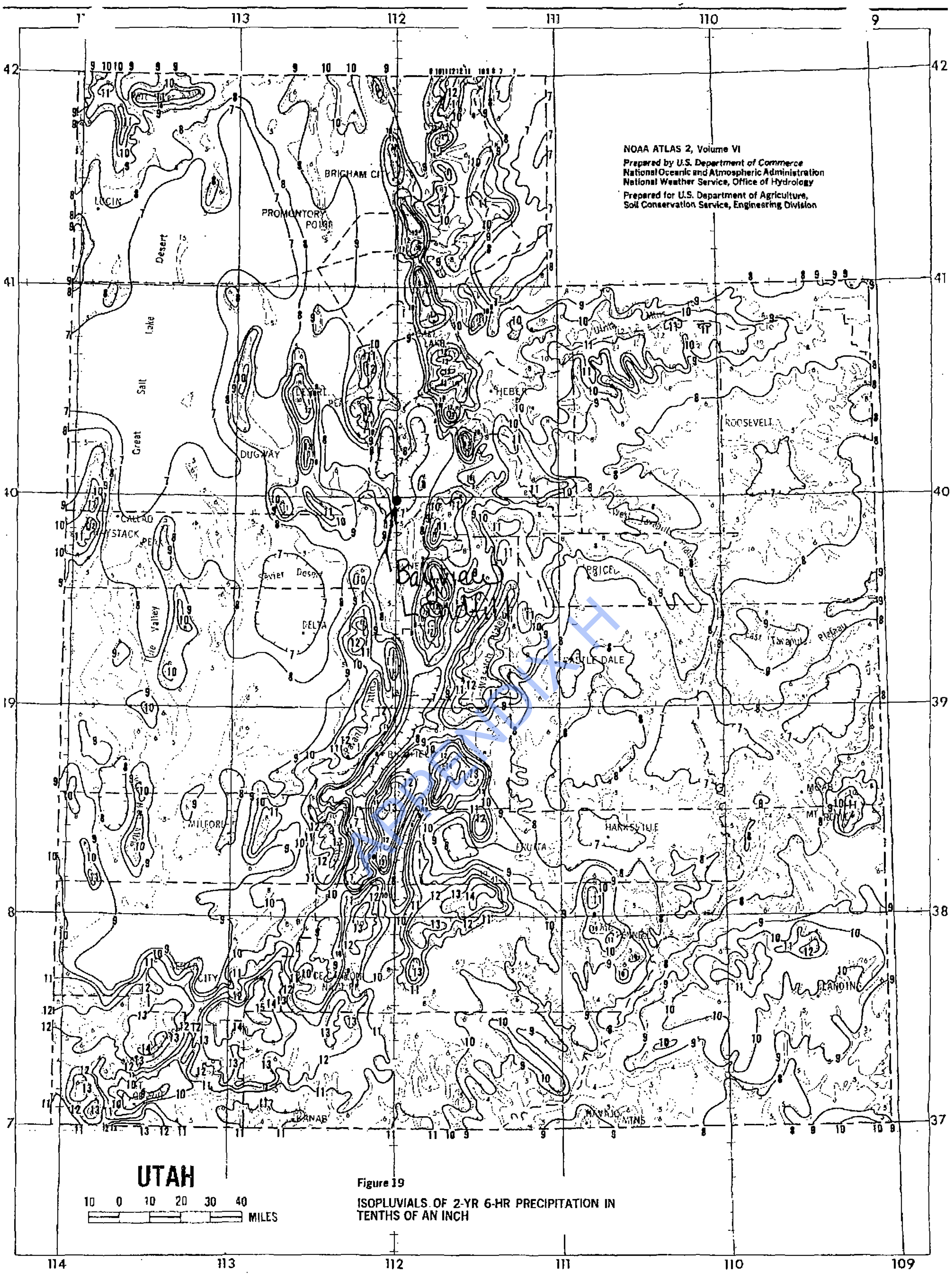


Figure 18

Regions used to develop equations for 2- and 100-yr 1-hr values.

REF. 3
p.11/a1



NOAA ATLAS 2, Volume VI

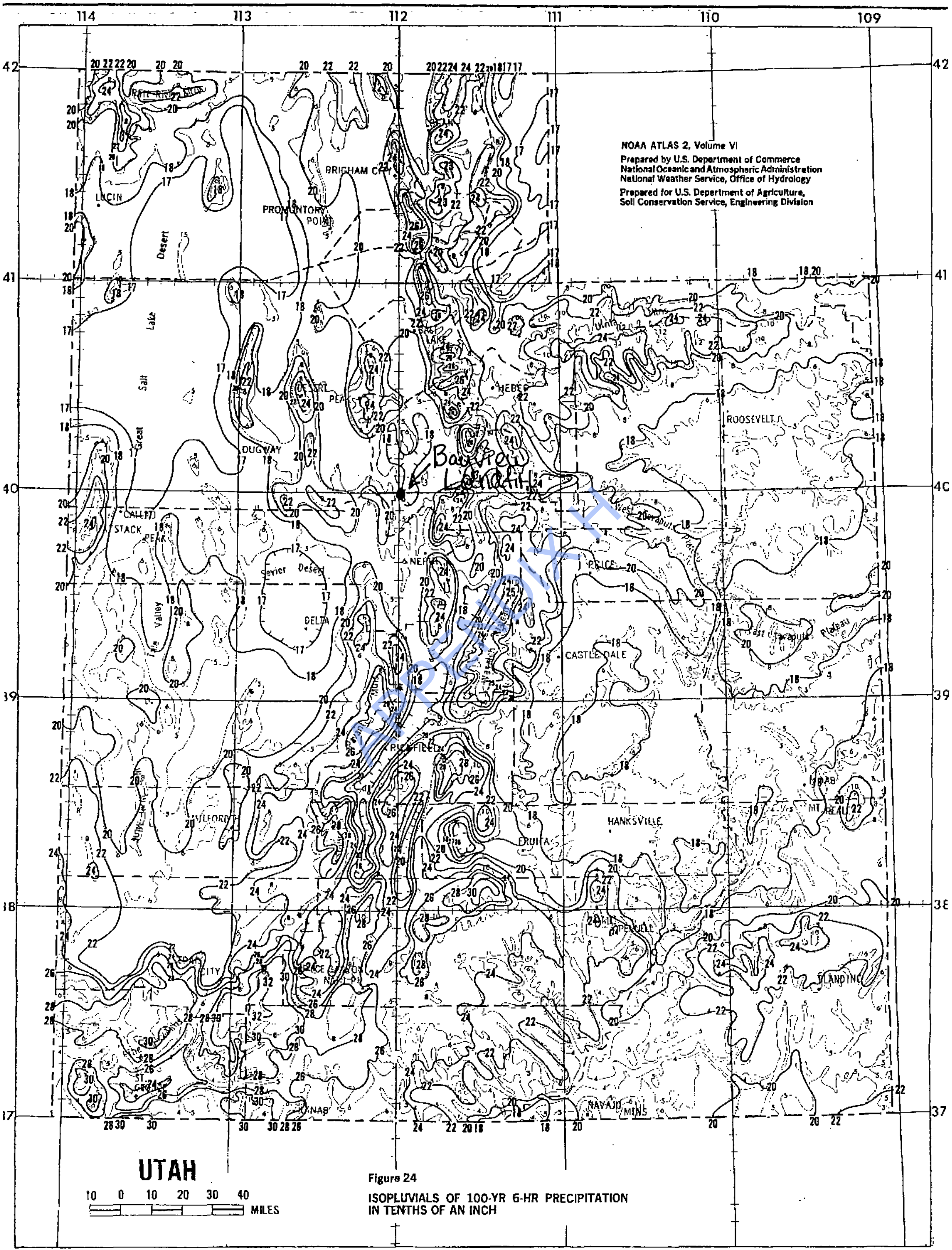
Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

Figure 19

ISOPLUVIALS OF 2-YR 6-HR PRECIPITATION IN TENTHS OF AN INCH

REF. 3
p.12/21

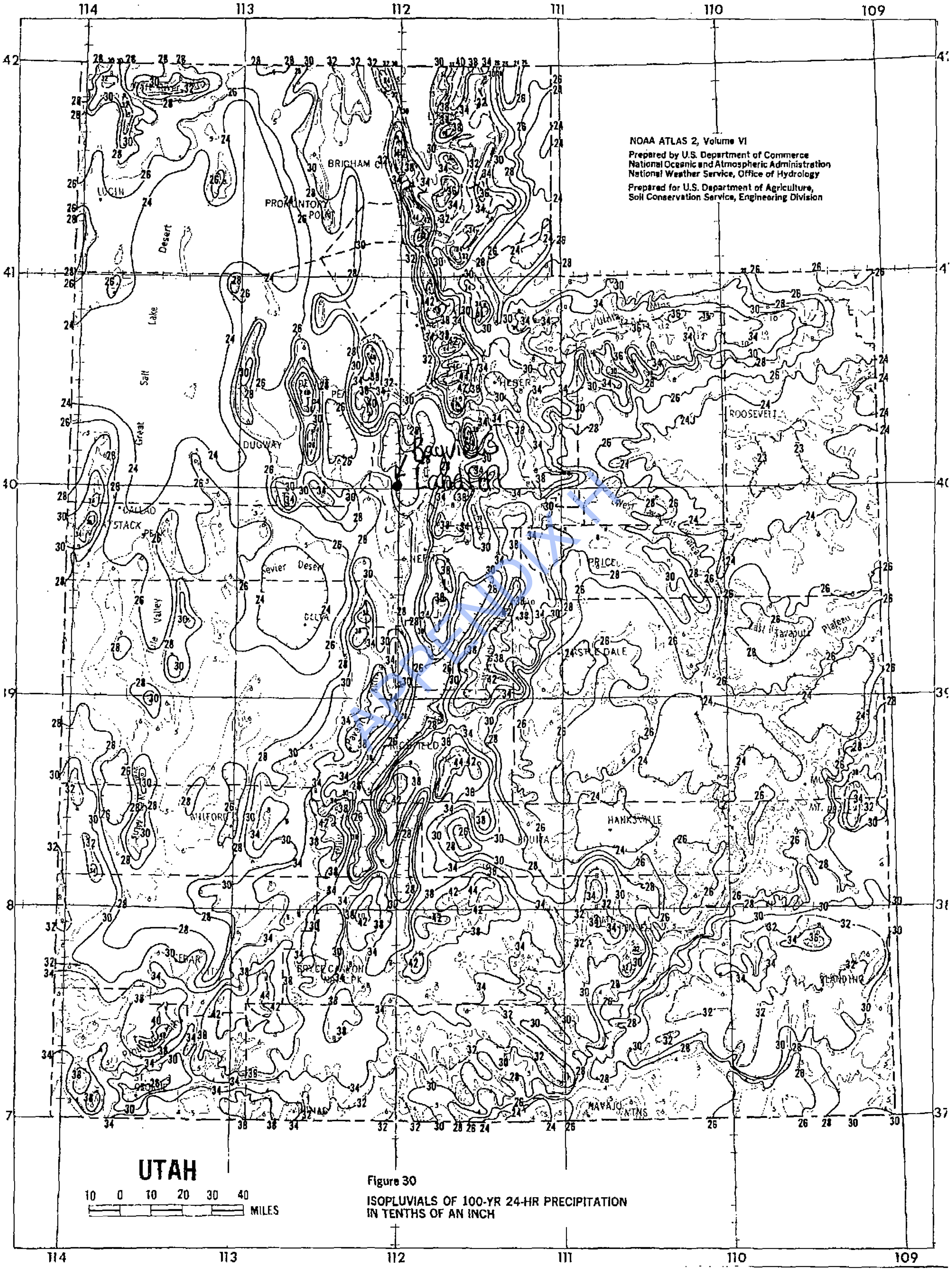


NOAA ATLAS 2, Volume VI
Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

Figure 24

ISOPLUVIALS OF 100-YR 6-HR PRECIPITATION IN TENTHS OF AN INCH

REF. 3
p.13/21



NOAA ATLAS 2, Volume VI
Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

Figure 30

ISOPLUVIALS OF 100-YR 24-HR PRECIPITATION
IN TENTHS OF AN INCH

REF. 3
pg. 14/21

Job No. | No.

HDR Computation

Project Bayview Landfill | Computed | Date 5/03

Subject | Checked | Date

Task Time of Concentration for Cell 2 | Sheet 15 | Of 21

Sheet Flow (overland flow)

Surface Description – Short grass prairie

$n = 0.15$

$L = 300'$

$P_2 = 1''$

$S = 0.05$

$$T_c = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\,S^{0.4}} = \frac{.007(0.15 * 300')^{0.8}}{(1'')^{0.5}(.05)^{0.4}}$$

$T_c = 0.4876$

Shallow concentrated flow (swale flow)

Surface description – short grass prairie

$L_1 = 120'$

$S_1 = 0.05$

$V = 3.6$ ft/s (from REF. 2 using $S = 0.05$ for unpaved soil)

$$T_{c,1} = \frac{L}{3600V} = \frac{120'}{3600(3.6\text{ ft/s})} = 0.0093$$

$L_2 = 100'$

$S_2 = .25$

$V = 8$ ft/sec (from REF. 2 using $S = .25$ for unpaved soil)

$$T_{c2} = \frac{L}{3600V} = \frac{100'}{3600(3.6\text{ ft/s})} = 0.0077$$

Channel Slope

$S = 1\%$

$A = 6.75\text{ ft}^2$

$n = .025$

$R = \frac{A}{P} = .7115\text{ ft}$

$V = 4.75$ ft/s (from Manning's Equation $V = \frac{1.49}{n} R^{2/3} S^{1/2}$)

Job No.
No.

HDR Computation

Project Bayview Landfill
Computed
Date 5/03
Subject
Checked
Date
Task
Sheet 16
Of 21

Channel Flow (continued)

$$T_c = \frac{L}{3600V} = \frac{1050 \text{ ft}}{3600(4.75 \text{ ft/s})} = .0614$$

$$T_{c,TOTAL} = .4876 + .0093 + .0077 + .0614 = .5660 \text{ hr}\left(\frac{60 \text{ min}}{1 \text{ hr}}\right)$$

$T_c = 33.96$ min (for runoff from Cell 2)

Since the time of concentration for Cell 1 is greater than the time of concentration for Cell 2, the time of concentration to be used is 44.11 min. (for Cell 1).

Based on REF. 3, Figure 6: Precipitation depth versus return period for partial-duration (see page 14), the 25 yr 1-hr storm is estimated to be 9.0 inch.

Based on REF. 3, to obtain estimates for a 25-year 30-min storm, the value of .79 must be applied to a 25-year 1-hour storm. Using linear interpolation, the value that must be applied to a 25-year 1-hour storm to obtain a depth for a 25-year 44-minute storm is 0.89.

∴ depth of a point for 25-year 44-min storm =

$= .89 * 1'' = .89''$

$$i = \frac{0.89''}{44 \text{ min}}\left(\frac{60 \text{ min}}{1 \text{ hr}}\right) = 1.21 \text{ in/hr}$$

REF. 3

p.17/21

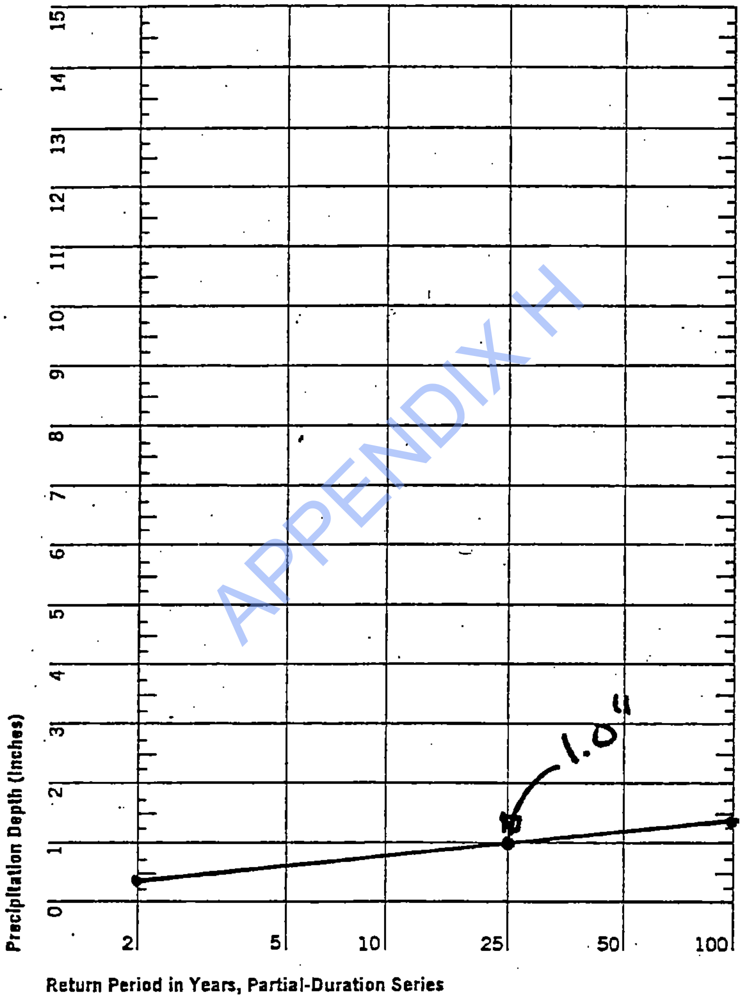


Figure 6. *Precipitation depth versus return period for partial-duration series.*

REF. 3

p.18/21

Table 1.—Five, 10-, 15- and 30-minute ratios for 2- and 100-year return periods

Region No.	Region	Ratios to 1 Hour 2-Year Return Period 5 minutes	10	15	30	100-Year Return Period 5 minutes	10	15	30
1	Coastal Northwest	.30	.45	.56	.73	.36	.53	.64	.82
2	Interior Northwest	.35	.53	.64	.81	.37	.56	.67	.85
3	Rocky Mountains-North	.38	.57	.68	.84	.35	.55	.67	.84
4	Front Face and High Plains-North	.39	.58	.69	.85	.37	.56	.69	.87
5	Great Basin	.34	.51	.61	.81	.34	.52	.63	.84
6	Rocky Mountains-South	.35	.54	.65	.83	.32	.50	.62	.81
7	Front Face and High Plains-South	.33	.51	.62	.83	.29	.46	.59	.81
8	Southwest Deserts	.34	.51	.62	.82	.30	.46	.59	.80

The final consideration was comparability to information for locations adjacent to the study area. Taking such information into account accomplished two goals. First, it contributed to the degree of consistency and continuity between this study and other reports. Second, it provided additional insight into the variation of the ratios in this report, providing anchors, so to speak, at the study area boundaries. For areas east of the study region, we compared our results to Frederick et al. (1977) and for California we related our results to Frederick and Miller (1979). In addition, we developed frequency estimates for several stations with short-duration data in surrounding states. Fourteen stations were analyzed for this purpose, 10 in the Plains States and 4 in California. Most of these stations were close enough to be directly comparable to adjacent stations within the study area, while a few were chosen at greater distances from the boundaries to provide some idea of the trend in ratios leading up to the study area.

It was concluded that the ratios in this report were consistent with previous studies. The final ratios are listed in Table 1. A comparison between these ratios and those from NOAA Atlas 2 and Weather Bureau (1953, 1954) is shown in Table 2.

Table 2.—Ratios compared to other reports

Dur. (min)	This Report*	Ratio to 1 Hour NOAA Atlas 2	Weather Bur. (1953, 1954)*
5	.34	.29	.32
10	.52	.45	.49
15	.64	.57	.59
30	.82	.79	.78

*Averaged over all regions and for all return periods

Note: Comparisons are for illustrative purposes only. Each report covers a different geographic area, and averaging is done without regard to size of region or specific return periods involved.

6. APPLICATION OF RATIOS

The ratios derived in the above analysis are based on stations whose elevations tended to be in the lower sections of each region. To extrapolate these statistics to much higher elevations would be a questionable undertaking, because of the complex effects of slope, funneling, and rain shadows that often occur in these areas. As such, the ratios are not applicable to all elevations within each region, but rather to a general range of elevations. The ranges of applicable elevation, approximately 3,000 to 3,500 ft in most areas, are summarized in table 3. In a few cases, areas are excluded that contain stations included in the analysis. The regional ratios were reviewed in light of this fact, and it was determined that no adjustments were necessary.

Areas of non-applicability, based on elevation and location considerations, are shown in figure 1 as shaded areas. These areas are based primarily on smoothed contour maps of the western states. Due to the generalized nature of the contours, there are isolated sections, primarily at the edge of shaded areas, where the ratios might be applicable. Conversely, there are isolated peaks and high elevations which are not shown as part of any shaded areas, but which may, in fact, be non-applicable areas.

Table 3.—Applicable elevations within regions

Region No.	Generally Applicable elevations (ft)
1	0-2500
2	50-3000 Columbia Basin to 2500-5500 SE
3	2000-5000 N to 4000-7000 S
4	2000-5000 N to 4000-7000 S
5	3500-7000
6	4500-8000 N to 3500-7000 S
7	4000-7500 N to 3500-7000 S
8	3000-6500 mountains to 100-3500 deserts

Job No.
No.

HDR Computation

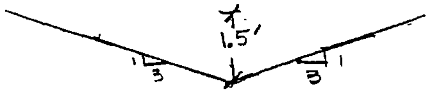
HDR

Project Bayview Landfill
Computed
Date 5/03
Subject
Checked
Date
Task
Sheet 19
Of 21

$$Q = CiA$$
$$= .33(1.21\ \text{in/hr})(18.4\ \text{acres})$$
$$= 7.37\ \text{ft}^3/\text{sec}$$ (flow in drainage ditch)

This flow is only the portion of the flow that runs off of Cell 1 and 2 that travels in the Northern direction of the ditch. There will be run-off from Cells 1 and 2 that travels in the Southern direction of the ditch, but that flow has not been computed. The flow computed for the Northward direction is a conservative value for the flow heading southward since the south portion has less contributing area than the north portion. There will be less flow in the south portion, so the ditch designed for the flow in the north portion will be acceptable for both directions.

Drainage Ditch Capacity



$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

Q = peak discharge
A = Area
R = Hydraulic radius $\left(\frac{A}{P}\right)$
n = Manning roughness coefficient
S = minimum slope

$$A = \tfrac{1}{2}(1.5')(4.5') + \tfrac{1}{2}(1.5')(4.5') = 6.75\ \text{ft}^2$$
$$P = \sqrt{22.5} + \sqrt{22.5} = 9.49\ \text{ft}$$
$$R = 6.75\ \text{ft}^2 / 9.49\ \text{ft} = .7115\ \text{ft}$$

Job No. No.

HDR Computation

Project Bayview Landfill | Computed | Date 5/03

Subject | Checked | Date

Task | Sheet 20 | Of 27

Drainage Ditch Capacity (continued)

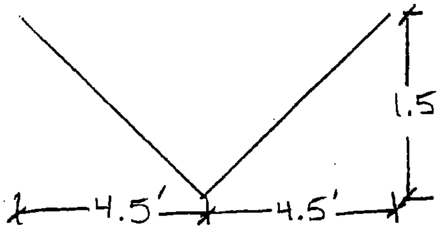
S = 0.005
n = 0.025 (for straight and uniform Earth that is clean and weathered)

$$Q = \frac{1.49}{0.025}(6.75\,ft^2)(.7115\,ft)^{2/3}(.005)^{1/2}$$

$$\underline{Q = 22.67\ cfs}$$

Since the capacity of the ditch is greater than the amount of flow that will be running off of cell 1 and cell 2, than this ditch configuration is adequate.

Drainage Ditch Configuration



*not drawn to scale

REF. 4 Pg. 21/21

TABLE 5-6. VALUES OF THE ROUGHNESS COEFFICIENT *n* (*continued*)

Type of channel and description	Minimum	Normal	Maximum
C. EXCAVATED OR DREDGED			
a. Earth, straight and uniform			
1. Clean, recently completed	0.016	0.018	0.020
2. Clean, after weathering	0.018	0.022	0.025
3. Gravel, uniform section, clean	0.022	0.025	0.030
4. With short grass, few weeds	0.022	0.027	0.033
b. Earth, winding and sluggish			
1. No vegetation	0.023	0.025	0.030
2. Grass, some weeds	0.025	0.030	0.033
3. Dense weeds or aquatic plants in deep channels	0.030	0.035	0.040
4. Earth bottom and rubble sides	0.028	0.030	0.035
5. Stony bottom and weedy banks	0.025	0.035	0.040
6. Cobble bottom and clean sides	0.030	0.040	0.050
c. Dragline-excavated or dredged			
1. No vegetation	0.025	0.028	0.033
2. Light brush on banks	0.035	0.050	0.060
d. Rock cuts			
1. Smooth and uniform	0.025	0.035	0.040
2. Jagged and irregular	0.035	0.040	0.050
e. Channels not maintained, weeds and brush uncut			
1. Dense weeds, high as flow depth	0.050	0.080	0.120
2. Clean bottom, brush on sides	0.040	0.050	0.080
3. Same, highest stage of flow	0.045	0.070	0.110
4. Dense brush, high stage	0.080	0.100	0.140

APPENDIX M

ATTACHMENT 2:

REQUIRED CAPACITY FOR SURFACE WATER DIVERSION DITCH

HDR ONE COMPANY *Many Solutions* ℠

Project:	Bayview Landfill	Computed:	RLR	Date:	1/9/2009
Subject:	Run-off calculations	Checked:		Date:	
Task:	Determine Flow Rates using Rational Method				
Job #:					

DA-1: Cell 2 - Diversion Ditch around Stage 1 (Final Contours)

Rational Equation Parameters

Drainage Area (A) = 12.61 ac

Time of Concentration

$$t_c = \sum_{i=1}^{k} T_{ti} = \sum_{i=1}^{k} \left(\frac{L_i}{60V_i} \right)$$

Eq. 7.11 from UDOT Manual: Roadway Drainage, Hydrology (See Attached)

$$V = kS^{0.5}$$

Eq. 7.12 from UDOT Manual: Roadway Drainage, Hydrology (See Attached)

where:
tc= Time of concentration (min)
V= Velocity (ft/s)
L= Length of segment (ft)
S= Slope (%)
k= Intercept coefficient from Table 7-10 from UDOT Manual: Roadway Drainage, Hydrology (See Attached)

Segment 1:
L= 395 ft
S= 9.5%
k= 1.61 (Assume shallow, concentrated flow)
V= 5.0 ft/s
Therefore, tc= 1.33 min

Segment 2:
L= 1770 ft
S= 3.3%
k= 1.61 (Assume shallow, concentrated flow)
V= 2.9 ft/s
Therefore, tc= 10.09 min

Total tc= 11.41 min

Rainfall intensity (i) for 25-year storm

For tc= 11.41 min
i_{25}= 3.00 in/hr (From IDF curves from NOAA Atlas 14 (See attached))

Rainfall Runoff Coefficient

C= 0.30 (C value for unimproved area from Table 7-24 from UDOT Manual of Instruction (See attached))

Frequency Factor for Rational Formula

C_f= 1.1 (Frequency Factor for 25-year recurrence internval, from Table 7-21 from UDOT Manual of Instruction)

Discharge Calculation

$Q=C*C_f*I*A$

Q_{25}= 12 cfs

HDR | **ONE COMPANY**
Many Solutions SM

Project:	Bayview Landfill	Computed:	RLR	Date:	1/9/2009
Subject:	Run-off calculations	Checked:		Date:	
Task:	Determine Flow Rates using Rational Method				
Job #:					

DA-2: Cell 2 - Diversion Ditch around Stage 2 (Final Contours)

Rational Equation Parameters

Drainage Area (A) = 20.96 ac

Time of Concentration

$$t_c = \sum_{i=1}^{k} T_{ti} = \sum_{i=1}^{k} \left(\frac{L_i}{60V_i} \right)$$

Eq. 7.11 from UDOT Manual: Roadway Drainage, Hydrology (See Attached)

$$V = kS^{0.5}$$

Eq. 7.12 from UDOT Manual: Roadway Drainage, Hydrology (See Attached)

where:
tc= Time of concentration (min)
V= Velocity (ft/s)
L= Length of segment (ft)
S= Slope (%)
k= Intercept coefficient from Table 7-10 from UDOT Manual: Roadway Drainage, Hydrology (See Attached)

Segment 1:
L= 400 ft
S= 9.5%
k= 1.61 (Assume shallow, concentrated flow)
V= 5.0 ft/s
Therefore, tc= 1.34 min

Segment 2:
L= 2275 ft
S= 2.3%
k= 1.61 (Assume shallow, concentrated flow)
V= 2.4 ft/s
Therefore, tc= 15.53 min

Total tc= 16.87 min

Rainfall intensity (i) for 25-year storm

For tc= 16.87 min
i_{25}= 2.50 in/hr (From IDF curves from NOAA Atlas 14 (See attached))

Rainfall Runoff Coefficient

C= 0.30 (C value for unimproved area from Table 7-24 from UDOT Manual of Instruction (See attached))

Frequency Factor for Rational Formula

C_f= 1.1 (Frequency Factor for 25-year recurrence internval, from Table 7-21 from UDOT Manual of Instruction (See attached))

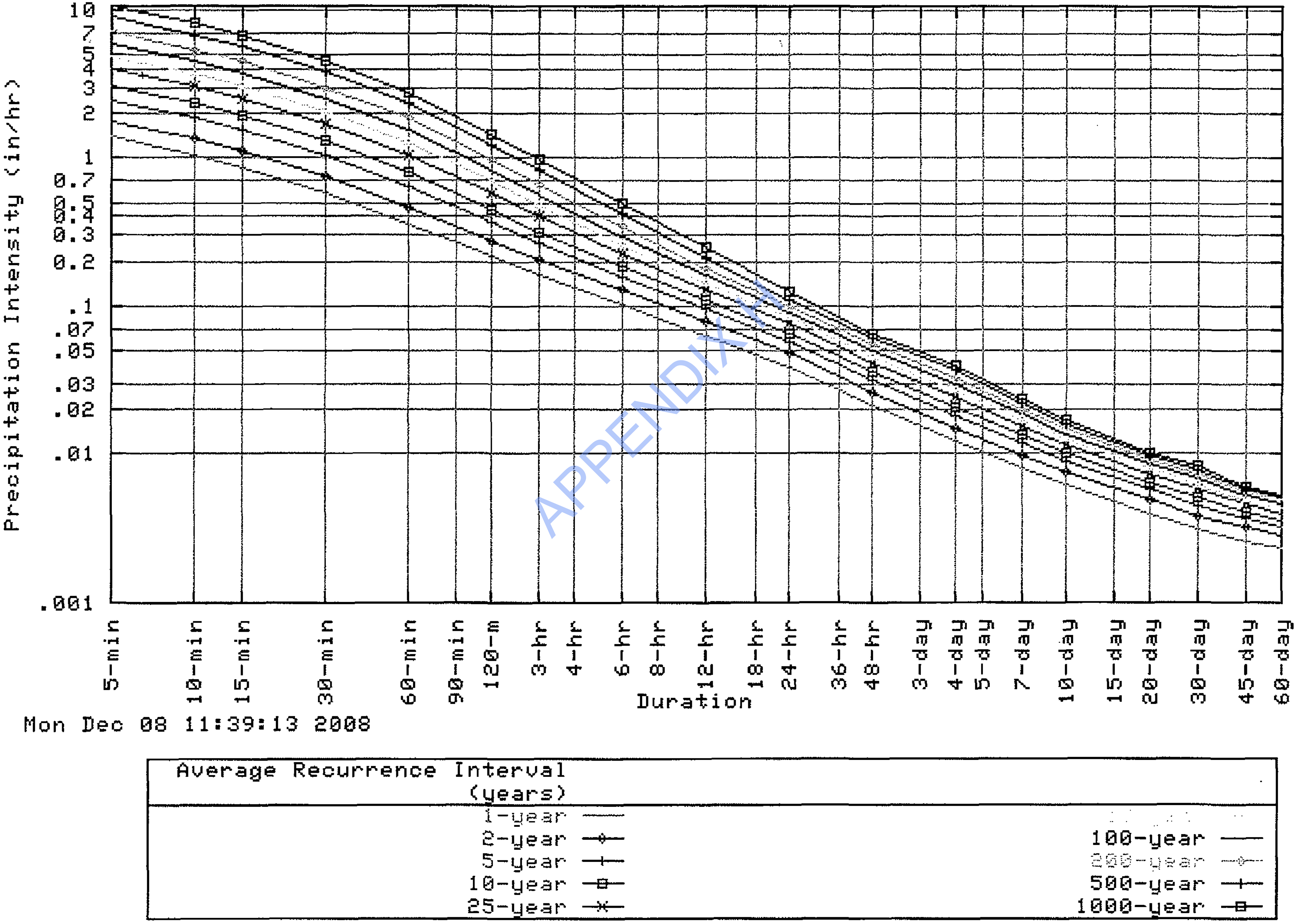
Discharge Calculation

$Q=C*C_f*I*A$

Q_{25}= 17 cfs

Partial duration based Point IDF Curves - Version: 4
40.036799 N 111.968129 W 4688 ft

Source: NOAA Atlas 14



In Equation 7.9, i depends on t_c and t_c is not initially known. Therefore, the computation of t_c is an iterative process. An initial estimate of t_c is assumed and used to obtain i from the intensity-duration-frequency curve for the locality. The t_c is computed from Equation 7.9 and used to check the initial value of i. If they are not the same, then the process is repeated until two successive t_c estimates are the same.

7.18.4.2 Velocity Method

The velocity method can be used to estimate travel times for sheet flow, shallow concentrated flow, pipe flow or channel flow. It is based on the concept that the travel time (T_t) for a flow segment is a function of the length of flow (L) and the velocity (V):

$$T_t = \frac{L}{60V} \qquad (7.10)$$

in which T_t, L and V have units of minutes, meters and meters/second, respectively. The travel time is computed for the principal flow path. Where the principal flow path consists of segments that have different slopes or land covers, the principal flow path should be divided into segments and Equation 7.10 used for each flow segment. The time of concentration is then the sum of travel times:

$$t_c = \sum_{i=1}^{k} T_{ti} = \sum_{i=1}^{k} \left(\frac{L_i}{60V_i} \right) \qquad (7.11)$$

in which k is the number of segments and the subscript i refers to the flow segment.

The velocity of Equation 7.10 is a function of the type of flow (overland, sheet, rill and gully flow, channel flow, pipe flow), the roughness of the flow path, and the slope of the flow path. Some methods also include a rainfall index such as the 2-yr, 24-hour rainfall depth. A number of methods have been developed for estimating the velocity.

After short distances, sheet flow tends to concentrate in rills and then gullies of increasing proportions. Such flow is usually referred to as shallow concentrated flow. The velocity of such flow can be estimated using an empirical relationship between the velocity and the slope:

$$V = kS^{0.5} \qquad (7.12)$$

in which V is the velocity (ft/s) and S is the slope (%). The value of k is a function of the land cover, with values for selected land covers given in Table 7-10.

7.18.4.3 Open Channels

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs or where blue lines (indicating streams) appear on USGS quadrangle sheets. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bankfull condition.

TABLE 7-10 Intercept Coefficients for Velocity vs. Slope Relationship of Equation 7.12

K	Land Cover/Flow Regime
0.25	Forest with heavy ground litter; hay meadow (overland flow)
0.5	Trash fallow or minimum tillage cultivation; contour or strip cropped; woodland (overland flow)
0.7	Short grass pasture (overland flow)
0.9	Cultivated straight row (overland flow)
1.0	Nearly bare and untilled (overland flow); alluvial fans in western mountain regions
1.5	Grassed waterway (shallow concentrated flow)
1.61	Unpaved (shallow concentrated flow)
2.0	Paved area (shallow concentrated flow); small upland gullies

Manning's equation is:

$$V = \frac{1.49\,R^{2/3}\,S^{1/2}}{n} \tag{7.13}$$

where:
V = average velocity, ft/s
R = hydraulic radius, ft (equal to A/WP)
A = cross sectional flow area, ft^2
WP = wetted perimeter, ft
S = slope of the hydraulic grade line, ft/ft
n = Manning's roughness coefficient

After average velocity is computed using Equation 7.13, T_t for the channel segment can be estimated using Equation 7.10.

7.18.4.4 Reservoir or Lake

Sometimes, it is necessary to compute a T_c for a watershed having a relatively large body of water in the flow path. In such cases, T_c is computed to the upstream end of the lake or reservoir and, for the body of water, the travel time is computed using the Equation:

$$V_w = (gD_m)^{0.5} \tag{7.14}$$

where:
V_w = the wave velocity across the water, ft/s
g = 32.2 ft/s^2
D_m = mean depth of lake or reservoir, ft

Generally, V_w will be high (8 to 30 ft/s).

One must not overlook the fact that Equation 7.14 only provides for estimating travel time across the lake and for the inflow hydrograph to the lake's outlet. It does not account for the

C = runoff coefficient representing a ratio of runoff to rainfall

I = average rainfall intensity for a duration equal to the time of concentration for a selected return period, in/h

A = drainage area tributary to the design location, ha

7.23.5 Infrequent Storm

The coefficients given in Tables 7-23 through 7-25 are applicable for storms of 5-yr to 10-yr frequencies. Less frequent, higher intensity storms will require modification of the coefficient because infiltration and other losses have a proportionally smaller effect on runoff Reference *(19)*. The adjustment of the Rational method for use with major storms can be made by multiplying the right side of the Rational formula by a frequency factor C_f. The Rational formula now becomes:

$$Q = CC_fIA \qquad (7.16)$$

C_f values are listed in Table 7-21.

TABLE 7-21 — Frequency Factors for Rational Formula

Recurrence Interval (years)	C_f
→ 25	1.1
50	1.2
100	1.25

The product of C_f times C shall not exceed 1.0.

TABLE 7-22 — Hydrologic Soils Groups For

Example for Orange County, North Carolina

Series Name	Hydrologic Groups	Series Name	Hydrologic Groups
Altavista	C	Herndon	B
Appling	B	Hiwassee	B
Cecil	B	Iredell	D
Chewacla	C	Lignum	C

TABLE 7-23 — Recommended Coefficient of Runoff for Pervious Surfaces (By Selected Hydrologic Soil Groupings and Slope Ranges)

Slope	A	B	C	D
Flat (0% – 1%)	0.04 – 0.09	0.07 – 0.12	0.11 – 0.16	0.15 – 0.20
Average (2% – 6%)	0.09 – 0.14	0.12 – 0.17	0.16 – 0.21	0.20 – 0.25
Steep (Over 6%)	0.13 – 0.18	0.18 – 0.24	0.23 – 0.31	0.28 – 0.38

Source: (Example from *Storm Drainage Design Manual*, Erie and Niagara Counties Regional Planning Board)

TABLE 7-24 — Recommended Coefficient of Runoff Values (For Various Selected Land Uses)

Description of Area		Runoff Coefficients
Business:	Downtown areas	0.70 – 0.95
Neighborhood areas		0.50 – 0.70
Residential:	Single-family areas	0.30 – 0.50
	Multi units, detached	0.40 – 0.60
	Multi units, attached	0.60 – 0.75
	Suburban	0.25 – 0.40
Residential (0.5 ha lots or more)		0.30 – 0.45
Apartment dwelling areas		0.50 – 0.70
Industrial:	Light areas	0.50 – 0.80
	Heavy areas	0.60 – 0.90
Parks, cemeteries		0.10 – 0.25
Playgrounds		0.20 – 0.40
Railroad yard areas		0.20 – 0.40
Unimproved areas		0.10 – 0.30

Source: Reference *(3)*.

TABLE 7-25 — Coefficients for Composite Runoff Analysis

Surface		Runoff Coefficients
Streets: Asphalt		0.70 – 0.95
	Concrete	0.80 – 0.95
Drives and walks		0.75 – 0.85
Roofs		0.75 – 0.95

Source: Reference *(3)*.

7.23.6 Procedures

The results of using the Rational formula to estimate peak discharges are very sensitive to the parameters used, especially time of concentration and runoff coefficient. The designer must use good engineering judgment in estimating values that are used in the method. Following is a discussion of the different variables used in the Rational method.

7.23.6.1 Time of Concentration

The time of concentration is the time required for water to flow from the hydraulically most remote point of the drainage area to the point under investigation. Use of the Rational formula requires the time of concentration (t_c) for each design point within the drainage basin. The duration of rainfall is then set equal to the time of concentration and is used to estimate the design average rainfall intensity (I). For a specific drainage basin, the time of concentration consists of an inlet time plus the time of flow in a closed conduit or open channel to the design point. Inlet time is the time required for runoff to flow over the surface to the nearest inlet and is primarily a function of the length of overland flow, the slope of the drainage basin and surface cover. Pipe or open channel flow time can be estimated from the hydraulic properties of the conduit or channel.

To obtain the total time of concentration, the pipe or open channel flow time must be calculated and added to the inlet time. After first determining the average flow velocity in the pipe or channel, the travel time is obtained by dividing velocity into the pipe or channel length.

Worksheet for Diversion Ditch around Cell 2

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.027	
Channel Slope	0.00500	ft/ft
Normal Depth	1.00	ft
Left Side Slope	50.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)

Results

Discharge	66.08	cfs
Flow Area	27.00	ft²
Wetted Perimeter	54.13	ft
Top Width	54.00	ft
Critical Depth	0.82	ft
Critical Slope	0.01434	ft/ft
Velocity	2.45	ft/s
Velocity Head	0.09	ft
Specific Energy	1.09	ft
Froude Number	0.61	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.82	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.01434	ft/ft

Cross Section for Diversion Ditch around Cell 2

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.027	
Channel Slope	0.00500	ft/ft
Normal Depth	1.00	ft
Left Side Slope	50.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Discharge	66.08	cfs

Cross Section Image

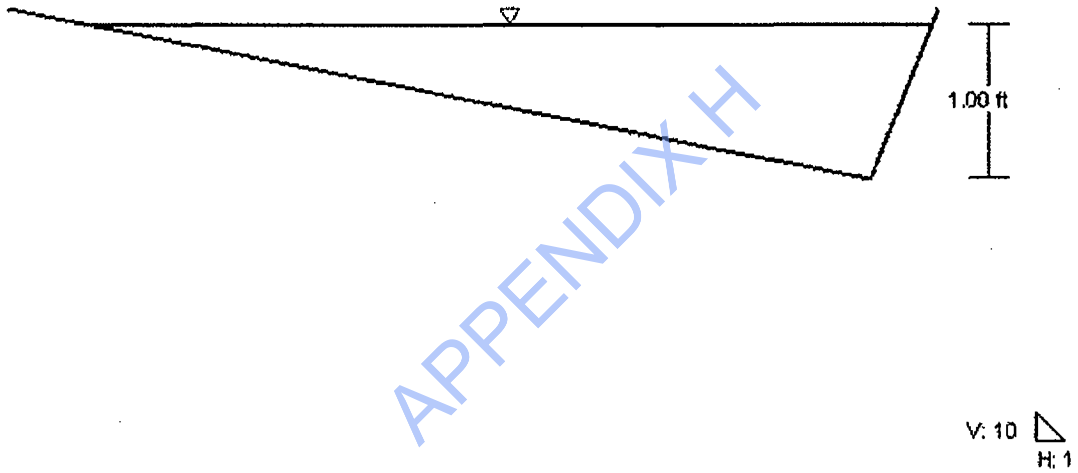
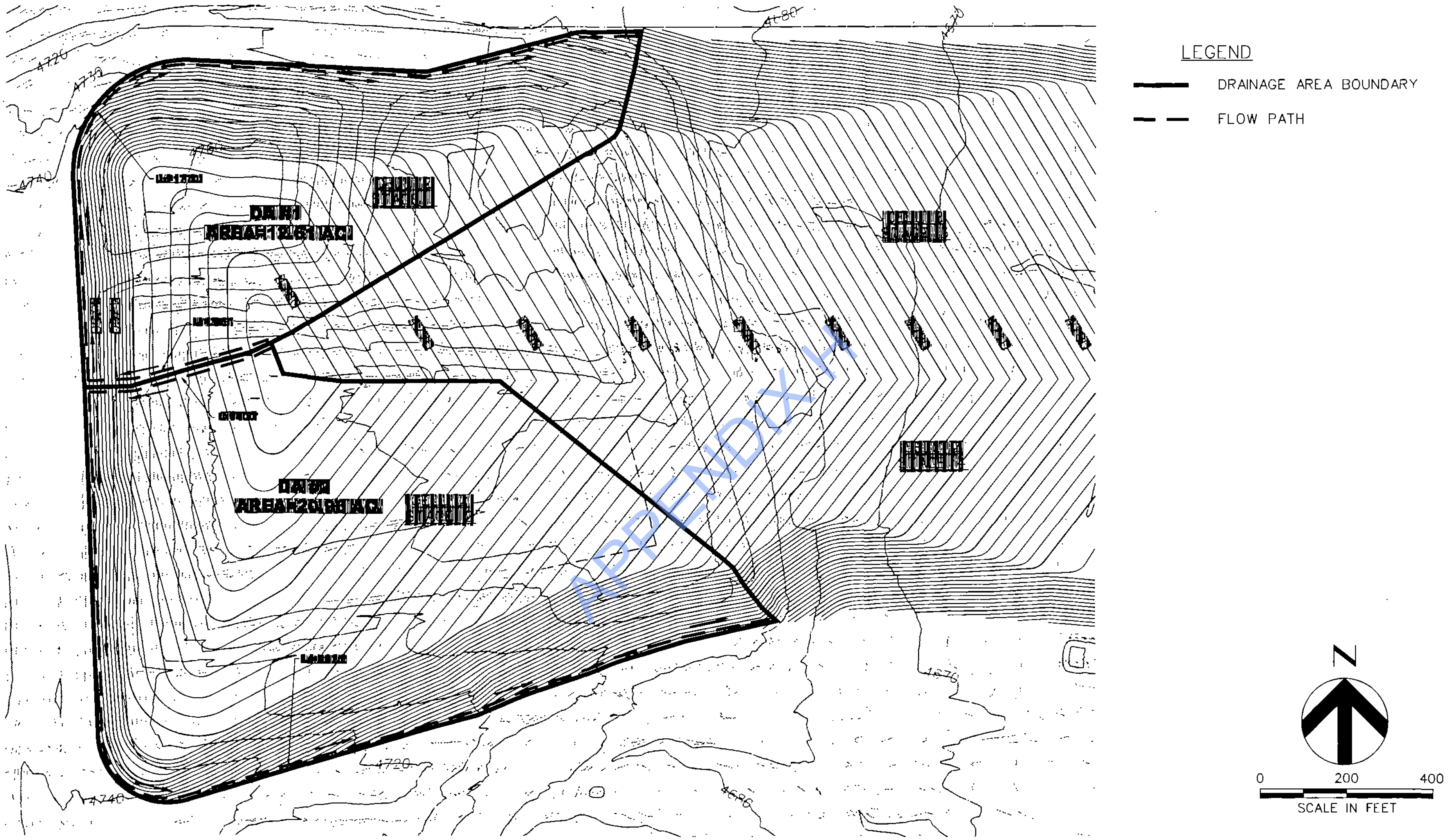


TABLE 8-2 — Values of Manning's Roughness Coefficient n (Uniform Flow)

Type of Channel and Description	Minimum	Normal	Maximum
EXCAVATED OR DREDGED			
1. Earth, straight and uniform			
a. Clean, recently completed	0.016	0.018	0.020
b. Clean, after weathering	0.018	0.022	0.025
c. Gravel, uniform section, clean	0.022	0.025	0.030
→ d. With short grass, few weeds	0.022	0.027	0.033
2. Earth, winding and sluggish			
a. No vegetation	0.023	0.025	0.030
b. Grass, some weeds	0.025	0.030	0.033
c. Dense weeds or aquatic plans in deep channels	0.030	0.035	0.040
d. Earth bottom and rubble sides	0.025	0.030	0.035
e. Stony bottom and weedy sides	0.025	0.035	0.045
f. Cobble bottom and clean sides	0.030	0.040	0.050
3. Dragline-excavated or dredged			
a. No vegetation	0.025	0.028	0.033
b. Light brush on banks	0.035	0.050	0.060
4. Rock cuts			
a. Smooth and uniform	0.025	0.035	0.040
b. Jagged and irregular	0.035	0.040	0.050
5. Channels not maintained, weeds and brush uncut			
a. Dense weeds, high as flow depth	0.050	0.080	0.120
b. Clean bottom, brush on sides	0.040	0.050	0.080
c. Same, highest stage of flow	0.045	0.070	0.110
d. Dense brush, high stage	0.080	0.100	0.140
NATURAL STREAMS			
1. Minor streams (top width at flood stage < 30 m)			
a. Streams on Plain			
1) Clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
2) Same as above, but more stones/weeds	0.030	0.035	0.040
3) Clean, winding, some pools/shoals	0.033	0.040	0.045
4) Same as above, but some weeds/stones	0.035	0.045	0.050
5) Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
6) Same as 4, but more stones	0.045	0.050	0.060
7) Sluggish reaches, weedy, deep pools	0.050	0.070	0.080
8) Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.075	0.100	0.150
b. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages			
1) Bottom: gravels, cobbles and few boulders	0.030	0.040	0.050
2) Bottom: cobbles with large boulders	0.040	0.050	0.070



LEGEND

DRAINAGE AREA BOUNDARY

FLOW PATH

HDR

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

CELL 2 FINAL CONTOURS DRAINAGE MAP

DATE
1-9-09

FIGURE
M-1

APPENDIX I – STORMWATER POLUTION PREVENTION PLAN (SWPPP)

Industrial Storm Water Permit
Storm Water Pollution Prevention Plan

APPENDIX I

SUVSWD

South Utah Valley Solid Waste District

STORM WATER POLLUTION PREVENTION PLAN

BAYVIEW LANDFILL
10800 S. STATE ROAD 68
UTAH COUNTY

UPDES Multi-Sector Group 5 General Permit No.: UTR000000
Expires: December 31, 2017

SUVSWD

South Utah Valley Solid Waste District

STORM WATER POLLUTION PREVENTION PLAN

BAYVIEW LANDFILL
10800 S. STATE ROAD 68
UTAH COUNTY

UPDES Multi-Sector Group 5 General Permit No.: UTR000000
Expires: December 31, 2017

Certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Terry Ficklin
District Manager
SUVSWD

Date

Prepared by:
HDR | ONE COMPANY *Many Solutions*℠
3949 South 700 East, Suite 500
Salt Lake City, UT 84107

June 2013

TABLE OF CONTENTS

LIST OF APPENDICES

DOCUMENT REVISIONS

BAYVIEW LANDFILL
STORMWATER POLLUTION PREVENTION PLAN

NUMBER	DATE	DESCRIPTION OF CHANGE
0	8/30/2005	Initial document
1	7/18/2013	SWPPP revision with permit re-issuance
2		
3		
4		
5		
6		
7		
8		
9		
10		

1.1 Action and Compliance Reporting Requirements

The following items have been compiled as actions required by SUVSWD to comply with current UPDES Multi-Sector Group 5 General Permit conditions.

Action	Form	Frequency	Notes
Certification of Non-Stormwater Discharges	Certification of Non-Storm Water Discharges-Appendix K	Upon permit renewal	Complete for and file with Utah Division of Water Quality (UDWQ) Per Section 5.9
Site inspections	Weekly Visual inspection Report - Appendix I	Weekly	Keep completed forms as part of this Storm water Pollution Prevention Plan (SWPPP) for a minimum of 3 years
Visual monitoring of stormwater Discharge	Stormwater Discharge Monitoring Report (SWDMR)-Appendix M	Once Quarterly	If no stormwater is discharged, record findings on SWDMR and keep in SWPPP document
Analytical monitoring of discharged stormwater	Stormwater Discharge Monitoring Report-Appendix M	Quarterly, in 2nd and 4th years of permit.	Collect grab samples as described in Appendix II.L Report Findings to UDWQ per section 7.1
Comprehensive Site Compliance Evaluation	Comprehensive Site Evaluation Form-Appendix L	Yearly	Conduct a comprehensive compliance evaluation per section6.0, and prepare report of findings
Track BMP Implementation	BMP Implementation Record- Appendix G	As needed	Record all newly implemented Best Management Practices (BMPs), repairs made, or removal of BMPs and responsibilities.
Document all hazardous Materials spills	Hazardous Material Spill Record-Appendix H	As needed	Record any spill of hazardous materials, and subsequent clean up efforts
Comprehensive Employee Training	Employee Training Record-Appendix J	Yearly, newly hired employees	Training on SWPPP procedures, record keeping requirements etc.

2.0 Introduction

2.1 Purpose

In compliance with the *Utah Water Pollution Control Act, Title 19, Chapter 5, Utah Code Annotated 1953*, as amended, and the Utah Pollutant Discharge Elimination System (UPDES), this Storm Water Pollution Prevention Plan (SWPPP or Plan) has been prepared for Bayview Landfill in accordance with the Multi-Sector General Permit (MSGP) for Storm Water Discharges Associated with Industrial Activity (Permit No. UTR-000000). Storm water discharge requirements associated with this permit are included in Appendix A.

The SWPPP identifies potential sources of pollution that may affect the quality of storm water that is discharged from the facility. The SWPPP also defines and requires the implementation of measures and controls that reduce pollutants in storm water associated with landfill construction and operation. This SWPPP, prepared for the Bayview Landfill, is to be amended whenever there is a change in landfill design, construction, operation, or maintenance that may significantly impact the potential for pollutants to be discharged.

3.0 Facility Overview

3.1 Facility Description and Location

The Bayview Landfill is located in Sections 17 and 18, T9S, R1W approximately 6 miles north of Elberta, Utah, and directly west of State Highway 68 (see Appendix B, Figure 1). The landfill property includes all 640 acres of Section 17, and a 20-acre parcel in Section 18. All solid waste disposal activities are planned within the Section 17 parcel; the 20-acre Section 18 parcel houses a culinary well, a water storage tank, and an upgradient monitoring well associated with the landfill operations.

The Bayview Landfill consists of the following parcels:

- Parcel “A": SW1/4 NW1/4 Section 17, T9S, R1W,
- Parcel "B": That portion of Section 17, T9S, R1W not described in Parcel "A”, and
- Parcel "C": S1/2 of the SE1/4 of the NE1/4, Section 18, T9S, R1W.

This land was conveyed by the Utah Division of State Lands to the Provo City Corporation for a term of 51 years under Special Use Lease Agreement No. 498. The term of this lease agreement extends through the year 2035. The lease agreement contains a clause for extension of the lease beyond the 51-year period.

3.2 Industrial Activity

The Bayview Landfill was located, permitted, designed, and constructed by Provo City Corporation during the 1980s and is operated by the South Utah Valley Solid Waste District (SUVSWD, referred to herein as the District). The landfill accepts compacted or baled solid waste from the District’s transfer station in Springville and a city-owned transfer station in Goshen. Permit conditions allow the disposal of waste from within the District only. The transfer stations accept residential and commercial solid wastes, including yard wastes, and generally do not accept construction debris (C&D) wastes. The transfer stations also do not accept regulated hazardous wastes.

Yard wastes and recyclable materials arriving at the transfer stations may either be segregated for composting or recycling, or commingled and compacted with the residential and commercial wastes for disposal.

3.3 Site Physical Characteristics

3.3.1 Topography and Land Use

The Bayview Landfill site is located in the Goshen Valley approximately 2 to 3 miles west of the southwestern-most bay of Utah Lake. The Goshen Valley slopes upward away from the lake toward the East Tintic Mountains some 7 miles southwest of the lake. The landfill site similarly slopes with an approximate 150-foot rise from the eastern to the western boundaries of Section 17. The eastern boundary of the landfill site is approximately 120 feet above the current water elevation of Utah Lake.

The land use surrounding the site is generally rural agricultural, with orchard, grain, hay, and livestock grazing as the predominant land uses in the vicinity of the site. The nearest residence is located more than 1 mile from the northern property boundary.

3.3.2 Climatology

Climate data from Elberta, Utah, best represent conditions at the Bayview Landfill based on proximity and similar elevations. Mean annual maximum and minimum temperatures are 64.9º F and 35.7º F, respectively. Mean annual precipitation is approximately 10.6 inches with April, May, and October typically being the wettest months. The Period of Record Monthly Climate Summary (1928-1992) and National Climatic Data Center (NCDC) 1971-2000 Monthly Normals are the most up-to-date records and are included in Appendix C.

Prevailing winds at the landfill site are from the south-southeast (SSE). However, the strongest winds, occurring during winter months, are from the west-southwest (WSW).

3.3.3 Surface Water Drainage

Three unnamed surface water channels intermittently drain water across the landfill from west to east. Each channel drains an area of less than 1,000 acres. Due to the sandy nature of the channel bottoms and the soils in and around the landfill, storm runoff is limited and the channels are dry during most years and during most storm events. The three surface water channels (north, middle, and south) are shown in Appendix B, Figure 1.

3.3.4 Outfall Locations

Landfill operations primarily affect the northernmost of the three surface water channels. This channel has been relocated around (to the north of) Cell 2 and handles only non-contact storm water (storm water that has no contact with solid waste). Any storm water that reaches the eastern property boundary via the north surface water channel is discharged through a culvert under State Highway 68.

All contact storm water is conveyed in the leachate collection system to the storm water/leachate pond located to the east of Cell 2 for storage and evaporation. Neither leachate nor contact storm water are discharged from the site via surface water channels.

The middle surface water channel is affected to a lesser degree by current landfill operations, and the southernmost channel is on an unimproved portion of the property. Runoff conveyed by the middle and south channels are non-contact storm water. An excess soil storage berm has been created for aesthetic purposes on the east side of the property and to the south of the existing windrow (compost) area. This berm blocks the middle surface water channel such that there is no outfall from the property. Due to the infrequency of flow in the channel, there is no ponding of water and the berm is of little consequence in terms of site drainage. Similarly, it is anticipated that a proposed berm near the southeast corner of the property will cut off the south surface water channel. When operations move to Cell #3, this channel will be relocated to divert stormwater run-on away from the active area. For the purposes of reporting and record keeping, the north, middle, and south outfalls shall be numbered 1, 2, and 3, respectively.

4.0 Pollution Prevention Team

The Bayview Landfill Pollution Prevention Team (Team) is responsible for the development and implementation of the SWPPP. Team members include the District Manager and the Landfill Foreman. Individuals currently holding these positions are identified in Appendix D. The District Manager is the signatory authority for the SWPPP and reports identified within the SWPPP. The District Manager shall approve any document revisions.

Responsibilities of the Landfill Foreman include the following:

- Implementation of SWPPP Measures and Controls (see Section 5.0),
- Identification and implementation of Measures and Controls for new operational and construction phases,
- Coordination of employee training,
- Outfall monitoring,
- Record keeping,
- Preparation and submittal of reports (see Section 7.1), and
- Updating the SWPPP.

5.0 Description of Potential Pollutant Sources

The following sections describe activities and potential sources that may reasonably be expected to add pollutants to storm water discharges or that may result in dry weather storm water discharges.

5.1 Drainage

Features associated with surface water drainage and pollution prevention for the facility are shown in Figure 2 (Appendix B). These features are briefly described in the following paragraphs.

Surface Water Channels

In general, storm water flows from west to east across the site as described Section 2.3.3, Surface Water Drainage. On the eastern portion of the landfill, the north surface water channel has been relocated around Cell 2 and the storm water/leachate pond. Storm water conveyed by the channel passes through a culvert under State Highway 68 at the eastern edge of the property.

Active and Closed Cells

Cell 1 was closed in 2005. Measures taken during placement of final cover are discussed in Section 5.0, Measures and Controls. Closure of the cell has been completed as cover slopes have been vegetated or otherwise stabilized with wood mulch. Cell 2 is active, and waste is currently placed in an excavated portion of the cell. Storm water on Cell 2 is therefore contained and handled via the leachate collection system.

Stockpile Areas

A final cover stockpile is located to the north of Cell 1. A second stockpile area is located south of Cell 2 and approximately 1,000 feet east of the maintenance building.

Leachate System

Leachate from Cell 1 exits from the northeast corner of the cell into a leachate drain line that runs generally eastward to the storm water/leachate pond. Leachate from Cell 2, the active portion of the landfill, collects in the bottom of the cell and is pumped up to the drain line. The pond receives contact storm water and leachate. The pond has no surface water discharge; rather, evaporation controls storm water/leachate levels.

Compost operations

The composting operations area includes a storm water pond, which receives runoff from the existing windrow area/expanded compost pad. The pond is also located to the east of Cell 2 and does not discharge to a surface water.

Maintenance Building

Maintenance of vehicles and equipment is performed within the maintenance building; storm water pollution potential is therefore limited. Washing of vehicles and equipment is completed in the active portion of Cell 2 such that wash waters are directed to the leachate system.

Above-Ground Storage Tanks (ASTs)

Three ASTs are located near the maintenance building. The fuels stored in the tanks are unleaded gasoline, propane, and diesel fuel.

Structural Controls

A berm is located between the northern landfill boundary and Cell 2. This berm acts primarily as a visual barrier; however, it is also a topographic barrier that helps control the direction of runoff such that precipitation coming in to contact with potential erosion areas is directed toward the outfall sampling point.

.

Litter control fences have been placed around the north, east, and south sides of Cell 2. Fence placement was based on the direction of strong, winter winds (from the west-southwest).

The following features do not exist or have not been identified at the Bayview Landfill and are therefore not noted in Figure 2:

- Locations where open dumping has occurred,
- Locations of known leachate springs or areas where uncontrolled leachate may commingle with runoff, and
- Locations of major spills or leaks.

5.2 Inventory of Exposed Materials

The Bayview Landfill receives compacted or baled residential and commercial solid wastes. These wastes include, but are not limited to, household food wastes, paper, plastics, and yard wastes. Construction debris (C&D) wastes are generally not accepted, and hazardous wastes are specifically prohibited.

Yard wastes, which are segregated from other wastes received, are used in composting operations. Yard wastes and biosolids which are used for composting are included in the inventory of materials.

Oils associated with the operation and maintenance of landfill equipment are stored in plastic 55-gallon drums inside the maintenance building. Typically, eight (8) drums are stored.

Materials used, stored, or produced on site that are or may be exposed to storm water are included in the Material Inventory in Appendix E. Those deemed to be significant exposed materials are included in Description of Significant Exposed Materials, also located in Appendix E.

5.3 Significant Spills or Leaks

There have been no significant spills or leaks within the previous reporting period. Significant spills or leaks include, but are not limited to, releases of hazardous substances equal to or in excess of reportable quantities as identified in Appendix F.

5.4 Sampling Data

As discussed previously, two types of storm water are handled at the Bayview Landfill. Contact storm water is that portion that comes into contact with the solid waste. The most common exposure potential for solid waste occurs during offloading at the active working face. Contact storm water and leachate are collected in the leachate collection system and directed to the evaporation pond; there is no surface water discharge from the pond. Therefore, no leachate sampling data is performed and no records are available.

Non-contact storm water is conveyed by three surface water channels (designated as north, middle, and south as noted previously. Due to low precipitation the landfill site and the high infiltration rates of site soils, the channels are dry during most years and during most precipitation events. Sampling opportunities are limited, and no sampling has taken place to date, nor have any storm water discharges been observed leaving the site through the north, middle or south channels. Permit requirements related to sampling are discussed in Section 7.0, Monitoring Requirements.

5.5 Potential Pollutant Sources

Potential pollutant sources associated with activities at the Bayview Landfill have been identified and are described in the following paragraphs.

Exposure of Active and Inactive Landfill

The most common exposure potential for municipal solid waste is daily disposal at the active working face, which may be exposed to storm water during rainstorms. Less common is erosion of the soil cover that may expose the underlying waste to storm water.

Earth/Soil Moving

Earth moving has the potential to generate dust and particulates, resulting in air and water quality concerns. Furthermore, earth moving activities often disturb vegetation or otherwise create exposed slopes and increase erosion potential.

Storage of Daily, Interim, and Final Cover Material

In conjunction with earth/soil moving, storage of daily and interim final cover material is a potential pollutant source. Unprotected materials are exposed to precipitation, allowing sediments to be conveyed with storm water.

Waste Hauling, Loading, and Unloading

Along haul roads, vehicle traffic is a source of dust and sediment. Wind-blown debris from improperly covered vehicles, waste spills due to accident or improper hauling, and improper unloading methods or locations are also potential sources of pollution.

Leachate System

When leachate cannot percolate vertically, it may escape laterally through the cover soils on the side slopes of the waste fill operations. Leaks may occur in the leachate conveyance piping or in the storm water/leachate pond. However, in most locations where the leachate piping is not on top of a landfill liner, the leachate conveyance pipe is encapsulated within a containment pipe to capture leaks in the primary conveyance pipeline. This dual line system helps prevent leaks from being wasted into surface water or infiltrate the groundwater. In addition, the leachate pond is dual lined with leak detection.

ASTs and Maintenance Products

Refilling and storage of fuels may result in spills and leaks. Hydraulic fluid, motor oil, lube grease materials, and other maintenance products stored and used at the maintenance building may be exposed to storm water, though the potential is minimized if operations are limited to indoor areas.

Composting Operations

The location of composting operations is marked on Appendix B as Existing Windrow Area and Expanded Compost Pad. Water is applied to compost materials, and the operations may therefore be a source of pollution due to potentially high nutrient and sediment content in discharged water. The windrow area is graded such that all discharged waters are directed to the storm water evaporation pond, which does not discharge to any on site channels.

6.0 Measures and Controls

Best Management Practices (BMPs) are measures used to prevent or reduce pollution from on-site operations. BMPs may include processes, schedules of activities, prohibitions on practices, and other management practices to prevent or reduce water pollution. These practices are generally divided into two categories, structural and non-structural, and include the following storm water management components:

Structural BMPs include the construction or implementation of:

- Storm water (runoff) management controls, and
- Erosion and sediment control practices.

Non-structural BMPs include the following components:

- Good housekeeping,
- Preventive maintenance,
- Inspections,
- Spill prevention and response,
- Employee training, and
- Record keeping and reporting.

The following sections describe each of these components in greater detail and list BMPs appropriate for the Bayview Landfill. These BMPs may be part of existing practices or may be selected for implementation as deemed appropriate by the Team. Implementation of some BMPs may be ongoing; others may be required on a periodic basis or during certain stages of landfill operation. The table in Appendix G provides a tool for BMP implementation tracking should BMPs be required. The BMPs described in the following sections are general in nature; BMPs selected for implementation should be accompanied by details such as:

- Description (activities, location, etc.),
- Scheduled completion date,
- Person responsible, and
- Notes (purpose/need, recommendations for follow-up, effectiveness, etc.)

In addition to BMPs, certification of non-storm water discharges from the landfill is required by the permit as a measure to prevent pollution. This certification process is addressed in Section 5.9.

6.1 Storm Water (Runoff) Management

All landfills must manage and control storm water runoff in order to properly drain the site, keep areas free from flooding, and prevent damage to landfill facilities and nearby infrastructure. The landfill design also considers stormwater run-on and includes diversions to help prevent stormwater runoff from upgradient areas. Storm water management can help to prevent pollution of storm water runoff by diverting runoff away from potential pollutant sources. Storm water management controls also direct runoff that contains pollutants to control devices or treatment systems. In general, the facility's storm water management approach is summarized as follows:

- Non-contact storm water is conveyed by surface water channels such that pollution sources are avoided.
- Contact storm water and leachate are directed to a storm water and leachate ponds. These ponds have no surface water discharge (outfall); evaporation reduces pond levels. Relatively low annual precipitation and other climatic conditions of the area make this a viable alternative.

Associated BMPs include:

- Construct and maintain berms, dikes, and/or channels to divert runoff away from pollutant sources, such as the active landfill working face, disturbed soils, and stockpile areas.
- Construct and maintain berms, dikes, and/or channels to direct contact storm water to the leachate collection system or directly to the storm water and leachate ponds.
- Construct and maintain perimeter drainage channels around closed cells and stockpile areas (prior to slope stabilization via vegetation or otherwise).
- As a precaution for spills, construct and maintain berms (or other secondary containment structures) to contain spilled material, preventing contaminated runoff from entering the storm water management system.
- Design drainage channels to facilitate infiltration of storm water and pollutants and to avoid erosive velocities.

6.2 Erosion and Sediment Control Practices

Human activities accelerate erosion by removing vegetation, disturbing and compacting the soil, and changing drainage patterns. When the land surface is developed or hardened, storm water cannot seep into, or infiltrate, the ground. This results in larger amounts of water at higher velocities, which will increase the sediment load capacity of runoff allowing migration of sediment and other pollutants to receiving drainage channels.

Sediment and erosion control practices that are properly implemented can help prevent erosion and reduce sediment pollution to receiving streams. Sediment and erosion control practices include the following actions:

- Divert storm water runoff away from disturbed areas through the use of contouring, paving, berms, dikes, and/or channels.
- Direct non-contact storm water to stabilized areas such as vegetated fields or riprap outlets.
- Install silt fence and/or straw bales to protect newly graded slopes until such slopes can be successfully vegetated or otherwise stabilized.
- Install silt fence and/or straw bales upstream of culverts and outfall locations to filter storm water.
- Apply compost to exposed slopes to slow runoff and minimize erosion potential.
- Preserve existing vegetation as much as possible.

- Revegetate disturbed areas to stabilize exposed soils, such as areas that have been excavated or newly graded.
- Revegetate to permanently stabilize completed sideslopes of landfill disposal cells and to temporarily stabilize intermediate landfill slopes that may not receive waste for an extended period.
- Minimize the time that disturbed soils are exposed, and promptly revegetate or otherwise stabilize exposed soils.

6.3 Good Housekeeping

Good housekeeping involves routine – often daily – practices that prevent pollution of storm water. Good housekeeping employs common sense and promotes cleanliness and order to minimize pollution potential. Elements of Good Housekeeping and Preventive Maintenance (Section 5.4) have been incorporated into a Weekly Visual Inspection and Maintenance Report (Appendix I; see Section 5.6, Inspections). The following procedures should be considered.

Operations

- Keep active landfill working face at a manageable size with efficient, methodical operating procedures for dumping, spreading, covering, and compacting waste.
- Deploy litter fences to minimize blown litter, and regularly schedule pick-up of blown litter and waste materials.
- Store heavy equipment in designated areas, with clear and easy access to inspection points.
- Maintain dry and clean floors (in the maintenance building) and ground surfaces.

Material Storage Practices

- Clearly label drums, tanks and other containers.
- Store hydraulic fluids, motor oils, clean solvents, etc., in designated areas in clean, well-marked containers. Display copies of Material Safety Data Sheets (MSDS) information at designated container storage areas.
- Store equipment, supplies, and other materials away from traffic areas to prevent accidents.
- Provide adequate space between and around stored materials to facilitate proper handling and access for inspections.
- Provide secondary containment on all ASTs and elsewhere as appropriate.
- Use drip pans on leaking equipment or vehicles.
- Permittees shall consider providing protected materials storage areas for pesticides, herbicides, fertilizers, and other significant materials as identified in Appendix E.

Material Inventory Procedure

- Develop and frequently update a material inventory to meet the following objectives:
  - Prevent overstocking,
  - Use materials more efficiently,
  - Identify which materials and activities pose the greatest environmental risk and/or may potentially impact storm water, and

    - Identify and implement measures to eliminate or use less hazardous materials.
- Develop a shelf-life program.

Employee Participation and Training

- Routinely train employees on Plan elements, including BMP implementation (see Section 5.7, Employee Training).
- Address good housekeeping issues at regular employee meetings and training sessions.
- Publicize pollution prevention concepts using posters, bulletin boards, tips, and reminders.

6.4 Preventive Maintenance

Preventive Maintenance involves routine inspections and maintenance of the facility, facility equipment, and structural controls to correct inadequate conditions prior to failure. The Preventive Maintenance Program utilizes the following components:

- Weekly inspection of equipment, storm water management controls, drainage features, and areas of current landfill activity (active face, disturbed areas, unstabilized areas, storm water/leachate pond, compost area).
- Schedule for periodic maintenance, inspection, or tests of equipment and systems.
- Prompt adjustment, repair, or replacement of parts or equipment.
- Record keeping of all maintenance activities.

The activities described below are included in the Preventive Maintenance Program and are reflected in the Weekly Visual Inspection and Maintenance Report (Appendix I). In general, the integrity of structural features should be verified and the proper working order of equipment, conveyance systems, and structural BMPs should be checked. Personnel should look for signs of erosion and other inadequate conditions that are or might lead to storm water management problems.

- Routinely inspect the active landfill working face for proper dumping, spreading, covering and compacting procedures. Promptly correct inadequate or ineffective procedures.
- Routinely inspect leachate conveyance piping and equipment and the storm water/leachate pond to ensure proper working order. Keep access to pipes and pumps clear and free from obstructions. Promptly repair any leaks.
- Routinely inspect final and intermediate landfill slopes for leachate seeps, with prompt repair of eroding seeps.
- Routinely inspect final and intermediate landfill slopes, levees, dikes, berms, drainage channels, and outfalls for signs of erosion, with prompt repair of rills and gullies.
- Routinely inspect landfill slopes, facility roadways, channels, and fences for blown litter and sediment, with regularly scheduled pick-up of blown litter and removal of sediment from roadways.
- Routinely inspect culverts and remove sediment, debris, or other obstructions.
- Routinely inspect all outfalls for proper storm water routing and remove any debris or other obstructions.

- Routinely inspect silt fence, straw barriers, or other structural BMPs as appropriate. Promptly repair fallen or torn fences, replace degraded bales, and clear accumulated silt.
- Routinely inspect areas of vegetation and revegetate areas of stressed vegetation.
- Routinely inspect newly graded areas of erosion and settling.
- Routinely inspect facility equipment for proper working order, proper fluid levels, secure hydraulic hoses, etc. Schedule routine replacement of parts, and prompt repair of broken or leaky parts and hoses.
- Routinely inspect facility storage areas for good housekeeping practices, leaks, and spilled materials. Promptly correct inadequate conditions, and clean-up spilled materials.
- Routinely inspect ASTs for proper working order, structural integrity, and leaks, with prompt repair of inadequate conditions. Include pumps, valves, pipes, secondary containment structures, and other appurtenant equipment.
- Routinely inspect secondary containment structures for structural integrity.
- Routinely inspect areas where spills and leaks have occurred in the past.
- Routinely inspect landfill gas (LFG) extraction wells for proper working order. Monitor well for proper gas levels, and ensure connections to conveyance piping are sound. (Not yet applicable at the time of this writing, July 2013)

The Weekly Visual Inspection and Maintenance Report form (Appendix I) will be used to maintain accurate records of the Preventive Maintenance Program. Reports should include test and/or inspection results and corrective actions implemented. Tests will include visual observations, tank tightness testing as required, systems equipment testing and secondary containment systems inspection. When a leak or threatening condition is found, corrective action must be taken immediately.

When revisions or additions to the SWPPP are recommended as a result of inspections, a summary description of these proposed changes must be attached to the Weekly Visual Inspection and Maintenance Report form. The summary must identify any necessary time frames required to implement the proposed changes. Inspections may also result in the Implementation of new BMPs.

6.5 Spill Prevention and Response Procedures

The potential for reportable and/or significant spills or leaks is minimized at the Bayview Landfill by controlling the types of wastes received. BMPs related to spill prevention also help minimize such incidents, and response procedures heighten preparedness for spills or leaks. However, there is a low potential for a significant spill of leak from landfill operations. The focus of the SWPPP, as related to spill prevention and response procedures, is on materials handling and storm water-related issues.

Existing berms and ditches along the haul roads help contain spills that may originate from moving equipment on site. For spills in the Maintenance Building, absorbent materials such as Floor Dry are used for clean-up. Any used absorbent, impacted soil or used oil is disposed of in Goshen, UT.

The following are BMPs that may be implemented for the spill prevention and response procedures component:

- Train employees in proper materials storage and handling (see Section 5.3, Good Housekeeping and Section 5.7, Employee Training.
- Purchase, inventory, and properly store spill response equipment. Train employees in the use of spill response equipment.
- Display emergency information (agencies, phone numbers) in appropriate locations.

Spills shall be documented and retained with the Plan. A template for spill documentation is included as Appendix H. As noted previously, a list of hazardous substances and their reportable quantities is located in Appendix F. Any spill of a hazardous substance equal to or in excess of its reportable quantity must be reported per the following instructions:

- Notify Utah Division of Environmental Response and Remediation within 24 hours.
    - 24-Hour Emergency Phone Number: (801) 536-4123
    - Daytime Phone Number: (801) 536-4100
- If the release involves health or environmental effects which require immediate action by local authorities, call 911.
- If the release affects "Waters of the State", contact the Division of Water Quality.
    - Daytime Phone Number: (801) 538-6146
    - This type of release may also require notification of the National Response Center (NRC) at (800) 424-8802.
- Oil spills (including fuels) must be reported to the NRC if harmful quantities are released. A release is considered harmful if the spill:
    - Violates applicable water quality standards; or
    - Causes a film or sheen upon or discoloration of the surface of the water or adjoining shorelines or causes a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines. (40 CFR 110.3)
- A written report may be required by one or more of the agencies noted above.

6.6 Inspections

In conjunction with Good Housekeeping (Section 5.3) and Preventative Maintenance (Section 5.4), weekly visual inspections are to be conducted to ensure that the elements of the Plan are implemented and functioning effectively. The inspection form, Weekly Visual Inspection and Maintenance Report, is included in Appendix I and described in Section 5.4. Completed forms shall be retained with the Plan.

Visual inspections are a critical part of the Plan but are not meant to be a comprehensive evaluation of the entire storm water pollution prevention program. The inspections should be routine and scheduled at the same time each week in order to facilitate the inspections and schedule other operations accordingly. It is important that the employees conducting the inspection be properly trained, familiar with the SWPPP, and knowledgeable about proper record keeping and reporting practices.

6.7 Employee Training

Training should educate employees on Plan components, objectives, and implementation. Each employee should gain an understanding of the importance of pollution prevention and his or her roles and responsibilities in the Plan. Training should address all Plan components including, but not limited to, the following:

- Good housekeeping measures, including operations and material storage practices.
- Preventative maintenance.
- Specific BMPs for which the trainees are responsible.

An Employee Training Schedule and an Employee Training Record are included in Appendix J. The former is a planning and scheduling tool for a program of regular training. Suggested training topics are noted; others may be added by the Team. The latter (Employee Training Record) should be used to document each training session. Use of the form will allow the Team to ensure that all employees are trained and determine when training topics need to be addressed again. At a minimum, comprehensive Plan training should be conducted annually. As discussed in Good Housekeeping (Section 5.3), employee training should be an ongoing activity and may be incorporated into employee meetings.

6.8 Record Keeping and Reporting

Record keeping relating to measures and controls has been discussed in previous sections. The following records should be kept by the Team:

- BMP Implementation Records (Appendix G),
- Spill Documentation Records (Appendix H),
- Weekly Visual Inspection and Maintenance Reports (Appendix I), and
- Employee Training Records (Appendix J).

Additional record keeping and reporting requirements are discussed in Section 6.2, Comprehensive Site Compliance Evaluation Report, and Section 7.0, Monitoring Requirements.

6.9 Non-Storm Water Discharges

The permit requires certification that the landfill has been evaluated for the presence of non-storm water discharges including leachate and vehicle wash waters. A certification form has been provided in Appendix K. Upon completion, the certification should be sent to the Executive Secretary and a copy should be retained with the plan. The mailing address follows:

Utah Department of Environmental Quality
Executive Secretary, Water Quality Board
Division of Water Quality
P.O. Box 144870
Salt Lake City, UT 84114-4870

Conditions may exist which prevent testing and certification to be completed. If applicable, documentation of such is still required.

7.0 Comprehensive Site Compliance Evaluation

The comprehensive site compliance evaluation (CSCE) is a required site inspection and an overall assessment of the effectiveness of the current SWPPP. At a minimum the CSCE shall be completed annually. CSCEs will help the Team identify new controls or practices for incorporation into the SWPPP. A CSCE form is included in Appendix L.

7.1 General Requirements of the CSCE

The evaluation shall be conducted at least once per year by either one or more qualified employees or designated representatives who are familiar with the industrial activities performed at the facility and the elements of the SWPPP. The evaluation will include the following:

- Visual inspection for evidence of, or the potential for, pollutants entering the drainage system,
- Inspection of structural BMPs, including operation, maintenance and effectiveness,
- Evaluation of non-structural BMPs and assessment of their effectiveness,
- Determination of additional measures and controls, if necessary, and
- Visual inspection of spill response equipment and other equipment required to implement the SWPPP.

7.2 Comprehensive Site Compliance Evaluation Report

The report should include a narrative discussion of the Landfill's compliance with the current SWPPP. Items to be included in the report follow:

- Scope of the evaluation,
- Names of personnel conducting the evaluation,
- Date of evaluation,
- Major observations relating to SWPPP implementation for a period of at least three (3) years prior to the date of evaluation, and
- Any incidents of noncompliance or signed certification of SWPPP and permit compliance. (A noncompliance incident is any instance where an element of the SWPPP is not implemented or where specific conditions of the permit are not met).

7.3 SWPPP Revision and Implementation

The SWPPP should be revised to include and address the findings of the Site Compliance Evaluation Report. Revisions may include additions, updates and/or modifications to the following:

- Description of Potential Pollutant Sources (Section 4.0) including inventory of exposed materials, significant spills and leaks, and potential pollutant sources;
- Measures and Controls (Section 5.0);
- Site Plan (Appendix B); and
- Any element of the SWPPP that requires correction, modification for effectiveness, or update.

8.0 Monitoring Requirements

In addition to inspections required as part of the identified Measures and Controls (Section 5.0) and the annual CSCE, quarterly analytical and visual water quality monitoring shall be conducted as described in the following sections.

8.1 Quarterly Analytical Monitoring

Quarterly analytical monitoring shall be conducted during years 2 and 4 of the permit term. Quarterly periods are defined in the permit requirements as January through March, April through June, July through September, and October through December. A Storm Water Discharge Monitoring Report (SWDMR) form, prepared by the Utah Division of Water Quality, is included as Appendix M. Required data for the report includes the following pollutants of concern and their limits:

- Total Suspended Solids (TSS), 100 mg/L; and
- Total Recoverable Iron, 1.0 mg/L.

<u>Storm Event and Sample Type</u>

Instructions regarding storm event and sample type are included on page 2 of the SWDMR and on page L-9 of Permit Appendix II.L (Plan Appendix A).

<u>Sampling Waiver</u>

A sampling waiver may apply in the following conditions:

- Adverse weather makes sample collection dangerous or impracticable (e.g., during drought or extended frozen conditions). See Appendix M (p. 4, Adverse Weather Waiver) and Appendix A (p. L-9, Adverse Conditions).
- If analytical monitoring during year 2 of the permit shows parameter concentrations below the cut-off limit, analytical monitoring during year 4 may be waived. However, the permitee must submit a certification to the Executive Secretary indicating that there has not been a significant change in either the industrial activity or the facility measures and controls. Whereas no analytical monitoring was conducted, because there was no stormwater discharges observed the Bayview Landfill during permit year 2 or 4, this waiver does <u>not</u> apply. See Appendix A (p. L-9, Low Concentration Waiver).
- A site is inactive and unstaffed, and certification of such is provided. See Appendix M (p. L-10, Inactive and Unstaffed Site). This condition does <u>not</u> apply to Bayview Landfill.

<u>Representative Discharge</u>

If two or more outfalls have substantially identical effluents, quantitative data for one outfall may be reported as applying to multiple outfalls. The determination of substantially identical effluents must be made considering industrial activity, significant materials, and measures, controls, and activities within the drainage areas of the outfalls. If analytical monitoring is conducted based on a representative discharge, documentation must be provided as outlined in Appendix M (p. 4, Substantially Identical Discharges) and Appendix A (p. L-10, Representative Discharge).

Alternative Certification

If a permitee can certify, by outfall, that equipment, materials, and products associated with the industrial activity are not presently nor are expected to be exposed to storm water during the certification period, analytical monitoring may be waived. Documentation must be completed per Appendix M (p. 4, Exemption to Monitoring Requirements) and Appendix A (p. L-10, Alternative Certification).

Reporting

Quarterly analytical monitoring results (SWDMR forms for each outfall or other certification) for each monitoring year must be sent to the Division of Water Quality no later than the 31st of March of the following year Contact information follows.

The mailing address is:

Utah Department of Environmental Quality
Division of Water Quality
P.O. Box 144870
Salt Lake City, UT 84114-4870

8.2 Quarterly Visual Monitoring

Quarterly visual monitoring shall be conducted for each outfall, with quarterly periods designated as January through March, April through June, July through September, and October through December.

Sample and Data Collection

Instructions for sample and qualitative data collection are included in Appendix M (p. 5) and Appendix A (p. L-11).

Record Keeping

Pages 1, 5, and 6 of the SWDMR (Appendix M) should be used to document quarterly visual monitoring. In addition to completing fields on the indicated pages, landfill personnel should note the collection/examination date and time and the nature of the discharge (i.e., runoff or snow melt).

Representative Discharge

If two or more outfalls have substantially identical effluents, qualitative data for one outfall may be reported as applying to multiple outfalls. The determination of substantially identical effluents must be made considering industrial activity, significant materials, and measures, controls, and activities within the drainage areas of the outfalls. If visual monitoring is conducted based on a representative discharge, documentation must be provided as outlined in Appendix A (p. L-12, Representative Discharge).

Adverse Conditions

If adverse weather makes sample collection dangerous or impracticable (e.g., during drought or extended frozen conditions), landfill personnel must document the reason for not performing visual monitoring. See Appendix A (p. L-12, Adverse Conditions).

Inactive and Unstaffed Site

If a site is inactive and unstaffed, and certification of such is provided, visual monitoring is not required. See Appendix M (p. L-12, Inactive and Unstaffed Site). This condition does not apply to Bayview Landfill.

Appendix A
UPDES Multi-Sector General Permit for Storm Water Discharges
Associated with Industrial Activities – Appendix II.L

L. Storm Water Discharges Associated With Industrial Activity From Landfills and Land Application Sites.

1. Coverage of This Section..

a. Discharges Covered Under This Section. The requirements listed under this section shall apply to storm water discharges associated with industrial activity from waste disposal at landfills, land application sites, and open dumps that receive or have received industrial wastes. Open dumps are solid waste disposal units that are not in compliance with Sate/Federal criteria established under RCRA Subtitle D. Landfills, land application sites, and open dumps that have storm water discharges from other types of industrial activities such as vehicle maintenance, truck washing, and/or recycling may be subject to additional requirements specified elsewhere in this permit.

b. Limitations. Storm water discharges associated with industrial activities from inactive landfills, land application sites, and open dumps occurring on Federal lands where an operator cannot be identified are ineligible for coverage under this permit.

c. Co-Located Industrial Activities. When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Special Conditions.

a. Prohibition of Non-storm Water Discharges. In addition to the broad non-storm water prohibition in *Part II.A.* of this permit, the discharge of leachate and vehicle and equipment washwaters to waters of the State or a municipal separate storm sewer system is not authorized by this permit. Operators with such discharges must obtain coverage under a separate *UPDES* permit (other than this permit).

3. Storm Water Pollution Prevention Plan Requirements.

a. Contents of Plan. The plan shall include, at a minimum, the following items:

1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each

team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutant to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials which may potentially be significant pollutant sources. Each plan shall include, at a minimum:

a) Drainage:

(1) A site map indicating an outline of the portions of the drainage area of each storm water outfall that are within the facility boundaries, each existing structural control measure to reduce pollutants in storm water runoff, surface water bodies, locations of active and closed landfill cells or trenches, locations of active and closed land application areas, locations where open dumping is occurring or has occurred, locations of any known leachate springs or other areas where uncontrolled leachate may commingle with runoff, locations of any leachate collection and handling systems, locations where major spills or leaks identified under paragraph *3.a(2)(c)* (Spills and Leaks) of this permit have occurred, and locations of the following activities where such activities are exposed to precipitation: fueling station, vehicle and equipment maintenance and/or cleaning areas, and waste and other significant material loading/unloading and storage areas. The map must indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls.

(2) For each area of the facility that generates storm water discharges associated with industrial activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow, and an identification of the types of pollutants which are likely to be present in storm water discharges associated with industrial activity. Factors to consider include the toxicity of chemicals; quantities of chemicals used, produced or discharged; the likelihood of contact with storm water; and the history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified.

b) Exposed Inventory of Materials. An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, or disposed of in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a *Notice of Intent* (*NOI*) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of submission of a *Notice of Intent* (*NOI*) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives. The inventory of exposed materials shall include, but shall not be limited to the significant material management practices employed.

c) Spills and Leaks. A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a *Notice of Intent* (*NOI*) to be covered under this permit. Such list shall be updated as appropriate during the term of the permit.

d) Sampling Data. A summary of existing discharge sampling data describing pollutants in storm water of sampling data collected during the term of this permit. Permittees shall also provide all available sampling data for leachate generated at the site.

e) Risk Identification and Summary of Potential Pollutant Sources. Include a narrative description of potential pollutant sources associated with any of the following, providing they occur at the facility: fertilizer, herbicide and pesticide application; earth/soil moving; waste hauling and loading/unloading; outdoor storage of significant materials including daily, interim and final cover material stockpiles as well as temporary waste storage areas; exposure of active and inactive landfill, land application, or open dumping areas; uncontrolled leachate flows; failure or leaks from leachate collection and treatment systems; haul roads; and vehicle tracking of sediments. The description shall specifically list any significant potential sources of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., biochemical oxygen demand, etc.) of concern shall be identified.

3) Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

a) Good Housekeeping. Good housekeeping requires the maintenance of areas which may contribute pollutants to storm water discharges in a clean, orderly manner. Permittees shall consider providing protected materials storage areas for pesticides, herbicides, fertilizers, and other significant materials.

b) Preventive Maintenance. A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, catch basins) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

(i) Where applicable, permittees addressed by this section shall also:

(2) maintain containers used for outdoor chemical and significant materials storage to prevent leaking or rupture;

(3) maintain all elements of leachate collection and treatment systems to prevent commingling of leachate with storm water; and

(4) maintain the integrity and effectiveness of any intermediate or final cover, including making repairs to the cover as necessary to minimize the effects of settlement, sinking, and erosion.

c) Spill Prevention and Response Procedures. Areas where potential spills which can contribute pollutants to storm water discharges can occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel.

d) Inspections. Qualified facility personnel shall be identified to inspect designated equipment and areas of the facility at appropriate intervals specified in the plan.

(1) For operating landfills, open dumps, and land application sites, inspections shall be conducted at least once every 7 days. Qualified personnel shall inspect areas of landfills and open dumps that have not yet been finally stabilized, active land application areas, areas used for storage of materials/wastes that are exposed to precipitation, stabilization and structural control measures, leachate collection and treatment systems, and locations where equipment and waste trucks enter and exit the site. Where landfill areas and open dumps have been finally stabilized and where land application has been completed, or during seasonal arid periods in arid areas (areas with an average annual rainfall of 0 to 10 inches) and semiarid areas (areas with an average annual rainfall of 10 to 20 inches), inspections will be conducted at least once every month. Erosion and sediment control measures shall be observed to ensure they are operating correctly.

(2) For inactive landfills, open dumps, and land application sites, inspections shall be conducted at least quarterly, and qualified personnel shall inspect: landfill or open dump stabilization and structural erosion control measures and leachate collection and treatment systems, and all closed land application areas.

(3) A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. The pollution prevention plan shall be revised to address any problems found during inspections. Records of inspections shall be maintained.

e) Employee Training. Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as conducting inspections, spill response, good housekeeping, conducting inspections and material management practices. The pollution prevention plan shall identify periodic dates for such training.

f) Recordkeeping and Internal Reporting Procedures. A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan. Landfill and open dump operators shall provide for a tracking system for the types of wastes disposed of in each cell or trench of a landfill or open dump. Land application site operators shall track the types and quantities of wastes applied in specific areas.

g) Non-storm Water Discharges.

(1) Certification. The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges including leachate and vehicle wash waters. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with *Part VI.G.* of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of

the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the *Executive Secretary* in accordance with paragraph *3.a.(3)(g)(iii)* (below).

(2) Exceptions. Except for flows from fire fighting activities, sources of non-storm water listed in *Part II.A.2* (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(3) Failure to Certify. Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the *Executive Secretary* within 180 days after submitting a notice of intent to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the State which are not authorized by a *UPDES* permit are unlawful and must be terminated.

h) Sediment and Erosion Control The plan shall identify areas which, due to topography activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

(1) Landfill and open dump operators shall provide for temporary stabilization of materials stockpiled for daily, intermediate, and final cover. Stabilization practices to consider include, but are not limited to, temporary seeding, mulching, and placing geotextiles on the inactive portions of the stockpiles.

(2) Landfill and open dump operators shall provide for temporary stabilization of inactive areas of the landfill or open dump which have an intermediate cover but no final cover.

(3) Landfill and open dump operators shall provide for temporary stabilization of any landfill or open dumping areas which have received a final cover until vegetation has established itself. Land application site operators shall also stabilize areas where waste application has been

completed until vegetation has been established.

i) Management of Runoff. The plan shall also contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity [see paragraph *3.a.(2)* of this section (Description of Potential Pollutant Sources)] shall be considered when determining reasonable and appropriate measures. Appropriate measures may include: silt fences, earth dikes, gradient terraces, drainage swales, sediment traps, check dams, pipe slope drains, level spreaders, storm drain inlet protection, rock outlet protection, reinforced soil retaining systems, gabions and temporary or permanent sediment basins, or other equivalent measures. Structural practices should be placed on upland soils as practicable.

4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations at appropriate intervals specified in the plan, but in no case less than once a year. Such evaluations shall provide:

a) Areas contributing to a storm water discharge associated with industrial activity at landfill, open dump and land application sites shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan such as spill response equipment, shall be made.

b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with paragraph *3.a.(2)* of this section (Description of Potential Pollutant Sources) and pollution prevention measures and controls identified in the plan in accordance with paragraph *3.a.(3)* of this section (Measures and Controls) shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in timely manner, but in no case more than 12 weeks after the evaluation.

c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan for at least 3 years from the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with *Part VI.G.* (Signatory Requirements) of this permit.

d) Where compliance evaluation schedules overlap with inspections required under *3.a.(3)(d)*, the compliance evaluation may be conducted in place of one such inspection.

4. Numeric Effluent Limitations. There are no additional numeric effluent limitations beyond those in *Part IV.B.* of this permit.

5. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. During the second and fourth year of the permit, permittees with landfill/land application/open dump sites must monitor their storm water discharges associated with industrial activity at least quarterly (4 times per year) except as provided in paragraphs *5.a.(3)* (Sampling Waiver), *5.a.(4)* (Representative Discharge), and *5.a.(5)* (Alternative Certification). Landfill/land application/open dump sites are required to monitor their storm water discharges for the pollutants of concern listed in Table L-1 below. Facilities must report in accordance with *5.b.* (Reporting). In addition to the parameters listed in Table L-1 below, the permittee shall provide: the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and, an estimate of the total volume (in gallons) of the discharge sampled.

Table L-1.
Industry Monitoring Requirements

Pollutants of Concern	**Benchmark Cut-Off Concentration**[1]	**Numeric Limitations**[2]
Total Suspended Solids (TSS)[i]	100 mg/L	
Total Recoverable Iron[ii]	1.0 mg/L	
BOD5[iii]		140mg/l daily max// 37mg/l, monthly average max
TSS[iii]		88mg/l daily max// 27mg/l monthly average max
Ammonia[iii]		10mg/l daily max// 4.9mg/l monthly average max
Alpha Terpineol[iii]		0.033mg/l daily max// 0.016 mg/l monthly average max
Benzoic Acid[iii]		0.12 mg/l daily max// 0.071mg/l monthly average max
p-Cresol[iii]		0.025mg/l daily max// 0.015mg/l monthly average max
Phenol[iii]		0.026mg/l daily max// 0.015mg/l monthly average max
Zinc (Total)[iii]		0.20mg/l daily max// 0.11mg/l monthly average max
pH[iii]		Within the range of 6-9pH units

[i] Applicable to all landfill and land application sites.

[ii] Applicable to all facilities except MSWLF areas closed in accordance with 40 CFR 258.60 requirements.

[iii] Applicable to all facilities which are subject to the requirements to 40 CFR Part 445 Subpart B (Industrial Activity Code "LF")

Benchmark monitoring cutoff concentrations apply to storm water discharges associated with industrial activity other than contaminated storm water discharges from landfills subject to the nuberic effluent limitatins set forth in above table. Monitor once/quarter for the year 2 and year 4 monitoring years.

As set forth at 40 CFR part 445 Subpart B, these numeric limitations apply to contaminated storm water discharges from MSWLFs which have not been closed in accordance with 40 CFR 258.60, and contaminated storm water discharges from those landfills which are subject to the provisions of 40 CFR Part 257 except for discharges from any of facilities described in (a) thru (d) below:

a) landfills operated in conjunction with other industrial or commercial operations when the landfill only receives wastes generated by the industrial or commercial operation directly associated with the landfill;

b) landfills operated in conjunction with other industrial or commercial operations when the landfill receives wastes generated by the industrial or commercial operation directly associated with the landfill and also receives other wastes provided the other wastes received for disposal are generated by a facility that is subject to the same provision in 40 CFR Sub-chapter N as the industrial or commercial operation or the other wastes received are of similar nature to the wastes generated by the industrial or commercial operation;

c) landfills operated in conjunction with Centralized Waste Treatment (CWT) facilities subject to 40 CFR Part 437 so long as the CWT facility commingles the landfill wastewater with other non-landfill wastewater for discharge. A landfill directly associated with a CWT facility is subject to this part if the CWT facility discharges landfill wastewater separately from other CWT wastewater or commingles the wastewater from its landfill only with wastewater from other landfills; or

d) landfills operated in conjunction with other industrial or commercial operations when the landfill receives wastes from public service activities so long as the company owning the landfill does not receive a fee or other remuneration for the disposal service.

1) Monitoring Periods. Landfill/land application/open dump sites shall monitor samples

collected during the sampling periods of: January through March, April through June, July through September, and October through December for the years specified in paragraph *a.* (above).

2) Sample Type. A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable, permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

3) Sampling Waiver.

   a) Adverse Conditions. When a discharger is unable to collect samples within a specified sampling period due to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next period and submit the data along with data for the routine sample in that period. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (e.g., drought, extended frozen conditions, etc.).

   b) Low Concentration Waiver. When the average concentration for a pollutant calculated from all monitoring data collected from an outfall during the second year monitoring period, is less than the corresponding value for that pollutant listed in Table L-1 under the column Monitoring Cut-Off Concentration, a facility may waive monitoring and reporting requirements in the fourth year monitoring period. The facility must submit to the *Executive Secretary*, in lieu of the monitoring data, a certification that there has not been a significant change in industrial activity or the pollution prevention measures in area of the facility which drains to the outfall for which sampling was waived.

   c) Inactive and Unstaffed Site. When a discharger is unable to conduct quarterly chemical storm water sampling at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirements as long as the facility remains inactive and unstaffed. The facility must submit to the *Executive Secretary*, in lieu of monitoring data, a certification statement on the *Storm Water Discharge Monitoring Report* (*SWDMR*) stating that the site is inactive and unstaffed so that collecting a sample during a qualifying event is not possible.

4) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan. The permittee shall include the description of the location of the outfalls, explanation of why outfalls are expected to discharge substantially identical effluents, and estimate of the size of the drainage area and runoff coefficient with the *SWDMR*.

5) Alternative Certification. A discharger is not subject to the monitoring requirements of this section provided the discharger makes a certification for a given outfall or on a pollutant-by-pollutant basis in lieu of monitoring reports required under paragraph *b.* below, under penalty of law, signed in accordance with Part VI.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, or significant materials from past industrial activity, that are located in areas of the facility within the drainage area of the outfall are not presently exposed to storm water and are not expected to be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan, and submitted to *DWQ* in accordance with *Part V.B.* of the fact sheet to this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph *b* below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations.

b. Reporting. Permittees with landfill/land application/open dump sites shall submit monitoring results for each outfall associated with industrial activity [or a certification in accordance with Sections *(3)*, *(4)*, or *(5)* above] obtained during the second year reporting period, on *SWDMR* form(s) postmarked no later than the 31st day of the following March. Monitoring results [or a certification in accordance with Sections *(3)*, *(4)*, or (5) above] obtained during the fourth year reporting period, shall be submitted on *SWDMR*s postmarked no later than the 31st day of the following March. For each outfall, one *SWDMR* form must be submitted per storm event sampled. Signed copies of *SWDMR*, or alternative certifications, shall be submitted to the *Executive Secretary* at the address listed in *Part V.B.* of this permit.

1) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph *1.b.* (above) landfill/land application/open dump sites, with at least one storm water discharge associated with industrial activity through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph *1.b.* (above).

c. Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination must be made at least once in each designated period [described in *(1)* below] during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

1) Visual Monitoring Period. Examinations shall be conducted in each of the following periods for the purposes of visually inspecting storm water quality associated with storm water runoff or snow melt: January through March; April through June; July through September; October through December.

2) Sample and Data Collection. Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for the entire permit term.

3) Visual Storm Water Discharge Examination Report. Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

4) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices

and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

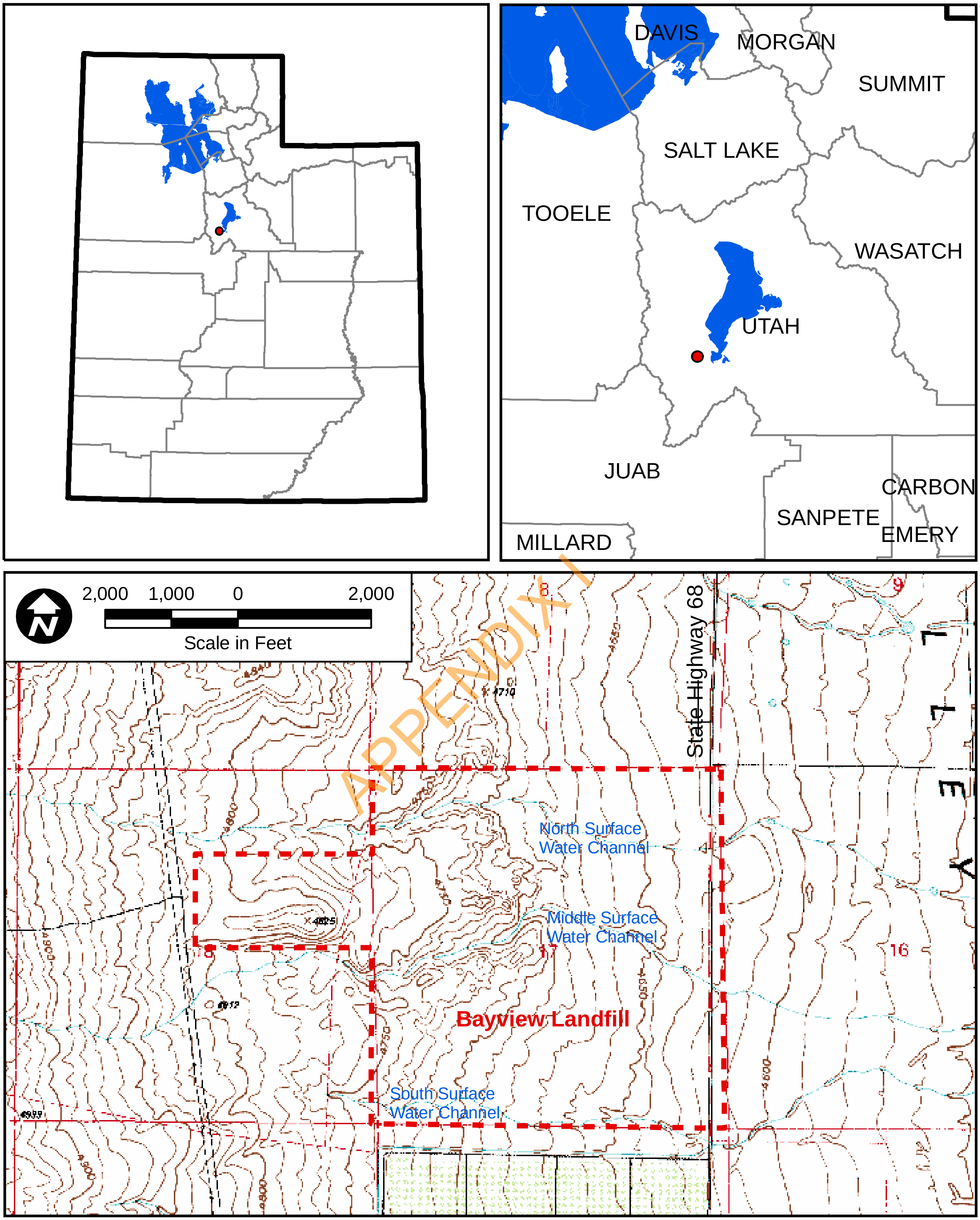
5) Adverse Conditions. When a discharger is unable to conduct a visual examination as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

6) Inactive and Unstaffed Site. When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

6. Definition.

a. "Inactive Landfill" For the purposes of this permit, a landfill is considered inactive when, on a permanent basis, it will no longer receive waste and has completed closure in accordance with any applicable Federal, State, and/or local requirements.

Appendix B
Site Location and Plan



HDR

Bayview Landfill
Site Location

South Utah Valley Solid Waste District
Stormwater Pollution Prevention Plan

DATE	August 2005
FIGURE	1

BAYVIEW LANDFILL

SOUTH UTAH VALLEY SOLID WASTE DISTRICT

Appendix C
Climatic Data – Elberta, UT

ELBERTA, UTAH (422418)

Period of Record Monthly Climate Summary

Period of Record : 1/ 1/1928 to 8/31/1992

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	37.1	43.6	53.5	64.1	73.7	84.7	92.6	90.3	81.1	67.4	50.7	39.8	64.9
Average Min. Temperature (F)	15.5	20.9	27.1	33.8	41.3	49.2	57.5	56.2	46.5	35.9	25.5	18.5	35.7
Average Total Precipitation (in.)	0.79	0.84	0.99	1.03	1.06	0.73	0.79	0.93	0.73	1.01	0.85	0.83	10.59
Average Total SnowFall (in.)	7.3	5.0	3.2	1.1	0.1	0.0	0.0	0.0	0.0	0.3	2.9	5.0	24.8
Average Snow Depth (in.)	2	1	0	0	0	0	0	0	0	0	0	1	0

Percent of possible observations for period of record.
Max. Temp.: 94.6% Min. Temp.: 96.7% Precipitation: 98.3% Snowfall: 94.2% Snow Depth: 90.6%
Check Station Metadata or Metadata graphics for more detail about data completeness.

Western Regional Climate Center, wrcc@dri.edu

ELBERTA, UTAH

NCDC 1971-2000 Monthly Normals

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Monthly
Mean Max. Temperature (F)	36.5	43.2	53.5	62.3	73.1	85.5	93.0	90.9	80.5	66.5	50.0	38.3	64.4
Highest Mean Max. Temperature (F)	43.5	52.5	61.3	70.9	79.1	91.0	96.9	94.7	86.4	73.7	60.1	47.5	96.9
Year Highest Occurred	1994	1995	1972	1992	1992	1994	1988	1994	1979	1988	1999	1977	1988
Lowest Mean Max. Temperature (F)	26.0	31.6	47.0	53.3	66.5	79.0	88.6	88.4	74.6	57.8	42.0	29.5	26.0
Year Lowest Occurred	1984	1984	1984	1975	1983	1998	1992	1993	1986	1984	2000	1985	1984
Mean Temperature (F)	25.9	31.4	40.2	47.6	57.1	67.5	75.4	73.5	63.5	50.6	37.6	27.4	49.8
Highest Mean Temperature (F)	34.0	38.6	45.7	54.5	62.3	72.2	79.3	77.1	69.3	56.5	44.1	35.4	79.3
Year Highest Occurred	2000	1995	1986	1992	1992	1994	1988	2000	1990	1988	1999	1977	1988
Lowest Mean Temperature (F)	17.2	20.0	34.4	40.8	51.8	62.3	70.9	70.4	56.7	44.7	31.0	19.3	17.2
Year Lowest Occurred	1973	1984	1976	1975	1983	1998	1993	1976	1971	1984	2000	1990	1973
Mean Min. Temperature (F)	15.2	19.5	26.8	32.9	41.1	49.5	57.8	56.1	46.5	34.6	25.1	16.4	35.1
Highest Mean Min. Temperature (F)	25.4	26.6	32.0	38.1	45.4	54.0	62.4	60.2	53.0	39.2	28.6	23.3	62.4
Year Highest Occurred	2000	2000	1978	1992	1992	1988	1990	2000	1990	1988	1998	1977	1990
Lowest Mean Min. Temperature (F)	4.9	8.3	20.3	28.2	36.3	45.4	52.6	51.2	38.6	30.2	19.8	6.8	4.9
Year Lowest Occurred	1989	1984	1976	1982	1975	1975	1993	1974	1971	1976	1979	1990	1989
Mean Precipitation (in.)	0.91	0.82	1.03	1.04	1.17	0.66	0.83	0.86	0.95	1.19	0.88	0.59	10.93
Highest Precipitation (in.)	2.47	2.09	2.55	2.92	3.01	2.12	3.67	2.11	5.30	2.83	2.69	1.97	5.30
Year Highest Occurred	1980	1990	1978	1971	1991	1984	1982	1983	1982	1981	1983	1983	1982
Lowest Precipitation (in.)	0.19	0.07	0.20	0.10	0.00	0.00	0.01	0.07	0.00	0.01	0.02	0.07	0.00
Year Lowest													

Appendix D
Pollution Prevention Team

POLLUTION PREVENTION TEAM MEMBERS

Name:	Terry Ficklin
Position:	District Manager
Organization:	South Utah Valley Solid Waste District
Address:	P.O. Box 507 Springville, UT 84663-0507
Phone Number:	(801) 486-3027
Email Address:	tficklin@suvswd.org

Name:	Scott Aitken
Position:	Landfill Foreman
Organization:	South Utah Valley Solid Waste District
Address:	P.O. Box 507 Springville, UT 84663-0507
Phone Number:	(801) 667-2031
Cell Phone Number:	(801) 404-0602

Appendix E
Material Inventory and
Description of Significant Exposed Materials

MATERIAL INVENTORY

Instructions: List all materials used, stored, or produced on site. Assess and evaluate these materials for their potential to contribute pollutants to storm water runoff. If the material has been exposed to storm water or becomes exposed to storm water, include the material in the Description of Significant Exposed Materials table.

Material	Location	Quantity			Exposure to Storm Water	Nature of Contact with Storm Water	Past Significant Spill or Leak
		Used	Produced	Stored			
Municipal Solid Waste	Active daily working face; landfill final and intermediate sideslopes			122,210 tons (July 2012-June 2013))	Yes	Contact due to precipitation during disposal activities, erosion of sideslopes, and accidents or spills along facility roadways.	☐ Y ☒ N
Yard Waste and Biosolids	Compost area (existing windrow area)		Varies		Yes	Rain falling directly on pad and rain not absorbed in the compost piles becomes runoff; however, this runoff is directed to the evaporation pond.	☐ Y ☒ N
Leachate	Within waste mass at active and inactive disposal cells; within conveyance system		13,300 gal / week*		Yes	Possible leachate seeps on landfill slopes; minor leaks and spills from leachate conveyance system. *Note: Quantity produced reflects a wet year and includes direct runoff from concrete compost pad.	☐ Y ☒ N
Soil/Sediment	Excavations, disturbed soils, and newly graded areas			Varies	Yes	Contact with precipitation during earth-moving activities and before slope stabilization and/or revegetation.	☐ Y ☒ N
Diesel Fuel	AST near maintenance building	7,500 gal / 6 weeks			Yes	Minor spills from fueling vehicles.	☐ Y ☒ N

MATERIAL INVENTORY

Instructions: List all materials used, stored, or produced on site. Assess and evaluate these materials for their potential to contribute pollutants to storm water runoff. If the material has been exposed to storm water or becomes exposed to storm water, include the material in the Description of Significant Exposed Materials table.

Material	Location	Quantity			Exposure to Storm Water	Nature of Contact with Storm Water	Past Significant Spill or Leak
		Used	Produced	Stored			
Unleaded Fuel	AST near maintenance building	500 gal / 2 mos.			Yes	Minor spills from fueling vehicles.	☐ Y ☒ N
Propane	AST near maintenance building	400 gal / 3 mos.			No	(Propane stored as liquid under pressure vaporizes upon release from tank.)	☐ Y ☒ N
							☐ Y ☐ N
							☐ Y ☐ N
							☐ Y ☐ N
							☐ Y ☐ N
							☐ Y ☐ N
							☐ Y ☐ N
							☐ Y ☐ N

DESCRIPTION OF SIGNIFICANT EXPOSED MATERIALS

Instructions: Based on the material inventory, describe the significant materials exposed to storm water between the time of three years prior to the date of submission of a Notice of Intent (NOI) and the present.

Significant Exposed Material	Period of Exposure	Quantity Exposed (units)	Location	Method of Storage or Disposal	Description of Material Management Practice
Municipal Solid Waste (working face)	During rainfall events	Size of working face	Active working face (varies)	Dumped and spread in controlled lifts in approved area	Daily cover
Municipal Solid Waste (within disposal cells)	Minimal	Varies	Cell 2	Waste mass placed within disposal cells	Covered with intermediate and final cover soil
Yard Waste and Biosolids	During rainfall events	Varies	Existing Windrow Area / Expanded Compost Pad	Windrow piles	Compost area drains to existing evaporation pond
Leachate	Minimal	Varies; limited to seeps and minor leaks in conveyance system	Cell 2 and conveyance system	Storm water/leachate pond	Pond controlled by evaporation; no discharge to surface waters
Soil/Sediment	During rainfall events	Varies	Excavation areas, disturbed or newly graded areas	N/A	Temporary or permanent slope stabilization, perimeter ditches
Diesel Fuel	Minimal	Minimal; limited to minor spills from vehicle fueling operations	Near maintenance building	AST	Secondary containment
Unleaded Fuel	Minimal	Minimal; limited to minor spills from vehicle fueling operations	Near maintenance building	AST	Double-walled tank

DESCRIPTION OF SIGNIFICANT EXPOSED MATERIALS

Instructions: Based on the material inventory, describe the significant materials exposed to storm water between the time of three years prior to the date of submission of a Notice of Intent (NOI) and the present.

Significant Exposed Material	Period of Exposure	Quantity Exposed (units)	Location	Method of Storage or Disposal	Description of Material Management Practice

Appendix F
Reportable Quantities of Hazardous Substances

pipes, sewers or other conveyances not connected to a facility providing treatment. The term also means the municipality as defined in section 502(4) of the Act, which has jurisdiction over the indirect discharges to and the discharges from such a treatment works.

(g) *Remove* or *removal* refers to removal of the oil or hazardous substances from the water and shoreline or the taking of such other actions as may be necessary to minimize or mitigate damage to the public health or welfare, including, but not limited to, fish, shellfish, wildlife, and public and private property, shorelines, and beaches.

(h) *Contiguous zone* means the entire zone established by the United States under Article 24 of the Convention on the Territorial Sea and Contiguous Zone.

(i) *Navigable waters* means ‘‘waters of the United States, including the territorial seas.’’ This term includes:

(1) All waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;

(2) Interstate waters, including interstate wetlands;

(3) All other waters such as intrastate lakes, rivers, streams, (including intermittent streams), mudflats, sandflats, and wetlands, the use, degradation or destruction of which would affect or could affect interstate or foreign commerce including any such waters:

(i) Which are or could be used by interstate or foreign travelers for recreational or other purposes;

(ii) From which fish or shellfish are or could be taken and sold in interstate or foreign commerce;

(iii) Which are used or could be used for industrial purposes by industries in interstate commerce;

(4) All impoundments of waters otherwise defined as navigable waters under this paragraph;

(5) Tributaries of waters identified in paragraphs (i) (1) through (4) of this section, including adjacent wetlands; and

(6) Wetlands adjacent to waters identified in paragraphs (i) (1) through (5) of this section (‘‘Wetlands’’ means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally included playa lakes, swamps, marshes, bogs, and similar areas such as sloughs, prairie potholes, wet meadows, prairie river overflows, mudflats, and natural ponds): *Provided*, That waste treatment systems (other than cooling ponds meeting the criteria of this paragraph) are not waters of the United States.

Navigable waters do not include prior converted cropland. Notwithstanding the determination of an area's status as prior converted cropland by any other federal agency, for the purposes of the Clean Water Act, the final authority regarding Clean Water Act jurisdiction remains with EPA.

(j) *Process waste water* means any water which, during manufacturing or processing, comes into direct contact with or results from the production or use of any raw material, intermediate product, finished product, byproduct, or waste product.

[44 FR 50776, Aug. 29, 1979, as amended at 58 FR 45039, Aug. 25, 1993; 65 FR 30904, May 15, 2000]

§ 117.2 Abbreviations.

NPDES equals National Pollutant Discharge Elimination System. RQ equals reportable quantity.

§ 117.3 Determination of reportable quantities.

Each substance in Table 117.3 that is listed in Table 302.4, 40 CFR part 302, is assigned the reportable quantity listed in Table 302.4 for that substance.

TABLE 117.3—REPORTABLE QUANTITIES OF HAZARDOUS SUBSTANCES DESIGNATED PURSUANT TO SECTION 311 OF THE CLEAN WATER ACT

NOTE: The first number under the column headed ‘‘RQ’’ is the reportable quantity in pounds. The number in parentheses is the metric equivalent in kilograms. For convenience, the table contains a column headed ‘‘Category’’ which lists the code letters ‘‘X’’, "A", "B", "C", and "D" associated with reportable quantities of 1, 10, 100, 1000, and 5000 pounds, respectively.

TABLE 117.3—REPORTABLE QUANTITIES OF HAZARDOUS SUBSTANCES DESIGNATED PURSUANT TO SECTION 311 OF THE CLEAN WATER ACT

Material	Category	RQ in pounds (kilograms)
Acetaldehyde	C	1,000 (454)
Acetic acid	D	5,000 (2,270)
Acetic anhydride	D	5,000 (2,270)
Acetone cyanohydrin	A	10 (4.54)
Acetyl bromide	D	5,000 (2,270)
Acetyl chloride	D	5,000 (2,270)
Acrolein	X	1 (0.454)
Acrylonitrile	B	100 (45.4)
Adipic acid	D	5,000 (2,270)
Aldrin	X	1 (0.454)
Allyl alcohol	B	100 (45.4)
Allyl chloride	C	1,000 (454)
Aluminum sulfate	D	5,000 (2,270)
Ammonia	B	100 (45.4)
Ammonium acetate	D	5,000 (2,270)
Ammonium benzoate	D	5,000 (2,270)
Ammonium bicarbonate	D	5,000 (2,270)
Ammonium bichromate	A	10 (4.54)
Ammonium bifluoride	B	100 (45.4)
Ammonium bisulfite	D	5,000 (2,270)
Ammonium carbamate	D	5,000 (2,270)
Ammonium carbonate	D	5,000 (2,270)
Ammonium chloride	D	5,000 (2,270)
Ammonium chromate	A	10 (4.54)
Ammonium citrate dibasic	D	5,000 (2,270)
Ammonium fluoborate	D	5,000 (2,270)
Ammonium fluoride	B	100 (45.4)
Ammonium hydroxide	C	1,000 (454)
Ammonium oxalate	D	5,000 (2,270)
Ammonium silicofluoride	C	1,000 (454)
Ammonium sulfamate	D	5,000 (2,270)
Ammonium sulfide	B	100 (45.4)
Ammonium sulfite	D	5,000 (2,270)
Ammonium tartrate	D	5,000 (2,270)
Ammonium thiocyanate	D	5,000 (2,270)
Amyl acetate	D	5,000 (2,270)
Aniline	D	5,000 (2,270)
Antimony pentachloride	C	1,000 (454)
Antimony potassium tartrate	B	100 (45.4)
Antimony tribromide	C	1,000 (454)
Antimony trichloride	C	1,000 (454)
Antimony trifluoride	C	1,000 (454)
Antimony trioxide	C	1,000 (454)
Arsenic disulfide	X	1 (0.454)
Arsenic pentoxide	X	1 (0.454)
Arsenic trichloride	X	1 (0.454)
Arsenic trioxide	X	1 (0.454)
Arsenic trisulfide	X	1 (0.454)
Barium cyanide	A	10 (4.54)
Benzene	A	10 (4.54)
Benzoic acid	D	5,000 (2,270)
Benzonitrile	D	5,000 (2,270)
Benzoyl chloride	C	1,000 (454)
Benzyl chloride	B	100 (45.4)
Beryllium chloride	X	1 (0.454)
Beryllium fluoride	X	1 (0.454)
Beryllium nitrate	X	1 (0.454)
Butyl acetate	D	5,000 (2,270)
Butylamine	C	1,000 (454)
n-Butyl phthalate	A	10 (4.54)
Butyric acid	D	5,000 (2,270)
Cadmium acetate	A	10 (4.54)
Cadmium bromide	A	10 (4.54)
Cadmium chloride	A	10 (4.54)
Calcium arsenate	X	1 (0.454)
Calcium arsenite	X	1 (0.454)
Calcium carbide	A	10 (4.54)

TABLE 117.3—REPORTABLE QUANTITIES OF HAZARDOUS SUBSTANCES DESIGNATED PURSUANT TO SECTION 311 OF THE CLEAN WATER ACT—Continued

Material	Category	RQ in pounds (kilograms)
Calcium chromate	A	10 (4.54)
Calcium cyanide	A	10 (4.54)
Calcium dodecylbenzenesulfonate	C	1,000 (454)
Calcium hypochlorite	A	10 (4.54)
Captan	A	10 (4.54)
Carbaryl	B	100 (45.4)
Carbofuran	A	10 (4.54)
Carbon disulfide	B	100 (45.4)
Carbon tetrachloride	A	10 (4.54)
Chlordane	X	1 (0.454)
Chlorine	A	10 (4.54)
Chlorobenzene	B	100 (45.4)
Chloroform	A	10 (4.54)
Chlorosulfonic acid	C	1,000 (454)
Chlorpyrifos	X	1 (0.454)
Chromic acetate	C	1,000 (454)
Chromic acid	A	10 (4.54)
Chromic sulfate	C	1,000 (454)
Chromous chloride	C	1,000 (454)
Cobaltous bromide	C	1,000 (454)
Cobaltous formate	C	1,000 (454)
Cobaltous sulfamate	C	1,000 (454)
Coumaphos	A	10 (4.54)
Cresol	B	100 (45.4)
Crotonaldehyde	B	100 (45.4)
Cupric acetate	B	100 (45.4)
Cupric acetoarsenite	X	1 (0.454)
Cupric chloride	A	10 (4.54)
Cupric nitrate	B	100 (45.4)
Cupric oxalate	B	100 (45.4)
Cupric sulfate	A	10 (4.54)
Cupric sulfate, ammoniated	B	100 (45.4)
Cupric tartrate	B	100 (45.4)
Cyanogen chloride	A	10 (4.54)
Cyclohexane	C	1,000 (454)
2,4-D Acid	B	100 (45.4)
2,4-D Esters	B	100 (45.4)
DDT	X	1 (0.454)
Diazinon	X	1 (0.454)
Dicamba	C	1,000 (454)
Dichlobenil	B	100 (45.4)
Dichlone	X	1 (0.454)
Dichlorobenzene	B	100 (45.4)
Dichloropropane	C	1,000 (454)
Dichloropropene	B	100 (45.4)
Dichloropropene-Dichloropropane (mixture)	B	100 (45.4)
2,2-Dichloropropionic acid	D	5,000 (2,270)
Dichlorvos	A	10 (4.54)
Dicofol	A	10 (4.54)
Dieldrin	X	1 (0.454)
Diethylamine	B	100 (45.4)
Dimethylamine	C	1,000 (454)
Dinitrobenzene (mixed)	B	100 (45.4)
Dinitrophenol	A	10 (45.4)
Dinitrotoluene	A	10 (4.54)
Diquat	C	1,000 (454)
Disulfoton	X	1 (0.454)
Diuron	B	100 (45.4)
Dodecylbenzenesulfonic acid	C	1,000 (454)
Endosulfan	X	1 (0.454)
Endrin	X	1 (0.454)
Epichlorohydrin	B	100 (45.4)
Ethion	A	10 (4.54)
Ethylbenzene	C	1,000 (454)
Ethylenediamine	D	5,000 (2,270)
Ethylenediamine-tetraacetic acid (EDTA)	D	5,000 (2,270)
Ethylene dibromide	X	1 (0.454)
Ethylene dichloride	B	100 (45.4)
Ferric ammonium citrate	C	1,000 (454)
Ferric ammonium oxalate	C	1,000 (454)
Ferric chloride	C	1,000 (454)

Table 117.3—Reportable Quantities of Hazardous Substances Designated Pursuant to Section 311 of the Clean Water Act—Continued

Material	Category	RQ in pounds (kilograms)
Ferric fluoride	B	100 (45.4)
Ferric nitrate	C	1,000 (454)
Ferric sulfate	C	1,000 (454)
Ferrous ammonium sulfate	C	1,000 (454)
Ferrous chloride	B	100 (45.4)
Ferrous sulfate	C	1,000 (454)
Formaldehyde	B	100 (45.4)
Formic acid	D	5,000 (2,270)
Fumaric acid	D	5,000 (2,270)
Furfural	D	5,000 (2,270)
Guthion	X	1 (0.454)
Heptachlor	X	1 (0.454)
Hexachlorocyclopentadiene	A	10 (4.54)
Hydrochloric acid	D	5,000 (2,270)
Hydrofluoric acid	B	100 (45.4)
Hydrogen cyanide	A	10 (4.54)
Hydrogen sulfide	B	100 (45.4)
Isoprene	B	100 (45.4)
Isopropanolamine dodecylbenzenesulfonate	C	1,000 (454)
Kepone	X	1 (0.454)
Lead acetate	A	10 (4.54)
Lead arsenate	X	1 (0.454)
Lead chloride	A	10 (4.54)
Lead fluoborate	A	10 (4.54)
Lead fluoride	A	10 (4.54)
Lead iodide	A	10 (4.54)
Lead nitrate	A	10 (4.54)
Lead stearate	A	10 (4.54)
Lead sulfate	A	10 (4.54)
Lead sulfide	A	10 (4.54)
Lead thiocyanate	A	10 (4.54)
Lindane	X	1 (0.454)
Lithium chromate	A	10 (4.54)
Malathion	B	100 (45.4)
Maleic acid	D	5,000 (2,270)
Maleic anhydride	D	5,000 (2,270)
Mercaptodimethur	A	10 (4.54)
Mercuric cyanide	X	1 (0.454)
Mercuric nitrate	A	10 (4.54)
Mercuric sulfate	A	10 (4.54)
Mercuric thiocyanate	A	10 (4.54)
Mercurous nitrate	A	10 (4.54)
Methoxychlor	X	1 (0.454)
Methyl mercaptan	B	100 (45.4)
Methyl methacrylate	C	1,000 (454)
Methyl parathion	B	100 (45.4)
Mevinphos	A	10 (4.54)
Mexacarbate	C	1,000 (454)
Monoethylamine	B	100 (45.4)
Monomethylamine	B	100 (45.4)
Naled	A	10 (4.54)
Naphthalene	B	100 (45.4)
Naphthenic acid	B	100 (45.4)
Nickel ammonium sulfate	B	100 (45.4)
Nickel chloride	B	100 (45.4)
Nickel hydroxide	A	10 (4.54)
Nickel nitrate	B	100 (45.4)
Nickel sulfate	B	100 (45.4)
Nitric acid	C	1,000 (454)
Nitrobenzene	C	1,000 (454)
Nitrogen dioxide	A	10 (4.54)
Nitrophenol (mixed)	B	100 (45.4)
Nitrotoluene	C	1,000 (454)
Paraformaldehyde	C	1,000 (454)
Parathion	A	10 (4.54)
Pentachlorophenol	A	10 (4.54)
Phenol	C	1,000 (454)
Phosgene	A	10 (4.54)
Phosphoric acid	D	5,000 (2,270)
Phosphorus	X	1 (0.454)
Phosphorus oxychloride	C	1,000 (454)

TABLE 117.3—REPORTABLE QUANTITIES OF HAZARDOUS SUBSTANCES DESIGNATED PURSUANT TO SECTION 311 OF THE CLEAN WATER ACT—Continued

Material	Category	RQ in pounds (kilograms)
Phosphorus pentasulfide	B	100 (45.4)
Phosphorus trichloride	C	1,000 (454)
Polychlorinated biphenyls	X	1 (0.454)
Potassium arsenate	X	1 (0.454)
Potassium arsenite	X	1 (0.454)
Potassium bichromate	A	10 (4.54)
Potassium chromate	A	10 (4.54)
Potassium cyanide	A	10 (4.54)
Potassium hydroxide	C	1,000 (454)
Potassium permanganate	B	100 (45.4)
Propargite	A	10 (4.54)
Propionic acid	D	5,000 (2,270)
Propionic anhydride	D	5,000 (2,270)
Propylene oxide	B	100 (45.4)
Pyrethrins	X	1 (0.454)
Quinoline	D	5,000 (2,270)
Resorcinol	D	5,000 (2,270)
Selenium oxide	A	10 (4.54)
Silver nitrate	X	1 (0.454)
Sodium	A	10 (4.54)
Sodium arsenate	X	1 (0.454)
Sodium arsenite	X	1 (0.454)
Sodium bichromate	A	10 (4.54)
Sodium bifluoride	B	100 (45.4)
Sodium bisulfite	D	5,000 (2,270)
Sodium chromate	A	10 (4.54)
Sodium cyanide	A	10 (4.54)
Sodium dodecylbenzenesulfonate	C	1,000 (454)
Sodium fluoride	C	1,000 (454)
Sodium hydrosulfide	D	5,000 (2,270)
Sodium hydroxide	C	1,000 (454)
Sodium hypochlorite	B	100 (45.4)
Sodium methylate	C	1,000 (454)
Sodium nitrite	B	100 (45.4)
Sodium phosphate, dibasic	D	5,000 (2,270)
Sodium phosphate, tribasic	D	5,000 (2,270)
Sodium selenite	B	100 (45.4)
Strontium chromate	A	10 (4.54)
Strychnine	A	10 (4.54)
Styrene	C	1,000 (454)
Sulfuric acid	C	1,000 (454)
Sulfur monochloride	C	1,000 (454)
2,4,5-T acid	C	1,000 (454)
2,4,5-T amines	D	5,000 (2,270)
2,4,5-T esters	C	1,000 (454)
2,4,5-T salts	C	1,000 (454)
TDE	X	1 (0.454)
2,4,5-TP acid	B	100 (45.4)
2,4,5-TP acid esters	B	100 (45.4)
Tetraethyl lead	A	10 (4.54)
Tetraethyl pyrophosphate	A	10 (4.54)
Thallium sulfate	B	100 (45.4)
Toluene	C	1,000 (454)
Toxaphene	X	1 (0.454)
Trichlorfon	B	100 (45.4)
Trichloroethylene	B	100 (45.4)
Trichlorophenol	A	10 (4.54)
Triethanolamine dodecylbenzenesulfonate	C	1,000 (454)
Triethylamine	D	5,000 (2,270)
Trimethylamine	B	100 (45.4)
Uranyl acetate	B	100 (45.4)
Uranyl nitrate	B	100 (45.4)
Vanadium pentoxide	C	1,000 (454)
Vanadyl sulfate	C	1,000 (454)
Vinyl acetate	D	5,000 (2,270)
Vinylidene chloride	B	100 (45.4)
Xylene (mixed)	B	100 (45.4)
Xylenol	C	1,000 (454)
Zinc acetate	C	1,000 (454)
Zinc ammonium chloride	C	1,000 (454)
Zinc borate	C	1,000 (454)

TABLE 117.3—REPORTABLE QUANTITIES OF HAZARDOUS SUBSTANCES DESIGNATED PURSUANT TO SECTION 311 OF THE CLEAN WATER ACT—Continued

Material	Category	RQ in pounds (kilograms)
Zinc bromide	C	1,000 (454)
Zinc carbonate	C	1,000 (454)
Zinc chloride	C	1,000 (454)
Zinc cyanide	A	10 (4.54)
Zinc fluoride	C	1,000 (454)
Zinc formate	C	1,000 (454)
Zinc hydrosulfite	C	1,000 (454)
Zinc nitrate	C	1,000 (454)
Zinc phenolsulfonate	D	5,000 (2,270)
Zinc phosphide	B	100 (45.4)
Zinc silicofluoride	D	5,000 (2,270)
Zinc sulfate	C	1,000 (454)
Zirconium nitrate	D	5,000 (2,270)
Zirconium potassium fluoride	C	1,000 (454)
Zirconium sulfate	D	5,000 (2,270)
Zirconium tetrachloride	D	5,000 (2,270)

[50 FR 13513, Apr. 4, 1985, as amended at 51 FR 34547, Sept. 29, 1986; 54 FR 33482, Aug. 14, 1989; 58 FR 35327, June 30, 1993; 60 FR 30937, June 12, 1995]

Subpart B—Applicability

§117.11 General applicability.

This regulation sets forth a determination of the reportable quantity for each substance designated as hazardous in 40 CFR part 116. The regulation applies to quantities of designated substances equal to or greater than the reportable quantities, when discharged into or upon the navigable waters of the United States, adjoining shorelines, into or upon the contiguous zone, or beyond the contiguous zone as provided in section 311(b)(3) of the Act, except to the extent that the owner or operator can show such that discharges are made:

(a) In compliance with a permit issued under the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1401 *et seq.*);

(b) In compliance with approved water treatment plant operations as specified by local or State regulations pertaining to safe drinking water;

(c) Pursuant to the label directions for application of a pesticide product registered under section 3 or section 24 of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended (7 U.S.C. 136 *et seq.*), or pursuant to the terms and conditions of an experimental use permit issued under section 5 of FIFRA, or pursuant to an exemption granted under section 18 of FIFRA;

(d) In compliance with the regulations issued under section 3004 or with permit conditions issued pursuant to section 3005 of the Resource Conservation and Recovery Act (90 Stat. 2795; 42 U.S.C. 6901);

(e) In compliance with instructions of the On-Scene Coordinator pursuant to 40 CFR part 1510 (the National Oil and Hazardous Substances Pollution Plan) or 33 CFR 153.10(e) (Pollution by Oil and Hazardous Substances) or in accordance with applicable removal regulations as required by section 311(j)(1)(A);

(f) In compliance with a permit issued under §165.7 of Title 14 of the State of California Administrative Code;

(g) From a properly functioning inert gas system when used to provide inert gas to the cargo tanks of a vessel;

(h) From a permitted source and are excluded by §117.12 of this regulation;

(i) To a POTW and are specifically excluded or reserved in §117.13; or

(j) In compliance with a permit issued under section 404(a) of the Clean Water Act or when the discharges are exempt from such requirements by section 404(f) or 404(r) of the Act (33 U.S.C. 1344(a), (f), (r)).

§117.12 Applicability to discharges from facilities with NPDES permits.

(a) This regulation does not apply to:

Appendix G
BMP Implementation Record

BMP IMPLEMENTATION RECORD

Instructions: The Pollution Prevention Team should identify and implement BMPs to meet site-specific needs. BMPs may be identified at any time; however, the following particularly lend themselves to BMP identification: weekly inspections, annual Comprehensive Site Compliance Evaluations, quarterly monitoring, and changes to landfill operations (cell closure, new grading, etc.). Each identified BMP should be accompanied by a scheduled completion date and a person responsible for action. Notes might describe the need for the BMP, necessary follow-up, comments on effectiveness, etc.

BMP Component	Description of BMP	Scheduled Completion Date(s) for Required Action	Person Responsible for Action	Notes
Storm Water Management				
Erosion and Sediment Control				
Good Housekeeping				

BMP IMPLEMENTATION RECORD

Instructions: The Pollution Prevention Team should identify and implement BMPs to meet site-specific needs. BMPs may be identified at any time; however, the following particularly lend themselves to BMP identification: weekly inspections, annual Comprehensive Site Compliance Evaluations, quarterly monitoring, and changes to landfill operations (cell closure, new grading, etc.). Each identified BMP should be accompanied by a scheduled completion date and a person responsible for action. Notes might describe the need for the BMP, necessary follow-up, comments on effectiveness, etc.

BMP Component	Description of BMP	Scheduled Completion Date(s) for Required Action	Person Responsible for Action	Notes
Preventive Maintenance				
Inspections				

BMP IMPLEMENTATION RECORD

Instructions: The Pollution Prevention Team should identify and implement BMPs to meet site-specific needs. BMPs may be identified at any time; however, the following particularly lend themselves to BMP identification: weekly inspections, annual Comprehensive Site Compliance Evaluations, quarterly monitoring, and changes to landfill operations (cell closure, new grading, etc.). Each identified BMP should be accompanied by a scheduled completion date and a person responsible for action. Notes might describe the need for the BMP, necessary follow-up, comments on effectiveness, etc.

BMP Component	Description of BMP	Scheduled Completion Date(s) for Required Action	Person Responsible for Action	Notes
Spill Prevention and Response				
Employee Training				
Record Keeping and Reporting				

BMP IMPLEMENTATION RECORD

Instructions: The Pollution Prevention Team should identify and implement BMPs to meet site-specific needs. BMPs may be identified at any time; however, the following particularly lend themselves to BMP identification: weekly inspections, annual Comprehensive Site Compliance Evaluations, quarterly monitoring, and changes to landfill operations (cell closure, new grading, etc.). Each identified BMP should be accompanied by a scheduled completion date and a person responsible for action. Notes might describe the need for the BMP, necessary follow-up, comments on effectiveness, etc.

BMP Component	Description of BMP	Scheduled Completion Date(s) for Required Action	Person Responsible for Action	Notes

Appendix H
Spill Documentation Record

SPILL DOCUMENTATION RECORD

Instructions: Make a record of all significant spills and significant leaks of hazardous pollutants. Significant spills include, but are not limited to, any raw materials and releases of oil or hazardous substances in excess of reportable quantities. Note dates in the following format: MM/DD/YYYY.

Documented by:

Date:

Date of Release:

Time of Release:

Spill Reported by:

Regulatory Agencies Notified (Date, Time, Person, Agency, and How Notified):

1. Spill/Leak Type

Release Product
- ☐ Diesel
- ☐ Gasoline
- ☐ Lubricating Oil
- ☐ Other: ____________________

Release Quantity
- ☐ 0–10 Gallons
- ☐ 10-100 Gallons
- ☐ 100-1,000 Gallons
- ☐ 1,000-5,000 Gallons

Did release reach receiving ditch or channel?
- ☐ Yes
- ☐ No

2. Source and Description of Spill or Leak:

3. Cause of Release:

4. Receiving Ditch or Channel:

5. Description of Physical Damages:

6. Amount of Product Recovered (gallons):

7. Estimated Cost of Damages:

8. Action Taken to Prevent Recurrence:

Appendix I
Weekly Visual Inspection and Maintenance Report

WEEKLY VISUAL INSPECTION AND MAINTENANCE REPORT

Person Conducting Inspection:	
Date (MM/DD/YYYY):	

GOOD HOUSEKEEPING

<u>Instructions</u>: As necessary, review Section 5.3, Good Housekeeping. Mark “Y” (yes) or “N” (no) as appropriate. For each “N”, note question number and corrective action(s) in the space below.

☐ Y ☐ N	1. Is the maintenance building orderly and neat?
☐ Y ☐ N	2. Is there adequate space in work areas? Are work areas free of clutter?
☐ Y ☐ N	3. Are equipment, materials, and tools stored properly?
☐ Y ☐ N	4. Are materials properly labeled and stored?
☐ Y ☐ N	5. Is the material inventory up to date?
☐ Y ☐ N	6. Are employees receiving regular training?
☐ Y ☐ N	7. Is there evidence of drips or leaks from equipment or machinery on site?
☐ Y ☐ N	8. Are outside areas orderly and neat?
☐ Y ☐ N	9. Are roads, walkways, and other passageways easily accessible, safe, and free of protruding objects, materials, or equipment?
☐ Y ☐ N	10. Is blown litter collected regularly?

No.	**Corrective Action(s)**

PREVENTIVE MAINTENANCE

<u>Instructions</u>: As necessary, review Section 5.4, Preventive Maintenance. As appropriate, inspect each facility feature for leaks, spills, signs of erosion, proper operation, etc. Indicate the type of test or observation: “V” for visual observation, “O” for other (if other, indicate type of test, e.g., pump operation). Note condition as “S” (satisfactory) or “N” (not satisfactory). For each “N”, include in comments the corrective action(s) taken, such as maintenance performed.

Facility Feature	**Type of Observation or Test**	**Condition**	**Comments (Corrective action, etc.)**
Active Landfill Working Face	☐ V ☐ O __________	☐ S ☐ N	
Leachate Conveyance Piping and Equipment	☐ V ☐ O __________	☐ S ☐ N	
Leachate Pond	☐ V ☐ O __________	☐ S ☐ N	

Facility Feature	Type of Observation or Test	Condition	Comments (Corrective action, etc.)
Landfill Slopes	☐ V ☐ O ______	☐ S ☐ N	
Berms	☐ V ☐ O ______	☐ S ☐ N	
Drainage Channels	☐ V ☐ O ______	☐ S ☐ N	
Culverts	☐ V ☐ O ______	☐ S ☐ N	
Outfalls	☐ V ☐ O ______	☐ S ☐ N	
Structural BMPs (Silt Fence, Straw Bales, etc.)	☐ V ☐ O ______	☐ S ☐ N	
Vegetative Cover	☐ V ☐ O ______	☐ S ☐ N	
Newly Graded Areas	☐ V ☐ O ______	☐ S ☐ N	
Heavy Equipment	☐ V ☐ O ______	☐ S ☐ N	
Storage Areas	☐ V ☐ O ______	☐ S ☐ N	
ASTs	☐ V ☐ O ______	☐ S ☐ N	
Secondary Containment Structures	☐ V ☐ O ______	☐ S ☐ N	
Previous Spill & Leak Areas	☐ V ☐ O ______	☐ S ☐ N	
Notes:			

Appendix J
Employee Training Schedule and Employee Training Record

EMPLOYEE TRAINING SCHEDULE

Instructions: Schedule and plan regular employee training as described in Section 5.7, Employee Training. Suggest training topics are noted; others may be added by the Pollution Prevention Team. The description of the training program or materials might be a reference to a portion of the SWPPP, the name of another reference document, a training film, etc.

Training Topics	**Date**	**Required Attendees**	**Brief Description of Training Program/Materials**
Pollution Prevention Team Responsibilities			
Storm Water Management			
Erosion and Sediment Control			
Good Housekeeping			
Inspections			
Spill Prevention and Response			
Record Keeping and Reporting			

EMPLOYEE TRAINING SCHEDULE

Instructions: Schedule and plan regular employee training as described in Section 5.7, Employee Training. Suggest training topics are noted; others may be added by the Pollution Prevention Team. The description of the training program or materials might be a reference to a portion of the SWPPP, the name of another reference document, a training film, etc.

Training Topics	Date	Required Attendees	Brief Description of Training Program/Materials

EMPLOYEE TRAINING RECORD

Instructions: Document training sessions as described in Section 5.7, Employee Training. Indicate the training topic, the date of the training, and describe the training (as applicable, include agenda, materials, duration, agenda, and/or certification).

Training Topic:

Date (MM/DD/YYYY):

Description:

Attendees	Name	Position
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Appendix K
Certification of Non-Storm Water Discharges

CERTIFICATION OF NON-STORM WATER DISCHARGE

Site:	Bayview Landfill
Location:	10800 S. State Road 68, Utah County
Evaluator:	
Title:	
Testing/Evaluation Date:	

Instructions:

Certification: Testing or evaluation of discharge must be completed to determine whether or not non-storm water discharges, including leachate and vehicle wash waters, are present. Methods of testing/evaluation include, but are not limited to, a visual inspection during dry weather conditions, a review of facility drawings and plumbing schematics (to ensure illicit connections have not been overlooked), and dye testing.

Certification not Feasible: If facility personnel have no access to an outfall, manhole, or other point of access to the ultimate receiving discharge conduit, they may declare that certification is not feasible; however, they must provide documentation of why certification is not feasible and must identify potential significant sources of non-storm water at the site.

Failure to Certify: If adequate tests cannot be performed, a failure to certify may be declared. However, documentation of the following is required: testing procedures, test results and/or observations, potential sources of non-storm water discharges, and why adequate tests were not feasible.

This record constitutes:

☐ Certification per Appendix II.L, p. L-5
☐ A declaration that certification was not feasible
☐ Failure to certify (see Appendix II.L, p. L-6)

1. Potential Significant Sources of Non-Storm Water

2. Onsite Drainage Points Observed/Tested

3. Evaluation Criteria or Testing Method
4. Observations / Description of Results
5. Additional Comments

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Signature ______________________ Date ______________________

Appendix L

Comprehensive Site Compliance Evaluation

COMPREHENSIVE SITE COMPLIANCE EVALUATION

Site:	Bayview Landfill
Location:	10800 S. State Road 68, Utah County
Evaluator:	
Title:	
Date of Inspection:	
Date of Last Inspection:	

<u>Instructions</u>: Conduct a comprehensive facility evaluation to ensure compliance with the Multi-Sector General Permit for Storm Water Discharges Associated with Industrial Activities (Permit) and the Storm Water Pollution Prevention Plan (Plan). Any necessary changes to the Description of Potential Pollutant Sources (Section 4.0 and related appendices) and Measures and Controls (Section 5.0 and related appendices) must be made within <u>2 weeks</u> of the evaluation. Implementation of changes must be completed within <u>12 weeks</u> of the evaluation.

For the evaluation areas noted below, references to Plan Sections imply also references to associated appendices. Mark "S" (satisfactory) or "N" (not satisfactory) as appropriate. For unsatisfactory items, note the evaluation area number and any comments, recommended actions, etc. below.

EVALUATION AREAS

☐ S ☐ N 1.	Review Plan Section 2.0 to determine adequacy of the facility overview, including the Site Plan. Does the Site Plan reflect current operations, BMPs, etc.?
☐ S ☐ N 2.	Verify that Plan Section 3.0 is up to date (Team members, responsibilities, contact information).
☐ S ☐ N 3.	Review Plan Section 4.0 for accuracy and completeness. Verify proper record keeping of the Material Inventory and the Description of Significant Exposed Materials.
☐ S ☐ N 4.	Review Plan Section 5.0, specifically evaluating BMP implementation and effectiveness. If necessary, identify additional control measures. Visually inspect spill response equipment.
☐ S ☐ N 5.	Review the last three CSCEs (see Plan Section 6.0), noting major observations relating to the implementation of the Plan. Determine if problems or conditions of non-compliance have been remedied.
☐ S ☐ N 6.	Verify that monitoring requirements, including record keeping, have been met (Plan Section 7.0).

No.	Comments/Recommended Action:

COMPLIANCE STATUS

☐ The facility is in compliance with the Permit and the Plan.
☐ The facility is not in compliance with the Permit and the Plan.

Describe Areas of Non-Compliance:

“I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.”

Signature

Date

Appendix M
Storm Water Discharge Monitoring Report (SWDMR)

STORM WATER DISCHARGE MONITORING REPORT (SWDMR)

(For additional forms copy this form or contact the DWQ)

IDENTIFICATION & LOCATION

Name ____________________ Permit No. UTR ____________________

Mailing Address: Location *(if different)*

____________________ ____________________
____________________ ____________________
____________________ ____________________
____________________ ____________________

Monitoring Period:

From: Month _______ Day _______Year _______ To: Month _______ Day _______ Year _______

Total Storm Water Discharge Points____________ Number assigned to this Discharge Point_______

INDUSTRY SECTOR(S)

Industrial Activities or Industry Sector(s) Drained by this Discharge:

~ A. Timber Products Facilities
~ B. Paper and Allied Products Manufacturing Facilities.
~ C. Chemical and Allied Products Manufacturing Facilities.
~ D. Asphalt Paving, Roofing Materials, and Lubricant Manufacturing Facilities.
~ E. Glass, Clay, Cement, Concrete, and Gypsum Product Manufacturing Facilities.
~ F. Primary Metals Facilities.
~ G. Metal Mines (Ore Mining and Dressing).
~ H. Coal Mines and Coal Mine-Related Facilities.
~ I. Oil or Gas Extraction Facilities.
~ J. Mineral Mining and Processing Facilities.
~ K. Hazardous Waste Treatment Storage or Disposal Facilities.
~ L. Landfills and Land Application Sites.
~ M. Automobile Salvage Yards.
~ N. Scrap Recycling and Waste Recycling Facilities.
~ O. Steam Electric Power Generating Facilities.
~ P. Motor Freight Transportation Facilities, Passenger Transportation Facilities, Petroleum Bulk Oil Stations and Terminals, the United States Postal Service, or Railroad Transportation Facilities.
~ Q. Vehicle Maintenance Areas and Equipment Cleaning Areas of Water Transportation Facilities.
~ R. Ship or Boat Building and Repair Yards.
~ S. Vehicle Maintenance Areas, Equipment Cleaning Areas or Airport Deicing Operations located at Air Transportation Facilities.
~ T. Wastewater Treatment Works.
~ U. Food and Kindred Products Facilities.
~ V. Textile Mills, Apparel and other Fabric Product Manufacturing Facilities.
~ W. Furniture and Fixture Manufacturing Facilities.
~ X. Printing and Publishing Facilities.
~ Y. Rubber and Miscellaneous Plastic Product Manufacturing Facilities.
~ Z. Leather Tanning and Finishing Facilities.
~ AA. Facilities That Manufacture Metal Products including Jewelry, Silverware and Plated Ware.
~ AB. Facilities That Manufacture Transportation Equipment, Industrial or Commercial Machinery.
~ AC. Facilities That Manufacture Electronic and Electrical Equipment and Components, Photographic and Optical Goods.
~ AD. Non-Classified Facilities.

ANALYTICAL MONITORING DATA *(For sectors where it is required)*

Storm Event: *All samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. This data must be submitted to the Division of Water Quality.*

Date of Storm Event	Month Day Year
Duration of Storm Event	Hours
Rain Fall Measurement	Inches
Time Elapsed Between Recorded & Previous Storm Event	Days
Estimated Total Volume of Discharge *(Include units; gal., ft^3, etc.)*	

Please check if there has been no discharge of Storm Water during this reporting period. (If none please explain in comment section)	~ No Discharge

Sample Type: *Data shall be reported for a grab sample taken during the first thirty minutes of the discharge. If the collection of a grab sample during the first thirty minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first thirty minutes was impracticable.*

Parameter	Effluent Limit (*If Applicable)*	*Concentration* *(Concentration quantity, for example -14.2)*	*Units* *(Example - mg/L)*

SIGNATURE

Name/Title Principle Executive Officer
(Typed or Printed)

____

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. See 18 U.S.C. 1001 and 33 U.S.C. 1319. (penalties under these statues may include fines up to $10,000 and or maximum imprisonment of between 6 months and 5 years.)

____________________________ ________________

Signature of Principle Executive Officer or Authorized Agent *Date*

Comments:

____

____

____

____

____

____

____

____

____

____

____

____

____

INFORMATION

Adverse Weather Waiver. When a discharger is unable to collect samples within a specified sampling period due to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next period and submit the data along with data for the routine sample in that period. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricanes, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

Exemption to Monitoring Requirements. (Does not apply to sector S or any Visual Monitoring Requirements.) As an alternative to monitoring an outfall, an annual certification may be made that material handling equipment or activities; raw or waste materials; intermediate, final, or by-products; industrial machinery or operations; and significant materials from past industrial activity that are located in areas of the facility within the drainage area of the outfall are not presently exposed to storm water and will not be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan, and submitted to the DWQ in accordance with Part V.B of the permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under reporting requirements in the sector. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations.

When to Monitor and Report. Samples must be collected and analyzed at least once during each three month monitoring period. Monitoring results must be submitted annually. See Reporting for dates.

More Frequent Monitoring. If sampling is conducted more frequently than semi-annually, all sampling results must be submitted. A separate SWDMR is required for each storm event sampled.

How to Report. A separate SWDMR form is required for each storm event and for each outfall sampled. SWDMRs must be signed and mailed to the Division of Water Quality, and must be postmarked by the date specified under Monitoring Periods and Reporting Deadlines. The permittee should retain a copy. The address and phone number for questions or to mail the SWDMR is:

Department of Environmental Quality
Division of Water Quality
Attention Storm Water Coordinator
PO Box 144870
Salt Lake City, UT 84114-4870

(801) 538-6146

Substantially Identical Discharges. If there is reason to believe that the discharges from two or more outfalls are substantially identical, one of the outfalls may be monitored and that data submitted for all substantially identical outfalls. A description of the location of the outfalls, an explanation of why the outfalls have substantially identical discharges, and the size of the drainage area and runoff coefficient must be submitted as an attachment to the SWDMR.

VISUAL MONITORING REQUIREMENTS

Sample and Data Collection: *Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed one hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable the same individual will carry out the collection and examination of discharges for the life of the permit.*

COLOR (Circle the ones that apply):

1. Identification of Color.

Black Dark Grey Medium Grey Light Grey Dark Chocolate Brown Medium Brown

Light Brown Tan Yellow Green Other____________________________

2. Intensity of Color. Very intense Prominent Moderately Perceptible Hardly Perceptible

Comments: ____

____

____

CLARITY (Circle the right one):

Totally Opague Slightly Translucent Translucent Nearly Transparent Transparent

ODOR (Circle the ones that apply):

Diesel Gasoline Petroleum Solvent Musty Sewage Chlorine

Rotten Egg Sulfur No Odor Noxious Other __________________

Comments: ____

____

____

____

SOLIDS

Floating Solids: (Description) ______________________________

____

____

____

Suspended and Settled Solids: (Description) ______________________________

____

____

____

FOAM, OIL SHEEN, OR OTHER OBVIOUS INDICATORS OF POLLUTION

____

____

____

____

____

____

____

____

____

____

____

____

Title V Permit
Air Quality Permit

APPENDIX I

1896

State of Utah

GARY R. HERBERT
Governor

SPENCER J. COX
Lieutenant Governor

Department of
Environmental Quality

Alan Matheson
Executive Director

DIVISION OF AIR QUALITY
Bryce C. Bird
Director

11975

DAQO-OP0119750006-15

September 18, 2015

CERTIFIED MAIL

Mr. Terry Ficklin
2450 W 400 S
PO Box 507
Springville UT 84663-0507

Dear Mr. Ficklin

Re: Operating Permit Application for South Utah Valley Solid Waste District- Bayview Landfill

The application for an Operating Permit for the above site was received on May 15, 2015. The application was classified as a Title V renewal application, in accordance with R307-415-7c.

Please review the enclosed copy of the permit thoroughly to assure that you and all affected staff members at your organization are aware of its requirements. If you have any questions regarding this permit, please contact me at (801) 536-4091 or by e-mail at rreece@utah.gov.

Sincerely,

Ron Reece
Environmental Engineer
Operating Permit Section

cc:
Mr. Marc Loveless
2450 W 400 S
PO Box 507
Springville UT 84663-0507

195 North 1950 West • Salt Lake City, UT
Mailing Address: P.O. Box 144820 • Salt Lake City, UT 84114-4820
Telephone (801) 536-4000 • Fax (801) 536-4099 • T.D.D. (801) 903-3978
www.deq.utah.gov
Printed on 100% recycled paper

State of Utah

GARY R. HERBERT
Governor

SPENCER J. COX
Lieutenant Governor

Department of
Environmental Quality

Alan Matheson
Executive Director

DIVISION OF AIR QUALITY
Bryce C. Bird
Director

11975

Title V Operating Permit

PERMIT NUMBER: 4900230003
DATE OF PERMIT: September 18, 2015
Date of Last Revision: September 18, 2015

This Operating Permit is issued to, and applies to the following:

Name of Permittee:

South Utah Valley Solid Waste District
2450 W 400 S
PO Box 507
Springville UT 84663-0507

Permitted Location:

Bayview Landfill
10802 S Redwood Rd (SR 68)
Elberta UT 84626

UTM coordinates: 412381 m Easting, 4445562 m Northing
SIC code: 4953 (Refuse Systems)

UTAH AIR QUALITY BOARD

By:

Bryce C. Bird, Director

Prepared By:

Ron Reece

150 North 1950 West • Salt Lake City, UT
Mailing Address: P.O. Box 144820 • Salt Lake City, UT 84114-4820
Telephone (801) 536-4000 • Fax (801) 536-4099 • T.D.D. (801) 536-4414
www.deq.utah.gov
Printed on 100% recycled paper

ENFORCEABLE DATES AND TIMELINES

The following dates or timeframes are referenced in
Section I: General Provisions of this permit.

Annual Certification Due:	April 15 and on that date of every calendar year that this permit is in force.
Renewal application due:	March 18, 2020
Permit expiration date:	September 18, 2020
Definition of "prompt":	written notification within 14 days.

ABSTRACT

The South Utah Valley Solid Waste District operates the South Utah Valley Landfill (Bayview Landfill), a municipal solid waste (MSW) landfill located in Utah County, Utah. The facility accepts municipal and commercial waste. Bayview Landfill is a Title V source because 40 CFR 60 Subpart Cc references the Utah State Plan which reference 40 CFR 60 Subpart WWW for MSW landfills and requires all landfills with a design capacity over 2.5 million megagrams to submit a Title V application. South Utah Valley Landfill is a Title V area source. Landfill was opened in 1990, no modification since May 30, 1991.

South Utah Valley Landfill (Bayview Landfill) is subject to :

New Source Performance Standards (NSPS) under 40 CFR 60, Subpart A - General Provisions

Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills - 40 CFR 60 Subpart Cc

New Source Performance Standards (NSPS) - Standards of Performance for Municipal Solid Waste Landfills - 40 CFR 60 Subpart WWW and Utah State Plan R307-220-2.

National Emissions Standards for Hazardous Air Pollutants (NESHAPS), 40 CFR Part 61, Subpart A - General Provisions

National Emission Standards for Asbestos: Standards for Active Waste Disposal Sites, 40 CFR 61 Subpart M

OPERATING PERMIT HISTORY

Permit/Activity	Date Issued	Recorded Changes
Title V renewal application (Project #OPP0119750006)	9/18/2015	Renewal. Removed all emission units not associated with the landfill.
Title V renewal application (Project #OPP0119750004)	10/4/2010	Renewal. Removed 1,000 gallon storage tank and 40 HP generator. Added 100 HP and 10 HP generators.
Title V administrative amendment by DAQ (Project #OPP0119750002)	3/24/2004	Action initiated by an administrative amendment (initiated by DAQ) to remove language pertaining to cold parts washer unit that was erroneously listed as an emission unit at the facility.
Title V initial application (Project #OPP0119750001)	5/21/2002	Permit issued

Table of Contents

Issued under authority of Utah Code Ann. Section 19-2-104 and 19-2-109.1, and in accordance with Utah Administrative Code R307-415 Operating Permit Requirements.

All definitions, terms and abbreviations used in this permit conform to those used in Utah Administrative Code R307-101 and R307-415 (Rules), and 40 Code of Federal Regulations (CFR), except as otherwise defined in this permit. Unless noted otherwise, references cited in the permit conditions refer to the Rules.

Where a permit condition in Section I, General Provisions, partially recites or summarizes an applicable rule, the full text of the applicable portion of the rule shall govern interpretations of the requirements of the rule. In the case of a conflict between the Rules and the permit terms and conditions of Section II, Special Provisions, the permit terms and conditions of Section II shall govern except as noted in Provision I.M, Permit Shield.

SECTION I: GENERAL PROVISIONS

I.A **Federal Enforcement.**

All terms and conditions in this permit, including those provisions designed to limit the potential to emit, are enforceable by the EPA and citizens under the Clean Air Act of 1990 (CAA) except those terms and conditions that are specifically designated as "State Requirements". (R307-415-6b)

I.B **Permitted Activity(ies).**

Except as provided in R307-415-7b(1), the permittee may not operate except in compliance with this permit. (See also Provision I.E, Application Shield)

I.C **Duty to Comply.**

I.C.1 The permittee must comply with all conditions of the operating permit. Any permit noncompliance constitutes a violation of the Air Conservation Act and is grounds for any of the following: enforcement action; permit termination; revocation and reissuance; modification; or denial of a permit renewal application. (R307-415-6a(6)(a))

I.C.2 It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit. (R307-415-6a(6)(b))

I.C.3 The permittee shall furnish to the Director, within a reasonable time, any information that the Director may request in writing to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. Upon request, the permittee shall also furnish to the Director copies of records required to be kept by this permit or, for information claimed to be confidential, the permittee may furnish such records directly to the EPA along with a claim of confidentiality. (R307-415-6a(6)(e))

I.C.4 This permit may be modified, revoked, reopened, and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or of a notification of planned changes or anticipated noncompliance shall not stay any permit condition, except as provided under R307-415-7f(1) for minor permit modifications. (R307-415-6a(6)(c))

I.D **Permit Expiration and Renewal.**

I.D.1 This permit is issued for a fixed term of five years and expires on the date shown under "Enforceable Dates and Timelines" at the front of this permit. (R307-415-6a(2)).

I.D.2 Application for renewal of this permit is due on or before the date shown under "Enforceable Dates and Timelines" at the front of this permit. An application may be submitted early for any reason. (R307-415-5a(1)(c)).

I.D.3 An application for renewal submitted after the due date listed in I.D.2 above shall be accepted for processing, but shall not be considered a timely application and shall not relieve the permittee of any enforcement actions resulting from submitting a late application. (R307-415-5a(5))

I.D.4 Permit expiration terminates the permittee's right to operate unless a timely and complete renewal application is submitted consistent with R307-415-7b (see also Provision I.E, Application Shield) and R307-415-5a(1)(c) (see also Provision I.D.2). (R307-415-7c(2))

I.E **Application Shield.**

If the permittee submits a timely and complete application for renewal, the permittee's failure to have an operating permit will not be a violation of R307-415, until the Director takes final action on the permit renewal application. In such case, the terms and conditions of this permit shall remain in force until permit renewal or denial. This protection shall cease to apply if, subsequent to the completeness determination required pursuant to R307-415-7a(3), and as required by R307-415-5a(2), the applicant fails to submit by the deadline specified in writing by the Director any additional information identified as being needed to process the application. (R307-415-7b(2))

I.F **Severability.**

In the event of a challenge to any portion of this permit, or if any portion of this permit is held invalid, the remaining permit conditions remain valid and in force. (R307-415-6a(5))

I.G **Permit Fee.**

I.G.1 The permittee shall pay an annual emission fee to the Director consistent with R307-415-9. (R307-415-6a(7))

I.G.2 The emission fee shall be due on October 1 of each calendar year or 45 days after the source receives notice of the amount of the fee, whichever is later. (R307-415-9(4)(a))

I.H **No Property Rights.**

This permit does not convey any property rights of any sort, or any exclusive privilege. (R307-415-6a(6)(d))

I.I **Revision Exception.**

No permit revision shall be required, under any approved economic incentives, marketable permits, emissions trading and other similar programs or processes for changes that are provided for in this permit. (R307-415-6a(8))

I.J **Inspection and Entry.**

I.J.1 Upon presentation of credentials and other documents as may be required by law, the permittee shall allow the Director or an authorized representative to perform any of the following:

I.J.1.a Enter upon the permittee's premises where the source is located or emissions related activity is conducted, or where records are kept under the conditions of this permit. (R307-415-6c(2)(a))

I.J.1.b Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit. (R307-415-6c(2)(b))

I.J.1.c Inspect at reasonable times any facilities, equipment (including monitoring and air pollution control equipment), practice, or operation regulated or required under this permit. (R307-415-6c(2)(c))

I.J.1.d Sample or monitor at reasonable times substances or parameters for the purpose of assuring compliance with this permit or applicable requirements. (R307-415-6c(2)(d))

I.J.2 Any claims of confidentiality made on the information obtained during an inspection shall be made pursuant to Utah Code Ann. Section 19-1-306. (R307-415-6c(2)(e))

I.K **Certification.**

Any application form, report, or compliance certification submitted pursuant to this permit shall contain certification as to its truth, accuracy, and completeness, by a responsible official as defined in R307-415-3. This certification shall state that, based on information and belief formed after reasonable inquiry, the statements and information in the document are true, accurate, and complete. (R307-415-5d)

I.L **Compliance Certification.**

I.L.1 Permittee shall submit to the Director an annual compliance certification, certifying compliance with the terms and conditions contained in this permit, including emission limitations, standards, or work practices. This certification shall be submitted no later than the date shown under "Enforceable Dates and Timelines" at the front of this permit, and that date each year following until this permit expires. The certification shall include all the following (permittee may cross-reference this permit or previous reports): (R307-415-6c(5)).

I.L.1.a The identification of each term or condition of this permit that is the basis of the certification;

I.L.1.b The identification of the methods or other means used by the permittee for determining the compliance status with each term and condition during the certification period. Such methods and other means shall include, at a minimum, the monitoring and related recordkeeping and reporting requirements in this permit. If necessary, the permittee also shall identify any other material information that must be included in the certification to comply with section 113(c)(2) of the Act, which prohibits knowingly making a false certification or omitting material information;

I.L.1.c The status of compliance with the terms and conditions of the permit for the period covered by the certification, including whether compliance during the period was continuous or intermittent. The certification shall be based on the method or means designated in

Provision I.L.1.b. The certification shall identify each deviation and take it into account in the compliance certification. The certification shall also identify as possible exceptions to compliance any periods during which compliance is required and in which an excursion or exceedance as defined under 40 CFR Part 64 occurred; and

I.L.1.d Such other facts as the Director may require to determine the compliance status.

I.L.2 The permittee shall also submit all compliance certifications to the EPA, Region VIII, at the following address or to such other address as may be required by the Director: (R307-415-6c(5)(d))

Environmental Protection Agency, Region VIII
Office of Enforcement, Compliance and Environmental Justice
(mail code 8ENF)
1595 Wynkoop Street
Denver, CO 80202-1129

I.M **Permit Shield.**

I.M.1 Compliance with the provisions of this permit shall be deemed compliance with any applicable requirements as of the date of this permit, provided that:

I.M.1.a Such applicable requirements are included and are specifically identified in this permit, or (R307-415-6f(1)(a))

I.M.1.b Those requirements not applicable to the source are specifically identified and listed in this permit. (R307-415-6f(1)(b))

I.M.2 Nothing in this permit shall alter or affect any of the following:

I.M.2.a The emergency provisions of Utah Code Ann. Section 19-1-202 and Section 19-2-112, and the provisions of the CAA Section 303. (R307-415-6f(3)(a))

I.M.2.b The liability of the owner or operator of the source for any violation of applicable requirements under Utah Code Ann. Section 19-2-107(2)(g) and Section 19-2-110 prior to or at the time of issuance of this permit. (R307-415-6f(3)(b)

I.M.2.c The applicable requirements of the Acid Rain Program, consistent with the CAA Section 408(a). (R307-415-6f(3)(c))

I.M.2.d The ability of the Director to obtain information from the source under Utah Code Ann. Section 19-2-120, and the ability of the EPA to obtain information from the source under the CAA Section 114. (R307-415-6f(3)(d))

I.N **Emergency Provision.**

I.N.1 An "emergency" is any situation arising from sudden and reasonably unforeseeable events beyond the control of the source, including acts of God, which situation requires immediate corrective action to restore normal operation, and that causes the source to exceed a technology-based emission limitation under this permit, due to unavoidable increases in emissions attributable to the emergency. An emergency shall not include noncompliance to the extent caused by improperly designed equipment, lack of preventive maintenance, careless or improper operation, or operator error. (R307-415-6g(1))

I.N.2 An emergency constitutes an affirmative defense to an action brought for noncompliance with such technology-based emission limitations if the affirmative defense is demonstrated through properly signed, contemporaneous operating logs, or other relevant evidence that:

I.N.2.a An emergency occurred and the permittee can identify the causes of the emergency. (R307-415-6g(3)(a))

I.N.2.b The permitted facility was at the time being properly operated. (R307-415-6g(3)(b))

I.N.2.c During the period of the emergency the permittee took all reasonable steps to minimize levels of emissions that exceeded the emission standards, or other requirements in this permit. (R307-415-6g(3)(c))

I.N.2.d The permittee submitted notice of the emergency to the Director within two working days of the time when emission limitations were exceeded due to the emergency. This notice must contain a description of the emergency, any steps taken to mitigate emissions, and corrective actions taken. This notice fulfills the requirement of Provision I.S.2.c below. (R307-415-6g(3)(d))

I.N.3 In any enforcement proceeding, the permittee seeking to establish the occurrence of an emergency has the burden of proof. (R307-415-6g(4))

I.N.4 This emergency provision is in addition to any emergency or upset provision contained in any other section of this permit. (R307-415-6g(5))

I.O **Operational Flexibility.**

Operational flexibility is governed by R307-415-7d(1).

I.P **Off-permit Changes.**

Off-permit changes are governed by R307-415-7d(2).

I.Q **Administrative Permit Amendments.**

Administrative permit amendments are governed by R307-415-7e.

I.R **Permit Modifications.**

Permit modifications are governed by R307-415-7f.

I.S **Records and Reporting.**

I.S.1 Records.

I.S.1.a The records of all required monitoring data and support information shall be retained by the permittee for a period of at least five years from the date of the monitoring sample, measurement, report, or application. Support information includes all calibration and maintenance records, all original strip-charts or appropriate recordings for continuous monitoring instrumentation, and copies of all reports required by this permit. (R307-415-6a(3)(b)(ii))

I.S.1.b For all monitoring requirements described in Section II, Special Provisions, the source shall record the following information, where applicable: (R307-415-6a(3)(b)(i))

I.S.1.b.1 The date, place as defined in this permit, and time of sampling or measurement.

I.S.1.b.2 The date analyses were performed.

I.S.1.b.3 The company or entity that performed the analyses.

I.S.1.b.4 The analytical techniques or methods used.

I.S.1.b.5 The results of such analyses.

I.S.1.b.6 The operating conditions as existing at the time of sampling or measurement.

I.S.1.c Additional record keeping requirements, if any, are described in Section II, Special Provisions.

I.S.2 Reports.

I.S.2.a Monitoring reports shall be submitted to the Director every six months, or more frequently if specified in Section II. All instances of deviation from permit requirements shall be clearly identified in the reports. (R307-415-6a(3)(c)(i))

I.S.2.b All reports submitted pursuant to Provision I.S.2.a shall be certified by a responsible official in accordance with Provision I.K of this permit. (R307-415-6a(3)(c)(i)

I.S.2.c The Director shall be notified promptly of any deviations from permit requirements including those attributable to upset conditions as defined in this permit, the probable cause of such deviations, and any corrective actions or preventative measures taken. Prompt, as used in this condition, shall be defined as written notification within the number of days shown under "Enforceable Dates and Timelines" at the front of this permit.. Deviations from permit requirements due to breakdowns shall be reported in accordance with the provisions of R307-107. (R307-415-6a(3)(c)(ii)).

I.S.3 Notification Addresses.

I.S.3.a All reports, notifications, or other submissions required by this permit to be submitted to the Director are to be sent to the following address or to such other address as may be required by the Director:

Utah Division of Air Quality
P.O. Box 144820
Salt Lake City, UT 84114-4820
Phone: 801-536-4000

I.S.3.b All reports, notifications or other submissions required by this permit to be submitted to the EPA should be sent to one of the following addresses or to such other address as may be required by the Director:

For annual compliance certifications:

Environmental Protection Agency, Region VIII
Office of Enforcement, Compliance and Environmental Justice
(mail code 8ENF)
1595 Wynkoop Street

Denver, CO 80202-1129

For reports, notifications, or other correspondence related to permit modifications, applications, etc.:

Environmental Protection Agency, Region VIII
Office of Partnerships & Regulatory Assistance Air & Radiation Program (mail code 8P-AR)
1595 Wynkoop Street
Denver, CO 80202-1129
Phone: 303-312-6440

I.T **Reopening for Cause.**

I.T.1 A permit shall be reopened and revised under any of the following circumstances:

I.T.1.a New applicable requirements become applicable to the permittee and there is a remaining permit term of three or more years. No such reopening is required if the effective date of the requirement is later than the date on which this permit is due to expire, unless the terms and conditions of this permit have been extended pursuant to R307-415-7c(3), application shield. (R307-415-7g(1)(a))

I.T.1.b The Director or EPA determines that this permit contains a material mistake or that inaccurate statements were made in establishing the emissions standards or other terms or conditions of this permit. (R307-415-7g(1)(c))

I.T.1.c EPA or the Director determines that this permit must be revised or revoked to assure compliance with applicable requirements. (R307-415-7g(1)(d))

I.T.1.d Additional applicable requirements are to become effective before the renewal date of this permit and are in conflict with existing permit conditions. (R307-415-7g(1)(e))

I.T.2 Additional requirements, including excess emissions requirements, become applicable to a Title IV affected source under the Acid Rain Program. Upon approval by EPA, excess emissions offset plans shall be deemed to be incorporated into this permit. (R307-415-7g(1)(b))

I.T.3 Proceedings to reopen and issue a permit shall follow the same procedures as apply to initial permit issuance and shall affect only those parts of this permit for which cause to reopen exists. (R307-415-7g(2))

I.U **Inventory Requirements.**

An emission inventory shall be submitted in accordance with the procedures of R307-150, Emission Inventories. (R307-150)

I.V **Title IV and Other, More Stringent Requirements**

Where an applicable requirement is more stringent than an applicable requirement of regulations promulgated under Title IV of the Act, Acid Deposition Control, both provisions shall be incorporated into this permit. (R307-415-6a(1)(b))

SECTION II: SPECIAL PROVISIONS

II.A **Emission Unit(s) Permitted to Discharge Air Contaminants.**
(R307-415-4(3)(a) and R307-415-4(4))

II.A.1 **Permitted Source**
Source-wide

II.A.2 **Landfill: MSW Landfill (designated as Landfill)**
Class I Sanitary Landfill with a 18.1 million Mg capacity. Opened in 1990, no modification since May 30, 1991. NSPS Cc and WWW applies to this unit.

II.B **Requirements and Limitations**

The following emission limitations, standards, and operational limitations apply to the permitted facility as indicated:

II.B.1 **Conditions on permitted source (Source-wide).**

II.B.1.a **Condition:**

Visible emissions caused by fugitive dust shall not exceed 10% at the property boundary, and 20% onsite. There is no exception during periods when wind speeds exceed 25 miles per hour. [Authority granted under R307-309-3(1); condition originated in R307-309-5].

II.B.1.a.1 **Monitoring:**

In lieu of monitoring via visible emissions observations, adherence to the most recently approved fugitive dust control plan shall be maintained in order to demonstrate that appropriate measures are being implemented to control fugitive dust.

II.B.1.a.2 **Recordkeeping:**

Records of measures taken to control fugitive dust shall be maintained to demonstrate adherence to the most recently approved fugitive dust control plan. If wind speeds are measured to establish an exception from the above visible emissions limits, records of those measurements shall be maintained. Records shall be maintained as described in Provision I.S.1 of this permit.

II.B.1.a.3 **Reporting:**

There are no reporting requirements for this provision except those specified in Section I of this permit.

II.B.1.b **Condition:**

Visible emissions shall be no greater than 20 percent opacity, unless otherwise specified in this permit. [Authority granted under R307-201-3(2); condition originated in R307-201].

II.B.1.b.1 **Monitoring:**

A visual opacity survey of each affected emission unit shall be performed on a quarterly basis by an individual trained on the observation procedures of 40 CFR 60, Appendix A, Method 9, or other EPA-approved testing method, as acceptable to the Director. If visible emissions other than steam are observed from an emission unit, an opacity determination of that emission unit shall be performed by a certified observer within 24 hours of the initial survey. The opacity determination shall be performed in accordance with 40 CFR 60, Appendix A, Method 9, or other EPA-approved testing method, as acceptable to the Director, for point sources, and in accordance with 58 FR 61640 Method 203C for fugitive emission sources.

II.B.1.b.2 **Recordkeeping:**

The permittee shall record the date of each visual opacity survey and keep a list of the emission points checked during the visual opacity survey. The permittee shall also keep a log of the following information for each observed visual emission: date and time visual emissions observed, emission point location and description, time and date of opacity test, and percent opacity. The records required by this provision and all data required by 40 CFR 60, Appendix A, Method 9 shall be maintained in accordance with Provision I.S.1 of this permit.

II.B.1.b.3 **Reporting:**

There are no reporting requirements for this provision except those specified in Section I of this permit.

II.B.1.c **Condition:**

Records shall be maintained of the material (salt, crushed slag, or sand) applied to the roads by the permitted source. If the permittee applies crushed slag, sand, or salt that is less than 92% sodium chloride to roads they must demonstrate to the Board that the material applied has no more PM_{10} emission than salt which is at least 92% sodium chloride. [Authority granted under R307-307; condition originated in R307-307].

II.B.1.c.1 **Monitoring:**

Records required for this permit condition will serve as monitoring.

II.B.1.c.2 **Recordkeeping:**

The following records shall be maintained as outlined in Provision I.S.1 of this permit:

For Salt - the quantity applied, the percent by weight of insoluble solids in the salt.

For Sand or Crushed Slag - the quantity applied and the percent by weight of fine material which passes the number 200 sieve in a standard gradation analysis.

II.B.1.c.3 **Reporting:**

There are no reporting requirements for this provision except those specified in Section I of this permit.

II.B.2 **Conditions on MSW Landfill (Landfill).**

II.B.2.a **Condition:**

The permittee shall comply with all applicable requirements in 40 CFR 60, Subpart WWW - New Source Performance Standards (NSPS) Standards of Performance for Municipal Solid Waste Landfills. The permittee shall comply with the applicable General Provisions in 40 CFR 60, Subpart A.

(a) The permittee shall calculate a nonmethane organic compounds (NMOC) emission rate for the landfill using the procedures specified in monitoring. The NMOC emission rate shall be recalculated annually, except as provided in paragraph (b)(1)(i) of reporting.

(1) If the calculated NMOC emission rate is less than 50 megagrams per year, the permittee shall:

(i) Submit an annual emission report to the Director, except as provided for in Section II.B.2.a.3 Reporting and paragraph (b)(1)(i) of reporting; and

(ii) Recalculate the NMOC emission rate annually using the procedures specified in (a) of monitoring until such time as the calculated NMOC emission rate is equal to or greater than 50 megagrams per year, or the landfill is closed.

(A) If the NMOC emission rate, upon recalculation required in paragraph (a)(1)(ii), is equal to or greater than 50 megagrams per year, the permittee shall install a collection and control system in compliance with 40 CFR 60.752(b)(2).

(B) If the landfill is permanently closed, a closure notification shall be submitted to the Director as provided for in (d) of reporting.

(2) If the calculated NMOC emission rate is equal to or greater than 50 megagrams per year, the permittee shall:

(i) Submit a collection and control system design plan prepared by a professional engineer to the Director within 1 year:

(A) The collection and control system as described in the plan shall meet the design requirements of paragraph 40 CFR 60.752(b)(2)(ii).

(B) The collection and control system design plan shall include any alternatives to the operational standards, test methods, procedures, compliance measures, monitoring, recordkeeping or reporting provisions of 40 CFR 60.753 through 60.758 proposed by the permittee.

(C) The collection and control system design plan shall either conform with specifications for active collection systems in 40 CFR 60.759 or include a demonstration to the Director's satisfaction of the sufficiency of the alternative provisions to 40 CFR 60.759.

(ii) The permittee shall install a collection and control system capable of meeting emissions standards in R307-221 within 30 months of the date when the landfill has an emission rate of NMOC of 50 megagrams per year or more.

(b) When the MSW landfill is closed, the permittee is no longer subject to the requirement to maintain an operating permit under 40 CFR 70 for the landfill if the landfill is not otherwise subject to the requirements of either 40 CFR 70 and if either of the following conditions are met:

(1) The landfill was never subject to the requirement for a control system under paragraph (a)(2); or

(2) The permittee meets the conditions for control system removal specified in 40 CFR 60.752(b)(2)(v).

[Authority granted under 40 CFR 60.750(d); condition originated in 40 CFR 60.750]

II.B.2.a.1 **Monitoring:**

The permittee shall monitor the NMOC emission rate by using the equations in (a) and following the three tier process outlined in (b), (c), and (d).

(a) The permittee shall calculate the NMOC emission rate using either the equation provided in paragraph (a)(1) or the equation provided in paragraph (a)(2). Both equations may be used if the actual year to year solid waste acceptance rate is known, as specified in paragraph (a)(1) for part of the life of the landfill and the actual year to year solid waste acceptance rate is unknown, as specified in paragraph (a)(2), for part of the life of the landfill. The values to be used in both equations are 0.02 per year for "k", 170 cubic meters per megagram for Lo, and 4,000 parts per million by volume as hexane for the C_{NMOC}. For either (a)(1) or (a)(2) below, the mass of non-degradable solid waste may be subtracted from the total mass of solid waste in a particular section of the landfill when calculating the value for Mi if documentation of the nature and amount of such wastes is maintained.

(1) The following equation shall be used if the actual year to year solid waste acceptance rate is known.

M_{NMOC} = Sum $(2\,k\,L_o\,M_i\,(e^{-kt_i})(C_{NMOC})(3.6x10^{-9}))$ of i through n

where,

M_{NMOC}=Total NMOC emission rate from the landfill, megagrams per year
k = methane generation rate constant, per year
Lo = methane generation potential, cubic meters per megagram solid waste
M_i = mass of solid waste in the i^{th} section, megagrams
t_i = age of the i^{th} section, years
C_{NMOC} = concentration of NMOC, parts per million by volume as hexane
3.6×10^{-9}=conversion factor

(2) The following alternative equations shall be used if incremental (tenths of one year) solid waste acceptance rate is known.

M_{NMOC} = Sum $(k\,L_o\,(M_i\,/10)e^{-kt_{ij}}\,(C_{NMOC})\,(3.6x10^{-9}))$ of i through n

Where:
i = 1 year time increment
n = (year of the calculation) – (initial year of waste acceptance)
j = 0.1 year time increment
M_{NMOC} = Total NMOC emission rate from the landfill, megagrams per year
k = methane generation rate constant, per year
Lo = methane generation potential, cubic meters per megagram solid waste
M_i = mass of solid waste in the i^{th} year, megagrams
t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (decimal years,

e.g., 3.2 years)
C_{NMOC} = concentration of NMOC, parts per million by volume as hexane
3.6×10^{-9}=conversion factor

(b) Tier 1. The permittee shall compare the calculated NMOC mass emission rate to the standard of 50 megagrams per year.

(1) If the NMOC emission rate calculated in (a) is less than 50 megagrams per year, then the permittee shall submit an emission rate report as provided in paragraph (b)(1) of reporting, and shall recalculate the NMOC mass emission rate annually as required under paragraph (a)(1) of this condition.

(2) If the calculated NMOC emission rate is equal to or greater than 50 megagrams per year, then the permittee shall either comply with paragraph (a)(2) of this condition, or determine a site specific NMOC concentration and recalculate the NMOC emission rate using the procedures provided in (c).

(c) Tier 2. The permittee shall determine the site-specific NMOC concentration using the following sampling procedure.

The permittee shall install at least two sample probes per hectare of landfill surface that has retained waste for at least 2 years. If the landfill is larger than 25 hectares in area, only 50 samples are required. The sample probes should be located to avoid known areas of non-degradable solid waste. The permittee shall collect and analyze one sample of landfill gas from each probe to determine the NMOC concentration using 40 CFR 60 Appendix A Method 25 or 25C. Method 18 of Appendix A may be used to analyze the samples collected by the Method 25 or 25C sampling procedure. Taking composite samples from different probes into a single canister is allowed; however, equal sample volumes must be taken from each probe. For each composite sample, the sampling rate, collection times, beginning and ending canister vacuums, or alternative volume measurements must be recorded to verify that composite volumes are equal. Composite sample volumes should not be less than one liter unless evidence can be provided to substantiate the accuracy of smaller volumes. Terminate compositing before the canister approaches ambient pressure where measurement accuracy diminishes.

If using Method 18, the permittee must identify all compounds in the sample and, as a minimum, test for those compounds published in the most recent Compilation of Air Pollutant Emission Factors (AP 42), minus carbon monoxide, hydrogen sulfide, and mercury. As a minimum, the instrument must be calibrated for each of the compounds on the list.

Convert the concentration of each Method 18 compound to CNMOC as hexane by multiplying by the ratio of its carbon atoms divided by six. If more than the required number of samples are taken, all samples must be used in the analysis. The permittee must divide the NMOC concentration from 40 CFR 60 Appendix A of Method 25 or 25C by six to convert from CNMOC as carbon to CNMOC as hexane.

If the landfill has an active or passive gas removal system in place, Method 25 or 25C samples may be collected from these systems instead of surface probes provided the removal system can be shown to provide sampling as representative as the two sampling probe per hectare requirement. For active collection systems, samples may be collected from the common header pipe before the gas moving or condensate removal equipment. For these systems, a minimum of three samples must be collected from the header pipe.

(1) The permittee shall recalculate the NMOC mass emission rate using the equations

provided in (a)(1) or (a)(2) using the average NMOC concentration from the collected samples instead of the default value in the equations provided in (a)(1) or (a)(2).

(2) If the resulting mass emission rate calculated using the site specific NMOC concentration is equal to or greater than 50 megagrams per year, then the permittee shall either comply with paragraph (a)(2) of this condition, or determine the site specific methane generation rate constant and recalculate the NMOC emission rate using the site specific methane generation rate using the procedure specified in (d).

(3) If the resulting NMOC mass emission rate is less than 50 megagrams per year, the permittee shall submit a periodic estimate of the emission rate report as provided in paragraph (b)(1) of reporting and retest the site specific NMOC concentration every 5 years using the methods specified in monitoring.

(d) Tier 3. The site specific methane generation rate constant shall be determined using the procedures provided in 40 CFR 60 Appendix A Method 2E. The permittee shall estimate the NMOC mass emission rate using equations in (a) and using a site specific methane generation rate constant k, and the site specific NMOC concentration as determined in (c) instead of the default values provided in (a). The permittee shall compare the resulting NMOC mass emission rate to the standard of 50 megagrams per year.

(1) If the NMOC mass emission rate as calculated using the site specific methane generation rate and concentration of NMOC is equal to or greater than 50 megagrams per year, the permittee shall comply with paragraph (a)(2) of this condition.

(2) If the NMOC mass emission rate is less than 50 megagrams per year, then the permittee shall submit a periodic emission rate report as provided in paragraph (b)(1) of reporting and shall recalculate the NMOC mass emission rate annually, as provided in paragraph (a)(1) of reporting using the equations in (a)(1) or (a)(2) and using the site specific methane generation rate constant and NMOC concentration obtained in (c). The calculation of the methane generation rate constant is performed only once, and the value obtained from this test shall be used in all subsequent annual NMOC emission rate calculations.

II.B.2.a.2 **Recordkeeping:**

(a) Except as provided in paragraph (a)(2)(i)(B) of this condition when subject to (a) of this condition, the permittee shall keep for at least 5 years up to date, readily accessible, on site records of the design capacity report which triggered (a) of this condition, the current amount of solid waste in place, and the year by year waste acceptance rate. Off site records may be maintained if they are retrievable within 4 hours. Either paper copy or electronic formats are acceptable.

(b) Results of monitoring shall also be maintained in accordance with provision I.S.1 of this permit.

II.B.2.a.3 **Reporting:**

Except as provided in paragraph (a)(2)(i)(B) of this condition,

(a) An amended design capacity report shall be submitted to the Director providing notification of any increase in the design capacity of the landfill, whether the increase results from an increase in the permitted area or depth of the landfill, a change in the operating procedures, or any other means which results in an increase in the maximum design capacity of the landfill.

The amended design capacity report shall be submitted within 90 days of the earliest of the following events:

(1) the issuance of an amended operating permit;
(2) submittal of application for a solid waste permit under R315-310; or
(3) the change in operating procedures which will result in an increase in design capacity.

(b) The permittee shall submit an NMOC emission rate report to the Director initially and annually thereafter, except as provided for in paragraph (b)(1)(i). The Director may request such additional information as may be necessary to verify the reported NMOC emission rate.

(1) The NMOC emission rate report shall contain an annual or 5 year estimate of the NMOC emission rate calculated using the formula and procedures provided in monitoring.

(i) If the estimated NMOC emission rate as reported in the annual report to the Director is less than 50 megagrams per year in each of the next 5 consecutive years, the permittee may elect to submit an estimate of the NMOC emission rate for the next 5 year period in lieu of the annual report. This estimate shall include the current amount of solid waste in place and the estimated waste acceptance rate for each year of the 5 years for which an NMOC emission rate is estimated. All data and calculations upon which this estimate is based shall be provided to the Director. This estimate shall be revised at least once every 5 years. If the actual waste acceptance rate exceeds the estimated waste acceptance rate in any year reported in the 5 year estimate, a revised 5 year estimate shall be submitted to the Director. The revised estimate shall cover the 5 year period beginning with the year in which the actual waste acceptance rate exceeded the estimated waste acceptance rate.

(2) The NMOC emission rate report shall include all the data, calculations, sample reports and measurements used to estimate the annual or 5 year emissions.

(c) Each permittee subject to the provisions of paragraph (a)(2)(i) of this condition shall submit a collection and control system design plan to the Director within 1 year of the first report required under (b) in which the emission rate equals or exceeds 50 megagrams per year, except as follows:

(1) If the permittee elects to recalculate the NMOC emission rate after Tier 2 NMOC sampling and analysis as provided in (c) of monitoring and the resulting rate is less than 50 megagrams per year, annual periodic reporting shall be resumed, using the Tier 2 determined site specific NMOC concentration, until the calculated emission rate is equal to or greater than 50 megagrams per year or the landfill is closed. The revised NMOC emission rate report, with the recalculated emission rate based on NMOC sampling and analysis, shall be submitted within 180 days of the first calculated exceedance of 50 megagrams per year.

(2) If the permittee elects to recalculate the NMOC emission rate after determining a site specific methane generation rate constant (k), as provided in Tier 3 in (d) of monitoring, and the resulting NMOC emission rate is less than 50 Mg/yr, annual periodic reporting shall be resumed. The resulting site specific methane generation rate constant (k) shall be used in the emission rate calculation until such time as the emissions rate calculation results in an exceedance. The revised NMOC emission rate report based on the provisions of (d) of monitoring and the resulting site specific methane generation rate constant (k) shall be submitted to the Director within 1 year

of the first calculated emission rate exceeding 50 megagrams per year.

(d) Each permittee of a landfill shall submit a closure report to the Director within 30 days of waste acceptance cessation. The Director may request additional information as may be necessary to verify that permanent closure has taken place in accordance with the requirements of 40 CFR 258.60. If a closure report has been submitted to the Director, no additional wastes may be placed into the landfill without filing a notification of modification as described under 40 CFR 60.7(a)(4).

(e) The permittee shall notify the Director of the awarding of contracts for the construction of the collection and control system or the order to purchase components for the system. This notification shall be submitted within 18 months after reporting an NMOC emission equal to or greater than 50 megagrams per year.

(f) The permittee shall also comply with the reporting requirements of Section I of this permit.

II.B.2.b **Condition:**

The permittee shall comply with all applicable requirements in 40 CFR 61, Subpart M - National Emission Standards for Asbestos. The permittee shall comply with the applicable General Provisions in 40 CFR 61 Subpart A – General Provisions. [Authority granted under 40 CFR 61.140 – 61.157; condition originated in 40 CFR 61 Subpart M]

The permittee shall meet one of the following requirements for all asbestos disposal operations at the landfill:

(a) there shall be no visible emissions to the outside air from any active waste disposal site where asbestos-containing waste material has been deposited,

(b) at the end of each operating day, or at least once every 24-hour period while the site is in continuous operation, the asbestos-containing waste material that has been deposited at the site during the operating day or previous 24-hour period shall:

(1) be covered with at least 15 centimeters (6 inches) of compacted non-asbestos-containing material, or

(2) be covered with a resinous or petroleum-based dust suppression agent that effectively binds dust and controls wind erosion. Such an agent shall be used in the manner and frequency recommended for the particular dust by the dust suppression agent manufacturer to achieve and maintain dust control. Other equally effective dust suppression agents may be used upon prior approval by the Director. For purposes of this paragraph, any used, spent, or other waste oil is not considered a dust suppression agent.

(c) use an alternative emissions control method that has received prior written approval by the U.S. Environmental Protection Agency (USEPA) according to the procedures described in 40 CFR 61.149(c)(2). [Authority granted under 40 CFR 61.154; condition originated in 40 CFR 61.154]

II.B.2.b.1 **Monitoring:**

If the permittee chooses to comply with the no visible emissions provisions of this condition, a visual opacity observation of each active asbestos disposal site shall be performed on a daily basis in accordance with 58 FR 61640 Method 203C.

If the permittee chooses to comply with the daily cover provisions of this condition, a visual inspection of the site(s) where asbestos containing waste material is deposited shall be conducted on the day of deposit to ensure that asbestos has been covered in accordance to (b)(1) above. Intermittent visual inspections at least once per week will be performed in order to verify the integrity of cover material, and compliance with this condition.

II.B.2.b.2 **Recordkeeping:**

If the permittee chooses to comply with the no visible emissions provisions of this condition, a log of the visual opacity observations shall be maintained as described in Provision S.1 in Section I of this permit. All data required by 40 CFR 60, Appendix A, Method 9 or 58 FR 61640, Method 203C shall also be maintained as described in Provision S.1 in Section I of this permit.

If the permittee chooses to comply with the daily cover provisions of this condition, results of the day of deposit and subsequent weekly visual inspections shall be recorded in a log and maintained as described in Provision S.1 in Section I of this permit.

II.B.2.b.3 **Reporting:**

There are no reporting requirements for this provision except those specified in Section I of this permit.

II.B.2.c **Condition:**

Unless a natural barrier adequately deters access by the general public, the permittee shall comply with one of the following:

(a) the fencing and warning sign requirements of 40 CFR 61.154 (b), or

(b) at the end of each operating day, or at least once every 24-hour period while the site is in continuous operation, the asbestos-containing waste material that has been deposited at the site during the operating day or previous 24-hour period shall be covered with at least 15 centimeters (6 inches) of compacted non-asbestos-containing material. [Authority granted under 40 CFR 61.154; condition originated in 40 CFR 61.154]

II.B.2.c.1 **Monitoring:**

If the permittee chooses to comply with the fencing and warning sign provisions of this condition, a visual inspection of the property line including all entrances to the site and/or sections of the site where asbestos containing waste material is deposited shall be conducted quarterly to verify compliance with the fencing and warning sign requirements of 40 CFR 61.154 (b)

If the permittee chooses to comply with the daily cover provisions of this condition, a visual inspection of the site(s) where asbestos containing waste material is deposited shall be conducted the day of deposit, and weekly thereafter to verify compliance with this condition.

II.B.2.c.2 **Recordkeeping:**

Results of all inspections shall be recorded in a log and maintained as described in Provision S.1 in Section I of this permit.

II.B.2.c.3 **Reporting:**

There are no reporting requirements for this provision except those specified in Section I of this permit.

II.B.2.d **Condition:**

The permittee shall maintain waste shipment records of all asbestos-containing waste material received. In addition to routine shipment-tracking information, the waste shipment records shall document instances of improperly enclosed or uncovered waste, or any asbestos-containing waste material not sealed in leak-tight containers. [Authority granted under 40 CFR 61.154 (e); condition originated in 40 CFR 61.154].

II.B.2.d.1 **Monitoring:**

Records required for this permit condition will serve as monitoring.

II.B.2.d.2 **Recordkeeping:**

For all asbestos-containing waste material received, the permittee shall maintain waste shipment records, using a form similar to that shown in 40 CFR 61.149, Figure 4, and include the following information:

(i) The name, address, and telephone number of the waste generator. Waste generator is defined as any owner or operator of a source covered by 40 CFR 61, Subpart M whose act or process produces asbestos-containing waste material.

(ii) The name, address, and telephone number of the transporter(s).

(iii) The quantity of the asbestos-containing waste material in cubic meters (cubic yards).

(iv) The presence of any improperly enclosed or uncovered waste, or any asbestos-containing waste material not sealed in leak-tight containers.

(v) The date of the receipt.

All Records shall be maintained as described in Provisions I.S.1 of this permit. (origin: 40 CFR 61.154(e))

II.B.2.d.3 **Reporting:**

As soon as possible and no longer than 30 days after receipt of the asbestos-containing waste material, the permittee shall send a copy of the signed waste shipment record to the waste generator. The permittee shall report in writing to the Director, by the following working day, the presence of a significant amount (either nine (9) or more drums/barrels (35 gallon each) or of seventeen (17) or more plastic bags) of improperly enclosed or uncovered waste and submit a copy of the waste shipment record along with the report.

Upon discovering a discrepancy between the quantity of waste designated on the waste shipment records and the quantity actually received, the permittee shall attempt to reconcile the discrepancy with the waste generator. If the discrepancy is not resolved within 15 days after receiving the waste, the permittee shall immediately submit a written report to the Director describing the discrepancy and attempts to reconcile it, and submit a copy of the waste shipment record along with the report. The permittee shall retain a copy of all records and reports required by this condition for at least 5 years. All reports shall be in accordance with Provision I.S.2 of this permit.

II.B.2.e **Condition:**

The permittee shall maintain, until closure, records of the location, depth and area, and quantity in cubic meters (cubic yards) of asbestos-containing waste material within the disposal site on a map or diagram of the disposal area. [Authority granted under 40 CFR 61.154 (f); condition originated in 40 CFR 61.154].

II.B.2.e.1 **Monitoring:**

Records required for this permit condition will serve as monitoring.

II.B.2.e.2 **Recordkeeping:**

Maintain, records of the location, depth and area, and quantity in cubic meters (cubic yards) of asbestos-containing waste material within the disposal site on a map or diagram of the disposal area. All Records shall be maintained as described in Provisions I.S.1 of this permit

II.B.2.e.3 **Reporting:**

Notify the Director in writing at least 45 days prior to excavating or otherwise disturbing any asbestos-containing waste material that has been deposited at a waste disposal site and is covered. If the excavation will begin on a date other than the one contained in the original notice, notice of the new start date must be provided to the Director at least 10 working days before excavation begins and in no event shall excavation begin earlier than the date specified in the original notification. Include the following information in the notice:

(1) Scheduled starting and completion dates.

(2) Reason for disturbing the waste.

(3) Procedures to be used to control emissions during the excavation, storage, transport, and ultimate disposal of the excavated asbestos-containing waste material. If deemed necessary, the Director may require changes in the emission control procedures to be used.

(4) Location of any temporary storage site and the final disposal site.

All reports shall be in accordance with Provision I.S.2 of this permit.

II.B.2.f **Condition:**

Upon closure of an asbestos-containing waste disposal site, the permittee shall submit a copy of records of asbestos waste disposal locations and quantities and shall:

(a) Comply with one of the following:

(1) Either discharge no visible emissions to the outside air from an inactive asbestos-containing waste disposal site or

(2) Cover the asbestos-containing waste material with at least 15 centimeters (6 inches) of compacted non-asbestos-containing material, and grow and maintain a cover of vegetation on the area adequate to prevent exposure of the asbestos-containing waste material. In desert areas where vegetation would be difficult to maintain, at least 8 additional centimeters (3 inches) of well-graded, non-asbestos crushed rock may be placed on top of the final cover instead of vegetation and maintained to prevent emissions; or

(3) Cover the asbestos-containing waste material with at least 60 centimeters (2 feet) of compacted non-asbestos-containing material, and maintain it to prevent exposure of the asbestos-containing waste; or

(4) For inactive waste disposal sites for asbestos tailings, a resinous or petroleum-based dust suppression agent that effectively binds dust to control surface air emissions may be used instead of the methods in paragraphs (a) (1), (2), and (3) of this section. Use the agent in the manner and frequency recommended for the particular asbestos tailings by the manufacturer of the dust suppression agent to achieve and maintain dust control. Obtain prior written approval of USEPA to use other equally effective dust suppression agents. For purposes of this paragraph, any used, spent, or other waste oil is not considered a dust suppression agent.

(b) Unless a natural barrier adequately deters access by the general public, install and maintain warning signs and fencing as follows, or comply with paragraph (a)(2) or (a)(3) of this condition:

(1) Display warning signs at all entrances and at intervals of 100 m (328 ft) or less along the property line of the site or along the perimeter of the sections of the site where asbestos-containing waste material was deposited. The warning signs must:

(i) Be posted in such a manner and location that a person can easily read the legend; and

(ii) Conform to the requirements for 51 cm×36 cm (20"×14") upright format signs specified in 29 CFR 1910.145(d)(4) and this paragraph; and

(iii) Display the following legend in the lower panel with letter sizes and styles of a visibility at least equal to those specified in this paragraph.

Legend	Notation
Asbestos Waste Disposal Site	2.5 cm (1 inch) Sans Serif, Gothic or Block
Do Not Create Dust	1.9 cm (3/4 inch) Sans Serif, Gothic or Block

Breathing Asbestos is Hazardous to Your Health	14 Point Gothic

Spacing between any two lines must be at least equal to the height of the upper of the two lines.

(2) Fence the perimeter of the site in a manner adequate to deter access by the general public.

(3) When requesting a determination on whether a natural barrier adequately deters public access, supply information enabling the Administrator to determine whether a fence or a natural barrier adequately deters access by the general public.

(c) In lieu of complying with the requirements of paragraph (a) or (b) of this condition, the permittee may use an alternative control method that has received prior approval of the USEPA. [Authority granted under 40 CFR 61.154 (g); condition originated in 40 CFR 61.151]

II.B.2.f.1 **Monitoring:**

A visual inspection of each closed site where asbestos containing waste material is deposited shall be conducted quarterly to verify compliance with all the requirements of 40 CFR 61.151.

II.B.2.f.2 **Recordkeeping:**

Results of all inspections shall be recorded in a log and maintained as described in Provision S.1 in Section I of this permit.

II.B.2.f.3 **Reporting:**

(a) Notify the Director in writing at least 45 days prior to excavating or otherwise disturbing any asbestos-containing waste material that has been deposited at a waste disposal site and is covered. If the excavation will begin on a date other than the one contained in the original notice, notice of the new start date must be provided to the Director at least 10 working days before excavation begins and in no event shall excavation begin earlier than the date specified in the original notification. Include the following information in the notice:

(1) Scheduled starting and completion dates.

(2) Reason for disturbing the waste.

(3) Procedures to be used to control emissions during the excavation, storage, transport, and ultimate disposal of the excavated asbestos-containing waste material. If deemed necessary, the Director may require changes in the emission control procedures to be used.

(4) Location of any temporary storage site and the final disposal site.

(b) Within 60 days of a site becoming inactive and after the effective date of this subpart, record, in accordance with State law, a notation on the deed to the facility property and on any other instrument that would normally be examined during a title search; this notation will in perpetuity notify any potential purchaser of the property that:

(1) The land has been used for the disposal of asbestos-containing waste material;

(2) The survey plot and record of the location and quantity of asbestos-containing waste disposed of within the disposal site required in 40 CFR 61.154(f) have been filed with the USEPA; and

(3) The site is subject to 40 CFR 61, Subpart M.

II.C **Emissions Trading**
(R307-415-6a(10))

Not applicable to this source.

II.D **Alternative Operating Scenarios.**
(R307-415-6a(9))

Not applicable to this source.

SECTION III: PERMIT SHIELD

III.A A permit shield was not granted for any specific requirements.

SECTION IV: ACID RAIN PROVISIONS

IV.A This source is not subject to Title IV. This section is not applicable.

REVIEWER COMMENTS

1. Comment on an item originating in 40 CFR 60.154 regarding Landfill: MSW Landfill (designated as Landfill)

   Definition of Significant Amount for asbestos shipments received: A significant amount of waste is hereby defined as one cubic meter of asbestos-containing waste material. Based on EPA standard conversion factors for typical asbestos-waste containers, one cubic meter of material is approximately equal to 9.8 drums or barrels (35 gallon each) or 17.4 plastic bags. [Last updated July 7, 2015]

2. Comment on an item originating in the 2004 Title V permit: Salting and Sanding Condition:

   The 2004 condition implied that the Landfill roads are exempt from the 92% minimum sodium chloride when applying salt to roads (R307-307-2). However, the rule states "any salt applied to roads in Salt Lake, Davis, or Utah Counties must be at least 92% sodium chloride [R307-307-2]. The permittee may demonstrate to the Board that the material applied has no more PM10 emissions than the 92% sodium chloride [R307-307-1(a)] OR they may vacuum sweep arterial roadways as outlined in R307-307-3(1)(b)." There was an error in reading the rule for an exclusion of salting requirements if a road was not an "arterial roadway." The salting requirements of R307-307-1 and R307-307-1(a) still must be upheld. [Last updated July 7, 2015]

3. Comment on an item originating in R307-205-5 regarding Municipal Solid Waste Landfill

   Fugitive dust: The requirement to minimize fugitive dust in condition II.B.1.a of this permit originates in R307-205-5. Although R307-1-4.5 (March 31, 1992) is the current Environmental Protection Agency (EPA)-approved State Implementation Plan (SIP) version of the rule, R307-205-5 is as stringent and is cited as the authority for the condition. [Last updated July 7, 2015]

4. Comment on an item originating in R307-415-4(3)(b) regarding Municipal Solid Waste Landfill

   Title V requirements for area sources: In accordance with the referenced rule, because the landfill is the emission unit that causes the permittee to be subject to the operating permit program, only requirements applicable to the landfill have been included in the permit. Any requirements applicable to emission units not directly related to the landfill have not been included. [Last updated July 7, 2015]

Solid Waste Permit
Bayview Landfill Permit

APPENDIX I

UTAH SOLID AND HAZARDOUS WASTE CONTROL BOARD
SOLID WASTE PERMIT RENEWAL

BAYVIEW
CLASS I LANDFILL

Pursuant to the provisions of the *Utah Solid and Hazardous Waste Act*, Title 19, Chapter 6, Part 1, Utah Code Annotated (UCA) 1953, as amended (the Act) and the *Utah Solid Waste Permitting and Management Rules*, Utah Administrative Code (UAC) R315-301 through 320 adopted thereunder,

South Utah Valley Solid Waste District as owner and operator

is hereby approved to operate the Bayview Class I Landfill located in Sections 17 & 18, Township 9 South, Range 1 West, Salt Lake Base and Meridian, Utah County, Utah as shown in the permit renewal application that was determined complete on October 27, 2009.

The operation of the landfill is subject to the conditions that South Utah Valley Solid Waste District (Permittee) meet the requirements of UAC R315-301 through 320 and the requirements set forth herein.

All references to UAC R315-301 through 320 are to regulations that are in effect on the date that this Permit becomes effective.

This Permit shall become effective May 1, 2010.

This Permit shall expire at midnight April 30, 2020.

Closure Cost Revision Date: May 1, 2015.

Signed this 21 day of April, 2010.

Original Document signed by Dennis R. Downs on 4/21/10

Dennis R. Downs, Executive Secretary
Utah Solid and Hazardous Waste Control Board

FACILITY OWNER/OPERATOR INFORMATION

LANDFILL NAME:	Bayview Class I Landfill
OWNER NAME:	South Utah Valley Solid Waste District
OWNER ADDRESS:	P.O. Box 507
OWNER PHONE NO.:	(801) 489-3027
TYPE OF PERMIT:	Class I Landfill
PERMIT NUMBER:	9420R2
LOCATION:	Landfill site is located in Township 9 South, Range 1West, Sections 17 and 18, SLMB; Utah County, Latitude 40º 02' 0", Longitude 111º 57' 30"
FACILITY ADDRESS:	10800 S. Utah State Route 68, Utah County (Approximately 6 miles north of Elberta, on the west side of State Route 68.)

PERMIT REQUIREMENTS

Permit as used in this document is defined in UAC R315-301-2(55).

The renewal application, *Draft Application for a Permit to Operate a Class I Landfill*, Tracking Number 2009.01105, as deemed complete on the date shown on the signature page of this Permit, is hereby incorporated by reference into this Solid Waste Permit and will be referred to as the permit application throughout this Permit. All representations made in the permit application are part of this Permit and are enforceable under UAC 315-301-5(2). The permit application will become part of the operating record of the Landfill. Where differences in wording exist between this Permit and the permit application, the wording of this Permit supersedes that of the permit application.

This Permit consists of the signature page, Facility Owner/Operator Information section, sections I through V, Appendix A, and the permit application as defined above.

The facility as described in this Permit consists of a heavy equipment maintenance building, staff break room, Cell 1 (closed), and Cell 2 (open and active). The facility has a compost operation site located east of Cell 2. The facility has two retention ponds both north of the compost location. One retention pond is designed to capture precipitation surface runoff from the compost pad. The other is duel-lined and is designed to capture any leachate from Cell 2.

By this Permit to own and operate, the Permittee is subject to the following conditions.

I. GENERAL COMPLIANCE RESPONSIBILITIES

A. General Operation

The Permittee shall operate the landfill in accordance with all applicable requirements of UAC R315-302 and 303, for a Class I landfill, that are in effect as of the date of this Permit unless otherwise noted in this Permit. Any permit noncompliance or noncompliance with any applicable portions of UCA 19-6-101 through 123 and applicable portions of UAC R315-301 through 320 constitutes a violation of the Permit or applicable statute or rule and is grounds for appropriate enforcement action, permit revocation, modification, or denial of a permit renewal application.

B. Acceptable Waste

This Permit is for the disposal of non-hazardous solid waste that may include municipal solid waste, commercial waste, industrial waste, construction/demolition waste, and special waste as allowed by UAC R315-315 and authorized in section III-I of this Permit and limited by this section. The Permittee may accept conditionally exempt small quantity generator hazardous waste as specified in UAC R315-303-4(7)(a)(i)(B) and PCB's as specified by UAC R315-315-7(2).

C. Prohibited Waste

No hazardous waste as defined by UAC R315-1 and R315-2 or PCB's as defined by UAC R315-301-2, except as allowed in Section IB (Acceptable Waste) of this Permit, may be accepted for treatment, storage, or disposal at the landfill. No regulated asbestos-containing may be accepted for treatment, storage, or disposal.

No containers larger than household size (five gallons) holding any liquid, non-containerized material containing free liquids or any waste containing free liquids in containers larger than five gallons.

Any prohibited waste received and accepted for disposal at the facility will constitute a violation of this Permit, of UCA 19-6-101 through 123 and of UAC R315-301 through 320.

D. Inspections and Inspection Access

The Permittee shall allow the Executive Secretary of the Utah Solid and Hazardous Waste Control Board or an authorized representative of the Board, or representatives from the Utah County Health Department, to enter at reasonable times and:

1. Inspect the landfill or other premises, practices or operations regulated or required under the terms and conditions of this Permit or UAC R315-301 through 320;

2. Have access to and copy any records required to be kept under the terms and conditions of this Permit or UAC R315-301 through 320;

3. Inspect any loads of waste, treatment facilities or processes, pollution management facilities or processes, or control facilities or processes required under this Permit or regulated under UAC R315-301 through 320; and

4. Create a record of any inspection by photographic, videotape, electronic, or any other reasonable means.

E. Noncompliance

If monitoring, inspection, or testing indicates that any permit condition or any applicable rule under UAC R315-301 through 320 may be or is being violated, the Permittee shall promptly make corrections to the operation or other activities to bring the facility into compliance with all permit conditions or rules.

In the event of any noncompliance with any permit condition or violation of an applicable rule, the Permittee shall promptly take any feasible action reasonably necessary to correct the noncompliance or violation and mitigate any risk to the human health or the environment. Actions may include eliminating the activity causing the noncompliance or violation and containment of any waste or contamination using barriers or access restrictions, placing of warning signs, or permanently closing areas of the facility.

The Permittee shall: document the noncompliance or violation in the operating record on the day the event occurred or the day it was discovered; notify the Executive Secretary of the Solid and Hazardous Waste Control Board by telephone within 24 hours or the next business day following documentation of the event; and give written notice of the noncompliance or violation and measures taken to protect public health and the environment within seven days of Executive Secretary notification.

Within thirty days of the documentation of the event, the Permittee shall submit to the Executive Secretary a written report describing the nature and extent of the noncompliance or violation and the remedial measures taken or to be taken to protect human health and the environment and to eliminate the noncompliance or violation. Upon receipt and review of the assessment report, the Executive Secretary may order the Permittee to perform appropriate remedial measures including development of a site remediation plan for approval by the Executive Secretary.

In an enforcement action, the Permittee may not claim as a defense that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with UAC R315-301 through 320 and this Permit.

Compliance with the terms of this Permit does not constitute a defense to actions brought under any other local, State, or Federal laws. This Permit does not exempt the Permittee from obtaining any other local, State or Federal permits or approvals required for the facility operation.

The issuance of this Permit does not convey any property rights, other than the rights inherent in this Permit, in either real or personal property, or any exclusive privileges other than those inherent in this Permit. Nor does this Permit authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations including zoning ordinances.

The provisions of this Permit are severable. If any provision of this Permit is held invalid for any reason, the remaining provisions shall remain in full force and effect. If the application of any provision of this Permit to any circumstance is held invalid, its application to other circumstances shall not be affected.

F. <u>Revocation</u>

This Permit is subject to revocation if any condition of this Permit is not being met. The Permittee will be notified in writing prior to any proposed revocation action and such action will be subject to all applicable hearing procedures established under UAC R315-12 and the *Utah Administrative Procedures Act.*

Revocation of this Permit does not revoke the financial assurance established for closure and post-closure care of the facility, nor remove any responsibility on the part of the Permittee for completion of closure and post-closure care for the facility required in UAC R315-302-3.

Revocation of this Permit will necessitate that the Executive Secretary exercise the option to require the funds or other mechanism provided for financial assurance for completion of closure and post-closure care for the facility required in UAC R315-302-3 be called.

G. Attachment Incorporation

Attachments to the permit application are incorporated by reference into this Permit and are enforceable conditions of this Permit, as are documents incorporated by reference into the attachments. Language in this Permit supersedes any conflicting language in the attachments or documents incorporated into the attachments.

II. DESIGN AND CONSTRUCTION

A. Design and Construction

The Permittee shall construct any landfill cell, sub-cell, run-on diversion system, runoff containment system, waste treatment facility, or final cover in accordance with the alternative design submitted as part of the permit application and in accordance with the Utah Solid Waste Permitting and Management Rules (UAC R315-301 thru 320). Prior to construction of any landfill cell, sub-cell, engineered control system, waste treatment facility, or final cover the Permittee shall submit construction design drawings and a Construction Quality Control and Construction Quality Assurance (CQC/CQA) Plan to the Executive Secretary for approval. Buildings do not require approval. The Permittee shall construct any landfill cell, sub-cell, cell liner, engineered control system, waste treatment facility, and the final cover in accordance with the design drawings and CQC/CQA Plans submitted and approved by the Executive Secretary.

Subsequent to construction the Permittee shall notify the Executive Secretary of completion of construction of any landfill cell, sub-cell, engineered control system, waste treatment facility, or final cover. Landfill cells may not be used for treatment or disposal of waste until all CQC/CQA documents and construction related documents including as-builts are approved by the Executive Secretary. The Permittee shall submit as-built drawings for each construction event that are signed and sealed by an engineer registered in the State of Utah.

The Permittee shall notify the Executive Secretary of any proposed incremental closure, placement of any part of the final cover, or placement of the full final cover. Construction of any portion of the final cover shall be considered as a separate construction event and shall be approved separately from any other construction or expansion of the landfill. Design approval must be received from the Executive Secretary prior to construction and must be accompanied by a CQC/CQA Plan, for each construction season where incremental or final closure is performed.

A qualified party, independent of the owner shall perform the quality assurance function on liner components, cover components, and other testing as required by the approved CQC/CQA Plan. The results must be submitted as part of the as-built drawings to the Executive Secretary.

All engineering drawings submitted to the Executive Secretary must be stamped and approved by a professional engineer with a current registration in Utah.

If ground water is encountered during excavation of the landfill, the Executive Secretary shall be notified immediately, and a contingency plan implemented or alternative construction design developed and submitted for approval.

B. Run-On Control

Drainage channels and diversions shall be constructed as specified in the permit application and maintained at all times to effectively prevent runoff from the surrounding area from entering the landfill.

C. Alternative Design

This facility has demonstrated through geologic, hydrogeologic, climatic, waste stream, and other factors that the landfill will not contaminate ground water and is approved for the alternative design as outlined in the permit application. Any contamination of ground water resulting from operation of the landfill may result in the revocation of this alternative design approval. The basis for approval of the alternative design is found in the "Alternative Design Statement of Basis" found in Appendix A of this Permit.

III. LANDFILL OPERATION

A. Operations Plan

The Operations Plan included in the permit application and the solid waste permit issued by the Executive Secretary shall be kept onsite at the landfill or at the location designated in section III-K of this Permit. The landfill shall be operated in accordance with the operations plan as included in the permit application. If necessary, the facility owner may modify the Operations Plan, provided that the modification meets all of the requirements of UAC R315-301 through 320, is as protective of human health and the environment as that approved in the permit application, and is approved by the Executive Secretary as a minor modification under UAC R315-311-2(1)(a)(xiii). Any modification to the Operations Plan shall be noted in the operating record.

Any modification to the operations plan must be submitted to the Executive Secretary for approval and is considered a minor permit modification in compliance with UAC R315-311-2(1)(a)(xiii) unless the Executive Secretary determines the change should be subject to public comment under UAC R315-311-2(1)(b).

B. Security

The Permittee shall operate the Landfill so that unauthorized entry to the facility is restricted. All facility gates and other access routes shall be locked during the time the landfill is closed. At least one person employed by the Permittee shall be at the landfill during all hours that the landfill is open. Fencing and any other access controls as shown in the permit application shall be constructed to prevent access of persons or livestock by other routes.

C. Training

Permittee shall provide training for on-site personnel in landfill operation, including waste load inspection, hazardous waste identification, and personal safety and protection.

D. Burning of Waste

Intentional burning of solid waste is prohibited and is a violation of UAC R315-303-4(2)(b). All accidental fires shall be extinguished as soon as reasonably possible.

E. Daily Cover

The solid waste received at the landfill shall be completely covered at the end of each working day with a minimum of six inches of earthen material.

An alternative daily cover material may be used when the material meets the requirements of UAC R315-303-4(4)(b) through (d) or when the alternative daily cover meets the requirement of UAC R315-303-4(4)(e).

An alternative daily cover material is approved and consists of oversized wood chips sufficient to prevent refuse from being blown away for a 24-hour period The facility shall also meet the following requirements:

1. Apply daily cover (min. 6 inches of soil) at the end of each week.

2. Apply standard daily cover if weather conditions (e.g., wind, rain, etc.) prevent the proper use and application of alternate daily cover.

Permission to use alternative daily cover may be rescinded or amended if the requirements to prevent blowing debris, minimize access to the waste by vectors, minimize the threat of fires at the open face, minimize odors, or shed precipitation are not met, or if necessary to prevent nuisance conditions or adverse impacts to human health and or the environment.

F. Ground Water Monitoring

The Permittee shall monitor the ground water underlying the landfill in accordance with the Ground Water Monitoring Plan and the Ground Water Monitoring Quality Assurance/Quality Control Plan contained in the permit application. If necessary, the facility owner may modify the Ground Water Monitoring Plan and the Ground Water Monitoring Quality Assurance/Quality Control Plan, provided that the modification meets all of the requirements of UAC R315-301 through 320 and is as protective of human health and the environment as that approved in the permit application, and is approved by the Executive Secretary as a minor modification under UAC R315-311-2(1)(a). Any modification to the Ground Water Monitoring Plan and the Ground Water Monitoring Quality Assurance/Quality Control Plan shall be noted in the operating record. Plan changes that are found by the Executive Secretary to be less protective of human health or the environment than the approved plan are a major modification and are subject to the requirements of UAC R315-311.

G. Gas Monitoring

The Permittee shall monitor explosive gases at the landfill in accordance with the Gas Monitoring Plan contained in the permit application and shall otherwise meet the requirements of UAC R315-303-3(5). If necessary, the Permittee may modify the Gas Monitoring Plan, provided that the modification meets all of the requirements of UAC R315-301 through 320 and is as protective of human health and the environment as that approved in the permit application, and is approved by the Executive Secretary as a minor modification under UAC R315-311-2(1). Any modification to the Gas Monitoring Plan shall be noted in the operating record.

If the concentrations of explosive gases at any of the facility structures, at the property boundary, or beyond the property boundary ever exceed the standards set in UAC R315-303-2(2)(a), the Permittee shall immediately take all necessary steps to ensure protection of human health and notify the Executive Secretary. Within seven days of detection, place in the operating record the explosive gas levels detected and a description of the immediate steps taken to protect human health. Implement a remediation plan that meets the requirements of UAC R315-303-3(5)(b) and shall submit the plan to, and receive approval from, the Executive Secretary prior to implementation.

H. Waste Inspections

The Permittee shall visually inspect incoming waste loads to verify that no wastes other than those allowed by this permit are disposed in the landfill. A complete waste inspection shall be conducted at a minimum frequency of 1 % of incoming loads, but no less than one complete inspection per day. Loads to be inspected are to be chosen on a random basis.

All loads suspected or known to have one or more containers capable of holding more than five gallons of liquid shall be inspected to assure that each container is empty.

All loads that the operator suspects may contain a waste not allowed for disposal at the landfill shall be inspected.

Complete random inspections shall be conducted as follows:

1. The operator shall conduct the random waste inspection at the transfer station, working face, or an area designated by the operator.
2. Loads subjected to complete inspection shall be unloaded at the designated area;
3. Loads shall be spread by equipment or by hand tools;
4. A visual inspection of the waste shall be conducted by personnel trained in hazardous waste recognition and recognition of other unacceptable waste; and

5. The inspection shall be recorded on the waste inspection form found in the permit application. The form shall be placed in the operating record at the end of the operating day.

I. Disposal of Special Wastes

If loads of incinerator ash are accepted for disposal it shall be transported in such a manner to prevent leakage or the release of fugitive dust. The ash shall be completely covered with a minimum of six inches of material, or use other methods or material, if necessary, to control fugitive dust. Ash may be used for daily cover when its use does not create a human health or environmental hazard.

Animal carcasses may be disposed in the landfill working face and must be covered with other solid waste or earth by the end of the operating day in which they are received. Alternatively, animal carcasses may be disposed in a special trench or pit prepared for the acceptance of dead animals. If a special trench is used, animals placed in the trench shall be covered with six inches of earth by the end of each operating day.

J. Self Inspections

The Permittee shall inspect the facility to prevent malfunctions and deterioration, operator errors, and discharges that may cause or lead to the release of wastes or contaminated materials to the environment or create a threat to human health or the environment. These general inspections shall be completed no less than quarterly and shall cover the following areas: Waste placement, compaction, cover; cell liner; leachate collection system; fences and access controls; roads; run-on/run-off controls; ground water monitoring wells; final and intermediate cover; litter controls; and records. A record of the inspections shall be placed in the daily operating record on the day of the inspection. Areas needing correction, as noted on the inspection report, shall be corrected in a timely manner. The corrective actions shall be documented in the daily operating record.

K. Recordkeeping

The Permittee shall maintain and keep on file at the heavy equipment maintenance building, a daily operating record and other general records of landfill operation as required by UAC R315-302-2(3). The landfill operator, or other designated personnel, shall date and sign the daily operating record at the end of each operating day. Each record to be kept shall contain the signature of the appropriate operator or personnel and the date signed.

1. The daily operating record shall include the following items:

   a. The number of loads of waste received each day of operation and recorded at the end of each operating day. Waste weights will be recorded at the transfer station;

   b. Major deviations from the approved plan of operation recorded at the end of the operating day the deviation occurred;

   c. Results of other monitoring required by this Permit recorded in the operating record on the day of the event or the day the information is received;

   d. Records of all inspections conducted by the Permittee, results of the inspections, and corrective actions taken shall be recorded in the record on the day of the event.

2. The general record of landfill operations shall include the following items:

   a. A copy of this Permit including the permit application;

   b. Results of inspections conducted by representatives of the Utah Solid and Hazardous Waste Control Board and/or representatives of the Utah County Health Department, when forwarded to the Permittee;

   c. Closure and Post-closure care plans;

   d. Records of employee training; and

   e. Results of groundwater monitoring; and

   f. Results of landfill gas monitoring.

L. <u>Reporting</u>

The Permittee shall prepare and submit, to the Executive Secretary, an Annual Report as required in UAC R315-302-2(4). The Annual Report shall include: the period covered by the report, the annual quantity of waste received, an annual update of the financial assurance mechanism, a re-application for approval of the financial assurance mechanism, any leachate analysis results, all ground water monitoring results, the statistical analysis of ground water monitoring results, the results of gas monitoring, the quantity of leachate pumped, and all training programs completed.

M. Roads

All access roads, within the landfill boundary, used for transporting waste to the landfill for disposal shall be improved and maintained as necessary to assure safe and reliable all-weather access to the disposal area.

IV. CLOSURE REQUIREMENTS

A. Closure

Final cover of the landfill shall be as shown in the permit application. The final cover shall meet, at a minimum, the standard design for closure as specified in the UAC (R315-303-3(4)) plus sufficient cover soil or equivalent material to protect the low permeability layer from the effects of frost, desiccation, and root penetration. A quality assurance plan for construction of the final landfill cover shall be submitted to, and approval of the plan must be received from the Executive Secretary prior to construction of any part of the final cover at the landfill. A qualified person not affiliated with the landfill owner shall perform permeability testing on the recompacted clay placed as part of the final cover.

This facility has demonstrated through geologic, hydrogeologic, climatic, waste stream, cover material properties, infiltration factors, and other factors that the landfill will not contaminate ground water and is approved for the alternative cover design as outlined in the permit application. Any contamination of ground water resulting from the landfill may result in the revocation of this alternative cover design approval and placement of a cover design meeting the requirements of UAC R315-303-3(4)(a) or other remedial action as required by the Executive Secretary. The basis for approval of the alternative cover design is found in the "Alternative Design Statement of Basis" in Appendix A of this Permit.

B. Title Recording

The Permittee shall meet the requirements of UAC R315-302-2(6) by recording with the Utah County Recorder as part of the record of title that the property has been used as a landfill. The recording shall include waste locations and waste types disposed.

C. Post-Closure Care

Post-closure care at the closed landfill shall be done in accordance with the Post-Closure Care Plan contained in the permit application. Post-closure care shall continue until all waste disposal sites at the landfill have stabilized and the finding of UAC R315-302-3(7)(c) is made.

D. Financial Assurance

The Permittee shall keep in effect and active the currently approved financial assurance mechanism or another mechanism that meets the requirements of UAC R315-309 to cover the costs of closure and post-closure care at the landfill. The financial assurance mechanism(s) shall be adequately maintained to provide for the cost of closure at any stage or phase or anytime during the life of the landfill or the permit life, whichever is shorter.

With each annual revision of the closure and post-closure care cost estimate, the annual payments to be made to the trust fund shall be determined by the following formula:

$$NP=[CE-CV]/Y$$

where NP is the next payment, CE is the current cost estimate for closure and post-closure care (updated for inflation or other changes), CV is the current value of the trust fund, and Y is the number of years remaining in the pay-in period.

E. Financial Assurance Annual Update

An annual revision of closure and post-closure costs for inflation and financial assurance funding as, required by R315-309-2(2), shall be submitted to the Executive Secretary as part of the annual report.

F. Closure Cost and Post-Closure Cost Revision

The Permittee shall submit a complete revision of the closure and post-closure cost estimates by the date listed on the signature page of this Permit, any time the facility is expanded, any time a new cell is constructed, or any time a cell is expanded.

V. ADMINISTRATIVE REQUIREMENTS

A. Permit Modification

Modifications to this Permit may be made upon application by the Permittee or by the Executive Secretary. The Permittee will be given written notice of any permit modification initiated by the Executive Secretary.

B. Permit Transfer

This Permit may be transferred to a new permittee or new permittees by meeting the requirements of the permit transfer provisions of UAC R315-310-11.

C. Expansion

This Permit is for a Class I Landfill. The permitted landfill must operate according to the design and Operation Plan described and explained in the permit application. Any expansion of the current footprint designated in the description contained in the permit application, but within the property boundaries designated in the permit application, will require submittal of plans and specifications to the Executive Secretary. The plans and specifications must be approved by the Executive Secretary prior to construction.

Any expansion of the landfill facility beyond the property boundaries designated in the description contained in the permit application will require submittal of a new permit application in accordance with the requirements of UAC R315-310.

Any addition to the acceptable wastes described in Section 1B will require submittal of all necessary information to the Executive Secretary and the approval of the Executive Secretary. Acceptance for PCB bulk product waste under UAC R315-315-7(3)(b) can only be done after submittal of the required information to the Executive Secretary and modification of Section IC of this Permit.

D. Expiration

Application for permit renewal shall be made at least six months prior to the expiration date, as shown on the signature (cover) page of this Permit. If a timely renewal application is made and the permit renewal is not complete by the expiration date, this Permit will continue in force until renewal is completed or denied.

Attachment A

Alternative Design Statement of Basis

State of Utah

Department of
Environmental Quality

Dianne R. Nielson, Ph.D.
Executive Director

DIVISION OF SOLID AND
HAZARDOUS WASTE
Dennis R. Downs
Director

JON M. HUNTSMAN, JR.
Governor

GARY HERBERT
Lieutenant Governor

October 27, 2005

Richard J. Henry, District Manager
South Utah Valley Solid Waste District
P.O. Box 507
Springville, Utah 84663

Subject: Bayview Class I Landfill Construction Approval of Alternative Final Cover of Cell 1

Dear Mr. Henry:

The Division of Solid and Hazardous Waste received the report entitled, *Bayview Landfill: Cell 1 Closure Documents*, on September 30, 2005. Based on our review of your revised Permit Application (dated March 8, 2004) and the September 30, 2005 report that includes your CQA/CQC plan, you are approved to construct the evaporative cover. This approval is based on construction of the cover design contained in the current permit #9420R1. Areas of concern during construction and post-construction maintenance are optimum soil compaction, erosion prevention measures, and other soil evaporative cover-related issues.

When construction gets underway, please ensure that your Construction Quality Assurance personnel on site provide daily records of field tests, such as soil compaction, and that they keep our office apprised of the various phases and construction progress being made. During the construction of the final cover for Cell 1, periodic inspections may be conducted. Personnel from the Division of Solid and Hazardous Waste and/or the Utah County Health Department may conduct these inspections to assess compliance with all conditions of your permit and the *Bayview Landfill: Cell 1 Closure Documents.*

If you have questions, please contact Matt Sullivan or Ralph Bohn at 801-538-6170.

Sincerely,

Original Document signed by Scott T. Anderson for Dennis R. Downs on 10/27/05

Dennis R. Downs, Executive Secretary
Utah Solid and Hazardous Waste Control Board

DRD/MS/kk

c: Joseph K. Miner, M.D., M.S.P.H., Director, Utah County Health Department
Terry Warner, Project Engineer, HDR Engineering, Inc.

File: Bayview Landfill
Permit TN201000327att.doc

288 North 1460 West • PO Box 144880 • Salt Lake City, UT 84114-4880 • phone (801) 538-6170 • fax (801) 538-6715
T.D.D. (801) 536-4414 • *www.deq.utah.gov*

APPENDIX I

RECEIVED
MAR 3 0 2009
UTAH DIVISION OF
SOLID & HAZARDOUS WASTE

2009.01105

Draft Application for a Permit to Operate a Class I Landfill

SUVSWD Bayview Class I Landfill Permit Application

Prepared for
Bayview Landfill
South Utah Valley Solid Waste District
Springville, Utah

Prepared by
HDR Engineering, Inc.
3995 South 700 East, Suite 100
Salt Lake City, UT 84107

March 19, 2009

SUVSWD Bayview Landfill
Class I Landfill Permit Application

Table of Contents

Part 4: Figures

List of Appendices

Part 1: General Information

Utah Class I and V Landfill Permit Application Form

<table>
<tr><td colspan="8"><i>Part I</i> General Information</td></tr>
<tr><td colspan="4"><i>I.</i> Landfill Type: Class I</td><td colspan="4"><i>II.</i> Application Type: Renewal Application</td></tr>
<tr><td colspan="8">Current Permit Number: 9420R1</td></tr>
<tr><td colspan="8"><i>III.</i> Facility Name and Location</td></tr>
<tr><td colspan="8">Legal Name of Facility: Bayview Landfill</td></tr>
<tr><td colspan="6">Site Address: 10800 S. State Road 68</td><td colspan="2">County: Utah</td></tr>
<tr><td colspan="2">Township 9 South</td><td colspan="2">Range 1 West</td><td colspan="4">All of Section 17 plus the S ½ of the SE ¼ of the NE ¼ of Section 18</td></tr>
<tr><td>Main Gate Latitude
North</td><td>degrees
40</td><td>minutes
02</td><td>seconds
00</td><td>Longitude
West</td><td>degrees
111</td><td>minutes
57</td><td>seconds
30</td></tr>
<tr><td colspan="8"><i>IV.</i> Facility Lessee and Operator Information</td></tr>
<tr><td colspan="8">Legal Name of Lessee and Operator: South Utah Valley Solid Waste District</td></tr>
<tr><td colspan="8">Address (mailing): PO Box 507</td></tr>
<tr><td colspan="2">City: Springville</td><td colspan="2">State: Utah</td><td colspan="2">Zip Code: 84663-0507</td><td colspan="2">Telephone: 801-489-3027</td></tr>
<tr><td colspan="8"><i>V.</i> Property Owner(s) Information</td></tr>
<tr><td colspan="8">Legal Name of Property Owner: Utah School and Institutional Trust Lands Administration</td></tr>
<tr><td colspan="8">Address (mailing): 675 East 500 South, Suite 500</td></tr>
<tr><td colspan="2">City: Salt Lake City</td><td colspan="2">State: Utah</td><td colspan="2">Zip Code: 84102-2818</td><td colspan="2">Telephone: 801-538-5100</td></tr>
<tr><td colspan="8"><i>VI.</i> Contact Information</td></tr>
<tr><td colspan="6">Operator Contact: Richard Henry</td><td colspan="2">Title: District Manager</td></tr>
<tr><td colspan="8">Address (mailing): PO Box 507</td></tr>
<tr><td colspan="2">City: Springville</td><td colspan="2">State: Utah</td><td colspan="2">Zip Code: 84663-0507</td><td colspan="2">Telephone: 801-489-3027</td></tr>
<tr><td colspan="4">Operator Contact: Scott Aitken</td><td colspan="4">Title: Landfill Foreman</td></tr>
<tr><td colspan="8">Address (mailing): PO Box 507</td></tr>
<tr><td colspan="2">City: Springville</td><td colspan="2">State: Utah</td><td colspan="2">Zip Code: 84663-0507</td><td colspan="2">Telephone: 801-489-3027</td></tr>
</table>

Certification of Submitted Information

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name: Richard Henry Title: District Manager

Signature: Date:

SUBSCRIBED AND SWORN to before this ________ day of _______________, 2009.

My commission expires on the ________ day of _______________, 20___.

Notary Public in and for

(Seal) ____________County, Utah

Part 2: General Report

2.1 Facility Description

2.1.1 General

The South Utah Valley Solid Waste District (the District) was formed in 1989 to own and operate solid waste facilities for the cities of Provo, Salem, Spanish Fork, Springville, Mapleton, and Goshen, Utah. It assumed the existing and previously permitted landfill operations from the City of Provo. Solid waste facilities operated by the District are:

- A transfer station located in Springville;
- The Bayview Landfill located north of Elberta.

A separate, non-District-owned transfer station in Goshen also provides waste to the Bayview Landfill. This Permit Application applies only to the landfill, and does not include design, construction, or operation plans of the transfer stations.

The District added a compost facility at the Bayview Landfill in 2004. The compost facility processes a combination of yard waste and biosolids and is jointly permitted through the Division of Solid and Hazardous Waste and the Division of Water Quality. The Operating Plan for the compost facility is included as Appendix R to this Permit Application.

The Bayview Landfill was located, permitted, designed, and constructed by Provo City Corporation during the 1980s. The City received a Conditional Use Permit for the landfill site through the Utah County Board of Adjustment. Several conditions were attached to the Conditional Use Permit, one of which requires that only compacted or baled garbage be accepted at the landfill. A second of these conditions permits disposal of garbage from Provo City Corporation only; this condition was later modified to allow disposal of garbage from the District only. Therefore, no out-of-District wastes can be disposed of in the Bayview Landfill without approval of the County Board of Adjustment. A copy of the District's Conditional Use Permit is included as an attachment to Appendix S.

The Bayview Landfill is located in Sections 17 and 18, T9S, R1W approximately 6 miles north of Elberta, Utah, and directly west of State Highway 68. The landfill property includes all 640 acres of Section 17, and a 20-acre parcel in Section 18. All solid waste disposal activities are planned within the Section 17 parcel; the 20-acre Section 18 parcel houses a culinary well, a water storage tank, and an upgradient monitoring well associated with the landfill operations.

The Bayview Landfill site is located in the Goshen Valley approximately 2 to 3 miles west of Goshen Bay, the southwestern-most portion of Utah Lake. The Goshen Valley slopes upward away from the lake toward the East Tintic Mountains some 7 miles southwest of the lake. The landfill site similarly slopes with an approximate 150-foot rise from the eastern to the western boundaries of Section 17. The eastern boundary of the landfill site is approximately 120 feet above the current water elevation of Utah Lake.

The land use surrounding the site is generally rural agricultural, with orchard, grain, hay, and livestock grazing as the predominant land uses in the vicinity of the site. The nearest residence is located more than 1 mile from the northern property boundary, and the nearest town, Elberta, is 5.5 miles south of the site.

2.1.2 Area Served

The service area for the Bayview Landfill includes the cities of Provo, Salem, Spanish Fork, Springville, Mapleton, Goshen, and some contiguous areas. As stated above, the landfill's Conditional Use Permit prohibits it from receiving wastes generated outside of the District service area. The landfill is also prohibited from receiving wastes that have not been compacted or baled. These prohibitions limit the landfill's ability to accept wastes from other areas of the County or adjoining counties. The conditions also prohibit use by the general public.

2.1.3 Waste Types

The Bayview Landfill accepts wastes from the District's transfer station in Springville and a city-owned transfer station in Goshen. The transfer stations provide record keeping, screening and compacting of incoming wastes, and shipping of the solid wastes to the Bayview Landfill. The transfer stations accept residential and commercial solid wastes, including yard wastes, but generally do not accept construction debris (C&D) wastes. The transfer stations also do not accept regulated hazardous wastes. The screening of the wastes at the transfer stations is not covered by this permit application.

Yard wastes arriving at the transfer stations may either be segregated for composting, or commingled and compacted with the residential and commercial wastes for compacting and disposal. Transfer station personnel make these decisions based on the quantity and ease of separation of the yard wastes, and the workload at the specific moment in time. Yard wastes that are segregated will be transferred to the closed Spanish Fork Landfill for grinding and then transferred to the compost facility at the Bayview Landfill.

The wastes accepted at the transfer stations are generally compacted, loaded into over-the-road vehicles, and transported to the landfill for disposal. When transfer station staff observe recyclable materials, and when there is time to easily and safely remove the recyclable materials, they will segregate these materials into on-site dumpsters for recycling.

Table 1-1 provides a summary of the quantity of wastes disposed of at the Bayview Landfill since it began operation in February 1991. The data reflects actual quantities shipped from the transfer stations during each fiscal year (July 1 through June 30).

Table 1-1: Tonnage Disposed at the Bayview Landfill

Year	Actual Tonnage
90-91	32,713
91-92	82,841
92-93	92,045
93-94	96,899
94-95	106,641
95-96	105,746
96-97	108,305
97-98	119,391
98-99	126,661
99-00	124,286
00-01	127,031
01-02	126,664
02-03	130,521
03-04	131,689
04-05	136,940
05-06	141,047
06-07	149,499
07-08	146,509

2.1.4 Landfill Development

Landfill Cell 1 reached capacity and Cell 2 – Stage 1 began receiving waste during fiscal year 2004. The landfill is currently placing waste in Cell 2 – Stage 1 and expects to reach capacity by the end of 2009, at which time Cell 2 – Stage 2 will begin receiving waste. Excavation of Cell 2 – Stage 2 is currently ongoing. Part 3 of this Permit Application describes the landfill staging plan.

The District has produced three master plans to guide development of the Bayview Landfill. The initial Landfill Master Plan (HDR, 1988) projected seven separate cells with a total waste disposal capacity of 7.64 million tons at the Bayview Landfill. This capacity was calculated based on a conservative in-place density of 1,000 pounds of solid waste per cubic yard (lbs/cy). The current in-place density based on known weights and surveyed volumes is approximately 1,500 lbs/cy, thereby increasing the capacity of the 7-cell plan by 50%. The Bayview Landfill Master Plan Update (HDR, 2002) considered several scenarios to utilize the airspace and footprint of Cells 2 and 3 more efficiently. The selected scenario combined Cells 2 and 3 into a single landfill Cell, deepened the excavation, and decreased the elevation of the liner requiring pumping of generated leachate.

A revised Cell 2 Master Plan (HDR, 2008; Appendix A) evaluated changes to the base grade of Cell 2 to further increase capacity. The Cell 2 Master Plan revised the base grade of Stage 2 to a 2% slope down to the northeast on the western portion of Stage 2, and a 2% slope down to the southeast on the eastern portion of Stage 2. This increased the capacity of Stage 2 to 2,300,000 cy, and the total capacity of Cell 2 to approximately 8,460,000 cy, with 7,800,000 cy remaining as of February 2009. At 1,500 lbs/cy, this equates to about a total capacity of 6,345,000 tons, with 5,900,000 tons remaining.

Since Cell 2 is expected to remain active through approximately 2032, it is not timely to revise the master plan for the remainder of the Bayview Landfill. However, it is expected that a revised master plan would more than double the capacity calculated in the 1988 Landfill Master Plan, yielding a total capacity of more than 20 million tons. This means that the Bayview Landfill has an expected useful lifetime of more than 50 years from the date of this Permit Application.

2.2 Solid Waste Management Plan

During 1992, the District participated in the development of the Utah County Solid Waste Management Plan (SWMP). The SWMP was developed in response to Senate Bill 255 to address county-wide planning for solid waste disposal over the next 20-year period. Two copies of this SWMP have previously been submitted to the Utah Division of Solid and Hazardous Waste. All of the activities discussed in this permit application were anticipated in, and are consistent with, the SWMP.

In addition, the District has prepared a Landfill Master Plan (HDR, 1988), a Bayview Landfill Master Plan Update (HDR, 2002), and a Cell 2 Master Plan (HDR, 2009) to guide development of the Bayview Landfill site. A copy of the most recent plan, the Cell 2 Master Plan is attached to this application as Appendix A.

2.3 Legal Description

The Bayview Landfill consists of the following parcels:

- Parcel "A": SW1/4 NW1/4 Section 17, T9S, R1W.
- Parcel "B": That portion of Section 17, T9S, R1W not described in Parcel "A. "
- Parcel "C": S1/2 of the SE1/4 of the NE1/4, Section 18, T9S, R1W.

This land was conveyed by the Utah Division of State Lands to the Provo City Corporation for a term of 51 years under Special Use Lease Agreement No. 498 (Appendix B). The term of this lease agreement extends through the year 2035. The lease agreement contains a clause for extension of the lease beyond the 51-year period.

2.4 Operations Plan

The two Operating Plans relevant to the Bayview Landfill site are presented in the Appendices to this Permit Application. Appendix S presents the current Landfill Operating Plan, while Appendix R presents the current Compost Facility Operating Plan.

2.5 Financial Assurance Plan

2.5.1 Cost Estimate for Closure and Post-Closure Care

Federal and State of Utah Rules and Regulations require that the owners of municipal solid waste landfills demonstrate the financial capability to conduct closure, post-closure care, and corrective action (if necessary). To meet these requirements, the owner must place in the operating record for the landfill an estimate of the cost of hiring a third party to perform closure, post-closure care, or corrective action. In addition, the owner must demonstrate that the funding is fully available for any year after 2009 to provide for closure, post-closure care, and corrective action for landfill cells that may require closure, post-closure care, or corrective action within the five year period between permit revisions. Both the cost estimate and the funding mechanism must be updated on an annual basis.

The regulations allow six different funding mechanisms to demonstrate financial assurance including: trust funds, surety bonds, insurance, letters of credit, local government financial tests, or local government guarantees. These funding mechanisms may be used individually or in combination with one another to demonstrate financial assurance. The regulations define specific requirements for each funding mechanism.

Appendix C contains an estimate of the costs for post-closure care of Cell 1 and closure and post-closure care of Cell 2 – Stage 1 and Stage 2 at the Bayview Landfill. Landfill Cell 2 – Stage 2 will remain active beyond the period covered by this permit application. As calculated in Appendix C, the estimate for third-party closure and post-closure care is $2,216,022.

2.5.2 Proposed Financial Assurance Mechanism

The District will use a trust fund to demonstrate financial assurance. In 1992, the District established separate accounts in the State Pool accumulating funds for closure and post-closure care of Cell 1 and corrective action. During 1997, the District transferred these funds into the Closure Trust Fund established by the State Treasurer. As of October 31, 2008, the closure/post-closure account held $2,979,148 which means that the trust fund is fully funded.

The District has consistently operated on a cash basis since its inception in 1990. It accumulates funds in advance to finance its capital facilities needs, and pays cash for all capital improvements, equipment, and services. This means that the District has no long-term debt to encumber its resources.

An alternative closure cap has been approved for the Bayview Landfill and the landfill plans to use the alternative cap design for Cell 2. Details of the alternative cap are discussed in Section 2.6 and Appendix N. The District plans to finance the partial closure of Cell 2 – Stage 1 from operating funds and does not intend to diminish the Trust Fund. In 2010, District personnel will begin depositing intermediate cover on the side slopes of Cell 2 – Stage 1. Therefore, Cell 2 will be partially closed during this permit period. Therefore, the Trust Fund account is adequately funded and will remain fully funded during the remainder of the current permit. In any case, the District will continue to report on the status and adequacy of the trust fund in its annual reports to UDEQ.

2.6 Closure Plan

This section describes post-closure care for Cell 1 and the closure plan for Cell 2. Landfill Cell 1 reached capacity in 2004 and the final cover was placed in 2008. Stage 1 of Cell 2 will reach operating capacity by the end of 2009, at which time Stage 2 of Cell 2 will begin receiving waste. Waste will be placed in Cell 2 Stage 2 for about 9 years, or until 2019. Landfill Cell 2 will operate beyond the five-year period covered by this permit and will not reach capacity until approximately 2032.

2.6.1 Final Cover Installation

An alternate final cover design of the capping system for the Bayview Landfill has been completed. The final contours of Cell 1 were projected in the 1988 Master Plan, and are depicted on Figure T-3 in Appendix T. Final contours of Cell 1 were achieved in 2004, at which point Cell 2 – Stage 1 began receiving waste. As mentioned, Stage 1 of Cell 2 will reach capacity and intermediate final cover placement will begin in 2010. The approved alternative final cover is planned for Cell 2 when it reaches final contours in 2032. The design for the alternate capping system includes the following layers of material from the bottom up:

- 6 inches of intermediate cover placed over the daily cover to provide a 12-inch cushion of soil over the solid waste;
- 34-inches of evaporative cap constructed from the olive-brown silty sand available on-site. The top six inches of this evaporative cap will be capable of supporting vegetative growth by amending it with compost to aid in initial seed germination.

As with Cell 1, a series of metal stakes with plastic fibers attached to the top will be placed in the final cover of Cell 2 on 100-foot centers across the cell. These metal stakes are commonly referred to as “blue tops” or “whiskers” and will be driven into the final cover until the plastic fibers are just below the completed final cover surface. This will provide a visual method (if the fibers begin to show over time) to determine if erosion of the final cover is occurring. Additionally, a series of benchmarks will be located around the perimeter of the landfill to be used to determine when settlement of the waste or cover materials has ceased.

The Landfill Foreman will inspect the completed cap weekly until vegetation is established, and monthly thereafter to ensure that damage to the capping system is detected and repaired early. The vegetation on the landfill cap will be maintained to blend into the surrounding semi-arid landscape.

The Landfill Foreman will also inspect the completed cap to determine that the final contours are maintained, and that the flow of stormwater is unimpeded. Areas in which excessive settlement or erosion of 1 inch has occurred, as evidenced by the exposure of the blue top survey stakes, will be regraded, mulched, and seeded as specified above.

2.6.2 Site Capacity

The landfill is currently achieving an in-place waste density of approximately 1,500 lbs/cy. At capacity, Cell 1contained approximately 1,800,000 tons of solid waste (2.4 million cubic yards at 1,500 lbs/cy). At the current rate of solid waste compaction, the District estimates that Cell 2 will contain approximately 6,345,000 tons of solid waste (8,460,000 million cy at 1,500lbs/cy). At the current waste acceptance rate of 146,000 tons plus a 3% annual increase, Cell 2 is expected to last until approximately 2032.

Based on the 1988 Master Plan, Cells 4 through 7, as currently configured, have a capacity of about 4,600,000 tons of waste with a waste density of 1,000 lbs/cy. The Bayview landfill currently achieves about 1,500 lbs/cy of in-place waste. Making this conversion, Cells 4 through 7 would have a capacity for about 6,900,000 tons, equating to an additional 46 years of life (at 150,000 tons per year).

2.6.3 Closure Schedule and Funding

Cell 1 reached capacity in 2004 and the final cover was placed in 2008. Seeding of the Cell 1 final cover is scheduled to be completed during early 2009 and is the only requirement remaining for final closure of Cell 1. Cell 2 – Stage 1 will reach capacity by the end of 2009 and begin receive intermediate cover on the side-slopes in 2010. Cell 2 – Stage 2 will begin receiving waste in 2010. Cell 2 – Stage 2 will remain active beyond the five-year period covered by this permit and will not reach final contours until approximately 2019.

Final closure construction will begin within 2 months of final receipt of solid waste in Cell 2. Closure construction will proceed on a continuous schedule to provide for completion of the closure cap within 18 months of final receipt of solid waste. The exact schedule cannot be predicted because the closure must be coordinated with both the final receipt of waste, and the beginning of the active growing season to provide cover vegetation an optimal chance of survival. The UDEQ will be notified when closure construction has been completed so that a final inspection can be made.

The closure costs projected in Section 2.5 assume that the entire closure cap, including intermediate soil cover, for Cell 2 Stage 1 and Stage 2 will be constructed as part of the closure. This is a very conservative assumption, since intermediate cover material will be placed as part of landfill operations. Furthermore, closure costs are anticipated to be paid from operating funds, leaving the trust fund intact. These assumptions allow the expedited closure of the landfill cell, and ensure that funding will be available to allow a third party to close the landfill under tight time constraints, if needed.

2.7 Post-Closure Care Plan

Post-closure care for Cell 1 of the Bayview Landfill will consist of long-term maintenance of the closure cap and ongoing sampling of the groundwater monitoring wells and gas monitoring stations to ensure that the landfill cell has been closed in accordance with regulations. The post-closure care period will be 30 years unless unexpected environmental contamination or continued subsidence occurs, or a shorter period if it can be proven that it no longer presents a threat to human health or the environment. The costs for post-closure care identified in Section 2.5 include Cell 2 – Stages 1 and 2, as well as Cell 1. The post-closure care plan will be applied to other cells as they are closed.

2.7.1 Monitoring and Maintenance

Semi-annual groundwater and quarterly landfill gas monitoring will occur throughout the post-closure period. This frequency will be increased if data indicate that contamination may have occurred. The post-closure monitoring frequency will revert if the more frequent monitoring demonstrates that contamination, if present, is not attributable to the landfill.

Collection and treatment of leachate generated in Cell 1 and Cell 2 will be provided by a new dual-lined evaporation pond to be constructed directly north and upstream of the existing evaporation pond. The new pond will also have a leak detection system. The existing pond will provide stormwater and process water runoff containment for the adjacent biosolids compost facility. These leachate collection and treatment systems will be inspected as part of the ongoing activities for other landfill cells during the post-closure period for Cell 1 and Cell 2. Since the Bayview Landfill has no planned surface water discharge, no surface water monitoring will be required during the post-closure period.

Table 7-1 provides a schedule for conducting inspections and maintenance and for recording these routine activities. The Landfill Foreman will be responsible for conducting the inspections, scheduling maintenance, and recording these activities on the forms provided in Appendix I.

Table 7-1: Frequency of Inspection and Maintenance of Facilities During Post-Closure Care

Landfill Facility	Inspection or Maintenance	Frequency
Landfill Cell	Closure cap integrity. Cell perimeter fence integrity.	Quarterly
Stormwater / Leachate Pond	Perimeter fence integrity. Water depth. Liner system integrity.	Quarterly
Other Appurtenances	Entrance gate integrity. Perimeter fence integrity. Monitoring station integrity. Berm integrity. Run-on and Run-off Control Systems.	Quarterly

The above activities will be carried out as part of the ongoing operations during the active life of the site. They will be expanded to include the entire site at final landfill closure and will continue throughout the post-closure monitoring period.

A written summary of the activities performed during each inspection will be maintained. The District will retain the right of entry to the closed landfill, maintain all right-of-ways, and conduct maintenance and/or remediation activities as needed. The landfill will be inspected on a quarterly basis for the following conditions:

- Integrity of the final cover (including erosion, subsidence, seeps and settlement);
- Loss of vegetative cover or growth of undesirable plant species;
- Visible debris, litter, and waste;
- Condition of access roads, gates, and fences;
- Integrity of on-site structures;
- Integrity of groundwater monitoring system;
- Integrity of methane monitoring system;
- Integrity of drainage features;
- Integrity of the leachate collection system;

The final cover will be inspected for erosion or other maintenance problems. Any problems detected during routine site inspections will be corrected as soon as practicable. All eroded areas will be recovered with suitable soil to establish erosion control and infiltration layers, as well as positive drainage to maintain the integrity of the final cover as outlined in Section 2.6.1. All bare areas in the final cover will be re-vegetated as necessary.

The need for final cover system repairs due to differential settlement or subsidence will be determined based on an evaluation of whether the final cover in the affected area has been impaired. Any areas where the integrity of the final cover has been compromised will be repaired as necessary.

Eroded areas in drainage ditches will be repaired and re-graded. Sediment buildup will be removed from areas where flow is restricted. Temporary stormwater control structures will be constructed and maintained as needed.

The leachate collection system will be maintained and operated as needed to minimize leachate head on the liner. The District may seek the approval of the UDEQ to cease leachate extraction and treatment if it can demonstrate that leachate generation has diminished and no longer poses a threat to human health and environment.

2.7.2 Land Title, Land Use, and Zoning Restrictions

The future land use of Cells 1 and 2 is reversion to grazing land, which is the historical land use. The title of the land is expected to remain with its current owner, the Utah Division of State Lands. The Utah County Board of Adjustment did not impose zoning restrictions on the site. However, the District will cooperate with the landowner and the County Board of Adjustment in developing zoning restrictions that are in the best interests of the landowner.

2.7.3 Post Closure Costs

The costs identified in Section 2.5 for post-closure care have been assumed to be recurring annual costs. The trust fund for this post-closure care has been assumed to be available in its entirety at the beginning of the post-closure care period. This is a very conservative assumption since the landfill is planned to operate for a minimum of 25 years (by term of lease). The interest on the principal of the trust fund is expected to cover the limited inspection and maintenance activities currently scheduled as part of the ongoing operation (e.g., leachate collection and evaporation facilities) of the landfill site if the site is unexpectedly closed.

2.8 References

HDR Techserv, Inc. 1987. Landfill Approval Assistance Hydrogeologic and Seismic Review, p.37.

HDR Techserv, Inc. 1988. Landfill Master Plan, Bayview Landfill.

South Utah Valley Solid Waste District. 1994. Annual Report, p.6.

HDR Engineering – Permit Application Bayview Landfill, 1996.

HDR Engineering – Master Plan Update, Bayview Landfill, 2002.

HDR Engineering – Permit Application, Bayview Landfill, 2003.

HDR Engineering – Permanent Composting Facility Operating Plan, 2004.

HDR Engineering – Cell 2 Master Plan Update, 2008.

South Utah Valley Solid Waste District. 2008. Annual Report.

Part 3: Technical and Engineering Report

3.1 Introduction

This Part 3 – Technical and Engineering Report presents information on geology, hydrology, location restrictions and engineering design for the Bayview Landfill. This information has been updated from previous permits to reflect the final closure of Cell 1, pending interim closure of Cell 2 – Stage 1, and modifications to the leachate collection system and Cell 2 – Stage 2 liner design and excavation contours. Portions of the text that do not require modifications have been left as originally presented in previous permit applications.

3.1.1 Facility Maps and Drawings

Figures for this permit application are found in Part 4. Figure 1 contains the most recent USGS Topographic Map of the vicinity surrounding and including the Bayview Landfill. The boundaries of the property are shown on this map, as well as a 1- and 2-mile radius around the property boundary. Figure 2 is the most recent USGS Topographic Map of just the Bayview landfill property. Figure 3 is a recent topographic map of Cell 2 produced from aerial photography performed in December 2008 and updated with ground survey information obtained during the same month.

Figure 4 is a portion of the state of Utah Earthquake Distribution Map (MF-1856). Figure 5 is a Landfill Facilities Map showing the current and planned facilities. Figure 6 to 13 contain permit level construction details for the development of revised Cell 2 – Stage 2, a new leachate evaporation pond, and projected final contours of Cell 2. Cell 2 is the combination of previously permitted Cells 2 and 3, as outlined in the January 2002 Master Plan update and modified in the January 2009 Cell 2 Master Plan by HDR, Inc. The most recent plan, the Cell 2 Master Plan, is included as Appendix A to this application.

Appendix D contains the final engineering drawings and specifications for the development of Cell 2 – Stage 2. Appendix T contains a draft Cell 1 closure status letter and as-built drawings.

3.2 Geohydrological Evaluation

3.2.1 General

Several studies are available in the public and nonpublic arenas that describe the geology and hydrogeology of the region and the site. The hydrogeology of the Goshen Valley has been described by Dustin (1978) and Cordova (1970). These studies also describe the general geology of the area including the Bayview Landfill site. Two hydrogeological investigations were commissioned by Provo City Corporation during the original permitting of the site in the 1980s (Chen and Associates, 1980; Rollin, Brown, and Gunnell [RBG], 1983). These investigations provided shallow geological data specific to the landfill site. During litigation regarding permitting of the site, several parties (Hintze and Fuhriman, 1983; Environmental Science and Engineering, 1986; and Danzberger, 1986) re-evaluated and re-interpreted the data presented in the Dustin, Cordova, Chen, and RBG studies, and re-interpreted site-specific geologic and hydrogeologic data. These re-evaluations presented no new data, and do not contribute to the understanding of the site.

During 1986 and 1987, the Utah County Planning Commission evaluated the Bayview Landfill site seismicity. This evaluation included on-site trenching to determine whether lineaments present on the site represented the surface expression of geologic faults. The Planning Commission's geologist concluded that the lineaments were not related to faults or seismic activities at the site (Robison, 1987).

During the original construction of the Bayview Landfill in 1989, the contractor drilled and installed 12 monitoring wells. Six of these wells are deep wells (170 to 310 feet below ground surface) that provide geological data from regions deeper than earlier Provo studies. Three additional deep monitoring wells have been installed since the Bayview Landfill began operating. These wells serve as compliance monitoring wells and also provide hydrogeological data specific to the site. In April 1994, the District published an evaluation of two years of hydrograph and laboratory analytical data. Groundwater monitoring has been ongoing at the site with evaluations submitted to the UDEQ. The Districts Groundwater Monitoring Plan is included as Appendix F. Boring logs for monitoring wells are included as Appendix E.

During 1993, the U.S. Geological Survey (U.S.G.S.) conducted an evaluation of the aquifers in Utah and Goshen Valleys. A summary of selected data collected during this evaluation has been published as Utah Hydrologic Data Report No. 50, and is attached to this permit application as Appendix G.

3.2.2 Geology

3.2.2.1 Stratigraphy

The Bayview Landfill site is located in Goshen Valley between the East Tintic Mountains and Utah Lake. The Goshen Valley is bounded on the north by the Lake Mountains, on the west by the Mosida Hills and the East Tintic Mountains, on the south by Long Ridge, and on the east by Utah Lake and West Mountain. The site lies on the eastern slope of the East Tintic Mountains as the slope approaches Utah Lake. The terrain in the vicinity of the landfill site slopes toward the lake at approximately 2.5%; the terrain is steeper to the west and shallower to the east of the site.

The Goshen Valley is underlain by a thick sequence of consolidated and unconsolidated sediments overlying sedimentary Paleozoic limestone and dolomitic basement rock. The surficial materials at the site consist of heterogeneous deposits of gravel, sand, silt, and clay laid down in Lake Bonneville. These deposits were derived from erosion of the East Tintic Mountains, and were dropped into the lake as beach, bar, and spit deposits along the fluctuating shoreline. The materials are poorly to moderately well sorted and are derived from a mixture of Paleozoic sedimentary (limestone and quartzite) and Tertiary volcanic outcrops. In some places, these lake sediments are overlain by beach and dune sands representing Lake Bonneville shoreline and Quaternary deposits, respectively. The western portion of the landfill site exhibits dune and beach sand deposits. The thickness of these strata is discussed in Section 3.2.3.2 – Aquifers.

Two other Pleistocene deposits underlie the Lake Bonneville Group sediments: the Terrace gravel, and the Older Alluvium. The Terrace gravel consists of gravel and sand benches and contains an aquifer referred to as the Upper Pleistocene aquifer. The Older Alluvium consists of cemented gravel and sand (fanglomerate) and contains an aquifer referred to as the Lower Pleistocene aquifer. Miocene latites and conglomerates reportedly underlie the Pleistocene deposits; the conglomerates reportedly consist of cobbles and boulders in a sandy matrix. It does not appear that the deep monitoring wells constructed at the Bayview Landfill site penetrate into the Lower Pleistocene aquifer.

3.2.2.2 Instability and Seismicity

No unstable slopes or subsidence areas have been mapped in the vicinity of the Bayview Landfill site. However, the Utah County Planning Commission has not prepared landslide, unstable area, or subsidence maps for this portion of the county. To the best recollection of Commission personnel, the Planning

Commission has received no reports of landslides or subsidence. The site is relatively flat and is not subject to steep cuts that would create slope stability problems. There does not appear to be any surface observable evidence that the site is located in a floc type land stability problem area.

Numerous faults traverse the Goshen Valley. Most of these faults are believed to be inactive; however, more than 25 earthquake epicenters have been plotted within approximately 5 miles of the landfill site. Most of these epicenters are located south, southeast, or southwest of the site (Figure 4). These epicenters include one with a reported intensity of VII on the Modified Mercali Intensity Scale, and several with reported intensities of IV or V (U.S.G.S, 1986).

The Utah County Planning Commission has not prepared seismicity maps for this portion of the county. The Uniform Building Code (1994) classifies this portion of Utah as a Class 3 Seismic Zone, and requires use of a horizontal acceleration of 0.3g in the design of engineered structures. This classification places the Bayview Landfill site in a seismic impact zone as defined under the Utah Solid Waste Permitting and Management Rules.

3.2.3 Hydrology

3.2.3.1 Surface Water

Three surface water channels cross the landfill site (see Figure 2). These surface water channels flow ephemerally from watersheds west of the landfill site. The northern and central channels originate about 2 miles west of the site in Section 14. Each of these channels has a drainage basin of less than 1,000 acres. The southern channel originates less than 1 mile west of the site in Section 18, and has a drainage basin of less than 200 acres.

The northern and central channels have cut gullies approximately 5 feet deep and 30 feet wide through the dune sands on the steep, western portion of the landfill site. These channels decrease in size to less than 3 feet in depth and less than 10 feet in width on the eastern portion of the site. The southern channel is only 1 to 2 feet in depth.

The drainage channels appear to be completely dry during most years. These channels carry water only during storm events and during spring run-off from the foothills west of the site. The sandy nature of the area and of the channel bottoms allows water to infiltrate into subsoils during storm events with a more frequent return period.

3.2.3.2 Hydrology

Aquifers

Previous studies (Cordova, 1980; Dustin, 1978) have defined four aquifers underlying the Goshen Valley; however, not all of these aquifers appear to be present at the Bayview Landfill site (Brook, 1994; Carpenter, 1994a). As identified in previous reports, the uppermost aquifer, the water table aquifer, is contained in the Lake Bonneville group, and is commonly found at depths of less than 25 feet below ground level (bgl). The second aquifer, the Upper Pleistocene aquifer, is contained in a sand and gravel deposit, the Terrace gravel, at depths of 150 to 300 feet bgl in the Goshen Valley. The Upper Pleistocene aquifer reportedly ranges from 75 to 100 feet in thickness. The Upper and Lower Pleistocene aquifers are separated by a 50- to 100-foot thick cemented sand and gravel confining layer. This confining layer is thought to partially separate the two Pleistocene aquifers. The Lower Pleistocene aquifer is reported to vary in thickness from 25 to 175 feet. The third aquifer, the Tertiary aquifer, is reportedly found at 200 to 500 feet bgl; its thickness is unknown, but may exceed 1,500 feet in the Goshen Valley.

Eight shallow soil borings, six shallow monitoring wells, and six deep monitoring wells indicate that the Lake Bonneville group water table aquifer is not present at the site (Carpenter, 1994a). The six shallow monitoring wells are constructed with a 20-foot screen and a 1-foot sump below 49 feet of casing. The wells contain dedicated pumps mounted at 65 feet bgl. Boring logs are attached to this permit application as Appendix E. All of the shallow wells have contained small amounts of water during most sampling events; however, none of the wells have contained sufficient water to allow purging or sampling. The water in these wells is believed to be condensation within the well, rather than perched groundwater (Carpenter, 1994a).

The nine deep monitoring wells appear to be screened in the Upper Pleistocene aquifer (Carpenter, 1994a). The nine deep monitoring wells do not appear to have penetrated through the Upper Pleistocene aquifer into the Lower Pleistocene aquifer. Boring logs for these wells are presented in Appendix E. This aquifer is the uppermost usable aquifer in the immediate vicinity of the landfill site.

The landfill culinary well appears to be screened in the Lower Pleistocene aquifer (Carpenter, 1994a). The well log indicates that the partially confining layer between Upper and Lower Pleistocene aquifers is not present at the site. This is consistent with the interpretation of the U.S. Geological Survey for this portion of the Goshen Valley (Brook, 1994). The Upper and Lower Pleistocene aquifers appear to represent a single, water table (unconfined) aquifer in the vicinity of the Bayview Landfill.

Water Rights

The Utah Department of Natural Resources Water Rights Division lists only one active water right within 2,000 feet of the Bayview Landfill site boundary. This active water right is the culinary water well for the landfill. This well is located upgradient of the site, and is screened in the Lower Pleistocene aquifer.

Based on a review of the USGS topographic maps for the site, approximately 7 wells are located up to 2 miles from the site boundary (USGS, 1993) including the landfill culinary well.

Groundwater Flow

The previous studies indicate that groundwater flow enters the Goshen Valley from the south through Current Creek Gap, and from the northwest through the Mosida Hills. These groundwater flows converge near the Bayview Landfill site. The groundwater underlying the site is expected to flow northeast toward Utah Lake. Cordova (1970) estimated transmissivity of the Pleistocene aquifer to be between 50,000 and 300,000 gallons per day per foot (gpd/ft). Earthfax (1984) estimated the velocity of groundwater flow north of Elberta to be 24 feet per year (ft/yr).

In April 1994, the District issued a report on the results of the District's background monitoring program (Carpenter, 1994b). This report provided an assessment of the background water quality and flow direction in the immediate vicinity of landfill. This report stated that the groundwater flow at the site moves northeasterly toward Utah Lake, and estimated the velocity of this flow at 1.8 ft/yr. The report in Appendix F has been updated to include recent groundwater monitoring events.

The discrepancy between the published values and the apparent velocity of groundwater at the site is unexplained. However, this does not seem to be important since the upper aquifer is more than 100 feet below the bottom of the landfill.

Groundwater Chemistry

The uppermost aquifer (the Upper Pleistocene aquifer) underlying the Bayview Landfill site is classified as a Class II aquifer. Appendix F contains the groundwater monitoring plan for the landfill. Statistical analyses of groundwater monitoring data have been completed semi-annually since the completion of background sampling in 1993. Statistical analysis results are submitted with the District's annual reports. The analyses show no contamination of the groundwater by inorganic or organic chemicals. Statistical evaluation of the data shows a general trend of increasing concentration for total dissolved solids, sulfate, chloride, calcium, magnesium, sodium, and bicarbonate from southwest to northeast below the site. This is consistent with the regional trend of increased concentration of inorganic chemicals as they move toward Utah Lake through the shallow Pleistocene aquifer (Carpenter, 1994). Groundwater analytical results are submitted to UDEQ annually.

3.3 Engineering Report

3.3.1 Location Standards

UDEQ has adopted specific locational restrictions that include the locational criteria specified in the federal Subtitle D regulations. The Utah location restrictions for municipal solid waste landfills are outlined below. Subtitle D criteria are highlighted with an asterisk (*).

Location Restriction Compliance was previously analyzed as part of the 1996 permit application. The following portions of Section 3.1 are excerpted from that application.

1. Land Use Compatibility (R315-302-1(2)(a))
    a. Parks and protected areas
    b. Ecologically and scientifically significant areas
    c. Prime farmland
    d. Dwellings and structures*
    e. Airport runways*
    f. Archeological sites
    g. Land use planning or zoning
2. Geology (R315-302-1(2)(b)) Fault areas*
    a. Seismic impact zones*
    b. Unstable areas*
3. Surface Water (R315-302-1(2)(c)
    a. Floodplains*
    b. Wetlands*

4. Groundwater (R315-302-1(2)(e))
    a. Groundwater/landfill separation
    b. Sole source aquifer
    c. Groundwater quality
    d. Source protection areas

The following sections present the State of Utah location restrictions and discuss the Bayview Landfill's compliance with those requirements.

3.3.1.1 Land Use Compatibility

The Utah Solid Waste Permitting and Management Rules state that no municipal solid waste landfill shall be located within the following restriction zones:

- One thousand feet of a national, state, or county park, monument, or recreation area; designated wilderness or wilderness study area; or wild and scenic river area.
- Ecologically and scientifically significant natural areas, including wildlife management areas and habitat for listed or proposed endangered species as designated pursuant to the Endangered Species Act of 1982.
- Farmland classified as prime, unique or of statewide importance by the U.S. Department of Agriculture Soil Conservation Service under the Prime Farmland Protection Act.
- One-fourth mile of existing permanent dwellings, residential areas, and other incompatible structures such as schools, churches, and historic structures or properties listed or eligible to be listed in the State or National Register of Historic Places.
- Ten thousand feet of any airport runway end used by turbojet aircraft, or 5,000 feet of any airport runway end used by only piston-type aircraft.
- Areas with respect to archeological sites that would violate R9-8-404.
- An area that is at variance with any locally adopted land use plan or zoning requirement unless otherwise provided by local law or ordinance.

The Bayview Landfill is not located within any of these restriction zones. The land use directly adjacent to the landfill is primarily agricultural. The nearest residence is located more than 1 mile north of the site boundary, and the nearest town, Elberta, is located approximately 5.5 miles south of the site. The nearest airport is located approximately 17 miles from the site. No parks, ecologically significant areas, prime farmland, or archeological sites are known to exist near the site. The Bayview Landfill site is surrounded on the north and west by land zoned mining and grazing (MEG1), and on the south and east by land zoned agricultural (A1). The landfill is not inconsistent with these planned land uses. In any case, the site was permitted by the Utah County Board of Adjustment under a Conditional Use Permit, and therefore, is consistent with the local zoning and land use planning.

3.3.1.2 Geology

The Utah Solid Waste Permitting and Management Rules state that no municipal solid waste landfill shall be located in a subsidence area, in a dam failure flood area, over an underground mine or salt bed, or on or adjacent to geologic features that could compromise the structural integrity of the facility.

- Fault Areas. A new facility or a lateral expansion of an existing facility shall not be located within 200 feet of a Holocene fault.
- Unstable Areas. Unstable areas require demonstration that the site has been engineered to ensure that the integrity of the structural components of the facility will not be damaged by the unstable conditions.
- Seismic Impact Zones. A new facility of a lateral expansion of an existing facility shall not be located in seismic impact zones unless all containment structures are designed to resist the maximum anticipated horizontal acceleration for the site.

The Bayview Landfill site does not include known Holocene faults, and all solid waste containment will occur more than 200 feet from the property boundary. A trenching study was conducted to determine whether apparent lineaments represented the surface expression of faults. This study concluded that the lineaments were not related to faults (see Appendix H). The Bayview Landfill is not located within a known unstable area as defined in the regulations.

Historic seismic records indicate that more than 25 earthquake events have occurred with epicenters within approximately 5 miles of the Bayview Landfill site. These earthquake events have occurred south, southwest, and southeast of the site. These earthquake events are presented in USGS Miscellaneous Field Studies Map MF-1856 and are summarized in Figure 4.

The Utah County Planning Department has not mapped the western portions of Utah County for seismic activity. The Uniform Building Code (1991) appears to classify all of Utah County as a Class 3 Seismic Zone. Structures in a Class 3

Seismic Zone are required to use a horizontal acceleration of 0.3g unless studies demonstrate that another horizontal acceleration is more appropriate.

Design for Cell 2 has been analyzed considering seismic activity and has been found to be stable with an adequate factor of safety. See Appendix J.

Seismic stability analyses have been conducted to demonstrate that the proposed landfill components can resist the maximum horizontal acceleration expected at the site. These analyses were conducted in accordance with the State of Utah Administrative Rules and EPA guidance presented in RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Facilities, (EPA, 1995).

The landfill components considered in these analyses included: linear systems, leachate collection and delivery systems, the leachate collection and run-on/run-off control systems and the final cover.

The scope of the analyses included a review of regional and local soils, geology and seismic selection of the design earthquake and the site specific earthquake acceleration; static and pseudo-static stability analyses for each landfill component: and evaluation of stability and potential deformations for each landfill component.

The results of these analyses are presented in Appendix J and indicate the following:

- The Bayview Landfill site is located in a Seismic Impact Zone. Both deterministic and probabilistic methods indicate a peak bedrock acceleration of 0.5g. The dense granular soils offer little amplification or attenuation of the bedrock acceleration through the overlying soil column.

- The cut and fill slopes and run-on/run-off structures have adequate static factor of safety and indicate minimal permanent deformations (U<1 cm) in response to the design seismic event.

- The side slope liner and leachate collection/recovery system will require a geosynthetic reinforcement to increase the static factor of safety and limit permanent deformations in response to the design seismic event.

- The closure cap system has an adequate static factor of safety and indicates acceptable permanent deformation (U<10 cm) in response to the design seismic event. No reinforcement is required for the final cover.

These demonstration analyses indicate that the proposed Bayview landfill components are designed to resist the "maximum horizontal acceleration" at the site.

3.3.1.3 Surface Water

The Utah Solid Waste Permitting and Management Rules state that no municipal solid waste landfill shall be located within a public water system watershed, a floodplain, or a wetland without specific approval of the Executive Secretary.

The Bayview Landfill site is not located within a public water system watershed or 100-year floodplain. Three surface water drainage features cross the site from west to east. The Landfill Master Plan provides that the three drainage areas will be improved to divert run-on from the active landfill cells. The drainage features do not contain vegetation that is characteristic of wetlands areas. No other wetland areas have been identified on the site. Calculations for run-on and run-off ditches can be found in Appendix M.

3.3.1.4 Groundwater

The Utah Solid Waste Permitting and Management Rules state that no municipal solid waste landfill shall be located within the following restriction zones:

- Within 5 feet of the historical high groundwater elevation.
- Within 100 feet vertically (50 feet for high total dissolved solids [TDS between 1,000 and 3,000 mg/l] aquifers) of an aquifer that could be used for drinking water unless constructed with a composite liner system.
- Over an aquifer designated as a sole source aquifer or a 1B aquifer.
- In a drinking water source protection area.

The Bayview Landfill is not located within a sole source or 1B aquifer, or in a drinking water source protection area. Landfill cells will not be constructed within 5 feet of the historical high groundwater elevation. The shallowest groundwater at the site, the Upper Pleistocene aquifer, is located more than 100 feet below the bottom of the proposed liner system. A composite liner system consisting of a geosynthetic clay liner (GCL) and an HDPE geomembrane is proposed for the bottom of Cell 2.

3.3.2 Engineering Design

In 1987, the District prepared a Landfill Master Plan (HDR, 1987) to guide development of the site over its active life, which is expected to exceed 50 years. Figure 5 in Part 4 illustrates the landfill facilities, which include the following:

- Six landfill cells (previous Cells 2 and 3 have been combined into Cell 2). Cell 2 will be approximately 83 acres in size. The cells are further subdivided into smaller areas, called "stages," to facilitate construction and to minimize the area open to receiving stormwater at any one time. Each stage represents approximately 15 acres;

- Three stormwater/leachate evaporation ponds:
    - An existing pond designed to receive contact stormwater and leachate from the northern half of the site,
    - A proposed leachate evaporation pond designed to receive stormwater and leachate from Cells 1 and 2 so that the existing pond can contain stormwater and process runoff produced by the compost facility, and
    - A third, future pond to receive contact stormwater and leachate from the southern half of the site;
- Screening berms to provide visual screening of the active landfill cells from State Highway 68;
- Three stormwater diversion channels using the existing ephemeral surface water drainage channels;
- A windrow composting facility located east of Cell 2;
- A maintenance building.

The Master Plan was updated in 2002 (HDR) to show a combined Cell 2 and 3, and to increase excavation depths in this new Cell 2. A 2008 Cell 2 Master Plan (Appendix A) modified Cell 2 – Stage 2 base grades to drain the western two-thirds down at 2% to the north and east, and the eastern third down at 2% to the southeast, and modified the leachate drainage plan to accommodate the new grades. Excavation depths remain more than 100 feet above the uppermost aquifer. An additional leachate evaporation pond was designed to collect leachate and stormwater from Cells 1 and 2 only. The Cell 2 Master Plan is attached to this permit application as Appendix A.

Landfill Cell 1 achieved final contours in 2004 and the final cover was placed in 2008. Cell 1 was built as designed and final cover seeding is all that remains for closure to be completed. Landfill Cell 2 – Stage 1 will reach capacity by the end of 2009, at which time landfill personnel will begin placing the intermediate cover on the side slopes of Stage 1. After Cell 2 reaches final contours and the final cap is in place in approximately 2032, long-term monitoring of the final cover and groundwater monitoring wells will continue for the 30-year post-closure care period.

3.3.2.1 Landfill Cell 2 – Stage 2

Stage 2 of Landfill Cell 2 consists of a 15-acre, geosynthetic clay and HDPE-lined area located in the E1/2 of the NW1/4 of Section 17. The excavation for this cell stage began in 2004 and is ongoing. The excavated soils have been used for liner protection, daily cover, with a portion used to close Cell 1or stockpiled. The stockpiled soil will be used for daily cover and intermediate cover on Cell 2 – Stage 1.

Cell 2 – Stage 2 grading is divided into two parts (Figure 9). Generally, excavation side slopes will be constructed on a 4:1 (H:V) slope. The excavation bottom slopes of the larger, western portion will be graded down at 2% north to south and 2.5% west to east, so that leachate drains to the northeast corner of the western portion of Cell 2 – Stage 2. The excavation will be constructed with a leachate collection trench along the eastern edge of the excavation bottom. The leachate collection swale will be graded at a 2.0% slope down from south to north toward a sump at the north edge of Stage 2. From the sump, leachate will be conveyed north to the existing leachate drain line. The smaller, eastern portion of Stage 2 slopes down at 2% to the south and east, where a new leachate collection sump will be built and a new leachate drain line will convey leachate from the eastern portion of Stage 2 to the leachate collection system in Stage 1.

The liner system for Cell 2 – Stage 2 consists of the following components (from bottom to top):

- A 12- to 20-ounce non-woven, needle punched polypropylene geotextile. The excavation specification will allow 4-inches minus material to remain on the surface of the excavation. A heavy geotextile will provide puncture resistance for the overlying geomembrane. Alternately, a sand cushion may be used in lieu of, or to reduce the required weight of, the geotextile cushion;
- A bentonite impregnated geotextile (geosynthetic clay liner – GCL). The GCL provides an additional barrier to leachate and landfill gas migration;
- A 60-mil textured HDPE flexible membrane liner;
- A woven reinforced geotextile. This high strength geotextile will provide the tensile strength necessary to resist the sliding forces generated on a 4:1 slope by the 2-foot-thick soil protective layer;
- A 12- to 16-ounce non-woven geotextile placed on top of the HPDE liner (of the floor of the excavation) to provide protection to the HDPE liner;

- A 2-foot thick protective cover layer. This soil layer will protect the geotextile, HDPE and GCL during placement of the first lift of solid waste. It is also intended to provide a pathway for leachate movement above the HDPE toward the leachate collection and removal system.

Appendix O contains a Construction Quality Assurance Plan (CQA). This CQA plan requires the installation contractor to conduct a construction quality control program during installation. As a result, all seams will be tested for continuity. In addition, periodic samples will be removed from the rolls and subjected to tensile testing at a third party laboratory. Construction oversight personnel will be on-site at all times during HDPE, GCL and geotextile installation, and during placement of the 2-foot thick protective layer. These personnel will provide a CQA review of the construction and installation of the liner system.

3.3.2.2 Leachate Management

In its current design, runoff and leachate from Cell 1, Cell 2 – Stage 1, and the compost facility are contained in the existing leachate pond. However, the pond is not dual lined and does not have leak detection, both of which are now required for leachate ponds. Therefore, a new leachate pond has been designed and will be constructed as part of this permit renewal. The new pond will receive leachate and stormwater from Cell 1 and Cell 2 only. The existing pond will receive stormwater and process runoff from the compost facility only.

Leachate and contact stormwater within the active landfill cell (Cell 2 – Stage 2) will drain via one of two collection pipes and sumps. Leachate and storm water will be transmitted through a 2-foot thick protective cover soil to a leachate collection pipe (See Figures 11 and 12). The leachate collection pipe will consist of an 8-inch diameter perforated PVC or HDPE pipe encased in a granular fill wrapped with a geotextile. The pipe trench will be approximately 2 feet in depth, matching the thickness of the protective cover. The perforated leachate collection pipe will enter a gravel-filled sump. The leachate collection pipes will be installed along the eastern edge of each portion of Stage 2. The western portion of Stage 2 will drain to a sump at the north edge of Stage 1. The eastern portion will drain to a new sump at the southeast corner of Stage 2 where it will be pumped back to the existing sump at the north edge of Stage 1. From the sumps, the pipe (solid wall) continues up the side slopes and terminates at the top of excavation as a clean-out. An 18-inch HDPE pipe also continues up the side slope. A submersible pump capable of pumping a minimum of 50 gallons per minute can be lowered down the 18-inch pipe to pump leachate out of the cell into the existing leachate drain line that runs along the northern edge of Cell 2. The leachate drain line will discharge to a newly designed evaporation pond that will be constructed immediately north of the existing pond. Leachate will be managed by this system during filling and after closure. Design details of these systems can be seen on Figures 11 to 13. Sizing calculations for the new pond are found in Appendix L.

The new leachate evaporation pond will be constructed, tested, and inspected using the same personnel and techniques as used for the previously constructed landfill cells and evaporation pond. The south side of the pond will be constructed on a 10:1 slope to allow access for equipment to remove sediments with the remaining sideslopes 4:1. The new evaporation pond was designed to contain the leachate generated from all of Cell 1 and Cell 2 and contact stormwater from the largest of the currently undeveloped Cell 2 stages (Stage 3) for the 25-year, 24-hour storm event.

The proposed evaporation pond liner system consists of the following layers (from bottom to top):

- A 16-ounce non-woven geotextile;
- A 60-mil HDPE geomembrane;
- A geonet, sandwiched between two layers of non-woven geotextile;
- A UV-resistant 60-mil HDPE geomembrane, textured on side slopes;
- A 6-inch layer of sand (bottom and the 10:1 sideslope only) as a cushion layer beneath the soil cement to protect the 60-mil HDPE geomembrane; and
- An 8-inch layer of soil cement (bottom and the 10:1 sideslope only). The cement will allow the District to enter the pond and remove accumulated sediment using a front-end loader.

The proposed evaporation pond will also have a leak detection system between the lower 60-mil HDPE geomembrane and the sandwiched geonet/geotextile layer. The geonet will convey any fluid that leaks through the primary liner to a gravel-filled sump with an 8" perforated HDPE pipe. The pipe will extend up a 4:1 sideslope as a solid-wall pipe and terminate at a manhole structure where a portable water level meter and, if needed, a pump can be lowered down to check for leaks in the primary evaporation pond liner.

Modeling

Since the leachate generation calculations were done for the October 2003 Permit Application, no modifications have been made to the landfill that affect the amount of leachate generated or the performance of the leachate collection system. Because of this, the Hydrologic Evaluation of Landfill Performance

(HELP) model, hydraulic head calculations, and calculations for the flow capacity of the leachate collection pipe used for the 2003 Permit Application are still valid and are included in Appendix K.

Analyses have been conducted to evaluate the sizing and capacity of the proposed leachate evaporation pond for the combination of contact stormwater run-off from the contributing cell area and leachate generation from all of Cell 1 and Cell 2. Only stormwater from the largest stage in Cell 2 (Stage 3) was considered in the stormwater runoff calculations because the stages will be developed in sequence, with each stage receiving intermediate cover when it reaches capacity, thereby reducing contact stormwater runoff. The 25-year, 24-hour storm event was used to compute run-off. The results of the analysis, presented in Appendix L, indicate the proposed leachate evaporation pond is sized adequately to contain the leachate generated from Cell 1 and Cell 2 and the contaminated stormwater run-off from the equivalent area of Cell 2 – Stage 3.

3.3.2.3 Surface Water Controls

The Bayview Landfill site and its vicinity generally drain from west to southeast. Stormwater originating west of the site is routed through three existing surface water channels. See Figure 2. Construction of Landfill Cells 2 required that the northern ephemeral surface drainage channel be relocated (see Figure 5).

Stormwater originating on-site is managed as either non-contact or contact stormwater depending on its source. Non-contact stormwater is water falling on unimproved portions of the site, or on improved portions of the site having no contact with solid waste (e.g., the maintenance building vicinity) or on the final cover of Cell 1. Run-on control structures divert this water from the active landfill cell and stormwater/leachate pond and route this water into the existing surface water channels. Contact stormwater is water falling onto the active landfill cell. Run-off control structures divert water falling on the active landfill cell into the leachate collection system. Ultimately, contact stormwater is stored and evaporated in the evaporation pond. Neither leachate nor contact stormwater are discharged from the site.

Analyses have been conducted for run-on and run-off control systems around Cell 2. These analyses were conducted for a 25-year storm event and the associated time of concentration that produced peak flow. The analyses, presented in Appendix M, indicate that a triangular ditch, nominally 1 foot deep, provides adequate flow capacity. This ditch geometry was constructed concurrent with the Cell 2 construction.

3.3.2.4 Closure and Post-Closure

Cell 1

The final cover of Cell 1 was completed in 2008. An alternate final cap consisting of 34 inches of on-site, olive-brown silty sand was used to close Cell 1. A seed mix similar to that shown in Table 3-1 will be used to establish vegetation during 2009. Final contours for Cell 1 can be seen on Figure T-3 in Appendix T. The side slopes of the landfill were constructed at a 4:1 (H:V) slope, with the top slope being approximately 5%. After seeding the final cover, closure of Cell 1 will be considered completed.

Table 3-1: Seed Mix for Bayview Landfill

% Mix	Type of Grass
0.50%	Sand Drop Seed
1.50%	Alkali Sacaton
3.50%	Blue Grama
17.50%	Blue Bunch Wheat Grass
17.50%	Indian Rice Grass
3.00%	Sandberg Blue Grass
4.00%	Sheep Fescue
16.25%	Slender Wheat Grass
16.25%	Stream Bank Wheat Grass
20.00%	Western Wheat Grass
100.00%	Total

The final capping system used for Cell 1 varies from the standard design in the Utah Administrative Code at R315-303-3(4). However, based on modeling performed for the 2003 permit application, the approved cap is equivalent to the standard design in preventing infiltration. A copy of this analysis is included in Appendix N.

A conceptual design of the gas system is included in Appendix Q. Recent landfill gas monitoring indicates that gas collection is not required. At such time that active extraction is needed, wells will be installed and connected to header pipes and the system will be connected to a blower and the landfill gas burned in a flare or used in a landfill gas generator.

Cell 2

Landfill Cell 2 – Stage 1 will reach capacity by the end of 2009. Stage 2 of Cell 2 will be constructed in 2009, with a portion of the excavated soils used for daily cover, intermediate cover on Stage 1, or stockpiled. Landfill Cell 2 is not expected to reach capacity until approximately 2032.

The same alternate final capping system as used for Cell 1 will be used for Cell 2 when final contours are reached. In general, this capping system consists of the following layers from the bottom up:

- 6 inches of intermediate cover placed over the daily cover to provide a 12-inch cushion of soil between the solid waste and the barrier layer;
- 34-inches of evaporative cap constructed from the olive-brown silty sand available on-site. The top six inches of this evaporative cap will be capable of supporting vegetative growth by amending the soil with compost to aid in initial seed germination.

A seed mix similar to that shown in Table 3-1 will be used to establish vegetation. Projected final contours for Cell 2 can be seen on Figure 6. The side slopes of Cell 2 will be constructed at a 4:1 (H:V) slope, with a top slope of approximately 5%.

Post-Closure Care

Post-closure care is expected to consist of the following tasks:

- Quarterly inspections of the cap to determine whether significant erosion or differential settlement has occurred;
- Quarterly inspections of the stormwater/leachate evaporation pond;
- Quarterly monitoring of landfill gases at the extraction wells;
- Quarterly inspection of groundwater well integrity;
- Semi-annual monitoring and sampling of groundwater wells.

These activities have been initiated on Cell 1 and will be expanded to all closed areas at the appropriate times. A maintenance program will be developed for the landfill gas recovery system when the system is activated. Closure and post-closure is discussed in more detail in Sections 2.6 and 2.7 of this application.

3.4 Composting

A composting facility was constructed in 2004 after Cell 1 reached capacity. The compost facility is jointly permitted through the Division of Solid and Hazardous waste and the Division of Water Quality. The facility is located east of Cell 2, adjacent to the existing leachate evaporation pond in the SE ¼ of the NE ¼ of Section 17. The composting facility uses windrows to processes two waste streams, one containing a mixture of biosolids, food and beverage waste, and yard waste, and another containing yard wastes only. An operations plan for the compost facility is included in Appendix R. Quantities of waste processed at the composting facility each year from 2004 through 2007 are shown in Table 3-2.

Table 3-2. Tons of Waste Processed at the Bayview Composting Facility

Year	Biosolids (tons)	Yard Waste (tons)
2004	496	1,556
2005	1015	2,866
2006	1036	4,189
2007	1058	5,874
Total	**3,605**	**14,485**

3.5 References

Brooke, L.E. 1994. U.S. Geological Survey. Personal Communication.

Carpenter, C.H. 1994a. Provo City Corporation, Department of Water Resources. Personal communication.

Carpenter, C.H. 1994b. Quality of Groundwater at the Bayview Landfill Site. Chen and Associates, Inc.. 1980. Proposed Sanitary Landfill Site. 15 p.

Cordova, R.M. 1970. Groundwater Conditions in Southern Utah Valley of Goshen Valley, Utah: Utah Department of Natural Resources. Technical Publication 28, 79 p.

Danzberger. 1986. Assessment of Siting Considerations at the Proposed Provo Sanitary Landfill Site. 4 p.

Dustin and C.B. Merritt. 1980. Hydrogeology of Utah Lake with Emphasis on Goshen Bay: Utah Geological and Mineral Survey Water Resources Bulletin No. 147-5, 115 p.

Environmental Science and Engineering. 1986. Evaluation of Hydrogeologic and Seismic Conditions, Proposed Sanitary Landfill Site in Goshen Valley, Utah. 31 p.

HDR Techserv, Inc. 1987. Landfill Approval Assistance Hydrogeologic and Seismic Review.

HDR Techserv, Inc. 1988. Landfill Master Plan, Bayview Landfill. 44 p.

HDR Engineering, Inc. 2002. Landfill Master Plan Update, Bayview Landfill. 29 p.

HDR Engineering, Inc. 2008. Cell 2 Master Plan, Bayview Landfill. 7 p.

Hintze, L.F. and D.K. Fuhrman. 1983. Geohydrology Study of Proposed West Lake Landfill Site. 20 p.

RBG (Rolin, Brown, and Gunnell, Inc.). 1983. Investigation Report. 12 p.

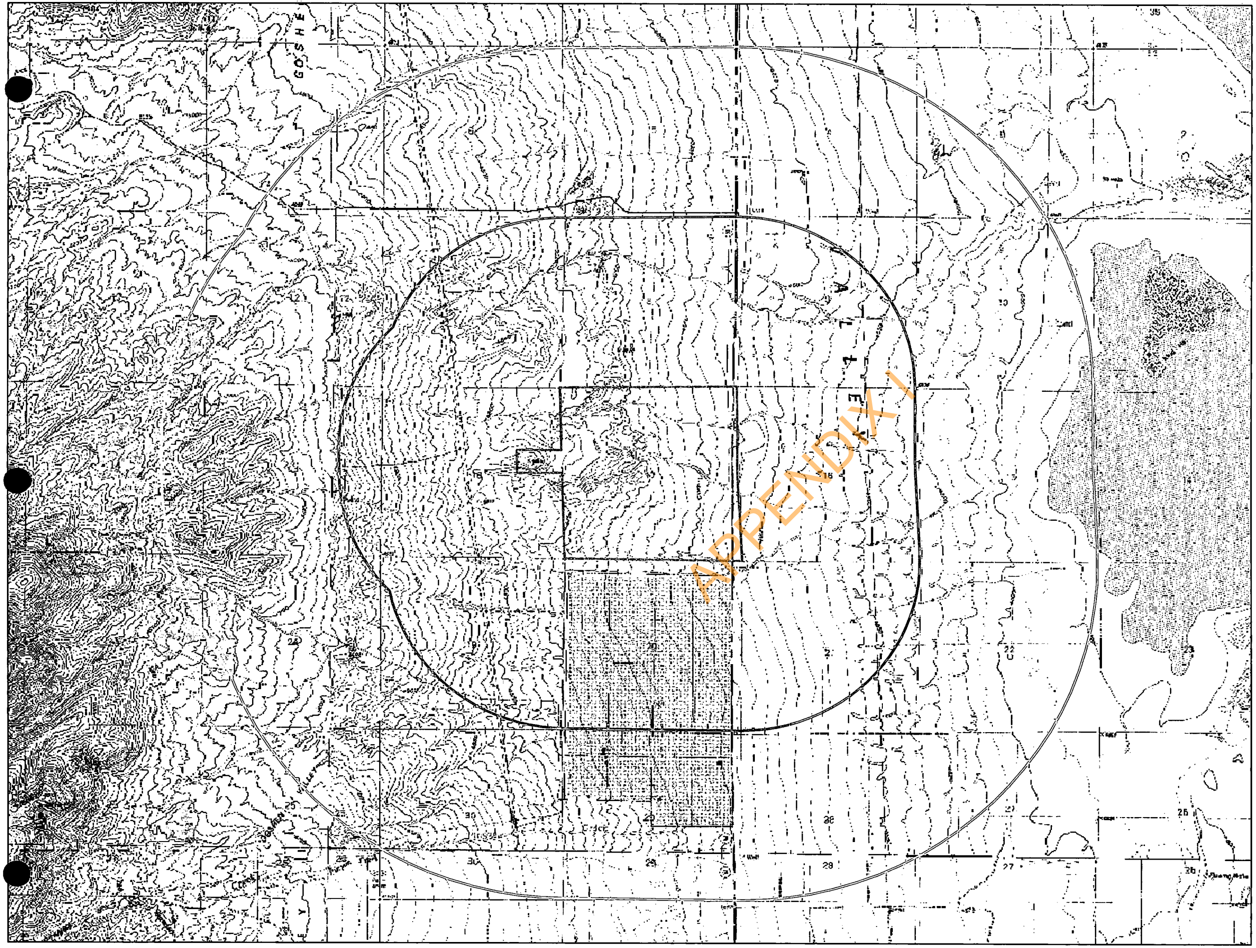
Robison, R.M. 1987. Evaluation of Lineaments at the Proposed Provo City Landfill, Goshen Valley, Utah. 15 p.

Uniform Building Code. 1994.

U.S.G.S. (U.S. Geological Survey). 1986. Seismicity Map of the State of Utah.

U.S.G.S. (U.S. Geological Survey). 1993. Selected Hydrologic Data for Southern Utah and Goshen Valleys, Utah 1890-1992.

Part 4: Figures



LEGEND

☐ 1-Mile Boundary

☐ 2-Mile Boundary

☐ Property Line (Approximate)

USGS TOPOGRAPHIC MAPS USED:
Allens Ranch
Eureka
Goshen
Goshen Valley North

N
S

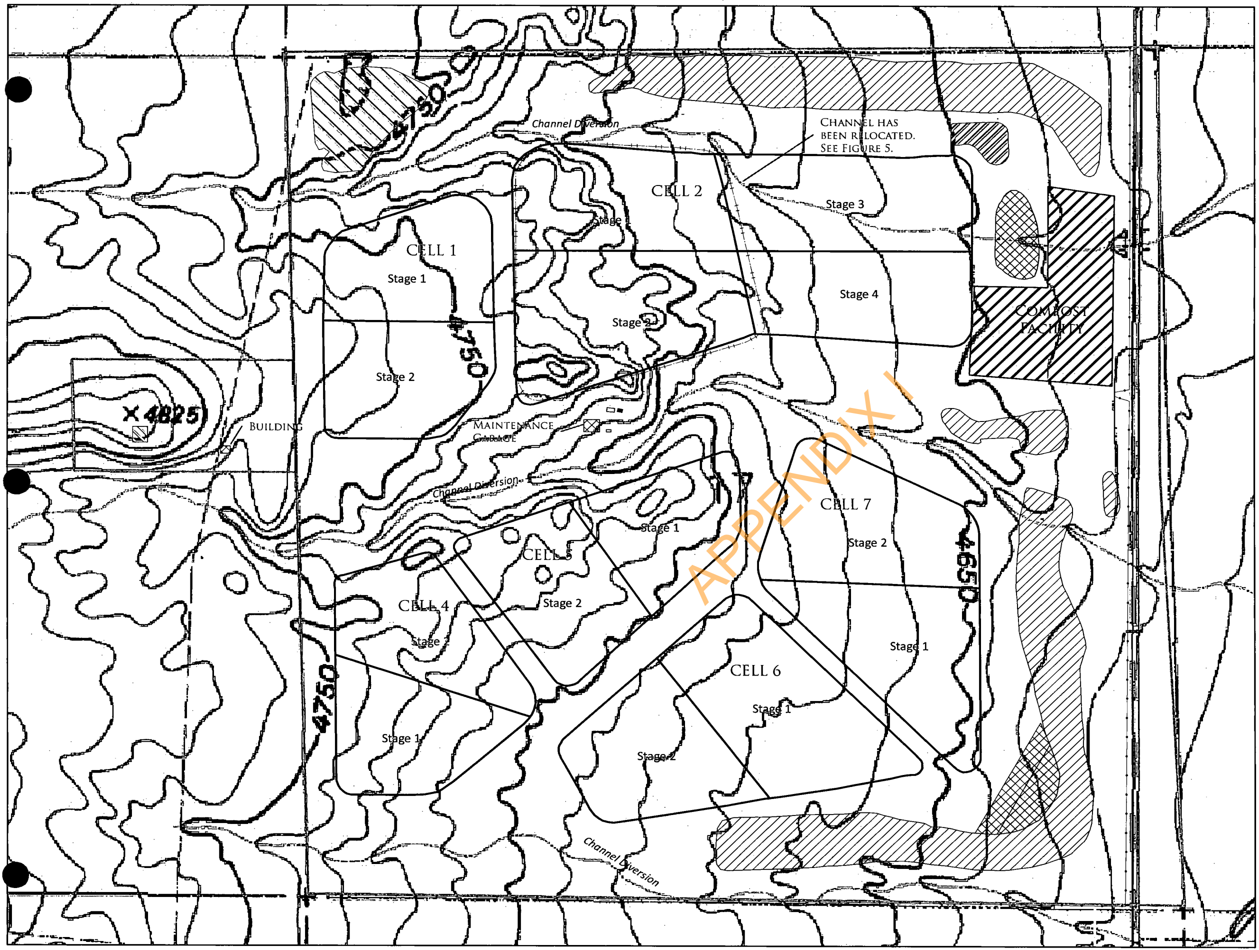
0 0.5 1
Miles

BAYVIEW LANDFILL

FIGURE 1

USGS Topographic Map
with Two Mile Boundary

Tuesday, January 13, 2009 1:58:43 PM



LEGEND

- ▨ Berm
- ☐ Cell
- ■ Cement Pad/Propane Tank
- ☐ Chain Link Fence
- ▨ Compost Facility
- ☐ Fuel Tank
- ▩ Leachate Basin
- ☐ Litter Control Fence
- ▨ Proposed Leachate Basin Location
- ☐ Septic Tank
- ▧ Soil Stockpile Area
- ▩ Structure
- ▧ Water Tank
- ☐ Property Line (Approximate)

USGS TOPOGRAPHIC MAP USED:
Goshen Valley North

N
S

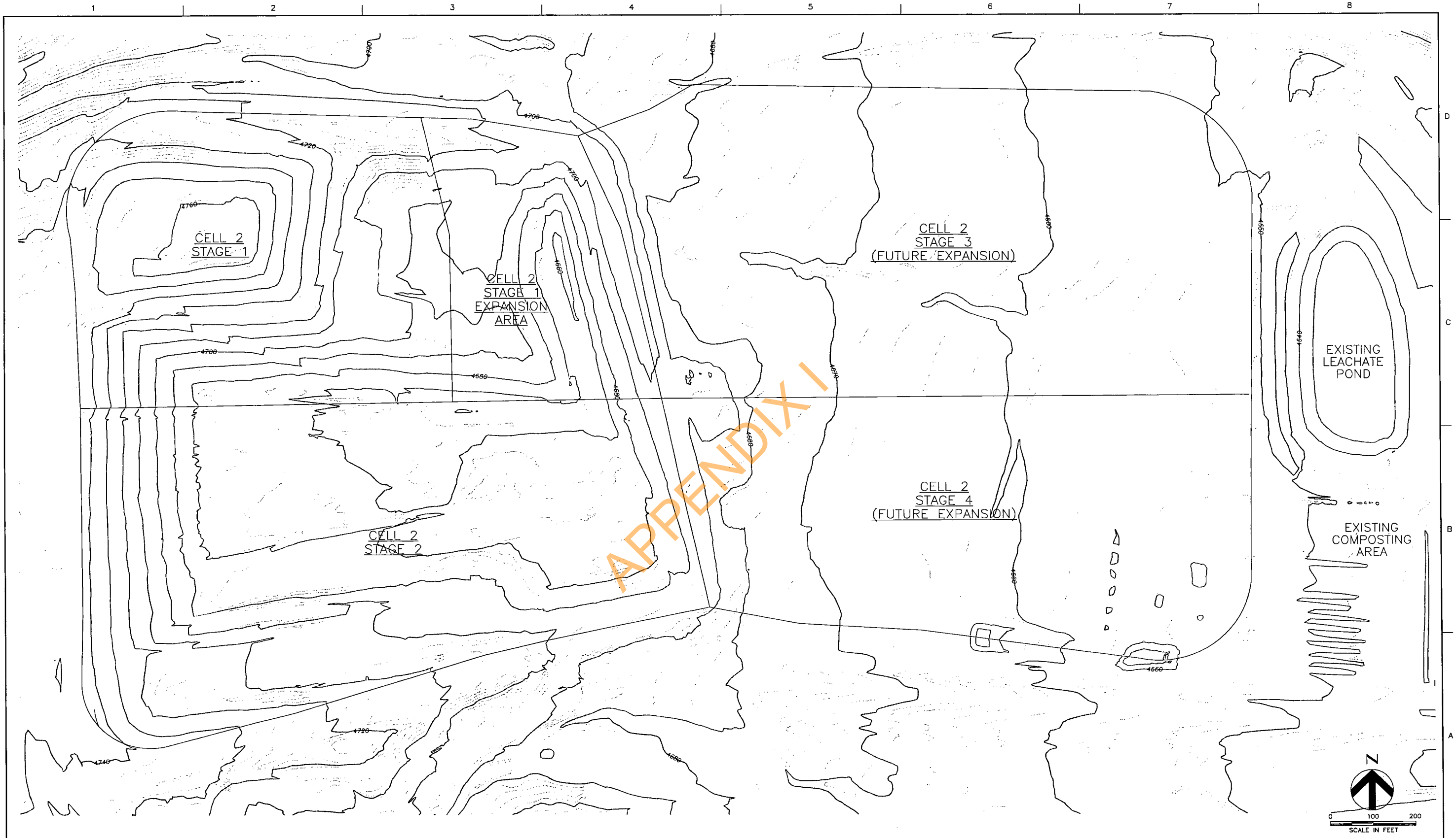
0 0.125 0.25
Miles

BAYVIEW LANDFILL

FIGURE 2

USGS Topographic Map
of Bayview Landfill

Monday, January 12, 2009 9:47:47 AM



HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION		
			PROJECT MANAGER	T. WARNER
			ARCHITECT	
			CIVIL	S. WOMACK
			MECHANICAL	
			ELECTRICAL	
			STRUCTURAL	
			DESIGNED	
			DRAWN BY	
			PROJECT NUMBER	96439

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
PERMIT APPLICATION

CELL 2 EXISTING CONTOURS

0 1" 2"

FILENAME FIGURE 3.DWG
SCALE AS SHOWN
FIGURE 3

BAYVIEW LANDFILL

FIGURE 4

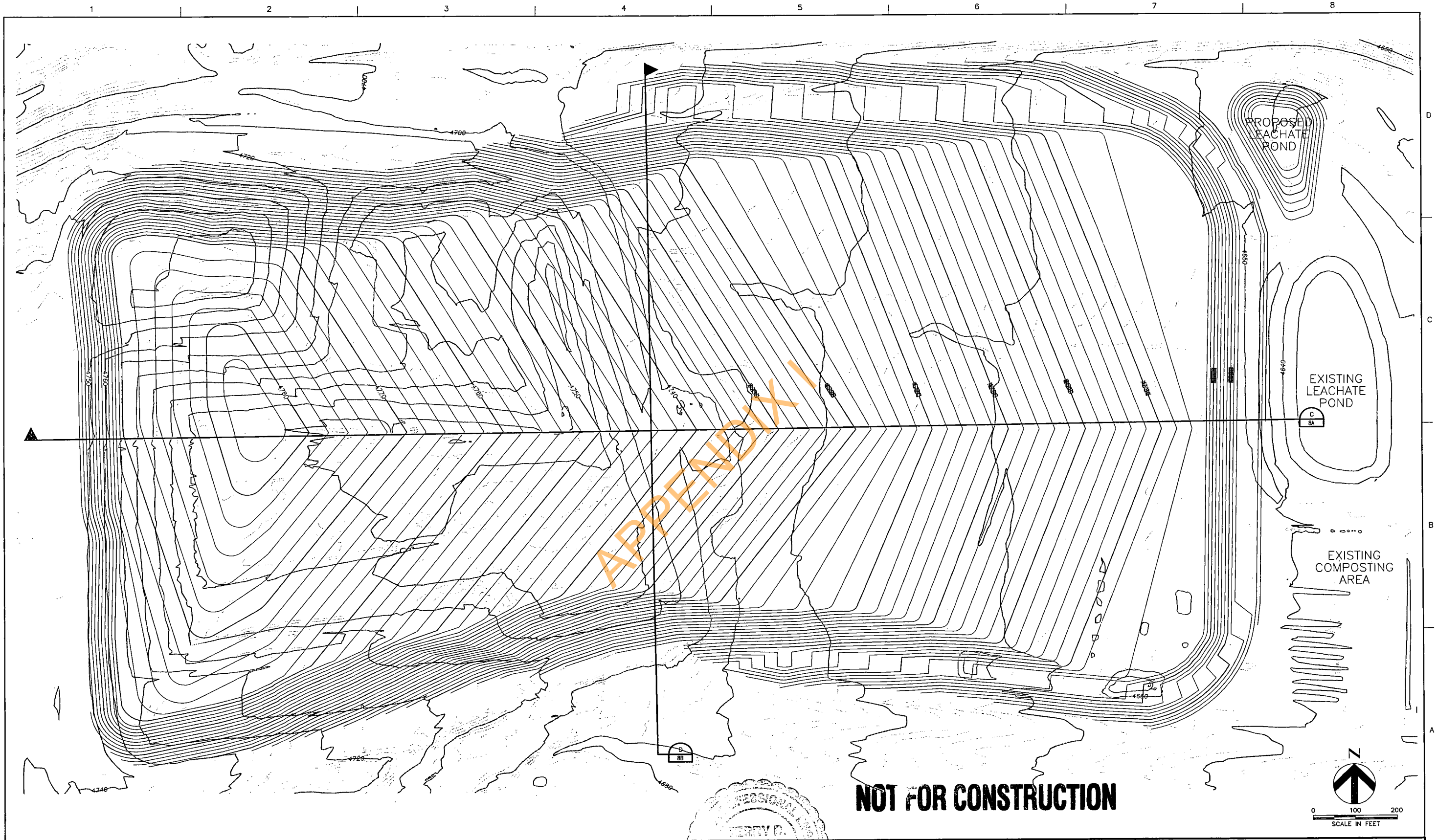
Earthquake Distribution Map

Friday, January 9, 2009 11:52:25 AM

BAYVIEW LANDFILL
FIGURE 5

Planned and Existing
Landfill Facilities

uesday, March 3, 2009 1:49:25 PM
:\SLC STAFF\Rosemary\SUVSWD\Bayview_Landfill\map_docs\mxd\map_bL_BayviewLandfill.mxd



NOT FOR CONSTRUCTION

TERRY D. WARNER

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	T. WARNER
ARCHITECT	
CIVIL	S. WOMACK
MECHANICAL	
ELECTRICAL	
STRUCTURAL	
DESIGNED	
DRAWN BY	
PROJECT NUMBER	96439

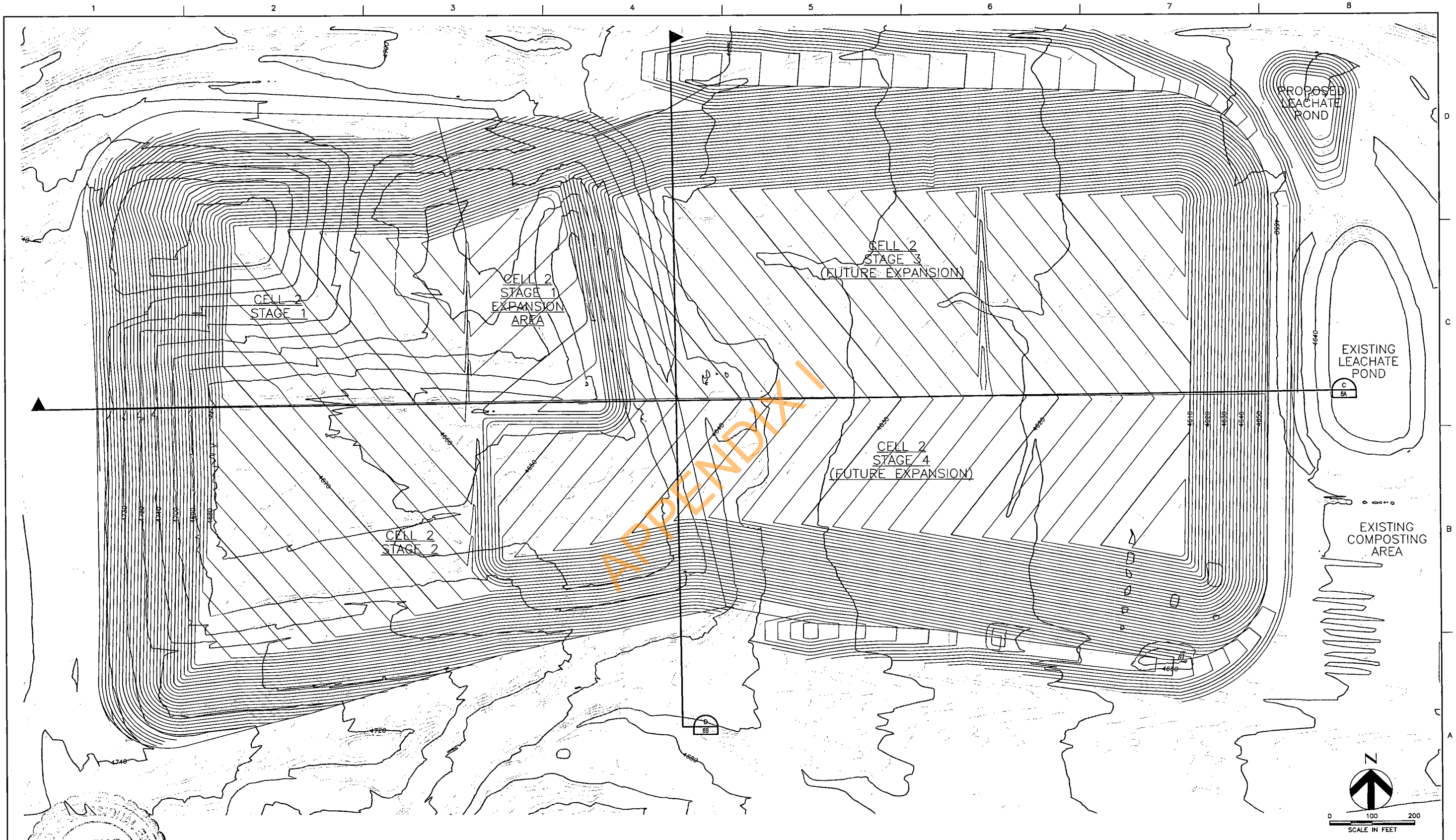
SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
PERMIT APPLICATION

CELL 2 FINAL CONTOURS

0 1" 2"

FILENAME	FIGURE 6.DWG
SCALE	1"=100'
FIGURE	6



HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

			PROJECT MANAGER	T. WARNER
			ARCHITECT	
			CIVIL	S. WOMACK
			MECHANICAL	
			ELECTRICAL	
			STRUCTURAL	
			DESIGNED	
			DRAWN BY	
ISSUE	DATE	DESCRIPTION	PROJECT NUMBER	96439

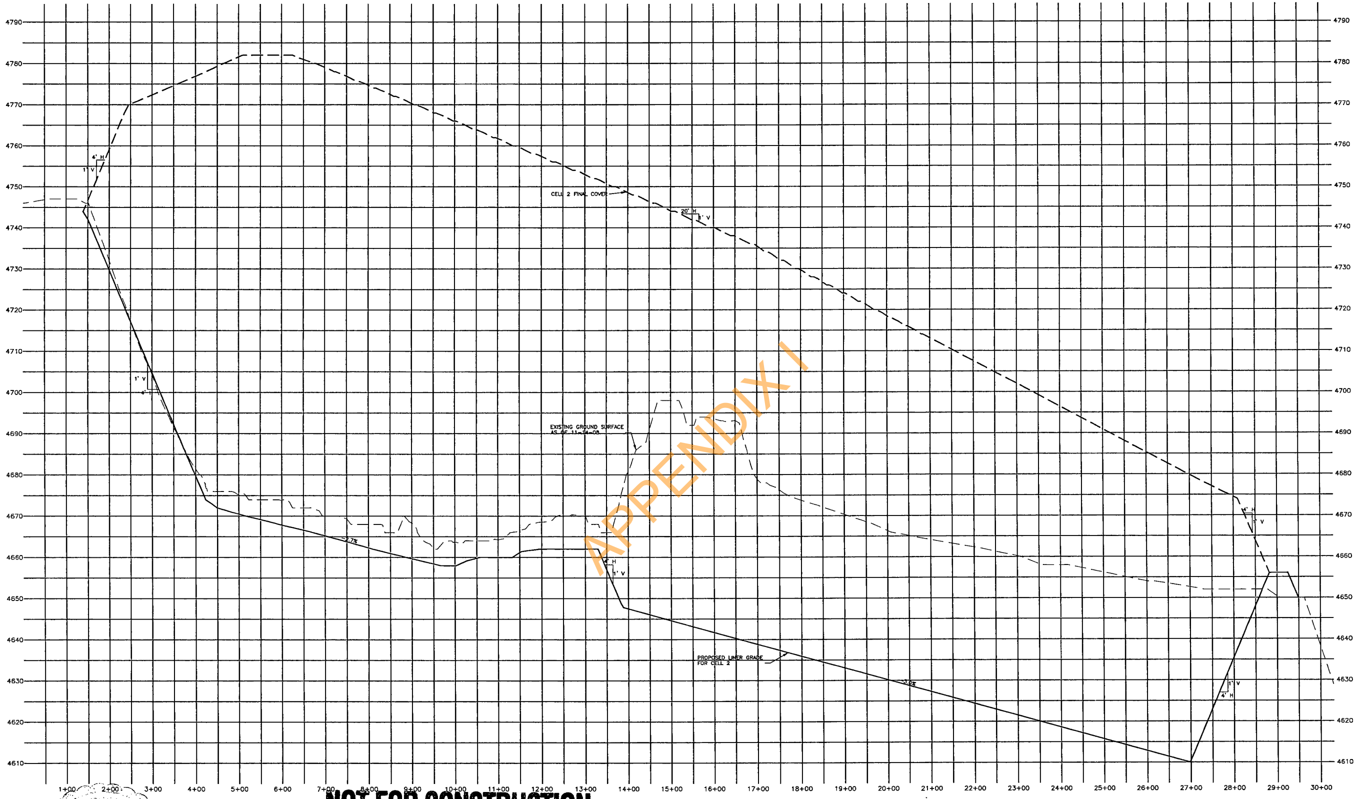
NOT FOR CONSTRUCTION

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT
BAYVIEW LANDFILL
PERMIT APPLICATION

CELL 2 LINER/EXCAVATION CONTOURS

0 1" 2"

FILENAME	FIGURE 7.DWG
SCALE	AS SHOWN
FIGURE	7



NOT FOR CONSTRUCTION

CROSS SECTION C

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	T. WARNER
ARCHITECT	
CIVIL	S. WOMACK
MECHANICAL	
ELECTRICAL	
STRUCTURAL	
DESIGNED	
DRAWN BY	
PROJECT NUMBER	96439

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

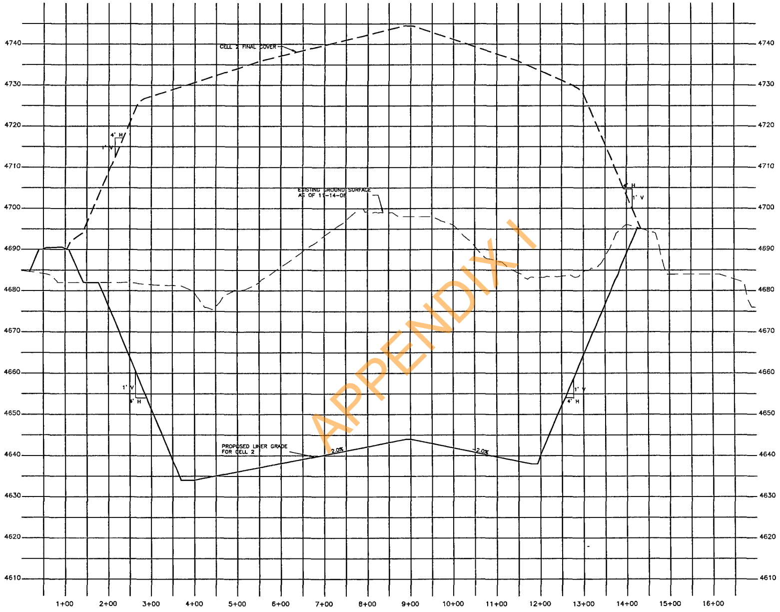
BAYVIEW LANDFILL
PERMIT APPLICATION

CELL 2
TYPICAL CROSS SECTION

0 1" 2"

FILENAME	00C-8.DWG
SCALE	H: 1"=100' V: 1"=10'

FIGURE
8A



CROSS SECTION D

NOT FOR CONSTRUCTION

TERRY R. WARNER

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

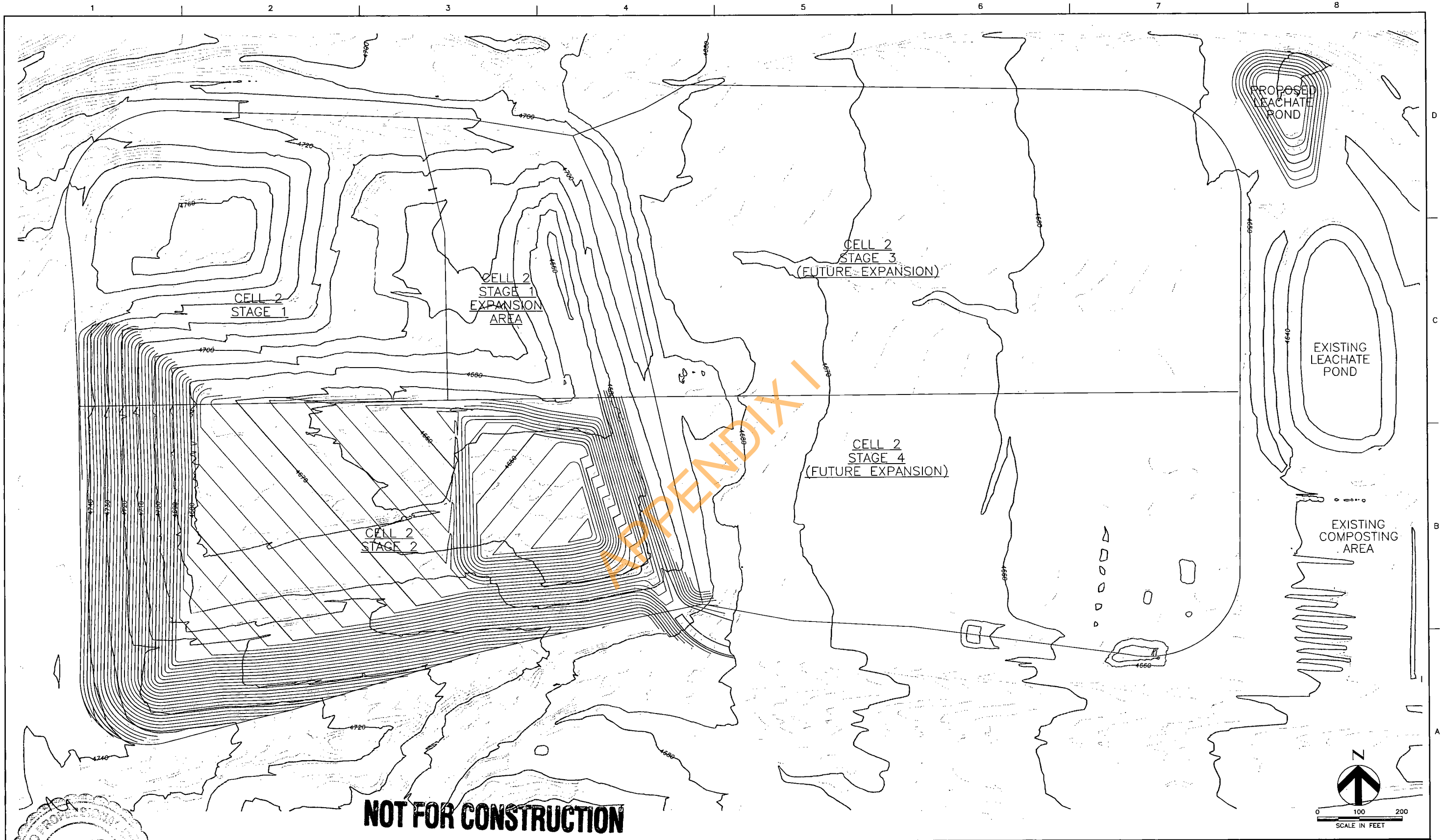
PROJECT MANAGER	T. WARNER
ARCHITECT	
CIVIL	S. WOMACK
MECHANICAL	
ELECTRICAL	
STRUCTURAL	
DESIGNED	
DRAWN BY	
PROJECT NUMBER	96439

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
PERMIT APPLICATION

CELL 2
TYPICAL CROSS SECTION

FILENAME	00C-8.DWG	FIGURE	8B
SCALE	NOT TO SCALE		



NOT FOR CONSTRUCTION

HDR
HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

			PROJECT MANAGER	T. WARNER
			ARCHITECT	
			CIVIL	S. WOMACK
			MECHANICAL	
			ELECTRICAL	
			STRUCTURAL	
			DESIGNED	
			DRAWN BY	
ISSUE	DATE	DESCRIPTION	PROJECT NUMBER	96439

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

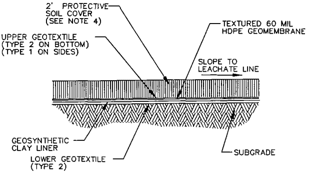
BAYVIEW LANDFILL
PERMIT APPLICATION

CELL 2 STAGE 1 & 2
LINER/EXCAVATION CONTOURS

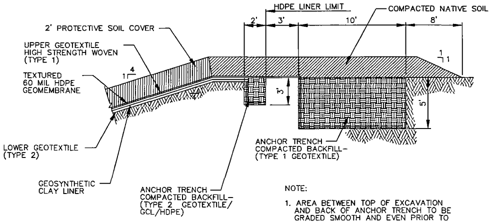
0 1" 2"

FILENAME FIGURE 9.DWG
SCALE AS SHOWN

FIGURE
9



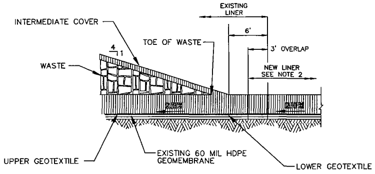
TYPICAL LANDFILL LINER DETAIL
NOT TO SCALE
1
C7



NOTE:

1. AREA BETWEEN TOP OF EXCAVATION AND BACK OF ANCHOR TRENCH TO BE GRADED SMOOTH AND EVEN PRIOR TO PLACING UPPER GEOTEXTILE. REMOVE ANGULAR STONES.

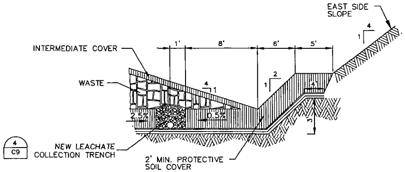
LINER SYSTEM ANCHOR TRENCH
NOT TO SCALE
2
C7



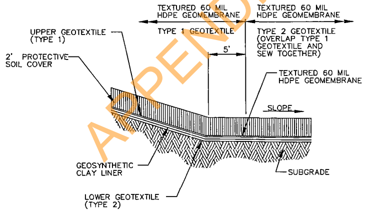
STAGE 1/STAGE 2 LINER CONNECTION
NOT TO SCALE
3
C7

NOTES:

1. TEMPORARY STORMWATER INTERCEPTOR BERM TO BE PLACED IN FRONT OF WORKING AREA TO DIVERT STORMWATER AWAY FROM ACTIVE FACE. OWNER WILL RELOCATE AS NEEDED.
2. STAGE 2 GEOMEMBRANE TO BE WELDED TO STAGE 1. FUTURE GEOSYNTHETIC COMPONENTS TO BE OVERLAPPED AND SECURED.
3. TYPE I GEOTEXTILE IS REINFORCED AND REQUIRED ON SIDE SLOPES ONLY, ABOVE HDPE LINER. TYPE 2 GEOTEXTILE IS NON–REINFORCED (NON–WOVEN) AND IS TO BE USED ABOVE HDPE LINER ON BOTTOM AND BETWEEN SUBGRADE AND GCL. A SAND CUSHION MAY BE USED IN LIEU OF THE LOWER TYPE 2 GEOTEXTILE WITH PRIOR APPROVAL OF ENGINEER AND OWNER.
4. SEE SPECIFICATION 02240 FOR PROTECTIVE COVER MATERIAL REQUIREMENTS.



STAGE 2 EASTERN LINER TERMINATION
NOT TO SCALE
4
C7



LINER AT SLOPE TRANSITION
NOT TO SCALE
5
C7

NOTE: THICKNESS MEASURED PERPENDICULAR TO EXCAVATION SURFACE.

GEOTEXTILE SCHEDULE

LOCATION	TYPE	COMMENTS
ALL	ALL	REMOVE ALL ANGULAR STONES GREATER THAN 0.5 INCHES
LOWER GEOTEXTILE	2	USE 16 OZ/SY NON–WOVEN IF ROUNDED STONES GREATER THAN 2.5 INCHES ARE REMOVED. USE 20 OZ/SY NON–WOVEN IF ONLY ROUNDED STONES GREATER THAN 4 INCHES ARE REMOVED. NO HORIZONTAL SEAMS ON SIDESLOPES.
UPPER GEOTEXTILE ON SIDESLOPES	1	REINFORCED GEOTEXTILE. NO HORIZONTAL SEAMS ON SIDESLOPES.
UPPER GEOTEXTILE ON BOTTOM (FLOOR)	2	USE 12 OZ/SY NON–WOVEN BENEATH DUNE SAND (PROTECTIVE SOIL COVER)

NOT FOR CONSTRUCTION

TERRY R.

HDR
HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107–2594

ISSUE	DATE	DESCRIPTION		
			PROJECT MANAGER	T. WARNER
			ARCHITECT	
			CIVIL	S. WOMACK
			MECHANICAL	
			ELECTRICAL	
			STRUCTURAL	
			DESIGNED	
			DRAWN BY	
			PROJECT NUMBER	96439

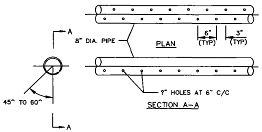
SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
PERMIT APPLICATION

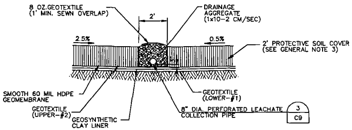
LINER DETAILS

0 1" 2"

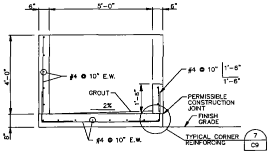
FILENAME FIGURE 10.DWG
SCALE N/A
FIGURE
10



8" DIA. PERFORATED LEACHATE COLLECTION PIPE
3 / C9
NOT TO SCALE



LEACHATE COLLECTION TRENCH
4 / C9
NOT TO SCALE



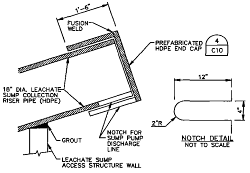
LEACHATE SUMP ACCESS STRUCTURE– SECTION
5 / C9
NOT TO SCALE

CONCRETE NOTES:

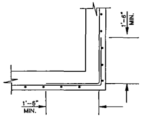
1. ALL CONCRETE SHALL HAVE 4000PSI COMPRESSIVE STRENGTH @ 28 DAYS, NORMAL WEIGHT.
2. ALL CONCRETE SHALL BE IN ACCORDANCE WITH THE "BUILDING CODE REQUIREMENT FOR REINFORCED CONCRETE" ACI–318 LATEST EDITION.
3. REINFORCING BARS SHALL CONFORM TO SPECIFICATIONS FOR "DEFORMED BILLET–STEEL FOR CONCRETE REINFORCEMENT" WITH 60KSI YIELD STRENGTH; ASTM A615 GRADE 60.
4. REINFORCING BARS TO BE WELDED SHALL COMPLY WITH THE REQUIREMENT OF ASTM A706 GRADE 60.
5. COVER ON ALL REINFORCEMENT SHALL BE AS FOLLOWS, UNLESS OTHERWISE NOTED:
   - i CONCRETE PLACED AGAINST GROUND 3 IN
   - ii EXPOSED FORMED SURFACES
     - A. #5 AND SMALLER 1.5 IN
     - B. #6 AND LARGER 2 IN
6. ALL EXPOSED CORNERS SHALL HAVE 1 IN CHAMFER, UNLESS OTHERWISE NOTED.
7. SAWED GROOVES SHOULD BE MADE WITHIN APPROXIMATELY 4 TO 12 HOURS OF SLAB OR PAVEMENT FINISHING. IF THIS IS NOT PRACTICABLE, USE PREMOLDED STRIPS.
8. AS AN ALTERNATIVE, A PRECAST CONCRETE BOX MAY BE USED. THE PRECAST BOX SHOULD HAVE A MINIMUM CONCRETE COMPRESSIVE STRENGTH OF 5000 PSI @ 28 DAYS.

GENERAL NOTES:

1. LEACHATE RETURN LINE IS TO ALLOW ANY SPILLAGE OR RAINWATER ACCUMULATION IN SUMP ACCESS STRUCTURE TO RETURN TO LANDFILL SUMP FOR REMOVAL. GROUT BOTTOM OF STRUCTURE TO VALVE AFTER INSTALLATION, IF NECESSARY.
2. GROUT BOTTOM TO DRAIN TO RETURN LINE.
3. SEE SPECIFICATION SECTION 02240 FOR PROTECTIVE SOIL COVER REQUIREMENTS.

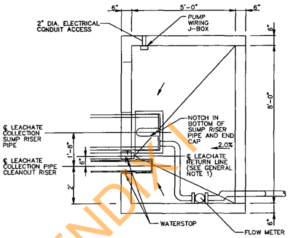


18" DIA. SUMP RISER PIPE
6 / C9
NOT TO SCALE

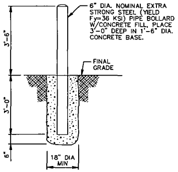


ALL LAP SPLICES FOR #4 BAR

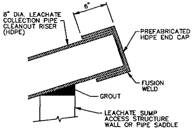
TYPICAL CORNER REINFORCING
7 / C9
NOT TO SCALE



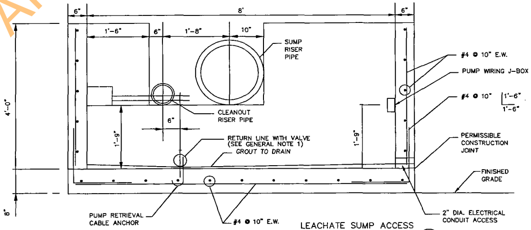
LEACHATE SUMP ACCESS STRUCTURE– PLAN
8 / C9
NOT TO SCALE



TYPICAL BOLLARD
10 / C9
NOT TO SCALE



8" DIAMETER CLEANOUT RISER PIPE END CAP
11 / C9
NOT TO SCALE



NOTE:
THIS AREA IS CORROSIVE.

LEACHATE SUMP ACCESS STRUCTURE– SECTION
9 / C9
NOT TO SCALE

NOT FOR CONSTRUCTION

TERRY R. WARNER

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107–2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	T. WARNER
ARCHITECT	
CIVIL	S. WOMACK
MECHANICAL	
ELECTRICAL	
STRUCTURAL	
DESIGNED	
DRAWN BY	
PROJECT NUMBER	96439

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
PERMIT APPLICATION

CELL 2 LEACHATE COLLECTION SYSTEM
AND LINER DETAILS

0 1" 2"

FILENAME	FIGURE 11.DWG
SCALE	N/A

FIGURE
11

Building and Conditional Use Permit

APPENDIX I

BUILDING PERMIT APPLICATION

Issued By

Permit Number UC 66744

Dist.	Application Date	Plans	Survey	Plot Plan	Type Con.
S	9-30-87	✓		✓	

To Be Filled in by Applicant — PLEASE PRINT OR TYPE

Owner PROVO CITY CORP. Phone No. 375-1822

Owner's Mailing Address 351 WEST CENTER City PROVO, UT Zip 84603

JOB SITE ADDRESS 5914 S 12800 W CITY Sec. 17 Twn. 9S Rng. 1W

Lot No Subdivision Tax Serial No. 61:013:0001

Existing Use of Parcel		Intended Use of Parcel	
☒ Vacant	☐ Commercial Specify Type	☐ Agriculture	☐ Commercial / Specify Type
☐ Agriculture	☐ Industrial Specify Type	☐ Single Family	☐ Industrial, Specify Type
☐ Single Family	☐ Other / Specify Type	☐ Duplex	☒ Other Specify Type LAND FILL AND ASSOCIATED OPERATIONS STRUCTURES
☐ Duplex	☐	☐ Multiple Units	☐
☐ Multiple Units	☐	☐	

No. Dwell Units	Owner Occupied or Rental	No. Bedrooms	No. Stories	Occupant Load
0			1	

Bldg. Dimensions	Carport Garage Dim	Attached	No. Parking Spaces	Fire Place
80' x 100'	—	~~No Yes~~		Yes No

Lot Dimensions	No. Dwell Units Now on Lot	Other Buildings now on lot and use
660 Ac.	0	NONE (WELL)

Contractor PROVO CITY Arch. Eng Phone No.

Contractor's Mailing Address PROVO CITY City Zip Phone No.

FLOOR	EXT. WALLS	INT. WALLS	CEILING	ROOF	HEATING	SEWAGE
___ Conc	☐ Masonry	☐ Masonry	☐ Open Beam	☐ Wood Sh	☐ Elect	☐
___ Wood	☐ Frame	☐ Frame	☐ Plaster	☐ Comp. Sh.	☐ Nat. Gas	☐ Public
___	☐ Stucco	☐ Plaster	☐ Sheetrock	☐ Built-up	☐ L.P.G.	☐ Private
___	☐ Siding	☐ Sheetrock	☐ Wood	☐ Metal	☐ Oil	☐
	☐ Metal	☐ Wood	☐ Fiber Board	☐ Shake	☐ Solid	☐

APPLICANT PLEASE READ CAREFULLY

I agree to comply with all City, County and State Building Laws and Ordinances, and that the representations in this application for a building permit are true and accurate, and any misrepresentations or errors herein, are the sole responsibility of applicant, and shall in no way incur or accrue liability or obligation to enforcing officers or agents.

This permit becomes null and void if work on construction authorized is not commenced within 120 days, or if construction or work is suspended or abandoned for a period of 120 days at any time after work is commenced.

OCCUPANCY OF STRUCTURE IS PROHIBITED UNTIL AFTER FINAL INSPECTION AND ZONING AND OCCUPANCY COMPLIANCE CERTIFICATE IS ISSUED.

I HAVE CHECKED THE SEWER DEPTH OF ABOVE LOT AND WILL TAKE ALL RESPONSIBILITY FOR SETTING BUILDING ACCORDINGLY.

Owner's Signature Provo City Corp. by

Contractor's Signature License No.

FOR DEPARTMENT USE ONLY

Date Permit Issued 9-30-87

Bldg. Insp. Signature N/A (PROVO CITY)

ZONE M & G-1

Fire Zone 1 2 3 4 5 6 7 8 9 9a 9b 10

TYPE	FEE
Temp. Power	
Sewer Fee	
Water Fee	
Plan Ck. Fee	
Constr. Fee	
Elect. Fee	
Plumbing Fee	
Heating Fee	
Off Site Fee	
Bldg. Permit Fee	
TOTAL FEE	$ FEE WAIVED
Total Valuation	$ PER SUBMIT LETTER

Receipt No.

Cash

Check No.

FLOORS	Sq. Ft.
1 ~~[illegible]~~ 1	8000
2	
3	
Carport/Gar.	

Minimum Property Setback Distan

100 Front Setback from ~~P.L.~~ CL OF HW

30 Rear Setback from property line

12 Side Street Setback from P.L.

12 Side Setback from property line

___ Side Setback from property line

COMMENTS

N

W

E

S

AS PER UTAH COUNTY BOARD OF ADJUSTMENT APPEAL # 653, MUST COMPLY WITH ALL 26 CONDITIONS LISTED. AND BY CIVIL COURT ORDER NO. 80-CV-219[illegible] SEPT 24, 1987

APPROVAL OF SEWAGE FACILITY
(Private System Only)

The above applicant agrees to construct sewage facilities in conformity with Utah County and Utah State regulations.

Septic Tank 750 min. gallons.

Absorption field 115 lineal ft. of 3 ft. wide trench.

Seepage pit ___ Absorption bed ___ sq. ft.

Water Supply well

Date Sept. 30, 19 87

Approved Glade H. Shelley
Utah County Health Department

TO BE FILLED IN BY PLANNING OFFICE

TRAFFIC ZONE	CENSUS TRACT	CENSUS BLOCK NO	SLU CODE

Distribution List: White - Office Green - [illegible] Yellow - Office Duplicate Pink - Assessor Gold - Customer

APPENDIX

1. Compacted or baled garbage will be placed in trenches and covered at the end of each day.

2. The waste shall be buried away from the gravel pit area.

3. A fence shall be installed surrounding each trench area at least eight (8) feet in height and higher if found inadequate to control blowing papers.

4. After an area has been filled, it will be contoured, mulched, and reseeded as indicated by the State Agronomist and the State Extension Service.

5. There will be a watchman on site during work hours.

6. The gate will be closed any time it is unattended; and it must be locked. (This is the main gate, not that around the particular area being filled.)

7. A new access road from the state highway into the deposit area will be provided as required by the Department of Transportation.

8. The size of the garbage trucks shall meet requirements of the Utah Department of Transportation and Utah Highway Patrol.

9. Provo City will cooperate with the State Highway Department and local residents to prevent inordinate damage to the road during periods when the road is saturated and subject to destruction; and comply with all state and local ordinances conforming to same.

10. All garbage would be collected and compacted at a location other than the landfill site and transported in covered trucks by Provo City.

11. No burning is to be allowed at the disposal site.

12. The trenching shall be done in such a manner as to protect the drainage channels in the area as required by the State Department of Environmental Health.

13. No hazardous wastes shall be deposited in the area.

14. All reasonable caution and prudence be exercised to not dispose of any waste during any unreasonable weather conditions.

15. All requirements in the "Code of Solid Waste Disposal Regulations" be met.

16. Any terms of the lease held by Mr. Jacobs be protected and that Provo City cooperate with him during lambing season to minimize the impact on his operation.

17. No public dumping.

18. Landfill to be used only by Provo City and if other cities are to use the landfill, approval from the Board of Adjustment would be necessary.

19. Personnel will police the grounds outside of the fence, and keep litter and garbage picked up.

20. Rodent control must be in effect at all times as state law provides.

21. Water samples will be taken by the Department of Environmental Health from any wells within 1500' of the disposal site prior to any dumping to determine the water quality. Samples would be taken every six months or more often as determined by the Department of Environmental Health.

22. The area used to begin the operation of filling must be selected to minimize the impact on people in the surrounding area.

23. In constructing the road or roads required by the Department of Transportation to get access to the landfill; Provo City shall minimize the amount of disruption to the environment of the area.

24. That Provo City maintain a buffer zone of at least 100' from existing state roads, homes and premises in dumping their compacted garbage.

25. Upon noncompliance with any of these provisions Utah County may revoke said right to the landfill.

26. Provo City will provide an annual report to the Board of Adjustment for their review, as to the progress in the engineering of the landfill.

APPENDIX J – LEACHATE GENERATION & HYDRAULIC HEAD ON LINER

APPENDIX K

ATTACHMENT 2:
LEACHATE GENERATION / HYDAULIC HEAD ON LINER

Job No. | No.

HDR Computation

HDR

Project Bayview Landfill | Computed KDG | Date 6/23/03
Subject Leachate Collection System | Checked [illegible] | Date 6/24/03
Task Leachate Generation/Hydraulic Head on Liner | Sheet 1 | Of 25

1.0 Progression of Cell 2 (Stage 1 and 2)

Cell 2 has a total area of approximately 82 acres, however only the first 30 acres to be filled were considered in the Hydrologic Evaluation of Landfill Performance (HELP) model. The first 30 acres of Cell 2 will have a life of approximately 15 years. Therefore, the following progression is used:

(1) one acre with an initial lift of 10 feet and 6" of daily cover for 1 year

(2) one acre with 130 feet of waste and 12" of intermediate cover for 30 years

(One acre is used as the default area for all HELP model runs. The results may be extrapolated to obtain results for any area.)

For condition one, the HELP model used a user specified precipitation file that contained the five wettest years at the landfill location.

For condition two, the HELP model used synthetic precipitation data for Salt Lake City, Utah to simulate 30 years of rainfall falling on the landfill.

Job No.
No.

HDR Computation

HDR

Project Bayview Landfill
Computed KDG
Date 6/23/03
Subject Leachate Collection System
Checked Smo
Date 6/24/03
Task
Sheet 2
Of 25

2.0 Climatologic and Rainfall Data

The five wettest year precipitation file was used to simulate precipitation for the first year of life for Cell 2.

The synthetic rainfall generator (SRG) was used for Salt Lake City, Utah for 30 years. The SRG was then adjusted to Bayview Landfill using monthly temperature and precipitation odata (REF. 4) for Fairfield, Utah.

The maximum leaf area index for Bare Ground and poor stand of grass is 0 and 1, respectively.

Evaporative zone depth for bare ground for Salt Lake City is 16 inches.

Pg. 3/25

APPENDIX J

REF 4

Fairfield

County: Utah Latitude: 40°16' Longitude: 112°05' Elevation: 4880 feet Period: 1950-1992*

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Normal max temp	37.1	43.4	52.4	62.2	71.8	81.8	88.9	87.2	78.9	65.7	50.4	38.6	63.2
Normal min temp	10.2	16.9	24.2	29.2	36.1	43.7	50.9	48.8	39.5	29.3	21.2	12.2	30.2
Normal mean temp	23.6	30.1	38.3	45.7	54.0	62.7	69.9	68.0	59.2	47.5	35.8	25.4	46.7
Record high temp	63	70	77	85	91	99	100	99	95	88	78	65	100
Record low temp	-29	-36	-11	10	16	17	32	27	18	4	-20	-29	-36
Normal pcpn	0.98	0.96	1.11	1.01	1.06	0.79	1.09	1.16	1.09	1.25	0.99	0.91	12.39
Record mly pcpn	2.37	3.29	3.86	2.53	3.41	2.90	5.23	4.77	5.29	3.02	2.70	3.08	5.29
Record dly pcpn	0.85	1.03	1.31	1.01	2.00	0.98	1.50	1.26	1.13	1.55	0.87	0.77	2.00
Normal snowfall	9.2	6.2	5.8	2.1	0.3	0.0	0.0	0.0	0.0	1.2	4.6	8.8	38.2
Record mly snow	27.0	28.5	13.0	20.0	4.0	0.0	0.0	0.0	0.5	6.0	18.0	32.0	32.0
Record dly snow	12.0	12.0	7.0	6.0	4.0	0.0	0.0	0.0	0.5	4.0	10.0	10.5	12.0
Evapotranspiration	0.86	1.38	2.62	4.17	6.08	7.43	8.38	7.31	5.06	3.07	1.40	0.83	48.57

*Percentage of period with data: 89% for temperature, 92% for precipitation, 89% for snowfall.

✓

Job No.
No.

HDR Computation

HDR

Project Bayview Landfill
Computed KDG
Date 6/23/03
Subject Leachate Collection System
Checked
Date 6/24/03
Task
Sheet 4
Of 25

3.0 Soil and Layer Data

Default layer types and soil textures in the HELP model were used for the following conditions:

Condition 1

6" of daily cover (Texture 6)
10" of waste (Texture 18)
24" of lateral drainage (Texture 6)
Flexible Membrane Liner (Texture 35)
Bentonite Mat (Texture 17)

Condition 2

12" of intermediate cover (Texture 6)
1560" of waste (Texture 18)
24" of lateral drainage (Texture 6)
Flexible Membrane Liner (Texture 35)
Bentonite Mat (Texture 17)

To be conservative, the intermediate cover, daily cover, lateral drainage layer and the barrier soil liner were all assumed to be saturated at the beginning of the simulation for both conditions. Based on Davis County Solid Waste Management and Energy Recovery Special Service District records, the solid waste moisture content for this area averaged 16 to 18% by weight.

Job No.

No.

HDR Computation

Project Bayview Landfill
Computed KDG
Date 6/23/03
Subject Leachate Collection System
Checked
Date 6/24/03
Task
Sheet 5
Of 25

Using 17% moisture by weight (weight of water by weight of waste), initial moisture content by volume (volume of water per volume of waste) for incorporation into the HELP model was estimated as follows:

$\Theta \equiv$ moisture content by volume $= w(\tau_d/\rho_w)$

$w \equiv$ moisture content by weight $= 17\%$
$\tau_d \equiv$ dry density of waste $= 41\ \text{lb/ft}^3$
$\rho_w \equiv$ density of water @ $50°F = 62.4\ \text{lb/ft}^3$

$$\Theta = .17\left(\frac{41}{62.4}\right) = .11$$

4.0 Landfill Profiles and Layer Properties

Condition 1

6" daily cover 10' of waste	} Type 1
* 24" of Lateral Drainage	-Type 2
** 60-mil FML	-Type 4
*** .25" Bentonite Mat	-Type 3

Job No.
No.

HDR Computation

Project Bayview Landfill
Computed KDG
Date 6/23/03
Subject Leachate Collection System
Checked MWO
Date 6/24/03
Task
Sheet 6
Of 25

Condition 2

12" Intermediate cover } Type 1
130' of Waste }
*24" Lateral Drainage Layer - Type 2
** 60-mil FML - Type 4
***.25" Bentonite Mat - Type 3

Type 1 ≡ vertical percolation layer
Type 2 ≡ lateral drainage layer
Type 3 ≡ Bentonite mat
Type 4 ≡ FML

* Geotextile used as filter layer for leachate collection track was not considered as a vertical drainage layer; resulting in a conservative impingement rate.

** Assumed pinhole density = 0.75 holes/acre; Installed defects = 2 holes/acre; good placement quality

*** Geotextile used as cushion underneath barrier soil was not considered as a vertical drainage layer.

pg. 7/25

TABLE 4. DEFAULT SOIL, WASTE, AND GEOSYNTHETIC CHARACTERISTICS

REF. 1

Classification			Total Porosity	Field Capacity	Wilting Point	Saturated Hydraulic Conductivity
HELP	USDA	USCS	vol/vol	vol/vol	vol/vol	cm/sec
1	CoS	SP	0.417	0.045	0.018	$1.0x10^{-2}$
2	S	SW	0.437	0.062	0.024	$5.8x10^{-3}$
3	FS	SW	0.457	0.083	0.033	$3.1x10^{-3}$
4	LS	SM	0.437	0.105	0.047	$1.7x10^{-3}$
5	LFS	SM	0.457	0.131	0.058	$1.0x10^{-3}$
6	SL	SM	0.453	0.190	0.085	$7.2x10^{-4}$
7	FSL	SM	0.473	0.222	0.104	$5.2x10^{-4}$
8	L	ML	0.463	0.232	0.116	$3.7x10^{-4}$
9	SiL	ML	0.501	0.284	0.135	$1.9x10^{-4}$
10	SCL	SC	0.398	0.244	0.136	$1.2x10^{-4}$
11	CL	CL	0.464	0.310	0.187	$6.4x10^{-5}$
12	SiCL	CL	0.471	0.342	0.210	$4.2x10^{-5}$
13	SC	SC	0.430	0.321	0.221	$3.3x10^{-5}$
14	SiC	CH	0.479	0.371	0.251	$2.5x10^{-5}$
15	C	CH	0.475	0.378	0.265	$1.7x10^{-5}$
16	Barrier Soil		0.427	0.418	0.367	$1.0x10^{-7}$
17	Bentonite Mat (0.6 cm)		0.750	0.747	0.400	$3.0x10^{-9}$
18	Municipal Waste (900 lb/yd^3 or 312 kg/m^3)		0.671	0.292	0.077	$1.0x10^{-3}$
19	Municipal Waste (channeling and dead zones)		0.168	0.073	0.019	$1.0x10^{-3}$
20	Drainage Net (0.5 cm)		0.850	0.010	0.005	$1.0x10^{+1}$
21	Gravel		0.397	0.032	0.013	$3.0x10^{-1}$
22	L*	ML	0.419	0.307	0.180	$1.9x10^{-5}$
23	SiL*	ML	0.461	0.360	0.203	$9.0x10^{-6}$
24	SCL*	SC	0.365	0.305	0.202	$2.7x10^{-6}$
25	CL*	CL	0.437	0.373	0.266	$3.6x10^{-6}$
26	SiCL*	CL	0.445	0.393	0.277	$1.9x10^{-6}$
27	SC*	SC	0.400	0.366	0.288	$7.8x10^{-7}$
28	SiC*	CH	0.452	0.411	0.311	$1.2x10^{-6}$
29	C*	CH	0.451	0.419	0.332	$6.8x10^{-7}$
30	Coal-Burning Electric Plant Fly Ash*		0.541	0.187	0.047	$5.0x10^{-5}$
31	Coal-Burning Electric Plant Bottom Ash*		0.578	0.076	0.025	$4.1x10^{-3}$
32	Municipal Incinerator Fly Ash*		0.450	0.116	0.049	$1.0x10^{-2}$
33	Fine Copper Slag*		0.375	0.055	0.020	$4.1x10^{-2}$
34	Drainage Net (0.6 cm)		0.850	0.010	0.005	$3.3x10^{-1}$

* Moderately Compacted (Continued)

pg. 8/25

TABLE 4 (continued). DEFAULT SOIL, WASTE, AND GEOSYNTHETIC CHARACTERISTICS

REF. 1

Classification		Total Porosity	Field Capacity	Wilting Point	Saturated Hydraulic Conductivity
HELP	Geomembrane Material	vol/vol	vol/vol	vol/vol	cm/sec
35	High Density Polyethylene (HDPE)				$2.0x10^{-13}$
36	Low Density Polyethylene (LDPE)				$4.0x10^{-13}$
37	Polyvinyl Chloride (PVC)				$2.0x10^{-11}$
38	Butyl Rubber				$1.0x10^{-12}$
39	Chlorinated Polyethylene (CPE)				$4.0x10^{-12}$
40	Hypalon or Chlorosulfonated Polyethylene (CSPE)				$3.0x10^{-12}$
41	Ethylene-Propylene Diene Monomer (EPDM)				$2.0x10^{-12}$
42	Neoprene				$3.0x10^{-12}$

(concluded)

Job No.

No.

HDR Computation

Project Bayview Landfill
Computed KDG
Date 6/23/03
Subject Leachate Collection System
Checked MWO
Date 6/24/03
Task
Sheet 9
Of 25

The maximum drainage pathway is 1400 feet; 230 feet at 25% slope and 1170 feet at 3% slope (page 10). Since two slopes contribute to the drainage pathway, the maximum drainage pathway is estimated as follows:

$$L_E' = L_E + L_E(Q_1/Q_2)$$

L_E' ≡ maximum drainage pathway
L_E ≡ 1400 feet
Q_1 ≡ leachate flowrate at 25% slope
Q_2 ≡ leachate flowrate at 3% slope

Based on impingment rates from a 25% slope, Q_1 is estimated as zero.

$$\Rightarrow L_E' = 1400' + 14\cancel{00'(Q_1/Q_2)}^{\to 0} = 1400'$$

For HELP Model, 1170 feet at 3% slope will be used.

5.0 Leachate Generation

From the HELP model, the following leachate generations were estimated:

Condition 1

1acre area with 10' of waste and 6" of daily cover for a drainage pathway of 1170' at a 3% slope = 0 in/day (page 17).

Job No.		No.	

HDR Computation HDR

Project	Bayview Landfill	Computed KDG	Date 6/23/03
Subject	Leachate Collection System	Checked MWO	Date 6/24/03
Task		Sheet 11	Of 25

Condition 2

1 acre area with 130' of waste and 12" of intermediate cover for a drainage pathway of 1170' at a 3% slope = 0 in/day (page 24).

6.0 Maximum Depth of Hydraulic Head on Liner System

Since the maximum lateral drainage rate (pg. 17 and 24) is approximately 0 in/day for each condition, the maximum head on the liner system approaches 0 feet. This is less than the 12 inch limit established in R315 - Environmental Quality, Solid and Hazardous Waste.

APPENDIX J

```
 ******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:     C:\HELP3\SUV\WET5_AV.D4
TEMPERATURE DATA FILE:       C:\HELP3\SUV\FAIRFIED.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\SUV\SLCDFLT.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\SUV\SLCDFLT.D11
SOIL AND DESIGN DATA FILE:   C:\HELP3\SUV\BVIEW1YR.D10
OUTPUT DATA FILE:            C:\HELP3\SUV\BVIEW1YR.OUT


TIME:  11:14      DATE:    6/26/2003


******************************************************************************

     TITLE:  Bayview Cell#2  Year 1

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                 LAYER  1
                                 --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER    6
           THICKNESS                      =      6.00    INCHES
           POROSITY                       =      0.4530 VOL/VOL
           FIELD CAPACITY                 =      0.1900 VOL/VOL
           WILTING POINT                  =      0.0850 VOL/VOL
           INITIAL SOIL WATER CONTENT     =      0.1900 VOL/VOL
           EFFECTIVE SAT. HYD. COND.      =  0.720000011000E-03 CM/SEC
```

p. 12/25

```
                         LAYER  2
                         --------

              TYPE 1 - VERTICAL PERCOLATION LAYER
                  MATERIAL TEXTURE NUMBER  18
THICKNESS                    =     120.00    INCHES
POROSITY                     =       0.6710 VOL/VOL
FIELD CAPACITY               =       0.2920 VOL/VOL
WILTING POINT                =       0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.1100 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =   0.100000005000E-02 CM/SEC


                         LAYER  3
                         --------

                TYPE 2 - LATERAL DRAINAGE LAYER
                  MATERIAL TEXTURE NUMBER   6
THICKNESS                    =      24.00    INCHES
POROSITY                     =       0.4530 VOL/VOL
FIELD CAPACITY               =       0.1900 VOL/VOL
WILTING POINT                =       0.0850 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.1900 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =   0.720000011000E-03 CM/SEC
SLOPE                        =       3.00    PERCENT
DRAINAGE LENGTH              =    1170.0     FEET


                         LAYER  4
                         --------

                TYPE 4 - FLEXIBLE MEMBRANE LINER
                  MATERIAL TEXTURE NUMBER  35
THICKNESS                    =       0.06    INCHES
POROSITY                     =       0.0000 VOL/VOL
FIELD CAPACITY               =       0.0000 VOL/VOL
WILTING POINT                =       0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =   0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY          =       0.75    HOLES/ACRE
FML INSTALLATION DEFECTS     =       2.00    HOLES/ACRE
FML PLACEMENT QUALITY        =   3 - GOOD
```

```
                         LAYER  5
                         --------

                 TYPE 3 - BARRIER SOIL LINER
                 MATERIAL TEXTURE NUMBER  17
   THICKNESS                    =       0.25    INCHES
   POROSITY                     =       0.7500 VOL/VOL
   FIELD CAPACITY               =       0.7470 VOL/VOL
   WILTING POINT                =       0.4000 VOL/VOL
   INITIAL SOIL WATER CONTENT   =       0.7500 VOL/VOL
   EFFECTIVE SAT. HYD. COND.    =   0.300000003000E-08 CM/SEC


              GENERAL DESIGN AND EVAPORATIVE ZONE DATA
              ----------------------------------------

 NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

 SCS RUNOFF CURVE NUMBER              =  77.00
 FRACTION OF AREA ALLOWING RUNOFF     =   0.0     PERCENT
 AREA PROJECTED ON HORIZONTAL PLANE   =   1.000   ACRES
 EVAPORATIVE ZONE DEPTH               =  16.0     INCHES
 INITIAL WATER IN EVAPORATIVE ZONE    =   2.240   INCHES
 UPPER LIMIT OF EVAPORATIVE STORAGE   =   9.428   INCHES
 LOWER LIMIT OF EVAPORATIVE STORAGE   =   1.280   INCHES
 INITIAL SNOW WATER                   =   2.000   INCHES
 INITIAL WATER IN LAYER MATERIALS     =  19.087   INCHES
 TOTAL INITIAL WATER                  =  21.087   INCHES
 TOTAL SUBSURFACE INFLOW              =   0.00    INCHES/YEAR


               EVAPOTRANSPIRATION AND WEATHER DATA
               -----------------------------------

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
          SALT LAKE CITY         UTAH

      STATION LATITUDE                          =  40.76 DEGREES
      MAXIMUM LEAF AREA INDEX                   =   0.00
      START OF GROWING SEASON (JULIAN DATE)     =    117
      END OF GROWING SEASON (JULIAN DATE)       =    289
      EVAPORATIVE ZONE DEPTH                    =  16.0  INCHES
      AVERAGE ANNUAL WIND SPEED                 =   8.80 MPH
      AVERAGE 1ST QUARTER RELATIVE HUMIDITY     =  67.00 %
      AVERAGE 2ND QUARTER RELATIVE HUMIDITY     =  48.00 %
      AVERAGE 3RD QUARTER RELATIVE HUMIDITY     =  39.00 %
      AVERAGE 4TH QUARTER RELATIVE HUMIDITY     =  65.00 %


 NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
          COEFFICIENTS FOR     SALT LAKE CITY       UTAH
```

```
               NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

    JAN/JUL      FEB/AUG      MAR/SEP      APR/OCT      MAY/NOV      JUN/DEC
    -------      -------      -------      -------      -------      -------
     1.37         1.63         2.06         1.07         1.30         1.12
     2.07         1.40         2.21         1.30         1.50         1.20


         NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR     SALT LAKE CITY       UTAH

           NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

    JAN/JUL      FEB/AUG      MAR/SEP      APR/OCT      MAY/NOV      JUN/DEC
    -------      -------      -------      -------      -------      -------
    25.20        30.30        38.50        45.70        54.20        62.70
    69.80        68.50        59.50        47.90        35.30        26.30


         NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR     SALT LAKE CITY       UTAH
                    AND STATION LATITUDE  =  40.27 DEGREES



*******************************************************************************

      AVERAGE MONTHLY VALUES IN INCHES FOR YEARS     1 THROUGH    1
-------------------------------------------------------------------------------

                         JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                         -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                0.45     0.93     1.84     0.47     0.63     0.46
                          1.42     2.50     1.91     2.28     1.20     1.21

    STD. DEVIATIONS       0.00     0.00     0.00     0.00     0.00     0.00
                          0.00     0.00     0.00     0.00     0.00     0.00

  RUNOFF
  ------
    TOTALS                0.000    0.000    0.000    0.000    0.000    0.000
                          0.000    0.000    0.000    0.000    0.000    0.000

    STD. DEVIATIONS       0.000    0.000    0.000    0.000    0.000    0.000
                          0.000    0.000    0.000    0.000    0.000    0.000

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                0.736    0.869    2.260    1.548    0.488    0.356
```

```
                                  0.831     2.814     1.653     2.151     1.039     0.679

    STD. DEVIATIONS               0.000     0.000     0.000     0.000     0.000     0.000
                                  0.000     0.000     0.000     0.000     0.000     0.000

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  ----------------------------------------
    TOTALS                        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
                                  0.0000    0.0000    0.0000    0.0000    0.0000    0.0000

    STD. DEVIATIONS               0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
                                  0.0000    0.0000    0.0000    0.0000    0.0000    0.0000

  PERCOLATION/LEAKAGE THROUGH LAYER  5
  ------------------------------------
    TOTALS                        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
                                  0.0000    0.0000    0.0000    0.0000    0.0000    0.0000

    STD. DEVIATIONS               0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
                                  0.0000    0.0000    0.0000    0.0000    0.0000    0.0000

-------------------------------------------------------------------------------
               AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


  DAILY AVERAGE HEAD ON TOP OF LAYER  4
  -------------------------------------
    AVERAGES                      0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
                                  0.0000    0.0000    0.0000    0.0000    0.0000    0.0000

    STD. DEVIATIONS               0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
                                  0.0000    0.0000    0.0000    0.0000    0.0000    0.0000

*******************************************************************************


*******************************************************************************

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS     1 THROUGH     1
-------------------------------------------------------------------------------
                                        INCHES              CU. FEET     PERCENT
                                 -------------------     -------------  ---------
 PRECIPITATION                    15.30    (   0.000)       55539.0     100.00

 RUNOFF                            0.000   (  0.0000)           0.00      0.000

 EVAPOTRANSPIRATION               15.423   (  0.0000)       55986.77    100.806

 LATERAL DRAINAGE COLLECTED        0.00000 (  0.00000)          0.000    0.00000
   FROM LAYER  3

 PERCOLATION/LEAKAGE THROUGH       0.00000 (  0.00000)          0.000     0.00000
   LAYER  5
```

```
AVERAGE HEAD ON TOP            0.000 (    0.000)
  OF LAYER  4

CHANGE IN WATER STORAGE      -0.123   (  0.0000)       -447.75     -0.806

*******************************************************************************


******************************************************************************

              PEAK DAILY VALUES FOR YEARS    1 THROUGH    1
------------------------------------------------------------------------
                                                 (INCHES)      (CU. FT.)
                                                ----------    -------------
     PRECIPITATION                                0.89          3230.700

     RUNOFF                                       0.000            0.0000

     DRAINAGE COLLECTED FROM LAYER  3             0.00000          0.00000

     PERCOLATION/LEAKAGE THROUGH LAYER  5         0.000000         0.00000

     AVERAGE HEAD ON TOP OF LAYER  4              0.000

     MAXIMUM HEAD ON TOP OF LAYER  4              0.000

     LOCATION OF MAXIMUM HEAD IN LAYER  3
           (DISTANCE FROM DRAIN)                  0.0 FEET

     SNOW WATER                                   2.00          7260.0000


     MAXIMUM VEG. SOIL WATER (VOL/VOL)                    0.2600

     MINIMUM VEG. SOIL WATER (VOL/VOL)                    0.0999

      ***  Maximum heads are computed using McEnroe's equations.  ***

           Reference:  Maximum Saturated Depth over Landfill Liner
                       by Bruce M. McEnroe, University of Kansas
                       ASCE Journal of Environmental Engineering
                       Vol. 119, No. 2, March 1993, pp. 262-270.

*******************************************************************************
```

```
******************************************************************************

              FINAL WATER STORAGE AT END OF YEAR     1
        ----------------------------------------------------------------------
               LAYER          (INCHES)        (VOL/VOL)
               -----          ---------       ----------
                 1             1.5758           0.2626

                 2            14.4955           0.1208

                 3             4.5600           0.1900

                 4             0.0000           0.0000

                 5             0.1875           0.7500

             SNOW WATER        0.145

******************************************************************************
******************************************************************************
```

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                 HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)               **
**                   DEVELOPED BY ENVIRONMENTAL LABORATORY                  **
**                     USAE WATERWAYS EXPERIMENT STATION                    **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:      C:\HELP3\SUV\BVPRECP.D4
TEMPERATURE DATA FILE:        C:\HELP3\SUV\BVTEMP.D7
SOLAR RADIATION DATA FILE:    C:\HELP3\SUV\BVRAD.D13
EVAPOTRANSPIRATION DATA:      C:\HELP3\SUV\BVEVAP.D11
SOIL AND DESIGN DATA FILE:    C:\HELP3\SUV\BAYVIEW3.D10
OUTPUT DATA FILE:             C:\HELP3\SUV\BAYVIEW3.OUT


TIME:  11:20     DATE:   6/26/2003


******************************************************************************

     TITLE:  Bayview Cell#2 Year 5

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                   LAYER  1
                                   --------

                        TYPE 1 - VERTICAL PERCOLATION LAYER
                            MATERIAL TEXTURE NUMBER   6
          THICKNESS                     =      12.00    INCHES
          POROSITY                      =       0.4530 VOL/VOL
          FIELD CAPACITY                =       0.1900 VOL/VOL
          WILTING POINT                 =       0.0850 VOL/VOL
          INITIAL SOIL WATER CONTENT    =       0.1900 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =    0.720000011000E-03 CM/SEC
```

```
                              LAYER  2
                              --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER  18
THICKNESS                     =   1560.00    INCHES
POROSITY                      =      0.6710 VOL/VOL
FIELD CAPACITY                =      0.2920 VOL/VOL
WILTING POINT                 =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT    =      0.1100 VOL/VOL
EFFECTIVE SAT. HYD. COND.     =  0.100000005000E-02 CM/SEC


                              LAYER  3
                              --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER   6
THICKNESS                     =     24.00    INCHES
POROSITY                      =      0.4530 VOL/VOL
FIELD CAPACITY                =      0.1900 VOL/VOL
WILTING POINT                 =      0.0850 VOL/VOL
INITIAL SOIL WATER CONTENT    =      0.1900 VOL/VOL
EFFECTIVE SAT. HYD. COND.     =  0.720000011000E-03 CM/SEC
SLOPE                         =      3.00    PERCENT
DRAINAGE LENGTH               =   1170.0     FEET


                              LAYER  4
                              --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                      MATERIAL TEXTURE NUMBER  35
THICKNESS                     =      0.06    INCHES
POROSITY                      =      0.0000 VOL/VOL
FIELD CAPACITY                =      0.0000 VOL/VOL
WILTING POINT                 =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT    =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.     =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY           =      0.75    HOLES/ACRE
FML INSTALLATION DEFECTS      =      2.00    HOLES/ACRE
FML PLACEMENT QUALITY         =  3 - GOOD
```

```
                              LAYER  5
                              --------

                     TYPE 3 - BARRIER SOIL LINER
                     MATERIAL TEXTURE NUMBER  17
  THICKNESS                       =       0.25   INCHES
  POROSITY                        =       0.7500 VOL/VOL
  FIELD CAPACITY                  =       0.7470 VOL/VOL
  WILTING POINT                   =       0.4000 VOL/VOL
  INITIAL SOIL WATER CONTENT      =       0.7500 VOL/VOL
  EFFECTIVE SAT. HYD. COND.       =    0.300000003000E-08 CM/SEC


               GENERAL DESIGN AND EVAPORATIVE ZONE DATA
               ----------------------------------------

  NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

 SCS RUNOFF CURVE NUMBER                =    77.00
 FRACTION OF AREA ALLOWING RUNOFF       =     0.0    PERCENT
 AREA PROJECTED ON HORIZONTAL PLANE     =     1.000  ACRES
 EVAPORATIVE ZONE DEPTH                 =    16.0    INCHES
 INITIAL WATER IN EVAPORATIVE ZONE      =     2.720  INCHES
 UPPER LIMIT OF EVAPORATIVE STORAGE     =     8.120  INCHES
 LOWER LIMIT OF EVAPORATIVE STORAGE     =     1.328  INCHES
 INITIAL SNOW WATER                     =     2.000  INCHES
 INITIAL WATER IN LAYER MATERIALS       =   178.628  INCHES
 TOTAL INITIAL WATER                    =   180.628  INCHES
 TOTAL SUBSURFACE INFLOW                =     0.00   INCHES/YEAR


                EVAPOTRANSPIRATION AND WEATHER DATA
                -----------------------------------

  NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
           SALT LAKE CITY        UTAH

     STATION LATITUDE                             =  40.76 DEGREES
     MAXIMUM LEAF AREA INDEX                      =   0.00
     START OF GROWING SEASON (JULIAN DATE)        =    117
     END OF GROWING SEASON (JULIAN DATE)          =    289
     EVAPORATIVE ZONE DEPTH                       =  16.0  INCHES
     AVERAGE ANNUAL WIND SPEED                    =   8.80 MPH
     AVERAGE 1ST QUARTER RELATIVE HUMIDITY        =  67.00 %
     AVERAGE 2ND QUARTER RELATIVE HUMIDITY        =  48.00 %
     AVERAGE 3RD QUARTER RELATIVE HUMIDITY        =  39.00 %
     AVERAGE 4TH QUARTER RELATIVE HUMIDITY        =  65.00 %


  NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
           COEFFICIENTS FOR     SALT LAKE CITY       UTAH
```

```
                NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
       1.35        1.33        1.72        2.21        1.47        0.97
       0.72        0.92        0.89        1.14        1.22        1.37


         NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR     SALT LAKE CITY       UTAH

             NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
      28.60       34.10       40.70       49.20       58.80       68.30
      77.50       74.90       65.00       53.00       39.70       30.30


         NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR     SALT LAKE CITY       UTAH
                    AND STATION LATITUDE  =  40.27 DEGREES



*******************************************************************************

         AVERAGE MONTHLY VALUES IN INCHES FOR YEARS     1 THROUGH   30
-------------------------------------------------------------------------------

                         JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                         -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 1.16     1.20     1.95     2.04     1.30     1.03
                           0.69     0.85     0.84     1.05     1.31     1.46

    STD. DEVIATIONS        0.60     0.54     0.77     0.87     0.68     0.74
                           0.48     0.80     0.61     0.82     0.73     0.59

  RUNOFF
  ------
    TOTALS                0.000    0.000    0.000    0.000    0.000    0.000
                          0.000    0.000    0.000    0.000    0.000    0.000

    STD. DEVIATIONS       0.000    0.000    0.000    0.000    0.000    0.000
                          0.000    0.000    0.000    0.000    0.000    0.000

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                0.572    0.673    2.225    2.301    1.525    1.048
```

```
                          0.706    0.840    0.789    0.922    0.823    0.763

  STD. DEVIATIONS         0.258    0.379    0.644    0.918    0.694    0.719
                          0.495    0.809    0.590    0.662    0.363    0.199

LATERAL DRAINAGE COLLECTED FROM LAYER  3
----------------------------------------
  TOTALS                  0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

  STD. DEVIATIONS         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

PERCOLATION/LEAKAGE THROUGH LAYER  5
------------------------------------
  TOTALS                  0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

  STD. DEVIATIONS         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000


-------------------------------------------------------------------------------
              AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


DAILY AVERAGE HEAD ON TOP OF LAYER  4
-------------------------------------
  AVERAGES                0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

  STD. DEVIATIONS         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

*******************************************************************************


*******************************************************************************

   AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH   30
-------------------------------------------------------------------------------
                                 INCHES            CU. FEET       PERCENT
                           -------------------   -------------   ---------
 PRECIPITATION               14.88    (   2.435)     54009.6      100.00

 RUNOFF                       0.000   (  0.0000)        0.00        0.000

 EVAPOTRANSPIRATION          13.186   (  2.0492)    47864.84       88.623

 LATERAL DRAINAGE COLLECTED   0.00000 (  0.00000)       0.000       0.00000
   FROM LAYER  3

 PERCOLATION/LEAKAGE THROUGH  0.00000 (  0.00000)       0.000       0.00000
   LAYER  5
```

```
AVERAGE HEAD ON TOP             0.000 (     0.000)
  OF LAYER  4

CHANGE IN WATER STORAGE         1.693    (  1.1317)        6144.74      11.377

*******************************************************************************


*******************************************************************************

              PEAK DAILY VALUES FOR YEARS    1 THROUGH   30
    ------------------------------------------------------------------------
                                                 (INCHES)      (CU. FT.)
                                                ----------    -------------
     PRECIPITATION                                1.66          6025.800

     RUNOFF                                       0.000            0.0000

     DRAINAGE COLLECTED FROM LAYER  3             0.00000          0.00000

     PERCOLATION/LEAKAGE THROUGH LAYER  5         0.000000         0.00000

     AVERAGE HEAD ON TOP OF LAYER  4              0.000

     MAXIMUM HEAD ON TOP OF LAYER  4              0.000

     LOCATION OF MAXIMUM HEAD IN LAYER  3
           (DISTANCE FROM DRAIN)                  0.0 FEET

     SNOW WATER                                   2.96         10733.1621


     MAXIMUM VEG. SOIL WATER (VOL/VOL)                    0.4143

     MINIMUM VEG. SOIL WATER (VOL/VOL)                    0.0830

      ***  Maximum heads are computed using McEnroe's equations.  ***

           Reference:  Maximum Saturated Depth over Landfill Liner
                       by Bruce M. McEnroe, University of Kansas
                       ASCE Journal of Environmental Engineering
                       Vol. 119, No. 2, March 1993, pp. 262-270.

*******************************************************************************
```

```
******************************************************************************

                FINAL WATER STORAGE AT END OF YEAR    30
    ----------------------------------------------------------------------
                 LAYER          (INCHES)         (VOL/VOL)
                 -----          --------         ---------
                   1             2.6547           0.2212

                   2           224.0082           0.1436

                   3             4.5600           0.1900

                   4             0.0000           0.0000

                   5             0.1875           0.7500

               SNOW WATER        0.000

******************************************************************************
******************************************************************************
```

APPENDIX K – ENGINEERING DRAWINGS

APPENDIX D

Engineering Drawing and Specifications

NOT FOR CONSTRUCTION

SUVSWD Bayview Class I Landfill
Permit Application

APPENDIX D – ENGINEERING DRAWINGS

The following conceptual engineering drawings are for reference only and are not intended for construction.

Final engineering drawings and specifications will be inserted here upon completion.

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL

CELL 2 STAGE 2
30% GRADING PLAN

MARCH 4, 2009

DRAWING SCHEDULE

1	COVER SHEET
2	GENERAL NOTES, SYMBOLS & ABBREVIATIONS
3	EXISTING CONTOURS & SITE PLAN
4	CELL 2 STAGE 2 EXCAVATION PLAN
5	CELL 2 STAGE 2 WASTE FILL CONTOURS
6	FINAL COVER PLAN
7	LINER DETAILS
8	LEACHATE COLLECTION PLAN AND PROFILE
9	LEACHATE COLLECTION SYSTEM DETAILS
10	LEACHATE COLLECTION SYSTEM DETAILS
11	TYPICAL CROSS SECTIONS
12	TYPICAL CROSS SECTIONS
13	TYPICAL CROSS SECTIONS
14	LEACHATE POND GRADING PLAN
15	LEACHATE POND DETAILS

HDR
HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION		
			PROJECT MANAGER	T. WARNER
			ARCHITECT	
			CIVIL	S. WOMACK
			MECHANICAL	
			ELECTRICAL	
			STRUCTURAL	
			DESIGNED	C. MCCARTY
			DRAWN BY	C. MCCARTY
			PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

COVER SHEET

0 1" 2"

FILENAME: 00C-01.DWG
SCALE: N/A

SHEET
C1 OF 15

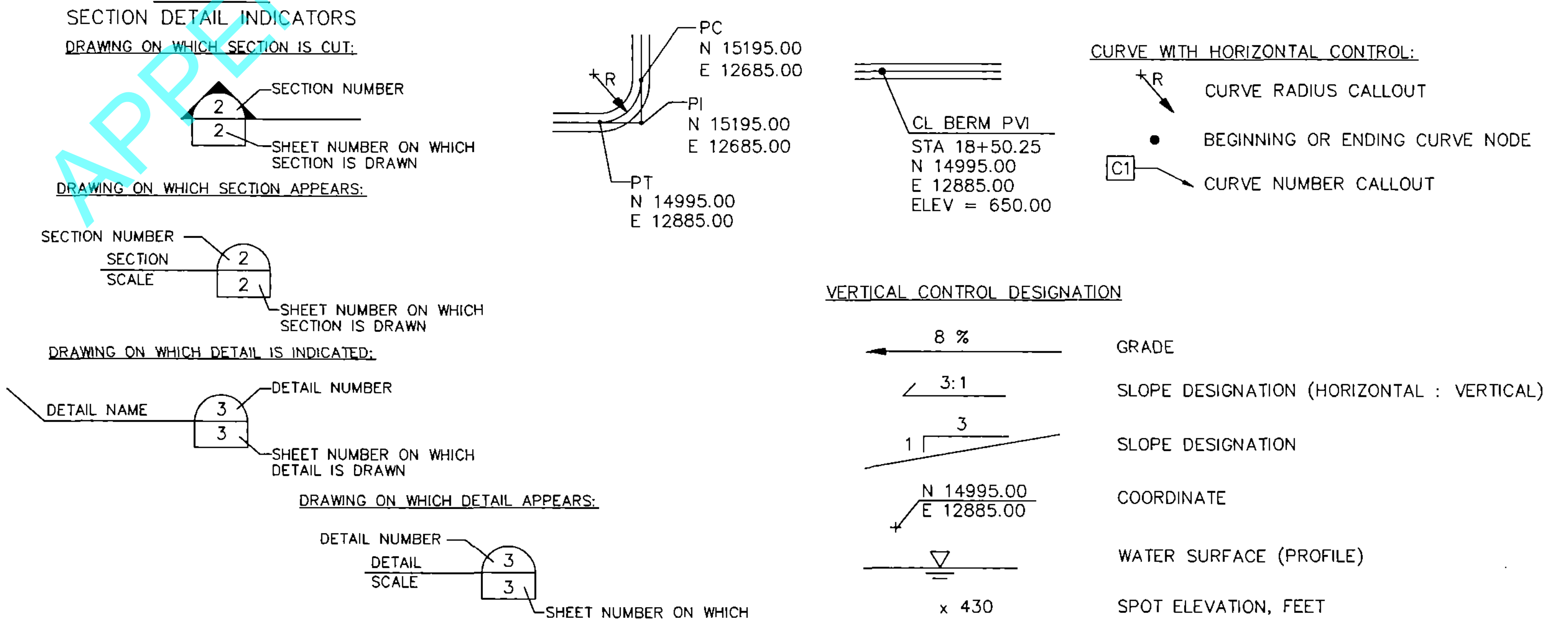
GENERAL NOTES

1. COORDINATE SYSTEM IS BASED ON LOCAL SURVEY. THE BENCHMARK TO BE USED FOR CONSTRUCTION IS LOCATED AS SHOWN ON DRAWING NO. C3. EXISTING CONTOURS ARE BASED ON AERIAL SURVEY FLOWN NOVEMBER 14, 2008, BY OLYMPUS AERIALS INC, SALT LAKE CITY, UTAH. CURRENT GROUND ELEVATIONS MAY VARY FROM THOSE SHOWN DUE TO SITE WORK THAT HAS BEEN PERFORMED SINCE THE AERIAL WAS FLOWN.
2. THE CONTRACTOR SHALL VERIFY EXISTING CONTOURS PRIOR TO THE START OF EARTHWORK.
3. GROUNDWATER AT THE SITE MAY VARY DEPENDING ON STREAM FLOW, RAINFALL, AND SUBSURFACE CONDITIONS. THERE SHALL NOT BE ANY ADDITIONAL PAYMENT OR EXTENSION OF CONTRACT TIME FOR WORKING WITH SATURATED SOILS OR HANDLING GROUNDWATER SEEPAGE.
4. THE CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO PROTECT THE EXISTING LANDFILL ROADS, GAS PROBES, AND GROUNDWATER MONITOR WELLS DURING THE CONSTRUCTION PERIOD. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE INCURRED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PROTECT EXISTING LANDFILL FEATURES.
5. THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES HAVE NOT BEEN ESTABLISHED BY THE OWNER OR HIS REPRESENTATIVES. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UTILITIES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING PROPER SAFE WORKING DISTANCE FROM ALL UTILITY EASEMENTS.
6. EXCAVATION BY "BLASTING" IS NOT PERMITTED ON THIS PROJECT.
7. FINISHED GROUND ELEVATIONS SHALL MATCH EXISTING GROUND ELEVATIONS EXCEPT AS SHOWN ON THE PLANS. EXCESS SOIL FROM EXCAVATION AND GRADING SHALL BE PLACED IN DESIGNATED STOCKPILE LOCATIONS AS APPROVED BY THE OWNER. TRANSPORT OF SOIL TO FILL AREAS SHALL BE CONDUCTED BY THE CONTRACTOR AT NO ADDITIONAL EXPENSE TO THE OWNER.
8. GEOTECHNICAL INVESTIGATION REPORTS FOR THE SITE ARE AVAILABLE FOR REVIEW AT THE DISTRICTS TRANSFER STATION OFFICE OR HDR ENGINEERING. THE CONTRACTOR MAY PERFORM ADDITIONAL GEOTECHNICAL INVESTIGATIONS AS HE DEEMS NECESSARY FOR CONSTRUCTION ACTIVITIES. HOWEVER, THERE SHALL BE NO ADDITIONAL PAYMENT TO THE CONTRACTOR FOR ADDITIONAL GEOTECHNICAL INVESTIGATIONS.
9. THE CONTRACTOR SHALL CONSTRUCT, AND UPON COMPLETION OF THE PROJECT, REMOVE TEMPORARY CONSTRUCTION ACCESS ROADS. SUCH ROADS SHALL BE LOCATED AS APPROVED BY THE OWNER. DRAINAGE PATTERNS AT THE SITE SHALL NOT BE ALTERED BY ROAD CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONSTRUCTION AND MAINTENANCE OF TEMPORARY DRAINAGE STRUCTURES, INCLUDING CULVERTS, AT NO ADDITIONAL COST TO THE OWNER.
10. THE CONTRACTOR SHALL CREATE SWPPP AND SUBMIT TO ENGINEER AND OWNER FOR APPROVAL. THE CONTRACTOR SHALL OBTAIN AND CONDUCT WORK CONSISTENT WITH A UPDES PERMIT FOR LANDFILL CONSTRUCTION. REFER TO TECHNICAL SPECIFICATIONS.
11. THE CONTRACTOR SHALL INSTALL, MAINTAIN, AND UPON COMPLETION OF THE PROJECT, REMOVE TEMPORARY EROSION AND SEDIMENT CONTROLS IN ACCORDANCE WITH THE SITE SWPPP AND PURSUANT TO REQUIREMENTS. SUCH CONTROLS SHALL BE PLACED AT THE LIMITS OF DISTURBED AREAS AND AT INTERMEDIATE LOCATIONS WHERE CONCENTRATED FLOW IS LIKELY.
12. THE CONTRACTOR SHALL KEEP THE LANDFILL HAUL ROAD OPERATIONAL AT ALL TIMES. THE CONTRACTOR SHALL SUBMIT A SCHEDULE TO THE OWNER FOR REVIEW AND APPROVAL 72 HOURS PRIOR TO CONDUCTING OPERATIONS THAT MAY AFFECT OPERATION OF THE LANDFILL ACCESS ROADS. DURING LANDFILL OPERATION, THE CONTRACTOR SHALL PROVIDE FLAGMEN AND FLASHING WARNING DEVICES AT ALL LOCATIONS WHERE EQUIPMENT WILL BE CROSSING THE LANDFILL ACCESS ROAD.
13. TEMPORARY CONSTRUCTION SLOPES SHALL NOT BE GREATER THAN 2H:1V. STEEPER SLOPES WILL ONLY BE ALLOWED IF THE CONTRACTOR PROVIDES A GEOTECHNICAL ENGINEERING REPORT SPECIFYING MAXIMUM SLOPES AND THE DURATION FOR WHICH SUCH SLOPES SHALL REMAIN IN PLACE.
14. THE CONTRACTOR SHALL REMOVE ALL VEGETATION WITHIN THE CONSTRUCTION LIMITS AS REQUIRED TO CONSTRUCT THE PROJECT. ALL VEGETATION MAY BE DISPOSED OF ON-SITE AS DIRECTED BY THE OWNER.
15. THE CONTRACTOR SHALL IMMEDIATELY REPORT TO THE ENGINEER ANY ERROR OR DISCREPANCY FOUND ONCE THE CONTRACT DOCUMENT IS CAREFULLY REVIEWED AND ALL ASPECTS OF FIELD WORK HAVE BEEN VERIFIED. IN THE EVENT THE CONTRACTOR CONTINUES TO WORK ON AN ITEM WHERE AN ERROR EXISTS, IT SHALL BE DEEMED THAT THE CONTRACTOR BID AND INTENDED TO EXECUTE THE MORE STRINGENT OR HIGHER QUALITY REQUIREMENT WITHOUT AN INCREASE IN CONTRACT SUM OR TIME. THE CONTRACTOR SHALL ALSO BE RESPONSIBLE TO CORRECT ANY FAILURE OF COMPANY PARTS TO COORDINATE OR FIT PROPERLY INTO FINAL POSITION, AS A RESULT OF CONTRACTOR FAILURE TO RAISE OR RESOLVE A DISCREPANCY.
16. THE DRAWINGS AND SPECIFICATIONS SHOULD AGREE WITH EACH OTHER, AND WORK CALLED FOR BY DRAWINGS AND NOT MENTIONED IN SPECIFICATIONS, OR VICE VERSA, SHALL BE FURNISHED BY BOTH. WHEN DISCREPANCIES EXIST BETWEEN SCALE AND DIMENSIONS, THE DIMENSIONED FIGURE SHALL BE USED. IF DISCREPANCIES EXIST BETWEEN THE DRAWINGS AND SPECIFICATIONS, THE CONTRACTOR SHALL NOT WORK WITHOUT CLARIFICATION FROM ENGINEER AND RESOLUTION BY OWNER. THE OWNER'S DECISION ON THE RESOLUTION IS FINAL.
17. CONTRACTORS AND EACH SUB CONTRACTOR SHALL VERIFY ALL GRADES, LINES, LEVELS, AND DIMENSIONS AS INDICATED ON DRAWINGS, AND HE SHALL REPORT ERRORS TO THE ENGINEER. THE CONTRACTOR SHALL ESTABLISH BENCHMARKS IN AT LEAST TWO WIDELY SEPARATED PLACES, AND AS WORK PROGRESSES THE CONTRACTOR WILL MAINTAIN ADEQUATE HORIZONTAL AND VERTICAL CONTROL.
18. REFER TO CQA DOCUMENT FOR MATERIAL SPECIFICATIONS.

STANDARD ABBREVIATIONS

&	AND
APPROX	APPROXIMATELY
ASPH	ASPHALT
@	AT
AVG	AVERAGE
BOE	BOTTOM OF EXCAVATION
BM	BENCHMARK
BOL	BOTTOM OF LINER
X	BY
BLDG	BUILDING
CL	CENTERLINE
CMP	CORRUGATED METAL PIPE
CO	CLEAN OUT
CFS	CUBIC FEET PER SECOND
CY	CUBIC YARD
DIA	DIAMETER
DET	DETAIL
DWG	DRAWING
ELEV	ELEVATION
EXIST	EXISTING
EXC	EXCAVATION
FL	FLOW LINE
FML	FLEXIBLE MEMBRANE LINER
FT	FEET
G	GAS PROBE
GAL	GALLON
GND	GROUND
GCL	GEOCOMPOSITE LINER
GCDL	GEOCOMPOSITE DRAINAGE LAYER
GDL	GRAVEL DRAINAGE LAYER
GLER	GEOMEMBRANE LINER EVALUATION REPORT
GNDL	GEONET DRAINAGE LAYER
GP	GAS PROBE
HDPE	HIGH DENSITY POLYETHYLENE
HORIZ	HORIZONTAL
ID	INSIDE DIAMETER
IN	INCHES
IE	INVERT ELEVATION
LCRS	LEACHATE COLLECTION AND REMOVAL SYSTEM
LCS	LEACHATE COLLECTION SYSTEM
LCP	LEACHATE COLLECTION PIPE
LCPR	LEACHATE COLLECTION PIPE RISER
LF	LINEAR FEET
LFG	LANDFILL GAS
LB	POUND
LG	LONG
MH	MANHOLE
MAX	MAXIMUM
MIL	.001 INCHES
MIN	MINIMUM
MW	MONITOR WELL
MSL	MEAN SEA LEVEL
N	NORTH
NIC	NOT IN CONTRACT
NO	NUMBER
NTS	NOT TO SCALE
OC	ON CENTER
OZ	OUNCE
%	PERCENT
PLCP	PERFORATED LEACHATE COLLECTION PIPE
PERF	PERFORATED
PGV	PASSIVE GAS VENT
PC	POINT OF CURVATURE
PVI	POINT OF VERTICAL INTERSECTION
PT	POINT OF TANGENCY
PZ	PIEZOMETER
Q	FLOW
QTY	QUANTITY
R	RADIUS
RCP	REINFORCED CONCRETE PIPE
REF	REFERENCE
REQ	REQUIRED
RD	ROAD
SCH	SCHEDULE
SDL	SAND DRAINAGE LAYER
SEC	SECTION
SHT	SHEET
S	SOUTH
SDR	STANDARD DIMENSION RATIO
SP	STEEL PIPE
SQ	SQUARE
STA	STATION
SLER	SOIL LINER EVALUATION REPORT
SLQCP	SOIL LINER QUALITY CONTROL PLAN
SS	SIDE SLOPE
SWPPP	STORMWATER POLLUTION PREVENTION PLAN
TL	TANGENT LENGTH
TOC	TOP OF COVER
TOFC	TOP OF FINAL COVER
TOL	TOP OF LINER
TOS	TOE OF SLOPE
TS	TOP SLOPE
TEMP	TEMPORARY
TYP	TYPICAL
VCP	VITRIFIED CLAY PIPE
VERT	VERTICAL
VLDPE	VERY LOW DENSITY POLYETHYLENE
W	WEST
W/	WITH
YD	YARD

SYMBOLS



HDR
HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION		
			PROJECT MANAGER	T. WARNER
			ARCHITECT	
			CIVIL	S. WOMACK
			MECHANICAL	
			ELECTRICAL	
			STRUCTURAL	
			DESIGNED	C. MCCARTY
			DRAWN BY	C. MCCARTY
			PROJECT NUMBER	96439

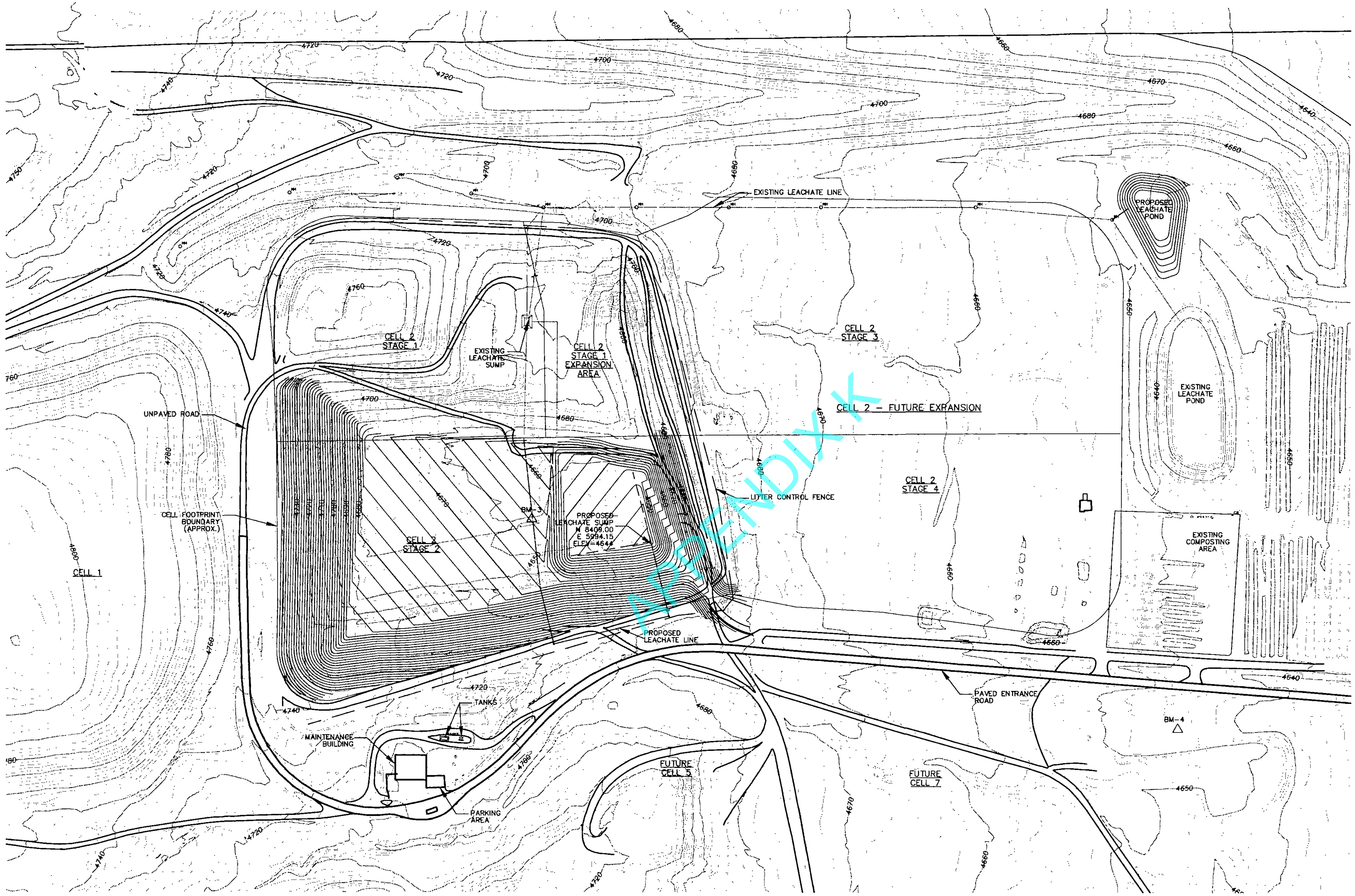
NOT FOR CONSTRUCTION

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

GENERAL NOTES, ABBREVIATIONS & SYMBOLS

0 1" 2"
FILENAME 00C-02.DWG
SCALE N/A
SHEET
C2 OF 15



N

0 150 300
SCALE IN FEET

LEGEND

········4640········	EXISTING CONTOURS
————	CELL FOOTPRINT BOUNDARY (APPROX.)
————	PROPOSED LEACHATE DRAIN LINE
—— ——	LITTER CONTROL FENCE LOCATION

NOTES:

TOPOGRAPHIC DATA IS PROVIDED FROM OLYMPUS AERIALS, INC., NOVEMBER 14, 2008. EXISTING CONTOURS IN CELL 2, STAGE 1 AREA WILL VARY FROM THOSE SHOWN DUE TO ONGOING EXCAVATION SINCE THE AERIAL MAPPING WAS COMPLETED.

BENCHMARKS

BM	N	E	ELEVATION
3	8492.798	5605.987	4711.11
4	7813.839	7697.793	4645.33
572	9992.856	3357.395	4757.29
573	10095.881	8608.668	4623.28
574	4670.902	8792.512	4610.47
575	4756.794	3567.638	4737.42
576	8118.956	1185.133	4806.22
577	7321.380	1456.147	4786.62
578	7334.971	3456.716	4763.08

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	T. WARNER
ARCHITECT	
CIVIL	S. WOMACK
MECHANICAL	
ELECTRICAL	
STRUCTURAL	
DESIGNED	C. MCCARTY
DRAWN BY	C. MCCARTY
PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

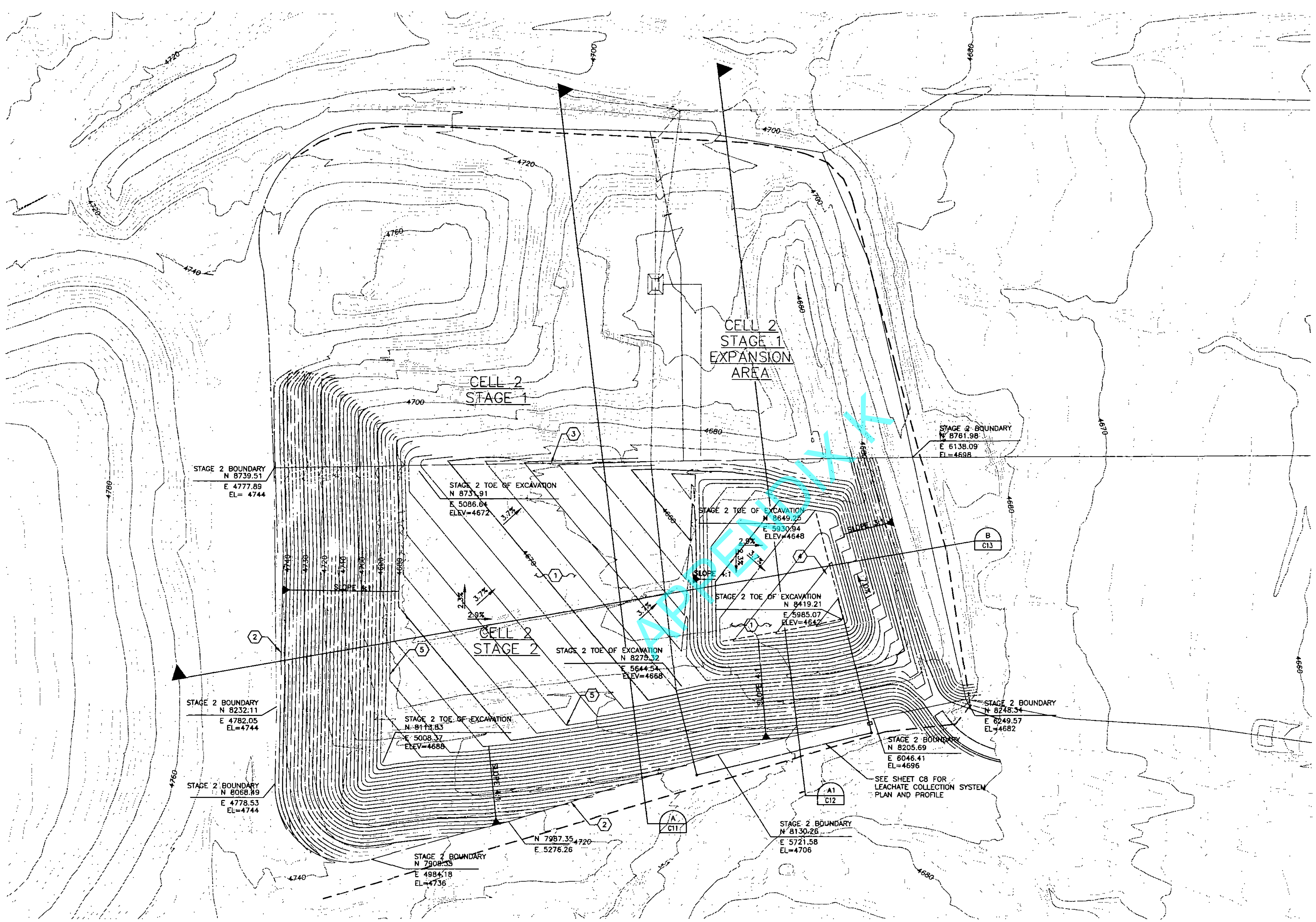
SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

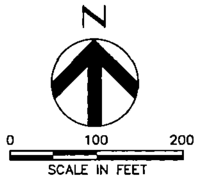
BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

EXISTING CONTOURS & SITE PLAN

0 1" 2"

FILENAME 00C-03.DWG
SCALE 1"=150'
SHEET C3 OF 15





LEGEND

——4640——	EXISTING CONTOURS
——4640——	PROPOSED CONTOURS
————	CELL FOOTPRINT BOUNDARY (APPROX.)
————	LEACHATE DRAIN LINE
— — — —	LITTER CONTROL FENCE LOCATION

NOTES:

1. STORMWATER INTERCEPTOR BERMS WILL BE BUILT BY OWNER AS NEEDED TO CONTROL RUNOFF.
2. TOPOGRAPHIC DATA IS PROVIDED FROM OLYMPUS AERIALS, INC., NOVEMBER 14, 2008. OWNER WILL PREPARE SUBGRADE FOR EXPANSION LINER. CONTRACTOR WILL BE RESPONSIBLE TO REMOVE ALL ANGULAR AND ROUNDED STONES TO MEET GEOTECHNICAL SPECIFICATIONS.
3. STAGE 2 BOUNDARY POINTS ARE APPROXIMATE.

CONSTRUCTION NOTES

(1) INSTALL LANDFILL LINER SYSTEM IN CELL 2, STAGE 2 PER DETAIL 1/C7

(2) INSTALL LINER SYSTEM ANCHOR TRENCH PER DETAIL 2/C7

(3) TIE STAGE 2 LINER INTO EXISTING LINER ALONG STAGE 1 LINER TERMINATION BERM. 4' X 8' SHEETS OF PLYWOOD OVERLAY EDGE OF EXISTING LINER. SEE DETAIL 3/C7

(4) INSTALL LINER TERMINATION ALONG EASTERN EDGE OF STAGE 2 PER DETAIL 4/C7

(5) INSTALL LINER AT SLOPE TRANSITION PER DETAIL 5/C7

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION		
			PROJECT MANAGER	T. WARNER
			ARCHITECT	
			CIVIL	S. WOMACK
			MECHANICAL	
			ELECTRICAL	
			STRUCTURAL	
			DESIGNED	C. MCCARTY
			DRAWN BY	C. MCCARTY
			PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

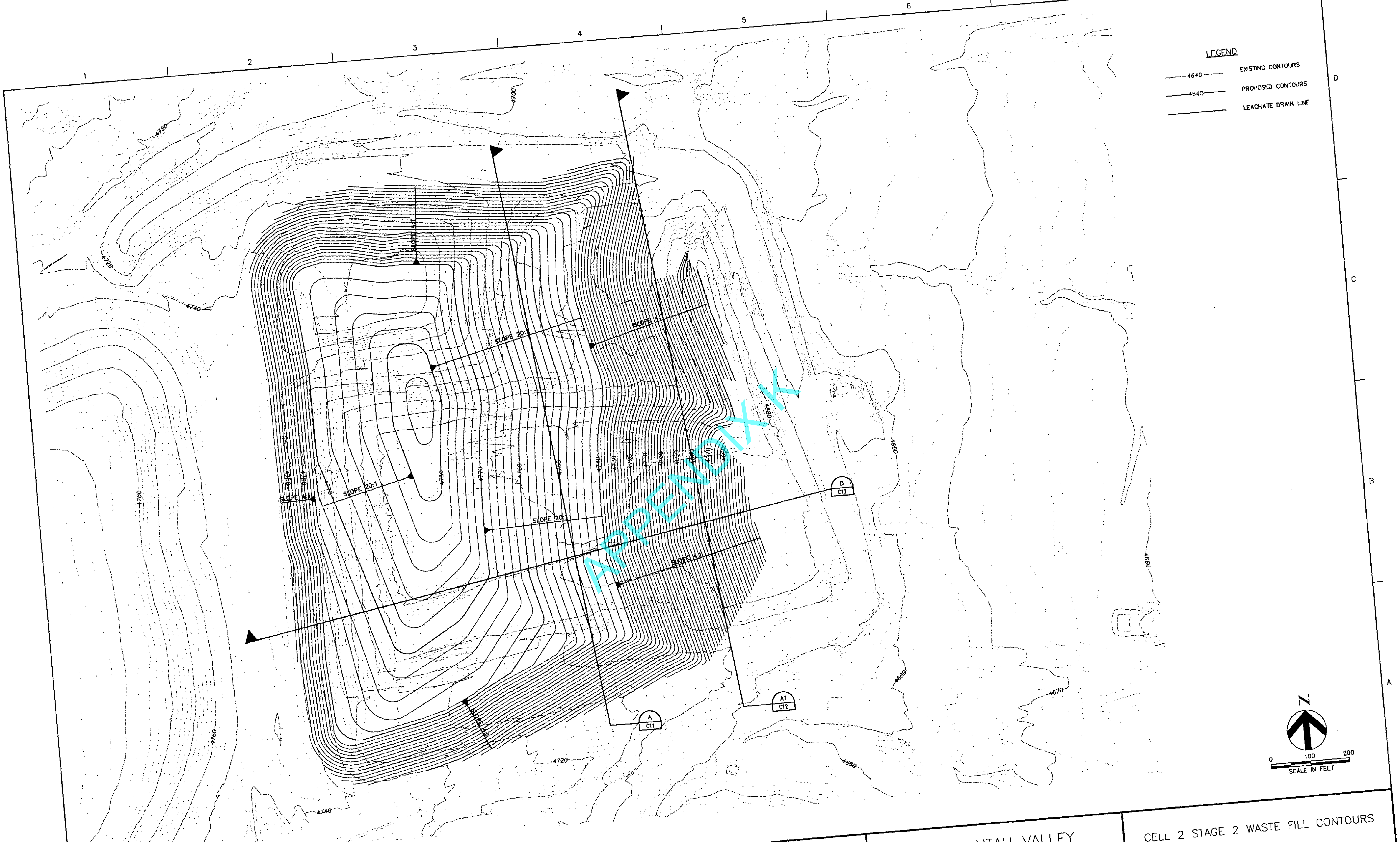
SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

CELL 2 STAGE 2 EXCAVATION PLAN

0 1" 2"

FILENAME	00C-04.DWG
SCALE	1"=100'
SHEET	C4 OF 15



HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	T. WARNER
ARCHITECT	
CIVIL	S. WOMACK
MECHANICAL	
ELECTRICAL	
STRUCTURAL	
DESIGNED	C. MCCARTY
DRAWN BY	C. MCCARTY
PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

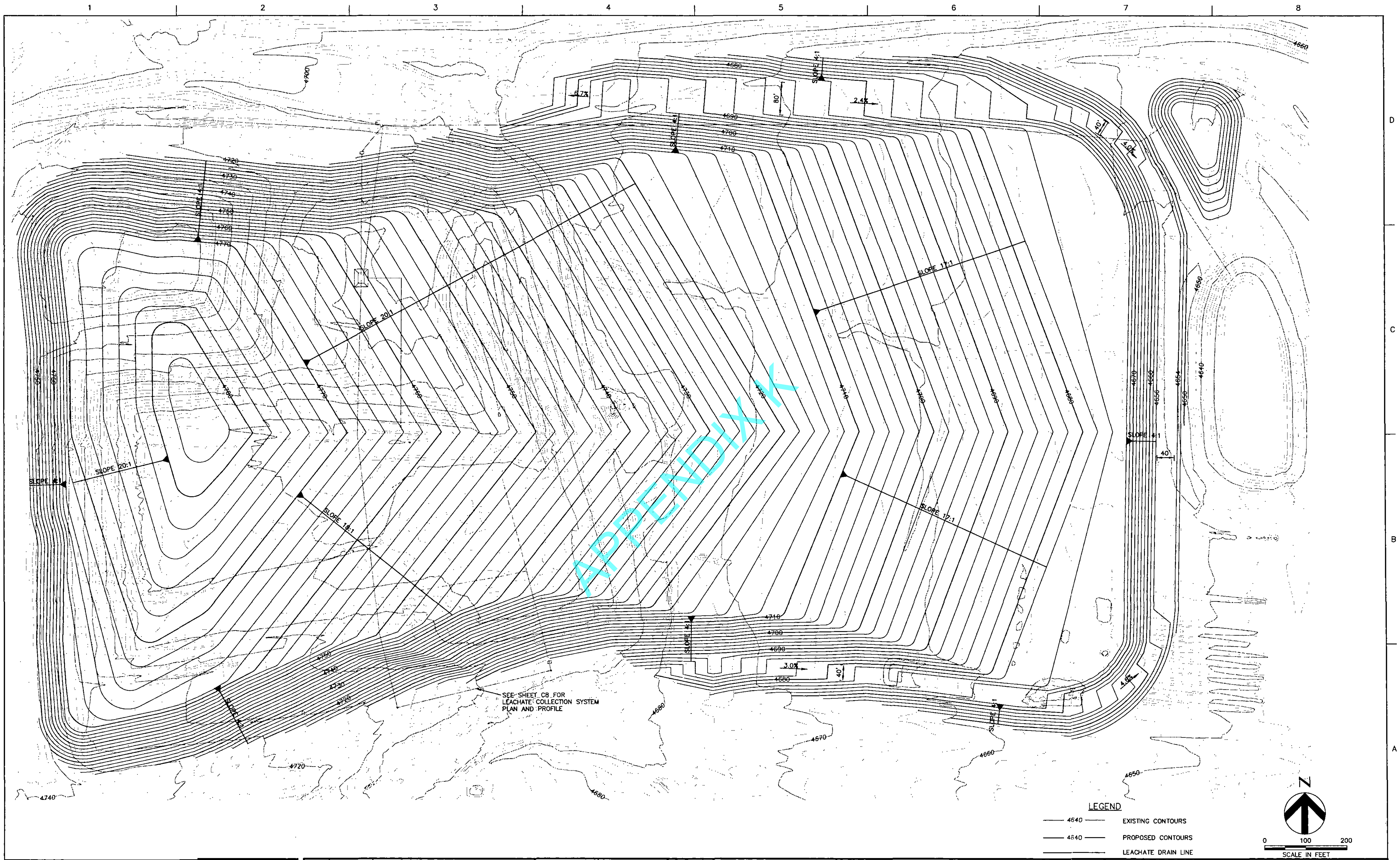
BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

CELL 2 STAGE 2 WASTE FILL CONTOURS

0 1" 2"

FILENAME	00C-05.DWG
SCALE	1"=100'

SHEET
C5 OF 15



HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	T. WARNER
ARCHITECT	
CIVIL	S. WOMACK
MECHANICAL	
ELECTRICAL	
STRUCTURAL	
DESIGNED	C. MCCARTY
DRAWN BY	C. MCCARTY
PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

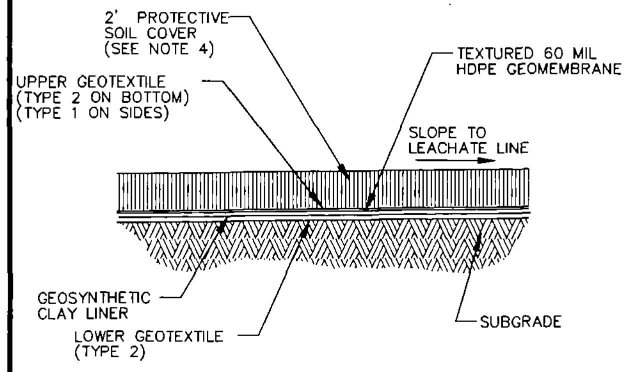
BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

FINAL COVER PLAN

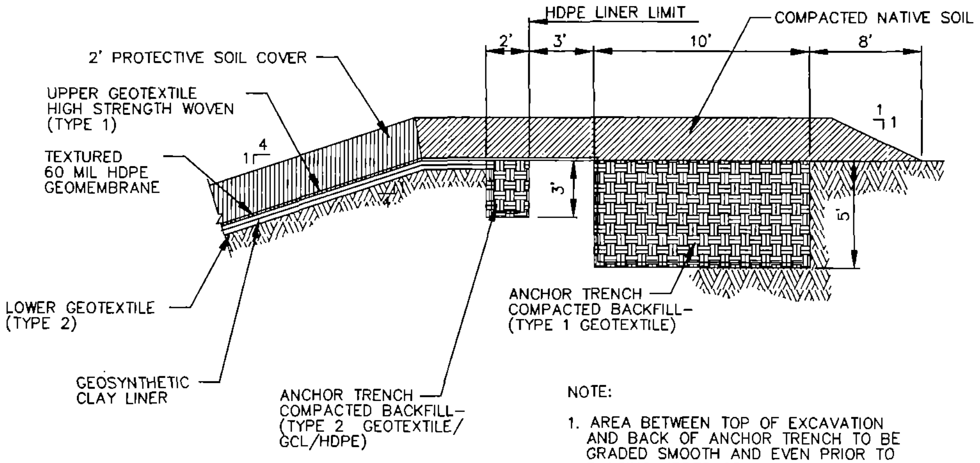
0 1" 2"

FILENAME	00C-06.DWG
SCALE	1"=100'

SHEET
C6 OF 15



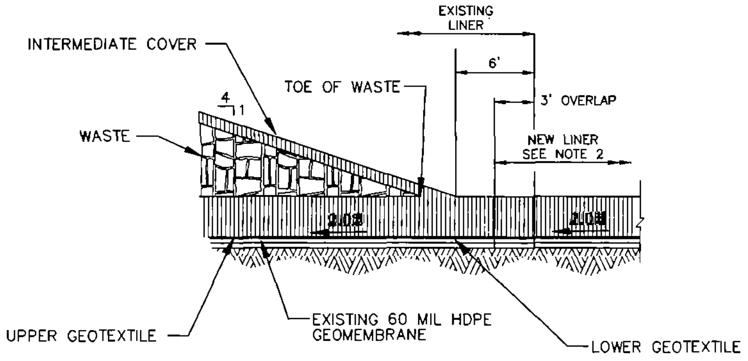
TYPICAL LANDFILL LINER DETAIL (1/C7)
NOT TO SCALE



NOTE:

1. AREA BETWEEN TOP OF EXCAVATION AND BACK OF ANCHOR TRENCH TO BE GRADED SMOOTH AND EVEN PRIOR TO PLACING UPPER GEOTEXTILE. REMOVE ANGULAR STONES.

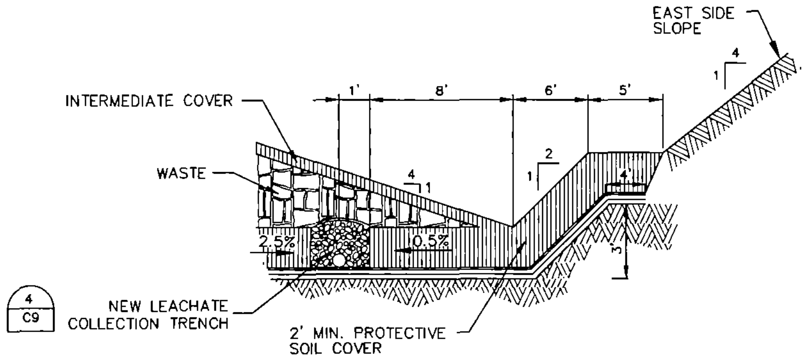
LINER SYSTEM ANCHOR TRENCH (2/C7)
NOT TO SCALE



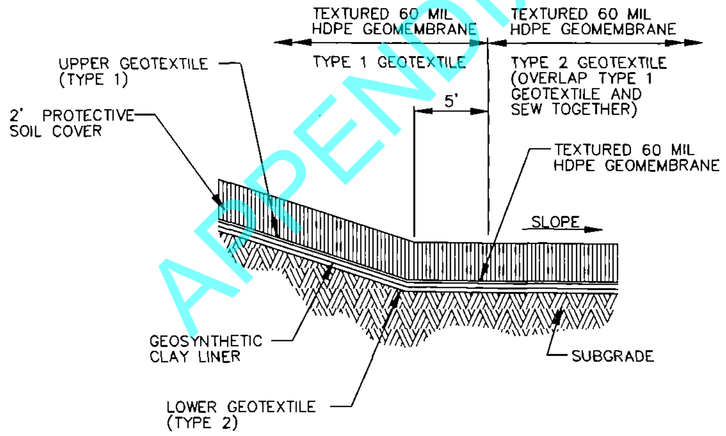
STAGE 1/STAGE 2 LINER CONNECTION (3/C7)
NOT TO SCALE

NOTES:

1. TEMPORARY STORMWATER INTERCEPTOR BERM TO BE PLACED IN FRONT OF WORKING AREA TO DIVERT STORMWATER AWAY FROM ACTIVE FACE. OWNER WILL RELOCATE AS NEEDED.
2. STAGE 2 GEOMEMBRANE TO BE WELDED TO STAGE 1. FUTURE GEOSYNTHETIC COMPONENTS TO BE OVERLAPPED AND SECURED.
3. TYPE I GEOTEXTILE IS REINFORCED AND REQUIRED ON SIDE SLOPES ONLY, ABOVE HDPE LINER. TYPE 2 GEOTEXTILE IS NON-REINFORCED (NON-WOVEN) AND IS TO BE USED ABOVE HDPE LINER ON BOTTOM AND BETWEEN SUBGRADE AND GCL. A SAND CUSHION MAY BE USED IN LIEU OF THE LOWER TYPE 2 GEOTEXTILE WITH PRIOR APPROVAL OF ENGINEER AND OWNER.
4. SEE SPECIFICATION 02240 FOR PROTECTIVE COVER MATERIAL REQUIREMENTS.



STAGE 2 EASTERN LINER TERMINATION (4/C7)
NOT TO SCALE



LINER AT SLOPE TRANSITION (5/C7)
NOT TO SCALE

NOTE: THICKNESS MEASURED PERPENDICULAR TO EXCAVATION SURFACE.

GEOTEXTILE SCHEDULE

LOCATION	TYPE	COMMENTS
ALL	ALL	REMOVE ALL ANGULAR STONES GREATER THAN 0.5 INCHES
LOWER GEOTEXTILE	2	USE 16 OZ/SY NON-WOVEN IF ROUNDED STONES GREATER THAN 2.5 INCHES ARE REMOVED. USE 20 OZ/SY NON-WOVEN IF ONLY ROUNDED STONES GREATER THAN 4 INCHES ARE REMOVED. NO HORIZONTAL SEAMS ON SIDESLOPES.
UPPER GEOTEXTILE ON SIDESLOPES	1	REINFORCED GEOTEXTILE. NO HORIZONTAL SEAMS ON SIDESLOPES.
UPPER GEOTEXTILE ON BOTTOM (FLOOR)	2	USE 12 OZ/SY NON-WOVEN BENEATH DUNE SAND (PROTECTIVE SOIL COVER)

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION		
			PROJECT MANAGER	T. WARNER
			ARCHITECT	
			CIVIL	S. WOMACK
			MECHANICAL	
			ELECTRICAL	
			STRUCTURAL	
			DESIGNED	C. MCCARTY
			DRAWN BY	C. MCCARTY
			PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

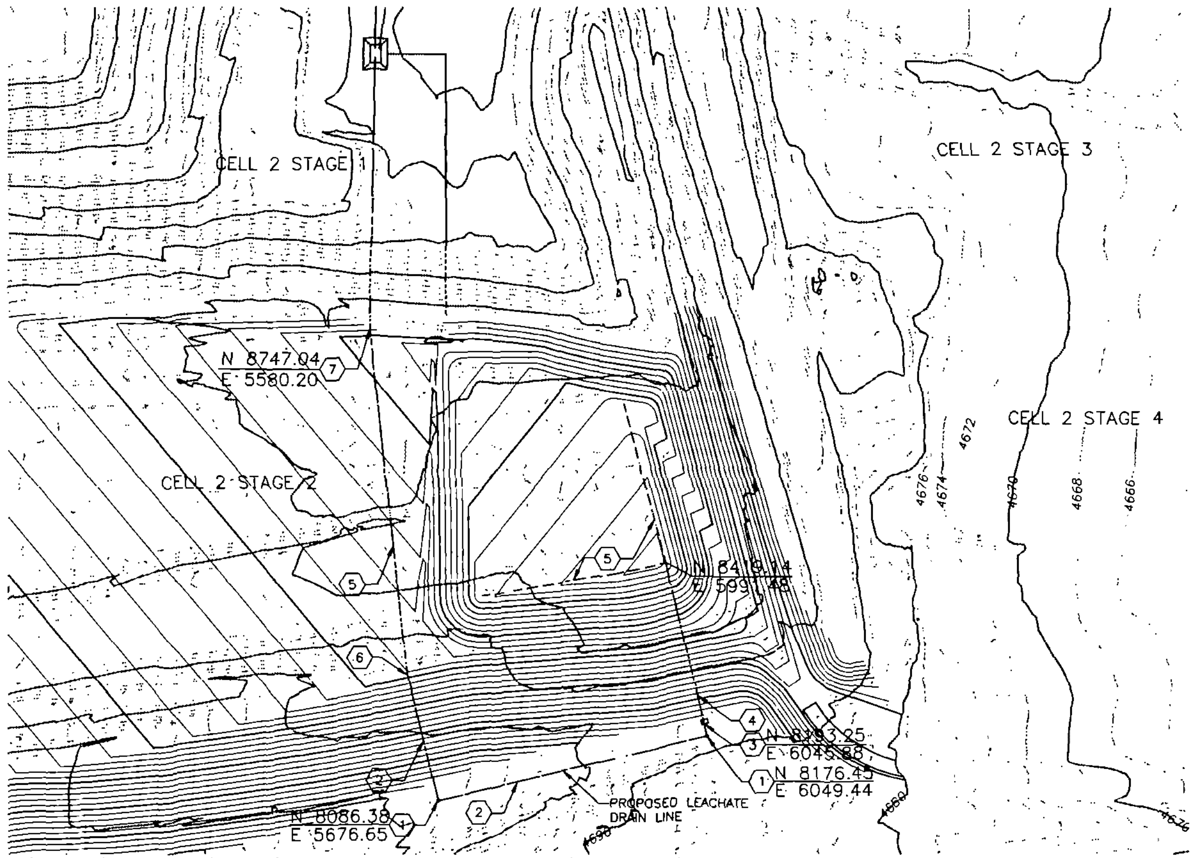
BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

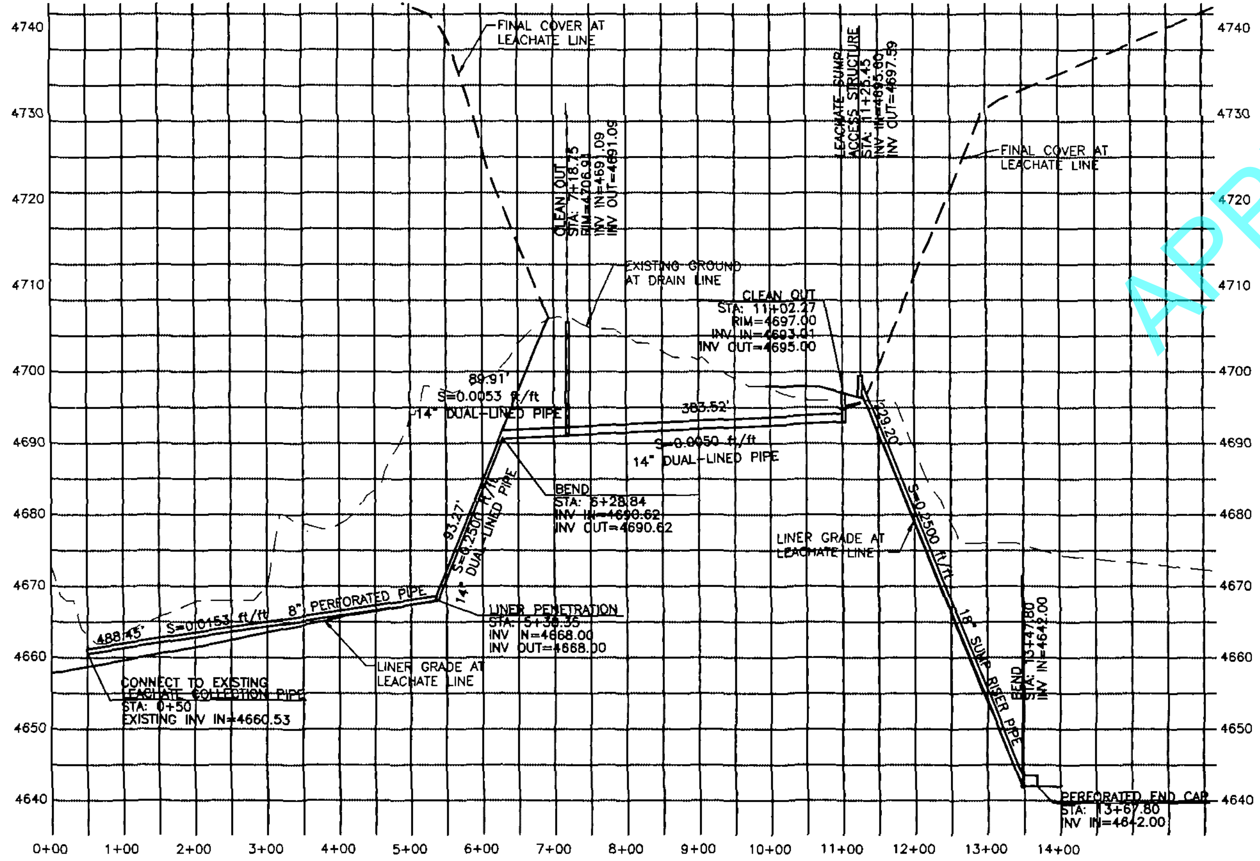
LINER DETAILS

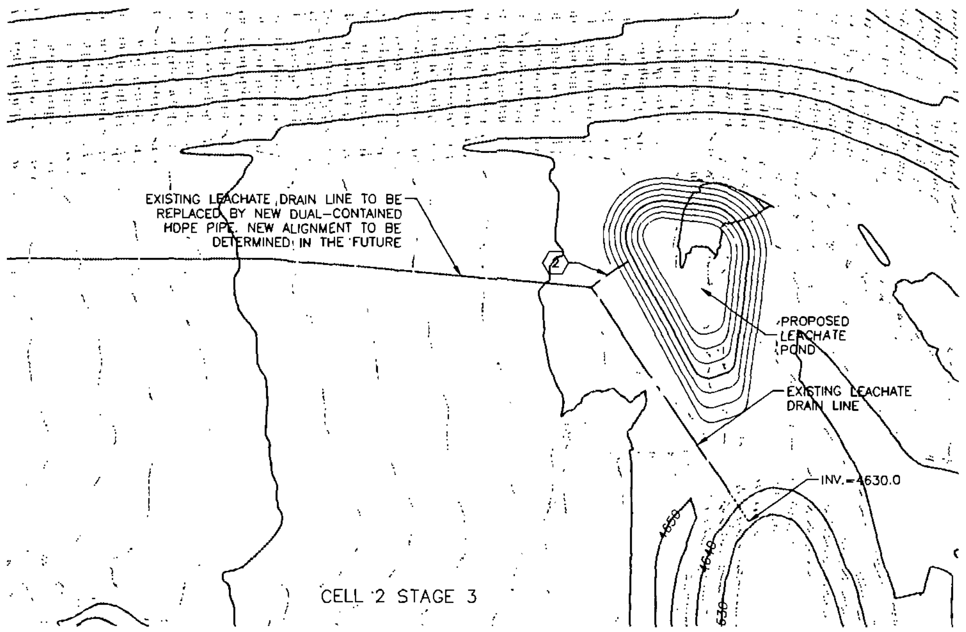
0 1" 2"

FILENAME 00C-07.DWG
SCALE N/A

SHEET C7 OF 15





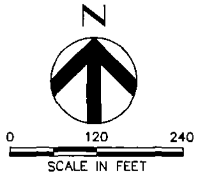


CONSTRUCTION NOTES

1. INSTALL CLEANOUT PER DETAIL X/X
2. INSTALL 14" SDR-17 X 10" SDR-17 DUAL CONTAINED PIPE PER DETAIL X/X
3. CONNECT 2" RETURN LINE TO 14" SDR-17 X 10" SDR-17 DUAL-CONTAINED PIPE IN LEACHATE SUMP ACCESS STRUCTURE PER DETAILS 8/C9 9/C9
4. INSTALL PARALLEL 18" DIA SOLID WALL LEACHATE SUMP COLLECTION RISER PIPE AND 8" DIA. SOLID CLEANOUT RISER PIPE PER DETAIL 1/C10
5. INSTALL 8" DIA. PERFORATED LEACHATE COLLECTION PIPE PER DETAILS 1/C10 3/C9 4/C9
6. INSTALL CONNECTION FOR DUAL-CONTAINED PIPE AND PERFORATED PIPE WITH PERFORATED END CAP PER DETAIL X/X
7. CONNECT PROPOSED PERFORATED LEACHATE COLLECTION PIPE TO EXISTING STAGE 1 LEACHATE COLLECTION PIPE.

NOTE:

DETAIL X/X NOT INCLUDED AS PART OF THIS SUBMITTAL



HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	T. WARNER
ARCHITECT	
CIVIL	S. WOMACK
MECHANICAL	
ELECTRICAL	
STRUCTURAL	
DESIGNED	C. MCCARTY
DRAWN BY	C. MCCARTY
PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

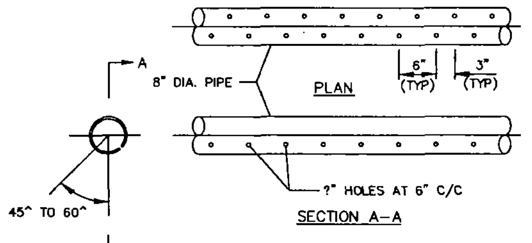
BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

LEACHATE COLLECTION SYSTEM PLAN AND PROFILE

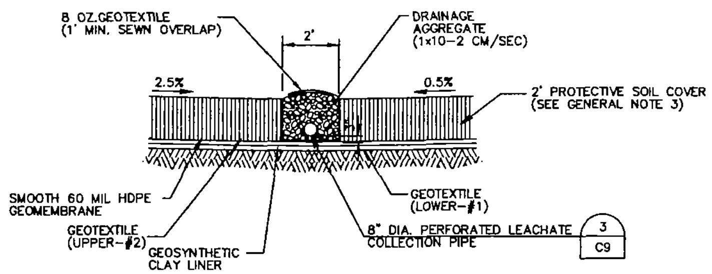
0 1" 2"

FILENAME	00C-08.DWG
SCALE	H: 1"=120' V: 1"=12'

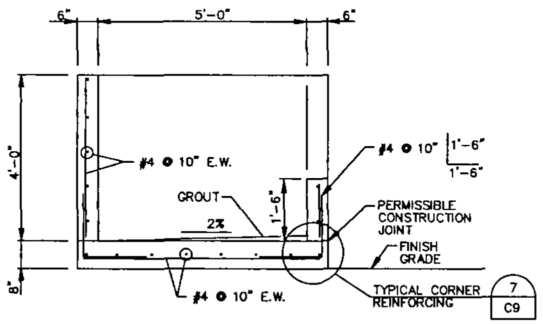
SHEET
C8 OF 15



8" DIA. PERFORATED LEACHATE COLLECTION PIPE 3/C9
NOT TO SCALE



LEACHATE COLLECTION TRENCH 4/C9
NOT TO SCALE



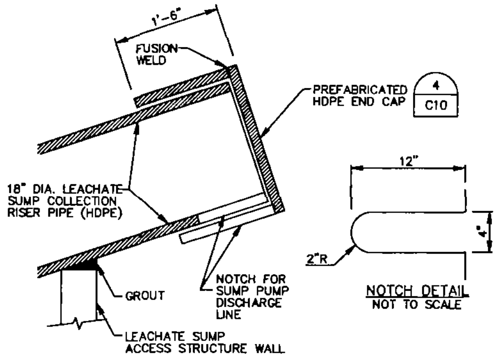
LEACHATE SUMP ACCESS STRUCTURE– SECTION 5/C9
NOT TO SCALE

CONCRETE NOTES:

1. ALL CONCRETE SHALL HAVE 4000PSI COMPRESSIVE STRENGTH @ 28 DAYS, NORMAL WEIGHT.
2. ALL CONCRETE SHALL BE IN ACCORDANCE WITH THE "BUILDING CODE REQUIREMENT FOR REINFORCED CONCRETE" ACI–318 LATEST EDITION.
3. REINFORCING BARS SHALL CONFORM TO SPECIFICATIONS FOR "DEFORMED BILLET–STEEL FOR CONCRETE REINFORCEMENT" WITH 60KSI YIELD STRENGTH; ASTM A615 GRADE 60.
4. REINFORCING BARS TO BE WELDED SHALL COMPLY WITH THE REQUIREMENT OF ASTM A706 GRADE 60.
5. COVER ON ALL REINFORCEMENT SHALL BE AS FOLLOWS, UNLESS OTHERWISE NOTED:
   - i CONCRETE PLACED AGAINST GROUND 3 IN
   - ii EXPOSED FORMED SURFACES
     - A. #5 AND SMALLER 1.5 IN
     - B. #6 AND LARGER 2 IN
6. ALL EXPOSED CORNERS SHALL HAVE 1 IN CHAMFER, UNLESS OTHERWISE NOTED.
7. SAWED GROOVES SHOULD BE MADE WITHIN APPROXIMATELY 4 TO 12 HOURS OF SLAB OR PAVEMENT FINISHING. IF THIS IS NOT PRACTICABLE, USE PREMOLDED STRIPS.
8. AS AN ALTERNATIVE, A PRECAST CONCRETE BOX MAY BE USED. THE PRECAST BOX SHOULD HAVE A MINIMUM CONCRETE COMPRESSIVE STRENGTH OF 5000 PSI @ 28 DAYS.

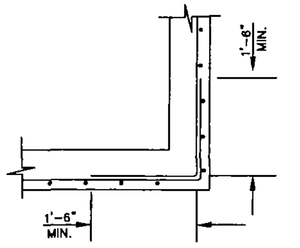
GENERAL NOTES:

1. LEACHATE RETURN LINE IS TO ALLOW ANY SPILLAGE OR RAINWATER ACCUMULATION IN SUMP ACCESS STRUCTURE TO RETURN TO LANDFILL SUMP FOR REMOVAL. GROUT BOTTOM OF STRUCTURE TO VALVE AFTER INSTALLATION, IF NECESSARY.
2. GROUT BOTTOM TO DRAIN TO RETURN LINE.
3. SEE SPECIFICATION SECTION 02240 FOR PROTECTIVE SOIL COVER REQUIREMENTS.



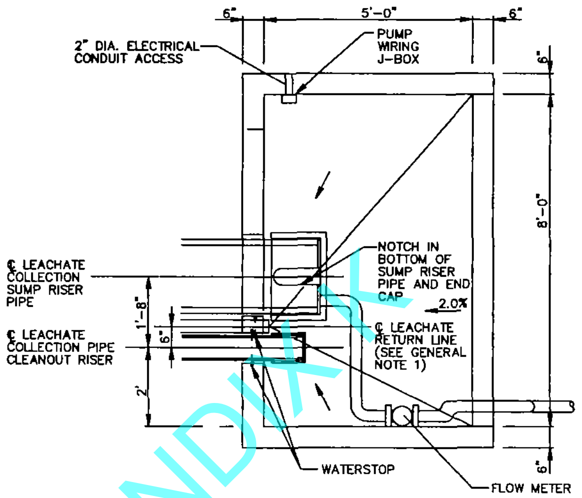
NOTCH DETAIL
NOT TO SCALE

18" DIA. SUMP RISER PIPE 6/C9
NOT TO SCALE

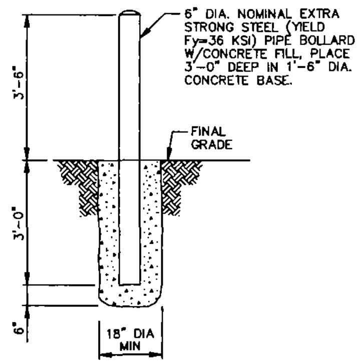


ALL LAP SPLICES FOR #4 BAR

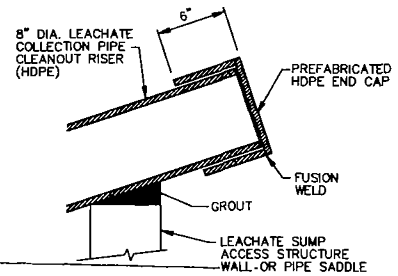
TYPICAL CORNER REINFORCING 7/C9
NOT TO SCALE



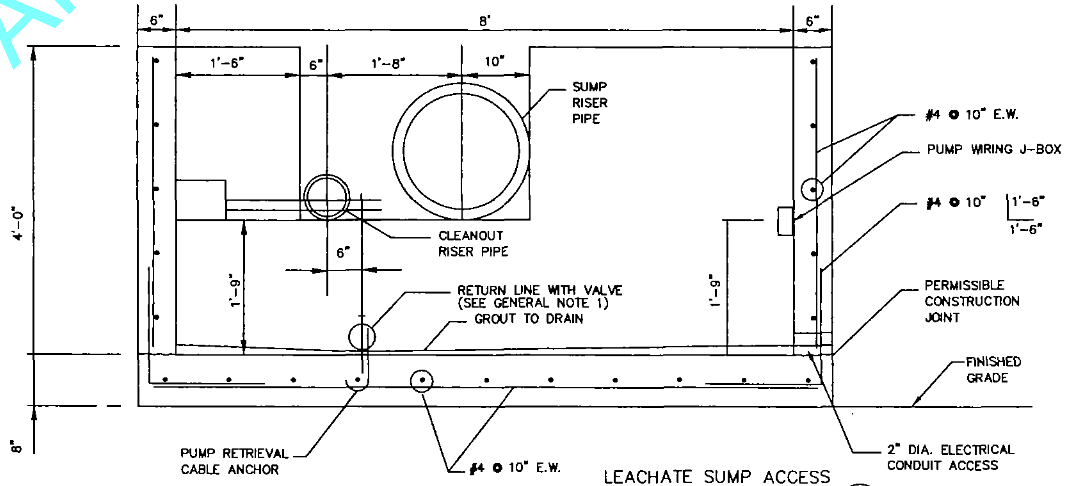
LEACHATE SUMP ACCESS STRUCTURE– PLAN 8/C9
NOT TO SCALE



TYPICAL BOLLARD 10/C9
NOT TO SCALE



8" DIAMETER CLEANOUT RISER PIPE END CAP 11/C9
NOT TO SCALE



NOTE:
THIS AREA IS CORROSIVE.

LEACHATE SUMP ACCESS STRUCTURE– SECTION 9/C9
NOT TO SCALE

HDR
HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107–2594

			PROJECT MANAGER	T. WARNER
			ARCHITECT	
			CIVIL	S. WOMACK
			MECHANICAL	
			ELECTRICAL	
			STRUCTURAL	
			DESIGNED	C. MCCARTY
			DRAWN BY	C. MCCARTY
ISSUE	DATE	DESCRIPTION	PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

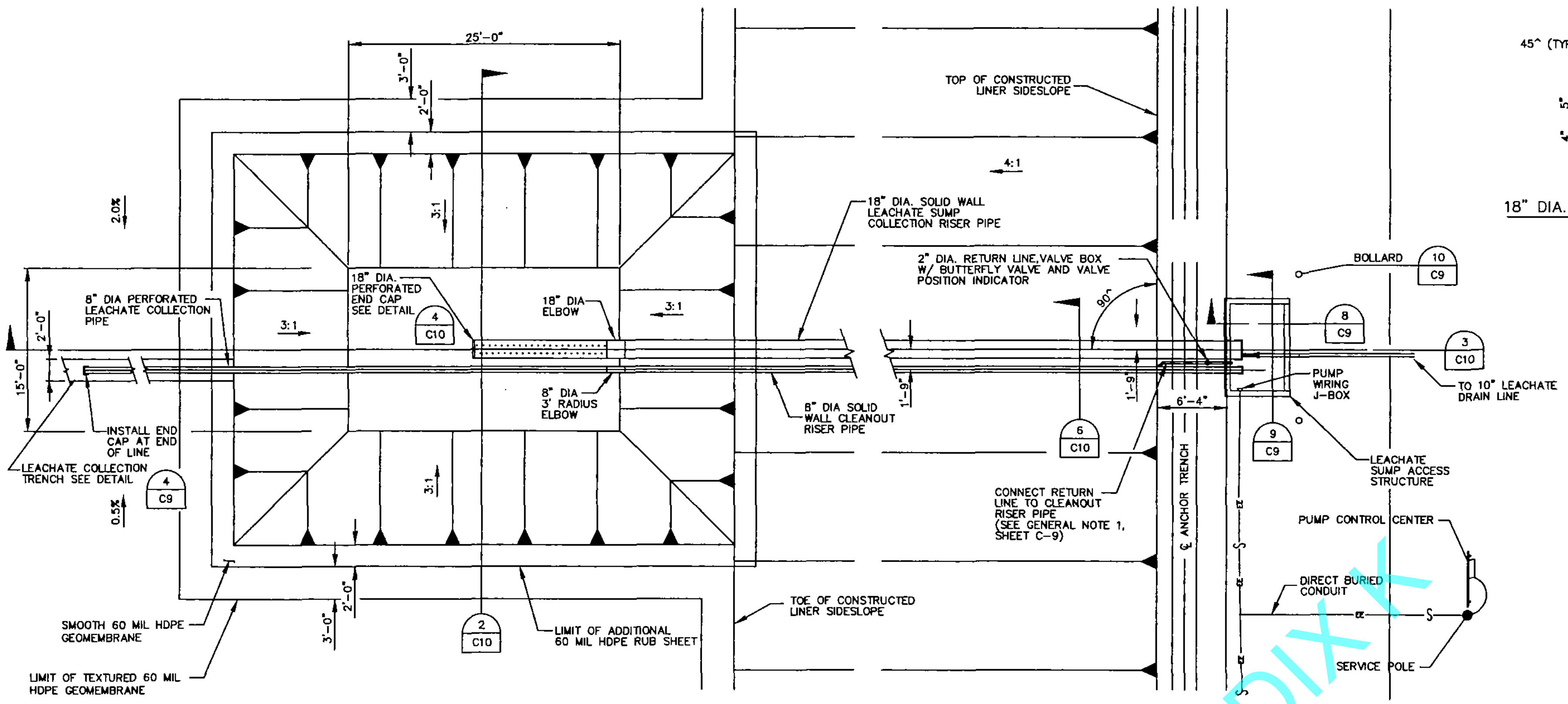
SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

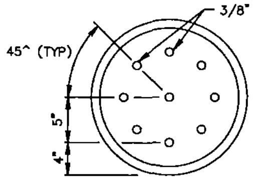
LEACHATE COLLECTION SYSTEM DETAILS

0 1" 2"

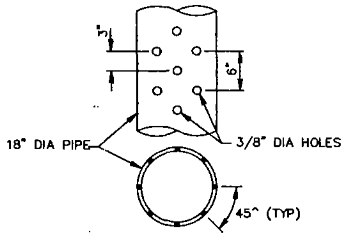
FILENAME 00C–09.DWG
SCALE N/A
SHEET C9 OF 15



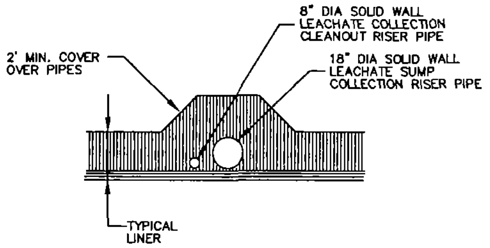
LEACHATE SUMP- PLAN 1 C10
NOT TO SCALE



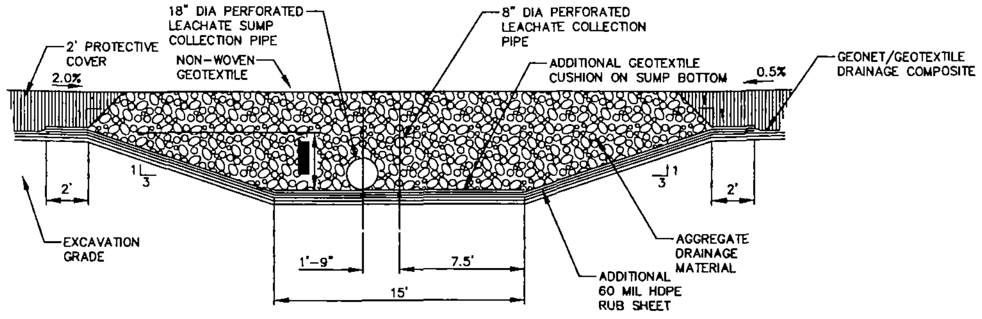
18" DIA. PERFORATED END CAP 4 C10
NOT TO SCALE



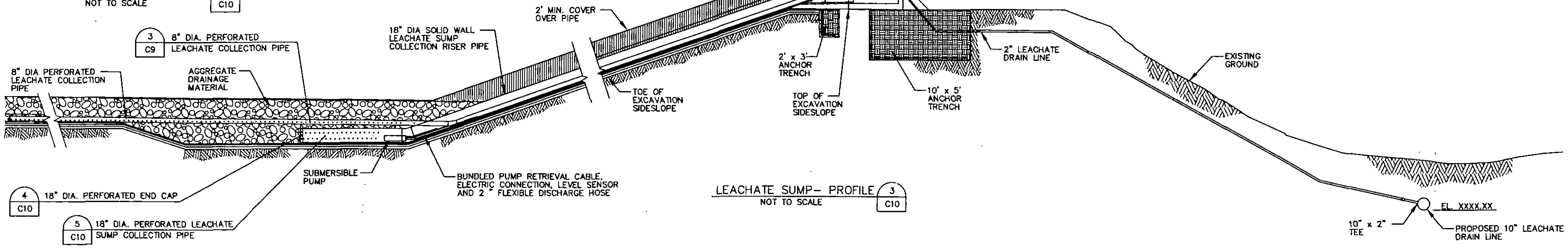
18" DIA. PERFORATED LEACHATE SUMP COLLECTION PIPE 5 C10
NOT TO SCALE



LEACHATE SUMP RISER- SECTION 6 C10
NOT TO SCALE



LEACHATE SUMP- SECTION 2 C10
NOT TO SCALE



LEACHATE SUMP- PROFILE 3 C10
NOT TO SCALE

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	T. WARNER
ARCHITECT	
CIVIL	S. WOMACK
MECHANICAL	
ELECTRICAL	
STRUCTURAL	
DESIGNED	C. MCCARTY
DRAWN BY	C. MCCARTY
PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

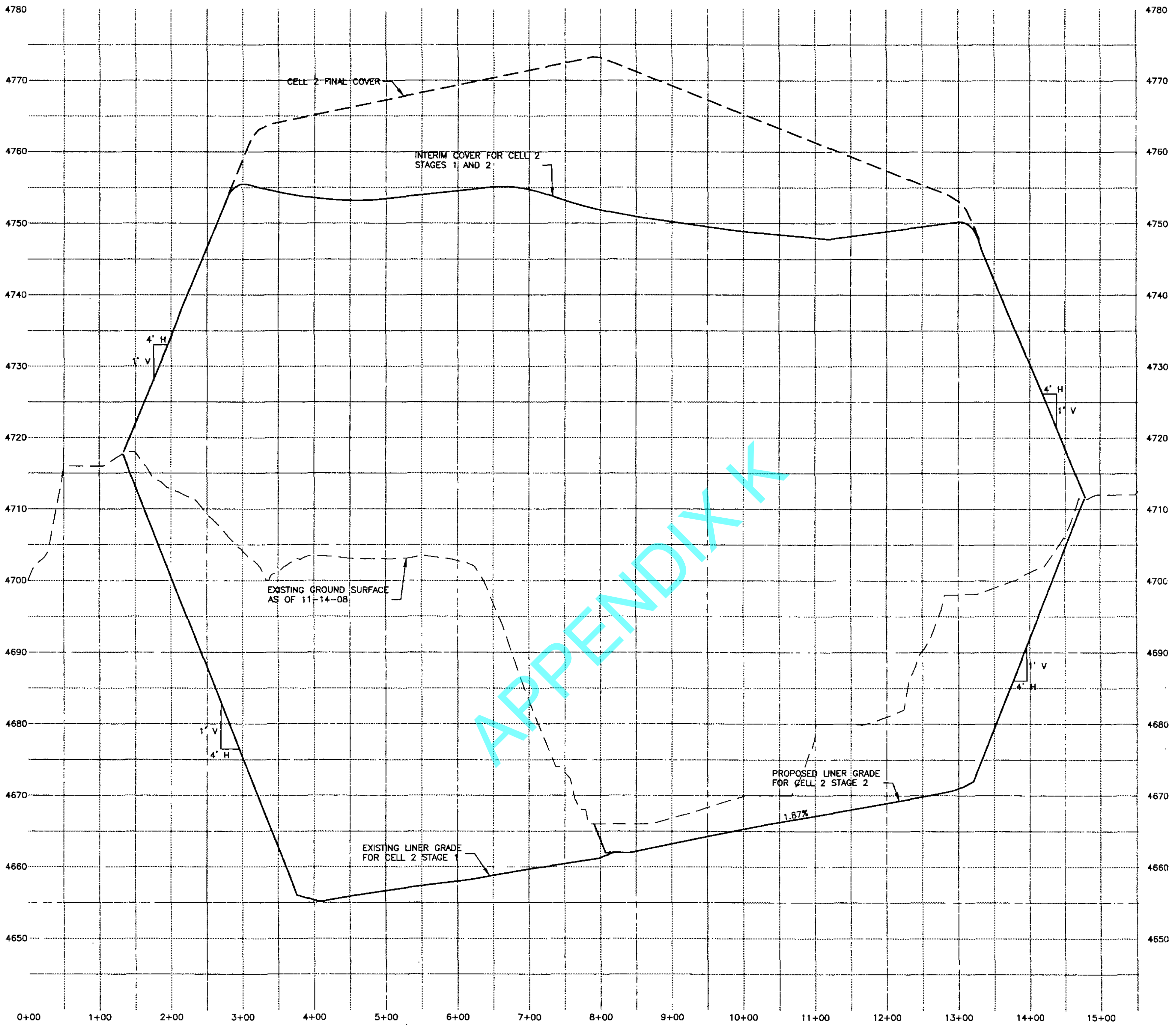
BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

LEACHATE COLLECTION SYSTEM DETAILS

0 1" 2"

FILENAME 00C-10.DWG
SCALE N/A

SHEET
C10 OF 15



CROSS SECTION A

NOTES

1. REFER TO SHEET C4 FOR LINER GRADING PLAN.

2. REFER TO SHEET C5 FOR INTERIM FINAL COVER GRADING PLAN.

3. REFER TO SHEET C6 FOR FINAL COVER GRADING PLAN.

4. INTERIM COVER IS FOR STAGES 1 AND 2. ADDITIONAL COVER WILL BE PLACED DURING CELL 2 FUTURE EXPANSION, AFTER BERM IS REMOVED.

HDR
HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	T. WARNER
ARCHITECT	
CIVIL	S. WOMACK
MECHANICAL	
ELECTRICAL	
STRUCTURAL	
DESIGNED	C. MCCARTY
DRAWN BY	C. MCCARTY
PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

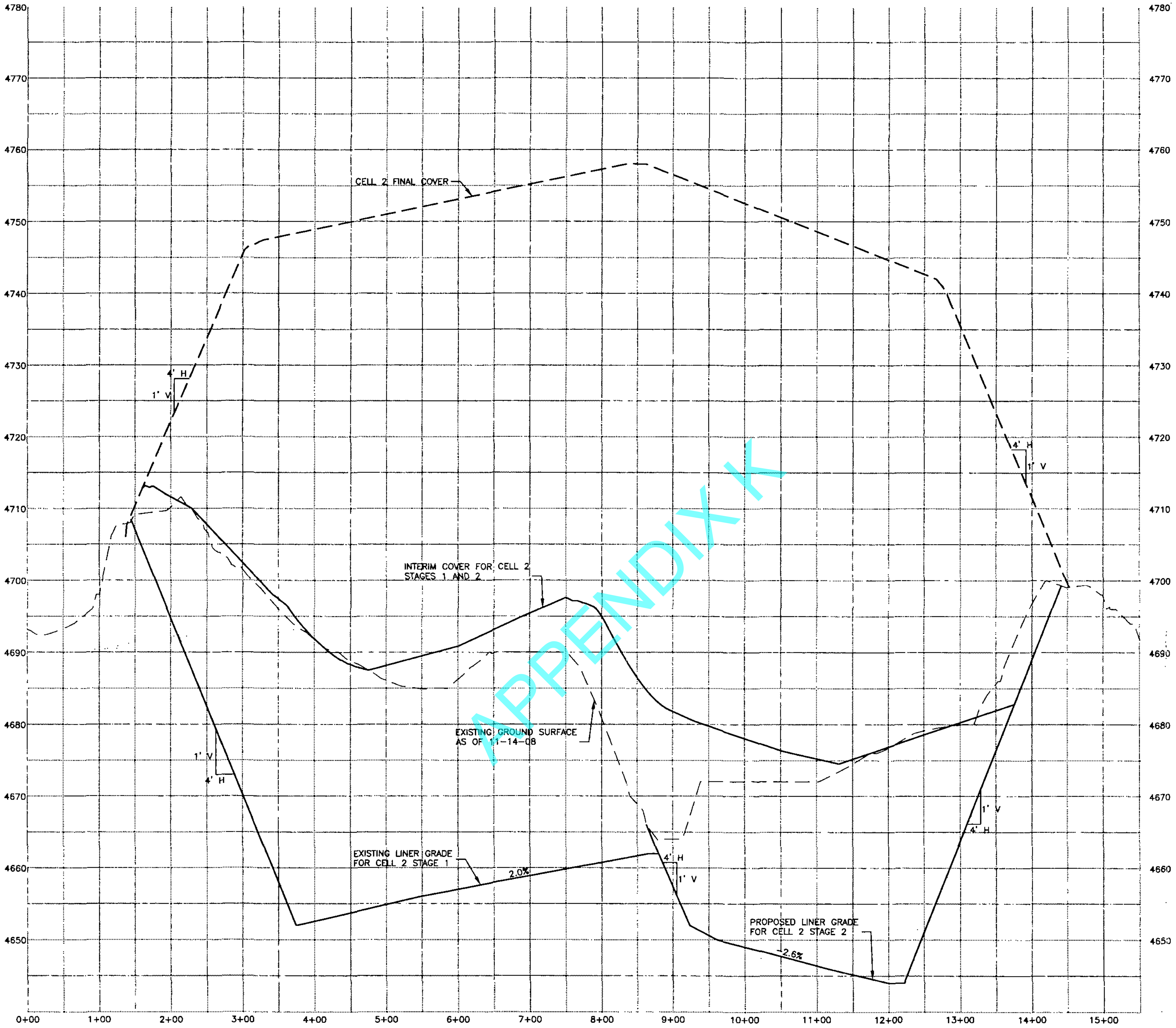
BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

CELL 2 STAGE 2
TYPICAL CROSS SECTIONS

0 1" 2"

FILENAME 00C-12.DWG
SCALE H: 1"=80' V: 1"=8'

SHEET
C11 OF 15



CROSS SECTION A1

NOTES

1. REFER TO SHEET C4 FOR LINER GRADING PLAN.
2. REFER TO SHEET C5 FOR INTERIM FINAL COVER GRADING PLAN.
3. REFER TO SHEET C6 FOR FINAL COVER GRADING PLAN.
4. INTERIM COVER IS FOR STAGES 1 AND 2. ADDITIONAL COVER WILL BE PLACED DURING CELL 2 FUTURE EXPANSION, AFTER BERM IS REMOVED.

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	T. WARNER
ARCHITECT	
CIVIL	S. WOMACK
MECHANICAL	
ELECTRICAL	
STRUCTURAL	
DESIGNED	C. MCCARTY
DRAWN BY	C. MCCARTY
PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

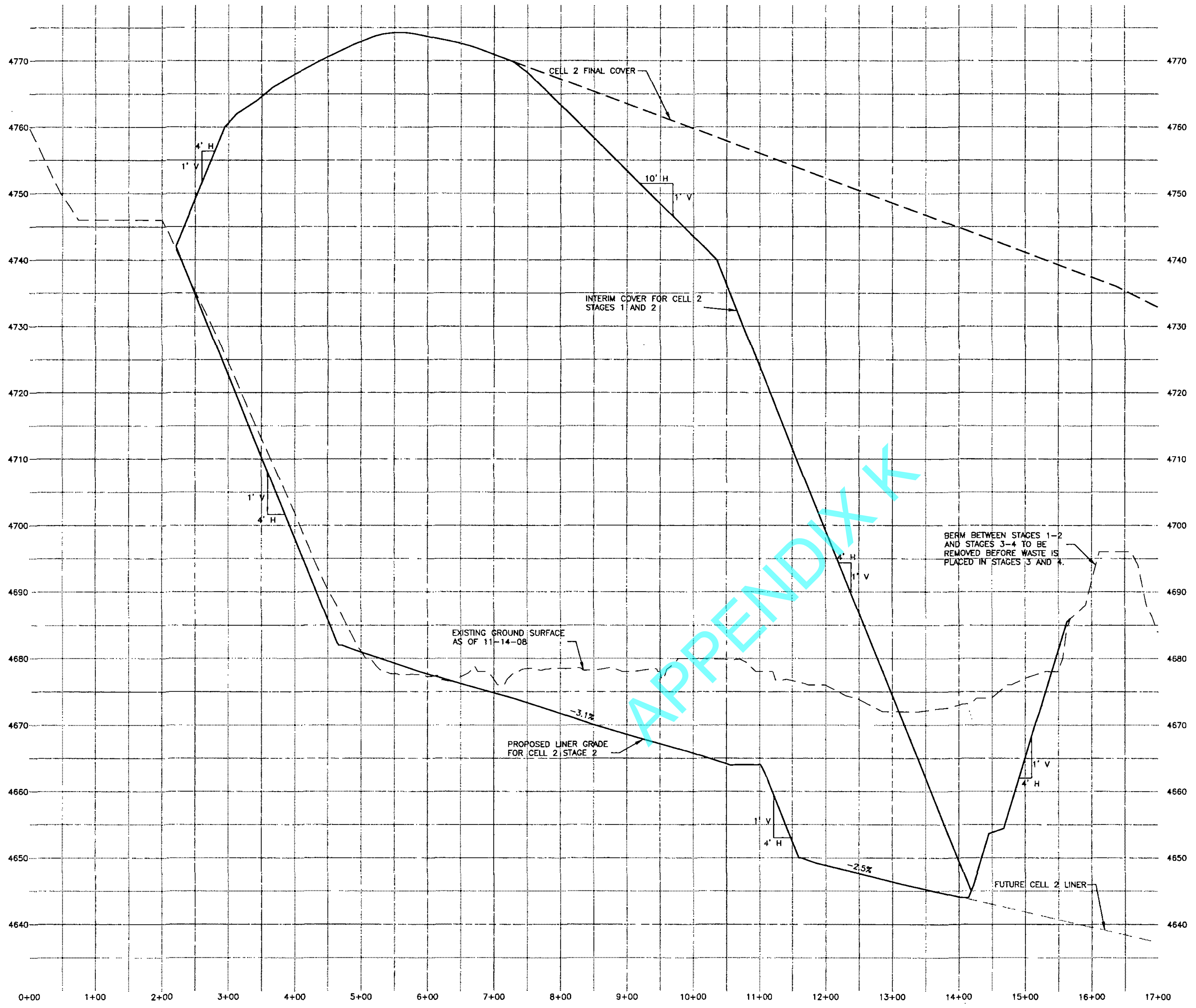
BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

CELL 2 STAGE 2
TYPICAL CROSS SECTIONS

0 1" 2"

FILENAME	00C-13.DWG
SCALE	H: 1"=80' V: 1"=8'

SHEET
C12 OF 15



CROSS SECTION B

NOTES

1. REFER TO SHEET C4 FOR LINER GRADING PLAN.

2. REFER TO SHEET C5 FOR INTERIM FINAL COVER GRADING PLAN.

3. REFER TO SHEET C6 FOR FINAL COVER GRADING PLAN.

4. INTERIM COVER IS FOR STAGES 1 AND 2. ADDITIONAL COVER WILL BE PLACED DURING CELL 2 FUTURE EXPANSION, AFTER BERM IS REMOVED.

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	T. WARNER
ARCHITECT	
CIVIL	S. WOMACK
MECHANICAL	
ELECTRICAL	
STRUCTURAL	
DESIGNED	C. MCCARTY
DRAWN BY	C. MCCARTY
PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

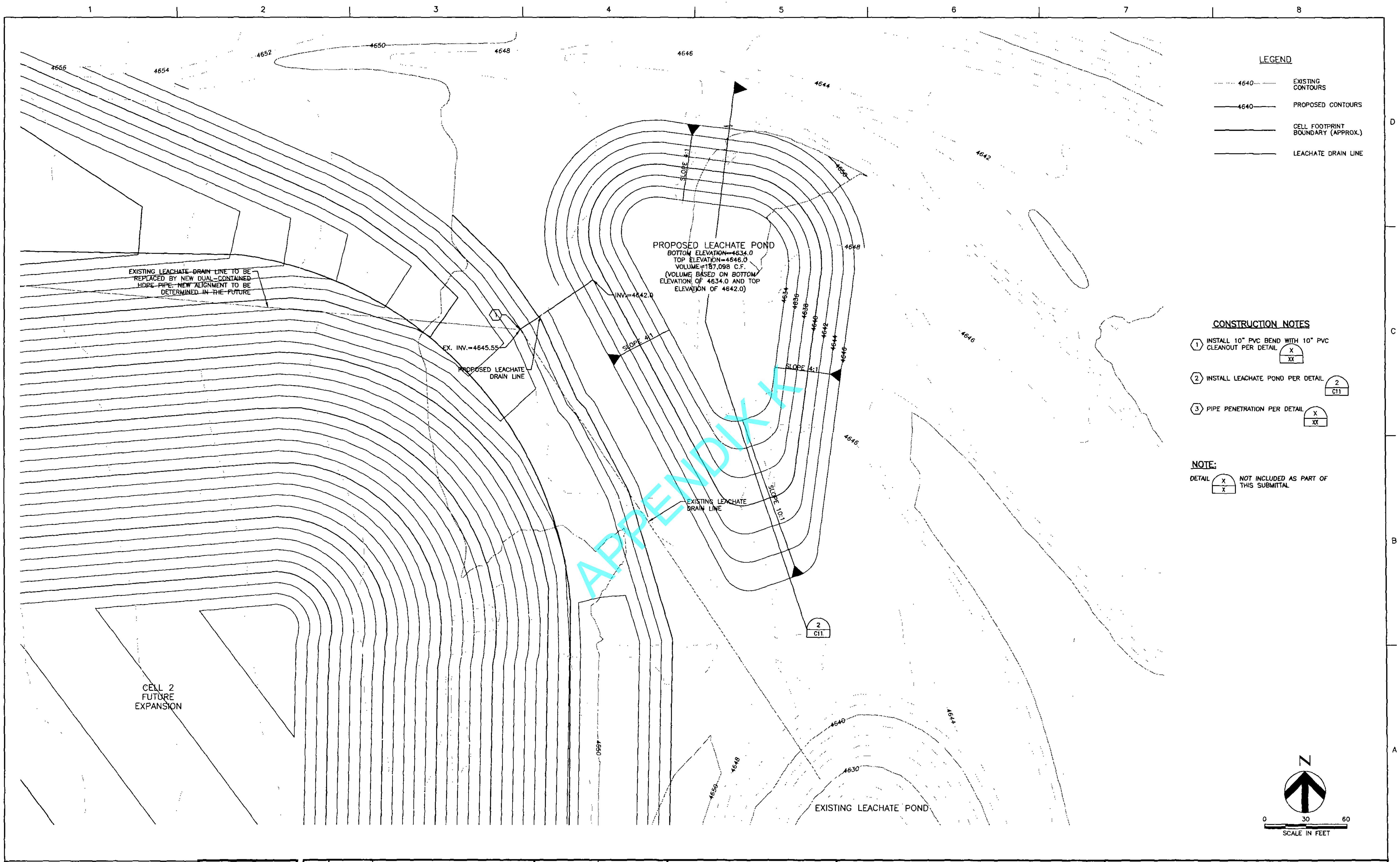
CELL 2 STAGE 2
TYPICAL CROSS SECTIONS

0 1" 2"

FILENAME	00C-14.DWG
SCALE	H: 1"=80' V: 1"=8'

SHEET
C13 OF 15

APPENDIX K



LEGEND

······ 4640 ······	EXISTING CONTOURS
—— 4640 ——	PROPOSED CONTOURS
————	CELL FOOTPRINT BOUNDARY (APPROX.)
————	LEACHATE DRAIN LINE

CONSTRUCTION NOTES

1. INSTALL 10" PVC BEND WITH 10" PVC CLEANOUT PER DETAIL X/XX
2. INSTALL LEACHATE POND PER DETAIL 2/C11
3. PIPE PENETRATION PER DETAIL X/XX

NOTE:

DETAIL X/X NOT INCLUDED AS PART OF THIS SUBMITTAL

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION		
			PROJECT MANAGER	T. WARNER
			ARCHITECT	
			CIVIL	S. WOMACK
			MECHANICAL	
			ELECTRICAL	
			STRUCTURAL	
			DESIGNED	C. MCCARTY
			DRAWN BY	C. MCCARTY
			PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

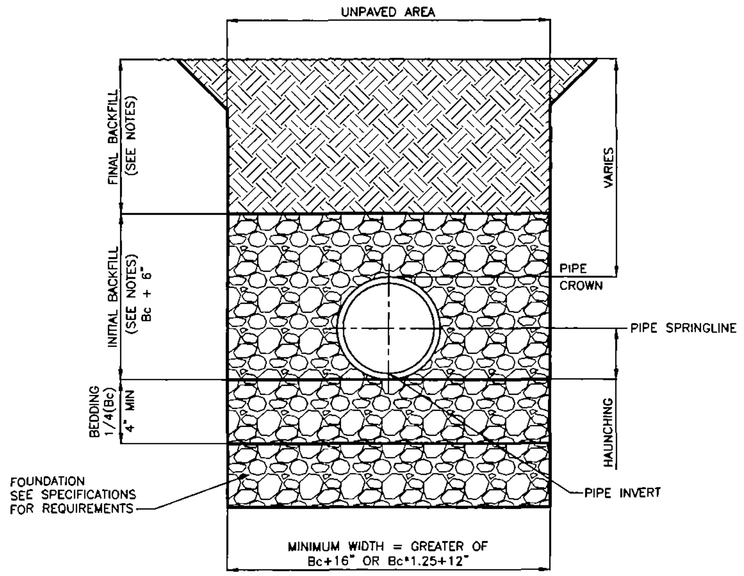
SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

LEACHATE POND GRADING PLAN

0 1" 2"

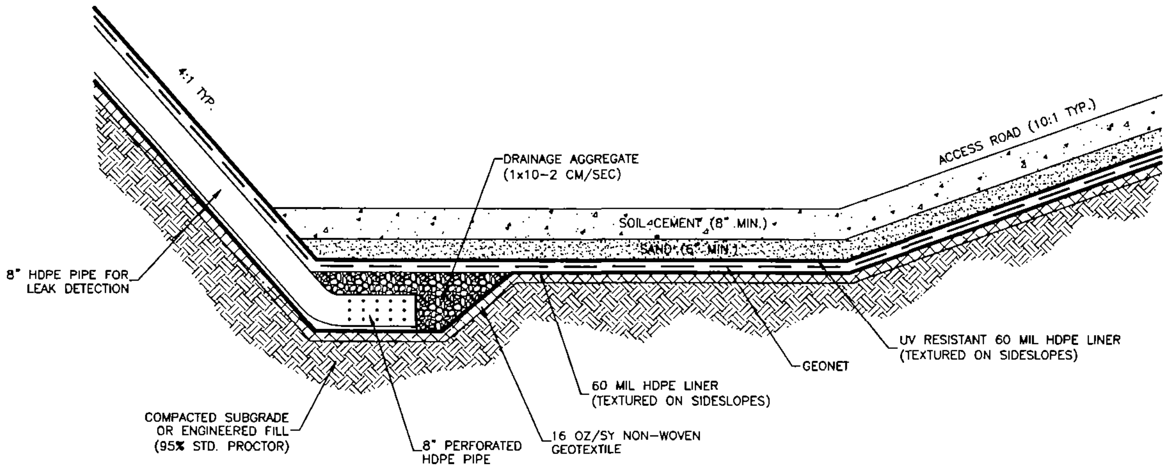
FILENAME 00C-15.DWG
SCALE 1"=30'
SHEET C14 OF 15



NOTES:

1. Bc=OUTSIDE DIAMETER OF PIPE.
2. NOT APPLICABLE TO TRENCH SECTIONS WITH NORMAL GROUNDWATER LEVELS ABOVE THE PIPE CROWN.
3. SEE SPECIFICATIONS FOR MATERIAL AND COMPACTION REQUIREMENTS.

PIPE TYPICAL TRENCH SECTION 1/C11
NOT TO SCALE



PROPOSED LEACHATE POND TYPICAL SECTION 2/C11
NOT TO SCALE

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER T. WARNER
ARCHITECT
CIVIL S. WOMACK
MECHANICAL
ELECTRICAL
STRUCTURAL
DESIGNED C. MCCARTY
DRAWN BY C. MCCARTY
PROJECT NUMBER 96439

NOT FOR CONSTRUCTION

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

LEACHATE POND DETAILS

0 1" 2"

FILENAME 00C-11.DWG
SCALE N/A
SHEET C15 OF 15

APPENDIX L – ANNUAL TITLE V COMPLIANCE REPORTS

NORTHERN UTAH
ENVIRONMENTAL RESOURCE AGENCY

Logan City
Environmental
Department
153 North 1400 West
Building A
Logan, Utah 84321
(435) 716-9755
loganutah.org

North Pointe
Solid Waste
Special Service District
2000 West 200 South
Lindon, Utah 84042
(801) 225-8538
utahcountygarbage.org

South Utah Valley
Solid Waste District
P.O. Box 507
Springville, Utah 84663
(801) 489-3027
suvswd.org

Trans-Jordan Cities
P.O. Box 95610
South Jordan, Utah 84095
(801) 569-8994
transjordan.org

Wasatch Integrated
Waste Management
District
1997 East 3500 North
Layton, Utah 84040
(801) 614-5600
wasatchintegrated.org

Weber County
Solid Waste
867 West Wilson Lane
Ogden, Utah 84401
(801) 399-8358
co.weber.ut.us

April 10, 2019

U.S. Environmental Protection Agency Region VIII
Office of Enforcement, Compliance, and
Environmental Justice
(Mail Code 8ENF)
1595 Wynkoop Street
Denver, CO 80202-1129

Dear Sir or Madam:

Please find attached the annual compliance certification for Bayview Landfill, Title V Operating Permit No. 4900230003. This report covers the period of April 1, 2018 through March 31, 2019. As of January 1, 2017, the Bayview Landfill is owned and operated by the Northern Utah Environmental Resource Agency (NUERA). Notification regarding change in ownership was provided to the Utah Division of Air Quality (UDAQ) on November 29, 2016. This certification is being submitted as required by Section I.L of our Title V Operating Permit and is also being submitted in duplicate to the Utah Division of Air Quality.

Please contact me if you have any questions regarding this report.

Sincerely,

NORTHERN UTAH ENVIRONMENTAL RESOURCE AGENCY

Mark Lamoreaux
General Manager, Bayview Landfill

cc. Kleinfelder

Northern Utah Environmental Resource Agency
1997 East 3500 North
Layton, Utah 84040

TO: **Office of Enforcement, Compliance, and Environmental Justice, Environmental Protection Agency, Region VIII**
Director, Utah Division of Air Quality

FROM: **Northern Utah Environmental Resource Agency – Bayview Landfill**

RE: **Annual Compliance Certification, Title V Operating Permit #4900230003**

DATE: **April 10, 2019**

In accordance with Operating Permit provision I.L and Utah Administrative Code (UAC) R307-415-6c(5), the following compliance certification is submitted.

This certification covers operations from: 04/01/2018 to 03/31/2019.

Term	Description of permit provision	Method used to determine compliance status	Is compliance continuous or intermittent?	Compliance status		Other facts relevant to compliance determination, including references to any and all deviations for this permit provision.
				In	Out	
I.B	Was the source operated in compliance with the operating permit?	The landfill was operated in compliance with the operating permit.	Continuous	X		A Title V permit was issued by the UDAQ on September 18, 2015. No deviations from any permit requirements occurred during this reporting period.
I.C.3	Did the permittee furnish information requested by the Director?	Yes, reports, notifications, and other required submissions were submitted to the Director of UDAQ.	Continuous	X		

Term	Description of permit provision	Method used to determine compliance status	Is compliance continuous or intermittent?	Compliance status		Other facts relevant to compliance determination, including references to any and all deviations for this permit provision.
				In	Out	
I.D.2	Did the permittee submit Application for renewal of this permit on or before the date shown under "Enforceable Dates and Timelines" at the front of the permit (March 18, 2020)?	The future permit renewal application will be submitted to UDAQ prior to the March 18, 2020 deadline.	Continuous	X		
I.G.1	Did the permittee pay the annual emission fee?	Yes, the annual emission fee was paid.	Continuous	X		NUERA paid the required fees, as invoiced.
I.G.2	Was the fee paid by the deadline specified in the permit condition?	Yes, the annual emission fee was paid by the deadline.	Continuous	X		The annual emission fee of $4,245.82 was paid by check dated September 4, 2018.
I.K	Were all application forms, reports and certifications submitted pursuant to the permit properly certified by a responsible official?	Yes, the application forms, reports, and certifications have been signed by a responsible official of NUERA.	Continuous	X		
I.L.1	Did the permittee submit this compliance certification complete & on time?	Yes, the annual compliance certification was mailed to EPA Region VIII and UDAQ prior to April 15, 2019.	Continuous	X		
I.L.2	Did the permittee also send all compliance certifications to EPA?	Yes, the previous annual compliance certification was sent to EPA Region VIII before April 15, 2018.	Continuous	X		

Term	Description of permit provision	Method used to determine compliance status	Is compliance continuous or intermittent?	Compliance status		Other facts relevant to compliance determination, including references to any and all deviations for this permit provision.
				In	Out	
I.S.1.a	Did the permittee properly retain all records required by the permit?	Yes, the records required by the permit are retained at Bayview Landfill.	Continuous	X		
I.S.1.b	Did the permittee include all applicable information in records of monitoring required by the permit?	Yes, Bayview Landfill included all applicable information in records of monitoring required by the permit.	Continuous	X		
I.S.2.a	Did the permittee submit monitoring reports every six months, or more frequently if specified in Section II, and were all instances of deviation from permit requirements clearly identified in the monitoring reports?	Submittal of semi-annual monitoring report.	Continuous	X		A semiannual monitoring report was submitted to UDAQ for the monitoring period of 4/1/2018 through 9/30/2018. A second semiannual report for the monitoring period of 10/1/2018 through 3/31/2019 was submitted to UDAQ by 4/15/2019.
I.S.2.b	Were all reports submitted pursuant to Provision I.S.2.a properly certified by a responsible official?	Yes, the reports have been signed by a responsible official of NUERA.	Continuous	X		
I.S.2.c	Did the permittee promptly notify the Director of all deviations from permit requirements?	No deviations occurred during this reporting period.	Continuous	X		

Term	Description of permit provision	Method used to determine compliance status	Is compliance continuous or intermittent?	Compliance status		Other facts relevant to compliance determination, including references to any and all deviations for this permit provision.
				In	Out	
I.U	Did the permittee submit the inventory required by R307-150 in accordance with the requirements of that rule?	An emissions inventory for reporting year 2017 was submitted to UDAQ prior to April 15, 2018. No emission inventory was required for reporting year 2018.	Continuous	X		
II.B.1.a	Visible emissions caused by fugitive dust shall not exceed 10% at the property boundary, and 20% onsite and control measures in the most recently approved fugitive dust control plan are being taken. [Authority granted under R307-309-3(1); condition originated in R307-309-5]	All monitoring, recordkeeping, and reporting requirements have been completed in accordance with II.B.1.a.1, II.B.1.a.2, and II.B.1.a.3.	Continuous	X		Bayview Landfill adheres to the most recently approved fugitive dust control plan and records are maintained as described in Provision I.S.1 of the permit.
II.B.1.b	Visible emissions shall be no greater than 20 percent opacity. [Authority granted under R307-201-3(2); condition originated in R307-201]	Visual opacity surveys of each affected emission unit are performed on a quarterly basis by an individual trained on the observation procedures of 40 CFR 60, Appendix A, Method 9, and in accordance with 58 FR 61640 Method 203C for fugitive emission sources. All records are maintained as described in Provision I.S.1 of the permit. The monitoring, recordkeeping, and reporting requirements have been completed in accordance with II.B.1.b.1, II.B.1.b.2, and II.B.1.b.3.	Continuous	X		Opacity observation forms are kept on-file at the source location, as specified by the Operating Permit. Opacity was less than 20 percent during the inspections conducted during this monitoring event.

Term	Description of permit provision	Method used to determine compliance status	Is compliance continuous or intermittent?	Compliance status		Other facts relevant to compliance determination, including references to any and all deviations for this permit provision.
				In	Out	
II.B.1.c	Records shall be maintained of the material (salt, crushed slag, or sand) applied to the roads by the permitted source. [Authority granted under R307-307; condition originated in R307-307]	The monitoring, recordkeeping, and reporting requirements have been completed in accordance with II.B.1.c.1, II.B.1.c.2, and II.B.1.c.3.	Continuous	X		The following records are maintained by Bayview Landfill: For Salt - the quantity applied, the percent by weight of insoluble solids in the salt, and the percentage of the material that is sodium chloride (NaCl). For Sand or Crushed Slag - the quantity applied and the percent by weight of fine material which passes the number 200 sieve in a standard gradation analysis. (Origin: R307-307)
II.B.2.a	(a) The permittee shall calculate a non-methane organic compounds (NMOC) emission rate for the landfill using the procedures specified in monitoring. The NMOC emission rate shall be recalculated annually, except as provided in paragraph (b)(1)(i) of reporting.	The monitoring, recordkeeping, and reporting requirements have been completed in accordance with II.B.2.a.1, II.B.2.a.2, and II.B.2.a.3.	Continuous	X		In lieu of an annual NMOC report, NUERA (in December 2015) submitted a five-year NMOC emissions estimate based on Tier 2 testing. The estimated NMOC emission rate was less than 50 megagrams per year for the period from January 1, 2016, to December 31, 2020.

Term	Description of permit provision	Method used to determine compliance status	Is compliance continuous or intermittent?	Compliance status		Other facts relevant to compliance determination, including references to any and all deviations for this permit provision.
				In	Out	
II.B.2.b	The permittee shall meet one of the following requirements for all asbestos disposal operations at the landfill: (a) there shall be no visible emissions to the outside air from any active waste disposal site where asbestos-containing waste material has been deposited, (b) at the end of each operating day, or at least once every 24-hour period while the site is in continuous operation, the asbestos-containing waste material that has been deposited at the site during the operating day or previous 24-hour period shall (1) be covered with at least 15 centimeters (6 inches) of compacted non-asbestos-containing material, or (2) be covered with a resinous or petroleum-	The operations, monitoring, recordkeeping, and reporting requirements have been completed in accordance with II.B.2.b, including II.B.2.b.1, II.B.2.b.2, and II.B.2.b.3.	Continuous	X		Although permitted to receive asbestos-containing materials (ACM), Bayview Landfill has not received ACM waste for disposal.

Term	Description of permit provision	Method used to determine compliance status	Is compliance continuous or intermittent?	Compliance status		Other facts relevant to compliance determination, including references to any and all deviations for this permit provision.
				In	Out	
II.B.2.b	based dust suppression agent that effectively binds dust and controls wind erosion. Such an agent shall be used in the manner and frequency recommended for the particular dust by the dust suppression agent manufacturer to achieve and maintain dust control. Other equally effective dust suppression agents may be used upon prior approval by the Director. For purposes of this paragraph, any used, spent, or other waste oil is not considered a dust suppression agent. (c) use an alternative emissions control method that has received prior written approval by the U.S. Environmental Protection Agency (USEPA) according to the procedures described in 40 CFR 61.149(c)(2). [Authority granted under 40 CFR 61.154; condition originated in 40 CFR 61.154]					

Term	Description of permit provision	Method used to determine compliance status	Is compliance continuous or intermittent?	Compliance status		Other facts relevant to compliance determination, including references to any and all deviations for this permit provision.
				In	Out	
II.B.2.c	Unless a natural barrier adequately deters access by the general public, the permittee shall comply with one of the following: (a) the fencing and warning sign requirements of 40 CFR 61.154 (b), or (b) at the end of each operating day, or at least once every 24-hour period while the site is in continuous operation, the asbestos-containing waste material that has been deposited at the site during the operating day or previous 24-hour period shall be covered with at least 15 centimeters (6 inches) of compacted non-asbestos-containing material. [Authority granted under 40 CFR 61.154; condition originated in 40 CFR 61.154]	The operations, monitoring, recordkeeping, and reporting requirements have been completed in accordance with II.B.2.c, including II.B.2.c.1, II.B.2.c.2, and II.B.2.c.3.	Continuous	X		Bayview Landfill has not received ACM for disposal.

Term	Description of permit provision	Method used to determine compliance status	Is compliance continuous or intermittent?	Compliance status		Other facts relevant to compliance determination, including references to any and all deviations for this permit provision.
				In	Out	
II.B.2.d	The permittee shall maintain waste shipment records of all asbestos-containing waste material received. In addition to routine shipment-tracking information, the waste shipment records shall document instances of improperly enclosed or uncovered waste, or any asbestos-containing waste material not sealed in leak-tight containers. [Authority granted under 40 CFR 61.154 (e); condition originated in 40 CFR 61.154]	Operations, monitoring, recordkeeping, and reporting requirements have been completed in accordance with II.B.2.d, including II.B.2.d.1, II.B.2.d.2, and II.B.2.d.3.	Continuous	X		Records are maintained by Bayview Landfill, as described in Provision I.S.1 of the permit. (Origin 40 CFR 61.154(e)). Bayview Landfill has not received ACM for disposal.
II.B.2.e	The permittee shall maintain, until closure, records of the location, depth and area, and quantity in cubic meters (cubic yards) of asbestos-containing waste material within the disposal site on a map or diagram of the disposal area. [Authority granted under 40 CFR 61.154 (f); condition originated in 40 CFR 61.154]	Operations, monitoring, recordkeeping, and reporting requirements have been completed in accordance with II.B.2.e, including II.B.2.e.1, II.B.2.e.2, and II.B.2.e.3.	Continuous	X		Records are maintained by Bayview Landfill, as described in Provision I.S.1 of the permit. Bayview Landfill has not received ACM for disposal.

Term	Description of permit provision	Method used to determine compliance status	Is compliance continuous or intermittent?	Compliance status		Other facts relevant to compliance determination, including references to any and all deviations for this permit provision.
				In	Out	
II.B.2.f	Upon closure of an asbestos-containing waste disposal site, the permittee shall submit a copy of records of asbestos waste disposal locations and quantities and shall comply with the following: (b) Unless a natural barrier adequately deters access by the general public, install and maintain warning signs and fencing as follows, or comply with paragraph (a)(2) or (a)(3) of this condition: (1) Display warning signs at all entrances and at intervals of 100 m (328 ft) or less along the property line of the site or along the perimeter of the sections of the site where asbestos-containing waste material was deposited. The warning signs must: (i) Be posted in such a manner and location that a	Operations, monitoring, recordkeeping, and reporting requirements have been completed in accordance with II.B.2.f, including II.B.2.f.1, II.B.2.f.2, and II.B.2.f.3.	Continuous	X		Records are maintained by Bayview Landfill, as described in Provision I.S.1 of the permit. Bayview Landfill has not received ACM for disposal.

Term	Description of permit provision	Method used to determine compliance status	Is compliance continuous or intermittent?	Compliance status		Other facts relevant to compliance determination, including references to any and all deviations for this permit provision.
				In	Out	
II.B.2.f	person can easily read the legend; and (ii) Conform to the requirements for 51 cm×36 cm (20"×14") upright format signs specified in 29 CFR 1910.145(d)(4) and this paragraph; and (iii) Display the following legend in the lower panel with letter sizes and styles of a visibility at least equal to those specified in this paragraph. (2) Fence the perimeter of the site in a manner adequate to deter access by the general public. (3) When requesting a determination on whether a natural barrier adequately deters public access, supply information enabling the Administrator to determine whether a fence or a natural barrier adequately deters access by the general public.					
CAA Title IV (Acid Rain) Provisions	Bayview Landfill is not subject to Title IV.	NA	NA	NA	NA	NA

Northern Utah Environmental Resource Agency
1997 East 3500 North
Layton, Utah 84040

In accordance with Operating Permit provision I.K and UAC R307-415-5d, and based on information and belief formed after reasonable inquiry, I certify that the statements and information in this document are true, accurate, and complete.

Mark Lamoreaux General Manager, Bayview Landfill	Date

NORTHERN UTAH
ENVIRONMENTAL RESOURCE AGENCY

TO: **Director, Utah Division of Air Quality**

FROM: **Northern Utah Environmental Resource Agency (NUERA), Bayview Landfill**

RE: **Semiannual Monitoring Report for Title V Operating Permit #4900230003**

DATE: **April 10, 2019**

Logan City
Environmental
Department
153 North 1400 West
Building A
Logan, Utah 84321
(435) 716-9755
loganutah.org

North Pointe
Solid Waste
Special Service District
2000 West 200 South
Lindon, Utah 84042
(801) 225-8538
utahcountygarbage.org

South Utah Valley
Solid Waste District
P.O. Box 507
Springville, Utah 84663
(801) 489-3027
suvswd.org

Trans-Jordan Cities
P.O. Box 95610
South Jordan, Utah 84095
(801) 569-8994
transjordan.org

Wasatch Integrated
Waste Management
District
1997 East 3500 North
Layton, Utah 84040
(801) 614-5600
wasatchintegrated.org

Weber County
Solid Waste
867 West Wilson Lane
Ogden, Utah 84401
(801) 399-8358
co.weber.ut.us

As of January 1, 2017, the Bayview Landfill (Bayview) is owned and operated by the Northern Utah Environmental Resource Agency (NUERA). Notification regarding change in ownership was provided to the Utah Division of Air Quality (UDAQ) on November 29, 2016. The ownership change does not alter the permit conditions or requirements listed in Bayview Landfill's current Title V Operating Permit (#4900230003, issued September 18, 2015), and the Landfill continues to operate under these conditions. This semiannual monitoring report is submitted to the UDAQ in accordance with Operating Permit provision I.S.2.a, and Utah Administrative Code (UAC) R307-415-6a(3)(c)(i), and is for the monitoring period from October 1, 2018 to March 31, 2019.

The Bayview Landfill's Title V Operating Permit specifies conditions for compliance with applicable air quality regulations.

There were no deviations from Operating Permit conditions or requirements during this six-month reporting period.

The next semiannual report (for the six-month period of April 1, 2019 through September30, 2019) will be submitted on or before October 30, 2019.

NUERA recognizes that new landfill gas (LFG) rules were published in the Federal Register on August 29, 2016. States and local air jurisdictions were to submit proposed Emission Guideline (EG) rules by May 30, 2017 regarding Cf and XXX; however, that process has since been delayed. Since Bayview was last constructed or modified before July 17, 2014, it will be subject to state plans approved by EPA under Subpart Cf, if approved. Since the State of Utah has not prepared any plan to address the new regulations, Subpart Cf has not been applicable to Bayview during this monitoring period. NUERA will continue to evaluate the applicability of these new regulations to its facility and incorporate new or additional monitoring and reporting requirements and submit reports by prescribed deadlines, as required.

In accordance with Operating Permit provision I.K and UAC R307-415-5d, and based on information and belief formed after reasonable inquiry, I certify that the statements and information in this document are true, accurate, and complete.

____________________________ __________________
Mark Lamoreaux Date
Bayview Landfill General Manager

cc: Kleinfelder

KLEINFELDER
Bright People. Right Solutions.

April 10, 2019
Kleinfelder Project No.: 20183937.001A

Mr. Mark Lamoreaux
Bayview Landfill General Manager
Northern Utah Environmental Resource Agency
P.O Box 900
Layton, UT 84041

SUBJECT: Bayview Landfill
2019 Annual and Semi-annual Compliance Reports
Title V Operating Permit #4900230003

Dear Mr. Lamoreaux:

Kleinfelder Inc. (Kleinfelder), acting on behalf of Northern Utah Environmental Resource Agency (NUERA), has completed the Annual Compliance Report (April 1, 2018 to March 31, 2019, Kleinfelder Document No. SLC19R93956) and Semi-annual Compliance Report (October 1, 2018, to March 31, 2019, Kleinfelder Document No. SLC19R93954) for the Bayview Landfill located in Elberta, Utah. The Annual and Semi-annual Title V Compliance Reports are provided as Attachments A and B, respectively.

Kleinfelder requests that you review these compliance reports and ensure they are accurate and complete. The reports should be printed out on NUERA letterhead, as appropriate, and must be signed by you attesting to their accuracy and completeness. If any revisions are necessary, please provide them to Kleinfelder immediately. The signed report must be submitted/postmarked to EPA and UDAQ *before* April 15, 2019, as follows:

One signed copy of Annual Compliance Report should be mailed to EPA at:

Environmental Protection Agency, Region VIII
Office of Enforcement, Compliance, and
Environmental Justice
(Mail code 8ENF)
US EPA, Region 8
1595 Wynkoop Street
Denver, CO 80202-1129

One signed copy of Annual and Semiannual Compliance Report should be mailed/ delivered to UDAQ at:

Attn: Director
Utah Division of Air Quality
195 North 1950 West
P.O. Box 144820
Salt Lake City, UT 84114-4820

We recommend that you use certified mail or a delivery service (FedEx or UPS) where a return receipt is generated and can be kept in your files. Please provide an electronic copy of your final report for our records.

LIMITATIONS

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions and recommendations are based on a limited number of observations and data provided solely by you. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no other representation, guarantee or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

The work performed was based on project information provided by the NUERA and Bayview Landfill employees. If NUERA does not retain Kleinfelder to review modifications to the compliance documents, Kleinfelder assumes no responsibility for ultimate changes to these documents. If there are any changes in the operational plan data used for the facility, NUERA must notify Kleinfelder, as those changes could affect the annual and semi-annual compliance certification. Failure to do so will vitiate Kleinfelder's recommendations.

CLOSURE

We appreciate the opportunity to be of continued service on this project. If you have any questions regarding this information or if we can be of further assistance, please contact us at 801.261.3336.

Sincerely,

KLEINFELDER

Jill Hernandez
Staff Professional II

Amit Nair
Senior Air Quality Professional

ATTACHMENTS

A	Annual Title V Compliance Report (SLC19R93956)
B	Semiannual Title V Compliance Report (SLC19R93954)

APPENDIX M – BORING LOGS

APPENDIX E

Boring Logs

SUVSWD Bayview Class I Landfill
Permit Application

APPENDIX E-1

CULINARY WELL

LS. ELLL. 4110

Page 1 of 4

Test Well Request

Form 113-514-1140

Examined ....
Recorded: B. C. .... T. B. ....
Inspection Sheet ....
Copied ....

REPORT OF WELL DRILLER
STATE OF UTAH

Application No. 86-53-11-TW
Claim No. ....
Coordinate No. ....

GENERAL STATEMENT: Report of well driller is hereby made and filed with the State Engineer, in accordance with the laws of Utah. (This report shall be filed with the State Engineer within 30 days after the completion or abandonment of the well. Failure to file such reports constitutes a misdemeanor.)

(1) WELL OWNER:
Name Provo City Water and Waste Water Dept.
Address P.O. 1849, Provo Utah

(2) LOCATION OF WELL:
County Utah Ground Water Basin .... (leave blank)
North ~~50~~ 2640 feet, East ~~56~~ 15 feet from NE Corner
South / West
of Section 17, T. 9 S, R. 1 [✓ W] SLBM (strike out words not needed)

0.130
1,447
from E 1/4 Cor.
Sec. 18

(3) NATURE OF WORK (check):
New Well ☑
Replacement Well ☐ Deepening ☐ Repair ☐ Abandon ☐
If abandonment, describe material and procedure: ....

(4) NATURE OF USE (check):
Domestic ☐ Industrial ☐ Municipal ☑ Stockwater ☐
Irrigation ☐ Mining ☐ Other ☐ Test Well ☐

(5) TYPE OF CONSTRUCTION (check):
Rotary ☐ Dug ☐ Jetted ☐
Cable ☑ Driven ☐ Bored ☐

(6) CASING SCHEDULE:
Threaded ☐ Welded ☑
18" Diam. from 0 feet to 100 feet Gage 250
12" Diam. from 0 feet to 502 feet Gage 375
...." Diam. from .... feet to .... feet Gage ....
New ☑ Reject ☐ Used ☐

(7) PERFORMATIONS:
Perforated? Yes ☑ No ☐
Type of perforator used Mills
Size of perforations 3/8 inches by 2 1/2 inches
1160 { perforations from 350 feet to 445 feet
perforations from 450 feet to 500 feet }
.... perforations from .... feet to .... feet
.... perforations from .... feet to .... feet
.... perforations from .... feet to .... feet

1 = 7.56 ft.²

@ 302 gpm
= 0.09 fps

(8) SCREENS:
Well screen installed? Yes ☐ No ☑
Manufacturer's Name ....
Type .... Model No. ....
Diam. .... Slot size .... Set from .... ft. to ....
Diam. .... Slot size .... Set from .... ft. to ....

(9) CONSTRUCTION:
Was well gravel packed? Yes ☐ No ☑ Size of gravel: ....
Gravel placed from .... feet to .... feet
Was a surface seal provided? Yes ☑ No ☐
To what depth? 100 feet
Material used in seal: Grout
Did any strata contain unusable water? Yes ☐ No ☑
Type of water: .... Depth of strata ....
Method of sealing strata off: ....

Was surface casing used? Yes ☑ No ☐
Was it cemented in place? Yes ☑ No ☐

(10) WATER LEVELS:
4505.5
Static level 264 1/2 feet below land surface Date 9/9/86
Artesian pressure .... feet above land surface Date ....

LOG RECEIVED:

(11) FLOWING WELL:
Controlled by (check) Valve ☐
Cap ☐ Plug ☐ No Control ☐
Does well leak around casing? Yes ☐
No ☐

(12) WELL TESTS:
Drawdown is the distance in feet the water level is lowered below static level.
Was a pump test made? Yes ☑ No ☐ If so, by whom? Rhodes Bros.

Yield: 153 gal./min.	with 26	feet drawdown after 2	hours
" 201	" 44	" 4	"
" 202	" 97	" 10	"

Bailer test .... gal./min. with .... feet drawdown after .... hours
Artesian flow .... g.p.m. Date ....
Temperature of water 68°F. Was a chemical analysis made? No ☐ Yes ☒

S.C.
5.9
4.6
3.1

T = 6,500 gpd/ft.

(13) WELL LOG:
Diameter of well 18" to 100' 12" inches
Depth drilled 510 feet. Depth of completed well 502 feet.

NOTE: Place an "X" in the space or combination of spaces needed to designate the material or combination of materials encountered in each depth interval. Under REMARKS make any desirable notes as to occurrence of water and the color, size, nature, etc., of material encountered in each depth interval. Use additional sheet if needed.

DEPTH		MATERIAL										
From	To	Clay	Silt	Sand	Gravel	Cobbles	Boulders	Hardpan	Conglomerate	Bedrock	Other	REMARKS
0	5	X		X	X							
5	10	X		X	X							
10	15	X		X	X							
15	20	X			X							
20	25	X			X							
25	30	X			X							
30	35	X			X							
35	40	X			X							Reddish Tan
40	45	X			X							" "
45	50	X			X							" "
50	55	X			X							" "
55	60	X			X							" "
60	65	X			X							" "
65	70	X			X							" "
70	75	X			X							" "
75	80	X			X							" "
80	85	X			X							" "
85	90	X			X							" "
90	95	X			X							" "
95	100	X			X							" "
100	105	X			X							" "
105	110	X			X							" "
110	115	X			X							" "
115	120	X			X							" "
120	125	X			X							" "
125	130	X			X							" "
130	135	X			X							" "
135	140	X			X							" "
140	145	X			X							" "
145	150	X			X							" "
150	155	X			X							" "
155	160	X			X							" "

Work started 7-2- 1986 Completed 9-9- 1986

(14) PUMP:
Manufacturer's Name ....
Type: Turbine H. P. ....
Depth to pump or bowles 400 feet

Well Driller's Statement:

This well was drilled under my supervision, and this report is true to the best of my knowledge and belief.

Name Binning Drlg. Co. (Person, firm or corporation) (Type or print)
Address 1085 E. 150 North Fairview, Ut.
(Signed) Lester L. Binning (Well Driller)
License No. 243 Date Sept. 10, 1986

USE OTHER SIDE FOR ADDITIONAL REMARKS

Form 113—524—1240

Examined

Recorded: B. C. .... T. B.

Inspection Sheet

Copied

REPORT OF WELL DRILLER
STATE OF UTAH

Page 2 of 4

Test Well Request

Application No. 86-5331-TW

Claim No.

Coordinate No.

GENERAL STATEMENT: Report of well driller is hereby made and filed with the State Engineer, in accordance with the laws of Utah. (This report shall be filed with the State Engineer within 30 days after the completion or abandonment of the well. Failure to file such reports constitutes a misdemeanor.)

(1) WELL OWNER:

Name Provo City Water and Waste Water

Address

(2) LOCATION OF WELL:

County .... Ground Water Basin (leave blank)

North/South .... feet, East/West .... feet from .... Corner

of Section ...., T. .... N/S, R. .... E/W SLBM/USM (strike out words not needed)

(3) NATURE OF WORK (check):

New Well ☐

Replacement Well ☐ Deepening ☐ Repair ☐ Abandon ☐

If abandonment, describe material and procedure:

(4) NATURE OF USE (check):

Domestic ☐ Industrial ☐ Municipal ☐ Stockwater ☐

Irrigation ☐ Mining ☐ Other ☐ Test Well ☐

(5) TYPE OF CONSTRUCTION (check):

Rotary ☐ Dug ☐ Jetted ☐

Cable ☐ Driven ☐ Bored ☐

(6) CASING SCHEDULE: Threaded ☐ Welded ☐

......" Diam. from .... feet to .... feet Gage ....

......" Diam. from .... feet to .... feet Gage ....

......" Diam. from .... feet to .... feet Gage ....

New ☐ Reject ☐ Used ☐

(7) PERFORATIONS: Perforated? Yes ☐ No ☐

Type of perforator used

Size of perforations .... inches by .... inches

.... perforations from .... feet to .... feet

.... perforations from .... feet to .... feet

.... perforations from .... feet to .... feet

.... perforations from .... feet to .... feet

.... perforations from .... feet to .... feet

(8) SCREENS: Well screen installed? Yes ☐ No ☐

Manufacturer's Name

Type .... Model No. ....

Diam. .... Slot size .... Set from .... ft. to ....

Diam. .... Slot size .... Set from .... ft. to ....

(9) CONSTRUCTION:

Was well gravel packed? Yes ☐ No ☐ Size of gravel:

Gravel placed from .... feet to .... feet

Was a surface seal provided? Yes ☐ No ☐

To what depth? .... feet

Material used in seal:

Did any strata contain unusable water? Yes ☐ No ☐

Type of water: .... Depth of strata ....

Method of sealing strata off:

Was surface casing used? Yes ☐ No ☐

Was it cemented in place? Yes ☐ No ☐

(10) WATER LEVELS:

Static level .... feet below land surface Date ....

Artesian pressure .... feet above land surface Date ....

LOG RECEIVED:

(11) FLOWING WELL:

Controlled by (check) Valve ☐

Cap ☐ Plug ☐ No Control ☐

Does well leak around casing? Yes ☐ No ☐

(12) WELL TESTS:

Drawdown is the distance in feet the water level is lowered below static level.

Was a pump test made? Yes ☐ No ☐ If so, by whom?

Yield: .... gal./min. with .... feet drawdown after .... hours

" .... " .... " .... "

" .... " .... " .... "

Bailer test .... gal./min. with .... feet drawdown after .... hours

Artesian flow .... g.p.m. Date ....

Temperature of water .... Was a chemical analysis made? No ☐ Yes ☐

(13) WELL LOG:

Diameter of well .... inches

Depth drilled .... feet. Depth of completed well .... feet.

NOTE: Place an "X" in the space or combination of spaces needed to designate the material or combination of materials encountered in each depth interval. Under REMARKS make any desirable notes as to occurrence of water and the color, size, nature, etc., of material encountered in each depth interval. Use additional sheet if needed.

DEPTH		MATERIAL										REMARKS
From	To	Clay	Silt	Sand	Gravel	Cobbles	Boulders	Hardpan	Conglomerate	Bedrock	Other	
160	165	X			X							
165	170	X			X							
170	175	X			X							
175	80	X			X							
180	85	X			X							
185	90	X			X							
190	95	X			X							
195	200	X			X							
200	205	X			X							
205	210	X			X							
210	215	X			X							
215	220	X			X							
220	225	X			X							
225	230	X			X							more Rocks
230	235	X			X							
235	240	X			X							
240	245	X			X							
245	250	X			X							
250	255	X			X							
255	260	X			X							
260	265	X			X							A little Water
265	270	X			X							" "
270	275	X			X							" "
275	280	X			X							" "
280	285	X			X							" "
285	290	X			X							
290	295	X			X							
295	300	X			X							
300	305	X			X							
305	310	X			X							
310	315	X			X							
315	320	X			X							

Work started .... 19.... Completed .... 19....

(14) PUMP:

Manufacturer's Name

Type: .... H. P. ....

Depth to pump or bowles .... feet

Well Driller's Statement:

This well was drilled under my supervision, and this report is true to the best of my knowledge and belief.

Name BINNING DRLG. Co. (Person, firm, or corporation) (Type or print)

Address

(Signed) .... (Well Driller)

License No. 243 Date .... 19....

USE OTHER SIDE FOR ADDITIONAL REMARKS

APPENDIX E-2

MONITORING WELLS

Herm Hughes & Sons, Inc. represents that we have determined and verified all field dimensions and measurements, field construction criteria, materials, and similar data, and that we have checked and coordinated this submittal with the requirements of the Work and the Contract Documents.

1-24-90

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-12-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. SMW-1 TYPE monitor

JOB OWNER Provo city

LOCATION Bayview LandfiLL

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Decon Rig + D.P. + caseing	Button	11	1
					move set up on #smw-1 DriLL+Drive			
		0	-		12" to 28'			
			5"	5"	sand+silt			
		5"	10		conglomarunt gravel - sand cemented			
		10	15					
		15	20					
		20	25					
		25	28		DriLL open hole to 75			
		28	30					
		30	45					
		45	60					
		60	75					
					Enstall 71' 4½ PVC and gravel			
					pack 25' of hole.			
					move rig Decon and set up on			
	6:00				smw #2			

STAND BY TIME HRS. ____ HOURLY WORK HRS. 11

Signature of Owner or Representative ____

CASING USED: Size 12 Ft. Used 30 Water G.P.M. ____

CASING USED: Size ____ Ft. Used ____ Water Static ____

DRILLING MUD: Type ____ Amount ____ Fuel ____ Oil ____

MISC.

Driller Marty Peterson	Helper mike spindeLL	Helper

LOG OF EXPLORATORY BORING

~~PROJECT NO.~~ DRILLER: MARTY PETERSON
BORING. NO. BV-SMW-1
PROJECT NAME BAYVIEW LANDFILL
LOGGED BY TOM BELCHAK
DRILLING. METHOD DRILL/DRIVE AIR ROTARY 12"CASING
DATE DRILLED 12-[illegible]/89
STATE ____ COUNTY __________ DESCRIPTIVE LOCATION NORTH OF WATER TANK
LOCATION: T______ R______ SECT.______ TRACT________
PAGE 1 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				5					GRAVELLY SAND: REDDISH-BROWN, COARSE-GRAINED MEDIUM SAND. 10% GRAVEL.
				10					SAND: REDDISH-BROWN MEDIUM GRAINED WELL SORTED
				15					GRAVELLY SAND: REDDISH-BROWN, MEDIUM SORTED 10% GRAVEL.
				20					GRAVELLY SAND: REDDISH-BROWN MEDIUM SORTED 20% GRAVEL.
				25					GRAVELLY SAND: FINE-GRAINED REDDISH BROWN MEDIUM SORTED 10% GRAVEL
				30					SANDY PEBBLY GRAVEL: REDDISH-BROWN. VERY POORLY SORTED 30% PEBBLES

REMARKS FIRST 2-3 FEET GREY, WEATHERED GRAVEL. REMAINDER OF BOREHOLE IS REDDISH BROWN SANDS + GRAVELS.

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______
PROJECT NAME ______
DRILLING METHOD ______
BORING NO. RV-SMW-1
LOGGED BY ______
DATE DRILLED ______
STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ______
LOCATION: T ______ R ______ SECT. ______ TRACT ______
PAGE 2 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GRAVELLY SAND: BROWNISH-RED, POORLY SORTED
				35					
									PEBBLY SILTY SAND: REDDISH BROWN, VERY
				40					POORLY SORTED, SOME CLAYBALLS
									PEBBLY SILTY SAND: REDDISH BROWN, VERY
				45					POORLY SORTED: CEMENTATION OF SAND.
									CEMENTED SILTY SAND: WHITE & REDDISH
				50					BROWN VERY FINE-GRAINED-CEMENTED.
				55					GRAVELLY SAND: REDDISH-BROWN, POORLY
									SORTED: SOME CEMENTATION OF SAND
									SILTY GRAVEL: REDDISH-BROWN POORLY SORTED
				60					SILT + GRAVEL CEMENTED

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. BV-SMW-1
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED ______

STATE ____ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ____ R ____ SECT. ____ TRACT ______ PAGE 3 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GRAVELLY SILTY SAND: REDDISH-BROWN CEMENTED VERY SOLIDLY
				65					
									GRAVELLY SAND: REDDISH-BROWN CEMENTED.
				70					
									GRAVELLY SAND: REDDISH-BROWN, POORLY SORTED, CEMENTED.
			T.D.	75					

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 10-13-89

RIG NO. 10 RIG TYPE Failing WELL NO. SMW-1 TYPE monitoring
JOB OWNER Provo City
LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
					Install 1' of blank 4½" pvc., 20'			
					of 4½" screen and 49' of blank			
					4½" pvc. To 70'			
		75'			Install silica sand from 75'-			
					44'			
					Install coarse bentonite from 44'-			
					20'			
					Install neat cement from 20'-			
			0	75'	5' and concrete from 5'-0			
					Install surface completion			

STAND BY TIME HRS. ______ HOURLY WORK HRS. ______
Signature of Owner or Representative ______

CASING USED: Size ______ Ft. Used ______ Water G.P.M. ______
CASING USED: Size ______ Ft. Used ______ Water Static ______
DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______
MISC.

Driller	Helper	Helper

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-13-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. SMW-2 TYPE monitor

JOB OWNER Provo City

LOCATION Bayview land Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					unload caseing + Drill pipe	Button	11	1
					move air comp.			
					start to drill + drive 12"			
		0	10		sandy silty + little bit of clay			
		10	20		gravel + sand. cobbles			
		20	30		gravel cemented cobbles			
		30	40		" "			
		40	50		gravel cemented cobbles			
		50	60		gravel sand cobbles			
	6:00	60	75		gravel sand cobbles			
					Move Rig to decon pad			

STAND BY TIME HRS. HOURLY WORK HRS. 11

Signature of Owner or Representative

CASING USED: Size 12 Ft. Used 75 Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

MISC.

Driller Martin Peterson	Helper Mike Swindell	Helper

LOG OF EXPLORATORY BORING

~~PROJECT NO.~~ DRILLER: MARTY PETERSON
BORING NO. BV-SMW-2
PROJECT NAME BAYVIEW LANDFILL
LOGGED BY T. BELCHAK
DRILLING METHOD DRILL/DRIVE AIR ROTARY 12' CASING
DATE DRILLED 10/13/89
STATE ____ COUNTY ________ DESCRIPTIVE LOCATION EAST OF CELL #1
LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 1 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				5					SANDY SILT: BROWN; 10% SAND, VERY WELL SORTED, FINE GRAINED
				10					SANDY SILT: BROWN, 20% SAND, WELL SORTED FINE GRAINED
				15					GRAVELLY SAND: BROWN, WELL SORTED (2-4mm) ANGULAR PARTICLES
				20					SANDY GRAVEL: BROWN, MEDIUM SORTED (3-6mm) ANGULAR to SUBANGULAR 30% SAND
				25					SANDY GRAVEL: BROWN, MEDIUM SORTED (4-10mm) 10% SAND, COARSE GRAVEL
				30					PEBBLY GRAVELLY SAND: BROWN, POORLY SORTED PEBBLES TO 20 mm 10% PEBBLES 30% GRAVEL

REMARKS FIRST 10' FINE-GRAINED SILT, PROBABLY WINDBLOWN. BALANCE OF BOREHOLE IS SAND + GRAVEL WITH NO FINE GRAINED MATERIAL

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______
PROJECT NAME ______
DRILLING METHOD ______
BORING NO. BV-Smw-2
LOGGED BY ______
DATE DRILLED ______

STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ______ R ______ SECT. ______ TRACT ______ PAGE 2 OF 2

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				35					SANDY GRAVEL: BROWN, POORLY SORTED SOME PEBBLES, 20% SAND.
				40					GRAVELLY SAND: BROWN, MEDIUM SORTED 20% GRAVEL
				45					GRAVELLY SAND: BROWN, POORLY SORTED 10% GRAVEL
				50					SANDY GRAVEL: BROWN, MEDIUM SORTED 10% SAND.
				55					PEBBLY SANDY GRAVEL; VERY POORLY SORTED 10% PEBBLE 30% SAND
				60					GRAVELLY SAND: BROWN, MEDIUM SORTED 40% GRAVEL (2-6 mm)

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______
BORING NO. BV-SMW-2
PROJECT NAME ______
LOGGED BY ______
DRILLING METHOD ______
DATE DRILLED ______
STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ______
LOCATION: T. ______ R ______ SECT. ______ TRACT ______
PAGE 3 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									SANDY GRAVEL: BROWN, POORLY SORTED 30% SAND
				65					
									SANDY GRAVEL: REDDISH BROWN, POORLY SORTED (2-10 mm)
				70					
				T.D. 73					

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 10-14-89

RIG NO. 10 RIG TYPE Failing WELL NO. SMW-2 TYPE monitoring

JOB OWNER Provo City

LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
					Install 1' of blank 4½" pvc, 20'			
					of 4½" screen and 49' of 4½"			
					pvc To 70'			
		74'			Install silica sand from 74' -			
					44'			
					Install coarse bentonite from 44'-			
					20'			
					Install neat cement from 20'-5'			
			0	74'	and concrete from 5'-0			
					Install surface completion			

STAND BY TIME HRS. ______ HOURLY WORK HRS. ______

Signature of Owner or Representative ______

CASING USED: Size ______ Ft. Used ______ Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller Robt Christensen	Helper	Helper

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-5-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. BU-SMW-3 TYPE Monitor

JOB OWNER Provo city

LOCATION Bay view Landfill

TIME		DEPTH			DRILLING INFORMATION	BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Move from #5 to Decon. clean Rig	Button	11	1
					D.P. + caseing. move and set up			
		0			on #3 Drill + Drive 12" Caseing			
			70	70				
		0	5		Gravelly Sand			
		5	10		Pebbly Gravel			
		10	20		Gravel - Sandy-silt			
		20	30		Gravel · silty-sand			
		30	40		Gravel - Sandy-silt			
		40	50		Sandy Gravel			
		50	60		Gravel clayey silt			
	6:00	60	70		Gravel Sand + silt			

STAND BY TIME HRS. ________ HOURLY WORK HRS. ________

Signature of Owner or Representative ________

CASING USED: Size 12 Ft. Used 74 Water G.P.M. ________

CASING USED: Size ________ Ft. Used ________ Water Static ________

DRILLING MUD: Type ________ Amount ________ Fuel ________ Oil ________

MISC.

Driller Martin Peterson	Helper mike Spindell	Helper Robert A

LOG OF EXPLORATORY BORING

~~PROJECT NO~~. DRILLER: MARTY PETERSON BORING. NO. BV-SMW-3

PROJECT NAME BAYVIEW LANDFILL LOGGED BY TOM BELCHAK

DRILLING. METHOD DRILL/DRIVE AIR ROTARY 12"CASING DATE DRILLED 10/5/99

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION NORTH of BERM 2

LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 1 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GRAVELLY SAND: GREY, MEDIUM SORTED
				5					
									PEBBLY GRAVEL: GREY, MEDIUM SORTED
				10					SOME PEBBLES TO 85 mm
									GRAVELLY SANDY SILT: BROWN, POORLY SORTED
				15					SILT IS QUITE COHESIVE
									GRAVELLY SILTY SAND: BROWN, POORLY SORTED
				20					
									PEBBLY GRAVELLY SAND: BROWN-GREY POORLY
				25					SORTED, SOME PEBBLES TO 40 MM
									PEBBLY
									GRAVELLY SAND: BROWN, MEDIUM SORTED
				30					

REMARKS

THIS BOREHOLE ENCOUNTERED MORE GRAVEL THAN THE FIRST TWO. PENETRATION RATE WAS BETTER. THE CUTTINGS PILE WAS 1-2 FEET BECAUSE OF THE GRAVEL CONTENT

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

~~PROJECT NO.~~ DRILLER: MARTY PETERSON
BORING. NO. BV-SMW-3
PROJECT NAME BAYVIEW LANDFILL
LOGGED BY TOM BELCHAK
DRILLING. METHOD DRILL/DRIVE AIR ROTARY 12" CASING
DATE DRILLED 10/5/99
STATE____ COUNTY____ DESCRIPTIVE LOCATION NORTH OF BERM 2
LOCATION: T____ R____ SECT.____ TRACT____
PAGE 2 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				35					PEBBLY SANDY GRAVEL: GREY BROWN, MEDIUM SORTED, PEBBLES TO 30 mm.
				40					PEBBLY GRAVEL: GREY, MEDIUM SORTED NO SAND PEBBLES to 20 MM.
				45					SANDY GRAVEL: BROWN MEDIUM SORTED 10% SAND.
				50					PEBBLY SAND: BROWN, VERY POORLY SORTED 10% PEBBLES ≤ 30 mm
				55					CLAYEY GRAVELLY SILT: BROWN POORLY SORTED VERY COHESIVE SILT
				60					PEBBLY SANDY GRAVEL: BROWN, POORLY SORTED (3-6 mm) PEBBLES to 20 mm.

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

~~PROJECT NO~~. DRILLER: MARTY PETERSON
BORING NO. BV-MW-3
PROJECT NAME BAYVIEW LANDFILL
LOGGED BY TOM BELCHAK
DRILLING METHOD DRILL/DRIVE AIR ROTARY 12" CASING
DATE DRILLED 10/5/89
STATE ____ COUNTY ____ DESCRIPTIVE LOCATION NORTH of BERM 2
LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 3 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									SANDY PEBBLY GRAVEL: MEDIUM SORTED PEBBLES TO 35 mm.
				65					
									GRAVELLY SILTY SAND: BROWN POORLY SORTED 20% GRAVEL 30% SILT.
				70					
			T.D. 71						

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 10-9-89

RIG NO. 10 RIG TYPE Failing WELL NO. SMW-3 TYPE monitoring
JOB OWNER Provo City
LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
					Install 1' of blank 4½" pvc, 20'			
					of screen and 49' of 4½" pvc			
					To 70'.			
		75'			Install silica sand from 75'–			
					44'.			
					Install coarse bentonite from			
					44'–20'			
					Install neat cement from 20'–			
			0	75'	5' and concrete from 5'–0.			
					Install surface completion.			

STAND BY TIME HRS. HOURLY WORK HRS.
Signature of Owner or Representative

CASING USED: Size Ft. Used Water G.P.M.
CASING USED: Size Ft. Used Water Static
DRILLING MUD: Type Amount Fuel Oil
MISC.

Driller	Helper	Helper

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-11-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. SMW-4 TYPE monitor

JOB OWNER Provo city

LOCATION Bayview Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Load 12" caseing and Drill pipe	Button	11	1
					Fill water truck.			
					set up and start to drill + drive			
					12"			
			0	5	silty and sandy			
			5	10	gravel sand			
			10	15	gravel + sand			
			15	20	gravel + sand			
			20	25	gravel cemented			
			25	30	" "			
			30	35	" "			
			35	40	" "			
			40	45	" "			
			45	60	" "			
			60	73	" "			
					pull Drill pipe move off the			
					hole.			
	6:30				work on the swivel packing.			

STAND BY TIME HRS. ______ HOURLY WORK HRS. 11 1/2

Signature of Owner or Representative ______

CASING USED: Size 12 Ft. Used 75 Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller Marty Peterson	Helper Mike Spindell 11 1/2	Helper

LOG OF EXPLORATORY BORING

~~PROJECT NO.~~ DRILLER: MARTY PETERSON

BORING. NO. BV-SMW-4

PROJECT NAME BAYVIEW LANDFILL

LOGGED BY [illegible]

DRILLING. METHOD DRILL/CASE AIR ROTARY 12" CASING

DATE DRILLED [illegible]

STATE ____ COUNTY ________ DESCRIPTIVE LOCATION NEXT TO ORCHARD

LOCATION: T ____ R ____ SECT. ____ TRACT ________

PAGE 1 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				5					GRAVELLY SILT: BROWN, POORLY SORTED (2-4mm) ANGULAR 10% GRAVEL
				10					SANDY GRAVEL: BROWN, MEDIUM SORTED
				15					GRAVELLY SILT: BROWN POORLY SORTED (3-8mm) ANGULAR 30% GRAVEL
				20					SANDY GRAVEL: BROWN, MEDIUM SORTED 40% SAND
				25					SANDY GRAVEL: BROWN MEDIUM SORTED 20% SAND
				30					SANDY GRAVEL: BROWN, MEDIUM SORTED 20% SAND

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____________
PROJECT NAME ____________
DRILLING METHOD ____________
BORING NO. BV-SMW-4
LOGGED BY ____________
DATE DRILLED ____________

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____________

LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 2 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				35					SILTY GRAVEL: BROWN, POORLY SORTED (2-6mm) 30% SILT
				40					GRAVELLY SAND: BROWN, WELL SORTED FINE GRAVEL 30% GRAVEL
				45					SANDY GRAVEL: BROWN POORLY SORTED (3-8mm) ANGULAR to SUB ANGULAR
				50					GRAVELLY SAND: REDDISH BROWN MEDIUM SORTED 20% GRAVEL
				55					GRAVELLY SAND: REDDISH BROWN MEDIUM SORTED 10% GRAVEL COARSE SAND
				60					GRAVELLY SAND: REDDISH BROWN, MEDIUM SORTED 10% GRAVEL, COARSE SAND

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. BV-SMW-4
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED ______
STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ______
LOCATION: T ______ R ______ SECT. ______ TRACT ______ PAGE 3 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				65					PEBBLY GRAVELLY SAND: BROWN, MEDIUM SORTED 10% PEBBLES, 30% GRAVEL, COARSE SAND, ROUNDED
				70					SANDY GRAVEL: GREY BROWN, MEDIUM SORTED 30% SAND.
			T.D.	73					GRAVELLY SAND: REDDISH BROWN, WELL SORTED 20% GRAVEL

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 10-13-89

RIG NO. 10 RIG TYPE Failing WELL NO. SMW-4 TYPE monitoring

JOB OWNER Provo City

LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
					Install 1' of blank 4½" pvc, 20'			
					of 4½" screen and 49' of blank			
					4½" pvc To 70'			
		75'			Install silica sand from 75' -			
					44'			
					Install course bentonite from 44' -			
					20'			
					Install neat cement from 20'-5'			
			0	75'	and concrete from 5'-0			
					Install surface completion			

STAND BY TIME HRS. ______ HOURLY WORK HRS. ______

Signature of Owner or Representative ______

CASING USED: Size ______ Ft. Used ______ Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller	Helper	Helper

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-4-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. 5 S M W TYPE Monitor

JOB OWNER Provo City

LOCATION Bay View Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Move Rig Decon Rig + D.P.	Button	11	1
		0			set up on #5 Drill + Drive			
					12" casing.			
			74	74				
					0-5' silt & sand			
					5-10' silt + sand			
					10-15 sand + silt Gravel			
					15-20 gravel - sand silt			
					20-25 gravel - silt			
					25-30 gravel - sand			
					30-35 gravel - silt			
					35-40 gravel			
					40-45 gravel			
					45-50 gravel + clay			
					50-55 gravel + clay			
					55-60 gravel + "			
					60-65 " - "			
					65-70 " - "			
	6:00				70-73 " - "			

STAND BY TIME HRS. ______ HOURLY WORK HRS. 11

Signature of Owner or Representative ______

CASING USED: Size 12 Ft. Used 75' Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller Marty Peterson	Helper Mike Spindell	Helper

LOG OF EXPLORATORY BORING

PROJECT NO. DRILLER: MARTY PETERSON
BORING. NO. SMW 5
PROJECT NAME BAYVIEW LANDFILL
LOGGED BY TOM PELCHAK
DRILLING. METHOD DRILL/DRIVE AIR ROTARY 12" CASING
DATE DRILLED 10/4/89

STATE____ COUNTY________ DESCRIPTIVE LOCATION EAST SIDE OF STORM WATER POND

LOCATION: T____ R____ SECT.____ TRACT______
PAGE 1 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									CLAYEY SILT: GREYISH BROWN, FINE GRAINED
				5					WELL SORTED 10% CLAY
									PEBBLY SAND: YELLOW BROWN, MEDIUM
				10					GRAINED, MEDIUM SORTING, SOME PEBBLES
									SANDY GRAVEL: GREY, VERY POORLY SORTED,
				15					SOME PEBBLES TO 25MM
									GRAVEL: GREY, MEDIUM SORTING
				20					(3-6mm)
									PEBBLY GRAVEL: GREY BROWN, POORLY SORTED
				25					SOME PEBBLES TO 40MM
									SANDY GRAVEL: GREY BROWN, VERY POORLY
				30					SORTED, 10% SILT. SOME PEBBLES TO 20mm

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______
BORING. NO. SMW 5
PROJECT NAME BAYVIEW
LOGGED BY TOM BELCHAK
DRILLING. METHOD DRILL, [illegible] AIR ROTARY 12"CASING
DATE DRILLED 10/4/89

STATE ____ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ____ R ____ SECT. ____ TRACT ______
PAGE 2 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
2:00		25		35					SILTY GRAVEL: BROWN, POORLY SORTED SILT IS COHESIVE PEBBLES TO 20mm
2:11	13	3/ft							
[illegible]									GRAVEL: GREY, MEDIUM SORTED, SOME (3-6 mm) PEBBLES to 10 mm
2:21	44/3'	11/ft		40					
[illegible]				45					SANDY GRAVEL: GREY, MEDIUM SORTED SOME (2-4 mm) PEBBLES to 10 mm
				50					SILTY GRAVEL: BROWN, VERY POORLY SORTED VERY COHESIVE SAMPLE 20% CLAY
				55					SANDY GRAVEL: BROWN, MEDIUM SORTED, SOME PEBBLES to 10mm
				60					PEBBLY GRAVEL: BROWN, WELL SORTED, ROUNDED (2-3 mm) UNIFORM SIZE DISTRIBUTION

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. SMW 5
PROJECT NAME BAYVIEW LOGGED BY TOM BELCHAK
DRILLING METHOD DRILL/DRIVE AIR ROTARY 12" CASING DATE DRILLED 10/4/99

STATE ____ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ____ R ____ SECT. ____ TRACT ______ PAGE 3 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									SANDY GRAVEL: REDDISH BROWN, POORLY SORTED, (3-6 mm) SOME PEBBLES TO 10 mm.
				65					
									GRAVELLY SAND: BROWN, MEDIUM SORTED,
				70					
			T.D. 76						

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

APPENDIX M

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 10-7-89

RIG NO. 10 RIG TYPE Failing WELL NO. SMW-5 TYPE monitoring
JOB OWNER Provo City
LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
					Install 1' of blank 4½" pvc, 20'			
					of 4½" screen and 49' of blank			
					4½" pvc To 70'			
		76'			Install silica sand from 76'-			
					44'.			
					Install course bentonite from 44'-			
					20'.			
					Install neat cement from 20'-5'			
			0	76'	and concrete from 5'-0			
					Install surface completion			

STAND BY TIME HRS. ______ HOURLY WORK HRS. ______
Signature of Owner or Representative ______

CASING USED: Size ______ Ft. Used ______ Water G.P.M. ______
CASING USED: Size ______ Ft. Used ______ Water Static ______
DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______
MISC.

Driller	Helper	Helper

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-3-89

RIG NO. 7 RIG TYPE C-P-7000 WELL NO. SMW-6 TYPE Moniter

JOB OWNER Provo city

LOCATION Bay view Land fill west of utah Lake

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					move rig and set up on #6	Button	11	1
		0			Drill + Drive 12" caseing.			
			73					
					0'-15' silt + Sand			
					15'-30' silt + Sand			
					30'-45' graoel + Sand			
					45'-60' gravel + Sand			
					60'-75' gravel + Sand			
	5:30				move comp. Rig to #6			

STAND BY TIME HRS. ______ HOURLY WORK HRS. 10½

Signature of Owner or Representative ______

CASING USED: Size 12 Ft. Used 75 Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

10-2-89. ready to set up but no pad

Driller Marty Peterson	Helper Robert A.	Helper mike S

LOG OF EXPLORATORY BORING

~~PROJECT NO~~. DRILLER: MARTY PETERSON BORING. NO BV-SMW-6
PROJECT NAME RAY VIEW LANDFILL LOGGED BY T. BELCHAK
DRILLING. METHOD DRILL/DRIVE AIR ROTARY 12" CASING DATE DRILLED 10/3/89
STATE ____ COUNTY ____ DESCRIPTIVE LOCATION EAST OF LEACHATE POND.
LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 1 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GRAVELLY
									SILTY SAND: BROWN, MEDIUM SORTED,
				5					SOME PEBBLES
									GRAVELLY
									SILTY SAND: BROWN, POORLY SORTED
				10					15% GRAVEL
									SILTY
									GRAVEL: GREY, MEDIUM SORTED, ANGULAR
				15					(3 mm) TO SUBANGULAR
									PEBBLY GRAVEL: GREY, MEDIUM SORTED
				20					(3-10mm)
									GRAVELLY SILTY SAND: BROWN MEDIUM
				25					SORTED, SILT IS COHESIVE
									SILTY GRAVEL: GREY BROWN, POORLY SORTED
				30					

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO.
BORING NO. BV-SMW-6
PROJECT NAME BAYVIEW LANDFILL
LOGGED BY T. BELCHAK
DRILLING METHOD DRILL/DRIVE AIR ROTARY 12" CASING
DATE DRILLED 10/3/89
STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____
LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 2 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				35					PEBBLY GRAVEL: GREY BROWN, MEDIUM (3-10 mm) SORTED
				40					GRAVEL: REDDISH GREY BROWN, WELL SORTED (3 mm) ROUNDED
				45					SANDY GRAVEL: REDDISH BROWN, VERY (<1 mm) WELL SORTED, ANGULAR
				50					SILTY GRAVEL: BROWN, POORLY SORTED ANGULAR, SOME PEBBLES
				55					SANDY CLAYEY SILT: BROWN, POORLY SORTED 30% CLAY CONTENT
				60					GRAVELLY CLAYEY SILT: BROWN, POORLY SORTED 40% CLAY

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

~~PROJECT NO~~. DRILLER: MARTY PETERSON
BORING. NO. BV-SMW-6
PROJECT NAME
LOGGED BY TOM BELCHAK
DRILLING. METHOD AIR/ROTARY CASING DRIVER 12" CASING
DATE DRILLED 10/5/89
STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____
LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 3 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				65					SILTY GRAVEL: BROWN, POORLY SORTED 10% CLAY
				70					GRAVELLY SAND: BROWN, POORLY SORTED SOME SILT + CLAY
			T.D	73					

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 10-6-89

RIG NO. #10 RIG TYPE Failing WELL NO. SMW-6 TYPE monitoring
JOB OWNER Arco City
LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
					Install 1' of blank 4½" pvc, 20'			
					of 4½" screen and 49' of blank			
					4½" pvc. To 70'.			
		73'			Install silica sand from 73'–			
					44'.			
					Install coarse bentonite from 44'–			
					20'.			
					Install neat cement from 20'-5'			
			0	73'	and concrete from 5'-0			
					Install surface completion			

STAND BY TIME HRS. ____ HOURLY WORK HRS. ____
Signature of Owner or Representative ____

CASING USED: Size ____ Ft. Used ____ Water G.P.M. ____
CASING USED: Size ____ Ft. Used ____ Water Static ____
DRILLING MUD: Type ____ Amount ____ Fuel ____ Oil ____
MISC.

Driller	Helper	Helper

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-16-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. Dmw-1 TYPE monitor

JOB OWNER Provo city

LOCATION Bay view LandFill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Drilling + Drive 10" caseing	Button	9¾	1
		65	80		Gravel + sand cemented			
					Fill water truck fuel up Rig's			
		80	90		cemented Rock			
					caseing stoped. pull D.P. put			
					on stableizer run back in the			
					hole. start to drill.			
		90	105		cemented Rock.			
		105	125		cemented Rock			
		125	145		mudstone with sand			
		145	165		" " "			
		165	185		" " sand + clay			
	5:30	185	205		mudstone with sand + clay			

STAND BY TIME HRS. _____ HOURLY WORK HRS. 10 1/2

Signature of Owner or Representative _____

CASING USED: Size 10" Ft. Used 90 Water G.P.M. _____

CASING USED: Size _____ Ft. Used _____ Water Static _____

DRILLING MUD: Type _____ Amount _____ Fuel _____ Oil _____

MISC.

Driller Marty Peterson	Helper Tim Ross	Helper Steve ~~[illegible]~~ Montague

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-17-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. DMW-1 TYPE monitor

JOB OWNER Provo city

LOCATION Bay view Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00		205			Drilling 9¾" open	B3 btn	9¾	1
			220		mud stone + clay + sand			
		220	240		same formation no change			
		240	260					
		260	280					
		280	300					
		300	320					
		320	340					
		340	360					
		360	380		water check at 380'			
		380	400					
		400	420					
		420	440		water check at 430'			
		440	460					
		460	480					
		480	500		water check at 500			
	6:00	500	520					
					Pull Drill pipe.			
					put new starter on pick-up			

STAND BY TIME HRS. ____ HOURLY WORK HRS. 11-Hrs

Signature of Owner or Representative ____

CASING USED: Size ____ Ft. Used ____ Water G.P.M. ____

CASING USED: Size ____ Ft. Used ____ Water Static ____

DRILLING MUD: Type ____ Amount ____ Fuel ____ Oil ____

MISC.

Driller Martin Peterson	Helper Robert A	Helper Tim Ross

TOTAL DEPTH 520'

LOG OF EXPLORATORY BORING

~~PROJECT NO~~. DRILLER: MARTY PETERSON
BORING. NO. BV-DMW-1
PROJECT NAME BAYVIEW LANDFILL
LOGGED BY TOM BELCHAK
DRILLING. METHOD DRILL/DRIVE AIR ROTARY 10"CASING
DATE DRILLED 10/14/99
STATE ____ COUNTY ________ DESCRIPTIVE LOCATION NORTH of WATER ST. AGE TANK
LOCATION: T ____ R ____ SECT. ____ TRACT ________
PAGE 1 OF 8

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									SILTY GRAVELLY PEBBLES: GREY VERY POORLY SORTED
				5					PEBBLES TO 40 MM 20% GRAVEL 10% SILT
									PEBBLY GRAVELLY SAND: GREY, POORLY SORTED
				10					PEBBLES to 30mm 10% PEBBLES
									PEBBLY SAND: REDDISH BROWN MEDIUM SORTED
				15					LG PEBBLE TO [illegible] MEDIUM SAND 10% [illegible]
									PEBBLY GRAVELLY SAND: REDDISH BROWN, POORLY SORTED
				20					PEBBLES to 25mm 20% GRAVEL.
									PEBBLY GRAVELLY SAND: REDDISH BROWN, POORLY SORTED
				25					20% GRAVEL
									PEBBLY SAND. REDDISH BROWN, MEDIUM SORTED
				30					10% PEBBLES MEDIUM SAND.

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO.
PROJECT NAME
DRILLING METHOD

BORING NO. BV-DWW-1
LOGGED BY
DATE DRILLED 10/14/99

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____

LOCATION: T ____ R ____ SECT. ____ TRACT ____

PAGE 2 OF 8

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				35					PEBBLY GRAVELLY SAND: REDDISH BROWN, POORLY SORTED 20% PEBBLES to 30 mm.
				40					PEBBLY GRAVELLY SAND: REDDISH BROWN, POORLY SORTED 10% PEBBLES to 30 mm. 30% GRAVEL.
				45					PEBBLY GRAVELLY SAND: REDDISH BROWN, POORLY SORTED COARSE SAND PEBBLES to 30 mm.
				50					SANDY PEBBLY GRAVEL: RED SAND, GREY GRAVEL; 20% SAND 30% PEBBLES
				55					PEBBLY GRAVELLY SAND: REDDISH BROWN, POORLY SORTED 20% GRAVEL.
				60					PEBBLY SAND: BROWN, WELL SORTED FINE SAND.
				65					GRAVELLY SAND: BROWN, WELL SORTED, FINE SAND (2-6mm)

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. BV-OMW-1
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED 10/16/89

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ______

LOCATION: T____ R____ SECT.____ TRACT____ PAGE 3 OF 8

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				70					SAND: REDDISH BROWN, WELL SORTED, FINE-MEDIUM SAND.
				75					FEEBLY GRAVELLY SAND: GREY, POORLY SORTED COARSE SAND
				80					SAND: REDDISH BROWN, WELL SORTED, FINE to MEDIUM SAND.
				85					GRAVELLY SAND: REDDISH BROWN, POORLY SORTED COARSE SAND. 30% GRAVEL.
				90					GRAVELLY SAND: REDDISH BROWN, VERY POORLY (3-6mm) SORTED. COARSE SAND 40% GRAVEL
				95					GRAVELLY SAND: REDDISH BROWN, POORLY SORTED (3-15mm) FINE to MEDIUM SAND.

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______
PROJECT NAME ______
DRILLING METHOD ______

BORING NO. BV-OMW-1
LOGGED BY ______
DATE DRILLED 10/16/89

STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ______ R ______ SECT. ______ TRACT ______

PAGE 4 OF 8

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									SAND: REDDISH BROWN, POORLY SORTED COARSE GRAINED SAND.
				100					
									PEBBLY SANDY GRAVEL: REDDISH BROWN, VERY POORLY SORTED
				105					
									SILT: REDDISH BROWN SILTSTONE
				110					
									GRAVELLY SILT: REDDISH BROWN, CEMENTED
				115					
									CLAY: REDDISH BROWN, FINE GRAINED.
				120					
									CLAY: REDDISH BROWN, FINE GRAINED
				125					

REMARKS LITHOLOGY CHANGES DRAMATICALLY AT 110' TO BROWN CLAY-SILTSTONE.

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____
PROJECT NAME ____
DRILLING METHOD ____
BORING NO. BV-DMW-1
LOGGED BY ____
DATE DRILLED 10/16/99
STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____
LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 5 OF 6

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				130					GRAVELLY SILT: REDDISH BROWN FINE-(2-3mm) GRAINED
				135					GRAVELLY SILT: SAME
				140					GRAVELLY SILT: SAME
				145					GRAVELLY SILT: SAME 30% GRAVEL
				150					GRAVELLY SILT: SAME 20% GRAVEL
				155					GRAVELLY SILTSTONE: 10% GRAVEL

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. AV-OMW-1
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED 10/16/89

STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ______ R ______ SECT. ______ TRACT ______ PAGE 6 OF 8

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				160					SILTSTONE: REDDISH BROWN.
				165					SILTSTONE: REDDISH BROWN
				170					SILTSTONE: SAME
				175					SILTSTONE: SAME
				180					SILTSTONE: SAME
				185					SILTSTONE: SAME

REMARKS SILTSTONE IS VERY HOMOGENEOUS FINE-GRAINED, WELL BONDED. "SHINY FLECKS" IN THE LIGHT MAY BE GYPSUM.

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______
PROJECT NAME ______
DRILLING METHOD ______
BORING NO. BV-DMW-1
LOGGED BY ______
DATE DRILLED 10/16/97

STATE ____ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ____ R ____ SECT. ____ TRACT ____

PAGE 7 OF 8

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				190					CLAYSTONE: REDDISH-BROWN, VERY FINE GRAINED, HOMOGENEOUS. CUTTINGS IN ¼ INCH CHIPS.
				195					CLAYSTONE: SAME
				200					CLAYSTONE: SAME
				205					CLAYSTONE: SAME

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______
PROJECT NAME ______
DRILLING METHOD ______
BORING NO. BV-DMW-1
LOGGED BY ______
DATE DRILLED 10/17/89

STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ______ R ______ SECT. ______ TRACT ______ PAGE 8 OF 8

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				205-520					CLAYSTONE: REDDISH BROWN, VERY FINE GRAINED, INDURATED, HOMOGENEOUS

REMARKS
BORING WAS TERMINATED AT 520' WITH NO SIGN OF WATER.

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date. 10-18-89

RIG NO. 10 RIG TYPE Failing WELL NO. DMW-1[illegible] TYPE monitoring

JOB OWNER Provo City

LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
					Install course bentonite in			
		520'	0	520'	hole from 520' – 0			

STAND BY TIME HRS. ______ HOURLY WORK HRS. ______

Signature of Owner or Representative ______

CASING USED: Size ______ Ft. Used ______ Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

BOREHOLE ABANDONED DUE to LACK of WATER

Driller ______ | Helper ______ | Helper ______

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-18-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. Omw-1-A TYPE monitor

JOB OWNER Provo city

LOCATION Bay view Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					move Rig from Dmw-1 to Decon	Button	9¾	1
					clean it Lube it.			
					Move to Dmw-1-2 set up start to			
		0			drill & Drive 10" caseing.			
					Had trouble getting caseing started			
			30		stright alot of Big rock's			
		0	5		gravel			
		5	10		gravel			
		10	15		gravel			
		15	20		gravel			
		20	25		sand			
		25	30		gravel + madstone with sand			
	5:30							

STAND BY TIME HRS. ______ HOURLY WORK HRS. 10 ½

Signature of Owner or Representative ______

CASING USED: Size 10" Ft. Used 30 Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

M

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-19-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. DMW-1-A TYPE Monitor

JOB OWNER Provo city

LOCATION Bay view land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					work on pick-up trying to get	Button	9⅞	1
					it started. No luck			
		30			start to drill + drive 10" caseing			
		30	35		Red mudstone			
		35	40		" "			
		40	45		" "			
		45	50		" "			
		50	55		" "			
		55	60		" "			
		~~60 ft~~						
	5:30							

STAND BY TIME HRS. ______ HOURLY WORK HRS. 10½

Signature of Owner or Representative ______

CASING USED: Size 10" Ft. Used 30 Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

called provo city carl came out and looked at the cutting's he said move hole more to the north.

Driller Martin Peterson Helper Tim Ross Helper Steve montague

LOG OF EXPLORATORY BORING

DRILLER: ~~PROJECT NO.~~ MARTY PETERSON
BORING. NO. BV-OMW-1A
PROJECT NAME
LOGGED BY
DRILLING. METHOD
DATE DRILLED
STATE COUNTY DESCRIPTIVE LOCATION
LOCATION: T R SECT. TRACT
PAGE OF

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									SAMPLES WERE DESTROYED BY ROAD GRADER PRIOR TO LITHOLOGIC LOGGING. NO LOG AVAILABLE FOR THIS BOREHOLE. DRILLER REPORT WAS FINE-GRAINED RED-MUDSTONE THROUGHOUT DEPTH.

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 10-23-89

RIG NO. 10 RIG TYPE Failing WELL NO. DMW-1A TYPE monitoring

JOB OWNER Provo City

LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
					Install coarse bentonite from			
		60'	0	60'	60' – 0 ABANDON HOLE			

STAND BY TIME HRS. ______ HOURLY WORK HRS. ______

Signature of Owner or Representative ______

CASING USED: Size ______ Ft. Used ______ Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller	Helper	Helper

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-23-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. Dmw-1-B TYPE monitor

JOB OWNER provo city

LOCATION Bayview Land Fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					move rig from Dmw-1-A to	Button	9 3/4	1
					1-B.			
					set up start to drill + Drive			
					10" caseing.			
		0	5		gravel + sand-silt			
		5	10		" " "			
		10	20		" " "			
		20	25					
		25	30		" " "			
		30	35		" " "			
		35	40		mudstone			
		40	45		mudstone 10" caseing stoped at 44'			
					Drill open hole			
		45	55		mudstone			
		55	65					
		65	75					
		75	95					
	4:00	95	105					

STAND BY TIME HRS. ______ HOURLY WORK HRS. 9-

Signature of Owner or Representative ______

CASING USED: Size 10" Ft. Used 45 Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller Martin Peterson	Helper mike spindell	Helper

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-24-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. OMW-1-B TYPE monitor

JOB OWNER provo city

LOCATION Bayview Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:30					Drilling 10" open hole	Button	9 3/4	1
		105	125		mud stone			
		125	145		"			
		145	165		"			
		165	185		"			
		185	205		"			
		205	225		"			
		225	245		"			
		245	255		"			
		255	265		Hit a Little bit of gravel seam's			
		265	275		mudstone with gravel seam's			
		275	285		" " "			
		285	295		" " " "			
		295	305		" " " "			
	5:30	305	308		mudstone Less gravel			

STAND BY TIME HRS. ______ HOURLY WORK HRS. 10

Signature of Owner or Representative ______

CASING USED: Size -- Ft. Used — Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Hit the water at 260'

Driller Marty Peterson	Helper Mike spindeLL	Helper

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-25-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. DMW-1-B TYPE monitor

JOB OWNER Provo city

LOCATION Bay view Landfill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:30					test for water. Run Drill pipe			
					into 265' Turn on the air it was			
					Blowing water. Ream to Botton 308'			
					pull the Drill pipe Run in 260'			
					4½ Blank pvc. 40' 4½ screen.			
					gravel pack from 300' to 245' Bentonite			
					seal from 245' - 415' move Rig			
					Take it to Decon. clean it move			
					to DMW-4 set up			
	5:30							

STAND BY TIME HRS. ____________ HOURLY WORK HRS. 10

Signature of Owner or Representative ____________

CASING USED: Size 4½" Blank P.V.C. Ft. Used 260 Water G.P.M. ____________

CASING USED: Size 4½" PVC screen Ft. Used 40 Water Static 255'

DRILLING MUD: Type ____________ Amount ____________ Fuel ____________ Oil ____________

MISC.

2 - 4½" P.V.C. cap's 3/4 Big Bag of Sand 10-20

n in well sounder Hit water 253'

Driller Marty - Dick	Helper mike spindell	Helper

LOG OF EXPLORATORY BORING

~~PROJECT NO.~~ DRILLER: MARTY PETERSON
BORING NO. BV-OMW-1B
PROJECT NAME BAYVIEW LANDFILL
LOGGED BY TOM BELCHAK
DRILLING METHOD AIR/ROTARY DRILL DRIVE 10"
DATE DRILLED 10/23/89
STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____
LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 1 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									SILTY GRAVEL: LIGHT BROWN POORLY SORTED
				5					
									PEBBLY SILT: LIGHT BROWN, VERY POORLY SORTED LARGE PEBBLES TO 50mm.
				10					
									SILTY GRAVEL: BROWN. POORLY SORTED
				15					
									SANDY GRAVEL: GREY
				20					
									SANDY GRAVEL: GREY, POORLY SORTED 3-8mm 30% SAND
				25					
									GRAVELLY SAND: GREY, POORLY SORTED 3-5mm GRAVEL. 20% GRAVEL
				30					

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______________________
PROJECT NAME ______________________
DRILLING METHOD ______________________
BORING NO. ____________
LOGGED BY ____________
DATE DRILLED ____________

STATE _____ COUNTY __________ DESCRIPTIVE LOCATION ______________________

LOCATION: T _____ R _____ SECT. _____ TRACT _________ PAGE 2 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				35					GRAVELLY SAND: GREY, POORLY SORTED, 3-5mm GRAVEL. 20% GRAVEL
				40					PEBBLY GRAVELLY SAND: REDDISH BROWN. PEBBLES TO 40mm 20% GRAVEL
				45					PEBBLY GRAVELLY SAND: REDDISH BROWN, PEBBLES to 20mm 20% GRAVEL
				50					PEBBLY GRAVELLY SAND: REDDISH BROWN, PEBBLES to 20mm. FINE SAND
				55-105					CLAYSTONE: REDDISH BROWN. VERY FINE GRAINED, COHESIVE 1/2 INCH CUTTINGS

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. BV-DMW-1B
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED 10/25/89

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ______

LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 3 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
			105-305						CLAYSTONE: REDDISH BROWN, VERY FINE-GRAINED, COHESIVE ½ INCH CUTTINGS.

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 10-30-89

RIG NO. 10 RIG TYPE Failing WELL NO. DMW-1B TYPE monitoring
JOB OWNER Provo City
LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
					Install 1' of blank 4½" pvc,			
					40' of 4½" screen and 260'			
					of blank 4½" pvc To 301'			
		308'			Install silica sand from 308'-			
					255'			
					Install coarse bentonite from			
					255'-20'			
					Install neat cement from 20'-5'			
			0	308'	and concrete from 5'-0			
					Install surface completion			

STAND BY TIME HRS. ______ HOURLY WORK HRS. ______
Signature of Owner or Representative ______

CASING USED: Size ______ Ft. Used ______ Water G.P.M. ______
CASING USED: Size ______ Ft. Used ______ Water Static ______
DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______
MISC.

Driller	Helper	Helper

WELL DEVELOPMENT

Project: BAYVIEW LANDFILL Well Number: DMW-1B

Project Number: Date: 11-22-89

Well inside diameter: 4½ IN

Depth of bottom: 302 FT

Length of gravel pack: 45 FT

Diameter of gravel pack: 10-20 IN

Measured by: M. PETERSON

Recorded by: Thomas A. Bolekl

Air temperature: 58 DegF

Weather condition: Hazey

WITHDRAWAL OF WELL VOLUMES

READINGS	Well Volume	Well Volume	Well Volume
Water level before	242		
Water level after	265		
Time begin flushing	11:30 A.M.		
Time end flushing	16:30		
Time water level after	17:30		
Estimated volume flushed (GAL)	<1 gal. per min.	MEASURED 1/4 gal/min AT 265' LEVEL	

FIELD ANALYSIS

Water temperature (DegC)	60°f
Sample pH	7
Sample conductivity (mhos/cm)	440
Buffer before	—
Buffer after	—
Odor	None
Color	~~[illegible]~~ ClearR
Other	

COMMENTS

THIS WELL PRODUCED VERY LITTLE WATER DURING DEVELOPMENT AND WAS THE MOST DIFFICULT TO CLARIFY FINES FROM THE WELL.

Blew until mist was coming out shut air off Let well Build up again every 1/2 hr. shut off air.

Attach photographs of water samples in labeled jars.

END OF SECTION

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 10-31-89

RIG NO. 7 RIG TYPE C-P-7000 WELL NO. DMW-2 TYPE monitor

JOB OWNER Provo city

LOCATION Bayview Landfill

APPENDIX M

TIME		DEPTH			DRILLING INFORMATION	BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					move Rig and set up on	Button	9 7/8	1
					DMW-2			
		0			Drill + Drive 10" casing			
			5		sand + silt			
		5	15		gravel + sand			
		15	30		gravel + sand			
	4:30	30	45					

STAND BY TIME HRS. HOURLY WORK HRS. 9 1/2

Signature of Owner or Representative

CASING USED: Size 10 Ft. Used 45 Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

MISC.

Driller Martin Peterson	Helper Tim Ross	Helper Steve Montague

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-1-89

RIG NO. 2 RIG TYPE C-P 7000 WELL NO. DMW-2 TYPE monitor

JOB OWNER provo city

LOCATION Bay View Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Drill + Drive 10" caseing	Botton	9 3/4	1
		45	60		gravel + Sand			
		60	75		gravel + sand			
					complete #DMW-4 from 145-45			
	4:00							

STAND BY TIME HRS. HOURLY WORK HRS. 9

Signature of Owner or Representative

CASING USED: Size 10 Ft. Used 30 Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

MISC.

Driller Martin Peterson	Helper Tim Ross	Helper Steve montague

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-7-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. OMW-2 TYPE monitor

JOB OWNER Provo city

LOCATION Bayview Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Drill + Drive 10" caseing	Button	9¾	1
		75	90		gravel + cobble's			
		90	105		gravel + cobble's			
		105	120		" "			
		120	135		" "			
		135	150		" "			
		150	165		" "			
	4:30				Blew fuel line on air comp.			
					went to Doug's and got new one.			

STAND BY TIME HRS. ______ HOURLY WORK HRS. 9 1/2

Signature of Owner or Representative ______

CASING USED: Size 10 Ft. Used 90 Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

change oil + filter on C-P-7000

Driller Martin Peterson	Helper tim Ross	Helper Steve Montague

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-3-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. Dmw-2 TYPE monitor

JOB OWNER Provo city

LOCATION Bayview Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Drill & Drive 10" caseing	Button	9 7/8	1
		165	180		gravel & cobble's			
		180	195		gravel & cobble's			
		195	210		" "			
		210	225		" "			
		225	240		" "			
	5:00							

STAND BY TIME HRS. ______ HOURLY WORK HRS. 10

Signature of Owner or Representative ______

CASING USED: Size 10 Ft. Used 75 Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Tryed to drill open hole at 195' drilled to 210' had 10' of
L in the hole. couldn't add another pipe
Caseing started to go harder at 165 cemented gravle's

Driller Marty Peterson	Helper Tim Ross	Helper Steve montoyue

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-6-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. Dmw 2 TYPE Monitor

JOB OWNER Provo city

LOCATION Bay view Land Fill west of utah Lake south end

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Drilling 10" open hole	Button	9⅞	1
		240	255		cemented gravel with Fractures			
		255	270		cemented gravel " "			
					water 245'			
					Run in 40' screen 230' 4½ Blank			
					gravel pack to 240' from 270'			
	5:00				Bottom of 10" caseing is at 240'			

STAND BY TIME HRS. HOURLY WORK HRS. 10

Signature of Owner or Representative

CASING USED: Size 4½" Screen Ft. Used 40 Water G.P.M. 15

CASING USED: Size 4½ PVC Ft. Used 230 Water Static 234'

DRILLING MUD: Type Amount Fuel Oil

MISC.

Driller Misty Peterson	Helper Tim Ross Mike Spindell	Helper Steve Montague

LOG OF EXPLORATORY BORING

PROJECT NO. DRILLER: MARTY PETERSON
BORING NO. BV-OMW-2
PROJECT NAME
LOGGED BY TOM BELCHAK
DRILLING METHOD
DATE DRILLED
STATE
COUNTY
DESCRIPTIVE LOCATION
LOCATION: T
R
SECT.
TRACT
PAGE 1 OF 9

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				5					SILT: GREY BROWN, WELL SORTED, VERY FINE WELL SORTED
				10					CLAYEY SILT: YELLOWISH BROWN, WELL SORTED VERY FINE GRAINED, COHESIVE
				15					SILTY PEBBLES: GREY, POORLY SORTED FINE-GRAINED
				20					PEBBLY GRAVEL: GREY POORLY SORTED PEBBLES TO 50mm
				25					SILTY GRAVELLY PEBBLES: GREY, VERY POORLY SORTED 10% SILT 20% GRAVEL
				30					PEBBLY SAND: BROWN, POORLY SORTED, MEDIUM SAND

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____ BORING NO. BV-DMW-2
PROJECT NAME ____ LOGGED BY ____
DRILLING METHOD ____ DATE DRILLED ____
STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____
LOCATION: T____ R____ SECT.____ TRACT____ PAGE 2 OF 9

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				35					GRAVELLY PEBBLES: GREY POORLY SORTED. VERY COARSE PEBBLES to 60 mm.
				40					GRAVELLY PEBBLY SAND: BROWN. VERY POORLY SORTED. MEDIUM SAND 20% GRAVEL 20% PEBBLE
				45					GRAVELLY PEBBLES: VERY POORLY SORTED. COARSE PEBBLES to 50 mm. 20% GRAVEL.
				50					PEBBLY GRAVEL: GREY, MEDIUM SORTED, COARSE (4-8mm) GRAINED NO FINES SOME PEBBLES to 90mm
				55					PEBBLY GRAVELLY SAND: GREY POORLY SORTED. 5% PEBBLES to 20mm, 30% GRAVEL.
				60					PEBBLY GRAVELLY SAND: GREY, POORLY SORTED 20% PEBBLES 30% GRAVEL, MEDIUM REDDISH SAND.

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO.
BORING NO. BV-OMW-2
PROJECT NAME
LOGGED BY
DRILLING METHOD
DATE DRILLED

STATE COUNTY DESCRIPTIVE LOCATION

LOCATION: T R SECT. TRACT
PAGE 3 OF 9

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				65					PEBBLY GRAVEL: GREY, MEDIUM SORTED 30% PEBBLES to [illegible]mm GRAVEL 2-9mm
				70					PEBBLY GRAVEL: GREY, MEDIUM SORTED, 10% PEBBLES to 30mm GRAVEL 2-6mm.
				75					PEBBLY GRAVEL: GREY, MEDIUM SORTED 10% PEBBLES to 50mm
				80					GRAVELLY PEBBLY SAND: GREY-BROWN, POORLY SORTED 10% GRAVEL 30% PEBBLES to 30mm.
				85					PEBBLY SANDY GRAVEL: GREY-BROWN, PEBBLES 20% to 40mm SAND 30%
				90					GRAVELLY, SANDY PEBBLES: GREY VERY POORLY SORTED. VERY COARSE

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____________
BORING NO. BV-DMW-7
PROJECT NAME ____________
LOGGED BY ____________
DRILLING METHOD ____________
DATE DRILLED ____________

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____________

LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 4 OF 9

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				95					PEBBLY GRAVELLY SAND: BROWN, POORLY SORTED, 10% PEBBLES to 40mm. 30% GRAVEL. MEDIUM SAND
				100					PEBBLY GRAVELLY SAND: BROWN, POORLY SORTED 10% PEBBLES to 30mm. 20% GRAVEL. FINE SAND.
				105					PEBBLY GRAVELLY SAND: BROWN POORLY SORTED 10% PEBBLES to 30mm. 30% GRAVEL. MEDIUM SAND.
				110					PEBBLY GRAVELLY SAND: BROWN POORLY SORTED. 10% PEBBLES to 40mm. 20% GRAVEL MEDIUM SAND
				115					PEBBLY GRAVELLY SAND: BROWN [illegible] SAND [illegible] PEBBLES [illegible] GRAVEL, MEDIUM SAND.
				120					SAME

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO.
PROJECT NAME
DRILLING METHOD
BORING NO. BV-CMW-7
LOGGED BY
DATE DRILLED

STATE COUNTY DESCRIPTIVE LOCATION

LOCATION: T R SECT. TRACT PAGE 5 OF 9

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									PEBBLY GRAVELLY SAND: BROWN POORLY SORTED
				125					10% PEBBLES 20% GRAVEL MEDIUM SAND.
									PEBBLY SAND: BROWN, WELL SORTED MEDIUM-FINE
				130					PEBBLES 5% to 20mm
									PEBBLY GRAVELLY SAND: REDDISH BROWN WELL SORTED
				135					MEDIUM SAND 10% PEBBLES 30% GRAVEL.
									GRAVELLY SAND: GREYISH BROWN, MEDIUM SORTED
				140					VERY COARSE SAND, 20% GRAVEL (3-6mm)
									PEBBLY GRAVELLY SAND: REDDISH BROWN MEDIUM
				145					SORTED MEDIUM SAND [illegible] PEBBLES [illegible] [illegible] GRAVEL
									PEBBLY GRAVELLY SAND: REDDISH BROWN, WELL SORTED
				150					FINE SAND, 10% PEBBLES to 20mm, 10% GRAVEL

APPENDIX M

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. BV-DMW-7
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED ______

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ______

LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 7 OF 9

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									PEBBLY GRAVELLY SAND: BROWN, POORLY SORTED 10% PEBBLES 30% GRAVEL.
				185					
									SAME
				190					
				195					SAME
				200					SAME
									GRAVELLY SAND: REDDISH BROWN, MEDIUM SORTED FINE SAND 30% GRAVEL.
				205					
									SAND: REDDISH BROWN, VERY WELL SORTED FINE to MEDIUM SAND.
				210					

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. BV-DMW-2
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED ______

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ______

LOCATION: T____ R____ SECT.____ TRACT____ PAGE 8 OF 9

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				215					GRAVELLY SAND: REDDISH BROWN, WELL SORTED MEDIUM SAND 10% GRAVEL.
				220					GRAVELLY SAND; REDDISH BROWN MEDIUM SORTED FINE SAND 30% GRAVEL.
				225					SILTY GRAVELLY SAND: REDDISH BROWN MEDIUM SORTED FINE SAND. 10% GRAVEL
				230					↓ SAME
				235					PEBBLY SAND: REDDISH BROWN, POORLY SORTED MEDIUM SAND 30% PEBBLES to 20mm.
				240					SANDY PEBBLES: REDDISH BROWN POORLY SORTED

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____ BORING NO. BV-DMW-2
PROJECT NAME ____ LOGGED BY ____
DRILLING METHOD ____ DATE DRILLED ____
STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____
LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 9 OF 9

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				245					GRAVELLY SAND: REDDISH BROWN MEDIUM SORTED MEDIUM SAND 20% GRAVEL
				250					SAME
				255					SAME
				260					GRAVELLY SAND: REDDISH BROWN, WELL SORTED COARSE-MEDIUM SAND 20% GRAVEL
				265					SAME
				270					SAME

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-6-89 thru 11-8-89

RIG NO. #10 RIG TYPE Failing WELL NO. DMW-4, 2 SMW-4 TYPE monitoring

JOB OWNER Provo City

LOCATION Bayview

TIME		DEPTH			DRILLING INFORMATION	BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					11-6			
					finish Completion on hole DMW-4			
					from 30'-0 : Install surface			
					completion			
					On hole DMW-2, Install 1' of			
					blank 40' of screen, and 228' of			
					4½" pvc To 269'. Install sand			
	5:00				from 270'- 240'.	10hrs		
7:00					11-7			
					Set Comping and Jacks on hole			
					DMW-4. Complete well from 240'-			
	5:00				50'.	10hrs		
7:00					11-8 finish completion on hole #2			
					from 50'-0. Install surface Comp.			
					Haul casing To drill rig.			
	5:00				Develope hole SMW-4	10hrs		

STAND BY TIME HRS. ______ HOURLY WORK HRS. ______

Signature of Owner or Representative ______

CASING USED: Size ______ Ft. Used ______ Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller

Helper Tim Ross

Helper Steve [illegible]

WELL DEVELOPMENT

Project: BAYVIEW LANDFILL Well Number: Dmw-2

Project Number: Date: 11-22-89

Well inside diameter: 4½ IN

Depth of bottom: 271 FT

Length of gravel pack: 45 FT

Diameter of gravel pack: 16-20 SAND IN

Measured by: M. PETERSON.

Recorded by: Howard A. Belch.

Air temperature: 30 DegF

Weather condition: Hazey + cold

WITHDRAWAL OF WELL VOLUMES

FLUSHING	Well Volume	Well Volume	Well Volume
Water level before	236		
Water level after	236		
Time begin flushing	8:30		
Time end flushing	9:30		
Time water level after	10:30		
Estimated volume flushed (GAL)	5-gal per min.		

FIELD ANALYSIS	
Water temperature (DegC)	58
Sample pH	6
Sample conductivity (mhos/cm)	460
Buffer before	-
Buffer after	-
Odor	None
Color	Clear
Other	

COMMENTS

THIS WELL RECOVERED VERY WELL AFTER DEVELOPMENT AND PRODUCED GOOD VOLUMES OF WATER.

Attach photographs of water samples in labeled jars.

END OF SECTION

APPENDIX M

DAVE'S DRILLING
5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-10-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. DMW-3 TYPE monitor

JOB OWNER provo city

LOCATION Bayview Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					set up on DMW-3 change air	Button	9 3/4	1
					filters on Rig & comp.			
					Haul 10" casing			
					make another shoe joint.			
					Drill + Drive 10" casing			
		0	5		Back fill			
		5	10		Back fill			
		10	15		gravel clay & sandy silt			
		15	20		gravel sand cobbles			
		20	25		gravel sand cobbles			
		25	30		gravel sand cobbles			
		30	45		gravel sand cobbles			
		45	60		gravel sand cobbles			
		60	75		gravel " "			
	5:00	75	90		" " "			

STAND BY TIME HRS. ______ HOURLY WORK HRS. 10

Signature of Owner or Representative ______

CASING USED: Size 10" Ft. Used ______ Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller Martin Peterson	Helper Mike spindell	Helper

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 11-13-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. OMW-3 TYPE monitor

JOB OWNER Provo city

LOCATION Bayview Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00		90			Drill + Drive 10" caseing	Button	9½	1
			105		gravel sand cobbles			
		105	120		gravel sand cobbles			
		120	135		gravel sand cobbles			
		135	150		gravel sand cobbles			
		150	165		gravel sand cobbles			
	5:00	165	180		open hole gravel cemented + cobbles			

STAND BY TIME HRS. ____ HOURLY WORK HRS. ____

Signature of Owner or Representative ____

CASING USED: Size 10" Ft. Used 75 Water G.P.M. ____

CASING USED: Size ____ Ft. Used ____ Water Static ____

DRILLING MUD: Type ____ Amount ____ Fuel ____ Oil ____

MISC.

Driller Marty Peterson Helper Mike spindell Helper

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-14-89

RIG NO. 7 RIG TYPE C.P-7000 WELL NO. DMW-3 TYPE monitor

JOB OWNER Provo city

LOCATION Bay view Land fiLL

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					pickup grout plant in Elberta	Bullen	9½	1
					took it to shop.			
					went to the geo store got			
					150' 4½" PVC			
		180	195		gravels + sand			
	5:00				unload Bentonite trailer			

STAND BY TIME HRS. HOURLY WORK HRS. 10

Signature of Owner or Representative

CASING USED: Size Ft. Used Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

MISC.

Driller Martin Peterson | Helper mike spindell | Helper tim Ross

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-15-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. DMW-3 TYPE monitor

JOB OWNER provo city

LOCATION Bay view Landfill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00		195			Drilling open hole	Button	9½	1
			210		cemented Gravel's & sand			
	9:30	210	225		cemented Gravel's			
9:30	5:00				went to trojan to set pump.			

STAND BY TIME HRS. ______ HOURLY WORK HRS. 10-

Signature of Owner or Representative ______

CASING USED: Size ______ Ft. Used ______ Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller Marty Peterson	Helper Mike spindell	Helper Tim Ross

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-16-89

RIG NO. 7 RIG TYPE C-P-7000 WELL NO. DMW-3 TYPE monitor

JOB OWNER Provo city

LOCATION Bayview Land Fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00		225			Drilling open hole	Button	9½	1
			240		Mud stone with clay & gravel			
		240	255		mud stone with clay & graveL			
		255	270		mud stone with gravel Little water	270'		
		270	285		mud stone with gravel Layer's			
		285	300		" " " "			
					Install 280' 4½ PVC 20' 4½			
	5:00				screen and gravel pack to 265'			

STAND BY TIME HRS. HOURLY WORK HRS. 10

Signature of Owner or Representative

CASING USED: Size 4½" BLank Ft. Used 280 Water G.P.M.

CASING USED: Size 4½" Screen Ft. Used 20 Water Static 260'

DRILLING MUD: Type Amount Fuel Oil

MISC.

Driller Martin Peterson

Helper Tim Ross

Helper Mike

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-17-89

RIG NO. 2 RIG TYPE completion Rig WELL NO. DMW-3 TYPE monitor

JOB OWNER provo city

LOCATION Bayview Land fiLL

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					move c-P-7000 to Laydown area.			
					setup completion Rig + Jack's			
					Bring Bentonite from 265'-165'.			
					start to pull 10" caseing at 165			
					still putting in Bentonite.			
					pulled caseing from 165'-45'			
					work in the Laydown area Loading			
	4:00				Truck's.			

STAND BY TIME HRS. ______ HOURLY WORK HRS. 9.

Signature of Owner or Representative ______

CASING USED: Size ______ Ft. Used ______ Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller Martin Petersen	Helper mike Spindell	Helper Tim Ross

LOG OF EXPLORATORY BORING

~~PROJECT NO.~~ DRILLER: MARTY PETERSON BORING NO. BV-MW-3
PROJECT NAME BAYVIEW LANDFILL - PROVO CITY LOGGED BY T. BELCHAK
DRILLING METHOD DRILL/DRIVE AIR ROTARY 10" CASING DATE DRILLED 11/10/89
STATE ____ COUNTY ________ DESCRIPTIVE LOCATION ________
LOCATION: T ____ R ____ SECT. ____ TRACT ________ PAGE 1 OF 10

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GRAVELLY SILTY SAND: BROWN, FINE GRAINED, 30% SILT 10% GRAVEL
				5					
									GRAVELLY SILT: OLIVE BROWN, VERY FINE GRAINED 10% GRAVEL
				10					
									SANDY SILTY GRAVEL: OLIVE BROWN, VERY POORLY SORTED, 10% SAND 20% SILT.
				15					
									SILTY PEBBLY GRAVEL: GREY BROWN, POORLY SORTED 10% SILT 30% PEBBLES ≤ 20 mm.
				20					
				25					SAME
				30					SAME

REMARKS
DATE DRILLED
0-90' 11/10/89
90-180 11/13/89
180-195 11/14/89
195-225 11/15
225-300 11/16

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____________ BORING NO. AV-MW-3
PROJECT NAME ____________ LOGGED BY ____________
DRILLING METHOD ____________ DATE DRILLED 11/10/89

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____________

LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 2 OF 10

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				35					PEBBLY GRAVELLY SAND: REDDISH BROWN, 10% PEBBLES to 20mm, 20% GRAVEL.
				40					SANDY PEBBLY GRAVEL: GREY, 10% SAND 30% PEBBLES to 20mm.
				45					SAME
				50					PEBBLY GRAVELLY SAND: BROWN 10% PEBBLES 20% GRAVEL, WELL SORTED MEDIUM SAND.
				55					PEBBLY GRAVELLY SAND REDDISH BROWN 20% PEBBLES. 25% GRAVEL, RED MEDIUM SAND.
				60					PEBBLY GRAVELLY SAND: REDDISH BROWN, 20% PEBBLES 30% GRAVEL, FINE SAND.

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ________ BORING NO. RV-CMW-3
PROJECT NAME ________ LOGGED BY ________
DRILLING METHOD ________ DATE DRILLED ________

STATE ____ COUNTY ________ DESCRIPTIVE LOCATION ________

LOCATION: T ____ R ____ SECT. ____ TRACT ________ PAGE 3 OF 10

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									PEBBLY SAND: REDDISH BROWN, 10% PEBBLES
				65					WELL SORTED MEDIUM SAND.
				70					SAME
				75					SAME
				80					SAME
									PEBBLY SAND: BROWN, 10% PEBBLES TO 30mm
				85					POORLY SORTED MEDIUM & COARSE SAND
				90					SAME

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO.
BORING NO. BY-OMW-2
PROJECT NAME
LOGGED BY
DRILLING METHOD
DATE DRILLED
STATE COUNTY DESCRIPTIVE LOCATION
LOCATION: T R SECT. TRACT
PAGE 4 OF 10

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				95					GRAVELLY SAND: BROWN: 20% GRAVEL MEDIUM SORTED MEDIUM BROWN SAND.
				100					SANDY PEBBLY GRAVEL: GREY-BROWN, VERY COARSE, 10% SAND 40% PEBBLES to 40mm.
				105					PEBBLY GRAVELLY SAND: GREY BROWN 10% PEBBLES 20% GRAVEL
				110					GRAVELLY SAND: RED, 20% GRAVEL. WELL SORTED, FINE RED SAND.
				115					PEBBLY GRAVELLY SAND, GREY BROWN, 20% PEBBLES to 22mm. 30% GRAVEL.
				120					SAME L

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____

BORING. NO. EY-DMW-2

PROJECT NAME ____

LOGGED BY ____

DRILLING. METHOD ____

DATE DRILLED ____

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____

LOCATION: T ____ R ____ SECT. ____ TRACT ____

PAGE 5 OF 10

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				125					PEBBLY GRAVELLY SAND: GREY BROWN 20% PEBBLES to 30 mm 30% GRAVEL.
				130					SAME
				135					SAME
				140					SANDY GRAVEL: GREY BROWN, 20 % SAND WELL SORTED GRAVEL.
				145					SAME
				150					GRAVELLY SAND: REDDISH BROWN, 30% GRAVEL WELL SORTED. FINE RED SAND.

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____________________ BORING NO. BY-DMW-3

PROJECT NAME ____________________ LOGGED BY ____________________

DRILLING METHOD ____________________ DATE DRILLED ____________________

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____________________

LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 6 OF 10

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GRAVELLY SAND: REDDISH BROWN, 10% GRAVEL WELL SORTED MEDIUM FED SAND.
				155					
									PEBBLY GRAVELLY SAND: REDDISH BROWN, POORLY SORTED, MEDIUM SAND.
				160					↓
				165					SAME
									↓
				170					SAME
									↓
				175					SAME
									GRAVELLY SAND: REDDISH BROWN 20% GRAVEL WELL SORTED FINE to MEDIUM FED SAND.
				180					

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____________

BORING. NO. AV-OMW-2

PROJECT NAME ____________

LOGGED BY ____________

DRILLING. METHOD ____________

DATE DRILLED ____________

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____________

LOCATION: T ____ R ____ SECT. ____ TRACT ____

PAGE 7 OF 10

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									PEBBLY GRAVELLY SAND: [illegible] BROWN 20% PEBBLES, 30% GRAVEL, FINE SAND.
				185					↓
				190					SAME
									↓
				195					SAME
									↓
				200					SAME
									↓
									SAME
				205					↓
				210					SAME

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO.
PROJECT NAME
DRILLING METHOD
BORING NO. AV-CMW-3
LOGGED BY
DATE DRILLED

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____

LOCATION: T ____ R ____ SECT. ____ TRACT ____

PAGE 8 OF 10

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GRAVELLY SILT: REDDISH BROWN, VERY FINE
				215					SILT to FINE SAND 10% GRAVEL.
									PEBBLY GRAVELLY SAND: REDDISH BROWN
				220					70% PEBBLES ~20% GRAVEL. FINE RED SAND
									SAME
				225					
									SAME
				230					
									CLAYSTONE; RED, PEBBLES + GRAVEL [illegible]
				235					IN CUTTINGS
									SAME
				240					

REMARKS AT 235' TRANSITION BEGINS FROM GRAVELLY SANDS to CLAYSTONE CUTTINGS ~1/4 INCH QUITE UNIFORMLY.

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____ BORING NO. AV-OMW-2
PROJECT NAME ____ LOGGED BY ____
DRILLING METHOD ____ DATE DRILLED ____
STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____
LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 9 OF 10

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									CLAYSTONE: RED, EXTREMELY FINE GRAINED
				245					
				250					SAME
				255					SAME
				260					SAME
				265					SAME
				270					SAME

REMARKS RED CLAYSTONE CUTTINGS ~1/4 INCH MIXED W/ PEBBLES + GRAVEL.

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. BV-OMW-3
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED ______

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ______

LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 10 OF 10

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GRAVELLY SAND: REDDISH BROWN, 10% GRAVEL VERY FINE GRAINED REL SAND.
				275					
				280					SAME
									|
				285					SAME
									*
				290					SAME
									|
				295					SAME
									|
				300					SAME

REMARKS THE WATER BEARING ZONE APPEARS TO BE CONTROLLED BY THE CLAYSTONE ZONE. THE FINE SAND-SILTSTONE MAY NOT BE A LARGE WATER PRODUCER.

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-20-89

RIG NO. ______ RIG TYPE Hole master WELL NO. DMW-3 TYPE monitor

JOB OWNER Provo city

LOCATION Bay view Land Fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Fill water truck			
					But Bentonite in and pull			
					10" caseing to 20' grout and			
					install 8" surface pipe and make			
					cement pad.			
					move everything to Lay down area.			
					get ready to set well's			
	5:30				Decon C-P-7000			

STAND BY TIME HRS. ______ HOURLY WORK HRS. 10 1/2

Signature of Owner or Representative ______

CASING USED: Size ______ Ft. Used ______ Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller ______ Helper ______ Helper ______

WELL COMPLETION LOG.

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 11/20/89

RIG NO. ____ RIG TYPE Hole master WELL NO. DMW-3 TYPE monitor

JOB OWNER Provo city

LOCATION Bay view

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
					Run in 280' 4½ P.V.C. Blank			
					20' 4½ Screen.			
					Gravel pack from 300' to 265'			
					Bentonite seal from 265'- 20'			
					grout from 20'-5'			
					Seakreat from 5'- 0'			
					10-20-sand			
					Drill + Drive 10" 0-165'			
					open Hole 165'-300'			
					Hit water at 275'			

STAND BY TIME HRS. ____ HOURLY WORK HRS. ____

Signature of Owner or Representative ____

CASING USED: Size ____ Ft. Used ____ Water G.P.M. 8

CASING USED: Size ____ Ft. Used ____ Water Static ____

DRILLING MUD: Type ____ Amount ____ Fuel ____ Oil ____

MISC.

Driller Marter Peterson	Helper	Helper

WELL DEVELOPMENT

Project: BAYVIEW LANDFILL Well Number: DMW 3

Project Number: ____________ Date: Nov 29 1989

Well inside diameter: 4.5 IN

Depth of bottom: 300 FT

Length of gravel pack: 25 FT

Diameter of gravel pack: 10 IN

Measured by: ____________

Recorded by: ____________

Air temperature: 40 DegF

Weather condition: ____________

WITHDRAWAL OF WELL VOLUMES

FLUSHING	Well Volume	Well Volume	Well Volume
Water level before	245.5		
Water level after			
Time begin flushing	12:00		
Time end flushing	15:00		
Time water level after			
Estimated volume flushed (GAL)	1000		

FIELD ANALYSIS			
Water temperature (DegC)	60 F		
Sample pH	7.0		
Sample conductivity (mhos/cm)	825		
Buffer before			
Buffer after			
Odor	None		
Color	Clear		
Other			

COMMENTS

Attach photographs of water samples in labeled jars.

END OF SECTION

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-26-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. Omw-4 TYPE monitor

JOB OWNER Provo city

LOCATION Bay view Landfill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:30					Haul caseing	Button	9¾	1
		0	5		start to drill + Drive 10" caseing			
		5	10		gravel + cobble's sand			
		10	15		" " "			
		15	25		" " "			
		25	35		" " "			
		35	45		" " "			
		45	55		" " "			
		55	65		" " "			
	4:30	65	75		" " "			

STAND BY TIME HRS. ____ HOURLY WORK HRS. 9

Signature of Owner or Representative ____

CASING USED: Size 10" Ft. Used 75 Water G.P.M. ____

CASING USED: Size ____ Ft. Used ____ Water Static ____

DRILLING MUD: Type ____ Amount ____ Fuel ____ Oil ____

MISC.

Driller Master Peterson | Helper Mike -spindell | Helper Dick - H

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-27-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. DMW-4 TYPE monitor

JOB OWNER provo city

LOCATION Bayview Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:30					Drill + Drive 10" caseing	Button	9¾	1
		75	85		gravel-sand-Bolders			
		85	95		gravel sand Bolders			
		95	105		" " "			
		105	115		" " "			
		115	125		" " "			
		125	135		" " "			
		135	145		" " "			
	5:00	145	150		" " "			

STAND BY TIME HRS. HOURLY WORK HRS. 9 1/2

Signature of Owner or Representative

CASING USED: Size 10" Ft. Used 75 Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

MISC.

Driller Marty Peterson	Helper Tim Ross	Helper Dick-A

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-28-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. DMW-4 TYPE monitor

JOB OWNER Provo city

LOCATION Bay view Land fiLL

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:30					not a thing would start But			
					C-P-7000.			
					finiley got thing's started			
		150			Drilled 10"			
			165		gravel - sand - Bolder's			
	2:30							

STAND BY TIME HRS. ______ HOURLY WORK HRS. 7

Signature of Owner or Representative ______

CASING USED: Size 10" Ft. Used 15 Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller Martin Peterson	Helper Tim Ross	Helper

LOG OF EXPLORATORY BORING

~~PROJECT NO~~. DRILLER: MARTY PETERSON
BORING. NO. RV-DMW-4
PROJECT NAME FAIRVIEW LANDFILL
LOGGED BY TOM MELCHAK
DRILLING. METHOD DRILL/DRIVE AIR ROTARY
DATE DRILLED ______
STATE ____ COUNTY ______ DESCRIPTIVE LOCATION ______
LOCATION: T ____ R ____ SECT. ____ TRACT ______
PAGE 1 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				5					PEBBLY SILT: BROWN, FINE-GRAVELED
				10					SANDY GRAVEL: GREY, MEDIUM [illegible] 20% SAND GRAVEL 2-4 mm
				15					PEBBLY, SANDY GRAVEL: GREY-BROWN 10% SAND PEBBLES [illegible] MEDIUM SORTED
				20					PEBBLY GRAVEL: GREY, MEDIUM SORTED [illegible] COARSE ANGULAR
				25					PEBBLY GRAVEL: GREY, MEDIUM SORTED VERY COARSE ANGULAR PEBBLES to 40 mm (40%)
				30					PEBBLY, SANDY GRAVEL: GREY, MEDIUM SORTED

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. BV-OMW-4
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED ______

STATE ____ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ____ R ____ SECT. ____ TRACT ______ PAGE 2 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									PEBBLY GRAVEL: GREY BROWN, MEDIUM SORTED PEBBLES TO 25 mm
				35					
									GRAVELLY SAND: GREY, MEDIUM SORTED
				40					
									PEBBLY MEDIUM SAND: BROWN, 30% GRAVEL
				45					
									GRAVELLY SAND: BROWN 40% GRAVEL
				50					
									PEBBLY GRAVEL: GREY ANGULAR, MEDIUM SORTED, 30% PEBBLES to 30 mm.
				55					
									PEBBLY GRAVEL: GREY, WELL SORTED SUB- ANGULAR. PEBBLES to 50 mm.
				60					

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. BV-OMW-4
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED ______

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ______

LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 3 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				65					GRAVEL: GREY VERY WELL SORTED. SUB-ANGULAR UNIFORM PEBBLE [illegible].
				70					SANDY GRAVEL: GREY, MEDIUM SORTED 40% SAND.
				75					GRAVELLY SAND: BROWN WELL SORTED. SUB-ANGULAR TO ROUNDED [illegible] COARSE SAND.
				80					SANDY GRAVEL: BROWN POORLY SORTED 30% SAND.
				85					PEBBLY GRAVEL: BROWN, POORLY SORTED ANGULAR, VERY [illegible] PEBBLE TO 20MM.
				90					PEBBLY SANDY GRAVEL: REDDISH BROWN. POORLY SORTED, ANGULAR, LARGE PEBBLE TO [illegible]

REMARKS REDDISH BROWN COLOR BEGINS AT 90' SAMPLE, REMAINS THROUGHOUT BOREHOLE [illegible]-182'

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____________________
BORING NO. BV-CMW-4
PROJECT NAME ____________________
LOGGED BY ____________________
DRILLING METHOD ____________________
DATE DRILLED ____________________
STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____________________
LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 4 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GRAVELLY SAND: REDDISH BROWN, WELL SORTED VERY COARSE SAND.
				95					
									GRAVELLY SAND: REDDISH BROWN MODERATELY SORTED MEDIUM SAND.
				100					
									PEBBLY GRAVELLY SAND: REDDISH BROWN MEDIUM SORTED 30% GRAVEL PEBBLES TO 40mm
				105					
									GRAVELLY SAND. REDDISH BROWN, MODERATELY SORTED 30% GRAVEL MEDIUM TO FINE SAND.
				110					
									SAND: REDDISH BROWN, WELL SORTED, MEDIUM SAND.
				115					
				120					GRAVELLY SAND: REDDISH BROWN. MEDIUM SORTED 10% GRAVEL, MEDIUM SAND.

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______
BORING NO. BV-CMW-4
PROJECT NAME ______
LOGGED BY ______
DRILLING METHOD ______
DATE DRILLED ______

STATE ____ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 5 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				125					PEBBLY GRAVELLY SAND: REDDISH BROWN, POORLY SORTED 20% GRAVEL MEDIUM SAND.
				130					SANDY GRAVEL: REDDISH BROWN, WELL SORTED, 3-6 mm PARTICLES. 20% SAND.
				135					GRAVELLY SAND; REDDISH BROWN WELL SORTED 10% GRAVEL MEDIUM SAND.
				140					GRAVEL: REDDISH BROWN, MEDIUM SORTED SUB-ROUNDED, 2-5 mm
				145					SANDY GRAVEL: REDDISH BROWN POORLY SORTED 10% SAND.
				150					PEBBLY GRAVEL; REDDISH BROWN, POORLY SORTED ANGULAR, PEBBLES to 20mm.

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. BV-DMW-4
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED ______

STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ______ R ______ SECT. ______ TRACT ______ PAGE 6 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				155					PEBBLY GRAVEL: REDDISH BROWN, POORLY SORTED ANGULAR PEBBLES to 20mm
				160					SAND: REDDISH BROWN, MEDIUM SORTED MEDIUM to COARSE SAND.
				165					PEBBLY GRAVEL: REDDISH BROWN, POORLY SORTED PEBBLES to 20 mm.
				170					SANDY PEBBLY GRAVEL: REDDISH BROWN, VERY POORLY SORTED 10% SAND PEBBLES to 20mm
				175					GRAVELLY SAND: REDDISH BROWN POORLY SORTED 70% GRAVEL 6-8 mm.
				180					GRAVELLY SAND: REDDISH BROWN, MEDIUM SORTED 10% GRAVEL

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. B1-OMW-4
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED ______

STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ______ R ______ SECT. ______ TRACT ______ PAGE 7 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				185					GRAVELLY SAND: REDDISH BROWN WELL SORTED 20% GRAVEL, FINE SAND.
				190					GRAVELLY, PEBBLY SAND: REDDISH BROWN, POORLY SORTED, LARGE PEBBLES to 40mm.
				195					SANDY PEBBLY GRAVEL: VARIEGATED COLOR, POORLY SORTED 10% SAND PEBBLES to [illegible]

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

APPENDIX M

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-2-89 11-3-89

RIG NO. 10 RIG TYPE Failing WELL NO. CMW-4, 2 TYPE monitoring

JOB OWNER Provo City

LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Th 11-2			
					Haul casing To drill rig.			
					change oil on rig.			
					drld from 75'-165'			
	4:30				Take fuel line off comp.	9½ hrs		
7:00					Fri 11-3			
					Put new fuel line on Comp			
					drld from 165'-240'. Haul			
	5:00				10" casing To drill rig.	10 hrs		

STAND BY TIME HRS. ______ HOURLY WORK HRS. ______

Signature of Owner or Representative ______

CASING USED: Size ______ Ft. Used ______ Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller	Helper	Helper

DAVE'S DRILLING
5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 10-31-84 ~~[illegible]~~ 11-1-84

RIG NO. #10 RIG TYPE Failing WELL NO. DMW-1C, 4, 2 TYPE monitoring

JOB OWNER Provo City

LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					M 10-30			
					Take tire off forklift. Move			
					drill rig off hole DMW-4. Set			
					Jacks and Comp. rig on hole #			
					DMW-1C. Complete hole from 45'-			
	5:30				0 and Install surface completion.	10½ hrs		
7:00					T 10-31			
					Set Jacks and Comp. rig on hole			
					#DMW-4. Set 7000 on hole #			
	4:30				DMW-2 and drill from 0-45'.	9½ hrs		
7:00					W 11-1 On hole #DMW4			
					Set 195' of PVC in hole and			
					Complete hole from 195'-30'			
					load casing on boom truck and			
	4:00				load with drill pipe	9 hrs		

STAND BY TIME HRS. ____ HOURLY WORK HRS. ____

Signature of Owner or Representative ____

CASING USED: Size ____ Ft. Used ____ Water G.P.M. ____

CASING USED: Size ____ Ft. Used ____ Water Static ____

DRILLING MUD: Type ____ Amount ____ Fuel ____ Oil ____

MISC.

Driller	Helper Tim Ross	Helper Steve Montague

WELL DEVELOPMENT

Project: VIEW LANDFILL   Well Number: D mw-4

Project Number: ____________   Date: 11-12-89

Well inside diameter: 4½ IN

Depth of bottom: 195 FT

Length of gravel pack: 25 FT

Diameter of gravel pack: 10-20 IN

Measured by: M. PETERSON

Recorded by: Howell W. Belikh

Air temperature: 42 DegF

Weather condition: Fair + Sunny + clear

WITHDRAWAL OF WELL VOLUMES

FLUSHING	Well Volume	Well Volume	Well Volume
Water level before	175'-6"		
Water level after	175		
Time begin flushing	9:15		
Time end flushing	11:15		
Time water level after	11:45		
Estimated volume flushed (GAL)	8 GaL Per min.		

FIELD ANALYSIS			
Water temperature (DegC)	60		
Sample pH	7		
Sample conductivity (mhos/cm)	475		
Buffer before	—		
Buffer after	—		
Odor	None		
Color	clear		
Other			

COMMENTS

THIS WELL PRODUCED VERY GOOD VOLUME

Attach photographs of water samples in labeled jars.

END OF SECTION

APPENDIX M

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-8-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. DMW-5 TYPE monitor
JOB OWNER Provo city
LOCATION Bayview Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Drill & Drive 10" caseing	Button	9½	1
		0	5		sand & silt			
		5	15		gravel & sand			
		15	30		gravel & cobble's			
		30	45		gravel - " & sand			
		45	60		gravel - " sand			
		60	75		gravel - " sand			
		75	90		gravel - " sand			
		90	105		gravel - " sand			
	5:00	105	120		gravel - " sand			

STAND BY TIME HRS. ______ HOURLY WORK HRS. 10
Signature of Owner or Representative ______

CASING USED: Size 10" Ft. Used 120 Water G.P.M. ______
CASING USED: Size ______ Ft. Used ______ Water Static ______
DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______
MISC.

Helper Helper

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-9-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. DMW-5 TYPE monitor

JOB OWNER Provo city

LOCATION Bay view Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Drilling & Driving 10" casing	Button	9½	1
		120	135		gravel & sand cobble's			
		135	150		gravel & sand "			
		150	165		gravel & sand "			
		165	175		gravel & Sand "			
		175	180		moist sand & gravel cobble's			
		180	185		water gravel sand & fractures			
		185	195		water gravel sand & fractures			
		195	210		water gravel sand fractures			
					Drilled from 195'-210 open Hole			
					pull Drill pipe and move Rig			
	5:00				to DMW-3.			

STAND BY TIME HRS. HOURLY WORK HRS. 10

Signature of Owner or Representative

CASING USED: Size Ft. Used Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

Driller Helper Helper

LOG OF EXPLORATORY BORING

~~PROJECT NO~~. DRILLER: MARTY PETERSON
BORING. NO. BV-DMW-5
PROJECT NAME BAYVIEW LANDFILL - PROVO CITY
LOGGED BY T. BELCHAK
DRILLING. METHOD AIR ROTARY DRILL/DRIVE 10" CASING
DATE DRILLED 10/8/89

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____

LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 1 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									SILT: OLIVE, WELL SORTED, FINE GRAINED
				5					
									PEBBLY SILTY GRAVEL: GREY VERY POORLY SORTED 10% PEBBLES TO 30mm. 20% SILT.
				10					
									PEBBLY GRAVELLY SILT: GREY POORLY SORTED 10% PEBBLES 20% GRAVEL VERY COMPACTED SILT CONCRETE-LIKE CONSISTENCY
				15					
									SAME
				20					
									PEBBLY GRAVELLY SAND: BROWN-GREY, VERY POORLY SORTED 10% PEBBLES, MEDIUM-COARSE SAND.
				25					
									PEBBLY SANDY GRAVEL: BROWN 20% PEBBLES TO 40mm 30% SAND.
				30					

REMARKS DRILLED 10/8 + 10/9/89

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____________ BORING NO. BV-OMW-5
PROJECT NAME ____________ LOGGED BY ____________
DRILLING METHOD ____________ DATE DRILLED 10/13/89

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____________

LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 2 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				35					SAME
				40					SAME
				45					SAME
				50					PEBBLY GRAVELLY SILT: OLIVE BROWN POORLY SORTED 10% PEBBLES to 30mm 20% GRAVEL, 70% [illegible] SILT.
				55					PEBBLY SILTY GRAVEL: BROWN, POORLY SORTED 10% PEBBLES to 30mm 30% SILT
				60					SAME S

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ________ BORING NO. BV-CMW-5
PROJECT NAME ________ LOGGED BY ________
DRILLING METHOD ________ DATE DRILLED ________
STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ________
LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 3 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				65					SAME
				70					PEBBLY SILTY GRAVEL: REDDISH BROWN, POORLY SORTED, 5% PEBBLES to 30mm, 30% SILT.
				75					SILTY GRAVELLY PEBBLES: GREY, PEBBLES RELATIVELY UNIFORM SIZE 20-30mm, 5% SILT, 20% GRAVEL
				80					SAME
				85					SAME
				90					PEBBLY GRAVELLY SAND; REDDISH BROWN, POORLY SORTED. 10% PEBBLES, 20% GRAVEL, REC. MEDIUM TO COARSE SAND.

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO.
PROJECT NAME
DRILLING METHOD

BORING NO. AV-DMW-5
LOGGED BY
DATE DRILLED 11/8/89

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____

LOCATION: T ____ R ____ SECT. ____ TRACT ____

PAGE 4 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									PEBBLY GRAVELLY SAND; REDDISH BROWN, POORLY SORTED 10% PEBBLES, 20% GRAVEL MEDIUM TO COARSE RED SAND.
				95					
				100					SAME
				105					SAME
				110					SAME
				115					SAME
				120					SAME

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______
PROJECT NAME ______
DRILLING METHOD ______
BORING NO. BV-OMW-5
LOGGED BY ______
DATE DRILLED 11/9/89
STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ______
LOCATION: T ______ R ______ SECT. ______ TRACT ______
PAGE 5 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GRAVELLY SAND: BROWN, MEDIUM SORTED
				125					20% GRAVEL, MEDIUM + COARSE RED SAND
				130					SAME
				135					SAME
				140					SAME
									PEBBLY GRAVELLY SAND: BROWN, POORLY SORTED
				145					10% PEBBLES, 30% GRAVEL, MEDIUM + COARSE RED SAND
				150					SAME

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____________________ BORING NO. BJ-CMW-5
PROJECT NAME ____________________ LOGGED BY ____________
DRILLING METHOD ____________________ DATE DRILLED ____________
STATE ____ COUNTY ____________ DESCRIPTIVE LOCATION ____________________
LOCATION: T ______ R ______ SECT. ______ TRACT ________ PAGE 6 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				155					SAME
									PEBBLY GRAVELLY SAND: REDDISH BROWN, 5% PEBBLES 10% GRAVEL, MEDIUM [illegible] FINE [illegible] SAND
				160					
									PEBBLY GRAVELLY SAND: BROWN. 5% PEBBLES 20% GRAVEL MEDIUM TO COARSE [illegible] SAND.
				165					
				170					SAME
				175					SAME
				180					SAME

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____________
BORING NO. AV-DMW-5
PROJECT NAME ____________
LOGGED BY ____________
DRILLING METHOD ____________
DATE DRILLED ____________

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____________

LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 7 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW. COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				185					SAME
				190					SAME
				195					SAME
				200					SAME
									PEBBLY GRAVELLY SAND: REDDISH [illegible]
				205					5% PEBBLES 10% GRAVEL WELL SORTED FINE RED SAND
				210					SAME

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date ~~11-9-84~~ 11-10-84

RIG NO. #10 RIG TYPE Failing WELL NO. SMW-1,5,6 TYPE monitoring
JOB OWNER Provo City
LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					11-9-84			
					Develope holes, SMW-1,5,6.			
					Move drilling off hole DMW-5			
	5:00				and set Jacks on hole.	10hrs		
7:00					11-10-84 On hole DMW-5			
					Set pvc in hole to 210'			
		210'			Install completion from 210'-			
5:00			50'	160'	50'. Haul casing to drill rig.	10hrs		

STAND BY TIME HRS. ________ HOURLY WORK HRS. ________
Signature of Owner or Representative ________

CASING USED: Size ________ Ft. Used ________ Water G.P.M. ________
CASING USED: Size ________ Ft. Used ________ Water Static ________
DRILLING MUD: Type ________ Amount ________ Fuel ________ Oil ________
MISC.

Driller Helper Tim Ross Helper Steve Montague

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-13-89

RIG NO. #10 RIG TYPE Failing WELL NO. DMW-5 TYPE monitoring

JOB OWNER Provo City

LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Finish Completion on hole DMW5			
					from 50' - 0. Install surface			
					completion.			
					Go To Trojan and pick up 2"			
	4:30				pipe and Take back To bayview			

STAND BY TIME HRS. ______ HOURLY WORK HRS. 9½ hrs

Signature of Owner or Representative ______

CASING USED: Size ______ Ft. Used ______ Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller | Helper | Helper

WELL DEVELOPMENT

Project: BAYVIEW LANDFILL Well Number: Dmw-5

Project Number: Date: 11-21-89

Well inside diameter: 4 1/2 IN

Depth of bottom: 211 FT

Length of gravel pack: 25 FT

Diameter of gravel pack: 10-20 SAND IN

Measured by: M. PETERSON

Recorded by:

Air temperature: 55 DegF

Weather condition: Fair but Hazey

WITHDRAWAL OF WELL VOLUMES

FLUSHING	Well Volume	Well Volume	Well Volume
Water level before	178' 6"		
Water level after	178'		
Time begin flushing	15:45		
Time end flushing	16:25		
Time water level after	16:45		
Estimated volume flushed (GAL)	10 per min.		

FIELD ANALYSIS	
Water temperature (DegC)	58
Sample pH	7
Sample conductivity (mhos/cm)	480
Buffer before	—
Buffer after	—
Odor	None
Color	Clear
Other	

COMMENTS

THE AQUIFER IN THIS WELL CONSISTED OF VERY CORSE GRAVEL AND PRODUCED A VERY GOOD VOLUME OF WATER.

Attach photographs of water samples in labeled jars.

END OF SECTION

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-7-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. DMW-6 TYPE Monitor

JOB OWNER Provo city

LOCATION Bayview Landfill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					put air filter in comp.	Button	10	1
					and start to drill + Drive 10"			
		0	5		sand + silt			
		10	20		Gravel + Sand			
		20	30		Gravel Sand + silt			
		30	40		Gravel Sand			
		40	50		Gravel sand			
		50	55		hard pan + Gravel			
		55	60		Gravel + Sand			
	3:30	60	75		Gravel + Sand			

STAND BY TIME HRS. ______ HOURLY WORK HRS. 8 1/2

Signature of Owner or Representative ______

CASING USED: Size 10 Ft. Used 75 Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller	Helper	Helper
Martin Peterson	Mike Spindell	

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-9-89

RIG NO. 7 RIG TYPE C-P-7000 WELL NO. OMW-6 TYPE monitor

JOB OWNER Provo city Corp.

LOCATION Bayview Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Load Drill pipe in caseing	Button	10	1
					haul 6 joint's to the rig			
					fill water truck. work on			
					axy air comp. Try to get more			
					air.			
		75	90	15	cemented gravel + sand			
		90	105	15	cemented gravel & sand			
	6:00							

STAND BY TIME HRS. ______ HOURLY WORK HRS. 11

Signature of Owner or Representative ______

CASING USED: Size 10 Ft. Used 30 Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller [illegible] | Helper [illegible] | Helper [illegible]

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-10-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. nmw-6 TYPE Monitor

JOB OWNER Provo city

LOCATION Bay view Land Fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Fuel up Equipment	Button	9 3/4	1
					Drilling & Driveing 10"			
		105	120		Cemented gravel & sand			
		120	135		mud stone & sand-Gravel			
		135	140		Cemented gravel & sand			
		140	150		water Fractured cemented gravel-sand			
		150	165		cemented gravel & water			
					clean hole and pull Drill pipe			
					move Rig to Decon. Load D. P. and			
					10" caseing onto water truck. take			
					it to Decon. unload. went to			
					# 5-6 Load 12" caseing.			
	6:00				move rig to smw-#1			

STAND BY TIME HRS. HOURLY WORK HRS. 11

Signature of Owner or Representative

CASING USED: Size 10" Ft. Used 45 Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

MISC.
drilled from 150' to 165' open hole

Driller	Helper	Helper
Marty Petersen	Tom carlson	

LOG OF EXPLORATORY BORING

~~PROJECT NO~~. [illegible]
BORING NO. [illegible]
PROJECT NAME BAYVIEW LANDFILL
LOGGED BY [illegible]
DRILLING METHOD DRILL/DRIVE AIR ROTARY 10" CASING
DATE DRILLED [illegible]
STATE ____ COUNTY ________ DESCRIPTIVE LOCATION EAST OF Berm 3
LOCATION: T______ R ______ SECT. ______ TRACT________ PAGE 1 OF 2

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				5					SILT: BROWN, WELL SORTED, VERY COHESIVE FINE-GRAINED
				10					SILTY PEBBLY GRAVEL: BROWN, VERY POORLY SORTED PEBBLES TO 60 mm.
				15					PEBBLY GRAVELLY SILT: BROWN, POORLY SORTED PEBBLES to 20mm. SILT IS VERY COHESIVE
				20					PEBBLY SILTY GRAVEL: BROWN, POORLY SORTED MANY LARGE PEBBLES to 50mm. 30% SILT.
				25					PEBBLY GRAVEL: GREY-BROWN, MEDIUM SORTED (20mm) (3-5mm) NO FINES, WELL WASHED
				30					SANDY SILT: BROWN, WELL SORTED, FINE GRAINED, COHESIVE WHEN WET.

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____ BORING NO. FY-DMW-6
PROJECT NAME ____ LOGGED BY ____
DRILLING METHOD ____ DATE DRILLED ____

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____

LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 2 OF 6

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				35					PEBBLY SILTY GRAVEL: BROWN, POORLY SORTED VERY ABUNDANT SILT 30% PEBBLES 10%
				40					PEBBLY GRAVEL: GREY, MEDIUM SORTED (2-4mm)
				45					PEBBLY GRAVEL: GREY MEDIUM SORTED (4-6mm)
				50					PEBBLY GRAVELLY SAND: BROWN-GREY. MEDIUM SORTED. PEBBLES TO 30 mm.
				55					GRAVELLY CLAYEY SILT: BROWN. VERY POORLY SORTED VERY FINE GRAINED.
				60					PEBBLY GRAVEL: GREY-BROWN, MEDIUM SORTED (3-8mm) ROUNDED PARTICLES

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. EV-CW11-6
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED ______

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ______

LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 3 OF 6

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GREY
									SILTY PEBBLY GRAVEL: BROWN, VERY POORLY SORTED.
				65					
									PEBBLY SANDY GRAVEL: GREY BROWN, POORLY SORTED, SOME FINES
				70					
									SANDY PEBBLES: GREY, POORLY SORTED, VERY COARSE
				75					
									PEBBLY GRAVELLY SAND: REDDISH BROWN, MEDIUM SORTED
				80					
									PEBBLY SANDY GRAVEL: REDDISH BROWN, POORLY SORTED, SUBANGULAR to ROUNDED.
				85					
									SANDY GRAVEL: REDDISH BROWN, POORLY SORTED.
				90					

REMARKS

AFTER 75' LITHOLOGY CHANGES DRAMATICALLY IN COLOR AND TEXTURE. REDDISH BROWN, SANDY MATERIAL WITH LITTLE OR NO FINES.

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. BV-OMW-6
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED ______
STATE ____ COUNTY ______ DESCRIPTIVE LOCATION ______
LOCATION: T ____ R ____ SECT. ____ TRACT ______ PAGE 4 OF 6

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									PEBBLY SANDY GRAVEL: REDDISH BROWN
				95					
									GRAVELLY SAND: REDDISH BROWN, MEDIUM SORTED
				100					
									PEBBLY GRAVELLY SAND: REDDISH BROWN, POORLY SORTED
				105					
									SAND: REDDISH BROWN, WELL SORTED
				110					
									SAND: REDDISH BROWN MEDIUM SORTED
				115					
									PEBBLY GRAVEL: GREYISH BROWN, POORLY SORTED PEBBLES TO 30 mm.
				120					

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____________ BORING. NO. RV-CMW-6
PROJECT NAME ____________ LOGGED BY ____________
DRILLING. METHOD ____________ DATE DRILLED ____________

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____________

LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 5 OF 6

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									PEBBLY SAND: REDDISH BROWN. POORLY SORTED PEBBLES to 20 mm.
				125					
									SILTY PEBBLY GRAVEL: BROWN. POORLY SORTED PEBBLES to 30 mm.
				130					
									GRAVELLY SAND: REDDISH BROWN MEDIUM SORTED
				135					
									SILTY GRAVELLY SAND: REDDISH BROWN VERY POORLY SORTED SOME PEBBLES
				140					
									GRAVELLY SAND: REDDISH BROWN
				145					
									GRAVELLY SAND: REDDISH BROWN
				150					

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______
BORING NO. BV-OMW-6
PROJECT NAME ______
LOGGED BY ______
DRILLING METHOD ______
DATE DRILLED ______
STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ______
LOCATION: T ______ R ______ SECT. ______ TRACT ______
PAGE 6 OF 6

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GRAVELLY SAND: BROWNISH RED 10% GRAVEL
				155					
									GRAVELLY SAND: BROWNISH RED, ROUNDED, MEDIUM SORTED. 10% GRAVEL
				160					
									GRAVELLY SAND: BROWNISH RED ROUNDED MEDIUM SORTED 10% GRAVEL
				165					
									PEBBLY. SANDY GRAVEL: BROWNISH RED, POORLY SORTED LARGE PEBBLES TO 60 mm.
				170					

REMARKS
COLOR CHANGE AT 155' & 170' MORE RED COLOR IN SAND SAMPLES.

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 10-12-89

RIG NO. 10 RIG TYPE Failing WELL NO. DMW - 6 TYPE monitoring

JOB OWNER Provo City

LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
					Install 1' of blank 4½" pvc,			
					20' of 4½" screen and 145' of			
		166'			blank 4½" pvc To 166'			
					Install silica sand from			
					166' – 140'			
					Install course bentonite from			
					140' – 20'			
					Install neat cement from 20'–			
			0	166'	5' and concrete from 5'–0.			
					Install surface completion			

STAND BY TIME HRS. HOURLY WORK HRS.

Signature of Owner or Representative

CASING USED: Size Ft. Used Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

MISC.

Driller Helper Helper

WELL DEVELOPMENT

Project: BAYVIEW LANDFILL Well Number: Dmw-6

Project Number: ____________ Date: 11-21-89

Well inside diameter: 4 1/2 IN

Depth of bottom: 169.2" FT

Length of gravel pack: 25 FT

Diameter of gravel pack: 10-20 ~~SAND~~ IN

Measured by: M. PETERSON

Recorded by: Thomas A. Belisle

Air temperature: 56 DegF

Weather condition: Sunny & clear Little Haze

WITHDRAWAL OF WELL VOLUMES

FLUSHING	Well Volume	Well Volume	Well Volume
Water level before	134'		
Water level after	139		
Time begin flushing	12:02		
Time end flushing	13:54		
Time water level after	14:20		
Estimated volume flushed (GAL)	8-Gal per min		

FIELD ANALYSIS

Water temperature (DegC) 60°f

Sample pH 7

Sample conductivity (mhos/cm) 471

Buffer before —

Buffer after —

Odor None

Color clear

Other ______

COMMENTS

THIS WELL RECOVERED MORE RAPIDLY AFTER DEVELOPMENT THAN ANY OTHER WELL DRILLED FOR THIS PROJECT.

Attach photographs of water samples in labeled jars.

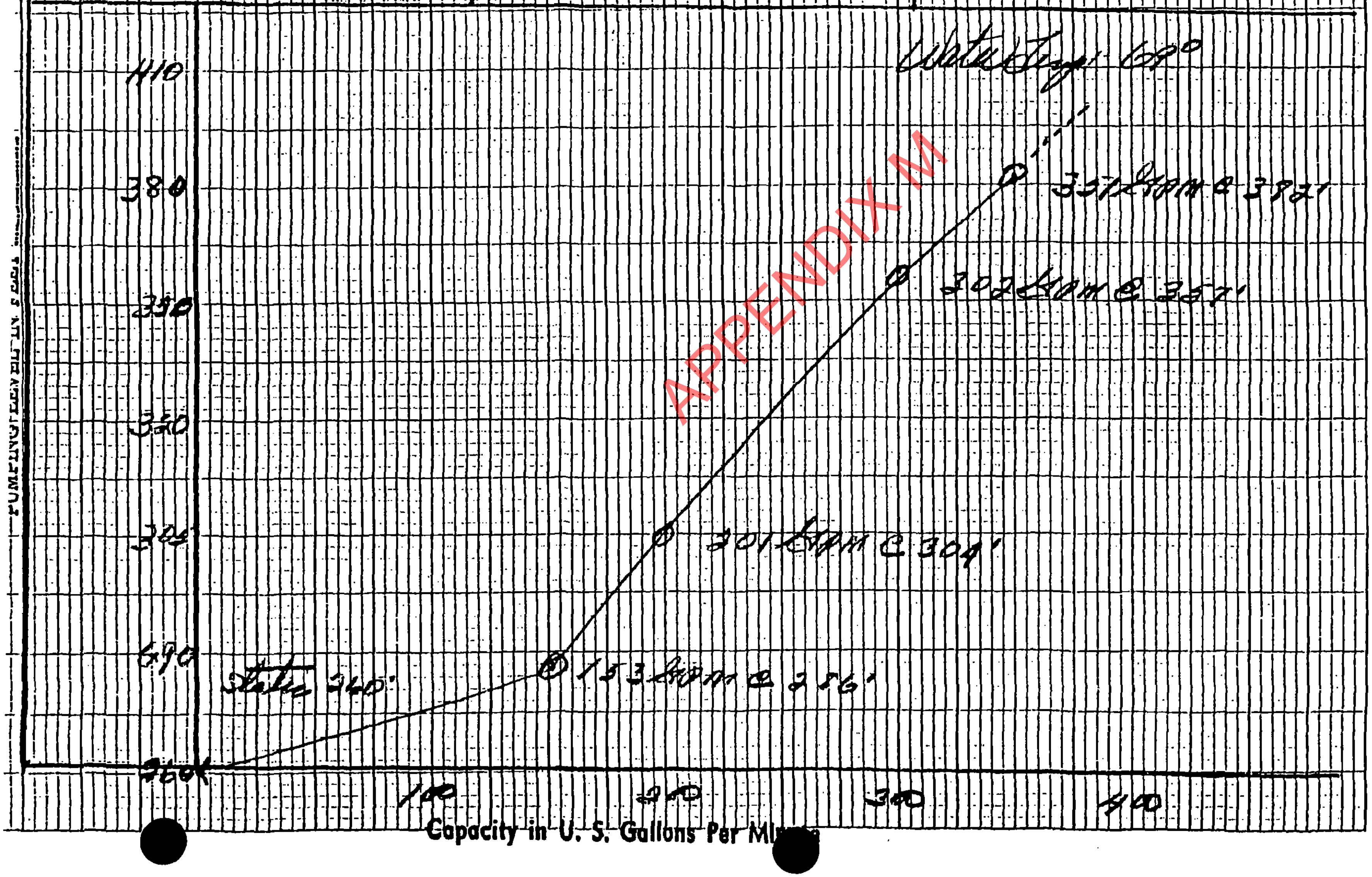
END OF SECTION

K+E 5 X 5 TO THE CENTIMETER 18 X 24 CM
KEUFFEL & ESSER CO. MADE IN U.S.A.

Field Copy of Well Test, Application No. .... | **Test Conducted by Rhodes Bros.; Fillmore, Utah — 743-6277**

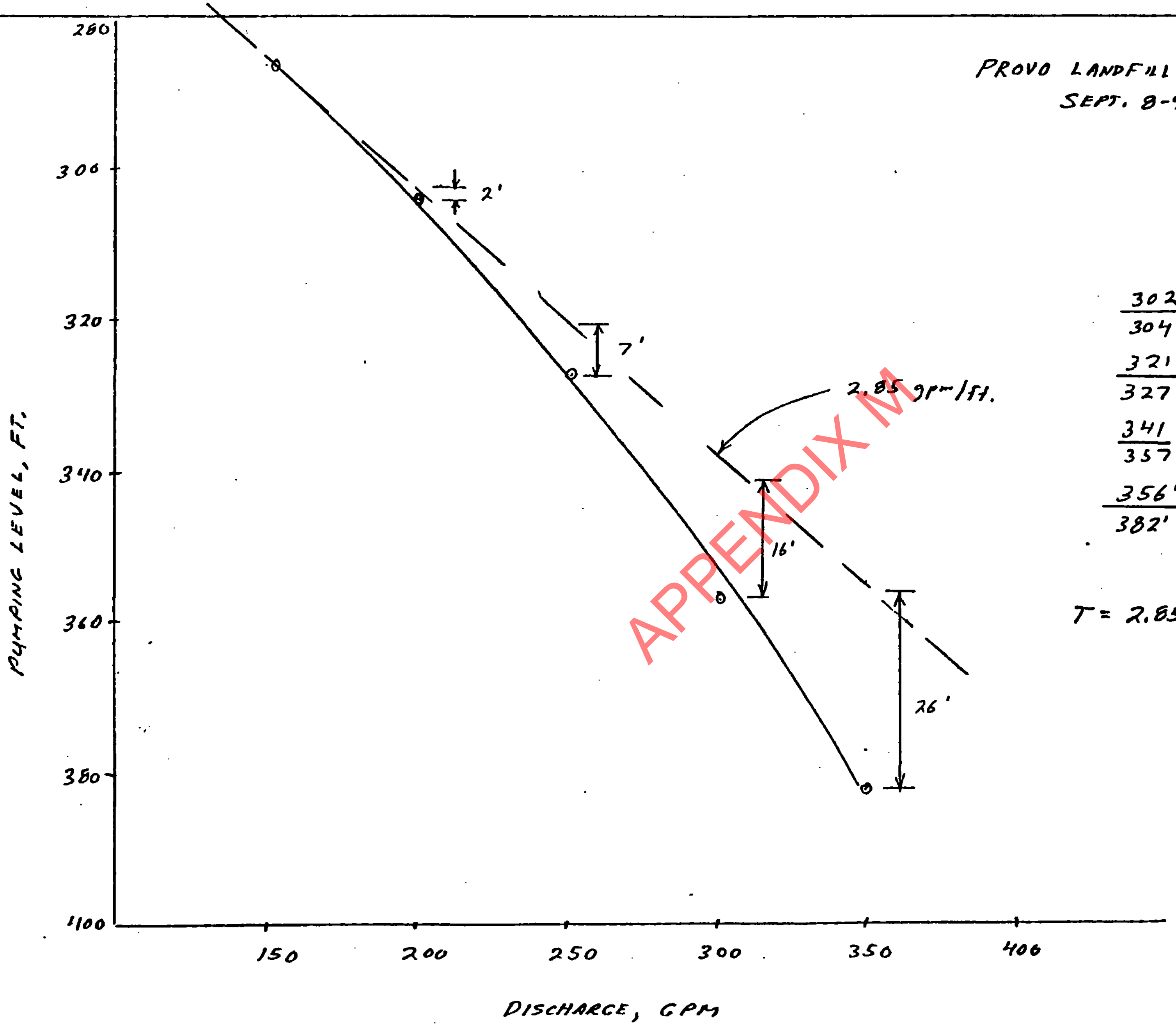
Job Name	[illegible]	Driller	[illegible] Drilling
Location	[illegible]	Column Size 6	Bowl Size 10
Date of Test	9-8 & 9-1984	No. Hours Pumped	29
Well Size	18" [illegible]	Feet of Drawdown from Static	
Well Depth	510'	Drawdown Measured with	Airline
Static	240'	Gallons Per Ft. of Drawdown	
Perforations	360 to 403' 405 to 500'	Pump Setting	400'

Remarks Water Clear at [illegible] of [illegible]



Land Fill Well | Pumping Test | CHC 9/10/86

PROVO LANDFILL SITE WELL
SEPT. 8-9, 1986



$\frac{302}{304}$ @ 200 gpm = 0.993

$\frac{321}{327}$ @ 250 gpm = 0.982

$\frac{341}{357}$ @ 300 gpm = 0.955

$\frac{356'}{382'}$ @ 350 gpm = 0.932

T = 2.85 × 2000 = 5,700 gpd/ft.

CHEMTECH

CHEMICAL AND BACTERIOLOGICAL ANALYSES

367 SOUTH COMMERCE LOOP
OREM, UTAH 84057
(801) 226-8822

2875 MAIN
SUITE #101
SALT LAKE CITY, UTAH 84115
(801) 483-1163

CERTIFICATE OF ANALYSIS

SAMPLE IDENTIFICATION

CLIENT: Provo City Water Dept.
Provo, UT 84601

LAB NO.: U014828

DATE SAMPLED: 9-9-86

TIME SAMPLED: 0940

SAMPLED BY: CHC

LOCATION: Land Fill Site, Well Discharge Pipe (dis = 350 gpm)

COMMENTS:

PARAMETER	LEVEL
Alkalinity as $CaCO_3$, mg/l	308
Ammonia as NH_3-N, mg/l	11.1
Arsenic as As, mg/l	<.01
Barium as Ba, mg/l	0.022
Bicarbonate as HCO_3, mg/l	375
Boron as B, mg/l	0.19
Cadmium as Cd, mg/l	<.01
Calcium as Ca, mg/l	72
Carbonate as CO_3, mg/l	0

PARAMETER	LEVEL
Chloride as Cl, mg/l	57.6
Chromium as Cr (Hex.), mg/l	<.01
Chromium as Cr (Total), mg/l	<.01
Conductivity, umhos/cm	676
Copper as Cu, mg/l	0.085
Fluoride as F, mg/l	0.72
Hardness as $CaCO_3$, mg/l	138
Hydroxide as OH, mg/l	0
Iron as Fe (Dissolved), mg/l	0.082
Iron as Fe (Total), mg/l	0.3[illegible]
Lead as Pb, mg/l	0.045
Magnesium as Mg, mg/l	13.3
Manganese as Mn, mg/l	<.01
Mercury as Hg, mg/l	0.0018
Nickel as Ni, mg/l	<.01
Nitrate as NO_3-N, mg/l	1.60
Nitrite as NO_2-N, mg/l	<.005
Phosphate as PO_4-P, mg/l	0.018
Potassium as K, mg/l	15.2
Selenium as Se, mg/l	<.002
Silica as SiO_2 (Dissolved), mg/l	70.2
Silver as Ag, mg/l	<.01
Sodium as Na, mg/l	82.4
Sulfate as SO_4, mg/l	60.3
Total Dissolved Solids, mg/l	614
Turbidity, NTU	0.[illegible]
Zinc as Zn, mg/l	0.082
pH Units	8.08

Positive $CaCO_3$ saturation index (Langlier)

Page 3 of 4

Form 113—534—1240

Examined
Recorded: B. C. .... T. B.
Inspection Sheet
Copied

REPORT OF WELL DRILLER

STATE OF UTAH

Test Well Request
Application No. 86-53-11-TW
Claim No.
Coordinate No.

GENERAL STATEMENT: Report of well driller is hereby made and filed with the State Engineer, in accordance with the laws of Utah. (This report shall be filed with the State Engineer within 30 days after the completion or abandonment of the well. Failure to file such reports constitutes a misdemeanor.)

(1) WELL OWNER:

Name Provo City Water and Waste Water
Address

(2) LOCATION OF WELL:

County .... Ground Water Basin .... (leave blank)

North/South .... feet, East/West .... feet from .... Corner

of Section ...., T. .... N/S, R. .... E/W SLBM/USM (strike out words not needed)

(3) NATURE OF WORK (check):

New Well ☐ Replacement Well ☐ Deepening ☐ Repair ☐ Abandon ☐

If abandonment, describe material and procedure:

(4) NATURE OF USE (check):

Domestic ☐ Industrial ☐ Municipal ☐ Stockwater ☐
Irrigation ☐ Mining ☐ Other ☐ Test Well ☐

(5) TYPE OF CONSTRUCTION (check):

Rotary ☐ Dug ☐ Jetted ☐
Cable ☐ Driven ☐ Bored ☐

(6) CASING SCHEDULE:

Threaded ☐ Welded ☐

........" Diam. from .... feet to .... feet Gage ....
........" Diam. from .... feet to .... feet Gage ....
........" Diam. from .... feet to .... feet Gage ....

New ☐ Reject ☐ Used ☐

(7) PERFORATIONS:

Perforated? Yes ☐ No ☐

Type of perforator used
Size of perforations .... inches by .... inches
.... perforations from .... feet to .... feet
.... perforations from .... feet to .... feet
.... perforations from .... feet to .... feet
.... perforations from .... feet to .... feet
.... perforations from .... feet to .... feet

(8) SCREENS:

Well screen installed? Yes ☐ No ☐

Manufacturer's Name
Type .... Model No.
Diam. .... Slot size .... Set from .... ft. to .... ft.
Diam. .... Slot size .... Set from .... ft. to .... ft.

(9) CONSTRUCTION:

Was well gravel packed? Yes ☐ No ☐ Size of gravel:
Gravel placed from .... feet to .... feet
Was a surface seal provided? Yes ☐ No ☐
To what depth? .... feet
Material used in seal:
Did any strata contain unusable water? Yes ☐ No ☐
Type of water: .... Depth of strata
Method of sealing strata off:

Was surface casing used? Yes ☐ No ☐
Was it cemented in place? Yes ☐ No ☐

(10) WATER LEVELS:

Static level .... feet below land surface Date
Artesian pressure .... feet above land surface Date

LOG RECEIVED:

(11) FLOWING WELL:

Controlled by (check) Valve ☐
Cap ☐ Plug ☐ No Control ☐
Does well leak around casing? Yes ☐ No ☐

(12) WELL TESTS:

Drawdown is the distance in feet the water level is lowered below static level.

Was a pump test made? Yes ☐ No ☐ If so, by whom?
Yield: .... gal./min. with .... feet drawdown after .... hours
" .... " .... " .... "
" .... " .... " .... "
Bailer test .... gal./min. with .... feet drawdown after .... hours
Artesian flow .... g.p.m. Date
Temperature of water .... Was a chemical analysis made? No ☐ Yes ☐

(13) WELL LOG:

Diameter of well .... inches
Depth drilled .... feet. Depth of completed well .... feet.

NOTE: Place an "X" in the space or combination of spaces needed to designate the material or combination of materials encountered in each depth interval. Under REMARKS make any desirable notes as to occurrence of water and the color, size, nature, etc., of material encountered in each depth interval. Use additional sheet if needed.

DEPTH		MATERIAL										REMARKS
From	To	Clay	Silt	Sand	Gravel	Cobbles	Boulders	Hardpan	Conglomerate	Bedrock	Other	
320	325	X			X							
325	330	X			X							
330	335	X			X							Water {More Gravel
335	340	X			X							" than Clay
340	345	X			X							"
345	350	X			X							" }
350	355	X			X							Water: Mostly Gravel
355	360	X			X							" " "
360	365	X			X							" " "
365	370	X			X							" " "
370	375	X			X							" " "
375	380	X			X							" " "
380	385	X			X							" " "
385	390	X			X							" " "
390	395	X			X							
395	400	X			X							
400	405	X			X							
405	410	X			X							
410	415	X			X							
415	420	X			X							
420	425	X			X							
425	430	X			X							
430	435	X			X							
435	440	X			X							
440	445	X			X							
445	450	X			X							
450	455	X			X							
455	460	X			X							
460	465	X			X							
465	470	X			X							
470	475	X			X		X					Beg Rock + Clay
475	480	X			X		X					" " "

Work started .... 19.... Completed .... 19....

(14) PUMP:

Manufacturer's Name
Type: .... H. P.
Depth to pump or bowls .... feet

Well Driller's Statement:

This well was drilled under my supervision, and this report is true to the best of my knowledge and belief.

Name Binning Drlg. Co.
(Person, firm, or corporation) (Type or print)
Address
(Signed)
(Well Driller)
License No. 243 Date .... 19....

USE OTHER SIDE FOR ADDITIONAL REMARKS

Page 4 of 4

Form 113-224-1240

Examined
Recorded: B. C. T. B.
Inspection Sheet
Copied

REPORT OF WELL DRILLER
STATE OF UTAH

Test Well Request
Application No.
Claim No. 86-53-1-TW
Coordinate No.

GENERAL STATEMENT: Report of well driller is hereby made and filed with the State Engineer, in accordance with the laws of Utah. (This report shall be filed with the State Engineer within 30 days after the completion or abandonment of the well. Failure to file such reports constitutes a misdemeanor.)

(1) WELL OWNER:
Name Provo City Water and Waste Water
Address

(2) LOCATION OF WELL:
County Ground Water Basin (leave blank)
North/South feet, East/West feet from Corner
of Section T. N/S, R. E/W SLBM/USM (strike out words not needed)

(3) NATURE OF WORK (check):
New Well ☐
Replacement Well ☐ Deepening ☐ Repair ☐ Abandon ☐
If abandonment, describe material and procedure:

(4) NATURE OF USE (check):
Domestic ☐ Industrial ☐ Municipal ☐ Stockwater ☐
Irrigation ☐ Mining ☐ Other ☐ Test Well ☐

(5) TYPE OF CONSTRUCTION (check):
Rotary ☐ Dug ☐ Jetted ☐
Cable ☐ Driven ☐ Bored ☐

(6) CASING SCHEDULE: Threaded ☐ Welded ☐
" Diam. from feet to feet Gage
" Diam. from feet to feet Gage
" Diam. from feet to feet Gage
New ☐ Reject ☐ Used ☐

(7) PERFORATIONS: Perforated? Yes ☐ No ☐
Type of perforator used
Size of perforations inches by inches
perforations from feet to feet
perforations from feet to feet
perforations from feet to feet
perforations from feet to feet
perforations from feet to feet

(8) SCREENS: Well screen installed? Yes ☐ No ☐
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to
Diam. Slot size Set from ft. to

(9) CONSTRUCTION:
Was well gravel packed? Yes ☐ No ☐ Size of gravel:
Gravel placed from feet to feet
Was a surface seal provided? Yes ☐ No ☐
To what depth? feet
Material used in seal:
Did any strata contain unusable water? Yes ☐ No ☐
Type of water: Depth of strata
Method of sealing strata off:

Was surface casing used? Yes ☐ No ☐
Was it cemented in place? Yes ☐ No ☐

(10) WATER LEVELS:
Static level feet below land surface Date
Artesian pressure feet above land surface Date

LOG RECEIVED:

(11) FLOWING WELL:
Controlled by (check) Valve ☐
Cap ☐ Plug ☐ No Control ☐
Does well leak around casing? Yes ☐
No ☐

(12) WELL TESTS:
Drawdown is the distance in feet the water level is lowered below static level.
Was a pump test made? Yes ☐ No ☐ If so, by whom?
Yield: gal./min. with feet drawdown after hours
" " " "
" " " "
Bailer test gal./min. with feet drawdown after hours
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? No ☐ Yes ☐

(13) WELL LOG:
Diameter of well inches
Depth drilled feet. Depth of completed well feet.

NOTE: Place an "X" in the space or combination of spaces needed to designate the material or combination of materials encountered in each depth interval. Under REMARKS make any desirable notes as to occurrence of water and the color, size, nature, etc., of material encountered in each depth interval. Use additional sheet if needed.

DEPTH		MATERIAL										REMARKS
From	To	Clay	Silt	Sand	Gravel	Cobbles	Boulders	Hardpan	Conglomerate	Bedrock	Other	
480	485	X			X		X					Big Rocks + Clay
485	490	X			X							
490	495	X			X							
495	500	X				X						
500	505	X			X							mostly Gravel
505	510	X			X							" "

Work started 19 Completed 19

(14) PUMP:
Manufacturer's Name
Type: H. P.
Depth to pump or bowls feet

Well Driller's Statement:

This well was drilled under my supervision, and this report is true to the best of my knowledge and belief.

Name BINNING DRLG. Co. (Person, firm, or corporation) (Type or print)
Address
(Signed) (Well Driller)
License No. 243 Date 19

USE OTHER SIDE FOR ADDITIONAL REMARKS

APPENDIX N – UTAH HYDROLOGIC DATA REPORT NO. 50

APPENDIX G

Utah Hydrologic Data Report No. 50

SUVSWD Bayview Class I Landfill
Permit Application

U.S. DEPARTMENT OF THE INTERIOR

BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information write to:

District Chief
U.S. Geological Survey, WRD
Room 1016 Administration Building
1745 West 1700 South
Salt Lake City, Utah 84104

Copies of this report can be purchased from:

U.S. Geological Survey
Books and Open-File Reports Section
Federal Center
Box 25425
Denver, Colorado 80225

CONTENTS

ILLUSTRATIONS

(Plate is in pocket)

TABLES

CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATED WATER-QUALITY UNITS

Multiply	By	To obtain
acre	0.4047	hectare
	4,047	square meter
foot	0.3048	meter
cubic foot per second	0.02832	cubic meter per second
gallon per minute	0.06308	liter per second
inch	25.4	millimeter
	0.0254	meter
mile	1.609	kilometer
square mile	2.59	square kilometer

Water temperature is given in degrees Celsius (°C), which can be converted to degrees Fahrenheit (°F) by the following equation:

$$^{\circ}F = 1.8\,(^{\circ}C) + 32.$$

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929—a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

Specific conductance and water temperature are given in metric units. Specific conductance is given in microsiemens per centimeter (µS/cm) at 25 degrees Celsius. Chemical concentration is given in milligrams per liter (mg/L) or micrograms per liter (µg/L). Milligrams per liter is a unit expressing the solute per unit volume (liter) of water. For concentrations less than 7000 milligrams per liter, the numerical value is about the same as concentration in parts per million. One thousand micrograms per liter is equivalent to 1 milligram per liter.

SELECTED HYDROLOGIC DATA FOR SOUTHERN UTAH AND GOSHEN VALLEYS, UTAH, 1890–1992

By Bernard J. Stolp, Marilyn Drumiler, and Lynette E. Brooks

INTRODUCTION

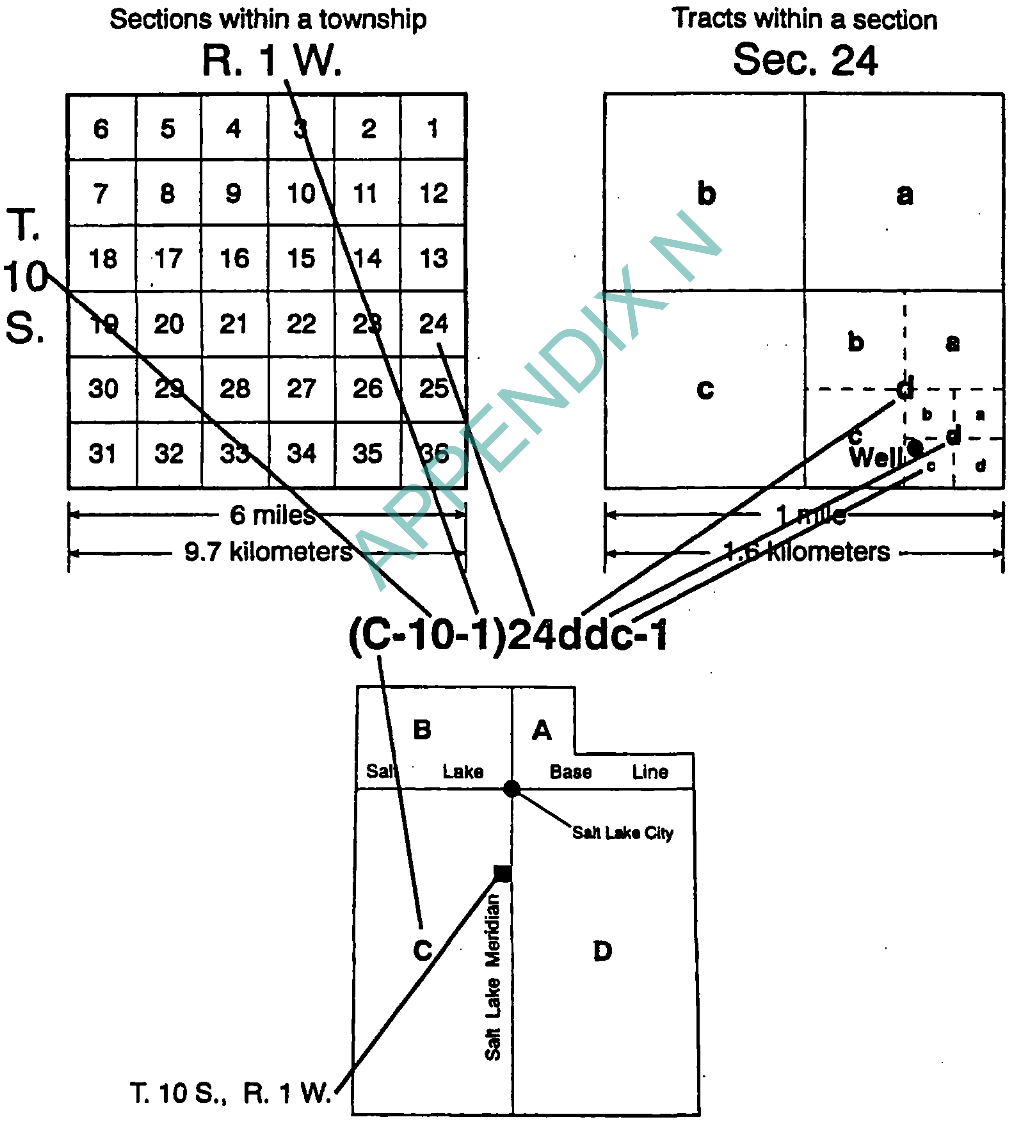
This report contains hydrologic data collected in southern Utah and Goshen Valleys from 1890 to 1992. Southern Utah and Goshen Valleys are south of Salt Lake City in Utah County, north-central Utah. The area is bounded on the east and south by the Wasatch Range, on the south by Long Ridge, on the west by the East Tintic Mountains and the Mosida Hills, and on the north by a line through about the middle of T. 7 S. Southern Utah Valley and Goshen Valley are divided by the northern tip of Long Ridge, West Mountain, and Utah Lake (Cordova, 1970). The area is in the Basin and Range physiographic province described by Fenneman (1931), and includes about 390 square miles.

Most of the data in this report were collected by the U.S. Geological Survey in cooperation with the Utah Department of Natural Resources, Division of Water Rights. Some of the earlier data were published previously by Cordova (1969 and 1970).

The purpose of this report is to provide hydrologic data for use by the general public and by officials managing the area's water resources, and to document data collected during a 4-year study of the ground-water resources in southern Utah and Goshen Valleys. Tables 1 to 8 contain selected ground- and surface-water data. Select data, including well depth and water level, is given for over 400 wells, and chemical analyses are given of samples from about 90 wells. The numbering system used in Utah for hydrologic-data sites is illustrated in figure 1. Hydrologic-data sites are shown on plate 1.

These data could not have been collected without the cooperation of local residents and officials of irrigation companies and municipalities, who permitted access to their wells and property.

The system of numbering wells and springs in Utah is based on the cadastral land-survey system of the U.S. Government. The number, in addition to designating the well or spring, describes its position in the land net. The land-survey system divides the State into four quadrants separated by the Salt Lake Base Line and the Salt Lake Meridian. These quadrants are designated by the uppercase letters A, B, C, and D, indicating the northeastern, northwestern, southwestern, and southeastern quadrants, respectively. Numbers designating the township and range, in that order, follow the quadrant letter, and all three are enclosed in parentheses. The number after the parentheses indicates the section, and is followed by three letters indicating the quarter section, the quarter-quarter section, and the quarter-quarter-quarter section—generally 10 acres[1]. The lowercase letters, a, b, c, and d indicate, respectively, the northeastern, northwestern, southwestern, and southeastern quarters of each subdivision. The number after the letters is the serial number of the well or spring within the 10-acre tract. When the serial number is not preceded by a letter, the number designates a well. When the serial number is preceded by an "S," the number designates a spring. Thus, (C-10-1)24ddc-1 designates the first well constructed or visited in the southwest 1/4, southeast 1/4, southeast 1/4, section 24, T. 10 S., R. 1 W. A location number with no serial number designates a surface-water data-collection site.



---

[1] Although the basic land unit, the section, is theoretically 1 square mile, many sections are irregular. Such sections are subdivided into 10-acre tracts, generally beginning at the southeastern corner, and the shortage is taken up along the northern and western sides of the section.

Figure 1. Numbering system used in Utah for hydrologic-data sites.

REFERENCES CITED

Cordova, R.M., 1969, Selected hydrologic data, southern Utah and Goshen Valleys, Utah: U.S. Geological Survey open-file report (duplicated as Utah Basic Data Release No. 16), 35 p.

—1970, Ground-water conditions in southern Utah Valley and Goshen Valley, Utah: Utah Department of Natural Resources Technical Publication No. 28, 79 p.

Fenneman, N.M., 1931, Physiography of the western United States: New York, McGraw-Hill, 534 p.

Table 1.—*Records of*

[—, no

Well number: See figure 1 for explanation of the numbering system for hydrologic-data sites.
Owner: Last known or reported owner.
Use of water: C, commercial; H, domestic or household; I, irrigation; K, mining; N, industrial; O,
Casing: Diameter: Diameter of the production string of casing; Reported from the driller's log or measured
reported, only top of perforated interval is known; R, wire wound; S, screened; X, open hole.
Elevation of land surface is given in feet above sea level. Elevations are reported to the nearest 0.01 foot
Water level is given in feet and decimal fractions. Measured except where noted R, reported.
Other data available: L, driller's log (table 2); W, water-level measurements (table 3); D, discharge

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(C-7-1)26cdd-1	Smith, Doyle	1979	S	116
(C-8-1)20cdb-2	Bateman	1967	S	345
(C-8-1)20cdb-3	Harold Howlett & Sons	1972	I	400
(C-8-1)20cdb-4	Unknown	—	I	225
(C-8-1)29dda-1	Bateman	1973	I	625
(C-8-1)34bcc-1	LDS Church	1970	H	412
(C-8-1)35dcb-1	Dixson, S.	1945	S	212
(C-8-2)25dac-1	Steadman, Bill	1972	S	600
(C-9-1)3ddb-1	LDS Church	1964	I	575
(C-9-1)4ccc-1	LDS Church	1970	I	756
(C-9-1)4ddc-1	LDS Church (No. 9)	—	I	690
(C-9-1)5ddc-1	Steadman, Bill	1970	I	776
(C-9-1)17abb-1	South Utah Valley Solid Waste District	1989	O	70
(C-9-1)17abb-2	South Utah Valley Solid Waste District	1989	O	210
(C-9-1)17ada-1	South Utah Valley Solid Waste District	1989	O	166
(C-9-1)17bba-1	South Utah Valley Solid Waste District	1989	O	269
(C-9-1)17bbc-1	South Utah Valley Solid Waste District	1989	O	301
(C-9-1)17bbd-1	South Utah Valley Solid Waste District	1989	O	70
(C-9-1)17bbd-2	South Utah Valley Solid Waste District	1989	O	300
(C-9-1)17cdd-1	South Utah Valley Solid Waste District	1989	O	195
(C-9-1)18add-1	South Utah Valley Solid Waste District	1986	P	502
[1] (C-9-1)20cdd-1	LDS Church	1964	I	532
(C-9-1)20ddd-1	LDS Church (No.7)	1963	I	788
(C-9-1)26bda-3	Burraston, B.	1915	S	56

selected wells

data available]

observation; P, public supply; Q, aquaculture; S, stock; U, unused; Z, other.
in the field. Finish: O, open end; P, perforated, where single depth is
Upper or lower limits of perforations or screen are given in feet below land surface.
when the well has been surveyed.

(table 4); C, chemical analysis (table 5).

Casing			Elevation of land surface (feet)	Water level			Other data available
Diameter (inches)	Finish (feet)			Above (-) or below land surface		Date	
8	O		4,495	22	R	03-05-79	
16	X	227-345	4,620	120.2	R	04-04-67	C
—	O		4,620	128	R	10-10-72	C
—	—		4,620	—		—	C
12	P	100-235	4,595	89.34		03-02-87	C
	P	307-595					
6	P	402	4,535	43.94		03-04-91	
4	O		4,489	-3.0	R	06-15-64	C
8	P	300-390	4,770	276	R	05-24-72	
18	P	190-205	4,510.36	17.08		03-04-91	L,W,C
	P	225-338					
	P	365-565					
16	P	240-405	4,620	128.76		03-14-91	W,C
	P	565-750					
18	P	200-683	4,570	81.01		03-04-91	L,W,C
16	P	280-390	4,640	163	R	03-30-70	C
	P	545-740					
4.5	S	49-70	4,670	69.18		03-07-91	
4.5	S	189-210	4,665	175.19		03-07-91	
4.5	S	145-166	4,635	136		03-07-91	
4.5	S	228-269	4,730	232.72		03-07-91	
4.5	S	260-301	4,745	241.19		03-07-91	
4.5	R	49-70	4,740	69.35		03-07-91	
4.5	R	280-300	4,740	243		03-07-91	
4.5	R	175-195	4,670	171.7		03-07-91	L
12	P	350-445	4,775	264	R	09-09-86	
	P	450-500					
20	P	275-521	4,701.40	200.34		03-04-91	L,W,C
18	P	300-490	4,640	137.98		03-05-91	L,W,C
	P	490-775					
1.5	O		4,496	-7.0		05-09-90	W,C

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(C-9-1)26dcd-1	Woodard, J.E.	1956	S	37
(C-9-1)28ccb-1	LDS Church	1962	I	802
(C-9-1)29acc-1	LDS Church	1963	I	700
(C-9-1)29bcc-1	LDS Church	1963	H	800
(C-9-1)29cdc-1	Town of Elberta	1977	P	400
(C-9-1)29cdc-2	Town of Elberta	1989	P	387
(C-9-1)34ccc-1	LDS Church	1951	I	650
[2] (C-9-1)34acd-1	Miller, H.	1961	S	265
(C-9-1)34ddc-1	Miller, A.	1964	H	256
(C-10-1)2bcd-1	Green, Duane	1981	S	100
(C-10-1)3ddb-1	White, G.T.	—	H	495
(C-10-1)4bbb-1	LDS Church (No. 2)	1962	I	882
(C-10-1)4cbb-1	LDS Church	1962	I	870
(C-10-1)9ccc-1	Wright, Bill	1961	I	474
(C-10-1)10ddc-3	Green, Duane	1979	H	162
(C-10-1)11ccd-1	Burraston, Carma	1980	—	160
[3] (C-10-1)15cca-1	Morgan, H.	1951	U	168
(C-10-1)17aaa-1	Town Of Elberta	1955	U	376
(C-10-1)17bba-1	Sunshine Mining Company	—	U	860
(C-10-1)17bba-2	Sunshine Mining Company	1986	U	320
(C-10-1)18ccc-1	Levering, Dean and Betty	—	U	450
(C-10-1)24ddc-1	Lunceford, Scott	1965	U	533
[4] (C-10-1)25abd-1	Lunceford, Scott	1951	I	645

selected wells—Continued

Casing: Diameter (inches)	Casing: Finish (feet)	Elevation of land surface (feet)	Water level: Above (-) or below land surface	Water level: Date	Other data available
2	O	4,505	-1.33	03-07-91	
20	—	4,643	127.65	03-04-91	L,W,C
18	P 280-380	4,719	214.28	03-04-91	L,W,C
	P 380-405				
	P 426-700				
18	P 300-350	4,792	300.10	04-02-90	L,W,C
	P 350-675				
	P 700-775				
8	P 315-385	4,760	288	05-23-88	
10	P 270-340	4,760	256.55	06-29-89	
8	P 70-580	4,551	17.85	12-13-74	C
	P 587-650				
1.25	O	4,508	-6.90	03-07-91	C
2	O	4,517	-5.50	03-07-91	L,C
6	O	4,515	9.18	03-07-91	
6	—	4,555	18.86	04-24-67	C
18	P 525-880	4,672	147.04	03-05-91	L,W,C
12	S 406-550	4,664	135.86	03-04-91	L,W,C
	S 640-680				
	S 700-740				
	S 750-850				
16	P 255-346	4,681	131.68	03-08-77	C
	P 360-420				
	P 427-474				
6	O	4,555	6 R	03-07-91	C
6	P 150-157	4,550	4.37	03-05-91	
12.5	—	4,600	28.29	03-07-91	W,C
6	O	4,711	170.37	12-30-71	C
4	S 750-860	4,810	266.71	03-04-91	W
6	P 300-320	4,810.4	266.56	03-04-91	W
8	O	4,918	353.46	03-05-91	W
20	P 366-391	4,750	212.54	03-05-91	W
	P 422-428				
	P 462-482				
12	P 372-450	4,778	245.15	03-05-91	W,C
	P 461-492				
	P 507-550				
	P 568-575				
	P 585-600				

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(C-10-1)28ada-2	LDS Church	1979	H	775
(C-10-1)29cdd-1	LDS Church	1961	I	842
(C-10-1)29dcd-1	LDS Church	1954	H	460
(C-10-1)29ddd-1	LDS Church	1962	I	700
(C-10-1)30baa-1	Unknown	—	S	—
(C-10-1)31cdd-1	LDS Church	1963	I	603
(C-10-1)32ccc-1	LDS Church	1961	I	507
(C-10-1)33cbb-1	LDS Church	1961	U	567
(C-10-1)34bbb-1	Critchfield, Ross	1949	H	342
(C-10-2)13bcc-1	Bronson, Jonathan	—	—	300
(C-11-1)6abc-1	LDS Church	1963	I	679
(C-11-1)6bdd-1	LDS Church	1964	I	762
(C-11-1)6cab-1	LDS Church	1981	I	825
(D-7-2)32dad-1	Batty, Roy	1978	H	550
[5] (D-7-2)33dcc-1	Banks, A.	—	S	400
(D-7-2)34dcd-1	Christofferson, B.	1959	S	194
(D-7-2)35ccd-1	Hales, G.	1900	I	300

selected wells—**Continued**

Casing		Elevation of land surface (feet)	Water level		Other data available
Diameter (inches)	Finish (feet)		Above (-) or below land surface	Date	
8	P 746-760	4,670	135 R	04-06-79	
16	P 185-189	4,680	151.3	03-29-66	C
	P 205-275				
	P 280-574				
	P 595-685				
	P 696-762				
	P 770-815				
6	O	4,670	129.06	03-07-91	
16	P 162-195	4,660	100.50	03-04-80	C
	P 228-246				
	P 408-411				
	P 420-428				
	P 532-695				
—	—	4,778	228.67	06-05-90	W
20	P 290-603	4,760	210.69	03-14-91	L,C
16	P 210-220	4,743	204.1	03-29-66	C
	P 263-324				
	P 352-356				
	P 367-398				
	P 420-505				
16	P 155-567	4,680	115.54	03-07-91	
—	O	4,660	89.39	03-07-91	W
6	P 180-220	5,140	172.24	03-05-91	W
18	P 315-322	4,770	229.99	12-11-75	L,C
	P 330-335				
	P 390-488				
	P 495-532				
	P 545-675				
18	P 425-500	4,780.9	234.39	04-06-90	L,W,C
	P 533-541				
	P 556-577				
	P 584-659				
	P 672-745				
20	P 474-807	4,795	262 R	09-18-81	
8	P 350-353	4,493	-22.7	03-04-91	L,W,D
	P 450-453				
2.5	P 370-400	4,495	—	—	D
2	O	4,505	-6.60	03-05-91	W,C
2	O	4,507.1	-7.4	03-23-61	D

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(D-7-2)35ccd-2	Hales, A.	1961	H	420
(D-7-2)36bbb-1	Money, W.	1943	S	147
(D-7-2)36ccb-1	Money, W.	1961	I	504
(D-7-2)36dad-1	Huntingdon, B.	—	S	100
(D-7-2)36dcc-2	Crandall, Condie	—	U	186
(D-7-3)18dcc-1	LDS Church	1962	H	322
(D-7-3)19aac-1	John Kuhni and Sons Animal By-Product Plant	1938	N	268
(D-7-3)20adb-1	Brigham Young University	1970	U	353
(D-7-3)20bcd-1	Pacific States Cast Iron Pipe	1926	N	308
(D-7-3)20bcd-3	Pacific States Cast Iron Pipe	1927	N	635
(D-7-3)28bdb-1	Utah Division of Wildlife Resources	1963	U	338
(D-7-3)28cab-1	Park Ro-She Corp. (H.J. Robbins, Pres.)	1961	U	285
(D-7-3)28dbb-1	Utah Division of Wildlife Resources	1988	U	37
(D-7-3)29bdb-1	Fibertek	1986	N	148
6 (D-7-3)29dcc-1	Sumsion, Howard C.	1953	I	136
(D-7-3)29ddd-1	Springville City	1986	U	413
(D-7-3)30aaa-1	Perry, Robert	1977	I	277
(D-7-3)30aac-3	Condie, A.	1953	S	125
(D-7-3)31cac-2	Childs, Neil	1964	S	135
(D-7-3)32bcc-1	Wood Springs Irrigation Company	1934	I	414
(D-7-3)32bcc-2	Metcalf, Harold	1972	H	164
(D-7-3)32bcd-1	Jensen, Clarence L.	1977	S	151
(D-7-3)33baa-6	Champerlain	1900	H	138
(D-7-3)33ccc-5	Vane, J.E.	—	U	140
(D-7-3)33ccc-6	Matson Springs Irrigation Company	1966	I	533
(D-7-3)34bcb-1	Springville City	1961	P	485
(D-7-3)34cdb-1	Springville City	1960	P	445
(D-8-1)2ccd-1	Hirst, Harold	—	H	55
(D-8-1)3dda-1	Unknown	1967	U	72
(D-8-1)10bcb-1	South Shore Fruit Farms	—	U	240
(D-8-1)10bcb-2	South Shore Fruit Farms	—	U	135
(D-8-1)11bac-1	Utah County	1981	P	300
(D-8-1)13aaa-1	Schaffer, S. B.	1906	H	358
(D-8-1)13bdd-1	Atwood, G.	1950	S	119
(D-8-1)13daa-3	Mecham, Darrell F.	1949	I	345
(D-8-1)14dad-1	C. B. Turkey, Inc.	1966	I	350
(D-8-1)20abb-1	Hi-Country Fruit Farms (Phil Belnap)	—	H	205

selected wells—Continued

Casing		Elevation of land surface (feet)	Water level		Other data available
Diameter (inches)	Finish (feet)		Above (-) or below land surface	Date	
4	O	4,507	-17	05-12-64	D
3	O	4,490	—	—	D
3	P 496-504	4,500	-35 R	10-01-61	D
—	—	4,500	-5.9	03-04-91	
2	O	4,503.1	-11.40	03-04-91	W,D
4	P 115-121	4,495	-18.9	03-05-91	L,W
3	O	4,493	-26.1	04-28-47	
16	P 115-350	4,520	-1 R	03-11-70	
4	O	4,495	-25.0	10-15-64	
4	O	4,494	-42.5	10-15-64	
16	P 270-330	4,520	-22.4	09-11-87	C
2	P 280-285	4,527	-14.8	03-04-91	L,W
2	O	4,550	8.43	04-18-89	
8	O	4,502	—	—	
2	O	4,515	-25 R	03-11-53	D
16	S 349-413	4,525	-28 R	01-15-87	
6	O	4,495	-40.9	03-09-82	C
2	O	4,496	-15.4	03-04-91	
4	P 130-135	4,503	-14.3	09-13-89	W,D
—	—	4,511	-5.4	03-04-91	
6	P 152-159	4,511	-14.5	03-26-81	L
6	O	4,518	-13.2	03-04-91	W
2	O	4,560	-4.7	03-04-91	W,D,C
2	O	4,567	-5.2	03-04-91	W,D
16	P 230-533	4,565	-14.3	03-08-91	W
16	P 410-475	4,580	2.0	04-22-64	
16	P 158-230	4,650	45.9	07-01-65	L,C
	P 284-395				
	P 402-442				
8	O	4,495	6.87	03-05-91	W
—	—	4,520	32.32	02-15-91	C
6	O	4,520	17.01	03-05-91	W,C
—	—	4,520	43.34	03-05-91	W
8	P 200-251	4,495	-7.7	03-04-91	C
4	O	4,499	-11.3	03-04-91	W,D
2	O	4,496	-1.5	03-05-91	W
8	P 285-328	4,499	-13.9	06-25-65	D
6	O	4,492	—	—	D
6	O	4,505	15.68	03-05-91	W

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(D-8-1)23bdd-1	Binning, Lester and Agnes	—	S	120
(D-8-1)25aad-1	Hansen, J.	1953	S	104
(D-8-1)25aba-1	Ludlow, W.	1944	I	173
(D-8-1)25cbb-1	Kelsey, C.	1964	S	300
(D-8-1)26bdd-1	Vannosdol, George	1977	S	126
(D-8-1)35cac-1	Hanson, Charles K.	1975	H	440
(D-8-1)35cac-2	Hanson, Charles K.	1962	I	351
(D-8-1)36bcc-1	Ercanbrack, L.	1963	S	231
(D-8-2)1baa-1	Finch, J.	1963	S	182
7 (D-8-2)2aac-1	Banks, L.	1961	I	336
(D-8-2)2caa-1	Thomas, G.	1951	S	338
(D-8-2)2cda-1	Roach, T.	1900	H	140
(D-8-2)2daa-1	Williams, R.D.	1948	S	346
(D-8-2)3aad-1	Monk, B.	1963	I	417
(D-8-2)3ccd-1	Banks, L.	1961	S	420
(D-8-2)4abb-1	Banks, L.M.	1900	S	150
(D-8-2)4abb-2	Sorensen, James Jr.	1895	H	—
(D-8-2)4abc-1	Sorenson, W.	1950	S	230
8 (D-8-2)4bab-1	Banks, L.	1963	H	324
(D-8-2)4cba-2	Sharp, Jeff	1909	I	330
9 (D-8-2)4cbb-1	Lakeside Irrigation Company	1934	I	500
(D-8-2)4cdc-1	Olsen, Chet	1908	H	80
(D-8-2)4cdc-4	Olsen, Chet	1945	H	143
(D-8-2)4dad-1	Sorensen, W.	1963	I	607
(D-8-2)7cab-1	Brooks, H. L.	1947	I	263
(D-8-2)7cbd-1	Nelson, Justin R.	1962	H	355
(D-8-2)7dda-1	Hall, M.	1956	S	276
(D-8-2)7ddd-1	Hall, M.	1913	H	520
(D-8-2)9aad-1	Banks, A.	1964	H	385
(D-8-2)10adb-1	Ottesen, H.	1966	H	588
(D-8-2)10bdd-1	Sorenson, F.	1955	H	411
(D-8-2)12ddc-1	Diamond, Harold	—	S	172
(D-8-2)12ddc-2	Diamond, Harold	1961	S	372
(D-8-2)13abc-1	Johns, K.	1961	I	378
(D-8-2)13bdd-1	Pace, R.	1962	H	378
(D-8-2)14cad-1	Elson, G.	1953	S	376
(D-8-2)14dcc-1	Johns, W.	1939	H	377
(D-8-2)16caa-1	Lewis, R.C.	1895	H	570

selected wells—Continued

Casing		Elevation of land surface (feet)	Water level		Other data available
Diameter (inches)	Finish (feet)		Above (-) or below land surface	Date	
2	O	4,500	-8.0	03-05-91	W,D
2	O	4,497	-9.9	03-05-91	D
2	X 163-173	4,498	-6.5	03-05-91	W
1.5	X 205-300	4,504	-11.8	03-04-91	W
6	O	4,620	77.86	03-06-91	
6	O	4,575	52.96	03-05-91	
8	P 100-345	4,578	60.7	06-29-65	C
4	—	4,518	-10.9	03-07-91	W
6	P 167-182	4,505	-10.3	08-08-89	W,D
2	O	4,511	-22.8 R	08-06-64	D
2	O	4,518	-11.6	09-21-89	W,D
2	O	4,524.4	-4.7	03-04-91	W,D
2.5	O	4,514.9	-25.7	04-02-90	W,D,C
2.5	P 412-417	4,512	-15.8	09-15-89	W,D
2.5	O	4,512	-8 R	11-01-61	D
1.25	O	4,494.1	-14.1	03-05-91	W,D
—	O	4,498.2	-6.0	09-12-89	D
2	O	4,496	-11.3	09-12-89	W,D
3	P 316-324	4,495	-4.4	09-12-89	W,D
2	O	4,501	-17.6	03-01-91	W,D,C
8	O	4,499	-6.1	09-15-89	W,D
2	O	4,500	-12.2	03-04-91	
2	O	4,500	-13.0	03-04-91	W
3	P 593-607	4,502	-13.4	09-28-89	W,D
2	O	4,493	-7.5	08-20-64	D
4	O	4,492	—	—	D
3	O	4,498	-4.9	03-04-91	W
1.25	O	4,498	-9.3	03-01-91	W
3	O	4,511	-8.7	03-05-91	D
3	O	4,520	-19.7	03-01-91	W,D
2.5	O	4,518	-4.0	09-28-89	D
2	O	4,540	-2.6	08-13-76	D,C
3	P 364-372	4,541	-48.6	09-10-84	D,C
3	P 368-378	4,548	-18.4	09-28-89	W,D,C
3	P 368-378	4,555	-28 R	04-02-64	D
2.5	O	4,547	-3.5	03-05-91	W
2	O	4,553	-14.2	07-09-65	D
3	O	4,525	-27.2	09-05-90	W,D,C

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(D-8-2)16dbb-2	Huff, J.	1962	H	168
(D-8-2)17ada-1	Hansen, B.	1964	H	466
(D-8-2)17add-5	Huff, E.	1962	H	105
(D-8-2)17add-6	Huff	1950	H	80
(D-8-2)17ccc-2	Clayson, Mrs. Allen	1959	H	363
(D-8-2)17dab-2	Beckstrom, J. L.	1959	H	100
(D-8-2)17dad-1	Evans, James S.	1975	H	110
(D-8-2)17ddd-1	Simmons, Steve	1944	H	94
(D-8-2)19add-1	Beckstrom, A.	1916	H	480
(D-8-2)20cad-2	Hawkins, C.	1900	H	420
(D-8-2)21aaa-1	Anderson, Mrs. John	—	H	498
(D-8-2)21bbb-2	Lee, Eddie	1956	H	110
(D-8-2)21ddd-1	Anderson, Bernell	1936	H	347
(D-8-2)22cdc-1	Salt Lake By-Products	1935	N	620
(D-8-2)22cdc-2	Salt Lake By-Products	1957	N	385
(D-8-2)23dbd-1	Ferto Corporation	1920	N	390
(D-8-2)23dbd-2	Ferto Corporation	1916	N	390
(D-8-2)23dbd-3	Ferto Corporation	—	H	—
(D-8-2)23dca-2	Ferto Corporation	1940	I	569
(D-8-2)24bdc-2	Thomas, R.	1963	H	352
(D-8-2)25bca-1	Valley Asphalt, Inc.	1978	N	246
(D-8-2)25dac-3	Spanish Fork City	1961	U	620
(D-8-2)26aad-3	Creer, R.	1961	H	223
(D-8-2)26aad-4	Leland Milling Company	1987	N	360
(D-8-2)26abb-3	Ludlow, A.	1946	H	371
(D-8-2)26adc-1	Unknown	1971	S	—
(D-8-2)27acd-1	Thomas, I.	1948	S	180
(D-8-2)28cbd-3	Hone, Melva	1944	H	92
(D-8-2)28cca-2	Thorton, S.	1951	S	200
(D-8-2)28daa-1	Larson, D.	1939	H	120
(D-8-2)29aaa-7	Hickman, Rex L.	1957	H	390
(D-8-2)29aab-5	Steele, Alice	1956	H	176
(D-8-2)29add-1	Reynolds, Reed	1935	H	222
(D-8-2)29bcb-1	Argyle, Bert	1966	H	165
(D-8-2)29bcd-2	Zieman, Jacob	1952	H	166
(D-8-2)29cab-1	Hansen, Arthur	1947	H	168

selected wells—Continued

Casing			Elevation of land surface (feet)	Water level			Other data available
Diameter (inches)	Finish (feet)			Above (-) or below land surface		Date	
2	—		4,522	-4.2		03-04-91	W
2	X	452-466	4,514	-5.4		03-01-91	W,L
2	P	84-105	4,517	7.74		03-17-70	D
2	O		4,515	8	R	06-07-50	D
2	O		4,509	-8.5		08-17-89	W,D
2	O		4,514	9.11		09-03-64	D
4	O		4,518	9.16		03-04-91	
2	X	83-94	4,522	8	R	07-13-44	D
2	—		4,514	-12.6		03-01-91	W
2	—		4,522	-2.7		03-01-91	W
3	O		4,536	-6.85		08-28-89	W
2	O		4,522	10	R	06-26-56	D
2	O		4,541	-12.5		10-02-89	W,D
2	O		4,545	-15.4		03-04-91	W,D
4	—		4,545	-10.9		03-04-91	W,D
3	P	380-390	4,565.1	-19.6		12-17-47	
4	P	380-390	4,561	-15.6		06-23-65	
2	—		4,560	-1.1		09-15-64	D
8	P	475-500	4,562	-18.2		10-05-73	C
3	P	327-352	4,570	-1.5		08-17-89	W,D
8	O		4,610	27	R	12-30-78	
16	P	505-508	4,622	38.42		03-05-91	W
	P	512-545					
	P	547-564					
	P	600-605					
4	O		4,595	35.45		03-06-91	W
6	O		4,595	8	R	09-25-87	
2.5	O		4,579	-3.9		03-04-91	W
8	O		4,550	-4.5	R	02-16-71	
2	O		4,546	-5.2		03-05-91	W
2	O		4,525	-6.6		07-31-89	W,D,C
3	O		4,525	-4.1		03-01-91	W
2	O		4,535	-2.6	R	09-25-64	D
2.5	O		4,530	-6.9		03-05-91	W
2.5	O		4,525	-4.6		03-01-91	
3.5	O		4,526	-3.8		08-10-77	C
4	O		4,508	-10.5		08-17-89	D
2.5	O		4,512	-19.6		08-17-89	W,D
2.5	O		4,513	-26.4		03-04-91	W,D

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(D-8-2)30bad-1	Stewart, I.	1944	I	32
(D-8-2)31bcd-1	Tanner, Art	1890	S	60
(D-8-2)31cbb-1	Schaerrer, Grant	1945	S	96
(D-8-2)31cda-1	Schearrer, Grant	—	I	450
(D-8-2)31cdb-1	Schearrer, Grant	1920	S	90
(D-8-2)31cdb-2	Schearrer, Grant	1963	I	435
(D-8-2)32aad-1	Young, K.	1934	H	117
(D-8-2)32daa-1	Benjamin Cemetery	1949	I	247
(D-8-2)33bcc-1	Mackey, Boley	—	I	—
(D-8-2)34acd-1	Ludlow, N.	1946	S	80
(D-8-2)34dda-1	Bearnson, Gill	1946	S	130
(D-8-2)36dbd-2	Gardner, L.	1952	H	260
(D-8-2)36dbd-3	Cloward, B.	1961	H	38
(D-8-3)2dcd-1	Mapleton City	1954	P	533
(D-8-3)2dcd-2	Dawn, Richard	1977	H	200
(D-8-3)3bca-1	Springville City	1990	P	428
(D-8-3)3cca-1	Snyder, Robert	1975	H	232
(D-8-3)3dcb-1	Fullmer, Richard	1978	H	305
(D-8-3)3dcd-1	Seal, Z.	1961	I	387
(D-8-3)4caa-2	Eddington Canning Company	1945	H	117
(D-8-3)4caa-3	Eddington Canning Company	1952	I	153
(D-8-3)4caa-4	Spanish Fork City	1965	U	—
(D-8-3)4cad-1	Eddington Canning Company	1935	—	231
(D-8-3)4daa-1	Springville City	1961	P	371
(D-8-3)5bca-1	Phillips, J.L.	1890	H	150
(D-8-3)6ddd-1	Unknown	—	U	—
(D-8-3)6ddd-2	Unknown	—	I	357
(D-8-3)6ddd-3	Unknown	1934	I	149
(D-8-3)6ddd-4	Unknown	1934	I	284
(D-8-3)6ddd-5	Springville Irrigation Company	1934	I	160
(D-8-3)7aad-1	Schwartz, Glade	1948	S	148
(D-8-3)7abc-1	Leftwich, Jack	1972	C	156
(D-8-3)7aca-2	Williams, Keith	1948	I	147
(D-8-3)8abd-1	Miner, F. Lee	1959	U	300
(D-8-3)10cba-1	Hjorth Brothers	1961	I	520
(D-8-3)10dac-1	Johnson, Kelly	1977	H	62

selected wells—Continued

Casing		Elevation of land surface (feet)	Water level		Other data available
Diameter (inches)	Finish (feet)		Above (-) or below land surface	Date	
2	O	4,500	-7.3	09-28-64	D
2	O	4,503.2	—	—	D
3	O	4,504	-14.8	08-28-89	W,D,C
12	P 150-450	4,510	—	—	D,C
22	O	4,510	-15.0	03-07-91	W,D,C
12	P 210-325 P 375-430	4,510	-30.2	03-07-91	W,D,C
2.5	O	4,520	-2.5 R	09-28-64	
5	O	4,545	11	11-10-49	C
—	—	4,525	—	—	
2	O	4,531	-7.4	03-05-91	W,D,C
2	O	4,528	-11.0	03-09-90	W,C
4	O	4,640	51.12	03-06-91	
6	—	4,640	9.13	03-06-91	W,C
10	P 238-243 P 246-533	4,805	221.70	03-19-65	
6	O	4,800	171.12	03-08-91	
16	P 280-420	4,640	70.23	03-05-91	L
6	P 200-232	4,702	114.17	03-05-91	L
6	P 285-305	4,725	148.69	03-05-91	
16	P 215-385	4,736	164	04-22-64	
4	O	4,560	-20 R	06-08-45	D
8	P 112	4,560	—	—	D
8	O	4,560	-25 R	07-19-65	D
4	O	4,580	-18.1	07-02-65	D
16	P 145-255 P 280-370	4,629	46.2	07-01-65	L
2	O	4,522.2	-9.7	03-04-91	WD
—	—	4,520	—	—	D
3	—	4,620	—	—	D
3	O	4,518	-2.7 R	11-04-64	
3	—	4,518	—	—	
3	—	4,518	—	—	
3	O	4,525	-25.1 R	03-31-64	D
8	P 132-156	4,519	-23.5	03-04-91	W,D
2.5	O	4,525	-25 R	07-14-48	D
4	O	4,560	6.14	03-04-91	L,W
8	P 395-520	4,714	127.6	06-30-65	L
6	O	4,725	34.44	03-05-91	L

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(D-8-3)10ddb-2	Porter, Rich D. & Lois G.	1977	H	203
(D-8-3)11abb-1	Edmonds, Paul K.	1986	I	242
(D-8-3)11caa-1	Perry, Fay L.	1983	I	215
(D-8-3)11ccc-1	Mapleton City	1961	P	500
(D-8-3)11ccc-2	Johnson, Frank	1977	H	70
(D-8-3)14acc-1	Orton, G.B.	1963	U	675
(D-8-3)14bab-1	Trojan Powder Corporation	1989	U	376
(D-8-3)14dab-1	Shurtleff, F.L.	1972	I	363
(D-8-3)14dca-1	Broadbent, J.	1965	I	395
(D-8-3)16aaa-1	Kimber and Johnson	1973	S	70
(D-8-3)16aaa-2	Rostron, Melvin	1977	H	275
(D-8-3)17ada-1	Garner, R.	1950	S	65
(D-8-3)17bad-1	Orton, G.B.	—	I	—
(D-8-3)17cdc-1	Pierce, L.	1960	H	127
(D-8-3)17cdc-2	Smith, F.	1960	H	295
(D-8-3)18aaa-3	Hanson, R.	1960	I	171
(D-8-3)18bdc-1	Spanish Fork City	1963	I	350
(D-8-3)19bbb-1	Spanish Fork City	1968	P	1,000
(D-8-3)19ccb-1	Spanish Fork City	1969	I	275
(D-8-3)19ccd-1	Christianson, H.	1890	H	25
(D-8-3)19cda-1	Spanish Fork City	1975	P	393
(D-8-3)19dca-1	Spanish Fork City	1970	P	603
(D-8-3)21bbd-1	Snyder, Paul	1977	H	358
(D-8-3)21cac-1	Storrs, Jan	1976	H	275
(D-8-3)22bab-1	Crandall, Condie	1972	H	26
[10](D-8-3)22cbd-3	Mapleton City	1961	P	541
(D-8-3)23baa-1	Dr. Orton	—	I	—
(D-8-3)23ccd-1	Biesinger, N.	1961	I	265
(D-8-3)23cdd-1	Whiting, R.W.	1973	H	381

selected wells—Continued

Casing		Elevation of land surface (feet)	Water level		Other data available
Diameter (inches)	Finish (feet)		Above (-) or below land surface	Date	
6	O	4,722	141.47	03-05-91	
8	P 210-215	4,790	200 R	04-01-86	C
8	O	4,770	185.60	03-05-91	W
12	P 383-405 P 409-494	4,730	140	03-06-91	W
6	P 65-67	4,735	46.16	03-07-91	W
8	P 189-200 P 372-395 P 507-675	4,775	177.05	03-05-91	W
4	R 351-371	4,729.1	144.85	12-22-89	W
8	P 200-363	4,800	210 R	02-25-72	
12.5	P 210-215 P 233-252 P 315-378	4,800	195 R	07-20-65	
6	P 55-65	4,710	14.68	03-05-91	L
6	O	4,705	123.43	03-05-91	L
4	O	4,700	24.53	03-07-91	W
—	—	4,600	—	—	
4	O	4,705	9.79	03-05-91	
4	O	4,710	142.22	03-05-91	W
4	O	4,550	-2.1	03-07-91	W
6	P 330-350	4,554	-23.9	06-22-65	
16	P 780-811 P 820-833 P 890-920 P 948-955	4,675	—	—	
12	P 170-250	4,585	10.7 R	10-19-69	
1.5	O	4,590	-6.4	03-04-91	W
12	P 160-179 P 303-332	4,660	88	11-05-75	
16	P 461-50	4,690	—	—	
6	X 330-358	4,719	135.24	03-06-91	
6	P 265-275	4,735	133.12	03-06-91	
4	P 15	4,720	11.32	03-06-91	
16	P 485-535	4,760	179.88	03-06-91	L,W
—	—	4,770	—	—	
8	O	4,960	220 R	09-29-61	L
6	P 360	4,980	182.96	03-07-91	

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(D-8-3)26bcd-1	Trojan Powder Corporation	1989	U	236
(D-8-3)26cbd-1	Trojan Powder Corporation	1989	U	302
(D-8-3)26cbd-2	Trojan Powder Corporation	1989	U	43
(D-8-3)26cca-2	Trojan Powder Corporation	1989	U	35
(D-8-3)26ccb-1	Trojan Powder Corporation	1940	N	399
(D-8-3)27adc-1	Trojan Powder Corporation	1989	U	188
(D-8-3)27adc-2	Trojan Powder Corporation	1989	U	395
(D-8-3)27bad-1	Trojan Powder Corporation	1989	U	276
(D-8-3)27bad-2	Trojan Powder Corporation	1989	U	468
(D-8-3)27cdc-1	Spanish Fork City	1963	P	630
(D-8-3)28abc-1	Jensen, J.	1961	I	470
(D-8-3)28bcd-1	Spanish Fork City	1961	P	410
(D-8-3)28bdc-1	Anderson, G.	1961	I	395
(D-8-3)29aaa-1	Farnsworth, Richard C.	1974	H	289
(D-8-3)30dba-1	Haderlie, P.	1970	U	285
(D-8-3)31ccd-1	Hendacka, H.	1970	H	246
(D-8-3)32add-1	Southeast Irrigation Company	—	I	—
(D-8-3)32baa-1	Vincent, W.	1960	H	276
(D-8-3)33aca-1	Spanish Fork City	1971	H	328
(D-8-3)33acb-1	Strawberry Water Users' Association	1910	H	50
(D-8-3)33cac-1	Hunter, W.	1958	H	100
(D-8-3)33cac-2	Shepherd, Lee	1973	H	693
(D-8-3)34aca-1	Trojan Powder Corporation	1940	N	261
(D-8-3)34bab-1	Spanish Fork City	—	U	470
(D-8-3)34bbb-1	Hurst, Harold	1973	S	151
(D-9-1)1bac-1	Powell, Lynn, and Young, Dallas	1976	I	600
(D-9-1)1bcb-2	Powell, L.M.	1973	H	416
(D-9-1)2ada-2	Farr, L.	1948	H	610
(D-9-1)2cab-1	Hi-Country Fruit Farm	1973	H	210
(D-9-1)2ccd-1	Critchfield, Gale	1980	—	280
(D-9-1)2ddd-1	Stewart, M.	1945	H	60
(D-9-1)11acc-1	Liddle, G.	1974	H	253
(D-9-1)11acc-2	Liddle, Parley	1981	S	85
(D-9-1)11baa-1	Bezzant, Clifford	1971	I	168

selected wells—Continued

Casing			Elevation of land surface (feet)	Water level		Other data available
Diameter (inches)	Finish (feet)			Above (-) or below land surface	Date	
4.5	S	216-236	4,965.6	189.04	03-08-91	W
—	—		5,012.6	231.16	03-08-91	W
—	—		4,991.1	36.13	03-08-91	W
—	—		4,983.9	21.86	03-08-91	W
8	P	365-399	5,000	266.1	03-23-65	
4	R	163-183	4,820.5	96.57	03-08-91	L,W
4.5	S	375-395	4,820.6	165.40	03-08-91	W
4	R	256-276	4,778.5	149.39	03-08-91	W
5	R	443-463	4,772.4	185.36	03-08-91	L,W
12	P	220-254	4,780	168.9	06-30-65	L
	P	377-432				
	P	515-520				
	P	541-546				
	P	583-589				
12	P	264-284	4,745	154.1	06-30-65	L
	P	425-465				
12.5	—		4,749	—	—	L
12	P	240-285	4,746	178.50	04-22-64	L
8	O		4,735	160 R	10-01-75	L
6	P	265-285	4,711	113.73	03-06-91	L,W
4	O		4,655	67.12	03-04-91	L
—	—		4,660	—	—	
5	O		4,720	164 R	03-03-65	
6	P	320	4,678	-40.6	03-04-91	
—	O		4,664	—	—	C
4	O		4,760	62.41	03-07-91	W
6	P	353-693	4,800	-13.5	03-08-91	
10	P	240-261	4,844	101.16	03-24-67	
16	—		4,797	142.75	03-06-91	W
8	P	135-146	4,720	70.87	03-06-91	W
6	—		4,520	-26.5	08-09-89	D
6	X	316-416	4,530	-6.4	03-05-91	
3	O		4,532	-3.1	03-05-91	
8	O		4,720	182.51	06-26-89	
8	O		4,730	205 R	06-22-80	
2	—		4,555	5.49	03-06-91	
6	P	175	4,610	73 R	07-01-74	
8	O		4,615	77.79	03-06-91	W
8	P	118-165	4,598	62.10	03-06-91	W

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(D-9-1)11bad-1	Bird, Terry	1971	H	160
(D-9-1)11ddc-1	Simpson, Leonard	1971	H	135
(D-9-1)12bbc-1	Bishop, A.	1947	H	70
(D-9-1)13bdb-1	McBeth, Clyde	1912	I	340
(D-9-1)13bdb-2	McBeth, Clyde	1920	I	340
(D-9-1)14aad-1	Wayman, Reid L.	1961	I	360
(D-9-1)14aad-2	Wayman, Craig	1971	I	300
(D-9-1)14ada-1	Stewart, D.	1945	H	55
(D-9-1)14ada-2	LDS Church	1961	I	363
(D-9-1)14ddd-1	Nay, C.	1950	H	125
(D-9-1)23acc-2	Payson Fruit Growers	1977	N	363
(D-9-1)23ada-1	Hi-Country Fruit Farm	1959	I	323
[11](D-9-1)23adb-1	Rowley Brothers	1959	H	290
(D-9-1)23daa-1	Meredity, V.	1963	H	86
(D-9-1)23dcb-1	Rowley Brothers	1970	H	201
[12](D-9-1)24acb-1	Daveport, L.	1962	H	100
(D-9-1)25aac-1	Spring Creek Irrigation Company	1934	I	34
(D-9-1)25aad-1	Holladay Field	1934	I	79
(D-9-1)25aad-2	Spring Creek Irrigation Company	1934	I	75
(D-9-1)25aca-1	Unknown	1934	I	160
(D-9-1)25ada-1	Spring Creek Irrigation Company	1934	I	124
(D-9-1)25ada-2	Unknown	—	I	—
(D-9-1)25ada-3	Holladay Field	—	I	90
(D-9-1)25ada-4	Unknown	—	—	—
(D-9-1)25ada-5	Unknown	—	I	—
(D-9-1)26aaa-1	McMullin, Dave	1973	I	380
(D-9-1)26aab-1	Rowley Brothers	1959	U	340
(D-9-1)26add-1	McMullin, Dave	1984	I	200
[13](D-9-1)26dda-1	McMullin, Dave	1961	I	307
(D-9-1)27aca-1	Keigley Quarry	—	K	310
(D-9-1)27aca-2	Keigley Quarry	1949	N	365
(D-9-1)32bbd-1	Oberg, Martin	—	U	80
[14](D-9-1)35abb-1	Strawberry Highline Canal Company	1963	I	435
(D-9-1)35bcd-1	Rowley	1957	S	190
(D-9-1)35bcd-2	Thompson, F.	1963	I	278

selected wells—Continued

Casing			Elevation of land surface (feet)	Water level			Other data available
Diameter (inches)		Finish (feet)		Above (-) or below land surface		Date	
8	P	126-160	4,615	80	R	07-20-71	
8	O		4,608	64.81		03-07-91	
4	O		4,562	3.63		03-06-91	
6	O		4,605.8	—		—	
12	O		4,605.8	-7	R	11-04-64	D
12	P	90-360	4,619	57.57		03-06-91	L,W
8	P	97-100	4,605	28.70		01-23-91	L,W,C
	P	190-300					
4	O		4,620	15	R	01-27-45	C
12	P	110-360	4,620	42.10		03-25-67	C
4	O		4,649	30.60		03-06-91	W
10	P	120-170	4,770	243	R	05-15-77	
	P	220-355					
12	P	44-308	4,667	23.04		03-06-91	W,C
12	—		4,695	50.09		03-06-91	
6	—		4,687	39.71		03-06-91	W
8	P	126-198	4,760	114	R	10-22-70	
6	O		4,659	3.41		03-08-91	W
4	O		4,695	-1.6	R	10-14-64	D
4	O		4,682	-3.1	R	05-28-64	D
4	O		4,680	-5.0		03-07-91	D
3	O		4,705	-2.6		08-30-89	D
4	O		4,680	-7.6		03-07-91	W,D
—	—		4,680	-12.5		07-20-89	D
—	—		4,680	-12.8		07-20-89	W,D
—	—		4,680	-9.4		07-20-89	D
—	—		4,680	—		—	D
10	P	100-380	4,705	53	R	06-26-73	C
12	P	70-340	4,715	61.92		03-06-91	W,C
10	P	100-200	4,735	45	R	07-31-84	C
14	P	90-300	4,741	51.4		06-29-65	
8.25	O		4,765	226.96		10-25-89	W
8.5	P	220-365	4,760	224	R	01-01-50	
3	—		4,530	15.95		03-05-91	W
16	P	145-430	4,800	103	R	03-29-67	C
6	O		4,822	151.23		03-06-91	
6	P	160-210	4,822	160		10-14-64	C
	P	218-275					

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(D-9-1)36acb-1	Ferguson, Bill	1975	I	415
(D-9-1)36bbc-1	Strawberry Highline Canal Company	1961	I	386
(D-9-1)36cdb-1	Miller, M.	1962	H	185
(D-9-1)36cdd-1	Shaw, W.E.	1955	I	325
(D-9-2)1bcb-1	LDS Church	1966	I	733
(D-9-2)2add-1	Davis, Frank	1936	H	188
(D-9-2)2dad-1	Culmer, E.	1967	I	196
(D-9-2)2dad-2	Culmer, E.	1956	I	227
(D-9-2)3aba-4	Taylor, R.	1964	S	138
(D-9-2)4cdc-1	Island Ranch Company	1943	H	310
(D-9-2)5acc-1	Jones, H. Max	—	I	165
(D-9-2)5acc-2	Jones, H. Max	—	I	—
(D-9-2)5acc-3	Jones, H. Max	—	H	—
(D-9-2)5bcc-1	Depew, Max	1953	H	133
(D-9-2)5bcc-2	Depew, Max	1956	I	142
(D-9-2)5bcd-1	Depew, Max	1967	H	146
(D-9-2)5bcd-2	Maurin, Charles	1970	I	156
(D-9-2)5bdd-1	Jones, H. Max	1915	I	60
(D-9-2)5bdd-2	Jones, H.	1915	I	162
(D-9-2)5bdd-3	Depew, Max	—	I	—
(D-9-2)5bdd-4	Jones, H.M.	—	I	363
(D-9-2)5cbb-3	Stickney, Donna	1961	I	121
(D-9-2)5ccc-1	Wilson, Sherol	1900	I	160
(D-9-2)5ccd-2	Unknown	1990	U	32.5
(D-9-2)5dcd-3	Payson City	1934	—	166
(D-9-2)5ddb-1	Brown, Wayne L.	1974	H	40
(D-9-2)5ddc-2	Payson City	1934	U	170
(D-9-2)5ddd-1	Unknown	1990	U	32.5
(D-9-2)6add-4	Christiansen, G.	1961	H	112
(D-9-2)6add-5	Walker, James	1962	H	310
(D-9-2)6ddb-1	Wilson, Shirley	1970	I	158
[15](D-9-2)6ddb-2	Wilson, C.	1964	I	302

selected wells—**Continued**

Casing		Elevation of land surface (feet)	Water level		Other data available
Diameter (inches)	Finish (feet)		Above (-) or below land surface	Date	
10	P 200-265	4,820	102.41	03-06-91	W,C
	P 365-415				
16	P 80-370	4,807	102.2	03-06-91	W,C
4	O	4,862	167.64	03-08-91	W
12	P 192-325	4,890	187.52	03-06-91	W,C
16	P 540-618	4,580	-7.2	03-05-91	W,D
	P 645-730				
2.5	O	4,570	-1.6	08-17-89	W,D
4	O	4,570	-.6	03-05-91	W
2	O	4,570	-9.6	03-04-91	W,D
4	O	4,528	-15.4	03-04-91	W
8.4	O	4,582	13	03-06-91	W
2	—	4,536	-32.3	03-06-91	W,D
—	—	4,542	—	—	
—	—	4,542	—	—	
4	O	4,537	-20 R	04-26-53	D
4	O	4,537	-14.2	08-09-89	W,D
6	P 136-146	4,537	-8.1	08-09-89	W,D
4	P 147-156	4,537	—	—	D
2	O	4,541.6	-13.1 R	09-23-64	
2	O	4,542	-27.9 R	09-23-64	D
—	—	4,540	—	—	
6	P 67-75	4,541	-40.0	01-02-69	D
	P 170-180				
	P 192-355				
4	O	4,541	-21.1	03-06-91	W,D
2	O	4,560.8	-8.3	12-04-64	D
1	O	4,562	3.44	07-02-90	W
3	O	4,576.8	-12.4	10-10 66	
—	O	4,565	-5.3	06-22-89	D,C
3	O	4,576.99	-15.2	03-11-74	D
1	O	4,576	5.96	03-06-91	W
6	O	4,534	-23.3	07-19-89	W,D
8	P 177	4,535	-31.2	07-19-89	W,D
8	P 85-90	4,546	-18.0	03-07-91	W,D,C
	P 100-105				
	P 121-126				
	P 146-152				
8	O	4,552	-17.9	03-07-91	W

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(D-9-2)7bdd-1	Peart, M.	1963	S	66
[16](D-9-2)7cda-2	Cornaby, B.	1962	S	16
(D-9-2)7dcc-1	Spencer, S.	1956	H	310
(D-9-2)8ccb-1	Unknown	1990	U	46.5
(D-9-2)9bac-1	LDS Church	1961	I	445
(D-9-2)10cad-2	Woodhouse, Ralph	1936	H	400
(D-9-2)10cad-4	Woodhouse, Mike	—	H	49
(D-9-2)10dac-1	Christensen, Don H.	1966	H	360
(D-9-2)11aaa-1	Wilson	1933	I	320
(D-9-2)11aca-3	Cole, Don	1958	H	285
(D-9-2)11adc-1	Salem City	1932	P	150
(D-9-2)13dbc-1	Johnson, Hal C.	1976	I	445
(D-9-2)13dca-1	Unknown	—	H	—
(D-9-2)14baa-1	Turpin, W.T.	1971	H	186
(D-9-2)14bdd-1	Vachea, Dan	1970	H	133
(D-9-2)15adb-1	Gasser, P.	1960	H	130
(D-9-2)15bbb-1	Payson City	1961	P	195
(D-9-2)15bcc-1	Reynaud, A.L.	1971	H	100
(D-9-2)15cda-1	Allred, Rey	1970	I	218
(D-9-2)16cbb-1	Payson City	1970	P	500
[17](D-9-2)17aaa-1	Payson City	1961	P	195
(D-9-2)17ada-1	Brimhall, Reed	—	U	165
(D-9-2)17bbb-1	Unknown	1990	U	31.5
(D-9-2)17cbc-1	Payson City	—	P	600
(D-9-2)17daa-1	Payson City	1954	P	225
(D-9-2)18aab-1	Unknown	1990	U	31.5
(D-9-2)18aca-1	Unknown	1934	H	278
(D-9-2)18dad-1	Haitt, W.	1949	H	92
(D-9-2)19aca-1	Emerald Turf Farm	1977	I	343

selected wells—Continued

Casing		Elevation of land surface (feet)	Water level		Other data available
Diameter (inches)	Finish (feet)		Above (-) or below land surface	Date	
6	O	4,594	20.16	03-06-91	W
—	P 13-16	4,600	8.02	03-06-91	W
6	O	4,603	7.94	03-06-91	W
1	O	4,606	5.5	07-02-90	
16	P 50-169	4,608	37.47	03-06-91	W,C
	P 202-252				
	P 288-337				
	P 377-427				
	O	4,585	-16.1	03-04-91	
—	—	4,585	3.63	03-04-91	
6	O	4,598	-20.9	03-04-91	W,D
3	P 175-185	4,584.63	-28.8	03-04-91	W,C
	P 310-320				
4	O	4,595	-22.3	03-04-91	W,D
3	O	4,596.9	-8.4 R	12-04-64	
6	P 347-445	4,960	346 R	07-17-76	
—	—	5,020	404.96	10-25-89	
4	O	4,690	72.20	03-06-91	
6	O	4,750	128.25	03-06-91	
4	O	4,695	77.48	03-06-91	
16	—	4,611	21.41	03-06-91	
6	O	4,665	64.84	03-06-91	
8	P 25-180	4,750	104 R	05-11-70	C
12	P 250-500	4,760	156 R	04-04-71	
16	P 100-195	4,682	74.9	06-28-65	
6	O	4,720	117.42	03-06-91	W
	O	4,623	14.2	07-02-90	
16	P 235-300	4,650	40 R	04-24-89	
	P 380-415				
	P 450-518				
12	P 160-220	4,764	158.50	01-18-67	
1	O	4,613	6.16	07-02-90	
3	O	4,620	17.15	03-06-91	W
4	O	4,645	37.01	03-07-91	
16	P 160-300	4,650	40.46	03-05-91	C
	P 323-343				

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(D-9-2)19acb-1	Emerald Turf Farm	1976	I	311
(D-9-2)20baa-1	Hardman, H.T.	1971	I	175
(D-9-2)20bbc-2	Mount Loafer Irrigation Company	1961	I	275
(D-9-2)20bdc-1	Revel, James M.	1974	I	445
(D-9-2)20cca-1	Peay, G.	1946	H	60
(D-9-2)20ccc-1	Spring Lake Water Works Company	1962	P	145
(D-9-2)22add-1	Haskel, F.E.	1972	H	272
(D-9-2)22bad-1	Allred, Rey	1957	Z	855
(D-9-2)22cad-1	Brunson, Reed A.	1976	I	220
(D-9-2)22dac-1	Goosenest Water Company	1970	P	500
(D-9-2)23abb-1	Elk Ridge Corporation	1979	P	957
(D-9-2)24aca-1	Hanks, Ted	1971	I	450
(D-9-2)24bda-1	Hanks, Ted	—	U	300
(D-9-2)25bbb-1	Elk Ridge Corporation	1970	P	340
(D-9-2)25bbc-1	Elk Ridge Corporation	1969	P	132
(D-9-2)26add-1	Elk Ridge Corporation	—	P	500
(D-9-2)26baa-1	Elk Ridge Corporation	1971	P	530
(D-9-2)29acd-1	Judd, Steve	1950	Q	70
(D-9-2)29acd-2	Judd, Steve	—	Q	—
(D-9-2)29acd-3	Judd, Steve	—	Q	—
(D-9-2)29acd-4	Judd, Steve	—	Q	—
(D-9-2)29bba-1	Mountain View Dairy	1972	S	250
(D-9-2)29cda-1	Spring Lake Water Works Company	1961	P	116
(D-9-2)29dbd-2	Spring Lake Water Works Company	1989	P	183
(D-9-2)30bcb-2	Unknown	—	I	—
(D-9-2)30cbb-2	Helm, Andrew	1957	H	95
(D-9-2)31cda-2	Thorvaldson, A.	1962	H	167
(D-9-2)32bac-1	Ashton, C.	1953	I	367
(D-9-2)32bbb-1	Jarvis, Marvin	1970	I	505
(D-9-2)36acd-1	Loafer Water Users' Association	1980	S	340

selected wells—Continued

Casing		Elevation of land surface (feet)	Water level		Other data available
Diameter (inches)	Finish (feet)		Above (-) or below land surface	Date	
12	P 157-309	4,645	35.61	03-05-91	C
—	X 175	4,740	136.81	03-05-91	
16	P 85-265	4,670	55.90	03-29-67	
8	P 190-440	4,740	120 R	09-27-74	
4	O	4,725	4.99	03-06-91	
12	P 95-110	4,716	20.40	03-05-91	L,W
	P 120-135				
8	P 262-272	4,960	248 R	09-01-72	
6	P 235	4,840	185 R	04-19-58	
8	P 160-200	5,020	140.26	03-06-91	W
12	P 185-415	5,035	190.60	04-28-89	
8	S 250-330	4,900	255 R	09-27-79	
	S 380-400				
	S 425-465				
	S 530-605				
	S 690-730				
	S 810-840				
	S 845-955				
8	P 305	5,140	266 R	11-01-71	L
4	O	5,100	286.90	03-04-91	W
6	P 150-340	5,290	158 R	04-20-70	
8	P 70-87	5,340	80.03	03-06-91	W
	P 100-130				
10	P 295-495	5,470	265 R	10-23-70	L
10	P 335-530	5,190	335 R	07-31-71	
4	O	4,780	-12.6	08-09-89	W,D
—	—	4,780	-11.8	08-09-89	
—	—	4,780	-11.1	08-09-89	
—	—	4,780	—	—	
8	X 155-250	4,730	67 R	10-01-72	
10	O	4,780	36.43	03-07-91	L
8	P 105-120	4,850	63.0	03-07-91	L
	P 140-150				
—	—	4,680	-8.6	08-03-89	D
4	O	4,705	7.74	08-03-89	W,D
6	O	4,832	140.1	06-28-65	
10	P 255-307	5,200	252.9	06-28-65	
10	P 127-500	4,800	87 R	12-01-70	
8	X 130-340	6,120	119	05-11-89	C

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(D-9-3)5bbb-2	Brigham Young University	1959	H	276
(D-9-3)5bbd-1	Brigham Young University	1962	I	601
(D-9-3)5cdc-1	Koyle, J.	1946	H	105
(D-9-3)6abb-1	Cloward, R.	1904	S	14
(D-9-3)6cbc-1	Guss, P.	1965	S	280
(D-9-3)7aab-1	Tanner, Paul	1973	H	190
(D-9-3)18bbb-1	Salem City	1971	P	584
(D-9-3)19bba-1	Woodland Hills	—	P	—
(D-9-3)19bba-2	Woodland Hills	—	—	—
(D-10-1)1acd-2	East Santaquin Irrigation Company	1965	I	650
(D-10-1)1cbb-1	Santaquin City	1956	P	456
(D-10-1)2adb-1	Summit Creek Irrigation Company	1961	I	580
(D-10-1)2bba-1	Genola	1960	P	527
(D-10-1)2ddd-1	Summit Creek Irrigation Company	1969	I	694
(D-10-1)4ddc-1	Ekins, Shirl	1976	H	400
(D-10-1)10aab-1	Beardall, Norman	1974	H	333
(D-10-1)11bbd-1	Rowley, Claude	1964	H	475
(D-10-1)17cca-1	D.S. Powelson & Sons	1955	U	102
(D-10-1)19bad-1	Unknown	—	—	—
(D-10-1)19bdc-1	Ekins, Shirl	1970	I	455
(D-10-1)30bac-1	Lunceford, Scott	1983	I	600

---

[1] Previously reported as (C-9-1)20dcc-1 (Cordova, 1969, table 1).
[2] Previously reported as (C-9-1)34dba-1 (Cordova, 1969, table 1).
[3] Previously reported as (C-10-1)15cdd-1 (Cordova, 1969, table 1).
[4] Previously reported as (C-10-1)25aab-1 (Cordova, 1969, table 1).
[5] Previously reported as (D-8-2)4aab-1 (Cordova, 1969, table 1).
[6] Previously reported as (D-7-3)29dcb-1 (Cordova, 1969, table 1).
[7] Previously reported as (D-8-2)2abd-1 (Cordova, 1969, table 1).
[8] Previously reported as (D-8-2)4baa-1 (Cordova, 1969, table 1).
[9] Previously reported as (D-8-2)4bcb-1 (Cordova, 1969, table 1).

selected wells—Continued

Casing		Elevation of land surface (feet)	Water level		Other data available
Diameter (inches)	Finish (feet)		Above (-) or below land surface	Date	
8	—	4,675	94.9 R	09-01-64	
12	P 300-340	4,684	91.10	03-08-73	L,C
	P 515-586				
6	O	4,820	40.74	03-04-91	W
20	X 1-20	4,661	9.60	03-04-91	W
6	—	4,675	86.23	03-05-91	W
6	P 175	4,705	91.50	03-04-91	W
16	P 406-566	4,870	256.66	02-15-91	
—	—	5,160	—	—	
—	—	5,160	—	—	
16	P 190-643	4,920	229.85	08-09-65	C
16	P 280-454	4,973	270.14	03-07-91	W
12	P 259-548	4,938	234.90	02-15-67	C
12	P 189-520	4,880	144.70	03-14-73	
12	P 212-496	5,015	313 R	02-14-70	C
	P 506-694				
8	X 120-400	5,040	—	—	
8	P 233-245	4,960	186 R	03-22-74	
	P 273-300				
6	P 335-470	5,020	311	11-04-64	
12	—	4,563	31.22	03-05-91	W
—	—	4,580	—	—	C
16	P 200-420	4,650	125 R	08-31-70	C
	X 431-455				
12	P 300-400	4,840	257.30	03-19-90	C
	P 482-501				
	P 520-538				
	P 556-572				

---

[10] Previously reported as (D-8-3)22cac-1 (Cordova, 1969, table 1).
[11] Previously reported as (D-9-1)23aac-1 (Cordova, 1969, table 1).
[12] Previously reported as (D-9-1)24acc-1 (Cordova, 1969, table 1).
[13] Previously reported as (D-9-1)26daa-1 (Cordova, 1969, table 1).
[14] Previously reported as (D-9-1)35aba-1 (Cordova, 1969, table 1).
[15] Previously reported as (D-9-2)6ddc-1 (Cordova, 1969, table 1).
[16] Previously reported as (D-9-2)7dbc-1 (Cordova, 1969, table 1).
[17] Previously reported as (D-9-2)16bbb-1 (Cordova, 1969, table 1).

Table 2.—*Drillers' logs of selected wells*

Well number: See figure 1 for explanation of the numbering system for hydrologic-data sites.

Thickness: In feet.

Depth: Depth to bottom of interval, in feet below land surface. Total depth may be deeper than well depth reported in table 1.

Material	Thickness	Depth
(C-9-1)3ddb-1		
Log by Robinson Drilling Company		
Clay, sand, and gravel	98	98
Clay, yellow	17	115
Clay and gravel	30	145
Clay and sand	35	180
Clay, yellow	10	190
Sand and gravel	15	205
Clay, yellow	10	215
Sand and gravel	55	270
Clay and gravel	60	330
Clay, yellow	10	340
Clay, sand, and gravel	213	553
Clay, yellow	22	575
(C-9-1)4ddc-1		
Log by Robinson Drilling Company		
Clay and sand	80	80
Sand and gravel (water)	32	112
Clay and sand	78	190
Clay and gravel	170	360
Clay and gravel	120	480
Clay, sand, and gravel	128	608
Sand and gravel	82	690
(C-9-1)17cdd-1		
Log by Dave's Drilling Company		
Sand, gravel, and cobbles	75	75
Sand, gravel, and boulders	75	150
Sand and gravel	45	195
[1](C-9-1)20cdd-1		
Log by Robinson Drilling Company		
Silt and sand	14	14
Clay and gravel	124	138
Clay and sand	20	158
Clay and gravel (water)	52	210
Clay and sand	35	245
Sand and gravel	11	256
Clay, tan	4	260
Sand and gravel	30	290
Conglomerate	30	320
Clay, sand, and gravel	230	550
Clay, red	25	575
(C-9-1)20ddd-1		
Log by Robinson Drilling Company		
Gravel and boulders	23	23
Clay, sand, and gravel	127	150
(C-9-1)20ddd-1—Continued		
Gravel (water)	8	158
Clay and gravel	32	190
Gravel	59	249
Clay and gravel	229	478
Conglomerate	24	502
Clay and gravel	225	727
Conglomerate	2	729
Clay and gravel (red)	69	798
(C-9-1)28ccb-1		
Log by Robinson Drilling Company		
Clay and sand	16	16
Gravel and boulders	2	18
Clay, sand, and gravel	57	75
Boulders	4	79
Clay and gravel	46	125
Sand and gravel (water)	47	172
Clay, sand, and gravel	65	237
Sand and gravel	26	263
Clay, gravel, and boulders	35	298
Sand and gravel	80	378
Conglomerate	6	384
Clay and gravel	204	588
Sand and gravel	32	620
Clay and gravel	92	712
Conglomerate	18	730
Clay and gravel	72	802
(C-9-1)29acc-1		
Log by Robinson Drilling Company		
Silt	2	2
Clay and boulders	13	15
Clay, sand, and gravel	39	54
Clay, gravel, and boulders	31	85
Sand and gravel	30	115
Sand, gravel, and boulders	68	183
Clay and gravel	27	210
Sand and gravel (water)	22	232
Sand, gravel, and boulders	20	252
Sand and gravel	102	354
Clay and gravel (yellow)	62	416
Sand	8	424
Clay and gravel	208	632
Clay and sand	68	700

Table 2.—*Drillers' logs of selected wells*—Continued

Material	Thickness	Depth
(C-9-1)29bcc-1		
Log by Robinson Drilling Company		
Silt	1	1
Clay, sand, and boulders	39	40
Clay, gravel, and boulders	127	167
Sand	20	187
Clay, sand, and gravel	100	287
Gravel and cobbles	43	330
Clay, sand, and gravel	36	366
Clay and silt	8	374
Sand	13	387
Clay	59	446
Gravel	2	448
Clay, sand, and gravel	314	762
Sand and gravel	25	787
Clay and sand	13	800
(C-9-1)34ddc-1		
Log by Angus Hales		
Clay and silt	100	100
Gravel	1	101
Silt and sand	56	157
Gravel	1	158
Silt and sand	38	196
Clay	12	208
Silt and sand	57	265
(C-10-1)4bbb-1		
Log by Robinson Drilling Company		
Clay and sand	45	45
Clay, sand, and gravel	330	375
Conglomerate	20	395
Clay, gravel, and boulders	5	400
Conglomerate	23	423
Clay, sand, and gravel	50	473
Conglomerate	5	478
Clay, sand, and gravel	46	524
Clay and gravel	238	762
Clay, sand, and gravel	118	880
Unknown	2	882
(C-10-1)4cbb-1		
Log by Layne-Texas Company		
Clay, sand, and gravel	90	90
Sand and gravel	54	144
Gravel and boulders	22	166
Sand and gravel	88	254
Clay and gravel	40	294
Gravel and shale	8	302
Shale	8	310
Gravel	30	340
Sand and gravel	69	409
Gravel	120	529
(C-10-1)4cbb-1—Continued		
Shale and rybite	50	579
Clay, sand, and gravel	608	1,187
Gravel and hard rock	13	1,200
Shale	18	1,218
(C-10-1)31cdd-1		
Log by Robinson Drilling Company		
Clay and silt	10	10
Sand and gravel	20	30
Clay, sand, and gravel	180	210
Clay and volcanic ash (water)	45	255
Sand and gravel	38	293
Clay, brown	19	312
Volcanic cinders	6	318
Clay, sand, and gravel	132	450
Conglomerate	55	505
Clay and sand	5	510
Sand and gravel	18	528
Volcanic ash	8	536
Clay, conglomerate, and volcanic ash	9	545
Clay and volcanic cinders	3	548
Clay, sand, and gravel	55	603
(C-11-1)6abc-1		
Log by Eldon Comer		
Clay, sand, and gravel	21	21
Clay and cobbles	109	130
Gravel and boulders	8	138
Clay, sand, and gravel (water)	248	386
Sand, gravel, and cobbles (water)	74	460
Clay, sand, and gravel	36	496
Sand and gravel (water)	36	532
Clay, sand, and gravel	103	635
Sand and gravel (water)	42	677
Clay and gravel	11	688
(C-11-1)6bdd-1		
Log by Eldon Comer		
Clay, sand, and gravel	23	23
Gravel and boulders	19	42
Clay, tan	6	48
Clay, gravel, and boulders	17	65
Clay, sand, and gravel	213	278
Sand, gravel, and cobbles (water)	26	304
Clay, sand, and gravel	20	324
Sand, gravel, and cobbles	60	384

Table 2.—*Drillers' logs of selected wells*—Continued

Material	Thickness	Depth
(C-11-1)6bdd-1—Continued		
Clay, sand, and gravel (water)	288	672
Sand, gravel, and boulders (water)	68	740
Clay, sand, and gravel	35	775
(D-7-2)32dad-1		
Log by Jensen Construction and Drilling Company		
Clay and sand	190	190
Clay	160	350
Sand (water)	10	360
Clay, sand, and gravel (water)	190	550
(D-7-3)18dcc-1		
Log by Eldon Comer		
Sand	26	26
Clay, blue	89	115
Gravel	6	121
Clay, tan	37	158
Sand	70	228
Clay	50	278
Gravel	4	282
Clay	7	289
Sand	33	322
(D-7-3)28cab-1		
Log by Technical Services Inc.		
Silt, sand, and gravel	20	20
Clay (gray)	17	37
Sand (water)	4	41
Clay	33	74
Silt, sand, and gravel	93	167
Clay and gravel	16	183
Hardpan	4	187
Silt, sand, and gravel	21	208
Boulders	1	209
Sand and gravel	41	250
Gravel and hardpan	35	285
Boulders	5	290
(D-7-3)32bcc-2		
Log by Jensen Construction and Drilling Company		
Clay	25	25
Silt and sand	8	33
Clay	72	105
Sand	3	108
Clay	36	144
Sand, gravel, and cobbles (water)	18	162
Clay	2	164

Material	Thickness	Depth
(D-7-3)34cdb-1		
Log by J.S. Lee and Sons		
Gravel and boulders	9	9
Sand	14	23
Clay and gravel (water)	29	52
Sand and gravel	28	80
Clay and sand	60	140
Sand and gravel	115	255
Clay and gravel	190	445
(D-8-2)17ada-1		
Log by Christopherson and Simmons		
Soil	10	10
Sand	26	36
Clay	41	77
Clay (red) and sand	132	209
Clay, blue	6	215
Clay (red) and sand	23	238
Clay, blue	38	276
Clay (white) and sand	93	369
Clay, blue	9	378
Clay (red) and sand	23	401
Clay (white) and sand	33	434
Clay (blue) and sand	32	466
(D-8-3)3bca-1		
Log by Lee Drilling Inc.		
Fill	3	3
Gravel, cobbles, and boulders	15	18
Clay, sand, and gravel	5	23
Sand	45	68
Clay, gray	70	138
Gravel (water)	75	213
Sand and gravel	32	245
Clay	28	273
Sand and gravel (water)	12	285
Conglomerate	18	303
Gravel (water)	125	428
(D-8-3)3cca-1		
Log by Jensen Construction and Drilling Company		
Top soil	5	5
Sand and boulders	5	10
Hardpan	3	13
Clay and sand	186	199
Gravel (water)	33	232
(D-8-3)4daa-1		
Log by J.S. Lee and Sons		
Clay, sand, and boulders	40	40
Clay and sand	103	143

Table 2.—*Drillers' logs of selected wells*—Continued

Material	Thickness	Depth
(D-8-3)4daa-1–Continued		
Gravel	112	255
Clay, blue	19	274
Gravel	94	368
Clay and sand	3	371
(D-8-3)8abd-1		
Log by Woodhouse Drilling		
Top soil	2	2
Clay and gravel	58	60
Sand (water)	20	80
Clay, blue	40	120
Sand and gravel	93	213
Sand (water)	57	270
Clay, red	15	285
Sand and gravel	10	295
Sand	5	300
(D-8-3)10cba-1		
Log by J.S. Lee and Sons		
Sand and gravel	17	17
Sand	118	135
Clay and sand	45	180
Clay, blue	52	232
Gravel	78	310
Clay, brown	2	312
Unknown	208	520
(D-8-3)10dac-1		
Log by Basin and Range Drilling Company		
Silt and sand	4	4
Sand	7	11
Gravel and cobbles	17	28
Sand and gravel	18	46
Gravel and cobbles (water)	16	62
(D-8-3)16aaa-1		
Log by Jensen Construction and Drilling Company		
Top soil	6	6
Gravel	9	15
Clay and silt	35	50
Gravel (water)	20	70
(D-8-3)16aaa-2		
Log by Basin and Range Drilling Company		
Silt	2	2
Gravel	6	8
Sand (water)	24	32
Clay, brown	17	49
Sand and gravel	13	62
Silt, sand, and gravel	22	84
Silt and sand	53	137
Clay and sand	107	244

Material	Thickness	Depth
(D-8-3)16aaa-2–Continued		
Sand	27	271
Gravel (water)	4	275
[1](D-8-3)22cbd-3		
Log by Eldon Comer		
Clay	250	250
Clay and sand	40	290
Sand, gravel, and cobbles	21	311
Clay	134	445
Clay and sand	37	482
Gravel and cobbles	59	541
(D-8-3)23ccd-1		
Log by Woodhouse Drilling		
Top soil	3	3
Clay, brown	17	20
Clay and sand	110	130
Clay and gravel	30	160
Sand	101	261
Gravel (water)	4	265
(D-8-3)27adc-1		
Log by Dave's Drilling		
Sand and silt	40	40
Sand and gravel	15	55
Sand and silt	20	75
Sand	15	90
Sand and silt	10	100
Sand (water)	20	120
Sand and gravel (water)	15	135
Silt and sand	12	147
Shale	8	155
Sand and gravel	30	185
Sand and silt	15	200
Sand	22	222
(D-8-3)27bad-2		
Log by Engineering Science, Inc.		
Sand	10	10
Clay and sand	15	25
Gravel	5	30
Sand	20	50
Clay and sand	15	65
Silt and sand	5	70
Clay and sand	35	105
Silt and sand	30	135
Clay, silt, and sand (water)	115	250
Silt, sand, and gravel	15	265
Gravel	20	285
Sand and gravel	10	295
Clay, silt, and sand	139	434

Table 2.—*Drillers' logs of selected wells*—Continued

Material	Thickness	Depth
(D-8-3)27bad-2 —Continued		
Sand and gravel	16	450
Gravel	10	460
Sand and gravel	5	465
Gravel	10	475
(D-8-3)27cdc-1		
Log by Eldon Comer		
Gravel and cobbles	18	18
Clay and sand	151	169
Sand	25	194
Clay, sand, and gravel	17	211
Sand, gravel, and cobbles (water)	35	246
Clay, sand, and gravel	127	373
Sand, gravel, and cobbles (water)	62	435
Clay, gravel, and boulders	16	451
Clay	14	465
Clay, gravel, and cobbles	7	472
Clay	42	514
Sand and gravel	6	520
Clay	20	540
Sand and gravel (water)	6	546
Clay and sand	36	582
Sand, gravel, and cobbles	2	584
Clay and sand	56	640
(D-8-3)28abc-1		
Log by Eldon Comer		
Gravel	19	19
Clay	183	202
Sand and gravel (water)	82	284
Clay and sand	137	421
Sand and gravel (water)	49	470
(D-8-3)28bcd-1		
Log by Woodhouse Drilling		
Gravel and boulders	30	30
Clay, blue	139	169
Sand (water)	85	254
Gravel (water)	37	291
Sand and clay	49	340
Conglomerate	40	380
Sand (water)	30	410
(D-8-3)28bdc-1		
Log by Woodhouse Drilling		
Gravel	25	25
Clay	175	200
Sand	35	235
Gravel	50	285
(D-8-3)28bdc-1–Continued		
Clay	93	378
Gravel	4	382
Sand and gravel (water)	13	395
(D-8-3)29aaa-1		
Log by Burt Drilling Company		
Clay, silt, and sand	22	22
Sand and gravel	45	67
Clay	203	270
Gravel (water)	19	289
(D-8-3)30dba-1		
Log by Jensen Drilling Company		
Clay, brown	7	7
Gravel and boulders	5	12
Clay and gravel	15	27
Clay and sand (water)	91	118
Clay, blue	11	129
Clay and sand	4	133
Clay, blue	24	157
Clay and sand	58	215
Clay, sand, and hardpan	6	221
Clay and sand	42	263
Gravel (water)	22	285
(D-8-3)31ccd-1		
Log by Basin and Range Drilling		
Sand and gravel (water)	35	35
Silt and sand (water)	30	65
Clay, gray	22	87
Silt and sand	18	105
Clay and sand (water)	60	165
Sand and hardpan	7	172
Clay and sand (water)	46	218
Sand and gravel (water)	5	223
Clay, silt, and sand	22	245
Hardpan	5	250
Sand, gravel, and cobbles (water)	25	275
Silt, sand, and gravel	12	287
Clay, silt, and gravel	28	315
Silt and sand (water)	2	317
(D-8-3)32baa-1		
Log by Reda Pump Co.		
Clay	10	10
Gravel	10	20
Sand	22	42
Clay	98	140
Silt (water)	20	160
Sand	55	215

Table 2.—*Drillers' logs of selected wells*—Continued

Material	Thickness	Depth
(D-8-3)32baa-1—Continued		
Clay	25	240
Silt	20	260
Hardpan	11	271
Sand and gravel (water)	5	276
(D-9-1)14aad-1		
Log by Eldon Comer		
Clay	60	60
Clay and gravel (water)	25	85
Clay	40	125
Clay and gravel	235	360
(D-9-1)14aad-2		
Log by Binning Drilling Company		
Top soil	6	6
Clay and gravel	91	97
Gravel (water)	3	100
Clay, sand, and gravel	47	147
Clay and gravel (water)	173	320
(D-9-2)20ccc-1		
Log by Reda Pump Company		
Gravel and cobbles	55	55
Clay and sand	35	90
Gravel (water)	20	110
Clay and gravel	12	122
Gravel (water)	3	125
Clay and gravel	20	145
(D-9-2)24aca-1		
Log by Binning Drilling Company		
Top soil	8	8
Clay, gravel, and cobbles	32	40
Clay, gravel, and boulders	40	80
Clay, gravel, and cobbles	69	149
Solid rock	5	154
Clay, gravel, and cobbles	13	167
Solid rock	10	177
Clay and gravel	63	240
Clay, gravel, and boulders	20	260
Clay and gravel	13	273
Solid rock	4	277
Clay, gravel, and cobbles	23	300
Clay and boulders	5	305
Gravel (water)	10	315
Clay and gravel	34	349
Solid rock	7	356
Clay, gravel, and boulders	44	400
Clay and cobbles	37	437
Clay and gravel	5	442
Solid rock	8	450
Clay, brown	2	452
(D-9-2)26add-1		
Log by Binning Drilling Company		
Clay	10	10
Clay and gravel	90	100
Clay, gravel, and boulders	35	135
Conglomerate	13	148
Clay, gravel, and boulders	22	170
Conglomerate (water)	10	180
Clay, gravel, and boulders	50	230
Conglomerate (water)	8	238
Clay, cobbles, and boulders	27	265
Clay	20	285
Conglomerate	8	293
Clay and gravel	172	465
Conglomerate	58	523
(D-9-2)29cda-1		
Log by Woodhouse Drilling		
Boulders	20	20
Clay and gravel	20	40
Sand and gravel	38	78
Gravel (water)	38	116
(D-9-2)29dbd-2		
Log by Binning Drilling Company		
Silt and gravel	5	5
Hardpan	15	20
Clay, brown	20	40
Clay and boulders	40	80
Clay, brown	25	105
Gravel (water)	15	120
Sand	10	130
Gravel (water)	20	150
Clay	15	165
Boulders (water)	35	200
(D-9-3)5bbd-1		
Log by Eldon Comer		
Top soil	3	3
Gravel and cobbles	12	15
Sand and gravel	18	33
Clay and sand	227	260
Clay, gravel, and hardpan	30	290
Sand, gravel, and cobbles (water)	50	340
Clay, tan	8	348
Clay and gravel	4	352
Clay	81	433
Clay and sand	64	497
Clay and gravel	3	500
Sand, gravel, and cobbles	89	589
Clay, tan	31	620

---

[1] Actual location is different from historic records. See footnote, table 1.

Table 3.—*Water levels in selected wells*

Well number: See figure 1 for explanation of the numbering system for hydrologic-data sites.
Water level: In feet above (-) or below land surface.

Well number	Date	Water level
(C-9-1)3ddb-1	07-01-1964	19.0
	10-01-1964	16.94
	11-02-1964	18.90
	12-07-1964	18.65
	11-02-1965	19.91
	12-02-1965	18.19
	11-05-1966	18.53
	12-19-1966	20.20
	12-08-1967	19.28
	12-21-1968	19.92
	12-19-1969	21.09
	12-09-1970	22.00
	10-11-1971	22.87
	12-15-1971	20.59
	10-03-1972	21.13
	10-14-1973	21.10
	10-13-1974	21.39
	03-04-1991	17.08
(C-9-1)4ccc-1	03-03-1974	135.00
	03-11-1975	136.52
	03-09-1976	137.39
	03-10-1977	136.67
	03-10-1978	136.74
	03-12-1979	138.79
	03-03-1980	138.61
	03-04-1981	138.62
	09-17-1981	148.26
	03-01-1982	138.13
	09-20-1982	139.90
	03-02-1983	136.04
	09-21-1983	135.74
	03-10-1984	133.17
	09-11-1984	133.24
	03-04-1985	131.29
	03-11-1986	131.30
	09-08-1986	135.05
	03-02-1987	132.67
	09-15-1987	133.84
	03-01-1988	130.43
	09-14-1988	135.80
	03-01-1989	131.09
	09-15-1989	131.72
	03-08-1990	129.86
	03-14-1991	128.76
	09-10-1991	138.60
	03-11-1992	130.68
(C-9-1)4ddc-1	04-15-1964	78.96
	05-12-1964	78.04
(C-9-1)4ddc-1	09-08-1964	82.20
Continued	10-02-1964	82.80
	11-05-1964	81.10
	12-07-1964	80.81
	02-03-1965	83.94
	03-02-1965	80.37
	03-25-1966	81.94
	04-05-1966	81.76
	12-19-1966	84.04
	03-08-1967	83.00
	04-05-1967	82.82
	03-21-1968	83.71
	03-19-1969	83.87
	03-20-1970	84.00
	03-15-1971	84.20
	03-03-1972	85.42
	03-14-1973	89.32
	03-13-1974	85.69
	03-11-1975	86.29
	03-09-1976	87.34
	03-10-1977	86.65
	03-10-1978	86.32
	03-12-1979	86.1
	03-03-1980	86.55
	03-04-1981	86.93
	03-01-1982	87.03
	03-02-1983	85.24
	03-10-1984	82.60
	03-04-1985	81.19
	03-11-1986	81.54
	03-02-1987	82.73
	03-01-1988	81.57
	12-15-1988	82.26
	01-23-1989	81.82
	02-27-1989	81.59
	03-09-1989	80.90
	06-22-1989	88.70
	07-18-1989	84.72
	08-15-1989	83.16
	09-15-1989	82.66
	10-23-1989	82.27
	11-17-1989	82.15
	12-20-1989	81.94
	02-15-1990	81.53
	03-08-1990	81.37
	04-02-1990	81.34
	05-09-1990	81.13
	07-05-1990	85.11
	08-03-1990	82.82
	09-07-1990	82.88
(C-9-1)4ddc-1	10-18-1990	81.67
Continued	11-20-1990	81.44
	12-18-1990	81.29
	01-22-1991	81.27
	03-04-1991	81.01
	03-11-1992	80.86
[1](C-9-1)20cdd-1	03-25-1964	195.1
	04-29-1964	193.3
	05-12-1964	194.0
	06-02-1964	194.2
	07-01-1964	195.1
	09-29-1964	203.2
	10-06-1964	202.3
	11-06-1964	200.5
	12-07-1964	199.77
	03-04-1965	198.40
	05-18-1965	199.71
	06-03-1965	199.1
	03-10-1967	207.33
	04-05-1967	207.01
	04-02-1990	199.82
	03-04-1991	200.34
(C-9-1)20ddd-1	02-07-1964	135.60
	03-11-1964	134.90
	04-29-1964	134.40
	05-12-1964	134.40
	06-02-1964	134.80
	07-01-1964	135.90
	08-18-1964	138.20
	09-04-1964	138.50
	10-06-1964	139.90
	11-05-1964	139.20
	12-07-1964	139.45
	01-06-1965	139.63
	02-03-1965	138.81
	03-02-1965	138.52
	04-07-1965	138.21
	05-04-1965	140.79
	06-09-1965	140.68
	07-01-1965	141.39
	10-15-1965	143.50
	12-30-1965	145.30
	03-25-1966	141.73
	04-05-1966	141.73
	08-11-1966	147.93
	12-19-1966	146.73
	03-08-1967	145.28

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(C-9-1)20ddd-1 Continued	04-05-1967	144.76
	03-21-1968	146.92
	03-19-1969	152.32
	03-20-1970	151.30
	09-09-1970	161.48
	03-15-1971	157.20
	10-06-1971	159.19
	03-03-1972	155.29
	09-27-1972	161.55
	03-14-1973	160.22
	03-13-1974	159.05
	03-11-1975	159.48
	03-09-1976	159.45
	03-10-1977	160.45
	03-10-1978	161.23
	03-12-1979	158.70
	03-04-1980	163.25
	03-04-1981	149.10
	03-01-1982	149.72
	03-02-1983	148.18
	03-10-1984	143.80
	03-04-1985	141.72
	03-11-1986	142.71
	03-02-1987	140.96
	03-01-1988	139.75
	03-09-1989	138.66
	05-12-1989	138.39
	06-22-1989	138.74
	07-18-1989	139.21
	08-15-1989	139.50
	10-23-1989	139.76
	12-20-1989	138.90
	01-30-1990	138.20
	03-08-1990	137.94
	04-02-1990	137.80
	04-06-1990	137.73
	06-05-1990	138.32
	08-03-1990	139.25
	09-07-1990	139.70
	10-18-1990	139.64
	12-18-1990	138.74
	03-05-1991	137.98
	09-10-1991	139.42
	03-11-1992	137.57
(C-9-1)26bda-3	04-09-1964	-4.5
	05-26-1964	-5.0
	10-09-1964	-5.3
	03-17-1965	-3.9
	06-28-1965	-5.3
	12-13-1988	-7.0
	05-15-1989	-6.2
(C-9-1)26bda-3 Continued	06-22-1989	-7.0
	07-18-1989	-6.2
	08-15-1989	-5.7
	09-15-1989	-5.7
	10-23-1989	-5.7
	12-20-1989	-5.5
	04-09-1990	-9.3
	05-09-1990	-7.0
(C-9-1)28ccb-1	01-10-1963	126.60
	02-13-1963	126.50
	03-14-1963	126.50
	06-10-1963	129.00
	10-29-1963	133.00
	11-14-1963	132.40
	12-19-1963	131.80
	01-17-1964	131.10
	02-24-1964	130.10
	03-23-1964	130.60
	04-28-1964	130.20
	05-11-1964	130.20
	09-29-1964	136.40
	10-06-1964	136.20
	12-07-1964	137.29
	01-06-1965	135.59
	02-03-1965	135.34
	03-02-1965	135.05
	04-07-1965	134.42
	06-09-1965	137.55
	10-15-1965	141.50
	12-30-1965	148.20
	03-25-1966	138.13
	12-19-1966	143.13
	03-08-1967	142.05
	04-05-1967	140.60
	03-21-1968	142.53
	03-19-1969	142.69
	03-20-1970	148.32
	03-14-1973	150.56
	03-13-1974	139.50
	03-11-1975	139.25
	03-09-1976	138.25
	03-10-1977	138.30
	03-10-1978	136.30
	03-12-1979	135.91
	03-04-1980	137.13
	03-04-1981	138.67
	03-01-1982	139.30
	03-02-1983	137.22
	03-10-1984	133.94
	03-04-1985	132.09
	03-11-1986	132.91
(C-9-1)28ccb-1 Continued	03-02-1987	130.98
	03-01-1988	133.53
	03-03-1989	128.43
	03-08-1990	127.79
	03-04-1991	127.65
	03-11-1992	127.62
(C-9-1)29acc-1	04-03-1963	205.50
	05-10-1963	205.70
	06-10-1963	216.70
	09-11-1963	214.50
	10-28-1963	211.20
	11-14-1963	210.80
	12-19-1963	210.30
	01-16-1964	209.90
	02-24-1964	209.50
	03-25-1964	209.70
	04-29-1964	209.20
	05-12-1964	209.20
	06-05-1964	213.60
	09-04-1964	216.60
	11-06-1964	216.20
	12-07-1964	217.29
	03-04-1965	215.40
	03-29-1966	221.20
	03-10-1967	222.30
	04-05-1967	221.86
	03-21-1968	227.00
	03-19-1969	228.40
	03-20-1970	230.34
	03-15-1971	231.10
	03-03-1972	235.02
	03-14-1973	227.95
	03-13-1974	226.85
	03-11-1975	228.52
	03-09-1976	228.16
	03-10-1977	227.64
	03-10-1978	227.19
	03-12-1979	226.59
	03-04-1980	227.00
	03-04-1981	227.98
	03-01-1982	228.37
	03-02-1983	225.17
	03-10-1984	220.78
	03-04-1985	218.53
	03-11-1986	219.59
	03-02-1987	217.57
	03-01-1988	216.40
	03-09-1989	214.97
	03-08-1990	214.50
	04-02-1990	214.26
	03-04-1991	214.28
	03-11-1992	213.37

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(C-9-1)29bcc-1	05-10-1963	287.0
	06-10-1963	287.7
	07-11-1963	288.5
	08-12-1963	289.9
	09-11-1963	290.7
	10-29-1963	292.0
	11-14-1963	291.9
	12-19-1963	292.0
	01-16-1964	291.9
	02-24-1964	291.4
	03-25-1964	292.0
	04-29-1964	291.1
	05-12-1964	291.1
	06-02-1964	291.13
	03-04-1965	296.6
	03-10-1967	304.6
	04-06-1967	304.6
	03-20-1970	309.6
	03-21-1990	298.64
	04-02-1990	300.10
(C-10-1)4bbb-1	07-23-1962	168.30
	08-16-1962	172.50
	09-14-1962	151.00
	10-15-1962	151.50
	12-03-1962	150.30
	01-10-1963	149.90
	02-13-1963	149.80
	03-11-1963	150.20
	10-28-1963	159.70
	11-14-1963	155.60
	12-19-1963	154.30
	01-17-1964	153.60
	02-24-1964	152.90
	03-23-1964	152.70
	04-28-1964	152.30
	05-11-1964	152.40
	06-01-1964	152.90
	09-04-1964	162.20
	10-06-1964	161.20
	12-07-1964	165.51
	01-06-1965	161.75
	02-03-1965	157.72
	03-02-1965	156.01
	07-01-1965	162.95
	12-30-1965	163.59
	03-24-1966	158.51
	12-19-1966	163.85
	03-08-1967	161.00
	04-05-1967	160.46
	03-21-1968	163.02
(C-10-1)4bbb-1 Continued	03-19-1969	169.58
	03-20-1970	161.62
	03-03-1972	161.96
	03-14-1973	152.24
	03-13-1974	149.29
	03-11-1975	151.45
	03-30-1977	147.16
	03-12-1979	148.08
	03-04-1980	151.44
	03-04-1981	153.57
	03-01-1982	155.87
	03-02-1983	154.89
	03-10-1984	152.22
	03-04-1985	150.66
	03-11-1986	151.80
	03-02-1987	150.06
	03-01-1988	151.13
	12-15-1988	147.61
	02-23-1989	147.17
	03-03-1989	147.35
	05-12-1989	146.95
	06-22-1989	146.74
	07-18-1989	146.93
	08-18-1989	146.89
	09-15-1989	146.97
	11-17-1989	147.17
	01-30-1990	146.71
	03-08-1990	146.76
	05-09-1990	146.70
	07-05-1990	147.42
	09-07-1990	147.25
	11-20-1990	147.18
	01-22-1991	147.13
	03-05-1991	147.04
	03-11-1992	147.15
(C-10-1)4cbb-1	04-10-1962	143.78
	03-08-1967	149.82
	04-05-1967	151.88
	03-21-1968	150.52
	03-19-1969	157.17
	03-20-1970	154.38
	03-15-1971	153.45
	03-03-1972	143.52
	03-14-1973	140.78
	03-13-1974	142.39
	03-11-1975	140.06
	03-09-1976	135.05
	03-10-1977	134.28
	03-10-1978	131.78
	03-12-1979	134.05
(C-10-1)4cbb-1 Continued	03-04-1980	138.53
	03-04-1981	148.75
	03-01-1982	150.06
	03-02-1983	149.91
	03-10-1984	147.45
	03-04-1985	141.20
	03-11-1986	141.44
	03-02-1987	139.01
	03-01-1988	138.41
	03-03-1989	138.16
	05-12-1989	135.40
	03-08-1990	135.28
	03-04-1991	135.86
	03-11-1992	136.06
[1](C-10-1)15cca-1	10-30-1964	31.80
	02-14-1991	28.47
	03-07-1991	28.29
(C-10-1)17bba-1	04-21-1989	265.56
	05-16-1989	265.83
	06-22-1989	265.93
	07-17-1989	266.24
	08-16-1989	266.31
	09-18-1989	266.41
	10-23-1989	266.19
	12-18-1989	266.02
	01-30-1990	265.69
	03-07-1990	265.71
	05-09-1990	265.81
	07-05-1990	266.42
	08-08-1990	266.64
	09-07-1990	266.75
	10-18-1990	266.93
	11-20-1990	266.82
	12-18-1990	266.85
	01-22-1991	266.99
	03-04-1991	266.71
	09-10-1991	267.71
	03-11-1992	268.04
(C-10-1)17bba-2	02-23-1989	271.90
	05-16-1989	272.66
	06-22-1989	265.68
	07-17-1989	266.03
	08-16-1989	266.08
	09-18-1989	266.23
	10-23-1989	266.00
	12-18-1989	265.87
	01-30-1990	265.47
	03-07-1990	265.46

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(C-10-1)17bba-2 Continued	05-09-1990	265.54
	08-08-1990	266.41
	09-07-1990	266.52
	10-18-1990	266.74
	11-20-1990	266.65
	12-18-1990	266.63
	01-22-1991	266.75
	03-04-1991	266.56
	09-10-1991	267.71
	03-11-1992	267.75
(C-10-1)18ccc-1	01-20-1989	352.16
	02-23-1989	352.01
	04-21-1989	351.83
	05-16-1989	351.91
	06-22-1989	351.89
	07-17-1989	352.08
	09-18-1989	351.99
	11-17-1989	352.17
	01-24-1990	352.37
	03-07-1990	352.27
	04-05-1990	352.06
	06-05-1990	352.13
	08-08-1990	352.49
	09-07-1990	352.69
	10-18-1990	352.97
	11-19-1990	352.73
	01-22-1991	353.58
	03-05-1991	353.46
	03-11-1992	355.42
(C-10-1)24ddc-1	12-20-1966	217.8
	01-05-1967	217.28
	02-05-1967	217.06
	03-05-1967	216.54
	04-05-1967	216.29
	05-05-1967	216.61
	07-10-1967	219.59
	08-05-1967	223.15
	09-05-1967	224.55
	10-05-1967	222.73
	11-05-1967	219.22
	12-05-1967	217.57
	03-21-1968	215.90
	04-05-1968	215.3
	05-05-1968	214.92
	06-05-1968	216.47
	07-05-1968	217.31
	08-05-1968	217.88
	09-05-1968	222.59
	10-05-1968	226.26
	11-05-1968	225.29
(C-10-1)24ddc-1 Continued	12-05-1968	220.78
	03-19-1969	216.30
	03-20-1970	222.70
	03-15-1971	214.34
	03-12-1974	212.30
	03-10-1975	212.60
	03-08-1976	212.51
	03-09-1977	210.66
	08-12-1977	231.63
	03-10-1978	212.64
	08-25-1978	220.10
	03-12-1979	212.67
	09-17-1979	212.70
	03-03-1980	211.32
	09-03-1980	217.59
	03-04-1981	211.09
	09-17-1981	218.80
	03-01-1982	212.26
	09-20-1982	217.27
	03-02-1983	210.54
	09-21-1983	211.35
	03-10-1984	206.60
	09-11-1984	210.37
	03-04-1985	205.18
	09-10-1985	212.92
	03-11-1986	206.60
	09-08-1986	215.02
	03-02-1987	208.14
	09-11-1987	218.29
	03-01-1988	209.65
	09-14-1988	219.21
	12-12-1988	212.59
	01-20-1989	211.37
	03-09-1989	210.59
	04-21-1989	212.52
	05-12-1989	217.62
	06-22-1989	220.28
	07-17-1989	220.40
	08-16-1989	220.12
	09-18-1989	219.98
	10-23-1989	217.18
	11-17-1989	214.92
	12-18-1989	214.25
	01-24-1990	212.84
	02-15-1990	212.16
	03-07-1990	211.93
	05-09-1990	213.94
	06-05-1990	215.54
	07-02-1990	223.73
	08-08-1990	224.36
	09-07-1990	222.00
	10-18-1990	217.98
(C-10-1)24ddc-1 Continued	11-20-1990	214.89
	12-18-1990	214.04
	01-22-1991	213.30
	03-05-1991	212.54
	09-10-1991	222.32
	09-13-1991	223.16
[1](C-10-1)25abd-1	02-04-1964	259.8
	07-01-1964	263.4
	08-19-1964	266.8
	05-18-1965	295.8
	06-10-1965	280.8
	03-30-1966	252.5
	03-21-1990	242.82
	03-05-1991	245.15
(C-10-1)30baa-1	09-18-1989	226.10
	11-17-1989	225.96
	01-24-1990	225.93
	02-15-1990	225.71
	03-07-1990	225.58
	05-09-1990	225.74
	06-05-1990	228.67
(C-10-1)34bbb-1	03-24-1964	96.1
	05-14-1964	96.5
	06-10-1964	96.5
	07-02-1964	97.4
	08-19-1964	96.8
	09-04-1964	96.8
	10-09-1964	97.0
	12-07-1964	96.70
	01-06-1965	96.56
	02-03-1965	96.79
	03-02-1965	96.82
	04-07-1965	96.88
	05-04-1965	97.01
	06-09-1965	97.33
	07-01-1965	99.15
	10-15-1965	95.60
	03-25-1966	99.58
	08-29-1966	96.76
	12-19-1966	99.15
	03-08-1967	97.47
	12-08-1967	97.47
	12-21-1968	97.60
	12-19-1969	97.53
	12-20-1970	95.86
	03-03-1972	90.59
	12-03-1972	94.59
	03-09-1973	94.29
	12-09-1973	98.29

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(C-10-1)34bbb-1 Continued	03-12-1974	87.03
	12-12-1974	91.03
	03-07-1991	89.39
(C-10-2)13bcc-1	01-20-1989	161.62
	02-24-1989	162.37
	04-21-1989	163.52
	05-15-1989	164.19
	06-22-1989	164.74
	07-17-1989	165.32
	08-16-1989	165.74
	09-18-1989	166.29
	10-23-1989	166.88
	11-17-1989	167.15
	12-18-1989	166.99
	01-24-1990	168.27
	03-07-1990	168.71
	04-05-1990	168.93
	06-05-1990	169.60
	07-05-1990	170.00
	08-08-1990	170.35
	10-18-1990	171.24
	11-20-1990	171.21
	01-22-1991	172.02
	03-05-1991	172.24
(C-11-1)6bdd-1	04-15-1964	244.68
	05-15-1964	246.50
	06-05-1964	247.10
	07-02-1964	247.60
	08-19-1964	253.00
	09-28-1964	249.70
	10-08-1964	253.60
	11-03-1964	249.40
	12-07-1964	248.63
	03-02-1965	247.68
	05-04-1965	249.73
	06-09-1965	281.53
	07-01-1965	277.10
	10-15-1965	267.00
	11-03-1965	257.48
	03-25-1966	250.71
	03-11-1967	256.20
	04-05-1967	255.77
	03-21-1968	258.00
	03-19-1969	258.42
	03-20-1970	257.10
	09-09-1970	271.64
	03-16-1971	254.60
	10-06-1971	261.44
	03-03-1972	254.34
	03-13-1974	249.74
(C-11-1)6bdd-1 Continued	03-10-1975	259.40
	03-09-1976	256.60
	03-10-1977	249.31
	03-19-1990	232.96
	04-06-1990	234.39
(D-7-2)32dad-1	12-12-1980	-32.4
	02-26-1981	-32.7
	03-09-1982	-33.3
	03-04-1991	-22.7
(D-7-2)34dcd-1	09-21-1959	-9.8
	04-02-1964	-8.9
	05-13-1964	-8.0
	08-03-1964	-7.3
	10-20-1964	-6.2
	03-05-1965	-8.3
	06-23-1965	-7.6
	03-11-1969	-9.2
	03-17-1970	-9.8
	03-24-1970	-9.6
	03-17-1971	-9.7
	03-09-1972	-10.2
	03-07-1973	-9.9
	03-26-1981	-8.4
	03-12-1982	-9.4
	03-01-1983	-10.4
	03-09-1984	-11.0
	03-04-1985	-10.9
	03-10-1986	-11.3
	03-04-1987	-11.0
	03-02-1988	-8.8
	03-09-1989	-7.1
	03-05-1990	-8.7
	03-05-1991	-6.6
	03-13-1992	-9.1
(D-7-2)36dcc-2	09-07-1938	-13.0
	12-12-1938	-13.4
	01-30-1939	-14.2
	03-17-1939	-15.0
	04-13-1939	-15.3
	06-13-1939	-15.0
	08-03-1939	-11.9
	10-17-1939	-12.3
	01-04-1940	-15.0
	02-28-1940	-16.2
	04-13-1940	-16.1
	05-02-1940	-17.0
	06-17-1940	-13.6
	01-21-1941	-14.3
	03-18-1941	-15.6
(D-7-2)36dcc-2 Continued	12-11-1941	-13.8
	03-27-1942	-15.4
	06-27-1942	-13.9
	12-26-1942	-15.2
	03-29-1943	-17.0
	12-29-1943	-14.7
	03-24-1944	-15.3
	12-27-1944	-14.0
	03-30-1945	-15.2
	12-17-1945	-16.4
	03-07-1946	-17.0
	12-17-1946	-18.4
	04-07-1947	-18.0
	12-17-1947	-17.2
	03-30-1948	-17.9
	12-23-1948	-15.7
	03-17-1949	-17.2
	12-16-1949	-17.1
	03-23-1950	-17.1
	12-19-1950	-16.7
	04-04-1951	-18.5
	12-26-1951	-18.3
	04-08-1952	-18.1
	12-11-1952	-18.2
	04-21-1953	-18.8
	12-08-1953	-15.1
	03-24-1954	-17.4
	12-29-1954	-14.5
	04-22-1955	-15.3
	12-22-1955	-13.8
	03-30-1956	-16.9
	12-19-1956	-14.9
	04-01-1957	-17.2
	12-06-1957	-16.5
	03-18-1958	-18.1
	12-04-1958	-15.3
	03-18-1959	-16.3
	12-24-1959	-14.5
	03-23-1960	-15.6
	12-09-1960	-14.1
	03-23-1961	-15.9
	01-05-1962	-14.2
	03-06-1962	-14.6
	12-06-1962	-15.6
	03-12-1963	-16.9
	08-27-1963	-10.4
	12-16-1963	-15.0
	03-11-1964	-15.9
	04-09-1964	-14.6
	06-01-1964	-15.1
	07-09-1964	-13.6
	08-03-1964	-12.7

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-7-2)36dcc-2	09-01-1964	-8.6
Continued	12-03-1964	-12.1
	03-01-1965	-15.9
	10-06-1965	-14.4
	12-28-1965	-6.5
	03-24-1966	-6.2
	08-17-1966	-3.4
	12-20-1966	-3.4
	03-27-1967	-6.2
	10-02-1968	-10.9
	03-26-1981	-12.8
	03-11-1982	-13.3
	03-01-1983	-14.8
	03-09-1984	-15.9
	03-04-1985	-16.0
	03-10-1986	-16.3
	03-04-1987	-15.9
	03-03-1988	-14.2
	12-13-1988	-13.0
	01-27-1989	-11.6
	03-01-1989	-12.6
	04-19-1989	-9.8
	05-12-1989	-10.0
	06-20-1989	-10.3
	07-18-1989	-9.0
	08-15-1989	-9.2
	08-24-1989	-7.9
	09-15-1989	-9.7
	10-23-1989	-10.3
	11-14-1989	-11.0
	12-19-1989	-12.2
	01-23-1990	-13.1
	02-12-1990	-12.5
	03-05-1990	-14.1
	04-09-1990	-14.2
	05-08-1990	-13.8
	06-04-1990	-13.8
	07-03-1990	-10.1
	08-02-1990	-11.9
	09-05-1990	-11.1
	10-18-1990	-12.1
	11-19-1990	-12.3
	12-17-1990	-12.2
	01-24-1991	-12.5
	03-04-1991	-11.4
	03-13-1992	-13.5
(D-7-3)18dcc-1	12-11-1980	-35.5
	03-26-1981	-33.6
	03-09-1982	-31.9
	02-04-1991	-18.8
	03-05-1991	-18.9
(D-7-3)28cab-1	03-01-1961	-15.0
	03-30-1964	-16.4
	05-12-1964	-17.0
	09-15-1964	-18.5
	06-19-1989	-17.8
	07-19-1989	-17.6
	08-24-1989	-12.4
	09-20-1989	-16.6
	10-26-1989	-16.5
	12-19-1989	-16.1
	01-23-1990	-15.5
	02-13-1990	-15.9
	03-05-1990	-15.7
	04-09-1990	-15.3
	05-10-1990	-15.3
	06-04-1990	-16.2
	07-03-1990	-14.9
	08-02-1990	-15.9
	09-05-1990	-15.5
	10-16-1990	-15.4
	11-19-1990	-15.3
	12-17-1990	-15.3
	01-24-1991	-15.2
	03-04-1991	-14.8
(D-7-3)31cac-2	11-02-1964	-11.2
	09-13-1989	-14.3
(D-7-3)32bcd-1	12-04-1980	-12.8
	03-26-1981	-11.8
	03-09-1982	-13.5
	02-06-1991	-13.1
	03-04-1991	-13.2
(D-7-3)33baa-6	08-31-1935	-6.8
	03-02-1936	-6.4
	10-03-1936	-8.7
	03-03-1937	-7.2
	09-23-1937	-9.0
	05-17-1938	-8.6
	09-14-1938	-9.6
	03-24-1939	-8.0
	09-21-1939	-8.1
	03-16-1940	-8.1
	09-24-1940	-8.2
	03-18-1941	-8.2
	12-10-1941	-10.6
	03-27-1942	-8.8
	06-27-1942	-12.4
	12-26-1942	-11.3
	03-29-1943	-9.7
	12-29-1943	-9.0
(D-7-3)33baa-6	03-24-1944	-8.4
Continued	12-27-1944	-10.7
	03-29-1945	-9.8
	12-17-1945	-11.7
	03-07-1946	-10.7
	12-17-1946	-11.5
	04-07-1947	-10.6
	12-17-1947	-11.3
	03-30-1948	-10.0
	12-23-1948	-10.9
	03-17-1949	-9.6
	12-16-1949	-11.1
	03-22-1950	-9.9
	12-19-1950	-11.3
	04-04-1951	-9.7
	12-28-1951	-11.3
	04-08-1952	-10.5
	12-11-1952	-17.3
	04-21-1953	-14.0
	12-08-1953	-12.5
	03-24-1954	-11.7
	12-29-1954	-10.0
	04-22-1955	-9.6
	12-22-1955	-9.6
	03-30-1956	-9.2
	12-19-1956	-9.5
	04-01-1957	-9.9
	12-06-1957	-11.6
	03-18-1958	-11.0
	12-04-1958	-13.8
	03-18-1959	-11.9
	12-24-1959	-8.9
	03-23-1960	-8.6
	12-09-1960	-8.7
	03-23-1961	-7.1
	01-05-1962	-6.8
	03-06-1962	-7.1
	12-06-1962	-9.7
	03-07-1963	-8.9
	08-27-1963	-5.6
	12-16-1963	-7.7
	04-09-1964	-6.2
	05-28-1964	-7.2
	07-09-1964	-7.3
	08-03-1964	-7.4
	09-01-1964	-6.4
	10-05-1964	-7.0
	11-02-1964	-7.7
	12-03-1964	-7.9
	01-05-1965	-8.0
	02-01-1965	-8.3
	03-01-1965	-7.9

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-7-3)33baa-6	04-05-1965	-7.7
Continued	05-03-1965	-7.9
	06-07-1965	-10.1
	07-02-1965	-11.3
	10-06-1965	-12.0
	12-28-1965	-10.3
	03-24-1966	-8.8
	08-17-1966	-5.3
	10-02-1968	-11.3
	03-11-1969	-10.4
	09-03-1969	-11.4
	03-17-1970	-10.7
	09-08-1970	-9.1
	03-17-1971	-9.4
	10-06-1971	-11.7
	03-09-1972	-9.9
	09-26-1972	-7.4
	03-07-1973	-8.9
	09-05-1973	-11.5
	03-07-1974	-11.1
	03-06-1975	-9.8
	08-18-1975	-14.4
	03-04-1976	-11.6
	08-12-1976	-6.2
	03-07-1977	-8.9
	08-10-1977	-3.2
	03-08-1978	-5.5
	08-22-1978	-7.9
	03-15-1979	-8.3
	09-18-1979	-9.7
	03-06-1980	-8.3
	09-03-1980	-10.6
	03-02-1981	-9.2
	09-03-1981	-6.8
	03-02-1982	-9.0
	09-20-1982	-14.5
	03-01-1983	-12.1
	09-21-1983	-17
	03-09-1984	-15.4
	09-10-1984	-19.4
	03-04-1985	-16.5
	09-10-1985	-16.4
	03-10-1986	-14.2
	09-08-1986	-16.5
	03-04-1987	-13.9
	09-11-1987	-9.9
	03-02-1988	-7.3
	09-14-1988	-5.8
	03-10-1989	-8.6
	06-19-1989	-7.3
	07-19-1989	-5.0
	08-24-1989	-5.0
(D-7-3)33baa-6	09-19-1989	-5.5
Continued	10-24-1989	-5.6
	11-13-1989	-5.5
	12-19-1989	-6.0
	03-05-1990	-7.0
	03-04-1991	-4.7
	09-12-1991	-4.9
	03-13-1992	-6.2
(D-7-3)33ccc-5	03-15-1938	-3.6
	09-25-1938	-8.7
	03-24-1939	-7.2
	09-21-1939	-7.3
	02-29-1940	-7.7
	10-01-1940	-7.1
	06-07-1964	-9.5
	09-01-1964	-5.5
	10-05-1964	-5.9
	03-01-1965	-8.0
	04-05-1965	-8.3
	05-03-1965	-7.9
	06-07-1965	-9.5
	07-02-1965	-10.7
	10-05-1965	-13.8
	12-28-1965	-12.0
	03-24-1966	-10.5
	08-13-1966	-4.2
	12-20-1966	-7.9
	01-21-1967	-7.6
	02-21-1967	-6.2
	03-27-1967	-7.1
	03-19-1968	-8.1
	03-11-1969	-11.3
	03-24-1970	-12.1
	03-17-1971	-10.9
	03-09-1972	-10.9
	03-12-1973	-10.5
	03-07-1974	-12.2
	03-07-1975	-11.7
	03-04-1976	-13.4
	03-07-1977	-10.2
	03-08-1978	-3.5
	03-15-1979	-9.1
	03-06-1980	-9.2
	03-02-1981	-10.6
	03-02-1982	-10.2
	03-01-1983	-14.1
	03-09-1984	-18.0
	03-04-1985	-19.0
	03-10-1986	-16.3
	03-04-1987	-15.9
	03-03-1988	-9.8
(D-7-3)33ccc-5	12-13-1988	-8.5
Continued	01-26-1989	-9.9
	03-01-1989	-9.9
	04-18-1989	-8.2
	05-15-1989	-8.7
	06-19-1989	-6.4
	07-19-1989	-5.7
	08-24-1989	-5.3
	09-19-1989	-5.7
	10-26-1989	-6.7
	11-14-1989	-6.6
	12-19-1989	-7.6
	01-23-1990	-8.0
	02-13-1990	-8.0
	03-05-1990	-8.3
	04-09-1990	-7.8
	05-10-1990	-5.9
	06-04-1990	-6.4
	07-03-1990	-2.2
	08-02-1990	-2.5
	09-05-1990	-1.8
	10-16-1990	-3.5
	11-19-1990	-4.6
	12-17-1990	-4.7
	01-24-1991	-4.7
	03-04-1991	-5.2
	03-13-1992	-7.1
(D-7-3)33ccc-6	01-21-1967	-21.8
	03-08-1991	-14.3
(D-8-1)2ccd-1	11-01-1988	5.94
	12-12-1988	5.95
	01-23-1989	5.90
	02-24-1989	5.76
	04-19-1989	5.52
	05-12-1989	5.66
	06-20-1989	5.92
	08-15-1989	6.34
	12-20-1989	6.48
	02-12-1990	6.49
	03-06-1990	6.26
	04-02-1990	6.32
	05-08-1990	6.36
	07-05-1990	6.70
	09-06-1990	7.00
	11-18-1990	7.11
	12-17-1990	7.07
	01-24-1991	7.01
	02-15-1991	7.10
	03-05-1991	6.87
	04-05-1991	6.99

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-8-1)2ccd-1	05-08-1991	6.92
Continued	06-14-1991	6.80
	08-12-1991	7.04
	09-30-1991	7.01
	01-15-1992	6.96
	03-13-1992	6.76
(D-8-1)10bcb-1	11-22-1988	14.11
	12-12-1988	14.28
	01-23-1989	14.38
	02-24-1989	14.50
	04-19-1989	14.62
	05-12-1989	14.63
	06-20-1989	14.68
	07-18-1989	14.85
	08-15-1989	14.86
	09-15-1989	14.99
	10-23-1989	15.00
	11-14-1989	15.18
	12-20-1989	15.49
	01-23-1990	15.62
	02-12-1990	15.65
	03-06-1990	15.78
	04-02-1990	15.93
	05-08-1990	16.08
	06-05-1990	16.14
	07-03-1990	16.20
	08-03-1990	16.34
	09-06-1990	16.50
	10-18-1990	16.70
	11-19-1990	16.83
	12-17-1990	17.00
	01-24-1991	17.06
	03-05-1991	17.01
	07-03-1991	17.07
	08-21-1991	17.06
	10-01-1991	17.02
	01-15-1992	17.15
(D-8-1)10bcb-2	11-22-1988	42.58
	12-12-1988	42.39
	01-23-1989	41.92
	02-24-1989	41.45
	04-19-1989	40.65
	05-12-1989	40.88
	06-20-1989	41.63
	07-18-1989	42.31
	08-18-1989	42.88
	09-15-1989	43.25
	10-23-1989	43.26
	11-14-1989	43.20
	12-20-1989	43.07
(D-8-1)10bcb-2	01-23-1990	42.78
Continued	02-12-1990	42.60
	03-06-1990	42.30
	04-02-1990	42.10
	05-08-1990	42.27
	06-05-1990	42.80
	07-05-1990	43.02
	08-03-1990	43.33
	09-06-1990	43.34
	10-18-1990	43.24
	11-19-1990	43.30
	12-17-1990	43.31
	01-24-1991	43.17
	03-05-1991	43.34
	07-03-1991	43.47
	08-21-1991	43.53
	10-01-1991	43.42
	01-15-1992	43.35
(D-8-1)13aaa-1	05-02-1936	-13.4
	12-01-1936	-13.8
	03-03-1937	-14.7
	09-23-1937	-13.0
	04-06-1938	-18.0
	09-12-1938	-13.2
	03-24-1939	-17.3
	09-21-1939	-15.4
	03-19-1940	-17.5
	09-20-1940	-14.0
	03-18-1941	-16.7
	11-27-1941	-15.2
	03-27-1942	-16.2
	12-26-1942	-14.0
	03-29-1943	-15.0
	12-29-1943	-15.8
	03-24-1944	-16.1
	12-27-1944	-14.6
	03-30-1945	-14.6
	12-17-1945	-16.3
	03-07-1946	-16.7
	12-17-1946	-17.0
	04-07-1947	-16.7
	12-17-1947	-15.0
	03-30-1948	-16.4
	12-23-1948	-15.3
	03-17-1949	-16.3
	12-16-1949	-15.9
	03-22-1950	-14.9
	12-19-1950	-15.3
	04-04-1951	-15.8
	12-26-1951	-15.6
	12-08-1953	-15.5
(D-8-1)13aaa-1	09-01-1964	-6.6
Continued	10-05-1964	-9.5
	11-02-1964	-10.9
	12-03-1964	-11.9
	09-20-1989	-10.8
	03-04-1991	-11.3
(D-8-1)13bdd-1	07-07-1964	-2.0
	03-05-1991	-1.5
(D-8-1)20abb-1	11-01-1988	12.64
	12-12-1988	12.92
	01-23-1989	12.88
	02-24-1989	12.83
	04-19-1989	11.50
	05-12-1989	12.65
	06-20-1989	13.19
	07-18-1989	13.71
	08-15-1989	14.10
	09-15-1989	14.50
	10-23-1989	14.68
	11-14-1989	14.67
	12-20-1989	14.68
	01-23-1990	14.51
	02-12-1990	14.41
	03-06-1990	14.22
	04-02-1990	14.15
	05-08-1990	14.17
	07-05-1990	14.80
	08-03-1990	15.20
	09-06-1990	15.67
	10-18-1990	16.02
	11-19-1990	15.98
	01-24-1991	15.75
	03-05-1991	15.68
(D-8-1)23bdd-1	06-09-1937	-7.3
	12-13-1988	-11.9
	01-26-1989	-11.9
	03-01-1989	-12.0
	04-19-1989	-10.3
	05-12-1989	-10.2
	06-20-1989	-10.6
	07-18-1989	-11.0
	08-15-1989	-10.8
	08-24-1989	-10.8
	09-15-1989	-11.1
	10-26-1989	-10.7
	11-14-1989	-10.2
	12-20-1989	-9.6
	01-23-1990	-9.4
	02-12-1990	-9.5

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-8-1)23bdd-1 Continued	03-06-1990	-10.1
	04-02-1990	-9.1
	05-08-1990	-9.1
	06-05-1990	-9.2
	07-03-1990	-9.3
	08-03-1990	-9.1
	09-05-1990	-7.9
	10-18-1990	-9.3
	11-19-1990	-9.3
	12-17-1990	-8.6
	01-24-1991	-9.0
	03-05-1991	-8.0
(D-8-1)25aba-1	03-24-1967	-12.9
	02-20-1991	-6.6
	03-05-1991	-6.5
(D-8-1)25cbb-1	07-21-1964	-15.2
	02-20-1991	-11.0
	03-04-1991	-11.8
(D-8-1)36bcc-1	07-21-1964	-15.9
	03-07-1991	-10.9
(D-8-2)1baa-1	04-08-1964	-11.0
	08-06-1964	-14.6
	08-08-1989	-10.3
(D-8-2)2caa-1	11-12-1951	-16
	08-06-1964	-16.7
	09-21-1989	-11.6
(D-8-2)2cda-1	08-06-1964	-6.2
	09-21-1989	-5.5
	03-04-1991	-4.7
(D-8-2)2daa-1	08-06-1964	-25.8
	04-19-1989	-26.7
	05-16-1989	-24.4
	06-22-1989	-23.6
	07-18-1989	-24.0
	08-15-1989	-22.8
	08-24-1989	-22.5
	09-15-1989	-22.9
	10-23-1989	-23.2
	11-14-1989	-24.6
	12-20-1989	-24.5
	01-23-1990	-24.8
	02-12-1990	-25.1
	03-05-1990	-25.5
	04-02-1990	-25.7
(D-8-2)3aad-1	05-01-1964	-10.0
	09-15-1989	-15.8
(D-8-2)4abb-1	08-20-1964	-8.8
	09-12-1989	-12.4
	03-05-1991	-14.1
(D-8-2)4abc-1	04-06-1964	-12.5
	05-12-1964	-12.7
	08-04-1964	-12.2
	03-05-1965	-12.5
	06-23-1965	-12.7
	09-12-1989	-11.3
[1](D-8-2)4bab-1	03-25-1963	-22.0
	08-20-1964	-15.2
	09-12-1989	-4.4
(D-8-2)4cba-2	03-03-1937	-26.1
	09-23-1937	-24.8
	03-14-1938	-28.1
	09-27-1938	-24.8
	03-24-1939	-29.4
	09-21-1939	-26.8
	04-12-1940	-29.5
	09-20-1940	-25.8
	03-18-1941	-29.8
	12-29-1941	-27.9
	03-27-1942	-27.6
	12-26-1942	-29.7
	03-29-1943	-29.9
	12-29-1943	-29.5
	03-24-1944	-30.8
	12-27-1944	-30.7
	03-30-1945	-32.1
	12-17-1945	-31.6
	03-07-1946	-32.5
	12-17-1946	-31.6
	04-07-1947	-34.1
	12-17-1947	-33.3
	03-30-1948	-35.2
	03-17-1949	-34.5
	12-16-1949	-35.1
	03-23-1950	-36.8
	12-19-1950	-35.8
	04-04-1951	-35.0
	12-26-1951	-34.4
	04-09-1952	-35.0
	12-16-1952	-38.1
	04-21-1953	-37.8
	03-24-1954	-37.4
	12-29-1954	-35.1
(D-8-2)4cba-2 Continued	04-22-1955	-34.7
	12-22-1955	-33.4
	03-30-1956	-33.4
	12-19-1956	-34.2
	04-01-1957	-35.6
	12-06-1957	-35.8
	03-18-1958	-36.7
	12-04-1958	-35.5
	03-18-1959	-36.5
	12-24-1959	-32.9
	03-23-1960	-35.1
	12-09-1960	-32.6
	03-23-1961	-35.1
	01-05-1962	-28.1
	03-06-1962	-29.9
	12-06-1962	-28.4
	03-07-1963	-26.3
	08-27-1963	-17.6
	12-16-1963	-20.2
	03-11-1964	-21.3
	04-09-1964	-20.6
	05-28-1964	-19.3
	07-09-1964	-18.9
	08-03-1964	-18.2
	09-01-1964	-17.0
	10-05-1964	-18.4
	11-02-1964	-19.6
	12-03-1964	-19.8
	01-05-1965	-20.8
	02-02-1965	-21.7
	03-01-1965	-21.7
	04-05-1965	-22.3
	05-03-1965	-19.6
	06-07-1965	-19.8
	07-02-1965	-19.9
	10-21-1965	-20.8
	12-28-1965	-22.1
	03-25-1966	-20.2
	08-23-1966	-18.0
	12-30-1966	-19.7
	01-27-1967	-20.9
	02-10-1967	-20.0
	03-01-1967	-21.0
	03-16-1967	-21.0
	04-13-1967	-21.0
	04-27-1967	-20.6
	03-19-1968	-21.8
	10-02-1968	-20.5
	03-11-1969	-23.4
	09-04-1969	-19.4
	03-24-1970	-22.4
	09-08-1970	-21.1

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-8-2)4cba-2 Continued	03-17-1971	-22.7
	10-06-1971	-21.2
	03-09-1972	-22.4
	09-26-1972	-20.3
	03-07-1973	-22.5
	09-05-1973	-21.5
	03-08-1974	-25.8
	03-07-1975	-24.6
	03-05-1976	-25.6
	08-13-1976	-16.4
	03-08-1977	-22.6
	08-10-1977	-21.2
	03-09-1978	-19.2
	08-28-1978	-14.6
	03-15-1979	-23.2
	09-18-1979	-18.8
	03-05-1980	-21.1
	09-04-1980	-20.9
	03-02-1981	-23.9
	09-03-1981	-19.6
	03-02-1982	-22.1
	09-20-1982	-20.5
	03-01-1983	-23.6
	09-21-1983	-21.0
	03-09-1984	-23.7
	09-10-1984	-14.2
	03-04-1985	-24.8
	09-10-1985	-20.9
	03-10-1986	-24.2
	09-08-1986	-19.1
	03-04-1987	-23.0
	09-11-1987	-19.5
	03-02-1988	-19.5
	09-14-1988	-17.9
	12-13-1988	-18.7
	01-26-1989	-20.3
	03-01-1989	-20.3
	04-19-1989	-17.9
	05-12-1989	-17.6
	06-20-1989	-16.5
	07-18-1989	-15.8
	08-15-1989	-15.9
	08-24-1989	-15.3
	09-15-1989	-15.5
	10-23-1989	-15.5
	11-14-1989	-16.1
	12-19-1989	-16.2
	01-23-1990	-16.4
	03-05-1990	-17.0
	04-02-1990	-16.7
	05-08-1990	-14.7
	06-04-1990	-14.7
(D-8-2)4cba-2 Continued	07-03-1990	-11.9
	08-03-1990	-13.3
	09-05-1990	-14.7
	10-18-1990	-14.8
	11-19-1990	-16.6
	03-01-1991	-17.6
	09-10-1991	-14.6
	03-13-1992	-16.3
[1](D-8-2)4cbb-1	04-28-1964	-39.0
	09-15-1989	-6.1
(D-8-2)4cdc-4	08-20-1964	-12.7
	03-04-1991	-13.0
(D-8-2)4dad-1	04-03-1964	-43.8
	05-19-1964	-43.7
	08-04-1964	-43.7
	10-08-1964	-42.7
	03-08-1965	-45.4
	06-23-1965	-45.2
	09-28-1989	-13.4
(D-8-2)7dda-1	03-30-1965	-7.7
	03-04-1991	-4.9
(D-8-2)7ddd-1	12-16-1963	-10.9
	03-01-1991	-9.3
(D-8-2)10adb-1	09-28-1989	-20.1
	03-01-1991	-19.7
(D-8-2)13abc-1	08-30-1961	-22.0
	04-02-1964	-28.1
	05-13-1964	-28.5
	08-25-1964	-18.7
	10-07-1964	-22.5
	03-04-1965	-29.5
	06-22-1965	-26.6
	09-28-1989	-18.4
(D-8-2)14cad-1	09-02-1964	-4.5
	02-20-1990	-3.4
	03-05-1991	-3.5
(D-8-2)16caa-1	04-13-1937	-37.3
	09-23-1937	-32.4
	04-06-1938	-41.9
	09-13-1938	-36.0
	03-24-1939	-39.2
	10-13-1939	-35.7
	04-04-1940	-40.6
(D-8-2)16caa-1 Continued	01-21-1941	-39.8
	09-02-1964	-33.5
	10-05-1964	-33.4
	11-02-1964	-34.7
	12-03-1964	-35.8
	01-05-1965	-36.0
	02-02-1965	-36.8
	03-01-1965	-37.4
	04-05-1965	-37.6
	05-03-1965	-37.6
	06-07-1965	-37.7
	07-02-1965	-36.7
	10-21-1965	-39.6
	12-29-1965	-38.8
	03-25-1966	-38.6
	08-23-1966	-35.4
	12-20-1966	-36.1
	01-20-1967	-36.4
	02-20-1967	-36.9
	03-27-1967	-37.5
	03-19-1968	-38.4
	10-02-1968	-37.5
	03-11-1969	-41.6
	09-03-1969	-39.5
	03-15-1970	-42.7
	09-08-1970	-38.7
	03-17-1971	-40.7
	10-06-1971	-38.4
	03-10-1972	-40.4
	09-26-1972	-36.6
	03-08-1973	-40.6
	09-05-1973	-37.8
	03-08-1974	-42.2
	03-07-1975	-41.4
	03-05-1976	-43.0
	08-13-1976	-36.4
	03-08-1977	-39.5
	08-10-1977	-34.2
	03-09-1978	-37.4
	08-23-1978	-33.8
	03-15-1979	-38.9
	09-17-1979	-35.1
	03-05-1980	-38.7
	09-04-1980	-36.3
	03-03-1981	-39.4
	09-03-1981	-35.9
	03-02-1982	-37.8
	09-20-1982	-39.6
	03-03-1983	-42.3
	09-21-1983	-44
	03-09-1984	-47.4
	09-10-1984	-48.4

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-8-2)16caa-1 Continued	03-05-1985	-50.1
	09-10-1985	-46.0
	03-10-1986	-47.0
	09-08-1986	-41.1
	03-04-1987	-44.2
	09-11-1987	-37.4
	03-02-1988	-38.0
	09-14-1988	-32.1
	12-13-1988	-31.0
	01-26-1989	-36.4
	03-01-1989	-36.3
	04-19-1989	-33.8
	05-12-1989	-32.4
	06-20-1989	-29.9
	07-18-1989	-29.0
	08-15-1989	-28.3
	09-15-1989	-28.3
	10-26-1989	-28.9
	11-14-1989	-29.3
	12-19-1989	-28.3
	01-23-1990	-32.9
	02-12-1990	-33.1
	03-05-1990	-33.7
	04-02-1990	-33.4
	06-04-1990	-32.6
	07-03-1990	-29.6
	08-03-1990	-27.7
	09-05-1990	-27.2
(D-8-2)16dbb-2	09-02-1964	-5.0
	03-04-1991	-4.2
(D-8-2)17ada-1	09-03-1964	-6.3
	03-01-1991	-5.4
(D-8-2)17ccc-2	04-03-1964	-20.6
	05-19-1964	-19.7
	07-23-1964	-17.3
	09-03-1964	-15.4
	10-08-1964	-18.9
	03-08-1965	-20.8
	06-24-1965	-17.4
	08-17-1989	-8.5
(D-8-2)19add-1	09-03-1964	-13.8
	03-01-1991	-12.6
(D-8-2)20cad-2	03-28-1967	-10.7
	03-01-1991	-2.7
(D-8-2)21aaa-1	03-03-1937	-25.6
	09-14-1964	-20.0
	08-28-1989	-6.8
(D-8-2)21ddd-1	04-02-1964	-18.4
	05-18-1964	-17.5
	09-15-1964	-14.8
	03-24-1965	-18.5
	06-24-1965	-19.2
	10-02-1989	-12.5
(D-8-2)22cdc-1	09-15-1964	-15.2
	07-19-1989	-15.1
	03-04-1991	-15.4
(D-8-2)22cdc-2	09-15-1964	-11.4
	07-19-1989	-7.8
	03-04-1991	-10.9
(D-8-2)24bdc-2	03-25-1963	-12.0
	04-08-1964	-9.7
	05-20-1964	-9.3
	09-17-1964	-3.7
	03-17-1965	-11.4
	06-24-1965	-6.6
	08-17-1989	-1.5
(D-8-2)25dac-3	08-15-1961	30.00
	03-19-1970	28.17
	03-17-1971	29.88
	10-12-1971	30.14
	03-06-1972	31.02
	03-08-1973	30.90
	03-11-1974	26.24
	03-07-1975	26.80
	03-05-1976	26.13
	03-08-1977	29.54
	03-09-1978	34.48
	03-15-1979	32.06
	03-05-1980	34.40
	03-03-1981	30.20
	03-02-1982	31.24
	03-03-1983	24.24
	03-12-1984	16.51
	03-05-1985	14.38
	03-10-1986	19.95
	03-02-1987	22.74
	03-02-1988	28.72
	11-02-1988	35.15
	12-14-1988	33.21
	01-17-1989	32.76
	02-23-1989	33.85
	03-03-1989	33.51
	04-18-1989	35.13
	05-15-1989	35.77
(D-8-2)25dac-3 Continued	06-20-1989	37.27
	07-17-1989	40.07
	08-16-1989	41.51
	09-19-1989	40.18
	10-24-1989	39.10
	11-13-1989	37.20
	12-19-1989	35.89
	01-25-1990	35.60
	02-13-1990	35.32
	03-06-1990	35.44
	04-09-1990	36.38
	05-08-1990	38.29
	06-04-1990	38.79
	07-03-1990	41.87
	08-02-1990	43.70
	09-04-1990	43.56
	10-22-1990	40.45
	11-19-1990	39.15
	12-18-1990	38.65
	01-23-1991	38.88
	03-05-1991	38.42
	09-12-1991	43.76
	03-12-1992	37.47
(D-8-2)26aad-3	03-25-1964	38.1
	05-22-1964	37.2
	09-17-1964	43.9
	10-14-1964	42.1
	03-22-1965	39.9
	07-01-1965	39.8
	01-31-1991	35.80
	03-06-1991	35.45
(D-8-2)26abb-3	09-23-1964	-2.9
	03-04-1991	-3.9
(D-8-2)27acd-1	09-23-1964	-2.5
	02-20-1991	-5.2
	03-05-1991	-5.2
(D-8-2)28cbd-3	11-04-1944	-4
	09-25-1964	-5.7
	07-31-1989	-6.6
(D-8-2)28cca-2	09-25-1964	-1.0
	03-01-1991	-4.1
(D-8-2)29aaa-7	09-27-1957	-12.0
	09-25-1964	-11.9
	11-02-1964	-12.7
	12-03-1964	-12.8

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-8-2)29aaa-7 Continued	01-05-1965	-13.1
	02-02-1965	-13.8
	03-01-1965	-14.2
	04-05-1965	-14.1
	05-03-1965	-13.2
	06-07-1965	-12.0
	10-21-1965	-14.8
	12-30-1965	-16.2
	03-25-1966	-14.2
	04-13-1966	-14.5
	08-23-1966	-12.1
	03-24-1967	-14.9
	03-19-1968	-16.3
	03-11-1969	-16.1
	03-24-1970	-16.4
	03-18-1971	-16.1
	03-10-1972	-16.0
	03-07-1973	-14.0
	03-11-1974	-16.0
	03-07-1975	-14.0
	03-05-1976	-12.1
	03-08-1977	-11.6
	03-09-1978	-9.4
	03-15-1979	-11.2
	03-05-1980	-7.8
	03-03-1981	-9.1
	03-02-1982	-8.7
	03-03-1983	-11.0
	03-09-1984	-10.6
	03-05-1985	-10.8
	03-10-1986	-10.6
	03-04-1987	-9.2
	03-02-1988	-7.3
	03-10-1989	-7.9
	03-06-1990	-7.5
	03-05-1991	-6.9
	03-12-1992	-6.6
(D-8-2)29bcd-2	04-06-1964	-24.0
	05-19-1964	-24.4
	09-25-1964	-22.7
	10-08-1964	-22.9
	03-08-1965	-24.4
	06-24-1965	-23.7
	08-17-1989	-19.6
(D-8-2)29cab-1	09-25-1964	-25.3
	08-17-1989	-22.0
	03-04-1991	-26.4
(D-8-2)31cbb-1	09-28-1964	-12.5
	08-01-1989	-14.4
	08-28-1989	-14.8
(D-8-2)31cdb-1	08-04-1964	-6.3
	09-01-1964	-5.8
	10-01-1964	-5.8
	11-02-1964	-6.5
	12-03-1964	-6.5
	01-05-1965	-7.2
	02-02-1965	-7.2
	03-01-1965	-7.7
	04-05-1965	-7.8
	05-03-1965	-8.0
	06-07-1965	-7.4
	07-02-1965	-7.9
	10-21-1965	-8.9
	12-29-1965	-9.5
	03-25-1966	-8.5
	08-24-1966	-6.8
	12-20-1966	-7.2
	03-24-1967	-8.8
	03-20-1968	-8.2
	03-21-1969	-8.4
	03-24-1970	-15.3
	03-18-1971	-13.3
	03-11-1972	-15.4
	03-08-1973	-14.6
	03-11-1974	-12.9
	03-10-1975	-10.9
	03-08-1976	-8.3
	08-09-1989	-5.6
	04-09-1990	-13.0
	05-08-1990	-7.2
	06-05-1990	-5.6
	07-03-1990	-5.6
	08-03-1990	-5.6
	09-05-1990	-5.0
	10-18-1990	-7.1
	11-19-1990	-14.3
	12-17-1990	-14.2
	01-24-1991	-14.3
	03-07-1991	-15.0
	09-10-1991	-5.9
	03-12-1992	-14.8
(D-8-2)31cdb-2	09-27-1968	-18
	03-12-1970	-31.7
	03-18-1971	-31.3
	03-11-1972	-29.4
	03-08-1973	-28.4
	03-11-1974	-30.2
	03-10-1975	-29.8
	03-08-1976	-30.7
	11-14-1989	-30.0
(D-8-2)31cdb-2 Continued	01-23-1990	-29.7
	03-06-1990	-29.9
	11-19-1990	-28.9
	12-17-1990	-28.9
	01-24-1991	-28.8
	03-07-1991	-30.2
	03-12-1992	-28.8
(D-8-2)34acd-1	06-20-1946	-3.0
	09-28-1964	-3.7
	07-31-1989	-4.4
	03-05-1991	-7.4
(D-8-2)34dda-1	09-29-1964	-12.4
	11-03-1964	-13.3
	12-04-1964	-13.9
	01-05-1965	-14.6
	02-02-1965	-14.5
	03-01-1965	-14.9
	04-05-1965	-14.7
	05-03-1965	-14.5
	06-07-1965	-14.2
	07-02-1965	-13.6
	10-20-1965	-15.0
	12-29-1965	-15.0
	03-25-1966	-14.3
	04-18-1966	-14.8
	08-23-1966	-10.9
	03-24-1967	-15.0
	03-20-1968	-15.8
	03-17-1969	-17.1
	03-24-1970	-18.7
	03-18-1971	-17.4
	03-10-1972	-17.3
	03-08-1973	-18.0
	03-11-1974	-18.0
	03-07-1975	-18.1
	03-05-1976	-16.8
	03-08-1977	-13.8
	03-15-1979	-14.9
	03-05-1980	-13.7
	03-03-1981	-15.5
	03-02-1982	-15.7
	03-03-1983	-16.2
	03-12-1984	-17.6
	03-05-1985	-18.9
	03-10-1986	-17.7
	03-04-1987	-15.8
	12-13-1988	-9.8
	01-26-1989	-13.2
	03-01-1989	-13.4

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-8-2)34dda-1 Continued	04-18-1989	-9.9
	05-15-1989	-9.0
	06-20-1989	-8.3
	07-18-1989	-6.5
	08-16-1989	-5.9
	09-19-1989	-6.5
	10-26-1989	-6.5
	11-14-1989	-8.1
	12-19-1989	-8.4
	02-13-1990	-10.5
	03-09-1990	-11.0
(D-8-2)36dbd-3	09-29-1964	6.9
	02-06-1991	9.6
	03-06-1991	9.1
((D-8-3)5bca-1	11-04-1964	-14.5
	09-14-1989	-7.0
	03-04-1991	-9.7
(D-8-3)7abc-1	08-03-1989	-16.0
	03-04-1991	-23.5
(D-8-3)8abd-1	03-26-1964	6.41
	05-13-1964	6.40
	10-14-1964	10.5
	03-05-1965	6.3
	06-30-1965	8.6
	03-19-1967	6.15
	03-19-1968	6.05
	03-08-1969	4.56
	03-19-1970	3.83
	03-07-1971	4.47
	03-08-1973	2.95
	03-11-1974	2.95
	03-10-1975	5.43
	03-05-1976	3.39
	03-09-1977	4.46
	03-09-1978	5.60
	03-15-1979	4.34
	03-06-1980	4.45
	03-02-1981	3.17
	03-02-1982	3.67
	03-03-1983	.65
	03-09-1984	flowing
	03-04-1985	flowing
	03-10-1986	flowing
	03-04-1987	flowing
	03-02-1988	2.32
	03-02-1989	3.98
	04-19-1989	4.94
(D-8-3)8abd-1 Continued	05-15-1989	7.00
	06-22-1989	12.59
	07-17-1989	10.14
	08-16-1989	12.97
	09-19-1989	12.21
	10-24-1989	11.25
	11-13-1989	7.23
	12-19-1989	5.23
	01-23-1990	4.77
	02-13-1990	4.46
	03-06-1990	4.31
	04-09-1990	5.37
	05-08-1990	8.68
	06-04-1990	10.02
	07-02-1990	13.18
	08-02-1990	14.05
	09-04-1990	14.05
	10-16-1990	8.96
	11-19-1990	7.30
	12-17-1990	6.73
	01-23-1991	6.55
	03-04-1991	6.14
	03-13-1992	5.35
(D-8-3)11caa-1	06-19-1989	180.39
	07-19-1989	182.5
	09-19-1989	184.50
	11-13-1989	182.60
	01-23-1990	181.19
	02-14-1990	181.39
	03-05-1990	181.67
	05-08-1990	182.65
	07-02-1990	185.08
	10-22-1990	187.76
	12-17-1990	185.67
	03-05-1991	185.60
(D-8-3)11ccc-1	06-08-1965	138.13
	07-02-1965	136.42
	03-27-1967	143.50
	02-04-1991	137.00
	03-06-1991	140.00
(D-8-3)11ccc-2	01-30-1991	45.05
	03-07-1991	46.16
(D-8-3)14acc-1	08-19-1963	165.30
	04-01-1964	171.0
	05-12-1964	171.4
	10-14-1964	171.1
	03-19-1965	169.7
	06-30-1965	167.0
(D-8-3)14acc-1 Continued	10-20-1965	165.1
	12-28-1965	165.62
	03-23-1966	168.00
	04-13-1966	168.82
	08-25-1966	175.52
	02-21-1967	172.56
	03-27-1967	172.34
	12-15-1988	170.76
	01-17-1989	169.82
	02-23-1989	170.53
	04-18-1989	171.48
	05-15-1989	171.47
	06-19-1989	172.27
	08-24-1989	175.46
	10-24-1989	174.41
	01-23-1990	172.18
	03-06-1990	172.39
	04-09-1990	172.86
	05-31-1990	175.23
	08-02-1990	179.75
	09-05-1990	180.70
	10-22-1990	178.84
	11-19-1990	177.49
	01-23-1991	177.36
	03-05-1991	177.05
	09-13-1991	178.60
	03-13-1992	175.37
(D-8-3)14bab-1	10-09-1989	146.45
	10-31-1989	145.93
	11-24-1989	145.02
	12-22-1989	144.85
(D-8-3)17ada-1	04-13-1965	23.60
	02-25-1991	24.11
	03-07-1991	24.43
(D-8-3)17cdc-2	03-23-1964	143.70
	03-05-1991	142.22
(D-8-3)18aaa-3	03-07-1991	-2.1
(D-8-3)19ccd-1	04-13-1965	-2.7
	02-26-1991	-6.7
	03-04-1991	-6.4
[1](D-8-3)22cbd-3	01-08-1962	180
	02-13-1962	175.5
	03-14-1962	175.4
	04-11-1962	175.4
	04-03-1964	176.1
	05-12-1964	176.1

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-8-3)22cbd-3 Continued	10-14-1964	176.3
	12-04-1964	175.7
	03-19-1965	173.9
	06-30-1965	172.1
	03-06-1991	179.88
(D-8-3)26bcd-1	03-30-1989	175.64
	06-28-1989	177.89
	07-31-1989	178.22
	08-30-1989	178.91
	09-29-1989	179.47
	10-31-1989	179.91
	11-24-1989	180.54
	12-22-1989	180.91
	03-08-1991	189.04
(D-8-3)26cbd-1	07-31-1989	222.45
	08-30-1989	223.02
	09-29-1989	223.68
	10-31-1989	223.88
	11-24-1989	224.29
	12-22-1989	224.77
	03-08-1991	231.16
(D-8-3)26cbd-2	03-29-1989	34.72
	06-29-1989	36.69
	07-31-1989	36.96
	08-30-1989	37.22
	09-29-1989	37.46
	10-31-1989	37.36
	11-24-1989	37.02
	12-21-1989	36.58
	03-08-1991	36.13
(D-8-3)26cca-2	03-29-1989	20.43
	06-29-1989	21.32
	07-31-1989	21.67
	08-30-1989	22.06
	09-28-1989	22.49
	10-31-1989	22.77
	11-24-1989	22.72
	12-21-1989	22.70
	03-08-1991	21.86
(D-8-3)27adc-1	10-10-1989	90.13
	10-31-1989	90.62
	11-24-1989	91.05
	12-22-1989	91.34
	03-08-1991	96.57
(D-8-3)27adc-2	03-30-1989	156.15
	06-28-1989	158.59
(D-8-3)27adc-2 Continued	07-31-1989	159.41
	08-30-1989	160.15
	09-29-1989	160.71
	10-31-1989	160.58
	11-24-1989	160.32
	12-26-1989	160.17
	03-08-1991	165.40
(D-8-3)27bad-1	10-31-1989	151.52
	11-24-1989	149.61
	12-22-1989	148.76
	03-08-1991	149.39
(D-8-3)27bad-2	01-05-1990	180.29
	03-08-1991	185.36
(D-8-3)30dba-1	05-24-1989	114.46
	03-06-1991	113.73
(D-8-3)33cac-1	10-15-1964	58.00
	03-07-1991	62.41
(D-8-3)34bab-1	11-13-1961	153.50
	12-06-1961	153.50
	01-22-1962	153.40
	02-14-1962	154.20
	03-14-1962	154.50
	04-11-1962	154.50
	03-27-1964	161.20
	04-22-1964	160.68
	05-21-1964	160.70
	07-23-1964	164.20
	10-14-1964	163.10
	12-04-1964	161.29
	01-05-1965	160.36
	02-01-1965	160.09
	03-03-1965	159.44
	04-06-1965	159.05
	05-03-1965	158.81
	06-08-1965	157.86
	07-02-1965	158.08
	10-20-1965	155.82
	12-29-1965	154.05
	01-25-1966	154.37
	02-15-1966	154.38
	03-10-1966	154.31
	04-05-1966	154.83
	05-05-1966	155.35
	06-05-1966	155.70
	07-05-1966	163.48
	08-05-1966	161.58
	09-10-1966	162.35
(D-8-3)34bab-1 Continued	10-05-1966	161.44
	11-15-1966	159.44
	12-15-1966	158.52
	01-10-1967	158.48
	02-05-1967	158.11
	03-05-1967	158.41
	04-05-1967	158.01
	05-05-1967	158.28
	07-10-1967	158.63
	08-05-1967	159.07
	09-05-1967	159.03
	10-05-1967	157.82
	11-05-1967	156.91
	12-05-1967	156.15
	01-05-1968	155.80
	02-05-1968	155.85
	03-05-1968	155.48
	04-05-1968	155.60
	05-05-1968	155.30
	06-05-1968	154.67
	07-05-1968	157.65
	08-05-1968	156.25
	09-05-1968	154.85
	10-05-1968	153.38
	11-05-1968	152.72
	12-05-1968	151.89
	01-05-1969	151.51
	02-05-1969	151.10
	03-05-1969	151.01
	04-05-1969	150.64
	05-05-1969	150.02
	06-05-1969	149.80
	07-05-1969	148.80
	08-05-1969	150.00
	09-05-1969	149.00
	10-05-1969	148.52
	11-05-1969	147.21
	12-20-1969	147.19
	01-05-1970	147.22
	02-05-1970	147.40
	03-05-1970	147.57
	04-05-1970	148.28
	05-05-1970	148.69
	06-05-1970	149.30
	07-05-1970	149.19
	08-05-1970	150.38
	09-05-1970	155.05
	10-05-1970	150.50
	11-05-1970	150.06
	12-05-1970	150.09
	01-05-1971	149.80
	02-05-1971	149.57

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-8-3)34bab-1	03-05-1971	149.57
Continued	04-05-1971	150.83
	05-15-1971	150.15
	06-05-1971	150.38
	07-05-1971	152.04
	08-05-1971	153.30
	09-05-1971	152.53
	10-05-1971	150.94
	11-05-1971	149.05
	12-05-1971	148.58
	01-05-1972	148.52
	02-05-1972	148.54
	03-05-1972	149.41
	04-05-1972	148.88
	05-05-1972	149.14
	06-05-1972	151.38
	07-05-1972	153.36
	08-05-1972	154.98
	09-05-1972	153.72
	10-05-1972	153.11
	11-05-1972	151.58
	12-05-1972	150.88
	01-05-1973	150.85
	02-05-1973	150.70
	03-05-1973	150.37
	04-05-1973	150.47
	05-05-1973	150.00
	06-05-1973	150.76
	07-05-1973	151.85
	08-05-1973	150.63
	09-05-1973	150.51
	10-05-1973	148.62
	11-05-1973	147.61
	12-05-1973	147.02
	01-05-1974	146.48
	02-05-1974	146.10
	03-05-1974	146.03
	04-05-1974	146.11
	05-05-1974	146.09
	06-05-1974	146.94
	07-05-1974	147.83
	08-05-1974	149.16
	09-05-1974	148.78
	10-05-1974	147.84
	11-05-1974	146.40
	12-05-1974	145.28
	01-05-1975	144.76
	02-05-1975	144.67
	03-05-1975	144.55
	04-05-1975	145.08
	05-05-1975	145.26
	06-05-1975	144.94
(D-8-3)34bab-1	07-05-1975	144.45
Continued	08-05-1975	144.65
	09-05-1975	145.42
	10-05-1975	143.30
	11-05-1975	142.37
	12-05-1975	141.11
	01-05-1976	141.94
	02-05-1976	141.69
	03-05-1976	142.31
	04-05-1976	142.25
	05-05-1976	142.59
	06-05-1976	145.20
	07-05-1976	146.62
	08-05-1976	148.12
	09-05-1976	149.93
	10-05-1976	148.15
	11-05-1976	146.60
	12-05-1976	145.90
	01-05-1977	145.90
	02-05-1977	145.91
	03-05-1977	146.18
	04-05-1977	145.74
	05-05-1977	147.30
	06-05-1977	148.41
	07-05-1977	154.47
	08-05-1977	152.67
	09-05-1977	152.91
	10-05-1977	153.01
	11-05-1977	151.45
	12-05-1977	151.00
	01-05-1978	150.73
	02-05-1978	150.48
	03-05-1978	150.34
	04-05-1978	150.77
	05-05-1978	150.21
	06-05-1978	150.08
	07-05-1978	152.68
	08-05-1978	152.83
	09-05-1978	152.42
	10-05-1978	149.70
	11-05-1978	148.51
	12-05-1978	147.77
	01-05-1979	147.85
	02-05-1979	147.77
	03-05-1979	148.05
	04-05-1979	147.98
	05-05-1979	147.93
	06-05-1979	149.00
	07-05-1979	150.87
	08-05-1979	151.28
	09-05-1979	149.43
	10-05-1979	149.07
(D-8-3)34bab-1	11-05-1979	147.85
Continued	12-05-1979	147.10
	01-05-1980	146.77
	02-05-1980	146.69
	03-05-1980	146.59
	04-05-1980	146.73
	05-05-1980	146.09
	06-05-1980	146.02
	07-05-1980	146.02
	08-05-1980	146.44
	09-05-1980	145.45
	10-05-1980	144.37
	11-05-1980	143.31
	12-05-1980	143.16
	01-05-1981	143.42
	02-05-1981	143.84
	03-05-1981	144.21
	04-05-1981	144.83
	05-05-1981	145.23
	06-05-1981	145.24
	07-05-1981	146.96
	08-05-1981	149.56
	09-05-1981	148.34
	10-05-1981	147.70
	11-05-1981	146.33
	12-05-1981	146.15
	01-05-1982	146.05
	02-05-1982	146.51
	03-05-1982	146.53
	04-05-1982	146.56
	05-05-1982	146.09
	06-05-1982	144.62
	07-05-1982	144.45
	08-05-1982	143.79
	09-05-1982	143.21
	03-10-1983	139.47
	03-04-1985	124.22
	03-10-1986	130.40
	03-02-1987	126.81
	03-02-1988	135.79
	11-02-1988	143.39
	12-14-1988	141.98
	01-17-1989	142.16
	02-23-1989	143.09
	03-03-1989	142.99
	04-18-1989	144.26
	05-15-1989	144.91
	06-19-1989	145.52
	07-19-1989	149.10
	08-16-1989	148.64
	09-19-1989	148.07
	10-24-1989	147.02

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-8-3)34bab-1 Continued	11-13-1989	145.84
	12-19-1989	143.98
	01-25-1990	142.24
	02-14-1990	141.39
	03-06-1990	141.07
	04-09-1990	140.99
	07-02-1990	146.40
	08-03-1990	147.93
	09-05-1990	147.11
	10-22-1990	146.09
	11-19-1990	144.99
	12-17-1990	144.28
	01-22-1991	143.44
	03-06-1991	142.75
	09-10-1991	147.47
	03-19-1992	144.98
(D-8-3)34bbb-1	06-02-1989	72.52
	07-19-1989	75.13
	09-18-1989	74.93
	10-24-1989	74.07
	11-13-1989	73.12
	12-19-1989	71.73
	01-25-1990	70.32
	02-14-1990	69.66
	03-06-1990	69.41
	04-09-1990	69.25
	05-10-1990	69.98
	06-04-1990	70.73
	07-02-1990	72.81
	08-02-1990	74.18
	09-05-1990	74.38
	10-22-1990	73.52
	11-19-1990	72.55
	12-17-1990	72.01
	01-23-1991	71.42
	03-06-1991	70.87
	09-12-1991	74.43
	03-13-1992	72.38
(D-9-1)11acc-2	06-20-1989	69.74
	03-06-1991	77.79
(D-9-1)11baa-1	01-23-1989	59.93
	06-20-1989	58.98
	09-18-1989	57.05
	11-14-1989	58.17
	02-14-1990	60.33
	03-06-1990	60.72
	04-09-1990	61.28
	05-08-1990	61.77
	06-04-1990	61.89
(D-9-1)11baa-1 Continued	08-02-1990	59.77
	09-05-1990	58.59
	10-18-1990	58.83
	11-19-1990	59.68
	12-17-1990	60.48
	01-23-1991	61.31
	03-06-1991	62.10
(D-9-1)14aad-1	01-06-1965	60.02
	02-01-1965	59.77
	03-02-1965	59.48
	04-05-1965	59.37
	05-03-1965	59.16
	06-08-1965	65.15
	07-01-1965	66.90
	10-21-1965	57.06
	12-30-1965	56.00
	03-23-1966	55.95
	04-11-1966	56.68
	12-19-1966	57.24
	03-30-1967	57.34
	03-20-1968	56.25
	03-20-1969	55.46
	03-19-1970	55.78
	03-16-1971	55.89
	03-06-1972	55.14
	03-09-1973	57.49
	03-12-1974	56.81
	03-10-1975	58.74
	03-08-1976	57.86
	03-09-1977	63.23
	03-09-1978	61.00
	03-21-1979	59.94
	03-05-1980	59.12
	03-03-1981	57.54
	03-01-1982	58.37
	03-02-1983	55.20
	03-12-1984	53.22
	03-04-1985	53.75
	03-11-1986	54.87
	03-02-1987	55.40
	03-01-1988	57.49
	03-03-1989	58.66
	03-06-1990	57.22
	10-18-1990	57.35
	11-19-1990	56.74
	12-17-1990	57.04
	01-23-1991	57.37
	03-06-1991	57.57
	09-10-1991	65.90
	03-12-1992	57.24
(D-9-1)14aad-2	03-14-1990	26.40
	03-21-1990	26.39
	10-18-1990	29.50
	11-19-1990	28.49
	12-17-1990	28.60
	01-23-1991	28.70
(D-9-1)14*ddd*-1	10-15-1964	34.70
	01-31-1991	30.58
	03-06-1991	30.60
(D-9-1)23ada-1	11-14-1961	24.20
	12-21-1961	24.50
	01-18-1962	24.70
	03-05-1962	24.80
	04-03-1962	24.80
	05-15-1962	25.20
	06-05-1962	24.90
	09-10-1962	27.30
	10-18-1962	25.40
	11-15-1962	24.20
	12-28-1962	23.10
	01-30-1963	22.50
	02-26-1963	22.10
	03-22-1963	22.50
	03-26-1964	27.25
	05-15-1964	26.90
	06-01-1964	27.2
	10-12-1964	28.30
	12-04-1964	26.77
	01-06-1965	25.97
	02-01-1965	25.56
	04-05-1965	24.68
	05-03-1965	24.45
	10-21-1965	22.05
	12-30-1965	20.27
	03-23-1966	19.49
	04-11-1966	19.34
	04-12-1966	19.57
	08-24-1966	26.03
	12-19-1966	22.08
	03-25-1967	22.02
	03-20-1968	16.77
	03-18-1969	12.20
	03-19-1970	11.85
	03-16-1971	12.30
	03-06-1972	11.87
	03-09-1973	18.12
	03-12-1974	9.28
	03-10-1975	15.09
	03-08-1976	11.45
	03-09-1977	17.49

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-9-1)23ada-1 Continued	03-09-1978	24.39
	03-15-1979	17.58
	03-05-1980	16.75
	03-03-1981	10.78
	03-01-1982	15.76
	03-02-1983	5.88
	03-12-1984	2.70
	03-04-1985	3.59
	03-11-1986	7.35
	03-02-1987	6.63
	03-01-1988	11.58
	03-03-1989	15.53
	03-06-1990	19.29
	03-06-1991	23.04
	03-12-1992	21.60
(D-9-1)23daa-1	10-14-1964	44.80
	03-06-1991	39.71
[1](D-9-1)24acb-1	10-14-1964	7.20
	03-08-1991	3.41
(D-9-1)25ada-1	12-02-1937	-14.4
	12-21-1937	-13.6
	02-25-1938	-11.6
	04-06-1938	-10.9
	06-02-1938	-10.4
	08-26-1938	-13.7
	10-09-1938	-13.4
	12-23-1938	-14.3
	03-17-1939	-13.4
	04-14-1939	-12.8
	06-19-1939	-10.5
	08-25-1939	-10.5
	10-13-1939	-10.7
	01-04-1940	-10.8
	07-20-1989	-12.4
	03-07-1991	-7.6
(D-9-1)25ada-3	04-14-1964	-5.7
	05-27-1964	-5.4
	07-09-1964	-6.5
	08-03-1964	-7.4
	08-31-1964	-6.4
	10-01-1964	-5.7
	11-03-1964	-6.4
	12-04-1964	-7.0
	01-06-1965	-7.3
	02-01-1965	-8.0
	03-02-1965	-8.0
	04-05-1965	-7.9
	05-03-1965	-8.1
(D-9-1)25ada-3 Continued	06-08-1965	-9.0
	07-01-1965	-10.7
	10-21-1965	-10.8
	12-30-1965	-12.3
	03-28-1966	-10.2
	08-24-1966	-7.7
	03-28-1967	-8.0
	03-20-1968	-10.6
	03-18-1969	-13.7
	03-24-1970	-14.4
	03-18-1971	-14.8
	03-11-1972	-15.0
	07-20-1989	-12.8
(D-9-1)26aab-1	11-14-1961	63.50
	12-21-1961	63.90
	01-18-1962	63.70
	03-05-1962	64.20
	04-03-1962	64.40
	06-05-1962	65.60
	09-10-1962	67.30
	10-18-1962	65.10
	11-15-1962	64.00
	12-28-1962	62.30
	01-30-1963	61.70
	02-26-1963	61.30
	03-22-1963	61.50
	05-15-1964	66.70
	10-12-1964	68.70
	12-04-1964	66.60
	01-06-1965	65.49
	02-01-1965	65.14
	03-02-1965	64.53
	04-05-1965	63.81
	05-03-1965	63.77
	07-01-1965	65.62
	10-21-1965	61.21
	12-30-1965	58.80
	03-23-1966	57.86
	04-11-1966	57.82
	12-19-1966	61.95
	01-18-1967	61.55
	02-15-1967	61.33
	03-18-1967	61.02
	03-20-1968	54.58
	03-18-1969	49.00
	03-19-1970	48.37
	03-16-1971	48.80
	03-06-1972	47.81
	03-09-1973	56.45
	03-12-1974	44.80
	03-10-1975	52.02
(D-9-1)26aab-1 Continued	03-08-1976	47.20
	03-09-1977	54.93
	03-09-1978	63.60
	03-15-1979	55.58
	03-05-1980	54.70
	03-03-1981	46.37
	03-01-1982	53.49
	03-02-1983	40.78
	03-12-1984	33.38
	03-04-1985	33.28
	03-11-1986	40.39
	03-02-1987	38.82
	03-01-1988	47.45
	11-22-1988	51.28
	12-14-1988	51.42
	01-23-1989	52.02
	02-24-1989	52.36
	03-03-1989	52.53
	04-19-1989	52.82
	05-16-1989	53.30
	06-20-1989	54.91
	07-17-1989	56.22
	08-18-1989	57.19
	09-18-1989	58.46
	10-25-1989	56.89
	11-14-1989	56.93
	12-18-1989	56.85
	01-23-1990	57.06
	02-14-1990	57.01
	03-06-1990	57.21
	04-06-1990	57.28
	05-08-1990	58.41
	06-04-1990	58.64
	07-03-1990	59.92
	08-03-1990	60.43
	09-05-1990	61.41
	10-17-1990	62.20
	11-19-1990	61.84
	12-17-1990	61.88
	01-23-1991	61.88
	03-06-1991	61.92
	03-12-1992	60.28
(D-9-1)27aca-1	02-14-1967	230.94
	03-18-1967	231.14
	03-20-1968	230.64
	03-20-1969	229.61
	03-19-1970	229.00
	12-14-1988	228.29
	01-23-1989	226.67
	02-27-1989	230.87
	04-21-1989	227.30

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-9-1)27aca-1	05-16-1989	227.12
Continued	06-20-1989	226.72
	07-17-1989	226.80
	08-24-1989	226.65
	10-25-1989	226.96
(D-9-1)32bbd-1	12-12-1988	13.70
	01-23-1989	14.30
	02-24-1989	14.82
	04-19-1989	15.43
	05-12-1989	15.60
	06-20-1989	15.07
	07-18-1989	14.33
	08-15-1989	13.76
	09-15-1989	13.73
	10-23-1989	12.99
	11-17-1989	13.19
	12-20-1989	13.47
	01-23-1990	13.75
	02-14-1990	13.98
	03-06-1990	14.21
	04-09-1990	14.56
	05-08-1990	14.84
	06-05-1990	15.04
	07-03-1990	15.13
	08-03-1990	15.13
	09-06-1990	15.12
	10-18-1990	15.12
	12-17-1990	15.22
	03-05-1991	15.95
	03-12-1992	14.39
(D-9-1)36acb-1	05-18-1989	97.41
	03-06-1991	102.41
(D-9-1)36bbc-1	07-09-1961	104
	10-12-1961	106.00
	11-13-1961	106.70
	12-22-1961	106.80
	01-19-1962	107.10
	03-05-1962	107.30
	04-04-1962	107.50
	05-14-1962	106.30
	06-05-1962	102.40
	07-31-1962	105.60
	10-22-1962	100.00
	11-15-1962	99.10
	12-28-1962	98.90
	01-29-1963	99.90
	02-26-1963	100.50
	05-03-1963	106.00
	06-17-1963	112.20
(D-9-1)36bbc-1	08-05-1963	112.40
Continued	09-19-1963	113.80
	10-17-1963	110.80
	11-26-1963	108.20
	12-18-1963	107.70
	01-24-1964	107.40
	04-02-1964	106.50
	05-14-1964	107.70
	10-08-1964	111.90
	03-23-1965	102.20
	06-29-1965	125.40
	03-18-1967	103.69
	03-20-1968	96.80
	03-18-1969	93.24
	03-19-1970	92.57
	03-16-1971	90.35
	03-14-1972	91.30
	03-09-1973	97.51
	03-12-1974	87.77
	03-10-1975	92.73
	03-08-1976	90.09
	03-09-1977	95.93
	03-10-1978	104.27
	03-15-1979	96.02
	03-12-1980	96.60
	03-03-1981	89.88
	03-02-1982	96.04
	03-02-1983	84.29
	03-12-1984	76.68
	03-04-1985	76.32
	03-11-1986	84.99
	03-02-1987	82.38
	03-01-1988	91.69
	03-10-1989	95.58
	05-16-1989	96.31
	06-22-1989	95.78
	07-17-1989	97.57
	08-18-1989	99.16
	09-18-1989	100.54
	10-25-1989	98.83
	11-14-1989	98.40
	01-25-1990	98.74
	02-14-1990	98.95
	03-07-1990	99.29
	04-06-1990	99.75
	05-08-1990	100.17
	06-04-1990	103.63
	08-08-1990	111.28
	09-05-1990	106.52
	10-17-1990	103.92
	11-19-1990	102.53
	12-18-1990	102.23
(D-9-1)36bbc-1	01-23-1991	102.55
Continued	03-06-1991	102.20
	09-12-1991	100.91
	03-12-1992	100.96
(D-9-1)36cdb-1	10-14-1964	170.10
	03-08-1991	167.64
(D-9-1)36cdd-1	03-02-1962	190.50
	04-03-1962	191.30
	05-14-1962	189.50
	06-04-1962	185.40
	07-24-1962	181.00
	10-17-1962	182.50
	11-14-1962	181.30
	12-17-1962	181.60
	01-29-1963	182.70
	02-25-1963	183.60
	03-22-1963	184.60
	05-03-1963	187.70
	06-14-1963	189.80
	08-05-1963	206.80
	09-19-1963	195.10
	10-18-1963	193.70
	11-22-1963	191.50
	12-18-1963	191.00
	01-03-1964	191.00
	01-22-1964	190.60
	03-24-1964	191.07
	05-15-1964	191.60
	10-08-1964	190.80
	12-04-1964	186.87
	01-06-1965	189.19
	02-01-1965	189.30
	03-02-1965	188.86
	04-05-1965	187.42
	05-03-1965	187.13
	06-08-1965	199.40
	10-21-1965	179.00
	12-30-1965	180.09
	03-23-1966	182.52
	12-19-1966	186.99
	03-25-1967	187.87
	03-20-1968	181.14
	03-20-1969	176.89
	03-19-1970	176.35
	03-16-1971	174.48
	03-06-1972	173.52
	03-09-1973	183.65
	03-12-1974	173.23
	03-10-1975	183.87
	03-08-1976	172.65

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-9-1)36cdd-1	03-09-1977	178.93
Continued	03-09-1978	189.05
	03-15-1979	179.96
	03-05-1980	180.52
	03-03-1981	172.83
	03-01-1982	179.49
	03-02-1983	165.95
	03-12-1984	157.25
	03-04-1985	156.19
	03-11-1986	166.42
	03-02-1987	153.49
	03-01-1988	177.55
	11-01-1988	175.71
	12-22-1988	183.09
	01-17-1989	185.19
	02-23-1989	178.37
	03-10-1989	185.19
	05-18-1989	189.66
	03-07-1990	187.86
	03-06-1991	187.52
	03-12-1992	185.57
(D-9-2)1bcb-1	10-10-1966	-6
	04-04-1967	-9.5
	03-05-1991	-7.2
(D-9-2)2add-1	09-30-1964	-12.0
	08-17-1989	-1.6
(D-9-2)2dad-1	04-10-1967	-14.8
	03-05-1991	-.6
(D-9-2)2dad-2	11-29-1956	-16
	09-30-1964	-6.0
	03-20-1967	-15.2
	03-20-1968	-15.1
	03-17-1969	-18.4
	03-24-1970	-19.5
	03-18-1971	-19.1
	03-10-1972	-20.5
	03-08-1973	-17.4
	03-11-1974	-21.4
	03-07-1975	-21.2
	03-05-1976	-18.7
	03-08-1977	-16.2
	03-09-1978	-14.2
	03-15-1979	-14.8
	03-05-1980	-3.5
	03-03-1981	-14.3
	03-01-1982	-14.4
	03-03-1983	-19.2
	03-12-1984	-24.3
(D-9-2)2dad-2	03-05-1985	-28.6
Continued	03-10-1986	-24.6
	03-02-1987	-22.9
	03-01-1988	-15.6
	03-01-1989	-14.4
	04-18-1989	-11.7
	05-15-1989	-9.8
	06-19-1989	-7.2
	07-19-1989	-3.0
	09-19-1989	-6.0
	11-13-1989	-9.2
	12-18-1989	-9.9
	01-25-1990	-10.1
	03-06-1990	-10.7
	04-09-1990	-10.6
	05-09-1990	-7.9
	06-04-1990	-6.6
	07-02-1990	-3.9
	08-02-1990	-2.9
	09-04-1990	-3.2
	10-17-1990	-6.6
	11-19-1990	-7.5
	12-17-1990	-8.5
	01-23-1991	-8.8
	03-04-1991	-9.6
	03-12-1992	-10.2
(D-9-2)3aba-4	11-03-1964	-11.30
	02-20-1991	-15.5
	03-04-1991	-15.4
(D-9-2)4cdc-1	02-10-1967	-11.70
	02-22-1991	12.90
	03-06-1991	13.00
(D-9-2)5acc-1	01-10-1967	-36.00
	08-09-1989	-26.4
	03-06-1991	-32.3
(D-9-2)5bcc-2	09-30-1964	-19.6
	08-09-1989	-14.2
(D-9-2)5bcd-1	02-25-1967	-18
	08-09-1989	-8.1
(D-9-2)5cbb-3	09-30-1964	-19.8
	08-28-1989	-17.5
	03-06-1991	-21.1
(D-9-2)5ccd-2	06-21-1990	3
	07-02-1990	3.44
(D-9-2)5ddd-1	06-21-1990	5
	07-02-1990	5.27
	02-06-1991	6.35
	03-06-1991	5.96
(D-9-2)6add-4	04-01-1964	-22.9
	07-19-1989	-23.3
(D-9-2)6add-5	04-10-1963	-15.0
	07-19-1989	-31.2
(D-9-2)6ddb-1	09-30-1964	-16.8
	03-07-1991	-18.0
(D-9-2)7bdd-1	10-05-1964	15.50
	03-06-1991	20.16
(D-9-2)7cda-2	10-05-1964	7.50
	01-30-1991	8.66
	03-06-1991	8.02
(D-9-2)7dcc-1	10-05-1964	12.30
	02-22-1991	8.20
	03-06-1991	7.94
(D-9-2)9bac-1	09-18-1961	43.00
	10-12-1961	40.40
	11-14-1961	39.70
	12-27-1961	39.60
	01-19-1962	39.70
	03-06-1962	39.30
	04-04-1962	39.10
	05-15-1962	37.50
	06-11-1962	35.70
	07-02-1962	35.20
	09-11-1962	41.00
	10-22-1962	36.80
	11-19-1962	36.50
	12-28-1962	36.10
	01-30-1963	35.20
	02-27-1963	37.50
	03-26-1963	38.70
	05-03-1963	40.00
	06-17-1963	40.20
	09-20-1963	40.10
	10-17-1963	38.20
	11-26-1963	37.50
	12-20-1963	36.60
	01-15-1964	35.80
	03-19-1964	35.60
	06-25-1964	36.80
	10-01-1964	38.20

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-9-2)9bac-1	06-28-1965	34.90
Continued	10-10-1966	36.81
	03-25-1967	38.39
	03-07-1968	35.55
	03-13-1969	34.61
	03-05-1970	33.98
	02-25-1971	33.70
	03-10-1972	34.40
	03-08-1973	35.65
	03-11-1974	32.30
	03-07-1975	31.23
	03-05-1976	32.55
	03-08-1977	33.97
	08-11-1977	63.20
	03-09-1978	35.67
	03-15-1979	35.14
	03-01-1982	33.96
	09-20-1982	32.55
	03-02-1983	30.95
	09-21-1983	27.67
	03-12-1984	27.67
	09-10-1984	26.12
	03-05-1985	27.62
	09-10-1985	28.33
	03-10-1986	28.98
	09-08-1986	28.77
	03-02-1987	30.20
	09-11-1987	29.63
	03-01-1988	35.05
	09-14-1988	32.30
	03-03-1989	34.61
	09-18-1989	33.96
	03-06-1990	36.29
	03-06-1991	37.47
	09-12-1991	36.85
	03-12-1992	37.90
(D-9-2)10dac-1	08-31-1966	-23.0
	09-20-1989	-27.5
	03-04-1991	-20.9
(D-9-2)11aaa-1	08-31-1935	-25.4
	10-08-1935	-25.6
	11-19-1935	-25.5
	12-14-1935	-25.4
	01-23-1936	-25.6
	03-05-1936	-25.3
	05-02-1936	-25.2
	06-20-1936	-26.7
	08-08-1936	-28.2
	10-03-1936	-29.2
	11-30-1936	-29.4
(D-9-2)11aaa-1	02-03-1937	-29.0
Continued	03-03-1937	-28.5
	04-13-1937	-28.4
	06-10-1937	-27.9
	08-01-1937	-29.0
	09-23-1937	-29.1
	11-02-1937	-29.6
	12-12-1937	-29.8
	02-14-1938	-29.5
	04-06-1938	-29.2
	05-05-1938	-29.1
	06-02-1938	-29.1
	08-26-1938	-30.7
	10-29-1938	-31.8
	12-23-1938	-31.8
	03-17-1939	-32.9
	04-14-1939	-31.2
	06-19-1939	-30.8
	08-25-1939	-30.0
	10-13-1939	-30.0
	01-04-1940	-30.0
	04-12-1940	-25.2
	05-01-1940	-25.3
	06-14-1940	-28.2
	01-21-1941	-29.5
	11-14-1941	-30.0
	12-29-1941	-31.3
	01-29-1942	-31.4
	03-26-1942	-31.2
	06-27-1942	-29.8
	03-29-1943	-39.0
	12-29-1943	-38.2
	03-24-1944	-37.0
	12-27-1944	-41.4
	03-29-1945	-40.7
	12-17-1945	-43.0
	03-07-1946	-41.5
	12-17-1946	-42.3
	04-07-1947	-40.9
	12-19-1947	-39.2
	03-30-1948	-41.4
	03-17-1949	-43.7
	12-16-1949	-43.3
	03-22-1950	-42.8
	12-19-1950	-44.5
	04-04-1951	-42.7
	07-19-1951	-41.9
	12-26-1951	-41.9
	04-09-1952	-39.8
	12-16-1952	-55.3
	04-21-1953	-53.5
	12-08-1953	-50.4
(D-9-2)11aaa-1	03-24-1954	-48.0
Continued	12-29-1954	-43.0
	04-22-1955	-40.2
	12-22-1955	-39.8
	03-30-1956	-39.4
	12-19-1956	-37.6
	04-01-1957	-36.0
	12-06-1957	-41.4
	03-18-1958	-41.7
	12-04-1958	-40.3
	03-18-1959	-46.1
	12-24-1959	-41.0
	03-23-1960	-39.8
	12-09-1960	-36.0
	01-05-1962	-34.2
	03-06-1962	-31.2
	12-06-1962	-31.3
	03-12-1963	-30.9
	08-27-1963	-27.9
	12-16-1963	-28.2
	04-09-1964	-27.1
	05-28-1964	-26.8
	07-09-1964	-26.2
	08-03-1964	-25.9
	08-31-1964	-25.8
	10-01-1964	-26.2
	11-03-1964	-26.9
	12-04-1964	-27.0
	01-05-1965	-27.5
	02-02-1965	-27.5
	03-01-1965	-28.0
	04-05-1965	-28.1
	05-03-1965	-28.2
	06-07-1965	-28.1
	07-02-1965	-28.6
	10-21-1965	-31.8
	12-29-1965	-33.2
	03-25-1966	-33.0
	08-25-1966	-33.1
	12-19-1966	-32.5
	03-25-1967	-31.4
	03-20-1968	-35.0
	10-02-1968	-36.9
	03-17-1969	-40.8
	09-03-1969	-42.1
	03-24-1970	-42.3
	09-09-1970	-40.5
	03-18-1971	-40.9
	10-06-1971	-42.6
	03-10-1972	-42.1
	09-26-1972	-40.4
	03-08-1973	-40.5

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-9-2)11aaa-1 Continued	09-06-1973	-44.5
	03-11-1974	-50.0
	03-07-1975	-50.7
	03-05-1976	-49.0
	08-16-1976	-45.5
	03-11-1977	-42.8
	08-10-1977	-37.0
	03-09-1978	-35.2
	03-15-1979	-36.7
	08-23-1979	-32.8
	03-05-1980	-36.1
	09-04-1980	-39.2
	03-03-1981	-41.0
	09-03-1981	-39.0
	03-01-1982	-39.0
	09-20-1982	-48.6
	03-03-1983	-53.8
	03-12-1984	-67.8
	09-10-1984	-74.3
	03-05-1985	-72.1
	09-10-1985	-67.3
	03-10-1986	-58.7
	09-08-1986	-59.7
	03-02-1987	-56.6
	09-11-1987	-50.9
	03-01-1988	-44.9
	09-14-1988	-39.2
	03-10-1989	-37.6
	07-19-1989	-34
	09-19-1989	-34.9
	03-06-1990	-31.6
	03-04-1991	-28.8
	09-12-1991	-26.6
	03-12-1992	-27.7
(D-9-2)11aca-3	10-06-1964	-19.3
	07-19-1989	-22.5
	03-04-1991	-22.3
(D-9-2)17ada-1	11-03-1964	112.79
	12-04-1964	113.25
	01-06-1965	113.80
	02-01-1965	114.50
	03-03-1965	114.93
	04-05-1965	115.31
	05-03-1965	115.20
	06-07-1965	112.90
	07-01-1965	113.66
	10-21-1965	108.05
	12-29-1965	109.92
	03-23-1966	111.95
	08-23-1966	115.30
(D-9-2)17ada-1 Continued	12-20-1966	112.45
	03-27-1967	113.39
	03-20-1968	110.80
	03-18-1969	109.70
	03-19-1970	110.07
	03-16-1971	110.62
	03-06-1972	115.57
	03-08-1973	111.68
	03-12-1974	109.82
	03-07-1975	110.75
	03-05-1976	111.23
	03-08-1977	112.08
	03-09-1978	114.88
	03-15-1979	112.78
	03-05-1980	112.72
	03-03-1981	110.56
	03-01-1982	110.59
	03-02-1983	106.07
	03-12-1984	105.90
	03-05-1985	106.13
	03-10-1986	108.39
	03-02-1987	108.83
	03-01-1988	113.43
	11-02-1988	112.04
	12-22-1988	111.96
	01-17-1989	112.16
	02-23-1989	112.41
	03-03-1989	112.63
	04-19-1989	113.77
	05-15-1989	116.57
	06-20-1989	116.89
	07-17-1989	117.19
	08-16-1989	116.87
	10-25-1989	113.92
	11-14-1989	113.70
	12-18-1989	113.74
	01-25-1990	114.01
	02-14-1990	114.28
	03-07-1990	114.59
	04-06-1990	115.35
	05-08-1990	117.01
	06-04-1990	117.73
	07-03-1990	119.02
	08-02-1990	118.70
	09-04-1990	119.17
	10-17-1990	117.43
	11-19-1990	116.50
	12-17-1990	116.58
	01-23-1991	117.20
	03-06-1991	117.42
	03-12-1992	118.17
(D-9-2)18aca-1	10-07-1964	17.20
	02-22-1991	17.42
	03-06-1991	17.15
(D-9-2)20ccc-1	05-09-1962	23.0
	10-17-1962	21.5
	11-15-1962	21.8
	12-17-1962	20.2
	01-29-1963	21.9
	02-26-1963	21.5
	03-22-1963	21.4
	12-24-1963	20.5
	03-01-1964	22.00
	03-24-1964	21.7
	05-21-1964	21.1
	07-24-1964	21.6
	10-09-1964	21.3
	03-23-1965	21.2
	06-28-1965	21.1
	02-15-1991	20.49
	03-05-1991	20.40
(D-9-2)22cad-1	04-20-1989	136.05
	07-10-1989	134.11
	09-18-1989	137.20
	10-25-1989	138.24
	11-13-1989	138.50
	01-25-1990	139.45
	02-14-1990	139.72
	03-06-1990	139.87
	04-06-1990	139.97
	06-04-1990	133.17
	09-05-1990	137.52
	10-17-1990	138.74
	11-19-1990	139.36
	12-18-1990	139.74
	01-23-1991	139.63
	03-06-1991	140.26
	09-12-1991	136.08
	03-12-1992	138.96
(D-9-2)24bda-1	03-02-1989	283.55
	04-20-1989	284.16
	05-15-1989	284.26
	06-19-1989	284.50
	08-18-1989	284.76
	10-25-1989	284.94
	01-25-1990	285.05
	03-07-1990	285.35
	05-09-1990	285.68
	10-22-1990	286.44
	01-23-1991	286.73
	03-04-1991	286.90

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-9-2)25bbc-1	05-01-1989	72.51
	03-06-1991	80.03
(D-9-2)29acd-1	06-18-1964	-12.5
	07-09-1964	-11.7
	08-03-1964	-11.6
	08-31-1964	-11.3
	10-01-1964	-11.2
	11-03-1964	-11.4
	12-04-1964	-11.8
	01-06-1965	-11.9
	02-01-1965	-12.7
	03-02-1965	-12.5
	04-05-1965	-12.6
	05-03-1965	-12.9
	06-08-1965	-12.8
	08-09-1989	-12.6
(D-9-2)30cbb-2	03-25-1967	13.25
	03-20-1968	9.00
	03-18-1969	6.46
	03-19-1970	6.04
	03-16-1971	5.05
	03-06-1972	5.02
	03-09-1973	9.44
	03-12-1974	2.52
	03-10-1975	5.90
	03-08-1976	3.93
	03-09-1977	8.02
	03-09-1978	14.10
	03-15-1979	8.04
	03-05-1980	8.11
	03-03-1981	4.08
	03-01-1982	8.00
	03-02-1983	Flowing
	03-12-1984	Flowing
	03-04-1985	Flowing
	08-03-1989	7.74
(D-9-3)5cdc-1	10-01-1964	40.98
	12-04-1964	41.17
	03-01-1965	41.23
	06-08-1965	41.29
	12-29-1965	40.12
	03-23-1966	39.56
	12-19-1966	40.19
(D-9-3)5cdc-1 Continued	02-25-1991	40.68
	03-04-1991	40.74
(D-9-3)6abb-1	03-11-1964	8.10
	02-08-1991	10.39
	03-04-1991	9.60
(D-9-3)6cbc-1	10-13-1965	80.50
	03-05-1991	86.23
(D-9-3)7aab-1	04-01-1973	80.00
	02-20-1991	91.49
	03-04-1991	91.50
(D-10-1)1cbb-1	02-13-1962	273.6
	03-02-1962	273.0
	04-03-1962	275.4
	05-14-1962	270.6
	06-04-1962	276.7
	07-03-1962	253.4
	08-06-1962	263.7
	09-10-1962	269.4
	10-17-1962	265.7
	11-14-1962	264.6
	12-17-1962	265.2
	01-29-1963	266.2
	02-25-1963	268.8
	03-22-1963	269.2
	01-07-1964	274.6
	03-24-1964	275.2
	05-15-1964	275.5
	07-27-1964	266.2
	10-09-1964	273.7
	03-23-1965	269.4
	06-28-1965	254.0
	02-21-1991	269.98
	03-07-1991	270.14
(D-10-1)17cca-1	03-19-1964	32.40
	04-15-1964	32.52
	06-01-1964	32.62
	07-09-1964	32.53
	08-03-1964	32.52
	08-31-1964	32.35
	10-01-1964	32.40
	11-03-1964	32.46
(D-10-1)17cca-1 Continued	12-02-1964	32.53
	01-06-1965	32.64
	02-02-1965	32.63
	03-02-1965	32.59
	04-07-1965	32.73
	05-04-1965	32.68
	06-09-1965	32.56
	07-01-1965	32.35
	11-02-1965	32.10
	12-30-1965	32.07
	03-25-1966	32.26
	08-22-1966	31.91
	12-19-1966	32.08
	03-08-1967	32.23
	03-21-1968	31.97
	03-20-1969	31.46
	03-20-1970	31.18
	03-15-1971	31.46
	03-03-1972	31.15
	03-09-1973	31.72
	03-12-1974	30.90
	03-10-1975	31.40
	03-08-1976	31.00
	03-09-1977	32.18
	02-14-1991	32.16
	03-05-1991	31.22

---

[1] Actual location is different from historic records. See footnotes, table 1.

Table 4.—*Discharge of selected wells*

Well number: See figure 1 for explanation of the numbering system for hydrologic-data sites.
Discharge: Natural flow except where noted P, pumped; flow measured except where noted e, estimated.

Well number	Date	Discharge (gallons per minute)
(C-9-1)26bda-3	11-15-39	1.0
	08-18-89	.8
	09-15-89	.8
	10-23-89	1.0
	12-20-89	1.0
(D-7-2)32dad-1	03-24-78	40
[1] (D-7-2)33dcc-1	04-03-67	33
	08-10-89	30
(D-7-2)35ccd-1	04-13-37	1.8
	06-11-37	2.0
	08-01-37	1.7
	09-23-37	1.6
	11-02-37	1.4
	12-23-37	1.9
	02-14-38	2.1
	04-06-38	2.4
	05-05-38	2.5
	06-02-38	2.5
	06-13-38	2.3
	08-25-38	1.6
	02-28-40	2.4
	04-13-40	2.0
	05-01-40	2.6
(D-7-2)35ccd-2	07-18-61	90
	07-18-61	150 P
	09-13-89	0
(D-7-2)36bbb-1	10-30-43	30
	03-17-65	60
(D-7-2)36ccb-1	10-01-61	300
	07-07-89	112
(D-7-2)36dcc-2	05-02-40	1.7
	06-01-64	.5
	07-09-64	.5
	09-01-64	2.0
	03-24-66	12
(D-7-2)36dcc-2	08-24-89	.1
	09-15-89	.1
	10-23-89	.1
	11-14-89	.1
	12-00-89	.1
	01-23-90	.1
[1] (D-7-3)29dcc-1	03-11-53	70
	08-04-64	35

Table 4.—*Discharge of selected wells*—Continued

Well number	Date	Discharge (gallons per minute)
(D-7-3)31cac-2	10-08-64	38
	11-02-64	35
	09-13-89	24
(D-7-3)33baa-6	10-07-35	12
	03-02-36	11
	05-02-36	14
	06-20-36	19
	08-08-36	19
	10-03-36	15
	12-01-36	14
	02-03-37	12
	06-11-37	19
	08-01-37	20
	09-23-37	16
	06-02-38	19
	12-23-38	15
	02-21-39	12
	03-24-39	9.6
	04-13-39	10
	04-13-40	11
	05-02-40	13
	07-09-64	7.5
	07-00-89	3.5
	11-13-89	4.4
	12-00-89	4.0
(D-7-3)33ccc-5	04-01-05	65
	07-00-89	12
	08-24-89	11
	10-26-89	11
	11-14-89	10
	12-00-89	12
	01-23-90	12
(D-8-1)13aaa-1	05-02-36	30
	04-12-40	21
	05-01-40	25
(D-8-1)13daa-3	07-06-64	48
(D-8-1)14dad-1	05-14-66	30
	05-14-66	80 P
	01-31-67	25
(D-8-1)23bdd-1	03-00-18	3.0
	08-24-89	1.1
	09-15-89	.9
	11-14-89	.9
	12-20-89	1.0
	01-23-90	.9
(D-8-1)25aad-1	02-07-53	6.5
	07-21-64	2.0
	08-01-89	.6

Table 4.—*Discharge of selected wells*—Continued

Well number	Date	Discharge (gallons per minute)
(D-8-2)1baa-1	05-12-63	50
	08-06-64	60
[1] (D-8-2)2acc-1	06-30-61	50
	08-06-64	45
(D-8-2)2caa-1	11-12-51	40
	08-06-64	30 P
	09-21-89	.8
(D-8-2)2cda-1	08-06-64	15 P
	09-21-89	3.0
(D-8-2)2daa-1	04-12-48	80
	08-06-64	72
	08-24-89	.7
	09-15-89	.9
	10-23-89	.9
	01-23-90	1.4
(D-8-2)3aad-1	03-17-65	30
	03-17-65	30
	09-15-89	6
(D-8-2)3ccd-1	12-07-61	40
(D-8-2)4abb-1	08-20-64	35
	09-12-89	3.0
(D-8-2)4abb-2	08-20-64	.5
	09-12-89	.2
(D-8-2)4abc-1	05-23-50	35
	07-09-64	30
	09-12-89	.8
[1] (D-8-2)4bab-1	03-25-63	80
	08-20-64	75
	09-12-89	.5
(D-8-2)4cba-2	04-01-36	30
	08-24-89	4.8
	09-15-89	5
	10-23-89	5.4
	11-14-89	5.8
	12-19-89	6.0
	01-23-90	5.64
[1] (D-8-2)4cbb-1	07-06-64	36
	09-15-89	.2
(D-8-2)4dad-1	03-00-63	60
	08-00-64	70
	09-28-89	5.4
(D-8-2)7cab-1	05-07-47	35
	08-20-64	30
(D-8-2)cbd-1	04-15-62	35
	08-20-64	30
(D-8-2)9aad-1	08-24-64	35
	09-28-89	7.2
(D-8-2)10adb-1	05-31-66	80
	06-06-66	60
	09-28-89	7.5

Table 4.—*Discharge of selected wells*—Continued

Well number	Date	Discharge (gallons per minute)
(D-8-2)10bdd-1	12-00-55	40
	09-28-89	4.5
(D-8-2)12ddc-1	09-08-61	225
(D-8-2)13abc-1	08-30-61	250
	08-25-64	88
	09-28-89	2.5
(D-8-2)13bdd-1	12-20-62	175
	08-25-64	135
(D-8-2)14dcc-1	08-05-39	30
	09-02-64	10
(D-8-2)16caa-1	09-15-89	7.1
	11-14-89	7.3
	12-00-89	6.9
	01-23-90	7.6
(D-8-2)17add-5	11-04-62	12 P
(D-8-2)17add-6	06-07-50	4 P
(D-8-2)17ccc-2	10-21-59	10
	09-03-64	60
(D-8-2)17dab-2	07-02-59	5 P
(D-8-2)17ddd-1	07-13-44	6.0 P
(D-8-2)21bbb-2	06-26-56	6.0 P
(D-8-2)21ddd-1	10-15-36	45
	09-15-64	30
(D-8-2)22cdc-1	05-22-35	60 P
	07-00-89	11
(D-8-2)22cdc-2	05-17-57	100
	07-00-89	1.0
(D-8-2)23dbd-3	04-12-40	1.0
	05-01-40	1.0
	09-15-64	.5
(D-8-2)24bdc-2	03-25-63	45
	09-17-64	30
(D-8-2)28cbd-3	11-04-44	1.0
	09-25-64	1.3
	07-31-89	.2
(D-8-2)28daa-1	06-20-39	5.0
	09-25-64	1.0 P
(D-8-2)29bcb-1	12-22-66	25
	03-27-67	50
(D-8-2)29bcd-2	07-10-52	35
	09-25-64	10
(D-8-2)29cab-1	07-28-47	35
	09-25-64	63
(D-8-2)30bad-1	12-04-44	3.0
	09-28-64	1.5
(D-8-2)31bcd-1	08-04-64	38
	11-14-89	22

Table 4.—*Discharge of selected wells*—Continued

Well number	Date	Discharge (gallons per minute)
(D-8-2)31cbb-1	08-28-89	46
(D-8-2)31cda-1	07-21-89	72
(D-8-2)31cdb-1	08-04-64	6.0
	10-21-65	5.5
	12-29-65	8.0
(D-8-2)31cdb-1	03-25-66	5.8
	08-24-66	5.4
	03-24-67	5.8
	08-31-67	4.6
	08-09-89	2.6
(D-8-2)31cdb-2	09-27-68	700
	07-21-89	264
(D-8-2)34acd-1	06-20-46	2.5
	09-28-64	1.3
	07-31-89	.7
(D-8-3)4caa-2	1945	30
	06-08-45	120
	08-06-64	30
(D-8-3)4caa-3	03-31-65	140
(D-8-3)4cad-1	06-18-35	300
	03-06-36	325
	05-27-64	15
(D-8-3)5bca-1	11-04-64	40
	09-14-89	1.0
(D-8-3)6ddd-1	07-07-89	47
(D-8-3)6ddd-2	10-01-64	25
	07-07-89	105
(D-8-3)7aad-1	09-02-48	140
	03-31-65	87
(D-8-3)7abc-1	06-20-72	450
(D-8-3)7aca-2	07-14-48	120
	03-31-65	125
(D-9-1)1bac-1	11-10-76	130
(D-9-1)13bdb-2	11-04-64	30
	08-04-89	18
(D-9-1)25aac-1	06-15-34	39
	10-14-64	3.0
	06-12-90	14
(D-9-1)25aad-1	05-27-64	50
	08-03-89	69
(D-9-1)25aad-2	05-27-64	10
	08-03-89	13
(D-9-1)25aca-1	1938	14
	08-30-89	1.1
(D-9-1)25ada-1	07-05-34	70
	02-25-38	36
	06-02-38	30
	07-09-64	10
	07-20-89	12

Table 4.—*Discharge of selected wells*—Continued

Well number	Date	Discharge (gallons per minute)	
(D-9-1)25ada-2	07-09-64	30	
	07-20-89	12	
(D-9-1)25ada-3	07-09-64	15	
	10-21-65	23	
	12-30-65	19	
	03-28-66	15	
	08-24-66	12	
	03-28-67	14	
	07-20-89	14	
(D-9-1)25ada-4	07-09-64	30	
	07-20-89	22	
(D-9-1)25ada-5	07-09-64	30	
	07-20-89	14	
(D-9-2)1bcb-1	10-10-66	300	
	10-10-66	900	P
	07-00-89	44	
(D-9-2)2add-1	12-00-36	45	
	09-30-64	30	
	08-17-89	.5	
(D-9-2)2dad-2	11-29-56	35	
	09-00-89	16	
	11-13-89	21	
	12-18-89	16	
	01-25-90	17	
(D-9-2)5acc-1	08-09-89	10	
(D-9-2)5bcc-1	04-26-53	38	
(D-9-2)5bcc-2	11-23-56	30	
	09-30-64	30	
	08-09-89	8.0	
(D-9-2)5bcd-1	02-25-67	70	
(D-9-2)5bcd-2	04-07-70	125	
	08-09-89	251	
(D-9-2)5bdd-2	09-23-64	6.0	
(D-9-2)5bdd-4	09-11-64	220	
	03-17-67	92	
	01-02-69	450	
(D-9-2)5cbb-3	05-11-61	25	
	09-30-64	45	
	08-28-89	23	
(D-9-2)5ccc-1	08-04-64	30	
	08-17-89	10	
(D-9-2)5ddb-1	05-11-74	15	
(D-9-2)5ddc-2	08-01-34	450	
	10-08-35	25	
	07-09-64	15	
(D-9-2)6add-4	05-20-61	130	
	09-11-64	100	P
	07-00-89	100	

Table 4.—*Discharge of selected wells*—Continued

Well number	Date	Discharge (gallons per minute)
(D-9-2)6add-5	04-10-63	450
(D-9-2)6ddb-1	10-05-70	150
(D-9-2)10dac-1	08-31-66	41
(D-9-2)11aca-3	12-13-58	250
(D-9-2)29acd-1	03-21-50	7
	06-18-64	75
	07-09-64	75
	08-31-64	70
	08-09-89	100
(D-9-2)30bcb-2	07-09-64	30
	08-03-89	15
(D-9-2)30cbb-2	06-29-57	40 P

---

[1] Actual location is different from historic records. See footnotes, table 1.

Table 5.—*Chemical analyses of*

[mg/L, milligrams per liter;

Well number: See figure 1 for explanation of the numbering system for hydrologic-data sites.
Date sampled: Except R, date received by laboratory (Cordova, 1969, table 5).
Specific conductance: µS/cm, microsiemens per centimeter at 25 degrees Celsius, measured in the
Temperature: ° C, degrees Celsius.

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dis-solved (mg/L as Ca)	Magnesium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
(C-8-1)20cdb-2	07-13-81	1,300	—	26.5	—	—	—	—
	07-07-89	1,340	7.7	26.0	340	76	37	130
	06-13-90	1,310	6.3	24.0	—	—	—	—
	08-19-91	1,260	7.6	25.5	—	—	—	—
(C-8-1)20cdb-3	07-30-80	1,290	—	24.0	—	—	—	—
	07-25-83	1,260	—	25.5	—	—	—	—
	07-12-89	1,350	7.7	25.0	—	—	—	—
(C-8-1)20cdb-4	07-12-89	1,340	7.7	25.0	—	—	—	—
(C-8-1)29dda-1	07-25-83	2,870	—	18.0	—	—	—	—
	08-23-89	3,550	7.9	22.5	—	—	—	—
	07-11-90	3,480	7.7	18.5	—	—	—	—
(C-8-1)35dcb-1	07-06-60	1,700	—	—	370	88	36	170
	06-15-64	1,630	—	20.5	410	88	45	170
	04-28-66	1,590	—	14.0	490	130	43	170
	08-08-90	1,840	—	19.5	450	120	36	160
(C-9-1)3ddb-1	05-04-65	1,340	7.9	14.5	270	60	29	180
	04-28-66	1,260	7.6	14.5	230	56	22	170
	07-13-81	1,300	—	15.5	—	—	—	—
	07-12-89	1,790	7.6	14.5	—	—	—	—
	08-23-89	1,400	7.6	14.5	—	—	—	—
	07-11-90	1,300	7.8	17.5	—	—	—	—
(C-9-1)4ccc-1	08-21-75	750	6.8	14.5	160	40	15	92
	08-16-76	790	7.4	14.0	170	46	14	100
	07-12-77	800	6.6	14.0	180	44	16	98
	08-24-78	900	6.8	14.0	210	54	19	100
	07-17-79	1,000	—	16.0	—	—	—	—
	08-01-79	1,100	7.7	16.0	250	62	23	110
	07-31-80	1,210	—	15.5	—	—	—	—
	09-03-80	1,200	7.6	15.0	270	66	25	130
	07-15-81	1,220	7.9	14.5	280	70	26	120

water from selected wells

—, no data; <, less than]

field.

Potassium, dis-solved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dis-solved (mg/L as SO_4)	Chloride, dis-solved (mg/L as Cl)	Fluoride, dis-solved (mg/L as F)	Silica, dis-solved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
—	—	—	—	—	—	—	—
—	—	100	210	.60	20	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
22	—	68	390	—	—	863	—
22	—	130	400	—	—	913	—
27	—	120	400	—	—	1,010	—
20	—	65	370	<.10	71	1,020	.80
—	176	95	280	—	61	810	—
15	—	98	240	—	—	712	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
8.1	148	59	110	.30	58	477	1.30
8.1	144	62	130	.30	58	512	1.60
8.0	140	59	140	.30	56	505	—
9.2	140	64	160	.30	56	558	2.60
—	—	—	—	—	—	—	—
11	130	87	210	.30	60	658	3.80
—	—	—	—	—	—	—	—
11	140	80	240	.30	60	717	4.70
8.6	—	84	240	.20	62	703	6.00

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dis-solved (mg/L as Ca)	Magnesium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
(C-9-1)4ccc-1	07-07-82	1,230	—	14.0	—	—	—	—
	08-16-85	1,460	8.0	13.0	380	93	36	150
	06-30-86	1,400	—	14.0	—	—	—	—
	07-02-87	—	7.7	14.0	350	86	34	290
	06-15-88	1,390	7.5	14.0	—	—	—	—
	08-07-90	1,050	7.7	14.0	240	61	22	99
(C-9-1)4ddc-1	05-28-64	980	8.5	16.5	200	55	16	120
	06-09-64	980	8.4	16.5	210	54	18	120
	06-17-65	1,050	8.3	16.5	230	59	21	130
	04-28-66	1,070	7.6	18.5	220	55	21	130
	07-16-79	1,750	—	17.0	—	—	—	—
	07-31-80	1,800	—	16.5	—	—	—	—
	08-07-90	1,320	7.6	20.0	310	80	26	120
(C-9-1)5ddc-1	08-29-90	790	7.7	15.0	180	45	16	81
[1](C-9-1)20cdd-1	08-19-64	720	8.2	16.0	130	34	11	—
	04-27-66	730	7.5	14.0	130	34	11	110
	06-22-81	810	—	16.5	—	—	—	—
	07-28-86	800	—	16.0	—	—	—	—
	07-05-89	1,090	7.9	18.0	220	56	19	110
	06-13-90	1,080	6.9	18.5	—	—	—	—
	07-23-90	1,060	7.8	17.0	—	—	—	—
(C-9-1)20ddd-1	06-23-65	720	—	17.0	144	32	15	91
	05-09-66	740	8.0	16.5	150	37	14	90
	07-10-73	690	7.9	17.0	130	34	12	85
	07-16-79	700	—	19.0	—	—	—	—
	07-31-80	720	—	17.0	—	—	—	—
	08-07-90	710	7.8	17.5	130	34	11	88
(C-9-1)26bda-3	01-25-61	2,130	7.8	—	370	81	41	280
	04-06-61	2,030	8.1	—	330	56	45	280
	05-26-64	2,200	7.9	11.0	450	100	46	280
	07-07-89	2,320	7.4	12.5	400	81	48	270
(C-9-1)28ccb-1	04-05-63	800	—	—	191	48	17	94
	09-11-63	830	—	—	223	62	17	101
	06-09-64	940	—	18.5	219	35	20	104
	06-17-65	980	—	18.5	235	63	19	107

water from selected wells—**Continued**

Potassium, dissolved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
—	—	—	—	—	—	—	—
9.9	—	110	320	.30	60	895	9.80
—	—	—	—	—	—	—	—
8.5	—	210	300	.30	58	1,110	9.20
—	—	—	—	—	—	—	—
9.1	—	63	170	.10	60	581	3.90
15	—	78	190	—	—	549	—
14	—	74	180	—	—	551	—
14	—	100	200	—	—	609	—
17	—	95	200	—	—	598	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
15	—	59	290	.20	77	759	2.10
9.7	—	61	110	.20	67	484	1.10
—	—	73	100	—	58	—	—
8.2	—	84	100	—	—	434	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	69	150	.30	59	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
10	—	84	98	—	—	—	—
10	—	73	94	—	—	408	—
8.9	152	53	86	—	64	434	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
8.4	—	53	87	.20	67	459	1.60
34	—	110	460	—	—	1,150	—
34	—	99	470	—	—	1,110	—
37	—	150	490	—	—	1,270	—
—	—	100	530	.40	66	—	—
11	—	80	112	—	—	—	—
11	—	102	146	—	—	—	—
13	—	98	151	—	—	—	—
13	—	115	165	—	—	—	—

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dis-solved (mg/L as Ca)	Magnesium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
(C-9-1)28ccb-1	04-27-66	960	—	14.5	243	64	20	107
	07-31-80	1,120	—	19.5	—	—	—	—
	07-15-81	1,170	7.7	18.0	300	77	25	100
	07-07-82	1,120	—	18.5	—	—	—	—
	07-17-84	1,140	7.5	18.5	280	71	24	100
	07-03-85	2,310	8.0	17.5	310	81	26	110
	06-12-86	1,120	7.6	18.5	—	—	—	—
	08-07-90	810	7.9	19.0	180	50	14	81
(C-9-1)29acc-1	05-23-63	760	8.5	—	120	29	11	110
	05-28-64	770	8.4	—	150	37	13	110
	06-18-65	760	8.5	15.0	170	38	18	100
	04-27-66	710	7.7	15.0	150	36	14	100
	07-31-80	960	—	17.0	—	—	—	—
	06-22-81	950	—	16.5	—	—	—	—
(C-9-1)29bcc-1	06-19-65	930	8.1	17.0	290	73	26	71
	05-06-66	860	7.5	17.0	350	89	32	71
	07-02-85	740	—	15.5	—	—	—	—
(C-9-1)34ccc-1	08-21-75	1,400	6.6	17.5	520	110	59	93
	07-17-79	1,550	—	17.0	—	—	—	—
	08-01-79	1,600	7.6	19.0	—	—	—	—
	09-03-80	1,700	7.1	17.5	590	130	65	100
	07-02-86	1,510	—	17.5	—	—	—	—
[1](C-9-1)34acd-1	10-09-62	1,120	8.2	—	350	60	48	78
	04-27-66	1,050	7.8	11.5	410	82	49	80
	08-17-72	1,200	7.7	12.0	390	77	48	77
(C-9-1)34ddc-1	04-27-66	930	7.6	13.0	330	66	40	69
	10-12-71	1,050	7.5	12.5	330	63	42	69
	06-04-91	1,040	7.5	15.0	320	61	41	67
(C-10-1)3ddb-1	10-09-62	2,140	—	—	400	61	60	320
	08-05-70	2,760	—	13.0	560	91	81	—
	08-11-72	4,010	—	14.0	910	150	130	560
	09-09-74	1,560	—	19.5	530	120	57	100
(C-10-1)4bbb-1	11-01-62	690	—	—	107	30	10	98
	04-03-63	670	8.3	—	110	26	10	98
	09-11-63	800	8.1	—	150	36	14	110

water from selected wells—**Continued**

Potassium, dissolved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
15	—	118	166	—	—	—	—
—	—	—	—	—	—	—	—
12	—	110	210	.20	70	695	4.30
—	—	—	—	—	—	—	—
14	—	110	210	.30	65	694	5.20
12	—	110	220	.30	68	728	5.80
—	—	—	—	—	—	—	—
11	—	64	100	.40	74	474	1.60
6.3	—	78	100	—	—	426	—
7.0	—	96	100	—	—	446	—
7.0	—	110	110	—	—	462	—
8.6	—	82	110	—	—	439	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
9.0	—	150	170	—	—	533	—
9.0	—	170	170	—	—	603	—
—	—	—	—	—	—	—	—
14	199	100	300	.20	65	864	.75
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
14	190	120	360	.30	65	983	3.20
—	—	—	—	—	—	—	—
11	—	84	240	—	—	583	—
12	—	99	240	—	—	654	—
11	143	96	250	—	60	705	—
12	—	33	230	—	—	531	—
9.2	144	35	220	—	—	525	—
8.4	—	25	220	.50	65	572	—
3.5	—	200	400	—	—	1,240	—
30	351	310	550	—	35	1,680	—
6.3	405	620	830	—	51	2,590	—
17	195	100	320	.20	63	898	.73
9.3	—	42	82	—	—	—	—
9.3	—	44	83	—	—	371	—
10	—	70	130	—	—	448	—

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dis-solved (mg/L as Ca)	Magnesium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
(C-10-1)4bbb-1	06-16-65	1,330	8.1	18.5	430	100	42	100
	04-27-66	1,340	7.4	15.5	420	100	41	110
	07-10-73	1,320	7.7	19.0	380	92	37	110
	08-03-73	1,230	—	18.5	—	—	—	—
	09-05-74	1,350	—	19.0	—	—	—	—
	08-30-76	1,160	—	19.5	—	—	—	—
	08-25-78	1,100	—	20.0	—	—	—	—
	08-01-80	1,200	—	19.5	—	—	—	—
	08-07-90	2,460	7.5	18.0	—	—	—	—
(C-10-1)4cbb-1	04-05-62	1,770	8.5	—	440	110	39	180
	08-06-62	1,440	8.2	—	370	94	34	140
	09-14-62	1,390	7.5	—	400	120	25	130
	06-07-63	1,310	8.3	—	420	130	22	120
	09-11-63	1,280	7.8	—	390	100	33	110
	06-09-64	1,300	8.2	19.0	380	100	31	120
	10-02-64	1,350	—	—	447	123	34	118
	06-16-65	1,320	8.3	19.0	670	190	49	110
	04-27-66	1,330	7.5	19.5	410	100	39	110
	09-05-69	1,230	7.7	17.0	400	93	40	—
	08-05-70	1,290	7.9	18.0	420	100	39	150
	10-07-71	1,260	7.6	16.5	370	89	35	100
	08-11-72	1,110	—	18.5	—	—	—	—
	08-03-73	1,100	7.7	19.0	330	82	30	97
	09-06-74	1,150	—	19.0	—	—	—	—
	08-16-76	1,050	7.2	19.0	320	82	27	97
	07-12-77	1,000	6.5	20.0	270	68	25	92
	07-17-79	1,100	—	19.0	—	—	—	—
	08-01-79	1,150	7.9	19.0	330	83	31	95
	08-01-80	1,510	—	19.0	—	—	—	—
	09-03-80	1,500	7.6	—	480	120	43	110
	07-13-81	1,750	7.8	19.0	530	130	49	120
	07-07-82	1,900	—	19.5	—	—	—	—
	07-18-84	1,740	7.4	17.5	610	130	69	110
	07-03-85	1,830	—	18.5	—	—	—	—
	06-30-86	2,490	7.6	19.0	900	220	84	150

water from selected wells—Continued

Potassium, dissolved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
12	—	200	240	—	—	768	—
14	—	200	240	—	—	778	—
11	135	140	230	—	—	701	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
15	—	300	310	—	—	1,020	—
14	—	220	240	—	—	831	—
13	—	240	230	—	—	839	—
13	—	240	220	—	—	825	—
11	—	200	220	—	—	755	—
13	—	230	230	—	—	777	—
13	—	338	235	—	—	—	—
13	—	260	230	—	—	906	—
15	—	210	220	—	—	788	—
—	162	160	200	—	60	767	—
—	149	300	190	—	—	896	—
10	148	180	180	—	—	683	—
—	—	—	—	—	—	—	—
9.0	153	160	160	—	64	693	—
—	—	—	—	—	—	—	—
11	158	120	160	.20	60	669	3.80
9.7	160	100	150	.20	64	602	—
—	—	—	—	—	—	—	—
11	140	99	220	.20	68	706	3.30
—	—	—	—	—	—	—	—
12	140	88	360	.20	65	898	3.60
11	—	95	420	.20	68	988	3.70
—	—	—	—	—	—	—	—
13	—	140	380	.30	62	1,040	5.20
—	—	—	—	—	—	—	—
15	—	100	710	.20	67	1,440	3.50

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dis- solved (mg/L as Ca)	Magnesium, dis- solved (mg/L as Mg)	Sodium, dis- solved (mg/L as Na)
(C-10-1)4cbb-1	08-07-90	740	7.5	20.5	200	52	18	61
(C-10-1)9ccc-1	06-13-61	2,710	7.8	—	1,200	270	120	86
	09-06-62	2,670	7.7	—	1,100	250	110	99
	06-06-63	2,540	7.8	—	1,100	260	110	100
	09-24-63	2,320	7.5	—	930	210	99	94
	05-28-64	2,530	8.1	16.5	1,100	250	110	100
	08-07-64	2,280	8.0	16.5	1,000	230	110	100
	04-28-66	2,200	7.4	18.5	920	210	94	110
	08-11-72	1,920	7.3	17.0	740	170	77	100
	09-09-74	1,940	—	18.0	740	170	77	100
	07-17-79	2,000	—	18.0	—	—	—	—
	08-04-80	2,100	—	17.0	—	—	—	—
	07-25-83	2,020	—	18.0	—	—	—	—
	07-28-86	1,670	—	18.0	—	—	—	—
	07-12-89	1,980	7.3	17.5	—	—	—	—
	08-18-89	1,960	7.4	18.0	690	160	70	120
(C-10-1)10ddc-3	06-04-91	2,800	—	14.5	960	170	130	220
[1](C-10-1)15cca-1	06-04-91	3,000	7.2	15.0	710	140	88	380
(C-10-1)17aaa-1	04-27-65	770	7.5	19.5	320	84	26	30
	10-12-71	1,390	7.3	18.0	560	140	50	45
	08-17-72	1,550	7.6	20.0	630	160	57	47
	07-10-73	1,620	7.5	20.0	730	190	63	54
	09-09-74	1,780	—	20.0	730	180	69	53
	08-21-75	1,800	6.8	18.5	830	210	73	55
	08-16-76	2,120	6.9	19.5	980	250	86	58
	07-12-77	2,180	6.8	19.5	1,100	290	95	61
[1](C-10-1)25abd-1	06-06-61	1,560	8.0	—	480	110	52	130
	07-07-61	1,570	8.3	—	490	110	50	140
	08-09-61	1,540	7.9	—	490	110	50	140
	08-31-62	1,460	7.8	—	380	75	47	150
	06-01-64	1,700	8.1	17.0	410	64	61	190
	08-04-80	2,150	—	17.5	—	—	—	—
	07-15-81	2,300	—	18.5	—	—	—	—
	07-02-86	2,100	—	17.5	—	—	—	—
	07-11-90	2,090	7.2	18.5	520	110	60	230

water from selected wells—Continued

Potassium, dissolved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
11	—	38	73	.20	78	455	2.70
16	—	580	480	—	—	1,610	—
17	—	560	490	—	—	1,560	—
15	—	610	460	—	—	1,600	—
17	—	490	410	—	—	1,360	—
17	—	630	430	—	—	1,580	—
16	—	580	380	—	—	1,480	—
18	—	510	370	—	—	1,390	—
12	134	310	330	—	60	1,140	—
14	136	290	300	.20	62	1,210	25.0
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	370	310	.10	61	—	—
14	—	190	790	.30	59	1,710	—
8.7	—	370	650	.40	41	1,860	—
—	145	67	99	—	59	484	—
12	126	140	200	—	—	663	—
12	117	170	230	—	59	805	—
14	113	200	250	—	58	897	—
16	112	230	260	.10	58	1,120	43.0
14	107	330	260	.10	56	1,250	42.0
15	109	420	300	.10	57	1,460	46.0
16	98	530	310	.10	55	1,420	—
11	—	110	250	—	—	861	—
11	—	130	250	—	—	875	—
11	—	130	260	—	—	884	—
12	—	120	260	—	—	813	—
18	—	160	360	—	—	962	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
14	—	120	340	.60	51	1,120	<.10

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dis-solved (mg/L as Ca)	Magnesium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
(C-10-1)25abd-1	07-31-90	2,130	7.2	18.5	—	—	—	—
(C-10-1)29cdd-1	04-14-61	1,430	7.6	—	630	110	87	71
	07-10-61	570	8.1	—	210	54	19	28
	04-04-63	480	8.4	—	150	29	20	30
	08-07-64	590	8.0	23.0	220	62	16	26
	04-28-66	580	7.6	21.0	220	58	18	26
	07-16-79	600	—	20.0	—	—	—	—
	07-10-90	780	7.5	23.0	300	78	26	27
	07-31-90	770	7.4	22.5	—	—	—	—
	08-20-91	690	6.9	22.5	—	—	—	—
(C-10-1)29ddd-1	04-04-63	3,180	7.9	—	1,000	210	130	110
	09-10-63	1,710	8.0	—	1,000	250	100	100
	07-24-64	2,710	8.0	20.0	1,100	240	110	110
	08-07-64	3,340	8.0	18.0	1,400	330	140	120
	04-28-66	3,650	7.1	17.0	1,700	410	170	130
	08-20-91	3,460	6.9	21.5	—	—	—	—
(C-10-1)31cdd-1	06-21-63	450	8.4	—	150	28	19	26
	09-26-63	600	7.9	—	180	41	19	38
	06-03-64	470	8.3	—	180	40	19	24
	10-08-64	470	8.3	19.0	180	38	20	25
	04-28-66	580	8.0	18.5	230	59	21	26
	07-16-79	750	—	18.5	—	—	—	—
	07-13-81	800	—	21.0	—	—	—	—
	07-31-90	880	7.4	18.5	—	—	—	—
(C-10-1)32ccc-1	06-06-61	690	8.1	—	260	66	22	36
	07-10-61	650	7.8	—	240	63	20	36
	09-06-62	680	7.7	—	250	67	20	37
	04-03-63	630	8.3	—	220	54	21	37
	09-10-63	580	8.1	—	190	45	19	37
	06-16-64	560	8.3	20.0	190	47	17	36
	08-07-64	700	8.0	20.0	260	65	23	38
	06-15-66	740	8.0	20.0	280	73	24	36
	07-17-79	1,150	—	19.5	—	—	—	—
	08-04-80	1,150	—	19.5	—	—	—	—
(C-11-1)6abc-1	07-10-63	510	8.2	—	170	43	16	30

water from selected wells—**Continued**

Potassium, dis- solved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dis- solved (mg/L as SO_4)	Chloride, dis- solved (mg/L as Cl)	Fluoride, dis- solved (mg/L as F)	Silica, dis- solved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
—	—	—	—	—	—	—	—
19	—	44	370	.30	46	811	—
9.8	—	36	63	—	—	306	—
5.9	—	41	69	—	—	249	—
9.8	—	46	58	—	—	315	—
9.4	—	40	62	—	—	308	—
—	—	—	—	—	—	—	—
9.4	—	31	100	.30	70	511	17.0
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
22	—	670	570	—	—	1,740	—
23	—	420	560	—	—	1,490	—
24	—	480	560	—	—	1,560	—
24	—	790	590	—	—	2,020	—
27	—	950	660	—	—	2,400	—
—	—	—	—	—	—	—	—
6.3	—	26	56	—	—	224	—
10	—	57	83	—	—	309	—
6.3	—	40	54	—	—	255	—
6.3	—	47	63	—	—	260	—
5.9	—	44	67	—	—	317	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
9.4	—	83	83	—	—	385	—
10	—	62	75	—	—	362	—
10	—	64	79	—	—	375	—
9.4	—	71	78	—	—	347	—
10	—	74	83	—	—	322	—
9.8	—	64	77	—	—	310	—
10	—	83	87	—	—	393	—
9.9	—	55	86	.50	62	440	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
7.0	—	67	58	—	—	279	—

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dis-solved (mg/L as Ca)	Magnesium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
(C-11-1)6abc-1	07-24-64	520	8.3	18.0	180	42	18	33
	06-10-65	470	8.3	18.5	160	36	16	29
	08-21-75	580	7.0	18.0	230	62	18	28
	07-12-77	620	7.0	19.0	240	68	18	28
	07-13-81	610	—	20.5	—	—	—	—
	07-11-89	590	7.7	19.0	—	—	—	—
	07-18-90	610	7.6	19.5	—	—	—	—
(C-11-1)6bdd-1	08-31-64	520	7.6	18.5	210	57	16	32
	06-11-65	460	8.2	19.0	170	43	15	25
	07-13-81	560	—	20.5	—	—	—	—
	07-18-90	550	7.6	19.5	220	57	18	25
	07-31-90	560	7.7	19.5	—	—	—	—
(D-7-2)34dcd-1	05-13-64	710	8.5	13.5	240	46	30	73
	06-22-65	570	8.6	14.0	160	16	29	75
	03-26-81	640	—	13.5	—	—	—	—
(D-7-3)28bdb-1	06-21-63	1,490	7.5	—	730	190	63	—
	06-24-63	1,340	8.0	—	590	130	63	60
	05-11-64	1,470	8.0	18.0	760	190	68	60
	10-14-68	1,120	7.8	—	470	73	69	—
	09-03-69	1,170	7.9	—	530	81	80	—
	10-08-71	1,000	—	—	—	—	—	—
	06-18-72	1,120	8.0	—	450	73	64	63
	06-18-73	1,120	8.0	—	450	73	64	63
	09-09-74	1,160	—	—	460	77	64	60
	08-18-75	1,050	—	—	—	—	—	—
	08-12-76	1,150	—	—	—	—	—	—
	07-12-77	1,150	—	—	—	—	—	—
	08-22-78	1,150	—	—	—	—	—	—
	07-30-79	1,200	7.9	—	480	82	66	60
	09-03-80	1,120	8.4	—	—	—	—	—
	07-30-81	1,180	—	—	—	—	—	—
(D-7-3)30aaa-1	08-28-81	490	—	14.0	170	44	15	33
(D-7-3)33baa-6	02-11-59	540	7.8	12.0	270	71	22	—
	04-21-60	540	8.1	12.0	260	69	22	—
	09-15-60	500	8.3	12.0	250	69	20	15

water from selected wells—Continued

Potassium, dissolved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
7.4	—	50	65	—	—	285	—
7.0	—	51	58	—	—	253	—
7.2	159	35	60	—	57	363	—
7.3	160	43	66	.20	57	386	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	27	58	—	57	—	—
6.6	—	29	55	—	—	248	—
—	—	—	—	—	—	—	—
7.1	—	26	58	.30	62	374	1.00
—	—	—	—	—	—	—	—
5.9	—	5.3	43	—	—	404	—
5.5	—	11	44	—	—	334	—
—	—	—	—	—	—	—	—
—	212	540	78	—	14	1,080	—
7.0	—	520	86	—	—	910	—
5.1	—	560	82	—	—	1,080	—
—	52	440	87	—	1.4	786	—
—	70	410	80	—	—	733	—
—	—	—	—	—	—	—	—
5.7	30	430	84	—	.70	738	—
5.7	30	430	84	—	.70	738	—
7.2	—	430	86	—	1.0	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
6.8	34	450	85	.30	1.0	772	<.10
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
2.5	—	<5.0	28	.30	5.8	248	.11
—	235	43	13	—	11	318	—
—	230	45	14	—	10	314	—
1.1	222	46	14	.20	9.8	311	—

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dis-solved (mg/L as Ca)	Magnesium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
(D-7-3)33baa-6	05-26-61	530	7.7	12.0	270	74	21	—
	08-12-76	560	—	12.5	—	—	—	—
	08-10-77	540	—	13.0	—	—	—	—
	08-22-78	540	—	13.5	—	—	—	—
	09-03-80	580	—	13.0	—	—	—	—
	09-03-81	580	—	12.5	—	—	—	—
	09-20-82	580	—	13.0	—	—	—	—
	07-29-83	560	7.2	13.5	260	68	22	14
	07-17-84	530	7.4	12.5	260	68	22	14
	08-02-85	880	7.5	13.5	—	—	—	—
	07-03-86	580	7.2	13.0	270	68	24	20
	07-29-87	—	—	13.0	260	68	22	14
	06-15-88	550	—	13.0	—	—	—	—
	06-09-89	560	7.2	13.0	270	70	22	13
	07-19-90	540	7.4	12.5	—	—	—	—
	07-22-91	540	7.4	—	—	—	—	—
(D-7-3)34cdb-1	10-14-60R	—	—	—	270	72	23	17
	09-09-74	460	8.2	18.5	220	56	20	8.8
	08-18-75	350	6.7	16.5	190	47	18	3.6
	08-12-76	590	6.8	15.5	300	72	28	16
	07-12-77	600	6.7	17.0	290	70	29	17
	08-25-78	590	6.8	19.0	300	74	27	18
	07-30-79	500	7.8	18.5	250	61	24	11
	09-02-80	540	—	17.0	—	—	—	—
	07-30-81	630	8.2	14.0	290	69	28	17
	09-20-82	600	—	12.5	—	—	—	—
	06-15-88	580	7.7	13.0	290	69	29	17
	07-20-89	580	—	26.5	—	—	—	—
	07-19-90	590	7.5	17.5	—	—	—	—
	07-22-91	600	6.2	13.0	290	70	27	16
(D-8-1)3dda-1	05-06-91	7,960	—	25.0	1,300	360	97	1,200
(D-8-1)10bcb-1	07-03-91	9,400	6.3	36.0	1,600	440	110	1,500
(D-8-1)11bac-1	06-14-91	740	7.7	16.0	210	50	20	50
(D-8-1)35cac-2	09-04-80	850	—	15.5	—	—	—	—
(D-8-2)2daa-1	08-06-64	450	7.7	16.0	210	51	21	—

water from selected wells—**Continued**

Potassium, dissolved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
—	228	45	14	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
1.6	—	47	14	.20	11	314	.76
1.7	—	45	10	.20	11	313	1.00
—	—	—	—	—	—	—	—
2.1	—	64	19	.20	12	348	.80
1.9	—	43	12	.20	11	310	.91
—	—	—	—	—	—	—	—
—	—	41	11	.10	11	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
5.2	224	55	26	.10	11	345	—
1.8	202	31	11	.20	9.3	263	.92
.50	179	14	3.3	—	6.8	200	—
2.3	236	59	19	.20	12	356	1.30
2.2	240	58	15	.20	12	346	—
2.4	220	57	20	.10	12	350	1.40
1.8	210	46	12	.20	10	296	1.00
—	—	—	—	—	—	—	—
2.1	—	57	14	.20	13	349	1.10
—	—	—	—	—	—	—	—
3.2	—	54	15	.30	13	354	1.40
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
2.1	—	55	15	.20	12	344	—
140	—	820	2,200	2.9	20	5,190	—
190	—	1,000	2,700	3.0	24	6,340	—
14	—	20	140	.90	52	424	—
—	—	—	—	—	—	—	—
—	—	17	12	—	25	—	—

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (^oC)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)
(D-8-2)2daa-1	06-09-89	480	7.8	15.0	220	52	21	15
(D-8-2)4cba-2	08-13-76	440	—	15.0	—	—	—	—
	09-20-82	440	—	15.5	—	—	—	—
(D-8-2)12ddc-1	05-03-65	630	7.7	12.0	190	30	27	75
	10-14-68	790	8.1	14.0	280	56	35	—
	09-03-69	740	7.8	12.0	260	30	44	—
	08-05-70	770	8.7	13.0	280	—	—	—
	10-14-71	780	—	14.0	—	—	—	—
	08-11-72	720	—	13.0	—	—	—	—
	06-18-73	800	8.0	—	270	62	29	71
	09-12-74	870	—	14.0	—	—	—	—
	08-13-76	750	—	12.5	—	—	—	—
(D-8-2)12ddc-2	05-27-64	440	—	16.5	200	46	20	25
	08-25-64	460	8.4	15.0	230	53	24	—
	09-03-69	480	8.0	14.0	240	49	28	—
	08-05-70	490	8.2	12.5	240	—	—	—
	10-14-71	490	—	15.5	—	—	—	—
	08-11-72	460	—	14.5	—	—	—	—
	06-18-73	470	—	14.0	—	—	—	—
	09-12-74	520	—	16.0	—	—	—	—
	08-13-76	500	—	15.5	—	—	—	—
	08-01-79	500	7.9	14.0	250	57	25	12
	09-04-80	530	—	15.0	—	—	—	—
	07-29-81	520	7.8	16.0	240	54	25	13
	09-20-82	520	—	16.0	—	—	—	—
	07-26-83	510	—	15.5	—	—	—	—
	07-17-84	510	7.6	16.0	240	55	26	13
(D-8-2)13abc-1	05-13-64	450	8.3	14.0	230	49	25	12
	08-17-90	520	7.9	15.5	250	59	25	11
(D-8-2)16caa-1	08-13-76	390	—	15.5	—	—	—	—
	09-17-79	360	—	15.0	—	—	—	—
	09-20-82	400	—	16.5	—	—	—	—
(D-8-2)23dca-2	05-27-64	440	—	16.5	200	46	20	25
	10-14-68	410	8.0	15.0	170	38	18	—
	07-30-70	390	8.6	14.0	170	—	—	—

water from selected wells—Continued

Potassium, dissolved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
—	—	17	9.1	.20	26	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	262	7.0	54	—	12	366	—
—	338	26	58	—	24	477	—
—	312	26	53	—	—	412	—
—	332	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
7.9	338	25	52	—	26	475	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
27	—	36	9.9	—	38	—	—
—	—	22	10	—	25	—	—
—	232	21	15	—	—	270	—
—	237	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
3.3	220	30	16	.20	28	304	.04
—	—	—	—	—	—	—	—
3.0	—	25	17	.20	29	298	0
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
3.1	—	25	15	.20	27	300	<.10
2.3	—	40	17	—	—	257	—
2.4	—	30	11	1.1	27	308	<.10
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	16	14	—	25	—	—
—	200	6.5	10	—	24	239	—
—	203	—	—	—	—	—	—

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dis-solved (mg/L as Ca)	Magnesium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
(D-8-2)28cbd-3	08-30-89	980	—	22.0	—	—	—	—
(D-8-2)29add-1	05-03-65	510	—	14.0	240	54	25	17
	08-13-76	540	—	15.5	—	—	—	—
(D-8-2)31cbb-1	08-30-89	650	—	13.5	—	—	—	—
(D-8-2)31cda-1	06-06-89	500	7.5	20.0	—	—	—	—
(D-8-2)31cdb-1	08-30-89	1,270	—	19.0	—	—	—	—
(D-8-2)31cdb-2	08-04-64	430	7.7	19.0	150	34	17	—
	07-21-65	360	8.7	—	120	19	18	30
	06-06-89	3,050	6.9	28.0	—	—	—	—
(D-8-2)32daa-1	09-05-80	850	—	16.5	—	—	—	—
(D-8-2)34acd-1	07-21-65	660	8.8	13.5	280	43	41	40
	08-30-89	710	—	14.0	—	—	—	—
(D-8-2)34dda-1	05-03-65	610	7.9	13.5	270	55	31	36
	07-12-89	660	7.6	19.0	260	53	31	35
(D-8-2)36dbd-3	08-23-89	1,190	—	17.0	—	—	—	—
(D-8-3)11abb-1	06-27-89	500	7.6	—	—	—	—	—
(D-8-3)33acb-1	06-03-64	750	—	9.0	280	49	38	56
	08-22-89	900	—	13.0	—	—	—	—
	07-27-90	900	—	18.0	360	85	37	48
(D-9-1)14aad-2	07-25-83	470	—	14.0	—	—	—	—
(D-9-1)14ada-1	07-27-90	870	—	12.0	370	86	37	34
(D-9-1)14ada-2	06-03-64	600	8.3	13.5	250	46	33	30
	09-04-80	760	—	13.0	—	—	—	—
	07-25-83	760	—	13.0	—	—	—	—
	08-09-85	780	—	12.0	—	—	—	—
	07-23-90	840	7.7	12.0	—	—	—	—
(D-9-1)23ada-1	07-05-62	380	7.7	—	170	40	17	5.5
	08-07-62	410	7.8	—	210	48	21	6.4
	06-11-63	380	8.8	—	150	20	25	16
	08-28-63	420	8.1	—	170	27	26	16
	07-27-79	650	—	12.5	—	—	—	—
(D-9-1)26aaa-1	07-05-89	660	7.4	11.5	300	74	27	18
	08-22-89	650	—	11.0	—	—	—	—
(D-9-1)26aab-1	06-03-64	500	8.4	14.5	220	37	30	24
	09-04-80	750	—	15.5	—	—	—	—

water from selected wells—**Continued**

Potassium, dissolved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
—	—	—	—	—	—	—	—
—	225	33	12	—	49	325	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	29	15	—	63	—	—
10	—	41	12	—	—	215	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
24	—	1.9	19	—	—	388	—
—	—	—	—	—	—	—	—
—	307	3.9	19	—	26	362	—
—	—	3.0	19	.40	30	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
3.5	—	160	54	—	—	456	—
—	—	—	—	—	—	—	—
4.0	—	98	51	.30	17	531	.60
—	—	—	—	—	—	—	—
2.6	—	94	37	.20	25	522	7.80
2.3	—	100	46	—	—	349	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
1.2	—	8.6	7.1	—	—	178	—
1.2	—	16	8.2	—	—	216	—
2.0	—	43	20	—	—	196	—
1.6	—	44	21	—	—	218	—
—	—	—	—	—	—	—	—
—	—	29	19	.20	19	—	—
—	—	—	—	—	—	—	—
2.3	—	75	26	—	—	286	—
—	—	—	—	—	—	—	—

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)
(D-9-1)26aab-1	07-11-89	580	7.5	13.0	—	—	—	—
(D-9-1)26add-1	08-09-85	680	—	13.5	—	—	—	—
	07-31-90	620	7.4	11.0	—	—	—	—
[1](D-9-1)35abb-1	06-03-63	460	8.4	—	230	58	21	6.4
	08-29-63	330	7.9	—	150	26	21	6.7
	07-02-65	290	8.5	—	140	19	23	7.1
	07-15-81	530	—	11.5	—	—	—	—
	07-23-90	530	7.5	11.0	270	66	26	6.7
(D-9-1)35bcd-2	07-16-81	700	—	14.0	—	—	—	—
	07-02-87	520	—	13.0	—	—	—	—
	08-01-90	660	7.8	18.0	—	—	—	—
(D-9-1)36acb-1	05-18-89	500	7.8	19.5	—	—	—	—
	07-10-89	470	7.7	12.0	—	—	—	—
(D-9-1)36bbc-1	07-05-62	470	7.5	—	220	56	20	6.2
	08-07-62	480	7.7	—	250	52	28	6.4
	07-01-63	330	8.5	—	160	30	21	6.2
	08-29-63	480	7.4	—	240	60	22	6.2
	07-13-64	480	7.5	10.0	250	63	23	6.4
	07-02-65	290	7.7	9.5	140	21	22	5.5
	07-29-65	300	8.3	9.5	150	24	22	6.4
	09-03-69	500	7.9	9.0	260	61	26	—
	08-11-72	520	—	10.0	—	—	—	—
	09-12-74	520	—	10.5	—	—	—	—
	08-16-76	520	7.3	10.0	280	75	23	5.9
	07-12-77	480	6.5	10.0	270	70	23	6.1
	07-15-81	530	7.6	11.0	270	69	23	6.7
	08-25-89	500	—	10.0	250	62	22	5.9
	07-23-90	490	7.4	10.0	260	63	24	6.0
(D-9-1)36cdd-1	07-13-64	560	7.5	9.5	300	78	26	7.1
	07-31-81	590	—	11.5	—	—	—	—
	07-11-89	520	7.7	12.0	—	—	—	—
	08-16-89	690	7.7	12.0	—	—	—	—
	07-27-90	500	7.5	10.0	260	68	21	6.4
(D-9-2)5ddb-1	05-24-89	1,000	7.0	14.0	—	—	—	—
(D-9-2)6ddb-1	05-24-89	800	7.4	14.0	—	—	—	—

water from selected wells—Continued

Potassium, dissolved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
1.2	—	14	12	—	—	240	—
1.2	—	24	8.9	—	—	168	—
1.2	—	31	9.9	—	—	159	—
—	—	—	—	—	—	—	—
1.6	—	18	26	.30	19	293	2.20
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
1.2	—	18	11	—	—	289	—
1.2	—	26	9.2	—	—	255	—
1.6	—	24	7.8	—	—	173	—
1.2	—	24	8.2	—	—	252	—
1.2	—	31	8.2	—	—	267	—
.80	—	24	11	—	—	153	—
.80	—	31	8.9	—	—	164	—
—	239	14	12	—	15	288	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
1.4	230	21	14	.20	15	303	2.20
1.5	220	22	13	.20	16	285	—
1.5	—	22	28	.20	17	309	2.20
1.3	—	15	25	.30	16	276	1.50
1.3	—	13	25	.30	17	298	1.70
1.2	—	41	9.6	—	—	321	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
1.2	—	20	13	.30	14	297	1.50
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)
(D-9-2)9bac-1	07-05-62	490	8.3	—	140	21	21	40
	08-07-62	570	8.0	—	210	42	25	34
	07-02-63	550	8.1	—	210	41	25	34
	08-01-63	690	7.7	—	290	73	26	33
	08-22-63	680	7.4	—	250	59	26	31
	07-14-64	520	8.3	14.5	190	31	27	34
	07-27-65	550	8.2	14.0	200	34	27	35
	07-30-70	680	8.1	12.5	290	67	29	—
	08-11-72	660	—	14.5	—	—	—	—
	07-30-73	730	—	14.5	—	—	—	—
	09-12-74	560	—	17.0	—	—	—	—
	08-13-76	700	7.3	14.0	310	78	27	30
	07-12-77	650	6.5	14.5	300	73	28	30
	08-23-78	650	6.8	14.0	290	71	27	29
	07-27-79	670	—	14.5	—	—	—	—
	08-01-79	670	—	14.5	—	—	—	—
	07-30-81	690	7.4	14.5	280	66	27	30
	09-20-82	650	—	14.5	—	—	—	—
	08-09-84	640	7.4	14.0	290	69	28	32
	07-02-87	580	7.3	14.0	270	67	26	180
	08-23-89	640	—	15.0	—	—	—	—
	09-04-90	610	7.5	14.5	230	56	21	36
	08-19-91	630	7.5	14.5	—	—	—	—
(D-9-2)11aaa-1	05-17-64	520	7.8	14.0	240	61	22	—
	08-16-76	570	—	14.0	—	—	—	—
	09-20-82	550	—	—	—	—	—	—
	07-19-90	550	7.5	14.5	270	66	26	15
(D-9-2)15cda-1	07-30-81	600	—	14.5	—	—	—	—
	07-10-89	540	7.6	14.0	—	—	—	—
(D-9-2)19aca-1	07-02-87	420	—	13.0	—	—	—	—
	07-10-89	690	8.0	14.0	—	—	—	—
(D-9-2)19acb-1	09-05-80	490	—	14.5	—	—	—	—
	07-26-83	510	—	14.5	—	—	—	—
	07-02-86	570	—	16.0	—	—	—	—
(D-9-2)36acd-1	05-11-89	540	6.9	12.0	—	—	—	—

Potassium, dissolved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
12	—	50	37	—	—	265	—
9.4	—	49	37	—	—	309	—
9.0	—	61	37	—	—	314	—
9.0	—	52	42	—	—	386	—
8.6	—	33	41	—	—	344	—
9.8	—	83	36	—	—	294	—
9.4	—	66	35	—	—	307	—
—	268	41	33	—	51	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
9.0	261	48	32	.30	49	448	4.00
8.3	250	51	31	.20	49	423	—
8.2	250	45	29	.20	45	417	3.40
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
8.1	—	44	25	.20	53	423	3.00
—	—	—	—	—	—	—	—
9.1	—	47	30	.30	51	440	3.40
8.5	—	110	25	.30	50	644	3.40
—	—	—	—	—	—	—	—
10	—	34	33	.20	56	402	2.90
—	—	—	—	—	—	—	—
—	—	27	24	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
1.2	—	28	19	.20	13	307	1.10
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dis-solved (mg/L as Ca)	Magnesium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
(D-9-3)5bbd-1	07-14-64	380	8.5	12.0	170	27	26	14
	09-03-69	560	7.9	11.0	270	65	27	—
	10-14-71	530	—	12.5	—	—	—	—
	08-11-72	650	7.5	12.5	320	73	33	18
	07-31-73	550	—	12.0	—	—	—	—
	08-17-76	670	7.2	12.5	300	75	28	16
	07-12-77	620	6.5	12.5	310	75	31	19
	08-23-78	590	6.8	12.5	300	72	29	18
	08-01-79	650	—	12.5	—	—	—	—
	09-04-80	600	—	15.5	—	—	—	—
(D-10-1)1acd-2	07-14-89	730	7.2	15.0	—	—	—	—
(D-10-1)2adb-1	07-29-65	—	—	—	170	—	—	—
	07-05-66	530	7.8	9.5	280	75	22	5.3
	07-30-80	530	—	11.0	—	—	—	—
	07-14-89	500	7.6	12.0	—	—	—	—
	08-17-90	540	7.9	10.5	270	71	22	6.4
(D-10-1)2ddd-1	08-22-89	570	7.3	10.0	—	—	—	—
(D-10-1)19bad-1	07-15-81	2,100	—	23.0	—	—	—	—
	06-30-86	2,060	—	21.0	—	—	—	—
(D-10-1)19bdc-1	09-04-80	2,000	—	21.5	—	—	—	—
	07-02-86	2,130	—	21.5	—	—	—	—
(D-10-1)30bac-1	08-09-85	3,800	—	22.0	—	—	—	—
	07-12-89	3,550	7.1	23.5	—	—	—	—
	08-29-90	3,410	7.4	24.0	500	110	54	460

---

[1] Actual location is different than historic record. See footnote, table 1.

water from selected wells—**Continued**

Potassium, dis-solved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dis-solved (mg/L as SO_4)	Chloride, dis-solved (mg/L as Cl)	Fluoride, dis-solved (mg/L as F)	Silica, dis-solved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
1.2	—	44	16	—	—	212	—
—	248	35	19	—	13	327	—
—	—	—	—	—	—	—	—
1.6	261	55	22	—	15	374	—
—	—	—	—	—	—	—	—
1.3	253	53	19	.20	12	360	.90
1.5	250	56	21	.10	13	369	—
1.6	200	54	28	.20	13	338	.94
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
.80	—	30	17	—	—	291	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
1.3	—	21	21	1.1	13	296	2.10
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
38	—	120	860	.30	36	1,860	.50

Table 6.—*Measurements of discharge, temperature, and specific conductance of water from selected springs*

[—, no data]

Location of spring or measurement site: See figure 1 for explanation of the numbering system for hydrologic-data sites.
Discharge: ft^3/s, cubic feet per second.
Temperature: °C, degrees Celsius.
Specific conductance: μS/cm, microsiemens per centimeter at 25 degrees Celsius.

Location of spring	Location of measurement site	Name of spring	Date of measurement	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (μS/cm)
(D-7-3)28d-S1	(D-7-3)28bcd	Spring Creek	07-02-90	15	15.5	—
			10-16-90	16	14.0	—
			04-02-91	15	—	—
(D-7-3)30a-S1	(D-7-3)30abb	Unnamed springs	11-14-90	.12	11.0	840
(D-7-3)32dba-S1	(D-7-3)31add	Wood Springs	05-31-90	[1]3.8	15.5	—
			10-16-90	[1]3.9	15.0	—
			04-02-91	[2]2.9	—	—
(D-8-3)3a-S1	(D-8-3)3abc	Wheeler Springs	05-31-90	1.1	14.0	—
			10-16-90	.89	14.0	—
			04-02-91	[3]1	—	—
(D-8-3)3dbb-S1	(D-8-3)3dbb	Clyde Springs	05-31-90	.55	13.0	—
			10-16-90	.72	13.0	—
			04-02-91	.02	—	—
(D-8-3)9d-S1	(D-8-3)9bac	Holley Springs	05-25-90	3.4	18.5	—
			10-22-90	4.1	9.0	—
			04-02-91	2.4	—	—
(D-9-2)11abd-S1	(D-9-2)11abd	Salem Lake Springs	06-01-90	5.0	16.0	—
			10-22-90	6.1	10.0	—
(D-9-2)29ac-S1	(D-9-2)29acc	Unnamed springs	08-22-89	[4]1.0	—	—
(D-9-2)29cbb-S1	(D-9-2)29cbb	Spring Lake Springs	06-01-90	[4]3.3	14.0	—
			10-17-90	[4]2.4	13.0	—
(D-9-1)25aac-S1	(D-9-1)24ddc	North Holladay Springs	06-12-90	1.1	13.5	—
			10-17-90	.78	8.0	—
(D-9-1)25adb-S1	(D-9-1)25ada	South Holladay Springs	06-12-90	.67	16.0	—
			10-17-90	.46	8.5	—

---

[1] Includes about 0.5 ft^3/s from Matson Springs.
[2] Includes 0.14 ft^3/s from Matson Springs.
[3] Estimated.
[4] Includes about 0.4 ft^3/s from flowing wells.

Table 7.—*Measurements of discharge, temperature, and specific conductance of water from selected springs, drains, and sloughs during seepage studies*

[—, no data]

Location of measurement site: See figure 1 for explanation of the numbering system for hydrologic-data sites. Listed in downstream order.

Inflow and outflow: Measured inflow to or outflow from the spring channel.

Discharge: ft³/s, cubic feet per second. Used to determine ground-water discharge to springs and drains. Upstream measurement plus inflow minus outflow may not equal downstream measurement because of stream leakage, ground water discharge, or measurement error.

Temperature: °C, degrees Celsius.

Specific conductance: μS/cm, microsiemens per centimeter at 25 degrees Celsius.

Location of measurement site	Inflow and outflow	Discharge (ft³/s)	Temperature (°C)	Specific conductance (μS/cm)
	Spring Creek north channel, November 14, 1990			
(D-7-3)28bca		15	13.0	890
(D-7-3)20bda		15	12.5	1,070
(D-7-3)20bbd	Inflow from industrial effluent	.43	38.0	880
(D-7-3)19bda		15	15.0	1,180
	Spring Creek south channel, November 14, 1990			
(D-7-3)28bcb		2.1	12.0	1,050
(D-7-3)20cdb	Inflow from flowing well	.22	—	—
(D-7-3)20cdb	Inflow from waste-water treatment plant	5.1	—	—
(D-7-3)20cdb		9.4	12.5	780
	Wood Springs channel, November 14, 1990			
(D-7-3)31add		[1]3.9	13.5	620
(D-7-3)30cdd		6.4	8.0	760
	Matson Springs channel, November 14, 1990			
(D-7-3)32ddd	Inflow from flowing well	1.1	16.0	560
(D-7-3)32cda		2.6	14.0	470
(D-7-3)32cda	Outflow to Wood Springs area	1.5	—	—
(D-7-3)31cdb		1.6	14.0	610

Table 7.—*Measurements of discharge, temperature, and specific conductance of water from selected springs, drains, and sloughs during seepage studies*—Continued

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (μS/cm)
	Dry Creek, November 15, 1990			
(D-8-3)5cdc		1.9	9.0	840
(D-8-3)5cdc	Inflow from Holley Springs	4.5	8.0	900
(D-8-3)5ccc	Inflow from unnamed springs	4.8	8.0	940
(D-8-3)6ddd	Inflow from flowing wells	.20	—	—
(D-8-3)6ccd	Inflow from waste-water treatment plant	3.7	—	—
(D-8-2)1dda	Inflow from unnamed drains	.38	10.5	580
(D-7-2)36dcc		16	9.5	1,070
	Holley Springs channel, November 15, 1990			
(D-8-3)9bac		5.0	10.0	910
(D-8-3)5cdc		4.5	8.0	900
	Unnamed channel, November 15, 1990			
(D-8-3)18add		1.2	7.0	1,070
(D-8-3)8cbd		1.4	8.0	1,130
(D-8-3)5ccc		4.8	8.0	940
	Spring Creek (near Payson), March 28, 1991			
(D-9-2)29cbb		[2]2.8	8.5	470
(D-9-2)30dad	Inflow from unnamed field drain	.06	9.0	1,020
(D-9-2)30daa	Outflow to West Ditch area	.18	10.5	485
(D-9-2)19bba		4.1	—	—
(D-9-2)18ccd	Inflow from West Ditch	1.0	—	—
(D-9-1)13ddd	Inflow from South Holladay Springs	.61	—	—
(D-9-1)13ddc	Inflow from North Holladay Springs	1.4	—	—
(D-9-2)7bba		6.8	8.0	710
(D-8-1)36dba		7.9	9.0	760

Table 7.—*Measurements of discharge, temperature, and specific conductance of water from selected springs, drains, and sloughs during seepage studies*—Continued

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)
Beer Creek and Benjamin Slough, March 28, 1991				
(D-8-1)36aad	Beer Creek	22	12.5	1,040
(D-8-1)36dba	Inflow from Spring Creek	7.9	9.0	760
(D-8-1)36dba	Inflow from Dry Hollow	1.2	11.5	1,400
(D-8-1)23aba	Benjamin Slough	33	12.0	1,060
North Holladay Springs channel, March 28, 1991				
(D-9-1)24ddc		.82	15.0	700
(D-9-1)13ddc		1.4	—	—
South Holladay Springs channel, March 28, 1991				
(D-9-1)25ada		[3].59	12.0	750
(D-9-1)25ada	Inflow from flowing wells	14	—	—
(D-9-1)13ddd		.61	—	—
Dry Hollow, March 28, 1991				
(D-9-1)12bdd		.36	—	—
(D-8-1)36dba		1.2	11.5	1,400
Beer Creek, March 29, 1991				
(D-8-2)35cdd		1.9	4.5	1,350
(D-8-2)35cdc	Inflow from waste-water treatment plant	.62	7.5	1,110
(D-9-2)3abc	Inflow from Salem Lake	6.4	10.5	770
(D-9-2)3bca		10	7.0	940
(D-8-2)33bbc		14	9.0	990
(D-8-2)32aac	Inflow from waste-water treatment plant	1.3	—	—
(D-8-2)31bb	Inflow from flowing wells	1.2	[4]14.0	[4]880
(D-8-1)36aad		20	—	—

---

[1] Includes 1.5 ft^3/s from Matson Springs.

[2] Includes about 0.4 ft^3/s from flowing wells.

[3] Includes 0.11 ft^3/s from flowing wells.

[4] Average of two flowing wells.

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*

[—, no data]

Location of measurement site: See figure 1 for explanation of the numbering system for hydrologic-data sites. Listed in downstream order. Unknown, exact location not known, is between known listed locations.

Inflow and outflow: Measured inflow to and outflow from the stream. Calculated inflow or outflow was determined by measuring the stream above and below the inflow or outflow. Diversion number refers to system used by the Strawberry Highline Canal Company.

Discharge: ft^3/s, cubic feet per second. Used to determine interaction between streams and ground-water system. Upstream measurement plus inflow minus outflow may not equal downstream measurement because of stream leakage, ground-water discharge, or measurement error.

Temperature: °C, degrees Celsius.

Specific conductance: µS/cm, microsiemens per centimeter at 25 degrees Celsius.

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)
Spanish Fork River, August 30, 1965				
(D-8-3)33acc		11	—	—
(D-8-3)32daa	Inflow from Mill Race Canal	1.0	—	—
(D-8-3)32cac		9.7	—	—
Spanish Fork River, September 3, 1965				
(D-8-3)34cda		3.8	—	—
(D-8-3)34bbc	Inflow from springs	1.1	—	—
(D-8-3)34bbb		7.4	—	—
Spanish Fork River, September 13, 1965				
(D-8-3)34bbb		8.9	11.5	—
(D-8-3)28ddc	Inflow from industrial effluent	.48	—	—
(D-8-3)33acb		7.4	—	—
Spanish Fork River, October 5, 1965				
(D-8-2)25ada		18	11.5	—
(D-8-2)25bab	Inflow from ditch	.48	—	—
(D-8-2)23dca		23	13.5	—
Spanish Fork River, October 8, 1965				
(D-8-2)23dca		32	—	—
(D-8-2)22dad	Inflow from South Field Canal	4.0	—	—
(D-8-2)22da	Inflow from ditch	.06	—	—
(D-8-2)22add		33	—	—

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—Continued

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)
	Spanish Fork River, October 12, 1965			
(D-8-2)15dcd		25	—	—
(D-8-2)15d	Inflow from ditch	.28	—	—
(D-8-2)15cab		22	—	—
	Spanish Fork River, October 13, 1965			
(D-8-2)15cab		38	—	—
Unknown	Inflow from drains	.22	—	—
(D-8-2)9aad		31	—	—
	Spanish Fork River, June 1, 1966			
(D-9-3)2cab		107	—	—
(D-8-3)35ccc	Outflow to East Bench Canal	103	—	—
(D-8-3)34cdd		18	—	—
(D-8-3)34bbb		20	—	—
(D-8-3)28ddc	Inflow from industrial effluent	.03	—	—
(D-8-3)33acb		21	—	—
	Spanish Fork River, June 2, 1966			
(D-8-3)33acc		31	—	—
(D-8-3)31acd	Inflow from drain	1.1	—	—
(D-8-3)30ccc	Inflow from ditch	.60	—	—
(D-8-2)25add		31	—	—
	Spanish Fork River, June 3, 1966			
(D-8-2)25ada		18	—	—
(D-8-2)25ada	Inflow from drains	.03	—	—
(D-8-2)23dca		21	—	—
(D-8-2)22dad	Inflow from South Field Canal	.39	—	—
(D-8-2)22da	Inflow from ditch	.31	—	—
(D-8-2)22da	Inflow from ditch	.05	—	—
(D-8-2)22add		21	—	—

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—Continued

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)
Spanish Fork River, September 29, 1966				
(D-8-3)34cda		3.9	—	—
(D-8-3)34bbb		7.2	15.5	—
(D-8-3)33acb		6.7	—	—
Spanish Fork River, September 30, 1966				
(D-8-3)33acc		20	—	—
(D-8-3)32cac		22	—	—
(D-8-3)31baa		21	—	—
(D-8-3)30c	Inflow	1.1	—	—
(D-8-2)25add		23	15.5	—
Spanish Fork River, October 3, 1966				
(D-8-2)25ada		77	11.0	500
(D-8-2)23dca		78	12.0	520
Unknown	Inflow from ditches	.33	—	—
(D-8-2)22aba	Outflow to South Ditch	27	—	—
(D-8-2)15dca		49	13.0	520
Unknown	Inflow from ditches and well	.60	—	—
(D-7-2)32ddd		39	—	—

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—**Continued**

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (μS/cm)
Mapleton Lateral, May 26, 1966				
(D-8-3)34cda		43	11.0	—
(D-8-3)34acc		40	—	—
(D-8-3)34aba		41	—	—
(D-8-3)27acc		39	13.0	—
(D-8-3)23bdd		40	—	—
(D-8-3)23bdd	Outflow to ditch	6.8	—	—
(D-8-3)14aac		34	15.0	—
(D-8-3)14aac	Outflow to pump	.97	—	—
(D-8-3)11ddb		33	—	—
(D-8-3)11ddb	Calculated inflow from Maple Creek	7.5	—	—
(D-8-3)11ddb	Outflow to ditch	11	—	—
(D-8-3)11adb		30	—	—
(D-8-3)11aac	Outflow to ditch	11	—	—
(D-8-3)11aac		17	—	—
(D-8-3)11aba		17	16.0	—
(D-8-3)11aba	Calculated outflow to Fullmer Ditch	8.6	—	—
(D-8-3)2dcd		7.9	—	—
(D-8-3)2dca		7.7	—	—
Mapleton Lateral, September 29, 1966				
(D-8-3)34acc		18	11.0	—
(D-8-3)34aba		17	—	—
(D-8-3)27acc		18	—	—
(D-8-3)23bdd		18	—	—
(D-8-3)14aac		19	—	—
(D-8-3)11ddb	Outflow to ditch	.14	—	—
(D-8-3)11ddb		18	—	—
(D-8-3)11aac	Outflow to ditch	.88	—	—
(D-8-3)2dcd		18	—	—

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—Continued

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)
Strawberry Highline Canal, September 28, 1965				
(D-8-3)33dbb		44	—	—
Unknown	Inflow	.17	—	—
Unknown	Outflow	3.3	—	—
(D-9-2)16adc		37	—	—
Strawberry Highline Canal, May 31, 1966				
(D-9-2)31acc		79	—	—
(D-9-2)31cbd	Outflow to diversion #24A	2.4	—	—
(D-9-1)36dad	Outflow to diversion #25	2.1	—	—
(D-9-1)36dad		70	—	—
(D-9-1)36acb	Outflow to diversion #26	3.7	—	—
(D-9-1)36bbc		66	—	—
(D-9-1)36bbc	Inflow from well	4.4	—	—
(D-9-1)35aaa	Outflow to diversion #27	3.6	—	—
(D-9-1)35aaa		70	—	—
(D-9-1)35abb	Inflow from well	8.7	—	—
(D-9-1)26cbb		78	15.5	—
Strawberry Highline Canal, June 1, 1966				
(D-8-3)33dbb		139	14.0	—
(D-9-3)5aaa	Outflow to diversion #3	13	—	—
(D-9-3)5adb		124	—	—
(D-9-3)7dbc		121	—	—
(D-9-3)7dbc	Calculated outflow to diversion #7	5.1	—	—
(D-9-3)7cdb	Outflow to diversion #8	.01	—	—
(D-9-2)13abc		111	—	—
(D-9-2)13bad	Calculated outflow to diversion #10	3.1	—	—
(D-9-2)13bd	Outflow to diversion #10-1	4.4	—	—
(D-9-2)14daa	Outflow to diversion #11	2.8	—	—
(D-9-2)14ccc		100	—	—

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—Continued

Location of measurement site	Inflow and outflow	Discharge (ft³/s)	Temperature (°C)	Specific conductance (µS/cm)
	Strawberry Highline Canal, June 2, 1966			
(D-9-2)14ccc		85	12.0	—
(D-9-2)22bba	Outflow to diversion #14.5	.65	—	—
(D-9-2)22bbb		77	13.0	—
(D-9-2)21bab	Outflow to diversion #18	1.4	—	—
(D-9-2)21bba	Outflow to diversion #19	5.2	—	—
(D-9-2)21bb	Outflow to diversion #19.5	1.1	—	—
(D-9-2)21bcb	Outflow to diversion #20	27	—	—
(D-9-2)21bcb	Outflow to diversion #20B	3.2	—	—
(D-9-2)31acc		41	16.0	—
	Strawberry Highline Canal, September 26, 1966			
(D-8-3)33dbb		73	—	—
(D-9-3)5aaa	Outflow to diversion #3	.19	—	—
(D-9-3)5adb		73	—	—
(D-9-3)7dbc		72	14.0	—
(D-9-2)13abc		71	14.5	—
(D-9-2)14cda	Outflow to diversion #12	2.8	—	—
(D-9-2)14ccc		68	—	—

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—Continued

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)
Strawberry Highline Canal, September 27, 1966				
(D-9-2)14ccc		64	—	—
(D-9-2)22bba		64	13.0	—
(D-9-2)21bab	Outflow to diversion #18	7.0	—	—
(D-9-2)21bcb	Outflow to diversion #20A	6.0	—	—
(D-9-2)20ddb	Outflow to diversion #21	.20	—	—
(D-9-2)31acc		48	14.0	—
(D-9-2)31cbd	Outflow to diversion #24A	.01	—	—
(D-9-1)36dad	Outflow to diversion #25	1.5	—	—
(D-9-1)36bbc		45	14.5	—
(D-9-1)35aaa	Outflow to diversion #27	4.0	—	—
(D-9-1)35a	Outflow to diversion #27.5	2.4	—	—
(D-9-1)26cbb		44	15.5	—
South Field Canal, September 13, 1965				
(D-8-3)32dda		10	—	—
(D-8-2)25dbc		10	15.5	—
South Field Canal, June 8, 1966				
(D-8-3)32dda		33	12.0	—
(D-8-3)31cdd		32	—	—
(D-8-2)36acd		35	15.0	—
(D-8-2)36acb	Outflow	4.9	—	—
(D-8-2)25dbc		30	—	—
South Field Canal, October 3, 1966				
(D-8-3)32dda		17	—	—
(D-8-3)32c	Outflow	4.3	—	—
(D-8-3)31cdd		13	11.5	—
(D-8-3)36acd		14	—	—
(D-8-3)25dbc		13	11.5	—

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—**Continued**

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)
South Field Canal, October 5, 1966				
(D-8-2)25dbc		4.9	—	—
(D-8-2)23ccc		4.6	12.0	—
Mill Race Canal, August 30, 1965				
(D-8-3)33acc		56	14.5	—
(D-8-3)33cab	Outflow	8.9	—	—
(D-8-3)32add	Outflow to Spanish Fork River	1.0	—	—
(D-8-3)19cdc		45	16.5	—
Mill Race Canal, June 9, 1966				
(D-8-3)33acc		51	—	—
(D-8-3)32bab		57	13.0	—
(D-8-3)30ddd		55	15.0	—
(D-8-3)30dbb		59	—	—
(D-8-3)30b	Outflow	.61	—	—
(D-8-3)19cdc		55	15.0	—
(D-8-3)19cca	Outflow	3.0	—	—
(D-8-2)24dca		50	—	—
Mill Race Canal, September 30, 1966				
(D-8-3)33acc		39	—	—
(D-8-3)32bab		38	—	—
(D-8-3)32bb	Outflow	5.7	—	—
(D-8-3)30dbb		34	—	—
(D-8-3)19cdc		34	—	—
(D-8-3)19cca	Outflow	2.5	—	—
(D-8-2)24dca		34	—	—

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—**Continued**

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)
East Bench Canal, August 25, 1965				
(D-8-3)34ddd		14	—	—
(D-8-3)27ccb		12	—	—
East Bench Canal, June 15, 1966				
(D-8-3)34ddd		78	—	—
(D-8-3)27ccb		75	18	—
(D-8-3)27cbc	Outflow	9.0	—	—
(D-8-3)28dac	Outflow	16	—	—
(D-8-3)28dac	Outflow	2.6	—	—
(D-8-3)28dbb	Outflow	8.6	—	—
(D-8-3)28bbd	Outflow	8.3	—	—
(D-8-3)29aaa		32	—	—
East Bench Canal, October 6, 1966				
(D-8-3)34ddd		17	—	—
(D-8-3)27ccb		15	9.0	—
(D-8-3)28dac	Outflow	9.3	—	—
(D-8-3)29aaa		5.7	9.5	—
South Ditch, June 17, 1966				
(D-8-2)22aba		52	15.0	—
(D-8-2)15caa	Outflow	18	15.5	—
(D-8-2)16dad	Outflow	15	16.0	—
(D-8-2)16dcc		17	16.5	—
(D-8-2)21bbd	Outflow	1.9	—	—
(D-8-2)20caa		14	16.5	—

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—**Continued**

Location of measurement site	Inflow and outflow	Discharge (ft³/s)	Temperature (°C)	Specific conductance (µS/cm)
	Hobble Creek, August 17, 1965			
(D-8-3)1dbc		.77	—	—
(D-8-3)1cac		5.4	—	—
(D-8-3)1cca		5.2	—	—
(D-8-3)1ccb	Inflow from canal	1.7	—	—
(D-8-3)2ddb		6.7	—	—
(D-8-3)2dca	Inflow from Mapleton Lateral	11	—	—
(D-8-3)2dca	Outflow to canal	7.7	—	—
(D-8-3)2dca		5.3	—	—
(D-8-3)2ccb	Outflow to irrigation ditch	5.0	—	—
(D-8-3)3dda	Calculated inflow from pipe	.48	—	—
(D-8-3)3dda		2.8	—	—
	Hobble Creek, August 18, 1965			
(D-8-3)3dda		2.8	—	—
(D-8-3)3acc	Inflow from springs	.20	—	—
(D-8-3)3bbd	Inflow from drains	.87	—	—
(D-8-3)4aaa		13	—	—
	Hobble Creek, August 19, 1965			
(D-8-3)3dda		4.7	—	—
(D-8-3)4aaa		18	—	—
	Hobble Creek, August 23, 1965			
(D-8-3)3dda		1.5	—	—
(D-8-3)4aaa		9.9	—	—
	Hobble Creek, September 22, 1965			
(D-8-3)4aaa		26	11.5	—
(D-7-3)29dcc		29	12.0	—

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—Continued

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)
Hobble Creek, May 24, 1966				
(D-8-3)1cac		18	8.5	—
(D-8-3)2ddb		20	9.5	—
(D-8-3)2dca	Outflow	8.4	—	—
(D-8-3)2	Outflow	7.6	—	—
(D-8-3)3d	Calculated inflow from pipe	2.6	—	—
(D-8-3)3b	Inflow from springs	1.6	—	—
(D-8-3)4aaa		19	—	—
Hobble Creek, September 23, 1966				
(D-8-3)1cac		3.8	10.5	—
(D-8-3)2ddb		2.8	11.5	—
Hobble Creek, September 27, 1966				
(D-8-3)2dca		1.2	—	—
(D-8-3)2ccb	Outflow to irrigation ditch	1.9	—	—
(D-8-3)3dda		1.0	13.0	410
(D-8-3)3dbb		4.8	13.0	600
(D-8-3)3b	Inflow from Wheeler Springs	.64	—	—
(D-8-3)4aaa		7.5	13.5	560
Hobble Creek, October 4, 1966				
(D-8-3)4aaa		5.2	11.5	540
(D-7-3)29dcc		5.4	12.0	540
Hobble Creek, May 23, 1990				
(D-8-4)6abb		17	14.5	—
Hobble Creek, November 14, 1990				
(D-7-3)29dcc		19	8.5	520
(D-7-3)30acc	Outflow	.04	—	—
(D-7-3)30bda		21	9.0	540

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—Continued

Location of measurement site	Inflow and outflow	Discharge (ft³/s)	Temperature (°C)	Specific conductance (µS/cm)
Springville Highline Canal, June 3, 1965				
(D-8-3)1acc		8.3	—	—
(D-8-3)2adb		7.5	—	—
Springville Highline Canal, July 23, 1965				
(D-8-3)1acc		8.0	—	—
Unknown	Outflow	.09	—	—
(D-8-3)2adb		6.1	—	—
Springville Highline Canal, May 23, 1966				
(D-8-4)6bab		6.7	—	—
(D-8-3)1acc		6.4	—	—
Springville Highline Canal, September 28, 1966				
(D-8-4)6bab		11	11.0	420
(D-8-3)1acc		8.8	10.5	430
Swenson Ditch, September 29, 1966				
(D-8-3)4aaa		7.9	—	—
(D-8-3)4bbd		7.1	—	—
Fullmer Ditch, May 25, 1966				
(D-8-3)12bbb		9.4	—	—
(D-8-3)11aba	Inflow from Mapleton Lateral	10	—	—
(D-8-3)11baa		18	—	—
Fullmer Ditch, October 5, 1966				
(D-8-3)1cdc		13	9.0	440
Unknown	Outflow	1.3	—	—
(D-8-3)3cdc		7.5	—	—

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—Continued

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (μS/cm)
Area of West Fields Irrigation Company, November 15, 1990				
(Measurements given below include all known surface inflow and outflow from the West Fields Irrigation Company area)				
(D-8-2)24acc	Inflow from Mill Race Canal	9.6	7.5	930
(D-8-2)23dba	Unnamed inflow	[1].05	—	—
(D-8-2)9aad	Unnamed outflow	.08	11.5	485
(D-8-2)4aab	Unnamed outflow	.42	9.0	[2]2,460
(D-7-2)34ddc	Unnamed outflow	2.8	8.0	895
(D-7-2)35ccc	Unnamed outflow	1.4	9.0	925
(D-7-2)35ccd	Unnamed outflow	1.8	8.5	930
(D-8-2)2abb	Unnamed outflow	.03	12.0	410
(D-8-2)1bbb	Unnamed outflow	.8	9.5	990
Peteetneet Creek West Ditch, March 28, 1991				
(D-9-2)21bbc		3.4	—	—
(D-9-2)20bc	Inflow	.18	—	—
(D-9-2)18ccd		.96	—	—
Summit Creek, May 23, 1990				
(D-10-1)13d		17	12.0	—
Kimball Creek, May 25, 1990				
(C-11-2)13cdc		.15	17.5	—

---

[1] Estimated.

[2] Specific conductance is higher than other values because the flow at this site is composed mainly of ground-water discharge.

★ U.S. GOVERNMENT PRINTING OFFICE: 1993 - 786 - 348

APPENDIX O – UTAH DEPARTMENT OF NATURAL RESOURCES

WATER RIGHTS DIVISION SEARCH

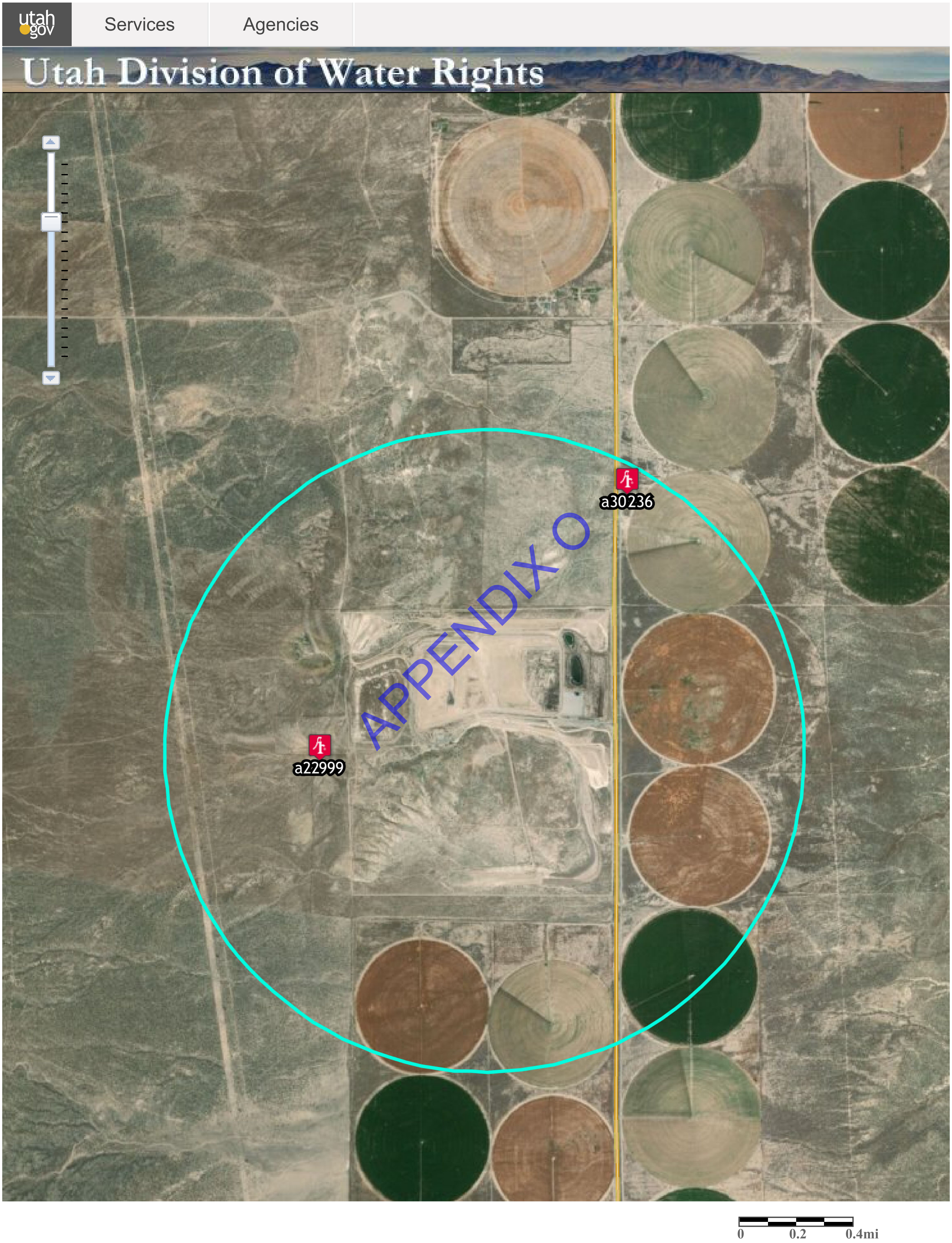
Utah Division of Water Rights

Search Radius: 6000 ft.

From the CT corner North 0 East 0 section 17 township 9S range 1W SLbm

WR Number	Diversion Type	Well Log	Location	Status	Priority	Uses	CFS	ACFT	Address	Owner Name
a22999	Underground		N100 W475 W4 17 9S 1W SL	A	20070716	O	0.000	100.000	WATER RESOURCES DEPARTMENT	PROVO CITY CORPORATION
a30236	Underground	27598	S300 E10 W4 09 9S 1W SL	A	20050516	I	0.000	1160.000	ATTN: NATURAL RESOURCE SERVICES	CORPORATION OF THE PRESIDING BISHOP OF THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS

APPENDIX O


utah gov
Services
Agencies
Utah Division of Water Rights
a30236
a22999
0
0.2
0.4mi

APPENDIX P – LINEAMENT STUDY

APPENDIX H

Lineament Study

SUVSWD Bayview Class I Landfill
Permit Application

APPENDIX P

EVALUATION OF LINEAMENTS AT THE
PROPOSED PROVO CITY LANDFILL,
GOSHEN VALLEY, UTAH

by

ROBERT M. ROBISON
UTAH COUNTY GEOLOGIST

APRIL 20, 1987

CONTENTS

INTRODUCTION

The proposed Provo City landfill is located in Goshen Valley, Utah, in Sec. 17, T. 9 S., R. 1 W., SLB&M (Fig. 1). The site is about 2 miles west of the southern end of Utah Lake and approximately 2 miles east of the Tintic Mountains. Elberta City is approximately 5.5 miles to the south.

The purpose of this investigation was to evaluate lineaments in Section 17 to determine if they were formed by surface fault rupture. Several lineaments were identified by the Utah County Geologist (Robison, 1986a) and Environmental Science and Engineering (ESE, Whiting, 1986) which may have been produced by faulting. The Utah County Board of Adjustments (minutes dated January 13, 1987) authorized an investigation of all lineaments. The Utah County Geologist had the responsibility to locate exploratory trenches and make the interpretation as to the presence/location of any faults found.

The scope of this investigation included a review of pertinent literature and aerial photographs, field reconnaissance, and the excavation, logging, photographing, and interpretation of eight trenches (Fig. 2). Trench locations were selected during a field reconnaissance on March 6, 1987, by the Utah County Geologist. Duane Whiting of ESE, Steve Sevier of Elberta Farms, and Dale Stephenson and Carl Carpenter of Provo City were present when the trenches were sited.

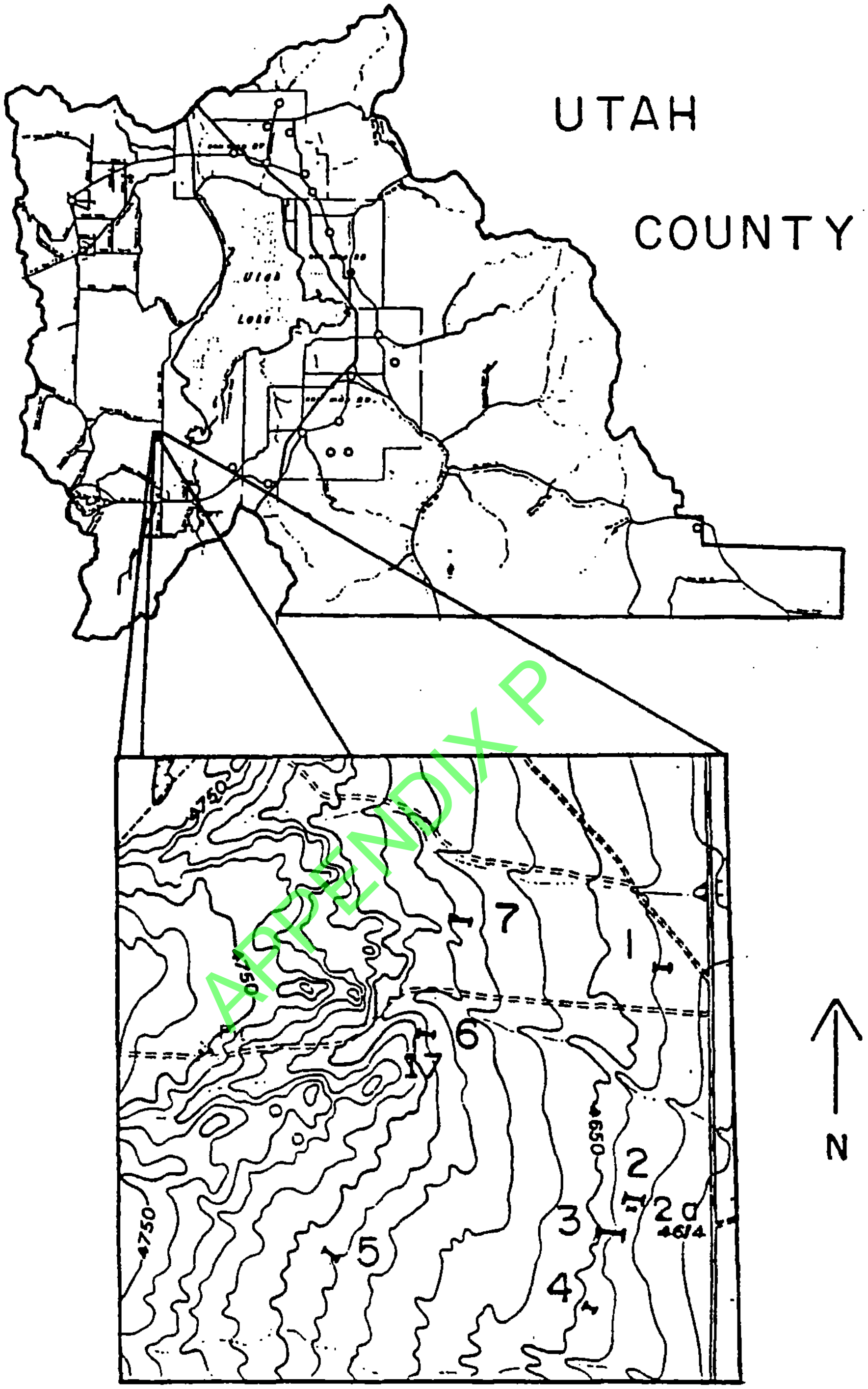


Figure 1. Map showing the location of the study area, Section 17, T. 9 S., R. 1 W., SLB&M, Goshen Valley, Utah. Single digit numbers refer to trenches. See text for logs and descriptions of trenches.

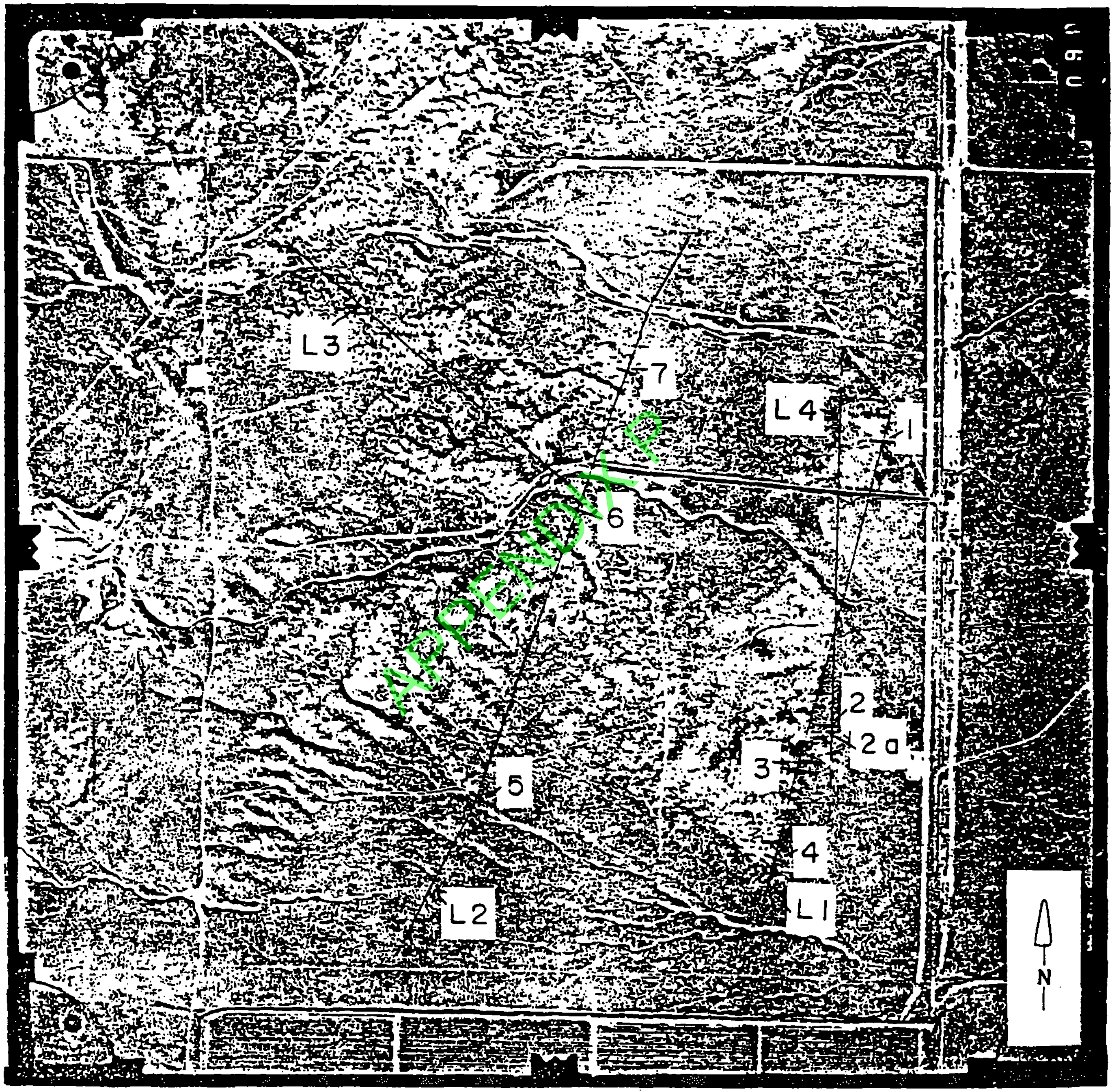


Figure 2. December, 1986, aerial photograph of the study area. Lineaments are labeled L1 to L4. Trench locations are labeled 1 to 7. Scale is approximately 1:11,500.

Eight trenches were excavated on March 24, 25, and 26, 1987 (Fig. 2) across lineaments L1, L2, and L4. Lineament L3 had no surface expression or traceable linear features, and hence was not trenched. Kimm Harty and Suzanne Hecker of the Utah Geological and Mineral Survey logged trench # 1 (Fig. 2). Robert M. Robison (Utah County Geologist) and John D. Garr (EarthFax Consultants) logged the other trenches. EarthFax Consultants were hired by Environmental Science and Engineering to participate in the investigation.

TRENCH LOCATIONS AND DESCRIPTIONS

Trenches were numbered from north-to-south on the eastern lineament (L1, trenches numbered 1 to 4, Fig.2) and from south-to-north on the western lineament (L2, trenches numbered 5 to 7, Fig. 2). The eighth trench (number 2a, Fig. 2) was parallel to trench number 2 to verify continuity of the sediments through a disturbed area. Horizontal level lines were used for elevation control and reference to bedding and features in logging trenches. The original scale of the trench logs was 1:50.

Five units were recognized in trench number 1 and were correlated in all of the trenches. A detailed explanation of each unit giving the type of deposit, thickness, color, texture and features, and genesis, is included in the appendix. A summary of the location and principal features in each trench is given below:

Trench Number 1. This trench was across the north end of lineament L1 (Fig. 2, Appendix A). Five stratigraphic units were delineated in this trench. The continuity of the beds can be seen in trench log #1 (Appendix A). Stringers of sand can be traced through the deposits. The fractures in the clayey sediments may be the result of shrinking from desiccation, or from liquefaction.

Trench Number 2. This trench was along lineament L4 (Fig.2). A total of 4 sedimentary units were logged in the trench. A large burrow(?) in the central portion of the trench made linear continuity of deposits unclear. A second trench (2a, Fig. 2) was excavated parallel to trench 2 which had continuous bedding in the region of the burrow. No logs were made of trench 2a, but photos (not included in this report) were taken.

Trench Number 3. A 5+ m high scarp was present at the site of trench number 3. A 36 m long trench was excavated across this scarp to ensure that any faults would be discovered (trench #3, Appendix A). Five stratigraphic units were logged in this trench.

Trench Number 4. This trench was located at the south end of lineament L1 (Fig. 2). Three continuous stratigraphic units were found.

Trench Number 5. Trench 5 was located at the south end of lineament L2 (Fig. 2). Three sedimentary units were identified. Unit 1 was subdivided into units 1 and 1a because of the presence of lacustrine(?) gastropods in unit 1a (Appendix A). Sand filled fissures were common.

Trench Number 6. Trench number 6 was located in the central portion of lineament L2 (Fig. 2). Three sedimentary units were found (Appendix A). Fissures were common and most were filled with sand. Several small (< 2 cm) fissures were open within unit 3.

Trench Number 7. Trench 7 (Fig. 2) was located on the north end of lineament L2. A 3 m (9 foot) scarp was trenched approximately 11 feet deep, which revealed only eolian sand. The scarp was apparently a dune slip face (lee slope). The trench walls were very unstable and no logs were made of the trench. Photographs were taken of the trench but were not included in this report.

DISCUSSION

Sediments and features of Pleistocene Lake Bonneville dominate the study area. The western margin of the site is approximately at the Provo shoreline of the lake occupied 14,000 - 15,000 years ago. Shoreline deposits are chiefly gravel which grades eastward to offshore facies of sand, silt, and clay. Most of the lake sediments are beneath a thin covering of sandy Holocene alluvium and eolian material. In addition to these surficial deposits, trenches exposed sand and gravel. Deposits representing the transgression of Lake Bonneville about 25 thousand years ago (unit 5, Appendix); deep lake clays of the highstand about 15 to 16 thousand years ago (units 3 and 4) and the drop to the Provo Shoreline 15 thousand years ago, and the regression of the lake out of the study area about 13 to 14 thousand years ago (unit 1a and 2). For a more complete discussion of the history of Lake Bonneville see Currey and Oviatt (1985).

The lineaments identified for study varied in surficial expression and probable origin. The aerial photographs used by Robison (1986) to identify lineaments were taken in 1959, and the photos used by ESE were taken in 1986 photos. Lineament number 1 (Fig. 2) was less visible on the 1986 photo as compared to the 1959 photo, and was at a slightly different orientation. Lineament number 2 (Fig. 2) was more evident on the 1986 photos. In addition to surface faulting, possible origins of the lineaments include grazing patterns, animal trails, fence lines, abandoned canals or ditches, differential erosion of surficial material, or natural drainage lines. The change in the character of the lineaments in the 27 years between the photos may be the result of stabilization after previous land uses, continued erosion of natural features. Also, several sand dunes are present roughly parallel to the lineaments.

No existing geologic or surficial maps indicate surface fault ruptures in this area, and none were found in the investigation. Faulting at depth has been inferred by Cordova (1970), but no faults were extended to the ground surface. Several trenches exhibited layers of sediments with sand-filled fissures with little or no offset. These fissures trended roughly parallel to lineaments, but none were found which reached the ground surface and are not the cause of the lineaments. The sand-filled fractures may be the result of either liquefaction or desiccation. If they resulted from earthquake-induced liquefaction, the earthquake causing the liquefaction would not necessarily have had an epicenter at the location of the liquefaction. A large earthquake on the Wasatch Fault, about 12 miles east, would shake the study area sufficiently hard to induce liquefaction when ground-water conditions were favorable. The earthquake would have had to occur after deposition of the clayey sediments (unit 3, Appendix A) about 13,000 to 12,000 years ago, but before the water table had dropped, possibly about 10,000 years ago.

If the sand-filled features are the result of desiccation, then a triggering earthquake is not necessary. The fissures could have formed any time following the retreat of Lake Bonneville from this level about 12 ka. Surface water or wind could have carried the sand into the fissures. Locally, some of the fissures were open (+/-1 cm) within unit 3.

CONCLUSIONS AND RECOMMENDATIONS

The trenches revealed no features which could be interpreted as tectonic faults. The trenches were sufficiently deep to encounter well-bedded late Pleistocene (Lake Bonneville age) and Holocene sediments in which offsets due to faulting would have been readily apparent. The lineaments must be the result of past land uses, meandering drainages, and/or wind erosion and deposition.

Small sand filled fractures in trenches may be result of liquefaction during times of higher ground-water or from desiccation as sediments dried. Under present conditions, the liquefaction potential for this area is very low (Anderson and others, 1986). There appears to be no surface fault rupture hazard at the site, however, trenches or other excavations produced from the construction of the landfill should be periodically inspected by the Utah County Geologist to check for possible faults in areas not covered by this investigation.

SELECTED REFERENCES

Anderson, L.R., Keaton, J.R., and Bischoff, J.E., 1986, Liquefaction potential map for Utah County, Utah: Utah State University and Dames and Moore unpublished report for the U.S. Geological Survey, 46 p.

Cordova, R.M., 1970, Ground water conditions in Southern Utah Valley and Goshen Valley, Utah: Utah Department of Natural Resources Technical Publication No. 28, 79 p.

Currey, D.R., and Oviatt, C.G., 1985, Durations, average rates, and probable causes of Lake Bonneville expansions, still stands, and contractions during the last deep-lake cycle, 32,000 to 10,000 years ago: in Kay, P.A., and Diaz, H.F., eds. Problems of and prospects for predicting Great Salt Lake levels, Conference Proceedings, Center for Public Affairs and Administration, University of Utah, p. 9-24.

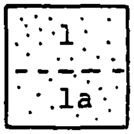
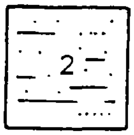
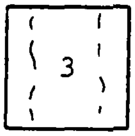
Robison,R.M., 1986a, Elberta landfill site: Unpublished Utah County Planning Commission Letter, 2 p.

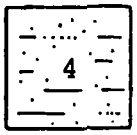
__________, 1986b, Elberta landfill site (Provo, Utah): Unpublished Utah County Planning Commission Letter, Dec., 1986, 4 p.

Whiting, Duane, 1986, Evaluation of hydrologic and seismic conditions, proposed sanitary landfill site in Goshen Valley, Utah: Unpublished report by Environmental Science and Engineering to Elberta Farms, Inc., Elberta, Utah, 55 p.

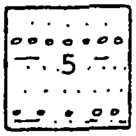
APPENDIX

EXPLANATION FOR TRENCH LOGS

UNIT	DESCRIPTION
	Sand, silt (SP, SM, ML): some organic material, gravel present locally; unit may be >1 m thick; light brown to tan, Munsell color is 2.5Y 7/2 (dry) to 2.5Y 6/4 (damp); if sand is predominant, color may be 10YR 5/3 . Material is eolian sand, loess and/or alluvium, roots are present and burrows are abundant. This unit is the present ground surface and is probably still being deposited. Unit 1a has sand with features and color similar to unit 1. This unit is bedded with pockets of gastropods, indicating that it may be lacustrine in origin and older than unit 1, possibly 13,000 to 14,000 years ago.
	Interbedded clay, silty clay and clayey silt, fine sand, (CL, CL-ML, SM): clay content increases toward bottom of unit, sand increases toward top of unit; unit thickness may be 2.6 m; color is green to gray, lower unit is 5Y 5.5 to 6.1 with laminations of 2.5Y 8/2 , unit grades upward to 5Y 7/2; laminated, may have sand filled fractures locally; probably represents the regressive deposits of Lake Bonneville, about 15,000 - 14,000 years ago.
	Blocky clay (CH): homogeneous, maximum thickness about 1 m; brown to reddish brown 10YR 5/2-3; some laminations or mottling present; may locally have sand filled fissures. $CaCO_3$ horizon may be present at the top of unit; these deposits may represent the deep water cycle of Lake Bonneville, about 18,000 years ago.

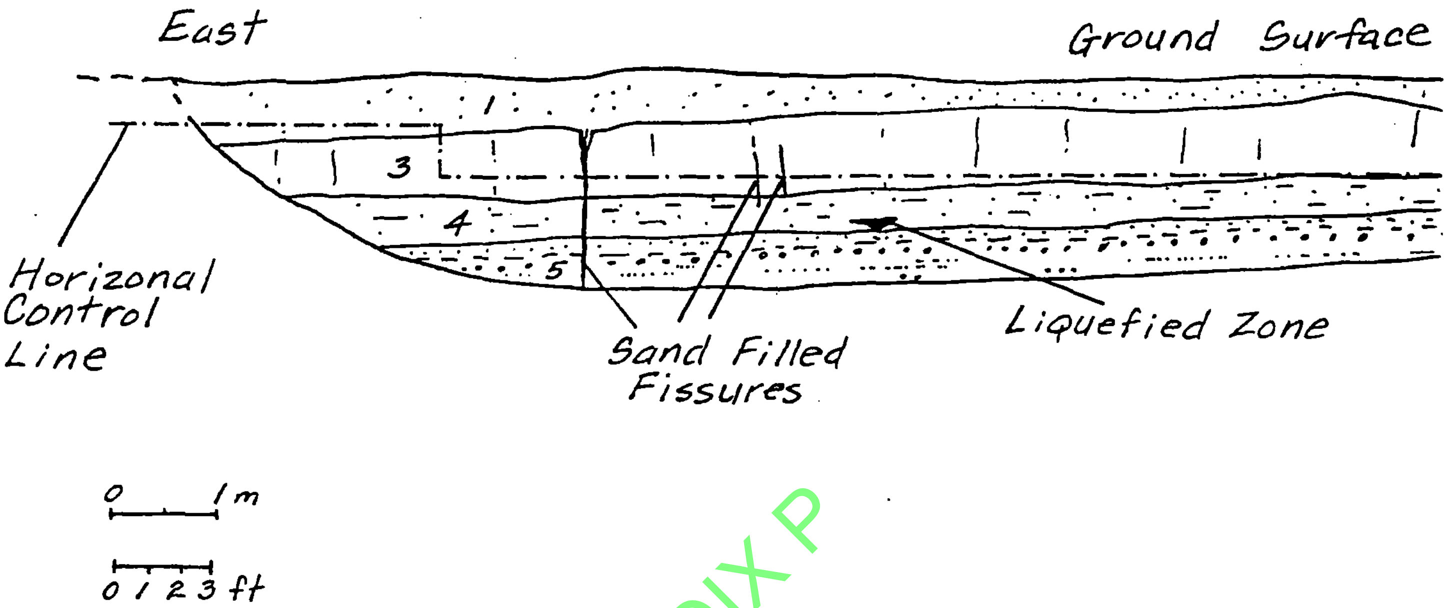


Interbedded clay, silty clay and clayey silt, some fine sand (CL, CL-ML, SM): clay content decreases at the base of unit; resembles unit 2; thickness is about .9 m maximum; laminated, color is green to gray, 5Y 6/1 with streaks of 5Y 8/1 to 7/2; some sand filled fissures present; this unit was probably deposited in the deepening waters of the transgression of Lake Bonneville, about 19,000 to 20,000 years ago.

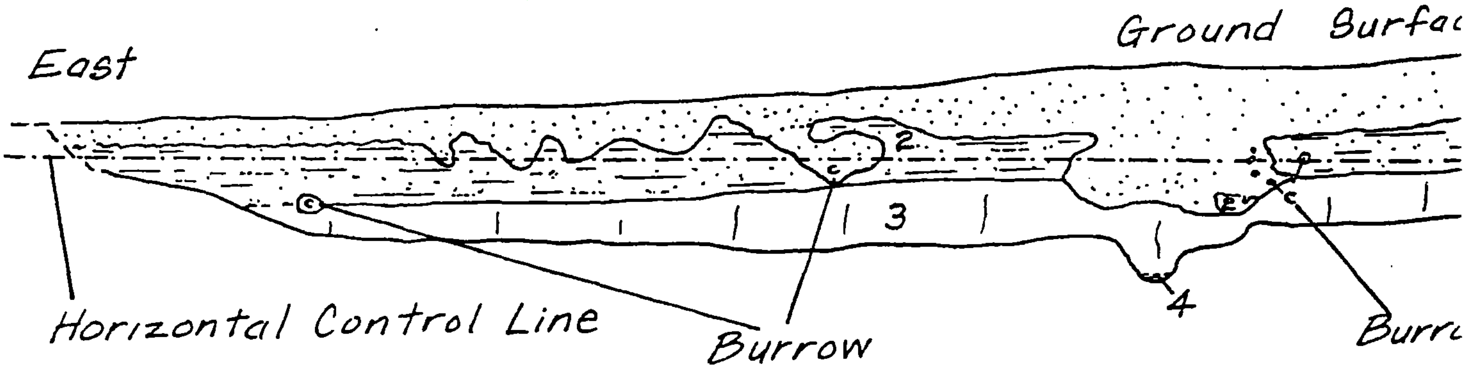


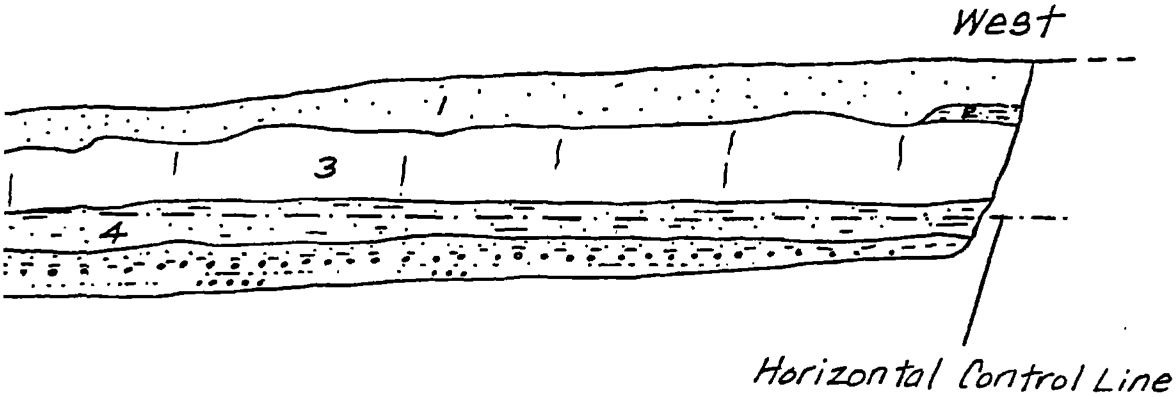
Interbedded gravel, sand, (GM, SM): bedded gravel, moderately to well sorted in places, maximum clast size 10 cm; unit thickness exceeds 1.2 m; light brown, 10YR 5/4 , a layer of red sand (oxidized iron stain) may be present at the contact between unit 4; liquefaction features (small diapirs) may be present at the upper contact; this unit may represent the transgressive gravels of Lake Bonneville, about 20,000 years ago.

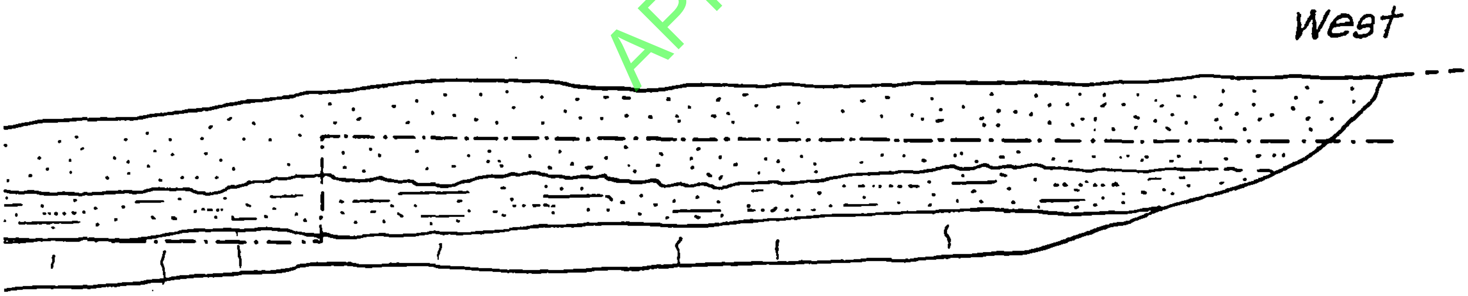
TRENCH #1

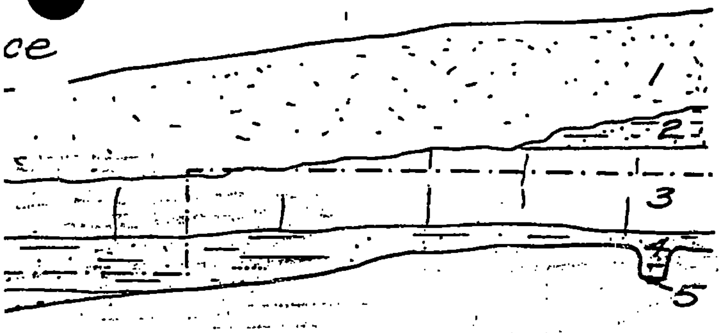


TRENCH #2

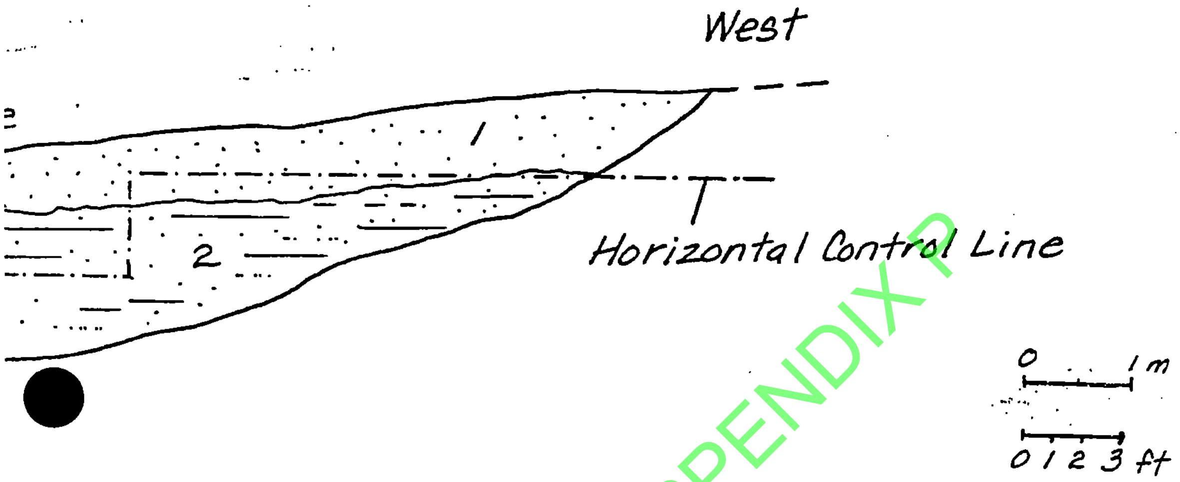


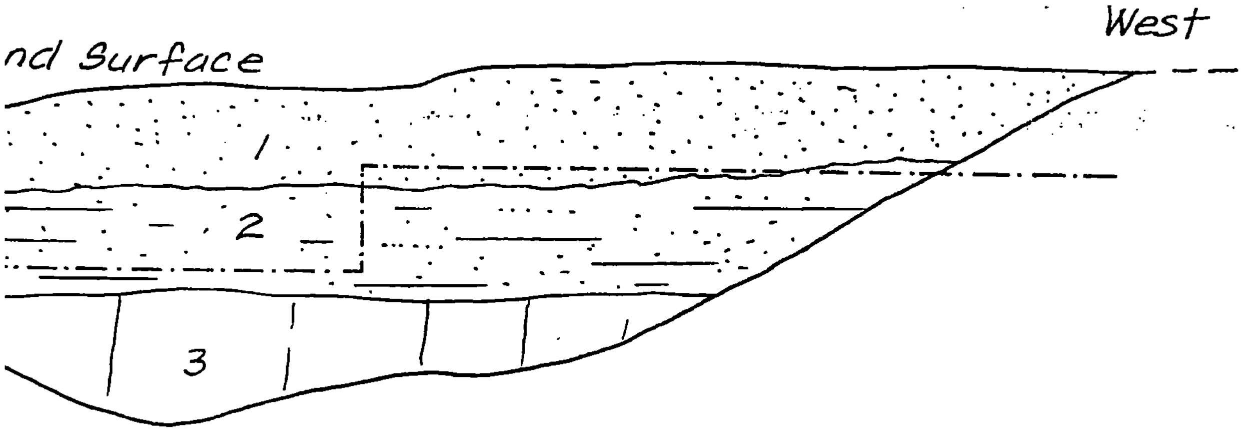

West
1
2
3
4
Horizontal Control Line


West

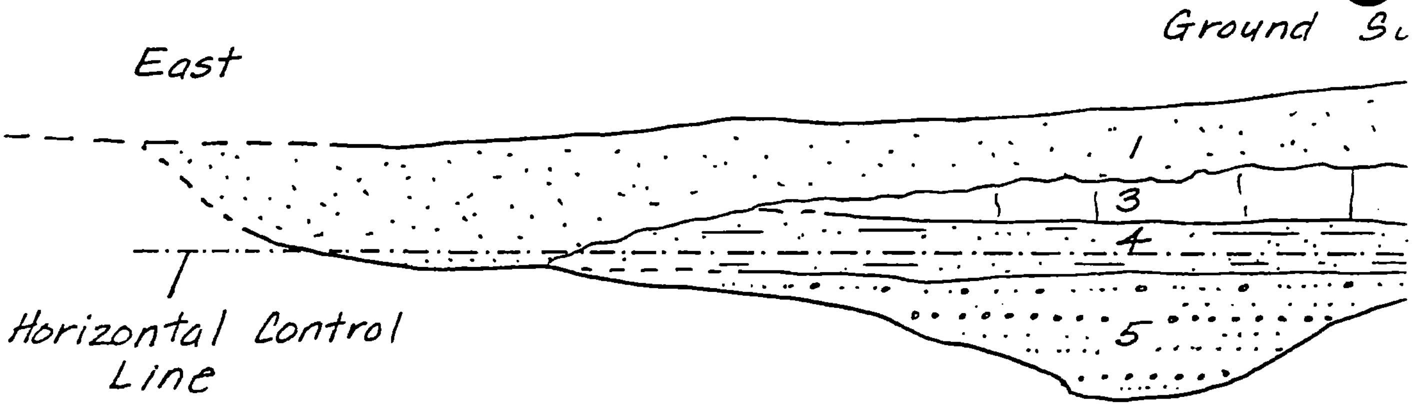


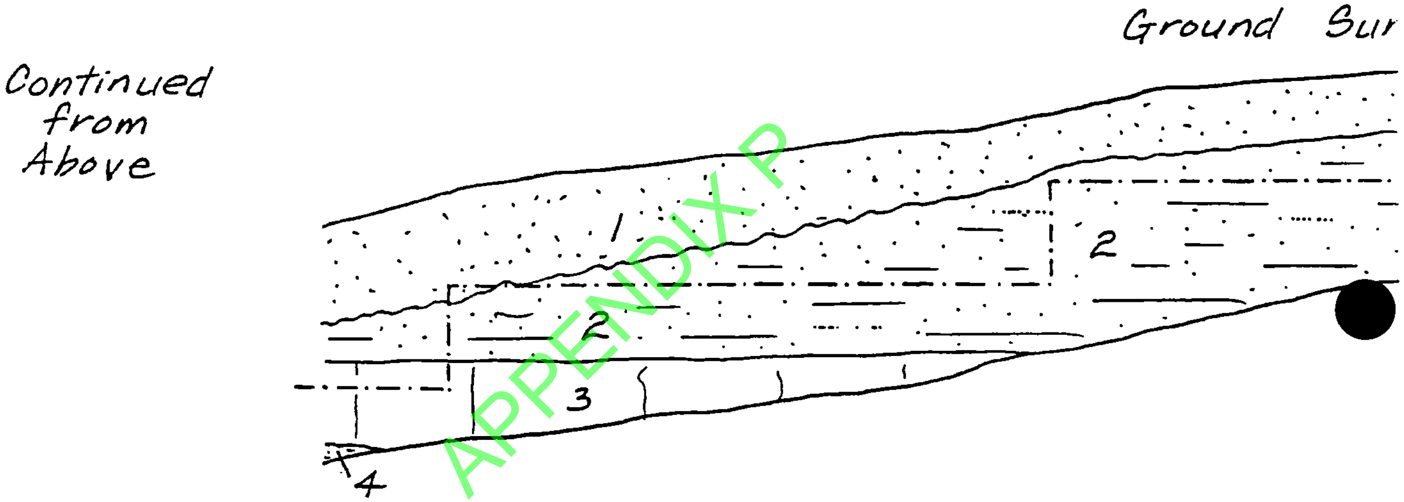
Continued Below



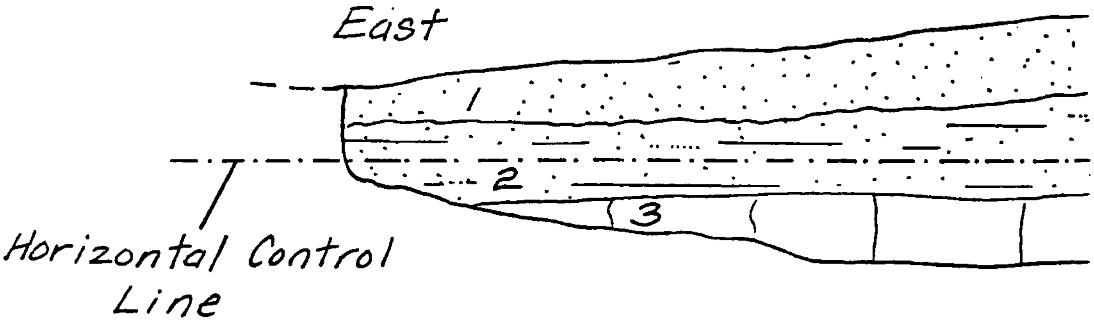


TRENCH # 3

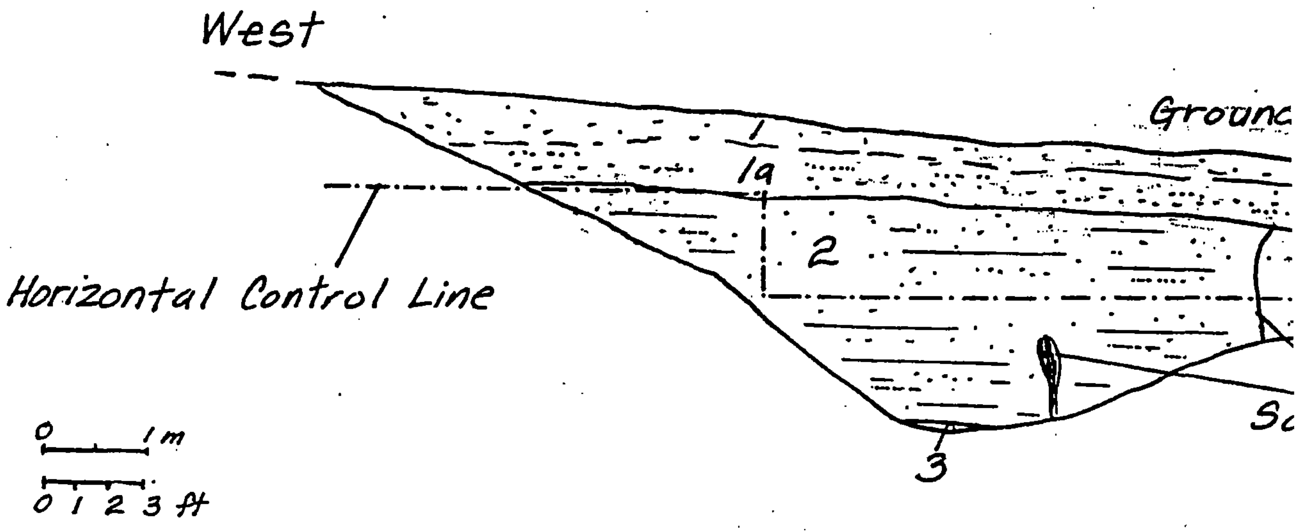




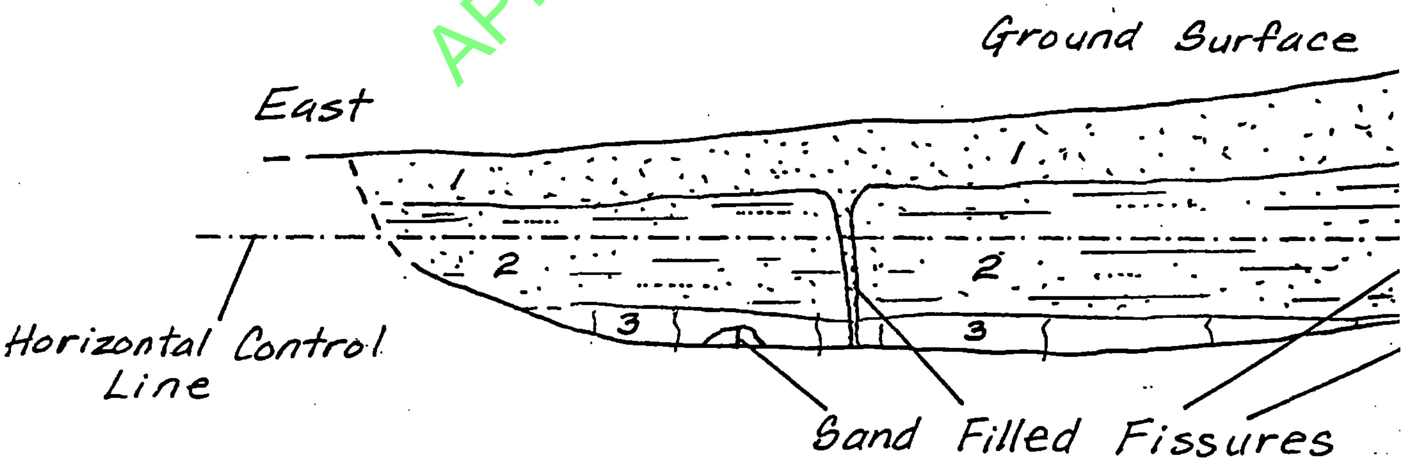
TRENCH # 4

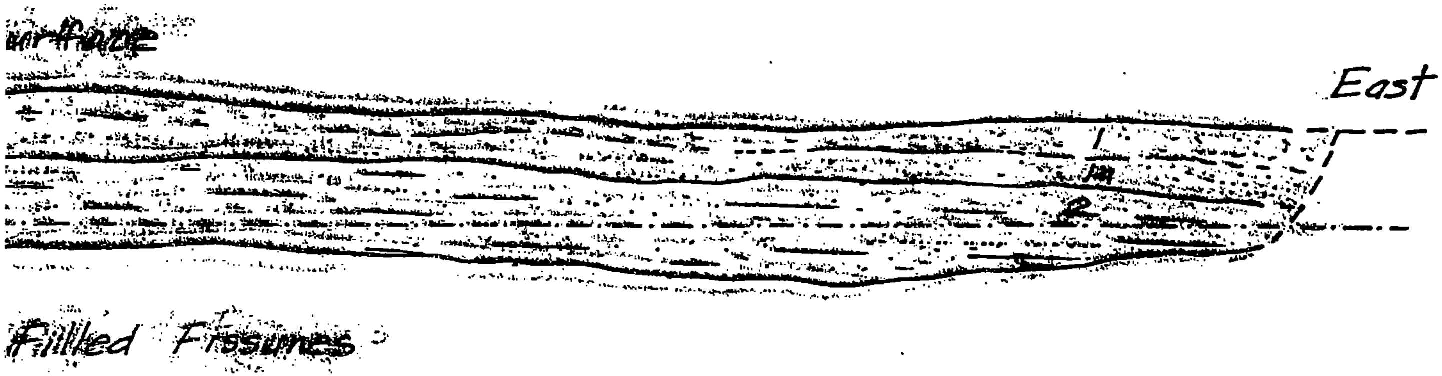


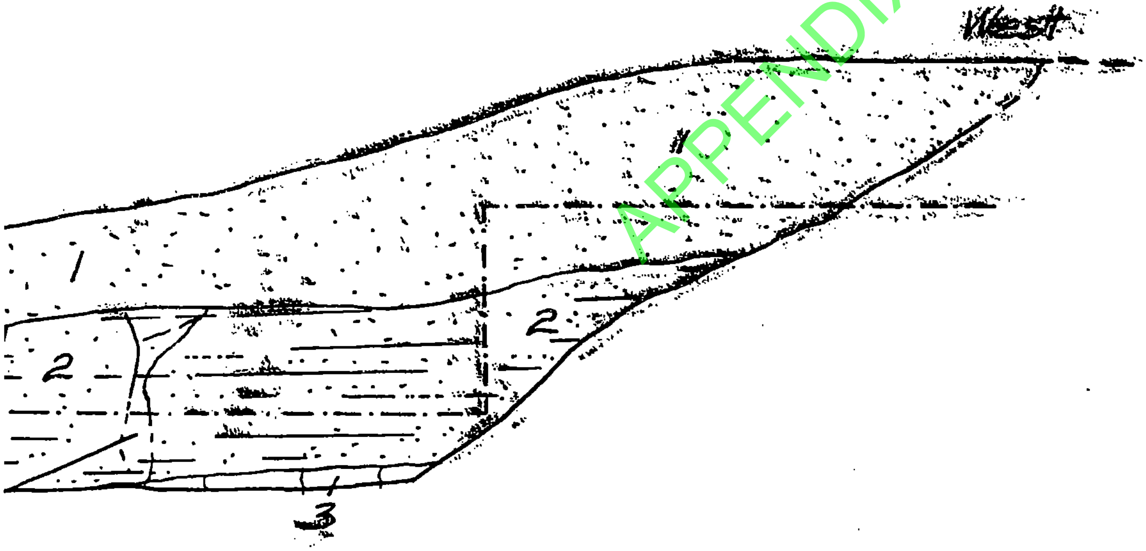
TRENCH # 5



TRENCH # 6




urface
East
1
2
Filled Fissures


West
1
1
2
2
3

APPENDIX Q – SEISMIC ANALYSIS

APPENDIX J

Seismic Analysis

SUVSWD Bayview Class I Landfill
Permit Application

APPENDIX J

SEISMIC ANALYSIS FOR

SOUTH UTAH VALLEY SOLID WASTE DISTRICT
BAYVIEW LANDFILL, CELL 1

ISSUED JULY 1996

PREPARED BY

HDR ENGINEERING, INC.

TABLE OF CONTENTS

REFERENCES

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

A - Design Earthquake Motions
B - Static and Pseudo Static Stability Analyses
C - Site Seismic Response Analyses
D - Seismic Deformation Analyses

SECTION 1.0
INTRODUCTION

1.1 Purpose

The Bayview Landfill (the Site) is located in a Seismic Impact Zone, as defined by the State of Utah Administrative Rules (Utah Department of Environmental Quality, 1996).

This report provides analyses demonstrating that, "...all containment structures...and surface water control systems are designed to resist the maximum horizontal acceleration in lithified earth material for the site."

These analyses have been conducted in accordance with the State of Utah Administrative Rules and EPA guidance presented in *RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities*, (EPA, 1995).

1.2 Scope

The scope of this report includes a literature review of regional and local seismicity, demonstration analyses of the seismic performance of the Site features and a report of findings and conclusions. This report is divided into the following sections:

- Section 2 - Site Conditions - presents soils, geology and seismicity data for the Site.
- Section 3 - Static and Pseudo-Static Stability Analyses - presents stability analyses for Cell 1 components; run-on/run-off controls; and the stormwater-leachate basin.
- Section 4 - Site Specific Ground Motions - presents site specific seismic response of the Site soils and landfill features
- Section 5 - Deformation Analyses - presents estimates of deformations of the Site soils and landfill features
- Section 6 - Findings and Conclusions - discusses the impact of the estimated deformations on the function of the landfill features.

SECTION 2.0
SITE CONDITIONS

2.1 Location

The Site is located in Sections 17 and 18, T9S, R1W, of Utah County. The site is approximately 5.5 miles north of Elberta, Utah and directly west of state Highway 68. The approximate latitude and longitude of the site are 40°02'N by 111°58'W.

2.2 Soils

Information on the site soils has been obtained from regional references, on-site soil borings and on-site monitoring well logs. The locations of the on-site borings and monitoring wells are shown on the Boring Location Plan, Figure 2-1.

The surficial soils consist of mostly Lake Bonneville Group, Provo Formation gravel, sand, silt and clay that were deposited in Lake Bonneville during Pleistocene time (Bissell, 1963). These soils were derived from erosion of the East Tintic Mountains and carried by streams into the ancient lake where they were deposited as beach, bar and spit deposits along the fluctuating shoreline (Hintze and Fuhriman, 1983). This fluctuating lakeshore environment created cycles of saturation and dessication, resulting in well consolidated deposits, commonly cemented with calcium carbonate (Chen and Associates, Inc., 1980).

Nine 50 feet deep soil borings were made on the site during site selection (Chen and Associates, Inc.) and site development (Rollins, Brown and Gunnell, Inc., 1983). The site-specific soil borings in the vicinity of Cell 1 indicate the soils consist of interbedded layers of dense to very dense sand (SW, SP, SC); medium dense to very dense gravel (GM, GW); and firm to very hard, low plasticity silt (ML) and clay (CL). Standard Penetration blow counts range from 13 to refusal in the silts and clays; 30 to 110 in the sands; and 85 to 125 in the gravels. No stratigraphic continuity was noted among the borings (Hintze and Fuhriman, 1983).

The six shallow monitoring wells shown on Figure 2-1 were advanced to nominal depths of 75 feet (Roy F. Weston, Inc., 1994). The soil types and discontinuous stratigraphy were similar to those observed in the soil borings.

The six deep monitoring wells shown on Figure 2-1 were advanced to depths ranging from 165 to 520 feet deep to encounter the "Shallow Pleistocene Aquifer." None of the borings encountered bedrock. These deeper borings indicated a trend to a more cemented soil structure and coarser gravel sizes at depths below 100 feet. The boring logs and gradation data (Bissell, 1963) indicate that cobble and boulder size materials are present.

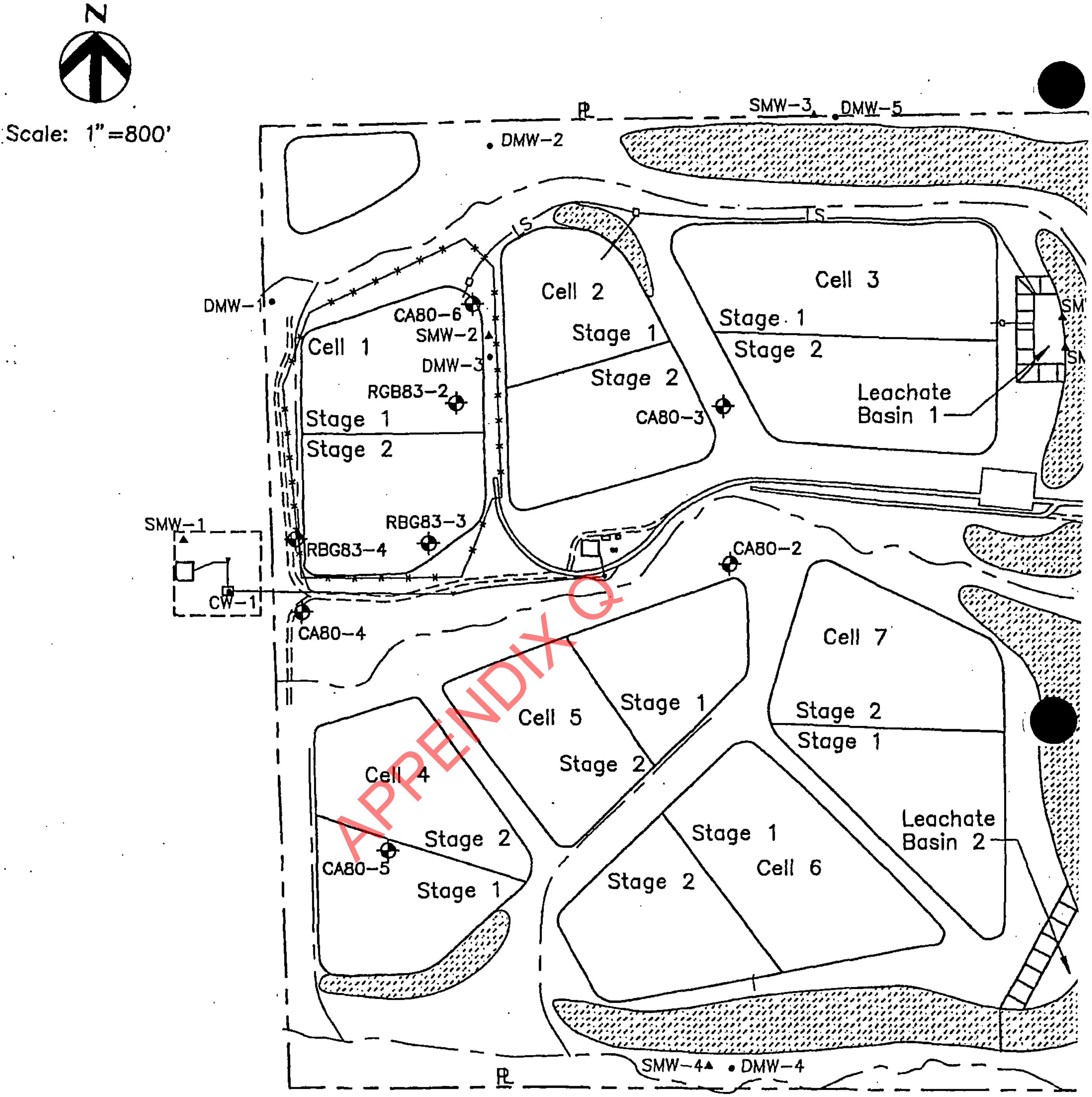


FIG2-1
BAYVIEW
5/7/96

Review of well logs summarized by the United States Geologic Survey (USGS, 1993) indicates that wells in nearby sections have been drilled to 800 feet without encountering bedrock.

Perched water table aquifers have been encountered within the Lake Bonneville Group deposits (Dustin and Merritt, 1980). However, culinary wells are advanced hundreds of feet deep to obtain adequate yield (USGS, 1993).

2.3 Geology

The Site is located in northwestern Goshen Valley, in the Great Basin portion of the Basin and Range Physiographic Province (Figure 2-2, after Dustin and Merritt, 1980). The eastern boundary of the Basin and Range Province is formed by the Wasatch Range, approximately 25 km east of the site (Hecker, 1993).

This Province is characterized by block faulting that has produced roughly parallel fault-block mountains that are separated by flat valley bottoms filled with alluvial and lake deposits.

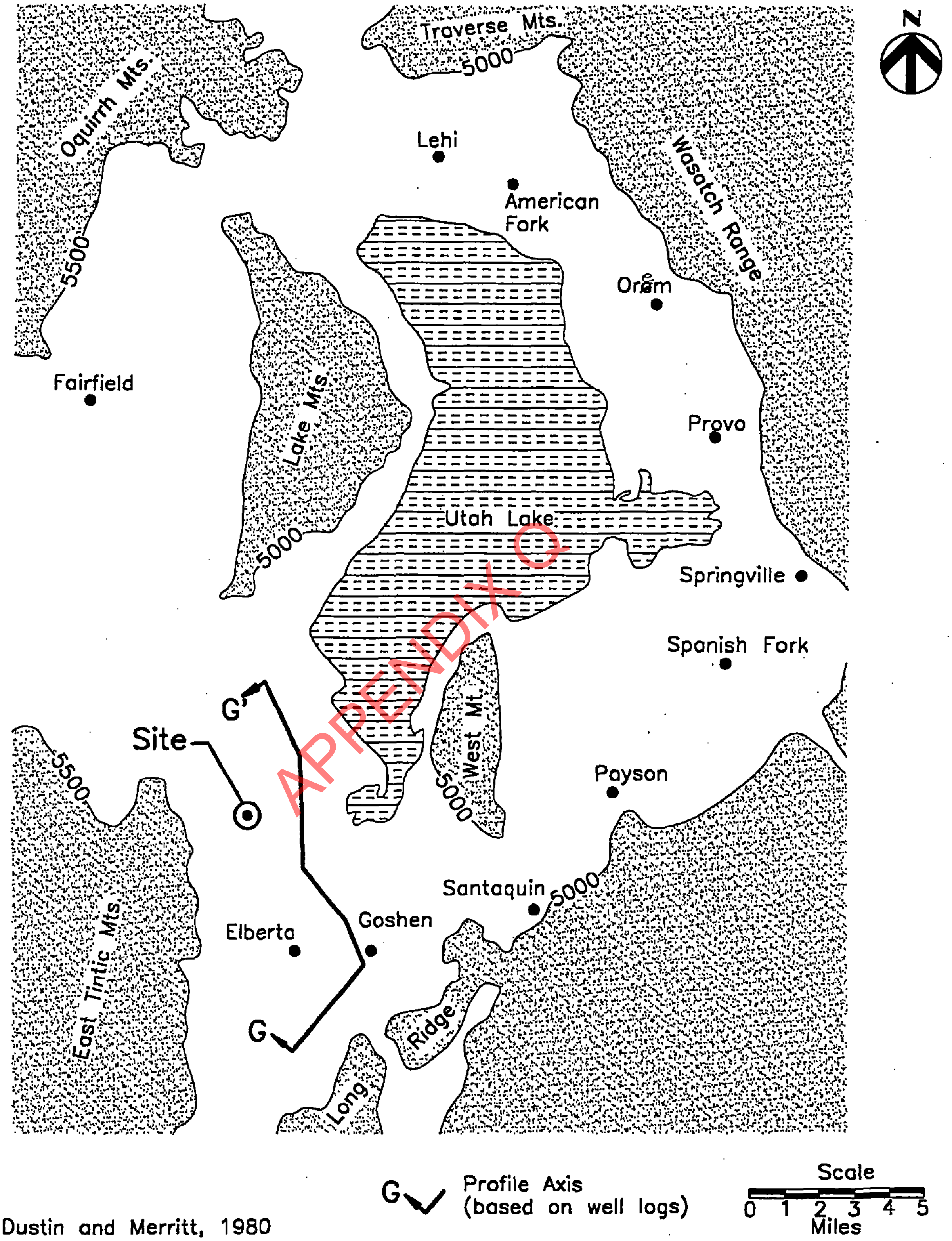
The Goshen Valley is bounded by the East Tintic Mountains on the west, Utah Lake on the north, West Mountain on the east, and Long Ridge on the south.

A cross-section of Goshen Valley, cut as shown on Figure 2-2, is presented on Figure 2-3 (Dustin and Merritt, 1980). The bedrock at the site is interpreted to consist of Miocene Epoch conglomerates, overlying Ogliocene Epoch volcanic flow materials and conglomerates, overlying Paleozoic Era limestones and dolomites.

2.4 Seismicity

The probabilistic bedrock acceleration at the Bayview site is 0.5g (490 cm/sec^2) as determined from the U.S. Geological Survey Map MF-2120 (Figure 2-4, after Algermissen et.al., 1990). The associated probabilistic maximum earthquake magnitude is 7.3 (Algermisson, et.al., 1982). An overview of state-wide seismicity is presented on Figure 2-5 (after Hecker, 1993). Earthquake magnitudes (M) greater than 2, as recorded during the time period 1962-1989, are also shown on this figure.

The maximum credible earthquake (MCE) for the Bayview site cannot be determined from the probabilistic maps. These map accelerations have been established on a probability basis and often eliminate peak accelerations that are judged as having the smallest chance of occurrence.



After Dustin and Merritt, 1980

HDR

HDR Engineering, Inc.

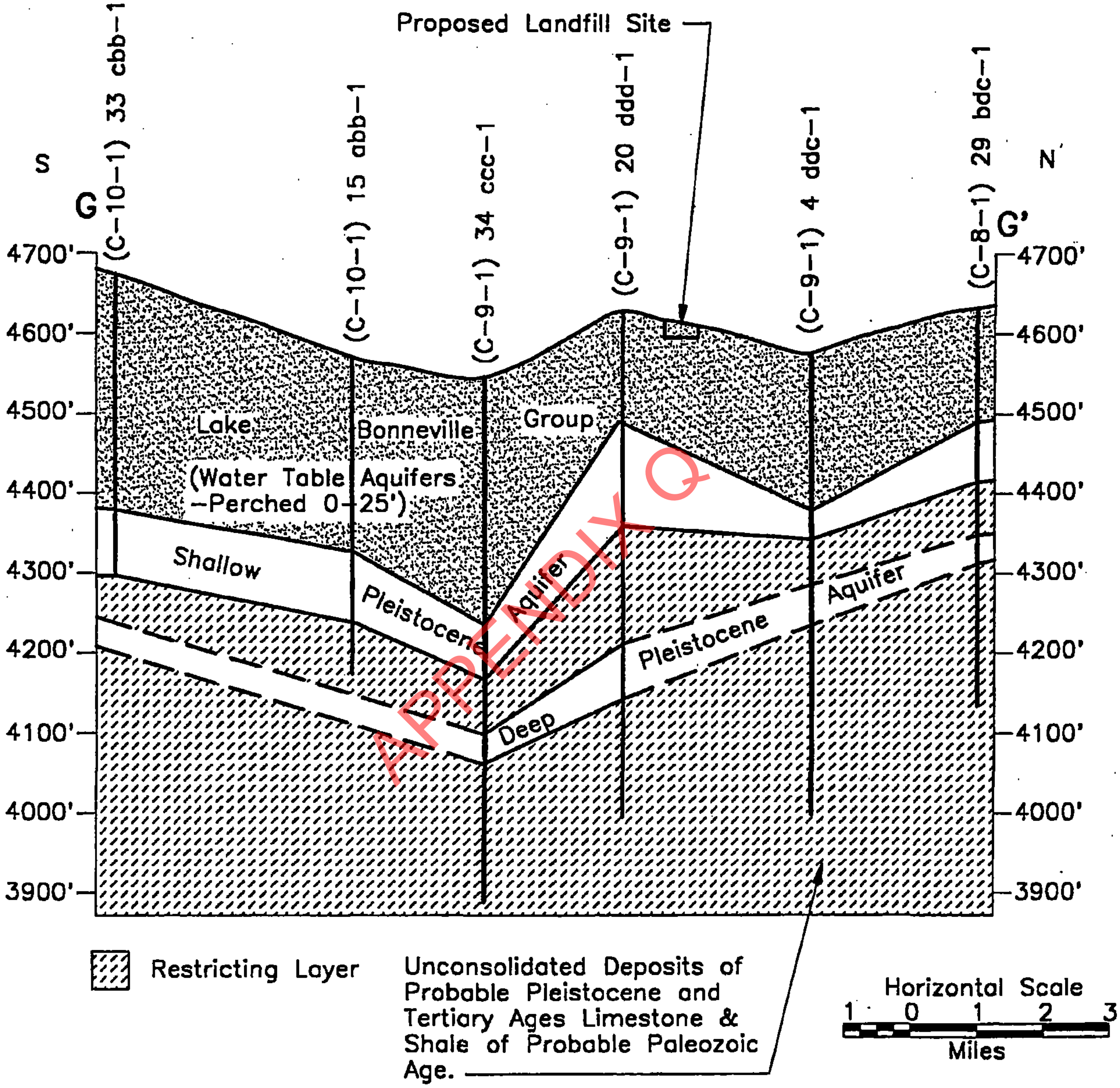
Geographic Location

South Utah Valley Solid Waste District
Bayview Landfill

Date
May 1996

Figure
2-2

FIG2-2
BAYVIEW
5/6/96



Atfer Dustin and Merritt, 1980

HDR

HDR Engineering, Inc.

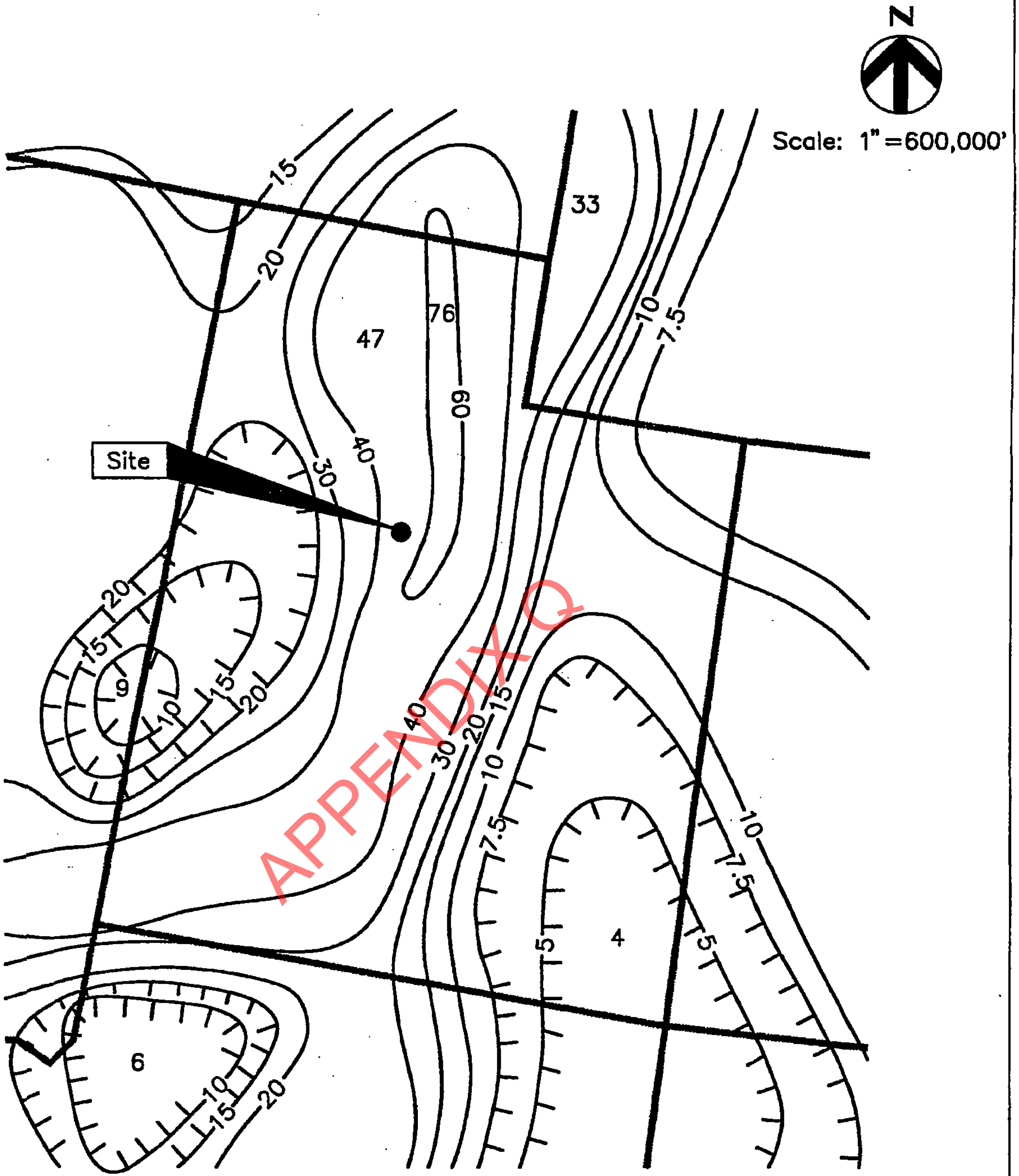
Aquifer Cross Section G-G
Goshea Valley, Utah

South Utah Valley Solid Waste District
Bayview Landfill

Date
May 1996

Figure
2-3

FIG2-3
BAYVIEW
5/6/96



After Algermissen, et.al., 1990

HDR Engineering, Inc.

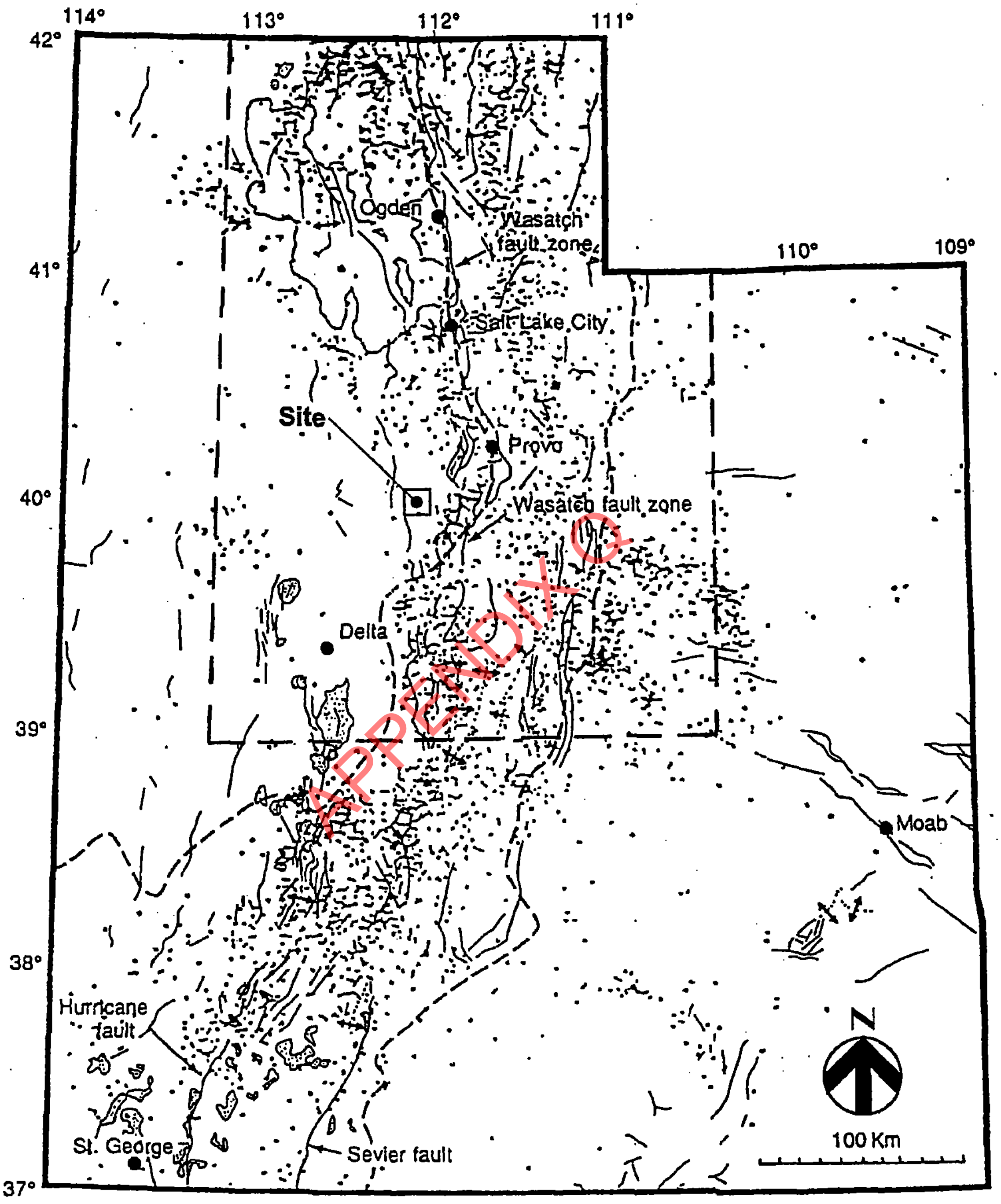
Probabalistic Earthquake Acceleration

South Utah Valley Solid Waste District
Bayview Landfill

Date
May 1996

Figure
2–4

FIG2-4
BAYVIEW
5/6/96



Notes:
1. After Hecker, 1993
2. Dots Represent M>2 Earthquakes
3. Dashed Area Represents Wasatch Fault Region

HDR

HDR Engineering, Inc.

Quaternary Tectonic Features and Seismicity of Utah

South Utah Valley Solid Waste District
Bayview Landfill

Date
May 1996

Figure
2-5

TECTFALT
BAYVIEW
5/8/96

Krinitsky (1989) has proposed a deterministic method, which considers the capability of a fault to produce an earthquake, independent of the probability of occurrence or return period. This method is based on the following premises:

- All earthquakes are caused by movement on faults.
- Whether or not a fault will produce earthquakes can be judged by the recency of previous fault movement.
- The size of the potential earthquake is in proportion to the size of the fault.
- Faults tend to produce earthquakes that are characteristic of each fault.

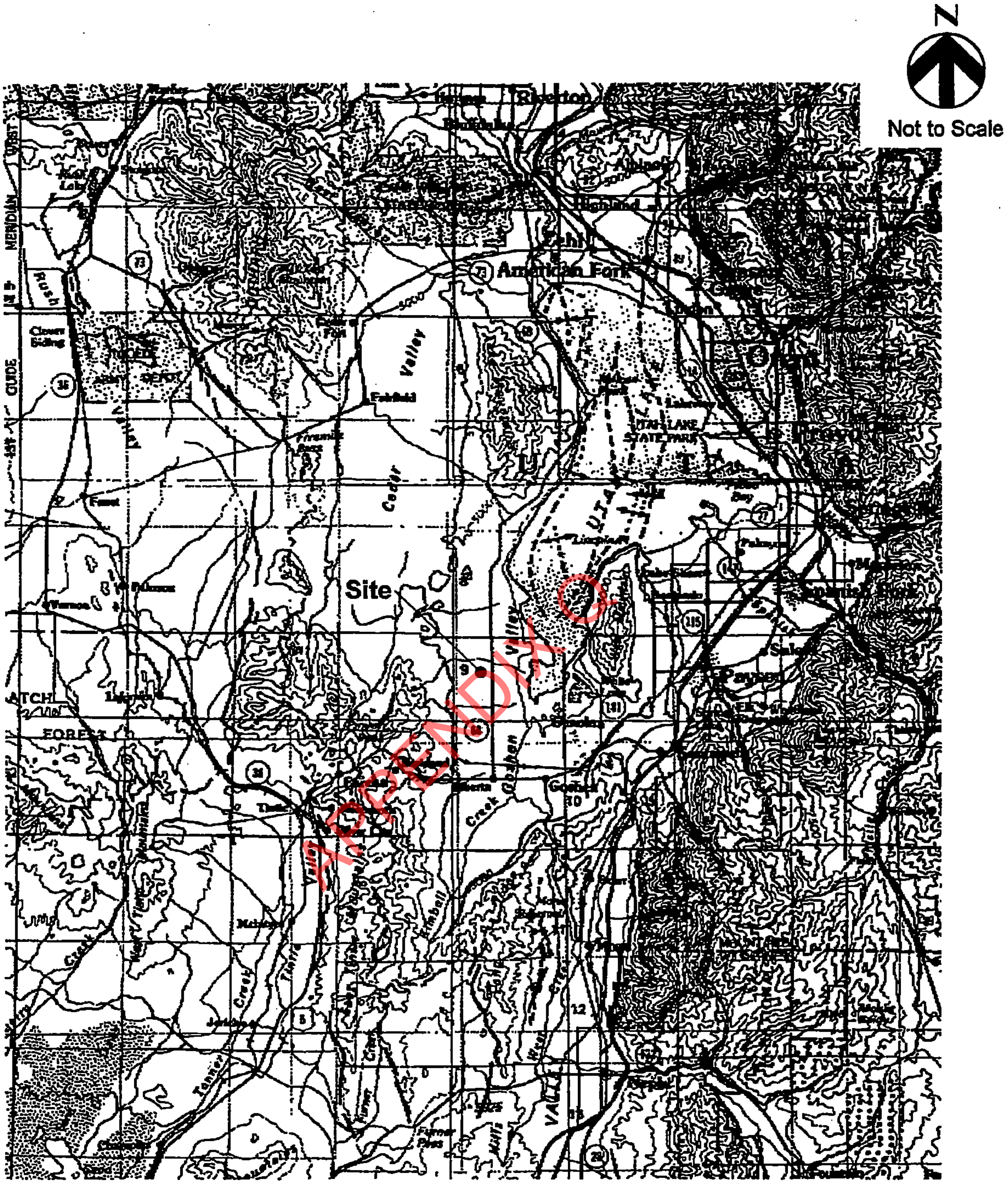
The MCE for a fault can be determined from measurements of fault length and surface displacement. The intensity and acceleration at the site can then be determined from source-to-site distance-attenuation relationships.

The Site is located in the "Wasatch Front region," defined as the geographical area from latitude 38°55'N to 42°30'N, and from longitude 110°25'W to 113°10'W (Hecker, 1993). The average regional recurrence interval for surface-faulting earthquakes (M>6 to 6.5) within the Wasatch Front region is 125 to 300 years. However, earthquakes below this M = 6.5 threshold for surface faulting may be capable of producing damaging ground motions. Faults in the vicinity of the Site are shown on Figure 2-6 (after Hecker, 1993).

The design earthquakes for the Bayview site were determined using the following steps, after Krinitsky (1989):

- Determine capable faults in the site vicinity. Capable faults are active faults judged capable of generating felt earthquakes. The criteria established by the Nuclear Regulatory Commission (Krinitsky, 1989) and the historic tectonic data (Hecker, 1993) were used to screen the potential faults.
- Determine the Maximum Credible Earthquake (MCE) for each capable fault. As discussed previously, the size of the potential earthquake is in proportion to the size of the fault. Relationships presented in Krinitsky (1989) were used to determine the source magnitude (M_0) from fault rupture length and displacement.

Determine the Modified Mercali Intensity (MMI) and maximum horizontal acceleration (MHA) of the MCE at the Bayview site. Source-to-site attenuation, intensity and acceleration at the Bayview site were determined in accordance with Krinitsky (1989).



After Hecker, 1993

HDR

HDR Engineering, Inc.

Quaternary Faults and Folds, Utah

South Utah Valley Solid Waste District
Bayview Landfill

Date
May 1996

Figure
2-6

QUATFALT
BAYVIEW
5/6/96

Details of these analyses are presented in Attachment A. The results of these analyses are presented on Table 2.1.

Table 2.1
Summary of Regional and Site Seismicity

FAULT DATA			SITE DATA	
Fault Name	Distance to Site (Km)	MCE (M_0)	MMI (-)	MHA (%g)
Topliff Hill	22	6.8	VIII	0.30
Mecur	24	7.0	IX	0.30
East Tintic Mountains	18	6.7	VIII	0.38
Wasatch - Provo segment	24-36	7.2	IX	0.40
Long Ridge	14	6.8	VIII	0.47
Wasatch - Nephi segment	18-21	7.2	IX	0.50

2.5 Adopted Design Values

The regional soil stratigraphy and site-specific boring logs were reviewed to establish a design profile for use in subsequent stability analyses. Soil shear strengths were based on the laboratory soil testing program and correlations with the Standard Penetration Test results (Department of the Navy, 1982). Waste shear strengths were based on EPA data (EPA, 1995). The adopted stratigraphy and corresponding physical properties are summarized on Table 2.2.

Table 2.2
Soil Stratigraphy and Physical Properties

DEPTH	UNIT WEIGHT (pcf)	COHESION (c) (psf)	FRICTION (ϕ) (degrees)
Waste	50	150	22
0-100	110	0	40
100-800	120	0	45
800+	120	0	45

The adopted design earthquake for the Bayview landfill site is a MMI = IX, with a corresponding MHA of 0.50g. This deterministic value is consistent with the probabilistic values of $M_0 = 7.3$ and MHA = 0.50g presented by Algermisson (1982, 1990).

SECTION 3.0
STATIC AND PSEUDO-STATIC STABILITY ANALYSES

3.1 Cases Considered

Stability analyses were conducted to determine the factor of safety against slope failures under static and pseudo-static loading conditions. The following landfill features, shown on Figure 2-1, were considered:

3.1.1 Cell 1, Stage 1 Excavation

Stage 1 of Cell 1 was constructed in 1989. The cell was excavated at 1V:4H (25 percent) slopes, to a maximum depth of nominally 40 feet. There was approximately 20 feet of relief in the original ground surface topography, resulting in higher slopes in the northern and western portions of the cell. These higher slopes are broken with a nominal 10 feet wide drainage bench approximately midway on the slope.

3.1.2 Cell 1, Stage 1 Liner and Leachate Collection System

The exisiting liner system for this stage consists of a 40-mil smooth High Density Polyethylene (HDPE) geomembrane sandwiched between two layers of 12 ounce per square yard nonwoven geotextile. The lower geotextile was used to provide a cushion against puncture from the underlying granular subgrade. The upper geotextile was used to provide the tensile strength necessary to resist the forces generated by the 2 feet thick leachate collection/protective cover layer sliding down the 1V:4H smooth HDPE surface.

3.1.3 Cell 1, Stage 2 Excavation

Stage 2 of Cell 1 is proposed for development. The proposed side slopes will match the Stage 1 grades and will consist of 1V:4H (25%) slopes, to a maximum depth of nominally 40 feet along the western and southern portions of the cell. These slopes are consistent with Utah Administrative Code R315-303-4 (3), (UDEQ, 1996).

3.1.4 Cell 1, Stage 2 Liner and Leachate Collection System

The proposed Stage 2 system will consist of a 60 mil smooth HDPE geomembrane over a cushion geotextile or a sand cushion layer.

The leachate collection/protective cover layer will consist of 2 feet of native dune sand. The side slope portions of the leachate collection/protective cover layer will be reinforced with a high strength geotextile to provide cushioning and increased side slope stability under both static and seismic loading.

3.1.5 Cell 1, Stage 2 Operational Filling

It is anticipated that the Stage 2 waste fills will be placed in 10 feet thick lifts, similar to the current operations for Stage 1. Fill slopes typically vary, with steeper slopes occuring at the working face. Two fill heights will be considered: 1) El. 4760±, representing a waste backfill to the initial ground surface, and 2)El. 4780, representing approximately 20 feet of waste above the initial ground surface.

3.1.6 Cell 1, Filled

The proposed waste fill slopes average 5 percent from the crest at El. 4812 to a variable slope break, ranging from El. 4800 to 4780. The side slopes are 1V:4H (25%) from the slope break to original grade. Maximum waste fill heights in Cell 1 are 90 feet above the cell bottom and 50 feet above original grade. These slopes are consistent with Utah Administrative Code R315-303-4 (4) (UDEQ, 1996).

3.1.7 Cell 1, Closure Cap

The proposed Cell 1 final cover liner will consist of a 60 mil Low Density Polyethylene (LDPE) smooth geomembrane; overlain by 12 inches of native sand drainage material; overlain by 6 inches of vegetative cover soil. This liner system will overlay a 12 inch gas transmission layer composed of native sand soils.

3.1.8 Stormwater-Leachate Basin

The Stormwater-Leachate Basin was constructed in 1989. The basin was excavated at 1V:3H slopes, to a maximum depth of nominally 24 feet. The basin is lined with a geotextile cushion layer and a 60 mil smooth HDPE geomembrane. A second, sacrificial 40 mil HDPE geomembrane is used for weather protection on the sideslopes. Six inches of concrete is used on the basin floor.

3.1.9 Adopted Design Cases

These features were consolidated into the following cases for analysis:

- Cell 1, excavation slopes, considering global soil stability.

  Cell 1, liner and leachate collection system (LCRS), considering side slope stability

- Cell 1, Stage 2 operational filling, considering sliding on cell floor liner and LCRS.

- Cell 1, final waste fill slopes, considering waste fill stability.
- Cell 1, closure cap, considering side slope stability
- Stormwater-leachate basin, considering global soil stability.

3.2 Methodology

Both static and pseudo-static conditions were evaluated. The generalized factor of safety against a slope failure is defined as: F.S. = s/τ, where s is the available shear strength of the slope and τ is the shear strength required for just-stable equilibrium.

The Simplified Bishop circular arc method was used to evaluate the global stability of the excavated and filled slopes. The computer program REAME (EPA, 1986) was used to conduct these analyses. This program searches for the potential failure surface which produces the lowest factor of safety. The location of this failure surface is a function of the site geometry (slope angle and height); material stratigraphy and physical properties; and loadings (weight of soil and/or waste above the failure surface).

The sliding block (wedge) method (USACE, 1970) was used to evaluate the sliding stability along the bottom liner and the LCRS system. The computer program UTEXAS3 (Wright, 1991) was used to conduct these analyses. The failure surface is defined by the bottom of the cell.

The infinite slope method (USACE, 1970) was used to evaluate the stability of the cell liner and LCRS system and the closure cap system. Generally, the failure surfaces for these features are defined by planar interfaces with the geosynthetic components.

For a given slope geometry, the interface friction angle, δ, between adjacent materials normally control slope stability, with the lowest interface friction angle controlling overall slope stability. Adopted friction values for the geosynthetic interfaces are presented on Table 3.1.

A minimum static safety factor of 1.3 was adopted (EPA, 1993). The pseudo-static seismic coefficient (k_s) was iterated for both the circular arc and the infinite slope analyses to determine the yield acceleration (k_y) corresponding to a factor of safety of 1.0. This yield acceleration is used to estimate the cell liner, cell leachate collection system and closure cap deformations (Section 5).

Table 3.1

Adopted Interface Friction Values

INTERFACE		FRICTION
LOWER	UPPER	ANGLE (δ)
	LINER AND LCRS	
Soil Subgrade	Cushion Geotextile -or-Sand Cushion	27° 27°
Cushion Geotextile -or- Sand Cushion	Smooth 60 mil HDPE	9° 17°
Smooth 60 mil HDPE	Granular LCRS	17°
	CLOSURE CAP	
Granular Gas Vent	Smooth 60 mil LDPE	25°
Smooth 60 mil LDPE	Granular Cap Drain	25°

The results of the static and pseudo-static stability analyses for the excavations and waste fills are presented in Attachment B and summarized on Table 3.2. The results indicate that the static factor of safety is adequate for the existing and proposed cut and fill slope geometry. The yield accelerations at a safety factor of 1.0 are near the the adopted peak bedrock acceleration, suggesting minimal permanent deformation (EPA, 1995). The estimated magnitude of this deformation is quantified in Section 5.

Table 3.2
Global Stability of Cut and Fill Slopes

FEATURE	STATIC FACTOR OF SAFETY	YIELD ACCELERATION
Cell 1, 1V:4H Excavation Slopes	2.5+	0.52g
Cell 1, 1V:4H Waste Fill Slopes	2.5+	0.44g
Stormwater-Leachate Basin, 1V:3H Slopes	2.5+	0.52g

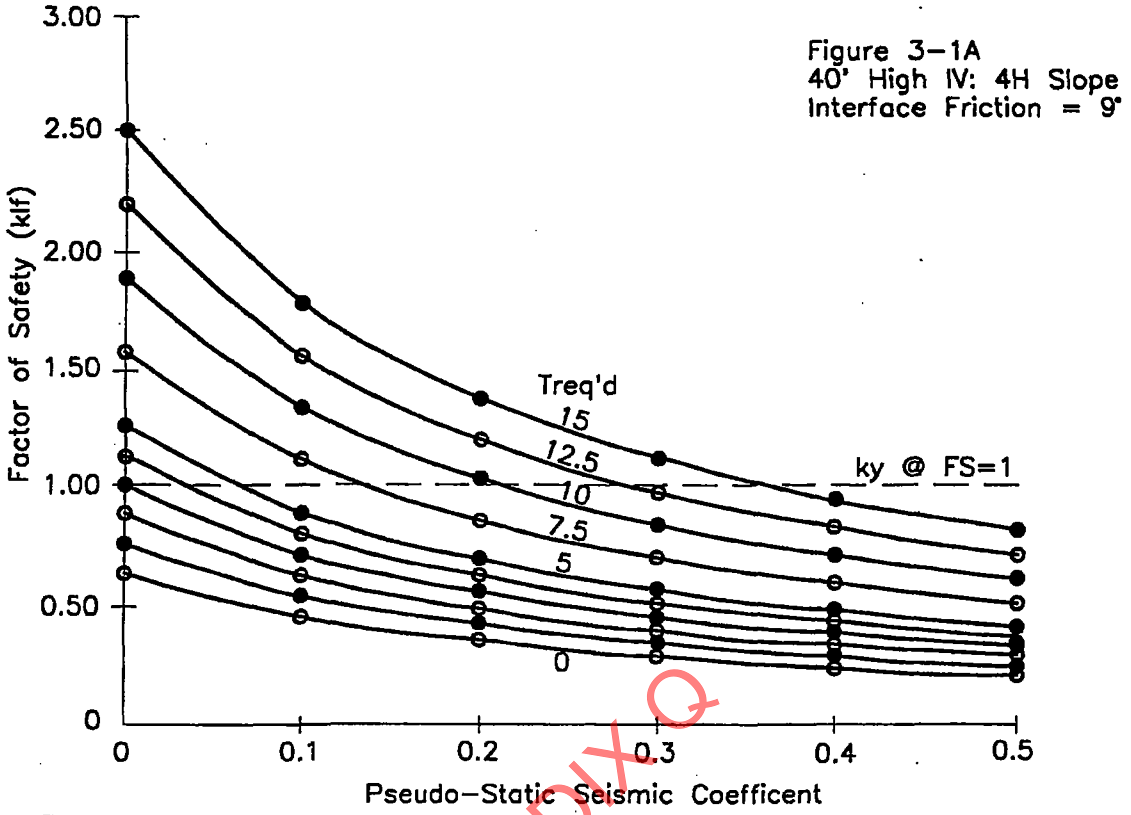
The results of the static and pseudo-static stability analyses for the cell liner and LCRS and the closure cap are presented in Attachment B and summarized on Table 3.3.

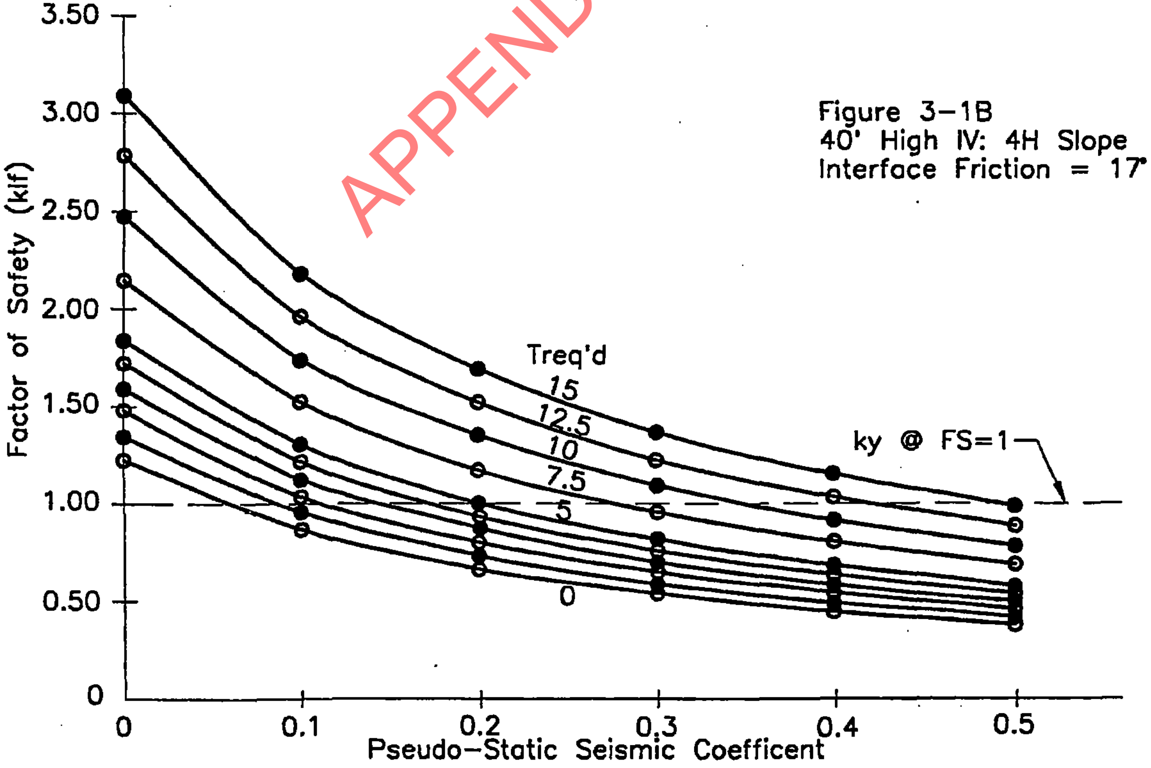
Table 3.3
Stability of Cell 1 Liner and Closure Cap Slopes

FEATURE	δ	F.S.	k_y	T_{reqd}
Side slope liner and LCRS	9	Fig 3-1A	Fig 3-1A	Fig 3-1A
	17	Fig 3-1B	Fig 3-1B	Fig 3-1B
Bottom liner and LCRS	9	3.25	0.15	None
	17	5.18	0.25	None
Closure Cap	25	1.87	0.21	None

Infinite slope analyses at the liner - LCRS interface indicate that the 9° and 17° interfaces will not meet the minimum static factor of safety on a 1V:4H (14 degrees) slope.

Tensile reinforcement, similar to that used in the Stage 1 construction, is required to provide additional resistance against both static and pseudo-seismic forces. Higher reinforcement levels will increase both the static safety factor and the yield acceleration at which permanent displacements begin. The relationship among the interface friction angle (δ), static factor of safety (FS), yield acceleration (k_y) and the required reinforcement strength (T_{reqd}) is shown on Figure 3-1.





HDR

HDR Engineering, Inc.

Cell 1 Liner and LCRS Stability

South Utah Valley Solid Waste District
Bayview Landfill

Date
May 1996

Figure
3–1

fig3–1
BAYVIEW
5/14/96

SECTION 4.0
SITE SPECIFIC GROUND MOTIONS

4.1 Approach

The MHA selected in Section 2 is the maximum horizontal acceleration in the Site bedrock and does not reflect the effect of the overlying soils on the horizontal acceleration developed at the ground surface or at the top of the closed Cell 1.

These ground motions were determined using the "Simplified Analysis" presented in EPA, 1995. This Simplified Analysis is considered appropriate for the Site, based on considerations of the soil stratigraphy and geology. The Simplified Analysis consists of the following steps:

- Classify the site, based on shear wave velocity in the upper 100 feet of the soil column.
- Estimate the free field peak ground surface acceleration (PGA), based on the site classification and the MHA in the bedrock.
- Estimate the peak acceleration at the top of the landfill, based on the PGA and the seismic response of the waste.

Details of this Simplified Analysis are presented in Attachment C.

4.2 Site Classification

The shear wave velocity was based on Utah Geologic Survey (UGS) experience in the area (Christensen, 1996) and the Site-specific soil borings.

The UGS has classified this area of Utah County as a "hard site," generally considered as having a shear wave velocity greater than 400 meters per second (m/s).

Site-specific shear wave velocities were computed from the Standard Penetration Test data (N values) reported in the geotechnical investigations (Department of the Navy, 1982). The computed average shear wave velocity in the upper 100 feet was 386 m/s.

Based on this range in shear wave velocity, the site was classified as a medium stiff (200 to 375 m/s) to stiff (375 to 700 m/s) site (EPA, 1995). Both classifications were carried forward for further analysis.

4.3 Free Field Acceleration

The PGA was determined from the site classification and the MHA (Section 2). Both the medium stiff and stiff classification ranges were considered. The results are presented on Table 4.1.

Table 4.1
Free Field Acceleration (PGA)

SITE CLASSIFICATION	MHA	PGA
Medium Stiff	0.50	0.50
Stiff	0.50	0.50

The results of this analysis indicate the Site soils provide little attenuation or amplification to the MHA. This is a function of both the site soils and the high MHA (EPA, 1995).

4.4 Peak Acceleration at Top of Landfill

The peak acceleration at the top of the landfill was determined from the PGA and the seismic response of the waste mass, using the recommended "soft-soil site" amplification curve of Idriss (EPA, 1995).

The results of this analysis indicate a peak acceleration of 0.42 g at the top of the landfill, suggesting a slight attenuation through the waste mass.

SECTION 5.0
DEFORMATION ANALYSIS

5.1 Approach

Permanent deformations resulting from the adopted design seismic event were estimated for each of the landfill features identified in Section 3. Chart solutions, based on the "Newmark sliding block" method, were used to quantify these deformations.

The Newmark method is based on the premise that permanent deformations (U) accumulate along a failure surface when the acceleration in the failure mass (a_{max}) exceeds the yield acceleration (k_y) along the failure surface. The yield acceleration and the mass acceleration for each feature are presented in Sections 3 and 4, respectively.

The results of these analyses are presented in Attachment D and discussed in the following.

5.2 Allowable Deformation

An upper limit of 30 cm.(1 foot) was established as the maximum tolerable deformation for the geosynthetic components (EPA, 1995). For a 40 feet high 1V:4H slope with a slope length of 165 feet, the elongation from this maximum 1 foot of deformation would be 0.6 percent (1ft ÷ 165ft, as a percent). The yield elongation for 60 mil smooth HDPE is nominally 12 percent (NSF, 1991), indicating adequate reserve elongation capacity.

5.3 Excavations and Fills

The permanent deformations for the Cell 1 excavations, the stormwater-leachate basin and the Cell 1 waste fill were estimated from the Makdisi and Seed chart version of the Newmark method (EPA, 1995). These estimates are presented in Table 5.1.

Table 5.1
Estimated Permanent Deformations

FEATURE	k_y	a_{max}	U
Cell 1 excavations	0.52g	0.50g	<1 cm.
Cell 1 waste fill	0.44g	0.50g	<1 cm
Stormwater-leachate basin	0.52g	0.50g	<1 cm

The estimated deformations are minor and reflect the high yield strength along the failure surface relative to the mass acceleration from the design earthquake event.

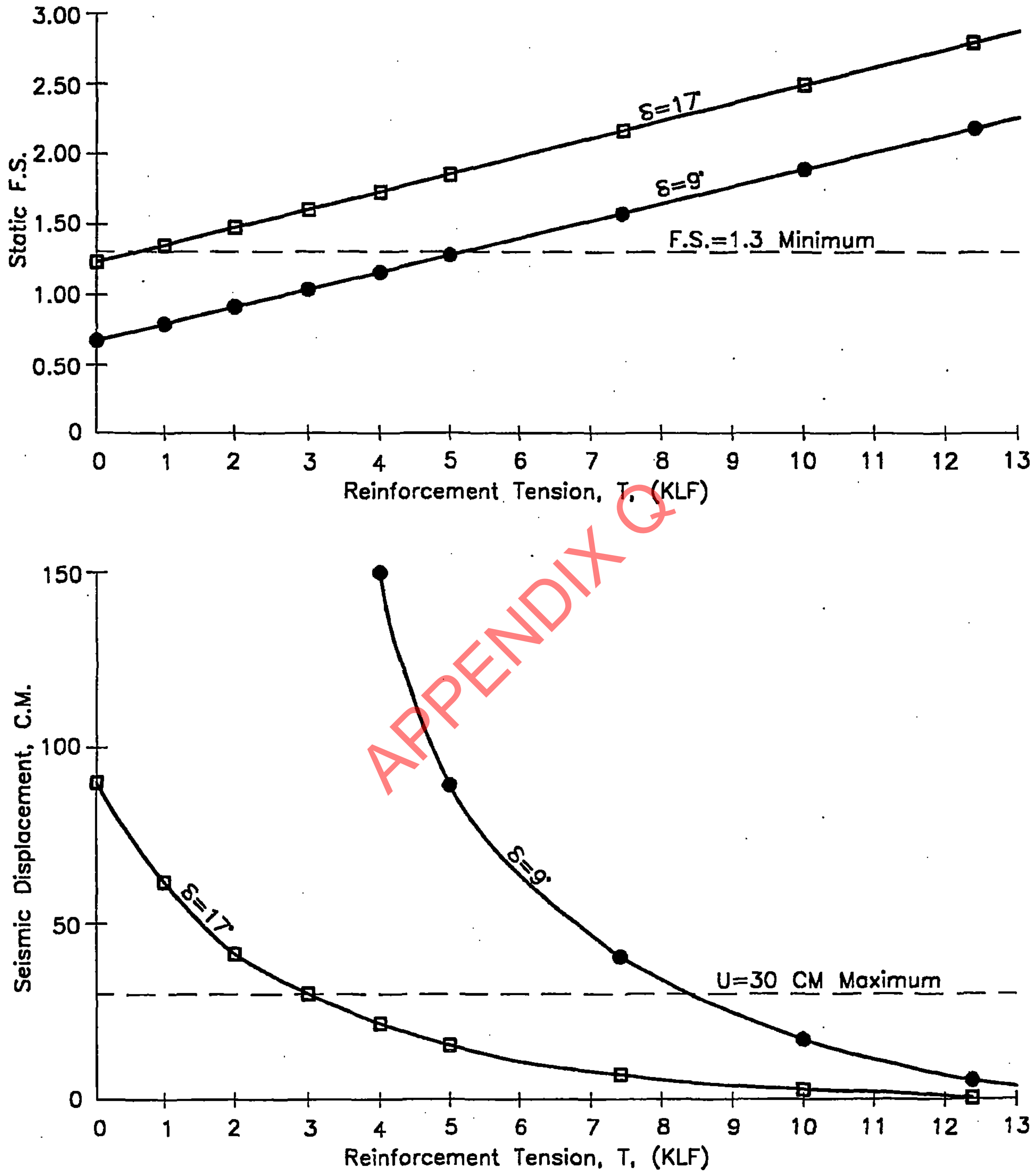
5.4 Liner and LCRS Systems

The permanent deformations for the Cell 1 liner and LCRS were estimated from the Makdisi and Seed chart version of the Newmark method (EPA, 1995). These estimates are presented on Figure 5-1.

As shown on Figure 5-1, the 9° cushion geotextile - smooth HDPE interface requires a minimum tensile reinforcement of 8.2 kips per linear foot (klf) to limit permanent deformations to less than 30 cm. The 17° sand cushion - smooth HDPE interface requires a minimum tensile reinforcement of 3.5 kips per linear foot (klf) to limit permanent deformations to less than 30 cm.

5.5 Closure Cap System

The permanent deformations for the Cell 1 closure cap were estimated from the Hynes and Franklin chart version of the Newmark method (EPA, 1995). None of the estimated deformations exceeded 10 cm. No reinforcement is required for this proposed clossure cap.



HDR

HDR Engineering, Inc.

Cell 1 Liner and LCRS Deformations

South Utah Valley Solid Waste District
Bayview Landfill

Date
May 1996

Figure
5-1

fig5-1
BAYVIEW
5/14/96

SECTION 6.0
FINDINGS AND CONCLUSIONS

6.1 Findings

The Bayview Landfill site is located in a Seismic Impact Zone. Both deterministic and probabilistic methods indicate a peak bedrock acceleration of 0.5g. The dense granular soils offer little amplification or attenuation of the bedrock acceleration through the overlying soil column.

The cut and fill slopes and run-on/run-off structures have adequate static factor of safety and indicate minimal permanent deformations (U<1 cm) in response to the design seismic event.

The side slope liner and LCRS system will require a geosynthetic reinforcement to increase the static factor of safety and limit permanent deformations in response to the design seismic event. Either sand or a geotextile can be used as a cushion beneath the geomembrane.

The closure cap system has an adequate static factor of safety and indicates acceptable permanent deformation (U<10 cm) in response to the design seismic event. No reinforcement is required.

6.2 Conclusions

These demonstration analyses indicate that the proposed Bayview landfill components are designed to resist the "maximum horizontal acceleration" at the site.

REFERENCES

Bissell, H.J., (1963), *Lake Bonneville: Geology of Southern Utah Valley, Utah*, Geological Survey Professional Paper 257-B.

Algermissen S.T. et.al., (1982), *Probablilistic Estimates of Maximum Acceleration and Velocity in Rock in the Contiguous United States*, Open-File Report 82-1033, U.S. Geological Survey.

Algermissen S.T. et.al., (1990), *Probablilistic Earthquake Acceleration and Velocity Maps for the United States and Puerto Rico*, Map MF-2120, U.S. Geological Survey.

Chen and Associates, Inc, (1980), "Proposed Sanitary Landfill Site, City of Provo, Utah," Job No. 130U, Chen and Associates, Inc. Salt Lake City.

Christensen, G.E., (1996), Utah Geological Survey, personal communication.

Department of the Navy, (1982), *Soil Mechanics Design Manual 7.1*, NAVFAC DM-7.1, Department of the Navy, Naval Facilities Engineering Command, Alexandria, VA.

Dustin, J.D. and Merritt, L.B., (1980), *Hydrogeology of Utah Lake with Emphasis on Goshen Bay*, Water Resources Bulletin 23, Utah Geological and Mineral Survey, Salt Lake City, UT.

Environmental Protection Agency, (1986), *Geotechnical Analysis for Review of Dike Stability (GARDS),* EPA 1600/2-86-109a, Office of Research and Development, Cincinnati, OH.

Environmental Protection Agency, (1993), *Solid Waste Disposal Facility Criteria,* EPA/530/R-93-017, Office of Solid Waste and Emergency Response, Washington, DC.

Environmental Protection Agency, (1995), *RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities*, EPA/600/R-95/051, Office of Research and Development, Washington, DC.

Hecker, S., (1993), *Quaternary Tectonics of Utah With Emphasis on Earthquake-Hazard Characterization*, Bulletin 127, Utah Geological Survey, Salt Lake City, Utah.

Hintze, L.F. and Fuhriman, D.K., (1983), "Geohydrology Study of Proposed West Lake Landfill Site."

Krinitsky, E.L., (1989), " Empirical Earthquake Ground Motions for an Engineering Site with Fault Sources: Tooele Army Deport, Utah," *Bulletin of the Association of Engineering Geologists*, Vol. XXVI, No. 3, pps. 283-308.

National Sanitation Foundation, (1991), *Flexible Membrane Liners*, ANSI/NSF 54-1991, NSF International, Ann Arbor, MI.

Rollins, Brown and Gunnell, (1983), Letter report of Subsoil Investigation Submitted to Provo City Department of Engineers. Rollins, Brown and Gunnell, Inc., Provo, Utah..

U.S. Army Corps of Engineers, (1970), *Stability of Earth and Rock-Fill Dams*, Engineer Manual EM 1110-2-1902, Department of the Army, Corps of Engineers, Office of the Chief of Engineers, Washington, DC.

U. S. Geological Survey, (1993). *Selected Hydrologic Data For Southern Utah and Goshen Valleys, Utah, 1890-1922*, Utah Hydrologic Data Report No. 50: prepared in cooperation with the Utah Department of Natural Resources, Division of Water Rights.

Utah Department of Environmental Quality, (1996), *Solid Waste Permitting and Management Rules*, Utah Administrative Code (R315-301 through 320), Revised as of February 15, 1996, State of Utah, Department of Environmental Quality, Division of Solid and Hazardous Waste, Salt Lake City, UT.

Roy F. Weston, Inc., (1994), *Application For A Permit To Operate A Class I Landfill. Bayview Landfill, South Utah SW District,* Roy F. Weston, Inc., Denver, CO.

Wright, S.G., (1991), *UTEXAS3, A Computer Program for Slope Stability Calculations*, Shinoak Software, Austin, TX.

ATTACHMENT A
DESIGN EARHTQUAKE MOTIONS

Job No.

No.

HDR Computation

HDR

Project	BAYVIEW LANDFILL	Computed	RLD	Date	4-29-96
Subject	LANDFILL SEISMIC EVALUATION	Checked	PHP	Date	6-4-96
Task	SELECT DESIGN EQ & MOTIONS	Sheet	1	Of	

OBJECTIVES : 1) DETERMINE CAPABLE FAULTS AROUND SITE
2) DETERMINE MAXIMUM CREDIBLE EARTHQUAKE (MCE) OF CAPABLE FAULTS
3) DETERMINE MMI, a_g AT SITE

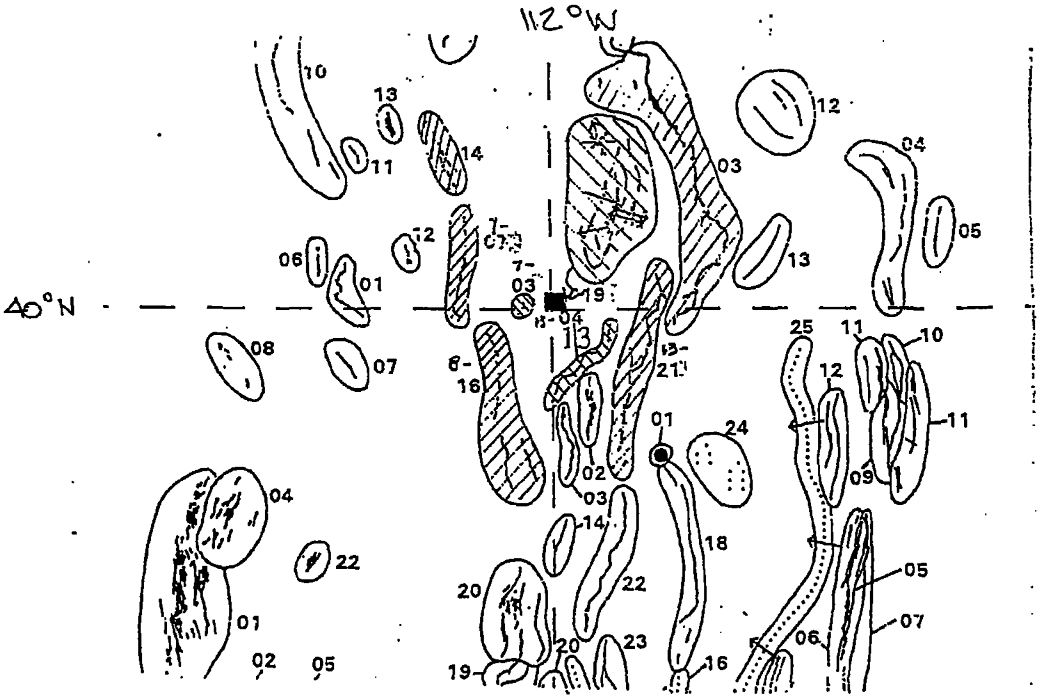
REFERENCES : 1) HECKER, S., (1993), "QUATERNARY TECTONICS OF UTAH WITH EMPHASIS ON EARTHQUAKE-HAZARD CHARACTERIZATION," <u>BULLETIN 127</u>, UTAH GEOLOGICAL SURVEY, SALT LAKE CITY, UT.

2) KRINITSKY, E.L., (1989), "EMPIRICAL EARTHQUAKE GROUND MOTIONS FOR AN ENGINEERING SITE WITH FAULT SOURCES: TOOELE ARMY DEPOT, UTAH," <u>BULLETIN OF THE ASSOCIATION OF ENGINEERING GEOLOGISTS</u>, VOL. 26, NO. 3, 1989, PPS 283-308.

---

1. DETERMINE CAPABLE FAULTS AROUND SITE

USE REF 1, APPENDIX C INDEX MAP, BELOW
SELECTED FAULTS SHOWN AS HATCHED



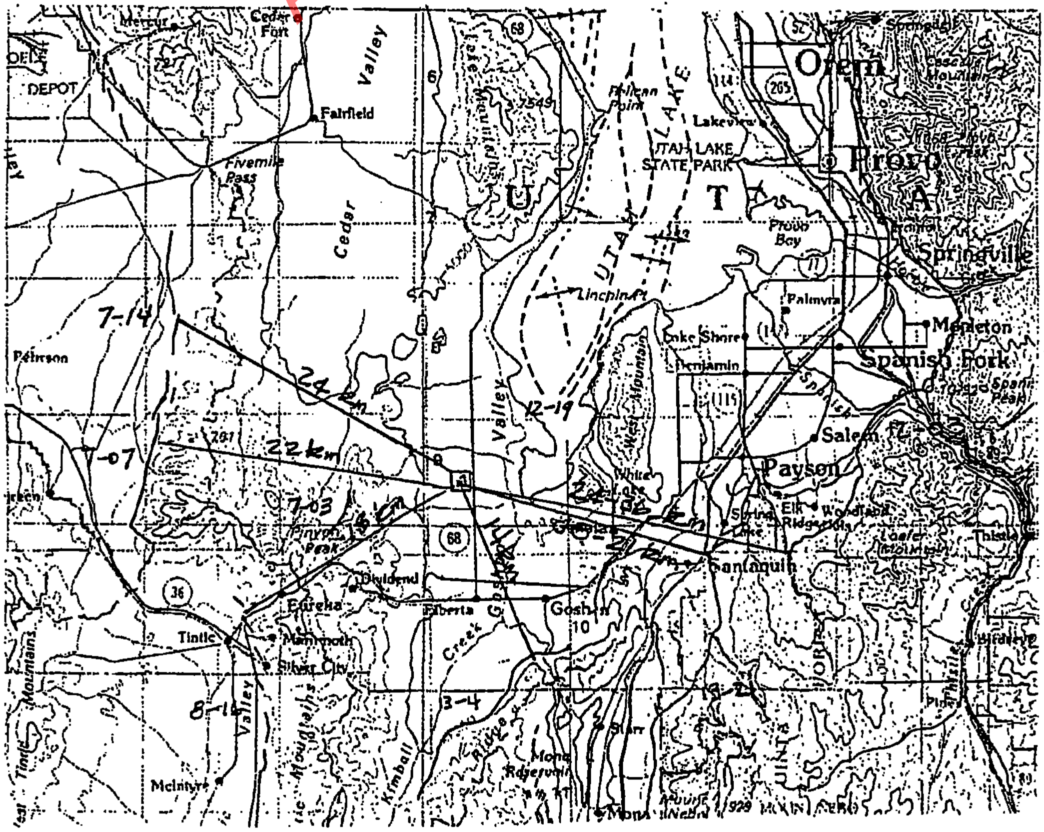
Project	Computed	Date
Subject	Checked	Date
Task	Sheet 2	Of

1.2 EVALUATE FOR "CAPABLE" OR 'ACTIVE FAULTS

CRITERIA (REF 2, APPENDIX E) BASED ON NRC TITLE 10, CHPT 1, PART 100
- MOVEMENT AT/NEAR GROUND SURFACE WITHIN PAST 35,000 yr, AND/OR
- MACROSEISMIC INSTRUMENTATION TO DEMONSTRATE DIRECT RELATIONSHIP W/FAULT, &/
- STRUCTURAL RELATIONSHIP TO ANOTHER CAPABLE FAULT

FROM REF 1, APPENDIX A (PORTIONS ATTACHED)
CAPABLE FAULTS:
- TOPLIFF HILL (7-7)
- MECUR (7-14)
- EAST TINTIC (8-16)
- WASATCH - PROVO (12-3)
- LONG RIDGE (13-4)
- WASATCH - NEPHI (13-21)

} SHOWN BELOW, FROM REF 1, PLATE 16.



NAME OR LOCATION OF FEATURE (Location No.)	AGE OF MOST RECENT MOVEMENT $X10^3$ years	SLIP RATE mm/yr (Time Period $X10^3$ years ago)	RECURRENCE INTERVAL $X10^3$ years (Time Period $X10^3$ years ago)	DISPLACEMENT PER EVENT meters	RUPTURE LENGTH kilometers

Goose Creek Mountains (faults)
(6-18)

Parameter values:	Quaternary(?)				

Age Criteria : fault control of bedrock-alluvium contact
References : Doelling and others, 1980

Grouse Creek and Dove Creek Mountains (faults)
(6-19)

Parameter values:	middle to late Pleistocene(?)				

Age Criteria : faulted colluvium
References : Compton, 1972
Comments : Faults are mapped as Quaternary(?) (plate 1) where faulting has uplifted Pliocene to early Pleistocene gravels, and where lineaments and aligned springs suggest active faulting (Todd, 1973; this study).

Sheeprock fault zone
(7-1)

Parameter values:	late Pleistocene(?)				

Age Criteria : scarp morphology
References : Barnhard and Dodge, 1988
Comments : From scarp-profile data, the Sheeprock scarps appear to be older than the Topliff Hill, Stansbury, and Mercur scarps (location nos. 7-7, 7-10, and 7-14). Diffusion-equation modeling of the scarps, which probably represent multiple events (with a cumulative displacement of <11.5 meters), yielded an age of about 53,000 years (Hanks and others, 1984). In contrast, Everitt and Kaliser (1980) concluded that scarp morphology suggests a possible Holocene age for latest faulting. The embayed character of the range front suggests a long period of inactivity preceding the recent episode of faulting (Everitt and Kaliser, 1980).

Silver Island Mountains
- southeast side (fault)
(7-2)

Parameter values:	3 - 5 ?			0.6 ?	

Age Criteria : artifacts
References : D.B. Madsen, written and verbal communication, 1987, 1988
Comments : Lake Bonneville deposits are vertically displaced 0.6 meters across the fault. Diagnostic artifacts in faulted sediments near fault-line springs and correlations between basal spring-related peat layers and Holocene lake levels provide an estimate of the time of origin of the springs and, presumably, the time of faulting.

Cedar Valley
- south end (fault)
(7-3)

Parameter values:	late Quaternary(?) 0-500,000 yR				

Age Criteria : range-front morphology
References : Anderson and Miller, 1979
Comments : Anderson and Miller (1979) indicated that Quaternary(?) alluvium may be displaced, and they mapped the fault as late Pleistocene (<500,000 years old), although an aerial photo check for this study yielded no clear evidence of faulted alluvium.

NAME OR LOCATION OF FEATURE (Location No.)	AGE OF MOST RECENT MOVEMENT X10^3 years	SLIP RATE mm/yr (Time Period X10^3 years ago)	RECURRENCE INTERVAL X10^3 years (Time Period X10^3 years ago)	DISPLACEMENT PER EVENT meters	RUPTURE LENGTH kilometers
Silver Island Mountains - west side (fault) (7-4)					
Parameter values:	Quaternary(?)				
Age Criteria :	fault control of bedrock-alluvium contact				
References :	Moore and Sorensen, 1979				
Lakeside Mountains - west side (fault) (7-5)					
Parameter values:	Quaternary(?)				
Age Criteria :	fault control of bedrock-alluvium contact				
References :	Moore and Sorensen, 1979; Young, 1955				
Comments :	Arabasz and others (1989) included the fault (queried as to state of activity) in a compilation of seismic sources in the region. They reference T.P. Barnhard as having identified the feature as a lineament that he feels is probably not related to faulting because it parallels topographic contours, and thus may be a shoreline feature.				
Lookout Pass - south side (fault) (7-6)					
Parameter values:	Quaternary(?)				
Age Criteria :	fault control of bedrock-alluvium contact				
References :	Moore and Sorensen, 1979				
Topliff Hill fault zone (7-7)					
Parameter values:	late Pleistocene(?) 10,000—130,000 yr				12 *
Age Criteria :	scarp morphology; shoreline relations				
References :	Barnhard and Dodge, 1988				
Comments :	Everitt and Kaliser (1980) interpreted a faulted alluvial fan as younger than the Bonneville shoreline, whereas Barnhard and Dodge (1988) mapped the same surface as wave-etched and older than the Bonneville shoreline. *From scarp-profile data, the Topliff Hill scarps appear to be younger than the Sheeprock, Stansbury, and Mercur* fault scarps (location nos. 7-1, 7-10, and 7-14). The Topliff Hill scarps show evidence for recurrent movement, with a cumulative maximum displacement of 5.8 meters. South of the scarps, the range-front (mapped as a Quaternary(?) fault, plate 1) rises in elevation, is linear and faceted, and has an active alluvial apron (Everitt and Kaliser, 1980).				

* FROM KRINITSKY, REF 2.

NAME OR LOCATION OF FEATURE (Location No.)	AGE OF MOST RECENT MOVEMENT X10^3 years	SLIP RATE mm/yr (Time Period X10^3 years ago)	RECURRENCE INTERVAL X10^3 years (Time Period X10^3 years ago)	DISPLACEMENT PER EVENT meters	RUPTURE LENGTH kilometers
Saint John Station fault zone (7-13)					
Parameter values:	late Pleistocene				

Age Criteria : presence of scarps on alluvium; relations to lacustrine features

References : Barnhard and Dodge, 1988; Everitt and Kaliser, 1980

Comments : Small-displacement faults in alluvium (not shown on plate 1) lie several kilometers southeast of the Saint John Station fault zone within a portion of the Tooele Army Depot and are buried beneath an unfaulted soil estimated to be older than 125,000 years (Krinitzsky, 1989: U.S. Department of the Army, 1989).

Mercur fault zone (7-14)					
Parameter values:	late Pleistocene(?) 10,000 - 130,000 yr			0.9-1.9 *	16 *

Age Criteria : scarp morphology; lacustrine stratigraphy

References : Barnhard and Dodge, 1988

Comments : Reinterpretation of a trench log that was presented by Everitt and Kaliser (1980) as evidence for post-Bonneville faulting shows a pre-existing fault scarp buried by Bonneville transgressive deposits. A shallow trench excavated across a feature identified by Everitt and Kaliser (1980) as a fault scarp in a post-lake terrace likewise revealed a buried pre-Bonneville fault scarp. From scarp profile data, the Mercur scarps record displacements of 1.8-5.6 meters and appear to be younger than the Sheeprock and Stansbury scarps (location nos. 7-1 and 7-10), but older than the Topliff Hill scarps (location no. 7-7). Faulted alluvium exposed in a mining shaft, together with an uplifted bedrock pediment, suggest a minimum of 60 meters of Quaternary displacement on the fault (Everitt and Kaliser, 1980).

northern Oquirrh fault zone (7-15)					
Parameter values:	9 - 13.5	0.21 - 0.53 *dm (<9 - 13.5)		2.9 - 4.8 h	

Age Criteria : scarp morphology; shoreline relations

References : Barnhard and Dodge, 1988; Everitt and Kaliser, 1980

Comments : Scarp morphology is more similar to the Bonneville shoreline scarps than to the Drum Mountains fault scarps (location no. 8-1), which have been dated at about 9,000 years old. This suggests an age close to but not greater than the Provo shoreline, which has been offset across the fault. Compound scarps, with as much as twice the height of the single-event scarps (and with surface displacements of up to 7.3 meters), record an older, pre-Bonneville displacement modified by lacustrine erosion. Hanks and others (1984) considered the Oquirrh Mountain fault scarps to be older than the Bonneville shoreline and tentatively assigned them a poorly constrained diffusion-model age of 32,000 years. The southern half of the mapped fault is expressed as a prominent break in slope at the base of the range front, where Barnhard and Dodge (1988) found no direct evidence of post-Bonneville faulting. However, Tooker and Roberts (1988) mapped several short faults in Bonneville and post-Bonneville(?) deposits at the north end of the range-front embayment. Because the calculated slip rate is based on scarp height rather than displacement, the values may be too high by a factor of two. Youngs and others (1987, in press) inferred a slip rate of 0.1-0.2 mm/yr for the fault.

* From Krinitsky, Ref 2.

East Tintic Mountains
- west side (faults)
(8-16)

NAME OR LOCATION OF FEATURE (Location No.)	AGE OF MOST RECENT MOVEMENT X10^3 years	SLIP RATE mm/yr (Time Period X10^3 years ago)	RECURRENCE INTERVAL X10^3 years (Time Period X10^3 years ago)	DISPLACEMENT PER EVENT meters	RUPTURE LENGTH kilometers
Parameter values:	middle to late Pleistocene 10,000 - 750,000 yr				4-9 (PLATE 1) ←

Age Criteria : scarp morphology
References : Bucknam and Anderson, 1979a
Comments : Alluvial scarps appear on aerial photos as isolated, highly dissected remnants surrounded by several different ages of unfaulted alluvium and appear to be among the oldest in western Utah. Steep faceted bedrock spurs north and south of Silver City (Goode, 1959) suggest active uplift north of the scarps. In addition, faults in alluvium (not shown on plate 1) were observed northwest of Eureka, about 2 kilometers east of the range front (Goode, 1959). Anderson and Miller (1979) mapped buried Quaternary(?) faults extending to the north and south of the alluvial scarps. These faults and faults that form bedrock-alluvium contacts at the south end of the East Tintic Mountains (Morris, 1987) are mapped as Quaternary(?) on plate 1. On the east side of the mountain range, faults in pre-Bonneville alluvium (not shown on plate 1) were recognized in a tunnel at the south end of Goshen Valley (Goode, 1959).

Maple Grove (faults)
(8-17)

Parameter values:	late Pleistocene(?)				

Age Criteria : scarp morphology; fault control of bedrock-alluvium contact
References : Bucknam and Anderson, 1979a; Oviatt, 1992
Comments : Crestal rounding and dissection suggest that fault scarps are older than the Bonneville shoreline. The steepness of scarp slopes (up to 47°) is attributed to the coarseness of the alluvium. Evidence of Holocene faulting, present in scarps to the north and south, was not noted for the Maple Grove scarps. The scarps represent displacements of up to 12 meters.

Scipio (faults)
(8-18)

Parameter values:	late Pleistocene				

Age Criteria : scarp morphology
References : Bucknam and Anderson, 1979a; Oviatt, 1992
Comments : Evidence of Holocene faulting, present in scarps to the north and south, is not seen in the subdued morphology of the Scipio fault scarps. Faults mapped as Quaternary(?) in age on plate 1 are concealed valley-fill structures.

NAME OR LOCATION OF FEATURE (Location No.)	AGE OF MOST RECENT MOVEMENT $X10^3$ years	SLIP RATE mm/yr (Time Period $X10^3$ years ago)	RECURRENCE INTERVAL $X10^3$ years (Time Period $X10^3$ years ago)	DISPLACEMENT PER EVENT meters	RUPTURE LENGTH kilometers
Towanta Flat graben (12-2)					
Parameter values:	130 - 500		60 (130-500)	0 n	

Age Criteria : soil development; cobble weathering

References : Martin and others, 1985; Nelson and Weisser, 1985

Comments : Some workers (Hansen, 1969a, 1969b; Utah Geological and Mineral Survey, 1977) have assigned late Pleistocene and Holocene ages to the scarps, based on estimated ages of faulted deposits and the freshness of the scarps. Nelson and Weisser (1985) concluded that there is no significant net tectonic displacement across the graben (although the throw across individual scarps has been 2.1-2.6 meters per event). This lack of net slip, together with an orientation that differs from planes defined by microseismicity, the limited extent of the scarps, and an average recurrence interval that is less than half as long as the time since the most recent event, suggests that the faults may not have a seismogenic origin and may not be capable of significant future surface-rupturing events. A reported late Pleistocene fault east of Tabiona that lies along the projected strike of the Towanta Flat faults (Ritzma, referenced in Anderson and Miller, 1979) shows no displacement in bedrock. An anomalous linear drainage used to infer the presence of the fault (Ritzma, referenced in Martin and others, 1985) is apparently a strike stream.

Wasatch fault zone - Provo segment (12-3)					
Parameter values:	0.5 - 0.6 e 500-600 yr	1.1 - 1.3 (<5.3) 1.0 - 1.7 • (<15)	2.4 (<5.3)	1.5 - 3.0 n	69.5

Age Criteria : ^{14}C; TL; lacustrine stratigraphy

References : Lund and others, 1991; Machette, 1989, in press; Machette and others, 1991, 1992

Comments : Based on fault geometry and apparent recency of movement as indicated by scarp morphology, Machette and others (1986) tentatively subdivided the Provo segment (as originally proposed by Schwartz and Coppersmith, 1984) into three subsegments (from north to south, the American Fork, Provo "restricted sense," and Spanish Fork). However, based on the timing of the last two events deciphered from trench studies, the entire length of the Wasatch fault zone in Utah Valley appears to be a single segment (Machette, 1989, in press; Lund and others, 1991; Machette and others, 1991). The penultimate event occurred about 2,600-3,000 years ago; based on results from the northern end of the segment (at American Fork), the prior two events occurred about 5,300 and 5,500-8,000 years ago. A conflicting chronology of faulting from a site near the southern boundary of the segment (at Water Canyon, where two events have occurred in the last 1,000 years) may be explained by spatial overlap of the Nephi and Provo segments, whereby events from both segments are recorded at the site (Machette, 1989, in press; Ostenaa, 1990). The slip-rate and recurrence data are from the American Fork site, where rates of activity appear to have been constant during post-Bonneville time. However, at the Hobble Creek site (east of Spanish Fork), there is two-to-three times more displacement recorded in Bonneville transgressive deposits than in Provo-age regressive deposits. Twenty to thirty meters of displacement in just a few thousand years represents slip rates as high as 10 mm/yr and may be related to the presence of Lake Bonneville. Six or seven post-Provo events are inferred to have occurred at the site, yielding an average recurrence interval of 1,700-2,600 years. The Woodland Hills splay of the Spanish Fork subsegment has evidence for three or four events, totaling 3 meters of displacement, in about the past 130,000 years, yielding a slip rate of 0.01-0.02 mm/yr and an average recurrence interval of about 40,000-65,000 years. Movement on the splay apparently occurs during only some of the events on the main fault, although the most recent event on the splay occurred about 1,000 years ago and may be correlative with the most recent event on the main fault. Movement on a couple of short subsidiary faults at the northern end of Utah Valley appears to have occurred during, and may be related to, the recession of Lake Bonneville.

NAME OR LOCATION OF FEATURE (Location No.)	AGE OF MOST RECENT MOVEMENT $X10^3$ years	SLIP RATE mm/yr (Time Period $X10^3$ years ago)	RECURRENCE INTERVAL $X10^3$ years (Time Period $X10^3$ years ago)	DISPLACEMENT PER EVENT meters	RUPTURE LENGTH kilometers

East Canyon fault
- southern segment
(12-17)

Parameter values:	late Quaternary(?)				12 ?

Age Criteria : range-front morphology
References : Sullivan, Nelson, and others, 1988
Comments : For the purpose of seismic-hazard assessment, values for slip rate, recurrence interval, and single-event displacement are inferred to be similar to those calculated for the Morgan fault (location no. 11-18), based on similarities in fault length and escarpment morphology. The estimated maximum credible earthquake for the fault is 6.5-6.75 (M_L).

Bear River fault zone
(12-18)

Parameter values:	2.4 ? e	0.8 - 2.7 ? (<4.6)	2.3 - 2.4+ ? (<4.6)	<1 - 5+ n	34-40

Age Criteria : ^{14}C
References : West, 1988, 1989, in press
Comments : The Bear River fault zone (BRFZ) extends from southeast of Evanston, Wyoming to the Uinta Mountains in Utah, where it ends at a complex juncture with the North Flank fault. The trend of scarps at the southern end of the zone is sharply discordant with the main, northerly trend of faulting, perhaps due to the buttressing effect of the Uinta Mountains. The fault lies between the leading edges of the Absaroka and Darby-Hogsback thrust faults and appears to be a new (Holocene) feature superimposed on older thrust-belt structure. The independent seismic potential of the Absaroka and Darby-Hogsback faults is unclear. A 5-kilometer-long Holocene scarp (the Martin Ranch scarp), together with at least 10 kilometers of related surface warping, lies west of the BRFZ in Wyoming and is coincident with the Absaroka thrust. The age of most recent movement on this fault is consistent with that on the BRFZ, suggesting that it represents movement that is simultaneous and sympathetic with that on the main fault zone. Scarp heights and tectonic displacements increase markedly from north to south along the BRFZ. The southernmost scarp, which displaces Pinedale glacial deposits, is 15+ meters high, suggesting that it may have formed from more than two Holocene events. The range in slip rates reflects the range in displacement along the fault zone. *Fault-activity parameters for the BRFZ are comparable to values for the Wasatch fault zone (see location nos. 6-6, 11-22, 12-3, 12-6, and 13-21).* There is no evidence to suggest that the BRFZ is segmented. Documented ages of faulting (4,600 and ~2,400 years ago) are considered to be maximum estimates because the residence times of organic matter in the dated soils have not been incorporated into the ages. The youthfulness of faulting is demonstrated by the presence of beheaded and reversed drainages, sag ponds, and displacements in the youngest flood-plain deposits. Northern portions of the BRFZ in Utah are expressed only as drainage lineaments or are obscured by recent landsliding. Assuming that it is planar and basement-penetrating, the BRFZ may be capable of producing earthquakes as large as 7.5 (M_L).

APPENDIX Q

Utah Lake (faults and folds)
(12-19)

Parameter values:	latest Pleistocene to Holocene(?) 0 — 30,000 yr				

Age Criteria : lacustrine stratigraphy; depth to faulted sediments
References : Brimhall and Merritt, 1981
Comments : Fault locations, based on widely spaced seismic-reflection transects, are uncertain. Acoustical profiles show a persistent 8-15 meter-deep layer identified as the Provo Formation that is displaced from <2 to 5 meters across individual faults and folds beneath the lake. Machette (1989, in press) interpreted the layer as lake bottom sediments probably deposited during the regressive phase of Lake Bonneville. The reflection profiles suggest that displacements decrease upward in strata above the marker horizon and occur within several meters of the lake bottom.

NAME OR LOCATION OF FEATURE (Location No.)	AGE OF MOST RECENT MOVEMENT X10³ years	SLIP RATE mm/yr (Time Period X10³ years ago)	RECURRENCE INTERVAL X10³ years (Time Period X10³ years ago)	DISPLACEMENT PER EVENT meters	RUPTURE LENGTH kilometers
Salt Creek area (fold) (13-1)					
Parameter values:	Quaternary(?)				
Juab Valley - west side (faults) (13-2)					
Parameter values:	late Quaternary				
Long Ridge - west side (fault) (13-3)					
Parameter values:	middle to late Pleistocene(?)				
Long Ridge - northwest side (fault) (13-4)					
Parameter values:	Quaternary(?) 0 - 1,650,000 yr				10 (PLATE 1) ←

Salt Creek area (fold) (13-1)

Age Criteria : deposit characteristics
References : Witkind and Sprinkel, 1982
Comments : *Pleistocene(?) deposits are tilted northwestward on the flank of a small diapiric fold.*

Juab Valley - west side (faults) (13-2)

Age Criteria : presence of scarps on alluvium
References : R.M. Robison, written communication, 1989; Sullivan and Baltzer, 1986
Comments : The scarps, which show a cumulative displacement of ~1 meter, are most likely tectonic, but alternatively may be related to lateral spreading. Although not defined by a bedrock escarpment, a fault has been inferred along the east side of Juab Valley near the contact between Tertiary volcanic rocks and unconsolidated valley fill. The east-dipping fault is thought to intersect the Wasatch fault zone well above the seismogenic crust and thus to be antithetic to the Wasatch fault zone and not an independent seismic source.

Long Ridge - west side (fault) (13-3)

Age Criteria : presence of scarps on alluvium
References : Meibos, 1983
Comments : The fault both cuts and is covered by "older" unconsolidated alluvium and forms the contact between bedrock and alluvium along much of its length.

Long Ridge - northwest side (fault) (13-4)

Age Criteria : range-front morphology
References : Sullivan and Baltzer, 1986

NAME OR LOCATION OF FEATURE (Location No.)	AGE OF MOST RECENT MOVEMENT X10^3 years	SLIP RATE mm/yr (Time Period X10^3 years ago)	RECURRENCE INTERVAL X10^3 years (Time Period X10^3 years ago)	DISPLACEMENT PER EVENT meters	RUPTURE LENGTH kilometers
Price River area (faults) (13-19) Parameter values:	Quaternary(?)				

Age Criteria : geomorphic position; structural setting; presence of lineaments
References : Howard and others, 1978; Osterwald and others, 1981
Comments : Some faults within the zone displace pre-Wisconsin-age pediments less than 2 meters. Most are normal faults that dip steeply or vertically. Structural relations indicate that the fault zone forms the crest of a broad, collapsed anticline. The fault zone is similar in trend, pattern, and length to faults along the crest of the Moab-Spanish Valley anticline (primarily location no. 18-2), although it is not as strongly developed. The faults are inferred to be related to a salt anticline at the northern margin of the Paradox basin. Early to middle Pleistocene pediments north of the fault zone steepen sharply at the base of the Book Cliffs and may be warped due to elastic rebound of the Mancos Shale during erosional unloading and/or monoclinal folding (not indicated on plate 1). The ancestral course of Whitmore Canyon (near Sunnyside) also appears to be warped.

Japanese and Cal Valleys (faults) (13-20) Parameter values:	middle to late Pleistocene				

Age Criteria : scarp morphology; fault control of bedrock-alluvium contact; basin closure
References : Anderson and others, 1978; Oviatt, 1992; Willis, 1991; Witkind and others, 1987
Comments : Alluvial scarps are up to 4 meters high. The pattern of faulting in Japanese Valley suggested to Witkind and others (1987) that the graben-formed valley may be a collapse feature, perhaps related to dissolution of salt from the underlying Arapien Shale. However, Willis (1991) interpreted the faults as basin-range-type extensional faults.

Wasatch fault zone - Nephi segment (13-21) Parameter values:	0.3 - 0.5 ? e 300-500 yr	0.8 - 1.3 ? (<5.5 ?)	1.7 - 2.7 ? (<5.5 ?)	1.4 - 2.5 n	42.5 ←

Age Criteria : ^{14}C; scarp morphology
References : Jackson, 1991; Machette and others, 1991, 1992; Schwartz and Coppersmith, 1984
Comments : Scarp morphology and continuity suggest very recent displacement (~300-500 years ago), although a combination of ^{14}C and TL dates suggest an age of about 1,200 years for the most recent event. Schwartz and Coppersmith (1984) determined that the penultimate event occurred before about 4,000 years ago, whereas Jackson (1991) constrained the event between about 3,000 and 3,500 years ago. The third-to-last event may have occurred between 4,000 and 4,500 years ago (Jackson, 1991). Thus, actual middle to late Holocene recurrence intervals may vary from less than 1,000 years to more than 3,000 years. Three middle to late Holocene events post-date a late Pleistocene(?) fan at the southern end of the segment (at Red Canyon), suggesting a possible hiatus in faulting activity during latest Pleistocene to early Holocene time (Jackson, 1991). The range in displacement-per-event and slip-rate values reflects a systematic decrease in slip between the middle (larger values) and southern end (smaller values) of the segment. The Benjamin fault, which extends into Utah Valley, may be the northern extension of the Nephi segment (which would then total about 50 kilometers in length). Sediments of the Provo phase of the Bonneville lake cycle are offset as much as 2 meters along this fault (Machette, 1989, in press). There is a 15-kilometer-long gap in Holocene faulting between the Nephi segment and the Levan segment to the south. Faults associated with young scarps north of the town of Nephi are probably continuous with near-surface faults in the town identified from seismic-reflection data (Crone and Harding, 1984b). A number of small faults in Quaternary deposits have been identified on the western flank of the Gunnison Plateau east of Nephi (not shown on plate 1; Biek, 1991).

Job No.

No.

HDR Computation

HDR

Project

Computed

Date

Subject

Checked

Date

Task

Sheet 3

Of

2. DETERMINE MCE OF CAPABLE FAULTS

2.1 USE REF 2, FIGS 4-1 + 4-2, BELOW

FAULT ID	FAULT NAME	LENGTH (km)	DISPL (m)	MAGNITUDE, M_s LENGTH	MAGNITUDE, M_s DISPL	ADOPTED M_s	ADOPTED MMI$_o$	DIST TO SITE (km)
7-7	TOPLIFF HILL	12	NA	6.8	NA	6.8	IX	22
7-14	MERCUR	16	0.9-1.9	6.9	6.9-7.2	7.0	X	24
8-16	EAST TINTIC MTNS	4-9	NA	6.7	NA	6.7	IX	18
12-3	WASATCH-PROVO	70	1.5-3.0	7.3	7.1-7.3	7.2	X	24-36
13-4	LONG RIDGE	10	NA	6.7	NA	6.7	IX	14
13-21	WASATCH-NEPHI	42	1.4-2.5	7.2	7.1-7.2	7.2	X	18-21

↑ ALL NEAR FIELD

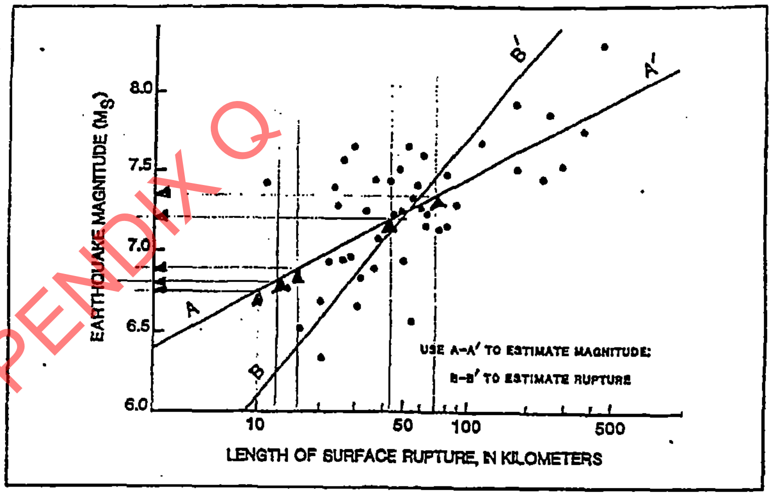


Figure 4-1. Relation of length of surface rupture to earthquake magnitude (Bonilla, Mark, and Lienkaemper 1984)

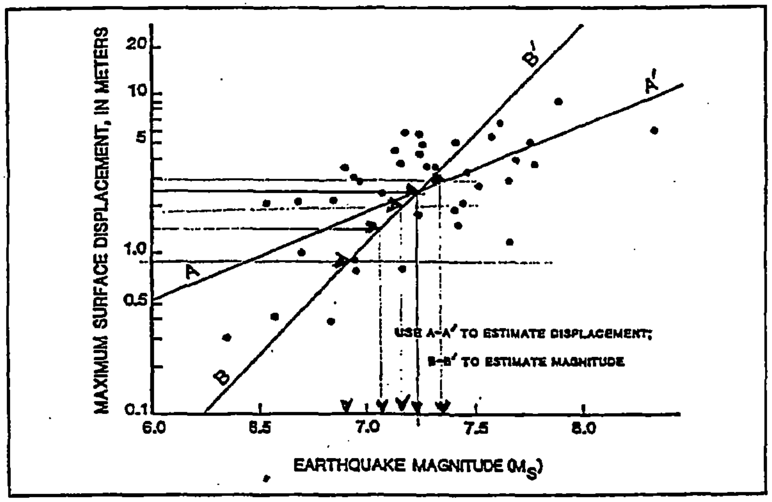


Figure 4-2. Relation of maximum surface displacement to earthquake magnitude (Bonilla, Mark, and Lienkaemper 1984)

Job No.	No.

HDR Computation

Project	Computed	Date
Subject	Checked	Date
Task	Sheet 4	Of

3 DETERMINE a_g AT SITE

HARD SITE CONDITIONS

$V_s > 400$ m/sec BASED on SPT BLOW COUNTS + GEOLOGIC DESCRIPTION

JOYNER + BOORE CURVES OF REF 2, BELOW:

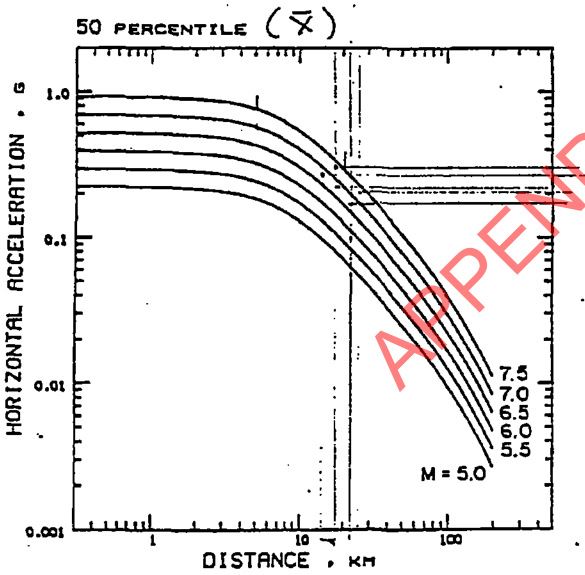


Figure 31. Joyner and Boore (1981) magnitude-distance chart: acceleration, mean.

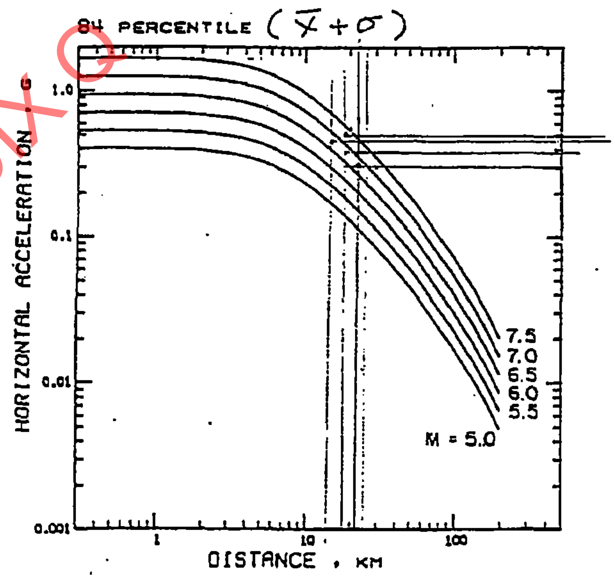


Figure 33. Joyner and Boore (1981) magnitude-distance chart: acceleration, mean and SD.

FAULT DATA				SITE DATA	
FAULT ID	NAME	DISTANCE	MO	$a_g(\bar{x})$	$a_g(\bar{x}+\sigma)$
	TOPLIFF HILL	22	6.8	0.18	0.30
	MERCUR	24	6.9	0.18	0.30
	EAST TINTIC	18	6.7	0.22	0.38
	WASATCH-PROVO	24 MIN	7.3	0.20	0.40
	LONG RIDGE	14	6.7	0.27	0.47
	WASATCH-NEPHI	18 MIN	7.2	0.30	0.50 ←

USE $a_g = 0.50g$ (490 cm/sec^2) AT BAYVIEW SITE ←

ATTACHMENT B
STATIC AND PSEUDO STATIC STABILITY ANALYSES

Job No.

No.

HDR Computation

Project BAYVIEW LANDFILL	Computed RLD	Date 5-01-96
Subject LANDFILL SEISMIC EVALUATION	Checked PVP	Date 6-4-96
Task STATIC AND PSEUDO-STATIC STABILITY ANALYSES	Sheet 1	Of

OBJECTIVE : DETERMINE STATIC F.S. AND SEISMIC YIELD ACCELERATION (k_y) FOR:

- CELL 1 CUT-SLOPE GEOMETRY
- CELL 1 LINER & LCRS SYSTEM
- CELL 1 WASTE FILL (CLOSED + OPERATIONAL FILLS)
- CELL 1 CLOSURE CAP
- STORMWATER - LEACHATE BASIN

REFERENCES :
A) CORPS OF ENGINEERS, "STABILITY OF EARTH AND ROCK-FILL DAMS", EM 1110-2-1902, DEPARTMENT OF THE ARMY, 1970
B) GEOSYNTHETIC RESEARCH INSTITUTE, "STABILITY OF MULTI-LINED SLOPES IN LANDFILL APPLICATIONS", GRI REPORT № 8.
C) EPA, "GEOTECHNICAL ANALYSIS AND REVIEW OF DIKE STABILITY (GARDS)",
D) "BAYVIEW LANDFILL, CELL 1 STAGE 1, PHASE 2" PLANS & SPECS, BY HDR ENGINEERING, INC
E) GEOTECHNICAL REPORTS BY CHEN & ASSOCIATES, 1980 AND ROLLINS, BROWN AND GUNNELL, 1983.
F) EPA, "RCRA SUBTITLE D SEISMIC DESIGN GUIDANCE FOR MSWLF", 1995.
G) UTEXAS3 SLOPE STABILITY PROGRAM, SHINOAK SOFTWARE, S.G. WRIGHT, 1991

1 SOIL PROFILE & MATERIAL PROPERTIES

1.1 SOILS, FROM REFS E & F

DEPTH	ELEV	γ	C	ϕ	MAT'L DESCRIPTION
0-100	4760-4660	110 pcf	0 psf	40°	INTERBEDDED DENSE, DRY SANDS, SILTS, GRAVEL
100-800	4660-3960	120 pcf	0 psf	45°	AS ABOVE W/ COBBLES, BOULDERS, CEMENTED
800-?	3960-?	NA	NA	NA	AS ABOVE ?, BASED ON GEOLOGY
WASTE	4812-4712±	50 pcf	150 psf	22°	SINGH + MURPHY REF CITED IN REF F
LCRS	2' THICK	100 pcf	0	32°	SM, TESTED FROM STOCKPILE

1.2 GEOSYNTHETIC INTERFACE FRICTION VALUES, FROM PUBLISHED LIT & FILES

COMPONENT	LOWER INTERFACE	UPPER INTERFACE	δ	
LINER & LCRS ↓	SOIL SUBGRADE	CUSHION GEOTEXTILE	27°	
	CUSHION GEOTEXTILE	60 MIL SMOOTH HDPE	9°	← CONTROLS
	60 MIL SMOOTH HDPE	GRANULAR LCRS	17°	
CLOSURE CAP ↓	GRAN. GAS VENT SOIL	60 MIL SMOOTH LDPE	25°	← CONTROLS
	60 MIL SMOOTH LDPE	GRAN DRAIN SOIL	25°	

Job No.
No.

HDR Computation

Project		Computed	Date
Subject		Checked ✓	Date
Task		Sheet 2	Of

2. CUT SLOPE STABILITY

2.1 DETERMINE STATIC F.S. FOR:

1V : 4H CUT SLOPE EL. 4760 – 4725±

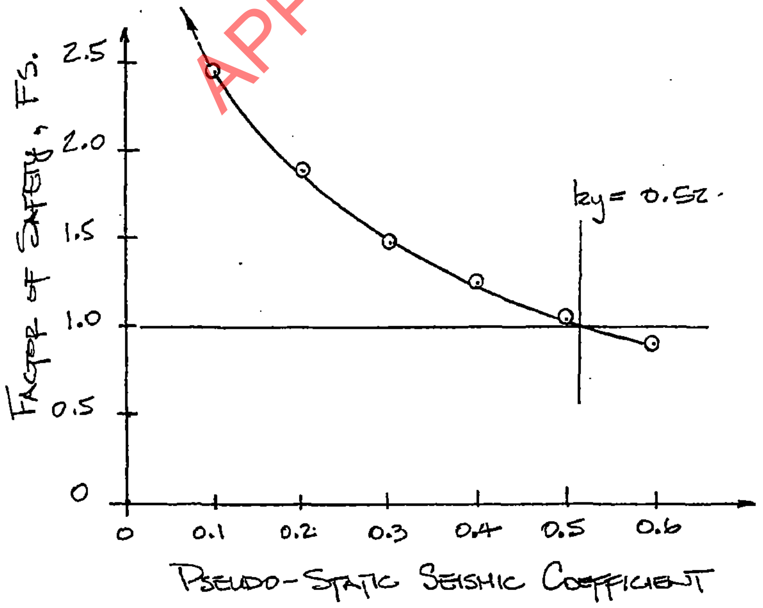
SOIL PROPERTIES FROM P 1.1

SECTION ATTACHED

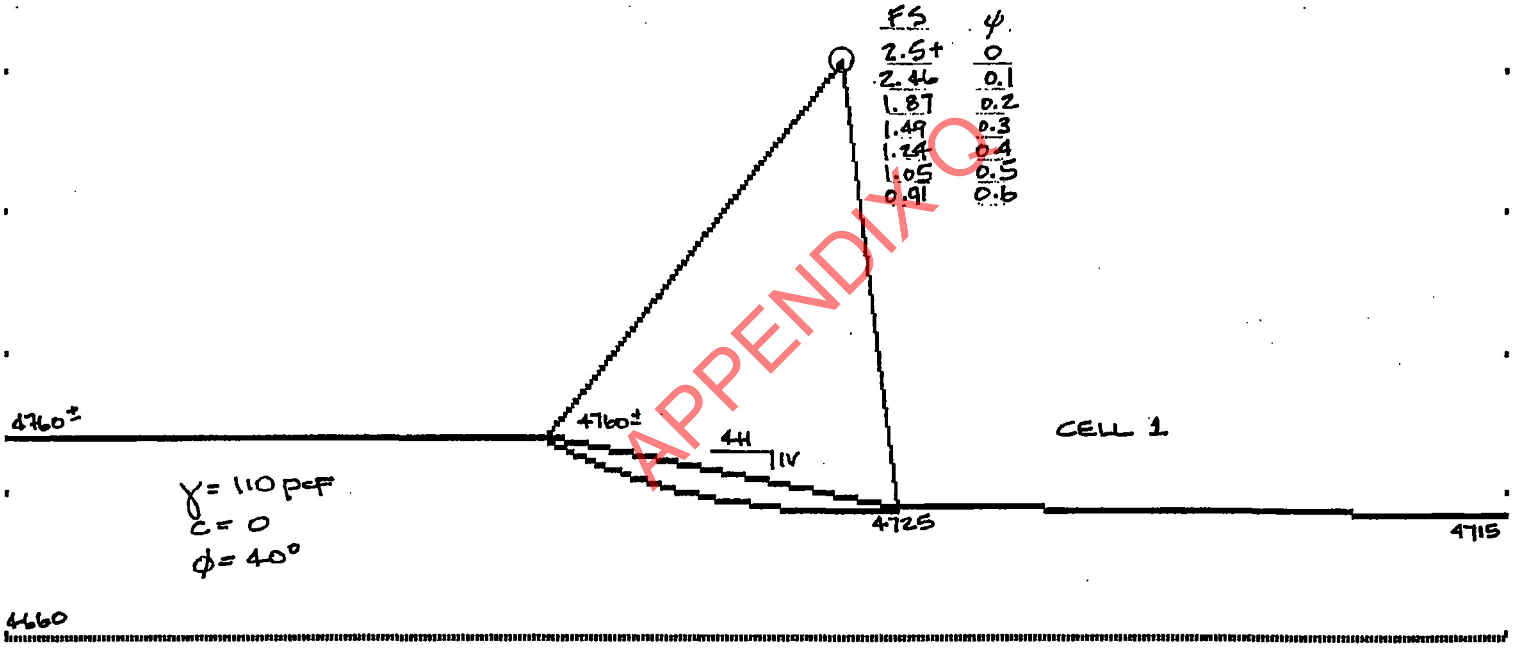
F.S. = 2.5+ , ANALYSIS ATTACHED

2.2 DETERMINE PSEUDO-STATIC F.S. FOR SAME CONDITIONS AS 2.1 W/ SEISMIC COEFFICIENT, ψ, VARYING FROM 0.1 TO 0.6 BY 0.1 INC.

F.S. = 0.9 – 2.46, SEE BELOW & ATTACHED ANALYSES



BAYVIEW LANDFILL CELL 1 PHASE 2 CUT SLOPE STABILITY File: PH2CSS
Hydraulic Condition 7: User Defined
Consolidated Drained Soil Parameters
Factor of Safety = 2.46, Failure Center: (620 , 4948), Radius: 224



FS	φ
2.5+	0
2.46	0.1
1.87	0.2
1.49	0.3
1.24	0.4
1.05	0.5
0.91	0.6

(273 , 4590) SCALE : 1 inch = 70.00001 feet

```
**********************************************************************
*                                                                    *
*                     G A R D S   S U M M A R Y                      *
*                                                                    *
*    Project:  BAYVIEW LANDFILL CELL 1 PHASE 2 CUT SLOPE STABILITY   *
*       File:  PH2CSS                                                *
*                                                                    *
*                        GARDS  Version 2.00                         *
*                           developed by                             *
*          Department of Civil and Environmental Engineering         *
*                      University of Cincinnati                      *
*                         under contract to                          *
*                U.S. Environmental Protection Agency                *
*                  Land Pollution Control Division                   *
*           Hazardous Waste Engineering Research Laboratory          *
*                                                                    *
**********************************************************************
```

```
**********************************************************************
*                        Site Characteristics                        *
**********************************************************************
*                                                                    *
*      The seismic coefficient is. . . . . . . . . . . . . . 0.10    *
*                                                                    *
*      The design earthquake magnitude is. . . . . . . . . . 7.20    *
*                                                                    *
*      The maximum flood elevation in this case is . . . . .    0    *
*                                                                    *
*      The elevation of the seasonal high ground water is. .    0    *
*                                                                    *
*      The design waste elevation in the cell is . . . . . .    0    *
*                                                                    *
*      The soil number representing the clay liner is. . . .    0    *
*                                                                    *
**********************************************************************
```

ITERATE
0-0.60
BY 0.10

```
***************************************************************************
*                           Section Geometry                              *
***************************************************************************
*                                                                         *
*      The number of soil boundary lines for this section is   2          *
*-------------------------------------------------------------------------*
*     Line   1         Point          X             Y                     *
*                     -------       ------        ------                  *
*                        1               0          4660                  *
*                        2            1140          4660                  *
*-------------------------------------------------------------------------*
*     Line   2         Point          X             Y                     *
*                     -------       ------        ------                  *
*                        1               0          4760                  *
*                        2             500          4760                  *
*                        3             640          4725                  *
*                        4            1140          4715                  *
***************************************************************************
```

```
************************************************************************
*                       Soil   1 Properties                            *
************************************************************************
*                                                                      *
*             Unconsolidated  Consolidated  Consolidated              *
*                 Undrained     Undrained     Drained                  *
*               ------------  ------------  ------------               *
*   Cohesion               0             0             0  (lb/sq.ft)  *
*   Phi Angle              0             0            40   (degrees)  *
*----------------------------------------------------------------------*
*                                                                      *
*        Unit Weight . . . . . . . . . .  110.000   (lb/cu.ft)         *
*        Clay Content  . . . . . . . . .    0.000   (%)                *
*        Overconsolidation Ratio . . . .    0.000                      *
*        Initial Void Ratio  . . . . . .    0.000                      *
*        Compression Index . . . . . . .    0.000                      *
*        Recompression Index . . . . . .    0.000                      *
*        Permeability  . . . . . . .        0.000   (ft/yr)            *
*        Median Grain Size . . . . . . .    0.000   (mm)               *
*        Plasticity Index  . . . . . . .    0.000   (%)                *
*        Liquid Limit  . . . . . . . . .    0.000   (%)                *
*        Standard Penetration Number . .    0.000   (blows/ft)         *
************************************************************************
```

```
************************************************************************
*                           User Defined                               *
*             Piezometric Surface for Hydraulic Condition              *
*             7: User Defined                                          *
************************************************************************
*                                                                      *
*                   Point           X             Y                    *
*                  ------        ------        ------                  *
*                      1             0          4660                   *
*                      2          1140          4660                   *
************************************************************************
```

```
*************************************************************************
*                                                                       *
*         R O T A T I O N A L   F A I L U R E   R E S U L T S           *
*                                                                       *
*                      Automatic Grid Search                            *
*                                                                       *
*     The slopes were analyzed for failure arcs having centers in       *
*     areas defined by the following parallelograms:                    *
*************************************************************************
*                                                                       *
*                               Slope  1                                *
*                                                                       *
*    Co-ord.       Point 1       Point 2       Point 3       Point 4    *
*    -------       -------       -------       -------       -------    *
*       X            500           640           675           535      *
*       Y           4769          4734          4795          4830      *
*-----------------------------------------------------------------------*
*                                                                       *
*        The number of divisions between points 1 and 2 were  4         *
*        The number of divisions between points 2 and 3 were  4         *
*        The X-increment used in the search was  . . . . . . 10         *
*        The Y-increment used in the search was  . . . . . . 10         *
*                                                                       *
*************************************************************************
```

```
*********************************************************************
*                                                                   *
*        R O T A T I O N A L   F A I L U R E   R E S U L T S        *
*                                                                   *
*********************************************************************
*                                                                   *
*            Hydraulic Condition 7: User Defined                    *
*                                                                   *
*                    Consolidated Drained (CD) Case                 *
*                    Seismic Coefficient = 0.10                     *
*-------------------------------------------------------------------*
*          Safety        Failure        X-           Y-             *
*          Factor        Radius       Co-ord       Co-ord           *
*         --------      --------     --------     --------          *
*           2.46         223.8        620.0       4947.5            *
*           2.46         221.3        620.0       4945.0            *
*           2.46         226.2        620.0       4950.0            *
*           2.46         218.9        620.0       4942.5            *
*           2.46         216.4        620.0       4940.0            *
*           2.46         224.3        622.5       4947.5            *
*           2.46         214.0        620.0       4937.5            *
*           2.47         211.6        620.0       4935.0            *
*           2.47         209.1        620.0       4932.5            *
*           2.47         223.2        617.5       4947.5            *
*           2.47         208.6        617.5       4932.5            *
*           2.47         208.1        615.0       4932.5            *
*           2.47         217.9        615.0       4942.5            *
*           2.48         198.4        615.0       4922.5            *
*           2.48         209.6        622.5       4932.5            *
*           2.48         188.6        615.0       4912.5            *
*           2.49         178.9        615.0       4902.5            *
*           2.49         210.1        625.0       4932.5            *
*           2.50         169.1        615.0       4892.5            *
*********************************************************************
```

Job No.

No.

HDR Computation

Project

Computed

Date

Subject

Checked ✓

Date

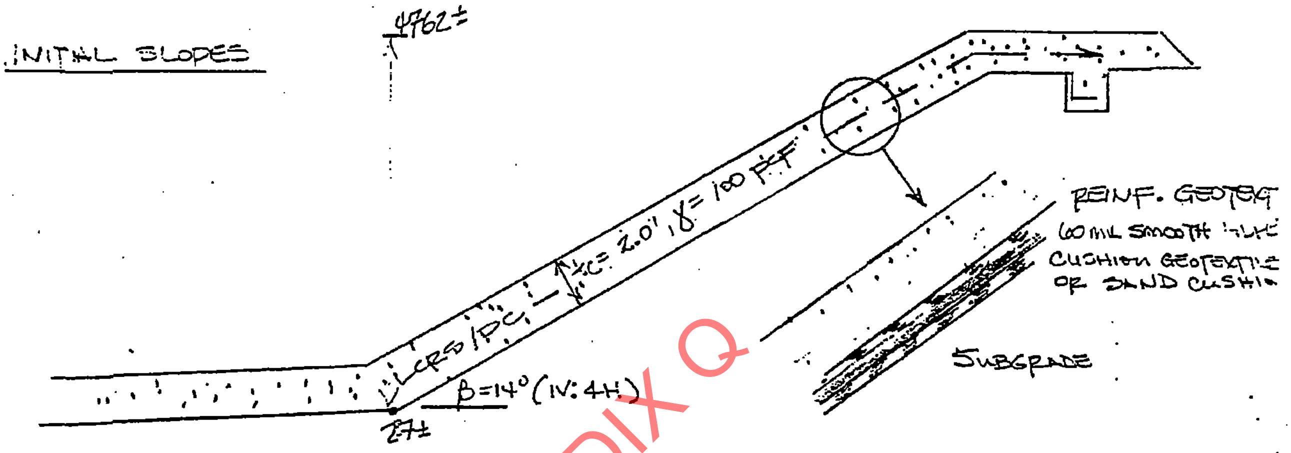
Task

Sheet

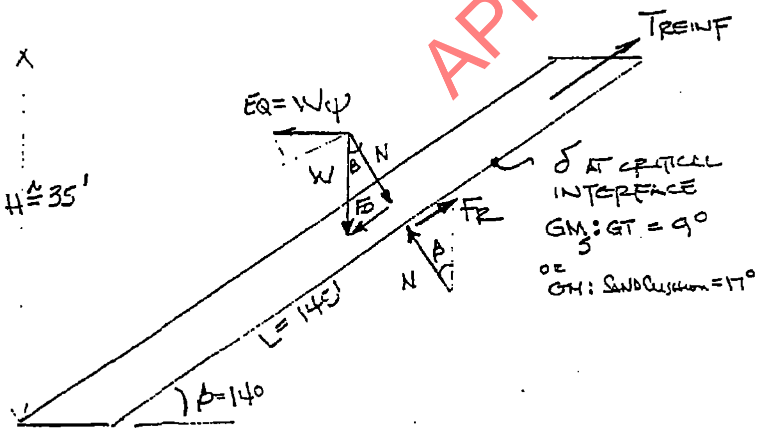
Of

3. CELL LINER & LCRS STABILITY

3.1 INITIAL SLOPES



USE INFINITE SLOPE METHOD, CONSIDER SEISMICITY w/ PSEUDO-STATIC COEFF.



$W = \gamma t_c L \div 1000$

$= 100 \frac{\#}{CF} * 2 FT * 145' \div 100$

$= 29.0^{KLF}$

$F_D = W \sin\beta + W k_y$

$= (29.0^{KLF} * \sin 14°) + (29.0^{KLF} * \psi)$

$= 7.0^{KLF} + 29.0\psi$

NOTE: EQ FORCE HORIZONTAL IS CONSERVATIVE SINCE DOWNSLOPE COMPONENT = $W\psi \cos\beta < W\psi$ WHERE ψ = PSEUDO-STATIC SEISMIC COEFFICIENT

$F_R = N \tan\delta + T_{REINF}$

$= (W \cos\beta) \tan\delta + T_{REINF}$

$= (29.0^{KLF} * \cos 14°) \tan\delta° + T_{REINF}$

$= 23.1 \tan\delta + T_{REINF}$

$$FS_{STATIC\ (k_y=0)} = \frac{F_R}{F_D} = \frac{(23.1 \tan\delta + T_{REINF})^{KLF}}{7.0^{KLF}}$$

$$FS_{P\text{-}S\ (k_y>0)} = \frac{F_R}{F_D} = \frac{(23.1 \tan\delta + T_{REINF})^{KLF}}{(7.0 + 29.0\psi)^{KLF}}$$

ITERATE FOR TREQD & ψ, ATTACHED

Job No.

No.

HDR Computation

Project

Computed

Date

Subject

Checked

Date

Task

Sheet

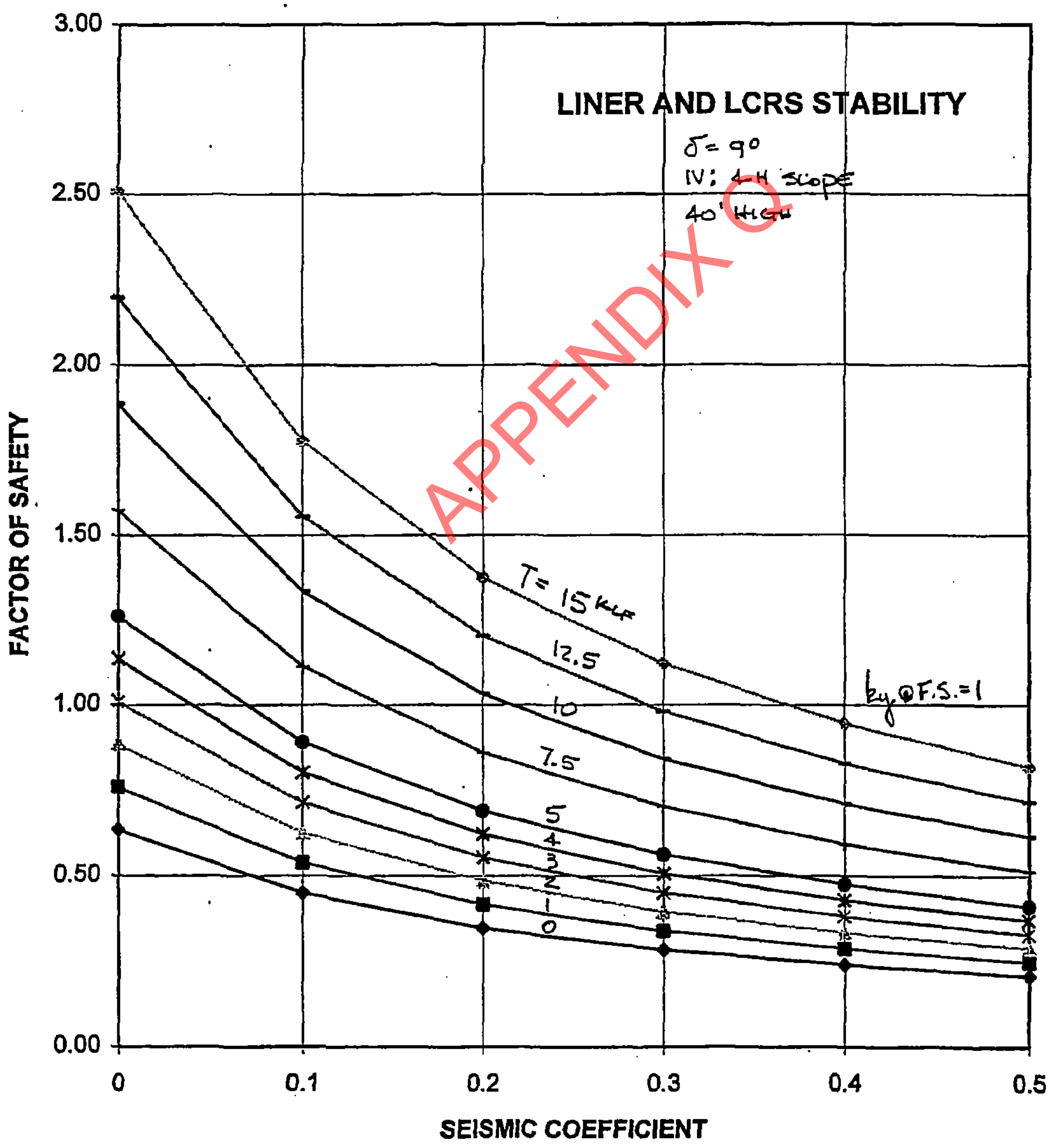
Of

BAYVIEW LANDFILL CELL 1 PHASE 2						
LINER & LCRS SLOPE STABILITY						
STATIC AND PSEUDO-STATIC ANALYSES						
(INFINITE SLOPE METHOD)						
SLOPE PROPERTIES						
	height	40.0	(ft.)			
	slope	14.0	(degrees)			
	length	165.3	(ft)			
LCRS PROPERTIES						
	thickness	2.0	(ft)			
	density	100.0	(pcf)			
INTERFACE FRICTION						
	friction	9.0	(degrees)	GEOTEXTILE CUSHION		
FACTOR OF SAFETY						
Treinf	Seismic Coefficient, (-)					
(klf)	0	0.1	0.2	0.3	0.4	0.5
0.0	0.64	0.45	0.35	0.28	0.24	0.21
1.0	0.76	0.54	0.42	0.34	0.29	0.25
2.0	0.89	0.63	0.48	0.40	0.33	0.29
3.0	1.01	0.71	0.55	0.45	0.38	0.33
4.0	1.14	0.80	0.62	0.51	0.43	0.37
5.0	1.26	0.89	0.69	0.56	0.47	0.41
7.5	1.57	1.11	0.86	0.70	0.59	0.51
10.0	1.89	1.33	1.03	0.84	0.71	0.61
12.5	2.20	1.55	1.20	0.98	0.83	0.72
15.0	2.51	1.78	1.37	1.12	0.95	0.82

Job No.
No.

HDR Computation

Project
Computed
Date
Subject
Checked
Date
Task
Sheet
Of



Job No.

No.

HDR Computation

HDR

Project

Computed

Date

Subject

Checked

Date

Task

Sheet

Of

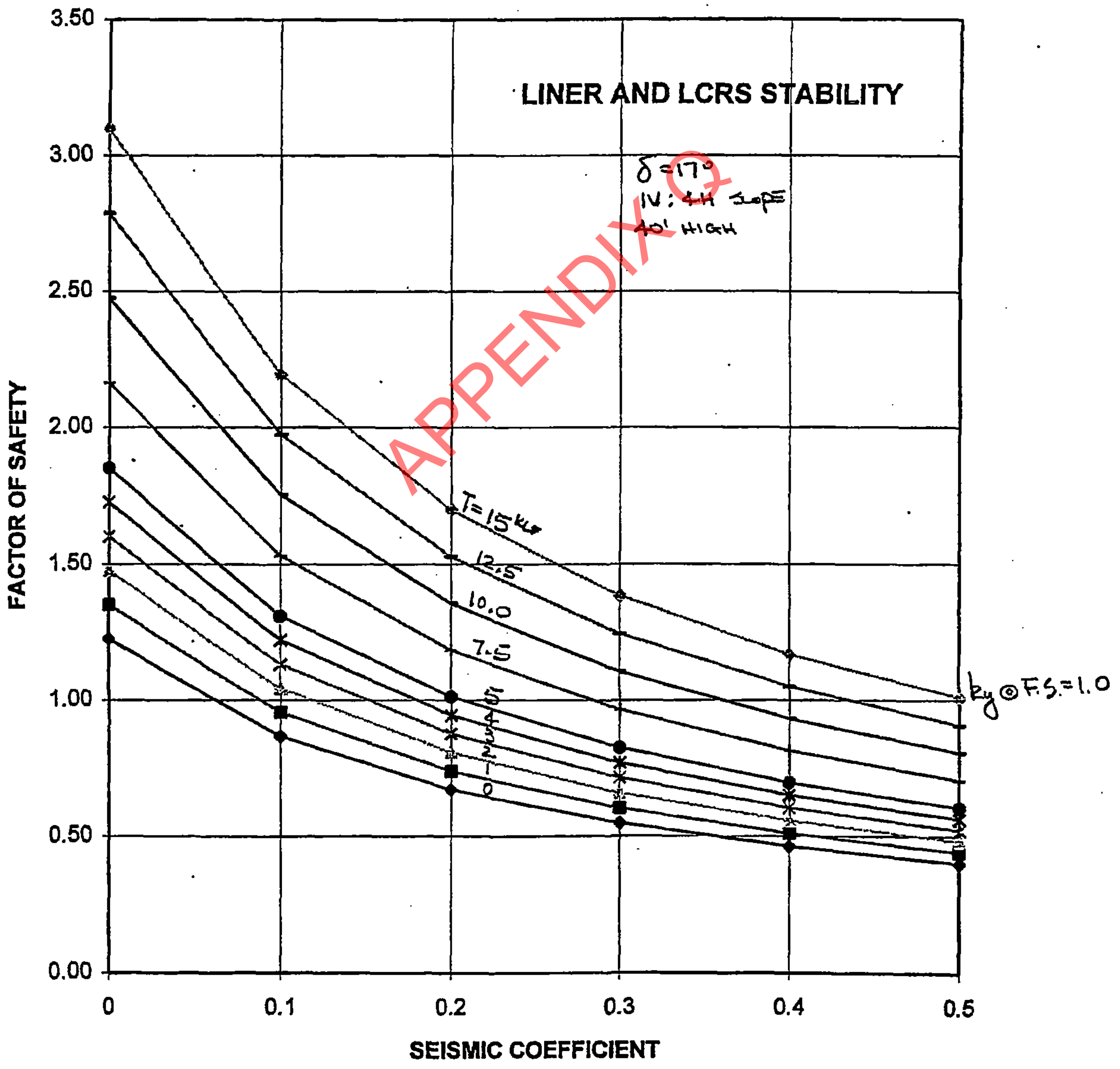
BAYVIEW LANDFILL CELL 1						
LINER AND LCRS CAP SLOPE STABILITY						
STATIC AND PSEUDO-STATIC ANALYSES						
(INFINITE SLOPE METHOD)						
SLOPE PROPERTIES						
	height	40.0	(ft.)			
	slope	14.0	(degrees)			
	length	165.3	(ft)			
LCRS PROPERTIES						
	thickness	2.0	(ft)			
	density	100.0	(pcf)			
INTERFACE FRICTION						
	friction	17.0	(degrees)	SAND	CUSHION	
FACTOR OF SAFETY						
Treinf	Seismic Coefficient, (-)					
(klf)	0	0.1	0.2	0.3	0.4	0.5
0.0	1.23	0.87	0.67	0.55	0.46	0.40
1.0	1.35	0.96	0.74	0.60	0.51	0.44
2.0	1.48	1.04	0.81	0.66	0.56	0.48
3.0	1.60	1.13	0.88	0.71	0.60	0.52
4.0	1.73	1.22	0.94	0.77	0.65	0.56
5.0	1.85	1.31	1.01	0.83	0.70	0.60
7.5	2.16	1.53	1.18	0.97	0.82	0.71
10.0	2.48	1.75	1.36	1.11	0.93	0.81
12.5	2.79	1.97	1.53	1.24	1.05	0.91
15.0	3.10	2.19	1.70	1.38	1.17	1.01

Job No.

No.

HDR Computation

Project	Computed	Date
Subject	Checked	Date
Task	Sheet	Of

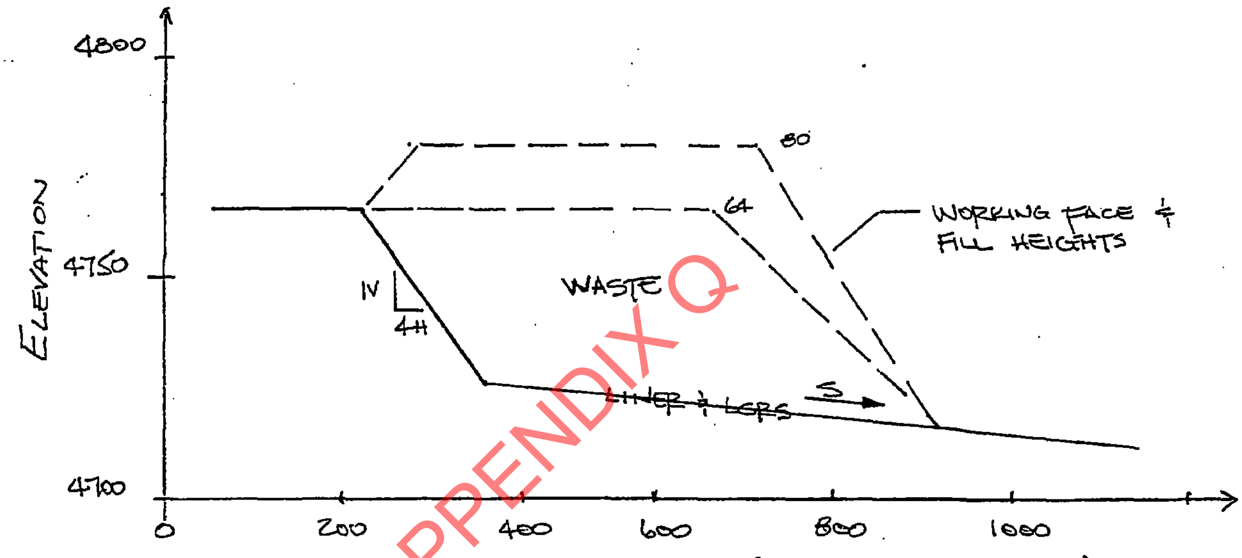


Job No. | No.

HDR Computation

Project	Computed	Date
Subject	Checked ✓	Date
Task	Sheet	Of

3.2 OPERATIONAL SLOPES DURING FILLING



SECTION CUT W-E @ STA N8000

USE SLIDING-BLOCK METHOD (UTEXAS 3, REF 6)
EVALUATE POTENTIAL SLIDING ON BOTTOM LCRS
OPERATIONAL FILL HTS 1464
1480

ITERATE ψ TO DETERMINE F.S = 1.0

CONSIDER
$\delta = 9°$ FOR GEOMEMBRANE – GEOTEXTILE CUSHION
$\delta = 17°$ FOR GEOMEMBRANE – SAND CUSHION

Job No.

No.

HDR Computation

Project

Computed

Date

Subject

Checked ✓

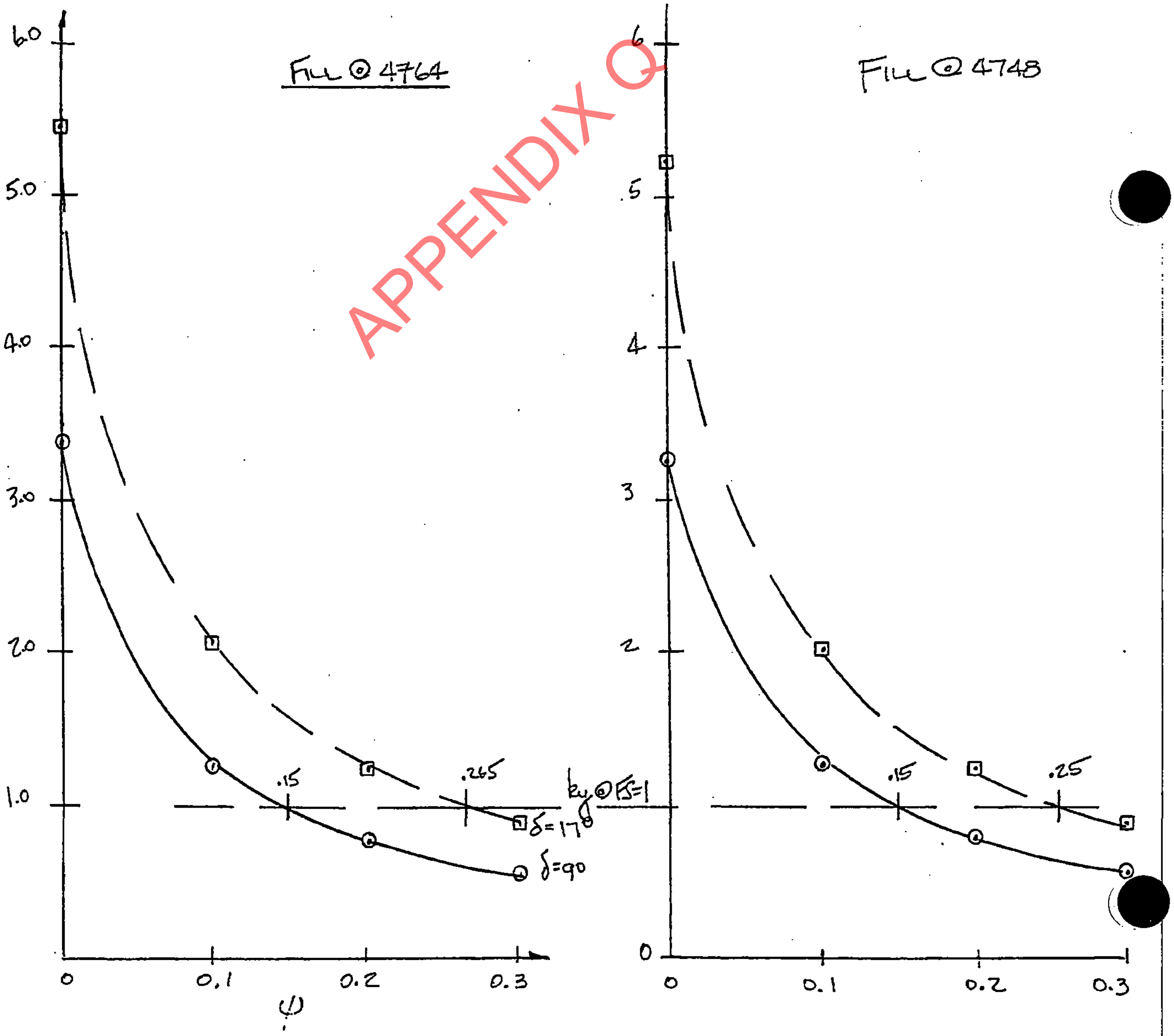
Date

Task

Sheet

Of

FILL @ 4764			FILL @ 4780	
δ = 9°	δ = 17°	ψ	δ = 9°	δ = 17°
3.36	5.40	0	3.25	5.18
1.25	2.03	0.1	1.25	2.00
0.76	1.24	0.2	0.76	1.24
0.54	0.89	0.3	0.54	0.89



```
HEADING
 Bayview Landfill Cell 1
 Sliding During Operational Filling @ 4764
 Geotextile Interface/Seismic Coeff varies/OF64G.DAT
PROFILE LINES
 1  1  Waste Fill to 4764
 225  4764
 615  4764
 865  4714

 2  2  Side Slope LCRS
  0    4764
 225  4764
 365  4724

 3  3  Bottom LCRS
 365  4724
 865  4714
 999  4714


MATERIAL PROPERTIES
 1  Waste Fill
 50
 C
   150  22
 N
 2  Side Slope LCRS    (INCLUDES SIDE SLOPE T)
 100
 C
   0  24
 N
 3  Bottom LCRS    (GEOTEXTILE CUSHION)
 100
 C
   0  9
 N

ANALYSIS  (SLIDING ALONG LCRS)
 N
 217  4764
 365  4722
 863  4712
 865  4714

 Seismic  ψ
   0.4   ←  ITERATE FOR FS ≤ 1.00
 Procedure
   C
   0.0

COMPUTE
```

APPENDIX Q

```
1    UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
     Date: 5:16:1996  Time: 10:46:18  Input file: of64g.dat


     TABLE NO. 1
     ********************************************
     * COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
     * Originally Coded By Stephen G. Wright  *
     * Version No. 1.107                      *
     * Last Revision Date 10/13/91            *
     * (C) Copyright 1985-1991 S. G. Wright   *
     * All Rights Reserved                    *
     ********************************************

     ****************************************************************
     *                                                              *
     *    RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
     * PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
     * HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL   *
     * DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE   *
     * ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER *
     * PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS      *
     * PROGRAM BEFORE ATTEMPTING ITS USE.                         *
     *                                                              *
     *    NEITHER THE UNIVERSITY OF TEXAS NOR STEPHEN G. WRIGHT *
     * MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR  *
     * IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS *
     * OR ADAPTABILITY OF THIS COMPUTER PROGRAM.                  *
     *                                                              *
     ****************************************************************
1    UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
     Date: 5:16:1996  Time: 10:46:18  Input file: of64g.dat
      Bayview Landfill Cell 1
      Sliding During Operational Filling @ 4764
      Geotextile Interface/Seismic Coeff varies/OF64G.DAT

     TABLE NO. 2
     **************************
     * NEW PROFILE LINE DATA *
     **************************

     PROFILE LINE  1 - MATERIAL TYPE =  1
     Waste Fill to 4764

        Point    X         Y

          1    225.000   4764.000
          2    615.000   4764.000
          3    865.000   4714.000

     PROFILE LINE  2 - MATERIAL TYPE =  2
     Side Slope LCRS

        Point    X         Y
```

```
      1      .000     4764.000
      2    225.000     4764.000
      3    365.000     4724.000

 PROFILE LINE  3 - MATERIAL TYPE =  3
 Bottom LCRS

    Point    X          Y

      1    365.000     4724.000
      2    865.000     4714.000
      3    999.000     4714.000

 All new profile lines defined - No old lines retained
1  UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
 Date:  5:16:1996   Time: 10:46:18   Input file: of64g.dat
  Bayview Landfill Cell 1
  Sliding During Operational Filling @ 4764
  Geotextile Interface/Seismic Coeff varies/OF64G.DAT

 TABLE NO.  3
 ***************************************************************************
 * NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS
*
 ***************************************************************************

 DATA FOR MATERIAL TYPE  1
 Waste Fill

    Unit weight of material =   50.000

    CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
    Cohesion - - - - - - - -      150.000
    Friction angle - - - - -  22.000 degrees

    No (or zero) pore water pressures

 DATA FOR MATERIAL TYPE  2
 Side Slope LCRS

    Unit weight of material =  100.000

    CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
    Cohesion - - - - - - - -        .000
    Friction angle - - - - -  24.000 degrees

    No (or zero) pore water pressures

 DATA FOR MATERIAL TYPE  3
 Bottom LCRS

    Unit weight of material =  100.000
```

```
    CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
    Cohesion - - - - - - - -      .000
    Friction angle - - - - -   9.000 degrees

    No (or zero) pore water pressures

   All new material properties defined - No old data retained
1   UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
   Date:  5:16:1996   Time: 10:46:18   Input file: of64g.dat
    Bayview Landfill Cell 1
    Sliding During Operational Filling @ 4764
    Geotextile Interface/Seismic Coeff varies/OF64G.DAT

   TABLE NO. 15
   **********************************
   * NEW ANALYSIS/COMPUTATION DATA *
   **********************************

   Noncircular Shear Surface(s)

   Computations Performed for Single Shear Surface


   Shear Surface Coordinates -

      Point      X          Y

        1     217.000    4764.000
        2     365.000    4722.000
        3     863.000    4712.000
        4     865.000    4714.000

   Procedure used to compute the factor of safety: CORPS
   Specified side force inclination =    .00 degrees

   ------------------------------------------------------------
   THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

   Initial trial estimate for the factor of safety =   3.000

   Maximum number of iterations allowed for
   calculating the factor of safety =   40

   Allowed force imbalance for convergence =     100.000

   Allowed moment imbalance for convergence =     100.000

   Number of increments for slice subdivision =   30

   Depth of water in crack =        .000

   Unit weight of water in crack =    62.400

   Seismic coefficient =  .000
```

```
    Conventional (single-stage) computations to be performed
1    UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
    Date:  5:16:1996   Time: 10:46:18   Input file: of64g.dat
     Bayview Landfill Cell 1
     Sliding During Operational Filling @ 4764
     Geotextile Interface/Seismic Coeff varies/OF64G.DAT

    TABLE NO. 16
    ****************************
    * NEW SLOPE GEOMETRY DATA *
    ****************************

    NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA
    WERE GENERATED BY THE PROGRAM

    Slope Coordinates -

       Point     X          Y

         1      .000    4764.000
         2    225.000    4764.000
         3    615.000    4764.000
         4    865.000    4714.000
         5    999.000    4714.000
1    UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
    Date:  5:16:1996   Time: 10:46:18   Input file: of64g.dat
     Bayview Landfill Cell 1
     Sliding During Operational Filling @ 4764
     Geotextile Interface/Seismic Coeff varies/OF64G.DAT

    TABLE NO. 26
    ***************************************************************
    *  Coordinate, Weight, Strength and Pore Water Pressure       *
    *  Information for Individual Slices for Conventional        *
    *  Computations or First Stage of Multi-Stage Computations.  *
    *  (Information is for the Critical Shear Surface in the     *
    *  Case of an Automatic Search.)                             *
    ***************************************************************

    Slice              Slice   Matl.        Friction   Pore
     No.    X      Y    Weight  Type  Cohesion  Angle  Pressure

           217.0  4764.0
      1    221.0  4762.9    908.2   2      .00   24.00      .0
           225.0  4761.7
      2    235.0  4758.9   7359.9   2      .00   24.00      .0
           245.0  4756.1
      3    255.0  4753.2  12997.1   2      .00   24.00      .0
           265.0  4750.4
      4    275.0  4747.5  18634.3   2      .00   24.00      .0
           285.0  4744.7
      5    295.0  4741.9  24271.5   2      .00   24.00      .0
           305.0  4739.0
```

```
   6  315.0  4736.2   29908.7  2    .00  24.00    .0
      325.0  4733.4
   7  335.0  4730.5   35545.9  2    .00  24.00    .0
      345.0  4727.7
   8  355.0  4724.8   41182.1  2    .00  24.00    .0
      365.0  4722.0
   9  375.4  4721.8   46051.6  3    .00   9.00    .0
      385.8  4721.6
  10   396.3  4721.4   46490.5  3    .00   9.00    .0
      406.7  4721.2
  11   417.1  4721.0   46927.4  3    .00   9.00    .0
      427.5  4720.7
  12   437.9  4720.5   47365.8  3    .00   9.00    .0
      448.3  4720.3
  13   458.8  4720.1   47802.8  3    .00   9.00    .0
      469.2  4719.9
  14   479.6  4719.7   48241.7  3    .00   9.00    .0
      490.0  4719.5
  15   500.4  4719.3   48678.1  3    .00   9.00    .0
      510.8  4719.1
  16   521.3  4718.9   49117.1  3    .00   9.00    .0
      531.7  4718.7
  17   542.1  4718.4   49553.9  3    .00   9.00    .0
      552.5  4718.2
  18   562.9  4718.0   49992.3  3    .00   9.00    .0
      573.3  4717.8
  19   583.8  4717.6   50429.2  3    .00   9.00    .0
      594.2  4717.4
  20   604.6  4717.2   50866.1  3    .00   9.00    .0
      615.0  4717.0
  21   625.3  4716.8   48754.4  3    .00   9.00    .0
      635.7  4716.6
1      UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
      Date:  5:16:1996   Time: 10:46:18   Input file: of64g.dat
       Bayview Landfill Cell 1
       Sliding During Operational Filling @ 4764
       Geotextile Interface/Seismic Coeff varies/OF64G.DAT

      TABLE NO. 26
      **************************************************************
      * Coordinate, Weight, Strength and Pore Water Pressure      *
      * Information for Individual Slices for Conventional      *
      * Computations or First Stage of Multi-Stage Computations.  *
      * (Information is for the Critical Shear Surface in the     *
      * Case of an Automatic Search.)                          *
      **************************************************************

      Slice              Slice  Matl.        Friction   Pore
       No.    X       Y    Weight  Type  Cohesion  Angle  Pressure

      635.7  4716.6
  22   646.0  4716.4   44913.7  3    .00   9.00    .0
      656.3  4716.1
  23   666.7  4715.9   41073.5  3    .00   9.00    .0
```

```
      677.0  4715.7
  24   687.3  4715.5   37232.8   3      .00    9.00       .0
      697.7  4715.3
  25   708.0  4715.1   33392.6   3      .00    9.00       .0
      718.3  4714.9
  26   728.7  4714.7   29551.9   3      .00    9.00       .0
      739.0  4714.5
  27   749.3  4714.3   25711.8   3      .00    9.00       .0
      759.7  4714.1
  28   770.0  4713.9   21871.1   3      .00    9.00       .0
      780.3  4713.7
  29   790.7  4713.5   18030.9   3      .00    9.00       .0
      801.0  4713.2
  30   811.3  4713.0   14190.2   3      .00    9.00       .0
      821.7  4712.8
  31   832.0  4712.6   10350.0   3      .00    9.00       .0
      842.3  4712.4
  32   852.7  4712.2    6509.2   3      .00    9.00       .0
      863.0  4712.0
  33   864.0  4713.0     222.0   3      .00    9.00       .0
      865.0  4714.0
1      UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
      Date:  5:16:1996   Time: 10:46:18   Input file: of64g.dat
       Bayview Landfill Cell 1
       Sliding During Operational Filling @ 4764
       Geotextile Interface/Seismic Coeff varies/OF64G.DAT

      TABLE NO. 27
      ***************************************************************
      *  Seismic Forces and Forces Due to Surface Pressures for   *
      *  Individual Slices for Conventional  Computations or the  *
      *  First Stage of Multi-Stage Computations.                 *
      *  (Information is for the Critical Shear Surface in the    *
      *  Case of an Automatic Search.)                            *
      ***************************************************************

                        FORCES DUE TO SURFACE PRESSURES
                Y for
  Slice       Seismic  Seismic   Normal   Shear
   No.    X    Force    Force    Force    Force     X       Y

    1   221.0    0.    4763.4    0.      0.     .0     .0
    2   235.0    0.    4761.0    0.      0.     .0     .0
    3   255.0    0.    4757.9    0.      0.     .0     .0
    4   275.0    0.    4754.9    0.      0.     .0     .0
    5   295.0    0.    4752.1    0.      0.     .0     .0
    6   315.0    0.    4749.2    0.      0.     .0     .0
    7   335.0    0.    4746.3    0.      0.     .0     .0
    8   355.0    0.    4743.5    0.      0.     .0     .0
    9   375.4    0.    4742.0    0.      0.     .0     .0
   10   396.3    0.    4741.8    0.      0.     .0     .0
   11   417.1    0.    4741.6    0.      0.     .0     .0
   12   437.9    0.    4741.4    0.      0.     .0     .0
   13   458.8    0.    4741.1    0.      0.     .0     .0
```

```
 14  479.6   0.  4740.9  0.   0.   .0   .0
 15  500.4   0.  4740.7  0.   0.   .0   .0
 16  521.3   0.  4740.5  0.   0.   .0   .0
 17  542.1   0.  4740.3  0.   0.   .0   .0
 18  562.9   0.  4740.1  0.   0.   .0   .0
 19  583.8   0.  4739.9  0.   0.   .0   .0
 20  604.6   0.  4739.7  0.   0.   .0   .0
 21  625.3   0.  4738.4  0.   0.   .0   .0
 22  646.0   0.  4736.2  0.   0.   .0   .0
 23  666.7   0.  4733.9  0.   0.   .0   .0
 24  687.3   0.  4731.6  0.   0.   .0   .0
 25  708.0   0.  4729.4  0.   0.   .0   .0
 26  728.7   0.  4727.1  0.   0.   .0   .0
 27  749.3   0.  4724.9  0.   0.   .0   .0
 28  770.0   0.  4722.6  0.   0.   .0   .0
 29  790.7   0.  4720.4  0.   0.   .0   .0
 30  811.3   0.  4718.2  0.   0.   .0   .0
 31  832.0   0.  4716.0  0.   0.   .0   .0
 32  852.7   0.  4714.0  0.   0.   .0   .0
 33  864.0   0.  4713.6  0.   0.   .0   .0
1     UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
     Date: 5:16:1996  Time: 10:46:18  Input file: of64g.dat
       Bayview Landfill Cell 1
       Sliding During Operational Filling @ 4764
       Geotextile Interface/Seismic Coeff varies/OF64G.DAT

     TABLE NO. 29
     ******************************************************************
     * INFORMATION GENERATED DURING ITERATIVE SOLUTION FOR THE FACTOR *
     * OF SAFETY BY THE CORPS OF ENGINEERS MODIFIED SWEDISH PROCEDURE *
     ******************************************************************

               Trial Factor   Force Imbalance
     Iteration    of Safety       (lbs.)      DELTA-F

         1        3.00000       -.790E+04    .323

         2        3.32297       -.758E+03    .379E-01

         3        3.36087       -.843E+01    .431E-03

         4        3.36130       -.219E-02    .112E-06

     Factor of Safety - - - - - - - -    3.361
     Side Force Inclination - - - - -      .00
     Number of Iterations - - - - - -    4
1     UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
     Date: 5:16:1996  Time: 10:46:18  Input file: of64g.dat
       Bayview Landfill Cell 1
       Sliding During Operational Filling @ 4764
       Geotextile Interface/Seismic Coeff varies/OF64G.DAT

     TABLE NO. 38
     ***************************************************************
```

```
*  Final Results for Stresses Along the Shear Surface       *
*  (Results for Critical Shear Surface in Case of a Search.)  *
*******************************************************************

CORPS OF ENGINEERS' PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety =   3.361

     -------- VALUES AT CENTER OF BASE OF SLICE--------

                        Total   Effective
Slice                   Normal   Normal     Shear
 No.  X-center  Y-center  Stress    Stress     Stress

  1    221.0   4762.9    109.4     109.4      14.5
  2    235.0   4758.9    354.7     354.7      47.0
  3    255.0   4753.2    626.3     626.3      83.0
  4    275.0   4747.5    898.0     898.0     118.9
  5    295.0   4741.9   1169.6    1169.6     154.9
  6    315.0   4736.2   1441.3    1441.3     190.9
  7    335.0   4730.5   1712.9    1712.9     226.9
  8    355.0   4724.8   1984.5    1984.5     262.9
  9    375.4   4721.8   2208.4    2208.4     104.1
 10    396.3   4721.4   2229.4    2229.4     105.1
 11    417.1   4721.0   2250.4    2250.4     106.0
 12    437.9   4720.5   2271.4    2271.4     107.0
 13    458.8   4720.1   2292.4    2292.4     108.0
 14    479.6   4719.7   2313.4    2313.4     109.0
 15    500.4   4719.3   2334.3    2334.3     110.0
 16    521.3   4718.9   2355.4    2355.4     111.0
 17    542.1   4718.4   2376.3    2376.3     112.0
 18    562.9   4718.0   2397.4    2397.4     113.0
 19    583.8   4717.6   2418.3    2418.3     114.0
 20    604.6   4717.2   2439.3    2439.3     114.9
 21    625.3   4716.8   2356.9    2356.9     111.1
 22    646.0   4716.4   2171.2    2171.2     102.3
 23    666.7   4715.9   1985.5    1985.5      93.6
 24    687.3   4715.5   1799.9    1799.9      84.8
 25    708.0   4715.1   1614.2    1614.2      76.1
 26    728.7   4714.7   1428.6    1428.6      67.3
 27    749.3   4714.3   1242.9    1242.9      58.6
 28    770.0   4713.9   1057.3    1057.3      49.8
 29    790.7   4713.5    871.6     871.6      41.1
 30    811.3   4713.0    686.0     686.0      32.3
 31    832.0   4712.6    500.3     500.3      23.6
 32    852.7   4712.2    314.7     314.7      14.8
 33    864.0   4713.0    116.5     116.5       5.5

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION   =      .02  (= .215E-01)
   SHOULD NOT EXCEED     .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION =      .00  (= .179E-02)
   SHOULD NOT EXCEED     .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM  =      .01  (= .999E-02)
```

```
    SHOULD NOT EXCEED      .100E+03
1  UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
   Date:  5:16:1996   Time: 10:46:18   Input file: of64g.dat
    Bayview Landfill Cell 1
    Sliding During Operational Filling @ 4764
    Geotextile Interface/Seismic Coeff varies/OF64G.DAT

   TABLE NO. 39
   *****************************************************************
   *  Final Results for Side Forces and Stresses Between Slices.  *
   *  (Results for Critical Shear Surface in Case of a Search.)   *
   *****************************************************************

   CORPS OF ENGINEERS' PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
   Factor of Safety =   3.361

      ----- VALUES AT RIGHT SIDE OF SLICE ----

                          Side Force
   Slice              Side   Inclination
    No.   X-Right    Force    (degrees)

     1    225.0      132.      .00
     2    245.0     1206.      .00
     3    265.0     3102.      .00
     4    285.0     5819.      .00
     5    305.0     9359.      .00
     6    325.0    13721.      .00
     7    345.0    18906.      .00
     8    365.0    24910.      .00
     9    385.8    23666.      .00
    10    406.7    22411.      .00
    11    427.5    21143.      .00
    12    448.3    19864.      .00
    13    469.2    18573.      .00
    14    490.0    17270.      .00
    15    510.8    15955.      .00
    16    531.7    14629.      .00
    17    552.5    13290.      .00
    18    573.3    11940.      .00
    19    594.2    10578.      .00
    20    615.0     9201.      .00
    21    635.7     7884.      .00
    22    656.3     6671.      .00
    23    677.0     5561.      .00
    24    697.7     4555.      .00
    25    718.3     3653.      .00
    26    739.0     2855.      .00
    27    759.7     2161.      .00
    28    780.3     1570.      .00
    29    801.0     1083.      .00
    30    821.7      700.      .00
    31    842.3      420.      .00
    32    863.0      244.      .00
```

```
33     865.0      0.     .00

END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED
```

```
HEADING
 Bayview Landfill Cell 1
 Sliding During Operational Filling @ 4764
 Sand Interface/Seismic Coeff varies/OF64S.DAT
PROFILE LINES
 1  1  Waste Fill to 4764
 225  4764
 615  4764
 865  4714

 2  2  Side Slope LCRS
  0    4764
 225  4764
 365  4724

 3  3  Bottom LCRS
 365  4724
 865  4714
 999  4714


MATERIAL PROPERTIES
 1  Waste Fill
 50
 C
   150  22
 N
 2  Side Slope LCRS  (INCLUDES SIDE SLOPE T )
 100
 C
   0  24
 N
 3  Bottom LCRS   ( SAND CUSHION)
 100
 C
   0  17
 N

ANALYSIS   (SLIDING ALONG LCRS)
 N
 217  4764
 365  4722
 863  4712
 865  4714

 Seismic ( ψ )
   0.3      ← ITERATE 0, 0.1 , ETC TO FS ≤ 1.00
 Procedure
   C
   0.0

COMPUTE
```

```
1     UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
      Date: 5:16:1996   Time: 10:59:10   Input file: of64s.dat


      TABLE NO. 1
      ********************************************
      * COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
      * Originally Coded By Stephen G. Wright  *
      * Version No. 1.107                      *
      * Last Revision Date 10/13/91            *
      * (C) Copyright 1985-1991 S. G. Wright   *
      * All Rights Reserved                    *
      ********************************************

      *****************************************************************
      *                                *
      *    RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
      * PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
      * HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL  *
      * DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE  *
      * ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER *
      * PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS     *
      * PROGRAM BEFORE ATTEMPTING ITS USE.          *
      *                                *
      *    NEITHER THE UNIVERSITY OF TEXAS NOR STEPHEN G. WRIGHT *
      * MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR  *
      * IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS  *
      * OR ADAPTABILITY OF THIS COMPUTER PROGRAM.          *
      *                                *
      *****************************************************************
1     UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
      Date: 5:16:1996   Time: 10:59:10   Input file: of64s.dat
       Bayview Landfill Cell 1
       Sliding During Operational Filling @ 4764
       Geotextile Interface/Seismic Coeff varies/OF64G.DAT

      TABLE NO.  2
      **************************
      * NEW PROFILE LINE DATA *
      **************************

      PROFILE LINE  1 - MATERIAL TYPE =  1
      Waste Fill to 4764

         Point    X          Y

           1    225.000    4764.000
           2    615.000    4764.000
           3    865.000    4714.000

      PROFILE LINE  2 - MATERIAL TYPE =  2
      Side Slope LCRS

         Point    X          Y
```

```
         1      .000     4764.000
         2    225.000    4764.000
         3    365.000    4724.000

      PROFILE LINE  3 - MATERIAL TYPE =  3
      Bottom LCRS

         Point      X          Y

         1    365.000    4724.000
         2    865.000    4714.000
         3    999.000    4714.000

      All new profile lines defined - No old lines retained
1      UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
      Date:  5:16:1996   Time: 10:59:10   Input file: of64s.dat
       Bayview Landfill Cell 1
       Sliding During Operational Filling @ 4764
       Geotextile Interface/Seismic Coeff varies/OF64G.DAT

      TABLE NO.  3
      ****************************************************************************
      * NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS
*
      ****************************************************************************

      DATA FOR MATERIAL TYPE  1
      Waste Fill

         Unit weight of material =   50.000

         CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
         Cohesion - - - - - - - -     150.000
         Friction angle - - - - -  22.000 degrees

         No (or zero) pore water pressures

      DATA FOR MATERIAL TYPE  2
      Side Slope LCRS

         Unit weight of material =  100.000

         CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
         Cohesion - - - - - - - -        .000
         Friction angle - - - - -  24.000 degrees

         No (or zero) pore water pressures

      DATA FOR MATERIAL TYPE  3
      Bottom LCRS

         Unit weight of material =  100.000
```

```
   CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
   Cohesion - - - - - - - -      .000
   Friction angle - - - - -  17.000 degrees

   No (or zero) pore water pressures

All new material properties defined - No old data retained
1  UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date:  5:16:1996   Time: 10:59:10   Input file: of64s.dat
 Bayview Landfill Cell 1
 Sliding During Operational Filling @ 4764
 Geotextile Interface/Seismic Coeff varies/OF64G.DAT

TABLE NO. 15
***********************************
* NEW ANALYSIS/COMPUTATION DATA *
***********************************

Noncircular Shear Surface(s)

Computations Performed for Single Shear Surface


Shear Surface Coordinates -

   Point     X          Y

     1     217.000    4764.000
     2     365.000    4722.000
     3     863.000    4712.000
     4     865.000    4714.000

Procedure used to compute the factor of safety: CORPS
Specified side force inclination =    .00 degrees

-----------------------------------------------------------------
THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

Initial trial estimate for the factor of safety =  3.000

Maximum number of iterations allowed for
calculating the factor of safety =  40

Allowed force imbalance for convergence =    100.000

Allowed moment imbalance for convergence =    100.000

Number of increments for slice subdivision =  30

Depth of water in crack =        .000

Unit weight of water in crack =   62.400

Seismic coefficient =  .000
```

```
      Conventional (single-stage) computations to be performed
1      UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
      Date:  5:16:1996   Time: 10:59:10   Input file: of64s.dat
        Bayview Landfill Cell 1
        Sliding During Operational Filling @ 4764
        Geotextile Interface/Seismic Coeff varies/OF64G.DAT

      TABLE NO. 16
      ****************************
      * NEW SLOPE GEOMETRY DATA *
      ****************************

      NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA
      WERE GENERATED BY THE PROGRAM

      Slope Coordinates -

         Point      X          Y

           1       .000    4764.000
           2    225.000    4764.000
           3    615.000    4764.000
           4    865.000    4714.000
           5    999.000    4714.000
1      UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
      Date:  5:16:1996   Time: 10:59:10   Input file: of64s.dat
        Bayview Landfill Cell 1
        Sliding During Operational Filling @ 4764
        Geotextile Interface/Seismic Coeff varies/OF64G.DAT

      TABLE NO. 26
      ************************************************************
      *  Coordinate, Weight, Strength and Pore Water Pressure     *
      *  Information for Individual Slices for Conventional       *
      *  Computations or First Stage of Multi-Stage Computations. *
      *  (Information is for the Critical Shear Surface in the    *
      *  Case of an Automatic Search.)                            *
      ************************************************************

      Slice              Slice   Matl.       Friction   Pore
        No.    X       Y     Weight  Type  Cohesion   Angle  Pressure

             217.0  4764.0
         1   221.0  4762.9     908.2   2      .00    24.00      .0
             225.0  4761.7
         2   235.0  4758.9    7359.9   2      .00    24.00      .0
             245.0  4756.1
         3   255.0  4753.2   12997.1   2      .00    24.00      .0
             265.0  4750.4
         4   275.0  4747.5   18634.3   2      .00    24.00      .0
             285.0  4744.7
         5   295.0  4741.9   24271.5   2      .00    24.00      .0
             305.0  4739.0
```

```
   6  315.0  4736.2   29908.7  2     .00   24.00      .0
      325.0  4733.4
   7  335.0  4730.5   35545.9  2     .00   24.00      .0
      345.0  4727.7
   8  355.0  4724.8   41182.1  2     .00   24.00      .0
      365.0  4722.0
   9  375.4  4721.8   46051.6  3     .00   17.00      .0
      385.8  4721.6
  10   396.3  4721.4   46490.5  3     .00   17.00      .0
      406.7  4721.2
  11   417.1  4721.0   46927.4  3     .00   17.00      .0
      427.5  4720.7
  12   437.9  4720.5   47365.8  3     .00   17.00      .0
      448.3  4720.3
  13   458.8  4720.1   47802.8  3     .00   17.00      .0
      469.2  4719.9
  14   479.6  4719.7   48241.7  3     .00   17.00      .0
      490.0  4719.5
  15   500.4  4719.3   48678.1  3     .00   17.00      .0
      510.8  4719.1
  16   521.3  4718.9   49117.1  3     .00   17.00      .0
      531.7  4718.7
  17   542.1  4718.4   49553.9  3     .00   17.00      .0
      552.5  4718.2
  18   562.9  4718.0   49992.3  3     .00   17.00      .0
      573.3  4717.8
  19   583.8  4717.6   50429.2  3     .00   17.00      .0
      594.2  4717.4
  20   604.6  4717.2   50866.1  3     .00   17.00      .0
      615.0  4717.0
  21   625.3  4716.8   48754.4  3     .00   17.00      .0
      635.7  4716.6
1       UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
       Date:  5:16:1996   Time: 10:59:10   Input file: of64s.dat
        Bayview Landfill Cell 1
        Sliding During Operational Filling @ 4764
        Geotextile Interface/Seismic Coeff varies/OF64G.DAT

       TABLE NO. 26
       ***************************************************************
       *  Coordinate, Weight, Strength and Pore Water Pressure       *
       *  Information for Individual Slices for Conventional        *
       *  Computations or First Stage of Multi-Stage Computations.  *
       *  (Information is for the Critical Shear Surface in the     *
       *  Case of an Automatic Search.)                             *
       ***************************************************************

       Slice              Slice  Matl.       Friction   Pore
        No.    X       Y     Weight  Type  Cohesion   Angle  Pressure

             635.7  4716.6
        22    646.0  4716.4   44913.7  3     .00   17.00      .0
             656.3  4716.1
        23    666.7  4715.9   41073.5  3     .00   17.00      .0
```

```
       677.0  4715.7
    24  687.3  4715.5  37232.8  3     .00   17.00       .0
       697.7  4715.3
    25  708.0  4715.1  33392.6  3     .00   17.00       .0
       718.3  4714.9
    26  728.7  4714.7  29551.9  3     .00   17.00       .0
       739.0  4714.5
    27  749.3  4714.3  25711.8  3     .00   17.00       .0
       759.7  4714.1
    28  770.0  4713.9  21871.1  3     .00   17.00       .0
       780.3  4713.7
    29  790.7  4713.5  18030.9  3     .00   17.00       .0
       801.0  4713.2
    30  811.3  4713.0  14190.2  3     .00   17.00       .0
       821.7  4712.8
    31  832.0  4712.6  10350.0  3     .00   17.00       .0
       842.3  4712.4
    32  852.7  4712.2   6509.2  3     .00   17.00       .0
       863.0  4712.0
    33  864.0  4713.0    222.0  3     .00   17.00       .0
       865.0  4714.0
1      UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
       Date: 5:16:1996   Time: 10:59:10   Input file: of64s.dat
        Bayview Landfill Cell 1
        Sliding During Operational Filling @ 4764
        Geotextile Interface/Seismic Coeff varies/OF64G.DAT

       TABLE NO. 27
       ***********************************************************
       * Seismic Forces and Forces Due to Surface Pressures for   *
       * Individual Slices for Conventional Computations or the  *
       * First Stage of Multi-Stage Computations.                *
       * (Information is for the Critical Shear Surface in the   *
       * Case of an Automatic Search.)                           *
       ***********************************************************

                          FORCES DUE TO SURFACE PRESSURES
                  Y for
       Slice    Seismic  Seismic   Normal  Shear
        No.   X   Force    Force    Force   Force    X      Y

         1  221.0    0.    4763.4    0.     0.     .0     .0
         2  235.0    0.    4761.0    0.     0.     .0     .0
         3  255.0    0.    4757.9    0.     0.     .0     .0
         4  275.0    0.    4754.9    0.     0.     .0     .0
         5  295.0    0.    4752.1    0.     0.     .0     .0
         6  315.0    0.    4749.2    0.     0.     .0     .0
         7  335.0    0.    4746.3    0.     0.     .0     .0
         8  355.0    0.    4743.5    0.     0.     .0     .0
         9  375.4    0.    4742.0    0.     0.     .0     .0
        10  396.3    0.    4741.8    0.     0.     .0     .0
        11  417.1    0.    4741.6    0.     0.     .0     .0
        12  437.9    0.    4741.4    0.     0.     .0     .0
        13  458.8    0.    4741.1    0.     0.     .0     .0
```

```
   14  479.6    0.  4740.9   0.    0.    .0    .0
   15  500.4    0.  4740.7   0.    0.    .0    .0
   16  521.3    0.  4740.5   0.    0.    .0    .0
   17  542.1    0.  4740.3   0.    0.    .0    .0
   18  562.9    0.  4740.1   0.    0.    .0    .0
   19  583.8    0.  4739.9   0.    0.    .0    .0
   20  604.6    0.  4739.7   0.    0.    .0    .0
   21  625.3    0.  4738.4   0.    0.    .0    .0
   22  646.0    0.  4736.2   0.    0.    .0    .0
   23  666.7    0.  4733.9   0.    0.    .0    .0
   24  687.3    0.  4731.6   0.    0.    .0    .0
   25  708.0    0.  4729.4   0.    0.    .0    .0
   26  728.7    0.  4727.1   0.    0.    .0    .0
   27  749.3    0.  4724.9   0.    0.    .0    .0
   28  770.0    0.  4722.6   0.    0.    .0    .0
   29  790.7    0.  4720.4   0.    0.    .0    .0
   30  811.3    0.  4718.2   0.    0.    .0    .0
   31  832.0    0.  4716.0   0.    0.    .0    .0
   32  852.7    0.  4714.0   0.    0.    .0    .0
   33  864.0    0.  4713.6   0.    0.    .0    .0
1   UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
  Date:  5:16:1996   Time: 10:59:10   Input file: of64s.dat
   Bayview Landfill Cell 1
   Sliding During Operational Filling @ 4764
   Geotextile Interface/Seismic Coeff varies/OF64G.DAT

  TABLE NO. 29
  *******************************************************************
  * INFORMATION GENERATED DURING ITERATIVE SOLUTION FOR THE FACTOR *
  * OF SAFETY BY THE CORPS OF ENGINEERS MODIFIED SWEDISH PROCEDURE *
  *******************************************************************

             Trial Factor    Force Imbalance
  Iteration    of Safety          (lbs.)       DELTA-F

     1        3.00000         -.527E+05     1.34
  Reduced value - Delta was too large ............  .500

     2        3.50000         -.358E+05     1.23
  Reduced value - Delta was too large ............  .500

     3        4.00000         -.231E+05     1.04
  Reduced value - Delta was too large ............  .500

     4        4.50000         -.132E+05     .749
  Reduced value - Delta was too large ............  .500

     5        5.00000         -.526E+04     .368

     6        5.36843         -.359E+03     .290E-01

     7        5.39738         -.193E+01     .157E-03

     8        5.39754          .360E-01    -.294E-05
```

```
Factor of Safety - - - - - - - -     5.398
Side Force Inclination - - - - -      .00
Number of Iterations - - - - - -    8
1    UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date:  5:16:1996   Time: 10:59:10   Input file: of64s.dat
 Bayview Landfill Cell 1
 Sliding During Operational Filling @ 4764
 Geotextile Interface/Seismic Coeff varies/OF64G.DAT

TABLE NO. 38
*******************************************************************
*  Final Results for Stresses Along the Shear Surface          *
*  (Results for Critical Shear Surface in Case of a Search.)  *
*******************************************************************

CORPS OF ENGINEERS' PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety =   5.398

     -------- VALUES AT CENTER OF BASE OF SLICE--------

                           Total    Effective
Slice                      Normal   Normal    Shear
 No.  X-center  Y-center   Stress   Stress    Stress

  1    221.0   4762.9    110.9     110.9      9.2
  2    235.0   4758.9    359.6     359.6     29.7
  3    255.0   4753.2    635.0     635.0     52.4
  4    275.0   4747.5    910.4     910.4     75.1
  5    295.0   4741.9   1185.8    1185.8     97.8
  6    315.0   4736.2   1461.2    1461.2    120.5
  7    335.0   4730.5   1736.6    1736.6    143.3
  8    355.0   4724.8   2012.0    2012.0    166.0
  9    375.4   4721.8   2208.0    2208.0    125.1
 10    396.3   4721.4   2229.0    2229.0    126.3
 11    417.1   4721.0   2250.0    2250.0    127.4
 12    437.9   4720.5   2271.0    2271.0    128.6
 13    458.8   4720.1   2291.9    2291.9    129.8
 14    479.6   4719.7   2313.0    2313.0    131.0
 15    500.4   4719.3   2333.9    2333.9    132.2
 16    521.3   4718.9   2354.9    2354.9    133.4
 17    542.1   4718.4   2375.9    2375.9    134.6
 18    562.9   4718.0   2396.9    2396.9    135.8
 19    583.8   4717.6   2417.9    2417.9    137.0
 20    604.6   4717.2   2438.8    2438.8    138.1
 21    625.3   4716.8   2356.4    2356.4    133.5
 22    646.0   4716.4   2170.8    2170.8    123.0
 23    666.7   4715.9   1985.2    1985.2    112.4
 24    687.3   4715.5   1799.5    1799.5    101.9
 25    708.0   4715.1   1613.9    1613.9     91.4
 26    728.7   4714.7   1428.3    1428.3     80.9
 27    749.3   4714.3   1242.7    1242.7     70.4
 28    770.0   4713.9   1057.1    1057.1     59.9
 29    790.7   4713.5    871.5     871.5     49.4
```

```
 30   811.3  4713.0   685.8   685.8   38.8
 31   832.0  4712.6   500.2   500.2   28.3
 32   852.7  4712.2   314.6   314.6   17.8
 33   864.0  4713.0   117.7   117.7    6.7


CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION   =      .03  (= .259E-01)
   SHOULD NOT EXCEED     .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION  =       .00  (= .218E-02)
   SHOULD NOT EXCEED     .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM   =       .06  (= .564E-01)
   SHOULD NOT EXCEED     .100E+03
1  UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date:  5:16:1996  Time: 10:59:10  Input file: of64s.dat
 Bayview Landfill Cell 1
 Sliding During Operational Filling @ 4764
 Geotextile Interface/Seismic Coeff varies/OF64G.DAT

TABLE NO. 39
*******************************************************************
*  Final Results for Side Forces and Stresses Between Slices.    *
*  (Results for Critical Shear Surface in Case of a Search.)  *
*******************************************************************

CORPS OF ENGINEERS' PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety =   5.398

    ----- VALUES AT RIGHT SIDE OF SLICE ----

                    Side Force
Slice          Side   Inclination
 No.   X-Right   Force    (degrees)

  1    225.0     179.     .00
  2    245.0    1626.     .00
  3    265.0    4183.     .00
  4    285.0    7848.     .00
  5    305.0   12622.     .00
  6    325.0   18505.     .00
  7    345.0   25497.     .00
  8    365.0   33595.     .00
  9    385.8   31914.     .00
 10    406.7   30216.     .00
 11    427.5   28503.     .00
 12    448.3   26773.     .00
 13    469.2   25028.     .00
 14    490.0   23266.     .00
 15    510.8   21489.     .00
 16    531.7   19695.     .00
 17    552.5   17886.     .00
 18    573.3   16060.     .00
 19    594.2   14219.     .00
 20    615.0   12358.     .00
```

```
21    635.7   10577.    .00
22    656.3    8937.    .00
23    677.0    7437.    .00
24    697.7    6078.    .00
25    718.3    4858.    .00
26    739.0    3779.    .00
27    759.7    2840.    .00
28    780.3    2041.    .00
29    801.0    1383.    .00
30    821.7     865.   .00
31    842.3     487.   .00
32    863.0     249.   .00
33    865.0       0.   .00


END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED
```

```
HEADING
 Bayview Landfill Cell 1
 Sliding During Operational Filling @ 4780
 Geotextile Interface/Seismic Coeff varies/OF80G.DAT
PROFILE LINES
 1  1  Waste Fill to 4764
 225  4764
 275  4780
 665  4780
 865  4714

 2  2  Side Slope LCRS
  0    4764
 225  4764
 365  4724

 3  3  Bottom LCRS
 365  4724
 865  4714
 999  4714


MATERIAL PROPERTIES
 1  Waste Fill
 50
 C
   150  22
 N
 2  Side Slope LCRS
 100
 C
   0  24
 N
 3  Bottom LCRS
 100
 C
   0  9
 N

ANALYSIS
 N
 217  4764
 365  4722
 863  4712
 865  4714

 Seismic
   0.2
 Procedure
   C
   0.0

COMPUTE
```

```
1      UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
       Date:  5:16:1996   Time: 11:13:51   Input file: of80g.dat


       TABLE NO. 1
       ********************************************
       * COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
       * Originally Coded By Stephen G. Wright  *
       * Version No. 1.107                      *
       * Last Revision Date 10/13/91            *
       * (C) Copyright 1985-1991 S. G. Wright   *
       * All Rights Reserved                    *
       ********************************************

       *****************************************************************
       *                                                               *
       *    RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER      *
       * PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY    *
       * HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL      *
       * DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE      *
       * ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER     *
       * PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS         *
       * PROGRAM BEFORE ATTEMPTING ITS USE.                            *
       *                                                               *
       *    NEITHER THE UNIVERSITY OF TEXAS NOR STEPHEN G. WRIGHT      *
       * MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR     *
       * IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS     *
       * OR ADAPTABILITY OF THIS COMPUTER PROGRAM.                     *
       *                                                               *
       *****************************************************************
1      UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
       Date:  5:16:1996   Time: 11:13:51   Input file: of80g.dat
        Bayview Landfill Cell 1
        Sliding During Operational Filling @ 4780
        Geotextile Interface/Seismic Coeff varies/OF80G.DAT

       TABLE NO.  2
       **************************
       * NEW PROFILE LINE DATA *
       **************************

       PROFILE LINE  1 - MATERIAL TYPE =  1
       Waste Fill to 4764

          Point    X          Y

            1     225.000    4764.000
            2     275.000    4780.000
            3     665.000    4780.000
            4     865.000    4714.000

       PROFILE LINE  2 - MATERIAL TYPE =  2
       Side Slope LCRS
```

```
     Point    X         Y

      1     .000    4764.000
      2   225.000    4764.000
      3   365.000    4724.000

  PROFILE LINE  3 - MATERIAL TYPE =  3
  Bottom LCRS

     Point    X         Y

      1   365.000    4724.000
      2   865.000    4714.000
      3   999.000    4714.000

  All new profile lines defined - No old lines retained
1  UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
  Date:  5:16:1996   Time: 11:13:51   Input file: of80g.dat
   Bayview Landfill Cell 1
   Sliding During Operational Filling @ 4780
   Geotextile Interface/Seismic Coeff varies/OF80G.DAT

  TABLE NO.  3
  ***********************************************************************
  * NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS
*
  ***********************************************************************

  DATA FOR MATERIAL TYPE  1
  Waste Fill

     Unit weight of material =   50.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -     150.000
     Friction angle - - - - -  22.000 degrees

     No (or zero) pore water pressures

  DATA FOR MATERIAL TYPE  2
  Side Slope LCRS

     Unit weight of material =  100.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -       .000
     Friction angle - - - - -  24.000 degrees

     No (or zero) pore water pressures

  DATA FOR MATERIAL TYPE  3
  Bottom LCRS

     Unit weight of material =  100.000
```

```
     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -        .000
     Friction angle - - - - -   9.000 degrees

     No (or zero) pore water pressures

   All new material properties defined - No old data retained
1   UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
   Date:  5:16:1996   Time: 11:13:51   Input file: of80g.dat
    Bayview Landfill Cell 1
    Sliding During Operational Filling @ 4780
    Geotextile Interface/Seismic Coeff varies/OF80G.DAT

   TABLE NO. 15
   ***********************************
   * NEW ANALYSIS/COMPUTATION DATA *
   ***********************************

   Noncircular Shear Surface(s)

   Computations Performed for Single Shear Surface


   Shear Surface Coordinates -

     Point     X          Y

       1     217.000    4764.000
       2     365.000    4722.000
       3     863.000    4712.000
       4     865.000    4714.000

   Procedure used to compute the factor of safety: CORPS
   Specified side force inclination =    .00 degrees

   --------------------------------------------------------------
   THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

   Initial trial estimate for the factor of safety =   3.000

   Maximum number of iterations allowed for
   calculating the factor of safety =   40

   Allowed force imbalance for convergence =    100.000

   Allowed moment imbalance for convergence =    100.000

   Number of increments for slice subdivision =   30

   Depth of water in crack =        .000

   Unit weight of water in crack =    62.400
```

```
Seismic coefficient =  .000

Conventional (single-stage) computations to be performed
1    UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
     Date:  5:16:1996   Time: 11:13:51   Input file: of80g.dat
      Bayview Landfill Cell 1
      Sliding During Operational Filling @ 4780
      Geotextile Interface/Seismic Coeff varies/OF80G.DAT

     TABLE NO. 16
     ****************************
     * NEW SLOPE GEOMETRY DATA *
     ****************************

     NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA
     WERE GENERATED BY THE PROGRAM

     Slope Coordinates -

        Point     X         Y

          1       .000    4764.000
          2    225.000    4764.000
          3    275.000    4780.000
          4    665.000    4780.000
          5    865.000    4714.000
          6    999.000    4714.000
1    UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
     Date:  5:16:1996   Time: 11:13:51   Input file: of80g.dat
      Bayview Landfill Cell 1
      Sliding During Operational Filling @ 4780
      Geotextile Interface/Seismic Coeff varies/OF80G.DAT

     TABLE NO. 26
     ***********************************************************
     *  Coordinate, Weight, Strength and Pore Water Pressure    *
     *  Information for Individual Slices for Conventional      *
     *  Computations or First Stage of Multi-Stage Computations. *
     *  (Information is for the Critical Shear Surface in the   *
     *  Case of an Automatic Search.)                           *
     ***********************************************************

     Slice                  Slice   Matl.         Friction   Pore
      No.     X       Y     Weight  Type  Cohesion  Angle   Pressure

           217.0  4764.0
       1   221.0  4762.9     908.2   2      .00    24.00       .0
           225.0  4761.7
       2   233.3  4759.4    7963.5   2      .00    24.00       .0
           241.7  4757.0
       3   250.0  4754.6   16322.0   2      .00    24.00       .0
           258.3  4752.3
       4   266.7  4749.9   24681.8   2      .00    24.00       .0
           275.0  4747.5
```

```
      5  284.0  4745.0   33453.4   2      .00   24.00      .0
        293.0  4742.4
      6  302.0  4739.9   38018.0   2      .00   24.00      .0
        311.0  4737.3
      7  320.0  4734.8   42584.3   2      .00   24.00      .0
        329.0  4732.2
      8  338.0  4729.7   47149.4   2      .00   24.00      .0
        347.0  4727.1
      9  356.0  4724.6   51715.7   2      .00   24.00      .0
        365.0  4722.0
     10   375.7  4721.8   64516.4   3      .00    9.00      .0
        386.4  4721.6
     11   397.1  4721.4   64979.9   3      .00    9.00      .0
        407.9  4721.1
     12   418.6  4720.9   65441.9   3      .00    9.00      .0
        429.3  4720.7
     13   440.0  4720.5   65905.4   3      .00    9.00      .0
        450.7  4720.3
     14   461.4  4720.1   66366.8   3      .00    9.00      .0
        472.1  4719.8
     15   482.9  4719.6   66830.8   3      .00    9.00      .0
        493.6  4719.4
     16   504.3  4719.2   67292.4   3      .00    9.00      .0
        515.0  4719.0
     17   525.7  4718.8   67755.9   3      .00    9.00      .0
        536.4  4718.6
     18   547.1  4718.3   68217.3   3      .00    9.00      .0
        557.9  4718.1
     19   568.6  4717.9   68681.4   3      .00    9.00      .0
        579.3  4717.7
     20   590.0  4717.5   69142.8   3      .00    9.00      .0
        600.7  4717.3
     21   611.4  4717.1   69606.3   3      .00    9.00      .0
        622.1  4716.8
1     UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
     Date:  5:16:1996   Time: 11:13:51   Input file: of80g.dat
      Bayview Landfill Cell 1
      Sliding During Operational Filling @ 4780
      Geotextile Interface/Seismic Coeff varies/OF80G.DAT

     TABLE NO. 26
     ***************************************************************
     * Coordinate, Weight, Strength and Pore Water Pressure      *
     * Information for Individual Slices for Conventional        *
     * Computations or First Stage of Multi-Stage Computations.  *
     * (Information is for the Critical Shear Surface in the     *
     * Case of an Automatic Search.)                             *
     ***************************************************************

     Slice              Slice   Matl.       Friction   Pore
      No.    X      Y    Weight  Type  Cohesion  Angle  Pressure

        622.1  4716.8
     22   632.9  4716.6   70068.2   3      .00    9.00      .0
```

```
     643.6  4716.4
 23   654.3  4716.2   70532.6   3     .00    9.00      .0
     665.0  4716.0
 24   674.9  4715.8   62350.1   3     .00    9.00      .0
     684.8  4715.6
 25   694.7  4715.4   56276.7   3     .00    9.00      .0
     704.6  4715.2
 26   714.5  4715.0   50202.8   3     .00    9.00      .0
     724.4  4714.8
 27   734.3  4714.6   44128.9   3     .00    9.00      .0
     744.2  4714.4
 28   754.1  4714.2   38055.5   3     .00    9.00      .0
     764.0  4714.0
 29   773.9  4713.8   31981.6   3     .00    9.00      .0
     783.8  4713.6
 30   793.7  4713.4   25907.7   3     .00    9.00      .0
     803.6  4713.2
 31   813.5  4713.0   19834.3   3     .00    9.00      .0
     823.4  4712.8
 32   833.3  4712.6   13760.4   3     .00    9.00      .0
     843.2  4712.4
 33   853.1  4712.2    7689.0   3     .00    9.00      .0
     863.0  4712.0
 34   864.0  4713.0     235.0   3     .00    9.00      .0
     865.0  4714.0
1     UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
     Date:  5:16:1996   Time: 11:13:51   Input file: of80g.dat
      Bayview Landfill Cell 1
      Sliding During Operational Filling @ 4780
      Geotextile Interface/Seismic Coeff varies/OF80G.DAT

     TABLE NO. 27
     ***************************************************************
     * Seismic Forces and Forces Due to Surface Pressures for    *
     * Individual Slices for Conventional  Computations or the  *
     * First Stage of Multi-Stage Computations.                *
     * (Information is for the Critical Shear Surface in the    *
     * Case of an Automatic Search.)                          *
     ***************************************************************

                         FORCES DUE TO SURFACE PRESSURES
                    Y for
     Slice        Seismic  Seismic   Normal   Shear
      No.     X    Force    Force    Force    Force       X      Y

       1   221.0     0.    4763.4     0.      0.      .0     .0
       2   233.3     0.    4762.4     0.      0.      .0     .0
       3   250.0     0.    4762.5     0.      0.      .0     .0
       4   266.7     0.    4762.7     0.      0.      .0     .0
       5   284.0     0.    4761.5     0.      0.      .0     .0
       6   302.0     0.    4759.0     0.      0.      .0     .0
       7   320.0     0.    4756.4     0.      0.      .0     .0
       8   338.0     0.    4753.9     0.      0.      .0     .0
       9   356.0     0.    4751.3     0.      0.      .0     .0
```

```
   10  375.7    0.   4750.0    0.    0.    .0    .0
   11  397.1    0.   4749.7    0.    0.    .0    .0
   12  418.6    0.   4749.5    0.    0.    .0    .0
   13  440.0    0.   4749.3    0.    0.    .0    .0
   14  461.4    0.   4749.1    0.    0.    .0    .0
   15  482.9    0.   4748.9    0.    0.    .0    .0
   16  504.3    0.   4748.7    0.    0.    .0    .0
   17  525.7    0.   4748.4    0.    0.    .0    .0
   18  547.1    0.   4748.2    0.    0.    .0    .0
   19  568.6    0.   4748.0    0.    0.    .0    .0
   20  590.0    0.   4747.8    0.    0.    .0    .0
   21  611.4    0.   4747.6    0.    0.    .0    .0
   22  632.9    0.   4747.4    0.    0.    .0    .0
   23  654.3    0.   4747.1    0.    0.    .0    .0
   24  674.9    0.   4745.3    0.    0.    .0    .0
   25  694.7    0.   4741.8    0.    0.    .0    .0
   26  714.5    0.   4738.4    0.    0.    .0    .0
   27  734.3    0.   4734.9    0.    0.    .0    .0
   28  754.1    0.   4731.5    0.    0.    .0    .0
   29  773.9    0.   4728.0    0.    0.    .0    .0
   30  793.7    0.   4724.6    0.    0.    .0    .0
   31  813.5    0.   4721.2    0.    0.    .0    .0
   32  833.3    0.   4717.8    0.    0.    .0    .0
   33  853.1    0.   4714.6    0.    0.    .0    .0
   34  864.0    0.   4713.6    0.    0.    .0    .0
1   UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
   Date:  5:16:1996   Time: 11:13:51   Input file: of80g.dat
    Bayview Landfill Cell 1
    Sliding During Operational Filling @ 4780
    Geotextile Interface/Seismic Coeff varies/OF80G.DAT

   TABLE NO. 29
   *******************************************************************
   * INFORMATION GENERATED DURING ITERATIVE SOLUTION FOR THE FACTOR *
   * OF SAFETY BY THE CORPS OF ENGINEERS MODIFIED SWEDISH PROCEDURE *
   *******************************************************************

               Trial Factor    Force Imbalance
   Iteration     of Safety        (lbs.)      DELTA-F

       1        3.00000        -.846E+04    .237

       2        3.23701        -.611E+03    .199E-01

       3        3.25688        -.368E+01    .121E-03

       4        3.25700         .283E-01   -.933E-06

   Factor of Safety --------      3.257
   Side Force Inclination -----     .00
   Number of Iterations ------    4
1   UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
   Date:  5:16:1996   Time: 11:13:51   Input file: of80g.dat
    Bayview Landfill Cell 1
```

```
Sliding During Operational Filling @ 4780
Geotextile Interface/Seismic Coeff varies/OF80G.DAT

TABLE NO. 38
*******************************************************************
* Final Results for Stresses Along the Shear Surface             *
* (Results for Critical Shear Surface in Case of a Search.)      *
*******************************************************************

CORPS OF ENGINEERS' PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety =   3.257

    -------- VALUES AT CENTER OF BASE OF SLICE--------

                         Total   Effective
Slice                    Normal   Normal    Shear
 No.  X-center Y-center  Stress   Stress    Stress

  1     221.0   4762.9    109.3    109.3     14.9
  2     233.3   4759.4    460.0    460.0     62.9
  3     250.0   4754.6    942.8    942.8    128.9
  4     266.7   4749.9   1425.6   1425.6    194.9
  5     284.0   4745.0   1789.1   1789.1    244.6
  6     302.0   4739.9   2033.2   2033.2    277.9
  7     320.0   4734.8   2277.5   2277.5    311.3
  8     338.0   4729.7   2521.6   2521.6    344.7
  9     356.0   4724.6   2765.8   2765.8    378.1
 10     375.7   4721.8   3007.8   3007.8    146.3
 11     397.1   4721.4   3029.4   3029.4    147.3
 12     418.6   4720.9   3051.0   3051.0    148.4
 13     440.0   4720.5   3072.6   3072.6    149.4
 14     461.4   4720.1   3094.1   3094.1    150.5
 15     482.9   4719.6   3115.7   3115.7    151.5
 16     504.3   4719.2   3137.2   3137.2    152.6
 17     525.7   4718.8   3158.9   3158.9    153.6
 18     547.1   4718.3   3180.4   3180.4    154.7
 19     568.6   4717.9   3202.0   3202.0    155.7
 20     590.0   4717.5   3223.5   3223.5    156.8
 21     611.4   4717.1   3245.1   3245.1    157.8
 22     632.9   4716.6   3266.7   3266.7    158.9
 23     654.3   4716.2   3288.3   3288.3    159.9
 24     674.9   4715.8   3145.9   3145.9    153.0
 25     694.7   4715.4   2839.5   2839.5    138.1
 26     714.5   4715.0   2533.0   2533.0    123.2
 27     734.3   4714.6   2226.6   2226.6    108.3
 28     754.1   4714.2   1920.1   1920.1     93.4
 29     773.9   4713.8   1613.7   1613.7     78.5
 30     793.7   4713.4   1307.2   1307.2     63.6
 31     813.5   4713.0   1000.8   1000.8     48.7
 32     833.3   4712.6    694.3    694.3     33.8
 33     853.1   4712.2    387.9    387.9     18.9
 34     864.0   4713.0    123.5    123.5      6.0
```

```
CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION   =      .03  (= .335E-01)
   SHOULD NOT EXCEED    .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION =      .00  (= .316E-02)
   SHOULD NOT EXCEED    .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM  =      .06  (= .625E-01)
   SHOULD NOT EXCEED    .100E+03
1    UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 5:16:1996  Time: 11:13:51  Input file: of80g.dat
 Bayview Landfill Cell I
 Sliding During Operational Filling @ 4780
 Geotextile Interface/Seismic Coeff varies/OF80G.DAT

TABLE NO. 39
*******************************************************************
* Final Results for Side Forces and Stresses Between Slices.  *
* (Results for Critical Shear Surface in Case of a Search.)   *
*******************************************************************

CORPS OF ENGINEERS' PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety =   3.257

   ----- VALUES AT RIGHT SIDE OF SLICE -----

                    Side Force
Slice            Side   Inclination
 No.  X-Right   Force    (degrees)

  1   225.0     129.     .00
  2   241.7    1256.     .00
  3   258.3    3567.     .00
  4   275.0    7062.     .00
  5   293.0   11798.     .00
  6   311.0   17181.     .00
  7   329.0   23210.     .00
  8   347.0   29886.     .00
  9   365.0   37210.     .00
 10   386.4   35370.     .00
 11   407.9   33516.     .00
 12   429.3   31650.     .00
 13   450.7   29770.     .00
 14   472.1   27876.     .00
 15   493.6   25970.     .00
 16   515.0   24050.     .00
 17   536.4   22118.     .00
 18   557.9   20172.     .00
 19   579.3   18212.     .00
 20   600.7   16240.     .00
 21   622.1   14254.     .00
 22   643.6   12256.     .00
 23   665.0   10248.     .00
 24   684.8    8470.     .00
 25   704.6    6864.     .00
 26   724.4    5432.     .00
```

```
27    744.2   4173.    .00
28    764.0   3088.    .00
29    783.8   2175.    .00
30    803.6   1436.    .00
31    823.4    870.    .00
32    843.2    478.    .00
33    863.0    259.    .00
34    865.0      0.    .00

END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED
```

```
HEADING
 Bayview Landfill Cell 1
 Sliding During Operational Filling @ 4780
 Sand Interface/Seismic Coeff varies/OF80S.DAT
PROFILE LINES
 1  1  Waste Fill to 4764
 225  4764
 275  4780
 665  4780
 865  4714

 2  2  Side Slope LCRS
  0    4764
 225  4764
 365  4724

 3  3  Bottom LCRS
 365  4724
 865  4714
 999  4714


MATERIAL PROPERTIES
 1  Waste Fill
 50
 C
   150  22
 N
 2  Side Slope LCRS
 100
 C
   0  24
 N
 3  Bottom LCRS
 100
 C
   0  17
 N

ANALYSIS
 N
 217  4764
 365  4722
 863  4712
 865  4714

Seismic
   0.30
Procedure
   C
   0.0

COMPUTE
```

APPENDIX C

```
1      UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
       Date:  5:16:1996   Time: 11:18:48   Input file: of80s.dat


       TABLE NO. 1
       ******************************************
       * COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
       * Originally Coded By Stephen G. Wright  *
       * Version No. 1.107                      *
       * Last Revision Date 10/13/91            *
       * (C) Copyright 1985-1991 S. G. Wright   *
       * All Rights Reserved                    *
       ******************************************

       **************************************************************
       *                                                            *
       *    RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER   *
       * PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
       * HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL   *
       * DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE   *
       * ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER  *
       * PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS      *
       * PROGRAM BEFORE ATTEMPTING ITS USE.                         *
       *                                                            *
       *    NEITHER THE UNIVERSITY OF TEXAS NOR STEPHEN G. WRIGHT   *
       * MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR  *
       * IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS  *
       * OR ADAPTABILITY OF THIS COMPUTER PROGRAM.                  *
       *                                                            *
       **************************************************************
1      UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
       Date:  5:16:1996   Time: 11:18:48   Input file: of80s.dat
        Bayview Landfill Cell 1
        Sliding During Operational Filling @ 4780
        Sand Interface/Seismic Coeff varies/OF80S.DAT

       TABLE NO.  2
       *************************
       * NEW PROFILE LINE DATA *
       *************************

       PROFILE LINE  1 - MATERIAL TYPE =  1
       Waste Fill to 4764

          Point     X          Y

            1     225.000    4764.000
            2     275.000    4780.000
            3     665.000    4780.000
            4     865.000    4714.000

       PROFILE LINE  2 - MATERIAL TYPE =  2
       Side Slope LCRS
```

```
        Point    X         Y

          1    .000     4764.000
          2  225.000    4764.000
          3  365.000    4724.000

     PROFILE LINE  3 - MATERIAL TYPE =  3
     Bottom LCRS

        Point    X         Y

          1  365.000    4724.000
          2  865.000    4714.000
          3  999.000    4714.000

     All new profile lines defined - No old lines retained
1     UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
     Date:  5:16:1996   Time: 11:18:48   Input file: of80s.dat
      Bayview Landfill Cell 1
      Sliding During Operational Filling @ 4780
      Sand Interface/Seismic Coeff varies/OF80S.DAT

     TABLE NO.  3
     *******************************************************************
     * NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS
*
     *******************************************************************

     DATA FOR MATERIAL TYPE  1
     Waste Fill

        Unit weight of material =   50.000

        CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
        Cohesion - - - - - - - -      150.000
        Friction angle - - - - -  22.000 degrees

        No (or zero) pore water pressures

     DATA FOR MATERIAL TYPE  2
     Side Slope LCRS

        Unit weight of material =  100.000

        CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
        Cohesion - - - - - - - -         .000
        Friction angle - - - - -  24.000 degrees

        No (or zero) pore water pressures

     DATA FOR MATERIAL TYPE  3
     Bottom LCRS

        Unit weight of material =  100.000
```

```
     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -        .000
     Friction angle - - - - -  17.000 degrees

     No (or zero) pore water pressures

   All new material properties defined - No old data retained
1   UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
   Date:  5:16:1996   Time: 11:18:48   Input file: of80s.dat
    Bayview Landfill Cell 1
    Sliding During Operational Filling @ 4780
    Sand Interface/Seismic Coeff varies/OF80S.DAT

   TABLE NO. 15
   **********************************
   * NEW ANALYSIS/COMPUTATION DATA *
   **********************************

   Noncircular Shear Surface(s)

   Computations Performed for Single Shear Surface


   Shear Surface Coordinates -

     Point      X          Y

       1    217.000    4764.000
       2    365.000    4722.000
       3    863.000    4712.000
       4    865.000    4714.000

   Procedure used to compute the factor of safety: CORPS
   Specified side force inclination =    .00 degrees

   ----------------------------------------------------------------
   THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

   Initial trial estimate for the factor of safety =  3.000

   Maximum number of iterations allowed for
   calculating the factor of safety =  40

   Allowed force imbalance for convergence =     100.000

   Allowed moment imbalance for convergence =     100.000

   Number of increments for slice subdivision =  30

   Depth of water in crack =        .000

   Unit weight of water in crack =    62.400
```

```
      Seismic coefficient =  .000

      Conventional (single-stage) computations to be performed
1      UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
      Date:  5:16:1996   Time: 11:18:48   Input file: of80s.dat
       Bayview Landfill Cell 1
       Sliding During Operational Filling @ 4780
       Sand Interface/Seismic Coeff varies/OF80S.DAT

      TABLE NO. 16
      ****************************
      * NEW SLOPE GEOMETRY DATA *
      ****************************

      NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA
      WERE GENERATED BY THE PROGRAM

      Slope Coordinates -

         Point     X          Y

           1       .000    4764.000
           2    225.000    4764.000
           3    275.000    4780.000
           4    665.000    4780.000
           5    865.000    4714.000
           6    999.000    4714.000
1      UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
      Date:  5:16:1996   Time: 11:18:48   Input file: of80s.dat
       Bayview Landfill Cell 1
       Sliding During Operational Filling @ 4780
       Sand Interface/Seismic Coeff varies/OF80S.DAT

      TABLE NO. 26
      *****************************************************************
      * Coordinate, Weight, Strength and Pore Water Pressure      *
      * Information for Individual Slices for Conventional       *
      * Computations or First Stage of Multi-Stage Computations. *
      * (Information is for the Critical Shear Surface in the    *
      * Case of an Automatic Search.)                           *
      *****************************************************************

      Slice              Slice  Matl.      Friction   Pore
       No.    X      Y     Weight  Type  Cohesion  Angle  Pressure

           217.0  4764.0
        1  221.0  4762.9     908.2   2      .00   24.00      .0
           225.0  4761.7
        2  233.3  4759.4    7963.5   2      .00   24.00      .0
           241.7  4757.0
        3  250.0  4754.6   16322.0   2      .00   24.00      .0
           258.3  4752.3
        4  266.7  4749.9   24681.8   2      .00   24.00      .0
           275.0  4747.5
```

```
   5  284.0  4745.0  33453.4  2     .00   24.00      .0
      293.0  4742.4
   6  302.0  4739.9  38018.0  2     .00   24.00      .0
      311.0  4737.3
   7  320.0  4734.8  42584.3  2     .00   24.00      .0
      329.0  4732.2
   8  338.0  4729.7  47149.4  2     .00   24.00      .0
      347.0  4727.1
   9  356.0  4724.6  51715.7  2     .00   24.00      .0
      365.0  4722.0
  10   375.7  4721.8  64516.4  3     .00   17.00      .0
      386.4  4721.6
  11   397.1  4721.4  64979.9  3     .00   17.00      .0
      407.9  4721.1
  12   418.6  4720.9  65441.9  3     .00   17.00      .0
      429.3  4720.7
  13   440.0  4720.5  65905.4  3     .00   17.00      .0
      450.7  4720.3
  14   461.4  4720.1  66366.8  3     .00   17.00      .0
      472.1  4719.8
  15   482.9  4719.6  66830.8  3     .00   17.00      .0
      493.6  4719.4
  16   504.3  4719.2  67292.4  3     .00   17.00      .0
      515.0  4719.0
  17   525.7  4718.8  67755.9  3     .00   17.00      .0
      536.4  4718.6
  18   547.1  4718.3  68217.3  3     .00   17.00      .0
      557.9  4718.1
  19   568.6  4717.9  68681.4  3     .00   17.00      .0
      579.3  4717.7
  20   590.0  4717.5  69142.8  3     .00   17.00      .0
      600.7  4717.3
  21   611.4  4717.1  69606.3  3     .00   17.00      .0
      622.1  4716.8
1      UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
      Date:  5:16:1996   Time: 11:18:48   Input file: of80s.dat
       Bayview Landfill Cell 1
       Sliding During Operational Filling @ 4780
       Sand Interface/Seismic Coeff varies/OF80S.DAT

      TABLE NO. 26
      ***********************************************************
      * Coordinate, Weight, Strength and Pore Water Pressure     *
      * Information for Individual Slices for Conventional     *
      * Computations or First Stage of Multi-Stage Computations. *
      * (Information is for the Critical Shear Surface in the    *
      * Case of an Automatic Search.)                          *
      ***********************************************************

      Slice              Slice   Matl.       Friction   Pore
       No.    X       Y    Weight  Type  Cohesion   Angle   Pressure

      622.1  4716.8
  22   632.9  4716.6  70068.2  3     .00   17.00      .0
```

```
     643.6  4716.4
 23   654.3  4716.2  70532.6  3    .00   17.00     .0
     665.0  4716.0
 24   674.9  4715.8  62350.1  3    .00   17.00     .0
     684.8  4715.6
 25   694.7  4715.4  56276.7  3    .00   17.00     .0
     704.6  4715.2
 26   714.5  4715.0  50202.8  3    .00   17.00     .0
     724.4  4714.8
 27   734.3  4714.6  44128.9  3    .00   17.00     .0
     744.2  4714.4
 28   754.1  4714.2  38055.5  3    .00   17.00     .0
     764.0  4714.0
 29   773.9  4713.8  31981.6  3    .00   17.00     .0
     783.8  4713.6
 30   793.7  4713.4  25907.7  3    .00   17.00     .0
     803.6  4713.2
 31   813.5  4713.0  19834.3  3    .00   17.00     .0
     823.4  4712.8
 32   833.3  4712.6  13760.4  3    .00   17.00     .0
     843.2  4712.4
 33   853.1  4712.2   7689.0  3    .00   17.00     .0
     863.0  4712.0
 34   864.0  4713.0    235.0  3    .00   17.00     .0
     865.0  4714.0
1   UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
   Date:  5:16:1996   Time: 11:18:48   Input file: of80s.dat
    Bayview Landfill Cell 1
    Sliding During Operational Filling @ 4780
    Sand Interface/Seismic Coeff varies/OF80S.DAT

   TABLE NO. 27
   ****************************************************************
   *  Seismic Forces and Forces Due to Surface Pressures for    *
   *  Individual Slices for Conventional  Computations or the   *
   *  First Stage of Multi-Stage Computations.                  *
   *  (Information is for the Critical Shear Surface in the     *
   *  Case of an Automatic Search.)                             *
   ****************************************************************

                        FORCES DUE TO SURFACE PRESSURES
                  Y for
   Slice      Seismic  Seismic  Normal  Shear
    No.    X    Force    Force   Force   Force     X      Y

     1   221.0    0.    4763.4    0.     0.     .0     .0
     2   233.3    0.    4762.4    0.     0.     .0     .0
     3   250.0    0.    4762.5    0.     0.     .0     .0
     4   266.7    0.    4762.7    0.     0.     .0     .0
     5   284.0    0.    4761.5    0.     0.     .0     .0
     6   302.0    0.    4759.0    0.     0.     .0     .0
     7   320.0    0.    4756.4    0.     0.     .0     .0
     8   338.0    0.    4753.9    0.     0.     .0     .0
     9   356.0    0.    4751.3    0.     0.     .0     .0
```

```
   10  375.7    0.   4750.0   0.    0.    .0    .0
   11  397.1    0.   4749.7   0.    0.    .0    .0
   12  418.6    0.   4749.5   0.    0.    .0    .0
   13  440.0    0.   4749.3   0.    0.    .0    .0
   14  461.4    0.   4749.1   0.    0.    .0    .0
   15  482.9    0.   4748.9   0.    0.    .0    .0
   16  504.3    0.   4748.7   0.    0.    .0    .0
   17  525.7    0.   4748.4   0.    0.    .0    .0
   18  547.1    0.   4748.2   0.    0.    .0    .0
   19  568.6    0.   4748.0   0.    0.    .0    .0
   20  590.0    0.   4747.8   0.    0.    .0    .0
   21  611.4    0.   4747.6   0.    0.    .0    .0
   22  632.9    0.   4747.4   0.    0.    .0    .0
   23  654.3    0.   4747.1   0.    0.    .0    .0
   24  674.9    0.   4745.3   0.    0.    .0    .0
   25  694.7    0.   4741.8   0.    0.    .0    .0
   26  714.5    0.   4738.4   0.    0.    .0    .0
   27  734.3    0.   4734.9   0.    0.    .0    .0
   28  754.1    0.   4731.5   0.    0.    .0    .0
   29  773.9    0.   4728.0   0.    0.    .0    .0
   30  793.7    0.   4724.6   0.    0.    .0    .0
   31  813.5    0.   4721.2   0.    0.    .0    .0
   32  833.3    0.   4717.8   0.    0.    .0    .0
   33  853.1    0.   4714.6   0.    0.    .0    .0
   34  864.0    0.   4713.6   0.    0.    .0    .0
1   UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
   Date:  5:16:1996   Time: 11:18:48   Input file: of80s.dat
    Bayview Landfill Cell 1
    Sliding During Operational Filling @ 4780
    Sand Interface/Seismic Coeff varies/OF80S.DAT

   TABLE NO. 29
   ********************************************************************
   * INFORMATION GENERATED DURING ITERATIVE SOLUTION FOR THE FACTOR *
   * OF SAFETY BY THE CORPS OF ENGINEERS MODIFIED SWEDISH PROCEDURE *
   ********************************************************************


             Trial Factor    Force Imbalance
   Iteration    of Safety         (lbs.)      DELTA-F

       1       3.00000        -.719E+05    1.27
   Reduced value - Delta was too large ............  .500

       2       3.50000        -.476E+05    1.14
   Reduced value - Delta was too large ............  .500

       3       4.00000        -.292E+05    .910
   Reduced value - Delta was too large ............  .500

       4       4.50000        -.149E+05    .588
   Reduced value - Delta was too large ............  .500

       5       5.00000        -.349E+04    .169
```

```
      6     5.16912        -.113E+03   .587E-02

      7     5.17499        -.141E+00   .734E-05

   Factor of Safety - - - - - - - -    5.175
   Side Force Inclination - - - - -      .00
   Number of Iterations - - - - - -    7
1   UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
   Date:  5:16:1996   Time: 11:18:48   Input file: of80s.dat
    Bayview Landfill Cell 1
    Sliding During Operational Filling @ 4780
    Sand Interface/Seismic Coeff varies/OF80S.DAT

   TABLE NO. 38
   ******************************************************************
   *  Final Results for Stresses Along the Shear Surface        *
   *  (Results for Critical Shear Surface in Case of a Search.)  *
   ******************************************************************

   CORPS OF ENGINEERS' PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
   Factor of Safety =   5.175

      -------- VALUES AT CENTER OF BASE OF SLICE---------

                          Total    Effective
   Slice                   Normal   Normal     Shear
    No.  X-center  Y-center  Stress    Stress     Stress

     1     221.0    4762.9    110.8    110.8      9.5
     2     233.3    4759.4    466.4    466.4     40.1
     3     250.0    4754.6    956.0    956.0     82.2
     4     266.7    4749.9   1445.6   1445.6    124.4
     5     284.0    4745.0   1814.2   1814.2    156.1
     6     302.0    4739.9   2061.8   2061.8    177.4
     7     320.0    4734.8   2309.4   2309.4    198.7
     8     338.0    4729.7   2557.0   2557.0    220.0
     9     356.0    4724.6   2804.6   2804.6    241.3
    10     375.7    4721.8   3007.2   3007.2    177.7
    11     397.1    4721.4   3028.8   3028.8    178.9
    12     418.6    4720.9   3050.3   3050.3    180.2
    13     440.0    4720.5   3071.9   3071.9    181.5
    14     461.4    4720.1   3093.5   3093.5    182.8
    15     482.9    4719.6   3115.1   3115.1    184.0
    16     504.3    4719.2   3136.6   3136.6    185.3
    17     525.7    4718.8   3158.2   3158.2    186.6
    18     547.1    4718.3   3179.7   3179.7    187.9
    19     568.6    4717.9   3201.3   3201.3    189.1
    20     590.0    4717.5   3222.8   3222.8    190.4
    21     611.4    4717.1   3244.4   3244.4    191.7
    22     632.9    4716.6   3266.0   3266.0    192.9
    23     654.3    4716.2   3287.6   3287.6    194.2
    24     674.9    4715.8   3145.3   3145.3    185.8
    25     694.7    4715.4   2838.9   2838.9    167.7
    26     714.5    4715.0   2532.5   2532.5    149.6
```

```
      27     734.3   4714.6   2226.1    2226.1     131.5
      28     754.1   4714.2   1919.7    1919.7     113.4
      29     773.9   4713.8   1613.3    1613.3      95.3
      30     793.7   4713.4   1306.9    1306.9      77.2
      31     813.5   4713.0   1000.5    1000.5      59.1
      32     833.3   4712.6    694.1     694.1      41.0
      33     853.1   4712.2    387.9     387.9      22.9
      34     864.0   4713.0    124.9     124.9       7.4

     CHECK SUMS - (ALL SHOULD BE SMALL)
     SUM OF FORCES IN VERTICAL DIRECTION    =       .04  (= .383E-01)
        SHOULD NOT EXCEED     .100E+03
     SUM OF FORCES IN HORIZONTAL DIRECTION =        .00  (= .304E-02)
        SHOULD NOT EXCEED     .100E+03
     SHEAR STRENGTH/SHEAR FORCE CHECK-SUM   =        .13  (= .130E+00)
        SHOULD NOT EXCEED     .100E+03
1     UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
     Date:  5:16:1996   Time: 11:18:48   Input file: of80s.dat
      Bayview Landfill Cell 1
      Sliding During Operational Filling @ 4780
      Sand Interface/Seismic Coeff varies/OF80S.DAT

     TABLE NO. 39
     ***********************************************************************
     *  Final Results for Side Forces and Stresses Between Slices.  *
     *  (Results for Critical Shear Surface in Case of a Search.)   *
     ***********************************************************************

     CORPS OF ENGINEERS' PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
     Factor of Safety =   5.175

         ----- VALUES AT RIGHT SIDE OF SLICE ----

                        Side Force
     Slice          Side    Inclination
      No.   X-Right   Force    (degrees)

      1     225.0     175.     .00
      2     241.7    1712.     .00
      3     258.3    4863.     .00
      4     275.0    9628.     .00
      5     293.0   16085.     .00
      6     311.0   23424.     .00
      7     329.0   31643.     .00
      8     347.0   40745.     .00
      9     365.0   50730.     .00
      10    386.4   48216.     .00
      11    407.9   45685.     .00
      12    429.3   43135.     .00
      13    450.7   40568.     .00
      14    472.1   37982.     .00
      15    493.6   35379.     .00
      16    515.0   32757.     .00
```

```
17   536.4  30118.   .00
18   557.9  27460.   .00
19   579.3  24784.   .00
20   600.7  22091.   .00
21   622.1  19379.   .00
22   643.6  16650.   .00
23   665.0  13907.   .00
24   684.8  11478.   .00
25   704.6   9285.  .00
26   724.4   7329.  .00
27   744.2   5610.  .00
28   764.0   4127.  .00
29   783.8   2881.  .00
30   803.6   1872.  .00
31   823.4   1099.  .00
32   843.2    563.  .00
33   863.0    264.  .00
34   865.0     0.   .00

END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED
```

HDR Computation

Project

Subject

Task

Job No.

No.

Computed

Date

Checked

Date

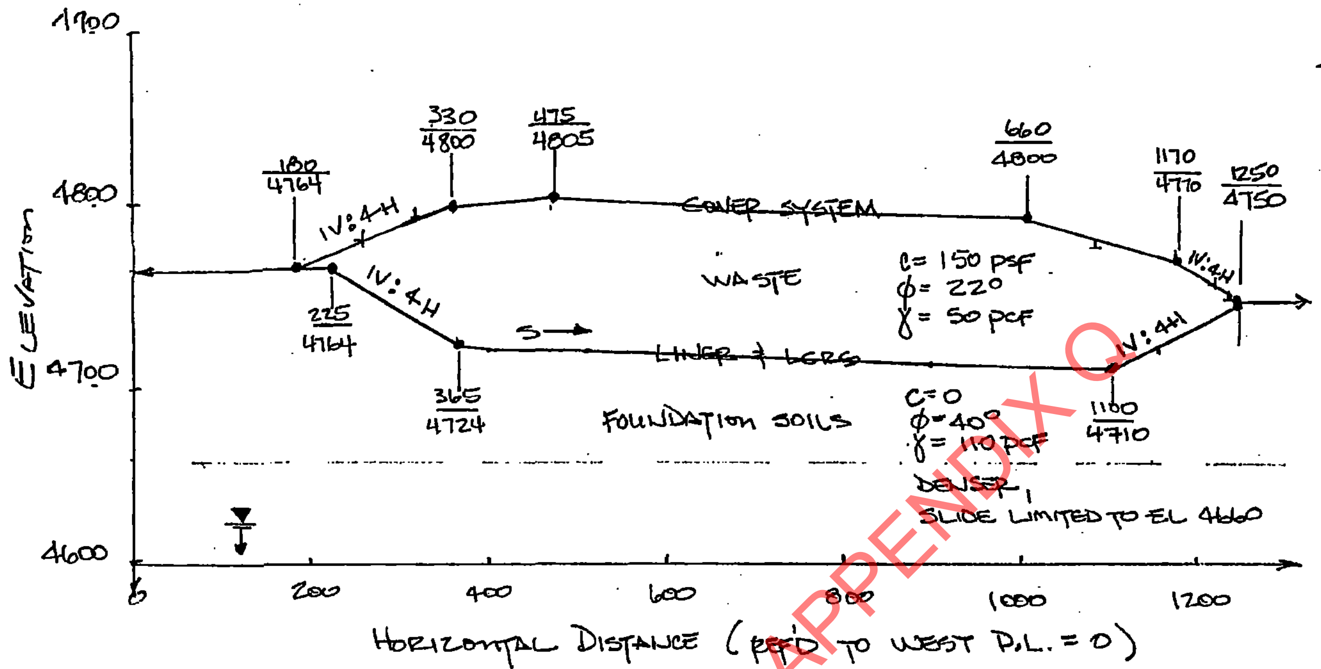
Sheet

Of

HDR

4 WASTE FILL

4.1 SKETCH



SECTION CUT W-E, @ STA N 8450

V: 1" = 100'
H: 1" = 200'

Job No.

No.

HDR Computation

Project

Computed

Date

Subject

Checked

Date

Task

Sheet

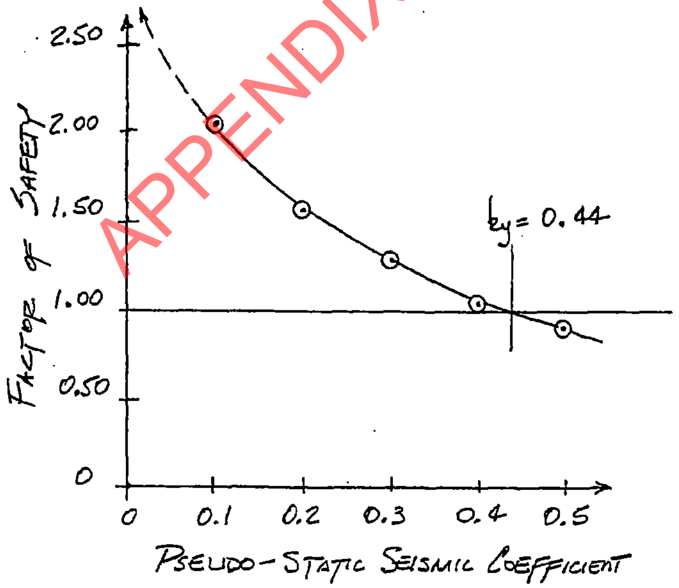
Of

4.2 Determine Static F.S. for section shown on 4.1 & attached

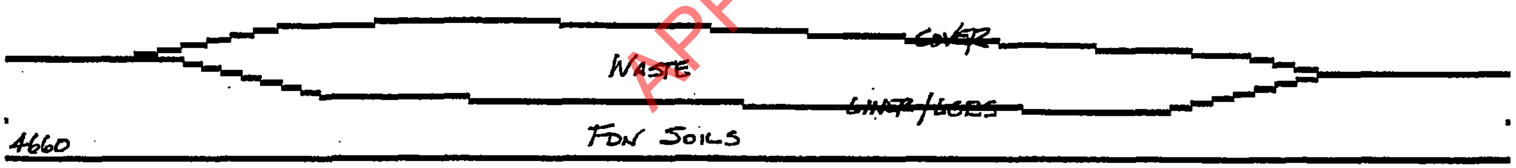
FS = 2.5+ , analysis attached

4.3 Determine Pseudo-Static F.S for same conditions as 4.1.1 w/ seismic coefficient, ψ, varying from 0.1 to 0.50 by 0.1 inc.

FS = 0.9 - 2.08, see below + attached analysis



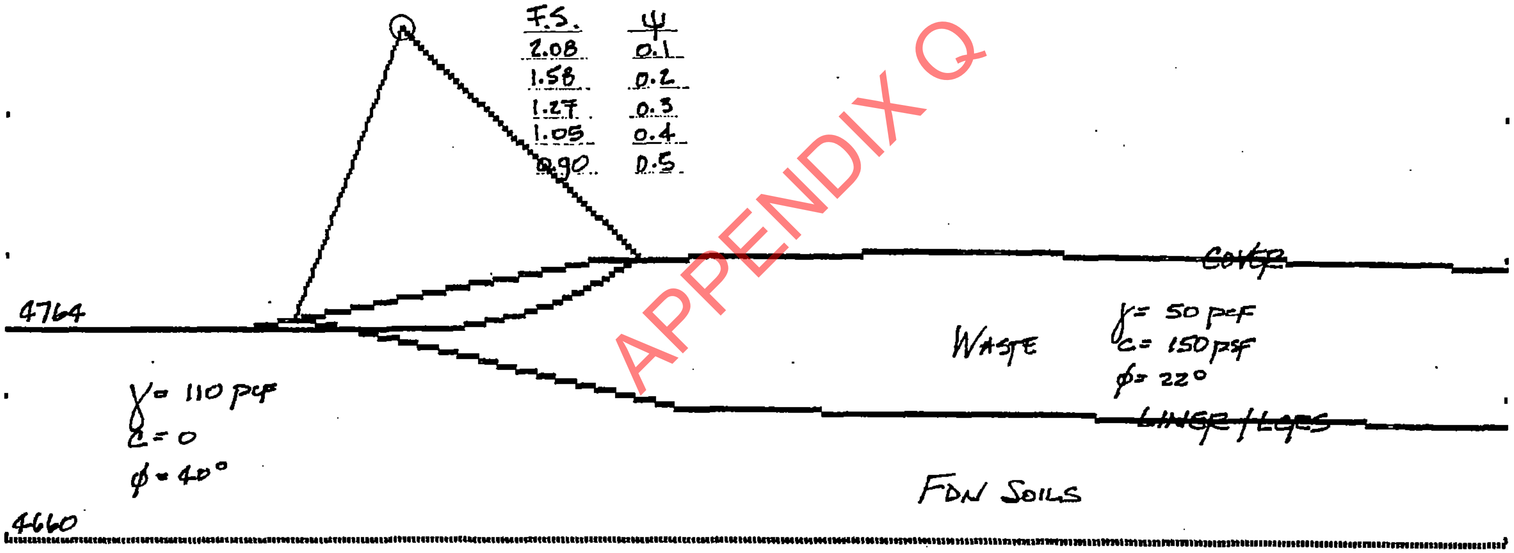
BAYVIEW LANDFILL CELL 1 CLOSURE CAP **File: C1CCS1**
Hydraulic Condition 7: User Defined



(78 , 4394)

SCALE : 1 inch = 150 feet

BAYVIEW LANDFILL CELL 1 CLOSURE CAP File: C1CCS1
Hydraulic Condition 7: User Defined
Consolidated Drained Soil Parameters
Factor of Safety = 2.08, Failure Center: (247 , 4913), Radius: 150



F.S.	ψ
2.08	0.1
1.58	0.2
1.27	0.3
1.05	0.4
0.90	0.5

(83 , 4590) SCALE : 1 inch = 70.00001 feet

```
********************************************************************
*                                                                  *
*                     G A R D S   S U M M A R Y                    *
*                                                                  *
*    Project:  BAYVIEW LANDFILL CELL 1 CLOSURE CAP                 *
*       File:  C1CCS1                                              *
*                                                                  *
*                        GARDS  Version 2.00                       *
*                           developed by                           *
*          Department of Civil and Environmental Engineering       *
*                    University of Cincinnati                      *
*                        under contract to                         *
*               U.S. Environmental Protection Agency               *
*                 Land Pollution Control Division                  *
*          Hazardous Waste Engineering Research Laboratory         *
*                                                                  *
********************************************************************
```

```
********************************************************************
*                     Site Characteristics                         *
********************************************************************
*                                                                  *
*      The seismic coefficient is. . . . . . . . . . . . . . 0.10   *
*                                                                  *
*      The design earthquake magnitude is. . . . . . . . . . 7.20   *
*                                                                  *
*      The maximum flood elevation in this case is . . . . .    0   *
*                                                                  *
*      The elevation of the seasonal high ground water is. .    0   *
*                                                                  *
*      The design waste elevation in the cell is . . . . . .    0   *
*                                                                  *
*      The soil number representing the clay liner is. . . .    0   *
*                                                                  *
********************************************************************
```

INCR BY 0.10 TO 0.50

```
************************************************************************
*                          Section Geometry                            *
************************************************************************
*                                                                      *
*     The number of soil boundary lines for this section is   3        *
*----------------------------------------------------------------------*
*     Line   1        Point          X            Y                    *
*                     -----        -----        -----                  *
*                       1              0        4660                   *
*                       2           1500        4660                   *
*----------------------------------------------------------------------*
*     Line   2        Point          X            Y                    *
*                     -----        -----        -----                  *
*                       1            180        4764                   *
*                       2            225        4764                   *
*                       3            365        4724                   *
*                       4           1100        4710                   *
*                       5           1250        4750                   *
*----------------------------------------------------------------------*
*     Line   3        Point          X            Y                    *
*                     -----        -----        -----                  *
*                       1              0        4764                   *
*                       2            180        4764                   *
*                       3            330        4800                   *
*                       4            475        4805                   *
*                       5            660        4800                   *
*                       6           1170        4770                   *
*                       7           1250        4750                   *
*                       8           1500        4750                   *
************************************************************************
```

```
*************************************************************************
*                          Soil   1 Properties                          *
*************************************************************************
*                                                                       *
*             Unconsolidated  Consolidated  Consolidated                *
*                Undrained      Undrained      Drained                  *
*                ------------  ------------  ------------               *
*   Cohesion          0             0             0       (lb/sq.ft)    *
*   Phi Angle         0             0            40        (degrees)    *
*-----------------------------------------------------------------------*
*                                                                       *
*        Unit Weight . . . . . . . . . .   110.000   (lb/cu.ft)         *
*        Clay Content  . . . . . . . . .     0.000   (%)                *
*        Overconsolidation Ratio . . . .     0.000                      *
*        Initial Void Ratio  . . . . . .     0.000                      *
*        Compression Index . . . . . . .     0.000                      *
*        Recompression Index . . . . . .     0.000                      *
*        Permeability  . . . . . . .         0.000   (ft/yr)            *
*        Median Grain Size . . . . . . .     0.000   (mm)               *
*        Plasticity Index  . . . . . . .     0.000   (%)                *
*        Liquid Limit  . . . . . . . . .     0.000   (%)                *
*        Standard Penetration Number . .     0.000   (blows/ft)         *
*************************************************************************


*************************************************************************
*                          Soil   2 Properties                          *
*************************************************************************
*                                                                       *
*             Unconsolidated  Consolidated  Consolidated                *
*                Undrained      Undrained      Drained                  *
*                ------------  ------------  ------------               *
*   Cohesion          0             0           150       (lb/sq.ft)    *
*   Phi Angle         0             0            22        (degrees)    *
*-----------------------------------------------------------------------*
*                                                                       *
*        Unit Weight . . . . . . . . . .    50.000   (lb/cu.ft)         *
*        Clay Content  . . . . . . . . .     0.000   (%)                *
*        Overconsolidation Ratio . . . .     0.000                      *
*        Initial Void Ratio  . . . . . .     0.000                      *
*        Compression Index . . . . . . .     0.000                      *
*        Recompression Index . . . . . .     0.000                      *
*        Permeability  . . . . . . .         0.000   (ft/yr)            *
*        Median Grain Size . . . . . . .     0.000   (mm)               *
*        Plasticity Index  . . . . . . .     0.000   (%)                *
*        Liquid Limit  . . . . . . . . .     0.000   (%)                *
*        Standard Penetration Number . .     0.000   (blows/ft)         *
*************************************************************************
```

```
*************************************************************************
*                           User Defined                                *
*             Piezometric Surface for Hydraulic Condition               *
*             7: User Defined                                           *
*************************************************************************
*                                                                       *
*                   Point           X             Y                     *
*                  -------       -------       -------                  *
*                      1             0          4660                    *
*                      2          1500          4660                    *
*************************************************************************
```

```
************************************************************************
*                                                                      *
*         R O T A T I O N A L   F A I L U R E   R E S U L T S          *
*                                                                      *
*                        Automatic Grid Search                         *
*                                                                      *
*     The slopes were analyzed for failure arcs having centers in      *
*     areas defined by the following parallelograms:                   *
************************************************************************
*                                                                      *
*                               Slope  1                               *
*                                                                      *
*    Co-ord.       Point 1       Point 2       Point 3       Point 4   *
*    -------       -------       -------       -------       -------   *
*       X            330           180           144           294     *
*       Y           4809          4773          4836          4872     *
*----------------------------------------------------------------------*
*                               Slope  2                               *
*                                                                      *
*    Co-ord.       Point 1       Point 2       Point 3       Point 4   *
*    -------       -------       -------       -------       -------   *
*       X           1170          1250          1270          1190     *
*       Y           4775          4755          4790          4810     *
*----------------------------------------------------------------------*
*                                                                      *
*        The number of divisions between points 1 and 2 were   4       *
*        The number of divisions between points 2 and 3 were   4       *
*        The X-increment used in the search was . . . . . . . 10       *
*        The Y-increment used in the search was . . . . . . . 10       *
*                                                                      *
************************************************************************
```

```
***********************************************************************
*                                                                     *
*        R O T A T I O N A L   F A I L U R E   R E S U L T S          *
*                                                                     *
***********************************************************************
*                                                                     *
*           Hydraulic Condition 7: User Defined                       *
*                                                                     *
*                     Consolidated Drained (CD) Case                  *
*                     Seismic Coefficient = 0.10                      *
*---------------------------------------------------------------------*
*           Safety        Failure        X-            Y-             *
*           Factor        Radius       Co-ord        Co-ord           *
*          --------      --------     --------      --------          *
*             2.08        150.0         246.5        4913.0           *
*             2.08        147.5         246.5        4910.5           *
*             2.08        152.4         246.5        4915.5           *
*             2.08        159.7         246.5        4923.0           *
*             2.08        140.2         246.5        4903.0           *
*             2.09        149.5         249.0        4913.0           *
*             2.09        150.5         244.0        4913.0           *
*             2.10        130.4         246.5        4893.0           *
*             2.12        120.7         246.5        4883.0           *
*             2.13        148.0         256.5        4913.0           *
*             2.14        110.9         246.5        4873.0           *
*             2.18        101.1         246.5        4863.0           *
*             2.19         99.2         256.5        4863.0           *
*             2.19         99.2         256.5        4863.0           *
*             2.21         97.2         266.5        4863.0           *
*             2.24        151.9         236.5        4913.0           *
*             2.27         82.0         265.5        4847.3           *
*             2.36         90.8        1215.0        4835.0           *
*             2.36         93.2        1215.0        4837.5           *
*             2.36         88.4        1215.0        4832.5           *
*             2.39         91.3        1217.5        4835.0           *
*             2.39         90.3        1212.5        4835.0           *
*             2.42         89.8        1210.0        4835.0           *
*             2.42         80.0        1210.0        4825.0           *
*             2.42         64.9         274.5        4831.5           *
*             2.43         99.6        1210.0        4845.0           *
*             2.45         70.3        1210.0        4815.0           *
*             2.47        100.7         294.0        4872.0           *
*             2.49         60.5        1210.0        4805.0           *
*             2.49         60.5        1210.0        4805.0           *
***********************************************************************
```

```
************************************************************************
*                                                                      *
*                        G A R D S   S U M M A R Y                     *
*                                                                      *
*    File:  C1CCS1                  Date: 05-02-1996    Time: 19:15:57 *
*    Project:  BAYVIEW LANDFILL CELL 1 CLOSURE CAP                     *
*    Hydraulic Condition 7: User Defined                               *
*                                                                      *
*----------------------------------------------------------------------*
*             Rotational Failure Analysis Safety Factor                *
*----------------------------------------------------------------------*
*       Unconsolidated Undrained Case . . . . . . . . . . Not Run      *
*       Consolidated Undrained Case . . . . . . . . . . . Not Run      *
*       Consolidated Drained Case . . . . . . . . . . . .   2.08       *
*----------------------------------------------------------------------*
*             Translational Failure Analysis. . . . . . . Not Run      *
*----------------------------------------------------------------------*
*             Settlement Analysis . . . . . . . . . . . . Not Run      *
*----------------------------------------------------------------------*
*             Liquefaction Analysis . . . . . . . . . . . Not Run      *
************************************************************************
```

Job No.
No.

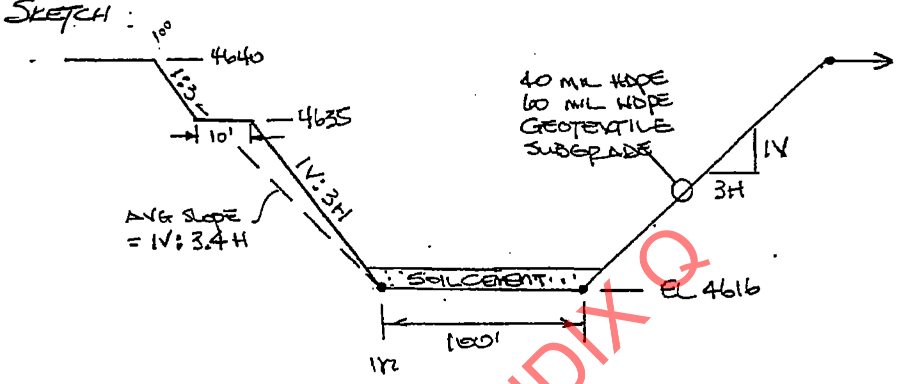
HDR Computation

HDR

Project
Computed
Date
Subject
Checked
Date
Task
Sheet
Of

6 Storm-Water Leachate Basin

6.1 Sketch:

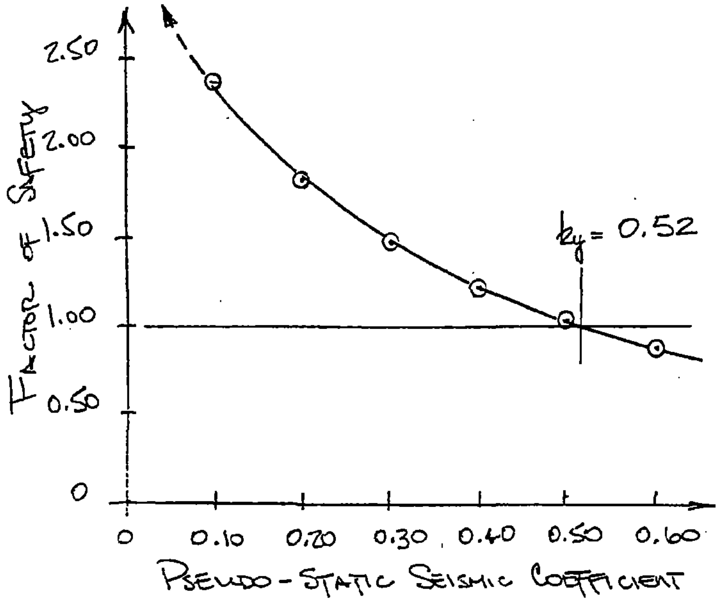


c=0
$\phi = 40°$
$\gamma = 110$ PCF

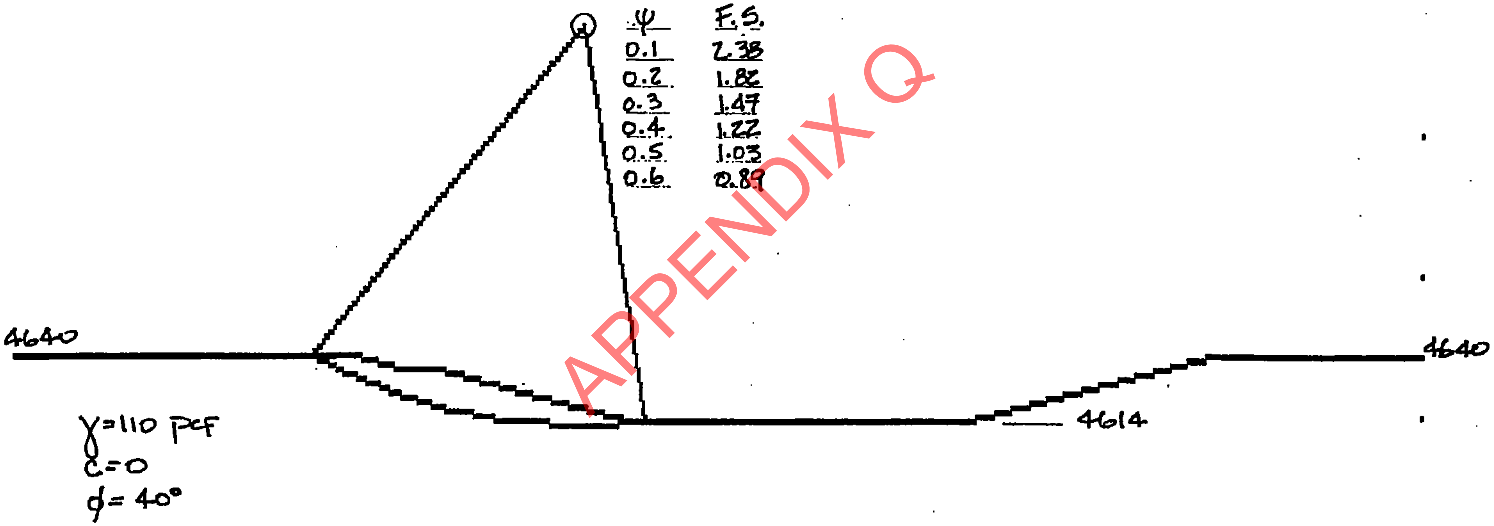
6.2 Determine Static F.S. for

1V: 3H slope EL 4640 - 4616
Soil properties from TP 1.1
FS = 2.50+, analysis attached

6.3 Determine Pseudo-Static F.S. for same conditions as 5.1 w/ seismic coefficient, ψ, varying from 0.1 to 0.6



BAYVIEW LANDFILL LEACHATE POND STABILITY **File: LPCSS1**
Hydraulic Condition 7: User Defined
Consolidated Drained Soil Parameters
Factor of Safety = 2.38, Failure Center: (168 , 4756), Radius: 141



ψ	F.S.
0.1	2.38
0.2	1.82
0.3	1.47
0.4	1.22
0.5	1.03
0.6	0.89

(-28 , 4517) **SCALE : 1 inch = 50 feet**

```
************************************************************************
*                                                                      *
*                       G A R D S   S U M M A R Y                      *
*                                                                      *
*    Project:  BAYVIEW LANDFILL LEACHATE POND STABILITY                *
*       File:  LPCSS1                                                  *
*                                                                      *
*                          GARDS  Version 2.00                         *
*                             developed by                             *
*          Department of Civil and Environmental Engineering           *
*                       University of Cincinnati                       *
*                           under contract to                          *
*                 U.S. Environmental Protection Agency                 *
*                    Land Pollution Control Division                   *
*           Hazardous Waste Engineering Research Laboratory            *
*                                                                      *
************************************************************************
```

```
************************************************************************
*                        Site Characteristics                          *
************************************************************************
*                                                          INC BY      *
*      The seismic coefficient is. . . . . . . . . . . . . 0.10 0.10 TO *
*                                                          0.60        *
*      The design earthquake magnitude is. . . . . . . . . 7.20        *
*                                                                      *
*      The maximum flood elevation in this case is . . . . .   0       *
*                                                                      *
*      The elevation of the seasonal high ground water is. .   0       *
*                                                                      *
*      The design waste elevation in the cell is . . . . . .   0       *
*                                                                      *
*      The soil number representing the clay liner is. . . .   0       *
*                                                                      *
************************************************************************
```

```
*************************************************************************
*                          Section Geometry                             *
*************************************************************************
*                                                                       *
*      The number of soil boundary lines for this section is   2        *
*-----------------------------------------------------------------------*
*     Line   1         Point            X             Y                 *
*                     ------         ------        ------               *
*                          1              0          4500               *
*                          2            500          4500               *
*-----------------------------------------------------------------------*
*     Line   2         Point            X             Y                 *
*                     ------         ------        ------               *
*                          1              0          4640               *
*                          2            100          4640               *
*                          3            115          4635               *
*                          4            125          4635               *
*                          5            182          4616               *
*                          6            282          4616               *
*                          7            354          4640               *
*                          8            500          4640               *
*************************************************************************
```

```
*************************************************************************
*                             Soil  1 Properties                        *
*************************************************************************
*                                                                       *
*             Unconsolidated  Consolidated  Consolidated                *
*                 Undrained     Undrained      Drained                  *
*               ------------  ------------  ------------                *
*   Cohesion            0             0            0      (lb/sq.ft)  *
*   Phi Angle           0             0           40       (degrees)  *
*-----------------------------------------------------------------------*
*                                                                       *
*        Unit Weight . . . . . . . . . .   110.000   (lb/cu.ft)         *
*        Clay Content  . . . . . . . . .     0.000   (%)                *
*        Overconsolidation Ratio . . . .     0.000                      *
*        Initial Void Ratio. . . . . . .     0.000                      *
*        Compression Index . . . . . . .     0.000                      *
*        Recompression Index . . . . . .     0.000                      *
*        Permeability  . . . . . . . .       0.000   (ft/yr)            *
*        Median Grain Size . . . . . . .     0.000   (mm)               *
*        Plasticity Index  . . . . . . .     0.000   (%)                *
*        Liquid Limit  . . . . . . . . .     0.000   (%)                *
*        Standard Penetration Number . .     0.000   (blows/ft)         *
*************************************************************************
```

```
************************************************************************
*                           User Defined                               *
*             Piezometric Surface for Hydraulic Condition              *
*             7: User Defined                                          *
************************************************************************
*                                                                      *
*                    Point         X             Y                     *
*                   ------       ------        ------                  *
*                       1            0        4500                     *
*                       2          500        4500                     *
************************************************************************
```

```
***********************************************************************
*                                                                     *
*         R O T A T I O N A L   F A I L U R E   R E S U L T S         *
*                                                                     *
*                     Automatic Grid Search                           *
*                                                                     *
*     The slopes were analyzed for failure arcs having centers in     *
*     areas defined by the following parallelograms:                  *
***********************************************************************
*                                                                     *
*                              Slope  1                               *
*                                                                     *
*    Co-ord.      Point 1       Point 2       Point 3       Point 4   *
*    -------      -------       -------       -------       -------   *
*       X           100           115           120           105     *
*       Y          4641          4636          4645          4650     *
*---------------------------------------------------------------------*
*                              Slope  2                               *
*                                                                     *
*    Co-ord.      Point 1       Point 2       Point 3       Point 4   *
*    -------      -------       -------       -------       -------   *
*       X           125           182           201           144     *
*       Y          4640          4621          4654          4673     *
*---------------------------------------------------------------------*
*                              Slope  3                               *
*                                                                     *
*    Co-ord.      Point 1       Point 2       Point 3       Point 4   *
*    -------      -------       -------       -------       -------   *
*       X           354           282           258           330     *
*       Y          4646          4622          4664          4688     *
*---------------------------------------------------------------------*
*                                                                     *
*        The number of divisions between points 1 and 2 were  4       *
*        The number of divisions between points 2 and 3 were  4       *
*        The X-increment used in the search was  . . . . . . . 10     *
*        The Y-increment used in the search was  . . . . . . . 10     *
*                                                                     *
***********************************************************************
```

```
************************************************************************
*                                                                      *
*        R O T A T I O N A L   F A I L U R E   R E S U L T S           *
*                                                                      *
************************************************************************
*                                                                      *
*          Hydraulic Condition 7: User Defined                         *
*                                                                      *
*                    Consolidated Drained (CD) Case                    *
*                    Seismic Coefficient = 0.10                        *
*----------------------------------------------------------------------*
*           Safety        Failure        X-            Y-              *
*           Factor        Radius        Co-ord        Co-ord           *
*          --------      --------      --------      --------          *
*             2.38         140.9         168.3        4755.8           *
*             2.38         143.1         168.3        4758.3           *
*             2.38         138.7         168.3        4753.3           *
*             2.38         144.1         170.8        4758.3           *
*             2.38         137.7         167.5        4752.5           *
*             2.38         145.3         168.3        4760.8           *
*             2.38         139.9         167.5        4755.0           *
*             2.38         135.5         167.5        4750.0           *
*             2.38         141.9         170.8        4755.8           *
*             2.38         133.3         167.5        4747.5           *
*             2.39         138.7         170.0        4752.5           *
*             2.39         134.3         168.3        4748.3           *
*             2.39         131.1         167.5        4745.0           *
*             2.39         152.0         168.3        4768.3           *
*             2.40         128.9         167.5        4742.5           *
*             2.40         127.9         165.0        4742.5           *
*             2.40         125.7         165.0        4740.0           *
*             2.40         123.5         165.0        4737.5           *
*             2.40         130.1         165.0        4745.0           *
*             2.40         121.3         165.0        4735.0           *
*             2.40         139.9         165.8        4755.8           *
*             2.41         142.1         165.8        4758.3           *
*             2.41         136.7         165.0        4752.5           *
*             2.41         119.1         165.0        4732.5           *
*             2.41         125.5         168.3        4738.3           *
*             2.41         117.0         165.0        4730.0           *
*             2.42         115.9         162.5        4730.0           *
*             2.42         118.1         162.5        4732.5           *
*             2.42         113.8         162.5        4727.5           *
*             2.42         129.9         170.0        4742.5           *
*             2.42         111.6         162.5        4725.0           *
*             2.43         112.6         165.0        4725.0           *
*             2.44         118.0         167.5        4730.0           *
*             2.44         110.6         160.0        4725.0           *
*             2.45         119.3         160.0        4735.0           *
*             2.45         101.9         160.0        4715.0           *
*             2.46         116.8         168.3        4728.3           *
*             2.46         112.7         158.3        4728.3           *
*             2.47         104.0         158.3        4718.3           *
*             2.47         121.4         158.3        4738.3           *
*             2.48          95.4         158.3        4708.3           *
*             2.48          93.3         160.0        4705.0           *
************************************************************************
```

```
************************************************************************
*                                                                      *
*                   G A R D S   S U M M A R Y                          *
*                                                                      *
*    File:  LPCSS1               Date: 05-02-1996    Time: 19:36:43    *
*    Project:  BAYVIEW LANDFILL LEACHATE POND STABILITY                *
*    Hydraulic Condition 7: User Defined                               *
*                                                                      *
*----------------------------------------------------------------------*
*             Rotational Failure Analysis Safety Factor                *
*----------------------------------------------------------------------*
*       Unconsolidated Undrained Case . . . . . . . . . Not Run        *
*       Consolidated Undrained Case . . . . . . . . . . Not Run        *
*       Consolidated Drained Case . . . . . . . . . . .   2.38         *
*----------------------------------------------------------------------*
*             Translational Failure Analysis. . . . . . Not Run        *
*----------------------------------------------------------------------*
*             Settlement Analysis . . . . . . . . . . . Not Run        *
*----------------------------------------------------------------------*
*             Liquefaction Analysis . . . . . . . . . . Not Run        *
************************************************************************
```

Job No.

No.

HDR Computation

Project

Computed

Date

Subject

Checked

Date

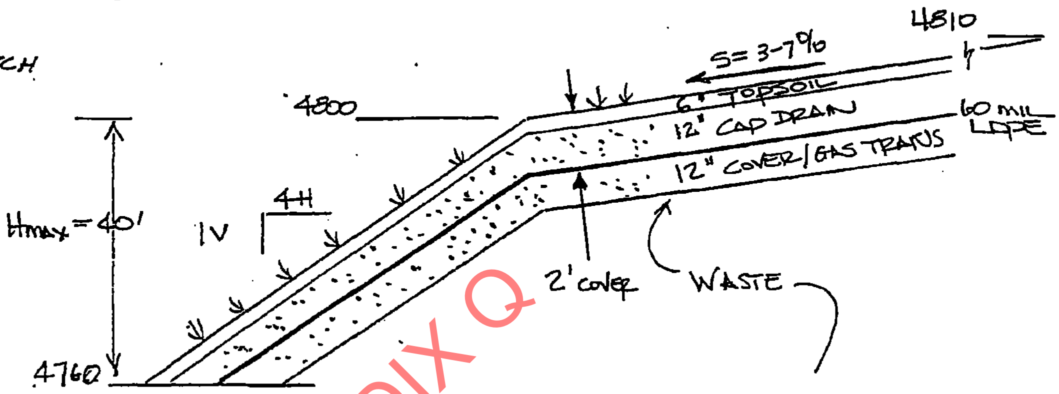
Task

Sheet

Of

5. Cap Stability

5.1 Sketch



5.2 Use infinite slope method, consider seismicity w/ ψ

- Consider 1V:4H slope EL 4800 - EL 4760
- $\delta_{GM: GRAN SOIL} = 25^\circ$
- See Para 3.2 for slope statics
- Iterate for T_{REQD} & ψ, see attached

Job No.
No.

HDR Computation

HDR

Project
Computed
Date
Subject
Checked
Date
Task
Sheet
Of

BAYVIEW LANDFILL CELL 1						
CLOSURE CAP SLOPE STABILITY						
STATIC AND PSEUDO-STATIC ANALYSES						
(INFINITE SLOPE METHOD)						
SLOPE PROPERTIES						
	height	40.0	(ft.)			
	slope	14.0	(degrees)			
	length	165.3	(ft)			
LCRS PROPERTIES						
	thickness	1.5	(ft)			
	density	100.0	(pcf)			
INTERFACE FRICTION						
	friction	25.0	(degrees)			
FACTOR OF SAFETY						
Treinf	Seismic Coefficient, (-)					
(klf)	0	0.1	0.2	0.3	0.4	0.5
0.0	1.87	1.32	1.02	0.83	0.70	0.61
1.0	2.04	1.44	1.12	0.91	0.77	0.66
2.0	2.20	1.56	1.21	0.98	0.83	0.72
3.0	2.37	1.68	1.30	1.06	0.89	0.77
4.0	2.54	1.79	1.39	1.13	0.96	0.83
5.0	2.70	1.91	1.48	1.21	1.02	0.88
7.5	3.12	2.21	1.71	1.39	1.18	1.02
10.0	3.54	2.50	1.94	1.58	1.33	1.15
12.5	3.95	2.80	2.16	1.76	1.49	1.29
15.0	4.37	3.09	2.39	1.95	1.65	1.43

Job No.

No.

HDR Computation

Project

Computed

Date

Subject

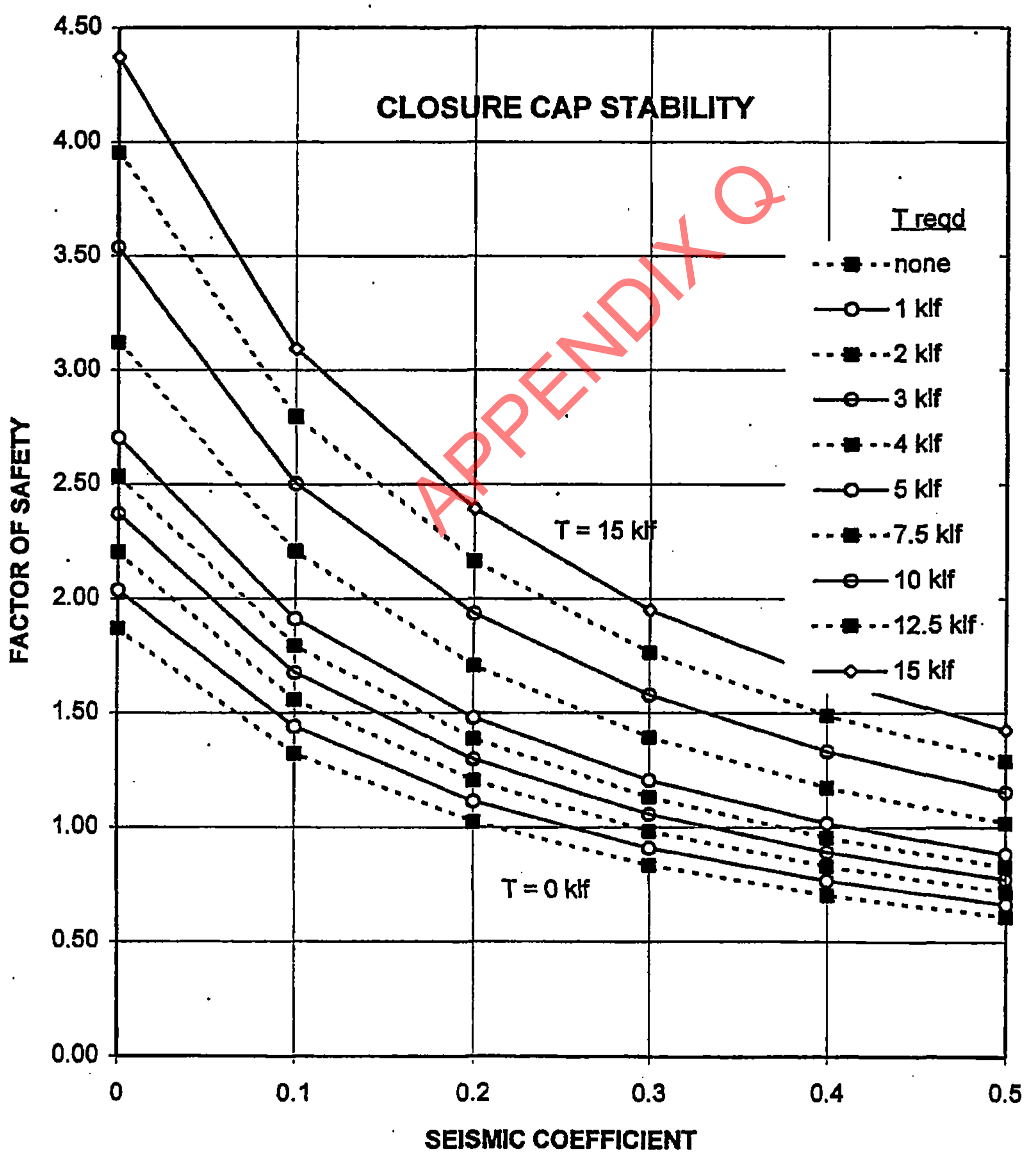
Checked

Date

Task

Sheet

Of



ATTACHMENT C
SITE SEISMIC RESPONSE ANALYSES

Job No. No.

HDR Computation HDR

Project BAYVIEW LANDFILL	Computed R.L.D.	Date 3-8-96
Subject LANDFILL SEISMIC EVALUATION	Checked PHP	Date 6-4-96
Task SITE SEISMIC RESPONSE ANALYSES	Sheet 1	Of

OBJECTIVE: DETERMINE SEISMIC RESPONSE FROM PEAK BEDROCK ACCELERATION OF ADOPTED DESIGN EQ ($a_g = 0.50g$) FOR:
- BASE OF LINER / LCRS SYSTEM FOR CELL 1
- CLOSURE CAP FOR CELL 1

REFERENCES: A) EPA, "RCRA SUBTITLE D (258) SEISMIC DESIGN GUIDANCE FOR MUNICIPAL SOLID WASTE LANDFILLS, EPA/600/R-95/051
B) GEOTECHNICAL REPORTS BY CHEN & ASSOCIATES, 1980; ROLLINS, BROWN AND GUNNELL, 1983
C) NAVDOCKS DM-7.3, "SOIL DYNAMICS ..."

---

1 CLASSIFY SITE

1.1 DETERMINE SHEAR WAVE VELOCITY, V_s, IN TOP 100' OF FDN.

- UTAH G.S. CLASSIFIES SITE AS "HARD SITE", i.e. $V_s \geq 400$ m/sec
- BASED ON REFS B:

  $SPT\ N_{AVG} = 50$

  $\gamma_{AVG} = 110$ pcf
- FROM REF C:

  $G_{T/SF} = 120 N^{0.8} = 120 \cdot 50^{0.8}$

  $= 2744\ ^{T}/_{SF} \cdot 2000\ ^{\#}/_{T} = 5.49 \times 10^{6}\ ^{\#}/_{SF}$
- FROM REF A:

$$V_s^2 = \sqrt{\frac{G}{\gamma/g}} = \sqrt{\frac{5.49 \times 10^{6}\ \#/SF}{110\ \#/CF / 32.2\ FT/sec^2}}$$

$$= 1270\ FT/sec,\ 386\ m/sec$$

Job No.
No.

HDR Computation

HDR

Project
Computed
Date
Subject
Checked
Date
Task
Sheet 2
Of

1.2 From Ref A:

CLASSIFICATION	AVERAGE SHEAR WAVE VELOCITY	
Special Study	Less than 100 m/s	(330ft/s)
Soft	100 to 200 m/s	(330 to 660 ft/s)
Medium Stiff	200 to 375 m/s	(600 to 1,230 ft/s)
Stiff	375 to 700 m/s	(1,230 to 2,300 ft/s)
Rock	Greater than 700 m/s	(2,300 ft/s)

Vs

∴ Check site response w/ medium stiff + stiff response
Use simplified analysis

2. Determine acceleration at base of landfill

2.1 For medium stiff soil (Ref A)

MHA (Max horizontal acceleration in bedrock) = 0.50g
PGA (Peak horizontal acceleration at ground surf) = 0.50g

2.2 For stiff soil (Ref A)

MHA = 0.50 g
PGA = 0.50 g

2.3 ∴ Use PGA = 0.50g for liner & LCRS evaluation

Job No.
No.

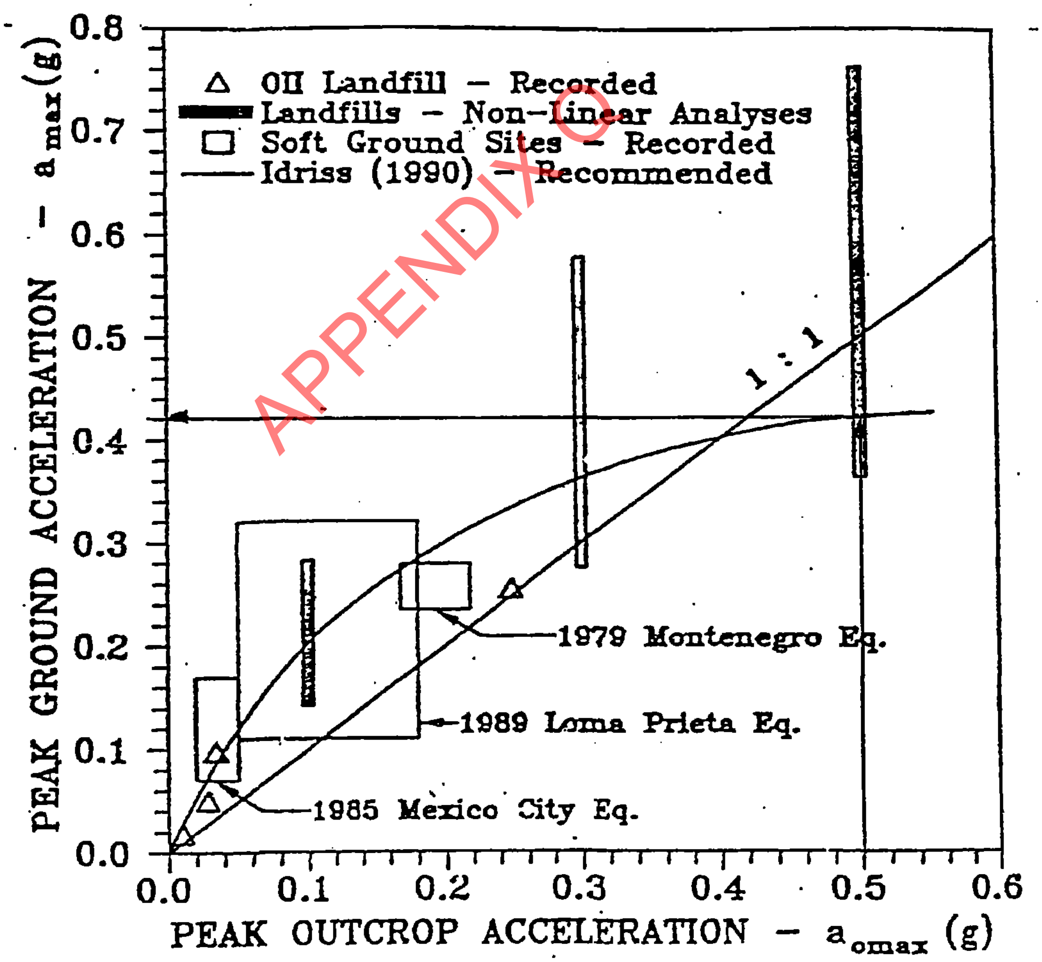
HDR Computation

HDR

Project
Computed
Date
Subject
Checked
Date
Task
Sheet 3
Of

3. DETERMINE ACCELERATION AT TOP OF LANDFILL

USE PGA AT BASE AND ATTENUATE THROUGH WASTE MASS USING "IDRISS (1990)" CURVE, FIGURE 4-5 OF REF A



∴ USE PGA = 0.42g FOR CLOSURE CAP EVALUATION

ATTACHMENT D
SEISMIC DEFORMATION ANALYSES

		Job No.	No.

HDR Computation

HDR

Project	BAYVIEW LANDFILL	Computed R.L.D.	Date –
Subject	LANDFILL SEISMIC EVALUATION	Checked DHP	Date 6-4-96
Task	SEISMIC DEFORMATION ANALYSES	Sheet 1	Of

OBJECTIVE: ESTIMATE SEISMIC DISPLACEMENTS FOR
- CELL 1 EXCAVATION
- CELL 1 LINER & LCRS
- CELL 1 WASTE FILL
- CELL 1 CLOSURE CAP
- STORMWATER-LEACHATE BASIN

REFERENCES: A) EPA, "RCRA SUBTITLE D SEISMIC DESIGN GUIDANCE FOR MSWLF, EPA/600/R-95/051, 1995.

APPROACH: 1. DETERMINE YIELD ACCELERATION, k_y, FOR F.S. = 1.0 FROM PSEUDO-STATIC STABILITY ANALYSES (ATTACHMENT B)

2. COMPUTE RATIO k_y / a_{max}

WHERE a_{max} FROM SITE RESPONSE ANALYSES (ATTACHMENT C)

= 0.50g FOR EXCAVATIONS, LINER, LCRS & WASTE MASS

= 0.42g FOR CLOSURE CAP

3. ESTIMATE DISPLACEMENTS FROM REF A

- USE MAKDISI & SEED PERMANENT DISPLACEMENT CHART (FIG 6-6 OF REF A) FOR EXCAVATIONS, LINER, LCRS & WASTE MASS
  USE CURVE FOR $M_s \doteq 7.2$

- USE HYNES & FRANKLIN PERMANENT DISPLACEMENT CHART (FIG 6-5 OF REF A) FOR CLOSURE CAP
  USE "MEAN + σ" CURVE

4. EVALUATE DISPLACEMENTS

Job No.	No.

HDR Computation

HDR

Project	Computed	Date
Subject	Checked	Date
Task	Sheet 2	Of

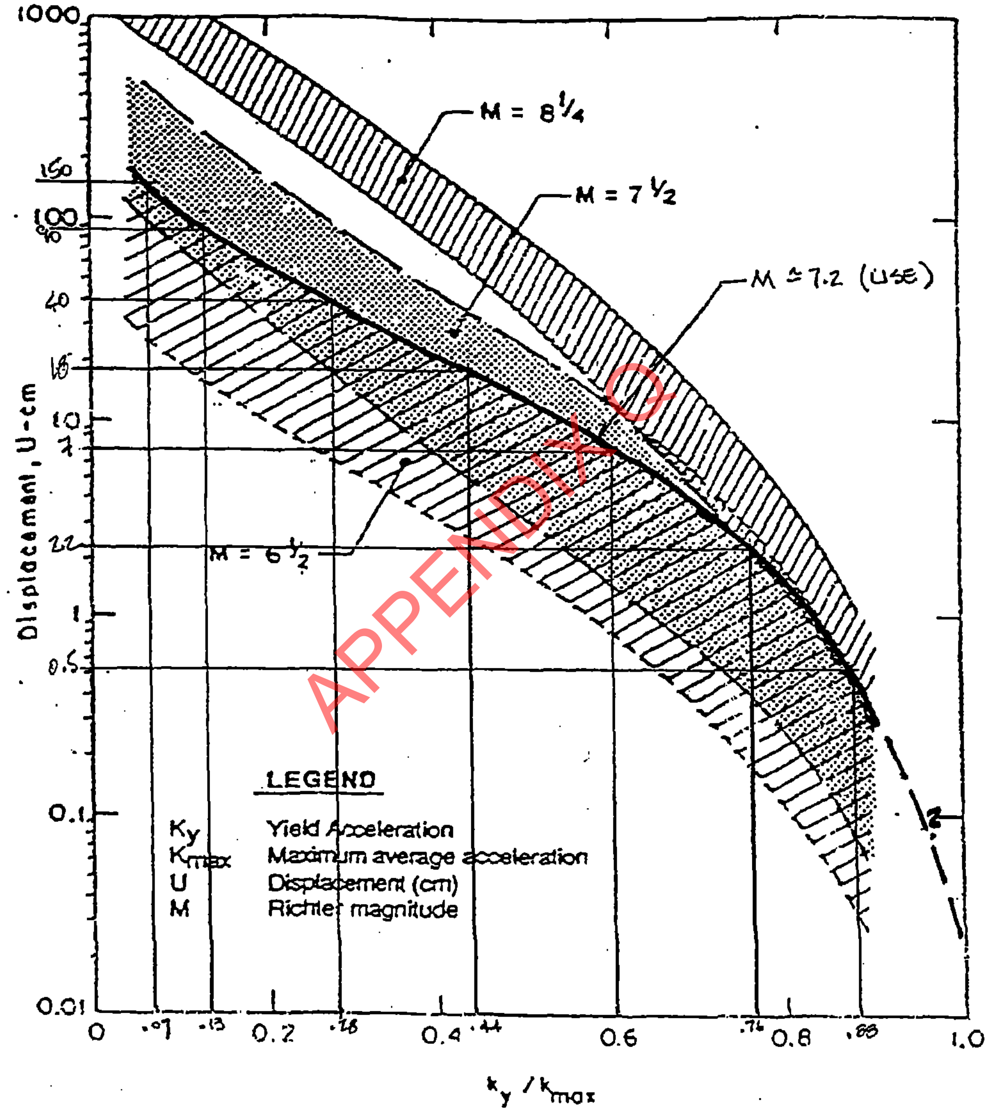


Figure 6.6 Makdisi and Seed Permanent Displacement Chart (Makdisi and Seed, 1978). FOR LINER + WASTE MASS

Job No.
No.

HDR Computation

HDR

Project
Computed
Date
Subject
Checked
Date
Task
Sheet 3
Of

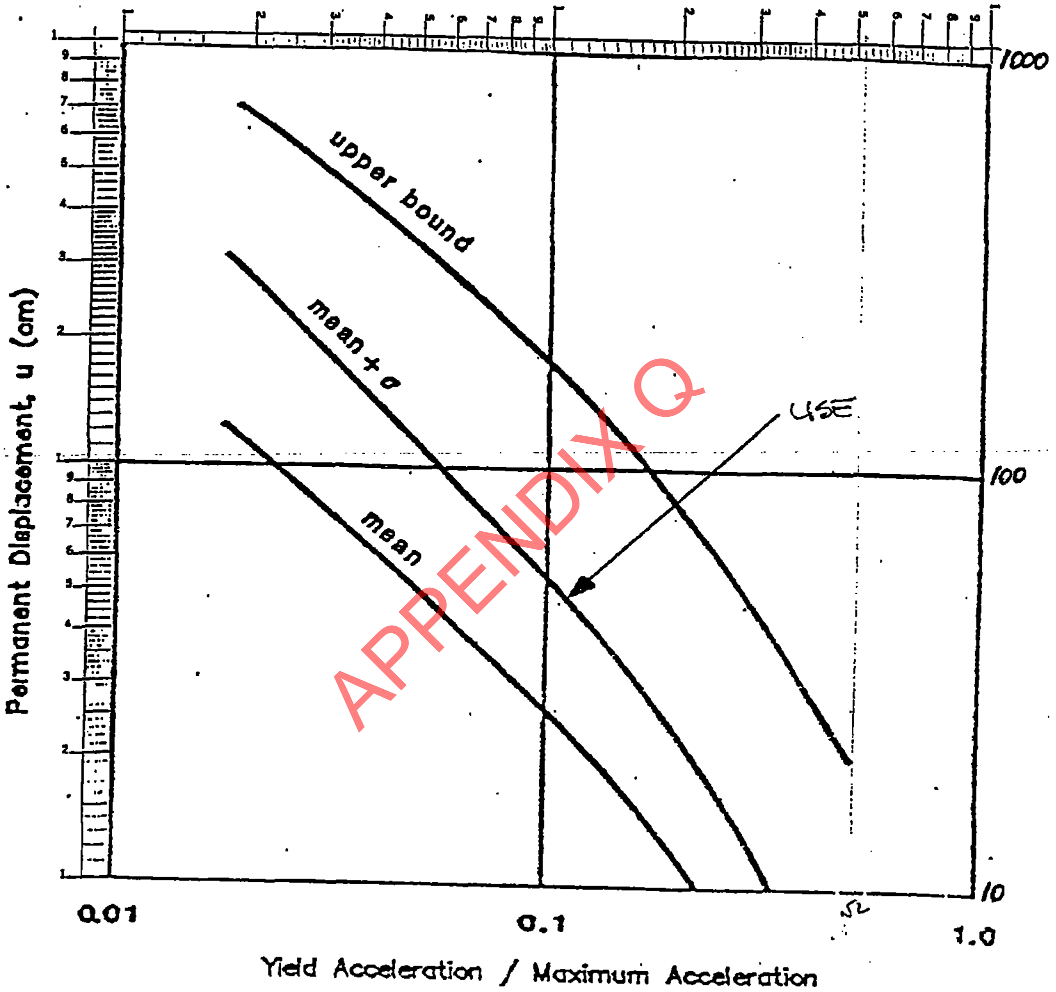


Figure 6.5 Hynes and Franklin Permanent Seismic Displacement Chart (Hynes and Franklin, 1984). FOR COVER SYSTEM

Job No.
No.

HDR Computation

HDR

Project
Computed
Date
Subject
Checked
Date
Task
Sheet 4
Of

1.0 CELL 1 EXCAVATION

$k_y = 0.52g$ (ATTACHMENT B, ¶ 2.2)

$a_{max} = 0.50g$ (ATTACHMENT C, ¶ 2.2)

$$\frac{k_y}{a_{max}} = \frac{0.52}{0.50} = 1.04$$

$u \cong 1$ cm < 30 cm (MAKDISI & SEED CURVE FOR $M \approx 7.2$) OK

2.0 LINER + LCRS

k_y = TABULATED BELOW (ATTACHMENT B, ¶ 3.1)

$a_{max} = 0.50\,g$ (ATTACHMENT C, ¶ 2.2)

$\delta = 9^0$

TREQD	FS STATIC	k_y	k_y/a_{max}	u^* (cm)	REMARKS
0 K/f	0.64	NA	–	–	NOT STABLE UNDER STATIC LOADS (FS<1.0)
1	0.76	NA	–	–	
2	0.89	NA	–	–	
3	1.01	NA	–	–	
4	1.14	0.035	0.07	150	SEE ATTACHED PLOT.
5	1.26	0.065	0.13	90	
7.5	1.57	0.14	0.28	40	
10	1.89	0.22	0.44	18	
12.5	2.20	0.30	0.60	7	
15	2.51	0.38	0.76	2+	

* FROM MAKDISI & SEED CURVE FOR $M \approx 7.2$

Job No.	No.

HDR Computation

Project	Computed	Date
Subject	Checked	Date
Task	Sheet 5	Of

$\delta = 17°$

TREQD	FS STATIC	k_y	k_y / a_{max}	U cm	REMARKS
0 KLF	1.23	0.065	0.13	90	STABLE, BUT FS<1.3
1	1.35	0.09	0.18	60	SEE ATTACHED PLOT
2	1.48	0.125	0.25	40	
3	1.60	0.16	0.32	30	
4	1.73	0.185	0.37	22	
5	1.85	0.22	0.44	16	
7.5	2.16	0.30	0.60	7	
10	2.48	0.355	0.71	3	
12.5	2.79	0.45	0.90	1<	
15.0	3.10	0.53	1.06	1<	

3.0 OPERATIONAL FILLS

3.1 @ EL 4764

$\delta = 9°$
$k_y = 0.15$
$a_{max} = 0.50$

$$\frac{k_y}{a_{max}} = \frac{0.15}{0.50} = 0.30$$

$U = 30$ cm $= 30$ cm

$\delta = 17°$
$k_y = 0.265$
$a_{max} = 0.50$

$$\frac{k_y}{a_{max}} = 0.53$$

$U = 10$ cm ≤ 30 cm ⓞ OK

3.2 @ EL 4780

$\delta = 9°$
$k_y = 0.15$
$a_{max} = 0.50$

$k_y / a_{max} = 0.15/0.50 = 0.30$

$U = 30$ cm $= 30$ cm

$\delta = 17°$
$k_y = 0.25$
$a_{max} = 0.50$

$k_y / a_{max} = 0.25/0.50 = 0.50$

$U = 13$ cm ≤ 30 cm OK

Job No.

No.

HDR Computation

HDR

Project

Computed

Date

Subject

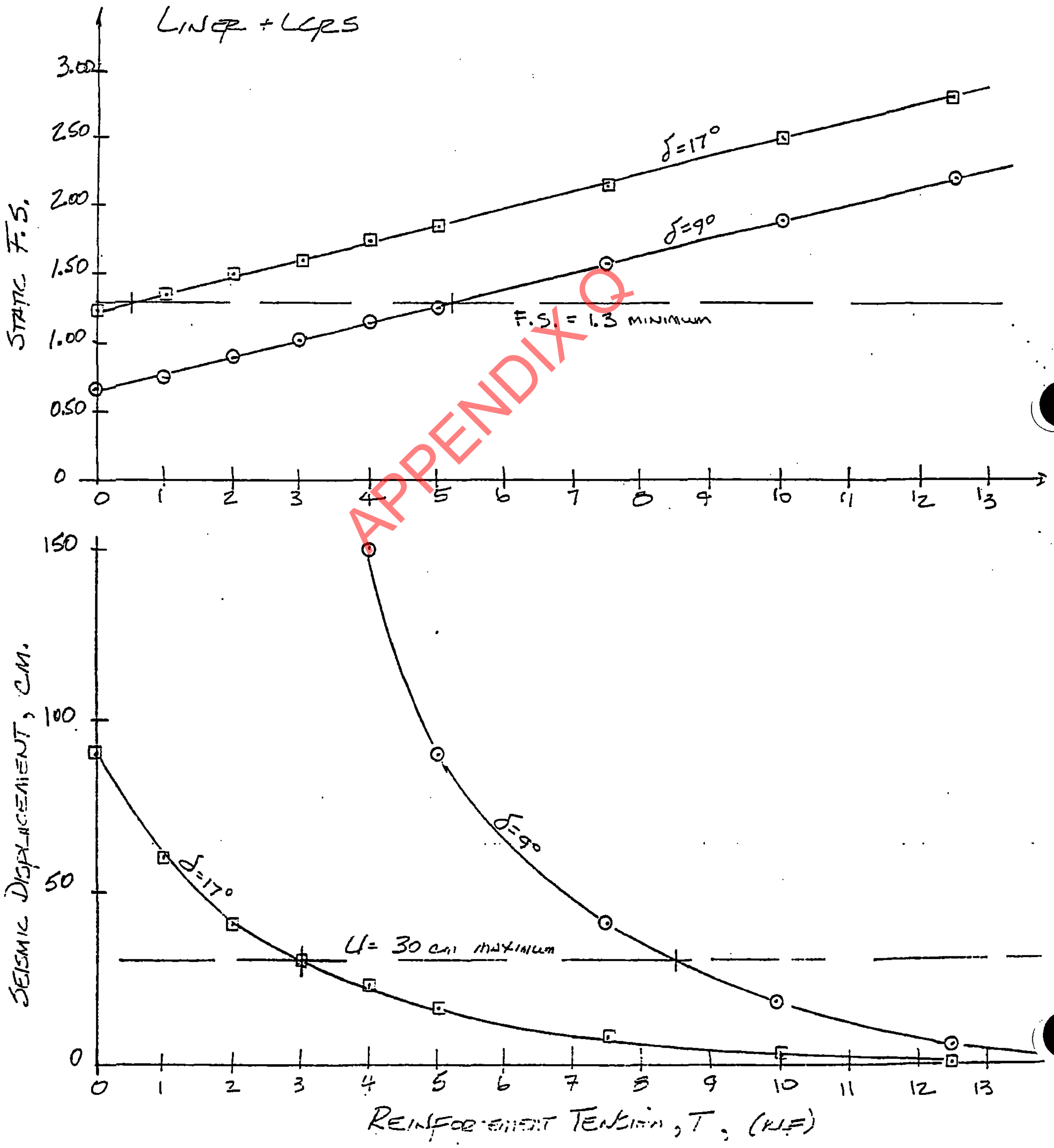
Checked

Date

Task

Sheet 6

Of



Job No.

No.

HDR Computation

HDR

Project

Computed

Date

Subject

Checked

Date

Task

Sheet 7

Of

4.0 WASTE FILL

$k_y = 0.44g$ (ATTACHMENT B, P 4.3)

$a_{max} = 0.50g$ (ATTACHMENT C, P 2.3)

$$\frac{k_y}{a_{max}} = \frac{0.44g}{0.50} = 0.88$$

$u \leq 1$ cm < 30 cm (MAKDISI + SEED CURVE FOR $M \approx 7.2$) (OK)

5.0 CLOSURE CAP

k_y = TABULATED BELOW (ATTACHMENT B, P 5.2)

$a_{max} = 0.42g$ (ATTACHMENT C, P 3)

T_{REQD}	FS_{STATIC}	k_y	k_y/a_{max}	u^* (cm)	REMARKS
0 klf		0.22	0.52	<10	ALL PERM. DEFORMATIONS < 10 cm ≪ 30 cm (OK)
1		0.26	0.62	↓	
2		0.30	0.71	↓	
3		0.34	0.81	↓	
4		0.38	0.90	↓	
5		0.42	1.00	↓	
7.5		0.5+	1+	↓	
10		↓	↓	↓	
12.5		↓	↓	↓	
15		↓	↓	↓	

* FROM HYNES + FRANKLIN CURVE FOR MEAN + σ

Job No.
No.

HDR Computation

HDR

Project
Computed
Date
Subject
Checked
Date
Task
Sheet 8
Of

6.0 STORMWATER – LEACHATE BASIN

k_y = 0.52 g (ATTACHMENT B, ¶ 6.2)

a_{max} = 0.50 g (ATTACHMENT C, ¶ 2.3)

$$\frac{k_y}{a_{max}} = \frac{0.52}{0.50} = 1.04$$

$U \leq 1$ cm < 30 cm (MAKDISI ÷ SEED CURVE FOR $M \simeq 7.2$) (OK)

APPENDIX R – LANDFILL LIFE

BAYVIEW LANDFILL LIFE

1500 compaction density (lbs/cy)

18% Percentage of soil

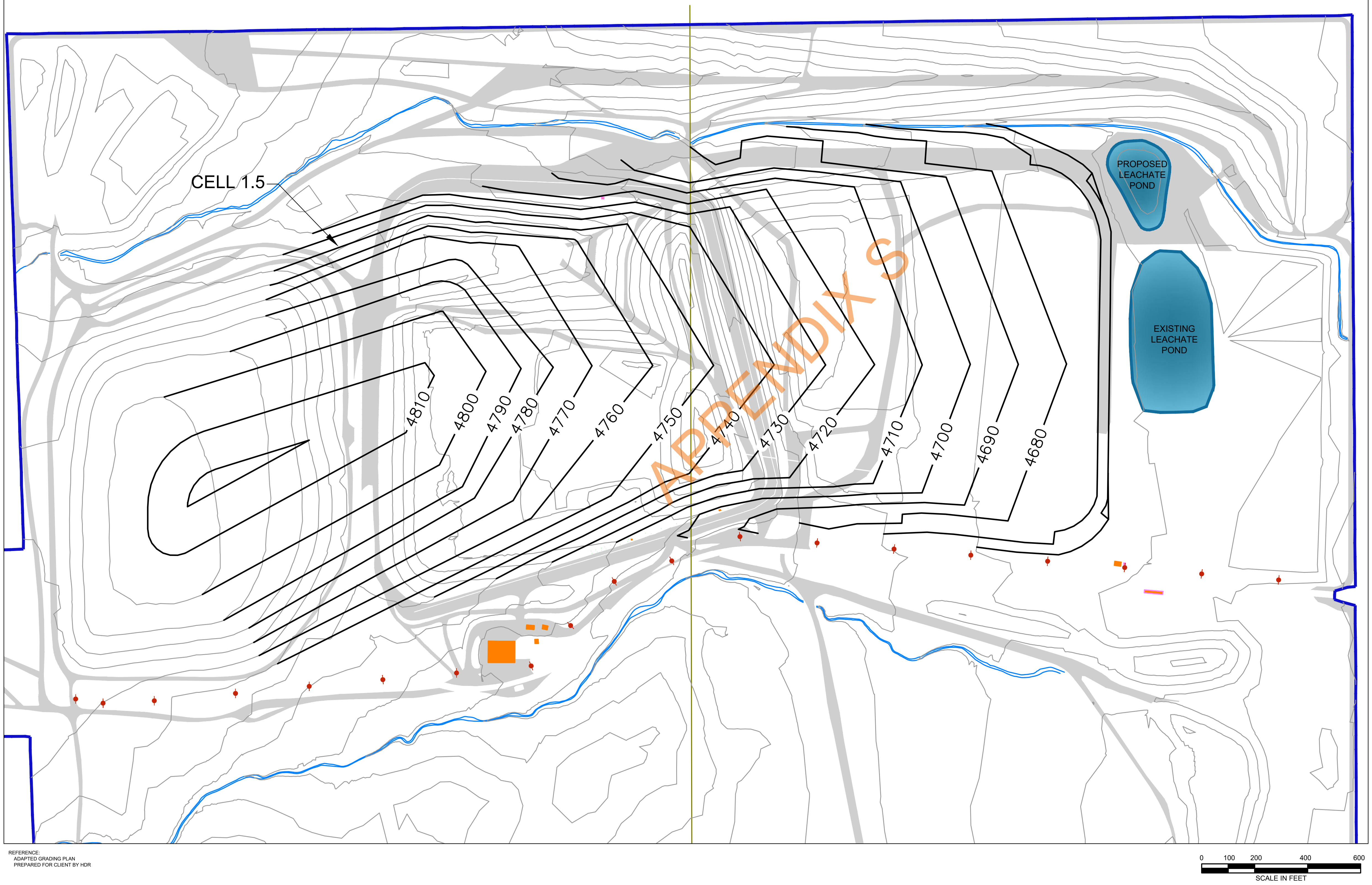
Year	MSW Tons	Cubic Yards Used	Cubic Yards Available	CU YDS Remaining	Location
2019	340,000	193,333	1,000,000	806,667	Cell 2 stage 2
2020	343,000	539,653	806,667	267,013	
2021	386,000	607,307	267,013	-	Closed
			852,492	512,199	Cell 1.5
2022	429,000	674,960	512,199	-	Closed
			3,010,000	2,847,239	Cell 2 Stage 3
2023	432,000	679,680	2,847,239	2,167,559	
2024	435,000	684,400	2,167,559	1,483,159	
2025	439,350	691,244	1,483,159	791,915	
2026	443,744	698,156	791,915	-	Closed
			6,020,000	6,113,758	Cell 2 Stage 4
2027	448,181	705,138	6,113,758	5,408,620	
2028	452,663	712,189	5,408,620	4,696,431	
2029	507,689	798,765	4,696,431	3,897,666	
2030	563,266	886,206	3,897,666	3,011,461	
2031	619,399	974,521	3,011,461	2,036,940	
2032	676,093	1,063,720	2,036,940	973,220	
2033	733,354	1,153,810	973,220	(180,590)	Closed
2034	791,187	1,244,801	(180,590)	(1,425,391)	

1800 compaction density (lbs/cy)

18% Percentage of soil

Year	MSW Tons	Cubic Yards Used	Cubic Yards Available	CU YDS Remaining	Location
2019	340,000	161,111	1,000,000	838,889	Cell 2 stage 2
2020	343,000	449,711	838,889	389,178	
2021	386,000	506,089	389,178	-	Closed
			852,492	735,581	Cell 1.5
2022	429,000	562,467	735,581	173,114	
2023	432,000	566,400	173,114	-	Closed
			3,010,000	2,616,714	Cell 2 Stage 3
2024	435,000	570,333	2,616,714	2,046,381	
2025	439,350	576,037	2,046,381	1,470,344	
2026	443,744	581,797	1,470,344	888,547	
2027	448,181	587,615	888,547	-	Closed
			6,020,000	6,320,932	Cell 2 Stage 4
2028	452,663	593,491	6,320,932	5,727,441	
2029	507,689	665,637	5,727,441	5,061,804	
2030	563,266	738,505	5,061,804	4,323,299	
2031	619,399	812,101	4,323,299	3,511,198	
2032	676,093	886,433	3,511,198	2,624,765	
2033	733,354	961,508	2,624,765	1,663,257	
2034	791,187	1,037,335	1,663,257	625,922	
2035	849,599	1,113,919	625,922	(487,997)	Closed
2036	908,595	1,191,269	(487,997)	(1,679,266)	
			10,882,492	**Total Available CY**	

APPENDIX S – FINAL COVER



REFERENCE:
ADAPTED GRADING PLAN
PREPARED FOR CLIENT BY HDR

Northern Utah Environmental Resource Agency
Bayview Landfill
10804 South State Route 68
Elberta, Utah

CONSULTANTS

IGES
ideas for a changing world

2702 South 1030 West, Suite 10
Salt Lake City, Utah 84119
(801)270-9400 (T)
(801)270-9401 (F)

NOTES:

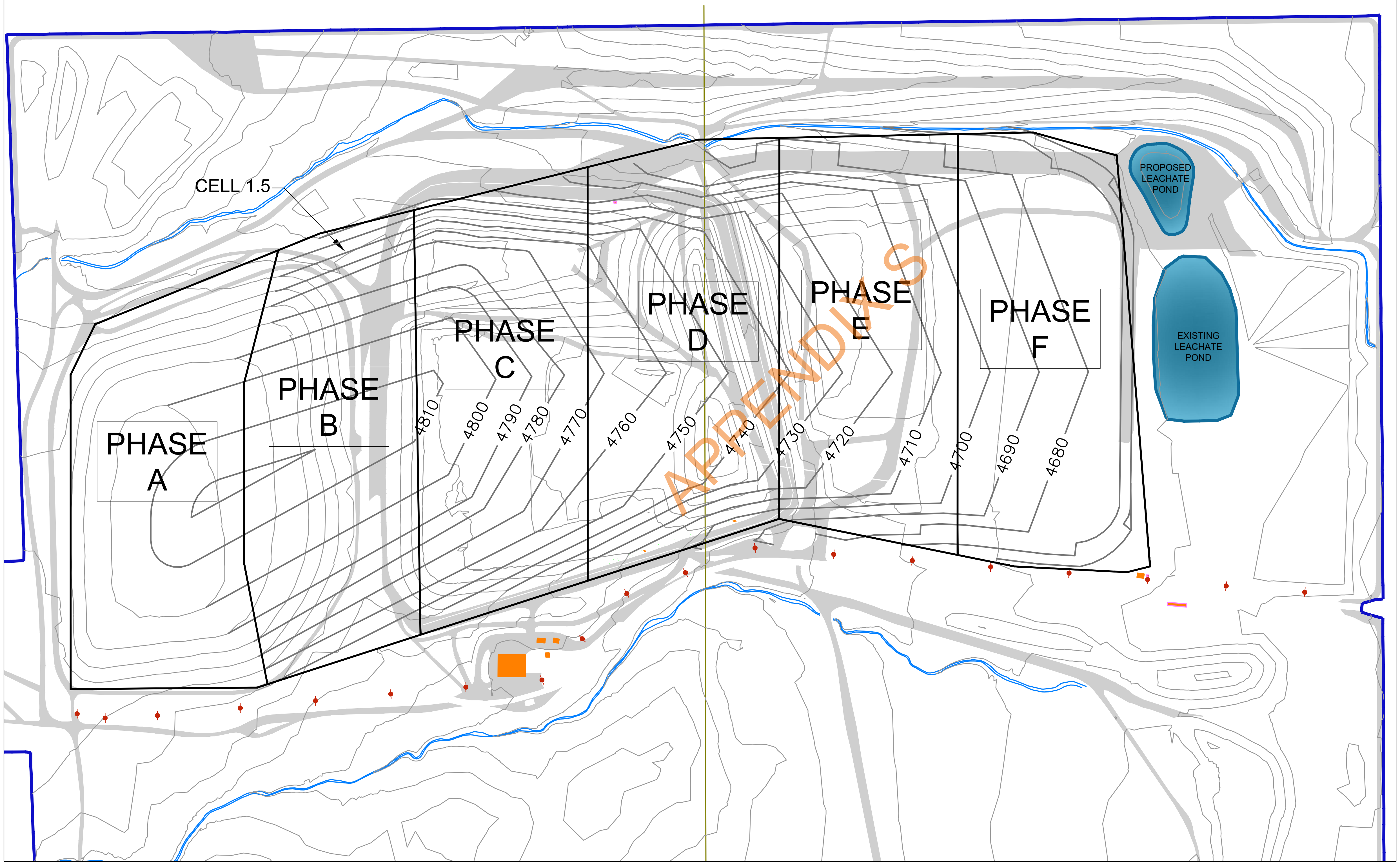
MARK	DATE	DESCRIPTION
	10/21/19	DRAFT

ISSUE:

PROJECT NO.: *02260–002*
CAD DWG FILE: *02260\Bayview\Location Map.dwg*
DRAWN BY: *JAH*
DESIGNED BY: *BDM*
CHECKED BY: *BDM*
COPYRIGHT: *IGES 2019*

SHEET TITLE

BAYVIEW LANDFILL PERMIT
FINAL GRADING PLAN



REFERENCE:
ADAPTED GRADING PLAN
PREPARED FOR CLIENT BY HDR

Northern Utah Environmental Resource Agency
Bayview Landfill
10804 South State Route 68
Elberta, Utah

CONSULTANTS

IGES
ideas for a changing world

2702 South 1030 West, Suite 10
Salt Lake City, Utah 84119
(801)270-9400 (T)
(801)270-9401 (F)

NOTES:

MARK	DATE	DESCRIPTION
	10/21/19	DRAFT

ISSUE:

PROJECT NO.: *02260-002*
CAD DWG FILE: *02260\Bayview\Location Map.dwg*
DRAWN BY: *JAH*
DESIGNED BY: *BDM*
CHECKED BY: *BDM*
COPYRIGHT: *IGES 2019*

SHEET TITLE

BAYVIEW LANDFILL PERMIT
CLOSURE PHASING PLAN

-

APPENDIX T – FLOW CAPACITY OF THE LEACHATE COLLECTION PIPE

APPENDIX K

ATTACHMENT 3:
FLOW CAPACITY OF THE LEACHATE COLLECTION PIPE

Job No.
No.

HDR Computation

HDR

Project Bayview Landfill
Computed KDG
Date 6/23/03
Subject Leachate Collection System
Checked mwd
Date 6/24/03
Task Flow capacity of Leachate Collection Pipe
Sheet 1
Of 2

Based on Manning's equation, the flow capacity for a 8 inch leachate pipe on a 2% slope is 1.114 cubic feet per second (or 719,824 gallons per day). (See page 2).

The HELP model output (K-2; pgs. 12-25) indicates that negligible leachate will be generated for either condition analyzed. Therefore, a 8 inch pipe will be able to handle the peak flow with an ample factor of safety.

However, stormwater that comes into contact with solid waste or daily cover is typically allowed to infiltrate into the waste to be managed by the leachate collection system. Contaminated stormwater will be minimized by keeping the active face as small as possible and by placing soil cover on all waste-filled areas not currently being utilized for disposal.

Since the waste is not at field capacity when placed in the landfill and the soil cover is not saturated, there is a large potential for these components to absorb and hold any contaminated water that may infiltrate into the landfill cell. Historical practice at the site has shown that the leachate collection system is adequate to handle the minimal leachate generated as well as the contact stormwater

Additionally, soil berms will be maintained to divert non-contact stormwater around the area to drainage channels.

Closure and Bayview pipe

Q:\ERM03608 : Redesi

Job No.	3608	*Calc No.*	K-3

Computation

HDR

Project	Bayview Landfill	*Computed*	kdf
System	Leachate and Contaminated Water Plan	*Date*	Jul-03
Component	Leachate Collection System	*Reviewed*	mo
Task	Pipe capacity	*Date*	8-20-03

Purpose

Using Manning's equation, calculate pipe capacity of leachate headers.

Find

Description	Variable	Units
Pipe capacity	Q	gal/day

Given

Description	Value	Source
Pipe diameter [in]	8	leachate pipe diameter
Slope [ft/ft]	0.02	design value
roughness coefficient	0.02	HDPE pipe

Solution

Description	Value	Comment
Pipe capacity	**719,824**	**gallons / day**

Assumptions

Use Manning's Equation

Equations

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$ *equation 1*

A = cross-sectional area [ft^2]

n = Manning's roughness coefficient

R = hydraulic radius [ft]

S = slope [ft/ft]

Q = flow [cfs]

Calculation

Description	Equation	Comment	Value	Verification
solve for area	$A = \pi r^2$	[SF]	0.349	
solve for perimeter	$P = \pi d$	[ft]	2.094	
solve for R	R = A / P	[ft]	0.166666667	
solve for Q	equation 1 above	[cfs]	1.114	
convert to gal/day	1 cfs = 646,272 gpd	[gpd]	719,824	

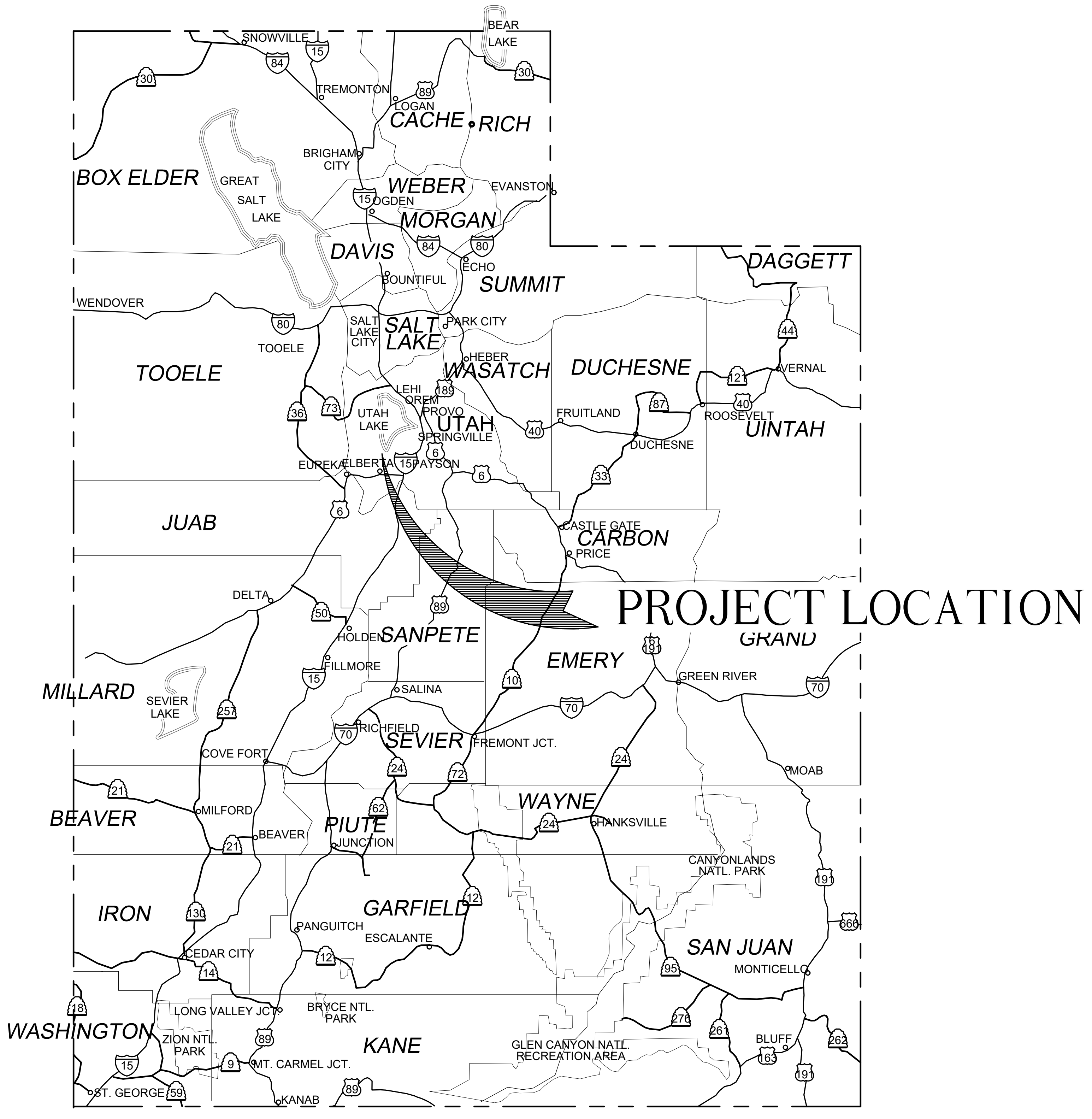
APPENDIX U – BAYVIEW LANDFILL LFG GAS COLLECTION SYSTEM

NORTHERN UTAH ENVIRONMENTAL MANAGEMENT AGENCY
(NUERA)
BAYVIEW LANDFILL LFG COLLECTION SYSTEM
ELBERTA, UTAH

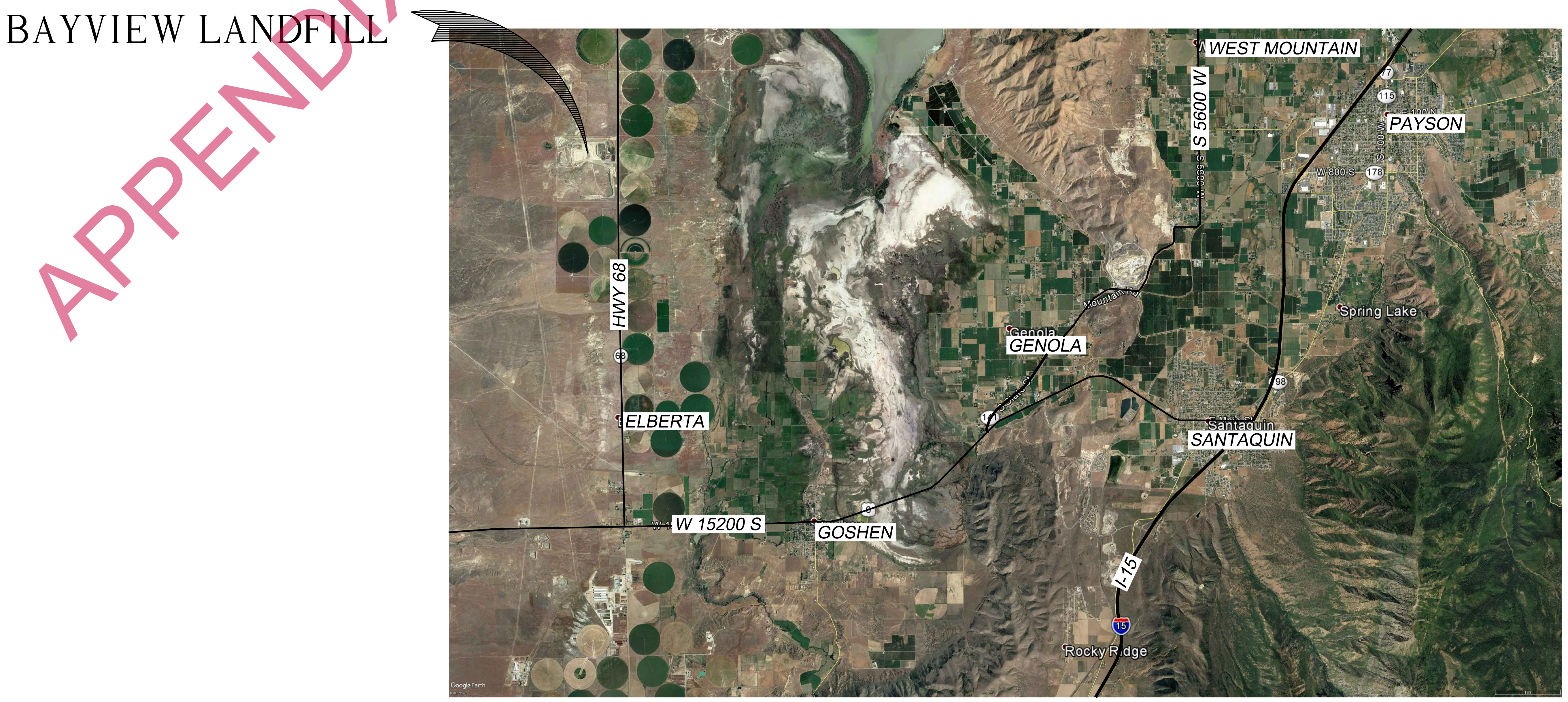
SHEET INDEX

SHEET NUMBER	DRAWING NUMBER	DESCRIPTION
1	G001	COVER SHEET
2	G002	DRAWING LIST, LEGEND, SYMBOLS AND GENERAL NOTES
3	G003	ABBREVIATIONS
4	C101	SITE PLAN
5	C-DT-01	CIVIL DETAILS
6	C-DT-02	CIVIL DETAILS

MAY, 2019



LOCATION MAP



VICINITY MAP

PRESENTED BY
WRH POWER SYSTEMS
A DIVISION OF
W.R. HENDERSON CONSTRUCTION, INC

NO.	REVISIONS	BY	DATE

W.R. HENDERSON CONSTRUCTION, INC.

PROJECT NO. 01-17-0002
DRAWN SS
DESIGNED BEC
APPROVED BEC
QA QC

NUERA
BAYVIEW LANDFILL

BAYVIEW LANDFILL LFG COLLECTION SYSTEM
COVER SHEET

SHEET NO: **G001**
DATE: MAY 2019
PAGE NO: 1

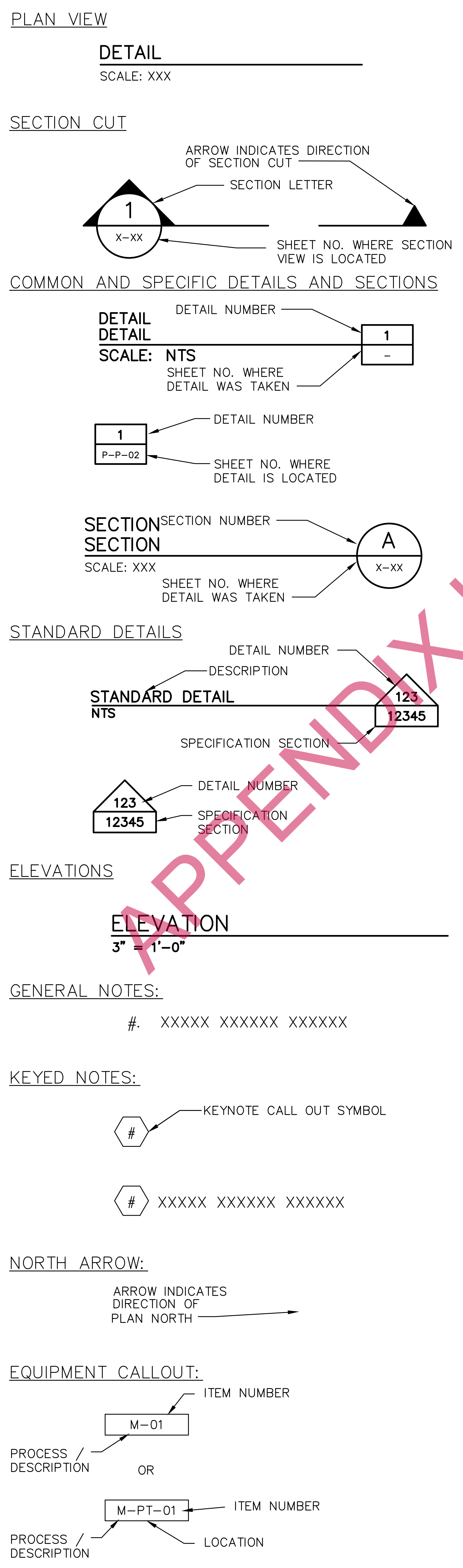
ABBREVIATIONS

AB	ANCHOR BOLT, AGGREGATE BASE
ABB	ABBREVIATIONS
ABC	AGGREGATE BASE COURSE
ABND	ABANDON
AC	ALTERNATING CURRENT
ACC	ASPHALTIC CEMENT CONCRETE
A/C	AIR CONDITIONING
ADMIN	ADMINISTRATION
AF	AIR FILTER
AFE	AREA FOR FUTURE EXPANSION
AFF	ABOVE FINISH FLOOR
AFG	ABOVE FINISH GRADE
AGGR	AGGREGATE
AL	ALUMINUM
BE	BELL END
BLDG	BUILDING
BM	BENCHMARK, BEAM
BOP	BOTTOM OF PIPE
BOW	BOTTOM OF WALL
BP	BASE PLATE
BS	BOTH SIDES
BU	BELL UP
BW	BOTH WAYS, BACKWASH LINE
CB	CATCH BASIN
CI	CURB INLET
CJ	CONSTRUCTION JOINT
℄ ,CL,C/L	CENTERLINE
CL	CHORD LENGTH
CLJ	CONTROL JOINT
CMP	CORRUGATED METAL PIPE
CMU	CONCRETE MASONRY UNIT
CO	CLEAN OUT
COL	COLUMN
CONC	CONCRETE
CTR	CENTER, CONTRACTOR
CVT	CULVERT
CV	CHECK VALVE
DEMO	DEMOLITION
DIA	DIAMETER
DI	DROP INLET, DUCTILE IRON
DWG	DRAWING
E	EAST
EA	EACH, EXHAUST AIR
EF	EACH FACE, EXHAUST FAN
EJ	EXPANSION JOINT
EL, ELEV	ELEVATION
EQUIP	EQUIPMENT
EW	EACH WAY
EWEF	EACH WAY, EACH FACE
EWTB	EACH WAY, TOP AND BOTTOM
EXIST	EXISTING
FDN	FOUNDATION
FFE	FINISHED FLOOR ELEVATION
FG	FINISHED GRADE
FL	FLOW, FLOW LINE
FT	FEET, FOOT
FTG	FOOTING
GB	GRADE BREAK, GRAB BAR
GPD	GALLONS PER DAY
GPH	GALLONS PER HOUR
GPM	GALLONS PER MINUTE
GP	GUY POLE
HB	HOSE BIBB
HDPE	HIGH DENSITY POLYETHYLENE
HVAC	HEATING, VENTILATION & AIR CONDITIONING
ID	INSIDE DIAMETER
IE	INVERT ELEVATION
IF	INSIDE FACE
IN	INCH, INCHES
INF	INFLUENT
LB	POUND
LB/FT	POUND(S) PER FOOT
LB/IN	POUND(S) PER INCH
LF	LINEAR FOOT (FEET)
MECH	MECHANICAL
MGD	MILLION GALLONS PER DAY
MH	MANHOLE
MIN	MINIMUM
MISC	MISCELLANEOUS
MJ	MECHANICAL JOINT
MW	MONITORING WELL
N	NORTH
NEG	NEGATIVE
NPT	NATIONAL PIPE THREADS
NTS	NOT TO SCALE
OC	ON CENTER(S), OPEN—CLOSE
OCEF	ON CENTER EACH FACE
OCEW	ON CENTER EACH WAY
OD	OUTSIDE DIAMETER
P	PUMP
PCV	PRESSURE CONTROL VALVE
PI	POINT OF INTERSECTION, PLANT INFLUENT, PRESSURE INDICATOR
PL, ℄	PLATE, PROPERTY LINE
POC	POINT OF CURVE
PP	POWER POLE
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PT (PT)	POINT OF TANGENCY, PRESSURE TRANSMITTER
PVC	POLY VINYL CHLORIDE
QTY	QUANTITY
R	RIGHT, RADIUS, RISERS
R/W	RIGHT OF WAY
REF	REFERENCE
REINF	REINFORCE, REINFORCING
REM	REMOVE, REMOVABLE
REQD	REQUIRED
RR	RAILROAD
SECT	SECTION
SHT	SHEET
SPEC	SPECIFICATION
SQ	SQUARE
SST	STAINLESS STEEL
STA	STATION
STD	STANDARD
STL	STEEL
STRUCT	STRUCTURE
SYM	SYMBOL
TA	TOP OF ASPHALT
TC	TOP OF CONCRETE, TEMPERATURE CONTROLLER
TEMP	TEMPORARY, TEMPERATURE
TF	TRANSFER FAN
THD	THREADED
TOG	TOP OF GRATING
TOPO	TOPOGRAPHY
TOW	TOP OF WALL
TYP	TYPICAL
UG	UNDERGROUND
UNO	UNLESS NOTED OTHERWISE
UTIL	UTILITY
VTR	VENT THRU ROOF
W	WEST
WSE	WATER SURFACE ELEVATION
W/	WITH
W/O	WITHOUT
XSECT	CROSS SECTION

ABBREVIATION GENERAL NOTES

THIS SHEET APPLIES TO THE ENTIRE SET OF DRAWINGS. LISTING OF ABBREVIATIONS DOES NOT IMPLY ALL ABBREVIATIONS HAVE BEEN USED ON THIS PROJECT.

GENERAL LEGEND AND SYMBOLS



GENERAL NOTES

1. THE ENGINEERING DESIGNS ON THESE PLANS ARE ONLY APPROVED BY THE OWNER IN SCOPE AND NOT IN DETAIL. IF CONSTRUCTION QUANTITIES ARE SHOWN ON THESE PLANS, THEY ARE NOT VERIFIED BY THE OWNER.
2. THE CONTRACTOR SHALL COORDINATE WORK SCHEDULES WITH THE OWNER'S REPRESENTATIVE TO PREVENT ANY CONFLICTING WORK CONDITIONS.
3. LOCATIONS, ELEVATIONS AND DIMENSIONS OF EXISTING UTILITIES, STRUCTURES AND OTHER FEATURES ARE SHOWN ACCORDING TO THE BEST INFORMATION AVAILABLE AT THE TIME OF THE PREPARATION OF THESE PLANS. BUT DO NOT PURPORT TO BE ABSOLUTELY CORRECT AND ARE APPROXIMATE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING LOCATIONS, ELEVATIONS AND DIMENSIONS OF ALL EXISTING UTILITIES, STRUCTURES AND OTHER FEATURES AFFECTING THIS WORK AND AVOIDING DAMAGE TO SAME.
4. (**) INDICATES DIMENSIONS, LOCATIONS OR ELEVATIONS TO BE FIELD VERIFIED.
5. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS BEFORE STARTING WORK AND SHALL IMMEDIATELY NOTIFY THE OWNER OF ANY DISCREPANCIES. ADDITIONALLY ALL OMISSIONS OR CONFLICTS BETWEEN THE VARIOUS ELEMENTS OF THE WORKING DRAWINGS AND/OR SPECIFICATIONS SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER BEFORE PROCEEDING WITH ANY WORK INVOLVED.
6. UNLESS DETAILED, SPECIFIED OR INDICATED OTHERWISE, CONSTRUCTION SHALL BE AS INDICATED IN THE APPLICABLE TYPICAL DETAILS AND GENERAL NOTES. TYPICAL DETAILS ARE MEANT TO APPLY EVEN THOUGH NOT REFERENCED AT SPECIFIC LOCATIONS OR ON SPECIFIC DRAWINGS.
7. SCREENING OR SHADING OF WORK IS USED TO INDICATE EXISTING COMPONENTS OR TO DE—EMPHASIZE PROPOSED IMPROVEMENTS TO HIGHLIGHT SELECTED TRADE WORK. REFER TO CONTEXT OF EACH DRAWING FOR USAGE.
8. CONTRACTOR SHALL PREPARE AND FURNISH TO THE OWNER A SET OF AS—BUILT DRAWINGS AT THE COMPLETION OF THE PROJECT.
9. CONTRACTOR SHALL KEEP ALL CONSTRUCTION EQUIPMENT AT LEAST 10' FROM EXISTING OVERHEAD POWER LINES. IF THIS IS NOT FEASIBLE, CONTACT THE UTILITY OWNER TO INSTALL A TEMPORARY PROTECTIVE COVERING ON THE POWER LINES.
10. DRAWINGS SHOWING GENERAL SYMBOLOGY ARE STANDARD DRAWINGS. ALL SYMBOLS ARE NOT NECESSARILY USED ON THIS PROJECT.
11. SEE PROJECT EQUIPMENT AND PIPING SYSTEMS DRAWING FOR SYMBOLS AND ABBREVIATIONS SPECIFIC TO THE PROJECT.
12. IF PLAN AND SECTION, OR DETAIL CALL—OUT AND DETAIL ARE SHOWN ON SAME DRAWING, DRAWING NUMBER IS REPLACED BY A LINE (—).
13. ALL DESIGN, CONSTRUCTION, AND INSPECTION SHALL BE IN CONFORMANCE WITH THE 2006 INTERNATIONAL BUILDING CODE.
14. DRAWINGS INDICATE THE FINISHED PRODUCT. THEY DO NOT INDICATE A METHOD OF CONSTRUCTION. CONTRACTOR SHALL TAKE ALL PRECAUTIONS NECESSARY TO PROTECT NEW AND EXISTING STRUCTURES DURING CONSTRUCTION. SUCH PRECAUTIONS SHALL INCLUDE, BUT NOT BE LIMITED TO, BRACING, SHORING FOR CONSTRUCTION EQUIPMENT, ETC.
15. THE CONTRACTOR SHALL BE RESPONSIBLE FOR COMPENSATING THE OWNER FOR ANY CHANGES MADE AS A RESULT OF A DEVIATION FROM THE CONTRACT DOCUMENTS SPECIFICATIONS, FAULTY MATERIALS, OR FAULTY WORKMANSHIP.
16. OPTIONS ARE FOR THE CONTRACTORS CONVENIENCE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING ALL REQUIRED DESIGN CHANGES. COST ASSOCIATED WITH ANY DESIGN WORK INITIATED BY THE OPTION SHALL BE BORN BY THE CONTRACTOR.
17. CONTRACTOR SHALL BE RESPONSIBLE FOR SAFETY AND PROTECTION WITHIN AND ADJACENT TO THE JOB SITE.
18. OBSERVATION VISITS TO THE JOB SITE BY FIELD REPRESENTATIVES OF THE ENGINEER SHALL NEITHER BE CONSTRUED AS INSPECTION NOR APPROVAL OF CONSTRUCTION.
19. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO NOTIFY THE APPROPRIATE UTILITY COMPANIES WHEN CONSTRUCTION MIGHT INTERFERE WITH NORMAL OPERATION OF ANY UTILITIES. IT SHALL ALSO BE THE CONTRACTOR'S RESPONSIBILITY TO CONTACT DIGLINE OF IDAHO 1—800—342—1585 OR 811 TO HAVE THE APPROPRIATE UTILITY COMPANIES LOCATE ANY UTILITY LOCATIONS WHICH MIGHT INTERFERE WITH CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING SERVICE OF EXISTING UTILITIES AND FOR RESTORING ANY UTILITIES DAMAGED DUE TO CONSTRUCTION AT NO ADDITIONAL COST TO THE OWNER.

NO.	REVISIONS	BY	DATE

W.R. HENDERSON™
CONSTRUCTION, INC.

PROJECT NO. 01-17-0002
DRAWN SS
DESIGNED BEC
APPROVED BEC
QA/QC

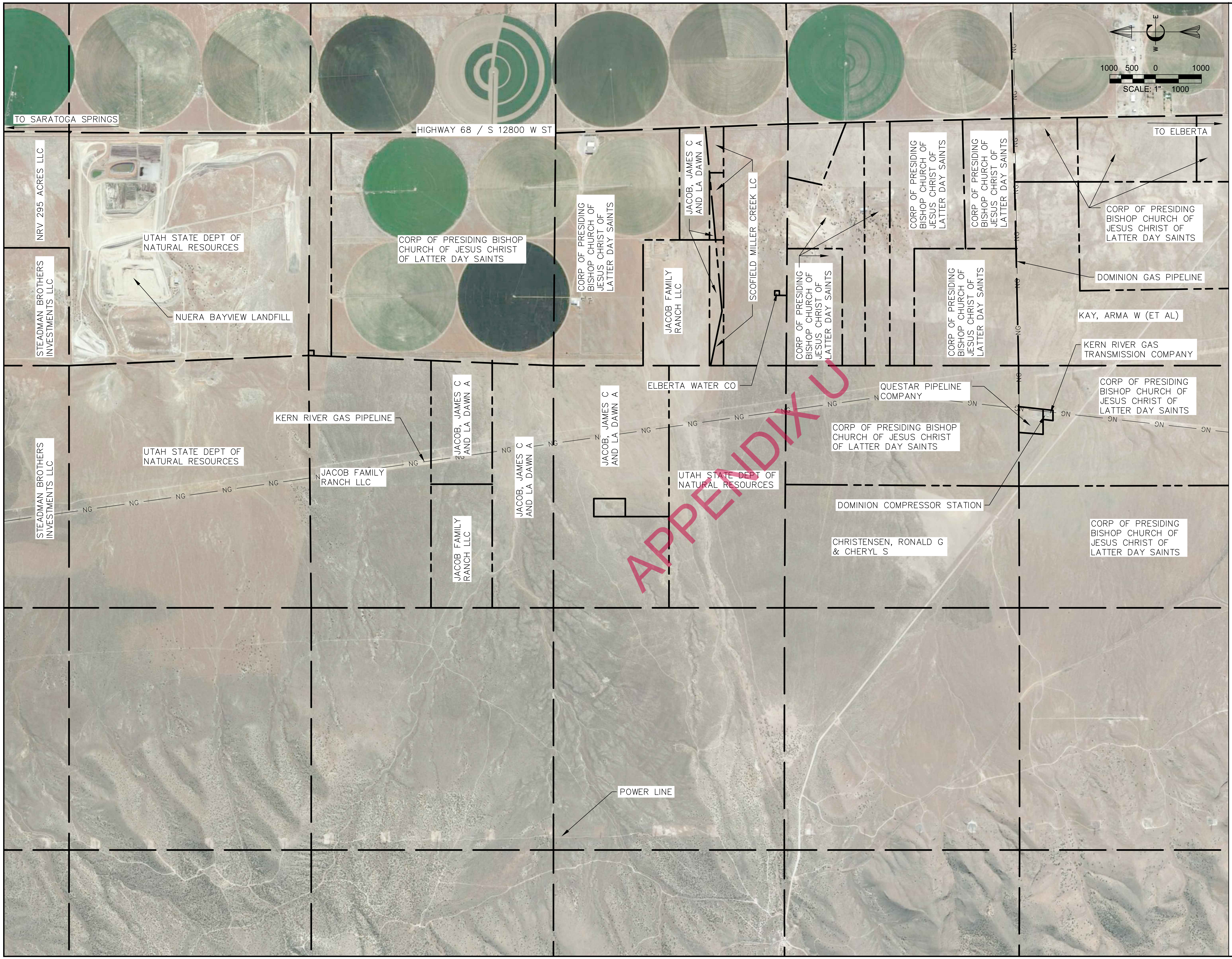
NUERA
BAYVIEW LANDFILL

BAYVIEW LANDFILL LFG COLLECTION SYSTEM

ABBREVIATIONS, GENERAL LEGEND AND SYMBOLS, AND GENERAL NOTES

SHEET NO:
G002
DATE:
MAY 2019
PAGE NO:
2 of 10

APPENDIX U



NO.	REVISIONS	BY	DATE

W.R. HENDERSON CONSTRUCTION, INC.

PROJECT NO. 01-17-0002
DRAWN SS
DESIGNED BEC
APPROVED BEC
QA/QC

NUERA
BAYVIEW LANDFILL

BAYVIEW LANDFILL LFG COLLECTION SYSTEM
BAYVIEW LANDFILL LFG COLLECTION SYSTEM

SHEET NO:
C100
DATE:
MAY 2019
PAGE NO:

APPENDIX U

NO.	REVISIONS	BY	DATE

W.R. HENDERSON
CONSTRUCTION, INC.

PROJECT NO. 01-17-0002
DRAWN SS
DESIGNED BEC
APPROVED BEC
QA/QC

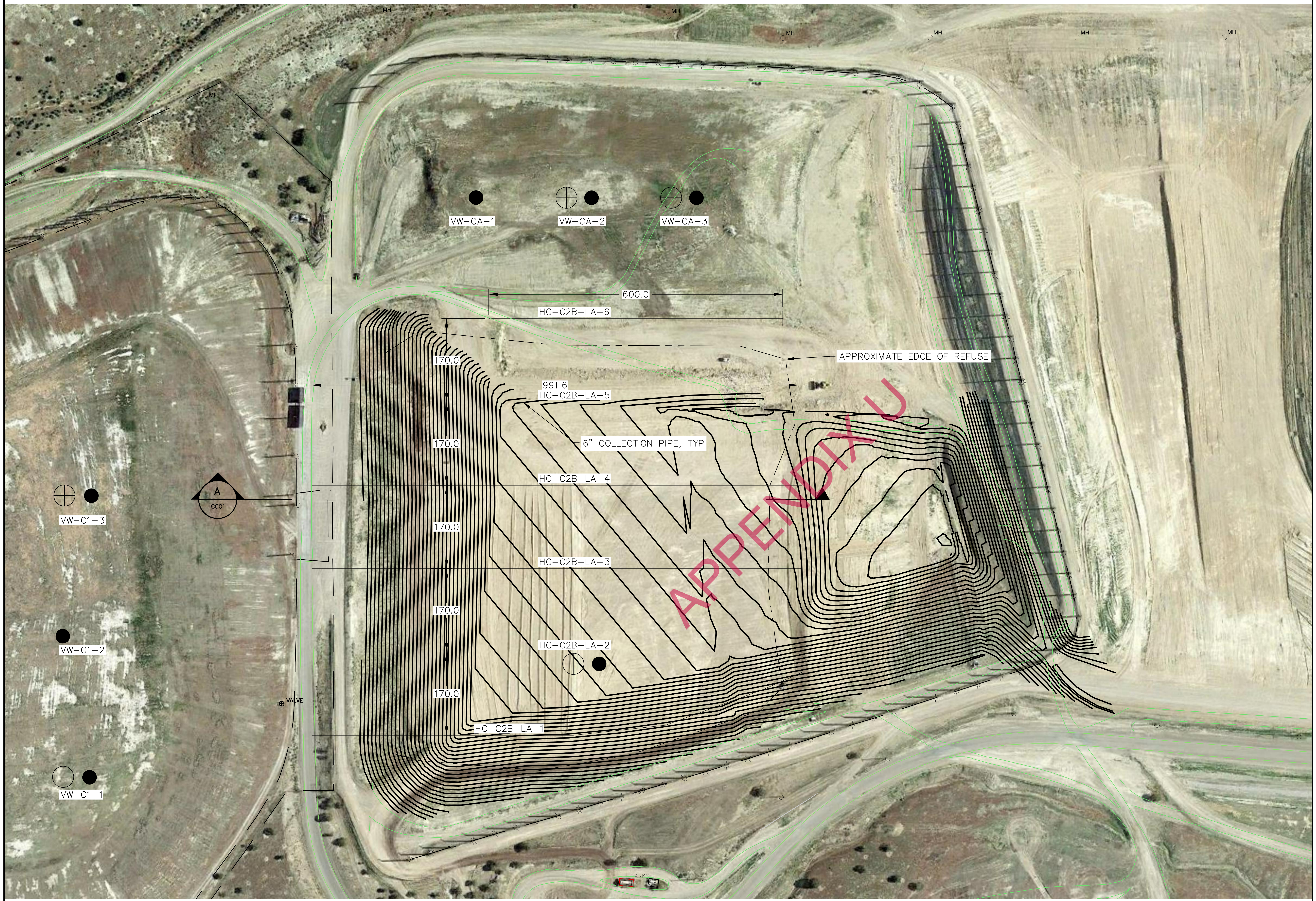
NUERA
BAYVIEW LANDFILL

BAYVIEW LANDFILL LFG COLLECTION SYSTEM

BAYVIEW LANDFILL LFG COLLECTION SYSTEM

SHEET NO:
C100

DATE:
MAY 2019
PAGE NO:



CELLS C2B-LEVEL A
HORIZONTAL COLLECTION SYSTEM

COLLECTOR	DIA	PERFORATED LENGTH	PERFORATIONS
HC-2B-LA-1	6"	800'	4 @ 90°, 5/8" ø @ 3" OC
HC-2B-LA-2	6"	800'	4 @ 90°, 5/8" ø @ 3" OC
HC-2B-LA-3	6"	800'	4 @ 90°, 5/8" ø @ 3" OC
HC-2B-LA-4	6"	800'	4 @ 90°, 5/8" ø @ 3" OC
HC-2B-LA-5	6"	800'	4 @ 90°, 5/8" ø @ 3" OC
HC-2B-LA-6	6"	800'	4 @ 90°, 5/8" ø @ 3" OC

CONSTRUCTION NOTES:

1. TOPOGRAPHIC AND BASE MAP PLANIMETRICS FOR THE BAYVIEW LANDFILL WERE OBTAINED FROM NORTHERN UTAH ENVIRONMENTAL SERVICE AGENCY (NUERA)

2. THIS DRAWING DEPICTS THE LAYOUT OF THE LANDFILL GAS COLLECTION AND CONTROL SYSTEM FOR THE LOWER LEVEL, LEVEL A, OF CELL 2B FOR THE BAYVIEW LANDFILL.

3. CONTRACTOR SHALL FURNISH ALL LABOR, MATERIAL, TESTING, TOOLS, EQUIPMENT, SUPERVISION AND INSTALLATION SERVICES REQUIRED TO CONSTRUCT THE LANDFILL GAS COLLECTION SYSTEM DEPICTING ON THESE DRAWINGS.

4. CONTRACTOR SHALL RECOGNIZE THAT THE BAYVIEW LANDFILL IS AN OPERATING LANDFILL AND SHALL COORDINATE ALL ACTIVITIES WITH THE SITE SUPERVISOR INCLUDING PROVIDING A CONSTRUCTION SCHEDULE, IDENTIFYING A LAYDOWN AREA, AND COMPLETING CONSTRUCTION WORK IN A FASHION THAT MINIMIZES ANY INTERFERENCE WITH LANDFILL OPERATIONS.

5. CONTRACTOR SHALL MINIMIZE DISTURBANCE RELATED TO CONSTRUCTION ACTIVITIES TO THE EXTENT POSSIBLE. CONTRACTOR SHALL RESTORE DISTURBED AREAS INSIDE AND OUTSIDE THE LANDFILL FOOTPRINT TO ITS ORIGINAL CONDITION.

6. CONTRACTOR SHALL FIELD LOCATE EXISTING UTILITIES AND ADJUST THE SLOPE OF ANY PROPOSED LFG PIPING TO ACCOMMODATE CROSSING OVER OR UNDER THE EXISTING UTILITIES.

7. PROVIDE A MINIMUM SLOPE ON ALL LFG COLLECTION PIPE AS FOLLOWS:

   a. SUBGRADE COMPRISED OF SOLID WASTE, MINIMUM SLOPE = 4%

   b. SUBGRADE COMPRISED OF COMPACTED NATIVE SOIL, MINIMUM SLOPE = 0.5%

8. IT IS LIKELY THAT LANDFILL SURFACE ELEVATIONS HAVE CHANGED DUE TO SETTLEMENT SINCE THE SURVEY WAS CONDUCTED. THE CONTRACTOR IS RESPONSIBLE FOR SURVEYING GROUND ELEVATIONS AND OBTAINING VERIFICATION OF WELL DEPTHS AND SLOPES.

9. THE CONTRACTOR IS RESPONSIBLE FOR LOCATION OF HEADER PIPING, LATERAL PIPING, WELL PIPING; IDENTIFYING AND CONSTRUCTING ANY DESIGNED HIGH POINTS AND LOW POINTS, MITIGATING HIGH POINTS AND LOW POINTS NOT SPECIFICALLY IDENTIFIED IN THE DESIGN, AND MAKING FIELD ADJUSTMENTS AS NECESSARY, SUBJECT TO APPROVAL BY THE ENGINEER.

10. THE PROJECT OWNER MAY ELECT TO DELETE OR MODIFY PROPOSED WELL LOCATIONS OR SYSTEM COMPONENTS THAT HAVE THE POTENTIAL TO INTERFERE WITH THE LANDFILL OPERATIONS.

11. CONTRACTOR SHALL SURVEY PROPOSED WELL LOCATIONS FOR ACTUAL GROUND ELEVATIONS BEFORE CONSTRUCTION AND SUBMIT THAT INFORMATION TO THE ENGINEER PRIOR TO BEGINNING CONSTRUCTION SO THAT ANY ADJUSTMENTS IN THE DESIGN CAN BE EFFECTED PRIOR TO EXCAVATING OR DRILLING.

NO.	REVISIONS	BY	DATE

W.R. HENDERSON
CONSTRUCTION, INC.

PROJECT NO.	01-17-0002
DRAWN	SS
DESIGNED	BEC
APPROVED	BEC
QA/QC	

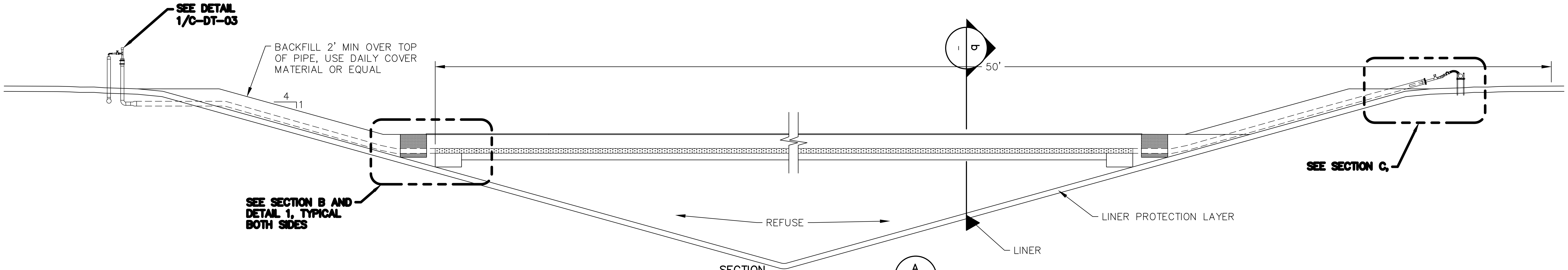
NUERA
BAYVIEW LANDFILL

BAYVIEW LANDFILL LFG COLLECTION SYSTEM
CELL 2B-LAYER A GAS COLLECTION PLAN

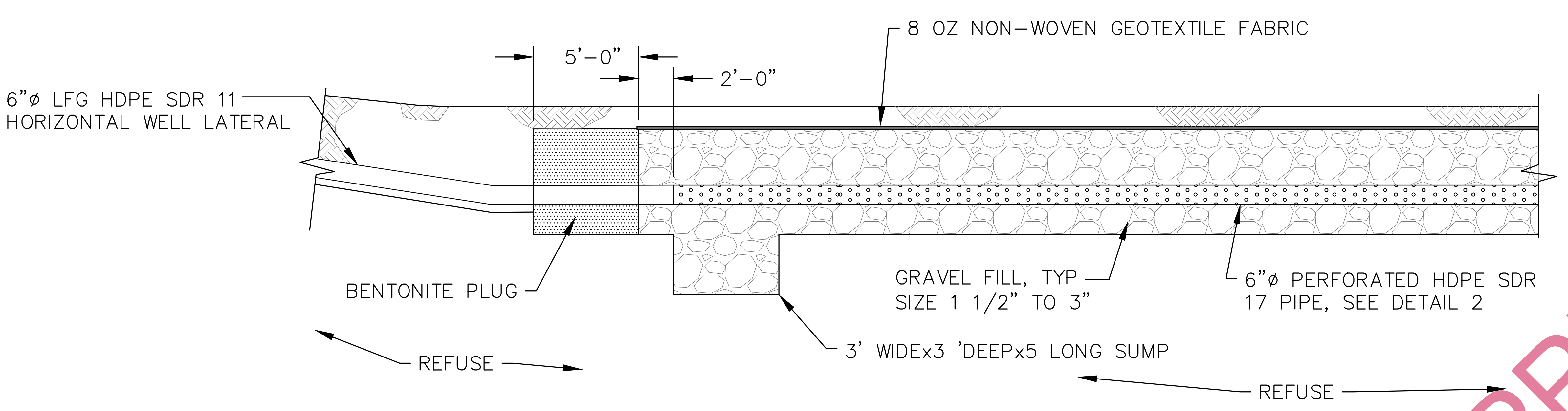
SHEET NO:
C101

DATE:
MAY 2019

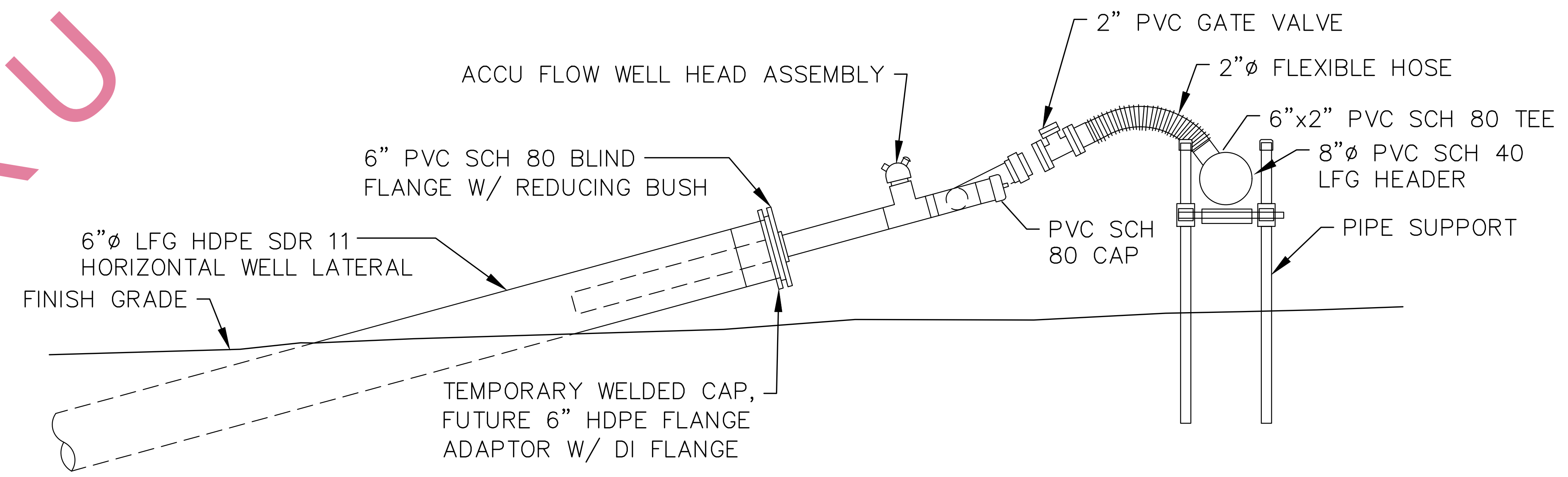
PAGE NO:



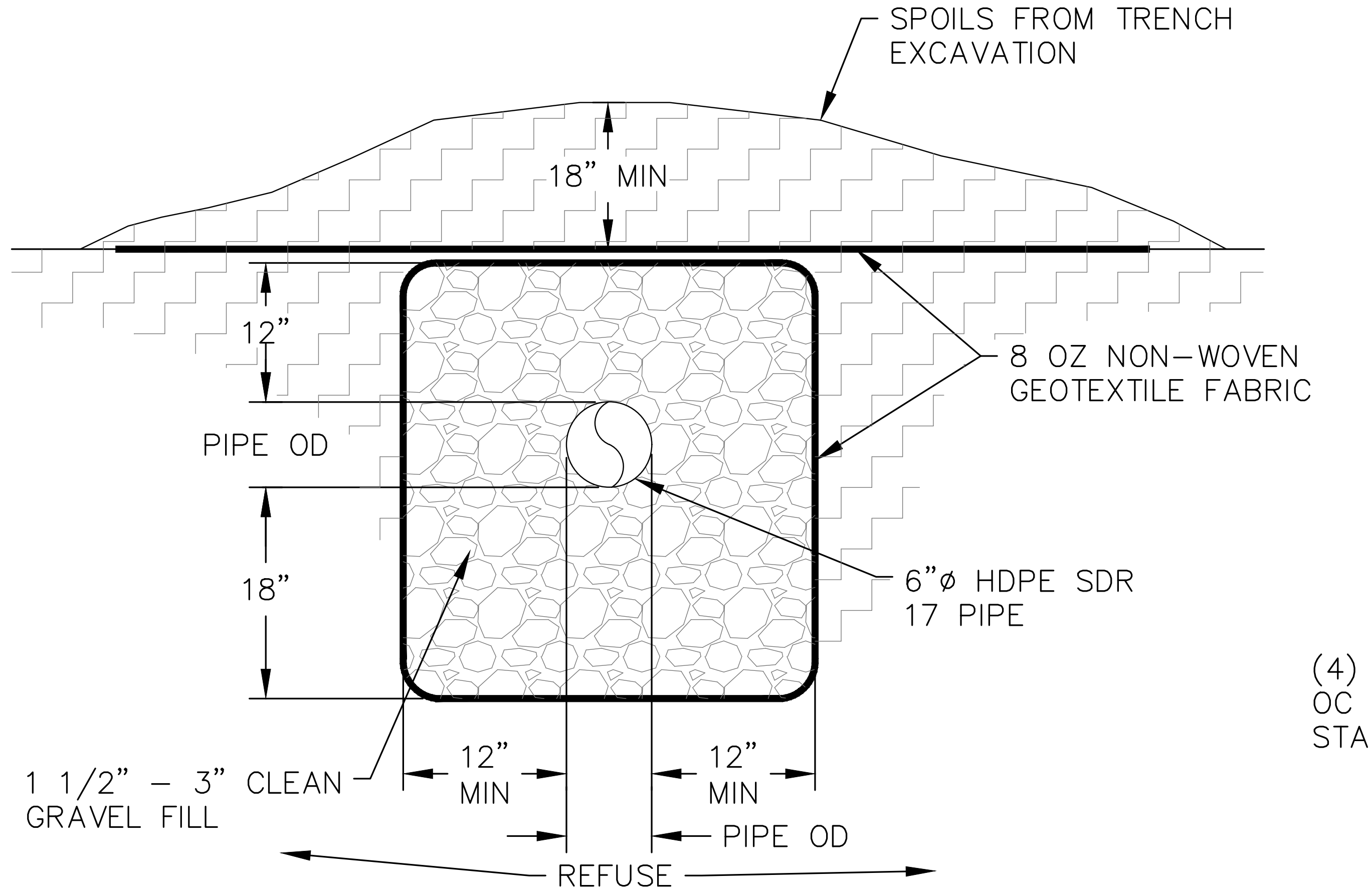
SECTION A
SCALE: NTS C100



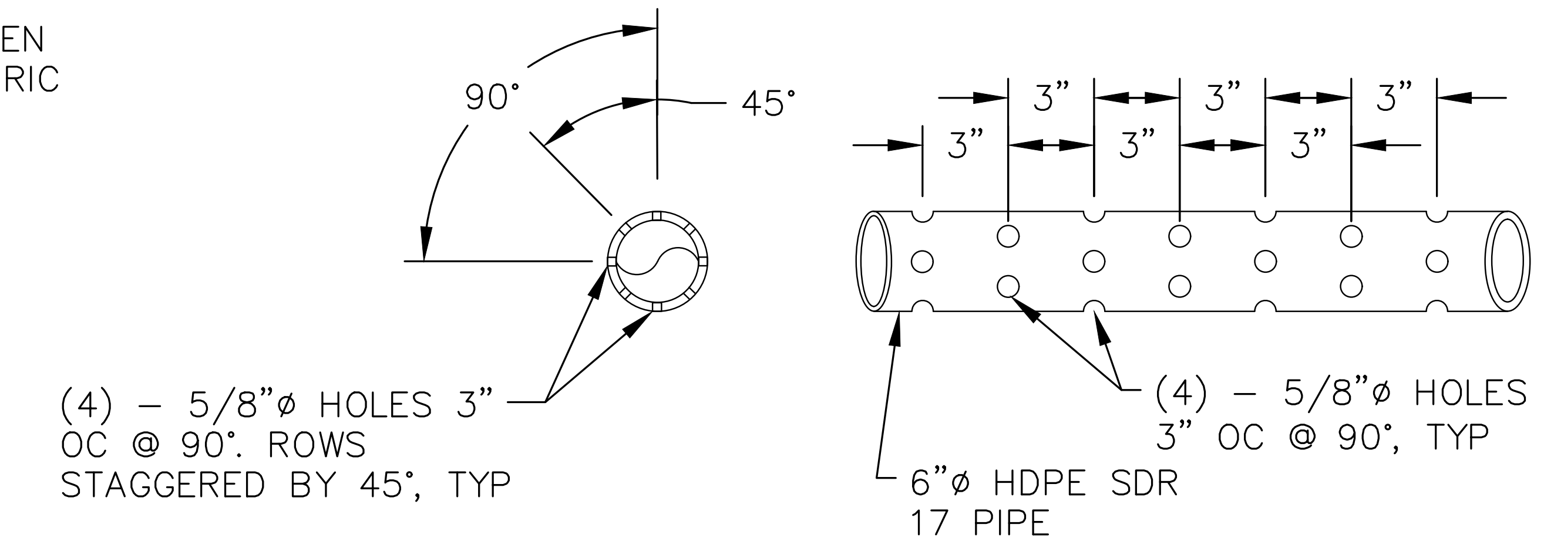
SECTION B
SCALE: NTS -



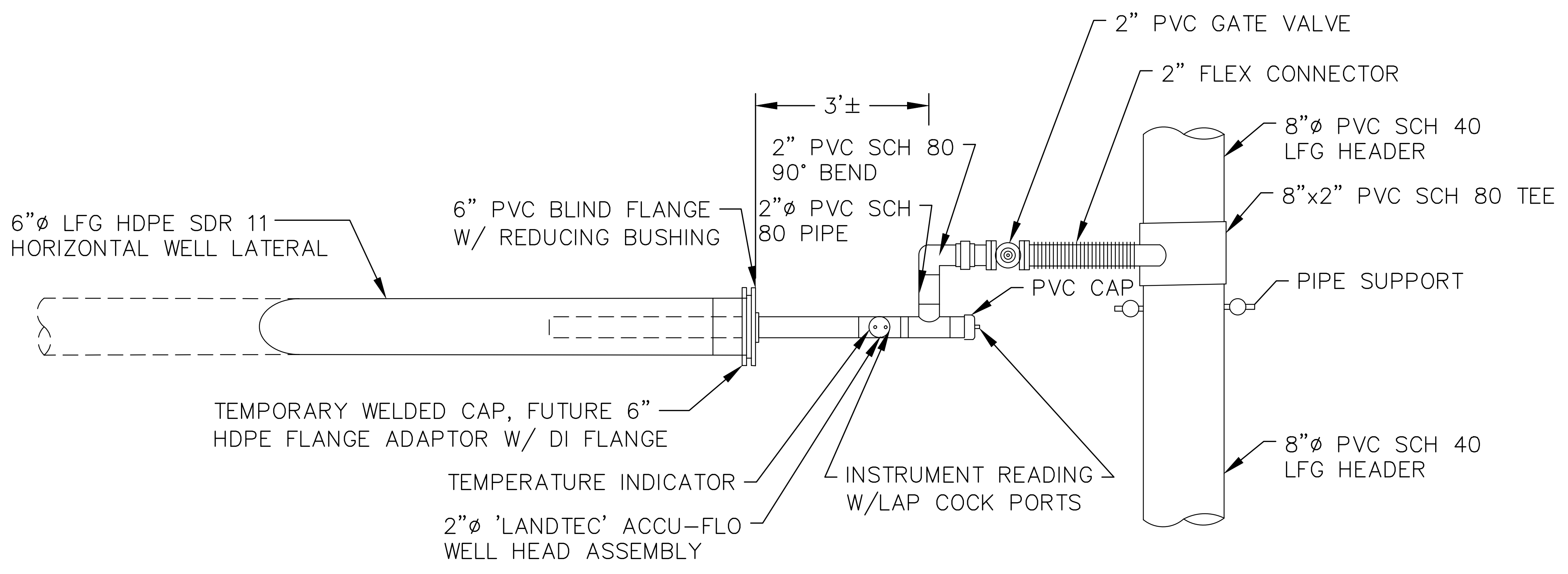
SECTION C
SCALE: NTS -



SECTION D
SCALE: NTS -



PERFORATED PIPE DETAIL 1
SCALE: NTS -



HORIZONTAL WELL LATERAL TO 8"ø LFG HEADER 2
SCALE: NTS -

NO.	REVISIONS	BY	DATE

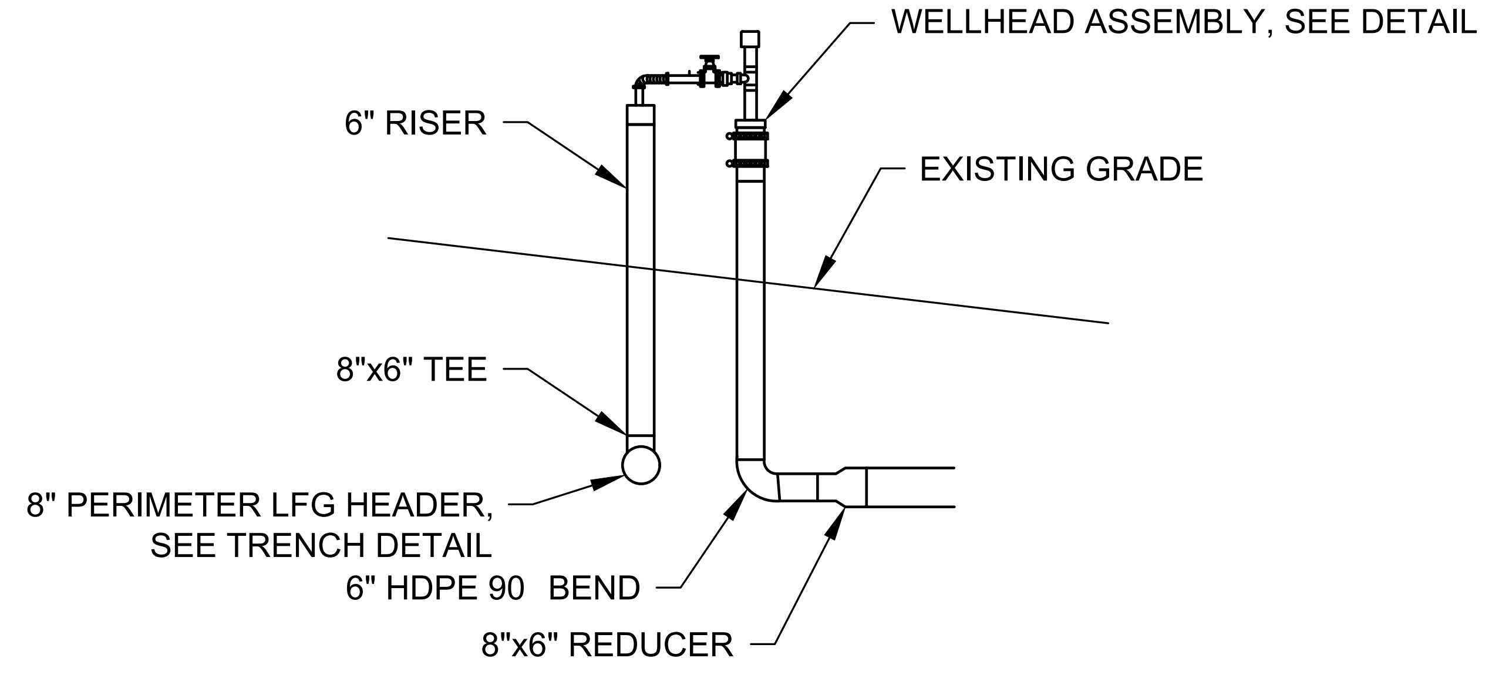
W.R. HENDERSON CONSTRUCTION, INC.

PROJECT NO. 01-17-0002
DRAWN SS
DESIGNED BEC
APPROVED BEC
QA/QC

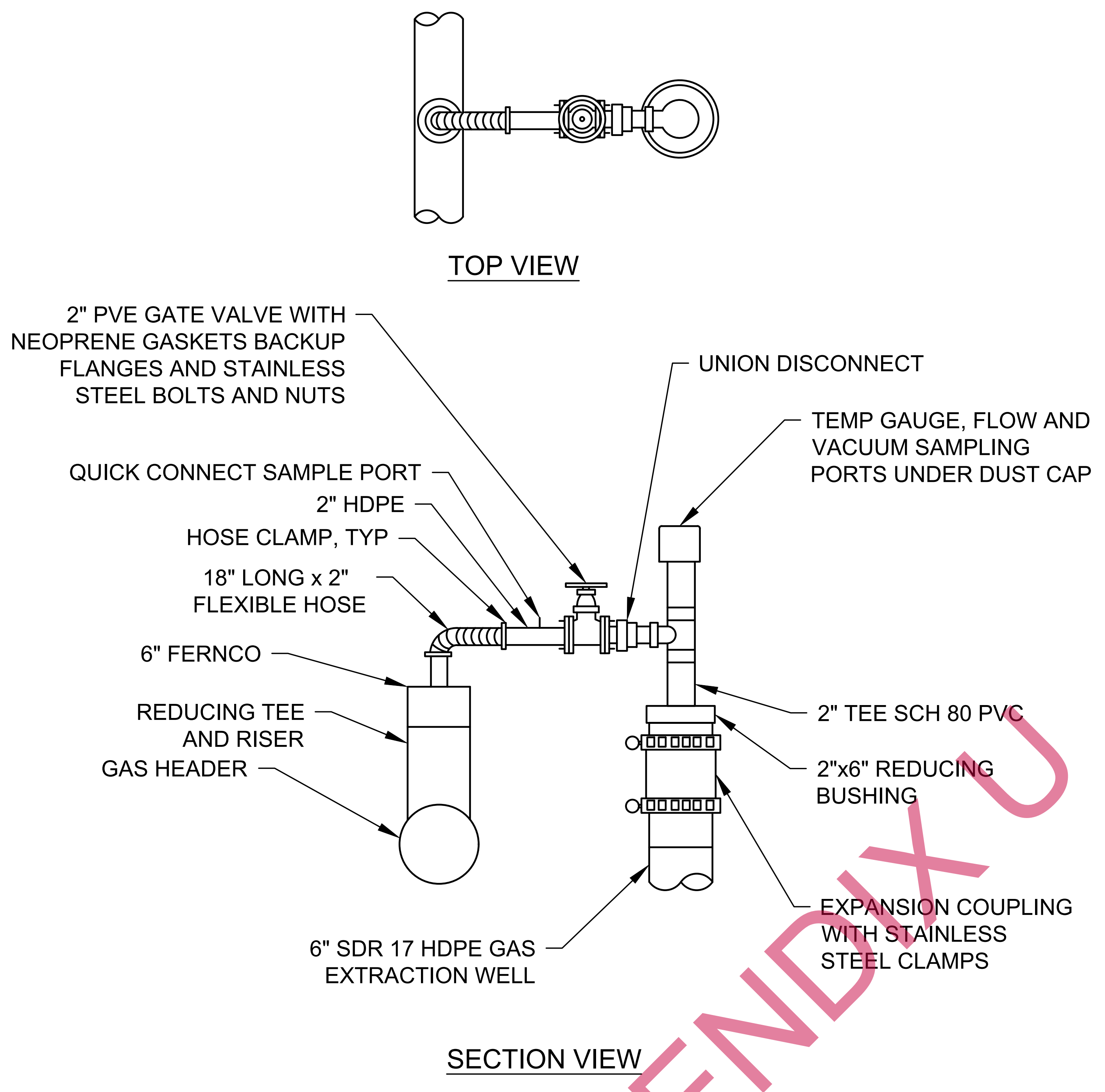
NUERA
BAYVIEW LANDFILL

BAYVIEW LANDFILL LFG COLLECTION SYSTEM
DETAILS

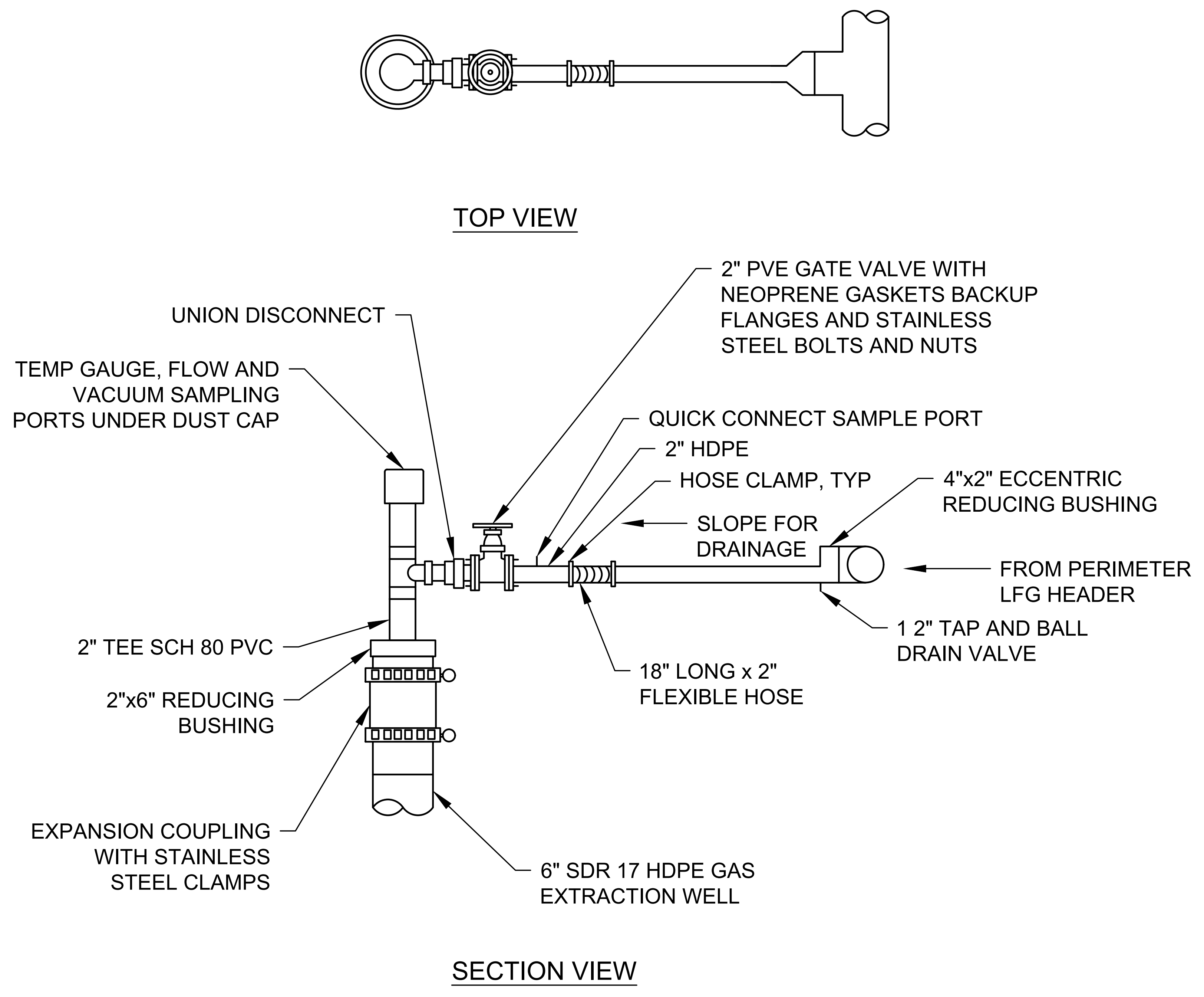
SHEET NO: C-DT-01
DATE: MAY 2019
PAGE NO:



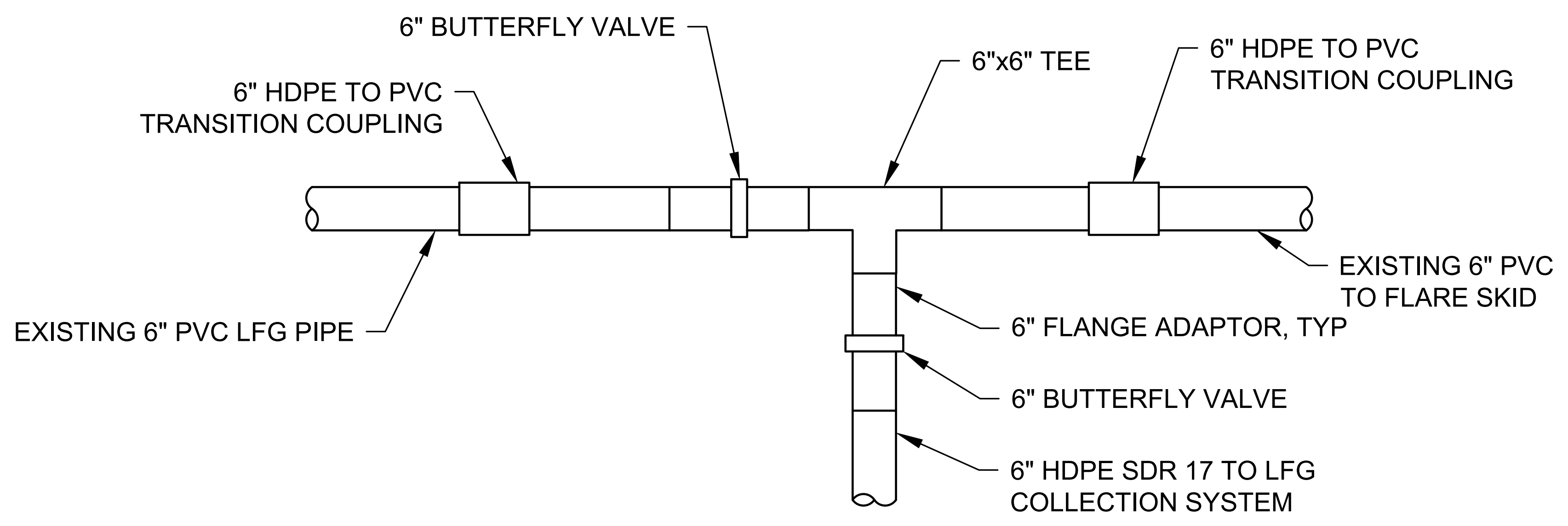
HORIZONTAL COLLECTOR TRENCH
WITH VERTICAL WELL HEAD DETAIL 1
-
SCALE: NTS



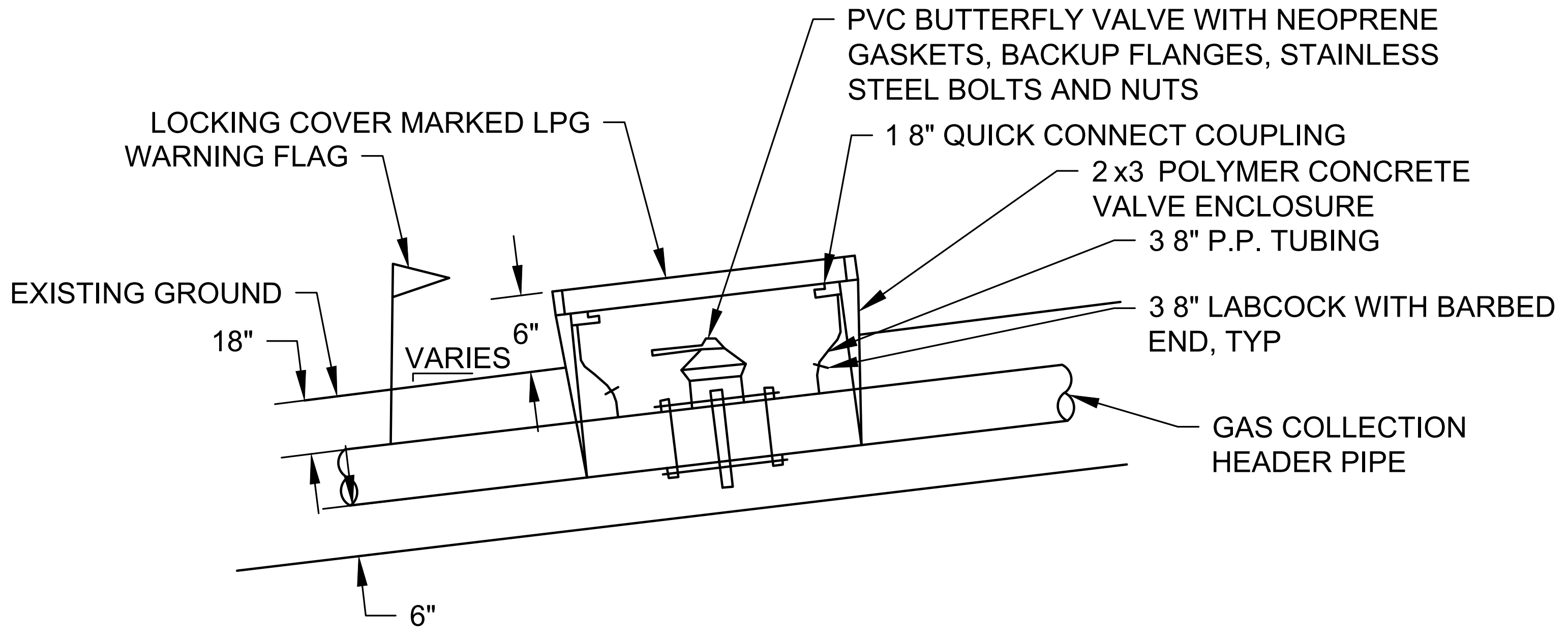
WELL HEAD DETAIL
(HORIZONTAL TRENCH) 2
-
SCALE: NTS



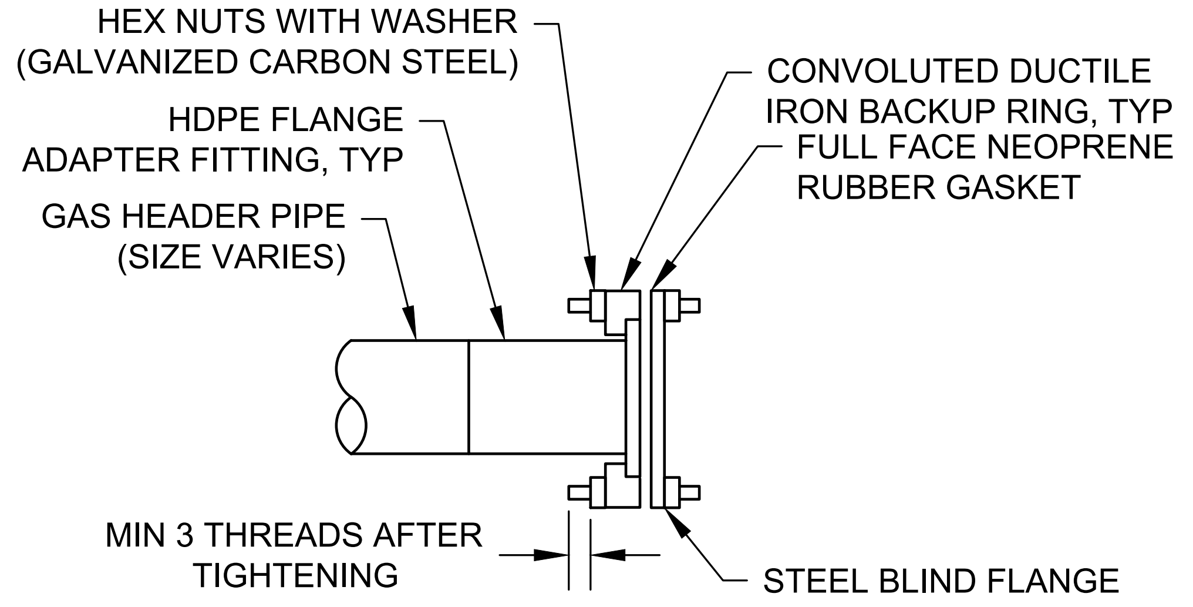
WELLHEAD DETAIL 3
-
SCALE: NTS



FLARE PIPING
CONNECTION DETAIL 4
-
SCALE: NTS



VALVE ENCLOSURE DETAIL 5
-
SCALE: NTS



BLIND FLANGE
CONNECTION DETAIL 6
-
SCALE: NTS

NO.	REVISIONS	BY	DATE

W.R. HENDERSON
CONSTRUCTION, INC.

PROJECT NO. 01-17-0002
DRAWN SS
DESIGNED BEC
APPROVED BEC
QAQC

NUERA
BAYVIEW
LANDFILL

BAYVIEW LANDFILL LFG
COLLECTION SYSTEM

DETAIL

SHEET NO:
C-DT-02

DATE:
MAY 2019

PAGE NO:

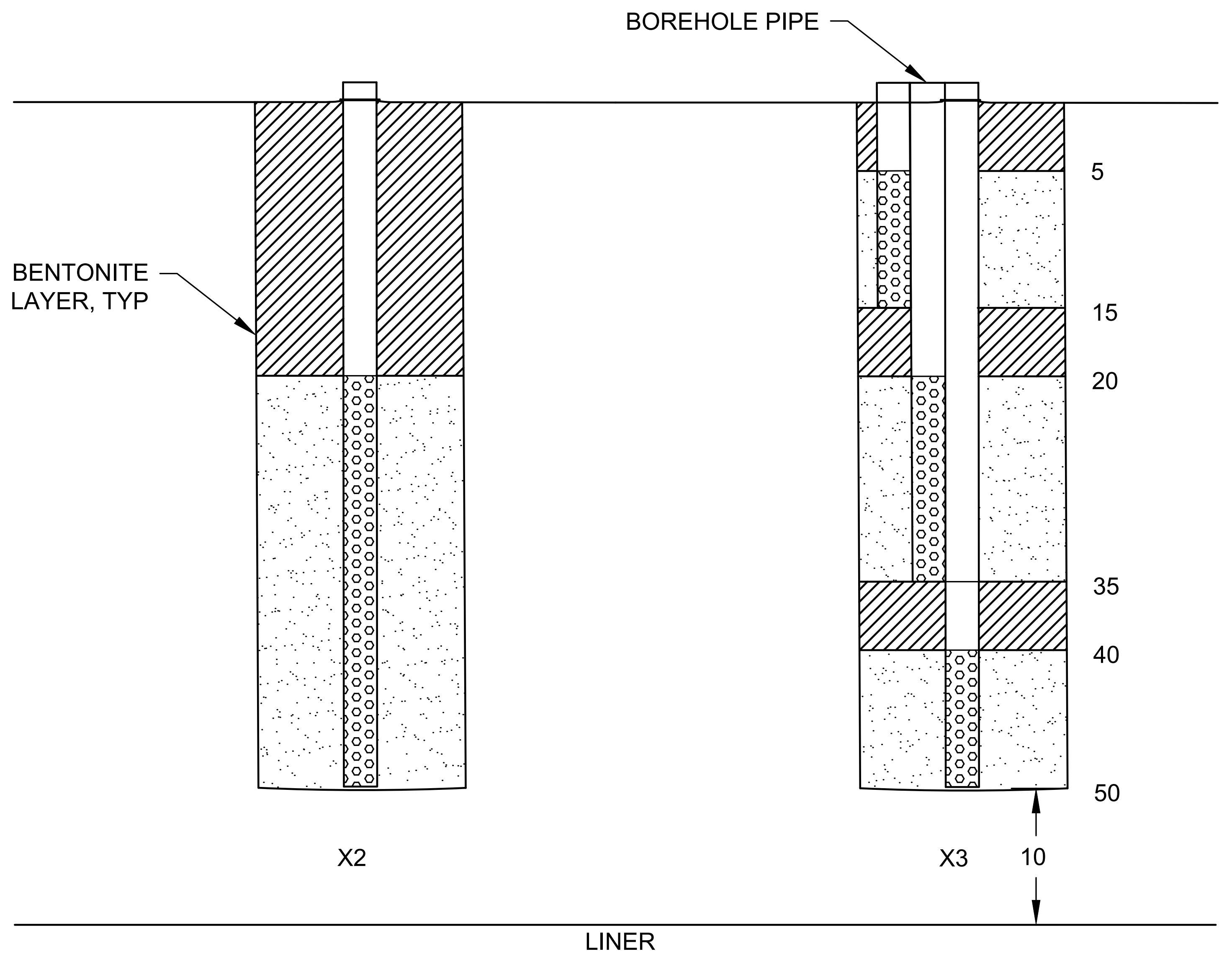
NOTES:

BOREHOLE PIPE: 4" SCH 40 PVC

BOREHOLE SCREEN: 40" SCH 40 PVC, SLF-PERFORATED WITH 1 4" PERFORATIONS

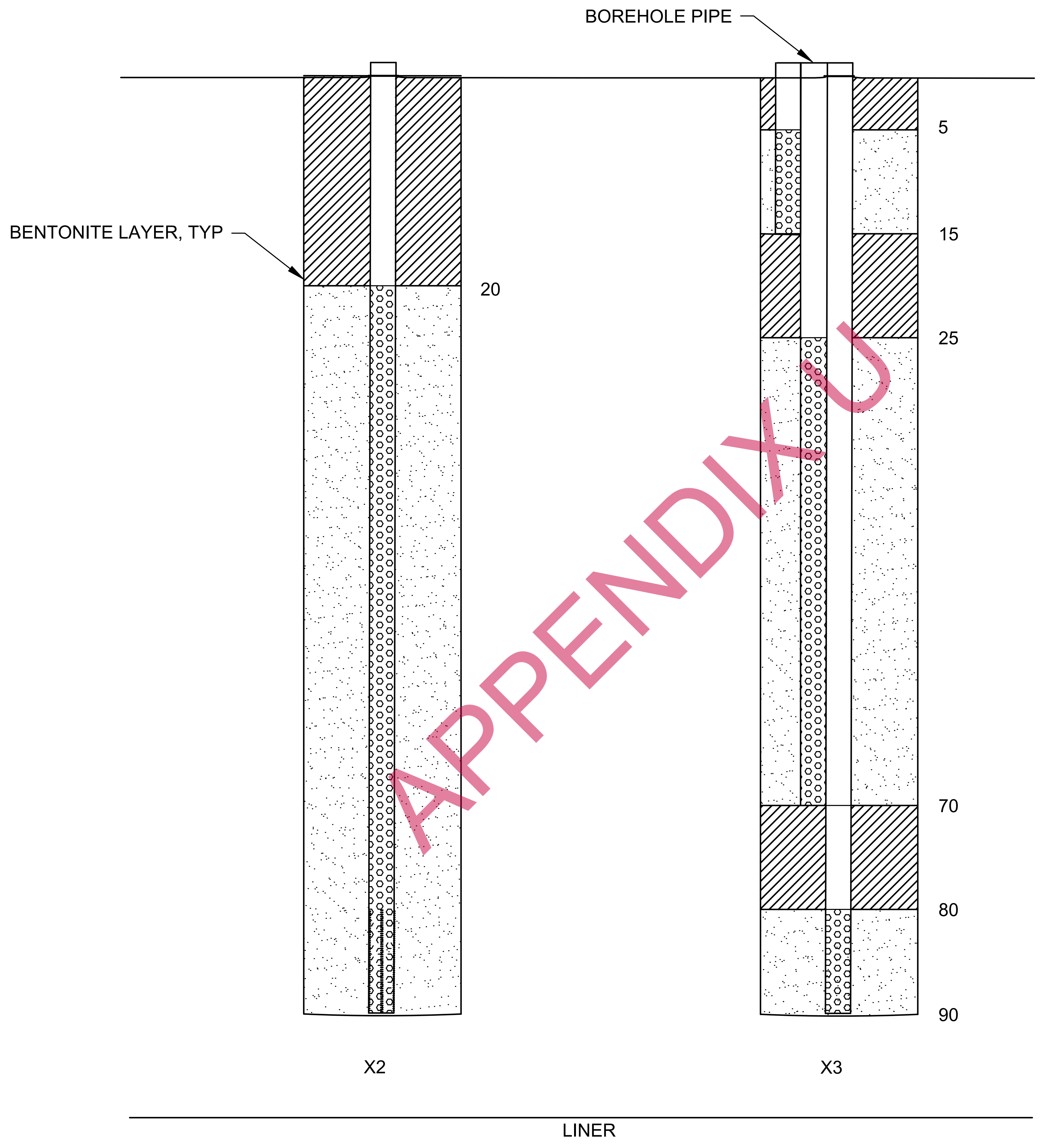
WELL SCREEN: 3 8"   GRAVEL

WELL SEAT: BENTONITE CHIPS - HYDRATED

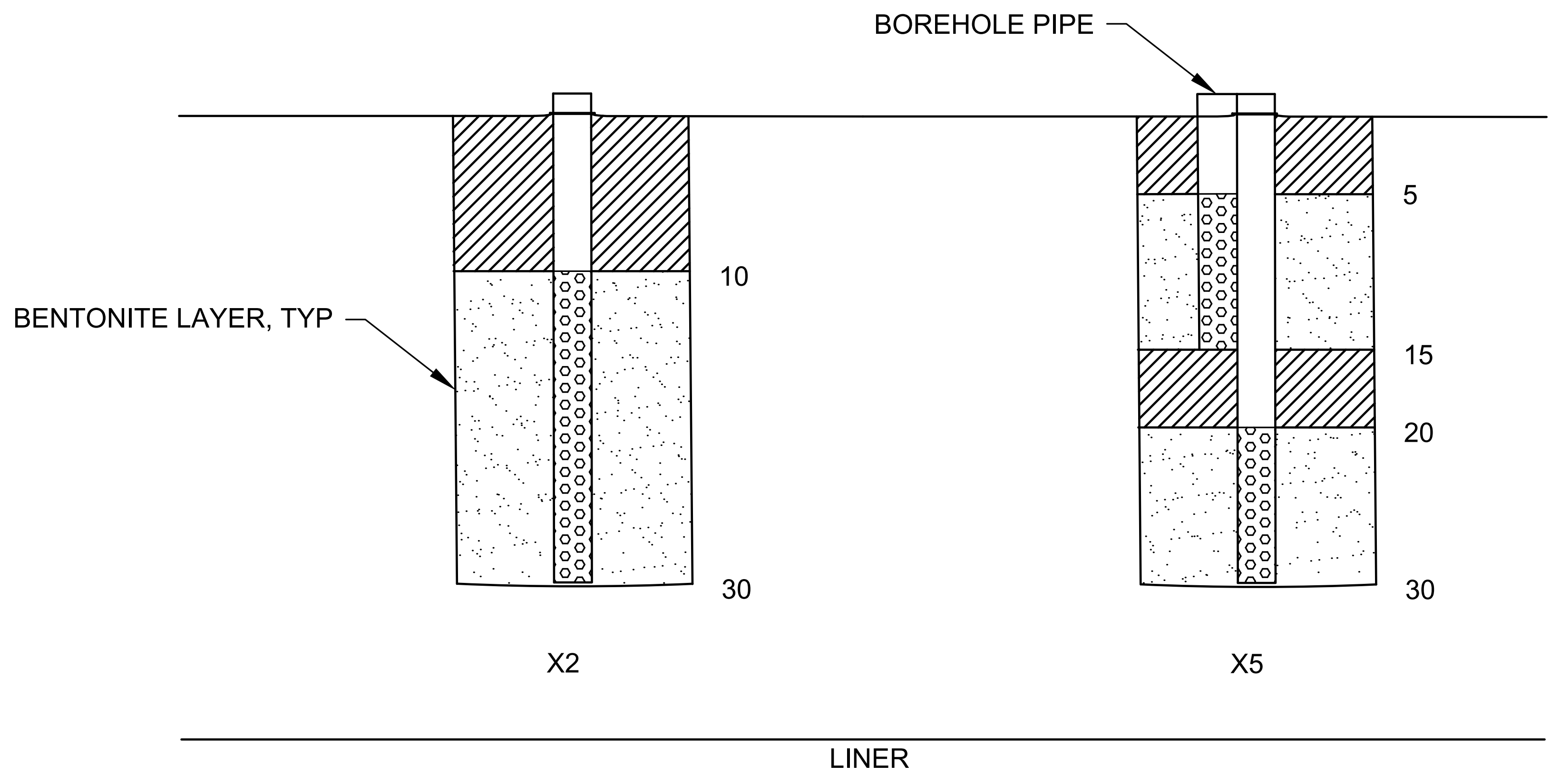


CELL 1 | 1
SCALE: NTS | –

APPENDIX U



CELL 2 | 2
SCALE: NTS | –



CELL 3 | 3
SCALE: NTS | –

NO.	REVISIONS	BY	DATE

W.R. HENDERSON
CONSTRUCTION, INC.

PROJECT NO. 01-17-0002
DRAWN SS
DESIGNED BEC
APPROVED BEC
QA/QC

NUERA
BAYVIEW LANDFILL

BAYVIEW LANDFILL LFG COLLECTION SYSTEM

DETAIL

SHEET NO:
C-DT-03
DATE:
MAY 2019
PAGE NO:

APPENDIX V – CLOSURE CAP EQUIVALENCY

APPENDIX N

APPENDIX V

Closure Cap Equivalency

SUVSWD Bayview Class I Landfill
Permit Application

METEORIC WATER INFILTRATION STUDY
SOUTH UTAH VALLEY LANDFILL
(BAYVIEW LANDFILL)
UTAH COUNTY, UTAH

For: HDR

HDR Engineering, Inc.

September 9, 2003

A Report Prepared For:

Mr. Dick Sprague
HDR Engineering, Inc.
303 East 17th Avenue, Suite 300
Denver, CO 80203-1256

METEORIC WATER INFILTRATION STUDY SOUTH UTAH VALLEY LANDFILL (BAYVIEW LANDFILL) UTAH COUNTY, UTAH

File No.: 26515.001

Prepared By:

RDZ for

Brian J. Peck, R.G.
Hydrogeologist

Renee Zollinger, P.G.
Senior Geologist

KLEINFELDER, INC.
849 West LeVoy Drive, Suite 200
Taylorsville, UT 84123
(801) 261-3336

September 9, 2003

TABLE OF CONTENTS

SECTION **PAGE**

TABLES

FIGURES

APPENDICES

1. INTRODUCTION

Bayview Landfill, also called the South Utah Valley Landfill, is located approximately 5 miles north of Elberta, Utah, along State Road 68 (Figure 1). This landfill is a Class I municipal solid waste landfill and began accepting solid waste in 1990. Cell 1 is scheduled for closure during the next year, and the South Utah Valley Solid Waste District wishes to consider modifying their permit to include closure with an evaporative cap. Recent studies have shown that appropriate evaporative caps out-perform standard clay caps in arid environments because they are less prone to desiccation, cracking, and frost damage when compared to traditional thin clay caps. South Utah Valley Solid Waste District would like to take advantage of long-term benefits offered by this type of alternative cap.

The following report describes our assessment of expected long-term meteoric water infiltration or seepage rates through an evaporative cap at Bayview Landfill constructed from on-site soils. Infiltration is defined as precipitation minus surface run-off, evaporation and plant transpiration. The net infiltration rate multiplied by the clay cap area is the net seepage volume that may contribute to formation of leachate. Expected infiltration rates were established by using the HYDRUS-2D saturated/unsaturated flow model (Version 2.0; Simunek and van Genuchten, 1999). Infiltration rates were determined for the standard regulatory prescribed cap and for the proposed site-specific cap materials. The prescriptive cap simulation was constructed using clay and silty clay materials, expected to have the lowest permeabilities. Infiltration processes are rarely saturated, however. Unsaturated soil hydraulic properties are highly non-linear functions of the pressure head (pressure head is also termed 'matric potential' and 'capillary suction'). Soil moisture or saturation and hydraulic conductivity are both a function of pressure head. These three variables interact to control the movement of soil moisture in the vadose or unsaturated zone. To simulate the behavior of a hypothetical prescriptive cap under the climatic conditions at the Bayview Landfill, a bracketing range of unsaturated soil parameters were selected. The resulting prescriptive cap infiltration rates are then compared to the infiltration rates modeled for the actual on-site materials.

2. MODEL CODE SELECTION

The U.S. Salinity Laboratory's HYDRUS-2D unsaturated flow code was used to predict infiltration through the Bayview Landfill's proposed evaporative cap. This model is a windows based platform for running the public domain SWMS_2D finite element code published by Simunek, Vogel and van Genuchten (1992, 1994).

This model code was chosen because it incorporates the Richard's equations for groundwater flow under conditions of partial saturation and can simulate hydraulic gradients and movement based on soil moisture retention characteristics. The code is widely used in arid regions research. A key factor of concern in arid environments is the upward capillary movement of water towards the drying atmospheric interface caused by soil suction or matric potential under changing conditions of surface soil moisture resulting from infrequent light precipitation events and the intervening relatively long duration desiccation periods. The EPA HELP3 model code developed for evaluation of infiltration into and leakage from landfills (Schroeder et al, 1994) only accounts for gravity drainage of rainfall and is therefore more appropriate for sites in the eastern U.S. where rainfall rates are much higher. In arid climates the HELP model tends to overestimate infiltration rates because it does not account for upward movement of soil moisture toward the land surface during drying intervals (Albright, 1997; Hart and Lassetter, 1999).

The HYDRUS-2D model reacts to heavy precipitation events by limiting surface infiltration to the maximum infiltration capacity of soil based on the unsaturated flow equations; precipitation amounts greater than this maximum rate are assumed to form runoff. The primary water budget processes that determine net infiltration rates occur in near surface materials that are transected by the evapotranspiration zone; the type and thickness of strata below the evapotranspiration depth do not significantly influence percolation rates if they are more transmissive than the near surface materials. The HELP model requires that the evapotranspiration depth be specified *a priori*. The HYDRUS-2D model handles evaporation by using maximum *potential* evaporation at the soil surface. The evaporation depth is implicitly computed by HYDRUS-2D during runtime according to the unsaturated flow equation. The user specifies the potential maximum evaporation rate and the simulation code computes movement of water based on saturated and/or unsaturated hydraulic gradients that depend on antecedent moisture conditions.

3. CLIMATIC CONDITIONS

The HYDRUS-2D model requires specification of daily rainfall and potential evaporation to simulate net infiltration. To obtain worst-case infiltration results, plant cover was excluded from all models prepared for this report, so potential transpiration was not quantified. It is assumed that the addition of plants will reduce infiltration approximately equally for each cap modeled. Potential evaporation at the Bayview Landfill site is a function of wind speed, relative humidity, temperature, precipitation, and insolation (solar energy). Daily precipitation and potential evapotranspiration values were obtained for the Elberta, Utah, weather station site from the Utah Climate Center, University of Utah.

The Utah Climate Center database precipitation values for the Elberta station have an annual average of 10.54 inches for the period of record (1928–1990). Monthly average precipitation amounts for Elberta are shown in Table 1.

For modeling a worst case scenario, the DSHW suggested running the five wettest years on record in sequence. The five wettest years in Elberta were 1983, 1982, 1941, 1967, and 1946, with precipitation rates of 19.34, 17.42, 14.28, 14.04, and 13.84 inches for these years, respectively. Monthly values for each of these years are shown in Table 1.

4. SOIL HYDRAULIC PROPERTIES

Partial saturation or unsaturated flow hydraulic properties include the effective porosity, the saturated and residual water capacity, the saturated hydraulic conductivity, and the matric potential versus water content curve that is summarized by the van Genuchten soil moisture retention parameters. Effective porosity is the maximum amount of water that fully saturated soil can store. Matric potential is the physical property of a porous medium to attract water as a result of capillary and adsorption processes. The residual capacity of a soil is the virtually irreducible amount of water in soil that has been exposed to desiccating conditions for a long period of time; it is defined as having a matric potential of –15 bar, which is a pressure of about –153 meters of water. The negative pressure is a convention for describing conditions of partial saturation; the pressure is equal to the absolute hydraulic pressure required to drive the water from a sample. The van Genuchten parameters describe the shape of the soil matric potential (capillary suction) curve as a function of volumetric soil moisture. From this is derived the hydraulic conductivity versus soil moisture curve using the equations of Mualem (1976).

4.1 PROPERTIES OF THE IN-PLACE CAP

Unsaturated hydraulic analyses were conducted on samples of potential cap materials collected from the Bayview Landfill site. Four soil samples were collected from representative locations on February 18, 2003. These samples were selected based on the range of observed soil types at the Landfill. The soil sample locations are shown on Figure 2. The samples are described as follows:

Sample ID	Location	Soil Description	General Compaction
BVLF-1	Soil berm	Red-yellow sandy silt (SM)	Uncompacted
BVLF-2	Soil stockpile	Olive-brown silty sand (SM)	Somewhat compacted by equipment during placement
BVLF-3	Soil stockpile	Olive-brown silty sand (SM)	Somewhat compacted by equipment during placement
BVLF-4	In-situ bottom of cell 2	Red-brown silty sand (SP-SM) referred to as "mud stone" or "hardpan"	In-situ compaction

The saturated hydraulic conductivity for the four samples ranges from 1.3 x 10^{-3} to 3.8 x 10^{-6} cm/sec, with the hydraulic conductivity of the olive-brown silty sand (BVL F-2 and -3) ranging from 1.3 x 10^{-5} to 3.8 x 10^{-6}. Other parameters are summarized in Table 2. The laboratory report is included in Appendix A.

4.2 PROPERTIES OF THE PRESCRIPTIVE CAP

Unsaturated flow parameters were estimated for the regulatory prescriptive cap assuming the prescriptive cap would be a clay material (see Table 3). Uncertainty regarding exactly which soil texture best approximates the low-permeability portion of the prescriptive cap material led to an approach involving three soil types which bracket the low-permeability portion of the most probable analogue. Three soil types were chosen that exhibited the lowest saturated hydraulic conductivities; these are silty clay, silty clay loam and sandy clay. The hydraulic parameters for these soils range from 5.6x10^{-6} to 3.3x10^{-5}. The low-permeability layer was then covered with a 28-inch sandy loam topsoil to protect the low permeability layer from frost damage. Site specific frost depth information is presented in Appendix B. Soil textures used for modeling are shown in Table 4.

The Solid Waste Rules also specify that the permeability of the prescriptive caps be lower than the permeability of the bottom liner. The bottom liner for Cell 1 consists of an HDPE synthetic liner placed on underlying native soil (a sandy silt to silty sand). The effective permeability of this liner system was calculated using equations developed by J.P. Giroud and R. Bonaparte, 1989. To be conservative, we assumed that the soil under the HDPE liner is a coarse sand, the liner makes good contact with the underlying soil, and that the installation quality was good to excellent (one small, circular hole per acre). We also assumed that up to 1 foot of leachate could be standing on the liner, creating a vertical head. These assumptions were input into Giroud and Bonaparte's equations, and the resulting predicted liner leakage rate is 470 gal/acre/day, or approximately 16 cm/year.

5. HYDRUS-2D MODEL DESIGN

The HYDRUS-2D finite element model was discretized in the manner of a soil column test, with one-dimensional flow from the atmospheric boundary condition at the top of the column to a free-drainage boundary at the bottom of the column. The height of the column was specified to be 215 cm using 50 rows and variable cell sizes from 0.5 to 5 cm. Row height was specified to be 0.5 cm at land surface, at the seepage face, and at each side of a soil texture interface. The uppermost boundary was specified to be an atmospheric boundary with daily time-variable records for rainfall and evaporation potential. Water leaves the model system by gravity drainage from the free drainage boundary when it is fully saturated. The amount of water draining from the drainage boundary was used to quantify the net amount of water infiltrating into the landfill waste.

The model for the prescriptive cap was designed to include a 71 cm (28 inch) thick topsoil layer at the surface, underlain by 45 cm (18 inches) of clay cap material, with the base of the model domain consisting of 94 cm (37.5 inches) of sand to simulate the landfill waste material. A summary of the materials used in the prescriptive cap simulations is shown in Table 5.

The model for the actual cap was designed to include a 5 cm (2 inch) thick topsoil layer consistent with normal surface disturbance, underlain by 81 cm (32 inches) of cap material, with the base of the model consisting of 130 cm (51 inches) of the sand/waste layer. The thickness of the evaporative cap was selected after running several models of various thicknesses to better understand the balance between promoting maximum evaporation (by using of a thinner cap to maintain moisture close to the evaporative surface) and providing sufficient storage for precipitation (by using of a thicker cap that doesn't become saturated and allow breakthrough.)

The initial soil moisture pressure, an important variable influencing short term seepage rates, was specified to be in equilibrium throughout the soil column with a –50 cm matric potential specified at the base of the model domain for all model runs. This pressure is slightly dryer than the subsequent dynamic equilibrium moisture at the base of the model. Net infiltration of rainfall at the land surface during the five wettest year sequence is more accurately quantified by having the water content at near-equilibrium levels at the base of the soil column. Model predictions of infiltration rates are sensitive to the initial soil moisture values, but the long-term dynamic equilibrium infiltration rates are not affected by antecedent soil moisture.

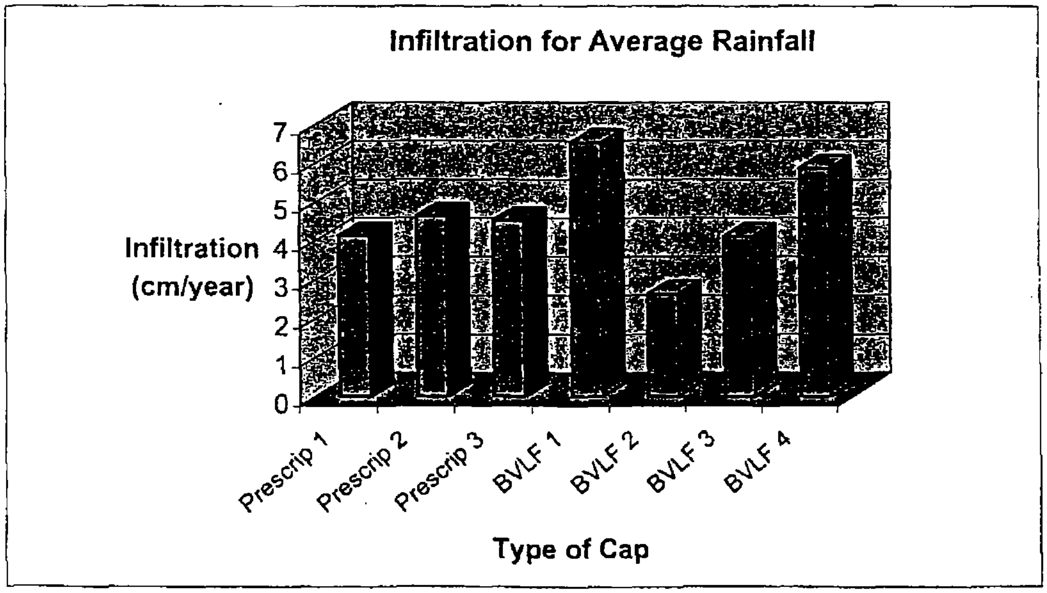
Transpiration was not included in the model due to the relatively small percentage that it constitutes relative to evaporation potential and the fact that parameters for soil moisture uptake rates for desert shrubs and grasses are poorly documented. One study reports plant transpiration as contributing three percent of the total evapotranspiration potential in Jean, Nevada, and 32 percent for good grass cover on a landfill in Elko, Nevada (Albright, 1997). Excluding plant transpiration is a conservative choice that tends to increase the predicted net infiltration rates. Similar plant growth is expected on both prescriptive and proposed evaporative caps, so making a comparison between performance of these caps should not be significantly affected by the presence or absence of vegetation.

6. HYDRUS-2D INFILTRATION SIMULATIONS

Three prescriptive cap design scenarios were evaluated based upon different soil textures for the 18-inch thick clay cap material. Four actual cap scenarios were evaluated based on measured soil properties. The models were run both for average climatic conditions, and for the five wettest years in sequence (beginning at equilibrium with the average years). Infiltration rates were calculated for both average conditions and each of the five wettest years.

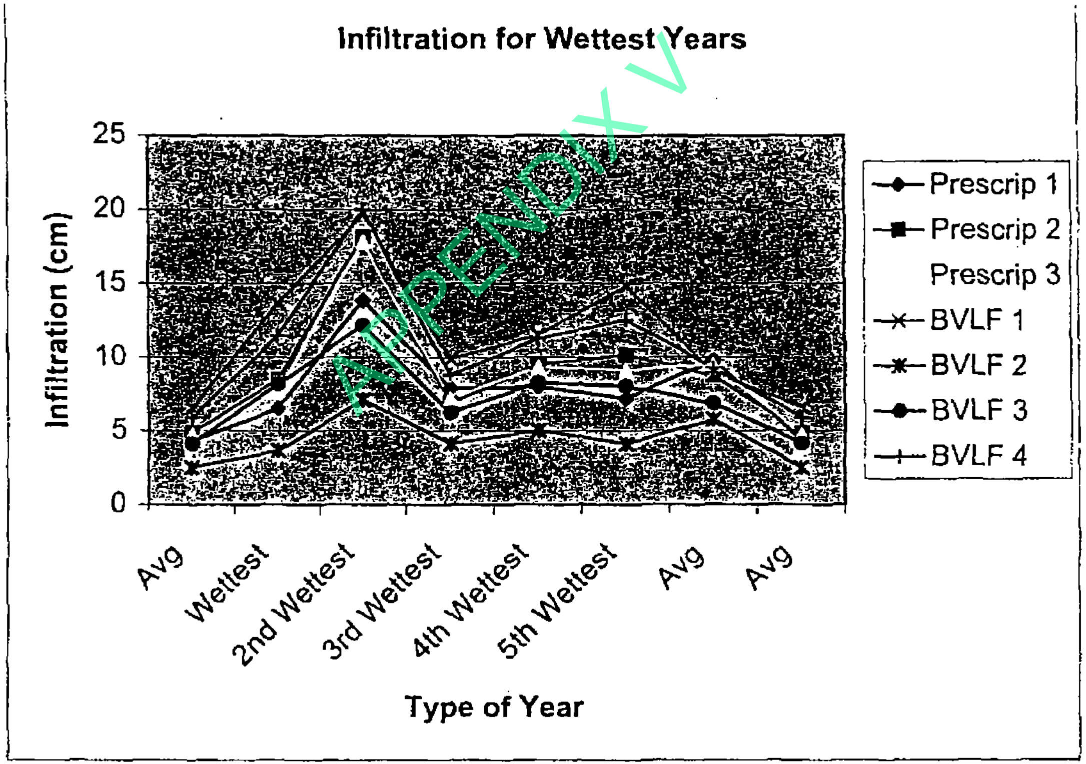
6.1 AVERAGE CLIMATIC CONDITIONS

Under average (normal) climatic conditions observed in nearby Elberta, Utah, the prescriptive caps allow an average of 4.14 to 4.65 cm of infiltration to occur each year. Under the same climatic conditions, evaporative caps constructed of the four potential soils assessed for use at Bayview Landfill allow 2.63 to 6.55 cm of infiltration to occur each year. The olive-brown silty sand material that has been stockpiled at the site (samples BVLF1 and BVLF2) is expected to allow infiltration rates of 2.63 to 4.12 cm/year. These results are shown on Table 5. A graph depicting these results is shown below.



6.2 WETTEST (WORST-CASE) CLIMATIC CONDITIONS

Under an assumed worst-case climatic condition where the five wettest years on record at Elberta, Utah were to occur sequentially, the three modeled prescriptive caps would allow infiltration at rates ranging from 6.49 to 18.12 cm/year. Under the same climatic conditions, evaporative caps constructed of the four potential soils assessed for use at Bayview Landfill allow 3.63 to 20 cm of infiltration per year. The olive-brown silty sand material that has been stockpiled at the site is associated with infiltration rates of 3.63 to 12.17 cm/year. These results are shown on Table 5. A graph depicting these results is shown below.



7. CONCLUSIONS

Based on unsaturated flow modeling, it appears that a 34-inch evaporative cap, constructed from the olive-brown silty sand material available at Bayview Landfill, will perform as well or better than the hypothetical prescriptive cap under the arid conditions that exist in the area. The proposed evaporative cap performed as well as the prescriptive cap during both the worst case "wet" years, and during normal (dry) years. Both the prescriptive cap and the proposed evaporative cap have much lower predicted infiltration rates (less than 7 cm/year) than the leakage rate of the bottom liner (16 cm/year). Therefore, both caps satisfy the requirement of the Solid Waste Rules that the cap be no more permeable than the liner.

To provide a more detailed description of the proposed capping material and provide quantitative criteria for identifying these materials in the field, Kleinfelder performed a source material investigation in May 2003 (Kleinfelder 2003). A summary of criteria that may be used to identify suitable material (materials that are represented by BVLF-2 and BVF-3) is included in Appendix C.

8. LIMITATIONS

The unsaturated groundwater model described in this report was used to predict infiltration rates based upon estimates of the regulatory prescriptive cap unsaturated hydraulic parameters and laboratory analyses of the on-site materials. The accuracy of infiltration rate estimates resulting from numerical models is entirely dependant upon the validity of the hydraulic parameters used to construct the model. The simulated infiltration rates are sensitive to the unsaturated flow parameters. These and other subsurface hydraulic parameters generally exhibit spatial heterogeneity. Therefore, simulated infiltration rates are considered to be best estimates and not precise predictions of actual field infiltration rates. No on-site hydraulic testing was performed for this project by Kleinfelder, Inc. Field tests are available which would reduce the level of uncertainty associated with estimating subsurface hydraulic properties.

This study was performed and findings obtained in substantial conformance with the engineering practice that exists within the area at the time of our investigation and includes professional opinions and judgements. We base this report on information derived from data in available literature and our knowledge of and experience in the local area. This report does not provide a warranty as to variable subsurface conditions which may exist and applies only to the specific area that was investigated. In addition, one should recognize that definition and evaluation of subsurface geologic and hydrogeologic conditions is a difficult and inexact art. Geologists and hydrogeologists must occasionally make general judgements leading to conclusions with incomplete knowledge of the geologic history, subsurface conditions and hydraulic characteristics present. No warranty, express or implied, is made.

9. REFERENCES

Albright, William, 1997, Application of the HYDRUS-2D Model to Landfill Cover Design in the State of Nevada, Water Resources Center, Desert Research Institute, Publication No. 41153, prepared for Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Solid Waste Branch, Bureau of Waste Management, January, 1997, 18 p.

Carsel, R.F., and Parrish, R.S., 1988, Developing Joint Probability Distributions of Soil-Water Retention Characteristics, Water Resources Research, 24 (5), pp. 755-769.

Daniel B. Stephens & Associates, Inc., 2003, laboratory analysis sheets for Bayview Landfill soil samples including: Predicted Water Retention Curves (Pressure Head vs. Moisture Content), Relative Hydraulic Conductivity vs. Moisture Content, Relative Hydraulic Conductivity vs. Pressure Head, Moisture Retention Data (Hanging Column/Pressure Plate/Thermocouple/Relative Humidity Box), Particle Size Characteristics, Particle Size Analyses (Dry Sieve, Wet Sieve and Hydrometer), Saturated Hydraulic Conductivity Tests, Atterburg Tests, Initial Moisture Content, Dry Bulk Density, Wet Bulk Density, Calculated Porosity, and Percent Saturation.

EPA, 1990, A Subtitle D Landfill Application Manual for the Multimedia Exposure Assessment Model (MultiMed), by Susan Sharp-Hansen, Constance Travers, Paul Hummel, AQUA TERRA Consultants, Mountain View, California, and Terry Allison, Computer Sciences Corporation, Athens Georgia, August, 1990; EPA Contract 68-03-3513, Project Monitor Gerard Laniak.

Giroud, J.P. and R. Bonaparte, 1989. "Leakage Through Liners Constructed with Geomembranes, Part 1," Geomembrane Liners, Geotextiles and Geomembranes, 8, 1:27-67.

Hart, B., and Lassetter, W., 1999, Numerical Modeling of Heap Leach, Tailings and Waste Rock Facility Cover Alternatives, In Closure, Remediation & Management of Precious Metals Heap Leach Facilities, edited by D. Kosich and G. Miller, Center for Environmental Sciences and Engineering, University of Nevada, Reno.

Kleinfelder, 2003. Source Material Investigation, South Utah Valley Landfill (Bayview Landfill), July 10, 2003. File No. 30268.001.

Mualem, Y., 1976, A new model for predicting the hydraulic conductivity of unsaturated porous media, Water Resources Research, 12(3), 513-522.

Schroeder, P.R., Dozier, T.S., Zappi, P.A., McEnroe, B.M., Sjostrom, J.W., and Peyton, R.L., 1994, The Hydrologic Evaluation of Landfill Performance (HELP) Model, Environmental Laboratory, U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS 39180-6199, with the Risk Reduction Engineering Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio, EPA/600/R-94/168b

Simunek, J.T. Vogel, T. and van Genuchten, M.T., 1992, The SWMS_2D code for simulating water flow and solute transport in two-dimensional variably saturated media, Version 1.1; Research Report No. 126, U.S. Salinity Laboratory, U.S. Department of Agriculture, Agriculture Research Station, Riverside, California.

Simunek, J.T. Vogel, T. and van Genuchten, M.T., 1994, The SWMS_2D code for simulating water flow and solute transport in two-dimensional variably saturated media, Version 1.1; Research Report No. 136, U.S. Salinity Laboratory, U.S. Department of Agriculture, Agriculture Research Station, Riverside, California.

Simunek, J.T., and van Genuchten, M.T., 1999, The HYDRUS-2D software package for simulating water flow and solute transport in two-dimensional variably saturated media, Version 2.0, U.S. Salinity Laboratory, U.S. Department of Agriculture, Agriculture Research Station, Riverside, California.

van Genuchten, M.T., 1980, A closed form equation for predicting the hydraulic conductivity of unsaturated soils, Soil Science Society of America Journal 44:892-898.

TABLE 1

Average Precipitation and Five Wettest Years on Record (inches)

Elberta, Utah

	Precipitation (inches)					
Month	**Average**	**1983**	**1982**	**1941**	**1967**	**1946**
Jan	.81	1.24	1.12	0.53	1.89	1.04
Feb	.84	2.00	0.33	1.42	0.23	0.11
Mar	.99	2.30	1.12	1.66	0.74	0.88
Apr	1.03	1.32	0.41	1.25	0.88	1.46
May	1.03	1.67	1.66	0.64	2.52	1.68
Jun	0.73	0.89	0.57	1.75	2.44	0
Jul	0.8	0.82	3.67	1.07	2.04	0.72
Aug	0.94	2.11	0.38	0.85	0.15	1.27
Sep	0.72	1.76	5.30	0.54	0.58	0
Oct	1.01	0.57	1.46	2.71	0.39	3.96
Nov	0.86	2.69	0.73	0.46	0.94	1.84
Dec	0.81	1.97	0.67	1.40	1.24	0.88
Sum:	**10.54**	**19.34**	**17.42**	**14.28**	**14.04**	**13.84**

Date from University of Utah, Utah Climate Center, Elberta Station
Period of Record (1/1/1928 to 12/31/90)
Station: Elberta, Utah

TABLE 2
Unsaturated Hydraulic Parameters for Bayview Landfill Samples

Sample Name	Sample Description	Other	Water Content		Saturated Hydraulic Conductivity	Calculated van Genuchten parameters	
			Saturation	Residual	(cm/sec)	Alpha (1/cm)	n
BVLF-1	Sandy Silt (MH)	Red yellow	0.6671	0.000	4.1 x10^{-5}	0.0051	1.35
BVLF-2	Silty Sand (SM)	Olive brown	0.4035	0.000	3.8 x10^{-6}	0.0062	1.30
BVLF-3	Silty Sand (SM)	Olive brown	0.3846	0.000	1.3 x10^{-5}	0.0071	1.27
BVLF-4	Silty Sand (SM)	Red to brown	0.5395	0.020	1.3 x10^{-3}	0.0470	1.36

Note: These values reported by Daniel B. Stephens and Associates, Inc.

TABLE 3
General Unsaturated Hydraulic Parameters from Literature

Soil Type	Water Content		Saturated Hydraulic Conductivity	van Genuchten parameters	
	Saturation	Residual	(cm/sec)	Alpha (1/cm)	n
Sand	0.43	0.045	8.3 x10^{-3}	0.145	2.68
Loamy sand	0.41	0.057	4.1 x10^{-3}	0.124	2.28
Sandy loam	0.41	0.065	1.2 x10^{-3}	0.075	1.89
Sandy clay loam	0.39	0.100	3.6 x10^{-4}	0.059	1.48
Loam	0.43	0.078	2.9 x10^{-4}	0.036	1.56
Sandy clay	**0.36**	**0.070**	**3.3 x10^{-5}**	**0.027**	**1.23**
Silty loam	0.45	0.067	1.3 x10^{-4}	0.020	1.41
Clay loam	0.41	0.095	7.2 x10^{-5}	0.019	1.31
Silt	0.46	0.034	6.9 x10^{-5}	0.016	1.37
Silty Clay Loam	**0.43**	**0.089**	**1.9 x10^{-5}**	**0.010**	**1.23**
Clay	0.38	0.068	5.6 x10^{-5}	0.008	1.09
Silty Clay	**0.36**	**0.070**	**5.6 x10^{-6}**	**0.005**	**1.09**

Note: Source: Carsel and Parrish (1988)
Values are averages of hundreds of samples for each soil type.

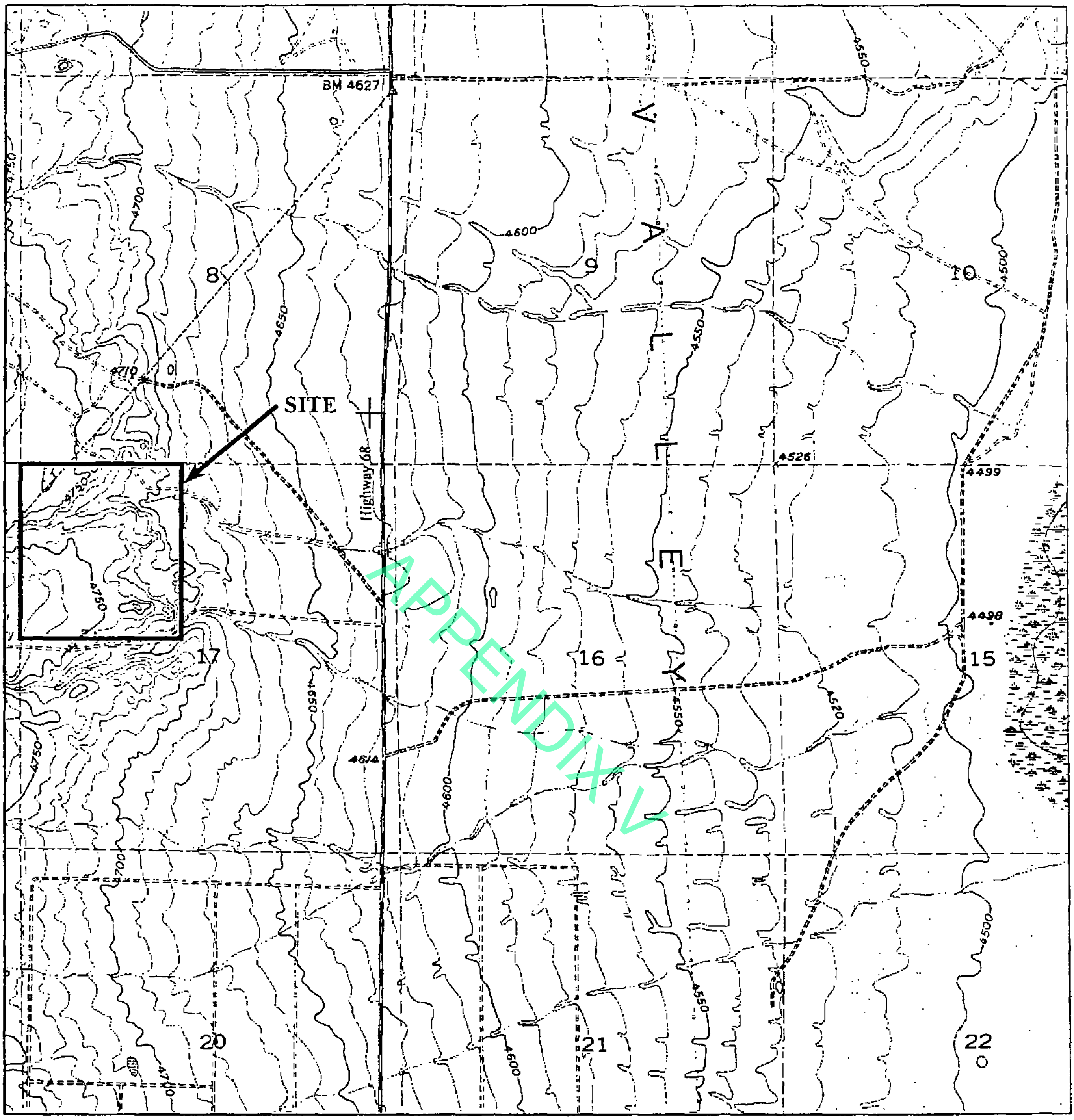
TABLE 4
Summary of Hydraulic Properties used for Prescriptive Cap Simulations

Material Description	Soil Type	Water Content		Saturated Hydraulic Conductivity (cm/sec)	van Genuchten parameters	
		Saturation	Residual		Alpha (1/cm)	n
Topsoil	Sandy loam	0.41	0.065	1.2 x10^{-3}	0.075	1.89
Clay Cap(1)	Silty Clay	0.36	0.070	5.6 x10^{-6}	0.005	1.09
Clay Cap(2)	Silty Clay Loam	0.43	0.089	1.9 x10^{-5}	0.010	1.23
Clay Cap(3)	Sandy clay	0.36	0.070	3.3 x10^{-5}	0.027	1.23
Fill material	Sand	0.43	0.045	8.3 x10^{-3}	0.145	2.68

TABLE 5
Summary of Model Results

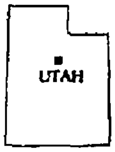
Scenario	Cap design	Annual Infiltration Rate for 5 wettest years (cm/year)	Annual Infiltration Rate for 5 wettest years (inches/year)	Average Annual Infiltration Rate for 5 normal years (cm/year)	Average Annual Infiltration Rate for 5 normal years (inches/year)
Prescriptive Caps					
Presc-1	Sandy Loam (28") Silty Clay cap (18") Sand* (37.5")	6.49 to 13.85	2.56 to 5.45	4.14	1.63
Presc -2	Sandy Loam (28") Silty Clay Loam cap (18") Sand* (37.5")	6.84 to 18.12	2.69 to 7.13	4.65	1.83
Presc -3	Sandy Loam (28") Sandy Clay cap (18") Sand* (37.5")	7.22 to 17.78	2.84 to 7.00	4.53	1.78
Evaporative Cap					
BV-1	Sandy Loam (2") Sample T1-D (32") Sand* (51")	9.9 to 19.65	3.9 to 7.74	6.55	2.58
BV-2	Sandy Loam (2") Sample T2-Da (32") Sand* (51")	3.63 to 7.07	1.43 to 2.78	2.63	1.04
BV-3	Sandy Loam (2") Sample T2-Db (32") Sand* (51")	6.23 to 12.17	2.45 to 4.79	4.12	1.62
BV-4	Sandy Loam (2") Sample T5-D (32") Sand* (51")	8.78 to 19.99	3.46 to 7.87	5.88	2.31

* "Sand" layer simulates the porous waste materials in the landfill.



BASE MAP:
GOSHEN VALLEY NORTH, UTAH
U.S.G.S. 7.5 MINUTE QUADRANGLES
PHOTOREVISED 1975

0' 1000' 2000'
SCALE 1:24,000
1" = 2000'
CONTOUR INTERVAL 10 FEET



QUADRANGLE LOCATION

SLC3Q102.ppt

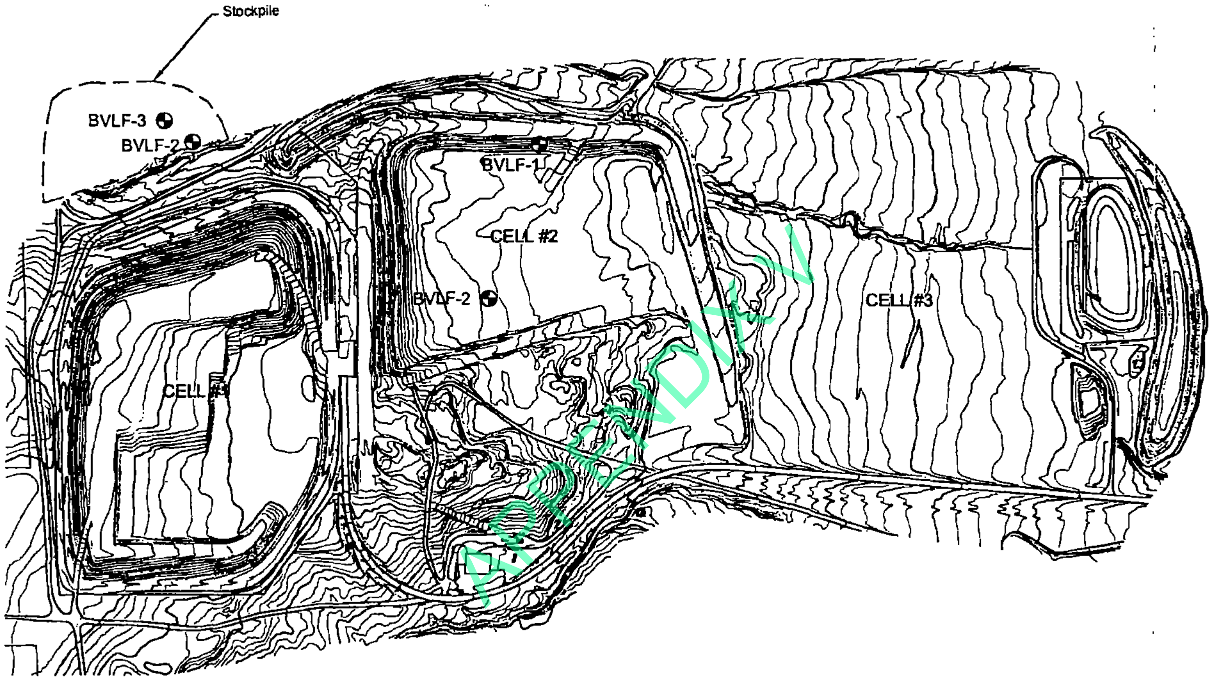
KLEINFELDER

Project Number 26515.001

South Utah Valley Landfill
Approximately 5.6 Miles North of
Elberta, Utah
on Highway 68

SITE LOCATION MAP

FIGURE
1



LEGEND

BVLF-3 ⊕ Approximate Soil Sample Location

SLC3d155.dwg

KLEINFELDER

Project Number 26515.001

Bayview Meteoric Infiltration Study
Approximately 5.6 Miles North of Elberta
Elberta, Utah

SOIL SAMPLE LOCATION MAP

FIGURE
2

March 13, 2003

Ms. Renee Zollinger
Kleinfelder
2677 East Parley's Way
Salt Lake City, UT 84109-1617
(801) 466-6769

Dear Ms. Zollinger:

Enclosed is the final report for the Kleinfelder (Bayview LF) job #26515.001. Please review this report and provide any comments as samples will be held for a maximum of 30 days. After 30 days samples will be returned or disposed of in an appropriate manner.

All testing results were evaluated subjectively for consistency and reasonableness, and the results appear to be reasonably representative of the material tested. However, DBS&A does not assume any responsibility for interpretations or analyses based on the data enclosed, nor can we guarantee that these data are fully representative of the undisturbed materials at the field site. We recommend that careful evaluation of these laboratory results be made for your particular application.

We are pleased to provide this service to Kleinfelder and look forward to future laboratory testing on other projects. If you have any questions about the enclosed data, please do not hesitate to call.

Sincerely,

DANIEL B. STEPHENS & ASSOCIATES, INC.

Daniel O'Dowd
Enclosure

L:\Lab\WR03 0035 00 Kleinfelder-Bayview LF\Cover Letter.doc

Daniel B. Stephens & Associates, Inc.
6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

Summary of Tests Performed

Laboratory Sample Number	Initial Soil Properties[1] (θ, ρ_d, ϕ)	Saturated Hydraulic Conductivity[2]		Moisture Characteristics[3]					Unsaturated Hydraulic Conductivity	Particle Size[4]			Effective Porosity	Particle Density	Air Permeability	1/3, 15 Bar Points and Water Holding Capacity	Atterberg Limits	Proctor Compaction
		CH	FH	HC	PP	TH	WP	RH		DS	WS	H						
BLUF-1	X	X		X	X		X	X	X									
BLUF-2	X	X		X	X		X	X	X									
BLUF-3	X	X		X	X		X	X	X									
BLUF-4	X	X		X	X		X	X	X									

[1] θ = Initial moisture content, ρ_d = Dry bulk density, ϕ = Calculated porosity

[2] CH = Constant head, FH = falling head

[3] HC = Hanging column, PP = Pressure plate, TH = Thermocouple psychrometer, WP = Water activity meter, RH = Relative humidity box

[4] DS = Dry sieve, WS = Wet sieve, H = Hydrometer

Summary of Saturated Hydraulic Conductivity Tests

Sample Number	K_{sat} (cm/sec)	Method of Analysis	
		Constant Head	Falling Head
BLUF-1	4.1E-05	X	
BLUF-2	3.8E-06	X	
BLUF-3	1.3E-05	X	
BLUF-4	1.3E-03	X	

Summary of Initial Moisture Content, Dry Bulk Density Wet Bulk Density and Calculated Porosity

Sample Number	Initial Moisture Content Gravimetric (%, g/g)	Initial Moisture Content Volumetric (%, cm³/cm³)	Dry Bulk Density (g/cm³)	Wet Bulk Density (g/cm³)	Calculated Porosity (%)
BLUF-1	35.0	29.3	0.84	1.13	68.4
BLUF-2	18.6	27.2	1.46	1.74	44.7
BLUF-3	13.4	21.2	1.58	1.79	40.4
BLUF-4	17.1	21.7	1.27	1.49	52.0

Summary of Moisture Characteristics of the Initial Drainage Curve

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm^3/cm^3)
BLUF-1	0	66.9
	21	65.6
	49	63.4
	150	60.4
	510	43.4
	16623	15.3
	851293	2.5
BLUF-2	0	40.1
	21	39.6
	49	38.0
	150	37.3
	510	25.2
	7445	14.1
	851293	2.7
BLUF-3	0	38.2
	21	37.8
	49	36.3
	150	34.4
	510	24.6
	17541	11.7
	851293	2.5
BLUF-4	0	54.6
	10	48.3
	43	41.7
	80	30.8
	510	18.5
	9892	8.1
	851293	2.9

Summary of Calculated Unsaturated Hydraulic Properties

Sample Number	α (cm^{-1})	N (dimensionless)	θ_r	θ_s
BLUF-1	0.0051	1.3508	0.0000	0.6671
BLUF-2	0.0062	1.2957	0.0000	0.4035
BLUF-3	0.0071	1.2714	0.0000	0.3846
BLUF-4	0.0470	1.3613	0.0200	0.5395

APPENDIX V

Raw Laboratory Data and Graphical Plots

Summary of Initial Moisture Content, Dry Bulk Density Wet Bulk Density and Calculated Porosity

	Initial Moisture Content		Dry Bulk	Wet Bulk	Calculated
Sample Number	Gravimetric (%, g/g)	Volumetric (%, cm^3/cm^3)	Density (g/cm^3)	Density (g/cm^3)	Porosity (%)
BLUF-1	35.0	29.3	0.84	1.13	68.4
BLUF-2	18.6	27.2	1.46	1.74	44.7
BLUF-3	13.4	21.2	1.58	1.79	40.4
BLUF-4	17.1	21.7	1.27	1.49	52.0

Daniel B. Stephens & Associates, Inc.

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: Kleinfelder
Job Number: WR03.0035.00
Sample Number: BLUF-1
Ring Number: NA
Depth: NA

Test Date: 2-Feb-03

Field weight of sample* (g): 98.16
Tare weight, ring (g): 36.57
Tare weight, cap/plate/epoxy (g): 0.00

Dry weight of sample (g): 45.63
Sample volume (cm^3): 54.44
Assumed particle density: 2.65

Initial Volumetric Moisture Content (% vol): 29.3
Initial Gravimetric Moisture Content (% g/g): 35.0
Dry bulk density (g/cm^3): 0.84
Wet bulk density (g/cm^3): 1.13
Calculated Porosity (% vol): 68.4
Percent Saturation: 42.9

Comments:

* Weight including tares

Laboratory analysis by: M. Devine
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Daniel B. Stephens & Associates, Inc.

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: Kleinfelder
Job Number: WR03.0035.00
Sample Number: BLUF-2
Ring Number: NA
Depth: NA

Test Date: 2-Feb-03

Field weight of sample* (g): 122.60
Tare weight, ring (g): 34.07
Tare weight, cap/plate/epoxy (g): 0.00

Dry weight of sample (g): 74.67
Sample volume (cm^3): 50.99
Assumed particle density: 2.65

Initial Volumetric Moisture Content (% vol): 27.2
Initial Gravimetric Moisture Content (% g/g): 18.6
Dry bulk density (g/cm^3): 1.46
Wet bulk density (g/cm^3): 1.74
Calculated Porosity (% vol): 44.7
Percent Saturation: 60.8

Comments:

* Weight including tares

Laboratory analysis by: M. Devine
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: Kleinfelder
Job Number: WR03.0035.00
Sample Number: BLUF-3
Ring Number: NA
Depth: NA

Test Date: 2-Feb-03

Field weight of sample* (g): 156.11
Tare weight, ring (g): 41.93
Tare weight, cap/plate/epoxy (g): 0.00

Dry weight of sample (g): 100.70
Sample volume (cm^3): 63.72
Assumed particle density: 2.65

Initial Volumetric Moisture Content (% vol): 21.2
Initial Gravimetric Moisture Content (% g/g): 13.4
Dry bulk density (g/cm^3): 1.58
Wet bulk density (g/cm^3): 1.79
Calculated Porosity (% vol): 40.4
Percent Saturation: 52.4

Comments:

* Weight including tares

Laboratory analysis by: M. Devine
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: Kleinfelder
Job Number: WR03.0035.00
Sample Number: BLUF-4
Ring Number: NA
Depth: NA

Test Date: 2-Feb-03

Field weight of sample* (g): 128.63
Tare weight, ring (g): 39.39
Tare weight, cap/plate/epoxy (g): 0.00

Dry weight of sample (g): 76.24
Sample volume (cm^3): 59.97
Assumed particle density: 2.65

Initial Volumetric Moisture Content (% vol): 21.7
Initial Gravimetric Moisture Content (% g/g): 17.1
Dry bulk density (g/cm^3): 1.27
Wet bulk density (g/cm^3): 1.49
Calculated Porosity (% vol): 52.0
Percent Saturation: 41.7

Comments:

* Weight including tares

Laboratory analysis by: M. Devine
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Summary of Saturated Hydraulic Conductivity Tests

Sample Number	K_{sat} (cm/sec)	Method of Analysis	
		Constant Head	Falling Head
BLUF-1	4.1E-05	X	
BLUF-2	3.8E-06	X	
BLUF-3	1.3E-05	X	
BLUF-4	1.3E-03	X	

Saturated Hydraulic Conductivity
Constant Head Method

Job name: Kleinfelder
Job number: WR03.0035.00
Sample number: BLUF-1
Ring number: NA
Depth: NA

Type of water used: TAP
Collection vessel tare (g): 11.81
Sample length (cm): 2.97
Sample diameter (cm): 4.84
Sample x-sectional area (cm^2): 18.36

Date	Time	Temp (°C)	Head (cm)	Q + Tare (g)	Q (cm^3)	Elapsed time (sec)	Ksat (cm/sec)	Ksat @ 20°C (cm/sec)
Test # 1:								
26-Feb-03	12:50:43	18.5	12.8	13.6	1.8	561	4.0E-05	4.1E-05
26-Feb-03	13:00:04							
Test # 2:								
27-Feb-03	08:53:42	18.5	12.8	15.2	3.4	1089	3.9E-05	4.0E-05
27-Feb-03	09:11:51							
Test # 3:								
27-Feb-03	10:45:38	18.5	12.8	14.4	2.6	850	3.9E-05	4.0E-05
27-Feb-03	10:59:48							

Average Ksat (cm/sec): **4.1E-05**

Comments:

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Daniel B. Stephens & Associates, Inc.

Saturated Hydraulic Conductivity
Constant Head Method

Job name:	Kleinfelder	*Type of water used:*	TAP
Job number:	WR03.0035.00	*Collection vessel tare* (g):	11.81
Sample number:	BLUF-2	*Sample length* (cm):	2.77
Ring number:	NA	*Sample diameter* (cm):	4.84
Depth:	NA	*Sample x-sectional area* (cm^2):	18.42

Date	Time	Temp (°C)	Head (cm)	Q + Tare (g)	Q (cm^3)	Elapsed time (sec)	Ksat (cm/sec)	Ksat @ 20°C (cm/sec)
Test # 1:								
27-Feb-03	08:54:06	18.5	14.6	12.3	0.4	1119	4.1E-06	4.3E-06
27-Feb-03	09:12:45							
Test # 2:								
27-Feb-03	10:45:11	18.5	14.6	13.9	2.1	6055	3.6E-06	3.7E-06
27-Feb-03	12:26:06							
Test # 3:								
28-Feb-03	10:07:39	18.0	14.6	12.2	0.4	1303	3.4E-06	3.5E-06
28-Feb-03	10:29:22							

Average Ksat (cm/sec): 3.8E-06

Comments:

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Daniel B. Stephens & Associates, Inc.

Saturated Hydraulic Conductivity
Constant Head Method

Job name:	Kleinfelder	*Type of water used:*	TAP
Job number:	WR03.0035.00	*Collection vessel tare* (g):	10.71
Sample number:	BLUF-3	*Sample length* (cm):	3.41
Ring number:	NA	*Sample diameter* (cm):	4.88
Depth:	NA	*Sample x-sectional area* (cm^2):	18.67

Date	Time	Temp (°C)	Head (cm)	Q + Tare (g)	Q (cm^3)	Elapsed time (sec)	Ksat (cm/sec)	Ksat @ 20°C (cm/sec)
Test # 1:								
27-Feb-03	08:54:12	18.5	13.2	11.7	1.0	1085	1.2E-05	1.3E-05
27-Feb-03	09:12:17							
Test # 2:								
27-Feb-03	10:45:48	18.5	13.2	15.8	5.1	5873	1.2E-05	1.2E-05
27-Feb-03	12:23:41							
Test # 3:								
28-Feb-03	10:05:05	18.0	13.2	11.9	1.2	1265	1.3E-05	1.3E-05
28-Feb-03	10:26:10							

Average Ksat (cm/sec): **1.3E-05**

Comments:

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Daniel B. Stephens & Associates, Inc.

Saturated Hydraulic Conductivity
Constant Head Method

Job name: Kleinfelder
Job number: WR03.0035.00
Sample number: BLUF-4
Ring number: NA
Depth: NA

Type of water used: TAP
Collection vessel tare (g): 11.93
Sample length (cm): 3.22
Sample diameter (cm): 4.87
Sample x-sectional area (cm^2): 18.64

Date	Time	Temp (°C)	Head (cm)	Q + Tare (g)	Q (cm^3)	Elapsed time (sec)	Ksat (cm/sec)	Ksat @ 20°C (cm/sec)
Test # 1:								
27-Feb-03	08:54:23	18.5	6.8	59.7	47.7	939	1.3E-03	1.3E-03
27-Feb-03	09:10:02							
Test # 2:								
27-Feb-03	10:44:50	18.5	6.8	53.6	41.7	807	1.3E-03	1.3E-03
27-Feb-03	10:58:17							
Test # 3:								
28-Feb-03	10:04:07	18.0	6.8	43.0	31.1	655	1.2E-03	1.3E-03
28-Feb-03	10:15:02							

***Average Ksat* (cm/sec): 1.3E-03**

Comments:

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Summary of Moisture Characteristics of the Initial Drainage Curve

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm^3/cm^3)
BLUF-1	0	66.9
	21	65.6
	49	63.4
	150	60.4
	510	43.4
	16623	15.3
	851293	2.5
BLUF-2	0	40.1
	21	39.6
	49	38.0
	150	37.3
	510	25.2
	7445	14.1
	851293	2.7
BLUF-3	0	38.2
	21	37.8
	49	36.3
	150	34.4
	510	24.6
	17541	11.7
	851293	2.5
BLUF-4	0	54.6
	10	48.3
	43	41.7
	80	30.8
	510	18.5
	9892	8.1
	851293	2.9

Summary of Calculated Unsaturated Hydraulic Properties

Sample Number	α (cm^{-1})	N (dimensionless)	θ_r	θ_s
BLUF-1	0.0051	1.3508	0.0000	0.6671
BLUF-2	0.0062	1.2957	0.0000	0.4035
BLUF-3	0.0071	1.2714	0.0000	0.3846
BLUF-4	0.0470	1.3613	0.0200	0.5395

Moisture Retention Data

Hanging Column/Pressure Plate/Thermocouple

(Main Drainage Curve)

Job Name: Kleinfelder
Job Number: WR03.0035.00
Sample Number: BLUF-1
Ring Number: NA
Depth: NA

Dry wt. of sample (g): 45.63
Tare wt., screen & clamp (g): 25.32
Tare wt., ring (g): 36.57
Tare wt., epoxy (g): 0.00
Sample volume (cm^3): 54.44

Saturated weight at 0 cm tension* (g): 143.92
Volume of water† *in saturated sample* (cm^3): 36.40
Saturated moisture content (% vol): 66.86
Sample bulk density (g/cm^3): 0.84

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Hanging column:	28-Feb-03 / 14:00	143.92	0.00	66.86
	03-Mar-03 / 12:30	143.25	21.00	65.63
	05-Mar-03 / 15:30	142.04	49.00	63.41
	07-Mar-03 / 15:30	140.38	150.00	60.36
Pressure plate:	10-Mar-03 / 13:00	131.13	509.90	43.37

Comments:

* Weight including tares
† Assumed density of water is 1.0 g/cm^3

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Daniel B. Stephens & Associates, Inc.

Moisture Retention Data

Water Activity Meter/Relative Humidity Box

(Main Drainage Curve)

Job Name: Kleinfelder
Job Number: WR03.0035.00
Sample Number: BLUF-1
Ring Number: NA
Depth: NA

Dry weight of water activity meter sample* (g): 134.82
Tare weight, jar (g): 113.64
Sample bulk density (g/cm³): 0.84

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Water Activity Meter:	26-Feb-03 / 13:30	138.68	16622.7	15.28

Dry weight of relative humidity box sample* (g): 65.04
Tare weight (g): 40.93
Sample bulk density (g/cm³): 0.84

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Relative humidity box:	03-Mar-03 / 12:30	65.75	851293	2.46

Comments:

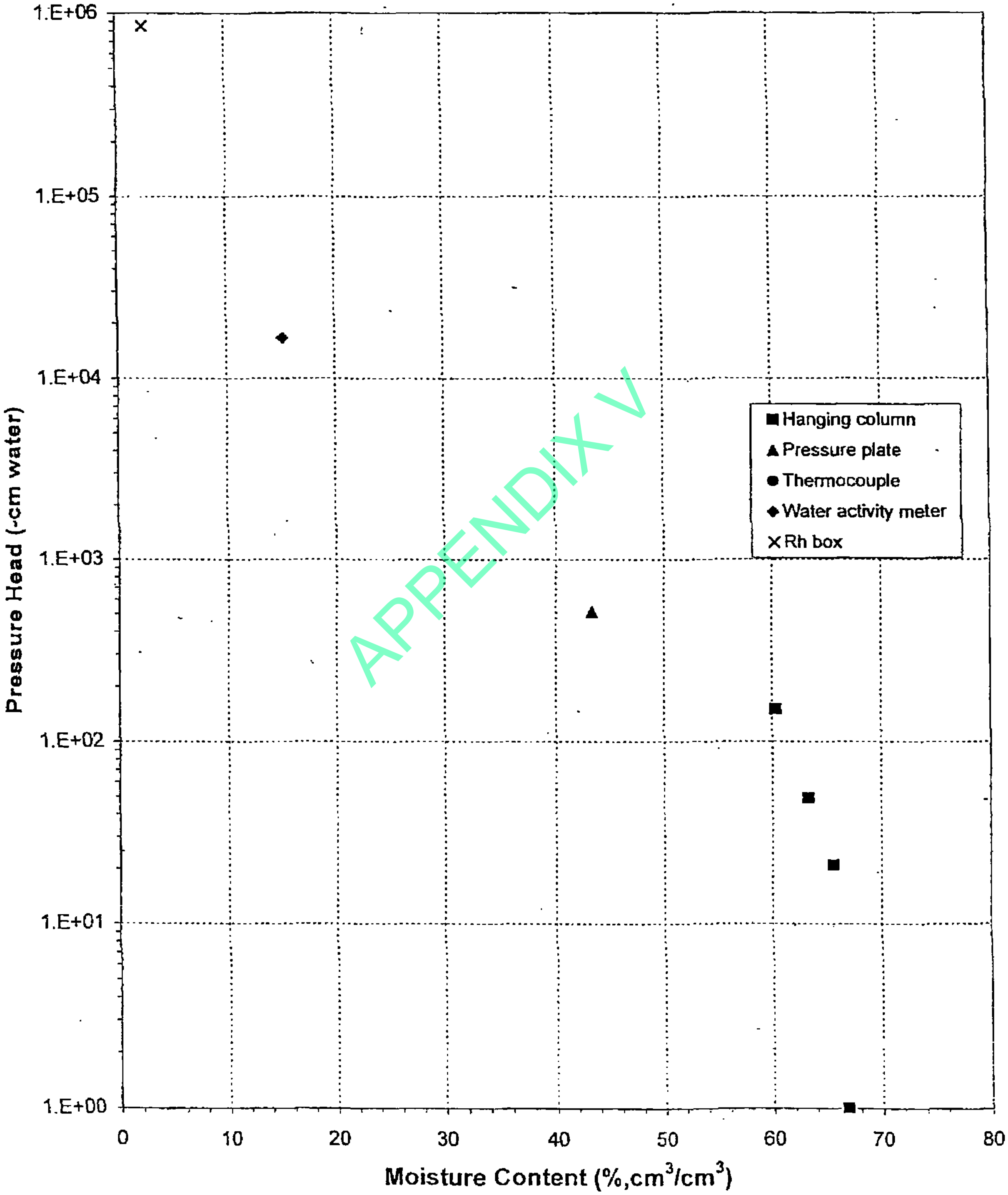
* Weight including tares

† Assumed density of water is 1.0 g/cm³

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

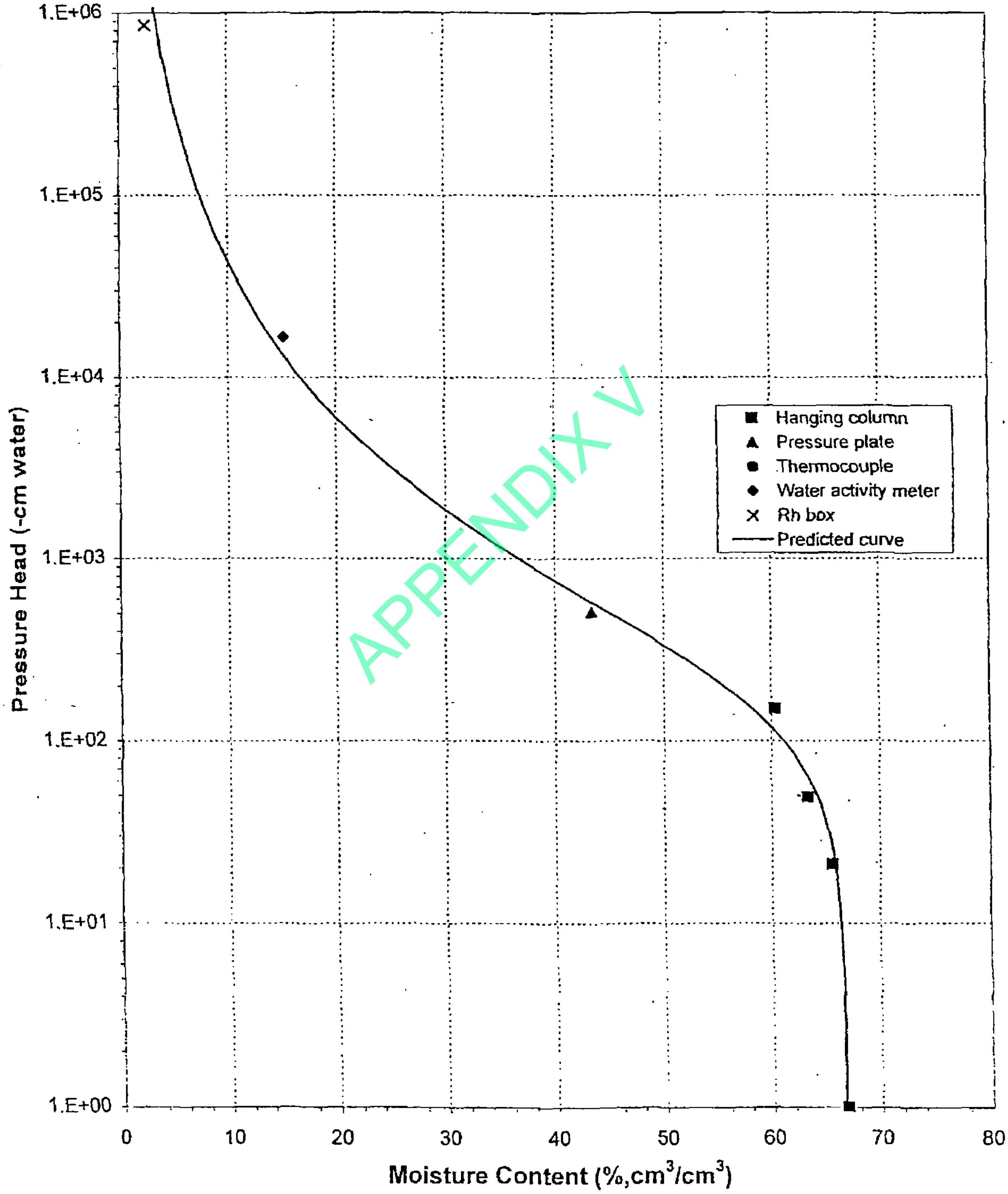
Water Retention Data Points

Sample Number: BLUF-1



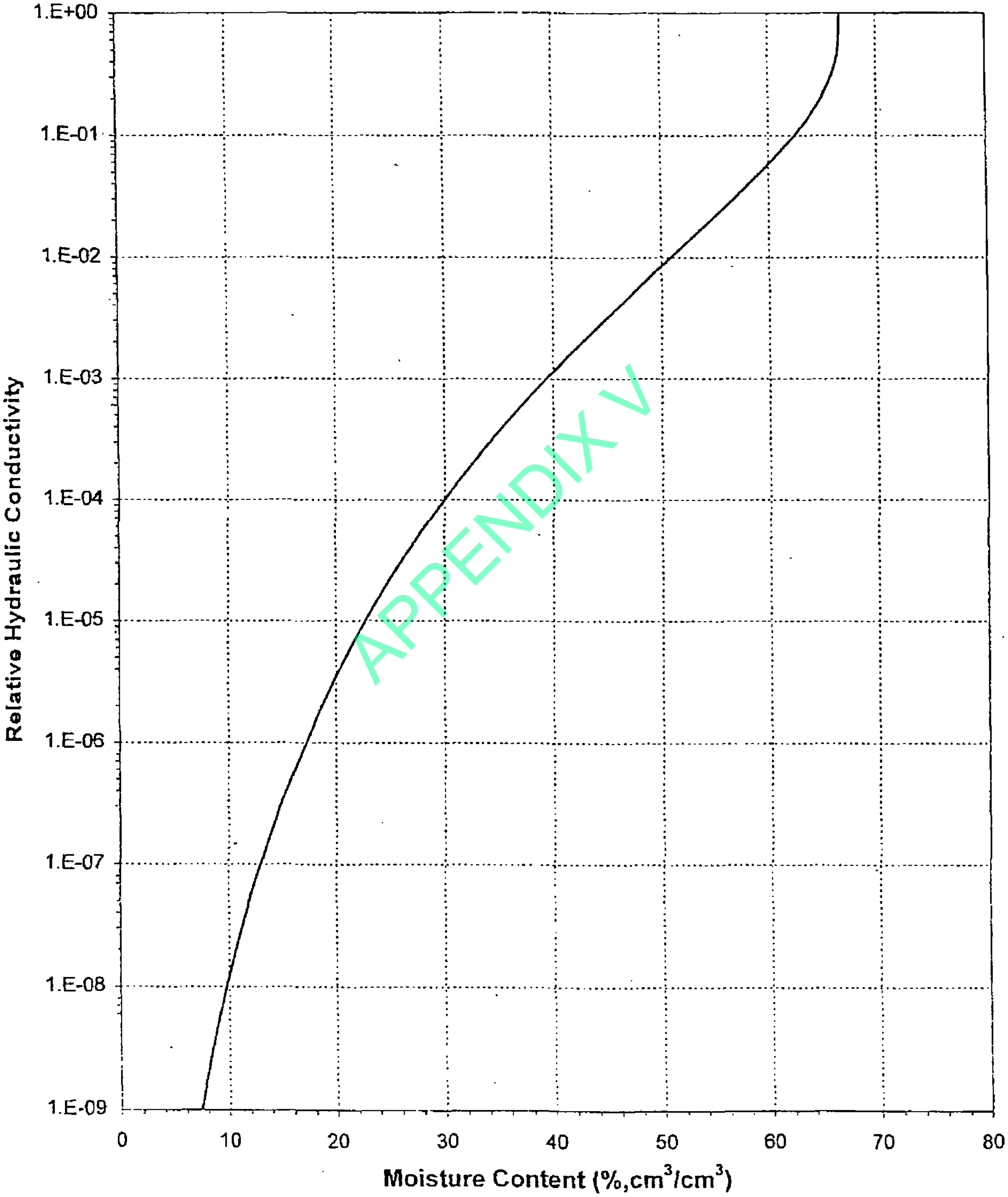
Predicted Water Retention Curve and Data Points

Sample Number: BLUF-1



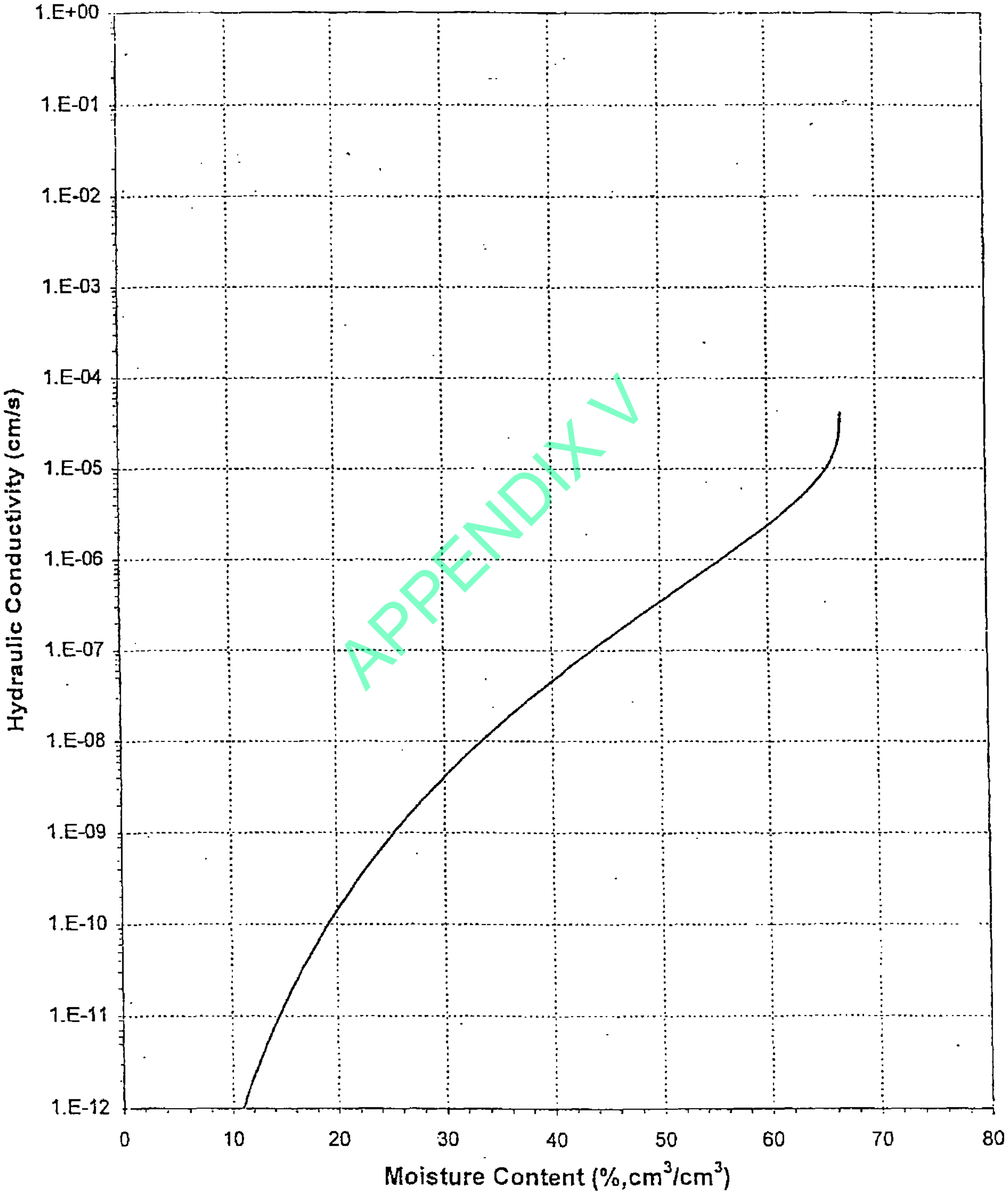
Plot of Relative Hydraulic Conductivity vs Moisture Content

Sample Number: BLUF-1



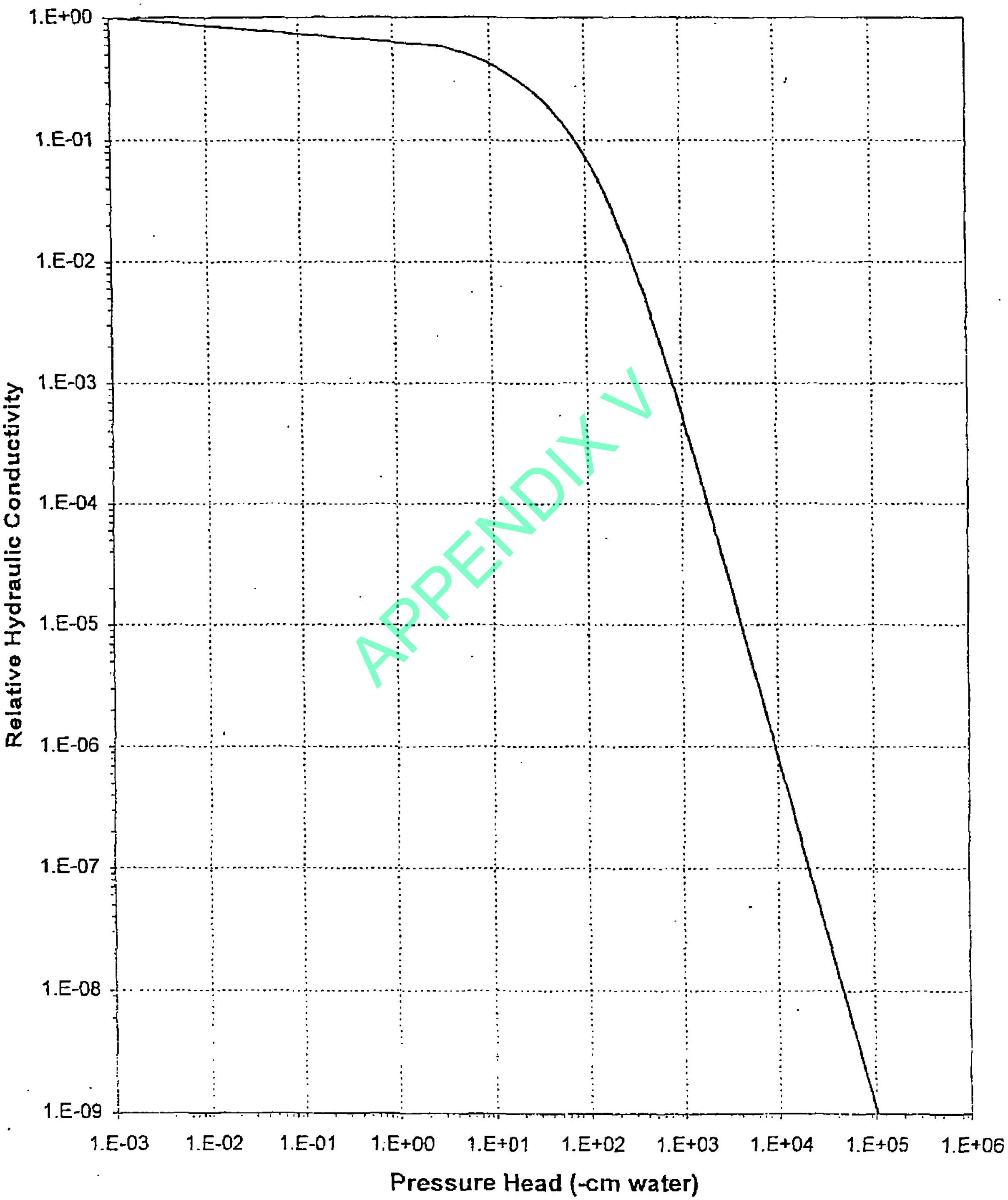
Plot of Hydraulic Conductivity vs Moisture Content

Sample Number: BLUF-1



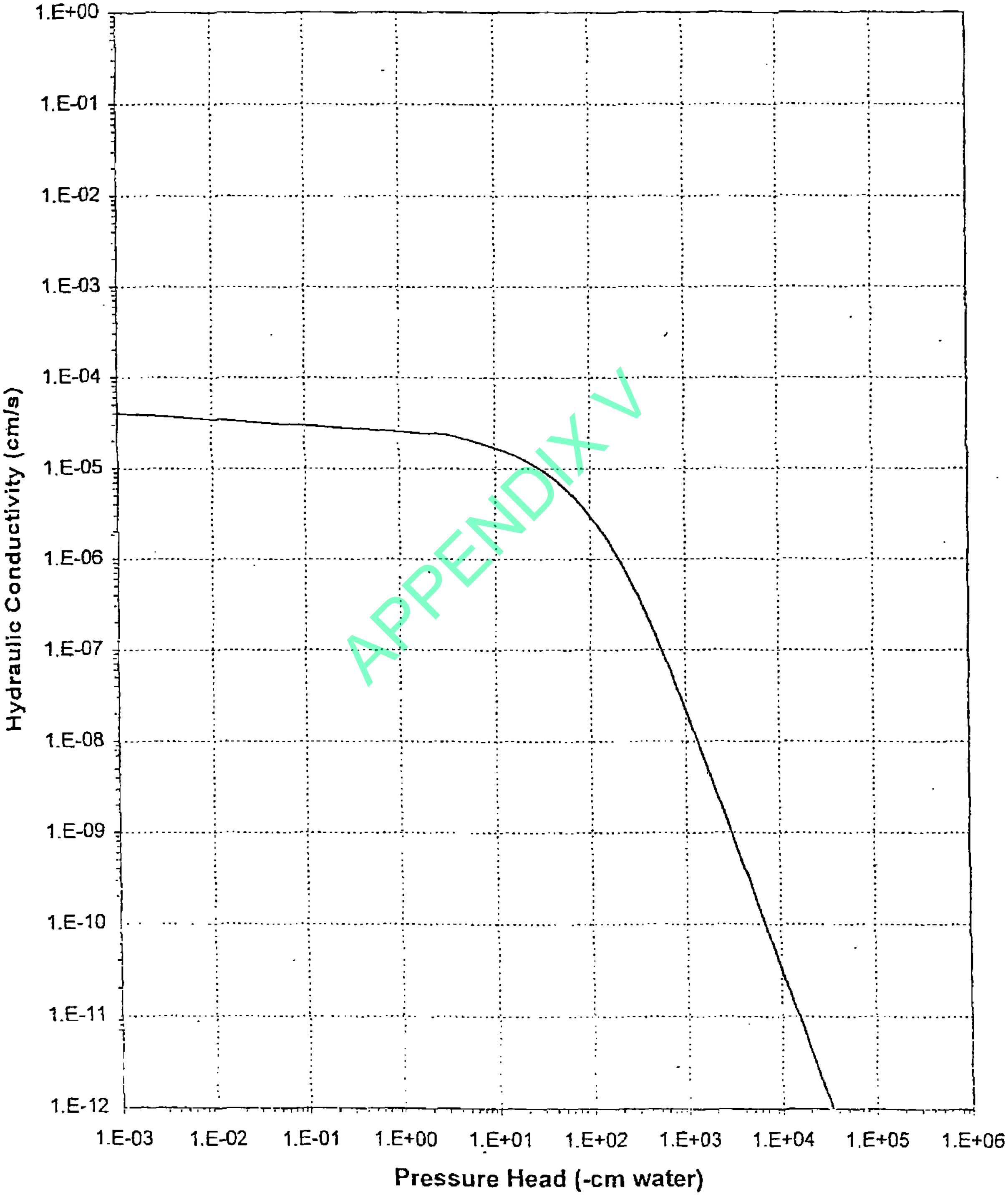
Plot of Relative Hydraulic Conductivity vs Pressure Head

Sample Number: BLUF-1



Plot of Hydraulic Conductivity vs Pressure Head

Sample Number: BLUF-1



Moisture Retention Data

Hanging Column/Pressure Plate/Thermocouple

(Main Drainage Curve)

Job Name:	Kleinfelder	*Dry wt. of sample (g):*	74.67
Job Number:	WR03.0035.00	*Tare wt., screen & clamp (g):*	25.33
Sample Number:	BLUF-2	*Tare wt., ring (g):*	34.07
Ring Number:	NA	*Tare wt., epoxy (g):*	0.00
Depth:	NA	*Sample volume (cm^3):*	50.99

Saturated weight at 0 cm tension (g):* 154.52
Volume of water[†] in saturated sample (cm^3): 20.45
Saturated moisture content (% vol): 40.11
Sample bulk density (g/cm^3): 1.46

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content[†] (% vol)
Hanging column:	28-Feb-03 / 14:00	154.52	0.00	40.11
	03-Mar-03 / 12:30	154.24	21.00	39.56
	05-Mar-03 / 15:30	153.47	49.00	38.05
	07-Mar-03 / 15:00	153.07	150.00	37.26
Pressure plate:	10-Mar-03 / 13:00	146.94	509.90	25.24

Comments:

* Weight including tares
[†] Assumed density of water is 1.0 g/cm^3

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Moisture Retention Data

Water Activity Meter/Relative Humidity Box

(Main Drainage Curve)

Job Name: Kleinfelder
Job Number: WR03.0035.00
Sample Number: BLUF-2
Ring Number: NA
Depth: NA

Dry weight of water activity meter sample* (g): 154.86
Tare weight, jar (g): 121.47
Sample bulk density (g/cm^3): 1.46

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content[†] (% vol)
Water Activity Meter:	27-Feb-03 / 10:00	158.08	7444.5	14.12

Dry weight of relative humidity box sample* (g): 71.00
Tare weight (g): 42.11
Sample bulk density (g/cm^3): 1.46

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content[†] (% vol)
Relative humidity box:	03-Mar-03 / 12:30	71.53	851293	2.73

Comments:

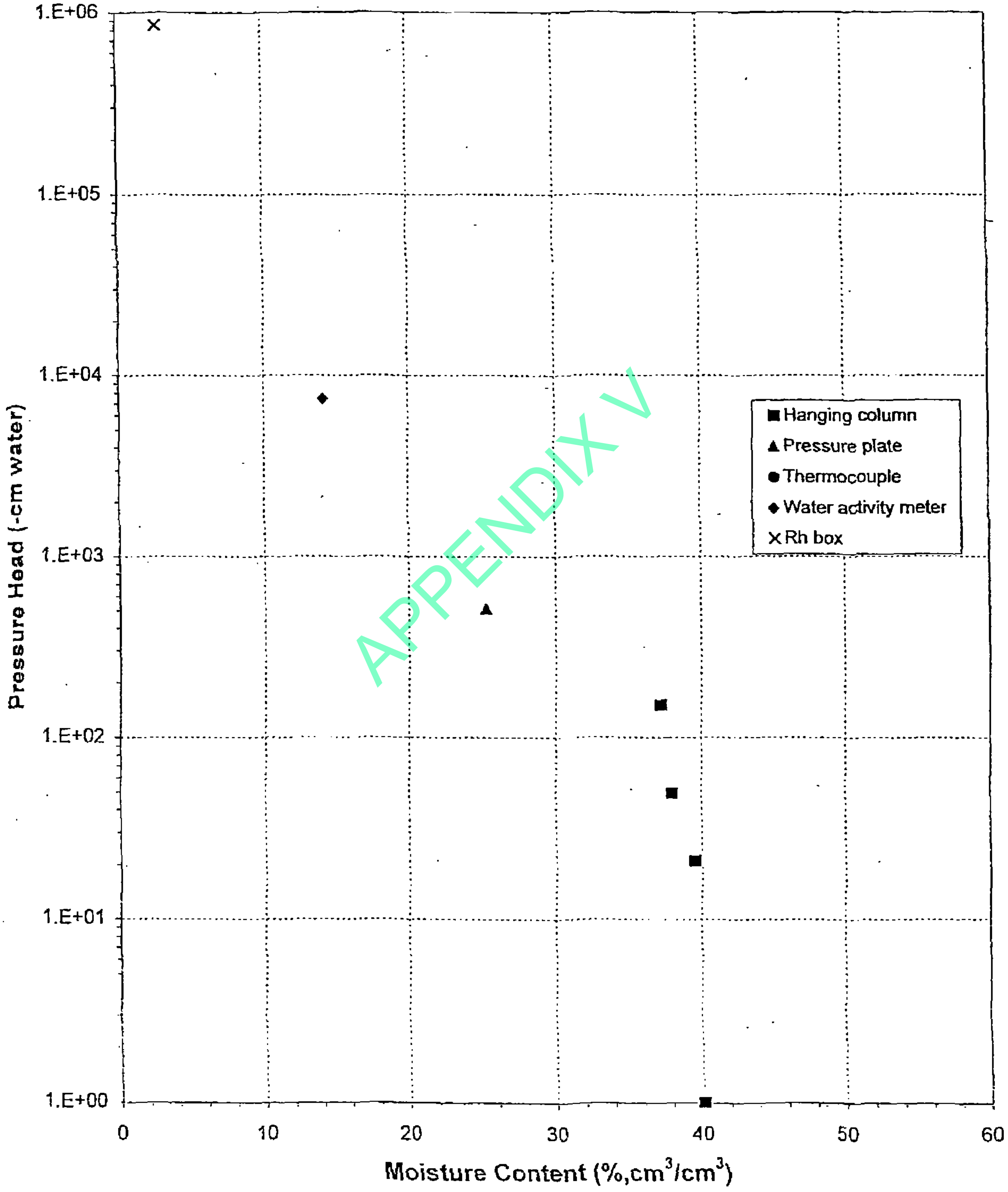
* Weight including tares

[†] Assumed density of water is 1.0 g/cm^3

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

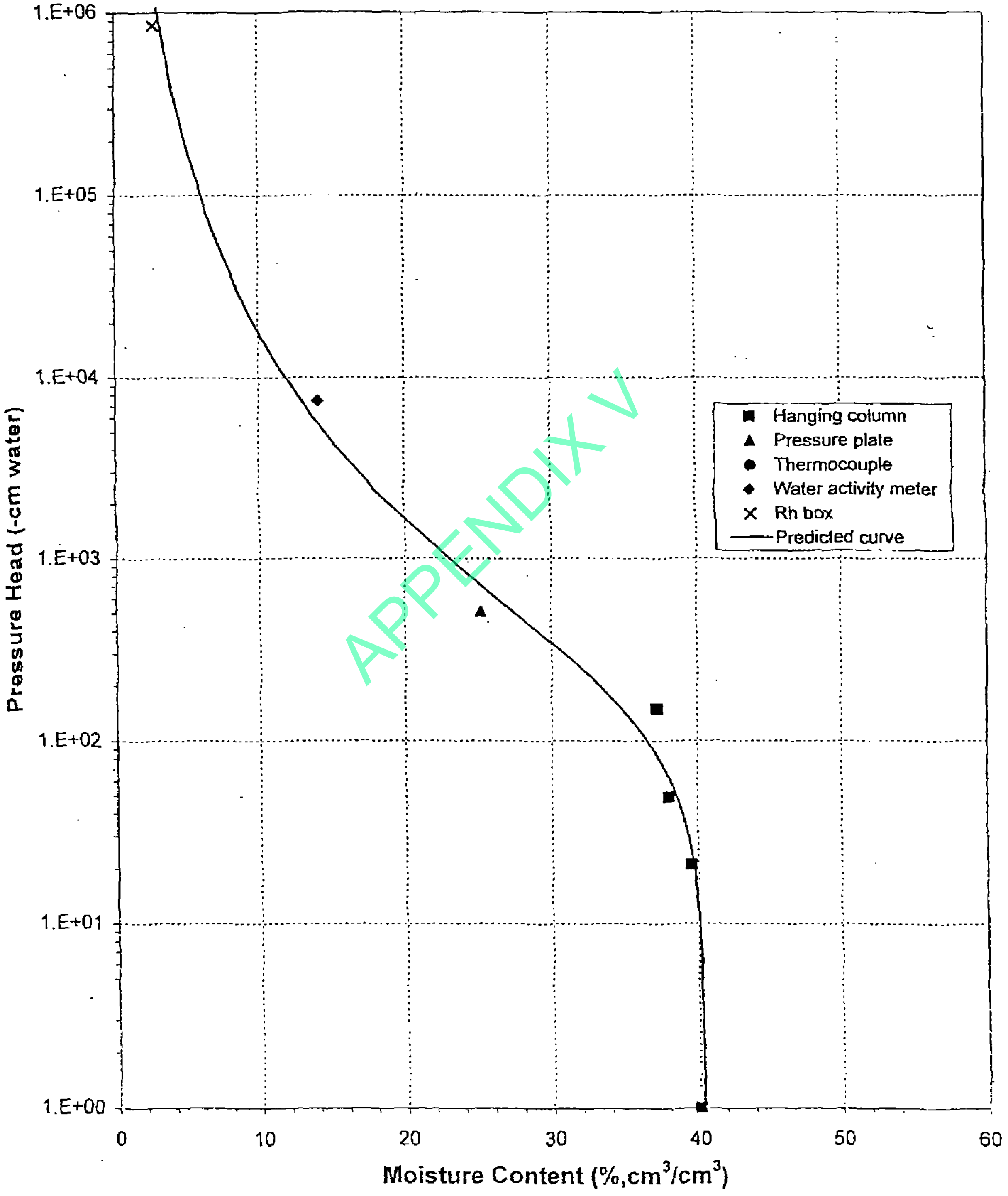
Water Retention Data Points

Sample Number: BLUF-2



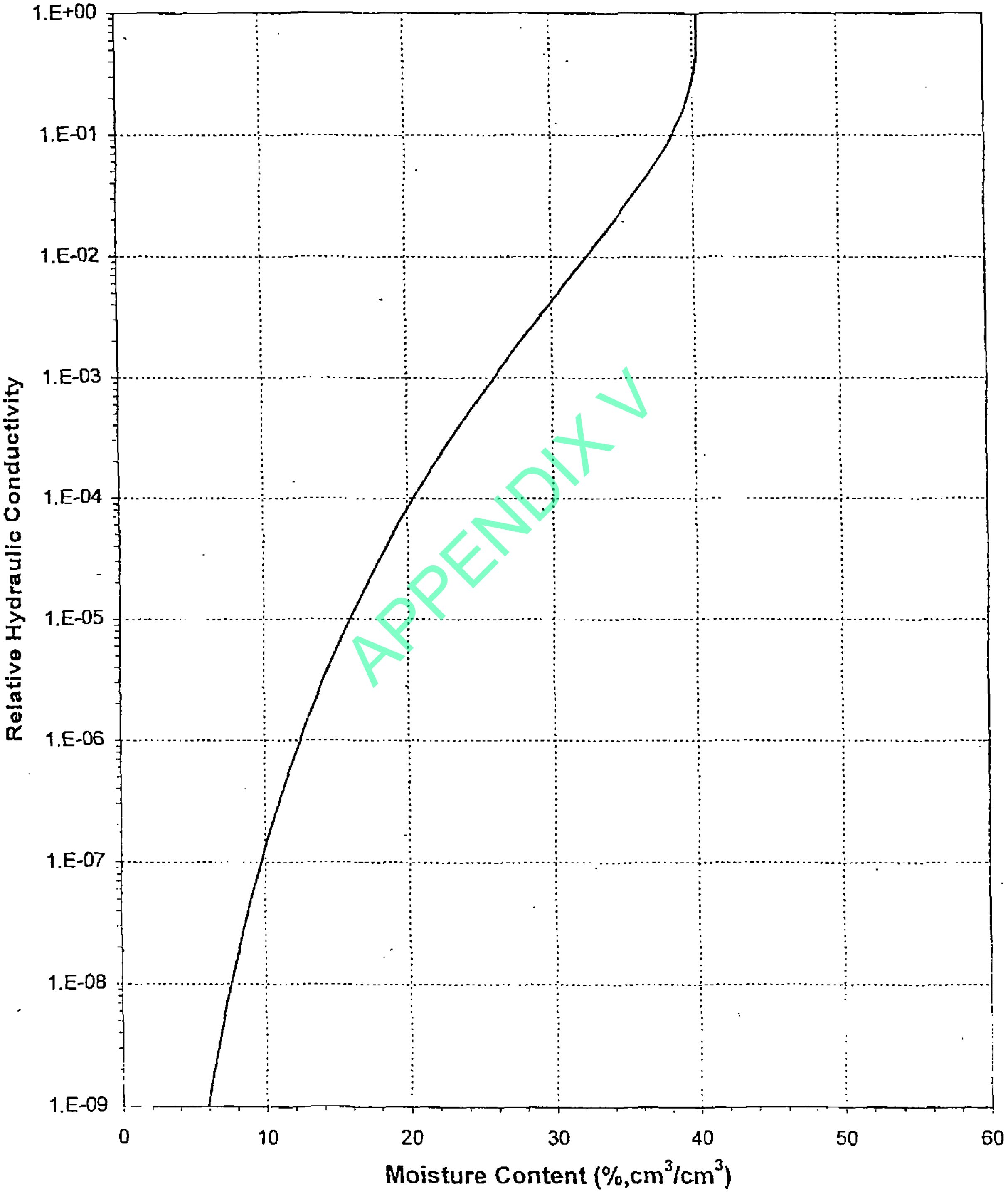
Predicted Water Retention Curve and Data Points

Sample Number: BLUF-2



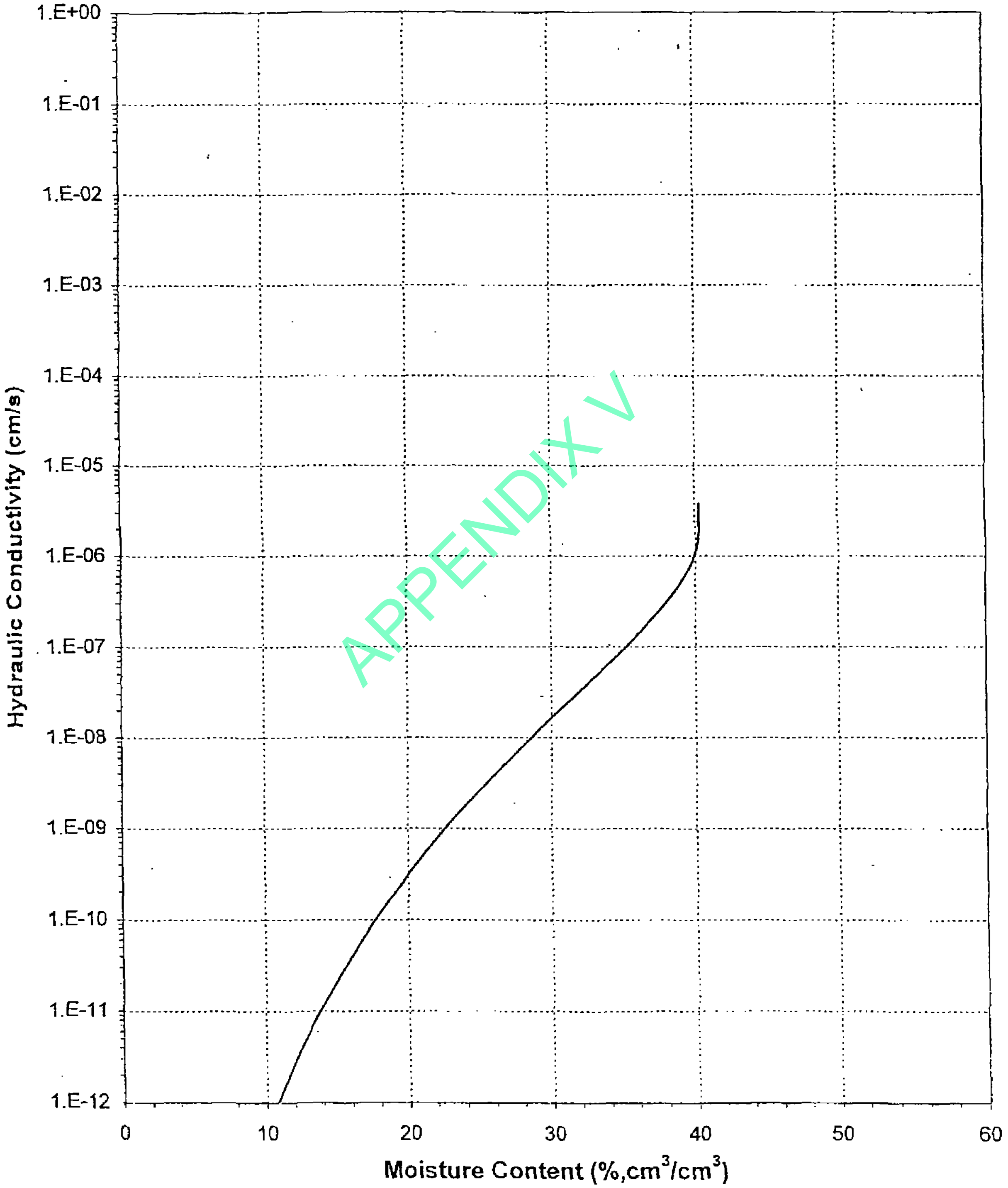
Plot of Relative Hydraulic Conductivity vs Moisture Content

Sample Number: BLUF-2



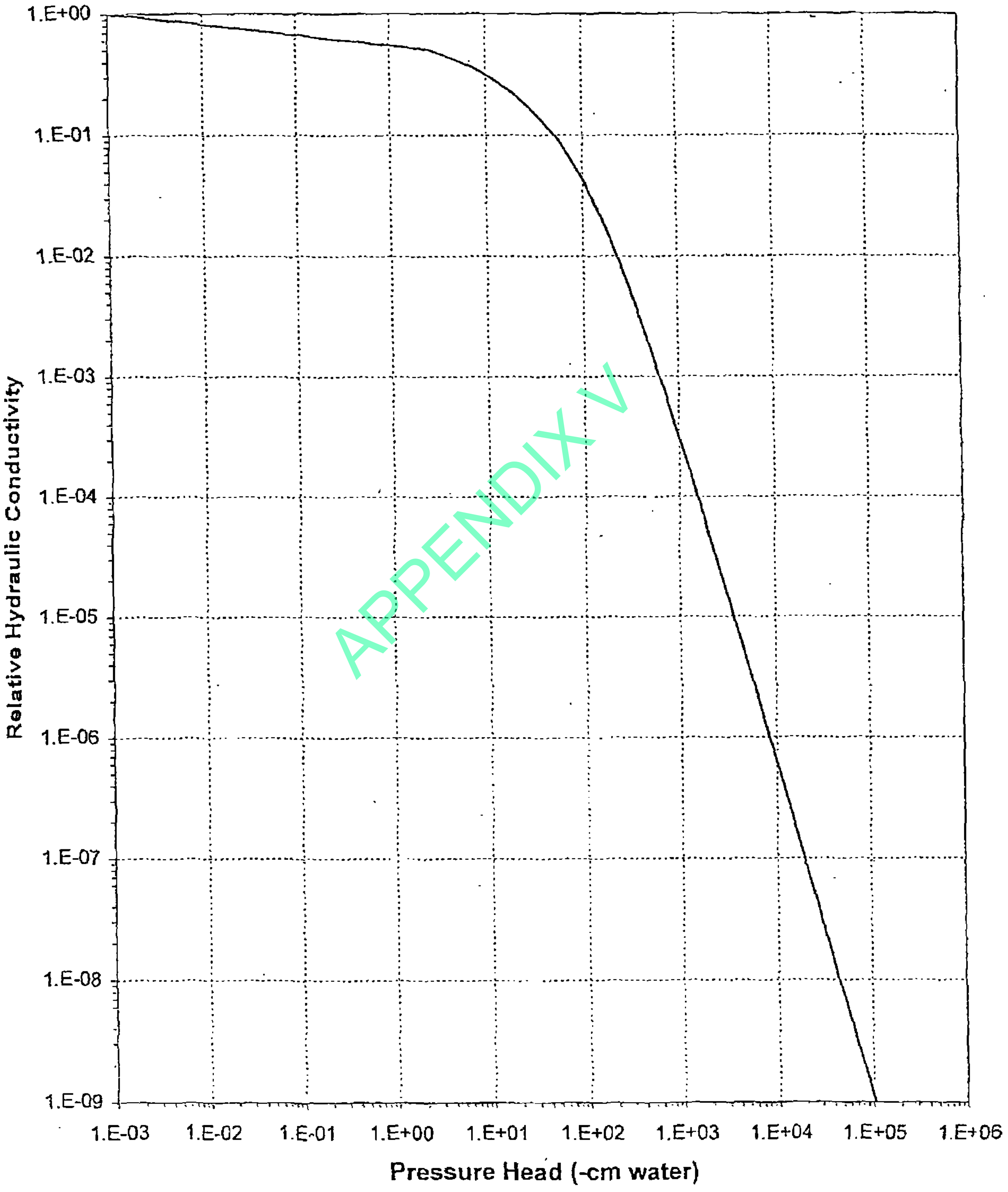
Plot of Hydraulic Conductivity vs Moisture Content

Sample Number: BLUF-2



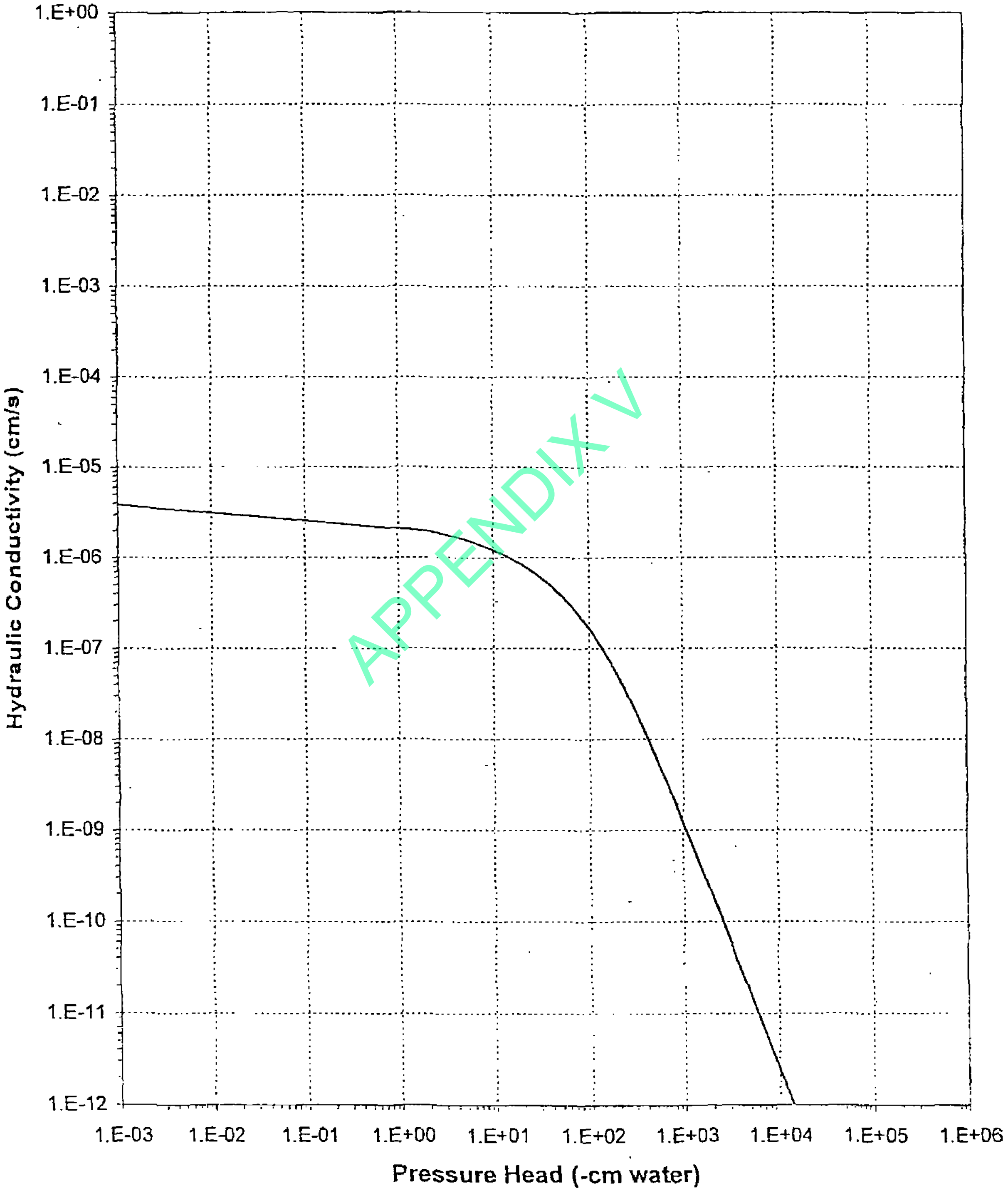
Plot of Relative Hydraulic Conductivity vs Pressure Head

Sample Number: BLUF-2



Plot of Hydraulic Conductivity vs Pressure Head

Sample Number: BLUF-2



Moisture Retention Data

Hanging Column/Pressure Plate/Thermocouple
(Main Drainage Curve)

Job Name: Kleinfelder
Job Number: WR03.0035.00
Sample Number: BLUF-3
Ring Number: NA
Depth: NA

Dry wt. of sample (g): 100.70
Tare wt., screen & clamp (g): 25.48
Tare wt., ring (g): 41.93
Tare wt., epoxy (g): 0.00
Sample volume (cm^3): 63.72

Saturated weight at 0 cm tension* (g): 192.47
Volume of water† *in saturated sample* (cm^3): 24.36
Saturated moisture content (% vol): 38.23
Sample bulk density (g/cm^3): 1.58

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Hanging column:	28-Feb-03 / 14:00	192.47	0.00	38.23
	03-Mar-03 / 12:30	192.17	21.00	37.76
	05-Mar-03 / 15:30	191.27	49.00	36.34
	07-Mar-03 / 15:00	190.00	150.00	34.35
Pressure plate:	10-Mar-03 / 13:00	183.80	509.90	24.62

Comments:

* Weight including tares
† Assumed density of water is 1.0 g/cm^3

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Moisture Retention Data

Water Activity Meter/Relative Humidity Box

(Main Drainage Curve)

Job Name: Kleinfelder
Job Number: WR03.0035.00
Sample Number: BLUF-3
Ring Number: NA
Depth: NA

Dry weight of water activity meter sample* (g): 141.82
Tare weight, jar (g): 111.56
Sample bulk density (g/cm³): 1.58

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Water Activity Meter:	27-Feb-03 / 09:50	144.06	17540.6	11.70

Dry weight of relative humidity box sample* (g): 85.94
Tare weight (g): 40.78
Sample bulk density (g/cm³): 1.58

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Relative humidity box:	03-Mar-03 / 12:30	86.67	851293	2.53

Comments:

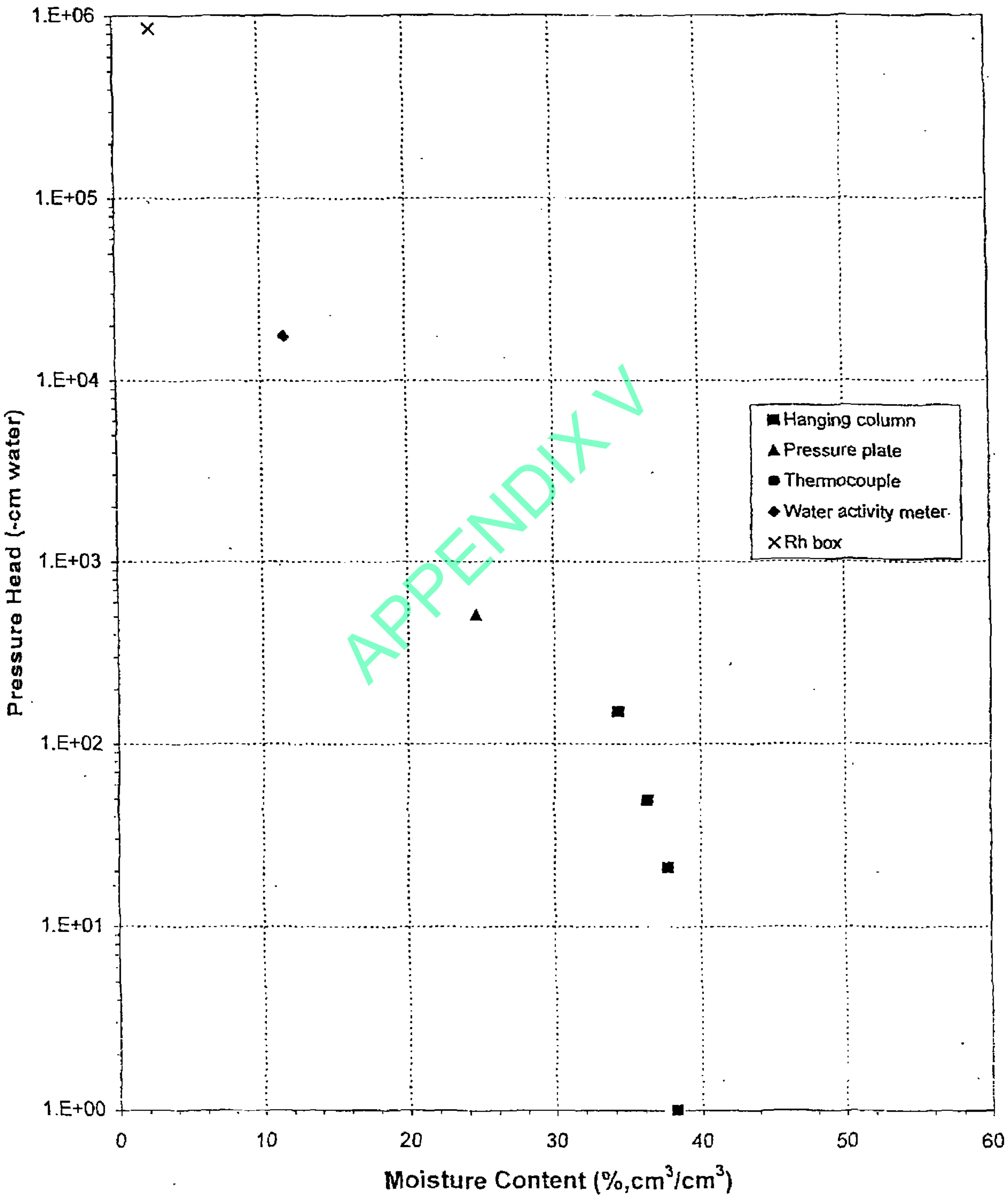
* Weight including tares

† Assumed density of water is 1.0 g/cm³

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

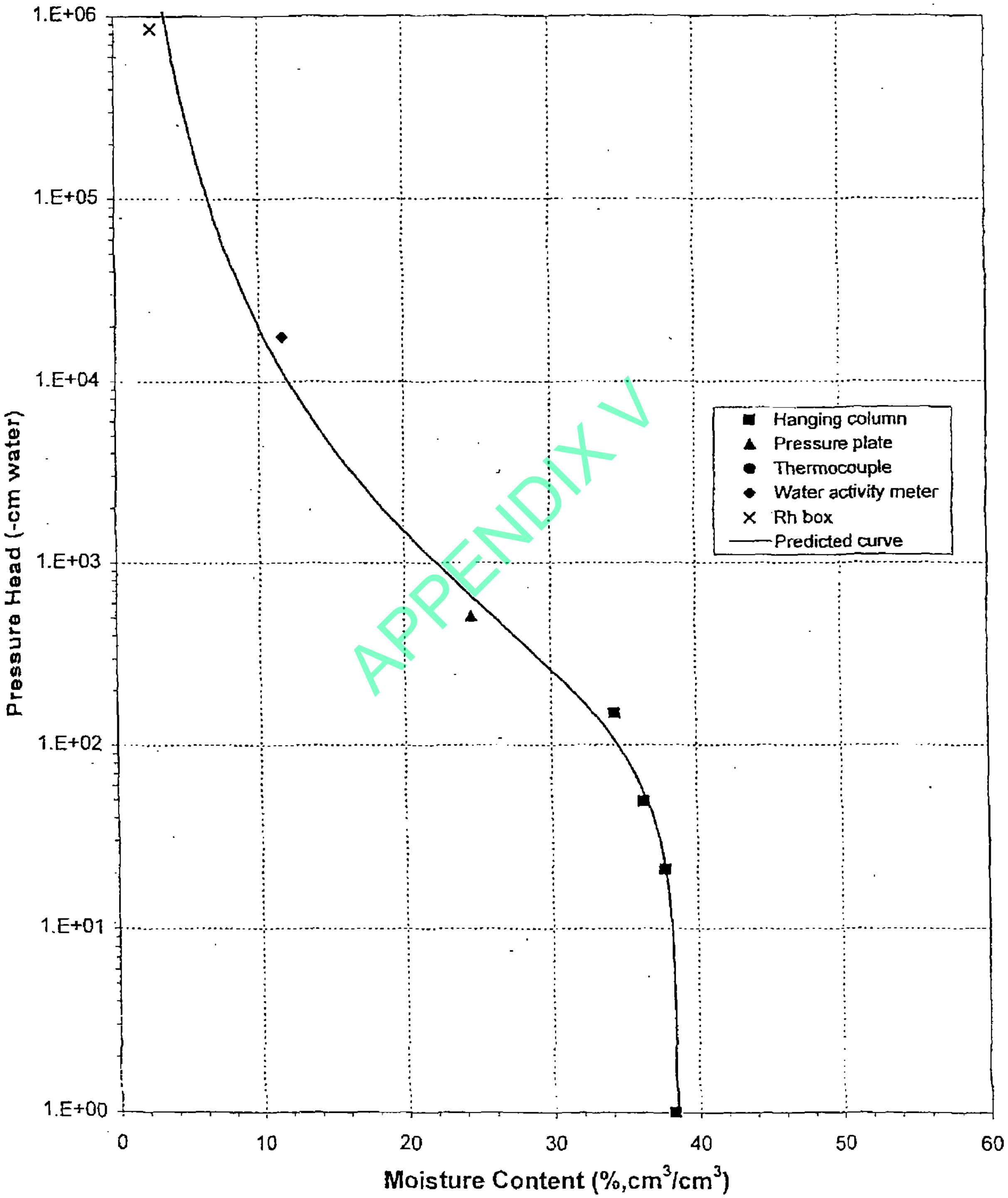
Water Retention Data Points

Sample Number: BLUF-3



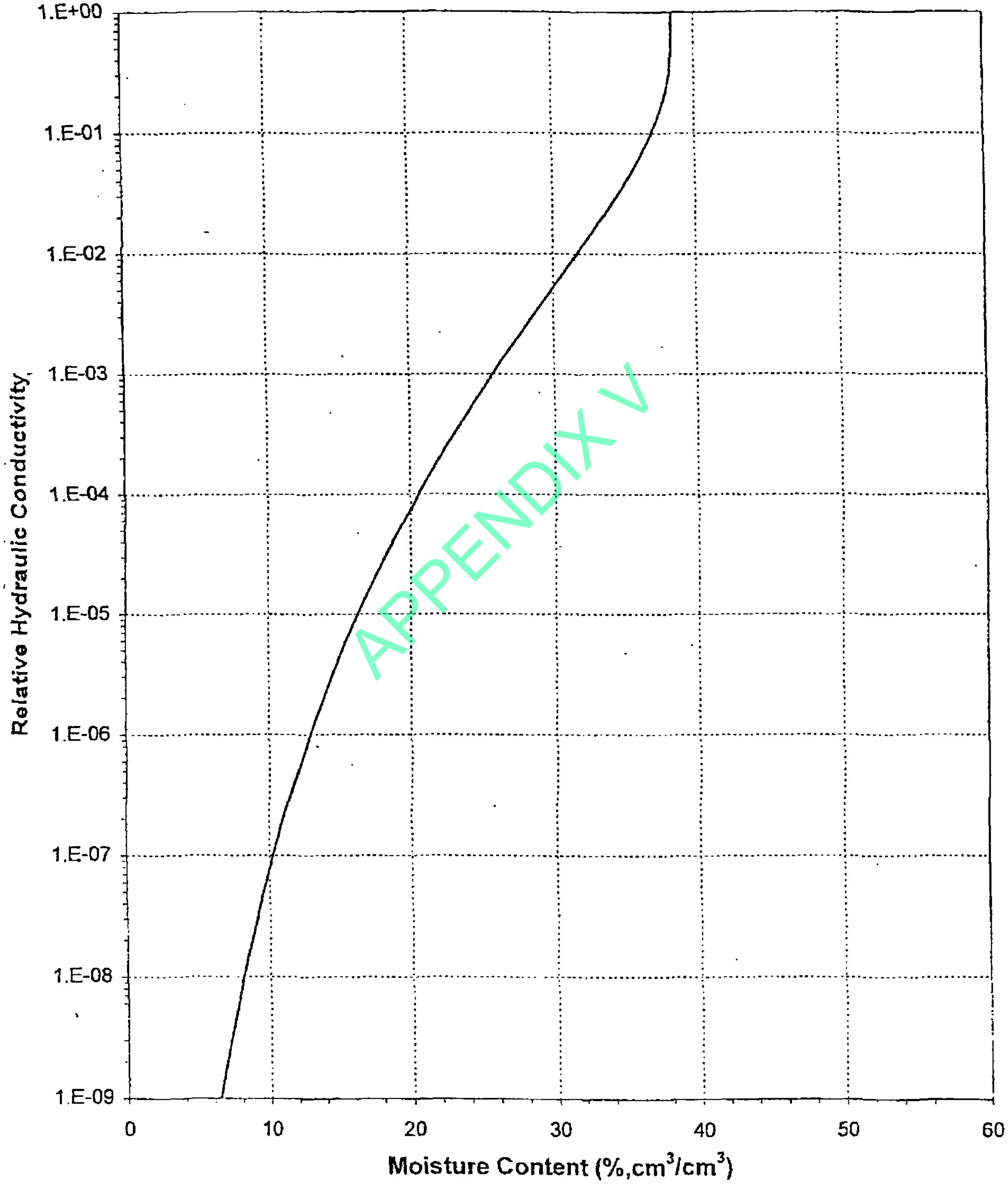
Predicted Water Retention Curve and Data Points

Sample Number: BLUF-3



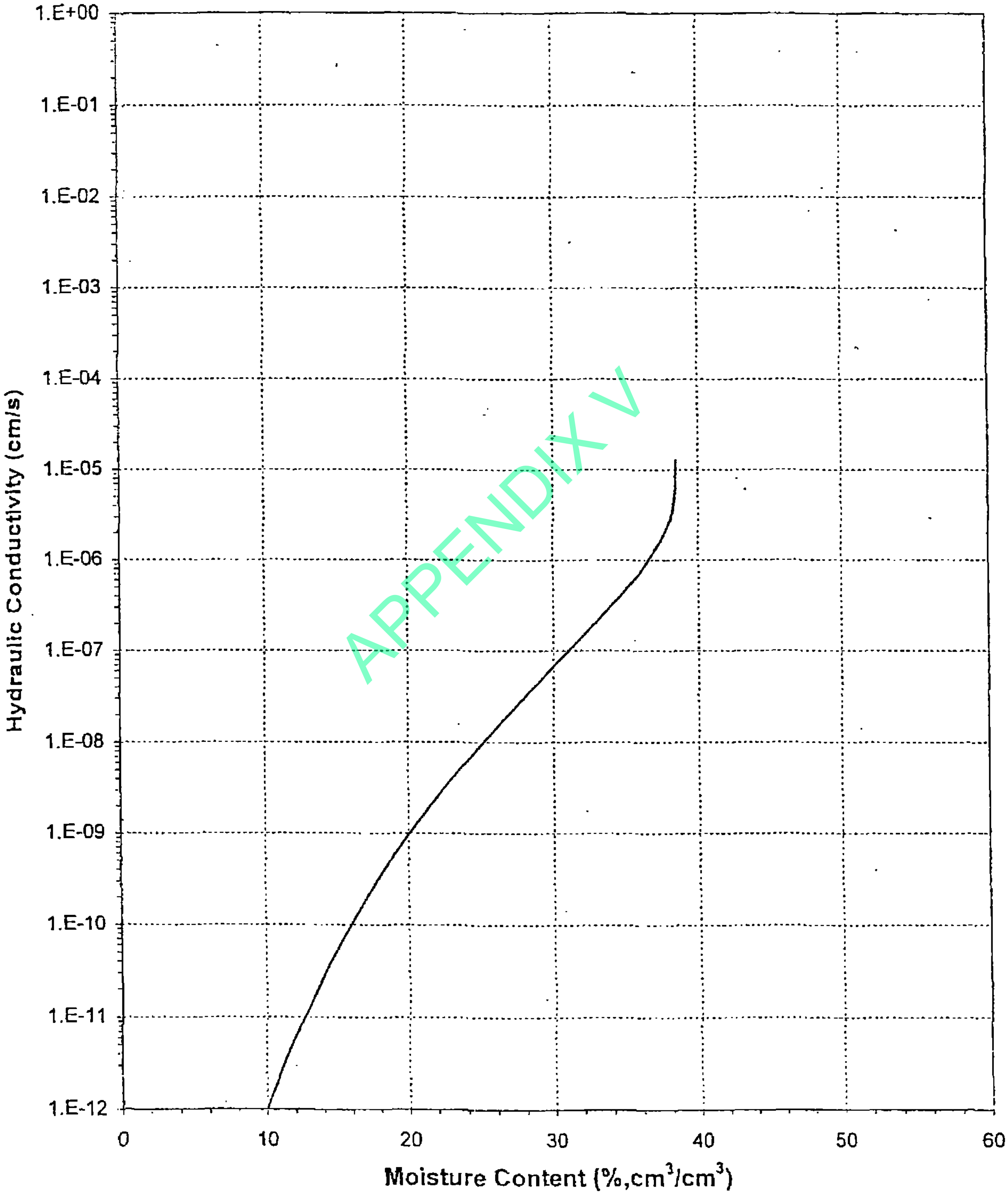
Plot of Relative Hydraulic Conductivity vs Moisture Content

Sample Number: BLUF-3



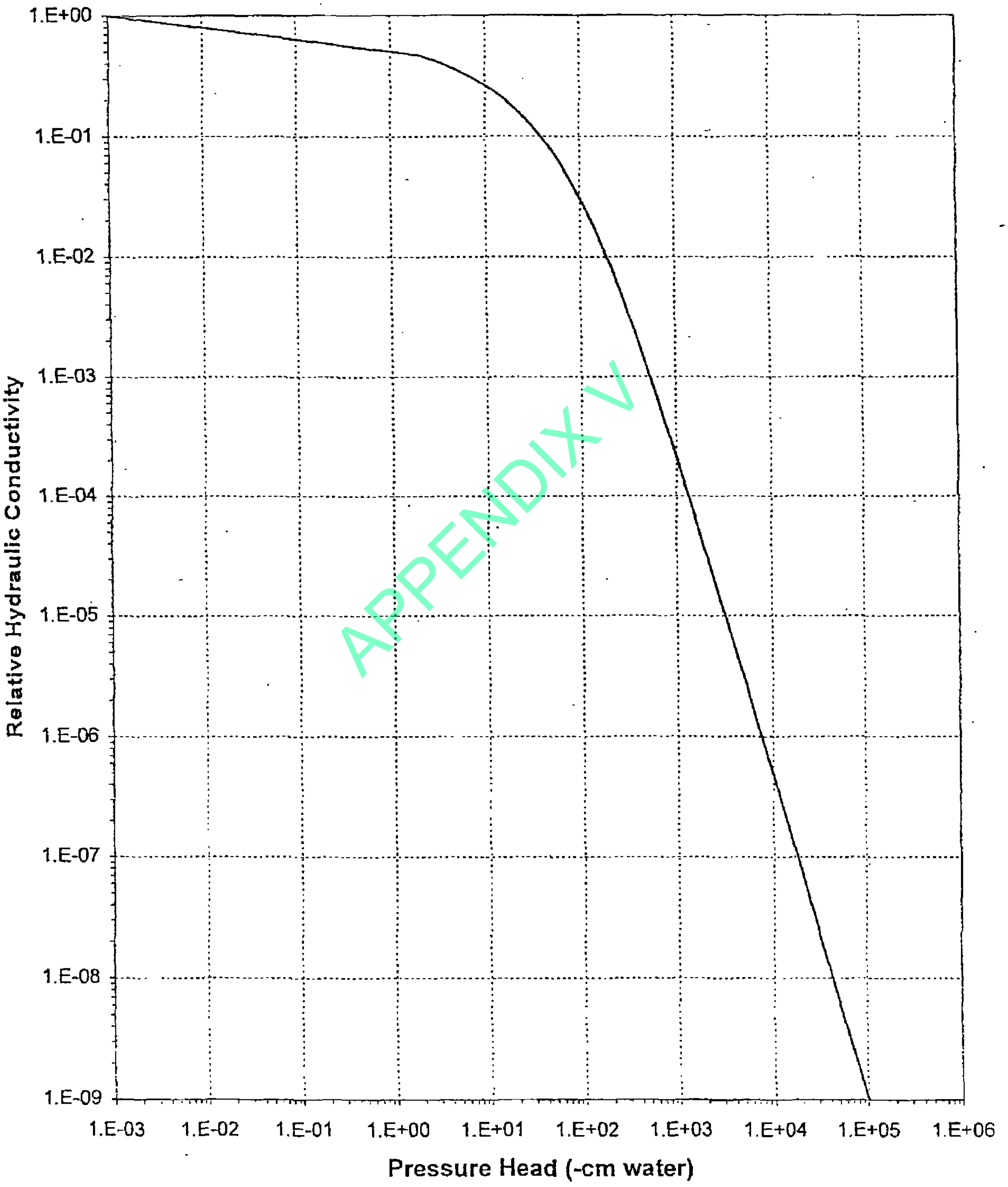
Plot of Hydraulic Conductivity vs Moisture Content

Sample Number: BLUF-3



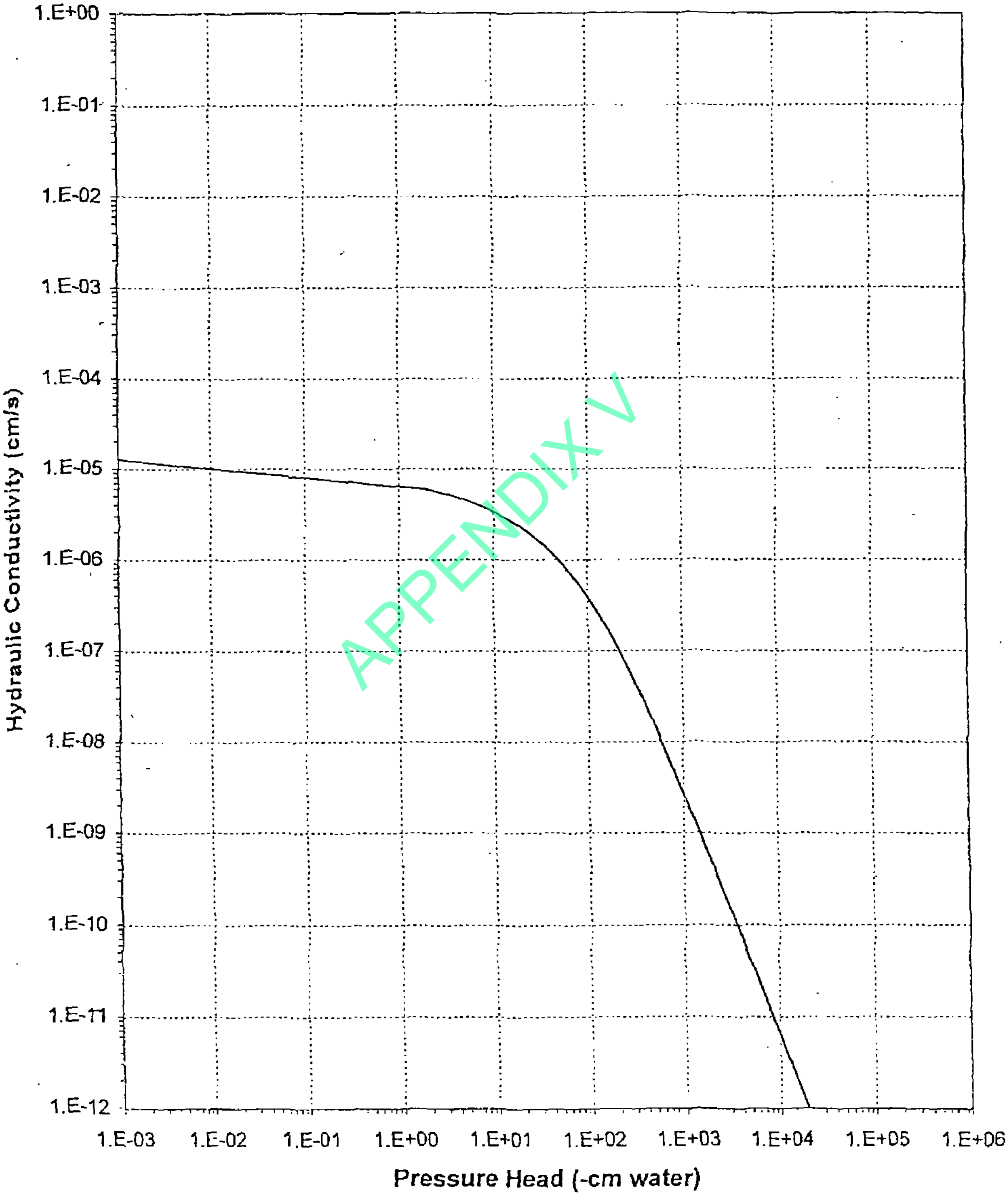
Plot of Relative Hydraulic Conductivity vs Pressure Head

Sample Number: BLUF-3



Plot of Hydraulic Conductivity vs Pressure Head

Sample Number: BLUF-3



Moisture Retention Data

Hanging Column/Pressure Plate/Thermocouple

(Main Drainage Curve)

Job Name: Kleinfelder
Job Number: WR03.0035.00
Sample Number: BLUF-4
Ring Number: NA
Depth: NA

Dry wt. of sample (g): 76.24
Tare wt., screen & clamp (g): 25.84
Tare wt., ring (g): 39.39
Tare wt., epoxy (g): 0.00
Sample volume (cm^3): 59.97

Saturated weight at 0 cm tension (g):* 174.24
Volume of water† *in saturated sample* (cm^3): 32.77
Saturated moisture content (% vol): 54.64
Sample bulk density (g/cm^3): 1.27

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Hanging column:	28-Feb-03 / 14:00	174.24	0.00	54.64
	03-Mar-03 / 12:30	170.46	10.00	48.34
	05-Mar-03 / 15:30	166.48	43.00	41.70
	07-Mar-03 / 15:00	159.94	80.00	30.80
Pressure plate:	10-Mar-03 / 13:00	152.54	509.90	18.46

Comments:

* Weight including tares
† Assumed density of water is 1.0 g/cm^3

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Moisture Retention Data

Water Activity Meter/Relative Humidity Box

(Main Drainage Curve)

Job Name: Kleinfelder
Job Number: WR03.0035.00
Sample Number: BLUF-4
Ring Number: NA
Depth: NA

Dry weight of water activity meter sample (g):* 140.98
Tare weight, jar (g): 116.07
Sample bulk density (g/cm^3): 1.27

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Water Activity Meter:	28-Feb-03 / 10:30	142.56	9892.1	8.06

Dry weight of relative humidity box sample (g):* 71.69
Tare weight (g): 44.95
Sample bulk density (g/cm^3): 1.27

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Relative humidity box:	03-Mar-03 / 12:30	72.31	851293	2.93

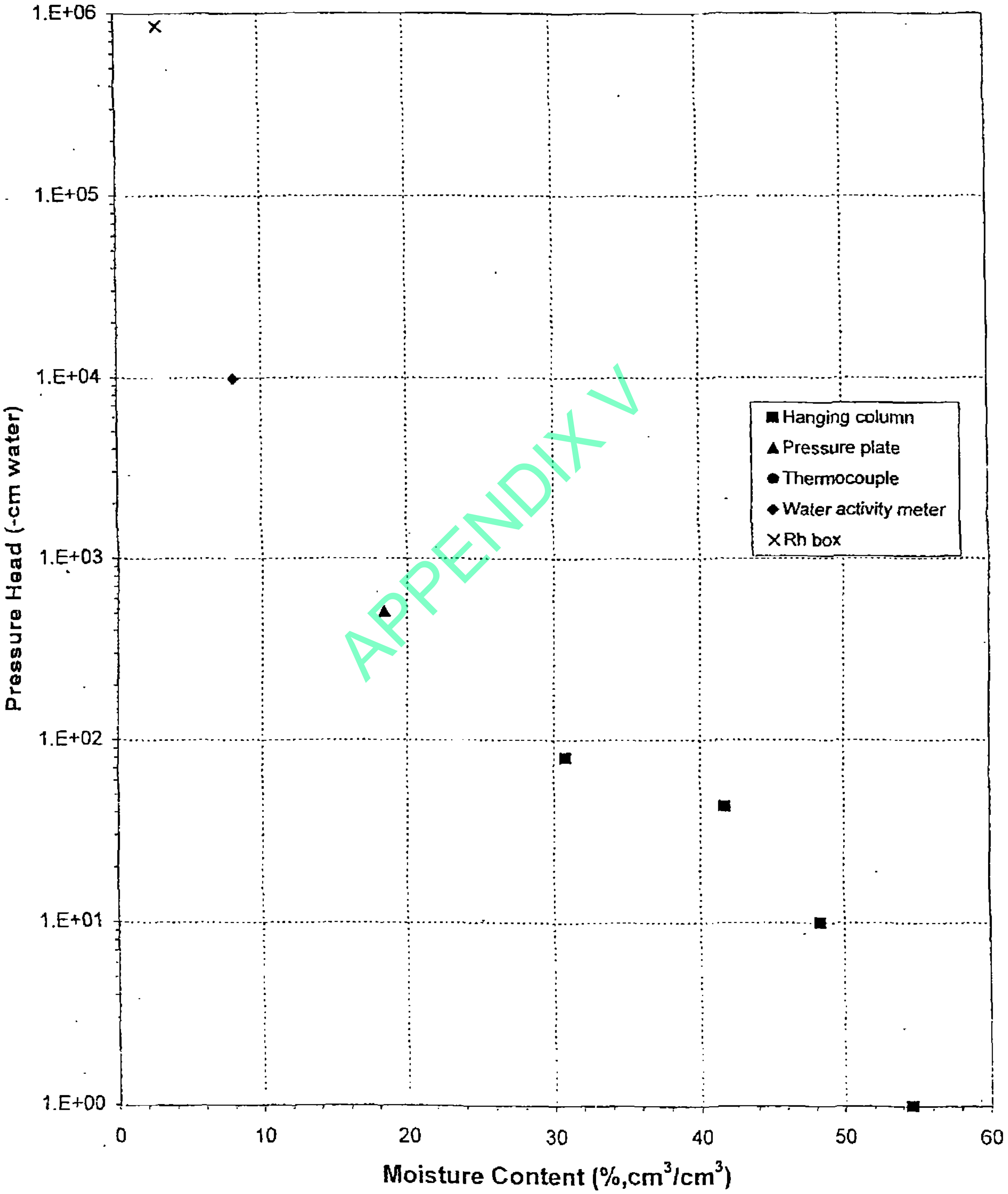
Comments:

* Weight including tares
† Assumed density of water is 1.0 g/cm^3

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

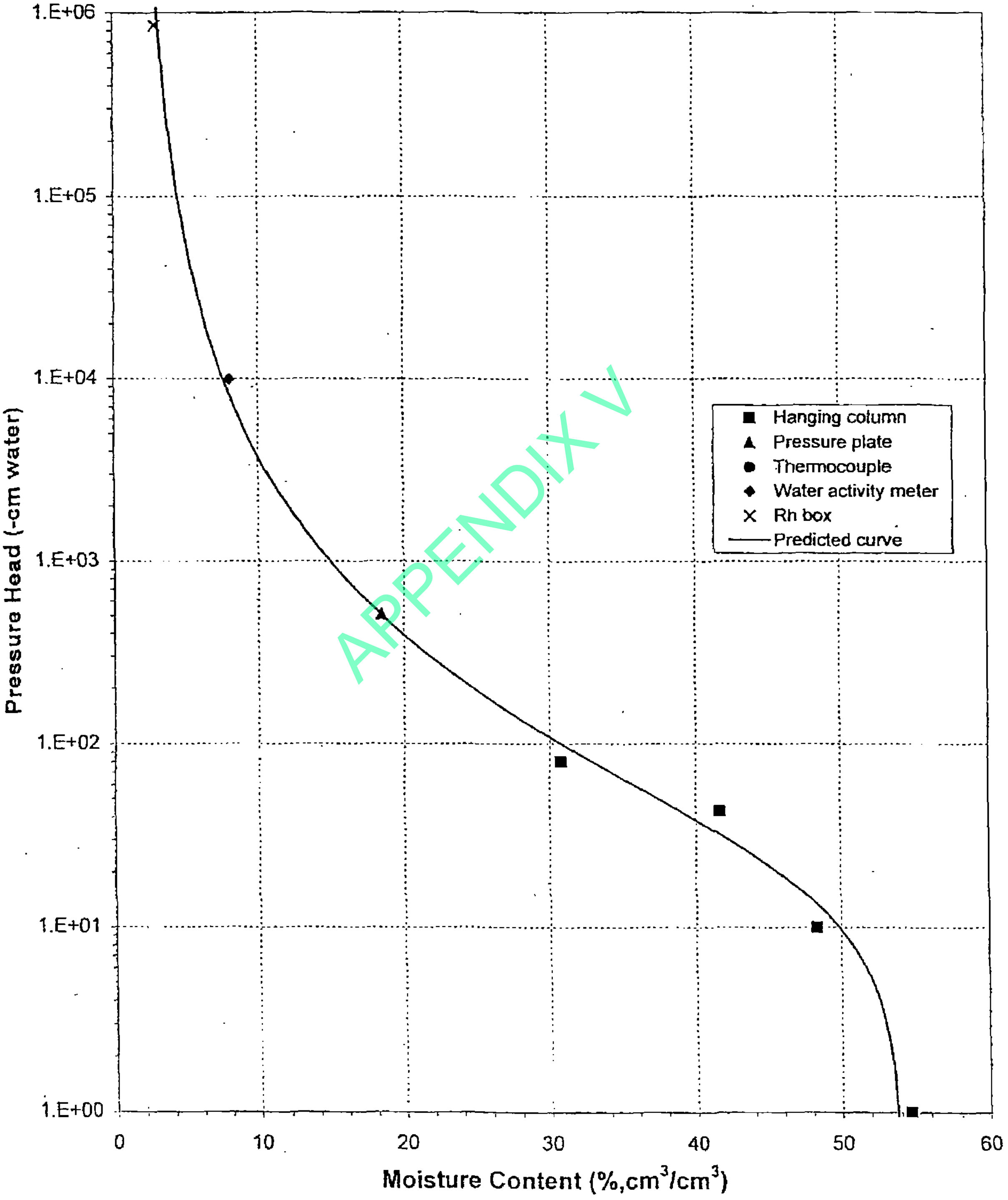
Water Retention Data Points

Sample Number: BLUF-4



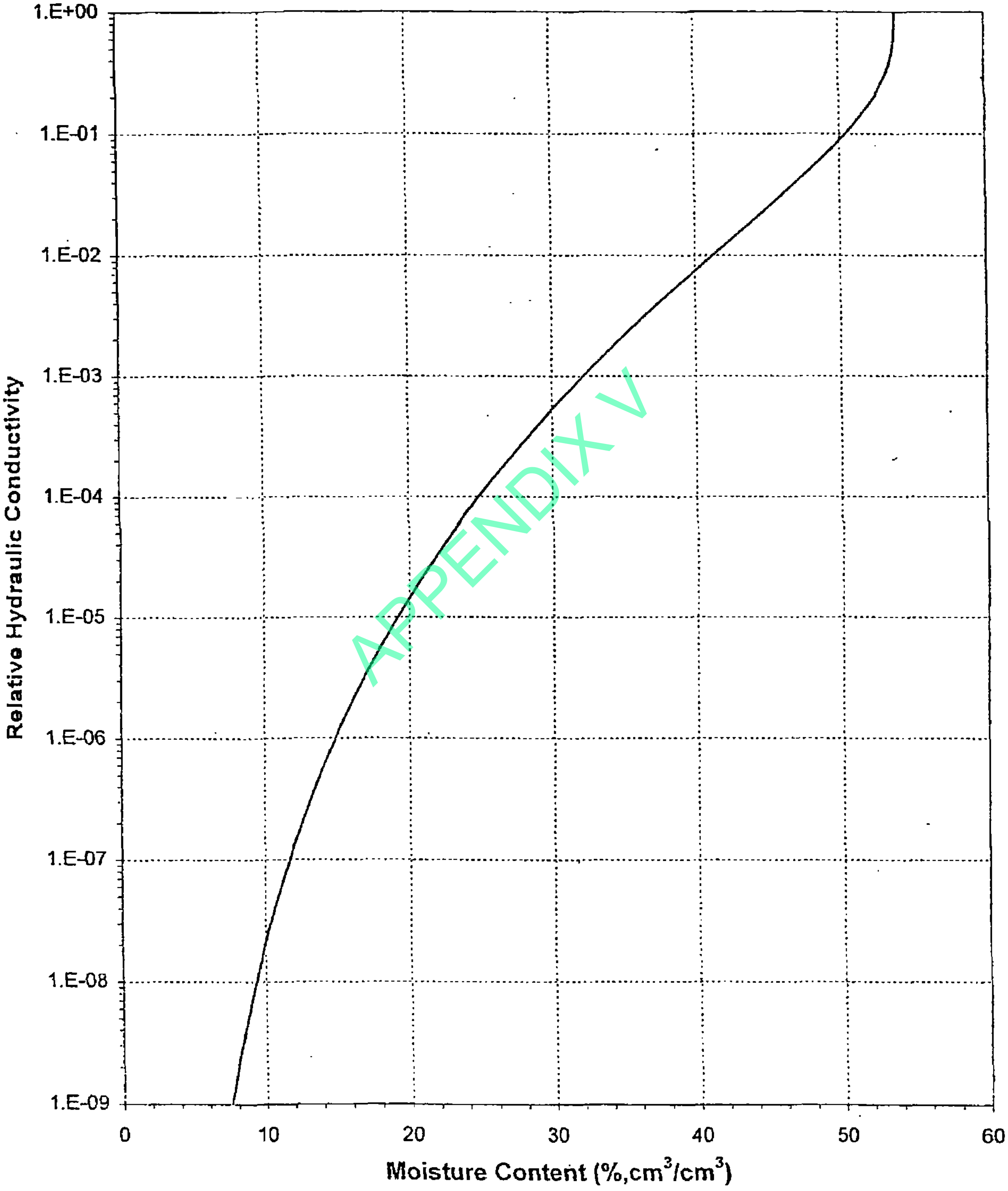
Predicted Water Retention Curve and Data Points

Sample Number: BLUF-4



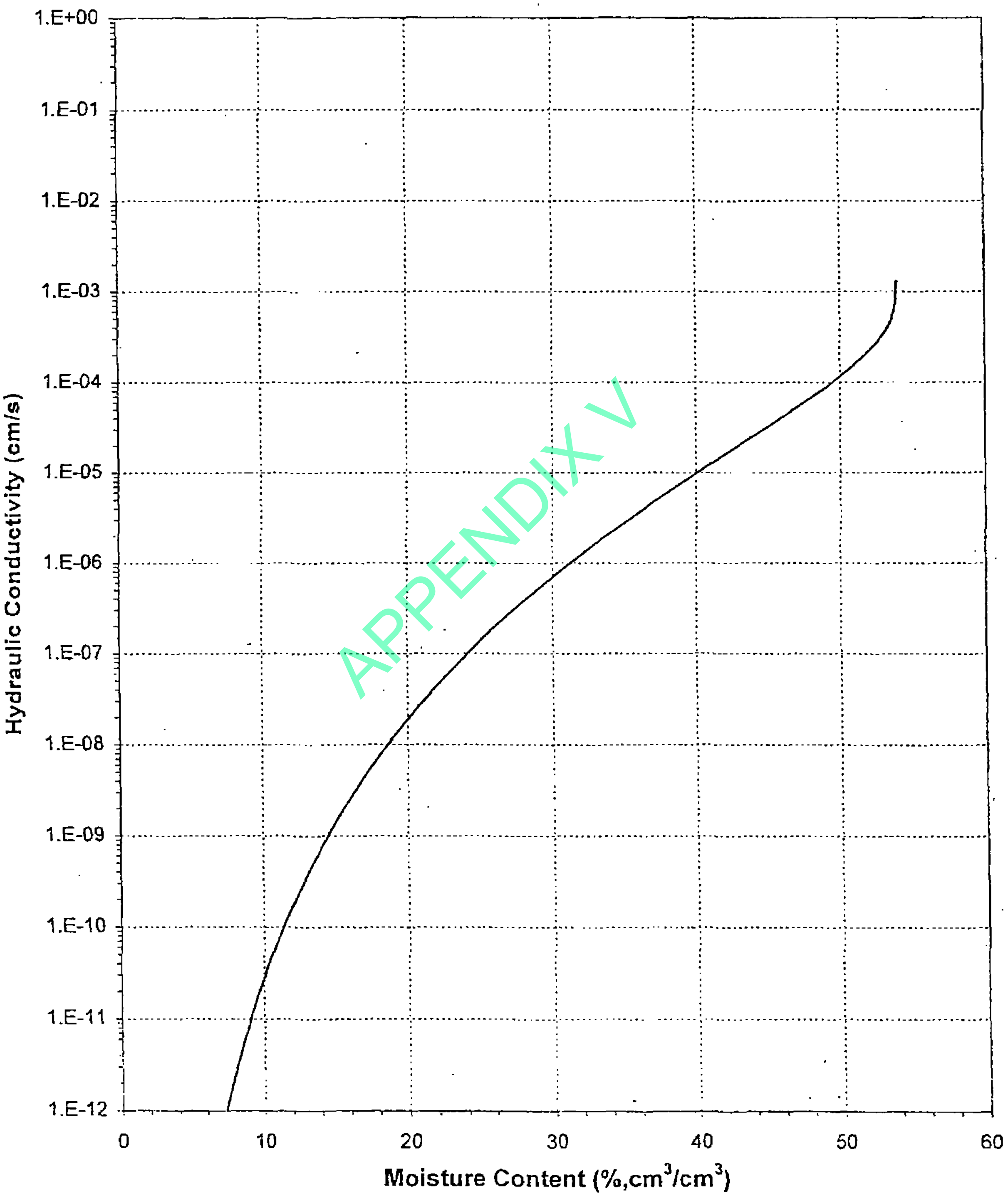
Plot of Relative Hydraulic Conductivity vs Moisture Content

Sample Number: BLUF-4



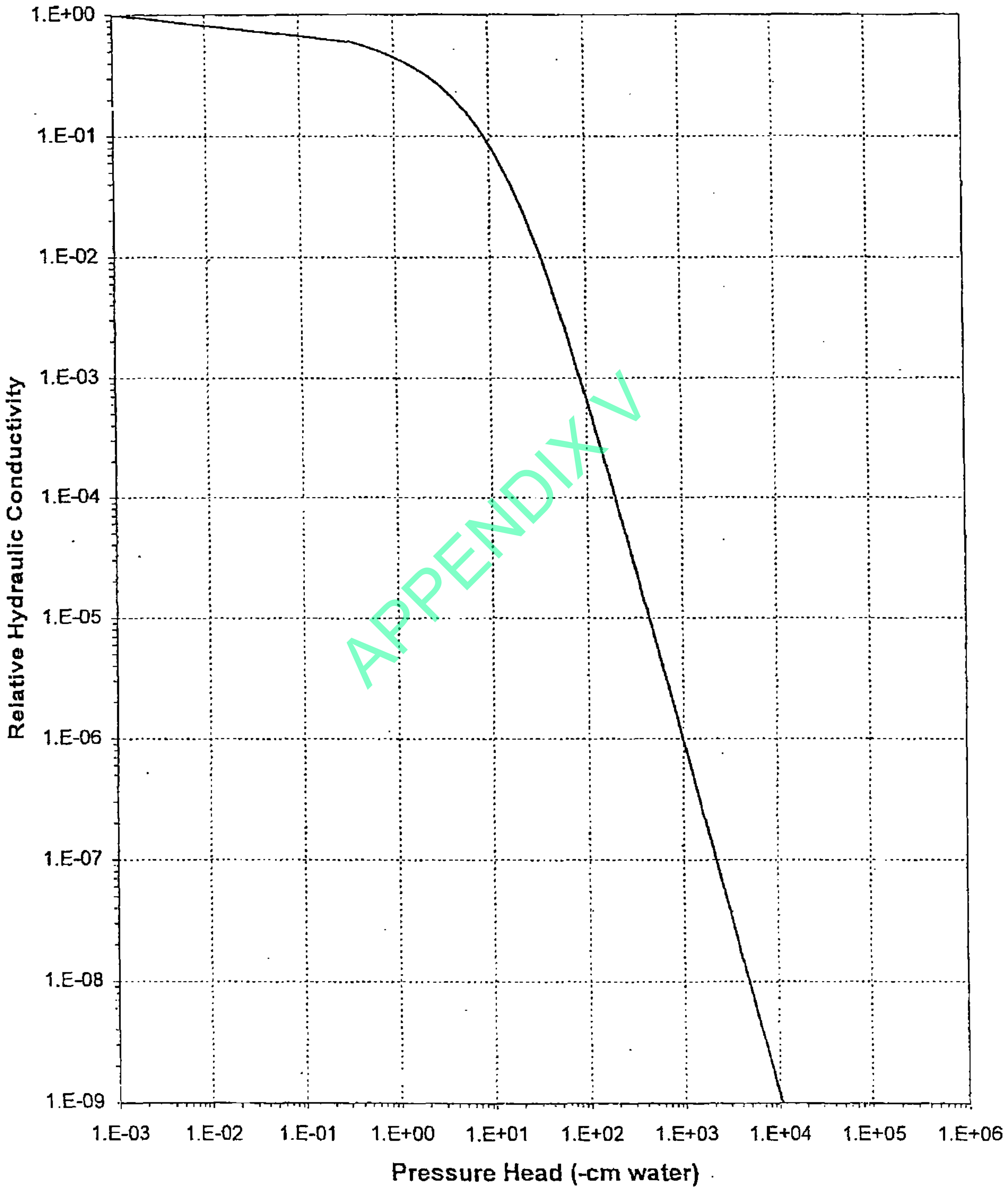
Plot of Hydraulic Conductivity vs Moisture Content

Sample Number: BLUF-4



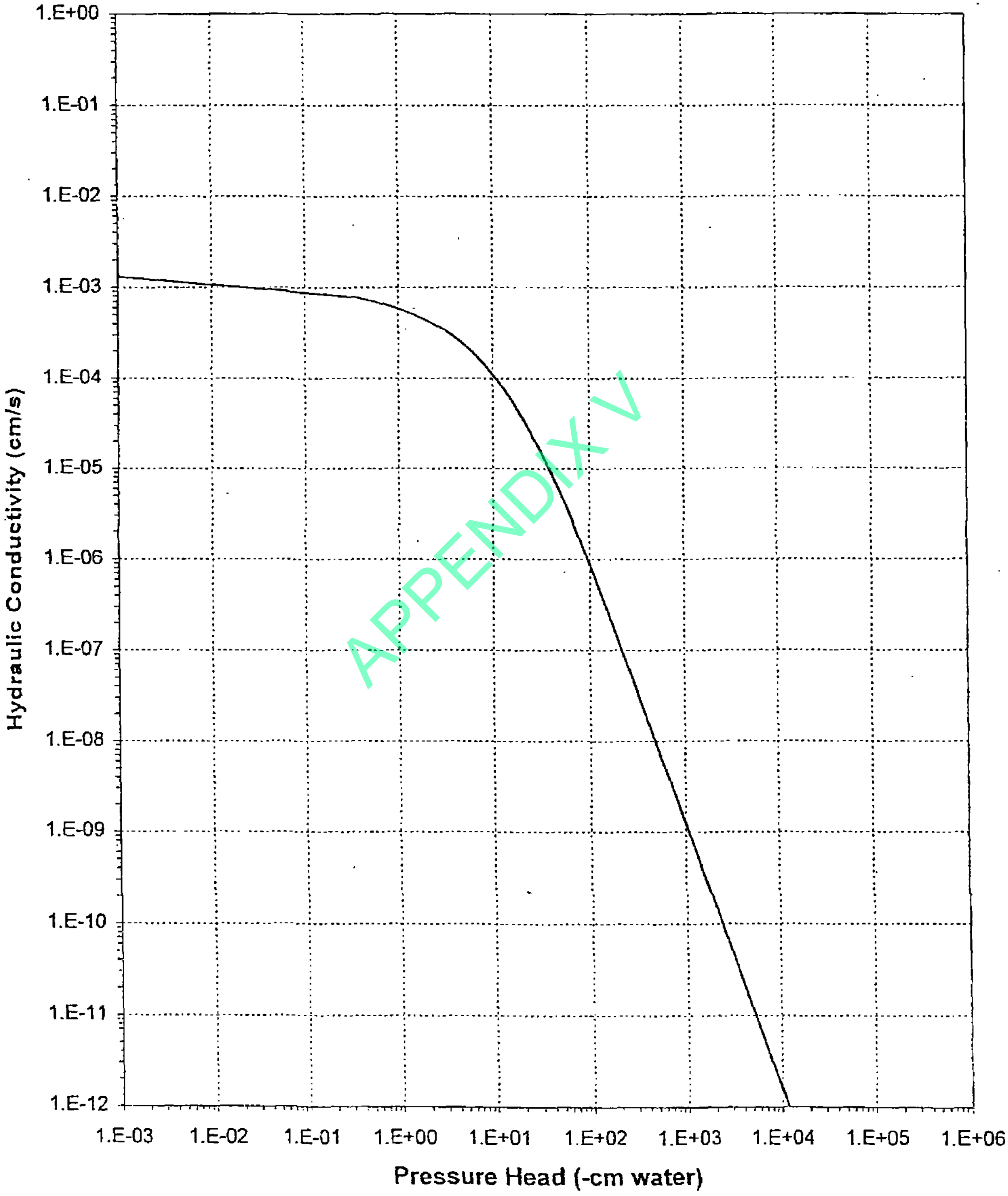
Plot of Relative Hydraulic Conductivity vs Pressure Head

Sample Number: BLUF-4



Plot of Hydraulic Conductivity vs Pressure Head

Sample Number: BLUF-4



APPENDIX V

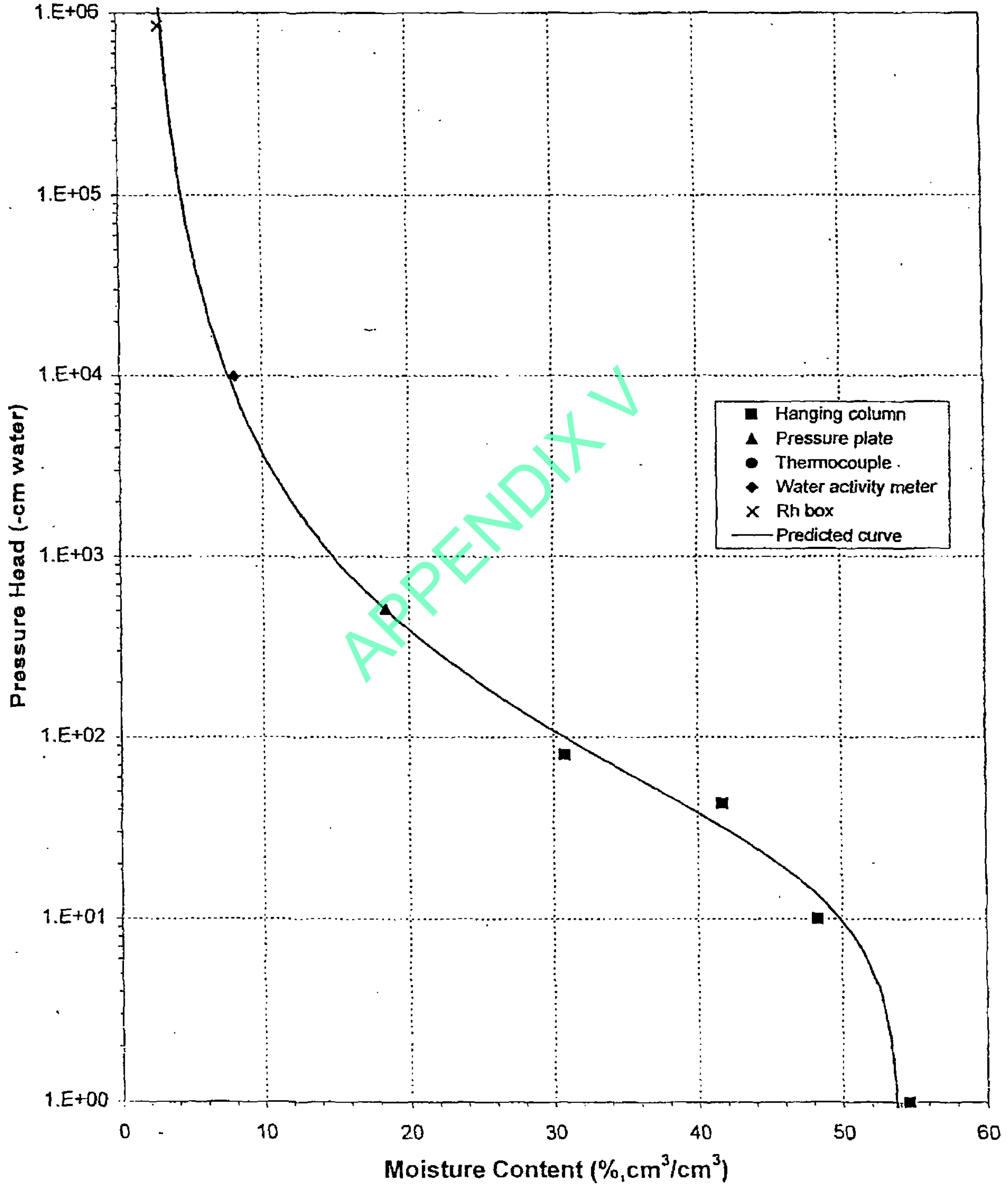
Laboratory Tests and Methods

Methods

Dry Bulk Density:	ASTM D 4531-91
Moisture Content:	ASTM D 2216-92
Calculated Porosity	Klute, A. 1986. Porosty. Chp.18-2.1, pp. 444-445, in A. Klute (ed.), Methods of Soil Analysis, American Society of Agronomy, Madison, WI
Ksat:	
Constant Head:	ASTM D 2434-68 (93)
Hanging Column Method	Klute, A. 1986. Porosty. Chp.26, in A. Klute (ed.), Methods of Soil Analysis, American Society of Agronomy, Madison, WI
Pressure Plate Method	ASTM D 2325-65 (94)
Water Potential Method	Dane, H. Jacob and G. Clark Topp. 2002. Chp.3. pp. 663-665, in J. H. Dane and G. C. Topp (ed.), Methods of Soil Analysis, American Society of Agronomy, Madison, WI
Relative Humidity Box	Klute, A. 1986. Porosty. Chp.26, in A. Klute (ed.), Methods of Soil Analysis, American Society of Agronomy, Madison, WI
Calc. Kunsat	Soil Sci. Soc. Am. J. 1980 44:892-898

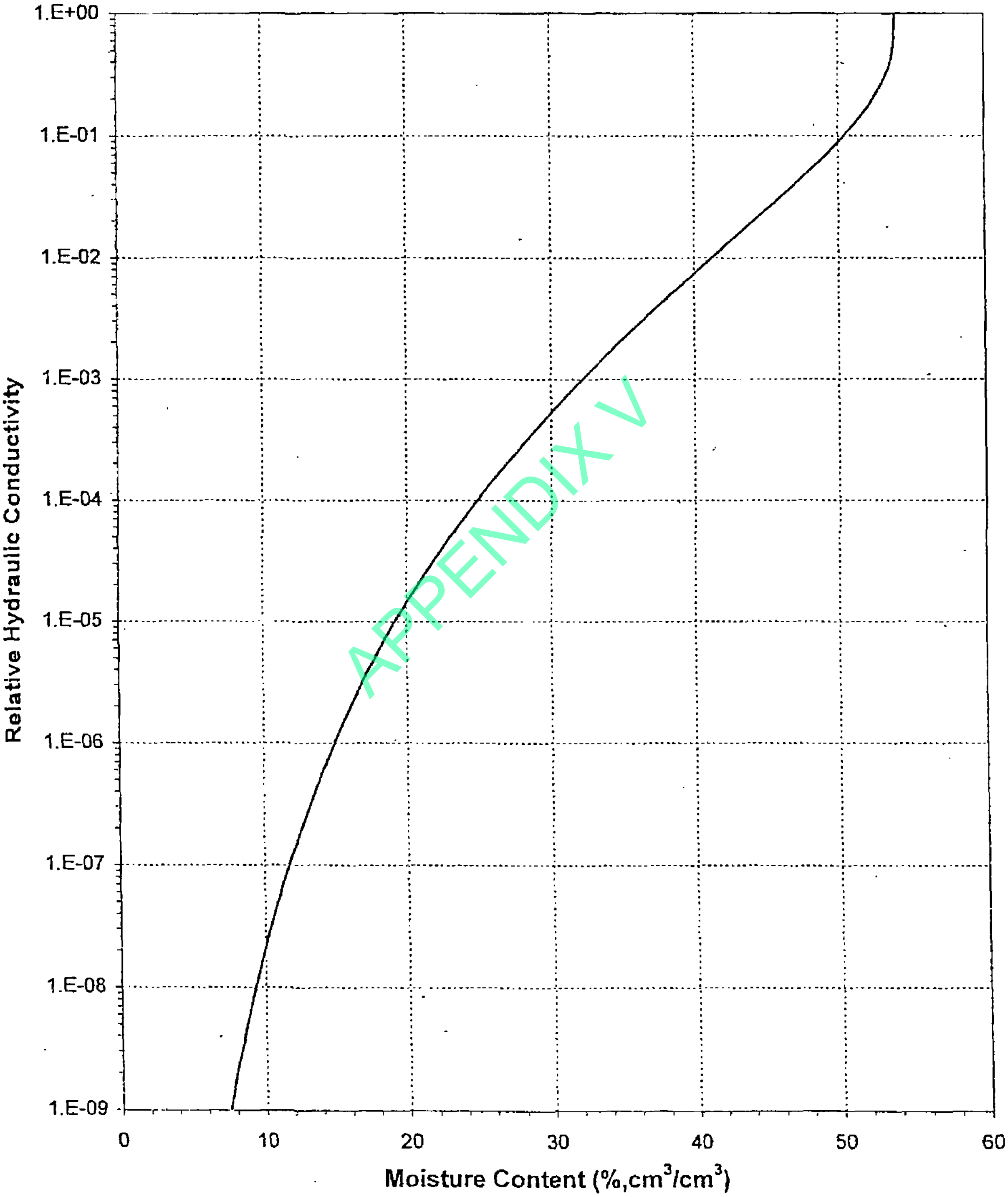
Predicted Water Retention Curve and Data Points

Sample Number: BLUF-4



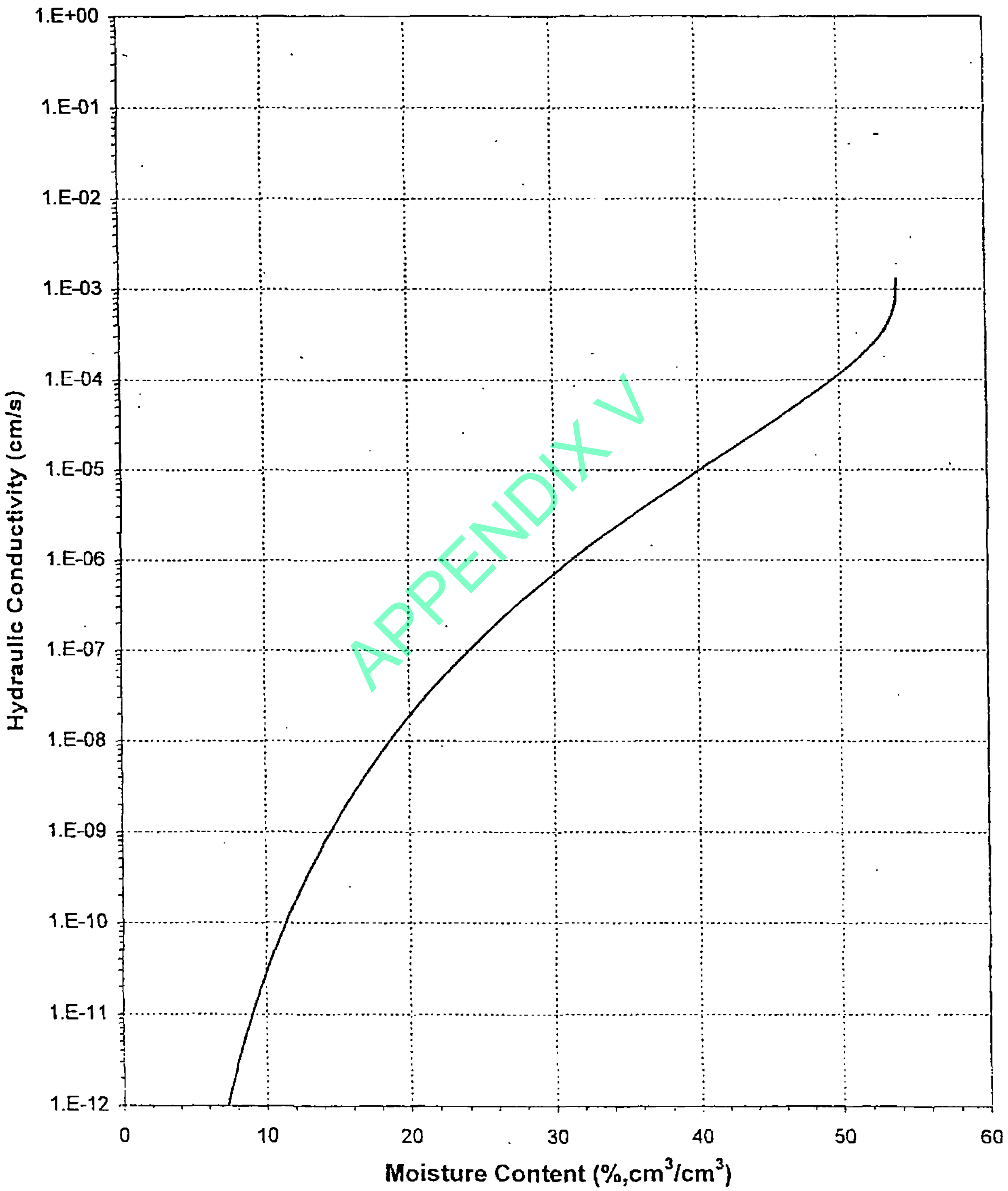
Plot of Relative Hydraulic Conductivity vs Moisture Content

Sample Number: BLUF-4



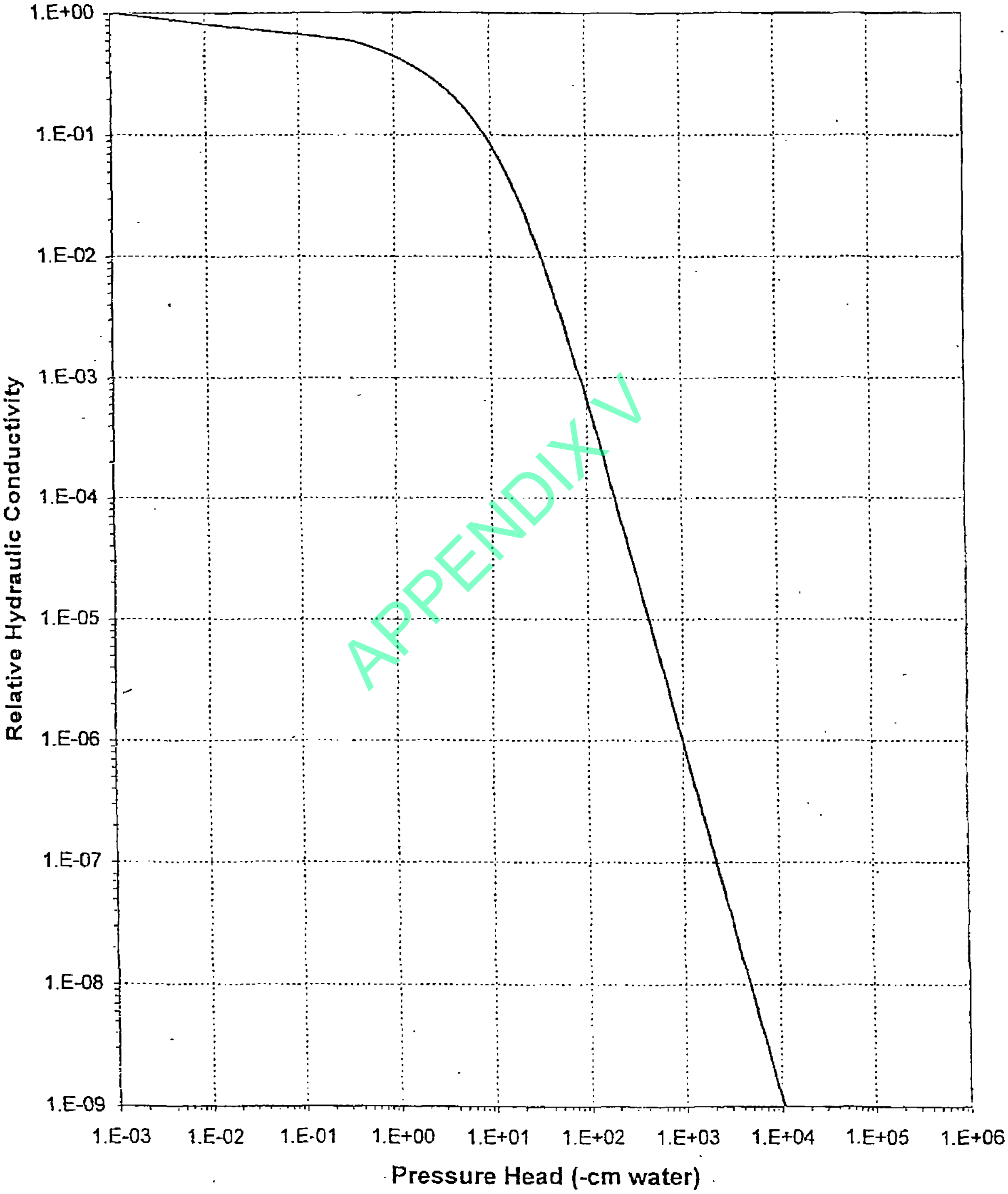
Plot of Hydraulic Conductivity vs Moisture Content

Sample Number: BLUF-4



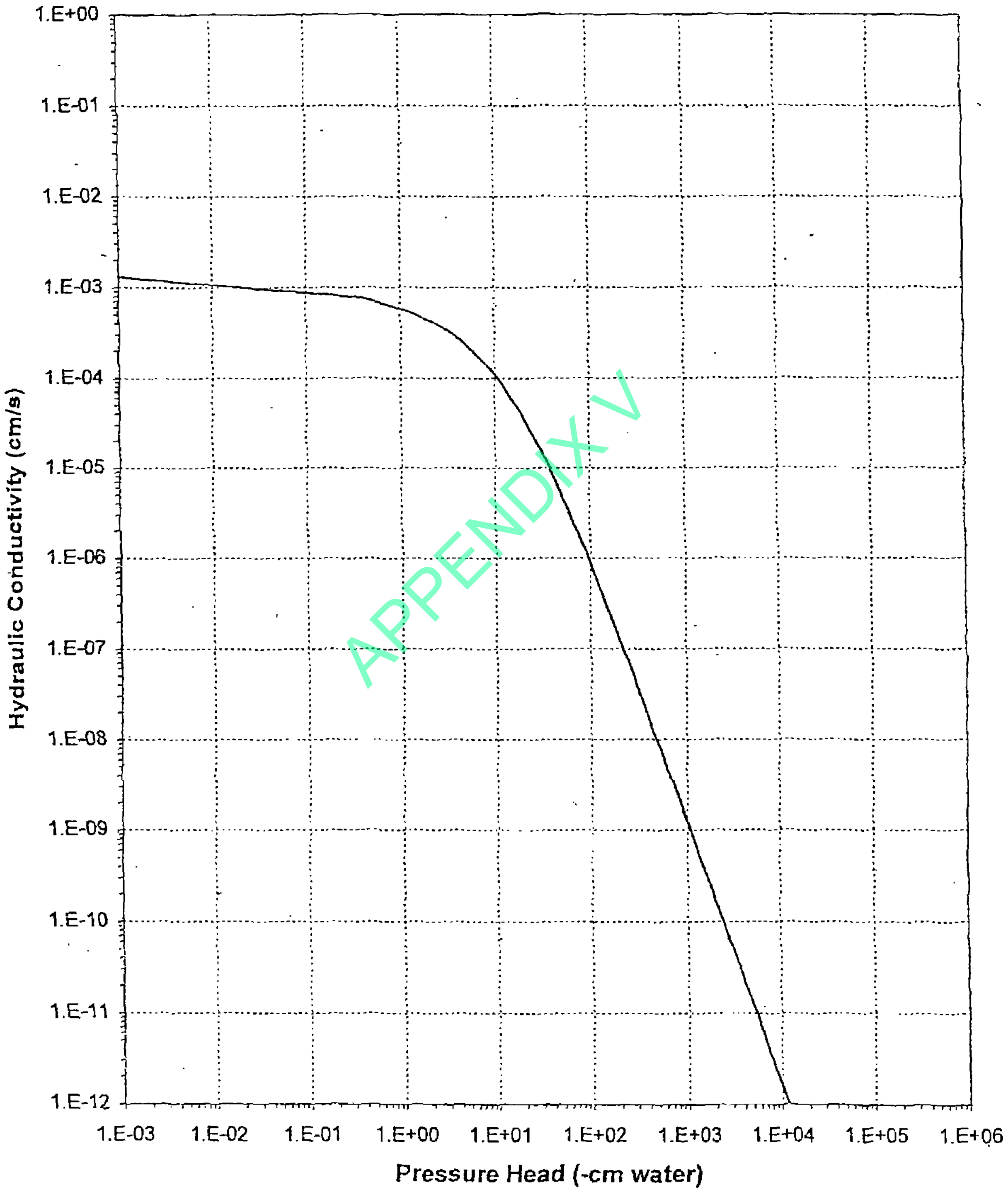
Plot of Relative Hydraulic Conductivity vs Pressure Head

Sample Number: BLUF-4



Plot of Hydraulic Conductivity vs Pressure Head

Sample Number: BLUF-4



Bayview Landfill
Frost Depth Calculation

Elberta, Utah NOAA Data
1951 - 1980

Dry Density	94	
Moisture Content	13	
Freezing Index (degree day)	880	
Mean Annual Air Temperature (deg F)	50.3	
Vo (deg F)	24.6	
Vs (deg F)	7.0	=freezing index/length of freezing
Length of Analysis Freezing Period (day)	125	
Latent Heat of Fustion "L" (Bty/ft^3)	1752.3	
Volumetric Heat "C" (Btu/ft/degF)	25.145	
Thermal Conductivity of Soil (Btu/ft^2/hr/degF/in)	0.6	
Alpha (Vo/Vs)	3.5	
Fusion Parameter "mu"	0.10	=C*Vs/L
Correction Coefficient "lambda"	0.62	chart

z = Lambda * ((48*F)/(L/k))^0.5

z = 2.36 feet

z = 28.3 inches

UDOT Map → 20 – 30 inches

Air Freezing Index- USA Method (Base 32^0 Fahrenheit)

Air Freezing Index Return Periods (^{0}F-Days) & Associated Probabilities (%)

State and Station Name	Station Number	Lat. (Deg. - Min.)	Long. (Deg. - Min.)	Elev. (feet)	Mean Annual Temp. (^{0} F)	1.1 Year (10%)	1.2 Year (20%)	2 Year (50%)	2.5 Year (60%)	3.3 Year (70%)	5 Year (80%)	10 Year (90%)	20 Year (95%)	25 Year (96%)	50 Year (98%)	100 Year (99%)
Utah																
BRYCE CANYON NP HDQ	421008	N3739	W11210	7915	41.1	606	743	1010	1090	1173	1270	1399	1503	1532	1615	1689
CAPITOL REEF NATL MON	421171	N3817	W11116	5500	53.3	60	100	217	263	317	387	493	590	620	708	791
CEDAR CITY FAA AP	421267	N3742	W11306	5620	50.3	80	125	248	293	345	411	509	596	622	699	771
COTTONWOOD WEIR //	421759	N4037	W11147	4950	53.6	50	80	165	198	235	283	355	420	439	497	551
COVE FORT //	421792	N3836	W11235	5980	47.8	158	231	407	468	537	621	743	847	878	968	1050
DEER CREEK DAM	422057	N4024	W11132	5270	43.5	464	614	936	1039	1150	1281	1464	1614	1658	1783	1895
DESERET	422101	N3917	W11239	4585	49.2	168	249	453	524	605	705	850	976	1014	1123	1223
DESERT EXP RANGE	422116	N3836	W11345	5252	49.0	136	212	416	491	578	686	849	992	1035	1162	1280
DUGWAY	422257	N4011	W11256	4340	51.4	114	178	344	405	475	562	693	807	842	943	1037
ECHO DAM	422385	N4058	W11126	5500	44.9	379	498	753	833	920	1023	1165	1282	1316	1413	1500
ELBERTA	422418	N3957	W11157	4690	50.3	113	177	347	410	482	572	708	828	864	969	1068
EPHRAIM SORENSENS FLD	422578	N3921	W11135	5580	47.0	297	405	650	730	818	923	1071	1195	1231	1335	1428
ESCALANTE	422592	N3746	W11136	5810	49.4	114	173	324	378	440	516	629	728	757	843	923
FAIRFIELD	422696	N4016	W11205	4876	46.6	271	375	614	692	779	883	1032	1156	1192	1297	1392
FARMINGTON USU FLD STA	422726	N4101	W11154	4340	51.2	76	123	253	302	360	432	543	641	671	760	842
FERRON	422798	N3905	W11108	5925	47.7	318	428	670	748	833	935	1077	1195	1229	1328	1416
FILLMORE	422828	N3857	W11219	5160	51.2	79	127	257	306	363	435	544	640	670	756	837
FORT DUCHESNE	422996	N4017	W10952	4990	44.7	627	846	1332	1489	1661	1866	2153	2392	2462	2662	2841
GARFIELD	423097	N4043	W11212	4310	53.0	68	109	223	266	316	379	475	560	586	663	734
GREEN RIVER AVN	423418	N3900	W11010	4070	51.5	180	274	516	603	702	826	1008	1167	1214	1354	1482
HANKSVILLE	423611	N3822	W11043	4308	53.1	122	194	390	463	548	655	817	961	1004	1132	1252
HEBER	423809	N4031	W11125	5580	44.4	414	544	822	910	1005	1117	1273	1401	1438	1543	1638
HIAWATHA	423896	N3929	W11101	7230	45.2	405	521	760	834	914	1007	1134	1238	1268	1354	1429
JENSEN	424342	N4022	W10921	4720	45.4	570	782	1261	1419	1592	1798	2091	2336	2408	2614	2800
KANAB	424508	N3703	W11232	4985	54.6	13	24	59	73	91	115	152	188	199	232	263
LAKETOWN	424856	N4149	W11119	5988	42.0	523	678	1001	1102	1211	1338	1514	1657	1699	1817	1921
LA VERKIN	424968	N3712	W11316	3200	58.6	3	6	20	26	33	44	61	78	83	100	116
LEVAN	425065	N3933	W11152	5300	49.1	175	254	445	511	584	674	804	915	948	1044	1131
LOA	425148	N3824	W11139	7045	43.2	397	513	754	830	911	1005	1136	1242	1273	1360	1438
LOGAN UTAH STATE UNIV	425186	N4145	W11149	4785	48.0	225	322	554	634	722	829	984	1116	1155	1268	1371
MANTI	425402	N3915	W11138	5740	47.6	214	297	485	547	616	698	815	914	943	1026	1101
MEXICAN HAT	425582	N3709	W10952	4270	56.3	15	35	118	159	212	289	422	558	602	740	880
MILFORD WSO //	425654	N3826	W11301	5028	49.1	149	226	420	489	568	666	811	936	974	1084	1185
MOAB 4 NW	425733	N3836	W10936	3965	56.6	36	68	176	222	278	355	478	595	631	743	850

30yr ≈ 88

Footnotes:

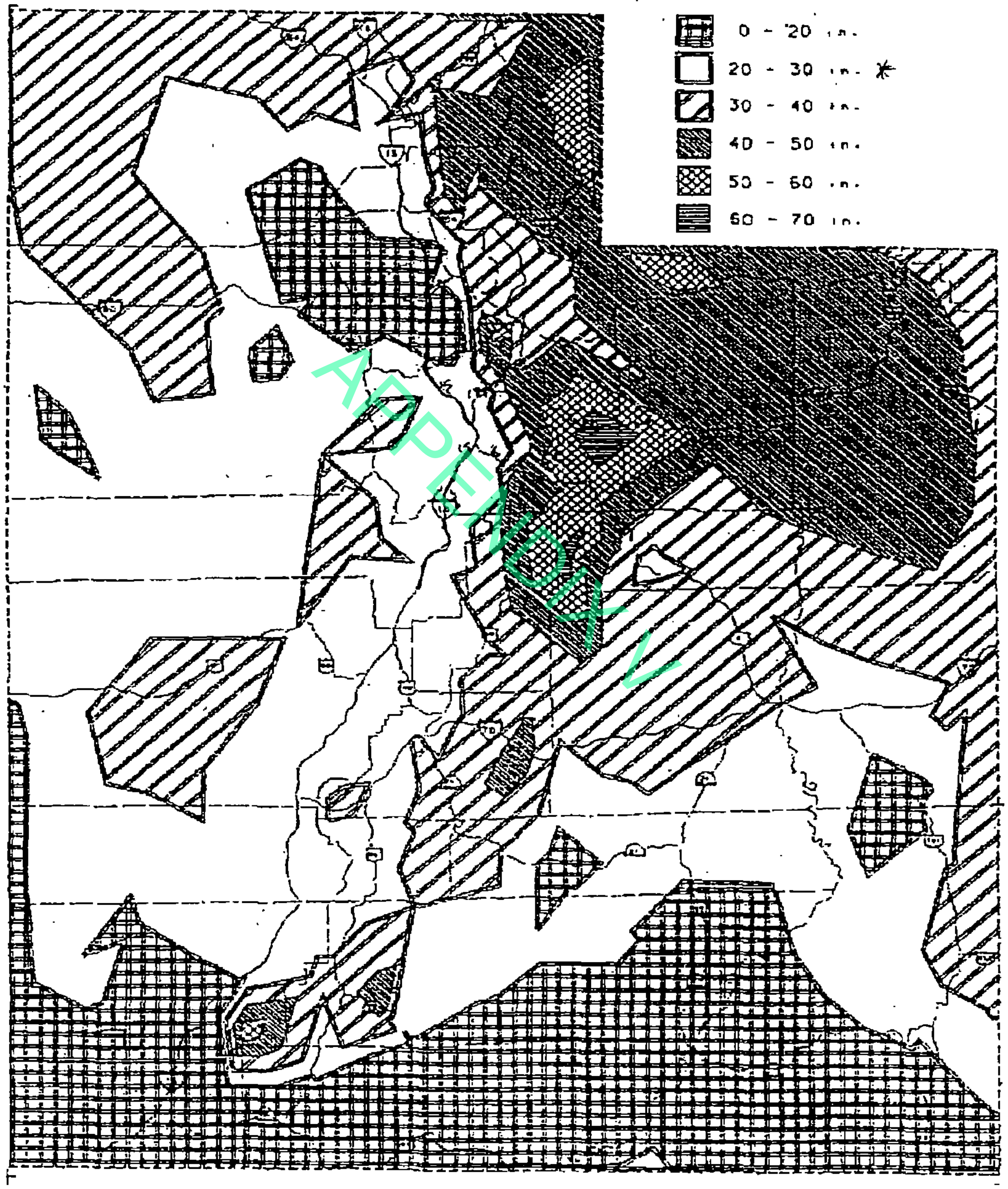
* Probability of occurrence less than indicated probability (Value=0)

** No Freezing Index Values Recorded during 1951-80 period (Value=0)

UDOT Map
from Pavement Design Manual

MAX. FROST PENETRATION DEPTH

Estimated Using Freezing Indices (Corps of Engineers Method)



KLEINFELDER
An employee owned company

July 31, 2003
File No.: 30268.001

Mr. Terry Warner
HDR Engineering, Inc.
3995 South 700 East, Suite 100
Salt Lake City, UT 84107

Subject: Source Material Investigation
South Utah Valley Landfill (Bayview Landfill)
Utah County, Utah

Dear Mr. Warner:

In conjunction with Kleinfelder's report dated July 1, 2003, we are providing the following information to summarize the findings of our report.

Identification of Suitable Material
Based on laboratory testing and modeling, as presented in Kleinfelder's Meteoric Water Infiltration Study, one of the predominant soils at Bayview Landfill has been identified as an acceptable material for the Cell 1 protective cap. This soil is classified as a silty sand (SM) to sandy silt (ML), and is generally olive brown in color. Based on numerous tests performed on this proposed capping material, this material can generally be characterized by the following grain-sizes:

Sieve Size	Percent Passing
No. 4 (1/4 inch)	95 – 100%
No. 40	70 – 100%
No. 60	60 – 95%
No. 200	30 – 70%

Other materials present at the site differ significantly from this gradation criteria and are generally easy to screen out based on field logging and gradation tests.

Location of Suitable Material
The proposed suitable cap material was found in the stockpile north of Cell 1 and in the floor of the excavation for Cell 2. In the three borings drilled in the stockpile north of Cell 1, we found one 5-foot thick layer in B-3, and a few other pockets of material that did not meet these specifications.

We investigated the materials immediately below the stockpile north of Cell 1 and beneath the dune sand south of Cell 2 and found only some pockets of material suitable for construction of the protective cap layer in those locations.

Two test pits excavated within Cell 2 contained 6 to 7 feet of the suitable cap material.

We recommend that lenses or pockets encountered within the stockpile or under Cell 2 that do not fall within the gradation criteria identified above be excluded from use in the protective cap layer unless further testing and analysis is performed to evaluate their suitability.

Kleinfelder appreciates this opportunity to assist you. If you have any questions regarding this report please do not hesitate to contact us at (801) 466-6769.

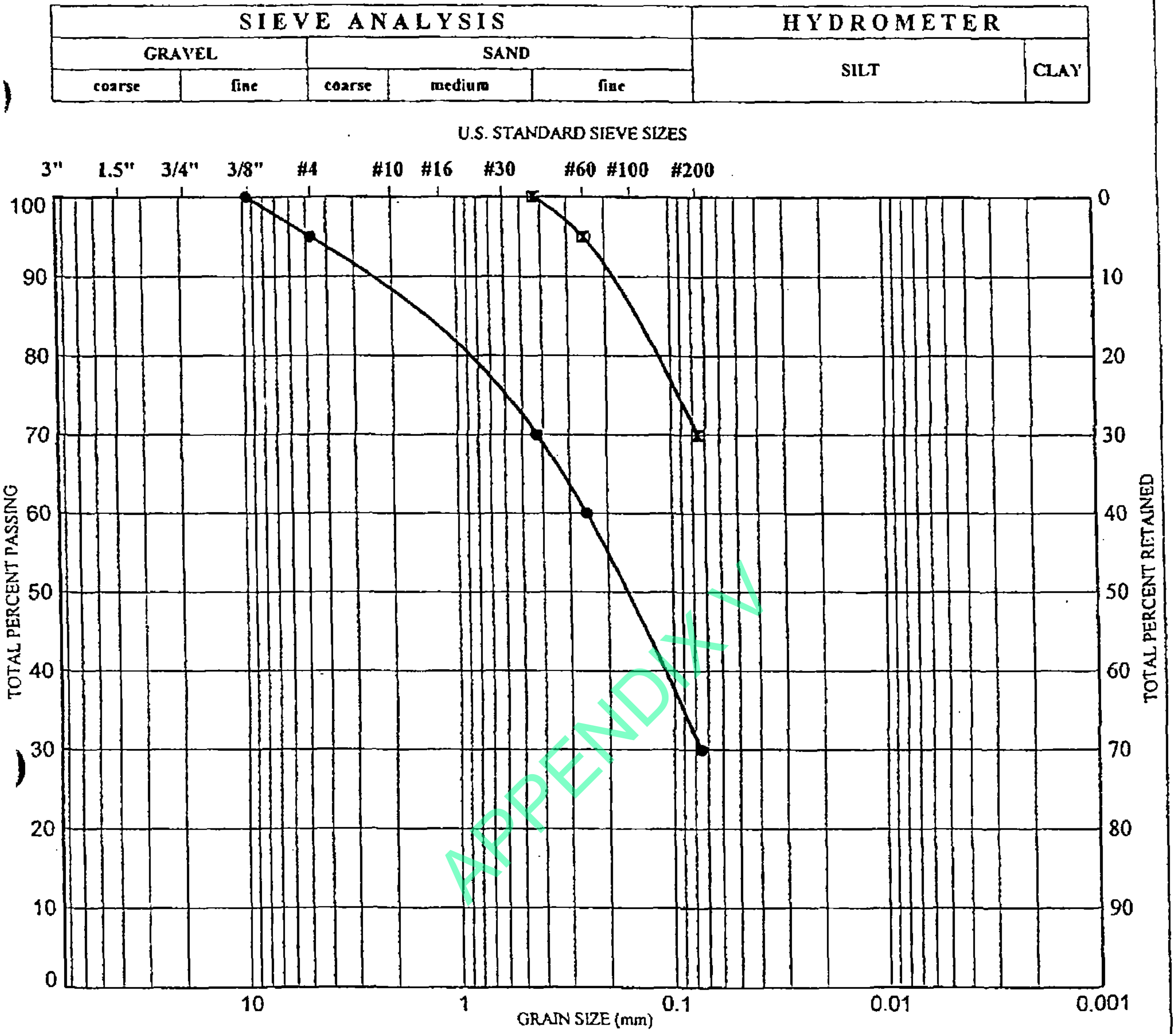
Respectfully,

KLEINFELDER, INC.

Renee Zollinger, P.G.
Senior Geologist

Scott Davis, P.E.
Geotechnical Division Manager

cc: Mike Oden, HDR Engineering
Richard Henry, South Utah Valley Solid Waste District



Symbol	Sample	Depth (ft)	USCS Soil Description	USCS Classification
●				
⊠				

KLEINFELDER

PROJECT NO.

GRAIN SIZE DISTRIBUTION

FIGURE

B-1

APPLICATION FOR AUTHORIZATION TO USE

Meteoric Water Infiltration Study
South Utah Valley Landfill (Bayview Landfill)
Utah County, Utah
Report originally prepared for *HDR Engineering, Inc.*

File Number: 26515.001 Report Date: September 9, 2003

KLEINFELDER, INC.
849 West LeVoy Drive, Suite 200
Taylorsville, UT 84123
(801) 261-3336
(801) 261-3306

To Whom It May Concern:

Applicant understands and agrees that the above-referenced report for the subject site is a copyrighted document, that Kleinfelder, Inc. is the copyright owner and that unauthorized use or copying of the report for the subject site is strictly prohibited without the express written permission of Kleinfelder, Inc. Applicant understands that Kleinfelder, Inc. may withhold such permission at its sole discretion, or grant permission upon such terms and conditions as it deems acceptable.

By signing below, the Relying Parties agree to the same terms and conditions as Kleinfelder's original client, including any limitations of liability or indemnity obligations. The original services agreement may be obtained from the original client identified above or from Kleinfelder, upon request.

To be Completed by Applicant

_______________ *(company name)*	By: _______________ *(Print Name)*
_______________ *(address)*	_______________ *(Signature)*
_______________ *(city, state, zip)*	Title: _______________
_______ *(telephone)* _______ *(FAX)*	Date: _______________

To be Completed by Kleinfelder, Inc.

_______ Approved for reuse with applicant agreeing to above terms and concurrence by original client. Additional fees are estimated at $__________.

_______ Disapproved, report needs to be updated.

By: ______________________ Date: ______________
Kleinfelder, Inc.

RETURN COMPLETED FORM TO KLEINFELDER

APPENDIX N

Attachment N-1

Addendum to Closure Cap Equivalency Report

KLEINFELDER
An employee owned company

February 9, 2004
File No.: 26515.001

FEB 10 2004

Mr. Terry Warner
HDR Engineering, Inc.
3995 South 700 East, Suite 100
Salt Lake City, Utah 84107

Subject: **Estimate of Realistic Infiltration Rates**
South Utah Valley Landfill (Bayview Landfill)
Utah County, Utah

Dear Terry,

I have reviewed the Utah Division of Solid and Hazardous Waste (DSHW) Request for Additional Information dated November 12, 2003. I also attended a meeting at DSHW with you on December 9, 2003. This letter addresses the questions raised by DSHW in Item No. 3 (2nd bullet) of the Request for Additional Information.

DSHW QUESTION

The DSHW requested that we provide evidence that the proposed evaporative cap will perform as well as an actual cap that Stephen Dwyer tested and found exhibited a leakage rate less than 3 mm/year.

This question is addressed below.

EVIDENCE THAT PROPOSED CAP MEETS PERFORMANCE STANDARD

When the modeling study was performed last year, no performance standard existed for evaporative caps. Under DSHW guidance, our modeling study (Kleinfelder, 2003[1]) showed that the proposed evaporative cap out-performs the prescriptive cap under normal and worst-case weather conditions. However, all modeling was performed on a comparative basis (prescriptive versus evaporative). Our study did not include developing an estimate of "real" infiltration rates under site conditions.

Since we performed the required modeling, DSHW has begun to consider using an infiltration rate of 3 mm/year as a performance standard for evaporative caps. I assume DSHW will enforce this standard under normal weather conditions (possibly including realistic/historical worst case weather), since the standard appears to be based on actual field test cases conducted under real weather patterns, as well as modeling performed using normal climate conditions.

---

[1] Kleinfelder, 2003. *Meteoric Water Infiltration Study, South Utah Valley Landfill,* September 9, 2003, File No. SLC3R082.

I have looked at the studies of "real" infiltration rates suggested by DSHW, compared these studies to our modeling study, and have concluded that the proposed evaporative cap at Bayview Landfill will meet the performance standard being considered by DSHW for the following reasons:

1. All studies I reviewed demonstrated that the evaporative caps out-perform prescriptive caps. This information is in agreement with our modeling study, where, under identical worst-case (conservative) assumptions, the proposed evaporative cap allowed less infiltration than the prescriptive cap.

   This result is summarized below.

	Range of Infiltration Rates	
	Normal Climate	**Hypothetical Worst Case Rainfall**
Prescriptive Cap	41.4 to 46.5 mm/yr	138.5 to 181.2 mm/yr
Evaporative Cap	26.3 to 41.2 mm/yr	70.7 to 121.7 mm/yr

2. Field studies performed by Stephen Dwyer (Dwyer, 2000[2]) quoted "real" (observed) prescriptive cap infiltration rates that average 4.82 mm/year compared to "real" evaporative cap infiltration rates that average 0.19 mm/year. The observed (Dwyer) and modeled prescriptive (Kleinfelder) caps should have similar rates, but the rates measured in the field differ from our modeled rates by an order of magnitude because: our model omitted the mitigating effects of plant transpiration; our modeled rates are based on conservative choices for cell size, boundary types, initial saturation, etc., used in "building" the numerical model; our model used hypothetical high rainfall (greater than observed in historical records) to evaluate worst case performance; and our modeled "normal" rainfall is approximately 3 times higher than actual rainfall in the Dwyer study.

   If our conservative assumptions increased the modeled prescriptive cap infiltration rate by an order of magnitude over Dwyer's results, they probably also increased our evaporative cap infiltration rates by an order of magnitude. Therefore, it appears that under more realistic assumptions, our modeled infiltration rates for the evaporative cap would have been around 2 to 4 mm/year.

3. The studies we reviewed consistently demonstrate that, in practice, evaporative caps allow about 10 times less moisture to infiltrate than do prescriptive caps. We made one modeling assumption on our evaporative cap that "overruled" the model's predication for producing that result. We added a 2-inch hypothetical "topsoil" layer to the top of the modeled evaporative cap that allowed excess water storage in an attempt to simulate a loosened ground surface produced by wind erosion. In our experience, adding a loose, organic topsoil significantly

---

[2] Dwyer, et al., 2000. *Water Balance Data from the Alternative Landfill Cover Demonstration.*

increases the infiltration rate predicted by the model. Our approach in the modeling study was to add a conservative "worst-case" condition to the evaporative cap and compare it to the prescriptive cap. Even under this worst-case assumption, the evaporative cap allowed less infiltration than the prescriptive cap. In reality, we do not observe a 2-inch, loose, organic topsoil developing in the area around Bayview Landfill and do not expect the cap to develop a permanent layer comparable to the modeled topsoil layer.

Based on the results of the other studies I reviewed, especially Dwyer's work, I believe this hypothetical "topsoil effect" we included produced unrealistically high infiltration rates for the evaporative cap. Removing this topsoil from the model would decrease the modeled infiltration rate significantly, and would result in predicted performance that better matches the observed performance in Dwyer's study.

4. Several studies I reviewed (Mackey, 2002[3]; Forlina, 2003[4]; Zornberg, 2003[5]; and Thompson, 2003[6]), described the composition and texture of evaporative cap material that either met the 3 mm/year performance standard or exceeded the Subtitle C prescriptive cap performance. Accepted cap thicknesses range from 20 to 48 inches and, when specified at all, fines comprised at least 28 to 50 percent of the soil material. These soils and cap thicknesses are very similar to the Bayview Landfill proposed evaporative cap, and were applied in similar climatic settings (Montana, Colorado, and California).

CONCLUSION

For the four reasons discussed above, I believe the proposed evaporative cap at Bayview Landfill will perform better than the prescriptive cap described in the Solid Waste Rules will perform as well as the other evaporative caps being documented in the literatures and will meet the 3 mm/year performance criteria under the same conditions that other evaporative caps meet that criteria.

LIMITATIONS

The conclusions drawn above are based on the study modeling performed by Kleinfelder and the information available in cited literature. These conclusions are subject to limitations on the current accepted understanding of unsaturated flow processes and the limited field tests that have been performed and documented to date. No warranty, express or implied, is made.

---

[3] Mackey, et al., 2003. *RCRA Equivalent Cover Demonstration Project, Rocky Mountain Arsenal.*

[4] Forlina, Ron, 2003. *The Approval Process for an Alternative Final Cover System for the Denver Arapahoe Disposal Site, Colorado.*

[5] Zornberg, Jorge, 2003. *Operating Industries, Inc., Superfund Landfill.*

[6] Thompson, Rick, 2003, *Mr. M. Landfill, Alternative Cover, Fergas County, Montana.*

I appreciate this opportunity to assist you. Please do not hesitate to call me if you have questions or need additional information.

Sincerely,

KLEINFELDER, INC.

Renee Zollinger, R.G.
Regional Manager

cc. Mike Oden, HDR Engineering, Inc.
Dick Sprague, HDR Engineering, Inc.
Richard Henry, South Utah Valley Landfill

APPENDIX W – FINANCIAL ASSURANCE PLAN

January 24, 2017

Scott Anderson, Director
Utah Division of Waste Management and Radiation Control
288 North 1460 West
Salt Lake City, Utah 84114-4880

Re: Financial Assurance Plan, Bayview Landfill

Dear Mr. Anderson:

The Northern Utah Environmental Resource Agency (NUERA) purchased the Bayview Landfill from South Utah Valley Solid Waste District (SUVSWD) on or about October 12, 2016 and transfer of the permit to operate a Class I Landfill has been requested.

This letter is intended to provide the financial assurance plan as required under UACR315-309-2(1) for operation of the Bayview Landfill by NUERA. Current estimates of closure and post closure care costs have been prepared consistent with the requirements of UACR315-309-2(3) and are attached to this letter as Attachment A and summarized as follows:

Cost Estimate for Landfill Closure	
Cell 1	
Closed	
Cell 2 – Stage 1	$ 671,272
Cell 2 – Stage 2	$ 771,962
Total Closure Costs	$1,443,234
Post-Closure Care Costs	$1,224,000
Total Closure and Post-Closure Costs	$2,667,234

Financial Assurance Mechanisms

NUERA, in accordance with **(UAC) R315-309-3(4),** intends to provide financial assurance for the period ending December 31, 2017 by a combination of mechanisms that together meet the **$2,667,234** requirements of subsection **(UAC) R315-309-1(1)**.

The financial assurance mechanisms chosen by the District are:

Local Government Financial Test	$ 839,790
Trust Fund	$1,827,444
Total Closure and Post-Closure Assurance	$2,667,234

(UAC) R315-309-8 Local Government Financial Test

NUERA intends to provide $1,021,104 in closure and post-closure financial assurance through the Local Government Financial Test. Supporting financial information including current statement of net assets and approved tentative budget for 2017 are included in attachment B to this letter.

The Local Government Test requires:

- (UAC) R315-309-8(2)(a)
  NUERA has no outstanding, rated general obligation bonds.

- (UAC) R315-309-8(2)(b)
  NUERA has no outstanding general obligation bonds, therefore must meet the following financial ratios
  (i) The ratio of cash plus marketable securities to total expenditures is greater than or equal to 0.05

  Projected Fiscal Year ended December 31, 2016

Cash + Marketable Securities	$2,706,298
Total Expenditures	$5,791,742

  Ratio of cash plus marketable securities to total expenditures is 0.46

  (ii) The ratio of annual debt service to total expenditures less than or equal to 0.20. NUERA currently has no annual debt service, therefore the ratio is zero.

- (UAC) R315-309-8(2)(c)
  NUERA's financial statements will be prepared in conformity with Generally Accepted Accounting Principles for governments and will have its financial statements audited by an independent certified public accountant beginning with the fiscal year ending December 31, 2016. The audited financial statement will be available no later than June 30, 2017 as required by Utah Code (UAC) 11-13-529.

- (UAC) R315-309-8(2)(d)
  NUERA will place a reference to the closure and post-closure costs in each audited financial report beginning with the financial report for the fiscal year ending December 31, 2016. All subsequent comprehensive annual financial reports during the time in which closure and post-closure care costs are assured through the financial test will include a reference to the closure and post-closure care costs assured through the financial test. The reference to the closure and post closure care cost will include:

  (i) the nature and source of the closure and post-closure care requirements
  (ii) the reported liability at the balance sheet date
  (iii) the estimated total closure and post-closure care costs remaining to be recognized
  (iv) the percentage of landfill capacity used to date
  (v) the estimated landfill life in years

- (UAC) R315-309-8(3)
  NUERA is eligible to assure closure and post-closure care costs through the financial test as it meets the following requirements.

  (a) NUERA is currently not in default on any outstanding general obligation bonds, and
  (b) NUERA does not have any outstanding general obligation bonds rated lower than Baa as issued by Moody's or BBB as issued by Standard and Poor's, and
  (c) Has not operated at a deficit equal to 5%, or more, of the total annual revenue in each of the past two fiscal years; and
  (d) Has not received an adverse opinion, disclaimer of opinion, or other qualified opinion from the independent certified public accountant, or appropriate state agency auditing its financial statement.

- (UAC) R315-309-8(4)
  NUERA will submit the following documents with the audited financial report for the fiscal year ended December 31, 2016 on or before June 30, 2017.

  (a) A letter signed by NUERA's CFO that (i) lists all current cost estimates covered by a financial test; and (ii) provides evidence and certifies that the local government meets the requirements of Subsections R315-309-8(2) and R315-309-8(6).
  (b) NUERA's independently audited year-end financial statements or the fiscal year ended December 31, 2016 including the opinion of the auditor who will be a certified public accountant (CPA).
  (c) A report to NUERA from the CPA stating the procedures performed and the findings relative to (i) the requirements of R315-309-8-(2)(c) and R315-309-8(3)(c) and (d) and the financial ratio is required by R315-309-8(2)(b).
  (d) A copy of the comprehensive annual financial report used to comply with R315-309-8(2)(d).

- (UAC) R315-309-8(6)
  NUERA does not assure other environmental obligations through a financial test and may assure closure, post-closure, and corrective action costs that equal up to 43% of the local government's total annual revenue.

  NUERA had a total revenue of $6,250,000 for the fiscal year ended December 30, 2016. NUERA has currently budgeted revenues of $1,953,000 for the fiscal year ended December 31, 2017, therefore, the maximum allowable assurance by the local government financial test will be $839,790. The Bayview Landfill has a long operating history and will continue to receive all of the waste from SUVSWD as well as additional waste from North Pointe Solid Waste Special Service District (North Pointe). This waste stream, and the associated revenue, is very stable.

(UAC) R315-309-4 Trust Fund

NUERA will established a trust fund held at the Utah Public Treasurers' Investment Fund (PTIF) which has been accepted by the Utah Division of Solid and Hazardous Waste meeting the requirements of (UAC) R315-309-4 in the amount of $1,827,444**.**

<u>Compliance Schedule</u>

As an existing facility, NUERA is hereby requests the Director establish a compliance schedule to have the financial assurance mechanism in place and affective in accordance with (UAC) R315-309-1(3)(a) as follows.

For the Local Government Test mechanism, because NUERA is a new entity, an audited financial statement may not be available until June 2017, we request an effective date of July 15, 2017.

For the Trust Fund, NUERA requests to make four equal annual payments into a restricted Trust Fund held at the Utah Public Treasurers' Investment Fund (PTIF) account of $456,861 as allowed under (UAC) R315-309-4(3)(a). The Bayview Landfill Class I Permit #9420R2 expires on April 30, 2020. This payment schedule will ensure the availability of sufficient funds are available within the current permit term. The first payment will be made upon release of funds currently held in the Trust Fund established by SUVSWD for assurance of the Bayview Landfill.

We look forward to scheduling a meeting at your earliest convenience to discuss this issue in detail. In the meantime, if you have any questions or require additional information please feel free to contact me at (801) 614-5601.

Sincerely,

Northern Utah Environmental Resource Agency

Nathan Rich, Secretary
Operations and Management Committee

Attachments

FINAL UPdate
Recieved
Oct. 2009

2009.01105

Application for a Permit to Operate a Class I Landfill

SUVSWD Bayview Class I Landfill
Permit Application

Prepared for
Bayview Landfill
South Utah Valley Solid Waste District
Springville, Utah

Prepared by
HDR Engineering, Inc.
3995 South 700 East, Suite 100
Salt Lake City, UT 84107

October 23, 2009

SUVSWD Bayview Landfill
Class I Landfill Permit Application

Table of Contents

Part 4: Figures

List of Appendices

Part 1: General Information

Utah Class I and V Landfill Permit Application Form

***Part I* General Information**			
***I.* Landfill Type:** Class I		***II.* Application Type:** Renewal Application	
Current Permit Number: 9420R1			
***III.* Facility Name and Location**			
Legal Name of Facility: Bayview Landfill			
Site Address: 10800 S. State Road 68			**County:** Utah
Township 9 South	Range 1 West	All of Section 17 plus the S ½ of the SE ¼ of the NE ¼ of Section 18	
Main Gate Latitude North	degrees 40	minutes 02	seconds 00
Longitude West	degrees 111	minutes 57	seconds 30
***IV.* Facility Lessee and Operator Information**			
Legal Name of Lessee and Operator: South Utah Valley Solid Waste District			
Address (mailing): PO Box 507			
City: Springville	**State:** Utah	**Zip Code:** 84663-0507	**Telephone:** 801-489-3027
***V.* Property Owner(s) Information**			
Legal Name of Property Owner: Utah School and Institutional Trust Lands Administration			
Address (mailing): 675 East 500 South, Suite 500			
City: Salt Lake City	**State:** Utah	**Zip Code:** 84102-2818	**Telephone:** 801-538-5100
***VI.* Contact Information**			
Operator Contact: Richard Henry			**Title:** District Manager
Address (mailing): PO Box 507			
City: Springville	**State:** Utah	**Zip Code:** 84663-0507	**Telephone:** 801-489-3027
Operator Contact: Scott Aitken		**Title:** Landfill Foreman	
Address (mailing): PO Box 507			
City: Springville	**State:** Utah	**Zip Code:** 84663-0507	**Telephone:** 801-489-3027

Certification of Submitted Information

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name: Richard Henry   Title: District Manager

Signature: Date:

SUBSCRIBED AND SWORN to before this ________ day of ________________, 2009.

My commission expires on the ________ day of ________________, 20___.

Notary Public in and for

(Seal)   ____________County, Utah

Part 2

Part 2: General Report

2.1 Facility Description

2.1.1 General

The South Utah Valley Solid Waste District (the District) was formed in 1989 to own and operate solid waste facilities for the cities of Provo, Salem, Spanish Fork, Springville, Mapleton, and Goshen, Utah. It assumed the existing and previously permitted landfill operations from the City of Provo. Solid waste facilities operated by the District are:

- A transfer station located in Springville;
- The Bayview Landfill located north of Elberta.

A separate, non-District-owned transfer station in Goshen also provides waste to the Bayview Landfill. This Permit Application applies only to the landfill, and does not include design, construction, or operation plans of the transfer stations.

The District added a compost facility at the Bayview Landfill in 2004. The compost facility processes a combination of yard waste and biosolids and is jointly permitted through the Division of Solid and Hazardous Waste and the Division of Water Quality. The Operating Plan for the compost facility is included as Appendix R to this Permit Application.

The Bayview Landfill was located, permitted, designed, and constructed by Provo City Corporation during the 1980s. The City received a Conditional Use Permit for the landfill site through the Utah County Board of Adjustment. Several conditions were attached to the Conditional Use Permit, one of which requires that only compacted or baled garbage be accepted at the landfill. A second of these conditions permits disposal of garbage from Provo City Corporation only; this condition was later modified to allow disposal of garbage from the District only. Therefore, no out-of-District wastes can be disposed of in the Bayview Landfill without approval of the County Board of Adjustment. A copy of the District's Conditional Use Permit is included as an attachment to Appendix S.

The Bayview Landfill is located in Sections 17 and 18, T9S, R1W approximately 6 miles north of Elberta, Utah, and directly west of State Highway 68. The landfill property includes all 640 acres of Section 17, and a 20-acre parcel in Section 18. All solid waste disposal activities are planned within the Section 17 parcel; the 20-acre Section 18 parcel houses a culinary well, a water storage tank, and an upgradient monitoring well associated with the landfill operations.

The Bayview Landfill site is located in the Goshen Valley approximately 2 to 3 miles west of Goshen Bay, the southwestern-most portion of Utah Lake. The Goshen Valley slopes upward away from the lake toward the East Tintic Mountains some 7 miles southwest of the lake. The landfill site similarly slopes with an approximate 150-foot rise from the eastern to the western boundaries of Section 17. The eastern boundary of the landfill site is approximately 120 feet above the current water elevation of Utah Lake.

The land use surrounding the site is generally rural agricultural, with orchard, grain, hay, and livestock grazing as the predominant land uses in the vicinity of the site. The nearest residence is located more than 1 mile from the northern property boundary, and the nearest town, Elberta, is 5.5 miles south of the site.

2.1.2 Area Served

The service area for the Bayview Landfill includes the cities of Provo, Salem, Spanish Fork, Springville, Mapleton, Goshen, and some contiguous areas. As stated above, the landfill's Conditional Use Permit prohibits it from receiving wastes generated outside of the District service area. The landfill is also prohibited from receiving wastes that have not been compacted or baled. These prohibitions limit the landfill's ability to accept wastes from other areas of the County or adjoining counties. The conditions also prohibit use by the general public.

2.1.3 Waste Types

The Bayview Landfill accepts wastes from the District's transfer station in Springville and a city-owned transfer station in Goshen. The transfer stations provide record keeping, screening and compacting of incoming wastes, and shipping of the solid wastes to the Bayview Landfill. The transfer stations accept residential and commercial solid wastes, including yard wastes, but generally do not accept construction debris (C&D) wastes. The transfer stations also do not accept regulated hazardous wastes. The waste screening operation is outlined in the transfer station’s operating plan.

Yard wastes arriving at the transfer stations may either be segregated for composting, or commingled and compacted with the residential and commercial wastes for compacting and disposal. Transfer station personnel make these decisions based on the quantity and ease of separation of the yard wastes, and the workload at the specific moment in time. Yard wastes that are segregated will be transferred to the closed Spanish Fork Landfill for grinding and then transferred to the compost facility at the Bayview Landfill.

The landfill will occasionally receive special waste (bulky waste and dead animals) directly at the landfill under special arrangements with the waste generator. Bulky waste is crushed and moved to the working face and is buried so that the potential for liner damage is avoided and so that large materials are not easily uncovered by operations at a later date. Dead animals are immediately covered with at least two (2) feet of material to minimize odors and to prevent the attraction from insects, rodents, and other animals.

The wastes accepted at the transfer stations are generally compacted, loaded into over-the-road vehicles, and transported to the landfill for disposal. When transfer station staff observe recyclable materials, and when there is time to easily and safely remove the recyclable materials, they will segregate these materials into on-site dumpsters for recycling.

Table 1-1 provides a summary of the quantity of wastes disposed of at the Bayview Landfill since it began operation in February 1991. The data reflects actual quantities shipped from the transfer stations during each fiscal year (July 1 through June 30).

Table 1-1: Tonnage Disposed at the Bayview Landfill

Year	Actual Tonnage
90-91	32,713
91-92	82,841
92-93	92,045
93-94	96,899
94-95	106,641
95-96	105,746
96-97	108,305
97-98	119,391
98-99	126,661
99-00	124,286
00-01	127,031
01-02	126,664
02-03	130,521
03-04	131,689
04-05	136,940
05-06	141,047
06-07	149,499
07-08	146,509

2.1.4 Landfill Development

Landfill Cell 1 reached capacity and Cell 2 – Stage 1 began receiving waste during fiscal year 2004. The landfill is currently placing waste in Cell 2 – Stage 1 and expects to reach capacity by the end of 2009, at which time Cell 2 – Stage 2 will begin receiving waste. Excavation of Cell 2 – Stage 2 is currently ongoing. Part 3 of this Permit Application describes the landfill staging plan.

The District has produced three master plans to guide development of the Bayview Landfill. The initial Landfill Master Plan (HDR, 1988) projected seven separate cells with a total waste disposal capacity of 7.64 million tons at the Bayview Landfill. This capacity was calculated based on a conservative in-place density of 1,000 pounds of solid waste per cubic yard (lbs/cy). The current in-place density based on known weights and surveyed volumes is approximately 1,500 lbs/cy, thereby increasing the capacity of the 7-cell plan by 50%. The Bayview Landfill Master Plan Update (HDR, 2002) considered several scenarios to utilize the airspace and footprint of Cells 2 and 3 more efficiently. The selected scenario combined Cells 2 and 3 into a single landfill Cell, deepened the excavation, and decreased the elevation of the liner requiring pumping of generated leachate.

A revised Cell 2 Master Plan (HDR, 2008; Appendix A) evaluated changes to the base grade of Cell 2 to further increase capacity. The Cell 2 Master Plan revised the base grade of Stage 2 to a 2% slope down to the northeast on the western portion of Stage 2, and a 2% slope down to the southeast on the eastern portion of Stage 2. This increased the capacity of Stage 2 to 2,300,000 cy, and the total capacity of Cell 2 to approximately 8,460,000 cy, with 7,800,000 cy remaining as of February 2009. At 1,500 lbs/cy, this equates to about a total capacity of 6,345,000 tons, with 5,900,000 tons remaining.

Since Cell 2 is expected to remain active through approximately 2032, it is not timely to revise the master plan for the remainder of the Bayview Landfill. However, it is expected that a revised master plan would more than double the capacity calculated in the 1988 Landfill Master Plan, yielding a total capacity of more than 20 million tons. This means that the Bayview Landfill has an expected useful lifetime of more than 50 years from the date of this Permit Application.

2.2 Solid Waste Management Plan

During 1992, the District participated in the development of the Utah County Solid Waste Management Plan (SWMP). The SWMP was developed in response to Senate Bill 255 to address county-wide planning for solid waste disposal over the next 20-year period. Two copies of this SWMP have previously been submitted to the Utah Division of Solid and Hazardous Waste. All of the activities discussed in this permit application were anticipated in, and are consistent with, the SWMP.

In addition, the District has prepared a Landfill Master Plan (HDR, 1988), a Bayview Landfill Master Plan Update (HDR, 2002), and a Cell 2 Master Plan (HDR, 2009) to guide development of the Bayview Landfill site. A copy of the most recent plan, the Cell 2 Master Plan is attached to this application as Appendix A.

2.3 Legal Description

The Bayview Landfill consists of the following parcels:

- Parcel "A": SW1/4 NW1/4 Section 17, T9S, R1W.
- Parcel "B": That portion of Section 17, T9S, R1W not described in Parcel "A. "
- Parcel "C": S1/2 of the SE1/4 of the NE1/4, Section 18, T9S, R1W.

This land was conveyed by the Utah Division of State Lands to the Provo City Corporation for a term of 51 years under Special Use Lease Agreement No. 498 (Appendix B). The term of this lease agreement extends through the year 2035. The lease agreement contains a clause for extension of the lease beyond the 51-year period.

2.4 Operations Plan

The two Operating Plans relevant to the Bayview Landfill site are presented in the Appendices to this Permit Application. Appendix S presents the current Landfill Operating Plan, while Appendix R presents the current Compost Facility Operating Plan.

2.5 Financial Assurance Plan

2.5.1 Cost Estimate for Closure and Post-Closure Care

Federal and State of Utah Rules and Regulations require that the owners of municipal solid waste landfills demonstrate the financial capability to conduct closure, post-closure care, and corrective action (if necessary). To meet these requirements, the owner must place in the operating record for the landfill an estimate of the cost of hiring a third party to perform closure, post-closure care, or corrective action. In addition, the owner must demonstrate that the funding is fully available for any year after 2009 to provide for closure, post-closure care, and corrective action for landfill cells that may require closure, post-closure care, or corrective action within the five year period between permit revisions. Both the cost estimate and the funding mechanism must be updated on an annual basis.

The regulations allow six different funding mechanisms to demonstrate financial assurance including: trust funds, surety bonds, insurance, letters of credit, local government financial tests, or local government guarantees. These funding mechanisms may be used individually or in combination with one another to demonstrate financial assurance. The regulations define specific requirements for each funding mechanism.

Appendix C contains an estimate of the costs for post-closure care of Cell 1 and closure and post-closure care of Cell 2 – Stage 1 and Stage 2 at the Bayview Landfill. Landfill Cell 2 – Stage 2 will remain active beyond the period covered by this permit application. As calculated in Appendix C, the estimate for third-party closure and post-closure care is $2,216,022.

2.5.2 Proposed Financial Assurance Mechanism

The District will use a trust fund to demonstrate financial assurance. In 1992, the District established separate accounts in the State Pool accumulating funds for closure and post-closure care of Cell 1 and corrective action. During 1997, the District transferred these funds into the Closure Trust Fund established by the State Treasurer. As of October 31, 2008, the closure/post-closure account held $2,979,148 which means that the trust fund is fully funded.

The District has consistently operated on a cash basis since its inception in 1990. It accumulates funds in advance to finance its capital facilities needs, and pays cash for all capital improvements, equipment, and services. This means that the District has no long-term debt to encumber its resources.

An alternative closure cap has been approved for the Bayview Landfill and the landfill plans to use the alternative cap design for Cell 2. Details of the alternative cap are discussed in Section 2.6 and Appendix N. The District plans to finance the partial closure of Cell 2 – Stage 1 from operating funds and does not intend to diminish the Trust Fund. In 2010, District personnel will begin depositing intermediate cover on the side slopes of Cell 2 – Stage 1. Therefore, Cell 2 will be partially closed during this permit period. Therefore, the Trust Fund account is adequately funded and will remain fully funded during the remainder of the current permit. In any case, the District will continue to report on the status and adequacy of the trust fund in its annual reports to UDEQ.

2.6 Closure Plan

This section describes post-closure care for Cell 1 and the closure plan for Cell 2. Landfill Cell 1 reached capacity in 2004 and the final cover was placed in 2008. Stage 1 of Cell 2 will reach operating capacity by the end of 2009, at which time Stage 2 of Cell 2 will begin receiving waste. Waste will be placed in Cell 2 Stage 2 for about 9 years, or until 2019. Landfill Cell 2 will operate beyond the five-year period covered by this permit and will not reach capacity until approximately 2032.

2.6.1 Final Cover Installation

An alternate final cover design of the capping system for the Bayview Landfill has been completed. The final contours of Cell 1 were projected in the 1988 Master Plan, and are depicted on Figure T-3 in Appendix T. Final contours of Cell 1 were achieved in 2004, at which point Cell 2 – Stage 1 began receiving waste. As mentioned, Stage 1 of Cell 2 will reach capacity and intermediate final cover placement will begin in 2010. The approved alternative final cover is planned for Cell 2 when it reaches final contours in 2032. The design for the alternate capping system includes the following layers of material from the bottom up:

- 6 inches of intermediate cover placed over the daily cover to provide a 12-inch cushion of soil over the solid waste;
- 34-inches of evaporative cap constructed from the olive-brown silty sand available on-site. The top six inches of this evaporative cap will be capable of supporting vegetative growth by amending it with compost to aid in initial seed germination.

As with Cell 1, a series of metal stakes with plastic fibers attached to the top will be placed in the final cover of Cell 2 on 100-foot centers across the cell. These metal stakes are commonly referred to as “blue tops” or “whiskers” and will be driven into the final cover until the plastic fibers are just below the completed final cover surface. This will provide a visual method (if the fibers begin to show over time) to determine if erosion of the final cover is occurring. Additionally, a series of benchmarks will be located around the perimeter of the landfill to be used to determine when settlement of the waste or cover materials has ceased.

The Landfill Foreman will inspect the completed cap weekly until vegetation is established, and monthly thereafter to ensure that damage to the capping system is detected and repaired early. The vegetation on the landfill cap will be maintained to blend into the surrounding semi-arid landscape.

The Landfill Foreman will also inspect the completed cap to determine that the final contours are maintained, and that the flow of stormwater is unimpeded. Areas in which excessive settlement or erosion of 1 inch has occurred, as evidenced by the exposure of the blue top survey stakes, will be regraded, mulched, and seeded as specified above.

2.6.2 Site Capacity

The landfill is currently achieving an in-place waste density of approximately 1,500 lbs/cy. At capacity, Cell 1contained approximately 1,800,000 tons of solid waste (2.4 million cubic yards at 1,500 lbs/cy). At the current rate of solid waste compaction, the District estimates that Cell 2 will contain approximately 6,345,000 tons of solid waste (8,460,000 million cy at 1,500lbs/cy). At the current waste acceptance rate of 146,000 tons plus a 3% annual increase, Cell 2 is expected to last until approximately 2032.

Based on the 1988 Master Plan, Cells 4 through 7, as currently configured, have a capacity of about 4,600,000 tons of waste with a waste density of 1,000 lbs/cy. The Bayview landfill currently achieves about 1,500 lbs/cy of in-place waste. Making this conversion, Cells 4 through 7 would have a capacity for about 6,900,000 tons, equating to an additional 46 years of life (at 150,000 tons per year).

2.6.3 Closure Schedule and Funding

Cell 1 reached capacity in 2004 and the final cover was placed in 2008. Seeding of the Cell 1 final cover is scheduled to be completed during early 2009 and is the only requirement remaining for final closure of Cell 1. Cell 2 – Stage 1 will reach capacity by the end of 2009 and begin receive intermediate cover on the side-slopes in 2010. Cell 2 – Stage 2 will begin receiving waste in 2010. Cell 2 – Stage 2 will remain active beyond the five-year period covered by this permit and will not reach final contours until approximately 2019.

Final closure construction will begin within 2 months of final receipt of solid waste in Cell 2. Closure construction will proceed on a continuous schedule to provide for completion of the closure cap within 18 months of final receipt of solid waste. The exact schedule cannot be predicted because the closure must be coordinated with both the final receipt of waste, and the beginning of the active growing season to provide cover vegetation an optimal chance of survival. The UDEQ will be notified when closure construction has been completed so that a final inspection can be made.

The closure costs projected in Section 2.5 assume that the entire closure cap, including intermediate soil cover, for Cell 2 Stage 1 and Stage 2 will be constructed as part of the closure. This is a very conservative assumption, since intermediate cover material will be placed as part of landfill operations. Furthermore, closure costs are anticipated to be paid from operating funds, leaving the trust fund intact. These assumptions allow the expedited closure of the landfill cell, and ensure that funding will be available to allow a third party to close the landfill under tight time constraints, if needed.

2.7 Post-Closure Care Plan

Post-closure care for Cell 1 of the Bayview Landfill will consist of long-term maintenance of the closure cap and ongoing sampling of the groundwater monitoring wells and gas monitoring stations to ensure that the landfill cell has been closed in accordance with regulations. The post-closure care period will be 30 years unless unexpected environmental contamination or continued subsidence occurs, or a shorter period if it can be proven that it no longer presents a threat to human health or the environment. The costs for post-closure care identified in Section 2.5 include Cell 2 – Stages 1 and 2, as well as Cell 1. The post-closure care plan will be applied to other cells as they are closed.

2.7.1 Monitoring and Maintenance

Semi-annual groundwater and quarterly landfill gas monitoring will occur throughout the post-closure period. This frequency will be increased if data indicate that contamination may have occurred. The post-closure monitoring frequency will revert if the more frequent monitoring demonstrates that contamination, if present, is not attributable to the landfill.

Collection and treatment of leachate generated in Cell 1 and Cell 2 will be provided by a new dual-lined evaporation pond to be constructed directly north and upstream of the existing evaporation pond. The new pond will also have a leak detection system. The existing pond will provide stormwater and process water runoff containment for the adjacent biosolids compost facility. These leachate collection and treatment systems will be inspected as part of the ongoing activities for other landfill cells during the post-closure period for Cell 1 and Cell 2. Since the Bayview Landfill has no planned surface water discharge, no surface water monitoring will be required during the post-closure period.

Table 7-1 provides a schedule for conducting inspections and maintenance and for recording these routine activities. The Landfill Foreman will be responsible for conducting the inspections, scheduling maintenance, and recording these activities on the forms provided in Appendix I.

Table 7-1: Frequency of Inspection and Maintenance of Facilities During Post-Closure Care

Landfill Facility	Inspection or Maintenance	Frequency
Landfill Cell	Closure cap integrity. Cell perimeter fence integrity.	Quarterly
Stormwater / Leachate Pond	Perimeter fence integrity. Water depth. Liner system integrity.	Quarterly
Other Appurtenances	Entrance gate integrity. Perimeter fence integrity. Monitoring station integrity. Berm integrity. Run-on and Run-off Control Systems.	Quarterly

The above activities will be carried out as part of the ongoing operations during the active life of the site. They will be expanded to include the entire site at final landfill closure and will continue throughout the post-closure monitoring period.

A written summary of the activities performed during each inspection will be maintained. The District will retain the right of entry to the closed landfill, maintain all right-of-ways, and conduct maintenance and/or remediation activities as needed. The landfill will be inspected on a quarterly basis for the following conditions:

- Integrity of the final cover (including erosion, subsidence, seeps and settlement);
- Loss of vegetative cover or growth of undesirable plant species;
- Visible debris, litter, and waste;
- Condition of access roads, gates, and fences;
- Integrity of on-site structures;
- Integrity of groundwater monitoring system;
- Integrity of methane monitoring system;
- Integrity of drainage features;
- Integrity of the leachate collection system;

The final cover will be inspected for erosion or other maintenance problems. Any problems detected during routine site inspections will be corrected as soon as practicable. All eroded areas will be recovered with suitable soil to establish erosion control and infiltration layers, as well as positive drainage to maintain the integrity of the final cover as outlined in Section 2.6.1. All bare areas in the final cover will be re-vegetated as necessary.

The need for final cover system repairs due to differential settlement or subsidence will be determined based on an evaluation of whether the final cover in the affected area has been impaired. Any areas where the integrity of the final cover has been compromised will be repaired as necessary.

Eroded areas in drainage ditches will be repaired and re-graded. Sediment buildup will be removed from areas where flow is restricted. Temporary stormwater control structures will be constructed and maintained as needed.

The leachate collection system will be maintained and operated as needed to minimize leachate head on the liner. The District may seek the approval of the UDEQ to cease leachate extraction and treatment if it can demonstrate that leachate generation has diminished and no longer poses a threat to human health and environment.

2.7.2 Land Title, Land Use, and Zoning Restrictions

The future land use of Cells 1 and 2 is reversion to grazing land, which is the historical land use. The title of the land is expected to remain with its current owner, the Utah Division of State Lands. The Utah County Board of Adjustment did not impose zoning restrictions on the site. However, the District will cooperate with the landowner and the County Board of Adjustment in developing zoning restrictions that are in the best interests of the landowner.

2.7.3 Post Closure Costs

The costs identified in Section 2.5 for post-closure care have been assumed to be recurring annual costs. The trust fund for this post-closure care has been assumed to be available in its entirety at the beginning of the post-closure care period. This is a very conservative assumption since the landfill is planned to operate for a minimum of 25 years (by term of lease). The interest on the principal of the trust fund is expected to cover the limited inspection and maintenance activities currently scheduled as part of the ongoing operation (e.g., leachate collection and evaporation facilities) of the landfill site if the site is unexpectedly closed.

2.8 References

HDR Techserv, Inc. 1987. Landfill Approval Assistance Hydrogeologic and Seismic Review, p.37.

HDR Techserv, Inc. 1988. Landfill Master Plan, Bayview Landfill.

South Utah Valley Solid Waste District. 1994. Annual Report, p.6.

HDR Engineering – Permit Application Bayview Landfill, 1996.

HDR Engineering – Master Plan Update, Bayview Landfill, 2002.

HDR Engineering – Permit Application, Bayview Landfill, 2003.

HDR Engineering – Permanent Composting Facility Operating Plan, 2004.

HDR Engineering – Cell 2 Master Plan Update, 2008.

South Utah Valley Solid Waste District. 2008. Annual Report.

Part 3

Part 3: Technical and Engineering Report

3.1 Introduction

This Part 3 – Technical and Engineering Report presents information on geology, hydrology, location restrictions and engineering design for the Bayview Landfill. This information has been updated from previous permits to reflect the final closure of Cell 1, pending interim closure of Cell 2 – Stage 1, and modifications to the leachate collection system and Cell 2 – Stage 2 liner design and excavation contours. Portions of the text that do not require modifications have been left as originally presented in previous permit applications.

3.1.1 Facility Maps and Drawings

Figures for this permit application are found in Part 4. Figure 1 contains the most recent USGS Topographic Map of the vicinity surrounding and including the Bayview Landfill. The boundaries of the property are shown on this map, as well as a 1- and 2-mile radius around the property boundary. Figure 2 is the most recent USGS Topographic Map of just the Bayview landfill property. Figure 3 is a recent topographic map of Cell 2 produced from aerial photography performed in December 2008 and updated with ground survey information obtained during the same month.

Figure 4 is a portion of the state of Utah Earthquake Distribution Map (MF-1856). Figure 5 is a Landfill Facilities Map showing the current and planned facilities. Figure 6 to 13 contain permit level construction details for the development of revised Cell 2 – Stage 2, a new leachate evaporation pond, and projected final contours of Cell 2. Cell 2 is the combination of previously permitted Cells 2 and 3, as outlined in the January 2002 Master Plan update and modified in the January 2009 Cell 2 Master Plan by HDR, Inc. The most recent plan, the Cell 2 Master Plan, is included as Appendix A to this application.

Appendix D contains the final engineering drawings and specifications for the development of Cell 2 – Stage 2. Appendix T contains a draft Cell 1 closure status letter and as-built drawings.

3.2 Geohydrological Evaluation

3.2.1 General

Several studies are available in the public and nonpublic arenas that describe the geology and hydrogeology of the region and the site. The hydrogeology of the Goshen Valley has been described by Dustin (1978) and Cordova (1970). These studies also describe the general geology of the area including the Bayview Landfill site. Two hydrogeological investigations were commissioned by Provo City Corporation during the original permitting of the site in the 1980s (Chen and Associates, 1980; Rollin, Brown, and Gunnell [RBG], 1983). These investigations provided shallow geological data specific to the landfill site. During litigation regarding permitting of the site, several parties (Hintze and Fuhriman, 1983; Environmental Science and Engineering, 1986; and Danzberger, 1986) re-evaluated and re-interpreted the data presented in the Dustin, Cordova, Chen, and RBG studies, and re-interpreted site-specific geologic and hydrogeologic data. These re-evaluations presented no new data, and do not contribute to the understanding of the site.

During 1986 and 1987, the Utah County Planning Commission evaluated the Bayview Landfill site seismicity. This evaluation included on-site trenching to determine whether lineaments present on the site represented the surface expression of geologic faults. The Planning Commission's geologist concluded that the lineaments were not related to faults or seismic activities at the site (Robison, 1987).

During the original construction of the Bayview Landfill in 1989, the contractor drilled and installed 12 monitoring wells. Six of these wells are deep wells (170 to 310 feet below ground surface) that provide geological data from regions deeper than earlier Provo studies. Three additional deep monitoring wells have been installed since the Bayview Landfill began operating. These wells serve as compliance monitoring wells and also provide hydrogeological data specific to the site. In April 1994, the District published an evaluation of two years of hydrograph and laboratory analytical data. Groundwater monitoring has been ongoing at the site with evaluations submitted to the UDEQ. The Districts Groundwater Monitoring Plan is included as Appendix F. Boring logs for monitoring wells are included as Appendix E.

During 1993, the U.S. Geological Survey (U.S.G.S.) conducted an evaluation of the aquifers in Utah and Goshen Valleys. A summary of selected data collected during this evaluation has been published as Utah Hydrologic Data Report No. 50, and is attached to this permit application as Appendix G.

3.2.2 Geology

3.2.2.1 Stratigraphy

The Bayview Landfill site is located in Goshen Valley between the East Tintic Mountains and Utah Lake. The Goshen Valley is bounded on the north by the Lake Mountains, on the west by the Mosida Hills and the East Tintic Mountains, on the south by Long Ridge, and on the east by Utah Lake and West Mountain. The site lies on the eastern slope of the East Tintic Mountains as the slope approaches Utah Lake. The terrain in the vicinity of the landfill site slopes toward the lake at approximately 2.5%; the terrain is steeper to the west and shallower to the east of the site.

The Goshen Valley is underlain by a thick sequence of consolidated and unconsolidated sediments overlying sedimentary Paleozoic limestone and dolomitic basement rock. The surficial materials at the site consist of heterogeneous deposits of gravel, sand, silt, and clay laid down in Lake Bonneville. These deposits were derived from erosion of the East Tintic Mountains, and were dropped into the lake as beach, bar, and spit deposits along the fluctuating shoreline. The materials are poorly to moderately well sorted and are derived from a mixture of Paleozoic sedimentary (limestone and quartzite) and Tertiary volcanic outcrops. In some places, these lake sediments are overlain by beach and dune sands representing Lake Bonneville shoreline and Quaternary deposits, respectively. The western portion of the landfill site exhibits dune and beach sand deposits. The thickness of these strata is discussed in Section 3.2.3.2 – Aquifers.

Two other Pleistocene deposits underlie the Lake Bonneville Group sediments: the Terrace gravel, and the Older Alluvium. The Terrace gravel consists of gravel and sand benches and contains an aquifer referred to as the Upper Pleistocene aquifer. The Older Alluvium consists of cemented gravel and sand (fanglomerate) and contains an aquifer referred to as the Lower Pleistocene aquifer. Miocene latites and conglomerates reportedly underlie the Pleistocene deposits; the conglomerates reportedly consist of cobbles and boulders in a sandy matrix. It does not appear that the deep monitoring wells constructed at the Bayview Landfill site penetrate into the Lower Pleistocene aquifer.

3.2.2.2 Instability and Seismicity

No unstable slopes or subsidence areas have been mapped in the vicinity of the Bayview Landfill site. However, the Utah County Planning Commission has not prepared landslide, unstable area, or subsidence maps for this portion of the county. To the best recollection of Commission personnel, the Planning

Commission has received no reports of landslides or subsidence. The site is relatively flat and is not subject to steep cuts that would create slope stability problems. There does not appear to be any surface observable evidence that the site is located in a floc type land stability problem area.

Numerous faults traverse the Goshen Valley. Most of these faults are believed to be inactive; however, more than 25 earthquake epicenters have been plotted within approximately 5 miles of the landfill site. Most of these epicenters are located south, southeast, or southwest of the site (Figure 4). These epicenters include one with a reported intensity of VII on the Modified Mercali Intensity Scale, and several with reported intensities of IV or V (U.S.G.S, 1986).

The Utah County Planning Commission has not prepared seismicity maps for this portion of the county. The Uniform Building Code (1994) classifies this portion of Utah as a Class 3 Seismic Zone, and requires use of a horizontal acceleration of 0.3g in the design of engineered structures. This classification places the Bayview Landfill site in a seismic impact zone as defined under the Utah Solid Waste Permitting and Management Rules.

3.2.3 Hydrology

3.2.3.1 Surface Water

Three surface water channels cross the landfill site (see Figure 2). These surface water channels flow ephemerally from watersheds west of the landfill site. The northern and central channels originate about 2 miles west of the site in Section 14. Each of these channels has a drainage basin of less than 1,000 acres. The southern channel originates less than 1 mile west of the site in Section 18, and has a drainage basin of less than 200 acres.

The northern and central channels have cut gullies approximately 5 feet deep and 30 feet wide through the dune sands on the steep, western portion of the landfill site. These channels decrease in size to less than 3 feet in depth and less than 10 feet in width on the eastern portion of the site. The southern channel is only 1 to 2 feet in depth.

The drainage channels appear to be completely dry during most years. These channels carry water only during storm events and during spring run-off from the foothills west of the site. The sandy nature of the area and of the channel bottoms allows water to infiltrate into subsoils during storm events with a more frequent return period.

3.2.3.2 Hydrology

Aquifers

Previous studies (Cordova, 1980; Dustin, 1978) have defined four aquifers underlying the Goshen Valley; however, not all of these aquifers appear to be present at the Bayview Landfill site (Brook, 1994; Carpenter, 1994a). As identified in previous reports, the uppermost aquifer, the water table aquifer, is contained in the Lake Bonneville group, and is commonly found at depths of less than 25 feet below ground level (bgl). The second aquifer, the Upper Pleistocene aquifer, is contained in a sand and gravel deposit, the Terrace gravel, at depths of 150 to 300 feet bgl in the Goshen Valley. The Upper Pleistocene aquifer reportedly ranges from 75 to 100 feet in thickness. The Upper and Lower Pleistocene aquifers are separated by a 50- to 100-foot thick cemented sand and gravel confining layer. This confining layer is thought to partially separate the two Pleistocene aquifers. The Lower Pleistocene aquifer is reported to vary in thickness from 25 to 175 feet. The third aquifer, the Tertiary aquifer, is reportedly found at 200 to 500 feet bgl; its thickness is unknown, but may exceed 1,500 feet in the Goshen Valley.

Eight shallow soil borings, six shallow monitoring wells, and six deep monitoring wells indicate that the Lake Bonneville group water table aquifer is not present at the site (Carpenter, 1994a). The six shallow monitoring wells are constructed with a 20-foot screen and a 1-foot sump below 49 feet of casing. The wells contain dedicated pumps mounted at 65 feet bgl. Boring logs are attached to this permit application as Appendix E. All of the shallow wells have contained small amounts of water during most sampling events; however, none of the wells have contained sufficient water to allow purging or sampling. The water in these wells is believed to be condensation within the well, rather than perched groundwater (Carpenter, 1994a).

The nine deep monitoring wells appear to be screened in the Upper Pleistocene aquifer (Carpenter, 1994a). The nine deep monitoring wells do not appear to have penetrated through the Upper Pleistocene aquifer into the Lower Pleistocene aquifer. Boring logs for these wells are presented in Appendix E. This aquifer is the uppermost usable aquifer in the immediate vicinity of the landfill site.

The landfill culinary well appears to be screened in the Lower Pleistocene aquifer (Carpenter, 1994a). The well log indicates that the partially confining layer between Upper and Lower Pleistocene aquifers is not present at the site. This is consistent with the interpretation of the U.S. Geological Survey for this portion of the Goshen Valley (Brook, 1994). The Upper and Lower Pleistocene aquifers appear to represent a single, water table (unconfined) aquifer in the vicinity of the Bayview Landfill.

Water Rights

The Utah Department of Natural Resources Water Rights Division lists only one active water right within 2,000 feet of the Bayview Landfill site boundary. This active water right is the culinary water well for the landfill. This well is located upgradient of the site, and is screened in the Lower Pleistocene aquifer.

Based on a review of the USGS topographic maps for the site, approximately 7 wells are located up to 2 miles from the site boundary (USGS, 1993) including the landfill culinary well.

Groundwater Flow

The previous studies indicate that groundwater flow enters the Goshen Valley from the south through Current Creek Gap, and from the northwest through the Mosida Hills. These groundwater flows converge near the Bayview Landfill site. The groundwater underlying the site is expected to flow northeast toward Utah Lake. Cordova (1970) estimated transmissivity of the Pleistocene aquifer to be between 50,000 and 300,000 gallons per day per foot (gpd/ft). Earthfax (1984) estimated the velocity of groundwater flow north of Elberta to be 24 feet per year (ft/yr).

In April 1994, the District issued a report on the results of the District's background monitoring program (Carpenter, 1994b). This report provided an assessment of the background water quality and flow direction in the immediate vicinity of landfill. This report stated that the groundwater flow at the site moves northeasterly toward Utah Lake, and estimated the velocity of this flow at 1.8 ft/yr. The report in Appendix F has been updated to include recent groundwater monitoring events.

The discrepancy between the published values and the apparent velocity of groundwater at the site is unexplained. However, this does not seem to be important since the upper aquifer is more than 100 feet below the bottom of the landfill.

Groundwater Chemistry

The uppermost aquifer (the Upper Pleistocene aquifer) underlying the Bayview Landfill site is classified as a Class II aquifer. Appendix F contains the groundwater monitoring plan for the landfill. Statistical analyses of groundwater monitoring data have been completed semi-annually since the completion of background sampling in 1993. Statistical analysis results are submitted with the District's annual reports. The analyses show no contamination of the groundwater by inorganic or organic chemicals. Statistical evaluation of the data shows a general trend of increasing concentration for total dissolved solids, sulfate, chloride, calcium, magnesium, sodium, and bicarbonate from southwest to northeast below the site. This is consistent with the regional trend of increased concentration of inorganic chemicals as they move toward Utah Lake through the shallow Pleistocene aquifer (Carpenter, 1994). Groundwater analytical results are submitted to UDEQ annually.

3.3 Engineering Report

3.3.1 Location Standards

UDEQ has adopted specific locational restrictions that include the locational criteria specified in the federal Subtitle D regulations. The Utah location restrictions for municipal solid waste landfills are outlined below. Subtitle D criteria are highlighted with an asterisk (*).

Location Restriction Compliance was previously analyzed as part of the 1996 permit application. The following portions of Section 3.1 are excerpted from that application.

1. Land Use Compatibility (R315-302-1(2)(a))
    a. Parks and protected areas
    b. Ecologically and scientifically significant areas
    c. Prime farmland
    d. Dwellings and structures*
    e. Airport runways*
    f. Archeological sites
    g. Land use planning or zoning
2. Geology (R315-302-1(2)(b)) Fault areas*
    a. Seismic impact zones*
    b. Unstable areas*
3. Surface Water (R315-302-1(2)(c)
    a. Floodplains*
    b. Wetlands*

4. Groundwater (R315-302-1(2)(e))
    a. Groundwater/landfill separation
    b. Sole source aquifer
    c. Groundwater quality
    d. Source protection areas

The following sections present the State of Utah location restrictions and discuss the Bayview Landfill's compliance with those requirements.

3.3.1.1 Land Use Compatibility

The Utah Solid Waste Permitting and Management Rules state that no municipal solid waste landfill shall be located within the following restriction zones:

- One thousand feet of a national, state, or county park, monument, or recreation area; designated wilderness or wilderness study area; or wild and scenic river area.
- Ecologically and scientifically significant natural areas, including wildlife management areas and habitat for listed or proposed endangered species as designated pursuant to the Endangered Species Act of 1982.
- Farmland classified as prime, unique or of statewide importance by the U.S. Department of Agriculture Soil Conservation Service under the Prime Farmland Protection Act.
- One-fourth mile of existing permanent dwellings, residential areas, and other incompatible structures such as schools, churches, and historic structures or properties listed or eligible to be listed in the State or National Register of Historic Places.
- Ten thousand feet of any airport runway end used by turbojet aircraft, or 5,000 feet of any airport runway end used by only piston-type aircraft.
- Areas with respect to archeological sites that would violate R9-8-404.
- An area that is at variance with any locally adopted land use plan or zoning requirement unless otherwise provided by local law or ordinance.

The Bayview Landfill is not located within any of these restriction zones. The land use directly adjacent to the landfill is primarily agricultural. The nearest residence is located more than 1 mile north of the site boundary, and the nearest town, Elberta, is located approximately 5.5 miles south of the site. The nearest airport is located approximately 17 miles from the site. No parks, ecologically significant areas, prime farmland, or archeological sites are known to exist near the site. The Bayview Landfill site is surrounded on the north and west by land zoned mining and grazing (MEG1), and on the south and east by land zoned agricultural (A1). The landfill is not inconsistent with these planned land uses. In any case, the site was permitted by the Utah County Board of Adjustment under a Conditional Use Permit, and therefore, is consistent with the local zoning and land use planning.

3.3.1.2 Geology

The Utah Solid Waste Permitting and Management Rules state that no municipal solid waste landfill shall be located in a subsidence area, in a dam failure flood area, over an underground mine or salt bed, or on or adjacent to geologic features that could compromise the structural integrity of the facility.

- Fault Areas. A new facility or a lateral expansion of an existing facility shall not be located within 200 feet of a Holocene fault.
- Unstable Areas. Unstable areas require demonstration that the site has been engineered to ensure that the integrity of the structural components of the facility will not be damaged by the unstable conditions.
- Seismic Impact Zones. A new facility of a lateral expansion of an existing facility shall not be located in seismic impact zones unless all containment structures are designed to resist the maximum anticipated horizontal acceleration for the site.

The Bayview Landfill site does not include known Holocene faults, and all solid waste containment will occur more than 200 feet from the property boundary. A trenching study was conducted to determine whether apparent lineaments represented the surface expression of faults. This study concluded that the lineaments were not related to faults (see Appendix H). The Bayview Landfill is not located within a known unstable area as defined in the regulations.

Historic seismic records indicate that more than 25 earthquake events have occurred with epicenters within approximately 5 miles of the Bayview Landfill site. These earthquake events have occurred south, southwest, and southeast of the site. These earthquake events are presented in USGS Miscellaneous Field Studies Map MF-1856 and are summarized in Figure 4.

The Utah County Planning Department has not mapped the western portions of Utah County for seismic activity. The Uniform Building Code (1991) appears to classify all of Utah County as a Class 3 Seismic Zone. Structures in a Class 3

Seismic Zone are required to use a horizontal acceleration of 0.3g unless studies demonstrate that another horizontal acceleration is more appropriate.

Design for Cell 2 has been analyzed considering seismic activity and has been found to be stable with an adequate factor of safety. See Appendix J.

Seismic stability analyses have been conducted to demonstrate that the proposed landfill components can resist the maximum horizontal acceleration expected at the site. These analyses were conducted in accordance with the State of Utah Administrative Rules and EPA guidance presented in RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Facilities, (EPA, 1995).

The landfill components considered in these analyses included: linear systems, leachate collection and delivery systems, the leachate collection and run-on/run-off control systems and the final cover.

The scope of the analyses included a review of regional and local soils, geology and seismic selection of the design earthquake and the site specific earthquake acceleration; static and pseudo-static stability analyses for each landfill component: and evaluation of stability and potential deformations for each landfill component.

The results of these analyses are presented in Appendix J and indicate the following:

- The Bayview Landfill site is located in a Seismic Impact Zone. Both deterministic and probabilistic methods indicate a peak bedrock acceleration of 0.5g. The dense granular soils offer little amplification or attenuation of the bedrock acceleration through the overlying soil column.
- The cut and fill slopes and run-on/run-off structures have adequate static factor of safety and indicate minimal permanent deformations (U<1 cm) in response to the design seismic event.
- The side slope liner and leachate collection/recovery system will require a geosynthetic reinforcement to increase the static factor of safety and limit permanent deformations in response to the design seismic event.
- The closure cap system has an adequate static factor of safety and indicates acceptable permanent deformation (U<10 cm) in response to the design seismic event. No reinforcement is required for the final cover.

These demonstration analyses indicate that the proposed Bayview landfill components are designed to resist the "maximum horizontal acceleration" at the site.

3.3.1.3 Surface Water

The Utah Solid Waste Permitting and Management Rules state that no municipal solid waste landfill shall be located within a public water system watershed, a floodplain, or a wetland without specific approval of the Executive Secretary.

The Bayview Landfill site is not located within a public water system watershed or 100-year floodplain. Three surface water drainage features cross the site from west to east. The Landfill Master Plan provides that the three drainage areas will be improved to divert run-on from the active landfill cells. The drainage features do not contain vegetation that is characteristic of wetlands areas. No other wetland areas have been identified on the site. Calculations for run-on and run-off ditches can be found in Appendix M.

3.3.1.4 Groundwater

The Utah Solid Waste Permitting and Management Rules state that no municipal solid waste landfill shall be located within the following restriction zones:

- Within 5 feet of the historical high groundwater elevation.
- Within 100 feet vertically (50 feet for high total dissolved solids [TDS between 1,000 and 3,000 mg/l] aquifers) of an aquifer that could be used for drinking water unless constructed with a composite liner system.
- Over an aquifer designated as a sole source aquifer or a 1B aquifer.
- In a drinking water source protection area.

The Bayview Landfill is not located within a sole source or 1B aquifer, or in a drinking water source protection area. Landfill cells will not be constructed within 5 feet of the historical high groundwater elevation. The shallowest groundwater at the site, the Upper Pleistocene aquifer, is located more than 100 feet below the bottom of the proposed liner system. A composite liner system consisting of a geosynthetic clay liner (GCL) and an HDPE geomembrane is proposed for the bottom of Cell 2.

3.3.2 Engineering Design

In 1987, the District prepared a Landfill Master Plan (HDR, 1987) to guide development of the site over its active life, which is expected to exceed 50 years. Figure 5 in Part 4 illustrates the landfill facilities, which include the following:

- Six landfill cells (previous Cells 2 and 3 have been combined into Cell 2). Cell 2 will be approximately 83 acres in size. The cells are further subdivided into smaller areas, called "stages," to facilitate construction and to minimize the area open to receiving stormwater at any one time. Each stage represents approximately 15 acres;

- Three stormwater/leachate evaporation ponds:
  - An existing pond designed to receive contact stormwater and leachate from the northern half of the site,
  - A proposed leachate evaporation pond designed to receive stormwater and leachate from Cells 1 and 2 so that the existing pond can contain stormwater and process runoff produced by the compost facility, and
  - A third, future pond to receive contact stormwater and leachate from the southern half of the site;
- Screening berms to provide visual screening of the active landfill cells from State Highway 68;
- Three stormwater diversion channels using the existing ephemeral surface water drainage channels;
- A windrow composting facility located east of Cell 2;
- A maintenance building.

The Master Plan was updated in 2002 (HDR) to show a combined Cell 2 and 3, and to increase excavation depths in this new Cell 2. A 2008 Cell 2 Master Plan (Appendix A) modified Cell 2 – Stage 2 base grades to drain the western two-thirds down at 2% to the north and east, and the eastern third down at 2% to the southeast, and modified the leachate drainage plan to accommodate the new grades. Excavation depths remain more than 100 feet above the uppermost aquifer. An additional leachate evaporation pond was designed to collect leachate and stormwater from Cells 1 and 2 only. The Cell 2 Master Plan is attached to this permit application as Appendix A.

Landfill Cell 1 achieved final contours in 2004 and the final cover was placed in 2008. Cell 1 was built as designed and final cover seeding is all that remains for closure to be completed. Landfill Cell 2 – Stage 1 will reach capacity by the end of 2009, at which time landfill personnel will begin placing the intermediate cover on the side slopes of Stage 1. After Cell 2 reaches final contours and the final cap is in place in approximately 2032, long-term monitoring of the final cover and groundwater monitoring wells will continue for the 30-year post-closure care period.

3.3.2.1 Landfill Cell 2 – Stage 2

Stage 2 of Landfill Cell 2 consists of a 15-acre, geosynthetic clay and HDPE-lined area located in the E1/2 of the NW1/4 of Section 17. The excavation for this cell stage began in 2004 and is ongoing. The excavated soils have been used for liner protection, daily cover, with a portion used to close Cell 1or stockpiled. The stockpiled soil will be used for daily cover and intermediate cover on Cell 2 – Stage 1.

Cell 2 – Stage 2 grading is divided into two parts (Figure 9). Generally, excavation side slopes will be constructed on a 4:1 (H:V) slope. The excavation bottom slopes of the larger, western portion will be graded down at 2% north to south and 2.5% west to east, so that leachate drains to the northeast corner of the western portion of Cell 2 – Stage 2. The excavation will be constructed with a leachate collection trench along the eastern edge of the excavation bottom. The leachate collection swale will be graded at a 2.0% slope down from south to north toward a sump at the north edge of Stage 2. From the sump, leachate will be conveyed north to the existing leachate drain line. The smaller, eastern portion of Stage 2 slopes down at 2% to the south and east, where a new leachate collection sump will be built and a new leachate drain line will convey leachate from the eastern portion of Stage 2 to the leachate collection system in Stage 1.

The liner system for Cell 2 – Stage 2 consists of the following components (from bottom to top):

- A 12- to 20-ounce non-woven, needle punched polypropylene geotextile. The excavation specification will allow 4-inches minus material to remain on the surface of the excavation. A heavy geotextile will provide puncture resistance for the overlying geomembrane. Alternately, a sand cushion may be used in lieu of, or to reduce the required weight of, the geotextile cushion;
- A bentonite impregnated geotextile (geosynthetic clay liner – GCL). The GCL provides an additional barrier to leachate and landfill gas migration;
- A 60-mil textured HDPE flexible membrane liner;
- A woven reinforced geotextile. This high strength geotextile will provide the tensile strength necessary to resist the sliding forces generated on a 4:1 slope by the 2-foot-thick soil protective layer;
- A 12- to 16-ounce non-woven geotextile placed on top of the HPDE liner (of the floor of the excavation) to provide protection to the HDPE liner;

- A 2-foot thick protective cover layer. This soil layer will protect the geotextile, HDPE and GCL during placement of the first lift of solid waste. It is also intended to provide a pathway for leachate movement above the HDPE toward the leachate collection and removal system.

Appendix O contains a Construction Quality Assurance Plan (CQA). This CQA plan requires the installation contractor to conduct a construction quality control program during installation. As a result, all seams will be tested for continuity. In addition, periodic samples will be removed from the rolls and subjected to tensile testing at a third party laboratory. Construction oversight personnel will be on-site at all times during HDPE, GCL and geotextile installation, and during placement of the 2-foot thick protective layer. These personnel will provide a CQA review of the construction and installation of the liner system.

3.3.2.2 Leachate Management

In its current design, runoff and leachate from Cell 1, Cell 2 – Stage 1, and the compost facility are contained in the existing leachate pond. However, the pond is not dual lined and does not have leak detection, both of which are now required for leachate ponds. Therefore, a new leachate pond has been designed and will be constructed as part of this permit renewal. The new pond will receive leachate and stormwater from Cell 1 and Cell 2 only. The existing pond will receive stormwater and process runoff from the compost facility only.

Leachate and contact stormwater within the active landfill cell (Cell 2 – Stage 2) will drain via one of two collection pipes and sumps. Leachate and storm water will be transmitted through a 2-foot thick protective cover soil to a leachate collection pipe (See Figures 11 and 12). The leachate collection pipe will consist of an 8-inch diameter perforated PVC or HDPE pipe encased in a granular fill wrapped with a geotextile. The pipe trench will be approximately 2 feet in depth, matching the thickness of the protective cover. The perforated leachate collection pipe will enter a gravel-filled sump. The leachate collection pipes will be installed along the eastern edge of each portion of Stage 2. The western portion of Stage 2 will drain to a sump at the north edge of Stage 1. The eastern portion will drain to a new sump at the southeast corner of Stage 2 where it will be pumped back to the existing sump at the north edge of Stage 1. From the sumps, the pipe (solid wall) continues up the side slopes and terminates at the top of excavation as a clean-out. An 18-inch HDPE pipe also continues up the side slope. A submersible pump capable of pumping a minimum of 50 gallons per minute can be lowered down the 18-inch pipe to pump leachate out of the cell into the existing leachate drain line that runs along the northern edge of Cell 2. The leachate drain line will discharge to a newly designed evaporation pond that will be constructed immediately north of the existing pond. Leachate will be managed by this system during filling and after closure. Design details of these systems can be seen on Figures 11 to 13. Sizing calculations for the new pond are found in Appendix L.

The new leachate evaporation pond will be constructed, tested, and inspected using the same personnel and techniques as used for the previously constructed landfill cells and evaporation pond. The south side of the pond will be constructed on a 10:1 slope to allow access for equipment to remove sediments with the remaining sideslopes 4:1. The new evaporation pond was designed to contain the leachate generated from all of Cell 1 and Cell 2 and contact stormwater from the largest of the currently undeveloped Cell 2 stages (Stage 3) for the 25-year, 24-hour storm event.

The proposed evaporation pond liner system consists of the following layers (from bottom to top):

- A 16-ounce non-woven geotextile;
- A 60-mil HDPE geomembrane;
- A geonet, sandwiched between two layers of non-woven geotextile;
- A UV-resistant 60-mil HDPE geomembrane, textured on side slopes;
- A 6-inch layer of sand (bottom and the 10:1 sideslope only) as a cushion layer beneath the soil cement to protect the 60-mil HDPE geomembrane; and
- An 8-inch layer of soil cement (bottom and the 10:1 sideslope only). The cement will allow the District to enter the pond and remove accumulated sediment using a front-end loader.

The proposed evaporation pond will also have a leak detection system between the lower 60-mil HDPE geomembrane and the sandwiched geonet/geotextile layer. The geonet will convey any fluid that leaks through the primary liner to a gravel-filled sump with an 8” perforated HDPE pipe. The pipe will extend up a 4:1 sideslope as a solid-wall pipe and terminate at a manhole structure where a portable water level meter and, if needed, a pump can be lowered down to check for leaks in the primary evaporation pond liner.

Modeling

Since the leachate generation calculations were done for the October 2003 Permit Application, no modifications have been made to the landfill that affect the amount of leachate generated or the performance of the leachate collection system. Because of this, the Hydrologic Evaluation of Landfill Performance

(HELP) model, hydraulic head calculations, and calculations for the flow capacity of the leachate collection pipe used for the 2003 Permit Application are still valid and are included in Appendix K.

Analyses have been conducted to evaluate the sizing and capacity of the proposed leachate evaporation pond for the combination of contact stormwater run-off from the contributing cell area and leachate generation from all of Cell 1 and Cell 2. Only stormwater from the largest stage in Cell 2 (Stage 3) was considered in the stormwater runoff calculations because the stages will be developed in sequence, with each stage receiving intermediate cover when it reaches capacity, thereby reducing contact stormwater runoff. The 25-year, 24-hour storm event was used to compute run-off. The results of the analysis, presented in Appendix L, indicate the proposed leachate evaporation pond is sized adequately to contain the leachate generated from Cell 1 and Cell 2 and the contaminated stormwater run-off from the equivalent area of Cell 2 – Stage 3.

3.3.2.3 Surface Water Controls

The Bayview Landfill site and its vicinity generally drain from west to southeast. Stormwater originating west of the site is routed through three existing surface water channels. See Figure 2. Construction of Landfill Cells 2 required that the northern ephemeral surface drainage channel be relocated (see Figure 5).

Stormwater originating on-site is managed as either non-contact or contact stormwater depending on its source. Non-contact stormwater is water falling on unimproved portions of the site, or on improved portions of the site having no contact with solid waste (e.g., the maintenance building vicinity) or on the final cover of Cell 1. Run-on control structures divert this water from the active landfill cell and stormwater/leachate pond and route this water into the existing surface water channels. Contact stormwater is water falling onto the active landfill cell. Run-off control structures divert water falling on the active landfill cell into the leachate collection system. Ultimately, contact stormwater is stored and evaporated in the evaporation pond. Neither leachate nor contact stormwater are discharged from the site.

Analyses have been conducted for run-on and run-off control systems around Cell 2. These analyses were conducted for a 25-year storm event and the associated time of concentration that produced peak flow. The analyses, presented in Appendix M, indicate that a triangular ditch, nominally 1 foot deep, provides adequate flow capacity. This ditch geometry was constructed concurrent with the Cell 2 construction.

3.3.2.4 Closure and Post-Closure

Cell 1

The final cover of Cell 1 was completed in 2008. An alternate final cap consisting of 34 inches of on-site, olive-brown silty sand was used to close Cell 1. A seed mix similar to that shown in Table 3-1 will be used to establish vegetation during 2009. Final contours for Cell 1 can be seen on Figure T-3 in Appendix T. The side slopes of the landfill were constructed at a 4:1 (H:V) slope, with the top slope being approximately 5%. After seeding the final cover, closure of Cell 1 will be considered completed.

Table 3-1: Seed Mix for Bayview Landfill

% Mix	Type of Grass
0.50%	Sand Drop Seed
1.50%	Alkali Sacaton
3.50%	Blue Grama
17.50%	Blue Bunch Wheat Grass
17.50%	Indian Rice Grass
3.00%	Sandberg Blue Grass
4.00%	Sheep Fescue
16.25%	Slender Wheat Grass
16.25%	Stream Bank Wheat Grass
20.00%	Western Wheat Grass
100.00%	Total

The final capping system used for Cell 1 varies from the standard design in the Utah Administrative Code at R315-303-3(4). However, based on modeling performed for the 2003 permit application, the approved cap is equivalent to the standard design in preventing infiltration. A copy of this analysis is included in Appendix N.

A conceptual design of the gas system is included in Appendix Q. Recent landfill gas monitoring indicates that gas collection is not required. At such time that active extraction is needed, wells will be installed and connected to header pipes and the system will be connected to a blower and the landfill gas burned in a flare or used in a landfill gas generator.

Cell 2

Landfill Cell 2 – Stage 1 will reach capacity by the end of 2009. Stage 2 of Cell 2 will be constructed in 2009, with a portion of the excavated soils used for daily cover, intermediate cover on Stage 1, or stockpiled. Landfill Cell 2 is not expected to reach capacity until approximately 2032.

The same alternate final capping system as used for Cell 1 will be used for Cell 2 when final contours are reached. In general, this capping system consists of the following layers from the bottom up:

- 6 inches of intermediate cover placed over the daily cover to provide a 12-inch cushion of soil between the solid waste and the barrier layer;
- 34-inches of evaporative cap constructed from the olive-brown silty sand available on-site. The top six inches of this evaporative cap will be capable of supporting vegetative growth by amending the soil with compost to aid in initial seed germination.

A seed mix similar to that shown in Table 3-1 will be used to establish vegetation. Projected final contours for Cell 2 can be seen on Figure 6. The side slopes of Cell 2 will be constructed at a 4:1 (H:V) slope, with a top slope of approximately 5%.

Post-Closure Care

Post-closure care is expected to consist of the following tasks:

- Quarterly inspections of the cap to determine whether significant erosion or differential settlement has occurred;
- Quarterly inspections of the stormwater/leachate evaporation pond;
- Quarterly monitoring of landfill gases at the extraction wells;
- Quarterly inspection of groundwater well integrity;
- Semi-annual monitoring and sampling of groundwater wells.

These activities have been initiated on Cell 1 and will be expanded to all closed areas at the appropriate times. A maintenance program will be developed for the landfill gas recovery system when the system is activated. Closure and post-closure is discussed in more detail in Sections 2.6 and 2.7 of this application.

3.4 Composting

A composting facility was constructed in 2004 after Cell 1 reached capacity. The compost facility is jointly permitted through the Division of Solid and Hazardous waste and the Division of Water Quality. The facility is located east of Cell 2, adjacent to the existing leachate evaporation pond in the SE ¼ of the NE ¼ of Section 17. The composting facility uses windrows to processes two waste streams, one containing a mixture of biosolids, food and beverage waste, and yard waste, and another containing yard wastes only. An operations plan for the compost facility is included in Appendix R. Quantities of waste processed at the composting facility each year from 2004 through 2007 are shown in Table 3-2.

Table 3-2. Tons of Waste Processed at the Bayview Composting Facility

Year	Biosolids (tons)	Yard Waste (tons)
2004	496	1,556
2005	1015	2,866
2006	1036	4,189
2007	1058	5,874
Total	**3,605**	**14,485**

3.5 References

Brooke, L.E. 1994. U.S. Geological Survey. Personal Communication.

Carpenter, C.H. 1994a. Provo City Corporation, Department of Water Resources. Personal communication.

Carpenter, C.H. 1994b. Quality of Groundwater at the Bayview Landfill Site. Chen and Associates, Inc.. 1980. Proposed Sanitary Landfill Site. 15 p.

Cordova, R.M. 1970. Groundwater Conditions in Southern Utah Valley of Goshen Valley, Utah: Utah Department of Natural Resources. Technical Publication 28, 79 p.

Danzberger. 1986. Assessment of Siting Considerations at the Proposed Provo Sanitary Landfill Site. 4 p.

Dustin and C.B. Merritt. 1980. Hydrogeology of Utah Lake with Emphasis on Goshen Bay: Utah Geological and Mineral Survey Water Resources Bulletin No. 147-5, 115 p.

Environmental Science and Engineering. 1986. Evaluation of Hydrogeologic and Seismic Conditions, Proposed Sanitary Landfill Site in Goshen Valley, Utah. 31 p.

HDR Techserv, Inc. 1987. Landfill Approval Assistance Hydrogeologic and Seismic Review.

HDR Techserv, Inc. 1988. Landfill Master Plan, Bayview Landfill. 44 p.

HDR Engineering, Inc. 2002. Landfill Master Plan Update, Bayview Landfill. 29 p.

HDR Engineering, Inc. 2008. Cell 2 Master Plan, Bayview Landfill. 7 p.

Hintze, L.F. and D.K. Fuhrman. 1983. Geohydrology Study of Proposed West Lake Landfill Site. 20 p.

RBG (Rolin, Brown, and Gunnell, Inc.). 1983. Investigation Report. 12 p.

Robison, R.M. 1987. Evaluation of Lineaments at the Proposed Provo City Landfill, Goshen Valley, Utah. 15 p.

Uniform Building Code. 1994.

U.S.G.S. (U.S. Geological Survey). 1986. Seismicity Map of the State of Utah.

U.S.G.S. (U.S. Geological Survey). 1993. Selected Hydrologic Data for Southern Utah and Goshen Valleys, Utah 1890-1992.

Part 4

Part 4: Figures

LEGEND

□ 1-Mile Boundary
□ 2-Mile Boundary
□ Property Line (Approximate)

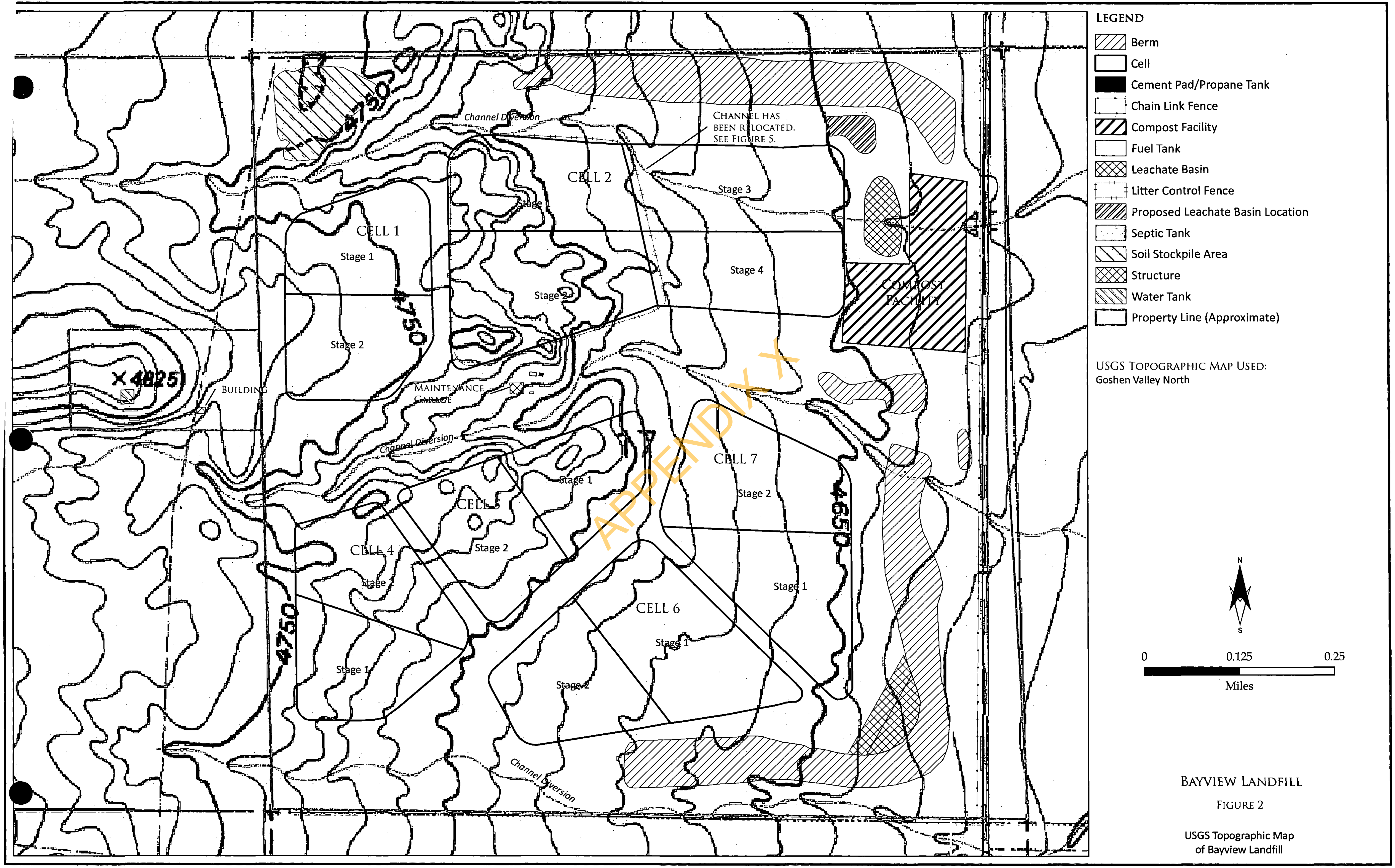
USGS TOPOGRAPHIC MAPS USED:
Allens Ranch
Eureka
Goshen
Goshen Valley North

BAYVIEW LANDFILL

FIGURE 1

USGS Topographic Map
with Two Mile Boundary

uesday, January 13, 2009 1:58:43 PM



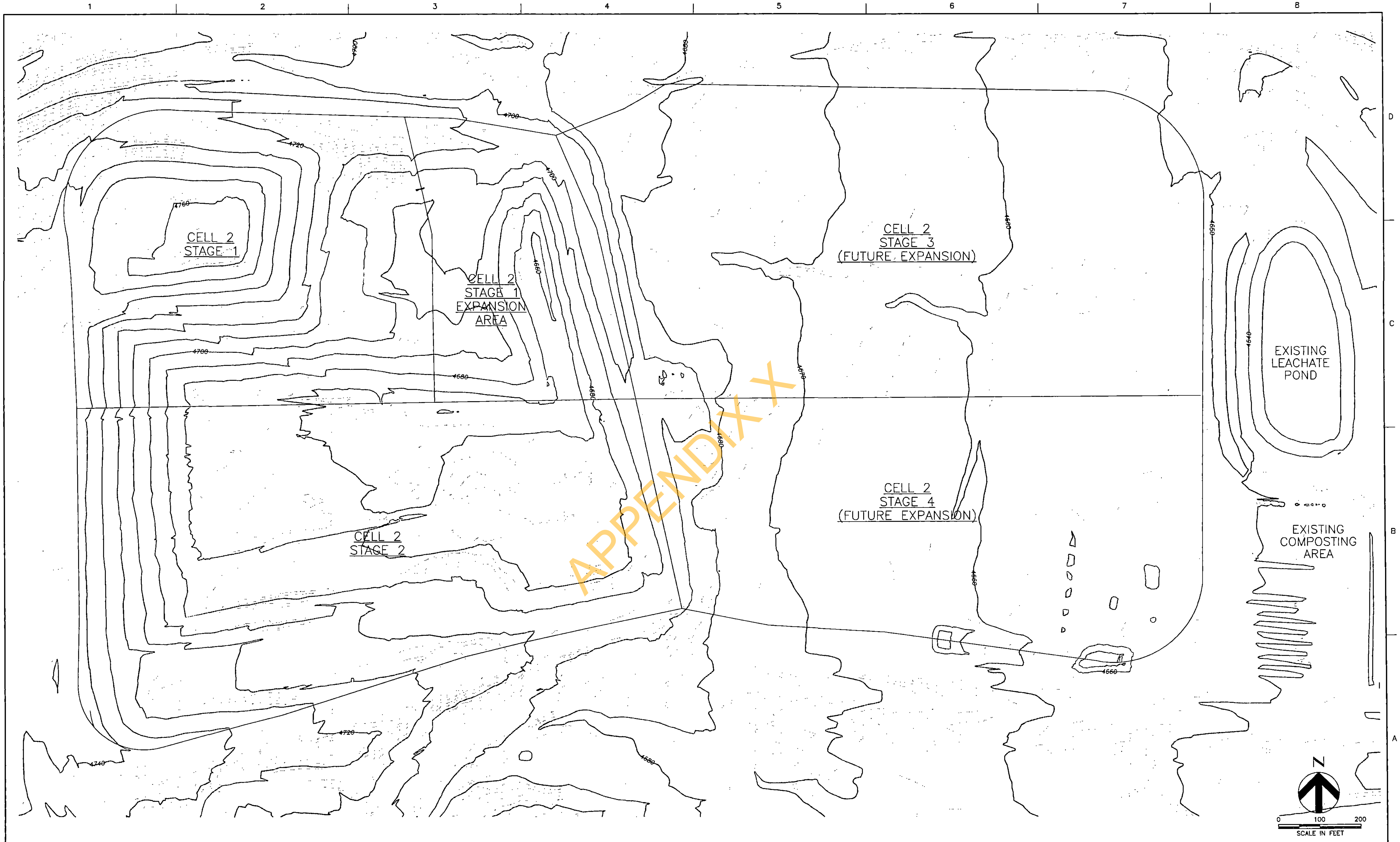
APPENDIX X

BAYVIEW LANDFILL

FIGURE 2

USGS Topographic Map of Bayview Landfill

Monday, January 12, 2009 9:47:47 AM



HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION		
			PROJECT MANAGER	T. WARNER
			ARCHITECT	
			CIVIL	S. WOMACK
			MECHANICAL	
			ELECTRICAL	
			STRUCTURAL	
			DESIGNED	
			DRAWN BY	
			PROJECT NUMBER	96439

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

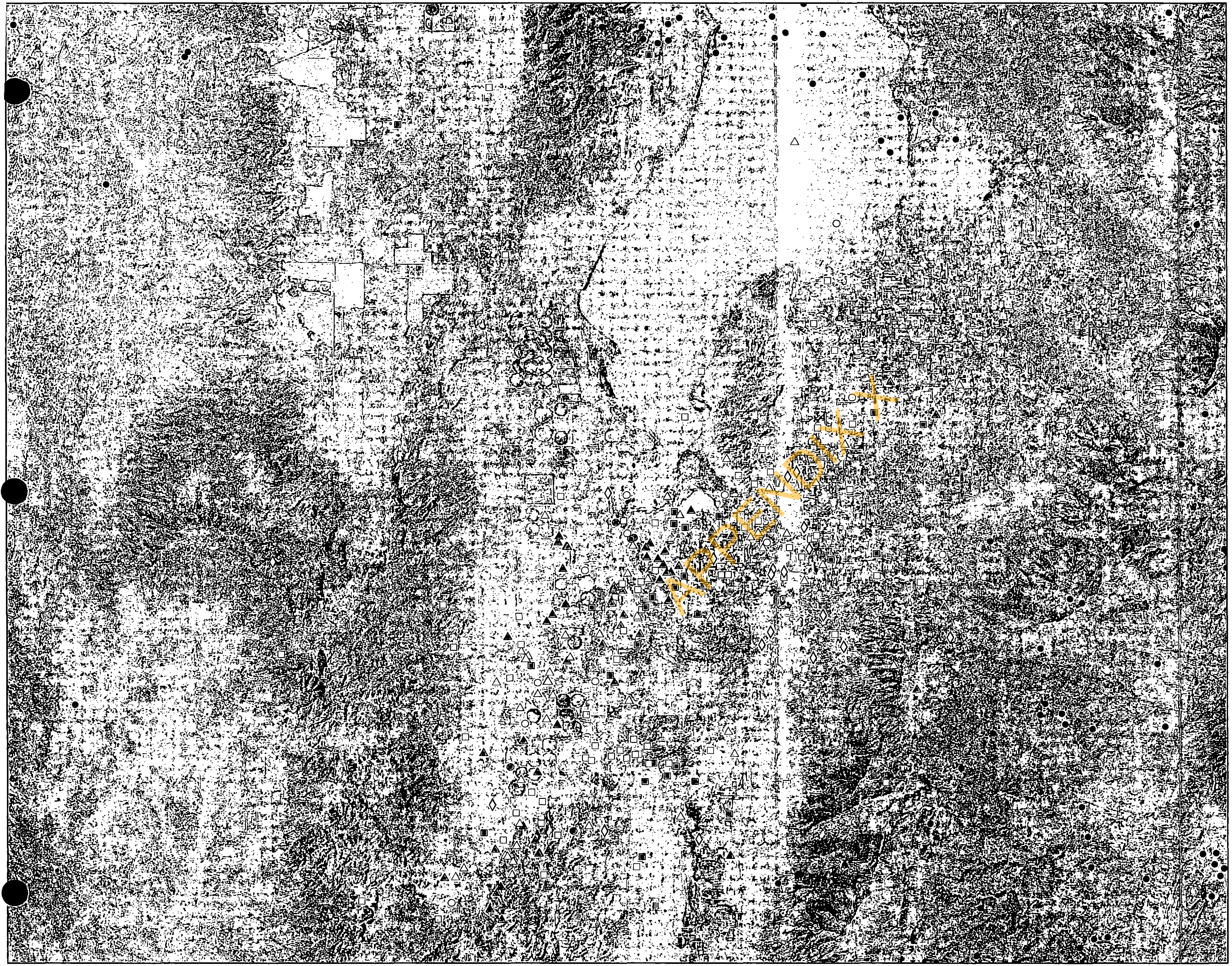
BAYVIEW LANDFILL
PERMIT APPLICATION

CELL 2 EXISTING CONTOURS

0 1" 2"

FILENAME FIGURE 3.DWG
SCALE AS SHOWN

FIGURE
3



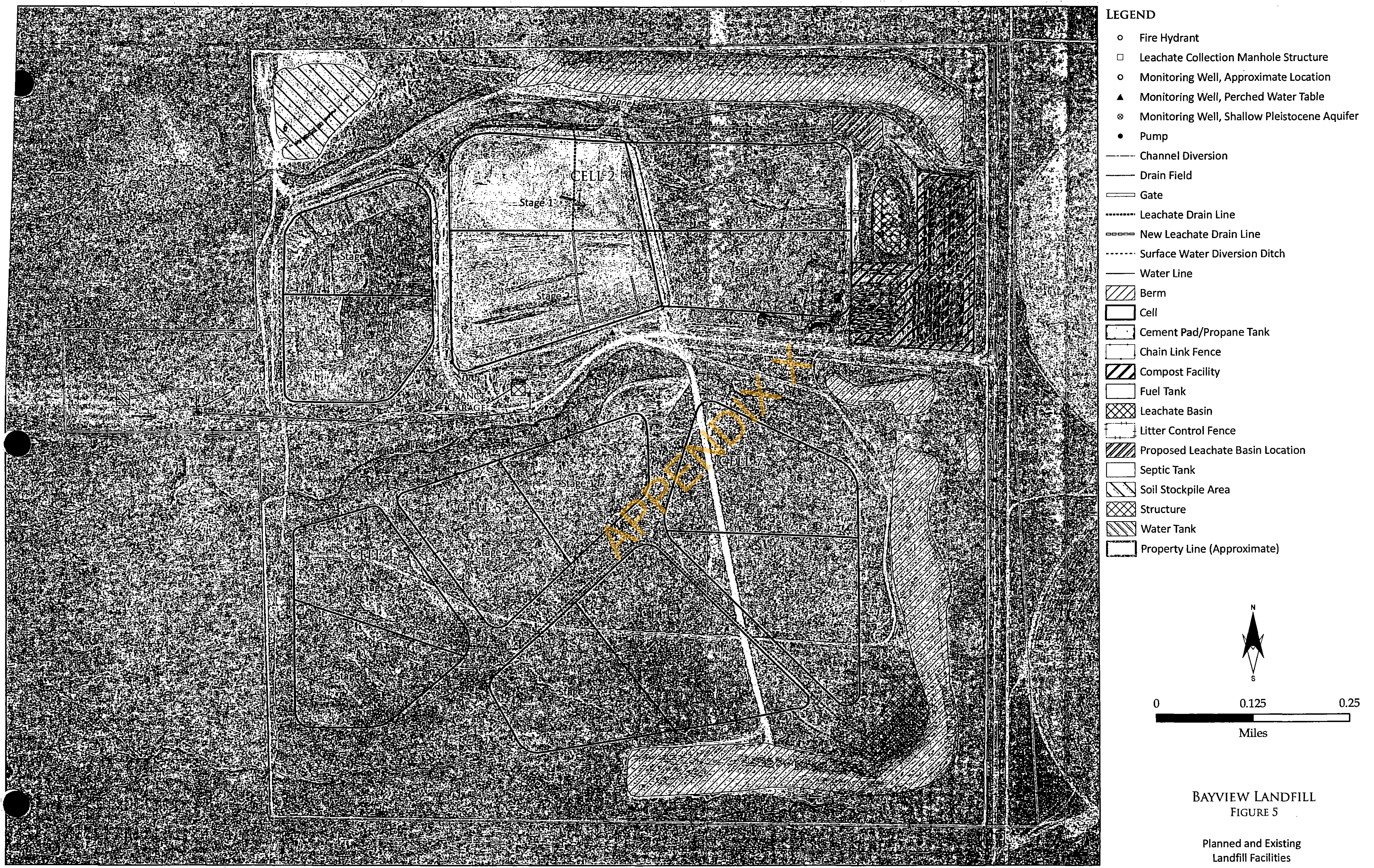
* Earthquakes displayed are within a 15-mile radius of the property line.

BAYVIEW LANDFILL

FIGURE 4

Earthquake Distribution Map

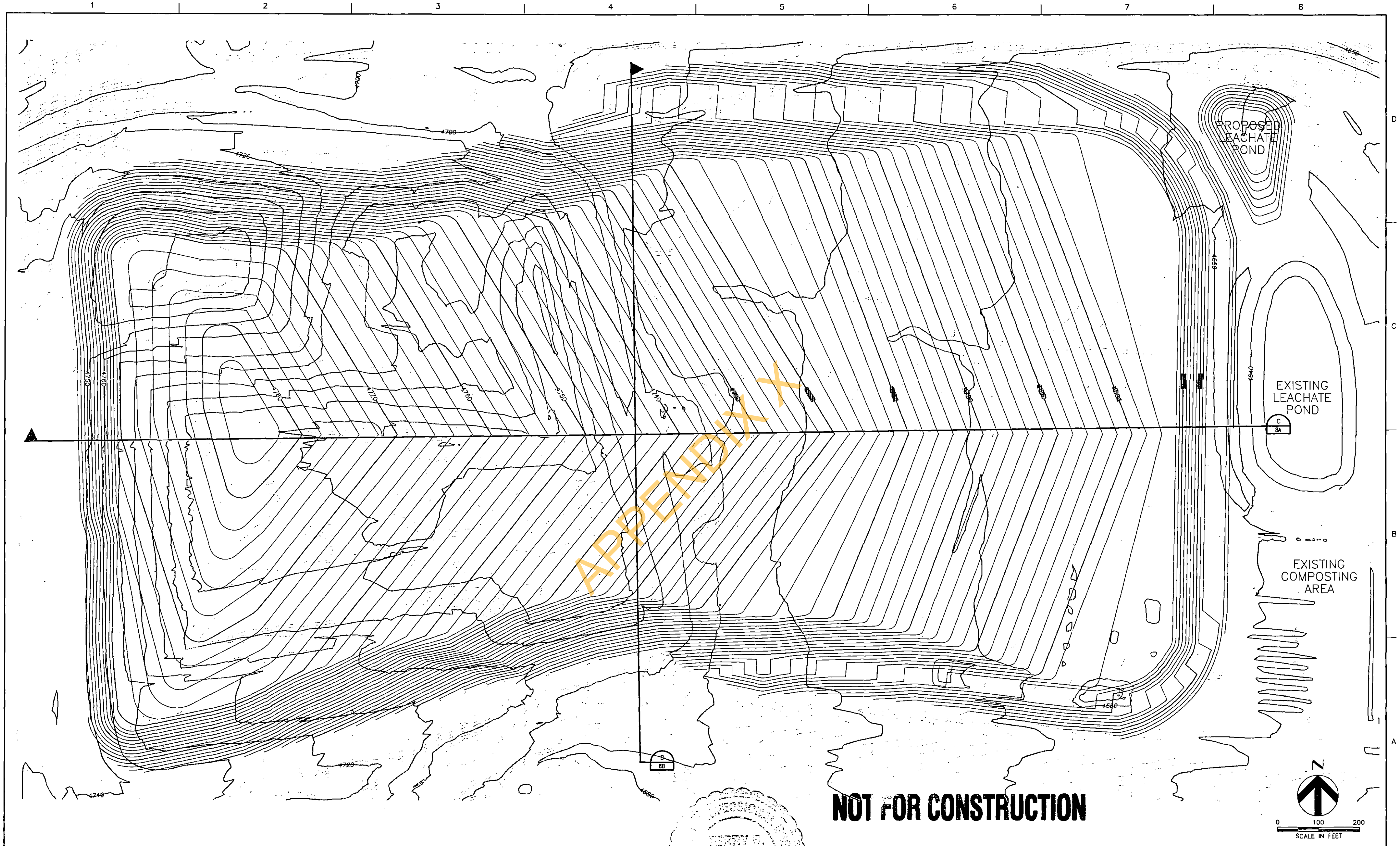
Friday, January 9, 2009 11:52:25 AM



BAYVIEW LANDFILL
FIGURE 5

Planned and Existing
Landfill Facilities

Tuesday, March 3, 2009 1:49:25 PM
H:\SLC STAFF\Rosemary\SUVSWD\Bayview_Landfill\map_docs\mxd\map_bL_BayviewLandfill.mxd



NOT FOR CONSTRUCTION

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	T. WARNER
ARCHITECT	
CIVIL	S. WOMACK
MECHANICAL	
ELECTRICAL	
STRUCTURAL	
DESIGNED	
DRAWN BY	
PROJECT NUMBER	96439

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

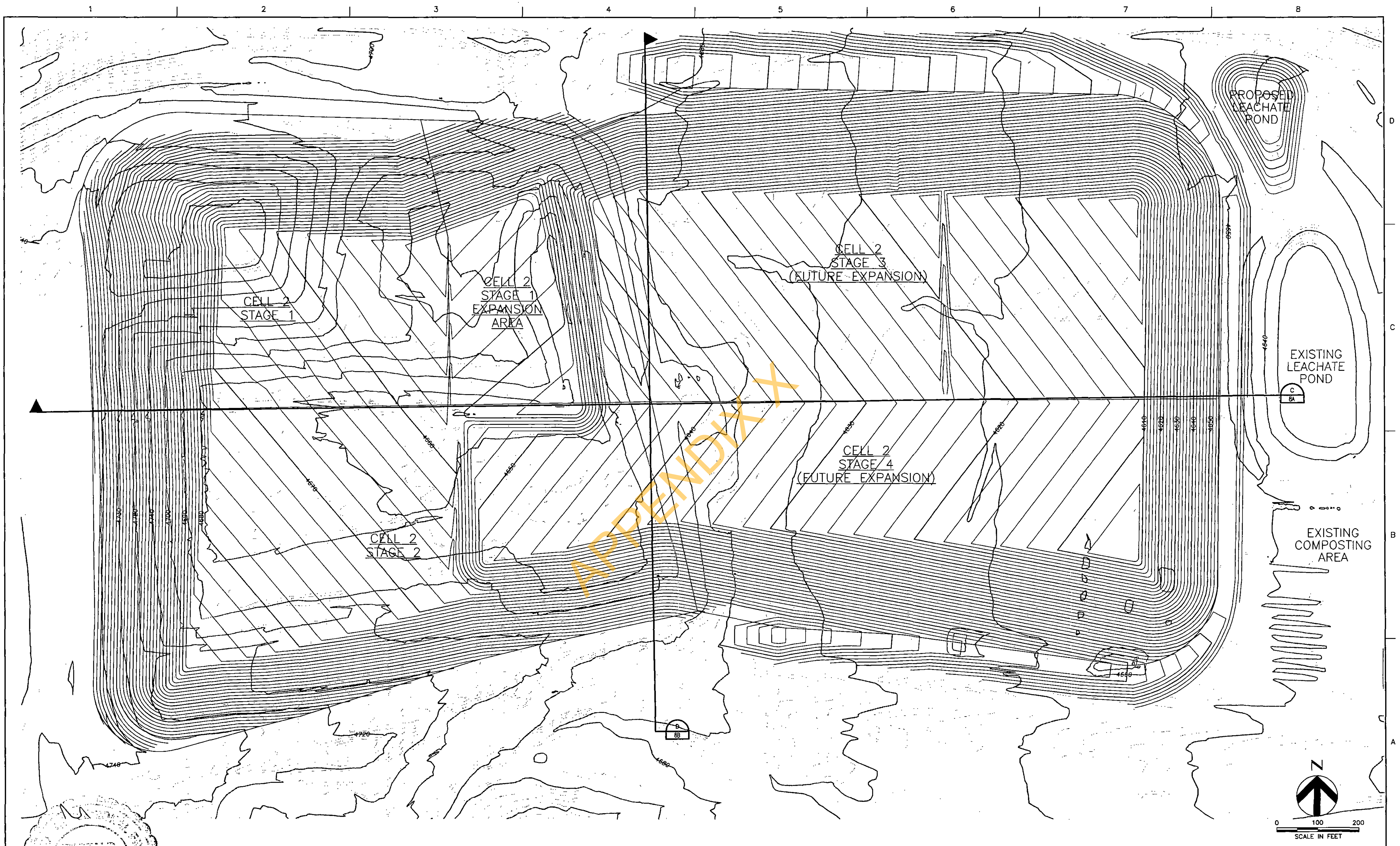
BAYVIEW LANDFILL
PERMIT APPLICATION

CELL 2 FINAL CONTOURS

0 1" 2"

FILENAME FIGURE 6.DWG
SCALE 1"=100'

FIGURE
6



HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

			PROJECT MANAGER	T. WARNER
			ARCHITECT	
			CIVIL	S. WOMACK
			MECHANICAL	
			ELECTRICAL	
			STRUCTURAL	
			DESIGNED	
			DRAWN BY	
ISSUE	DATE	DESCRIPTION	PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

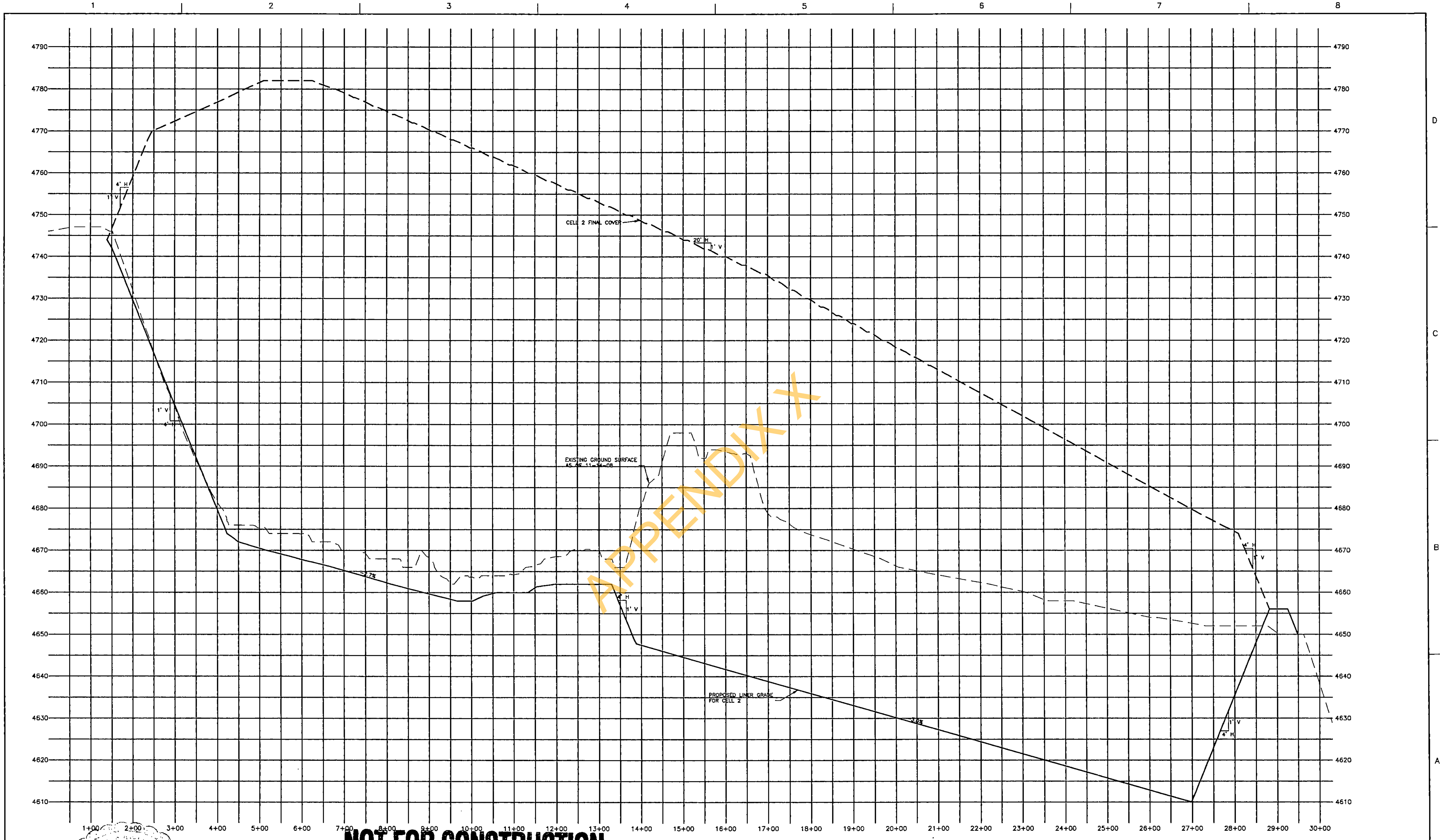
SOUTH UTAH VALLEY
SOLID WASTE DISTRICT
BAYVIEW LANDFILL
PERMIT APPLICATION

CELL 2 LINER/EXCAVATION CONTOURS

0 1" 2"

FILENAME FIGURE 7.DWG
SCALE AS SHOWN

FIGURE
7



NOT FOR CONSTRUCTION CROSS SECTION C

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER T. WARNER
ARCHITECT
CIVIL S. WOMACK
MECHANICAL
ELECTRICAL
STRUCTURAL
DESIGNED
DRAWN BY
PROJECT NUMBER 96439

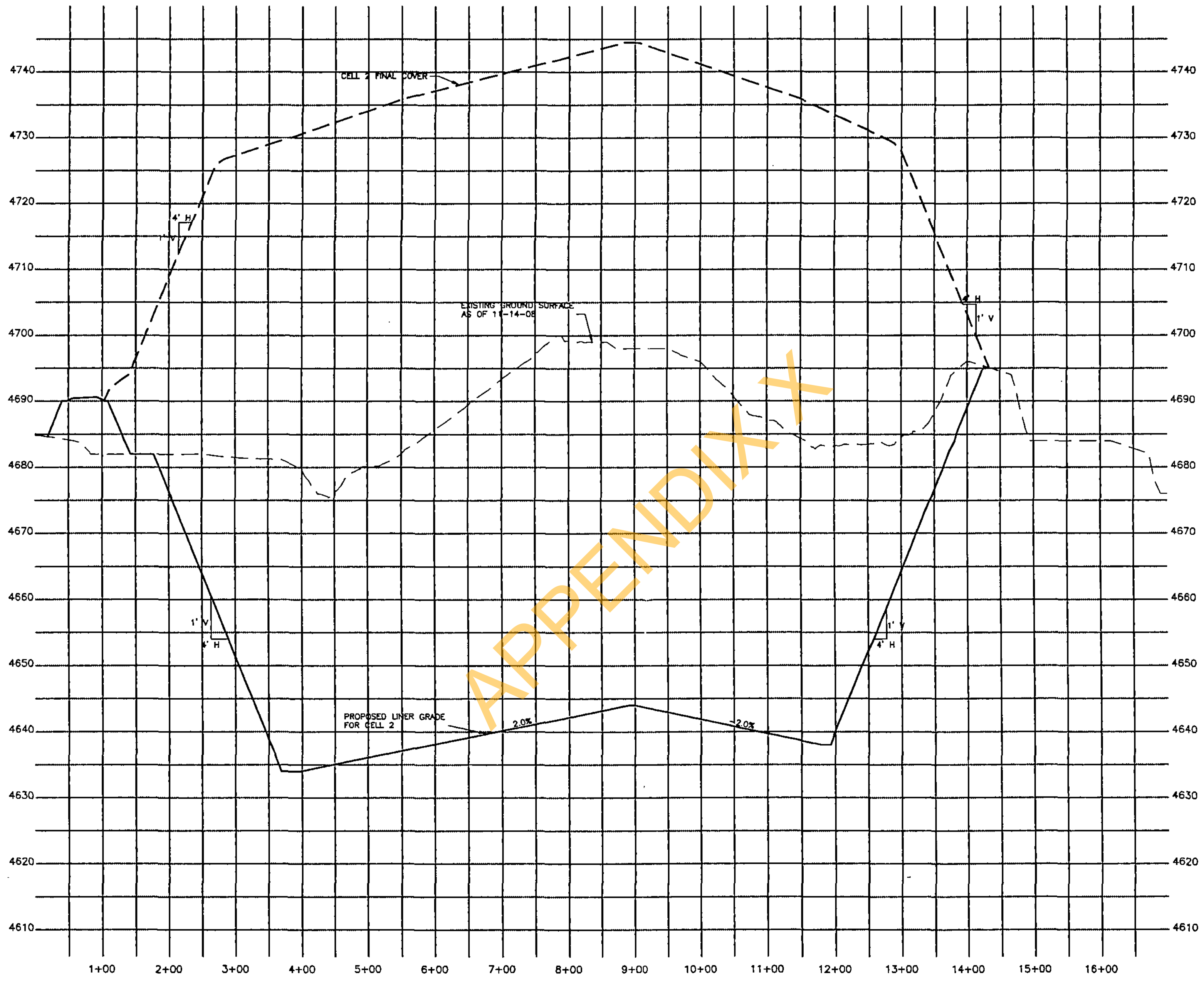
SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
PERMIT APPLICATION

CELL 2
TYPICAL CROSS SECTION

0 1" 2"

FILENAME 00C-8.DWG
SCALE H: 1"=100' V: 1"=10'
FIGURE 8A



CROSS SECTION D

NOT FOR CONSTRUCTION

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	T. WARNER
ARCHITECT	
CIVIL	S. WOMACK
MECHANICAL	
ELECTRICAL	
STRUCTURAL	
DESIGNED	
DRAWN BY	
PROJECT NUMBER	96439

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

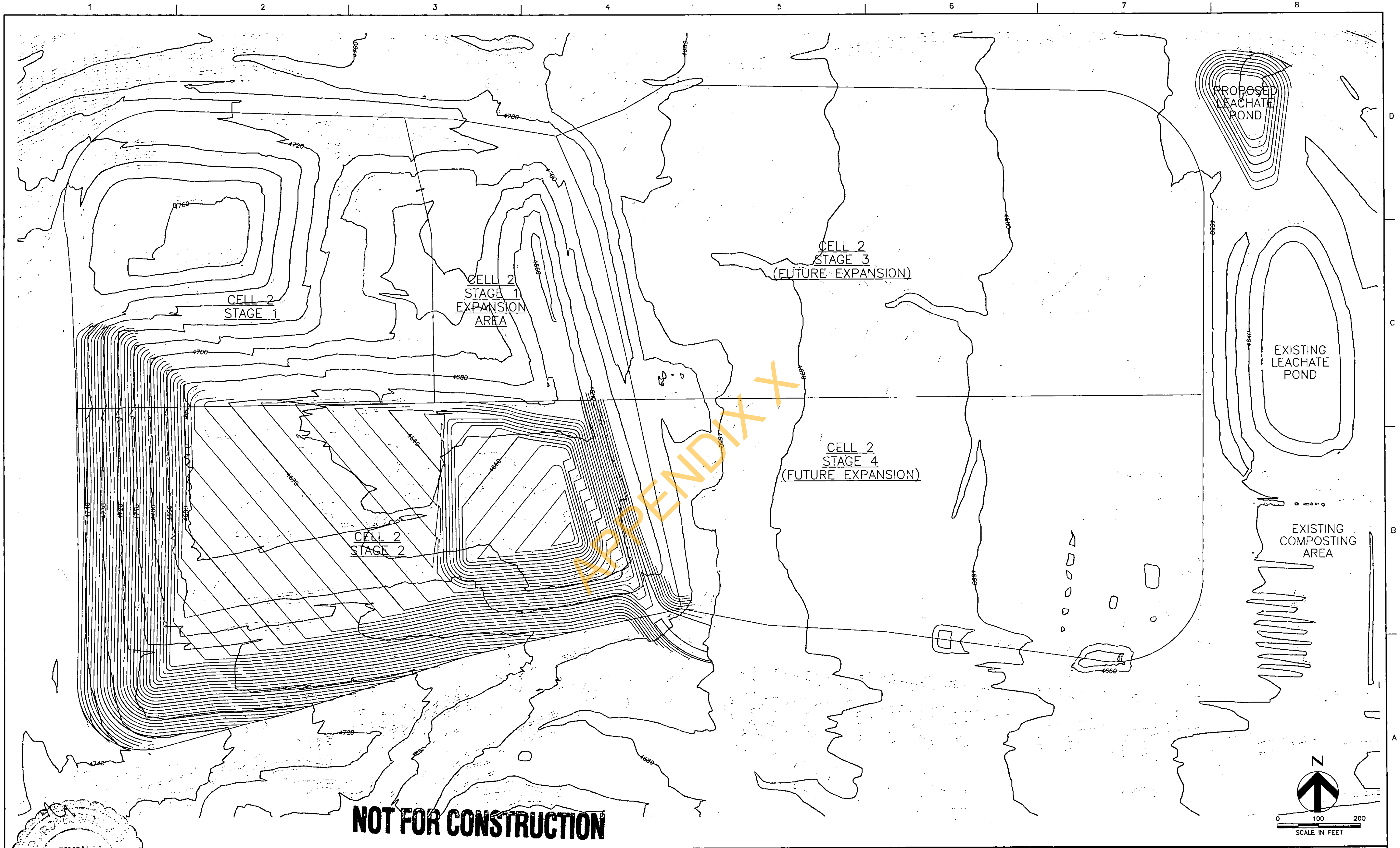
BAYVIEW LANDFILL
PERMIT APPLICATION

CELL 2
TYPICAL CROSS SECTION

0 1" 2"

FILENAME	00C-8.DWG
SCALE	NOT TO SCALE

FIGURE
8B



NOT FOR CONSTRUCTION

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION		
			PROJECT MANAGER	T. WARNER
			ARCHITECT	
			CIVIL	S. WOMACK
			MECHANICAL	
			ELECTRICAL	
			STRUCTURAL	
			DESIGNED	
			DRAWN BY	
			PROJECT NUMBER	96439

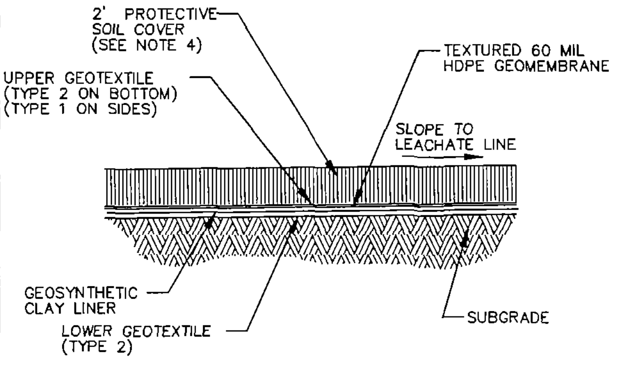
SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
PERMIT APPLICATION

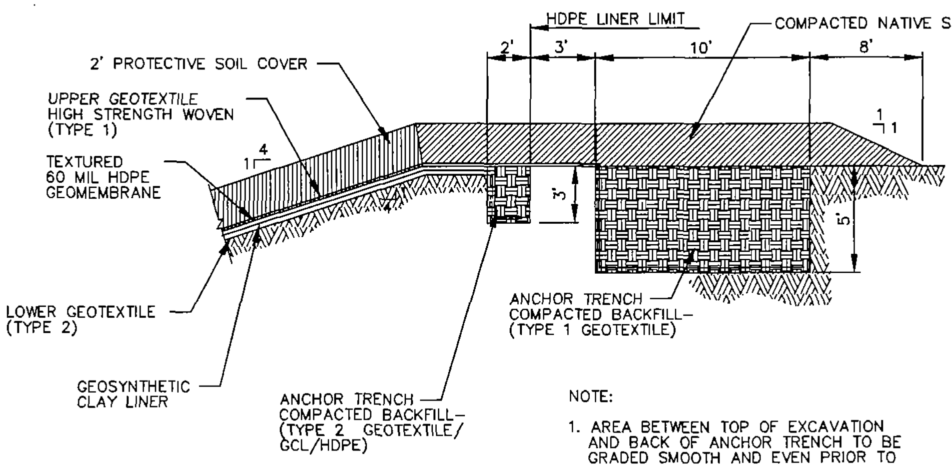
CELL 2 STAGE 1 & 2
LINER/EXCAVATION CONTOURS

0 1" 2"

FILENAME FIGURE 9.DWG
SCALE AS SHOWN
FIGURE 9



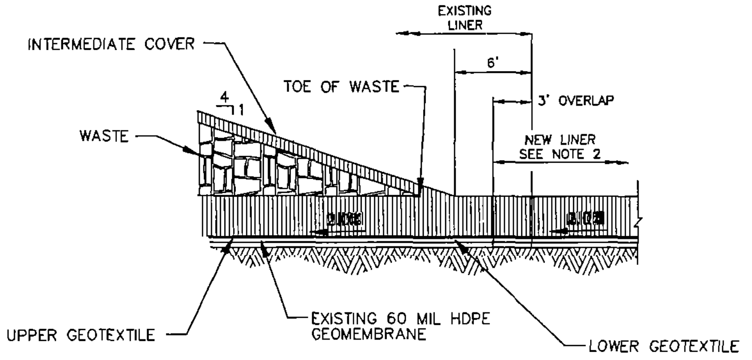
TYPICAL LANDFILL LINER DETAIL (1/C7)
NOT TO SCALE



NOTE:

1. AREA BETWEEN TOP OF EXCAVATION AND BACK OF ANCHOR TRENCH TO BE GRADED SMOOTH AND EVEN PRIOR TO PLACING UPPER GEOTEXTILE. REMOVE ANGULAR STONES.

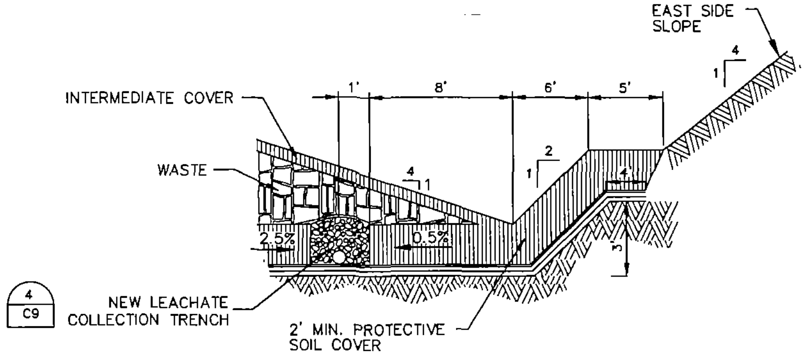
LINER SYSTEM ANCHOR TRENCH (2/C7)
NOT TO SCALE



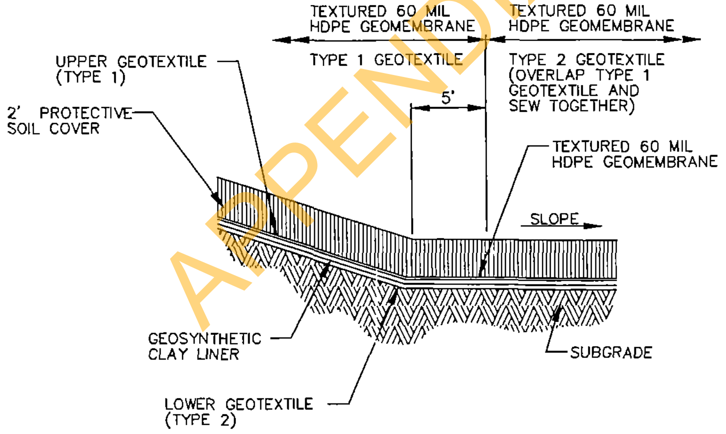
STAGE 1/STAGE 2 LINER CONNECTION (3/C7)
NOT TO SCALE

NOTES:

1. TEMPORARY STORMWATER INTERCEPTOR BERM TO BE PLACED IN FRONT OF WORKING AREA TO DIVERT STORMWATER AWAY FROM ACTIVE FACE. OWNER WILL RELOCATE AS NEEDED.
2. STAGE 2 GEOMEMBRANE TO BE WELDED TO STAGE 1. FUTURE GEOSYNTHETIC COMPONENTS TO BE OVERLAPPED AND SECURED.
3. TYPE I GEOTEXTILE IS REINFORCED AND REQUIRED ON SIDE SLOPES ONLY, ABOVE HDPE LINER. TYPE 2 GEOTEXTILE IS NON-REINFORCED (NON-WOVEN) AND IS TO BE USED ABOVE HDPE LINER ON BOTTOM AND BETWEEN SUBGRADE AND GCL. A SAND CUSHION MAY BE USED IN LIEU OF THE LOWER TYPE 2 GEOTEXTILE WITH PRIOR APPROVAL OF ENGINEER AND OWNER.
4. SEE SPECIFICATION 02240 FOR PROTECTIVE COVER MATERIAL REQUIREMENTS.



STAGE 2 EASTERN LINER TERMINATION (4/C7)
NOT TO SCALE



LINER AT SLOPE TRANSITION (5/C7)
NOT TO SCALE

NOTE: THICKNESS MEASURED PERPENDICULAR TO EXCAVATION SURFACE.

GEOTEXTILE SCHEDULE

LOCATION	TYPE	COMMENTS
ALL	ALL	REMOVE ALL ANGULAR STONES GREATER THAN 0.5 INCHES
LOWER GEOTEXTILE	2	USE 16 OZ/SY NON-WOVEN IF ROUNDED STONES GREATER THAN 2.5 INCHES ARE REMOVED. USE 20 OZ/SY NON-WOVEN IF ONLY ROUNDED STONES GREATER THAN 4 INCHES ARE REMOVED. NO HORIZONTAL SEAMS ON SIDESLOPES.
UPPER GEOTEXTILE ON SIDESLOPES	1	REINFORCED GEOTEXTILE. NO HORIZONTAL SEAMS ON SIDESLOPES.
UPPER GEOTEXTILE ON BOTTOM (FLOOR)	2	USE 12 OZ/SY NON-WOVEN BENEATH DUNE SAND (PROTECTIVE SOIL COVER)

NOT FOR CONSTRUCTION

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER T. WARNER
ARCHITECT
CIVIL S. WOMACK
MECHANICAL
ELECTRICAL
STRUCTURAL
DESIGNED
DRAWN BY
PROJECT NUMBER 96439

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

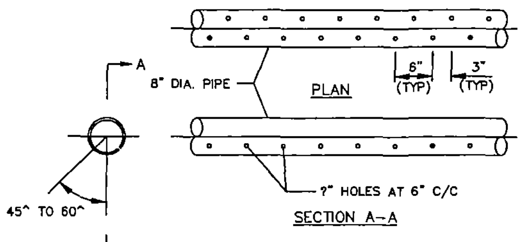
BAYVIEW LANDFILL
PERMIT APPLICATION

LINER DETAILS

0 1" 2"

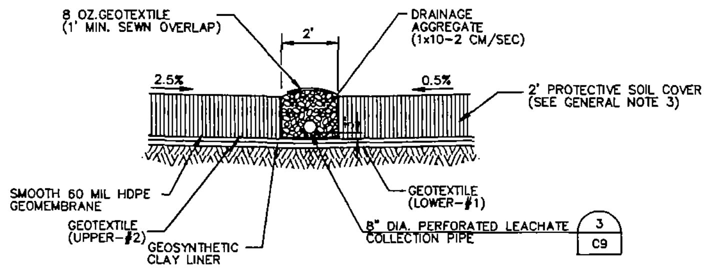
FILENAME FIGURE 10.DWG
SCALE N/A

FIGURE
10



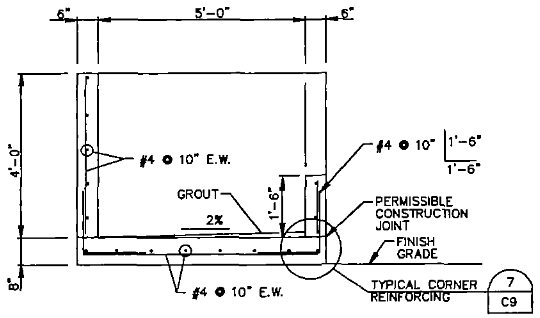
8" DIA. PERFORATED LEACHATE COLLECTION PIPE 3 C9

NOT TO SCALE



LEACHATE COLLECTION TRENCH 4 C9

NOT TO SCALE



LEACHATE SUMP ACCESS STRUCTURE– SECTION 5 C9

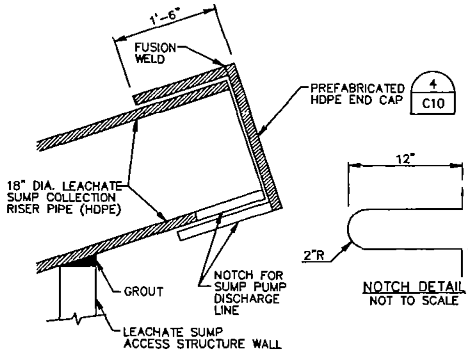
NOT TO SCALE

CONCRETE NOTES:

1. ALL CONCRETE SHALL HAVE 4000PSI COMPRESSIVE STRENGTH @ 28 DAYS, NORMAL WEIGHT.
2. ALL CONCRETE SHALL BE IN ACCORDANCE WITH THE "BUILDING CODE REQUIREMENT FOR REINFORCED CONCRETE" ACI–318 LATEST EDITION.
3. REINFORCING BARS SHALL CONFORM TO SPECIFICATIONS FOR "DEFORMED BILLET–STEEL FOR CONCRETE REINFORCEMENT" WITH 60KSI YIELD STRENGTH; ASTM A615 GRADE 60.
4. REINFORCING BARS TO BE WELDED SHALL COMPLY WITH THE REQUIREMENT OF ASTM A706 GRADE 60.
5. COVER ON ALL REINFORCEMENT SHALL BE AS FOLLOWS, UNLESS OTHERWISE NOTED:
   - I CONCRETE PLACED AGAINST GROUND 3 IN
   - II EXPOSED FORMED SURFACES
     - A. #5 AND SMALLER 1.5 IN
     - B. #6 AND LARGER 2 IN
6. ALL EXPOSED CORNERS SHALL HAVE 1 IN CHAMFER, UNLESS OTHERWISE NOTED.
7. SAWED GROOVES SHOULD BE MADE WITHIN APPROXIMATELY 4 TO 12 HOURS OF SLAB OR PAVEMENT FINISHING. IF THIS IS NOT PRACTICABLE, USE PREMOLDED STRIPS.
8. *AS AN ALTERNATIVE, A PRECAST CONCRETE BOX MAY BE USED.* THE PRECAST BOX SHOULD HAVE A MINIMUM CONCRETE COMPRESSIVE STRENGTH OF 5000 PSI @ 28 DAYS.

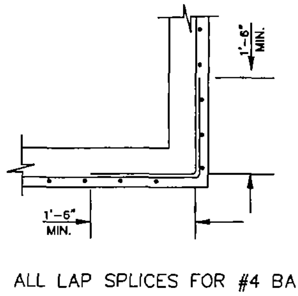
GENERAL NOTES:

1. LEACHATE RETURN LINE IS TO ALLOW *ANY SPILLAGE OR RAINWATER ACCUMULATION* IN SUMP ACCESS STRUCTURE TO RETURN TO LANDFILL SUMP FOR REMOVAL. GROUT BOTTOM OF STRUCTURE TO VALVE AFTER INSTALLATION, IF NECESSARY.
2. GROUT BOTTOM TO DRAIN TO RETURN LINE.
3. SEE SPECIFICATION SECTION 02240 FOR PROTECTIVE SOIL COVER REQUIREMENTS.



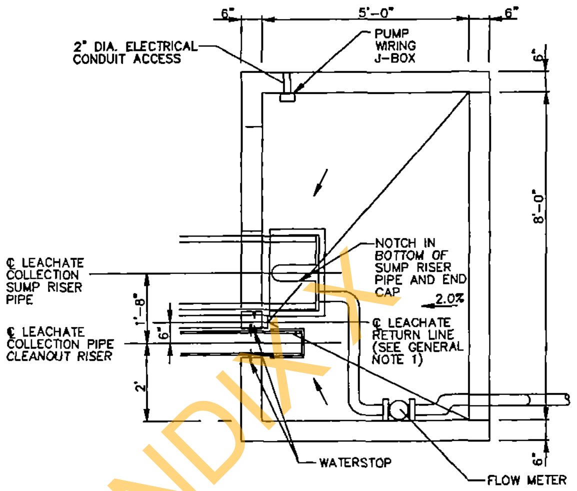
18" DIA. SUMP RISER PIPE 6 C9

NOT TO SCALE



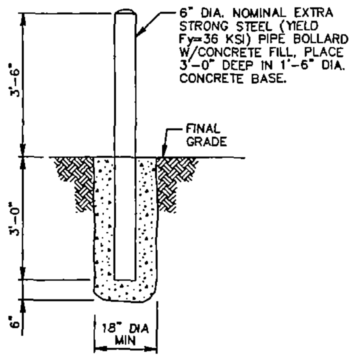
TYPICAL CORNER REINFORCING 7 C9

NOT TO SCALE



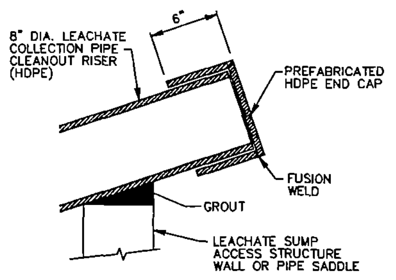
LEACHATE SUMP ACCESS STRUCTURE– PLAN 8 C9

NOT TO SCALE



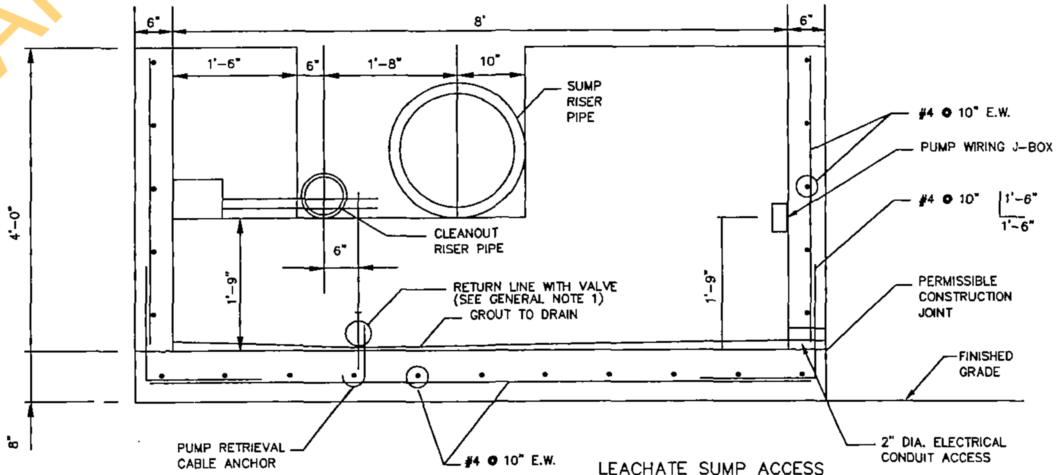
TYPICAL BOLLARD 10 C9

NOT TO SCALE



8" DIAMETER CLEANOUT RISER PIPE END CAP 11 C9

NOT TO SCALE



NOTE:
THIS AREA IS CORROSIVE.

LEACHATE SUMP ACCESS STRUCTURE– SECTION 9 C9

NOT TO SCALE

NOT FOR CONSTRUCTION

TERRY R. WARNER

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107–2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	T. WARNER
ARCHITECT	
CIVIL	S. WOMACK
MECHANICAL	
ELECTRICAL	
STRUCTURAL	
DESIGNED	
DRAWN BY	
PROJECT NUMBER	96439

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

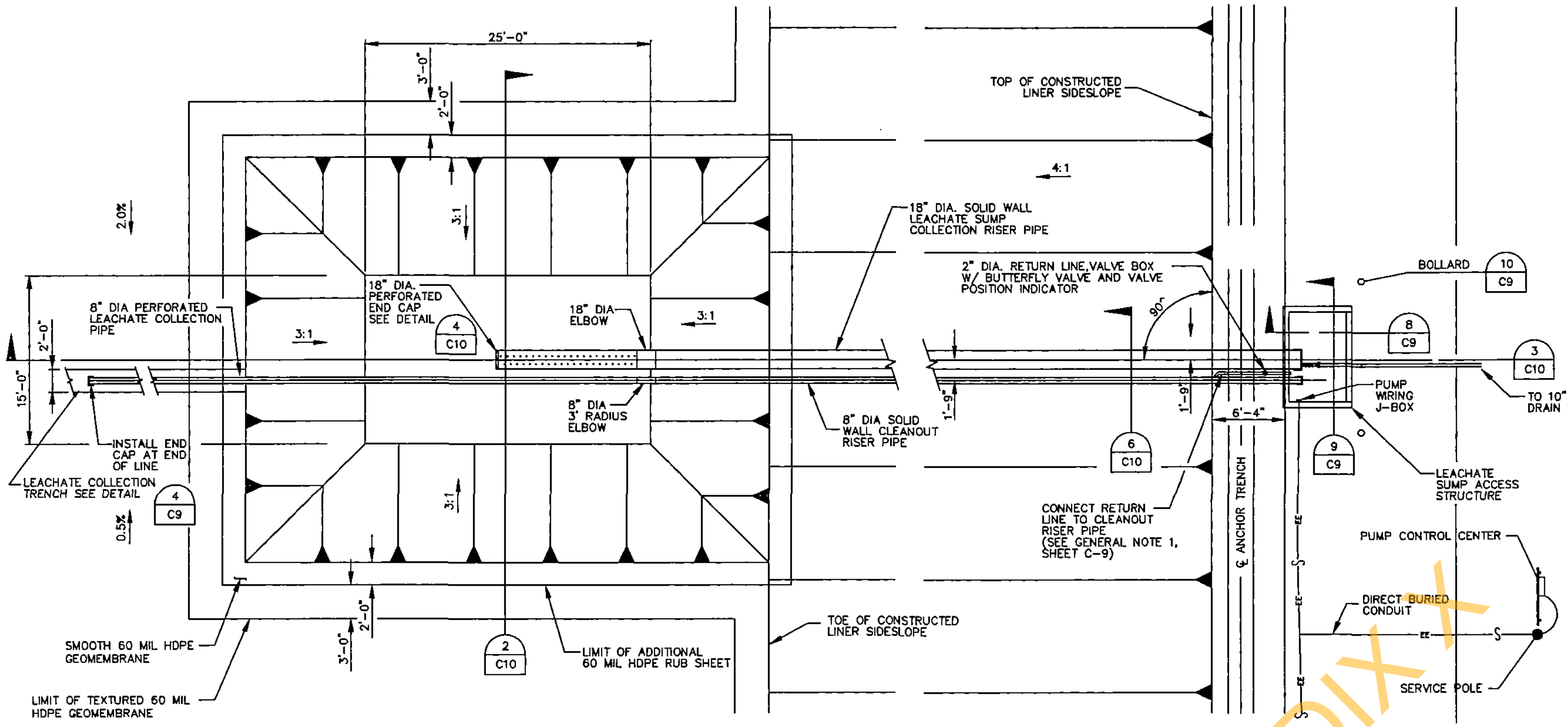
BAYVIEW LANDFILL
PERMIT APPLICATION

CELL 2 LEACHATE COLLECTION SYSTEM AND LINER DETAILS

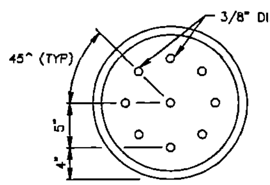
0 1" 2"

FILENAME	FIGURE 11.DWG
SCALE	N/A

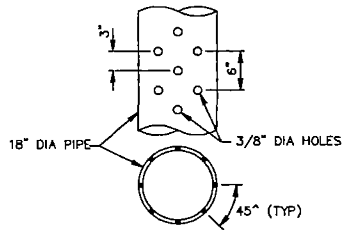
FIGURE
11



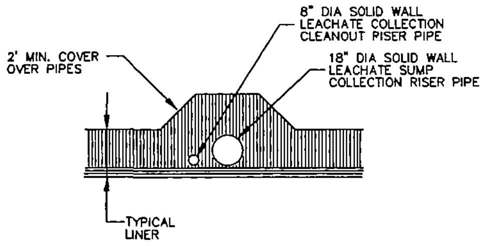
LEACHATE SUMP- PLAN 1 C10
NOT TO SCALE



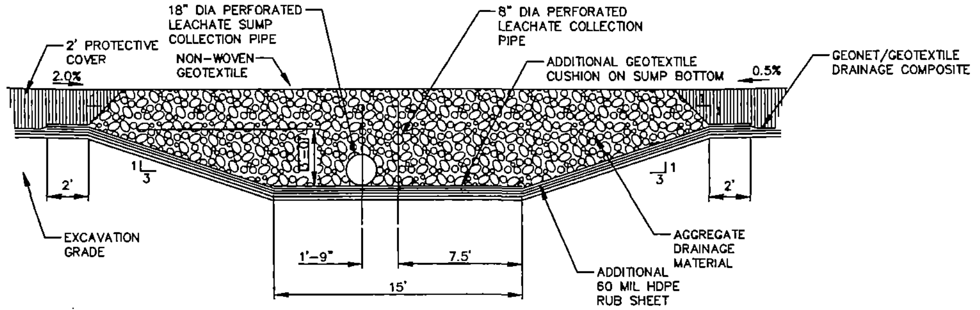
18" DIA. PERFORATED END CAP 4 C10
NOT TO SCALE



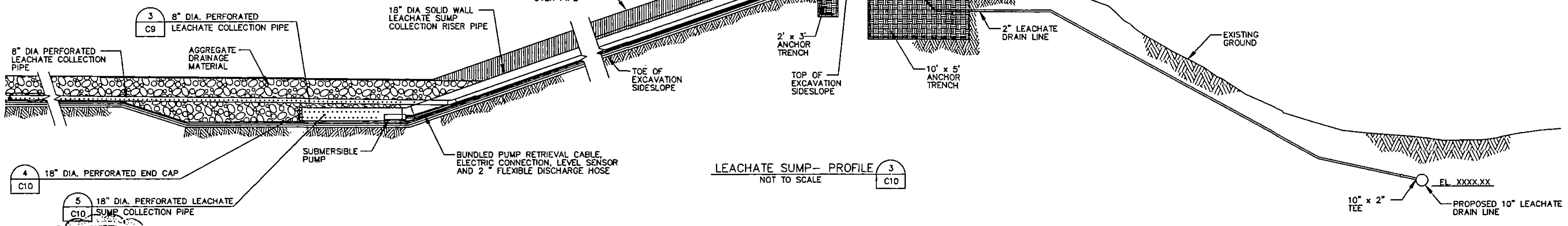
18" DIA. PERFORATED LEACHATE SUMP COLLECTION PIPE 5 C10
NOT TO SCALE



LEACHATE SUMP RISER- SECTION 6 C10
NOT TO SCALE



LEACHATE SUMP- SECTION 2 C10
NOT TO SCALE



LEACHATE SUMP- PROFILE 3 C10
NOT TO SCALE

NOT FOR CONSTRUCTION

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION		
			PROJECT MANAGER	T. WARNER
			ARCHITECT	
			CIVIL	S. WOMACK
			MECHANICAL	
			ELECTRICAL	
			STRUCTURAL	
			DESIGNED	
			DRAWN BY	
			PROJECT NUMBER	96439

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

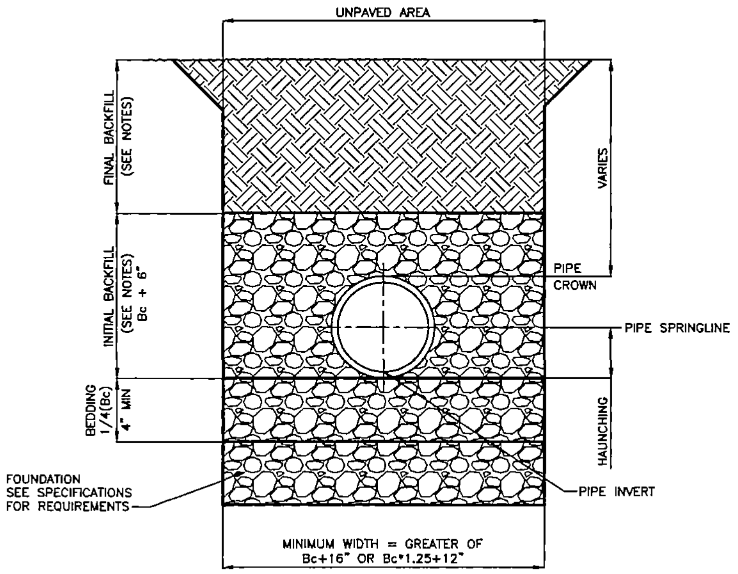
BAYVIEW LANDFILL
PERMIT APPLICATION

CELL 2 LEACHATE COLLECTION SYSTEM,
SUMP PLAN, AND SECTION DETAILS

0 1" 2"

FILENAME FIGURE 12.DWG
SCALE N/A

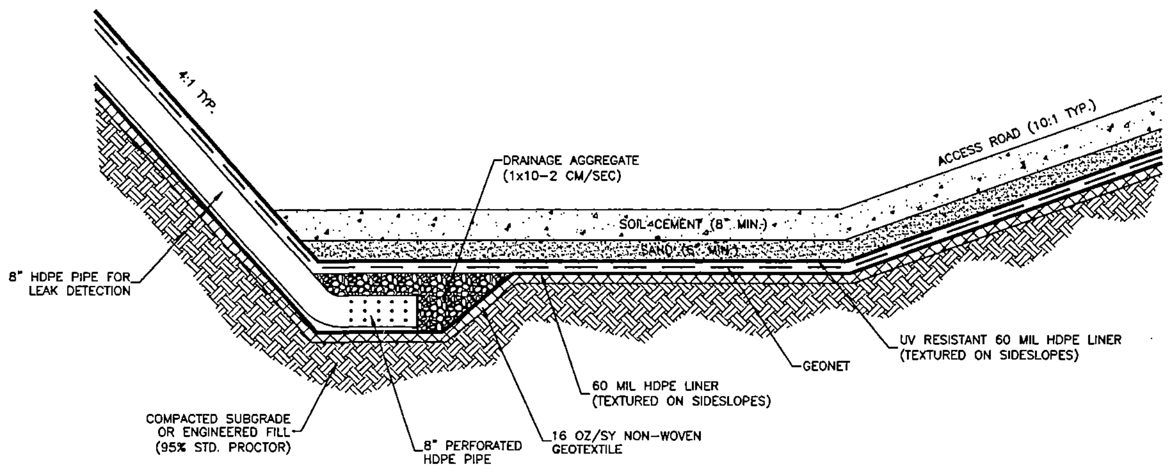
FIGURE
12



NOTES:

1. Bc=OUTSIDE DIAMETER OF PIPE.
2. NOT APPLICABLE TO TRENCH SECTIONS WITH NORMAL GROUNDWATER LEVELS ABOVE THE PIPE CROWN.
3. SEE SPECIFICATIONS FOR MATERIAL AND COMPACTION REQUIREMENTS.

PIPE TYPICAL TRENCH SECTION 1/C11
NOT TO SCALE



PROPOSED LEACHATE POND TYPICAL SECTION 2/C11
NOT TO SCALE

NOT FOR CONSTRUCTION

TERRY R. [illegible]

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION		
			PROJECT MANAGER	T. WARNER
			ARCHITECT	
			CIVIL	S. WOMACK
			MECHANICAL	
			ELECTRICAL	
			STRUCTURAL	
			DESIGNED	
			DRAWN BY	
			PROJECT NUMBER	96439

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
PERMIT APPLICATION

CELL 2 LEACHATE COLLECTION
SYSTEM DETAILS

0 1" 2"

FILENAME FIGURE 13.DWG
SCALE N/A

FIGURE
13

APPENDIX A

Cell 2 Master Plan

SUVSWD Bayview Class I Landfill
Permit Application

Appendix A: Bayview Landfill Cell 2 Master Plan

SUVSWD Bayview Class I Landfill Permit Application

Prepared for
Bayview Landfill
South Utah Valley Solid Waste District
Springville, Utah

Prepared by
HDR Engineering, Inc.
3995 South 700 East, Suite 100
Salt Lake City, UT 84107

March 2009

Contents

Attachments

A-1: Figures

A-2: Volume and Operating Life Calculations

1.0 Introduction

The South Utah Valley Solid Waste District (SUVSWD) was formed in 1989 to own and operate solid waste facilities for the cities of Provo, Salem, Spanish Fork, Springville and Mapleton, Utah. It assumed the existing and previously permitted landfill operations from the City of Provo. These solid waste facilities include a transfer station located in Springville and a landfill located north of Elberta. An additional transfer station owned and operated by the City of Goshen also provides waste to the Bayview Landfill. A vicinity map showing the site is included as Figure 1 in Part 4 of the Bayview Landfill Permit Application.

Two Landfill Master Plans have been previously prepared for the Bayview Landfill, the Landfill Master Plan (HDR, 1988), which provided an overview and outlined the sequential development of the site; and the Master Plan Update (HDR, 2002), which evaluated several scenarios for optimizing the development of landfill Cells 2 and 3, and ultimately combined the cells into one revised Cell 2. These plans are available from the SUVSWD and were included in previous submittals of the Landfill Permit Application. This master plan covers only those changes since the previous Master Plan Update (HDR, 2002). Further details can be found in the previous master plans and in the 2009 Permit Application.

Current In-place Tonnages as of January 2009

Cell – Stage	Tons of Waste[1]	Status
Cell 1	1,800,000	Pending Closure
Cell 2 – Stage 1	1,000,000	Currently Operating
Cell 2 – Stage 2	NA	Excavation Ongoing
Total	**2,800,000**	

[1] Assumes an in-place density of 1,500 lbs/cy

2.0 Design Considerations

This Cell 2 Master Plan provides information on the status of Stage 1 of Cell 2 and further revises the design of the remaining Cell 2 stages. Design modifications described in this Cell 2 Master Plan include (Attachment A):

- Revising the base grade of Cell 2 – Stage 2 so that the west two-thirds is graded at 2% down to the northeast, and the east third is graded at 2% down to the southeast;
- Adding a second leachate collection sump and drain line for the eastern portion of Cell 2 – Stage 2;
- Design of a new leachate collection pond to be solely dedicated to leachate and contact stormwater from Cells 1 and 2;
- Final contours of the interim closure of Stage 1, and the anticipated final contours of Cell 2 upon closure;

2.1 Landfill Development

Incorporating the above design modifications, the landfill development schedule has been revised. The following assumptions were used to estimate the volume and operating life of each Cell 2 stage:

- In-place waste density: 1,500 lbs/cy;
- In-place waste to daily cover soil ratio: 4:1;
- Waste tonnage annual increase: 3%;

2.1.1 Stage 2 Volume Increase and Operating Life Estimates

Removing the intercell berm between Stages 1 and 2 and revising the base grade of Stage 2 results in a Cell 2 total volume of 8,460,000 cubic yards, and a remaining operating life of 24 years. At the current waste acceptance rate of 140,000 tons per year, plus a 3% annual increase, Cell 2 is projected to reach final contours by 2032.

Development Schedule

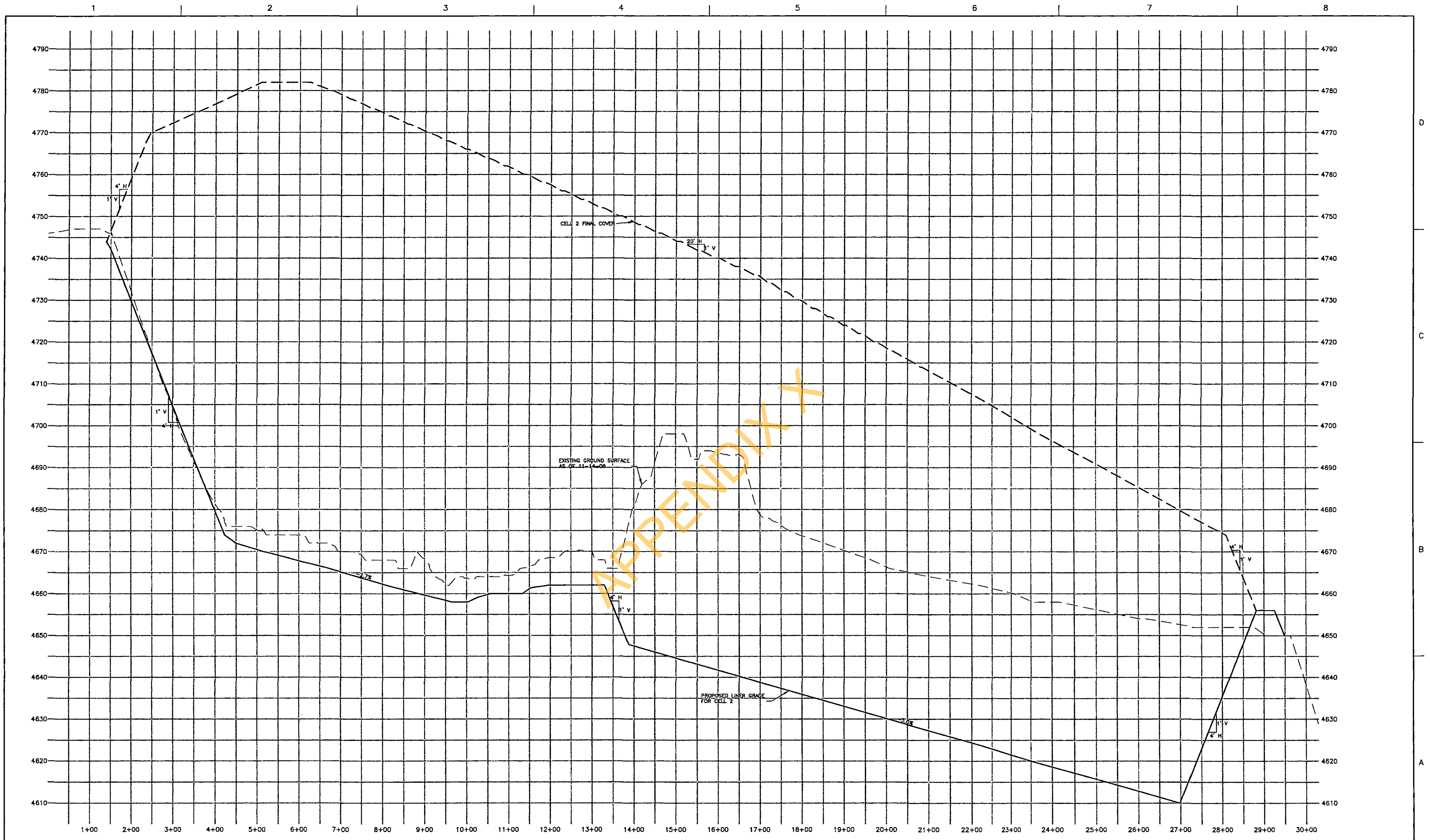
Cell 2 – Stage 1 is expected to reach capacity by the end of 2009, at which time Cell 2 – Stage 2 will begin receiving waste. Excavation has already begun in Cell 2 – Stage 2. Excavation in Stage 2 is expected to be completed by September, 2009. The useful life of Stage 2 will last until 2019, at which time Stage 3 will begin receiving waste. Excavation will begin on Stage 3 during 2017 to simultaneously excavate waste capacity and provide daily and intermediate cover material for Stage 2. Excess soil will be stockpiled and used for daily and intermediate cover material. Stage 3 is estimated to operate for 6 years beyond the life of Stage 2. Stage 4 will be excavated to provide cover material while Stage 3 is receiving waste. Using the above assumptions of waste acceptance rates and waste density, Stage 4 will begin receiving waste in 2024 and will have an operating life of 9 years, or a total operating life of Cell 2 through the year 2032.

3.0 Conclusion

The design specifications included in this document and attachments replace and supersede portions of the 1988 Master Plan (HDR) and 2002 Master Plan Update (HDR). These modifications have or will provide the SUVSWD a more cost effective and time efficient means of operating Landfill Cell 2. The design specifications contained herein result in a net cost savings and life-span increase for the Bayview Landfill. Incorporating these specifications will result in a useful life of Cell 2 through approximately the year 2032.

ATTACHMENT A-1

Figures



CROSS SECTION C

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

			PROJECT MANAGER	T. WARNER
			ARCHITECT	
			CIVIL	S. WOMACK
			MECHANICAL	
			ELECTRICAL	
			STRUCTURAL	
			DESIGNED	
			DRAWN BY	
ISSUE	DATE	DESCRIPTION	PROJECT NUMBER	96439

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

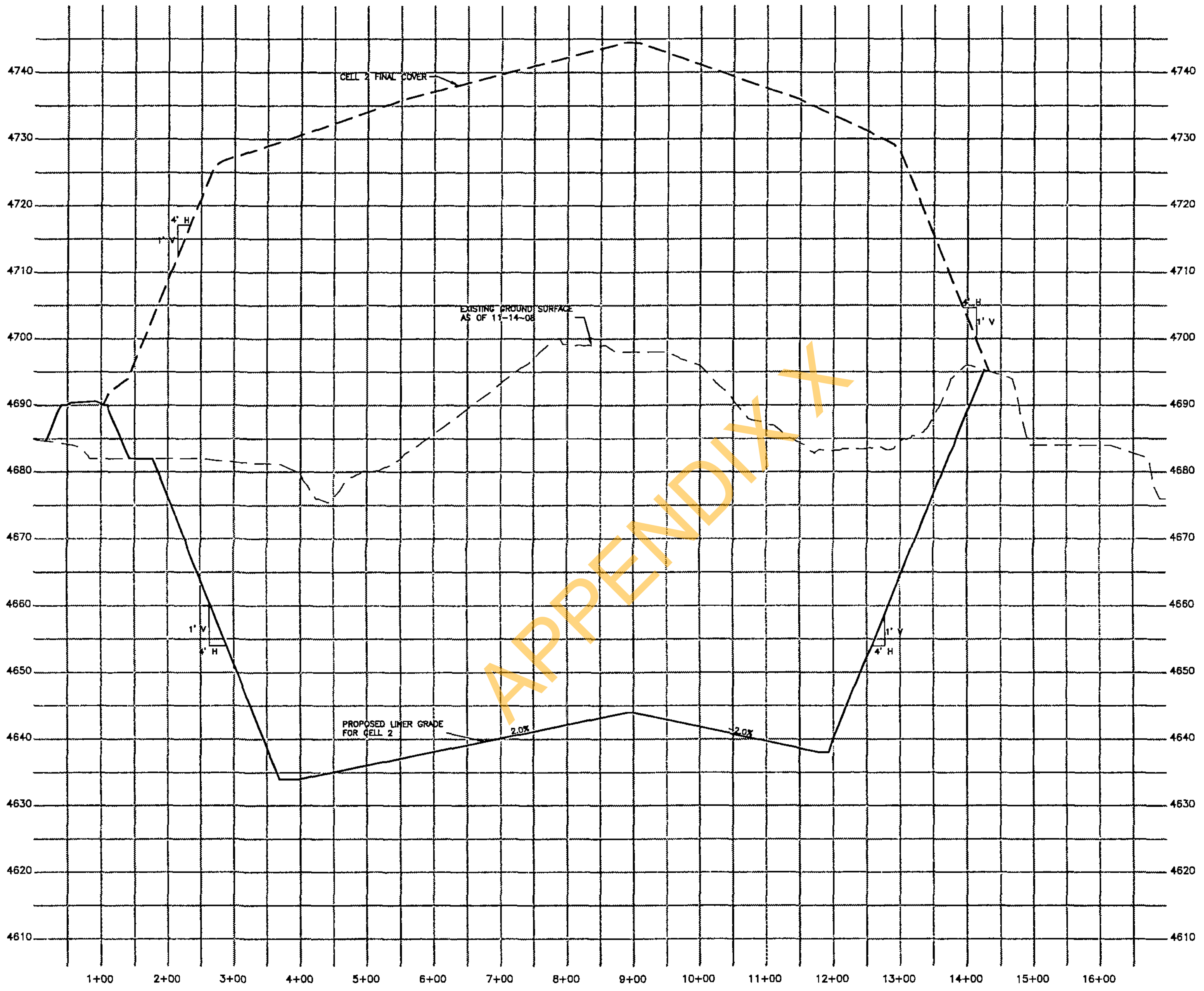
BAYVIEW LANDFILL
PERMIT APPLICATION

CELL 2
TYPICAL CROSS SECTION

0 1" 2"

FILENAME	00C-8.DWG
SCALE	H: 1"=100' V: 1"=10'

FIGURE
A 4



CROSS SECTION D

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION		
			PROJECT MANAGER	T. WARNER
			ARCHITECT	
			CIVIL	S. WOMACK
			MECHANICAL	
			ELECTRICAL	
			STRUCTURAL	
			DESIGNED	
			DRAWN BY	
			PROJECT NUMBER	96439

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
PERMIT APPLICATION

CELL 2
TYPICAL CROSS SECTION

0 1" 2"

FILENAME 00C-8.DWG
SCALE NOT TO SCALE

FIGURE
A 5

ATTACHMENT A-2

Volume and Operating Life Calculations

Cell 2 Remaining Capacity
Projected Waste Volumes

Yearly Tonnage	**140,649**	Annual Increase	**3%**	Waste Density [LB/CY]	**1,500**
Total Volume Remaining [CY]	**8,460,000**	**Site Area [ACRE]**	**83.0**	**Bottom Cover Depth [FT]**	**2**
Waste	**4**	Soil	**1**	**Soil Cap/Cover Depth [FT]**	**2.83**

CALCULATIONS

Soil For Cover [CY] [1]	**582,682**	Initial Airspace [CY]	**7,877,318**

SOIL BALANCE

Year (July 1- June 30)	Yearly Tonnage	Cumulative Tonnage Received	Waste Volume Received [CY]	Cumulative Waste Volume Received [CY]	Daily Soil Cover Volume Required [CY]	Cumulative Daily Soil Cover Required [CY]	Airspace Consumed [CY]	Cumulative Airspace Consumed [CY]	Remaining Airspace [CY]	Remaining Life [3] [YR]
2008 - 09	140,649	140,649	187,532	187,532	37,506	37,506	225,038	225,038	7,652,279	*34.0*
2009 - 10	144,868	285,517	193,158	380,690	38,632	76,138	231,790	456,828	7,420,490	*32.0*
2010 - 11	149,215	434,732	198,953	579,643	39,791	115,929	238,743	695,571	7,181,747	*30.1*
2011 - 12	153,691	588,423	204,921	784,564	40,984	156,913	245,906	941,477	6,935,841	*28.2*
2012 - 13	158,302	746,725	211,069	995,633	42,214	199,127	253,283	1,194,759	6,682,558	*26.4*
2013 - 14	163,051	909,775	217,401	1,213,034	43,480	242,607	260,881	1,455,641	6,421,677	*24.6*
2014 - 15	167,942	1,077,718	223,923	1,436,957	44,785	287,391	268,708	1,724,348	6,152,970	*22.9*
2015 - 16	172,981	1,250,698	230,641	1,667,598	46,128	333,520	276,769	2,001,117	5,876,201	*21.2*
2016 - 17	178,170	1,428,868	237,560	1,905,157	47,512	381,031	285,072	2,286,189	5,591,129	*19.6*
2017 - 18	183,515	1,612,383	244,687	2,149,844	48,937	429,969	293,624	2,579,813	5,297,505	*18.0*
2018 - 19	189,020	1,801,404	252,027	2,401,872	50,405	480,374	302,433	2,882,246	4,995,072	*16.5*
2019 - 20	194,691	1,996,095	259,588	2,661,460	51,918	532,292	311,506	3,193,752	4,683,566	*15.0*
2020 - 21	200,532	2,196,627	267,376	2,928,835	53,475	585,767	320,851	3,514,603	4,362,715	*13.6*
2021 - 22	206,548	2,403,174	275,397	3,204,233	55,079	640,847	330,476	3,845,079	4,032,239	*12.2*
2022 - 23	212,744	2,615,919	283,659	3,487,892	56,732	697,578	340,391	4,185,470	3,691,848	*10.8*
2023 - 24	219,127	2,835,045	292,169	3,780,060	58,434	756,012	350,602	4,536,072	3,341,245	*9.5*
2024 - 25	225,700	3,060,746	300,934	4,080,994	60,187	816,199	361,121	4,897,193	2,980,125	*8.3*
2025 - 26	232,471	3,293,217	309,962	4,390,956	61,992	878,191	371,954	5,269,147	2,608,171	*7.0*
2026 - 27	239,446	3,532,662	319,261	4,710,217	63,852	942,043	383,113	5,652,260	2,225,058	*5.8*
2027 - 28	246,629	3,779,291	328,838	5,039,055	65,768	1,007,811	394,606	6,046,866	1,830,452	*4.6*
2028 - 29	254,028	4,033,319	338,704	5,377,759	67,741	1,075,552	406,444	6,453,310	1,424,007	*3.5*
2029 - 30	261,649	4,294,968	348,865	5,726,623	69,773	1,145,325	418,638	6,871,948	1,005,370	*2.4*
2030 - 31	269,498	4,564,466	359,331	6,085,954	71,866	1,217,191	431,197	7,303,145	574,173	*1.3*
2031 - 32	277,583	4,842,049	370,111	6,456,065	74,022	1,291,213	444,133	7,747,278	130,040	*0.3*
2032 - 33	285,910	5,127,959	381,214	6,837,279	76,243	1,367,456	457,457	8,204,735	(327,417)	*-0.7*

CONSTRUCTION SCHEDULE

Stage	Airspace Available [CY]	Cumulative Airspace Available [CY]	Construction Start	Year Airspace Consumed [2]
Stage 2	2,650,000	2,650,000	2009	2018-2019
Stage 3	1,870,000	4,520,000	2017	2023-2024
Stage 4	3,357,318	7,877,318	2022	2032-2033

Notes:
1.Soil for bottom cover of Cell 2 Stage 1 not included because the stage has already been constructed.
2. Year airspace consumed taken from Soil Balance table, above.
3. Remaining life estimate is based on the projected annual waste accepted in the year represented in each row.

APPENDIX B

Special Use Lease Agreement

SUVSWD Bayview Class I Landfill
Permit Application

January 6, 1984

Dale

Provo City Corporation
359 West Center Street
Provo, Utah 84601

Gentlemen:

RE: SULA #[illegible]

Enclosed please find two copies of the above referenced special use lease. Please sign both copies have your signature notarized and return both copies to this office, at which time we will send you the fully executed original for your file and reference.

Thank you.

Sincerely,

Richard B. Wilcox
LAND SPECIALIST

RBW:jcl

Enclosures (2)

Note - paragraph 6 has been added to the lease.

RECEIVED
JAN 10 1984
PROVO CITY MAYOR

SPECIAL USE LEASE AGREEMENT NO. 498

School Fund

The STATE OF UTAH, acting by and through the DIVISION OF STATE LANDS, LESSOR, hereby leases to Provo City Corporation, LESSEE, 359 West Center Street, Provo, Utah 84601, the following described tract of State land in Utah County, Utah , to-wit:

Parcel "A":

<u>Township 9 South, Range 1 West, SLB&M</u>
Section 17: SW¼NW¼

Containing 40 acres, more or less.

Parcel "B":

<u>Township 9 South, Range 1 West, SLB&M</u>
Section 17: That portion of the section ot described by Parcel "A".

Containing 600 acres, more or less.

TO HAVE AND TO HOLD for a term of 51 years, beginning as of January 1, 1984, subject to any and all existing valid rights in said land and subject also to the following terms and conditions. LESSOR and LESSEE enter into this Special Use Lease Agreement for the purpose that LESSEE develop the land in the manner hereinafter described and consistent with the principles and objectives of land development expressed and implicit in the Enabling Act of Utah (Act of July 16, 1894, Ch. 138, 28 Stat. 107) and Article X of the Constitution of the State of Utah.

1. The subject tract shall be used by LESSEE for the purpose of constructing and maintaining a sanitary landfill, including all improvements reasonably associated therewith. All improvements constructed on the subject tract shall comply with the applicable provisions of the Uniform Building Code, Current Edition, International Conference of Building Officials.

2. LESSEE shall pay, to the LESSOR as rental, for the subject tract, the sum of $1,000.00 per year until LESSEE commences construction of the sanitary landfill on the subject property, after which the annual rate shall be $40.00 per acre per annum for that portion of the subject property which is currently being used as the sanitary landfill proper (Parcel A). The sanitary landfill proper is that portion of the subject tract enclosed by a fence and which is used for sanitary landfill purposes. The fee for that portion of the subject property which is not currently being used as the sanitary landfill proper is $10.00 per acre per annum (Parcel B). The annual lease fee, based on th above rates is $7600.00 per annum. LESSOR acknowledges the receipt of $1,020.00 which is payment of this rental for the year January 1, 1984 through December 31, 1984 plus the $20.00

application fee. Should construction on the sanitary landfill commence during the 1984 rental year, or any other subsequent rental year, the lease rates will be prorated according to the rates as outlined above. Failure to pay the rental for a period of one month from the date such rent is due shall work a forfeiture of the lease upon expiration of thirty (30) days written notice by LESSOR to LESSEE, requiring performance, if payment shall not be made within said thirty (30) day period.

3. LESSEE agrees that LESSOR shall have the right to adjust the annual rentals as provided for in Paragraph 2 at the end of each five (5) year period as LESSOR shall deem to be reasonably necessary in the best interest of the State.

LESSEE also agrees that at the end of five (5) years from the date of this lease, and, if necessary, for each two (2) year period thereafter, LESSEE has not developed the land as proposed in Paragraph (1), LESSEE shall then be required to appear before the Board of State Lands and show that it has exercised due diligence toward development of the land. If LESSEE fails to show due diligence, then LESSEE agrees that LESSOR may at its option, terminate this lease agreement as to any or all the land leased hereunder. In the event LESSOR so terminates, LESSEE 's interest in the land shall revert to the State.

4. LESSEE, in exercising the privileges granted by this lease, shall comply with the provisions of all valid Federal, State, County, and Municipal laws, ordinances, and regulations which are applicable to the subject tract and operations covered by this lease.

5. LESSEE shall take reasonable precautions to protect, in place, all public land survey monuments and private property corners.

6. LESSEE shall be bound by all of the provisions, conditions, and prohibitions of Chapter 14 of Title 73, Utah Code Annotated (1953) as amended. No waste or by-products shall be discharged which contain any substance in concentrations which will result in substantial harm to fish and wildlife, or to human water supplies. Storage facilites for materials capable of causing water pollution, if accidentally discharged, shall be located so as to prevent any spillage into waters, or channels leading into water, that would result in substantial harm to fish and wildlife or to human water supplies.

7. LESSEE agrees to permit LESSOR free and unrestricted access to and upon the subject tract at all reasonable times for all lawful and proper purposes not inconsistent with the intent of this lease or with the reasonable exercise and enjoyment by the LESSEE of the rights and privileges granted herein.

8. It is hereby understood and agreed that all treasure-trove and all articles of antiquity in or upon the subject lands are and shall remain the property of the State of Utah. LESSEE shall report any discovery of a "site" or "Specimen" to the Division of State History in compliance with the provisions of Section 63-18-27, Utah Code Annotated (1953), as amended.

9. LESSEE may relinquish or surrender this lease at any time during the term hereof by giving LESSOR one year's advance written notice, and by paying all rentals due to the effective date of such relinquishment or surrender; provided, all accounts are in good standing and all terms and conditions have been performed by LESSEE. The relinquishment or surrender shall become effective upon written acceptance thereof by LESSOR.

10. This lease may be terminated by LESSOR upon breach of any conditions hereof. If LESSOR determines that the LESSEE, its assigns or successors in interest have breached any conditions of this lease, LESSOR shall notify the breaching party (parties) in writing by certified mail, return receipt requested, specifying the particular breach. The breaching party (parties) shall have thirty (30) days from the date of such notice, or such longer period as may reasonably be required under the circumstances, to correct such breach. If breaching party (parties) fails (fail) to correct such breach within such period, LESSOR may terminate this lease upon thirty (30) days notice; provided, however, such termination shall not release breaching party (parties) from liability for damage prior to such termination.

11. This lease is made pursuant to the provisions of all applicable laws and subject to the rules and regulations of the departments and agencies of the State of Utah presently in effect and to such laws, rules and regulations as may be hereafter promulgated by the State.

12. It is understood that the LESSEE will use the subject lands as a sanitary landfill and consistent with such a use, the LESSEE shal maintain the subject lands in a reasonable state of repair, orderliness, neatness, sanitation and safety. In no event shall the condition of the subject lands be less than that required by law and applicable regulations.

13. LESSEE shall have the right to remove any improvements and any personal property placed on the lands by LESSEE, provided that the same shall be removed within sixty (60) days after the expiration of the term of this lease, provided that the LESSEE shall properly restore any damage caused thereby to the subject tract or any improvements remaining thereon; provided further, that LESSOR shall have the option to retain without compensation to LESSEE any and all underground pipes or facilities for water and sewer now on the premises or subsequently installed thereon by LESSEE.

14. LESSEE assumes liability for and agrees to indemnify LESSOR for and against any and all liability (including attorney's fees) of any nature imposed upon, incurred by, or asserted against LESSOR which in any way relates to or arises out of the activity or presence upon the premises of LESSEE, its servants, employees, agents, sublessees, assignees or invitees.

15. LESSEE shall not assign this lease, in whole or in part, nor sublease the leased premises, nor allow unauthorized or commercial use of the premises without obtaining the prior written consent of LESSOR.

16. LESSOR expressly reserves the right to lease said lands to third parties for mineral exploration and/or development purposes together with the right to grant the mineral lessee reasonable access by ingress and egress to and from the mineral estate through the surface estate in connection with mineral exploration and/or development, but without damage to improvements made by LESSEE. Provided, however, that the rights reserved by this paragraph and any rights conveyed by the LESSOR to a mineral lessee shall in no event be inconsistent with the construction or maintenance of a sanitary landfill.

17. LESSOR claims title in fee simple, but does not warrant to LESSEE the validity of title to the leased premises. LESSEE shall have no claim from damages or refund against the LESSOR for any claimed failure or deficiency of LESSOR's title to said lands or for interference by any third party.

18. If LESSEE shall initiate or establish any water right on the leased premises, such right shall become an appurtenance of the leased premises. LESSEE agrees that any existing application to appropriate water on said State land shall be transferred to the Division of State Lands after the application has been completed, without any cost to the State. It is expressly understood and agreed that this lease does not confer any rights upon LESSEE to use any water presently developed on the subject lands.

19. LESSEE shall at all times observe reasonable precautions to prevent fire on the leased premises and shall comply with all applicable laws and regulations of any governmental agency having jurisdiction. In the event of a fire on the leased premises proximately caused by LESSEE, its servants, employees, agents, sublessees, assignees or licensees which necessitates suppression action by the State Forester, LESSEE agrees to reimburse LESSOR for the cost of such fire suppression action.

20. LESSEE shall comply with any and all valid sanitation and pollution regulations prescribed by any governmental agency having jurisdiction; and the LESSEE agrees to indemnify LESSOR for any damage which LESSOR may suffer which arises out of the improper or unlawful disposal of refuse associated with said land.

21. LESSEE may fence the leased premises at his own expense, but if there is no fence erected, LESSEE shall have no right of action against any other State grazing permittee by reason of a trespass upon the leased premises.

22. In the event of any breach of this agreement, the party at fault shall pay all costs of enforcing the same, including reasonable attorney's fees.

23. Any notice contemplated herein to be served upon LESSEE shall be in writing and shall be deemed sufficient if deposited in the United States mail, postage prepaid and certified or registered, and addressed as follows:

Provo City Corporation
359 West Center Street
Provo, Utah 84601

or at any such other address as LESSEE may from time to time designate by written notice to LESSOR.

24. The provisions hereof shall inure to and be binding upon the successors and assigns of LESSEE.

25. IN WITNESS WHEREOF, the Director of the Utah Division of State Lands has executed this instrument as of the ____________ day of ______________, 1983, by authority of a resolution of the Board of State Lands, dated January 20, 1982.

LESSOR: STATE OF UTAH
DIVISION OF STATE LANDS
3100 State Office Building
Salt Lake City, Utah 84114

By: ____________________________
RALPH A. MILES, Director

ATTORNEY GENERALS OFFICE
APPROVED AS TO FORM
By

LESSEE:

By: ____________________________

STATE OF UTAH)
: ss.
COUNTY OF SALT LAKE)

On the ________ day of ______________, 1983, personally appeared before me Ralph A. Miles, who being by me duly sworn did say that he is the Director of the Division of State Lands of the State of Utah, and that said instrument was signed in behalf of said Board by resolution of the Board, and said Ralph A. Miles acknowledged to me that said Board executed the same in behalf of the State of Utah.

Given under my hand and seal this ________ day of ____________, 1983.

____
Notary Public, residing at:

My Commission Expires:

26.

STATE OF UTAH)
: ss.
COUNTY OF)

On the ________ day of ______________, 1983, personally appeared before me ________________________________, who being by me duly sworn did say that he is the _________________________ of Provo City Corporation, and said _____________________________ acknowledged to me that said City executed the same.

Given under my hand and seal this __________ day of ______________, 1983.

____
Notary Public, residing at:

My Commission Expires:

AMENDMENT

TO

SPECIAL USE LEASE AGREEMENT NO. 498

The STATE OF UTAH, acting by and through the DIVISION OF STATE LANDS & FORESTRY, LESSOR, and Provo City Corporation, LESSEE, hereby agree to amend Special Use Lease Agreement No. 489, as follows:

The leased premises shall include, in addition to Parcel "A" and Parcel "B" as described in SULA No. 498, Parcel "C" which is a tract of State land in Utah County, Utah, to-wit:

Township 9 South, Range 1 West, SLB&M
Section 18: S2SE4NE4

Containing 20 acres

1. Parcel "C" shall be used by LESSEE for the purpose of constructing and maintaining a water well and water tank to be used in conjuction with a sanitary landfill including improvements reasonably associated . All improvements constructed on the subject tract shall comply with the applicable provisions of the Uniform Building Code, Current Edition, International Conference of Building Officials.

2. LESSEE shall pay, to the LESSOR as rental, for the subject tract the sum of $1000.00 per year until LESSEE commences construction of the sanitary landfill on the subject property, after which the annual rate shall be $40.00 per acre per annum for that portion of subject property which is currently being used as the sanitary landfill proper (Parcel A). The sanitary landfill proper is that portion of the subject tract enclosed by a fence which is used for sanitary landfill purposes. The fee for that portion of the subject property which is not currently being used as the sanitary landfill proper is $10.00 per acre per annum (Parcel B). The fee for that portion of the subject property which is used for the water well and water tank site (Parcel C) will be $600.00 per year. The annual lease fee, based on the above rates is $8,200.00 per annum.

3. IN WITNESS WHEREOF, the Director of the Utah Division of State Lands and Forestry has executed this instrument as of the 14th day of JAN., 1987, by authority of a resolution of the Board of State Lands, dated January 20, 1982.

LESSOR: STATE OF UTAH
DIVISION OF STATE LANDS AND FORESTRY
3 Triad Center, Suite 400
355 West North Temple
Salt Lake City, Utah 84180

By: Ralph A. Miles
RALPH A. MILES, Director

APPROVED AS TO FORM:
DAVID L. WILKINSON
ATTORNEY GENERAL
BY: David Christensen

LESSEE: Provo City Corporation
359 West Center
Provo City, UT 84601

By: Joseph A. Jenkins

STATE OF UTAH)
: ss.
COUNTY OF SALT LAKE)

On the 14th day of January, 1987, personally appeared before me Ralph A. Miles, who being by me duly sworn did say that he is the Director of the Division of State Lands and Forestry of the State of Utah, and that said instrument was signed in behalf of said Board by resolution of the Board, and said Ralph A. Miles acknowledged to me that said Board executed the same in behalf of the State of Utah.

Given under my hand and seal this 14th day of January, 1987.

Jan C. Lucas
Notary Public, residing at: S.L.C.

My Commission Expires: 4-16-90

4.

STATE OF UTAH)
: ss.
COUNTY OF)

On the 31 day of Dec., 1986, personally appeared before me Joseph A. Jenkins, who being by me duly sworn did say that he is the Mayor of Provo City, and said Joseph A. Jenkins acknowledged to me that said company executed the same.

Given under my hand and seal this 31 day of Dec., 1986.

Dean Eklund
Notary Public, residing at:

My Commission Expires:
12-10-90

Appendix C

APPENDIX C

Cost Breakdown for Closure/Post-Closure

SUVSWD Bayview Class I Landfill
Permit Application

Bayview Landfill
Closure Cost Estimate
Cell 2 - Stages 1 and 2 (2008 Dollars)

Cell #2 Stage 1	20	Acres
Cell #2 Stage 2	23	Acres
Total	43	Acres

	Item	Unit	Unit Cost	Quantity	Cost
1.00	**Engineering/Management**				
1.01	Topo Survey Initial	HR	$140	95	$13,300
1.02	Topo Survey Final	HR	$140	80	$11,200
1.03	Site Reconnaissance	HR	$140	55	$7,700
1.04	Boundary Survey	HR	$140	40	$5,600
1.05	Construction Plans/Specs	LUMP	$55,000	1	$55,000
1.06	Bidding and Award	LUMP	$6,000	1	$6,000
1.07	Quality Control Testing	LUMP	$20,000	1	$20,000
1.08	Construction Management/QC	LUMP	$180,000	1	$180,000
1.09	Closure Report/As-Builts	LUMP	$25,000	1	$25,000
1.10	Obtain UPDES and other permits	LUMP	$10,000	1	$10,000
			Subtotal		$333,800
			Contingency	20%	$66,760
			Engineering Subtotal		**$400,560**

2.00	**Construction**				
2.01	Grading Top of Intermediate Cover	SY	$1.25	208,120	$260,150
2.02	34" On-site Fill Placement/Grading	CY	$1.75	196,558	$343,977
2.03	Silt Fence/Erosion Control	LF	$2.50	5,500	$13,750
2.04	Dust Control and Watering	LS	$11,000.00	1	$11,000
2.05	Drainage Ditches	LF	$3.00	5,500	$16,500
2.06	Temporary Drainage Control	LS	$11,000.00	1	$11,000
2.07	Gas Collection System [6]	ACRE	$15,000.00	0	$0
			Subtotal		$656,377
			Contingency	20%	$131,275
			Construction Subtotal		**$787,652**

	Summary		Engineering		$400,560
			Construction		$787,652
			Legal	5%	$59,411
				Total	**$1,247,622**

Assumptions/Notes:

1. Estimate assumes closure of Cell #2 Stage 1 and 2.
2. Proposed pond will be constructed with Cell 2 Stage 2 and no additional improvements will be necessary.
3. No permanent culverts or drainage piping is required.
4. Assumes cover is imported from an off-site source TBD.
5. Assumes topsoil is available onsite.
6. Active gas collection system not required at this time.

Bayview Landfill
Post-Closure Care Cost Estimate for
Cell 1 and Cell 2 - Stages 1 and 2
(2008 Dollars)

COST ESTIMATE FOR LANDFILL POST-CLOSURE CARE

	Item	**Unit**	**Unit Cost**	**Quantity**	**Cost**
1.0	ENGINEERING				
1.1	Post Closure Plan	LUMP	$6,000	1	$6,000
1.2	Site Inspection & Recordkeeping (quarterly)	PER YEAR	$2,500	30	$75,000
1.3	Correctional Plans & Specs (annual)	PER YEAR	$1,200	30	$36,000
1.4	Site Monitoring (semi-annually) (1)	PER YEAR	$17,000	30	$510,000
2.0	MAINTENANCE COSTS	PER YEAR	$6,000	30	$180,000
3.0	LEACHATE DISPOSAL (2)	PER GALLON	$0.05	0	$0
			Subtotal		$807,000
			Contingency (20%)		$161,400
			Total		$968,400

Closure Estimate (previous page)	$1,247,622
Total Closure/Post Closure	**$2,216,022**

Assumptions/Notes:

1. Includes groundwater monitoring and statistical analysis and gas sampling
2. Includes repairing eroded final cover material with on site material, compost and seed

STATEMENT OF ACCOUNT

PTIF

UTAH PUBLIC TREASURERS' INVESTMENT FUND

Edward T. Alter, Utah State Treasurer, Fund Manager
PO Box 142315
350 N State Street, Suite 180
Salt Lake City, Utah 84114-2315
Local Call (801) 538-1042 Toll Free (800) 395-7665
www.treasurer.utah.gov

ESC-SO UT VALL SOLID WASTE
GEORGE STEWART
PO BOX 507
SPRINGVILLE, UT 84663-0507

Account	**Account Period**
254	October 01, 2008 through October 31, 2008

Summary

Beginning Balance	$ 2,971,839.48	Average Daily Balance	$ 2,971,839.48
Deposits	$ 7,309.17	Interest Earned	$ 7,309.17
Withdrawals	$ 0.00	360 Day Rate	2.8562
[illegible]ding Balance	$ 2,979,148.65	365 Day Rate	2.8958

Date	**Activity**	**Deposits**	**Withdrawals**	**Balance**
10/01/2008	FORWARD BALANCE	$ 0.00	$ 0.00	$ 2,971,839.48
10/31/2008	REINVESTMENT	$ 7,309.17	$ 0.00	$ 2,979,148.65
10/31/2008	ENDING BALANCE	$ 0.00	$ 0.00	$ 2,979,148.65

Appendix D

APPENDIX D

Engineering Drawing and Specifications

NOT FOR CONSTRUCTION

SUVSWD Bayview Class I Landfill
Permit Application

APPENDIX D – ENGINEERING DRAWINGS

The following conceptual engineering drawings are for reference only and are not intended for construction.

Final engineering drawings and specifications will be inserted here upon completion.

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL

CELL 2 STAGE 2
30% GRADING PLAN

MARCH 4, 2009

DRAWING SCHEDULE

1	COVER SHEET
2	GENERAL NOTES, SYMBOLS & ABBREVIATIONS
3	EXISTING CONTOURS & SITE PLAN
4	CELL 2 STAGE 2 EXCAVATION PLAN
5	CELL 2 STAGE 2 WASTE FILL CONTOURS
6	FINAL COVER PLAN
7	LINER DETAILS
8	LEACHATE COLLECTION PLAN AND PROFILE
9	LEACHATE COLLECTION SYSTEM DETAILS
10	LEACHATE COLLECTION SYSTEM DETAILS
11	TYPICAL CROSS SECTIONS
12	TYPICAL CROSS SECTIONS
13	TYPICAL CROSS SECTIONS
14	LEACHATE POND GRADING PLAN
15	LEACHATE POND DETAILS

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	T. WARNER
ARCHITECT	
CIVIL	S. WOMACK
MECHANICAL	
ELECTRICAL	
STRUCTURAL	
DESIGNED	C. MCCARTY
DRAWN BY	C. MCCARTY
PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

COVER SHEET

0 1" 2"

FILENAME	00C-01.DWG
SCALE	N/A

SHEET
C1 OF 15

GENERAL NOTES

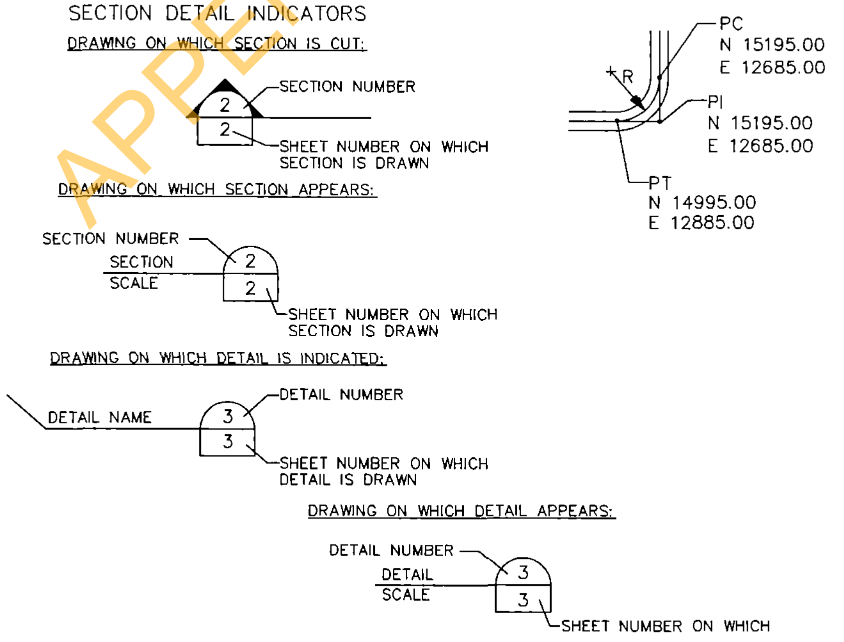
1. COORDINATE SYSTEM IS BASED ON LOCAL SURVEY. THE BENCHMARK TO BE USED FOR CONSTRUCTION IS LOCATED AS SHOWN ON DRAWING NO. C3. EXISTING CONTOURS ARE BASED ON AERIAL SURVEY FLOWN NOVEMBER 14, 2008, BY OLYMPUS AERIALS INC, SALT LAKE CITY, UTAH. CURRENT GROUND ELEVATIONS MAY VARY FROM THOSE SHOWN DUE TO SITE WORK THAT HAS BEEN PERFORMED SINCE THE AERIAL WAS FLOWN.
2. THE CONTRACTOR SHALL VERIFY EXISTING CONTOURS PRIOR TO THE START OF EARTHWORK.
3. GROUNDWATER AT THE SITE MAY VARY DEPENDING ON STREAM FLOW, RAINFALL, AND SUBSURFACE CONDITIONS. THERE SHALL NOT BE ANY ADDITIONAL PAYMENT OR EXTENSION OF CONTRACT TIME FOR WORKING WITH SATURATED SOILS OR HANDLING GROUNDWATER SEEPAGE.
4. THE CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO PROTECT THE EXISTING LANDFILL ROADS, GAS PROBES, AND GROUNDWATER MONITOR WELLS DURING THE CONSTRUCTION PERIOD. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE INCURRED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PROTECT EXISTING LANDFILL FEATURES.
5. THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES HAVE NOT BEEN ESTABLISHED BY THE OWNER OR HIS REPRESENTATIVES. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UTILITIES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING PROPER SAFE WORKING DISTANCE FROM ALL UTILITY EASEMENTS.
6. EXCAVATION BY "BLASTING" IS NOT PERMITTED ON THIS PROJECT.
7. FINISHED GROUND ELEVATIONS SHALL MATCH EXISTING GROUND ELEVATIONS EXCEPT AS SHOWN ON THE PLANS. EXCESS SOIL FROM EXCAVATION AND GRADING SHALL BE PLACED IN DESIGNATED STOCKPILE LOCATIONS AS APPROVED BY THE OWNER. TRANSPORT OF SOIL TO FILL AREAS SHALL BE CONDUCTED BY THE CONTRACTOR AT NO ADDITIONAL EXPENSE TO THE OWNER.
8. GEOTECHNICAL INVESTIGATION REPORTS FOR THE SITE ARE AVAILABLE FOR REVIEW AT THE DISTRICTS TRANSFER STATION OFFICE OR HDR ENGINEERING. THE CONTRACTOR MAY PERFORM ADDITIONAL GEOTECHNICAL INVESTIGATIONS AS HE DEEMS NECESSARY FOR CONSTRUCTION ACTIVITIES. HOWEVER, THERE SHALL BE NO ADDITIONAL PAYMENT TO THE CONTRACTOR FOR ADDITIONAL GEOTECHNICAL INVESTIGATIONS.
9. THE CONTRACTOR SHALL CONSTRUCT, AND UPON COMPLETION OF THE PROJECT, REMOVE TEMPORARY CONSTRUCTION ACCESS ROADS. SUCH ROADS SHALL BE LOCATED AS APPROVED BY THE OWNER. DRAINAGE PATTERNS AT THE SITE SHALL NOT BE ALTERED BY ROAD CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONSTRUCTION AND MAINTENANCE OF TEMPORARY DRAINAGE STRUCTURES, INCLUDING CULVERTS, AT NO ADDITIONAL COST TO THE OWNER.
10. THE CONTRACTOR SHALL CREATE SWPPP AND SUBMIT TO ENGINEER AND OWNER FOR APPROVAL. THE CONTRACTOR SHALL OBTAIN AND CONDUCT WORK CONSISTENT WITH A UPDES PERMIT FOR LANDFILL CONSTRUCTION. REFER TO TECHNICAL SPECIFICATIONS.
11. THE CONTRACTOR SHALL INSTALL, MAINTAIN, AND UPON COMPLETION OF THE PROJECT, REMOVE TEMPORARY EROSION AND SEDIMENT CONTROLS IN ACCORDANCE WITH THE SITE SWPPP AND PURSUANT TO REQUIREMENTS. SUCH CONTROLS SHALL BE PLACED AT THE LIMITS OF DISTURBED AREAS AND AT INTERMEDIATE LOCATIONS WHERE CONCENTRATED FLOW IS LIKELY.
12. THE CONTRACTOR SHALL KEEP THE LANDFILL HAUL ROAD OPERATIONAL AT ALL TIMES. THE CONTRACTOR SHALL SUBMIT A SCHEDULE TO THE OWNER FOR REVIEW AND APPROVAL 72 HOURS PRIOR TO CONDUCTING OPERATIONS THAT MAY AFFECT OPERATION OF THE LANDFILL ACCESS ROADS. DURING LANDFILL OPERATION, THE CONTRACTOR SHALL PROVIDE FLAGMEN AND FLASHING WARNING DEVICES AT ALL LOCATIONS WHERE EQUIPMENT WILL BE CROSSING THE LANDFILL ACCESS ROAD.
13. TEMPORARY CONSTRUCTION SLOPES SHALL NOT BE GREATER THAN 2H:1V. STEEPER SLOPES WILL ONLY BE ALLOWED IF THE CONTRACTOR PROVIDES A GEOTECHNICAL ENGINEERING REPORT SPECIFYING MAXIMUM SLOPES AND THE DURATION FOR WHICH SUCH SLOPES SHALL REMAIN IN PLACE.
14. THE CONTRACTOR SHALL REMOVE ALL VEGETATION WITHIN THE CONSTRUCTION LIMITS AS REQUIRED TO CONSTRUCT THE PROJECT. ALL VEGETATION MAY BE DISPOSED OF ON-SITE AS DIRECTED BY THE OWNER.
15. THE CONTRACTOR SHALL IMMEDIATELY REPORT TO THE ENGINEER ANY ERROR OR DISCREPANCY FOUND ONCE THE CONTRACT DOCUMENT IS CAREFULLY REVIEWED AND ALL ASPECTS OF FIELD WORK HAVE BEEN VERIFIED. IN THE EVENT THE CONTRACTOR CONTINUES TO WORK ON AN ITEM WHERE AN ERROR EXISTS, IT SHALL BE DEEMED THAT THE CONTRACTOR BID AND INTENDED TO EXECUTE THE MORE STRINGENT OR HIGHER QUALITY REQUIREMENT WITHOUT AN INCREASE IN CONTRACT SUM OR TIME. THE CONTRACTOR SHALL ALSO BE RESPONSIBLE TO CORRECT ANY FAILURE OF COMPANY PARTS TO COORDINATE OR FIT PROPERLY INTO FINAL POSITION, AS A RESULT OF CONTRACTOR FAILURE TO RAISE OR RESOLVE A DISCREPANCY.
16. THE DRAWINGS AND SPECIFICATIONS SHOULD AGREE WITH EACH OTHER, AND WORK CALLED FOR BY DRAWINGS AND NOT MENTIONED IN SPECIFICATIONS, OR VICE VERSA, SHALL BE FURNISHED BY BOTH. WHEN DISCREPANCIES EXIST BETWEEN SCALE AND DIMENSIONS, THE DIMENSIONED FIGURE SHALL BE USED. IF DISCREPANCIES EXIST BETWEEN THE DRAWINGS AND SPECIFICATIONS, THE CONTRACTOR SHALL NOT WORK WITHOUT CLARIFICATION FROM ENGINEER AND RESOLUTION BY OWNER. THE OWNER'S DECISION ON THE RESOLUTION IS FINAL.
17. CONTRACTORS AND EACH SUB CONTRACTOR SHALL VERIFY ALL GRADES, LINES, LEVELS, AND DIMENSIONS AS INDICATED ON DRAWINGS, AND HE SHALL REPORT ERRORS TO THE ENGINEER. THE CONTRACTOR SHALL ESTABLISH BENCHMARKS IN AT LEAST TWO WIDELY SEPARATED PLACES, AND AS WORK PROGRESSES THE CONTRACTOR WILL MAINTAIN ADEQUATE HORIZONTAL AND VERTICAL CONTROL.
18. REFER TO CQA DOCUMENT FOR MATERIAL SPECIFICATIONS.

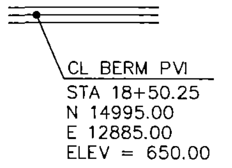
STANDARD ABBREVIATIONS

&	AND
APPROX	APPROXIMATELY
ASPH	ASPHALT
@	AT
AVG	AVERAGE
BOE	BOTTOM OF EXCAVATION
BM	BENCHMARK
BOL	BOTTOM OF LINER
X	BY
BLDG	BUILDING
CL	CENTERLINE
CMP	CORRUGATED METAL PIPE
CO	CLEAN OUT
CFS	CUBIC FEET PER SECOND
CY	CUBIC YARD
DIA	DIAMETER
DET	DETAIL
DWG	DRAWING
ELEV	ELEVATION
EXIST	EXISTING
EXC	EXCAVATION
FL	FLOW LINE
FML	FLEXIBLE MEMBRANE LINER
FT	FEET
G	GAS PROBE
GAL	GALLON
GND	GROUND
GCL	GEOCOMPOSITE LINER
GCDL	GEOCOMPOSITE DRAINAGE LAYER
GDL	GRAVEL DRAINAGE LAYER
GLER	GEOMEMBRANE LINER EVALUATION REPORT
GNDL	GEONET DRAINAGE LAYER
GP	GAS PROBE
HDPE	HIGH DENSITY POLYETHYLENE
HORIZ	HORIZONTAL
ID	INSIDE DIAMETER
IN	INCHES
IE	INVERT ELEVATION
LCRS	LEACHATE COLLECTION AND REMOVAL SYSTEM
LCS	LEACHATE COLLECTION SYSTEM
LCP	LEACHATE COLLECTION PIPE
LCPR	LEACHATE COLLECTION PIPE RISER
LF	LINEAR FEET
LFG	LANDFILL GAS
LB	POUND
LG	LONG
MH	MANHOLE
MAX	MAXIMUM
MIL	.001 INCHES
MIN	MINIMUM
MW	MONITOR WELL
MSL	MEAN SEA LEVEL
N	NORTH
NIC	NOT IN CONTRACT
NO	NUMBER
NTS	NOT TO SCALE
OC	ON CENTER
OZ	OUNCE
%	PERCENT
PLCP	PERFORATED LEACHATE COLLECTION PIPE
PERF	PERFORATED
PGV	PASSIVE GAS VENT
PC	POINT OF CURVATURE
PVI	POINT OF VERTICAL INTERSECTION
PT	POINT OF TANGENCY
PZ	PIEZOMETER
Q	FLOW
QTY	QUANTITY
R	RADIUS
RCP	REINFORCED CONCRETE PIPE
REF	REFERENCE
REQ	REQUIRED
RD	ROAD
SCH	SCHEDULE
SDL	SAND DRAINAGE LAYER
SEC	SECTION
SHT	SHEET
S	SOUTH
SDR	STANDARD DIMENSION RATIO
SP	STEEL PIPE
SQ	SQUARE
STA	STATION
SLER	SOIL LINER EVALUATION REPORT
SLQCP	SOIL LINER QUALITY CONTROL PLAN
SS	SIDE SLOPE
SWPPP	STORMWATER POLLUTION PREVENTION PLAN
TL	TANGENT LENGTH
TOC	TOP OF COVER
TOFC	TOP OF FINAL COVER
TOL	TOP OF LINER
TOS	TOE OF SLOPE
TS	TOP SLOPE
TEMP	TEMPORARY
TYP	TYPICAL
VCP	VITRIFIED CLAY PIPE
VERT	VERTICAL
VLDPE	VERY LOW DENSITY POLYETHYLENE
W	WEST
W/	WITH
YD	YARD

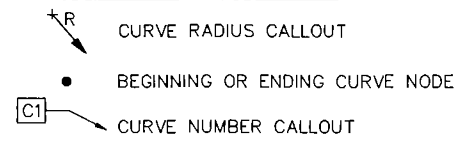
SYMBOLS

SECTION DETAIL INDICATORS

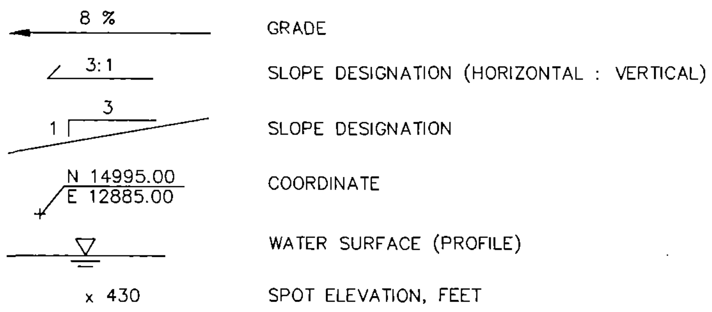




CURVE WITH HORIZONTAL CONTROL:



VERTICAL CONTROL DESIGNATION



HDR
HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION		
			PROJECT MANAGER	T. WARNER
			ARCHITECT	
			CIVIL	S. WOMACK
			MECHANICAL	
			ELECTRICAL	
			STRUCTURAL	
			DESIGNED	C. MCCARTY
			DRAWN BY	C. MCCARTY
			PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

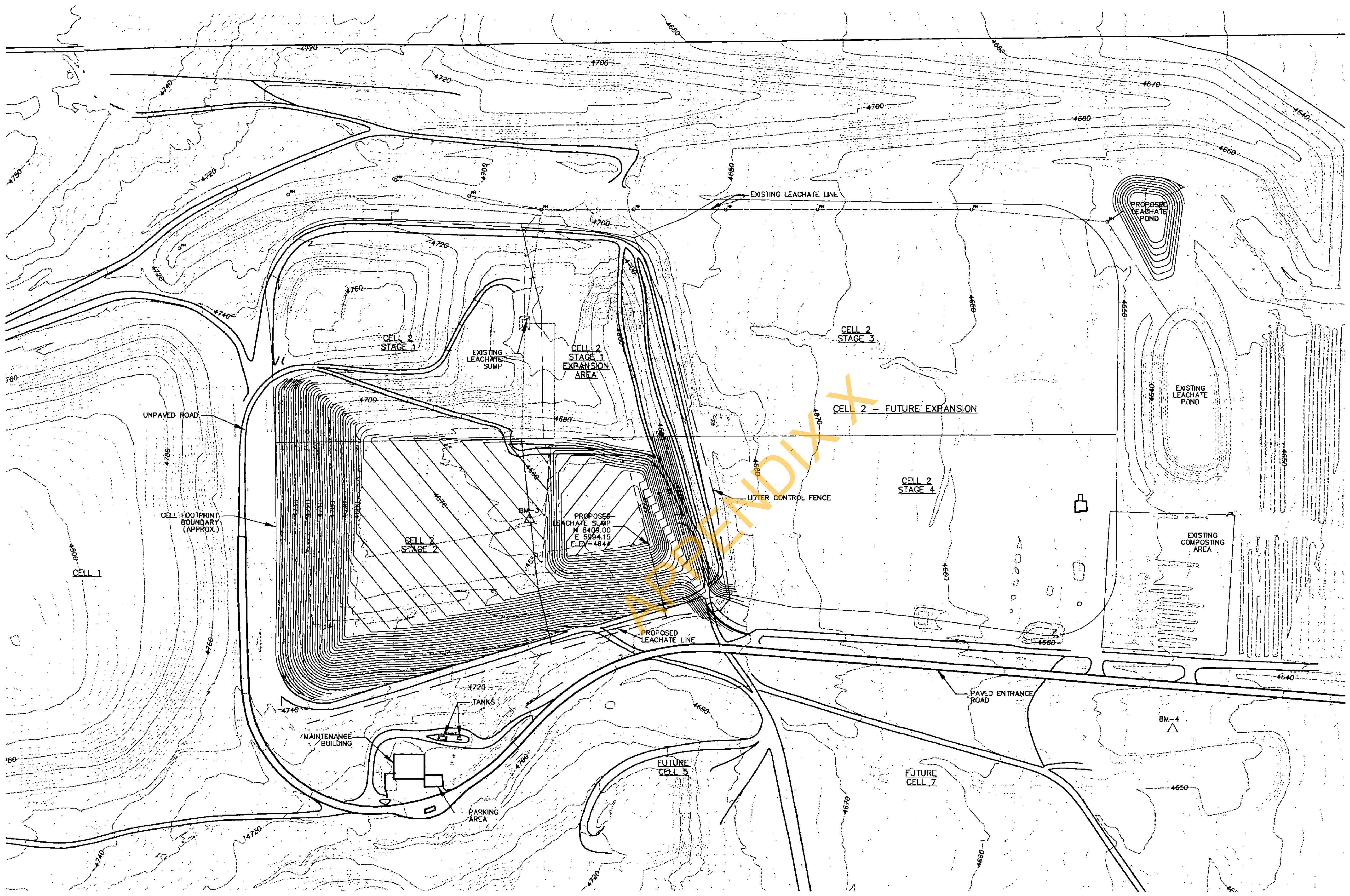
SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

GENERAL NOTES, ABBREVIATIONS & SYMBOLS

0 1" 2"

FILENAME 00C-02.DWG
SCALE N/A
SHEET C2 OF 15



LEGEND

——4640——	EXISTING CONTOURS
————	CELL FOOTPRINT BOUNDARY (APPROX.)
————	PROPOSED LEACHATE DRAIN LINE
—— ——	LITTER CONTROL FENCE LOCATION

NOTES:

TOPOGRAPHIC DATA IS PROVIDED FROM OLYMPUS AERIALS, INC., NOVEMBER 14, 2008. EXISTING CONTOURS IN CELL 2, STAGE 1 AREA WILL VARY FROM THOSE SHOWN DUE TO ONGOING EXCAVATION SINCE THE AERIAL MAPPING WAS COMPLETED.

BENCHMARKS

BM	N	E	ELEVATION
3	8492.798	5605.987	4711.11
4	7813.839	7697.793	4645.33
572	9992.856	3357.395	4757.29
573	10095.881	8608.668	4623.28
574	4670.902	8792.512	4610.47
575	4756.794	3567.638	4737.42
576	8118.956	1185.133	4806.22
577	7321.380	1456.147	4786.62
578	7334.971	3456.716	4763.08

N

0 150 300
SCALE IN FEET

HDR
HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	T. WARNER
ARCHITECT	
CIVIL	S. WOMACK
MECHANICAL	
ELECTRICAL	
STRUCTURAL	
DESIGNED	C. MCCARTY
DRAWN BY	C. MCCARTY
PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

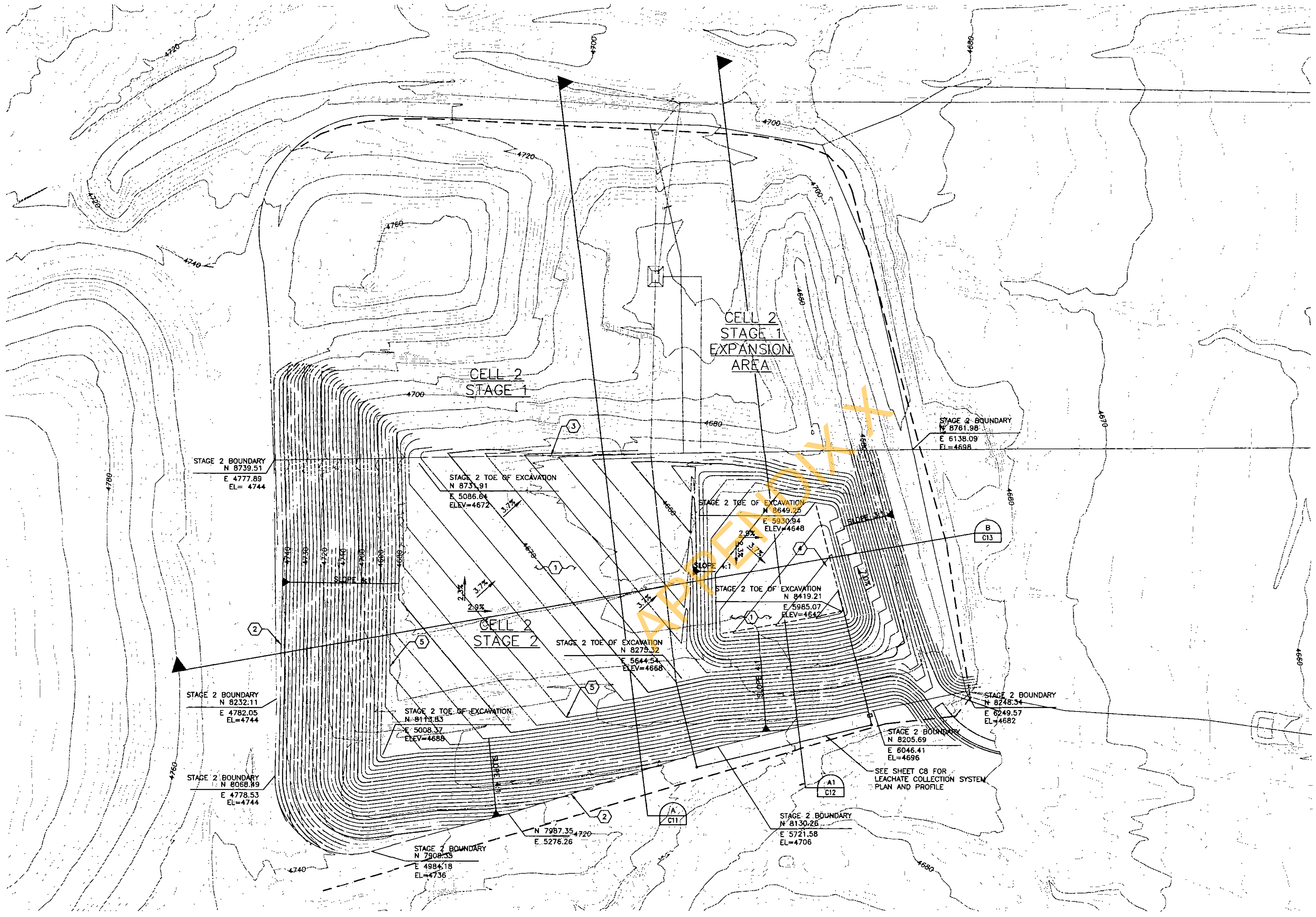
SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

EXISTING CONTOURS & SITE PLAN

0 1" 2"

FILENAME	00C-03.DWG	SHEET	C3 OF 15
SCALE	1"=150'		



LEGEND

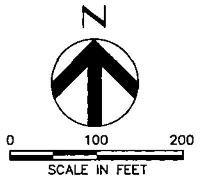
—— 4640 ——	EXISTING CONTOURS
—— 4640 ——	PROPOSED CONTOURS
————	CELL FOOTPRINT BOUNDARY (APPROX.)
————	LEACHATE DRAIN LINE
— — — —	LITTER CONTROL FENCE LOCATION

NOTES:

1. STORMWATER INTERCEPTOR BERMS WILL BE BUILT BY OWNER AS NEEDED TO CONTROL RUNOFF.
2. TOPOGRAPHIC DATA IS PROVIDED FROM OLYMPUS AERIALS, INC., NOVEMBER 14, 2008. OWNER WILL PREPARE SUBGRADE FOR EXPANSION LINER. CONTRACTOR WILL BE RESPONSIBLE TO REMOVE ALL ANGULAR AND ROUNDED STONES TO MEET GEOTECHNICAL SPECIFICATIONS.
3. STAGE 2 BOUNDARY POINTS ARE APPROXIMATE.

CONSTRUCTION NOTES

- ⟨1⟩ INSTALL LANDFILL LINER SYSTEM IN CELL 2, STAGE 2 PER DETAIL 1/C7
- ⟨2⟩ INSTALL LINER SYSTEM ANCHOR TRENCH PER DETAIL 2/C7
- ⟨3⟩ TIE STAGE 2 LINER INTO EXISTING LINER ALONG STAGE 1 LINER TERMINATION BERM. 4' X 8' SHEETS OF PLYWOOD OVERLAY EDGE OF EXISTING LINER. SEE DETAIL 3/C7
- ⟨4⟩ INSTALL LINER TERMINATION ALONG EASTERN EDGE OF STAGE 2 PER DETAIL 4/C7
- ⟨5⟩ INSTALL LINER AT SLOPE TRANSITION PER DETAIL 5/C7



HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION		
			PROJECT MANAGER	T. WARNER
			ARCHITECT	
			CIVIL	S. WOMACK
			MECHANICAL	
			ELECTRICAL	
			STRUCTURAL	
			DESIGNED	C. MCCARTY
			DRAWN BY	C. MCCARTY
			PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

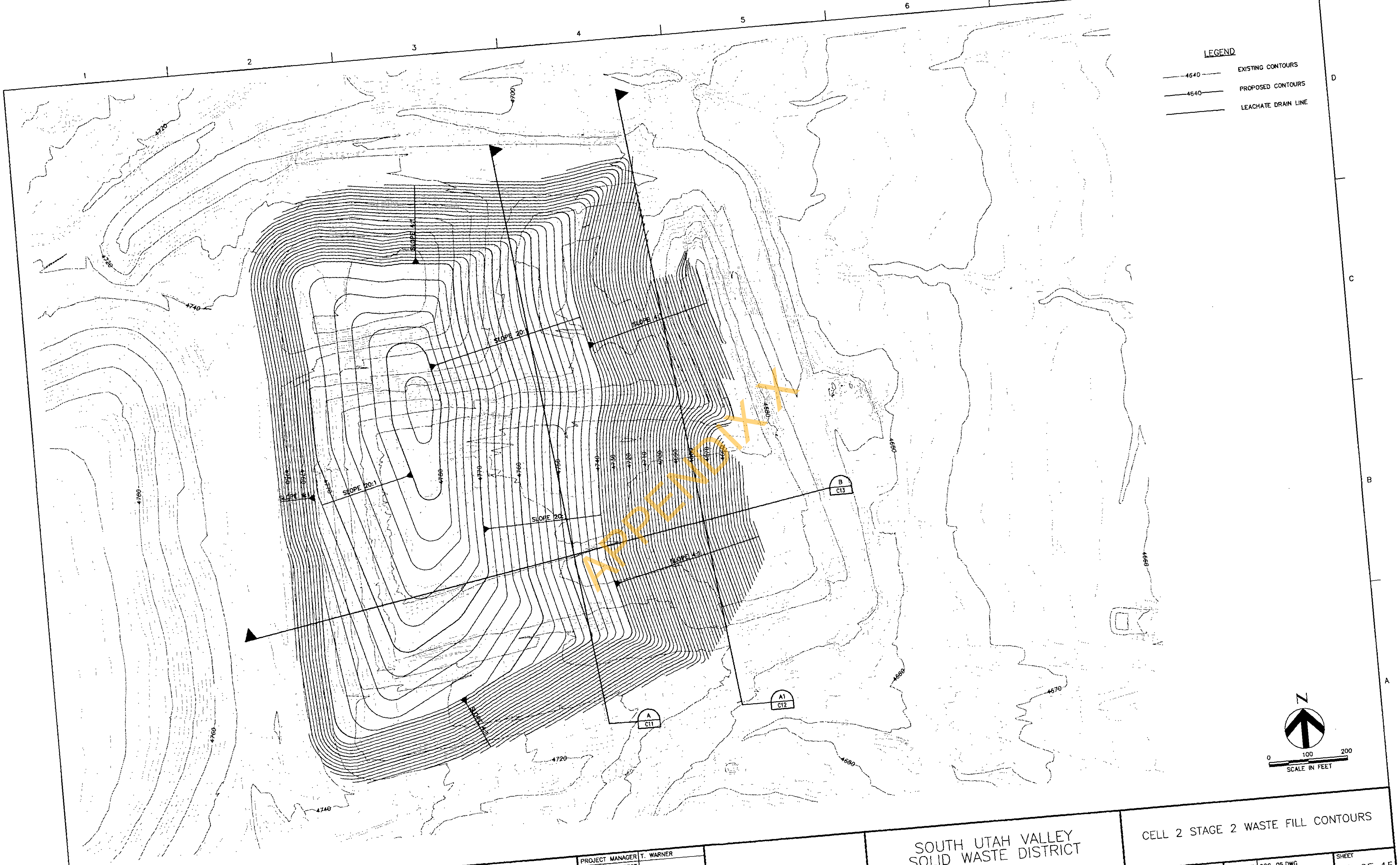
SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

CELL 2 STAGE 2 EXCAVATION PLAN

0 1" 2"

FILENAME 00C-04.DWG
SCALE 1"=100'
SHEET C4 OF 15



HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	T. WARNER
ARCHITECT	
CIVIL	S. WOMACK
MECHANICAL	
ELECTRICAL	
STRUCTURAL	
DESIGNED	C. MCCARTY
DRAWN BY	C. MCCARTY
PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

CELL 2 STAGE 2 WASTE FILL CONTOURS

0 1" 2"

FILENAME	00C-05.DWG
SCALE	1"=100'

SHEET
C5 OF 15

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	T. WARNER
ARCHITECT	
CIVIL	S. WOMACK
MECHANICAL	
ELECTRICAL	
STRUCTURAL	
DESIGNED	C. MCCARTY
DRAWN BY	C. MCCARTY
PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

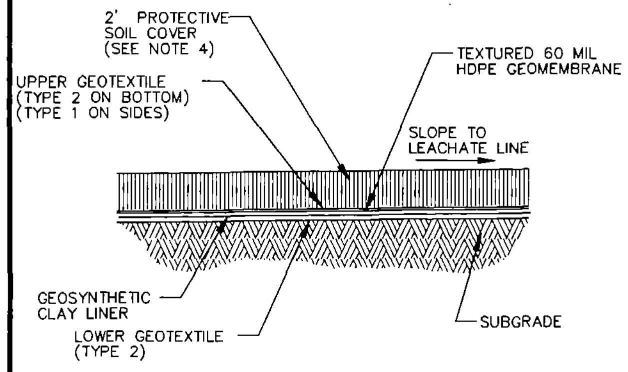
FINAL COVER PLAN

0 1" 2"

FILENAME	00C-06.DWG
SCALE	1"=100'

SHEET
C6 OF 15

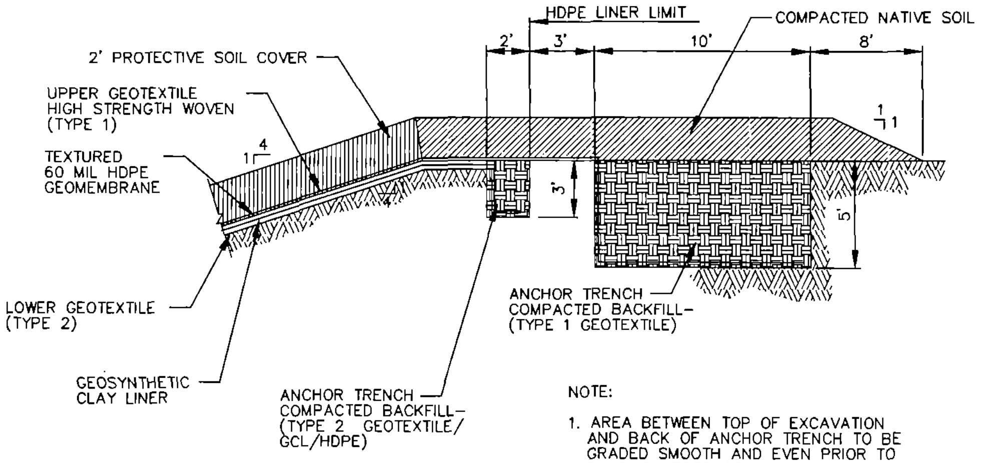
1 2 3 4 5 6 7 8



TYPICAL LANDFILL LINER DETAIL

NOT TO SCALE

1
C7



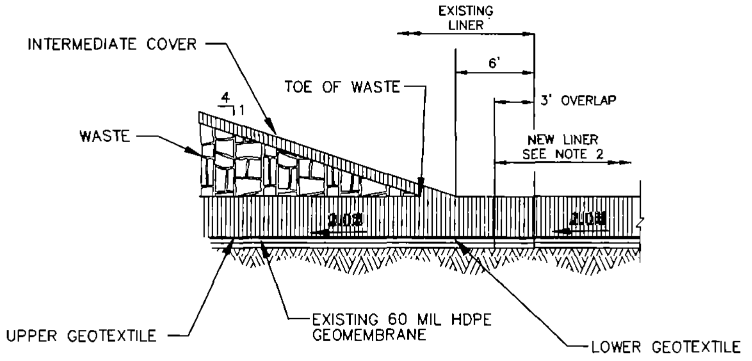
NOTE:

1. AREA BETWEEN TOP OF EXCAVATION AND BACK OF ANCHOR TRENCH TO BE GRADED SMOOTH AND EVEN PRIOR TO PLACING UPPER GEOTEXTILE. REMOVE ANGULAR STONES.

LINER SYSTEM ANCHOR TRENCH

NOT TO SCALE

2
C7



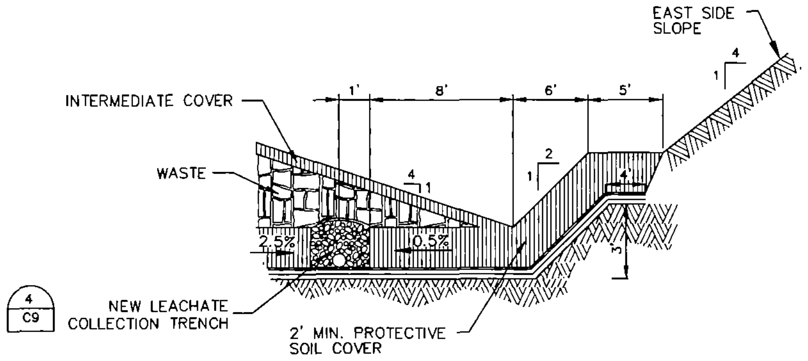
STAGE 1/STAGE 2 LINER CONNECTION

NOT TO SCALE

3
C7

NOTES:

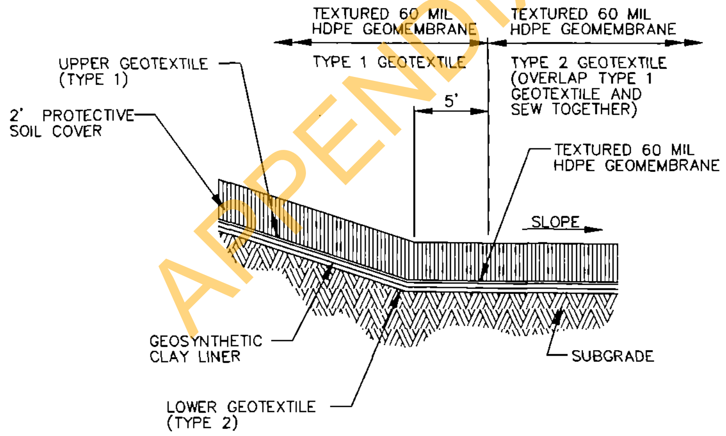
1. TEMPORARY STORMWATER INTERCEPTOR BERM TO BE PLACED IN FRONT OF WORKING AREA TO DIVERT STORMWATER AWAY FROM ACTIVE FACE. OWNER WILL RELOCATE AS NEEDED.
2. STAGE 2 GEOMEMBRANE TO BE WELDED TO STAGE 1. FUTURE GEOSYNTHETIC COMPONENTS TO BE OVERLAPPED AND SECURED.
3. TYPE I GEOTEXTILE IS REINFORCED AND REQUIRED ON SIDE SLOPES ONLY, ABOVE HDPE LINER. TYPE 2 GEOTEXTILE IS NON-REINFORCED (NON-WOVEN) AND IS TO BE USED ABOVE HDPE LINER ON BOTTOM AND BETWEEN SUBGRADE AND GCL. A SAND CUSHION MAY BE USED IN LIEU OF THE LOWER TYPE 2 GEOTEXTILE WITH PRIOR APPROVAL OF ENGINEER AND OWNER.
4. SEE SPECIFICATION 02240 FOR PROTECTIVE COVER MATERIAL REQUIREMENTS.



STAGE 2 EASTERN LINER TERMINATION

NOT TO SCALE

4
C7



LINER AT SLOPE TRANSITION

NOT TO SCALE

5
C7

NOTE: THICKNESS MEASURED PERPENDICULAR TO EXCAVATION SURFACE.

GEOTEXTILE SCHEDULE

LOCATION	TYPE	COMMENTS
ALL	ALL	REMOVE ALL ANGULAR STONES GREATER THAN 0.5 INCHES
LOWER GEOTEXTILE	2	USE 16 OZ/SY NON–WOVEN IF ROUNDED STONES GREATER THAN 2.5 INCHES ARE REMOVED. USE 20 OZ/SY NON–WOVEN IF ONLY ROUNDED STONES GREATER THAN 4 INCHES ARE REMOVED. NO HORIZONTAL SEAMS ON SIDESLOPES.
UPPER GEOTEXTILE ON SIDESLOPES	1	REINFORCED GEOTEXTILE. NO HORIZONTAL SEAMS ON SIDESLOPES.
UPPER GEOTEXTILE ON BOTTOM (FLOOR)	2	USE 12 OZ/SY NON–WOVEN BENEATH DUNE SAND (PROTECTIVE SOIL COVER)

D C B A

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107–2594

ISSUE	DATE	DESCRIPTION		
			PROJECT MANAGER	T. WARNER
			ARCHITECT	
			CIVIL	S. WOMACK
			MECHANICAL	
			ELECTRICAL	
			STRUCTURAL	
			DESIGNED	C. MCCARTY
			DRAWN BY	C. MCCARTY
			PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

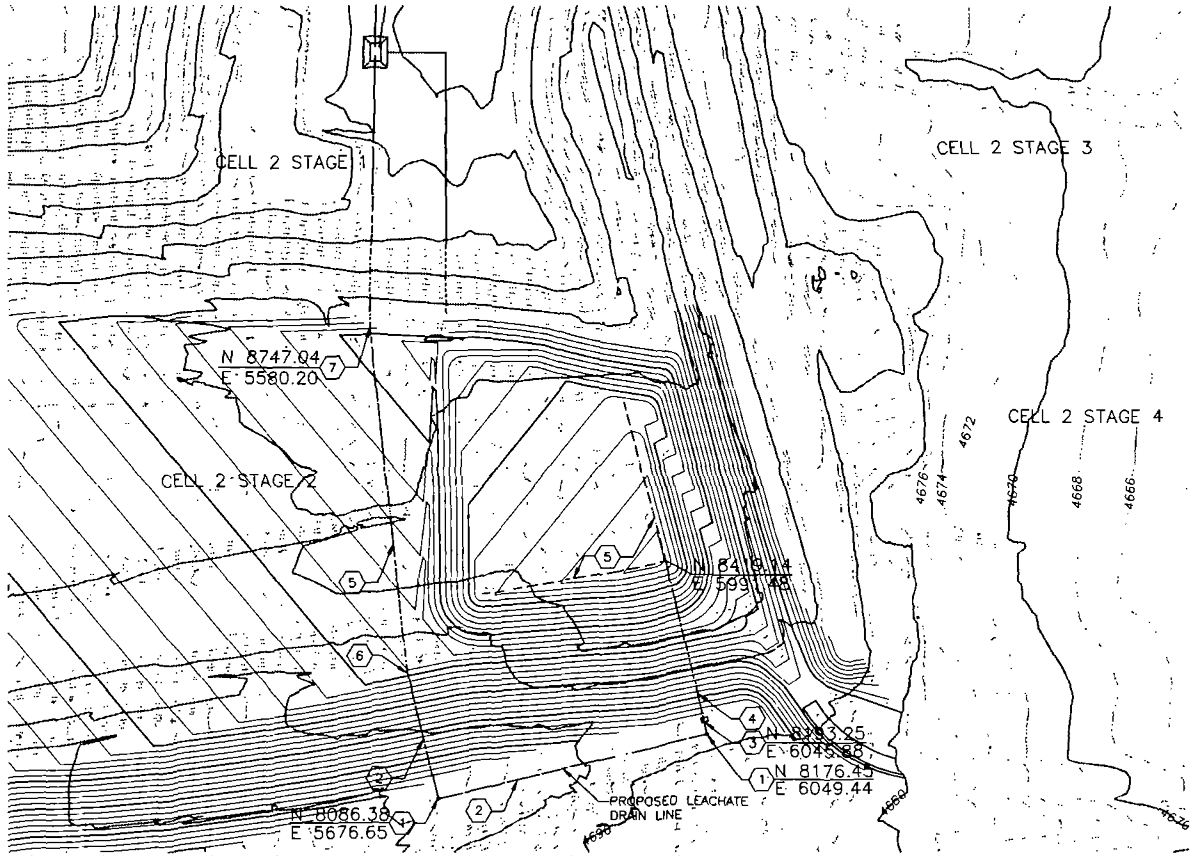
BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

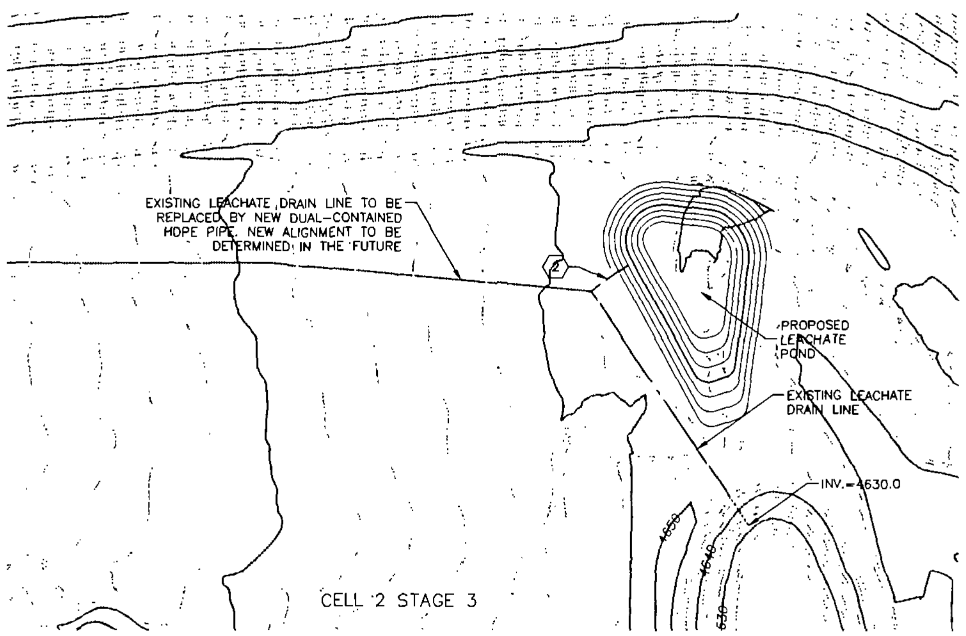
LINER DETAILS

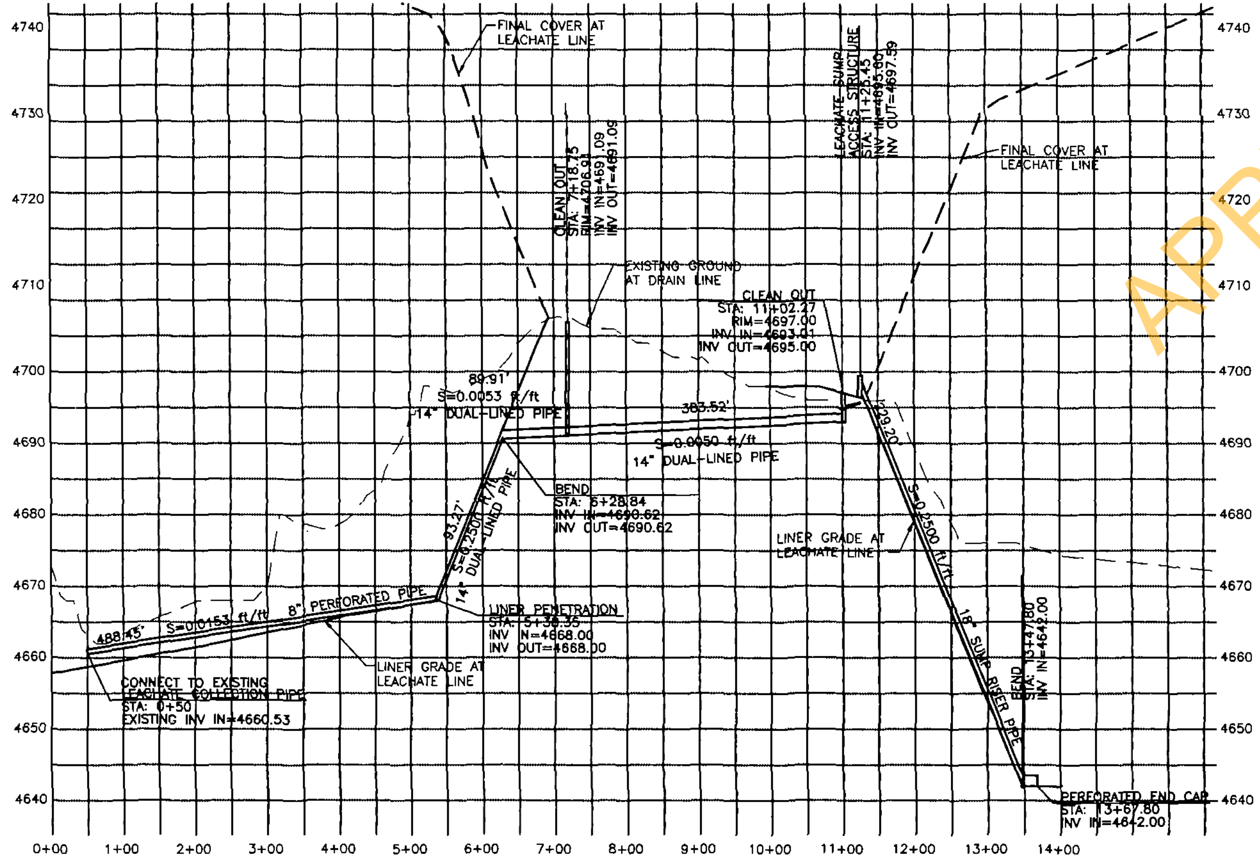
0 1" 2"

FILENAME 00C–07.DWG
SCALE N/A

SHEET
C7 OF 15





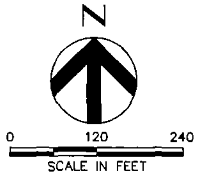


CONSTRUCTION NOTES

1. INSTALL CLEANOUT PER DETAIL X/X
2. INSTALL 14" SDR-17 X 10" SDR-17 DUAL CONTAINED PIPE PER DETAIL X/X
3. CONNECT 2" RETURN LINE TO 14" SDR-17 X 10" SDR-17 DUAL-CONTAINED PIPE IN LEACHATE SUMP ACCESS STRUCTURE PER DETAILS 8/C9 9/C9
4. INSTALL PARALLEL 18" DIA SOLID WALL LEACHATE SUMP COLLECTION RISER PIPE AND 8" DIA. SOLID CLEANOUT RISER PIPE PER DETAIL 1/C10
5. INSTALL 8" DIA. PERFORATED LEACHATE COLLECTION PIPE PER DETAILS 1/C10 3/C9 4/C9
6. INSTALL CONNECTION FOR DUAL-CONTAINED PIPE AND PERFORATED PIPE WITH PERFORATED END CAP PER DETAIL X/X
7. CONNECT PROPOSED PERFORATED LEACHATE COLLECTION PIPE TO EXISTING STAGE 1 LEACHATE COLLECTION PIPE.

NOTE:

DETAIL X/X NOT INCLUDED AS PART OF THIS SUBMITTAL



HDR
HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	T. WARNER
ARCHITECT	
CIVIL	S. WOMACK
MECHANICAL	
ELECTRICAL	
STRUCTURAL	
DESIGNED	C. MCCARTY
DRAWN BY	C. MCCARTY
PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

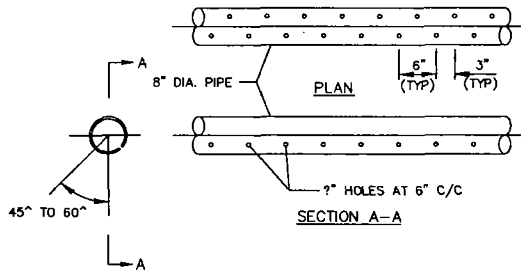
SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

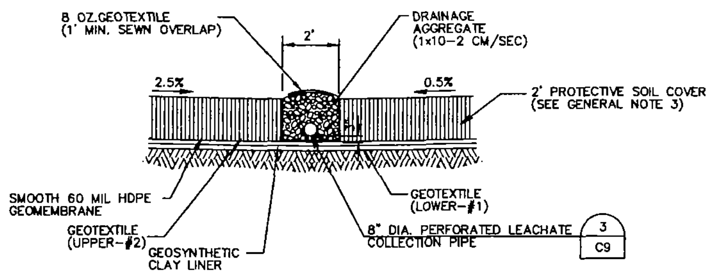
LEACHATE COLLECTION SYSTEM
PLAN AND PROFILE

0 1" 2"

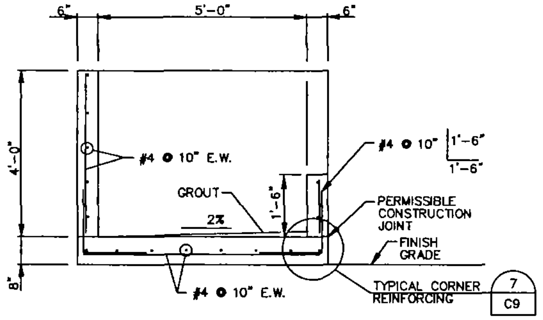
FILENAME	00C-08.DWG
SCALE	H: 1"=120' V: 1"=12'
SHEET	C8 OF 15



8" DIA. PERFORATED LEACHATE COLLECTION PIPE (3/C9)
NOT TO SCALE



LEACHATE COLLECTION TRENCH (4/C9)
NOT TO SCALE



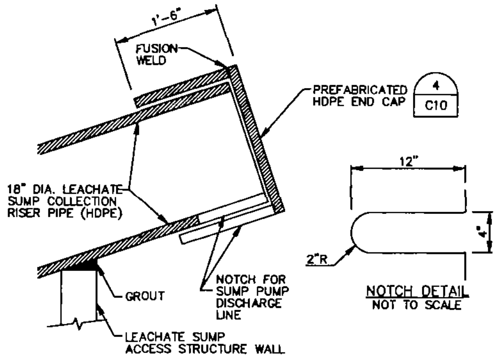
LEACHATE SUMP ACCESS STRUCTURE– SECTION (5/C9)
NOT TO SCALE

CONCRETE NOTES:

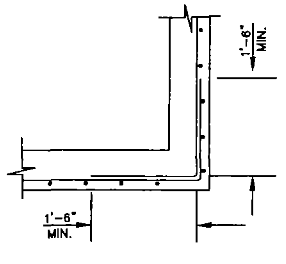
1. ALL CONCRETE SHALL HAVE 4000PSI COMPRESSIVE STRENGTH @ 28 DAYS, NORMAL WEIGHT.
2. ALL CONCRETE SHALL BE IN ACCORDANCE WITH THE "BUILDING CODE REQUIREMENT FOR REINFORCED CONCRETE" ACI–318 LATEST EDITION.
3. REINFORCING BARS SHALL CONFORM TO SPECIFICATIONS FOR "DEFORMED BILLET–STEEL FOR CONCRETE REINFORCEMENT" WITH 60KSI YIELD STRENGTH; ASTM A615 GRADE 60.
4. REINFORCING BARS TO BE WELDED SHALL COMPLY WITH THE REQUIREMENT OF ASTM A706 GRADE 60.
5. COVER ON ALL REINFORCEMENT SHALL BE AS FOLLOWS, UNLESS OTHERWISE NOTED:
   - i CONCRETE PLACED AGAINST GROUND 3 IN
   - ii EXPOSED FORMED SURFACES
     - A. #5 AND SMALLER 1.5 IN
     - B. #6 AND LARGER 2 IN
6. ALL EXPOSED CORNERS SHALL HAVE 1 IN CHAMFER, UNLESS OTHERWISE NOTED.
7. SAWED GROOVES SHOULD BE MADE WITHIN APPROXIMATELY 4 TO 12 HOURS OF SLAB OR PAVEMENT FINISHING. IF THIS IS NOT PRACTICABLE, USE PREMOLDED STRIPS.
8. AS AN ALTERNATIVE, A PRECAST CONCRETE BOX MAY BE USED. THE PRECAST BOX SHOULD HAVE A MINIMUM CONCRETE COMPRESSIVE STRENGTH OF 5000 PSI @ 28 DAYS.

GENERAL NOTES:

1. LEACHATE RETURN LINE IS TO ALLOW ANY SPILLAGE OR RAINWATER ACCUMULATION IN SUMP ACCESS STRUCTURE TO RETURN TO LANDFILL SUMP FOR REMOVAL. GROUT BOTTOM OF STRUCTURE TO VALVE AFTER INSTALLATION, IF NECESSARY.
2. GROUT BOTTOM TO DRAIN TO RETURN LINE.
3. SEE SPECIFICATION SECTION 02240 FOR PROTECTIVE SOIL COVER REQUIREMENTS.

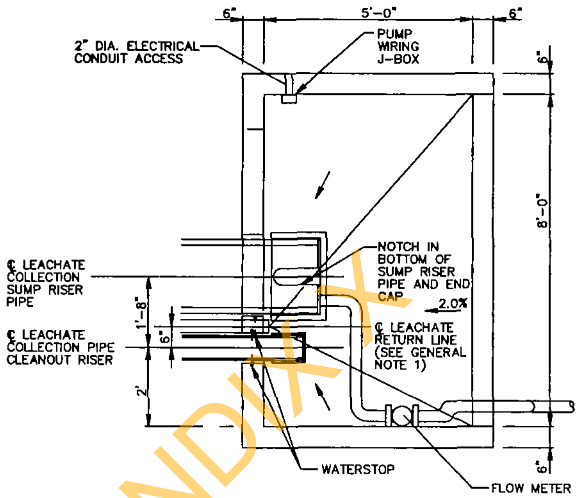


18" DIA. SUMP RISER PIPE (6/C9)
NOT TO SCALE

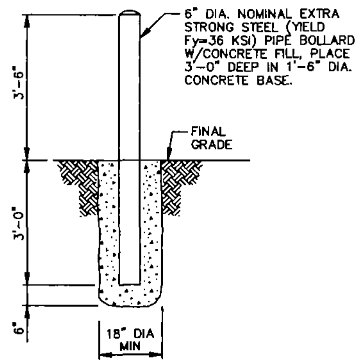


ALL LAP SPLICES FOR #4 BAR

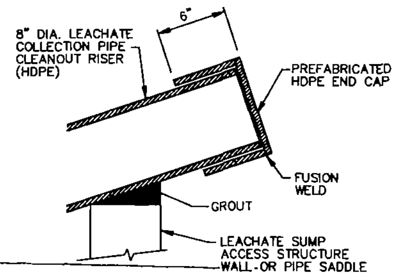
TYPICAL CORNER REINFORCING (7/C9)
NOT TO SCALE



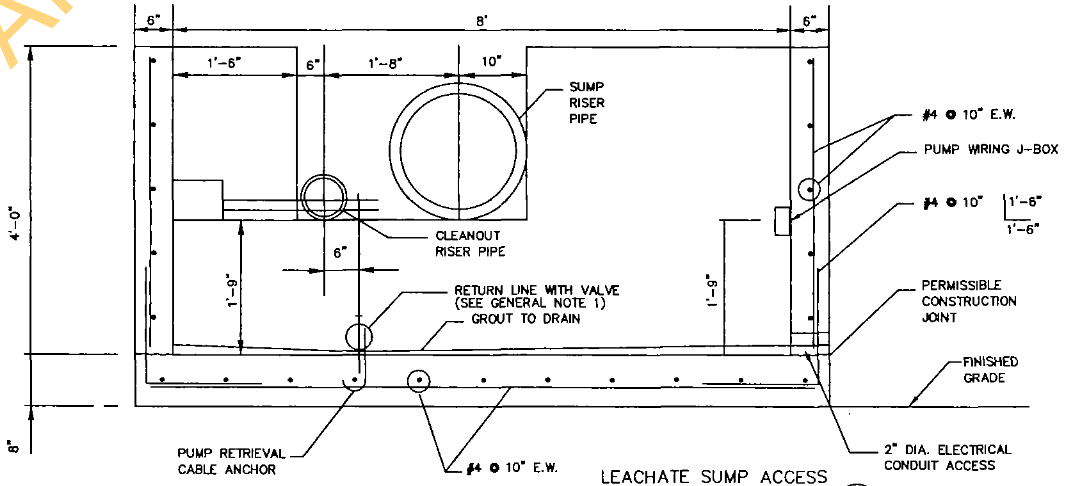
LEACHATE SUMP ACCESS STRUCTURE– PLAN (8/C9)
NOT TO SCALE



TYPICAL BOLLARD (10/C9)
NOT TO SCALE



8" DIAMETER CLEANOUT RISER PIPE END CAP (11/C9)
NOT TO SCALE



NOTE:
THIS AREA IS CORROSIVE.

LEACHATE SUMP ACCESS STRUCTURE– SECTION (9/C9)
NOT TO SCALE

HDR
HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107–2594

ISSUE	DATE	DESCRIPTION		
			PROJECT MANAGER	T. WARNER
			ARCHITECT	
			CIVIL	S. WOMACK
			MECHANICAL	
			ELECTRICAL	
			STRUCTURAL	
			DESIGNED	C. MCCARTY
			DRAWN BY	C. MCCARTY
			PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

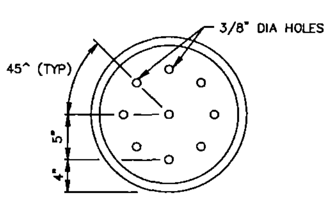
BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

LEACHATE COLLECTION SYSTEM DETAILS

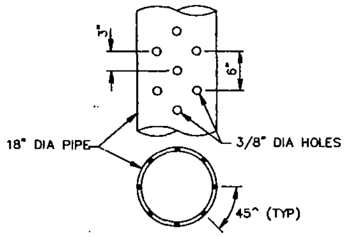
0 1" 2"

FILENAME 00C–09.DWG
SCALE N/A

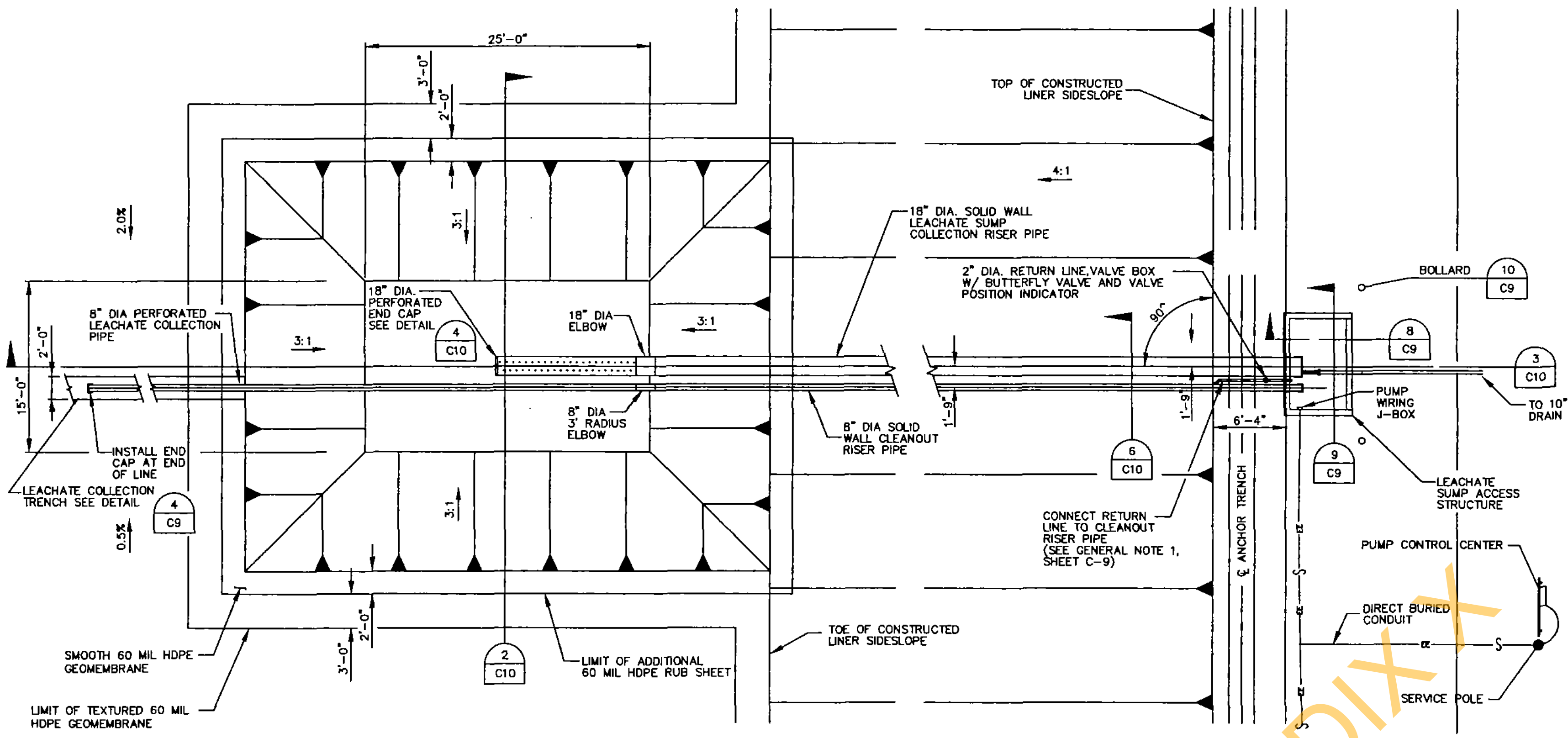
SHEET
C9 OF 15

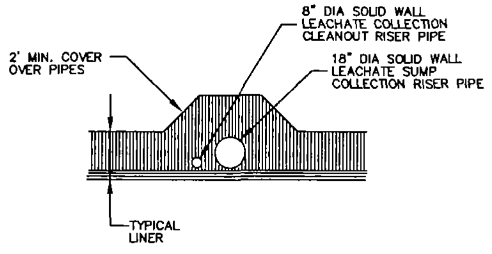


18" DIA. PERFORATED END CAP 4 C10
NOT TO SCALE



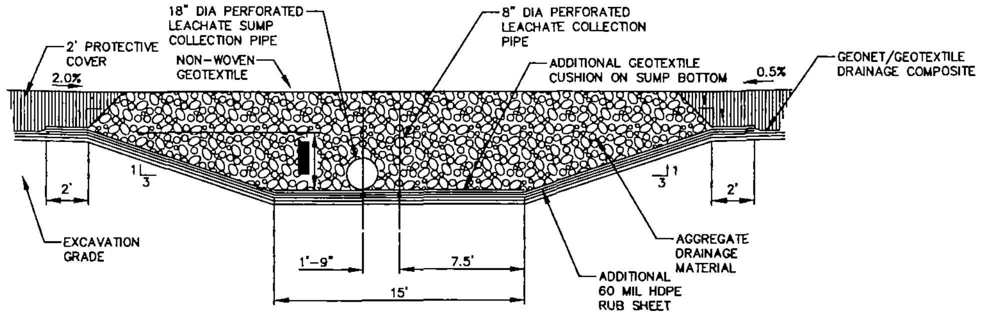
18" DIA. PERFORATED LEACHATE SUMP COLLECTION PIPE 5 C10
NOT TO SCALE



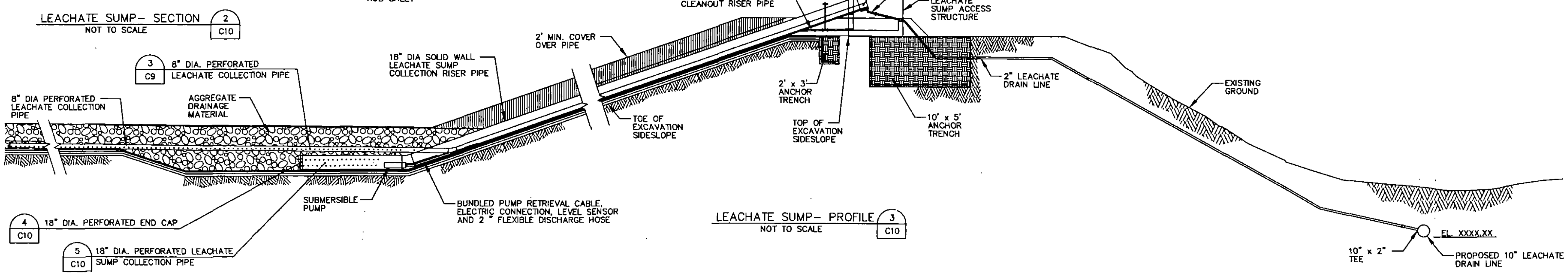


LEACHATE SUMP RISER– SECTION 6 C10
NOT TO SCALE

LEACHATE SUMP– PLAN 1 C10
NOT TO SCALE



LEACHATE SUMP– SECTION 2 C10
NOT TO SCALE



LEACHATE SUMP– PROFILE 3 C10
NOT TO SCALE

HDR
HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107–2594

			PROJECT MANAGER	T. WARNER
			ARCHITECT	
			CIVIL	S. WOMACK
			MECHANICAL	
			ELECTRICAL	
			STRUCTURAL	
			DESIGNED	C. MCCARTY
			DRAWN BY	C. MCCARTY
ISSUE	DATE	DESCRIPTION	PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

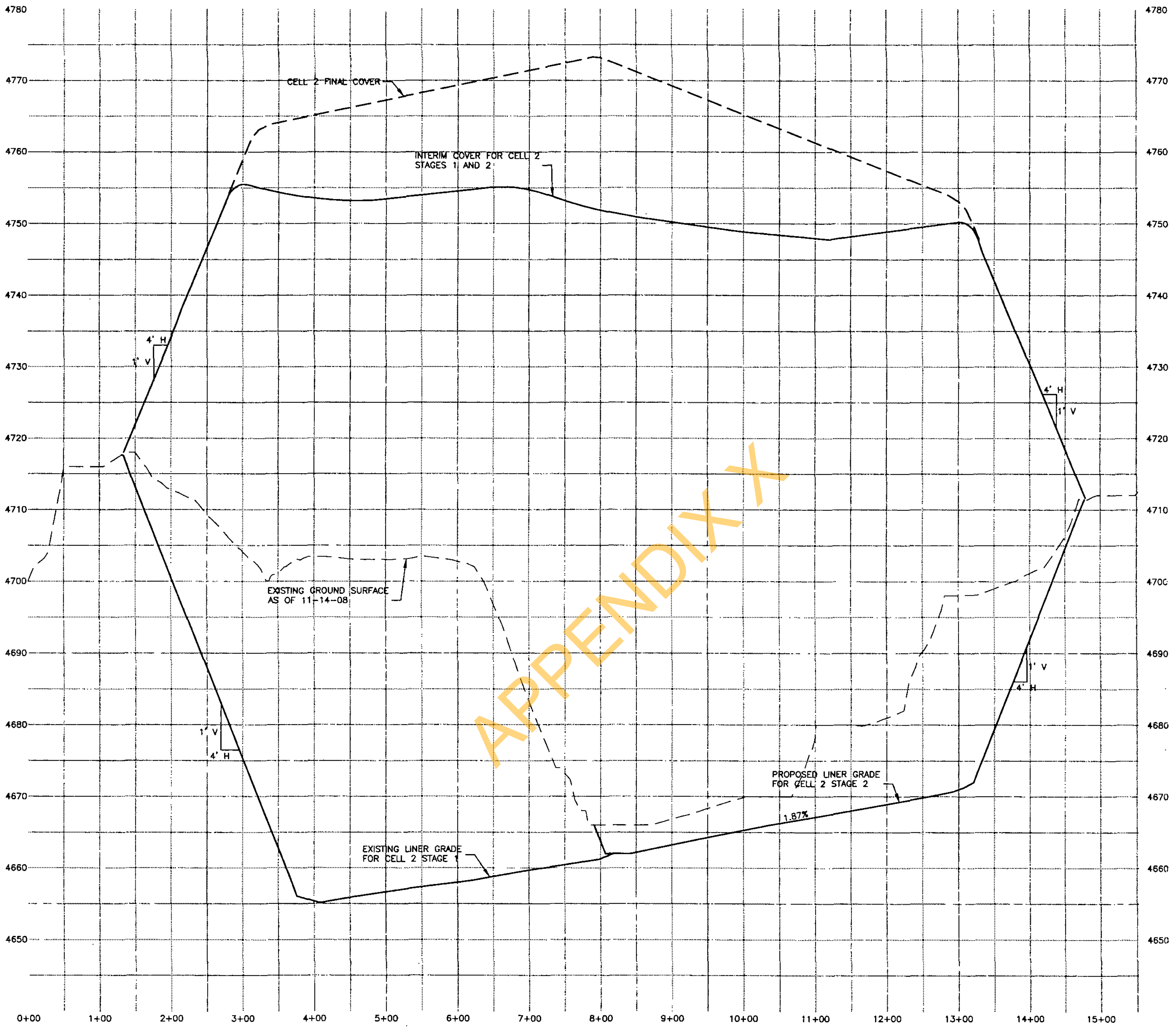
SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

LEACHATE COLLECTION SYSTEM DETAILS

0 1" 2"

FILENAME 00C–10.DWG
SCALE N/A
SHEET C10 OF 15



CROSS SECTION A

NOTES

1. REFER TO SHEET C4 FOR LINER GRADING PLAN.
2. REFER TO SHEET C5 FOR INTERIM FINAL COVER GRADING PLAN.
3. REFER TO SHEET C6 FOR FINAL COVER GRADING PLAN.
4. INTERIM COVER IS FOR STAGES 1 AND 2. ADDITIONAL COVER WILL BE PLACED DURING CELL 2 FUTURE EXPANSION, AFTER BERM IS REMOVED.

HDR
HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	T. WARNER
ARCHITECT	
CIVIL	S. WOMACK
MECHANICAL	
ELECTRICAL	
STRUCTURAL	
DESIGNED	C. MCCARTY
DRAWN BY	C. MCCARTY
PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

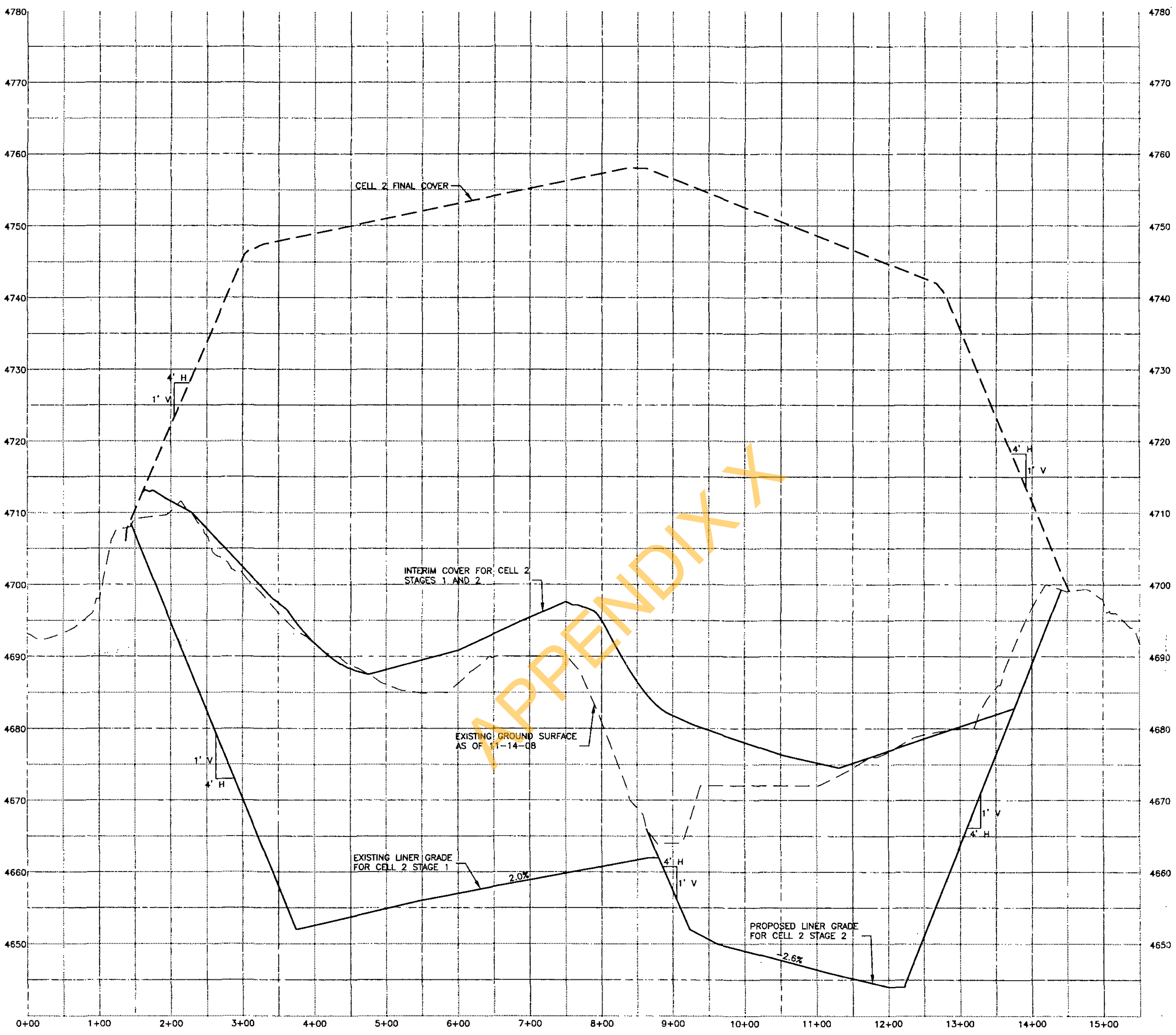
BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

CELL 2 STAGE 2
TYPICAL CROSS SECTIONS

0 1" 2"

FILENAME	00C-12.DWG
SCALE	H: 1"=80' V: 1"=8'

SHEET
C11 OF 15



CROSS SECTION A1

NOTES

1. REFER TO SHEET C4 FOR LINER GRADING PLAN.

2. REFER TO SHEET C5 FOR INTERIM FINAL COVER GRADING PLAN.

3. REFER TO SHEET C6 FOR FINAL COVER GRADING PLAN.

4. INTERIM COVER IS FOR STAGES 1 AND 2. ADDITIONAL COVER WILL BE PLACED DURING CELL 2 FUTURE EXPANSION, AFTER BERM IS REMOVED.

HDR
HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	T. WARNER
ARCHITECT	
CIVIL	S. WOMACK
MECHANICAL	
ELECTRICAL	
STRUCTURAL	
DESIGNED	C. MCCARTY
DRAWN BY	C. MCCARTY
PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

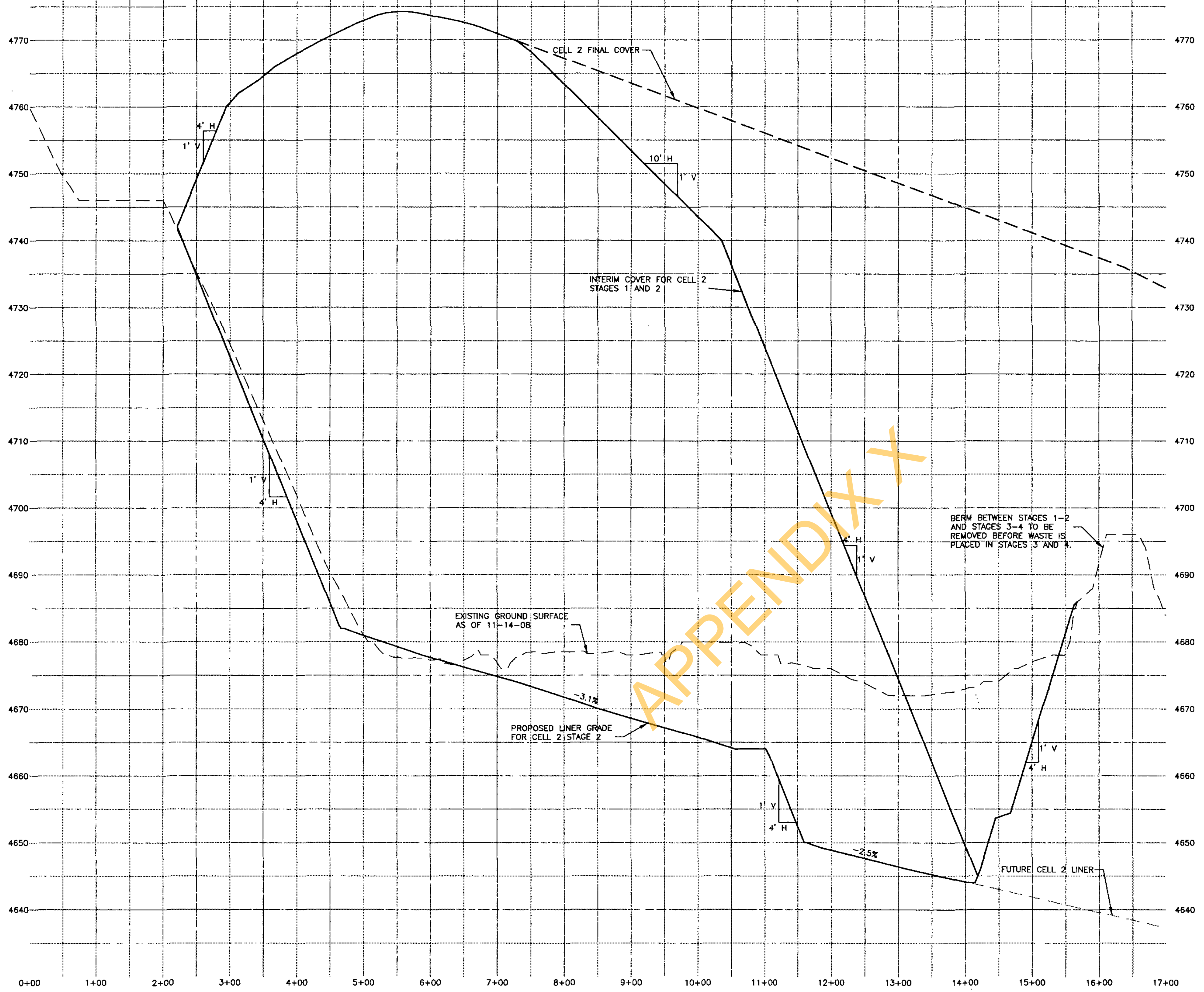
BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

CELL 2 STAGE 2
TYPICAL CROSS SECTIONS

0 1" 2"

FILENAME	00C-13.DWG
SCALE	H: 1"=80' V: 1"=8'

SHEET
C12 OF 15



CROSS SECTION B

NOTES

1. REFER TO SHEET C4 FOR LINER GRADING PLAN.
2. REFER TO SHEET C5 FOR INTERIM FINAL COVER GRADING PLAN.
3. REFER TO SHEET C6 FOR FINAL COVER GRADING PLAN.
4. INTERIM COVER IS FOR STAGES 1 AND 2. ADDITIONAL COVER WILL BE PLACED DURING CELL 2 FUTURE EXPANSION, AFTER BERM IS REMOVED.

HDR
HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER T. WARNER
ARCHITECT
CIVIL S. WOMACK
MECHANICAL
ELECTRICAL
STRUCTURAL
DESIGNED C. MCCARTY
DRAWN BY C. MCCARTY
PROJECT NUMBER 96439

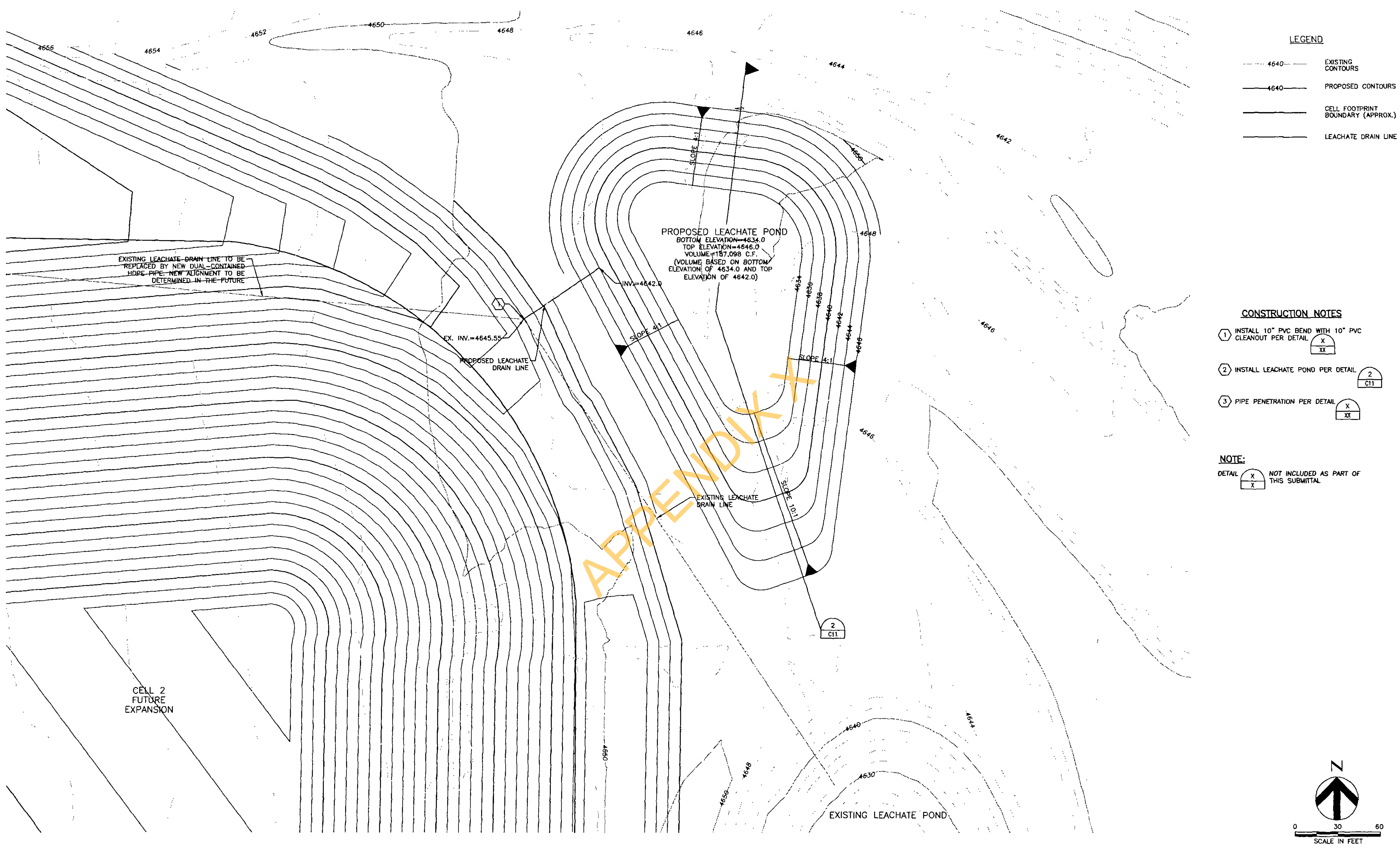
NOT FOR CONSTRUCTION

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

CELL 2 STAGE 2
TYPICAL CROSS SECTIONS

0 1" 2"
FILENAME 00C-14.DWG
SCALE H: 1"=80' V: 1"=8'
SHEET C13 OF 15



LEGEND

······ 4640 ······	EXISTING CONTOURS
——4640——	PROPOSED CONTOURS
————	CELL FOOTPRINT BOUNDARY (APPROX.)
————	LEACHATE DRAIN LINE

CONSTRUCTION NOTES

1. INSTALL 10" PVC BEND WITH 10" PVC CLEANOUT PER DETAIL X/XX
2. INSTALL LEACHATE POND PER DETAIL 2/C11
3. PIPE PENETRATION PER DETAIL X/XX

NOTE:

DETAIL X/X NOT INCLUDED AS PART OF THIS SUBMITTAL

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION		
			PROJECT MANAGER	T. WARNER
			ARCHITECT	
			CIVIL	S. WOMACK
			MECHANICAL	
			ELECTRICAL	
			STRUCTURAL	
			DESIGNED	C. MCCARTY
			DRAWN BY	C. MCCARTY
			PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

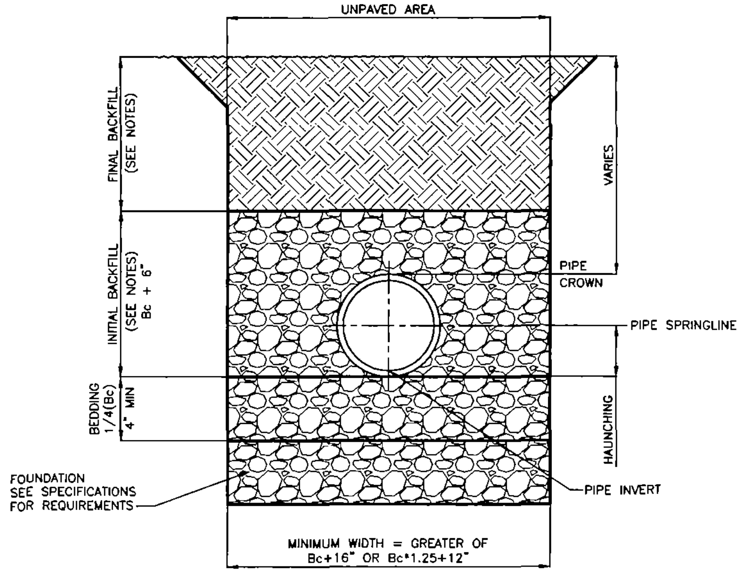
BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

LEACHATE POND GRADING PLAN

0 1" 2"

FILENAME 00C-15.DWG
SCALE 1"=30'

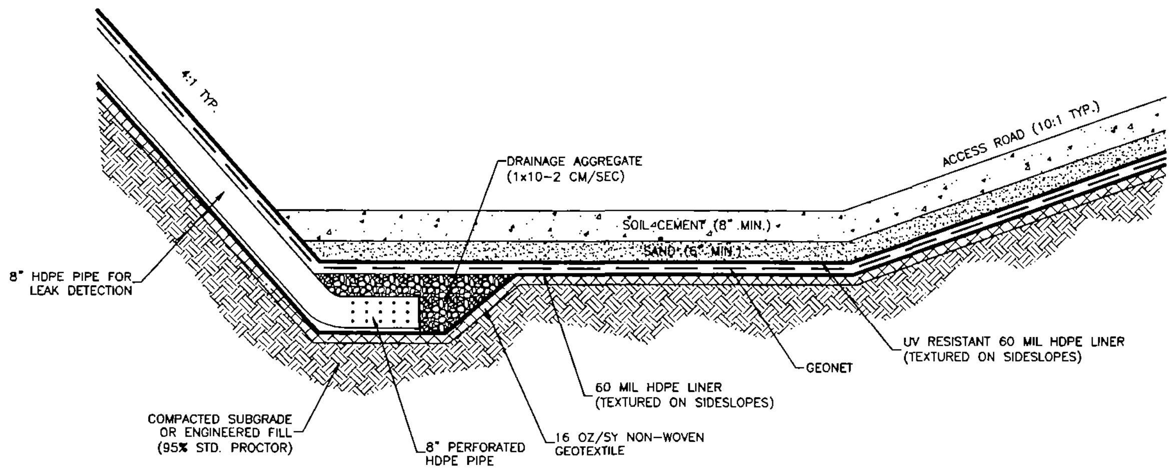
SHEET
C14 OF 15



NOTES:

1. Bc=OUTSIDE DIAMETER OF PIPE.
2. NOT APPLICABLE TO TRENCH SECTIONS WITH NORMAL GROUNDWATER LEVELS ABOVE THE PIPE CROWN.
3. SEE SPECIFICATIONS FOR MATERIAL AND COMPACTION REQUIREMENTS.

PIPE TYPICAL TRENCH SECTION 1/C11
NOT TO SCALE



PROPOSED LEACHATE POND TYPICAL SECTION 2/C11
NOT TO SCALE

HDR

HDR Engineering, Inc.
3995 S 700 E
Suite 100
Salt Lake City, UT 84107-2594

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	T. WARNER
ARCHITECT	
CIVIL	S. WOMACK
MECHANICAL	
ELECTRICAL	
STRUCTURAL	
DESIGNED	C. MCCARTY
DRAWN BY	C. MCCARTY
PROJECT NUMBER	96439

NOT FOR CONSTRUCTION

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT

BAYVIEW LANDFILL
CELL 2 STAGE 2
30% GRADING PLAN

LEACHATE POND DETAILS

0 1" 2"

FILENAME	00C-11.DWG
SCALE	N/A
SHEET	C15 OF 15

Appendix E

APPENDIX E

Boring Logs

SUVSWD Bayview Class I Landfill
Permit Application

APPENDIX E-1

CULINARY WELL

43. 2221. 4110

Page 1 of 4

Test Well Request

Form 113-534-11-40

Examined
Recorded: B. C. T. B.
Inspection Sheet
Copied

REPORT OF WELL DRILLER
STATE OF UTAH

Application No. 86-5351-TW
Claim No.
Coordinate No.

GENERAL STATEMENT: Report of well driller is hereby made and filed with the State Engineer, in accordance with the laws of Utah. (This report shall be filed with the State Engineer within 30 days after the completion or abandonment of the well. Failure to file such reports constitutes a misdemeanor.)

S.C.

!

(1) WELL OWNER:
Name Provo City Water and Waste Water Dept.
Address P.O. 1849, Provo Utah

(2) LOCATION OF WELL:
County Utah Ground Water Basin (leave blank)
North ~~South~~ ~~50~~ 2640 feet, East ~~West~~ ~~50~~ 15 feet from NW Corner
of Section 17, T. 9 S., R 1 [✓ W] ~~E~~ SLBM (strike out words not needed)

0.130
1,447
from E 1/4 Cor.
Sec. 18

(3) NATURE OF WORK (check):
New Well ☑
Replacement Well ☐ Deepening ☐ Repair ☐ Abandon ☐
If abandonment, describe material and procedure:

(4) NATURE OF USE (check):
Domestic ☐ Industrial ☐ Municipal ☑ Stockwater ☐
Irrigation ☐ Mining ☐ Other ☐ Test Well ☐

(5) TYPE OF CONSTRUCTION (check):
Rotary ☐ Dug ☐ Jetted ☐
Cable ☑ Driven ☐ Bored ☐

(6) CASING SCHEDULE:
Threaded ☐ Welded ☑
18" Diam. from 0 feet to 100 feet Gage 250
12½" Diam. from 0 feet to 502½ feet Gage 375
" Diam. from feet to feet Gage
New ☑ Reject ☐ Used ☐

(7) PERFORATIONS:
Perforated? Yes ☑ No ☐
Type of perforator used Mills
Size of perforations 3/8 inches by 2½ inches
1160 { perforations from 350 feet to 445 feet
perforations from 450 feet to 500 feet }
perforations from feet to feet
perforations from feet to feet
perforations from feet to feet

1 = 7.56 ft.²

@ 302 gpm
= 0.09 fps

(8) SCREENS:
Well screen installed? Yes ☐ No ☑
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to
Diam. Slot size Set from ft. to

(9) CONSTRUCTION:
Was well gravel packed? Yes ☐ No ☑ Size of gravel:
Gravel placed from feet to feet
Was a surface seal provided? Yes ☑ No ☐
To what depth? 100 feet
Material used in seal: Grout
Did any strata contain unusable water? Yes ☐ No ☑
Type of water: Depth of strata
Method of sealing strata off:

Was surface casing used? Yes ☑ No ☐
Was it cemented in place? Yes ☑ No ☐

(10) WATER LEVELS:
4505.5
Static level 264½ feet below land surface Date 9/9/86
Artesian pressure feet above land surface Date

LOG RECEIVED:

(11) FLOWING WELL:
Controlled by (check) Valve ☐
Cap ☐ Plug ☐ No Control ☐
Does well leak around casing? Yes ☐
No ☐

(12) WELL TESTS:
Drawdown is the distance in feet the water level is lowered below static level.
Was a pump test made? Yes ☑ No ☐ If so, by whom? Rhodes Bros.
Yield: 153 gal./min. with 26 feet drawdown after 2 hours
" 201 " 44 " 4 "
" 202 " 97 " 10 "
Bailer test gal./min. with feet drawdown after hours
Artesian flow g.p.m. Date
Temperature of water 68°F. Was a chemical analysis made? No ☐ Yes ☒

5.9
4.6
3.1

T = 6,500 gpd/ft.

(13) WELL LOG:
18" to 100'
Diameter of well 12" inches
Depth drilled 510 feet. Depth of completed well 502 feet.

NOTE: Place an "X" in the space or combination of spaces needed to designate the material or combination of materials encountered in each depth interval. Under REMARKS make any desirable notes as to occurrence of water and the color, size, nature, etc., of material encountered in each depth interval. Use additional sheet if needed.

DEPTH		MATERIAL										REMARKS
From	To	Clay	Silt	Sand	Gravel	Cobbles	Boulders	Hardpan	Conglomerate	Bedrock	Other	
0	5	X		X	X							
5	10	X		X	X							
10	15	X		X	X							
15	20	X			X							
20	25	X			X							
25	30	X			X							
30	35	X			X							
35	40	X			X							Reddish Tan
40	45	X			X							" "
45	50	X			X							" "
50	55	X			X							" "
55	60	X			X							" "
60	65	X			X							" "
65	70	X			X							" "
70	75	X			X							" "
75	80	X			X							" "
80	85	X			X							" "
85	90	X			X							" "
90	95	X			X							" "
95	100	X			X							" "
100	105	X			X							" "
105	110	X			X							" "
110	115	X			X							" "
115	120	X			X							" "
120	125	X			X							" "
125	130	X			X							" "
130	135	X			X							" "
135	140	X			X							" "
140	145	X			X							" "
145	150	X			X							" "
150	155	X			X							" "
155	160	X			X							" "

Work started 7-2- 1986 Completed 9-9- 1986

(14) PUMP:
Manufacturer's Name
Type: Turbine H. P.
Depth to pump or bowles 400 feet

Well Driller's Statement:

This well was drilled under my supervision, and this report is true to the best of my knowledge and belief.

Name BINNING DRLG. Co. (Person, firm, or corporation) (Type or print)
Address 1085 E. 150 North Fairview, Ut.
(Signed) Lester L. Binning (Well Driller)
License No. 243 Date Sept. 10, 1986

USE OTHER SIDE FOR ADDITIONAL REMARKS

Page 2 of 4

Test Well Request

Form 113–534–12-60

Examined
Recorded: B. C. .... T. B.
Inspection Sheet
Copied

REPORT OF WELL DRILLER
STATE OF UTAH

Application No. 86-5331-TW
Claim No.
Coordinate No.

GENERAL STATEMENT: Report of well driller is hereby made and filed with the State Engineer, in accordance with the laws of Utah. (This report shall be filed with the State Engineer within 30 days after the completion or abandonment of the well. Failure to file such reports constitutes a misdemeanor.)

(1) WELL OWNER:
Name Provo City Water and Waste Water
Address

(2) LOCATION OF WELL:
County .... Ground Water Basin .... (leave blank)
North/South .... feet, East/West .... feet from .... Corner
of Section ...., T. .... N/S, R. .... E/W SLBM/USM (strike out words not needed)

(3) NATURE OF WORK (check):
New Well ☐ Replacement Well ☐ Deepening ☐ Repair ☐ Abandon ☐
If abandonment, describe material and procedure:

(4) NATURE OF USE (check):
Domestic ☐ Industrial ☐ Municipal ☐ Stockwater ☐
Irrigation ☐ Mining ☐ Other ☐ Test Well ☐

(5) TYPE OF CONSTRUCTION (check):
Rotary ☐ Dug ☐ Jetted ☐
Cable ☐ Driven ☐ Bored ☐

(6) CASING SCHEDULE: Threaded ☐ Welded ☐
........" Diam. from .... feet to .... feet Gage ....
........" Diam. from .... feet to .... feet Gage ....
........" Diam. from .... feet to .... feet Gage ....
New ☐ Reject ☐ Used ☐

(7) PERFORATIONS: Perforated? Yes ☐ No ☐
Type of perforator used
Size of perforations .... inches by .... inches
.... perforations from .... feet to .... feet
.... perforations from .... feet to .... feet
.... perforations from .... feet to .... feet
.... perforations from .... feet to .... feet
.... perforations from .... feet to .... feet

(8) SCREENS: Well screen installed? Yes ☐ No ☐
Manufacturer's Name
Type .... Model No.
Diam. .... Slot size .... Set from .... ft. to ....
Diam. .... Slot size .... Set from .... ft. to ....

(9) CONSTRUCTION:
Was well gravel packed? Yes ☐ No ☐ Size of gravel:
Gravel placed from .... feet to .... feet
Was a surface seal provided? Yes ☐ No ☐
To what depth? .... feet
Material used in seal:
Did any strata contain unusable water? Yes ☐ No ☐
Type of water: .... Depth of strata
Method of sealing strata off:

Was surface casing used? Yes ☐ No ☐
Was it cemented in place? Yes ☐ No ☐

(10) WATER LEVELS:
Static level .... feet below land surface Date
Artesian pressure .... feet above land surface Date

LOG RECEIVED:

(11) FLOWING WELL:
Controlled by (check) Valve ☐
Cap ☐ Plug ☐ No Control ☐
Does well leak around casing? Yes ☐ No ☐

(12) WELL TESTS:
Drawdown is the distance in feet the water level is lowered below static level.
Was a pump test made? Yes ☐ No ☐ If so, by whom?
Yield: .... gal./min. with .... feet drawdown after .... hours
" .... " .... " .... "
" .... " .... " .... "
Bailer test .... gal./min. with .... feet drawdown after .... hours
Artesian flow .... g.p.m. Date
Temperature of water .... Was a chemical analysis made? No ☐ Yes ☐

(13) WELL LOG:
Diameter of well .... inches
Depth drilled .... feet. Depth of completed well .... feet.

NOTE: Place an "X" in the space or combination of spaces needed to designate the material or combination of materials encountered in each depth interval. Under REMARKS make any desirable notes as to occurrence of water and the color, size, nature, etc., of material encountered in each depth interval. Use additional sheet if needed.

DEPTH From	DEPTH To	Clay	Silt	Sand	Gravel	Cobbles	Boulders	Hardpan	Conglomerate	Bedrock	Other	REMARKS
160	165	X			X							
165	170	X			X							
170	175	X			X							
175	80	X			X							
180	85	X			X							
185	90	X			X							
190	95	X			X							
195	200	X			X							
200	205	X			X							
205	210	X			X							
210	215	X			X							
215	220	X			X							
220	225	X			X							
225	230	X			X							more Rocks
230	235	X			X							
235	240	X			X							
240	245	X			X							
245	250	X			X							
250	255	X			X							
255	260	X			X							
260	265	X			X							A little Water
265	270	X			X							" "
270	275	X			X							" "
275	280	X			X							" "
280	285	X			X							" "
285	290	X			X							
290	295	X			X							
295	300	X			X							
300	305	X			X							
305	310	X			X							
310	315	X			X							
315	320	X			X							

Work started .... 19...... Completed .... 19......

(14) PUMP:
Manufacturer's Name
Type: .... H. P.
Depth to pump or bowles .... feet

Well Driller's Statement:

This well was drilled under my supervision, and this report is true to the best of my knowledge and belief.

Name BINNING DRLG. Co. (Person, firm, or corporation) (Type or print)
Address
(Signed) .... (Well Driller)
License No. 243 Date ...., 19......

USE OTHER SIDE FOR ADDITIONAL REMARKS

APPENDIX E-2

MONITORING WELLS

Herm Hughes & Sons, Inc. represents that we have determined and verified all field dimensions and measurements, field construction criteria, materials, and similar data, and that we have ~~checked~~ and coordinated this submittal with the requirements of the Work and the Contract Documents.

1-24-90

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-12-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. SMW-1 TYPE monitor

JOB OWNER Provo city

LOCATION Bayview Landfill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Decon Rig & D.P. + caseing	Button	11	1
					move set up on #SMW-1 Drill + Drive			
		0	-		12" to 28'			
			5"	5"	sand + silt			
		5"	10		conglomarunt gravel-sand cemented			
		10	15					
		15	20					
		20	25					
		25	28		Drill open hole to 75			
		28	30					
		30	45					
		45	60					
		60	75					
					Install 71' 4½ PVC and gravel			
					pack 25' of hole.			
					move rig Decon and set up on			
	6:00				SMW#2			

STAND BY TIME HRS. HOURLY WORK HRS. 11

Signature of Owner or Representative

CASING USED: Size 12 Ft. Used 30 Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

MISC.

Driller Marty Peterson	Helper mike spindell	Helper

LOG OF EXPLORATORY BORING

~~PROJECT NO.~~ DRILLER: MARTY PETERSON BORING. NO. BV-SMW-1
PROJECT NAME BAYVIEW LANDFILL LOGGED BY TOM BELCHAK
DRILLING. METHOD DRILL/DRIVE AIR ROTARY 12"CASING DATE DRILLED 12-[illegible]-89

STATE____ COUNTY________ DESCRIPTIVE LOCATION NORTH OF WATER TANK

LOCATION: T____ R____ SECT.____ TRACT______ PAGE 1 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				5					GRAVELLY SAND: REDDISH-BROWN, COARSE-GRAINED MEDIUM SAND. 10% GRAVEL.
				10					SAND: REDDISH-BROWN MEDIUM GRAINED WELL SORTED
				15					GRAVELLY SAND: REDDISH-BROWN, MEDIUM SORTED 10% GRAVEL.
				20					GRAVELLY SAND: REDDISH-BROWN MEDIUM SORTED 20% GRAVEL.
				25					GRAVELLY SAND: FINE-GRAINED REDDISH BROWN MEDIUM SORTED 10% GRAVEL
				30					SANDY PEBBLY GRAVEL: REDDISH-BROWN. VERY POORLY SORTED 30% PEBBLES

REMARKS FIRST 2-3 FEET GREY, WEATHERED GRAVEL. REMAINDER OF BOREHOLE IS REDDISH BROWN SANDS + GRAVELS.

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. RV-SMW-1
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED ______
STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ______
LOCATION: T ______ R ______ SECT. ______ TRACT ______ PAGE 2 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GRAVELLY SAND: BROWNISH-RED, POORLY SORTED
				35					
									PEBBLY SILTY SAND: REDDISH BROWN, VERY
				40					POORLY SORTED, SOME CLAYBALLS
									PEBBLY SILTY SAND: REDDISH BROWN, VERY
				45					POORLY SORTED: CEMENTATION OF SAND.
									CEMENTED SILTY SAND: WHITE TO REDDISH
				50					BROWN VERY FINE-GRAINED-CEMENTED.
				55					GRAVELLY SAND: REDDISH-BROWN, POORLY
									SORTED: SOME CEMENTATION OF SAND
									SILTY GRAVEL: REDDISH-BROWN POORLY SORTED
				60					SILT + GRAVEL CEMENTED

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. BV-SMW-1
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED ______

STATE ____ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ____ R ____ SECT. ____ TRACT ______ PAGE 3 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GRAVELLY SILTY SAND: REDDISH-BROWN CEMENTED VERY SOLIDLY
				65					
									GRAVELLY SAND: REDDISH-BROWN CEMENTED.
				70					
									GRAVELLY SAND: REDDISH-BROWN, POORLY SORTED, CEMENTED.
			T.D.	75					

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 10-13-89

RIG NO. 10 RIG TYPE Failing WELL NO. Smw-1 TYPE monitoring

JOB OWNER Provo City

LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
					Install 1' of blank 4½" pvc, 20'			
					of 4½" screen and 49' of blank			
					4½" pvc To 70'			
		75'			Install silica sand from 75'-			
					44'			
					Install coarse bentonite from 44'-			
					20'			
					Install neat cement from 20'-			
			0	75'	5' and concrete from 5'-0			
					Install surface completion			

STAND BY TIME HRS. ______ HOURLY WORK HRS. ______

Signature of Owner or Representative ______

CASING USED: Size ______ Ft. Used ______ Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller	Helper	Helper

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-13-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. SMW-2 TYPE monitor

JOB OWNER Provo City

LOCATION Bayview land Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					unload caseing + Drill pipe	Button	11	1
					move axy comp			
					start to drill + drive 12"			
		0	10		sandy silty + little bit of clay			
		10	20		gravel + sand · cobbles			
		20	30		gravel cemented cobbles			
		30	40		" "			
		40	50		gravel cemented cobbles			
		50	60		gravel sand cobbles			
	6:00	60	75		gravel sand cobbles			
					Move Rig to decon pad			

STAND BY TIME HRS. HOURLY WORK HRS. 11

Signature of Owner or Representative

CASING USED: Size 12 Ft. Used 75 Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

MISC.

Driller Martin Peterson Helper Mike Swindell Helper

LOG OF EXPLORATORY BORING

~~PROJECT NO.~~ DRILLER: MARTY PETERSON BORING NO. BV-SMW-2
PROJECT NAME BAYVIEW LANDFILL LOGGED BY T. BELCHAK
DRILLING METHOD DRILL/DRIVE AIR ROTARY 12' CASING DATE DRILLED 10/13/89
STATE ____ COUNTY ________ DESCRIPTIVE LOCATION EAST OF CELL #1
LOCATION: T ____ R ____ SECT. ____ TRACT ______ PAGE 1 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				5					SANDY SILT: BROWN; 10% SAND, VERY WELL SORTED, FINE GRAINED
				10					SANDY SILT: BROWN, 20% SAND, WELL SORTED FINE GRAINED
				15					GRAVELLY SAND: BROWN, WELL SORTED (2-4 mm) ANGULAR PARTICLES
				20					SANDY GRAVEL: BROWN, MEDIUM SORTED (3-6 mm) ANGULAR to SUBANGULAR, 30% SAND
				25					SANDY GRAVEL: BROWN, MEDIUM SORTED (4-10 mm) 10% SAND, COARSE GRAVEL
				30					PEBBLY GRAVELLY SAND: BROWN, POORLY SORTED PEBBLES TO 20 mm 10% PEBBLES 30% GRAVEL

REMARKS FIRST 10' FINE-GRAINED SILT, PROBABLY WINDBLOWN. BALANCE OF BOREHOLE IS SAND + GRAVEL WITH NO FINE GRAINED MATERIAL

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____________ BORING NO. BV-Smw-2
PROJECT NAME ____________ LOGGED BY ____________
DRILLING METHOD ____________ DATE DRILLED ____________

STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ____________

LOCATION: T ______ R ______ SECT. ______ TRACT ______ PAGE 2 OF 2

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									SANDY GRAVEL: BROWN, POORLY SORTED
				35					SOME PEBBLES, 20% SAND.
									GRAVELLY SAND: BROWN, MEDIUM SORTED
				40					20% GRAVEL
									GRAVELLY SAND: BROWN, POORLY SORTED
				45					10% GRAVEL
									SANDY GRAVEL: BROWN, MEDIUM SORTED
				50					10% SAND.
									PEBBLY SANDY GRAVEL; VERY POORLY SORTED
				55					10% PEBBLE 30% SAND
									GRAVELLY SAND: BROWN, MEDIUM SORTED
				60					40% GRAVEL (2-6 mm)

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. BV-SMW-2
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED ______

STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ______ R ______ SECT. ______ TRACT ______ PAGE 3 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									SANDY GRAVEL: BROWN, POORLY SORTED
				65					30% SAND
									SANDY GRAVEL: REDDISH BROWN, POORLY
				70					SORTED (2-10 mm)
				T.D. 73					

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 10-14-89

RIG NO. 10 **RIG TYPE** Failing **WELL NO.** SMW-2 **TYPE** monitoring

JOB OWNER Provo City

LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
					Install 1' of blank 4½" pvc, 20'			
					of 4½" screen and 49' of 4½"			
					pvc To 70'			
		74'			Install silica sand from 74' –			
					44'			
					Install coarse bentonite from 44'-			
					20'			
					Install neat cement from 20'-5'			
			0	74'	and concrete from 5'-0			
					Install surface completion			

STAND BY TIME HRS. ______ **HOURLY WORK HRS.** ______

Signature of Owner or Representative ______

CASING USED: Size ______ **Ft. Used** ______ **Water G.P.M.** ______

CASING USED: Size ______ **Ft. Used** ______ **Water Static** ______

DRILLING MUD: Type ______ **Amount** ______ **Fuel** ______ **Oil** ______

MISC.

Driller Robert Christensen	**Helper**	**Helper**

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-5-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. BU-SMW-3 TYPE Monitor

JOB OWNER Provo city

LOCATION Bayview Landfill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Move from #5 to Decon. Clean Rig	Button	11	1
					D.P. + caseing. move and set up			
		0			on #3 Drill + Drive 12" Caseing			
			70	70				
		0	5		Gravelly Sand			
		5	10		Pebbly Gravel			
		10	20		Gravel - Sandy-silt			
		20	30		Gravel · silty-sand			
		30	40		Gravel - Sandy-silt			
		40	50		Sandy Gravel			
		50	60		Gravel Clayey silt			
	6:00	60	70		Gravel Sand + silt			

STAND BY TIME HRS. ______ HOURLY WORK HRS. ______

Signature of Owner or Representative ______

CASING USED: Size 12 Ft. Used 74 Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller Martin Peterson Helper mike Spindell Helper Robert A

LOG OF EXPLORATORY BORING

~~PROJECT NO~~. DRILLER: MARTY PETERSON
BORING NO. BV-SMW-3
PROJECT NAME BAYVIEW LANDFILL
LOGGED BY TOM BELCHAK
DRILLING METHOD DRILL/DRIVE AIR ROTARY 12" CASING
DATE DRILLED 10/5/99
STATE ____ COUNTY ____ DESCRIPTIVE LOCATION NORTH of BERM 2
LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 1 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GRAVELLY SAND: GREY, MEDIUM SORTED
				5					
									PEBBLY GRAVEL: GREY, MEDIUM SORTED SOME PEBBLES TO 35 mm
				10					
									GRAVELLY SANDY SILT: BROWN, POORLY SORTED SILT IS QUITE COHESIVE
				15					
									GRAVELLY SILTY SAND: BROWN, POORLY SORTED
				20					
									PEBBLY GRAVELLY SAND: BROWN-GREY POORLY SORTED, SOME PEBBLES TO 40 MM
				25					
									PEBBLY GRAVELLY SAND: BROWN, MEDIUM SORTED
				30					

REMARKS
THIS BOREHOLE ENCOUNTERED MORE GRAVEL THAN THE FIRST TWO. PENETRATION RATE WAS BETTER. THE CUTTINGS PILE WAS 1-2 FEET BECAUSE OF THE GRAVEL CONTENT

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

~~PROJECT NO.~~ DRILLER: MARTY PETERSON

BORING. NO. BV-SMW-3

PROJECT NAME BAYVIEW LANDFILL

LOGGED BY TOM BELCHAK

DRILLING. METHOD DRILL/DRIVE AIR ROTARY 12" CASING

DATE DRILLED 10/5/99

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION NORTH [illegible] 2

LOCATION: T ____ R ____ SECT. ____ TRACT ____

PAGE 2 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									PEBBLY SANDY GRAVEL: GREY BROWN, MEDIUM SORTED, PEBBLES TO 30 mm.
				35					
									PEBBLY GRAVEL: GREY, MEDIUM SORTED NO SAND PEBBLES to 20 mm.
				40					
									SANDY GRAVEL: BROWN MEDIUM SORTED 10% SAND.
				45					
									PEBBLY SAND. BROWN, VERY POORLY SORTED 10% PEBBLES ≤ 30 mm
				50					
									CLAYEY GRAVELLY SILT: BROWN POORLY SORTED VERY COHESIVE SILT
				55					
									PEBBLY SANDY GRAVEL: BROWN, POORLY SORTED (3-6 mm) PEBBLES to 20 mm.
				60					

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

~~PROJECT NO~~. DRILLER: MARTY PETERSON

BORING NO. BV-MW-3

PROJECT NAME BAYVIEW LANDFILL

LOGGED BY TOM BELCHAK

DRILLING METHOD DRILL/DRIVE AIR ROTARY 12" CASING

DATE DRILLED 10/5/89

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION NORTH of Berm 2

LOCATION: T ____ R ____ SECT. ____ TRACT ____

PAGE 3 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									SANDY PEBBLY GRAVEL: MEDIUM SORTED PEBBLES TO 35 mm.
				65					
									GRAVELLY SILTY SAND: BROWN POORLY SORTED 20% GRAVEL 30% SILT.
				70					
			T.D. 71						

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 10-9-89

RIG NO. 10 RIG TYPE Failing WELL NO. Smw-3 TYPE monitoring
JOB OWNER Provo City
LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
					Install 1' of blank 4½" pvc, 20'			
					of screen and 49' of 4½" pvc			
					To 70'.			
		75'			Install silica sand from 75' –			
					44'.			
					Install course bentonite from			
					44'-20'			
					Install neat cement from 20' –			
			0	75'	5' and concrete from 5'-0.			
					Install surface completion.			

STAND BY TIME HRS. ______ HOURLY WORK HRS. ______
Signature of Owner or Representative ______

CASING USED: Size ______ Ft. Used ______ Water G.P.M. ______
CASING USED: Size ______ Ft. Used ______ Water Static ______
DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______
MISC.

Driller	Helper	Helper

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-11-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. SMW-4 TYPE monitor

JOB OWNER Provo city

LOCATION Bay view Land fill

TIME		DEPTH			DRILLING INFORMATION	BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Load 12" caseing and Drill pipe	Button	11	1
					Fill water truck.			
					set up and start to drill & drive			
					12"			
			0	5	silty and sandy			
			5	10	gravel sand			
			10	15	gravel + sand			
			15	20	gravel + sand			
			20	25	gravel cemented			
			25	30	" "			
			30	35	" "			
			35	40	" "			
			40	45	" "			
			45	60	" "			
			60	73	" "			
					pull Drill pipe move off the			
					hole.			
	6:30				work on the swivel packing.			

STAND BY TIME HRS. ______ HOURLY WORK HRS. 11 1/2

Signature of Owner or Representative ______

CASING USED: Size 12 Ft. Used 75 Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller Marty Peterson | Helper Mike Spindell 11 1/2 | Helper

LOG OF EXPLORATORY BORING

~~PROJECT NO~~. DRILLER: MARTY PETERSON
BORING NO. BV-SMW-4
PROJECT NAME BAYVIEW LANDFILL
LOGGED BY [illegible]
DRILLING METHOD DRILL/DRIVE AIR ROTARY 12" CASING
DATE DRILLED [illegible]
STATE ____ COUNTY ____ DESCRIPTIVE LOCATION NEXT TO ORCHARD
LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 1 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				5					GRAVELLY SILT: BROWN, POORLY SORTED (2-4mm) ANGULAR 10% GRAVEL
				10					SANDY GRAVEL: BROWN, MEDIUM SORTED
				15					GRAVELLY SILT: BROWN POORLY SORTED (3-8mm) ANGULAR 20% GRAVEL
				20					SANDY GRAVEL: BROWN, MEDIUM SORTED 40% SAND
				25					SANDY GRAVEL: BROWN MEDIUM SORTED 20% SAND
				30					SANDY GRAVEL: BROWN, MEDIUM SORTED 20% SAND

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____
PROJECT NAME ____
DRILLING METHOD ____
BORING NO. BV-SMW-4
LOGGED BY ____
DATE DRILLED ____

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____

LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 2 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				35					SILTY GRAVEL: BROWN, POORLY SORTED (2-6mm) 30% SILT
				40					GRAVELLY SAND: BROWN, WELL SORTED FINE GRAINED 30% GRAVEL
				45					SANDY GRAVEL: BROWN POORLY SORTED (3-8mm) ANGULAR to SUB ANGULAR
				50					GRAVELLY SAND: REDDISH BROWN MEDIUM SORTED 20% GRAVEL
				55					GRAVELLY SAND: REDDISH BROWN MEDIUM SORTED 10% GRAVEL COARSE SAND
				60					GRAVELLY SAND: REDDISH BROWN, MEDIUM SORTED 10% GRAVEL, COARSE SAND

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____ BORING NO. BV-SMW-4
PROJECT NAME ____ LOGGED BY ____
DRILLING METHOD ____ DATE DRILLED ____

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____

LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 3 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				65					PEBBLY GRAVELLY SAND: BROWN, MEDIUM SORTED 10% PEBBLES, 30% GRAVEL, COARSE SAND, ROUNDED
				70					SANDY GRAVEL: GREY BROWN, MEDIUM SORTED 30% SAND.
			T.D.	73					GRAVELLY SAND: REDDISH BROWN, WELL SORTED 20% GRAVEL

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 10-13-89

RIG NO. 10 RIG TYPE Failing WELL NO. SMW-4 TYPE monitoring
JOB OWNER Provo City
LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
					Install 1' of blank 4½" pvc, 20'			
					of 4½" screen and 49' of blank			
					4½" pvc To 70'			
		75'			Install silica sand from 75'–			
					44'			
					Install course bentonite from 44'–			
					20'			
					Install neat cement from 20'–5'			
			0	75'	and concrete from 5'–0			
					Install surface completion			

STAND BY TIME HRS. ____________ HOURLY WORK HRS. ____________

Signature of Owner or Representative ____________

CASING USED: Size ________ Ft. Used ________ Water G.P.M. ________
CASING USED: Size ________ Ft. Used ________ Water Static ________
DRILLING MUD: Type ________ Amount ________ Fuel ________ Oil ________
MISC.

Driller ________ Helper ________ Helper ________

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-4-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. 5 S m w TYPE Monitor

JOB OWNER Provo city

LOCATION Bay view Land fiLL

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Move Rig Decon Rig + D.P.	Button	11	1
		0			set up on #5 Drill + Drive			
					12" casing.			
			74	74				
					0-5' silt + sand			
					5-10' silt + sand			
					10-15 sand + silt Gravel			
					15-20 gravel - sand silt			
					20-25 gravel - silt			
					25-30 gravel - sand			
					30-35 gravel - silt			
					35-40 gravel			
					40-45 gravel			
					45-50 gravel + clay			
					50-55 gravel + clay			
					55-60 gravel + "			
					60-65 " - "			
					65-70 " - "			
	6:00				70-73 " - "			

STAND BY TIME HRS. HOURLY WORK HRS. 11

Signature of Owner or Representative

CASING USED: Size 12 Ft. Used 75' Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

MISC.

Driller Marty Peterson

Helper Mike Spindell

Helper

LOG OF EXPLORATORY BORING

PROJECT NO. DRILLER: MARTY PETERSON
BORING NO. SMW 5
PROJECT NAME BAYVIEW LANDFILL
LOGGED BY TOM PELCHAK
DRILLING METHOD DRILL/DRIVE AIR ROTARY 12" CASING
DATE DRILLED 10/4/89
STATE ____ COUNTY ____ DESCRIPTIVE LOCATION EAST SIDE OF STORM WATER POND
LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 1 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				5					CLAYEY SILT: GREYISH BROWN, FINE GRAINED WELL SORTED 10% CLAY
				10					PEBBLY SAND: YELLOW BROWN, MEDIUM GRAINED, MEDIUM SORTING, SOME PEBBLES
				15					SANDY GRAVEL: GREY, VERY POORLY SORTED, SOME PEBBLES TO 25 MM
				20					GRAVEL: GREY, MEDIUM SORTING (3-6mm)
				25					PEBBLY GRAVEL: GREY BROWN, POORLY SORTED SOME PEBBLES TO 40 MM
				30					SANDY GRAVEL: GREY BROWN, VERY POORLY SORTED, 10% SILT. SOME PEBBLES TO 20mm

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO.

BORING. NO. SMW 5

PROJECT NAME BAYVIEW

LOGGED BY TOM BELCHAK

DRILLING. METHOD DRILL, [illegible] AIR ROTARY 12"CASING

DATE DRILLED 10/4/99

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____

LOCATION: T ____ R ____ SECT. ____ TRACT ____

PAGE 2 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
		25							SILTY GRAVEL: BROWN. POORLY SORTED
2:00				35					SILT IS COHESIVE PEBBLES TO 20mm
2:11									
	13	3/ft							
									GRAVEL: GREY. MEDIUM SORTED, SOME
2:1[illegible]				40					(3-6 mm) PEBBLES to 10 mm
2:21									
	44⅓'	[illegible]/ft							
[illegible]									
									SANDY GRAVEL: GREY, MEDIUM SORTED SOME
				45					(2-4 mm) PEBBLES to 10 mm
									SILTY GRAVEL: BROWN, VERY POORLY SORTED
				50					VERY COHESIVE SAMPLE 20% CLAY
									SANDY GRAVEL: BROWN, MEDIUM SORTED,
				55					SOME PEBBLES to 10 mm
									PEBBLY GRAVEL: BROWN, WELL SORTED, ROUNDED
				60					(2-3 mm) UNIFORM SIZE DISTRIBUTION

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____________________ BORING NO. SMW 5
PROJECT NAME BAYVIEW LOGGED BY TOM BEICHAK
DRILLING METHOD DRILL/DAVE AIR ROTARY 12" CASING DATE DRILLED 10/4/99

STATE ____ COUNTY __________ DESCRIPTIVE LOCATION __________

LOCATION: T ______ R ______ SECT. ______ TRACT __________ PAGE 3 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									SANDY GRAVEL: REDDISH BROWN, POORLY SORTED, (3-6 mm) SOME PEBBLES TO 10mm.
				65					
									GRAVELLY SAND: BROWN, MEDIUM SORTED
				70					
			T.D. 76						

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 10-7-89

RIG NO. 10 RIG TYPE Failing WELL NO. SMW-5 TYPE monitoring

JOB OWNER Provo City

LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
					Install 1' of blank 4½" pvc, 20'			
					of 4½" screen and 49' of blank			
					4½" pvc To 70'			
		76'			Install silica sand from 76'-			
					44'.			
					Install coarse bentonite from 44'-			
					20'.			
					Install neat cement from 20'-5'			
			0	76'	and concrete from 5'-0			
					Install surface completion			

STAND BY TIME HRS. ________ HOURLY WORK HRS. ________

Signature of Owner or Representative ________

CASING USED: Size ________ Ft. Used ________ Water G.P.M. ________

CASING USED: Size ________ Ft. Used ________ Water Static ________

DRILLING MUD: Type ________ Amount ________ Fuel ________ Oil ________

MISC.

Driller	Helper	Helper

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-3-89

RIG NO. 7 RIG TYPE C-P-7000 WELL NO. SMW-6 TYPE Moniter

JOB OWNER Provo city

LOCATION Bay View Land fill west of utah Lake

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					move rig and set up on #6	Button	11	1
		0			Drill + Drive 12" caseing.			
			73					
					0'-15' silt + sand			
					15'-30' silt + sand			
					30'-45' gravel + sand			
					45'-60' gravel + sand			
					60'-75' gravel + sand			
	5:30				move comp. Rig to #6			

STAND BY TIME HRS. HOURLY WORK HRS. 10½

Signature of Owner or Representative

CASING USED: Size 12 Ft. Used 75 Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

MISC.
10-2-89. ready to set up but no pad

Driller Marty Peterson Helper Robert A. Helper mike S

LOG OF EXPLORATORY BORING

~~PROJECT NO~~. DRILLER: MARTY PETERSON
BORING. NO BV-SMW-6
PROJECT NAME RAY VIEW LANDFILL
LOGGED BY T. BELCHAK
DRILLING. METHOD DRILL/DRIVE AIR ROTARY 12" CASING
DATE DRILLED 10/18/89
STATE____ COUNTY________ DESCRIPTIVE LOCATION EAST OF LEACHATE POND.
LOCATION: T____ R____ SECT.____ TRACT______
PAGE 1 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GRAVELLY
									SILTY SAND: BROWN, MEDIUM SORTED,
				5					SOME PEBBLES
									GRAVELLY
									SILTY SAND: BROWN, POORLY SORTED
				10					15% GRAVEL
									SILTY
									GRAVEL: GREY, MEDIUM SORTED, ANGULAR
				15					(3 mm) TO SUBANGULAR
									PEBBLY GRAVEL: GREY, MEDIUM SORTED
				20					(3-10mm)
									GRAVELLY SILTY SAND: BROWN MEDIUM
				25					SORTED, SILT IS COHESIVE
									SILTY GRAVEL: GREY BROWN, POORLY SORTED
				30					

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO.
BORING NO. BV-SMW-6
PROJECT NAME BAYVIEW LANDFILL
LOGGED BY T. BELCHAK
DRILLING METHOD DRILL/DRIVE AIR ROTARY 12" CASING
DATE DRILLED 10/3/89
STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____
LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 2 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				35					PEBBLY GRAVEL: GREY BROWN, MEDIUM (3-10 mm) SORTED
				40					GRAVEL; REDDISH GREY BROWN, WELL SORTED (3 mm) ROUNDED
				45					SANDY GRAVEL: REDDISH BROWN, VERY (<1 mm) WELL SORTED, ANGULAR
				50					SILTY GRAVEL: BROWN, POORLY SORTED ANGULAR, SOME PEBBLES
				55					SANDY CLAYEY SILT: BROWN, POORLY SORTED 30% CLAY CONTENT
				60					GRAVELLY CLAYEY SILT: BROWN, POORLY SORTED 40% CLAY

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

~~PROJECT NO~~. DRILLER: MARTY PETERSON BORING NO. BV-SMW-6
PROJECT NAME LOGGED BY TOM BELCHIK
DRILLING METHOD AIR/ROTARY CASING DRIVER 12" CASING DATE DRILLED 10/5/99

STATE COUNTY DESCRIPTIVE LOCATION

LOCATION: T R SECT. TRACT PAGE 3 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									SILTY GRAVEL: BROWN, POORLY SORTED
				65					10% CLAY
									GRAVELLY SAND: BROWN, POORLY SORTED
				70					SOME SILT + CLAY
			T.D	73					

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 10-6-89

RIG NO. #10 RIG TYPE Failing WELL NO. SMW-6 TYPE monitoring

JOB OWNER Amoco City

LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
					Install 1' of blank 4½" pvc, 20'			
					of 4½" screen and 49' of blank			
					4½" pvc to 70'.			
		73'			Install silica sand from 73'–			
					44'.			
					Install coarse bentonite from 44'–			
					20'.			
					Install neat cement from 20'–5'			
			0	73'	and concrete from 5'–0			
					Install surface Completion			

STAND BY TIME HRS. ____ HOURLY WORK HRS. ____

Signature of Owner or Representative ____

CASING USED: Size ____ Ft. Used ____ Water G.P.M. ____

CASING USED: Size ____ Ft. Used ____ Water Static ____

DRILLING MUD: Type ____ Amount ____ Fuel ____ Oil ____

MISC.

Driller	Helper	Helper

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-16-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. Dmw-1 TYPE monitor

JOB OWNER Provo city

LOCATION Bay view Landfill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Drilling & Drive 10" caseing	Button	9¾	1
		65	80		Gravel + sand cemented			
					Fill water truck fuel up Rig's			
		80	90		cemented Rock			
					caseing stoped. pull D.P. put			
					on stableizer run back in the			
					hole. start to drill.			
		90	105		cemented Rock			
		105	125		cemented Rock			
		125	145		mudstone with sand			
		145	165		" " "			
		165	185		" " sand + clay			
	5:30	185	205		mudstone with sand + clay			

STAND BY TIME HRS. HOURLY WORK HRS. 10 ½

Signature of Owner or Representative

CASING USED: Size 10" Ft. Used 90 Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

MISC.

Driller Marty Peterson | Helper Tim Ross | Helper Steve montaque ~~[illegible]~~

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-17-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. Dmw-1 TYPE monitor

JOB OWNER Provo city

LOCATION Bay view land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00		205			Drilling 9¾" open	[illegible]	9¾	1
			220		mud stone + clay + sand			
		220	240		same formation no change			
		240	260					
		260	280		↓			
		280	300					
		300	320					
		320	340					
		340	360					
		360	380		water check at 380'			
		380	400		↓			
		400	420					
		420	440		water check at 430'			
		440	460		↓			
		460	480					
		480	500		water check at 500			
	6:00	500	520					
					Pull Drill pipe.			
					put new starter on pick-up			

STAND BY TIME HRS. ______ HOURLY WORK HRS. 11-Hrs

Signature of Owner or Representative ______

CASING USED: Size ______ Ft. Used ______ Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller Martin Peterson	Helper Robert A	Helper Tim Ross

TOTAL DEPTH 520'

LOG OF EXPLORATORY BORING

~~PROJECT NO~~. DRILLER: MARTY PETERSON BORING NO. BV-DMW-1
PROJECT NAME BAYVIEW LANDFILL LOGGED BY TOM BELCHAK
DRILLING METHOD DRILL/DRIVE AIR ROTARY 10" CASING DATE DRILLED 10/14/99
STATE ____ COUNTY ________ DESCRIPTIVE LOCATION NORTH of WATER ST. AGE TANK
LOCATION: T ____ R ____ SECT. ____ TRACT ________ PAGE 1 OF 8

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				5					SILTY GRAVELLY PEBBLES: GREY VERY POORLY SORTED PEBBLES TO 40 MM 20% GRAVEL 10% SILT
				10					PEBBLY GRAVELLY SAND: GREY, POORLY SORTED PEBBLES to 30mm 10% PEBBLES
				15					PEBBLY SAND: REDDISH BROWN MEDIUM SORTED. LG PEBBLE TO [illegible] MEDIUM SAND 10% PEBBLES
				20					PEBBLY GRAVELLY SAND: REDDISH BROWN, POORLY SORTED PEBBLES to 25mm 20% GRAVEL.
				25					PEBBLY GRAVELLY SAND: REDDISH BROWN, POORLY SORTED 20% GRAVEL
				30					PEBBLY SAND. REDDISH BROWN, MEDIUM SORTED 10% PEBBLES MEDIUM SAND.

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO.
PROJECT NAME
DRILLING METHOD

BORING NO. BV-DWW-1
LOGGED BY
DATE DRILLED 10/14/99

STATE COUNTY DESCRIPTIVE LOCATION

LOCATION: T R SECT. TRACT

PAGE 2 OF 8

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				35					PEBBLY GRAVELLY SAND: REDDISH BROWN, POORLY SORTED 20% PEBBLES to 30 mm.
				40					PEBBLY GRAVELLY SAND: REDDISH BROWN, POORLY SORTED 10% PEBBLES to 20 mm. 30% GRAVEL.
				45					PEBBLY GRAVELLY SAND: REDDISH BROWN, POORLY SORTED COARSE SAND PEBBLES to 30 mm.
				50					SANDY PEBBLY GRAVEL: RED SAND, GREY GRAVEL; 20% SAND 30% PEBBLES
				55					PEBBLY GRAVELLY SAND: REDDISH BROWN, POORLY SORTED 20% GRAVEL.
				60					PEBBLY SAND: BROWN, WELL SORTED FINE SAND.
				65					GRAVELLY SAND: BROWN, WELL SORTED, FINE SAND (2-6mm)

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. BV-OMW-1
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED 10/16/89
STATE ____ COUNTY ______ DESCRIPTIVE LOCATION ______
LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 3 OF 8

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									SAND: REDDISH BROWN, WELL SORTED,
				70					FINE-MEDIUM SAND.
									PEBBLY GRAVELLY SAND: GREY, POORLY SORTED
				75					COARSE SAND
									SAND: REDDISH BROWN, WELL SORTED, FINE to
				80					MEDIUM SAND.
									GRAVELLY SAND: REDDISH BROWN, POORLY SORTED
				85					COARSE SAND. 30% GRAVEL.
									GRAVELLY SAND: REDDISH BROWN, VERY POORLY
				90					(3-6mm) SORTED. COARSE SAND 40% GRAVEL
									GRAVELLY SAND: REDDISH BROWN, POORLY SORTED
				95					(3-15mm) FINE to MEDIUM SAND.

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____________________ BORING NO. BV-OMW-1
PROJECT NAME ____________________ LOGGED BY ____________________
DRILLING METHOD ____________________ DATE DRILLED 10/16/89

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____________________

LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 4 OF 8

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									SAND: REDDISH BROWN, POORLY SORTED COARSE GRAINED SAND.
				100					
									PEBBLY SANDY GRAVEL: REDDISH BROWN. VERY POORLY SORTED
				105					
									SILT: REDDISH BROWN SILTSTONE
				110					
									GRAVELLY SILT: REDDISH BROWN. CEMENTED
				115					
									CLAY: REDDISH BROWN, FINE GRAINED.
				120					
									CLAY: REDDISH BROWN, FINE GRAINED
				125					

REMARKS LITHOLOGY CHANGES DRAMATICALLY
AT 110' TO BROWN CLAY-SILTSTONE.

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO.
PROJECT NAME
DRILLING METHOD
BORING NO. BV-DMW-1
LOGGED BY
DATE DRILLED 10/16/99

STATE COUNTY DESCRIPTIVE LOCATION

LOCATION: T R SECT. TRACT

PAGE 5 OF 6

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				130					GRAVELLY SILT: REDDISH BROWN FINE- (2-3mm) GRAINED
				135					GRAVELLY SILT: SAME
				140					GRAVELLY SILT: SAME
				145					GRAVELLY SILT : SAME 20% GRAVEL
				150					GRAVELLY SILT : SAME 20% GRAVEL
				155					GRAVELLY SILTSTONE: 10% GRAVEL

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______
PROJECT NAME ______
DRILLING METHOD ______
BORING NO. AV-OMW-1
LOGGED BY ______
DATE DRILLED 10/16/89

STATE ____ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ____ R ____ SECT. ____ TRACT ______

PAGE 6 OF 8

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				160					SILTSTONE: REDDISH BROWN.
				165					SILTSTONE: REDDISH BROWN
				170					SILTSTONE: SAME
				175					SILTSTONE: SAME
				180					SILTSTONE: SAME
				185					SILTSTONE: SAME

REMARKS SILTSTONE IS VERY HOMOGENEOUS FINE-GRAINED, WELL BONDED. "SHINY FLECKS" IN THE LIGHT MAY BE GYPSUM.

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____ BORING. NO. BV-DMW-1
PROJECT NAME ____ LOGGED BY ____
DRILLING. METHOD ____ DATE DRILLED 10/16/97

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____

LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 7 OF 8

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				190					CLAYSTONE: REDDISH-BROWN, VERY FINE GRAINED HOMOGENEOUS. CUTTINGS IN ¼ INCH CHIPS.
				195					CLAYSTONE: SAME
				200					CLAYSTONE: SAME
				205					CLAYSTONE: SAME

REMARKS

Exploratory & Monitor Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____
BORING NO. BV-DMW-1
PROJECT NAME ____
LOGGED BY ____
DRILLING METHOD ____
DATE DRILLED 10/17/89

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____

LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 8 OF 8

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				205-520					CLAYSTONE: REDDISH BROWN, VERY FINE GRAINED, INDURATED, HOMOGENEOUS

REMARKS
BORING WAS TERMINATED AT 520'
WITH NO SIGN OF WATER.

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 10-18-89

RIG NO. 10 RIG TYPE Failing WELL NO. DMW-1 TYPE monitoring
JOB OWNER Provo City
LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
					Install coarse bentonite in			
		520'	0	520'	hole from 520' – 0			

STAND BY TIME HRS. HOURLY WORK HRS.
Signature of Owner or Representative

CASING USED: Size Ft. Used Water G.P.M.
CASING USED: Size Ft. Used Water Static
DRILLING MUD: Type Amount Fuel Oil
MISC.
BOREHOLE ABANDONED DUE to LACK of WATER

Driller	Helper	Helper

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-18-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. Dmw-1-A TYPE monitor

JOB OWNER Provo city

LOCATION Bay view Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					move Rig from Dmw-1 to Decon	Button	9¾	1
					clean it. Lube it.			
					Move to Dmw-1-2 set up start to			
		0			drill & Drive 10" caseing.			
					Had trouble getting caseing started			
			30		straight alot of Big rock's			
		0	5		gravel			
		5	10		gravel			
		10	15		gravel			
		15	20		gravel			
		20	25		sand			
		25	30		gravel + madstone with Sand			
	5:30							

STAND BY TIME HRS. HOURLY WORK HRS. 10 1/2

Signature of Owner or Representative

CASING USED: Size 10" Ft. Used 30 Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

M.

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-19-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. Dmw-1-A TYPE Monitor

JOB OWNER provo city

LOCATION Bay view land Fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					work on pick-up trying to get	Button	9⅞	1
					it started. No luck			
		30			start to drill + drive 10" caseing			
		30	35		Red mudstone			
		35	40		" "			
		40	45		" "			
		45	50		" "			
		50	55		" "			
		55	60		" "			
		~~60~~						
	5:30							

STAND BY TIME HRS. HOURLY WORK HRS. 10½

Signature of Owner or Representative

CASING USED: Size 10" Ft. Used 30 Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

MISC.

called provo city carl came out and Looked at the cutting's he said move hole more to the north.

Driller Martin Peterson Helper Tim Ross Helper Steve montague

LOG OF EXPLORATORY BORING

DRILLER: ~~PROJECT NO.~~ MARTY PETERSON

BORING NO. BV-OMW-1A

PROJECT NAME

LOGGED BY

DRILLING METHOD

DATE DRILLED

STATE COUNTY DESCRIPTIVE LOCATION

LOCATION: T R SECT. TRACT

PAGE OF

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									SAMPLES WERE DESTROYED BY ROAD GRADER PRIOR TO LITHOLOGIC LOGGING. NO LOG AVAILABLE FOR THIS BOREHOLE. DRILLER REPORT WAS FINE-GRAINED RED-MUDSTONE THROUGHOUT DEPTH.

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 10-23-89

RIG NO. 10 RIG TYPE Failing WELL NO. DMW-1A TYPE monitoring

JOB OWNER Provo City

LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
					Install coarse bentonite from			
		60'	0	60'	60' — 0 ABANDON HOLE			

STAND BY TIME HRS. ______ HOURLY WORK HRS. ______

Signature of Owner or Representative ______

CASING USED: Size ______ Ft. Used ______ Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller	Helper	Helper

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-23-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. Dmw-1-B TYPE monitor

JOB OWNER provo city

LOCATION Bayview Land Fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Move rig from Dmw-1-A to	Button	9 3/4	1
					1-B.			
					set up start to drill + Drive			
					10" caseing.			
		0	5		gravel + sand-silt			
		5	10		" " "			
		10	20		" " "			
		20	25					
		25	30		" " "			
		30	35		" " "			
		35	40		mudstone			
		40	45		mudstone 10" caseing steped at 44'			
					Drill open hole			
		45	55		mudstone			
		55	65					
		65	75					
		75	95					
	4:00	95	105					

STAND BY TIME HRS. HOURLY WORK HRS. 9-

Signature of Owner or Representative

CASING USED: Size 10" Ft. Used 45 Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

MISC.

Driller Marty Peterson Helper mike spindell Helper

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-24-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. OMW-1-B TYPE monitor

JOB OWNER provo city

LOCATION Bayview Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:30					Drilling 10" open hole	Button	9 3/4	1
		105	125		mudstone			
		125	145		"			
		145	165		"			
		165	185		"			
		185	205		"			
		205	225		"			
		225	245		"			
		245	255		"			
		255	265		Hit a Little bit of gravel seam's			
		265	275		mudstone with gravel seam's			
		275	285		" " "			
		285	295		" " " "			
		295	305		" " " "			
	5:30	305	308		mudstone Less gravel			

STAND BY TIME HRS. HOURLY WORK HRS. 10

Signature of Owner or Representative

CASING USED: Size — Ft. Used — Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

MISC.

Hit the water at 260'

Driller Marty Peterson	Helper Mike spindeLL	Helper

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-25-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. Dmw-1-B TYPE monitor

JOB OWNER Provo city

LOCATION Bay view Land fiLL

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:30					test for water. Run Drill pipe			
					into 265' Turn on the airiwus			
					Blowing water. Ream to Botton 308'			
					pull the Drill pipe Run in 260'			
					4½ BlanK pvc. 40' 4½ screen.			
					gravel pack from 300' to 245' Bentonite			
					seal from 245'- 415' move Rig			
					Take it to Decon. clean it move			
					to DMW-4 set up			
	5:30							

STAND BY TIME HRS. ______ HOURLY WORK HRS. 10

Signature of Owner or Representative ______

CASING USED: Size 4½" BLank P.V.C. Ft. Used 260 Water G.P.M. ______

CASING USED: Size 4½" PVC screen Ft. Used 40 Water Static 255'

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

2- 4½" P.V.C. cap's 3/4 Big Bag of Sand 10-20

n in well sounder Hit water 253'

Driller Marty - Dick	Helper mike spindeLL	Helper

LOG OF EXPLORATORY BORING

~~PROJECT NO.~~ DRILLER: MARTY PETERSON
BORING NO. BV-OMW-1B
PROJECT NAME BAYVIEW LANDFILL
LOGGED BY TOM BELCHAK
DRILLING METHOD AIR/ROTARY DRILL DRIVE 10"
DATE DRILLED 10/23/89

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____

LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 1 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				5					SILTY GRAVEL: LIGHT BROWN POORLY SORTED
				10					PEBBLY SILT: LIGHT BROWN, VERY POORLY SORTED LARGE PEBBLES TO 50MM.
				15					SILTY GRAVEL: BROWN. POORLY SORTED
				20					SANDY GRAVEL: GREY
				25					SANDY GRAVEL: GREY, POORLY SORTED 3-8mm 30% SAND
				30					GRAVELLY SAND: GREY, POORLY SORTED 3-5MM GRAVEL, 20% GRAVEL

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____ BORING NO. ____
PROJECT NAME ____ LOGGED BY ____
DRILLING METHOD ____ DATE DRILLED ____

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____

LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 2 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				35					GRAVELLY SAND: GREY, POORLY SORTED. 3-5mm GRAVEL. 20% GRAVEL
				40					PEBBLY GRAVELLY SAND: REDDISH BROWN. PEBBLES TO 40mm 20% GRAVEL
				45					PEBBLY GRAVELLY SAND: REDDISH BROWN, PEBBLES to 20mm 20% GRAVEL
				50					PEBBLY GRAVELLY SAND: REDDISH BROWN, PEBBLES to 20mm. FINE SAND
				55-105					CLAYSTONE: REDDISH BROWN. VERY FINE GRAINED, COHESIVE 1/2 INCH CUTTINGS

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____________ BORING NO. BV-DMW-1B
PROJECT NAME ____________ LOGGED BY ____________
DRILLING METHOD ____________ DATE DRILLED 10/25/89

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____________

LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 3 OF 3

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
			105-305						CLAYSTONE: REDDISH BROWN, VERY FINE-GRAINED, COHESIVE ½ INCH CUTTINGS.

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 10-30-89

RIG NO. 10 **RIG TYPE** Failing **WELL NO.** DMW-1B **TYPE** monitoring

JOB OWNER Provo City

LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
					Install 1' of blank 4½" pvc,			
					40' of 4½" screen and 260'			
					of blank 4½" pvc To 301'			
		308'			Install silica sand from 308'-			
					255'			
					Install coarse bentonite from			
					255'-20'			
					Install neat cement from 20'-5'			
			0	308'	and concrete from 5'-0			
					Install surface completion			

STAND BY TIME HRS. ______ **HOURLY WORK HRS.** ______

Signature of Owner or Representative ______

CASING USED: Size ______ **Ft. Used** ______ **Water G.P.M.** ______

CASING USED: Size ______ **Ft. Used** ______ **Water Static** ______

DRILLING MUD: Type ______ **Amount** ______ **Fuel** ______ **Oil** ______

MISC.

Driller

Helper

Helper

WELL DEVELOPMENT

Project: BAYVIEW LANDFILL Well Number: DMW-1B

Project Number: Date: 11-22-89

Well inside diameter: 4 1/2 IN

Depth of bottom: 302 FT

Length of gravel pack: 45 FT

Diameter of gravel pack: 10-20 IN

Measured by: M. PETERSON

Recorded by: Thomas A. Belleleb

Air temperature: 58 DegF

Weather condition: Hazey

WITHDRAWAL OF WELL VOLUMES

FLUSHING	Well Volume	Well Volume	Well Volume
Water level before	242		
Water level after	265		
Time begin flushing	11:30 A.M.		
Time end flushing	16:30		
Time water level after	17:30		
Estimated volume flushed (GAL)	<1-gal. per min.	MEASURED 1/4 gal/min AT 265' LEVEL	

FIELD ANALYSIS	
Water temperature (DegC)	60°f
Sample pH	7
Sample conductivity (mhos/cm)	440
Buffer before	—
Buffer after	—
Odor	None
Color	~~tan~~ clear
Other	

COMMENTS

THIS WELL PRODUCED VERY LITTLE WATER DURING DEVELOPMENT AND WAS THE MOST DIFFICULT TO CLARIFY FINES FROM THE WELL.

Blew until mist was coming out shut air off. Let well Build up again. every 1/2 hr. shut off air.

Attach photographs of water samples in labeled jars.

END OF SECTION

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 10-31-89

RIG NO. 7 RIG TYPE C-P-7000 WELL NO. DMW-2 TYPE monitor

JOB OWNER Provo city

LOCATION Bayview Landfill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					move Rig and set up on	Button	9 7/8	1
					DMW-2			
		0			Drill + Drive 10" caseing			
			5		sand + silt			
		5	15		gravel + sand			
		15	30		gravel + sand			
	4:30	30	45					

STAND BY TIME HRS. HOURLY WORK HRS. 9 1/2

Signature of Owner or Representative

CASING USED: Size 10 Ft. Used 45 Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

MISC.

Driller Martin Peterson	Helper Tim Ross	Helper Steve Montague

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-1-89

RIG NO. 2 RIG TYPE C-P 7000 WELL NO. DMW-2 TYPE monitor

JOB OWNER Provo city

LOCATION Bay View Land Fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Drill + Drive 10" caseing	Botton	4 3/4"	1
		45	60		gravel & Sand			
		60	75		gravel & sand			
					complete #DMW-4 from 145-45			
	4:00							

STAND BY TIME HRS. ______ HOURLY WORK HRS. 9

Signature of Owner or Representative ______

CASING USED: Size 10 Ft. Used 30 Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller Martin Peterson	Helper Tim Ross	Helper Steve montague

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-7-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. Omw-2 TYPE monitor

JOB OWNER Provo city

LOCATION Bayview Land fill

TIME		DEPTH			DRILLING INFORMATION	BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Drill + Drive 10" caseing	Button	9¾	1
		75	90		gravel + cobble's			
		90	105		gravel + cobble's			
		105	120		" "			
		120	135		" "			
		135	150		" "			
		150	165		" "			
	4:30				Blew fuel line on air comp.			
					went to Doug's and got new one.			

STAND BY TIME HRS. HOURLY WORK HRS. 9 1/2

Signature of Owner or Representative

CASING USED: Size 10 Ft. Used 90 Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

MISC.

change oil + filter on C-P-7000

Driller Martin Peterson	Helper tim Ross	Helper Steve montague

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-3-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. Dmw-2 TYPE monitor

JOB OWNER Provo city

LOCATION Bayview Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Drill & Drive 10" caseing	Button	9 7/8	1
		165	180		gravel & cobble's			
		180	195		gravel & cobble's			
		195	210		" "			
		210	225		" "			
		225	240		" "			
	5:00							

STAND BY TIME HRS. ______ HOURLY WORK HRS. 10

Signature of Owner or Representative ______

CASING USED: Size 10 Ft. Used 75 Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Tryed to drill open hole at 195' drilled to 210' had 10' of
L in the hole. couldn't add another pipe
Caseing started to go harder at 165 cemented gravle's

Driller Marty Peterson Helper Tim Ross Helper Steve montoyue

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-6-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. DMW 2 TYPE Monitor
JOB OWNER Provo city
LOCATION Bay view Land fill west of utah Lake south end

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Drilling 10" open hole	Button	9 7/8	1
		240	255		cemented gravel with Fractures			
		255	270		cemented gravel " "			
					water 245'			
					Run in 40' screen 230' 4½ Blank			
					gravel pack to 240' from 270'			
	See'				Bottom of 10" caseing is at 240'			

STAND BY TIME HRS. ____________ HOURLY WORK HRS. 10
Signature of Owner or Representative ____________

CASING USED: Size 4½" screen Ft. Used 40 Water G.P.M. 15
CASING USED: Size 4½ PVC Ft. Used 230 Water Static 234'
DRILLING MUD: Type ____________ Amount ____________ Fuel ________ Oil ________
MISC.

Driller Musty Peterson	Helper Tim Ross Mike Spindell	Helper Steve Montague

LOG OF EXPLORATORY BORING

PROJECT NO. DRILLER: MARTY PETERSON
BORING. NO. BV-DMW-2
PROJECT NAME
LOGGED BY TOM BELCHAK
DRILLING. METHOD
DATE DRILLED
STATE COUNTY DESCRIPTIVE LOCATION
LOCATION: T R SECT. TRACT
PAGE 1 OF 9

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									SILT: GREY BROWN, WELL SORTED, VERY
				5					FINE WELL SORTED
									CLAYEY SILT: YELLOWISH BROWN, WELL SORTED
				10					VERY FINE GRAINED, COHESIVE
									SILTY PEBBLES: GREY, POORLY SORTED
				15					FINE-GRAINED
									PEBBLY GRAVEL: GREY POORLY SORTED
				20					PEBBLES TO 50mm
									SILTY GRAVELLY PEBBLES: GREY, VERY POORLY SORTED
				25					10% SILT 20% GRAVEL
									PEBBLY SAND: BROWN, POORLY SORTED,
				30					MEDIUM SAND

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO.
BORING NO. BV-DMW-2
PROJECT NAME
LOGGED BY
DRILLING METHOD
DATE DRILLED
STATE ____ COUNTY ____ DESCRIPTIVE LOCATION
LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 2 OF 9

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				35					GRAVELLY PEBBLES: GREY POORLY SORTED. VERY COARSE PEBBLES TO 60 MM.
				40					GRAVELLY PEBBLY SAND: BROWN. VERY POORLY SORTED, MEDIUM SAND 20% GRAVEL 20% PEBBLE
				45					GRAVELLY PEBBLES: VERY POORLY SORTED. COARSE PEBBLES TO 50 MM. 20% GRAVEL.
				50					PEBBLY GRAVEL: GREY, MEDIUM SORTED, COARSE (4-8mm) GRAINED NO FINES SOME PEBBLES TO 90mm
				55					PEBBLY GRAVELLY SAND: GREY POORLY SORTED. 5% PEBBLES to 20MM, 30% GRAVEL.
				60					PEBBLY GRAVELLY SAND: GREY, POORLY SORTED 20% PEBBLES 30% GRAVEL, MEDIUM BROWNISH SAND.

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING. NO. BV-OMW-2
PROJECT NAME ______ LOGGED BY ______
DRILLING. METHOD ______ DATE DRILLED ______
STATE ____ COUNTY ______ DESCRIPTIVE LOCATION ______
LOCATION: T ____ R ____ SECT. ____ TRACT ______ PAGE 3 OF 9

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				65					PEEBLY GRAVEL: GREY, MEDIUM SORTED 30% PEBBLES to [illegible] mm GRAVEL 2-9mm
				70					PEBBLY GRAVEL: GREY, MEDIUM SORTED. 10% PEBBLES to 30mm GRAVEL 2-6mm.
				75					PEBBLY GRAVEL: GREY, MEDIUM SORTED 10% PEBBLES to 50mm
				80					GRAVELLY PEBBLY SAND: GREY-BROWN, POORLY SORTED 10% GRAVEL 30% PEBBLES to 30mm.
				85					PEBBLY SANDY GRAVEL: GREY-BROWN, PEBBLES 20% to 40mm SAND 30%
				90					GRAVELLY SANDY PEBBLES: GREY VERY POORLY SORTED. VERY COARSE

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____
PROJECT NAME ____
DRILLING METHOD ____
BORING NO. BV-DMW-7
LOGGED BY ____
DATE DRILLED ____
STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____
LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 4 OF 9

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				95					PEBBLY GRAVELLY SAND: BROWN, POORLY SORTED, 10% PEBBLES to 40mm, 30% GRAVEL, MEDIUM SAND
				100					PEBBLY GRAVELLY SAND: BROWN, POORLY SORTED 10% PEBBLES TO 30mm, 20% GRAVEL, FINE SAND.
				105					PEBBLY GRAVELLY SAND: BROWN POORLY SORTED 10% PEBBLES to 30mm, 30% GRAVEL, MEDIUM SAND.
				110					PEBBLY GRAVELLY SAND: BROWN POORLY SORTED. 10% PEBBLES to 40mm, 20% GRAVEL, MEDIUM SAND.
				115					PEBBLY GRAVELLY SAND: BROWN [illegible] SAND [illegible] PEBBLES [illegible]% GRAVEL, MEDIUM SAND.
				120					SAME

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______
PROJECT NAME ______
DRILLING METHOD ______
BORING NO. RV-EMW-7
LOGGED BY ______
DATE DRILLED ______
STATE ____ COUNTY ______ DESCRIPTIVE LOCATION ______
LOCATION: T ____ R ____ SECT. ____ TRACT ______
PAGE 5 OF 9

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									PEBBLY GRAVELLY SAND: BROWN POORLY SORTED
				125					10% PEBBLES 20% GRAVEL MEDIUM SAND.
									PEBBLY SAND: BROWN WELL SORTED MEDIUM-FINE
				130					PEBBLES 5% to 20mm
									PEBBLY GRAVELLY SAND: REDDISH BROWN WELL SORTED
				135					MEDIUM SAND 10% PEBBLES 30% GRAVEL.
									GRAVELLY SAND: GREYISH BROWN, MEDIUM SORTED
				140					VERY COARSE SAND, 20% GRAVEL (3-6mm)
									PEBBLY GRAVELLY SAND: REDDISH BROWN MEDIUM
				145					SORTED MEDIUM SAND [illegible] PEBBLES to [illegible] [illegible]% GRAVEL
									PEBBLY GRAVELLY SAND: REDDISH BROWN, WELL SORTED
				150					FINE SAND, 10% PEBBLES to 20mm, 10% GRAVEL

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. BV-DMW-7
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED ______

STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ______ R ______ SECT. ______ TRACT ______ PAGE 7 OF 9

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				185					PEBBLY GRAVELLY SAND: BROWN, POORLY SORTED 10% PEBBLES, 30% GRAVEL.
									SAME
				190					
				195					SAME
				200					SAME
				205					GRAVELLY SAND: REDDISH BROWN, MEDIUM SORTED FINE SAND 30% GRAVEL.
				210					SAND: REDDISH BROWN, VERY WELL SORTED FINE TO MEDIUM SAND.

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____
BORING NO. BV-DMW-2
PROJECT NAME ____
LOGGED BY ____
DRILLING METHOD ____
DATE DRILLED ____

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____

LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 8 OF 9

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GRAVELLY SAND: REDDISH BROWN, WELL SORTED MEDIUM SAND 20% GRAVEL
				215					
									GRAVELLY SAND; REDDISH BROWN MEDIUM SORTED FINE SAND 30% GRAVEL
				220					
									SILTY GRAVELLY SAND: REDDISH BROWN MEDIUM SORTED FINE SAND 10% GRAVEL
				225					↓
									SAME
				230					
									PEBBLY SAND: REDDISH BROWN, POORLY SORTED MEDIUM SAND 30% PEBBLES to 20mm.
				235					
									SANDY PEBBLES: REDDISH BROWN POORLY SORTED
				240					

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____________________ BORING. NO. BV-DMW-2
PROJECT NAME ____________________ LOGGED BY ____________________
DRILLING. METHOD ____________________ DATE DRILLED ____________________
STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____________________
LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 9 OF 9

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GRAVELLY SAND: REDDISH BROWN MEDIUM
				245					SORTED MEDIUM SAND 20% GRAVEL
									SAME
				250					
									SAME
				255					
									GRAVELLY SAND: REDDISH BROWN, WELL SORTED
				260					COARSE-MEDIUM SAND 20% GRAVEL
				265					SAME
				270					SAME

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-6-89 thru 11-8-89

RIG NO. #10 RIG TYPE Failing WELL NO. DMW-4,2 SMW-4 TYPE monitoring

JOB OWNER Provo City

LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					11-6			
					finish Completion on hole DMW-4			
					from 30'-0 : Install surface			
					completion			
					On hole DMW-2, Install 1' of			
					blank 40' of screen, and 228' of			
					4½" pvc To 269'. Install sand			
	5:00				from 270'- 240'.	10 hrs		
7:00					11-7			
					Set Camp rig and Jacks on hole			
					DMW-4. Complete well from 240'-			
	5:00				50'.	10 hrs		
7:00					11-8 finish completion on hole #2			
					from 50'-0. Install surface comp.			
					Haul casing To drill rig.			
	5:00				Develope hole SMW-4	10 hrs		

STAND BY TIME HRS. ______ HOURLY WORK HRS. ______

Signature of Owner or Representative ______

CASING USED: Size ______ Ft. Used ______ Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller

Helper Tim Ross

Helper Steve Montane

WELL DEVELOPMENT

Project: BAYVIEW LANDFILL Well Number: Dmw-2

Project Number: ______ Date: 11-22-89

Well inside diameter: 4½ IN

Depth of bottom: 271 FT

Length of gravel pack: 45 FT

Diameter of gravel pack: 16-20 SAND IN

Measured by: M. PETERSON

Recorded by:

Air temperature: 30 DegF

Weather condition: Hazey + cold

WITHDRAWAL OF WELL VOLUMES

FLUSHING	Well Volume	Well Volume	Well Volume
Water level before	236		
Water level after	236		
Time begin flushing	8:30		
Time end flushing	9:30		
Time water level after	10:30		
Estimated volume flushed (GAL)	5-gal per min.		

FIELD ANALYSIS

Water temperature (DegC)	58
Sample pH	6
Sample conductivity (mhos/cm)	460
Buffer before	-
Buffer after	-
Odor	None
Color	Clear
Other	

COMMENTS

THIS WELL RECOVERED VERY WELL AFTER DEVELOPMENT AND PRODUCED GOOD VOLUMES OF WATER.

Attach photographs of water samples in labeled jars.

END OF SECTION

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-10-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. DMW-3 TYPE monitor

JOB OWNER provo city

LOCATION Bayview Landfill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					set up on DMW-3 change air	Button	9 3/4	1
					filters on Rig & comp.			
					Haul 10" casing			
					make another shoe joint.			
					Drill & Drive 10" casing			
		0	5		Back fill			
		5	10		Back fill			
		10	15		gravel clay & sandy silt			
		15	20		gravel sand cobbles			
		20	25		gravel sand cobbles			
		25	30		gravel sand cobbles			
		30	45		gravel sand cobbles			
		45	60		gravel sand cobbles			
		60	75		gravel " "			
	5:00	75	90		" " "			

STAND BY TIME HRS. HOURLY WORK HRS. 10

Signature of Owner or Representative

CASING USED: Size 10" Ft. Used Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

MISC.

Driller Martin Peterson	Helper Mike Spindell	Helper

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 11-13-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. OMW-3 TYPE monitor

JOB OWNER Provo city

LOCATION Bay view Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00		90			Drill + Drive 10" caseing	Button	9½	1
			105		gravel sand cobbles			
		105	120		gravel sand cobbles			
		120	135		gravel sand cobbles			
		135	150		gravel sand cobbles			
		150	165		gravel sand cobbles			
	5:00	165	180		open hole gravel cemented & cobbles			

STAND BY TIME HRS. ______ HOURLY WORK HRS. ______

Signature of Owner or Representative ______

CASING USED: Size 10" Ft. Used 75 Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller Marty Peterson	Helper Mike Spindell	Helper

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-14-89

RIG NO. 7 RIG TYPE C.P.-7000 WELL NO. DMW-3 TYPE monitor

JOB OWNER Provo city

LOCATION Bay view land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					pickup grout plant in Elberta	Butkin	9½	1
					took it to shop.			
					went to the geo store got			
					150' 4½" PVC			
		180	195		gravels & sand ~~[illegible]~~			
	5:00				unload Bentonite trailer			

STAND BY TIME HRS. ________ HOURLY WORK HRS. 10

Signature of Owner or Representative ________

CASING USED: Size ________ Ft. Used ________ Water G.P.M. ________

CASING USED: Size ________ Ft. Used ________ Water Static ________

DRILLING MUD: Type ________ Amount ________ Fuel ________ Oil ________

MISC.

Driller Martin Peterson | Helper mike spindell | Helper tim Ross

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-15-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. DMW-3 TYPE monitor

JOB OWNER provo city

LOCATION Bay view Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00		195			Drilling open hole	Butler	9 1/2	1
			210		cemented Gravel's & sand			
	9:30	210	225		cemented Gravel's			
9:30	5:00				went to trojan to set pump.			

STAND BY TIME HRS. ________ HOURLY WORK HRS. 10-

Signature of Owner or Representative ________

CASING USED: Size ________ Ft. Used ________ Water G.P.M. ________

CASING USED: Size ________ Ft. Used ________ Water Static ________

DRILLING MUD: Type ________ Amount ________ Fuel ________ Oil ________

MISC.

Driller Marty Peterson	Helper Mike spindell	Helper Tim Ross

7:00 - 12:00

7:00 - 12:00

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-16-89

RIG NO. 7 RIG TYPE C-P-7000 WELL NO. DMW-3 TYPE Monitor

JOB OWNER Provo city

LOCATION Bayview Land Fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00		225			Drilling open hole	Button	9½	1
			240		Mud stone with clay & gravel			
		240	255		mud stone with clay & gravel			
		255	270		mud stone with gravel Little water	270'		
		270	285		mud stone with gravel Layer's			
		285	300		" " " "			
					Install 280' 4½ P.V.C. 20' 4½			
	5:00				screen and gravel pack to 265'			

STAND BY TIME HRS. ______ HOURLY WORK HRS. 10

Signature of Owner or Representative ______

CASING USED: Size 4½" BLank Ft. Used 280 Water G.P.M. ______

CASING USED: Size 4½" Screen Ft. Used 20 Water Static 260'

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller Martin Peterson

Helper Tim Ross

Helper Mike

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-17-89

RIG NO. 2 RIG TYPE completion Rig WELL NO. DMW-3 TYPE monitor

JOB OWNER Provo city

LOCATION Bayview Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					move c-P-7000 to Laydown area.			
					setup completion Rig + Jack's			
					Bring Bentonite from 265'-165'.			
					start to pull 10" caseing at 165			
					still putting in Bentonite.			
					Pulled caseing from 165'-45'			
					work in the Laydown area Loading			
	4:00				Truck's.			

STAND BY TIME HRS. ______ HOURLY WORK HRS. 9.

Signature of Owner or Representative ______

CASING USED: Size ______ Ft. Used ______ Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller Martin Peterson | Helper Mike Spindell | Helper Tim Ross

LOG OF EXPLORATORY BORING

~~PROJECT NO.~~ DRILLER: MARTY PETERSON
BORING NO. BV-OMW-3
PROJECT NAME BAYVIEW LANDFILL - PROVO CITY
LOGGED BY T. BELCHAK
DRILLING METHOD DRILL/DRIVE AIR ROTARY 10" CASING
DATE DRILLED 11/10/89
STATE ____ COUNTY ________ DESCRIPTIVE LOCATION ________
LOCATION: T____ R____ SECT.____ TRACT________
PAGE 1 OF 10

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GRAVELLY SILTY SAND: BROWN, FINE GRAINED, 30% SILT 10% GRAVEL
				5					
									GRAVELLY SILT: OLIVE BROWN, VERY FINE GRAINED 10% GRAVEL
				10					
									SANDY SILTY GRAVEL: OLIVE BROWN, VERY POORLY SORTED, 10% SAND 25% SILT.
				15					
									SILTY PEBBLY GRAVEL: GREY BROWN, POORLY SORTED 10% SILT 30% PEBBLES TO 30 mm.
				20					
				25					SAME
				30					SAME

REMARKS
DATE DRILLED
0-90' 11/10/89
90-180 11/13/89
180-195 11/14/89
195-225 11/15
225-300 11/16

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______
BORING NO. AV-MW-3
PROJECT NAME ______
LOGGED BY ______
DRILLING METHOD ______
DATE DRILLED 11/10/89
STATE ____ COUNTY ______ DESCRIPTIVE LOCATION ______
LOCATION: T____ R____ SECT.____ TRACT______
PAGE 2 OF 10

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									PEBBLY GRAVELLY SAND: REDDISH BROWN, 10% PEBBLES to 20mm, 20% GRAVEL.
				35					
									SANDY PEBBLY GRAVEL: GREY, 10% SAND 30% PEBBLES to 20mm.
				40					
									SAME
				45					
									PEBBLY GRAVELLY SAND: BROWN 10% PEBBLES 20% GRAVEL, WELL SORTED MEDIUM SAND.
				50					
									PEBBLY GRAVELLY SAND REDDISH BROWN 20% PEBBLES. 25% GRAVEL, RED MEDIUM SAND.
				55					
									PEBBLY GRAVELLY SAND: REDDISH BROWN, 20% PEBBLES 30% GRAVEL, FINE SAND.
				60					

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____
BORING NO. BV-CMW-3
PROJECT NAME ____
LOGGED BY ____
DRILLING METHOD ____
DATE DRILLED ____

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____

LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 3 OF 10

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									PEBBLY SAND: REDDISH BROWN, 10% PEBBLES WELL SORTED MEDIUM SAND.
				65					
				70					SAME
				75					SAME
				80					SAME
									PEBBLY SAND: BROWN, 10% PEBBLES TO 30mm POORLY SORTED MEDIUM & COARSE SAND
				85					
				90					SAME

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. EY-OMW-2
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED ______
STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ______
LOCATION: T ______ R ______ SECT. ______ TRACT ______ PAGE 4 OF 10

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				95					GRAVELLY SAND: BROWN: 20% GRAVEL MEDIUM SORTED MEDIUM BROWN SAND.
				100					SANDY PEBBLY GRAVEL: GREY-BROWN, VERY COARSE, 10% SAND 40% PEBBLES to 40mm.
				105					PEBBLY GRAVELLY SAND: GREY BROWN 10% PEBBLES 20% GRAVEL
				110					GRAVELLY SAND: RED, 20% GRAVEL. WELL SORTED, FINE RED SAND.
				115					PEBBLY GRAVELLY SAND, GREY BROWN, 20% PEBBLES to 20mm. 30% GRAVEL.
				120					SAME L

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____ BORING NO. EY-DMW-2
PROJECT NAME ____ LOGGED BY ____
DRILLING METHOD ____ DATE DRILLED ____
STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____
LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 5 OF 10

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				125					PEBBLY GRAVELLY SAND: GREY BROWN 20% PEBBLES to 30 mm 30% GRAVEL.
				130					SAME
				135					SAME
				140					SANDY GRAVEL: GREY BROWN, 20 % SAND WELL SORTED GRAVEL.
									SAME
				145					
				150					GRAVELLY SAND: REDDISH BROWN, 30% GRAVEL WELL SORTED. FINE RED SAND.

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______

BORING NO. BY-DMW-3

PROJECT NAME ______

LOGGED BY ______

DRILLING METHOD ______

DATE DRILLED ______

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ______

LOCATION: T ____ R ____ SECT. ____ TRACT ____

PAGE 6 OF 10

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GRAVELLY SAND: REDDISH BROWN, 10% GRAVEL WELL SORTED MEDIUM FEL SAND.
				155					
									PEBBLY GRAVELLY SAND: REDDISH BROWN, POORLY SORTED, MEDIUM SAND.
				160					
				165					SAME
				170					SAME
				175					SAME
									GRAVELLY SAND: REDDISH BROWN 20% GRAVEL WELL SORTED FINE TO MEDIUM FEL SAND.
				180					

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______
BORING. NO. AV-OMW-2
PROJECT NAME ______
LOGGED BY ______
DRILLING. METHOD ______
DATE DRILLED ______

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ______

LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 7 OF 10

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									PEBBLY GRAVELLY SAND: REDDISH BROWN
				185					20% PEBBLES, 30% GRAVEL, FINE SAND.
				190					SAME
				195					SAME
				200					SAME
									SAME
				205					
									SAME
				210					

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING. NO. AV-CMW-3
PROJECT NAME ______ LOGGED BY ______
DRILLING. METHOD ______ DATE DRILLED ______

STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ______ R ______ SECT. ______ TRACT ______ PAGE 8 OF 10

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GRAVELLY SILT: REDDISH BROWN, VERY FINE SILT to FINE SAND 10% GRAVEL.
				215					
									PEBBLY GRAVELLY SAND; REDDISH BROWN 70% PEBBLES ~20% GRAVEL. FINE RED SAND
				220					
									SAME
				225					
									SAME
				230					
									CLAYSTONE; RED, PEBBLES + GRAVEL [illegible] IN CUTTINGS
				235					
									SAME
				240					

REMARKS AT 235' TRANSITION BEGINS FROM GRAVELLY SANDS to CLAYSTONE CUTTINGS ~1/4 INCH QUITE UNIFORMLY.

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____________________ BORING NO. AV-OMW-2
PROJECT NAME ____________________ LOGGED BY ____________
DRILLING METHOD ____________________ DATE DRILLED ____________

STATE ____ COUNTY ________ DESCRIPTIVE LOCATION ____________________

LOCATION: T ______ R ______ SECT. ______ TRACT ________ PAGE 9 OF 10

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									CLAYSTONE: RED, EXTREMELY FINE GRAINED
				245					
				250					SAME
				255					SAME
				260					SAME
				265					SAME
				270					SAME

REMARKS RED CLAYSTONE CUTTINGS ~1/4 INCH MIXED W/ PEBBLES + GRAVEL.

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____________________
PROJECT NAME ____________________
DRILLING METHOD ____________________
BORING NO. BV-OMW-3
LOGGED BY ____________________
DATE DRILLED ____________________

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____________________

LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 10 OF 10

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GRAVELLY SAND: REDDISH BROWN, 10% GRAVEL VERY FINE GRAINED RED SAND.
				275					
				280					SAME
				285					SAME
				290					SAME
				295					SAME
				300					SAME

REMARKS THE WATER BEARING ZONE APPEARS TO BE CONTROLLED BY THE CLAYSTONE ZONE. THE FINE SAND-SILTSTONE MAY NOT BE A LARGE WATER PRODUCER.

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-20-89

RIG NO. ______ RIG TYPE Hole master WELL NO. DMW-3 TYPE monitor

JOB OWNER Provo city

LOCATION Bay view Land Fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Fill water truck			
					Put Bentonite in and pull			
					10" caseing to 20' grout and			
					install 8" surface pipe and make			
					cement pad.			
					move everything to lay down area.			
					get ready to set well's			
	5:30				Decon C-P-7000			

STAND BY TIME HRS. ______ HOURLY WORK HRS. 10 1/2

Signature of Owner or Representative ______

CASING USED: Size ______ Ft. Used ______ Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller	Helper	Helper

WELL COMPLETION LOG.

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 11/20/89

RIG NO. ______ RIG TYPE Hole master WELL NO. DMW-3 TYPE monitor

JOB OWNER Provo city

LOCATION Bay view

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
					Run in 280' 4½ P.V.C. Blank			
					20' 4½ Screen			
					Gravel pack from 300' to 265'			
					Bentonite seal from 265'-20'			
					grout from 20'-5'			
					Seal kreat from 5'-0'			
					10-20-sand			
					Drill + Drive 10" 0-165'			
					open Hole 165'-300'			
					Hit water at 275'			

STAND BY TIME HRS. ______ HOURLY WORK HRS. ______

Signature of Owner or Representative ______

CASING USED: Size ______ Ft. Used ______ Water G.P.M. 8

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller Master Peterson	Helper	Helper

WELL DEVELOPMENT

Project: BAYVIEW LANDFILL Well Number: DMW 3

Project Number: ______ Date: Nov 29 1989

Well inside diameter: 4.5 IN

Depth of bottom: 300 FT

Length of gravel pack: 25 FT

Diameter of gravel pack: 10 IN

Measured by: EDS

Recorded by: ______

Air temperature: 40 DegF

Weather condition: ______

WITHDRAWAL OF WELL VOLUMES

FLUSHING	Well Volume	Well Volume	Well Volume
Water level before	245.5		
Water level after			
Time begin flushing	12:00		
Time end flushing	15:00		
Time water level after			
Estimated volume flushed (GAL)	1000		

FIELD ANALYSIS	
Water temperature (DegC)	60 F
Sample pH	7.0
Sample conductivity (mhos/cm)	825
Buffer before	
Buffer after	
Odor	None
Color	Clear
Other	

COMMENTS

Attach photographs of water samples in labeled jars.

END OF SECTION

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-26-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. Omw-4 TYPE monitor

JOB OWNER Provo city

LOCATION Bay view LandfiLL

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:30					Haul caseing	Button	9 7/8"	1
		0	5		start to driLL + Drive 10" caseing			
		5	10		graveL + cobble's sand			
		10	15		" " "			
		15	25		" " "			
		25	35		" " "			
		35	45		" " "			
		45	55		" " "			
		55	65		" " "			
	4:30	65	75		" " "			

STAND BY TIME HRS. ______ HOURLY WORK HRS. 9

Signature of Owner or Representative ______

CASING USED: Size 10" Ft. Used 75 Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller Marty Peterson

Helper Mike -spindeLL

Helper Dick - H

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-27-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. Dmw-4 TYPE monitor

JOB OWNER provo city

LOCATION Bayview Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:30					Drill + Drive 10" caseing	Button	9 3/4	1
		75	85		gravel-sand-Bolders			
		85	95		gravel sand Bolders			
		95	105		" " "			
		105	115		" " "			
		115	125		" " "			
		125	135		" " "			
		135	145		" " "			
	5:00	145	150		" " "			

STAND BY TIME HRS. HOURLY WORK HRS. 9 1/2

Signature of Owner or Representative

CASING USED: Size 10" Ft. Used 75 Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

MISC.

Driller Marty Peterson	Helper Tim Ross	Helper Dick-H

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-28-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. DMW-4 TYPE monitor

JOB OWNER Provo city

LOCATION Bay view Land fiLL

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:30					not a thing would start But			
					C-P-7000.			
					finiley got thing's started			
		150			Drilled 10''			
			165		gravel - sand - Bolder's			
	2:30							

STAND BY TIME HRS. ______ HOURLY WORK HRS. 7

Signature of Owner or Representative ______

CASING USED: Size 10'' Ft. Used 15 Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller Martin Peterson	Helper Tim Ross	Helper

LOG OF EXPLORATORY BORING

~~PROJECT NO~~. DRILLER: MARTY PETERSON
BORING. NO. BV-DMW-4
PROJECT NAME BAYVIEW LANDFILL
LOGGED BY TOM MELCHAK
DRILLING. METHOD DRILL/DRIVE AIR ROTARY
DATE DRILLED
STATE COUNTY DESCRIPTIVE LOCATION
LOCATION: T R SECT. TRACT
PAGE 1 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				5					PEBBLY SILT: BROWN, FINE-GRAINED
				10					SANDY GRAVEL: GREY, MEDIUM SORTED, 30% SAND GRAVEL 2-4 mm
				15					PEBBLY, SANDY GRAVEL: GREY-BROWN 10% SAND PEBBLES TO [illegible] MEDIUM SORTED
				20					PEBBLY GRAVEL: GREY MEDIUM SORTED [illegible] COARSE ANGULAR
				25					PEBBLY GRAVEL: GREY, MEDIUM SORTED [illegible] COARSE ANGULAR. PEBBLES TO 40 mm (40%)
				30					PEBBLY, SANDY GRAVEL: GREY, MEDIUM SORTED

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____________________ BORING NO. BV-OMW-4

PROJECT NAME ____________________ LOGGED BY ____________________

DRILLING METHOD ____________________ DATE DRILLED ____________________

STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ____________________

LOCATION: T ______ R ______ SECT. ______ TRACT ______ PAGE 2 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									PEBBLY GRAVEL: GREY BROWN, MEDIUM SORTED PEBBLES to 25 mm
				35					
									GRAVELLY SAND: GREY, MEDIUM SORTED
				40					
									PEBBLY [illegible] SAND: BROWN, 30% GRAVEL
				45					
									GRAVELLY SAND: BROWN 40% GRAVEL
				50					
									PEBBLY GRAVEL: GREY ANGULAR, [illegible] SORTED, 30% PEBBLES to 30 mm.
				55					
									PEBBLY GRAVEL: GREY, WELL SORTED SUB-ANGULAR, PEBBLES to 30 mm.
				60					

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____________________ BORING NO. BV-OMW-4
PROJECT NAME ____________________ LOGGED BY ____________________
DRILLING METHOD ____________________ DATE DRILLED ____________________

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____________________

LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 3 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				65					GRAVEL: GREY VERY WELL SORTED. SUB-ANGULAR UNIFORM PEBBLE [illegible].
				70					SANDY GRAVEL: GREY, MEDIUM SORTED 40% SAND.
				75					GRAVELLY SAND: BROWN WELL SORTED. SUB-ANGULAR TO ROUNDED [illegible] COARSE SAND.
				80					SANDY GRAVEL: BROWN POORLY SORTED 30% SAND.
				85					PEBBLY GRAVEL: BROWN, POORLY SORTED ANGULAR, VERY LARGE PEBBLE TO 20MM.
				90					PEBBLY SANDY GRAVEL: REDDISH BROWN. POORLY SORTED, ANGULAR. LARGE PEBBLE TO [illegible]

REMARKS REDDISH BROWN COLOR BEGINS AT 90' SAMPLE, COLOR REMAINS THROUGHOUT BOREHOLE [illegible]

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. BV-CMW-4
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED ______

STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ______ R ______ SECT. ______ TRACT ______ PAGE 4 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GRAVELLY SAND: REDDISH BROWN, WELL SORTED
				95					VERY COARSE SAND.
									GRAVELLY SAND: REDDISH BROWN MODERATELY SORTED
				100					MEDIUM SAND.
									PEBBLY GRAVELLY SAND: REDDISH BROWN MEDIUM
				105					SORTED 30% GRAVEL PEBBLES TO 40mm
									GRAVELLY SAND. REDDISH BROWN, POORLY SORTED
				110					30% GRAVEL MEDIUM TO FINE SAND.
									SAND: REDDISH BROWN, WELL SORTED,
				115					MEDIUM SAND.
									GRAVELLY SAND: REDDISH BROWN, MEDIUM SORTED
				120					10% GRAVEL, MEDIUM SAND.

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. BV-CMW-4
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED ______

STATE ____ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 5 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									PEBBLY GRAVELLY SAND: REDDISH BROWN, POORLY
				125					SORTED, 20% GRAVEL, MEDIUM SAND.
									SANDY
									GRAVEL: REDDISH BROWN, WELL SORTED,
				130					3-6 mm PARTICLES. 20% SAND.
									GRAVELLY SAND: REDDISH BROWN WELL SORTED
				135					10% GRAVEL MEDIUM SAND.
									GRAVEL: REDDISH BROWN, MEDIUM SORTED
				140					SUB-ROUNDED, 2-5 mm
									SANDY GRAVEL: REDDISH BROWN POORLY SORTED
				145					10% SAND.
									PEBBLY GRAVEL: REDDISH BROWN, POORLY SORTED
				150					ANGULAR, PEBBLES to 20 mm.

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. BV-OMW-4
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED ______

STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ______ R ______ SECT. ______ TRACT ______ PAGE 6 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				155					PEBBLY GRAVEL: REDDISH BROWN, POORLY SORTED ANGULAR, PEBBLES to 20mm
				160					SAND: REDDISH BROWN, MEDIUM SORTED MEDIUM to COARSE SAND,
				165					PEBBLY GRAVEL: REDDISH BROWN, POORLY SORTED PEBBLES to 20 mm.
				170					SANDY PEBBLY GRAVEL: REDDISH BROWN, VERY POORLY SORTED 10% SAND PEBBLES to 20mm
				175					GRAVELLY SAND: REDDISH BROWN POORLY SORTED 20% GRAVEL 6-8mm.
				180					GRAVELLY SAND: REDDISH BROWN, MEDIUM SORTED 10% GRAVEL

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. B1-OMW-4
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED ______
STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ______
LOCATION: T ______ R ______ SECT. ______ TRACT ______ PAGE 7 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				185					GRAVELLY SAND: REDDISH BROWN WELL SORTED 20% GRAVEL, FINE SAND.
				190					GRAVELLY, PEBBLY SAND: REDDISH BROWN POORLY SORTED, LARGE PEBBLES to 40mm.
				195					SANDY PEBBLY GRAVEL: VARIEGATED COLOR, POORLY SORTED 10% SAND PEBBLES to [illegible]

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-2-89 11-3-89

RIG NO. 10 **RIG TYPE** Failing **WELL NO.** Cmw-4, 2 **TYPE** monitoring

JOB OWNER Provo City

LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Th 11-2			
					Haul casing To drill rig.			
					change oil on rig.			
					drld from 75'-165'			
	4:30				Take fuel line off comp.	9½ hrs		
7:00					Fri 11-3			
					Put new fuel line on Comp			
					drld from 165'-240'. Haul			
	5:00				10" casing To drill rig.	10 hrs		

STAND BY TIME HRS. ____________ **HOURLY WORK HRS.** ____________

Signature of Owner or Representative ____________

CASING USED: Size ____________ **Ft. Used** ____________ **Water G.P.M.** ____________

CASING USED: Size ____________ **Ft. Used** ____________ **Water Static** ____________

DRILLING MUD: Type ____________ **Amount** ____________ **Fuel** ________ **Oil** ________

MISC.

Driller	**Helper**	**Helper**

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 10-31-84 thru 11-1-84

RIG NO. #10 RIG TYPE Failing WELL NO. DMW-1C, 4, 2 TYPE monitoring

JOB OWNER Provo City

LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					M 10-30			
					Take tire off forklift. Move			
					drill rig off hole DMW-4. Set			
					Jacks and Comp. rig on hole #			
					DMW-1C. Complete hole from 45'-			
	5:30				0 and Install surface completion.	10½ hrs		
7:00					T 10-31			
					Set Jacks and Comp. rig on hole			
					#DMW-4. Set 7000 on hole #			
	4:30				DMW-2 and drill from 0-45'.	9½ hrs		
7:00					W 11-1 On hole #DMW-4			
					Set 195' of PVC in hole and			
					Complete hole from 195'-30'			
					load casing on boom truck and			
	4:00				load with drill pipe	9 hrs		

STAND BY TIME HRS. ____ HOURLY WORK HRS. ____

Signature of Owner or Representative ____

CASING USED: Size ____ Ft. Used ____ Water G.P.M. ____

CASING USED: Size ____ Ft. Used ____ Water Static ____

DRILLING MUD: Type ____ Amount ____ Fuel ____ Oil ____

MISC.

Driller	Helper Tim Ross	Helper Steve Montague

WELL DEVELOPMENT

Project: BAYVIEW LANDFILL　Well Number: DMW-4

Project Number: ________　Date: 11-12-89

Well inside diameter: 4½ IN

Depth of bottom: 195 FT

Length of gravel pack: 25 FT

Diameter of gravel pack: 10-20 IN

Measured by: M. PETERSON

Recorded by:

Air temperature: 42 DegF

Weather condition: Fair + Sunny + clear

WITHDRAWAL OF WELL VOLUMES

FLUSHING	Well Volume	Well Volume	Well Volume
Water level before	175'-6"		
Water level after	175'		
Time begin flushing	9:15		
Time end flushing	11:15		
Time water level after	11:45		
Estimated volume flushed (GAL)	8 Gal Per min.		

FIELD ANALYSIS			
Water temperature (DegC)	60		
Sample pH	7		
Sample conductivity (mhos/cm)	475		
Buffer before	—		
Buffer after	—		
Odor	None		
Color	clear		
Other			

COMMENTS

THIS WELL PRODUCED VERY GOOD VOLUME

Attach photographs of water samples in labeled jars.

END OF SECTION

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-8-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. DMW-5 TYPE monitor

JOB OWNER Provo city

LOCATION Bayview Land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Drill & Drive 10" caseing	Button	9½	1
		0	5		sand & silt			
		5	15		gravel & sand			
		15	30		gravel & cobble's			
		30	45		gravel - " + sand			
		45	60		gravel - " sand			
		60	75		gravel - " sand			
		75	90		gravel - " sand			
		90	105		gravel - " sand			
	5:00	105	120		gravel - " sand			

STAND BY TIME HRS. HOURLY WORK HRS. 10

Signature of Owner or Representative

CASING USED: Size 10" Ft. Used 120 Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

MISC.

Helper Helper

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11- 9-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. Dmw-5 TYPE monitor

JOB OWNER Provo city

LOCATION Bay view land fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Drilling & Driveing 10" caseing	Button	9½	1
		120	135		gravel & sand cobble's			
		135	150		gravel & sand "			
		150	165		gravel & sand "			
		165	175		gravel & sand "			
		175	180		moist sand & gravel cobble's			
		180	185		water gravel sand & fractures			
		185	195		water gravel sand & fractures			
		195	210		water gravel sand fractures			
					Drilled from 195'-210 open Hole			
					pull Drill pipe and move Rig			
	5:00				to Dmw-3.			

STAND BY TIME HRS. HOURLY WORK HRS. 10

Signature of Owner or Representative

CASING USED: Size Ft. Used Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

Driller Helper Helper

LOG OF EXPLORATORY BORING

~~PROJECT NO~~. DRILLER: MARTY PETERSON
BORING. NO. BV-DMW-5
PROJECT NAME BAYVIEW LANDFILL - FROVO CITY
LOGGED BY T. BELCHAK
DRILLING. METHOD AIR ROTARY DRILL/DRIVE 10" CASING
DATE DRILLED 10/8/89
STATE____ COUNTY________ DESCRIPTIVE LOCATION ________
LOCATION: T_____ R _____ SECT. _____ TRACT_______
PAGE 1 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									SILT: OLIVE, WELL SORTED, FINE GRAINED
				5					
									PEBBLY SILTY GRAVEL: GREY VERY POORLY
				10					SORTED 10% PEBBLES TO 30mm. 20% SILT.
									PEBBLY GRAVELLY SILT: GREY POORLY SORTED
				15					10% PEBBLES 20% GRAVEL VERY [illegible] SILT
									CONCRETE-LIKE CONSISTENCY
				20					SAME
									PEBBLY GRAVELLY SAND: BROWN-GREY, VERY POORLY
				25					SORTED 10% PEBBLES, MEDIUM-COARSE SAND.
									PEBBLY SANDY GRAVEL: BROWN 20% PEBBLES
				30					TO 40mm 30% SAND.

REMARKS DRILLED 10/8 + 10/9/89

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______
PROJECT NAME ______
DRILLING METHOD ______
BORING NO. BV-OMW-5
LOGGED BY ______
DATE DRILLED 10/8/89
STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ______
LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 2 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				35					SAME
				40					SAME
				45					SAME
				50					PEBBLY GRAVELLY SILT: OLIVE BROWN, POORLY SORTED 10% PEBBLES to 30mm, 20% GRAVEL, 70% OLIVE SILT.
				55					PEBBLY SILTY GRAVEL: BROWN, POORLY SORTED 10% PEBBLES to 30mm, 30% SILT
				60					SAME SC

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____________ BORING. NO. BV-CMW-5
PROJECT NAME ____________ LOGGED BY ____________
DRILLING. METHOD ____________ DATE DRILLED ____________
STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____________
LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 3 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				65					SAME
				70					PEBBLY SILTY GRAVEL: REDDISH BROWN, POORLY SORTED, 5% PEBBLES to 30mm, 30% SILT.
				75					SILTY GRAVELLY PEBBLES: GREY, PEBBLES RELATIVELY UNIFORM SIZE 20-30mm, 5% SILT 20% GRAVEL
				80					SAME
				85					SAME
				90					PEBBLY GRAVELLY SAND: REDDISH BROWN, POORLY SORTED, 10% PEBBLES, 20% GRAVEL, REC MEDIUM TO COARSE SAND.

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO.
PROJECT NAME
DRILLING METHOD

BORING NO. AV-DMW-5
LOGGED BY
DATE DRILLED 11/8/89

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____

LOCATION: T ____ R ____ SECT. ____ TRACT ____

PAGE 4 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				95					PEBBLY GRAVELLY SAND: REDDISH BROWN, POORLY SORTED 10% PEBBLES, 20% GRAVEL MEDIUM & COARSE RED SAND.
				100					SAME
				105					SAME
				110					SAME
				115					SAME
				120					SAME

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______________________
PROJECT NAME ______________________
DRILLING METHOD ______________________
BORING NO. BV-OMW-5
LOGGED BY ______________________
DATE DRILLED 11/9/89

STATE ____ COUNTY ________ DESCRIPTIVE LOCATION ______________________

LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 5 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GRAVELLY SAND: BROWN, MEDIUM SORTED 20% GRAVEL, MEDIUM + COARSE BED SAND
				125					
				130					SAME
				135					SAME
				140					SAME
									PEBBLY GRAVELLY SAND: BROWN, POORLY SORTED 10% PEBBLES, 30% GRAVEL, MEDIUM + COARSE BED SAND
				145					
				150					SAME

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______
PROJECT NAME ______
DRILLING METHOD ______
BORING NO. B1-CMW-5
LOGGED BY ______
DATE DRILLED ______

STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ______ R ______ SECT. ______ TRACT ______

PAGE 6 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				155					SAME
				160					PEBBLY GRAVELLY SAND: REDDISH BROWN, 5% PEBBLES 10% GRAVEL, MEDIUM [illegible] FINE [illegible] SAND
				165					PEBBLY GRAVELLY SAND: BROWN. 5% PEBBLES 20% GRAVEL MEDIUM TO COARSE [illegible] SAND.
				170					SAME
				175					SAME
				180					SAME

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____ BORING NO. AV-DMW-5
PROJECT NAME ____ LOGGED BY ____
DRILLING METHOD ____ DATE DRILLED ____
STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____
LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 7 OF 7

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				185					SAME
				190					SAME
				195					SAME
				200					SAME
				205					PEBBLY GRAVELLY SAND: REDDISH [illegible] 5% PEBBLES 10% GRAVEL WELL SORTED FINE RED SAND
				210					SAME

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

11-9-84
Date 11-10-84

RIG NO. #10 RIG TYPE Failing WELL NO. SMW-1,5,6 TYPE monitoring

JOB OWNER Provo City

LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					11-9-84			
					Develope holes, SMW-1,5,6.			
					Move drill rig off hole DMW-5			
	5:00				and set Jacks on hole.	10hrs		
7:00					11-10-84 On hole DMW-5			
					Set pvc in hole To 210'			
		210'			Install completion from 210'-			
5:00			50'	160'	50'. Haul casing to drill rig.	10hrs		

STAND BY TIME HRS. ______ HOURLY WORK HRS. ______

Signature of Owner or Representative ______

CASING USED: Size ______ Ft. Used ______ Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller

Helper Tim Ross

Helper Steve Montague

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 11-13-89

RIG NO. #10 RIG TYPE Failing WELL NO. DMW-5 TYPE monitoring

JOB OWNER Provo City

LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Finish Completion on hole DMW5			
					from 50'-0. Install surface			
					completion.			
					Go To Trojan and pick up 2"			
	4:30				pipe and Take back To bayview			

STAND BY TIME HRS. ______ HOURLY WORK HRS. 9½ hrs

Signature of Owner or Representative ______

CASING USED: Size ______ Ft. Used ______ Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller	Helper	Helper

WELL DEVELOPMENT

Project: BAYVIEW LANDFILL Well Number: Dmw-5

Project Number: ______ Date: 11-21-89

Well inside diameter: 4 1/2 IN

Depth of bottom: 211 FT

Length of gravel pack: 25 FT

Diameter of gravel pack: 10-20 SAND IN

Measured by: M. PETERSON

Recorded by: Duane A. [illegible]

Air temperature: 55 DegF

Weather condition: Fair but Hazey

WITHDRAWAL OF WELL VOLUMES

FLUSHING	Well Volume	Well Volume	Well Volume
Water level before	178'-6"		
Water level after	178'		
Time begin flushing	15:45		
Time end flushing	16:25		
Time water level after	16:45		
Estimated volume flushed (GAL)	10 per min.		

FIELD ANALYSIS			
Water temperature (DegC)	58		
Sample pH	7		
Sample conductivity (mhos/cm)	480		
Buffer before	—		
Buffer after	—		
Odor	None		
Color	Clear		
Other			

COMMENTS

THE AQUIFER IN THIS WELL CONSISTED OF VERY COARSE GRAVEL AND PRODUCED A VERY GOOD VOLUME OF WATER.

Attach photographs of water samples in labeled jars.

END OF SECTION

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-7-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. DMW-6 TYPE Monitor

JOB OWNER Provo city

LOCATION Bayview Landfill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					put air filter in comp.	Button	10	1
					and start to drill + Drive 10"			
		0	5		sand + silt			
		10	20		Gravel + Sand			
		20	30		Gravel Sand + silt			
		30	40		Gravel Sand			
		40	50		Gravel sand			
		50	55		hard pan + Gravel			
		55	60		Gravel + Sand			
	3:30	60	75		Gravel + Sand			

STAND BY TIME HRS. ______ HOURLY WORK HRS. 8 1/2

Signature of Owner or Representative ______

CASING USED: Size 10 Ft. Used 75 Water G.P.M. ______

CASING USED: Size ______ Ft. Used ______ Water Static ______

DRILLING MUD: Type ______ Amount ______ Fuel ______ Oil ______

MISC.

Driller Martin Peterson	Helper Mike spindell	Helper

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-9-89

RIG NO. 7 RIG TYPE C-P-7000 WELL NO. OMW-6 TYPE monitor

JOB OWNER Provo city Corp.

LOCATION Bayview Landfill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Load Drill pipe in caseing	Button	10	1
					haul 6 Joints to the rig			
					fill water truck. work on			
					aux air comp. try to get more			
					air.			
		75	90	15	cemented gravel + sand			
		90	105	15	cemented gravel + sand			
	6:00							

STAND BY TIME HRS. HOURLY WORK HRS. 11

Signature of Owner or Representative

CASING USED: Size 10 Ft. Used 30 Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

MISC.

Driller [illegible] | Helper [illegible] | Helper [illegible]

DAVE'S DRILLING

577 West 3410 South
Salt Lake City, Utah 84115
(801) 263-9099

Date 10-10-89

RIG NO. 2 RIG TYPE C-P-7000 WELL NO. nmw-6 TYPE Monitor

JOB OWNER Provo city

LOCATION Bay view Land Fill

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
7:00					Fuel up Equipment	Button	9¾	1
					Drilling + Driveing 10"			
		105	120		Cemented gravel + sand			
		120	135		mud stone + sand-Gravel			
		135	140		cemented gravel + sand.			
		140	150		water Fractured cemented gravel-sand			
		150	165		cemented gravel + water			
					clean hole and pull Drill pipe			
					move Rig to Decon. Load D. P. and			
					10" caseing onto water truck. take			
					it to Decon. unload. went to			
					# 5-6 Load 12" caseing.			
	6:00				move rig to s mw-#4			

STAND BY TIME HRS. HOURLY WORK HRS. 11

Signature of Owner or Representative

CASING USED: Size 10" Ft. Used 45 Water G.P.M.

CASING USED: Size Ft. Used Water Static

DRILLING MUD: Type Amount Fuel Oil

MISC.

drilled from 150' to 165' open hole

Driller Marty Peterson	Helper Tom carlson	Helper

LOG OF EXPLORATORY BORING

~~PROJECT NO.~~ [illegible]
BORING NO. BY-OMW-2
PROJECT NAME BAYVIEW LANDFILL
LOGGED BY [illegible]
DRILLING METHOD DRILL/DRIVE AIR ROTARY 10" CASING
DATE DRILLED 10-7-[illegible], 83
STATE ____ COUNTY ____ DESCRIPTIVE LOCATION EAST OF Berm 3
LOCATION: T ____ R ____ SECT. ____ TRACT ____
PAGE 1 OF 2

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									SILT: BROWN, WELL SORTED, VERY COHESIVE
				5					FINE-GRAINED
									SILTY PEBBLY GRAVEL: BROWN, VERY POORLY SORTED
				10					PEBBLES TO 60 mm.
									PEBBLY GRAVELLY SILT: BROWN, POORLY SORTED
									PEBBLES to 20mm. SILT IS VERY COHESIVE
									PEBBLY SILTY GRAVEL: BROWN, POORLY SORTED
				20					MANY LARGE PEBBLES to 50mm, 30% SILT.
									PEBBLY GRAVEL: GREY-BROWN, MEDIUM SORTED
				25					(20mm) (3-5mm) NO FINES, WELL WASHED
									SANDY SILT: BROWN, WELL SORTED, FINE
				30					GRAINED, COHESIVE WHEN WET.

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______
BORING. NO. EV-DMW-6
PROJECT NAME ______
LOGGED BY ______
DRILLING METHOD ______
DATE CRILLED ______

STATE ____ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ____ R ____ SECT. ____ TRACT ______ PAGE 2 OF 6

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				35					PEBBLY SILTY GRAVEL: BROWN, POORLY SORTED VERY ABUNDANT SILT 30% PEBBLES 10%
				40					PEBBLY GRAVEL: GREY, MEDIUM SORTED (2-4mm)
				45					PEBBLY GRAVEL: GREY MEDIUM SORTED (4-6mm)
				50					PEBBLY GRAVELLY SAND: BROWN-GREY, MEDIUM SORTED, PEBBLES TO 30 mm.
				55					GRAVELLY CLAYEY SILT: BROWN, VERY POORLY SORTED VERY FINE GRAINED.
				60					PEBBLY GRAVEL: GREY-BROWN, MEDIUM SORTED (3-8 mm) ROUNDED PARTICLES

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. EV-CWM-6
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED ______

STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ______ R ______ SECT. ______ TRACT ______ PAGE 3 OF 6

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									GREY SILTY PEBBLY GRAVEL: BROWN, VERY POORLY SORTED.
				65					
									PEBBLY SANDY GRAVEL: GREY BROWN, POORLY SORTED, SOME FINES
				70					
									SANDY PEBBLES: GREY, POORLY SORTED, VERY COARSE
				75					
									PEBBLY GRAVELLY SAND: REDDISH BROWN, MEDIUM SORTED
				80					
									PEBBLY SANDY GRAVEL: REDDISH BROWN, POORLY SORTED, SUBANGULAR to ROUNDED.
				85					
									SANDY GRAVEL: REDDISH BROWN, POORLY SORTED.
				90					

REMARKS

AFTER 75' LITHOLOGY CHANGES DRAMATICALLY IN COLOR AND TEXTURE. REDDISH BROWN, SANDY MATERIAL WITH LITTLE OR NO FINES.

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ______ BORING NO. BV-CMW-6
PROJECT NAME ______ LOGGED BY ______
DRILLING METHOD ______ DATE DRILLED ______

STATE ______ COUNTY ______ DESCRIPTIVE LOCATION ______

LOCATION: T ______ R ______ SECT. ______ TRACT ______ PAGE 4 OF 6

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									PEBBLY SANDY GRAVEL: REDDISH BROWN
				95					
									GRAVELLY SAND: REDDISH BROWN, MEDIUM SORTED
				100					
									PEBBLY GRAVELLY SAND: REDDISH BROWN, POORLY SORTED
				105					
									SAND: REDDISH BROWN, WELL SORTED
				110					
									SAND: REDDISH BROWN MEDIUM SORTED
				115					
									PEBBLY GRAVEL: GREYISH BROWN, POORLY SORTED PEBBLES TO 30 MM.
				120					

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO. ____________ BORING. NO. RV-CMW-6
PROJECT NAME ____________ LOGGED BY ____________
DRILLING. METHOD ____________ DATE DRILLED ____________

STATE ____ COUNTY ____ DESCRIPTIVE LOCATION ____

LOCATION: T ____ R ____ SECT. ____ TRACT ____ PAGE 5 OF 6

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
									PEBBLY SAND: REDDISH BROWN. POORLY SORTED PEBBLES to 20 mm.
				125					
									SILTY PEBBLY GRAVEL: BROWN. POORLY SORTED PEBBLES to 30 mm.
				130					
									GRAVELLY SAND: REDDISH BROWN MEDIUM SORTED
				135					
									SILTY GRAVELLY SAND: REDDISH BROWN VERY POORLY SORTED SOME PEBBLES
				140					
									GRAVELLY SAND: REDDISH BROWN
				145					
									GRAVELLY SAND: REDDISH BROWN
				150					

REMARKS

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

LOG OF EXPLORATORY BORING

PROJECT NO.
BORING NO. BV-OMW-6
PROJECT NAME
LOGGED BY
DRILLING METHOD
DATE DRILLED
STATE COUNTY DESCRIPTIVE LOCATION
LOCATION: T R SECT. TRACT
PAGE 6 OF 6

HEAD SPACE USING (PPM)		PENETRATION BLOW COUNT	SAMPLE TYPE	DEPTH IN FEET	SAMPLES	SAMPLE SYMBOL	LITHOGRAPHIC COLUMN	WATER LEVEL	LITHOLOGIC DESCRIPTION
				155					GRAVELLY SAND: BROWNISH RED 10% GRAVEL
				160					GRAVELLY SAND: BROWNISH RED, ROUNDED, MEDIUM SORTED. 10% GRAVEL
				165					GRAVELLY SAND: BROWNISH RED ROUNDED MEDIUM SORTED 10% GRAVEL
				170					PEBBLY. SANDY GRAVEL: BROWNISH RED, POORY SORTED LARGE PEBBLES TO 60 mm.

REMARKS
COLOR CHANGE AT 155' & 170' MORE RED
COLOR IN SAND SAMPLES.

Exploratory & Monitor
Well Drilling

DAVE'S DRILLING COMPANY

DAVE'S DRILLING

5617 W. Wells Park Road
Salt Lake City, Utah 84088
(801) 569-2000

Date 10-12-89

RIG NO. 10 RIG TYPE Failing WELL NO. DMW - 6 TYPE monitoring

JOB OWNER Provo City

LOCATION Bayview

TIME		DEPTH		DRILLING INFORMATION		BIT		
Start	Stop	From	To	Ft.	Log or Remarks	Type	Size	No.
					Install 1' of blank 4½" pvc,			
					20' of 4½" screen and 145' of			
		166'			blank 4½" pvc To 166'			
					Install silica sand from			
					166' - 140'			
					Install coarse bentonite from			
					140' - 20'			
					Install neat cement from 20'-			
			0	166'	5' and concrete from 5'-0.			
					Install surface completion			

STAND BY TIME HRS. ____ HOURLY WORK HRS. ____

Signature of Owner or Representative ____

CASING USED: Size ____ Ft. Used ____ Water G.P.M. ____

CASING USED: Size ____ Ft. Used ____ Water Static ____

DRILLING MUD: Type ____ Amount ____ Fuel ____ Oil ____

MISC.

Driller	Helper	Helper

WELL DEVELOPMENT

Project: BAYVIEW LANDFILL Well Number: Dmw-6

Project Number: ______ Date: 11-21-89

Well inside diameter: 4 1/2 IN

Depth of bottom: 169.2" FT

Length of gravel pack: 25 FT

Diameter of gravel pack: 10-20 SAND IN

Measured by: M. PETERSON

Recorded by: Thomas A. Belohlt

Air temperature: 56 DegF

Weather condition: Sunny & clear Little Haze

WITHDRAWAL OF WELL VOLUMES

FLUSHING	Well Volume	Well Volume	Well Volume
Water level before	139'		
Water level after	139		
Time begin flushing	13:02		
Time end flushing	13:59		
Time water level after	14:20		
Estimated volume flushed (GAL)	8-Gal per min		

FIELD ANALYSIS	
Water temperature (DegC)	60°f
Sample pH	7
Sample conductivity (mhos/cm)	471
Buffer before	—
Buffer after	—
Odor	None
Color	clear
Other	

COMMENTS

THIS WELL RECOVERED MORE RAPIDLY AFTER DEVELOPMENT THAN ANY OTHER WELL DRILLED FOR THIS PROJECT.

Attach photographs of water samples in labeled jars.

END OF SECTION

K+E 5 X 5 TO THE CENTIMETER 18 X 24 CM
KEUFFEL & ESSER CO. MADE IN U.S.A.

[illegible] Dale H Carpenter

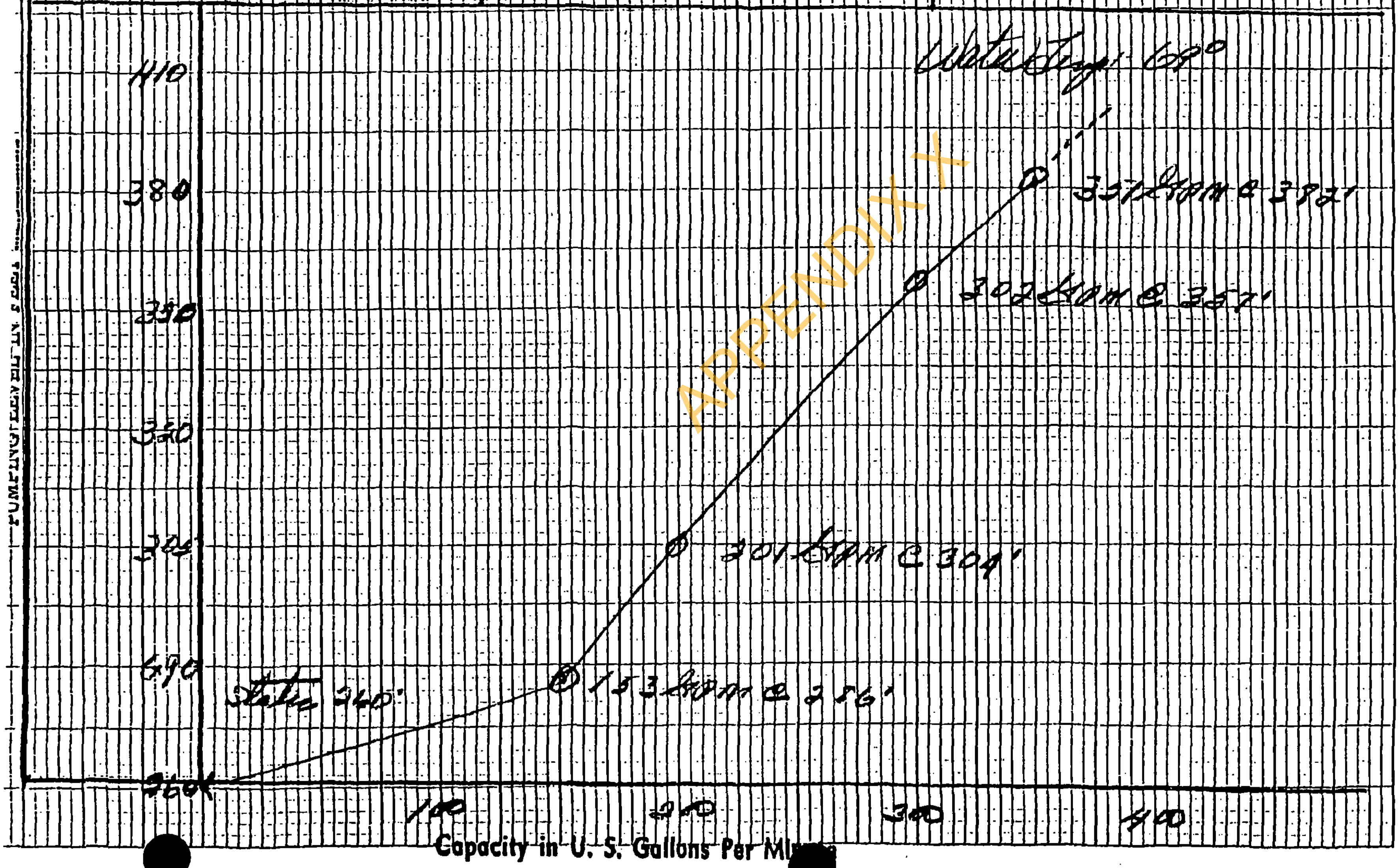
Field Copy of Well Test, Application No. ....

Test Conducted by Rhodes Bros.; Fillmore, Utah — 743-6277

Job Name [illegible]
Location [illegible] UT
Date of Test 9-27-1984
Well Size 18" ID
Well Depth 510'
Static 240'
Perforations 360' to 443'
405 to 500'

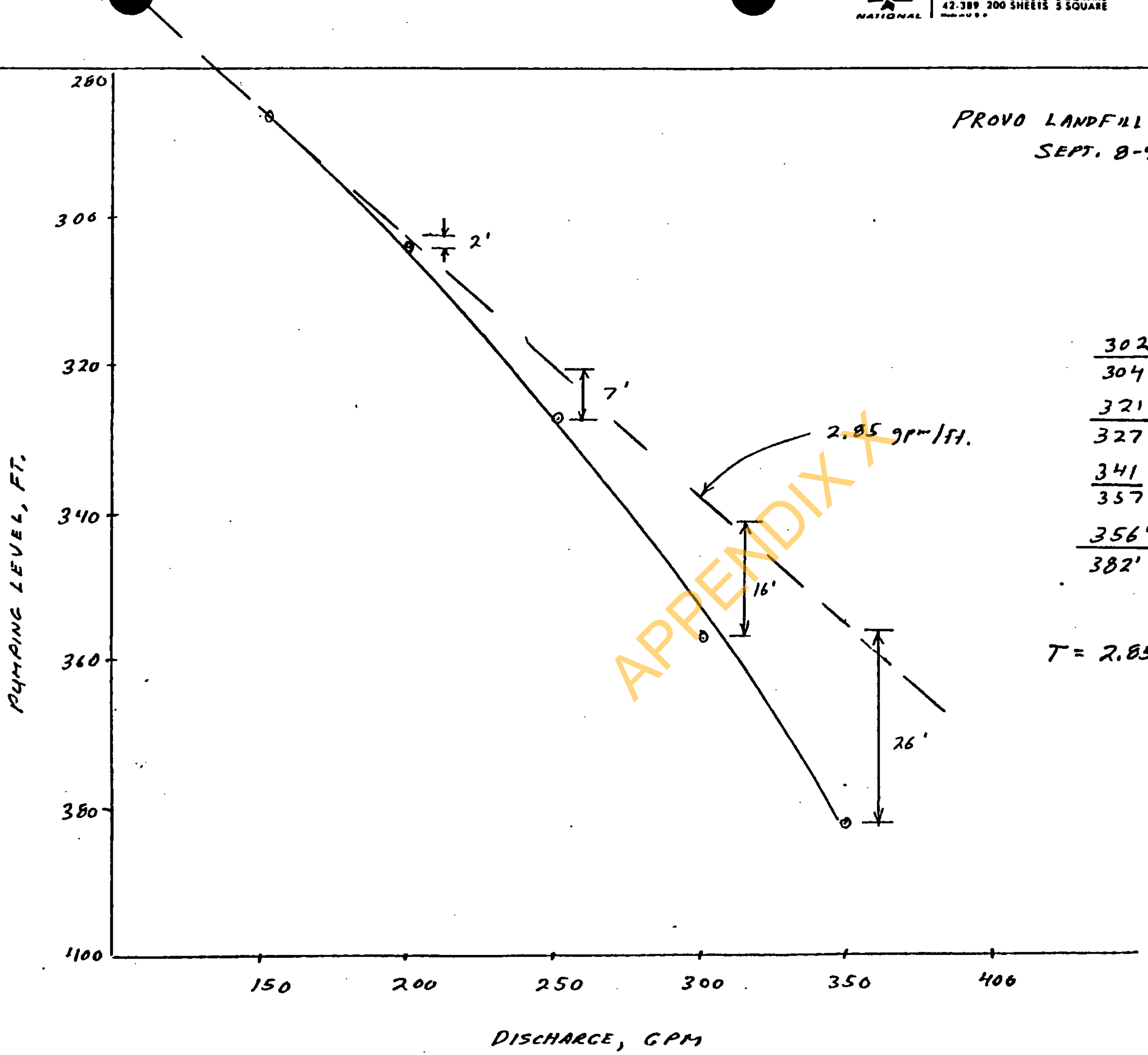
Driller [illegible] Drilling
Column Size 6" Bowl Size 12
No. Hours Pumped 39
Feet of Drawdown from Static ....
Drawdown Measured with Airline
Gallons Per Ft. of Drawdown ....
Pump Setting 400'

Remarks Water Cleared [illegible] of Pumping Period.



Capacity in U. S. Gallons Per Minute

PROVO LANDFILL SITE WELL
SEPT. 8-9, 1986



$\frac{302}{304}$ @ 200 gpm = 0.993

$\frac{321}{327}$ @ 250 gpm = 0.982

$\frac{341}{357}$ @ 300 gpm = 0.955

$\frac{356'}{382'}$ @ 350 gpm = 0.932

T = 2.85 × 2000 = 5,700 gpd/ft.

Landfill Well

Pumping Test

CHC 9/10/86

CHEMTECH
CHEMICAL AND BACTERIOLOGICAL ANALYSES

367 SOUTH COMMERCE LOOP
OREM, UTAH 84057
(801) 226-8822

2875 MAIN
SUITE #101
SALT LAKE CITY, UTAH 84115
(801) 483-1163

CERTIFICATE OF ANALYSIS

SAMPLE IDENTIFICATION

CLIENT: Provo City Water Dept.
Provo, UT 84601

LAB NO.: U014828

DATE SAMPLED: 9-9-86

TIME SAMPLED: 0940

SAMPLED BY: CHC

LOCATION: Land Fill Site, Well Discharge
Pipe (dis = 350 gpm)

COMMENTS:

PARAMETER	LEVEL
Alkalinity as $CaCO_3$, mg/l	308
Ammonia as NH_3-N, mg/l	11.1
Arsenic as As, mg/l	<.01 ✓
Barium as Ba, mg/l	0.022 ✓
Bicarbonate as HCO_3, mg/l	375
Boron as B, mg/l	0.19 ✓
Cadmium as Cd, mg/l	<.01 ✓
[illegible]lcium as Ca, mg/l	72
Carbonate as CO_3, mg/l	0

PARAMETER	LEVEL
Chloride as Cl, mg/l	57.6 ✓
Chromium as Cr (Hex.), mg/l	<.01 ✓
Chromium as Cr (Total), mg/l	<.01 ✓
Conductivity, umhos/cm	676
Copper as Cu, mg/l	0.085 ✓
Fluoride as F, mg/l	0.72 ✓
Hardness as $CaCO_3$, mg/l	138
Hydroxide as OH, mg/l	0
Iron as Fe (Dissolved), mg/l	0.082 ✓
Iron as Fe (Total), mg/l	0.3[illegible]
Lead as Pb, mg/l	0.045 ✓
Magnesium as Mg, mg/l	13.3
Manganese as Mn, mg/l	<.01 ✓
Mercury as Hg, mg/l	0.0018
Nickel as Ni, mg/l	<.01
Nitrate as NO_3-N, mg/l	1.60 ✓
Nitrite as NO_2-N, mg/l	<.005 ✓
Phosphate as PO_4-P, mg/l	0.018
Potassium as K, mg/l	15.2
Selenium as Se, mg/l	<.002 ✓
Silica as SiO_2 (Dissolved), mg/l	70.2
Silver as Ag, mg/l	<.01 ✓
Sodium as Na, mg/l	82.4
Sulfate as SO_4, mg/l	60.3 ✓
Total Dissolved Solids, mg/l	614 ✓
Turbidity, NTU	0.[illegible] ✓
Zinc as Zn, mg/l	0.082 ✓
pH Units	8.08 ✓

Positive $CaCO_3$ saturation index (Langlier)

Page 3 of 4

Test Well Request

Form 113—934—1240

Examined ....

Recorded: B. C. .... T. B. ....

Inspection Sheet ....

Copied ....

REPORT OF WELL DRILLER

STATE OF UTAH

Application No. 86-53/1-TW

Claim No. ....

Coordinate No. ....

GENERAL STATEMENT: Report of well driller is hereby made and filed with the State Engineer, in accordance with the laws of Utah. (This report shall be filed with the State Engineer within 30 days after the completion or abandonment of the well. Failure to file such reports constitutes a misdemeanor.)

(1) WELL OWNER:

Name Provo City Water and Waste Water

Address ....

(2) LOCATION OF WELL:

County .... Ground Water Basin .... (leave blank)

North / South .... feet, East / West .... feet from .... Corner

of Section ...., T. .... N / S, R. .... E SLBM / W USM (strike out words not needed)

(3) NATURE OF WORK (check):

New Well ☐

Replacement Well ☐ Deepening ☐ Repair ☐ Abandon ☐

If abandonment, describe material and procedure: ....

(4) NATURE OF USE (check):

Domestic ☐ Industrial ☐ Municipal ☐ Stockwater ☐

Irrigation ☐ Mining ☐ Other ☐ Test Well ☐

(5) TYPE OF CONSTRUCTION (check):

Rotary ☐ Dug ☐ Jetted ☐

Cable ☐ Driven ☐ Bored ☐

(6) CASING SCHEDULE: Threaded ☐ Welded ☐

......" Diam. from .... feet to .... feet Gage ....

......" Diam. from .... feet to .... feet Gage ....

......" Diam. from .... feet to .... feet Gage ....

New ☐ Reject ☐ Used ☐

(7) PERFORATIONS: Perforated? Yes ☐ No ☐

Type of perforator used ....

Size of perforations .... inches by .... inches

.... perforations from .... feet to .... feet

.... perforations from .... feet to .... feet

.... perforations from .... feet to .... feet

.... perforations from .... feet to .... feet

.... perforations from .... feet to .... feet

(8) SCREENS: Well screen installed? Yes ☐ No ☐

Manufacturer's Name ....

Type .... Model No. ....

Diam. .... Slot size .... Set from .... ft. to ....

Diam. .... Slot size .... Set from .... ft. to ....

(9) CONSTRUCTION:

Was well gravel packed? Yes ☐ No ☐ Size of gravel: ....

Gravel placed from .... feet to .... feet

Was a surface seal provided? Yes ☐ No ☐

To what depth? .... feet

Material used in seal: ....

Did any strata contain unusable water? Yes ☐ No ☐

Type of water: .... Depth of strata ....

Method of sealing strata off: ....

Was surface casing used? Yes ☐ No ☐

Was it cemented in place? Yes ☐ No ☐

(10) WATER LEVELS:

Static level .... feet below land surface Date ....

Artesian pressure .... feet above land surface Date ....

LOG RECEIVED:

(11) FLOWING WELL:

Controlled by (check) Valve ☐

Cap ☐ Plug ☐ No Control ☐

Does well leak around casing? Yes ☐ No ☐

(12) WELL TESTS:

Drawdown is the distance in feet the water level is lowered below static level.

Was a pump test made? Yes ☐ No ☐ If so, by whom? ....

Yield: .... gal./min. with .... feet drawdown after .... hours

" .... " .... " .... "

" .... " .... " .... "

Bailer test .... gal./min. with .... feet drawdown after .... hours

Artesian flow .... g.p.m. Date ....

Temperature of water .... Was a chemical analysis made? No ☐ Yes ☐

(13) WELL LOG:

Diameter of well .... inches

Depth drilled .... feet. Depth of completed well .... feet.

NOTE: Place an "X" in the space or combination of spaces needed to designate the material or combination of materials encountered in each depth interval. Under REMARKS make any desirable notes as to occurrence of water and the color, size, nature, etc., of material encountered in each depth interval. Use additional sheet if needed.

DEPTH		MATERIAL										REMARKS
From	To	Clay	Silt	Sand	Gravel	Cobbles	Boulders	Hardpan	Conglomerate	Bedrock	Other	
320	325	X			X							
325	330	X			X							
330	335	X			X							Water { more gravel
335	340	X			X							" than clay
340	345	X			X							"
345	350	X			X							"
350	355	X			X							Water: Mostly Gravel
355	360	X			X							" " "
360	365	X			X							" " "
365	370	X			X							" " "
370	375	X			X							" " "
375	380	X			X							" " "
380	385	X			X							" " "
385	390	X			X							" " "
390	395	X			X							
395	400	X			X							
400	405	X			X							
405	410	X			X							
410	415	X			X							
415	420	X			X							
420	425	X			X							
425	430	X			X							
430	435	X			X							
435	440	X			X							
440	445	X			X							
445	450	X			X							
450	455	X			X							
455	460	X			X							
460	465	X			X							
465	470	X			X							
470	475	X			X		X					Beg Rock + Clay
475	480	X			X		X					" " "

Work started .... 19...... Completed .... 19......

(14) PUMP:

Manufacturer's Name ....

Type: .... H. P. ....

Depth to pump or bowls .... feet

Well Driller's Statement:

This well was drilled under my supervision, and this report is true to the best of my knowledge and belief.

Name BINNING Drlg. Co.
(Person, firm, or corporation) (Type or print)

Address ....

(Signed) ....
(Well Driller)

License No. 243 Date ...., 19......

USE OTHER SIDE FOR ADDITIONAL REMARKS

Page 4 of 4

Form 113-324-1240

Examined ____
Recorded: B. C. ____ T. B. ____
Inspection Sheet ____
Copied ____

REPORT OF WELL DRILLER
STATE OF UTAH

Test Well Request
Application No. ____
Claim No. 86-53-1-TW
Coordinate No. ____

GENERAL STATEMENT: Report of well driller is hereby made and filed with the State Engineer, in accordance with the laws of Utah. (This report shall be filed with the State Engineer within 30 days after the completion or abandonment of the well. Failure to file such reports constitutes a misdemeanor.)

(1) WELL OWNER:
Name Provo City Water and Waste Water
Address ____

(2) LOCATION OF WELL:
County ____ Ground Water Basin ____ (leave blank)
North / South ____ feet, East / West ____ feet from ____ Corner
of Section ____, T. ____ N / S, R. ____ E / W SLBM / USM (strike out words not needed)

(3) NATURE OF WORK (check):
New Well ☐
Replacement Well ☐ Deepening ☐ Repair ☐ Abandon ☐
If abandonment, describe material and procedure: ____

(4) NATURE OF USE (check):
Domestic ☐ Industrial ☐ Municipal ☐ Stockwater ☐
Irrigation ☐ Mining ☐ Other ☐ Test Well ☐

(5) TYPE OF CONSTRUCTION (check):
Rotary ☐ Dug ☐ Jetted ☐
Cable ☐ Driven ☐ Bored ☐

(6) CASING SCHEDULE:
Threaded ☐ Welded ☐
____" Diam. from ____ feet to ____ feet Gage ____
____" Diam. from ____ feet to ____ feet Gage ____
____" Diam. from ____ feet to ____ feet Gage ____
New ☐ Reject ☐ Used ☐

(7) PERFORATIONS:
Perforated? Yes ☐ No ☐
Type of perforator used ____
Size of perforations ____ inches by ____ inches
____ perforations from ____ feet to ____ feet
____ perforations from ____ feet to ____ feet
____ perforations from ____ feet to ____ feet
____ perforations from ____ feet to ____ feet
____ perforations from ____ feet to ____ feet

(8) SCREENS:
Well screen installed? Yes ☐ No ☐
Manufacturer's Name ____
Type ____ Model No. ____
Diam. ____ Slot size ____ Set from ____ ft. to ____
Diam. ____ Slot size ____ Set from ____ ft. to ____

(9) CONSTRUCTION:
Was well gravel packed? Yes ☐ No ☐ Size of gravel: ____
Gravel placed from ____ feet to ____ feet
Was a surface seal provided? Yes ☐ No ☐
To what depth? ____ feet
Material used in seal: ____
Did any strata contain unusable water? Yes ☐ No ☐
Type of water: ____ Depth of strata ____
Method of sealing strata off: ____
Was surface casing used? Yes ☐ No ☐
Was it cemented in place? Yes ☐ No ☐

(10) WATER LEVELS:
Static level ____ feet below land surface Date ____
Artesian pressure ____ feet above land surface Date ____

LOG RECEIVED:

(11) FLOWING WELL:
Controlled by (check) Valve ☐
Cap ☐ Plug ☐ No Control ☐
Does well leak around casing? Yes ☐
No ☐

(12) WELL TESTS:
Drawdown is the distance in feet the water level is lowered below static level.
Was a pump test made? Yes ☐ No ☐ If so, by whom? ____
Yield: ____ gal./min. with ____ feet drawdown after ____ hours
" ____ " ____ " ____ "
" ____ " ____ " ____ "
Bailer test ____ gal./min. with ____ feet drawdown after ____ hours
Artesian flow ____ g.p.m. Date ____
Temperature of water ____ Was a chemical analysis made? No ☐ Yes ☐

(13) WELL LOG:
Diameter of well ____ inches
Depth drilled ____ feet. Depth of completed well ____ feet.

NOTE: Place an "X" in the space or combination of spaces needed to designate the material or combination of materials encountered in each depth interval. Under REMARKS make any desirable notes as to occurrence of water and the color, size, nature, etc., of material encountered in each depth interval. Use additional sheet if needed.

DEPTH		MATERIAL										REMARKS
From	To	Clay	Silt	Sand	Gravel	Cobbles	Boulders	Hardpan	Conglomerate	Bedrock	Other	
480	485	X			X		X					Big Rocks + Clay
485	490	X			X							
490	495	X			X							
495	500	X				X						
500	505	X			X							Mostly Gravel
505	510	X			X							" "

Work started ____, 19__ Completed ____, 19__

(14) PUMP:
Manufacturer's Name ____
Type: ____ H. P. ____
Depth to pump or bowles ____ feet

Well Driller's Statement:

This well was drilled under my supervision, and this report is true to the best of my knowledge and belief.

Name Binning Drlg. Co. (Person, firm, or corporation) (Type or print)
Address ____
(Signed) ____ (Well Driller)
License No. 243 Date ____, 19__

USE OTHER SIDE FOR ADDITIONAL REMARKS

Appendix F

APPENDIX F

District's Groundwater Quality Report

SUVSWD Bayview Class I Landfill
Permit Application

Appendix F: District's Groundwater Monitoring Report

SUVSWD Bayview Class I Landfill
Permit Application

Prepared for
Bayview Landfill
South Utah Valley Solid Waste District
Springville, Utah

Prepared by
HDR Engineering, Inc.
3995 South 700 East, Suite 100
Salt Lake City, UT 84107

March 2009

Contents

Figures

Attachments

1.0 Introduction

The Bayview Landfill is located in southwestern Utah County about 6 miles north of Elberta and 3 miles west of Goshen Bay of Utah Lake. The Bayview Landfill is underlain by unconsolidated deposits of the Provo Formation, Lake Bonneville Group, of the Pleistocene age. These deposits consist of poorly sorted, homogeneous matrix of silt, clay, sand, and gravel. Groundwater occurs under unconfined conditions in the shallow Pleistocene Aquifer and moves in a northeast direction from the East Tintic Mountains towards Utah Lake. The hydraulic gradient is very flat (0.02%) and the estimated velocity is 1.8 feet per year. The groundwater surface is at an approximate elevation of 4500 feet (Carpenter 1994).

2.0 Monitoring System

The existing groundwater monitoring system for the site consists of nine deep monitoring wells, DMW-1 through DMW-9. Wells DMW-1 and DMW-7 provide upgradient background data for Cells 1 and 2. DMW-4 is on the southern boundary upgradient of parts of Cells 6 and 7. Wells DMW-3 and DMW-8 are compliance monitoring wells for Cell 1. Well DMW-6 is east of the existing leachate basin. The remaining wells, DMW-2, DMW-5, and DMW-9 are located along the property boundary north of Cells 1 and 2. See Figure F-1 (Monitoring Wells). The locations of the monitoring wells shown in this figure are approximate; this figure is intended to present the general location relative to the landfill cells.

DMW-9 serves as a compliance well, and is within 500 feet hydraulically downgradient, for Cell #2. As shown in Figure F-1, two future compliance-monitoring wells may be installed along the northern boundary of Cell #2. The location of these two wells will be determined after future stages of Cell #2 are designed. Figure F-2 shows a typical design of a groundwater monitoring well.

The groundwater monitoring system also includes six shallow groundwater-monitoring wells, SMW-1 through SMW-6. None of the six shallow monitoring wells have contained water sufficient to either purge or sample on any sampling event, and these wells are not included in the discussion that follows.

3.0 Groundwater Sampling Program

The sampling program began in March of 1991 in monitoring wells DMW-1 through DMW-6 as part of the initial landfill development process. Data from nine sampling events, from March 1991 to June 1992, was used to established background water quality in these wells. Wells DMW-7 and DMW-8 were installed in late 1999 with background samples collected quarterly through 2001. DMW-9 was installed in 2004 with background water quality being collected during semi-annual sampling events.

In accordance with Utah Administrative Code Rule 315-308-2, groundwater samples are collected from all deep wells and submitted for laboratory analysis on a semi-annual basis. The samples collected are analyzed for the parameters listed in Utah Administrative Code Rule 315-308-4 (constituents for detection monitoring). When possible, laboratory detection limits will be set one order of magnitude below the groundwater protection standards listed in Rule 315-308-4. Attachment 1 (Groundwater Monitoring Plan for Bayview Municipal Solid

Waste Landfill) provides more information on sampling procedures and monitored constituents.

The statistical analysis approach selected to analyze the ground water data uses intra-well methods consisting of control charts and prediction limits. The purpose of this analysis is to determine if there are any statistically significant changes in the compliance data relative to background pollutant concentrations. These methods compare monitoring results to values established during background water quality data collection for each well. Reports summarizing statistical analysis of semi-annual ground water sampling are prepared and submitted to the Division of Solid and Hazardous Waste annually. These reports disclose any statistically significant changes in the water quality.

4.0 Groundwater Quality

Laboratory analyses of background samples collected March 1991 to June 1992 show no prior contamination of the groundwater by inorganic chemicals, volatile organic chemicals (VOC), or synthetic organic chemicals. (Carpenter 1994)

Laboratory analyses have never detected VOCs in groundwater samples so no statistical analysis has been needed.

As mentioned, reports summarizing the statistical analysis are submitted to the Division of Solid and Hazardous Waste annually. These reports disclose any statistically significant changes in ground water quality. Analysis of ground water laboratory results has shown very few statistically significant changes in the data from compliance monitoring wells. Additional analysis of statistically significant increases in pollutant concentration eliminated the need for any corrective action. In most cases the pollutant concentrations that were found to be statistically significant increases when conducting an intra-well analysis were found to be similar to background concentrations in other upgradient and compliance monitoring wells. Analysis of results from subsequent sampling events showed that the ground water pollutant concentrations were again near background levels, indicating that the landfill was not likely the source of the increased pollutant concentration. Other statistically significant increases were attributed to laboratory error and a change in laboratory detection limits.

Historic changes in the laboratory detection limits may have resulted in the reporting of statistically significant changes for many constituents. In the event of a constituent not being detected, the statistical analysis used one-half of the laboratory detection limit as the actual concentration. The detection limit may have been greater than the projected limit value (above which would constitute a statistical change) calculated from background data. The result is a statistically significant change being reported even though a constituent was not detected by laboratory analysis. The laboratory detection limits will be set at or below the groundwater protection standards listed in R315-308-4 for all future analysis.

5.0 References

Carpenter, Carl, CGWP No. 361. 1994. Quality of Groundwater at the Bayview Landfill Site, Elberta, Utah, April 1994.

1

Figures

LEGEND:

- ● DMW-X EXISTING MONITOR WELL
- ● DMW-X PROPOSED MONITOR WELL
- ▨ BERM

HDR ENGINEERING INC.
SALT LAKE CITY, UTAH

DESIGN ____ CHECK ____
DRAWN ____ CHECK ____
QUANT. ____ CHECK ____
APPROVAL RECOMM. ____ DATE ____
APPROVED ____ DATE ____

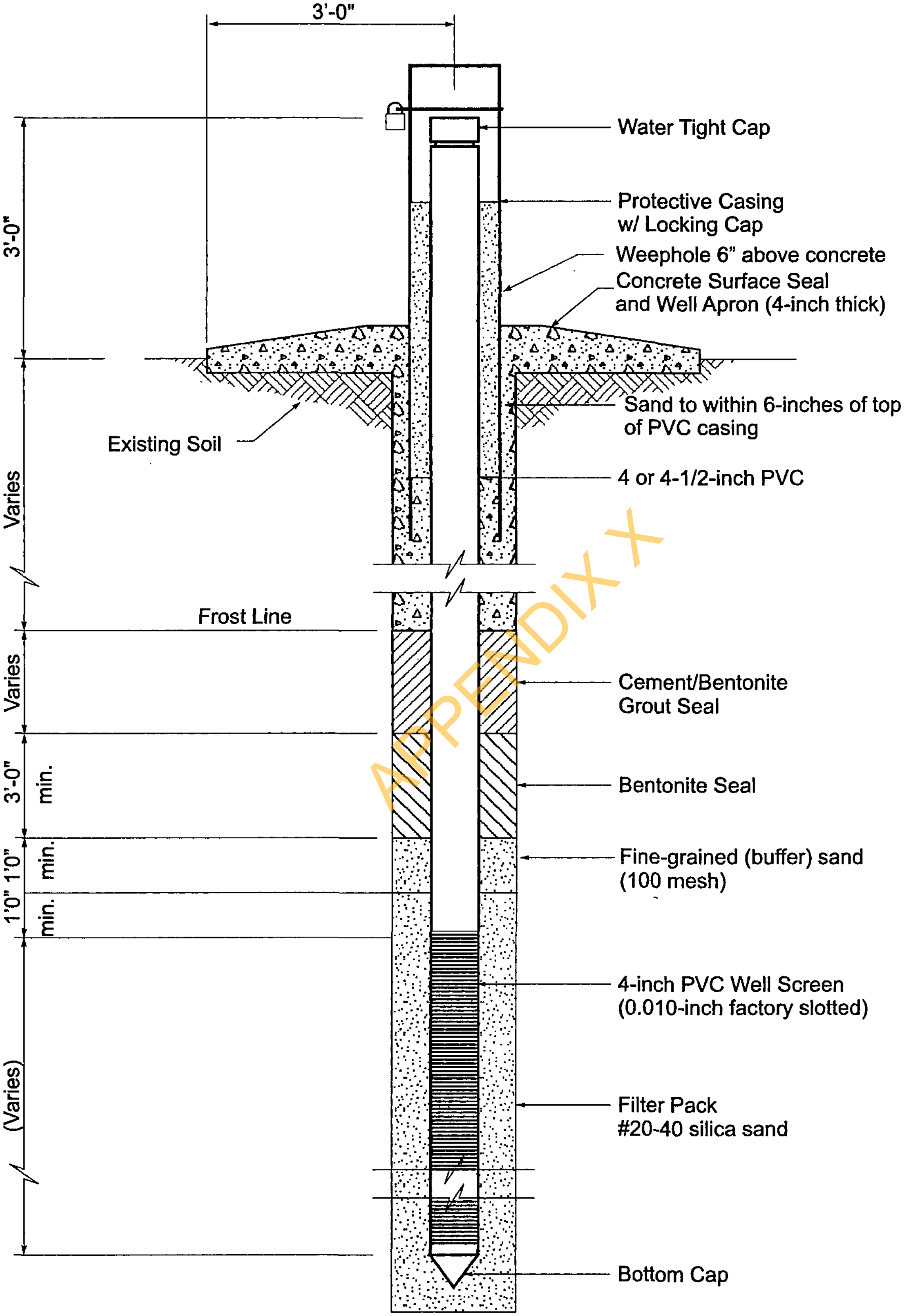
BAYVIEW LANDFILL
SUVSWD
Figure F1-
Monitoing Wells

SALT LAKE
COUNTY

DWG. NO.

DATE: December 2003

User:
Project number: 000000000002830
Filename: \Springville-SUVSWD\Bayview Design Files\v7\bayview.dgn
Date plotted: 12/30/2003 3:37 pm



HDR

HDR Engineering, Inc.

Typical Monitoring Well

Date
Jan. 2004

Figure
F-2

2/2001

Attachment F-1

District's Groundwater Monitoring Plan

GROUNDWATER MONITORING PLAN

FOR

BAYVIEW MUNICIPAL SOLID WASTE LANDFILL

SOUTH UTAH VALLEY SOLID WASTE DISTRICT

SPRINGVILLE, UTAH

Prepared by:

HDR Engineering, Inc.
3995 South 700 East, Suite 100
Salt Lake City, Utah 84107
(801) 281-8892

Submitted
January 1999

Revised
July 2003

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF TABLES

APPENDICES

1.0 INTRODUCTION

This groundwater monitoring plan (GMP) addresses the groundwater monitoring and sampling program at the South Utah Valley Solid Waste District's Bayview Landfill in Elberta, Utah. The GMP is required by the Utah Department of Environmental Quality (UDEQ) Municipal Solid Waste Regulations (R315-308-2) and will meet the requirements of the Federal US EPA Regulations under Subtitle D of the Resource Conservation and Recovery Act (RCRA).

1.1 Groundwater Monitoring System

The groundwater monitoring system for the site consists of eight deep monitoring wells, DMW-1 through DMW-8. Wells DMW-1 and DMW-7 serve as the upgradient or background wells for the first three cells, which are scheduled for development during the next 25 to 50 years. DMW-3 and DMW-8 are downgradient or compliance wells for Cell 1, and DMW-6 is downgradient of Leachate Basin 1. The remaining wells serve as property boundary wells; DMW-2 and DMW-5 are on the northern boundary downgradient from parts of Cells 1 and 2; and DMW-4 is on the southern boundary upgradient of parts of Cells 6 and 7.

The groundwater monitoring system also includes six shallow groundwater monitoring wells, SMW-1 through SMW-6. None of the six shallow monitoring wells has contained water sufficient to either purge or sample on any sampling event, and these wells are not included in the follow discussion.

Additional monitoring wells may be added to the system as information becomes available indicating the necessity to meet the requirements of the regulations. New wells may also be added to the system as new cells or leachate basins are designed and constructed.

1.2 Well Construction

Well construction records, including drilling logs, are presented in Appendix E of the Bayview Landfill Permit. Generally, wells have been constructed of 4- or 4½ -inch diameter PVC pipe with a 20-foot screened interval and a 1-foot silt sump. Table 1 provides information on wells DMW-1 through DMW-8, including total depth and approximately depth to groundwater for each of the deep monitoring wells.

Table 1. Monitoring well data for the Bayview Landfill.

Well Designation	Screened Interval		Water Depth (ft.)		
	Top	Bottom	Drilling[1]	Monitoring[2]	Variation[3]
DMW-1	280	300	265	242	1.5
DMW-2	270	278	236	232	7.5
DMW-3	245	308	245	245	2.0
DMW-4	175	195	175	174	2.5
DMW-5	189	210	178	172	20.0
DMW-6	145	166	139	137	2.0
DMW-7	243	295	NA	265	NA
DMW-8	225	270	NA		
DMW-9	225	270	NA		

1. Drilling means the depth at which water was reported during drilling.
2. Monitoring is an approximate average depth to groundwater as measured during monitoring events.
3. Variation is the approximate ranges of values observed during monitoring events.

2.0 GROUNDWATER ELEVATION MONITORING

2.1 Well Inspections

During each monitoring event, the wells will be inspected for damage to the well casing, protective cover, lock, well cap, and concrete pad. In addition, the ground surface around the well pads will be inspected for erosion. If any problems are discovered, they will be repaired or replaced as soon as practicable.

2.2 Monitoring Procedures

Groundwater level measurements will be collected using either an electric well sounder marked in 1-foot increments. A measuring tape will be used to determine the distance between 1-foot markings, with measurements recorded to the nearest ½-inch (0.04-foot) increment. For each monitoring event the total well depth will be measured to evaluate whether the casing has silted up. Water levels in the monitor wells will be measured prior to purging or sampling to minimize the potential effects of these activities the water levels across the site. The groundwater level measurement will be recorded to the nearest 0.04 foot from the top of the monitor well casing. Water level measurements will always be referenced to the survey mark on the well casing. When a measurement is collected, the measuring device will be raised and lowered several times to be sure the correct measurement is read off the tape measure. Water level measurements collected for each monitoring event will be converted to elevations (nearest 0.04 foot) and submitted with the groundwater sampling report. The survey data for each monitoring well will be referenced to the benchmark established for the landfill.

2.3 Protocol for Water-Level Measurements and Instrumentation

During each monitoring event, the current water level readings will be compared to the readings from the previous monitoring event in order to avoid discrepancies. If an obvious discrepancy is encountered, the water level will be measured again to ensure the measurement was recorded correctly.

Prior to collecting water level measurements, the measuring device will be checked for damage, including bends or kinks in the tape. To maintain consistency and precision, and to the degree possible, the same measuring device will be used during each monitoring event. Also once each year, the tape will be checked against a calibrated tape measure to verify its accuracy.

Prior to conducting the well purging activities, the pH and conductivity meters will be calibrated. Calibration of the instruments will be in accordance with the manufacturer's procedures for the particular instrument. At a minimum, the pH meter will be calibrated using standard calibration solutions as recommended by the manufacturer. The conductivity meter will be calibrated using standard solutions as recommended or supplied by the manufacturer. The same instrumentation will be used for each monitoring event.

3.0 DECONTAMINATION PROCEDURES

Prior to beginning each sampling event and between wells, all non-dedicated equipment including the water level measuring device will be decontaminated thoroughly to minimize the potential for cross contamination. The decontamination procedures will consist of thoroughly flushing the equipment with potable water three times followed by a final rinse with deionized water. Decontamination of larger items, such as dedicated pumps removed for repair, will be accomplished by steam cleaning. If steam cleaning is necessary, then a container will be used to collect the rinsate water to prevent the water from coming into contact with the ground. Purge and decontamination water will be stored in closed top drums and stored in a designated area on site until analytical data is complete. The drums will be typically labeled with the well identification number, date of collection, and contents of drums. The disposal of the water will be based on analytical results: contaminated water will be discharged into the leachate basin; uncontaminated water will be discharged to the ground adjacent to the well from which it came.

4.0 GROUNDWATER SAMPLE COLLECTION

4.1 Well Purging Procedures

Prior to each sampling event, the groundwater level in each well and the total well depth will be measured as described in Section 2.2. During the purging activities, disposable latex gloves will be worn by the sampling team and changed between wells. To purge a well temperature, conductivity, and pH will be continuously measured. Once all these parameters stabilize, indicating stagnant water has been replaced by formation water, purging will be considered complete. If a well dewaters prior to achieving the stabile water quality parameters, it will be allowed to recharge before sampling.

The method of well purging for this site consists of using a dedicated submersible pump system for each well where the discharge rate can be regulated for sampling. The pump intake will be placed within the screened section of the well casing. For wells that sustain continuous pumping without dewatering, the discharge rate on the pump will be set to allow minimal drawdown in the well. This procedure will minimize any cascading effects that may volatilize constituents in the groundwater entering the well casing and will also minimize agitating sediment collected in the bottom of the well. If the main pump system fails, temporary portable pumps will be used as backups. If portable pumps are needed, the intake will be gently lowered into the upper most portion of the water column to minimize agitating any residual sediment that has collected in the bottom of the well. If a portable pump is used for more than one well, then proper cleaning of the pump is necessary to minimize the potential of cross contamination (refer to Section 3.0).

During the purging operations, a record of the climatic conditions, condition of the wells and surrounding ground surface, field collected water quality, color, odors, water level, depth of well and purge rate will be recorded. The information will be recorded in indelible ink, will be stored either on site at the landfill office or at the District's office in Springville, and will become part of the site operating record for the landfill.

4.2 Groundwater Collection and Handling Procedures

During groundwater collection disposable latex gloves will be worn, and changed between wells to minimize cross contamination of samples and to reduce the possibility of coming into contact with groundwater containing contaminants. Prior to collecting a groundwater sample the monitor wells will be purged of groundwater as described in Section 4.1. Purge water will be handled as discussed in Section 4.5. The monitor wells will be sampled in the same order they are purged. Samples will be collected within 24-hours following purging. If sufficient recharge does not occur within 7 days following purging, then the well will be considered dry and a sample will not be collected. The District will follow the laboratory's QA/QC protocols regarding sampling containers, preservation, and holding times.

The samples will be collected off the pump discharge. The pump discharge will be regulated at the time of sampling to maintain as slow discharge rate as possible (typically 0.1 liter per minute) to minimize cascading and volatilization as the sample containers are being filled. Once the discharge rate is set for sampling, it will be maintained at that rate for several minutes so that the sample collected will not be from the period of time when the pump was operating at a higher discharge rate, and to ensure that air has been adequate purged from the discharge line. The sample containers will be held as close to the pump discharge as possible without touching to minimize the loss of volatiles. The containers for the VOCs will be tilted slightly to allow the water to gently run down the inside wall of the container.

Following the filling of each sample container, they will be labeled with the well number, date and time collected, preservatives used, analyses to be run, and the sampler's initials. The 40-milliliter vials will be placed in zip-locked plastic bags. The sample containers for each well will include as a minimum two-40 milliliter VOA glass vials with Teflon® septa screw caps for volatile organic constituents (VOC), and other bottles as provided by the laboratory. Sample containers for VOCs will be completely filled and sealed carefully to prevent air bubbles. If an air bubble is present, then the sample will be discarded and the sample will be collected again. All other sample containers will be filled as completely as possible.

Once the samples have been properly sealed and labeled as described above, they will be recorded on a Chain-of-Custody (COC) form, signed and dated by the sampling technician(s). An example of a typical COC is presented in Appendix 2. The COC will accompany the samples to the laboratory. The samples will be placed in a plastic ice chest (similar to an Igloo ice chest) with ice or a re-freezable type product to maintain a temperature as close to 4^0C as possible until the analyses are performed. Dry ice is not permitted due to the potential of freezing the samples and breaking the containers. Precautions will be taken to secure the samples in the ice chest to prevent them from breaking during transport. The samples will be delivered to the laboratory within 24-hours after collection, therefore it will not be necessary to preserve the samples in the field, except samples collected for dissolved constituent analyses. Any samples, other than the samples collected for dissolved constituent analyses, requiring preservatives will be collected in pre-preserved containers supplied by the laboratory.

4.2.1 Detection Monitoring Sampling Frequency

The sampling schedule for Detection Monitoring consists of collecting samples from each monitor well for the Detection Monitoring Constituents on a semi-annual basis after background data has been established. Any changes to the frequency and/or number and type of constituents for Detection Monitoring must be approved by the Executive Secretary prior to implementing the change. The schedule for establishing background data will be discussed in Section 5.5.

4.3 Quality Assurance and Quality Control Samples

To provide screening of field procedures, additional samples will be collected. Trip blank samples will be prepared by the laboratory and will accompany the empty sample containers and collected samples to and from the laboratory. The trip will consist of filling four-40 milliliter VOA vials (two sets each) with deionized and laboratory-grade water, respectively. The purpose of the trip blank is to assess whether any of the sample containers or collected samples has been contaminated before or during sampling, and during transport to the laboratory. At least one trip blank will be prepared for each day of sampling or for every container transported to the laboratory. The QA/QC samples will be collected and handled in a similar fashion as the other samples and will be analyzed for VOCs.

At the discretion of the District or direction of UDEQ, blind field duplicate samples will be collected to assess the precision of the sampling and laboratory methods. The blind duplicate samples will be collected from well(s) with typically the highest concentrations of contaminants. When a blind sample is collected, it will be handled in a similar fashion as the other samples, but will be labeled in such a manner that the laboratory does not know it is a duplicate sample for QA/QC purposes.

4.4 Weather Protocol

Sampling of the monitor wells will not be permitted during inclement weather, thunderstorms; to the extent possible, monitor wells will not be sampled during periods when the temperature drops below freezing. Caution should be taken when the temperature exceeds 100 ^{0}F. If contamination is detected, the District will develop a health and safety plan for further ground water monitoring activities. While in the field, personnel engaged in the monitoring program shall adhere to this health and safety protocol.

4.5 Purge Water Handling Procedures

Purge and decontamination water will be collected in closable drums and stored on site for subsequent disposal. The analytical data will be reviewed to determine the proper disposal procedures. If needed, the UDEQ can be consulted to assist in assessing proper disposal procedures.

5.0 ANALYTICAL TESTING

5.1 Laboratory Performing the Analyses

The analytical laboratory selected to perform the required analyses will be licensed and certified by the State of Utah. At a minimum the selected laboratory will apply quality control procedures in accordance with EPA SW-846, Test Methods for Evaluating Solid Waste, Third Edition, November 1986 as revised December 1987.

5.2 Laboratory Procedures

The laboratory will follow appropriate QA/QC protocol developed as part of its licensing and certification. At a minimum, upon receipt of the samples by the laboratory, the sample lot will be verified with the information on the COC, Appendix 2. If there is a discrepancy with the samples, the responsible party that collected the samples will be notified and the problem will be resolved before the analyses are performed. The COC will be signed and dated by the designated receiving personnel at the laboratory. The COC will remain with the laboratory until the analyses are completed, then will be attached to the completed laboratory report. For samples that require overnight transport to the laboratory, the COC will be signed; including date and time received by the transporter. The COC will be attached to the sample container(s) and delivered to the laboratory and a copy of the bill of lading will be supplied by the transporter. After the analyses is completed and the laboratory report finalized, the complete COC with the bill of lading or receipt if sent by certified mail will be attached to the laboratory report. The laboratory will keep a copy of the COC and laboratory results for a period of at least three years.

5.3 Laboratory Quality Assurance and Quality Control Samples

The laboratory will adhere to its QA/QC plan developed as part of its licensing and certification. If possible, the laboratory will be required to achieve detection limits (DLs) that are at least one order of magnitude below the maximum contaminant levels (MCLs) for a constituent for which an MCL has been promulgated.

5.4 Constituents to be Analyzed and Test Methods

As specified in the UDEQ (R315-308-2) and Subtitle D (40 CFR 258.53) regulations, the groundwater monitoring program at all MSWLFs shall consist of detection monitoring that includes specific constituents. The constituents to be tested for during the detection-monitoring program are listed in Table 2. Approved testing methods, as described in 5.1, will be used for all constituents. The laboratory DLs will be below the MCLs for each of the constituents. If a change in the analytical method is needed, then the Executive Secretary will be notified in writing. The Executive Secretary shall approve of the change prior to implementing the change. All samples will be analyzed within the required holding times for the particular analyses. The laboratory will report the CAS number for each constituent analyzed.

TABLE 2

Background/Detection Monitoring Constituents

Inorganic Constituents

Ammonia (7664-41-7)
Carbonate/Bicarbonate
Calcium
Chemical Oxygen Demand (COD)
Chlorides
Iron (7439-89-6)
Magnesium
Manganese (7439-96-5)
Nitrate (as N)
pH
Potassium
Sodium
Sulfate
Total Dissolved Solids (TDS)
Total Organic Carbon (TOC)

Heavy Metals

Antimony (7440-36-0)
Arsenic (7440-38-2)
Barium (7440-39-3)
Beryllium (7440-41-7)
Cadmium (7440-43-9)
Chromium
Cobalt (7440-48-4)
Copper (7440-50-8)
Lead
Mercury (7439-97-6
Nickel (7440-02-0)
Selenium (7782-49-2)
Silver (7440-22-4)
Thallium
Vanadium (7440-62-2)
Zinc (7440-66-6)

VOCs

Acetone (67-64-1)
Acrylonitrile (107-13-1)
Benzene (71-43-2)
Bromochloromethane (74-97-5)
Bromodichloromethane (75-27-4)
Bromoform (75-25-2)
Carbon disulfide (75-15-0)
Carbon tetrachloride (56-23-5)
Chlorobenzene (108-90-7)
Chloroethane (75-00-3)
Chloroform (67-66-3)
Dibromochloromethane (124-48-1)
1,2-Dibromo-3-chloropropane (96-12-8)
1,2-Dibromoethane (106-93-4)
1,2-Dichlorobenzene, ortho (95-50-1)
1,4-Dichlorobenzene, para (106-46-7)
trans-1,4-Dichloro-2-butene (110-57-6)
1,1-Dichloroethane (75-34-3)
1,2-Dichloroethane (107-06-2)
1,1-Dichloroethylene (75-35-4)
cis-1,2-Dichloroethylene (156-59-2)
trans-1,2-Dichloroethylene (156-60-5)
1,2-Dichloropropane (78-87-5)
cis-1,3-Dichloropropene (100061-01-5)
trans-1,3-Dichloropropene (10061-02-6)
Ethylbenzene (100-41-4)
2-Hexanone (591-78-6)
Methyl bromide (74-83-9)
Methyl chloride (74-87-3)
Methylene bromide (74-95-3)
Methylene chloride (75-09-2)
Methyl ethyl ketone; MEK (78-93-3)
Methyl iodide (74-88-4)
4-Methyl-2-pentanone (108-10-1)
Styrene (100-42-5)
1,1,1,2-Tetrachloroethane (630-20-6)
1,1,2,2-Tetrachloroethane (79-34-5)
Tetrachloroethylene (127-18-4)
Toluene (108-88-3)
1,1,1-Trichloroethane (71-55-6)
1,1,2-Trichloroethane (79-00-5)
Trichloroethylene (79-01-6)
Trichlorofluoromethane; CFC-11 (75-69-4)
1,2,3-Trichloropropane (96-18-4)
Vinyl acetate (108-05-4)
Vinyl chloride (75-01-4)
Xylenes (1330-20-7)

Note: The CAS Number if appropriate) is listed in parentheses. These parameters were taken from UAC R315-308-2, and should be verified at least annually.

5.5 Establishment of Background Data

As specified in the UDEQ regulations (R315-308-2 (4)(a)) and Subtitle D (40 CFR 258.53) regulations, background data for the Detection Monitoring Constituents was established. The monitoring wells were installed, and background data were collected prior to the effective date of these regulations. The background sampling was performed from March 1991 to June 1992 from deep monitoring wells DMW-1 through DMW-6 with more than eight samples collected from each of these wells. Monitoring wells DMW-7 and DMW-8 were installed during 1996, background sampling was conducted the eight background samples on these two wells during 1999 and 2000 by collecting a sample from each well on a quarterly basis.

The District plans to install new monitoring wells adjacent to each new landfill cell as the cells are developed. Background data on new wells will adhere to the protocols outlined in the cited regulations.

6.0 STATISTICAL METHOD TO EVALUATE ANALYTICAL DATA

After each sampling event the groundwater monitoring data will be evaluated to determine if statistically significant changes from background values exist for each constituent listed in Table 2. The statistical analyses will be performed in accordance with R315-308-2 (7). To perform the statistical methods with some degree of confidence, a minimum of eight statistically independent samples will be collected from each monitor well during the background-monitoring period. Based on the available statistical methods cited in the regulations, the preferred method selected for this site is an intra-well comparison with a control chart such as a Shewert-CUSUM control chart. This procedure is the preferred method because of its relative ease to implement and because it is especially applicable to sites where no groundwater contamination exists. The analytical data may also be analyzed using Prediction Limits (PL) with the PLs determined based on background data collected.

7.0 REPORTING REQUIREMENTS

Upon completion of each Detection Monitoring sampling event, the analytical data will be summarized in a report. The report will be submitted with the District's annual report unless more immediate notification is required. Any statistically significant change observed from the background data will be reported in writing to UDEQ within 60 days following a sampling event. Only statistically significant changes (SSC) detected in the compliance wells (downgradient wells) will be reported to the UDEQ.

When a SSC has been determined, the owner/operator within 14 days of receipt of the sample analysis results will enter this information into the operating record and notify the Executive Secretary of the finding in writing. The notification must indicate what constituents have shown SSC. In addition, immediately resample all monitoring wells for the constituents listed in Table 3. If an SSC is still present after resampling, the owner/operator must notify the Executive Secretary in writing within seven days of receipt of the sample results. However, if the SSC change from the background data is believed to be caused by a source other than the landfill, then the owner/operator can prepare a report that explains the cause of the significant change. This report must be prepared and certified by a qualified groundwater scientist and submitted to the Executive Secretary within 90 days after the sampling event for approval. If the Executive Secretary approves the report, then the landfill may return to Detection Monitoring. If the Executive Secretary believes a satisfactory explanation is not given, the Assessment Monitoring Program will be implemented at the direction of the Executive Secretary. The Assessment Monitoring Program shall be implemented in accordance with R315-308-2 (11)

Attachment F-2

Recording Forms

GROUNDWATER MONITORING PROGRAM
BAYVIEW MUNICIPAL SOLID WASTE LANDFILL
SOUTH UTAH VALLEY SOLID WASTE DISTRICT

DATE: 20-Dec-00
SAMPLED BY: Craig Hoffman
RECORDED BY: Craig Hoffman
WEATHER:

Well Number	Depth of Well ((feet)	Depth to Water (feet)	Temp. C_X__ F___	pH	Conductivity	Comments
DMW1	300					
DMW2	278					
DMW3	308					
DMW4	195					
DMW5	210					
DMW6	168					
DMW7	293					
DMW8	270					

Attachment F-3

Typical Chain of Custody

Chain of Custody Log Form

COC / SL # : ____________

Page ____ of ____

TO : ____________
Address : ____________

Client : ____________
Address : ____________
Quote # : ____________

ID : ____________
PO # : ____________
Contact : ____________
Phone : ____________

Date : ____________
Turnaround : ____________
Job # : ____________
Sampled By : ____________

Report To : ____________
Address : ____________
Invoice To : ____________

Sample ID	Date / Time	MATRIX	Preservatives				Analyses														Comments
			Cool < 4°C																		

Relinquished By	Date	Time	Received By	Date	Time	Temperature	Airbill #

Appendix G

APPENDIX G

Utah Hydrologic Data Report No. 50

SUVSWD Bayview Class I Landfill
Permit Application

U.S. DEPARTMENT OF THE INTERIOR

BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information write to:

District Chief
U.S. Geological Survey, WRD
Room 1016 Administration Building
1745 West 1700 South
Salt Lake City, Utah 84104

Copies of this report can be purchased from:

U.S. Geological Survey
Books and Open-File Reports Section
Federal Center
Box 25425
Denver, Colorado 80225

CONTENTS

ILLUSTRATIONS

(Plate is in pocket)

TABLES

CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATED WATER-QUALITY UNITS

Multiply	By	To obtain
acre	0.4047	hectare
	4,047	square meter
foot	0.3048	meter
cubic foot per second	0.02832	cubic meter per second
gallon per minute	0.06308	liter per second
inch	25.4	millimeter
	0.0254	meter
mile	1.609	kilometer
square mile	2.59	square kilometer

Water temperature is given in degrees Celsius (°C), which can be converted to degrees Fahrenheit (°F) by the following equation:

$$^{\circ}F = 1.8\,(^{\circ}C) + 32.$$

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929—a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

Specific conductance and water temperature are given in metric units. Specific conductance is given in microsiemens per centimeter (µS/cm) at 25 degrees Celsius. Chemical concentration is given in milligrams per liter (mg/L) or micrograms per liter (µg/L). Milligrams per liter is a unit expressing the solute per unit volume (liter) of water. For concentrations less than 7000 milligrams per liter, the numerical value is about the same as concentration in parts per million. One thousand micrograms per liter is equivalent to 1 milligram per liter.

SELECTED HYDROLOGIC DATA FOR SOUTHERN UTAH AND GOSHEN VALLEYS, UTAH, 1890–1992

By Bernard J. Stolp, Marilyn Drumiler, and Lynette E. Brooks

INTRODUCTION

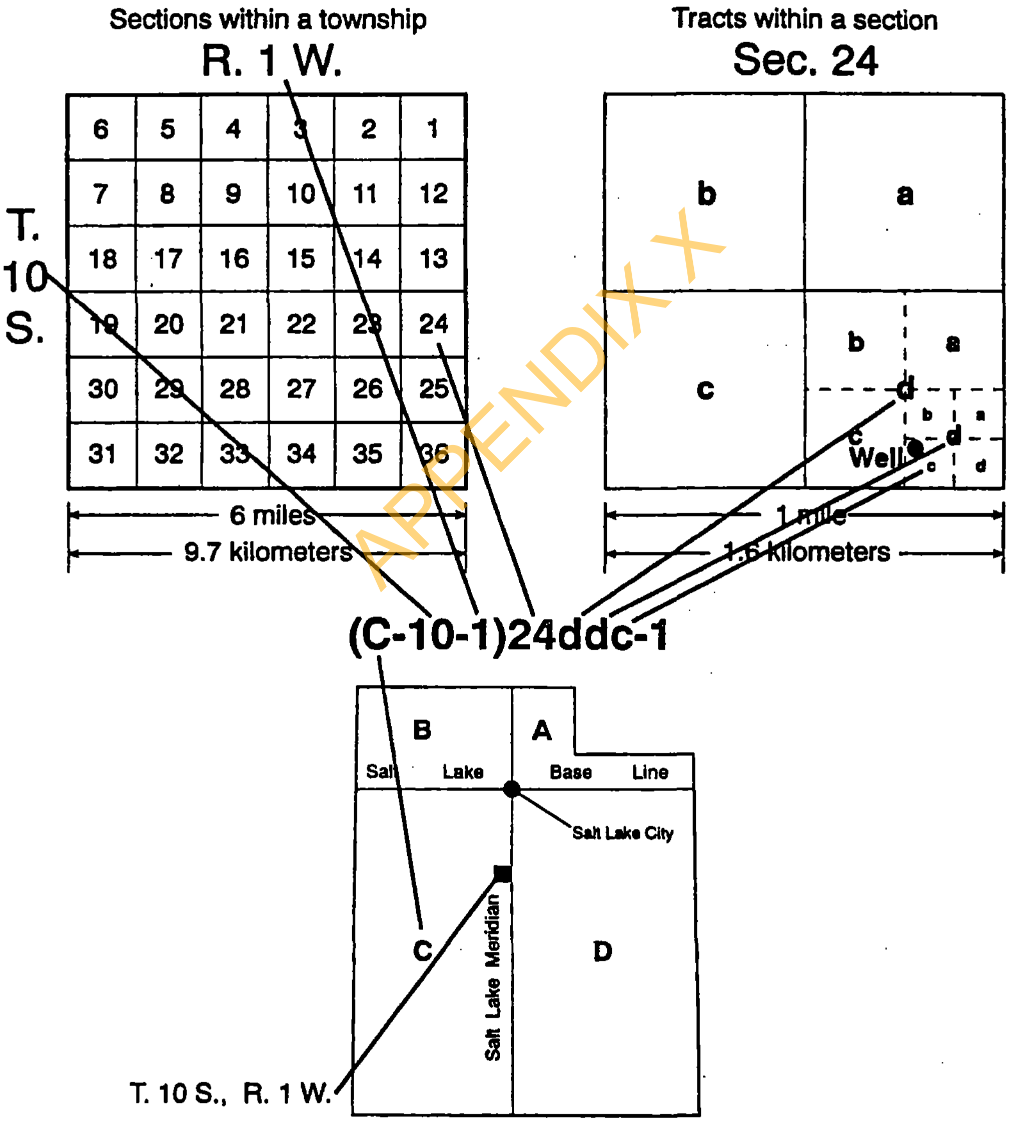
This report contains hydrologic data collected in southern Utah and Goshen Valleys from 1890 to 1992. Southern Utah and Goshen Valleys are south of Salt Lake City in Utah County, north-central Utah. The area is bounded on the east and south by the Wasatch Range, on the south by Long Ridge, on the west by the East Tintic Mountains and the Mosida Hills, and on the north by a line through about the middle of T. 7 S. Southern Utah Valley and Goshen Valley are divided by the northern tip of Long Ridge, West Mountain, and Utah Lake (Cordova, 1970). The area is in the Basin and Range physiographic province described by Fenneman (1931), and includes about 390 square miles.

Most of the data in this report were collected by the U.S. Geological Survey in cooperation with the Utah Department of Natural Resources, Division of Water Rights. Some of the earlier data were published previously by Cordova (1969 and 1970).

The purpose of this report is to provide hydrologic data for use by the general public and by officials managing the area's water resources, and to document data collected during a 4-year study of the ground-water resources in southern Utah and Goshen Valleys. Tables 1 to 8 contain selected ground- and surface-water data. Select data, including well depth and water level, is given for over 400 wells, and chemical analyses are given of samples from about 90 wells. The numbering system used in Utah for hydrologic-data sites is illustrated in figure 1. Hydrologic-data sites are shown on plate 1.

These data could not have been collected without the cooperation of local residents and officials of irrigation companies and municipalities, who permitted access to their wells and property.

The system of numbering wells and springs in Utah is based on the cadastral land-survey system of the U.S. Government. The number, in addition to designating the well or spring, describes its position in the land net. The land-survey system divides the State into four quadrants separated by the Salt Lake Base Line and the Salt Lake Meridian. These quadrants are designated by the uppercase letters A, B, C, and D, indicating the northeastern, northwestern, southwestern, and southeastern quadrants, respectively. Numbers designating the township and range, in that order, follow the quadrant letter, and all three are enclosed in parentheses. The number after the parentheses indicates the section, and is followed by three letters indicating the quarter section, the quarter-quarter section, and the quarter-quarter-quarter section—generally 10 acres[1]. The lowercase letters, a, b, c, and d indicate, respectively, the northeastern, northwestern, southwestern, and southeastern quarters of each subdivision. The number after the letters is the serial number of the well or spring within the 10-acre tract. When the serial number is not preceded by a letter, the number designates a well. When the serial number is preceded by an "S," the number designates a spring. Thus, (C-10-1)24ddc-1 designates the first well constructed or visited in the southwest 1/4, southeast 1/4, southeast 1/4, section 24, T. 10 S., R. 1 W. A location number with no serial number designates a surface-water data-collection site.



---

[1] Although the basic land unit, the section, is theoretically 1 square mile, many sections are irregular. Such sections are subdivided into 10-acre tracts, generally beginning at the southeastern corner, and the shortage is taken up along the northern and western sides of the section.

Figure 1. Numbering system used in Utah for hydrologic-data sites.

REFERENCES CITED

Cordova, R.M., 1969, Selected hydrologic data, southern Utah and Goshen Valleys, Utah: U.S. Geological Survey open-file report (duplicated as Utah Basic Data Release No. 16), 35 p.

—1970, Ground-water conditions in southern Utah Valley and Goshen Valley, Utah: Utah Department of Natural Resources Technical Publication No. 28, 79 p.

Fenneman, N.M., 1931, Physiography of the western United States: New York, McGraw-Hill, 534 p.

Table 1.—*Records of*

[—, no

Well number: See figure 1 for explanation of the numbering system for hydrologic-data sites.
Owner: Last known or reported owner.
Use of water: C, commercial; H, domestic or household; I, irrigation; K, mining; N, industrial; O,
Casing: Diameter: Diameter of the production string of casing; Reported from the driller's log or measured
reported, only top of perforated interval is known; R, wire wound; S, screened; X, open hole.
Elevation of land surface is given in feet above sea level. Elevations are reported to the nearest 0.01 foot
Water level is given in feet and decimal fractions. Measured except where noted R, reported.
Other data available: L, driller's log (table 2); W, water-level measurements (table 3); D, discharge

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(C-7-1)26cdd-1	Smith, Doyle	1979	S	116
(C-8-1)20cdb-2	Bateman	1967	S	345
(C-8-1)20cdb-3	Harold Howlett & Sons	1972	I	400
(C-8-1)20cdb-4	Unknown	—	I	225
(C-8-1)29dda-1	Bateman	1973	I	625
(C-8-1)34bcc-1	LDS Church	1970	H	412
(C-8-1)35dcb-1	Dixson, S.	1945	S	212
(C-8-2)25dac-1	Steadman, Bill	1972	S	600
(C-9-1)3ddb-1	LDS Church	1964	I	575
(C-9-1)4ccc-1	LDS Church	1970	I	756
(C-9-1)4ddc-1	LDS Church (No. 9)	—	I	690
(C-9-1)5ddc-1	Steadman, Bill	1970	I	776
(C-9-1)17abb-1	South Utah Valley Solid Waste District	1989	O	70
(C-9-1)17abb-2	South Utah Valley Solid Waste District	1989	O	210
(C-9-1)17ada-1	South Utah Valley Solid Waste District	1989	O	166
(C-9-1)17bba-1	South Utah Valley Solid Waste District	1989	O	269
(C-9-1)17bbc-1	South Utah Valley Solid Waste District	1989	O	301
(C-9-1)17bbd-1	South Utah Valley Solid Waste District	1989	O	70
(C-9-1)17bbd-2	South Utah Valley Solid Waste District	1989	O	300
(C-9-1)17cdd-1	South Utah Valley Solid Waste District	1989	O	195
(C-9-1)18add-1	South Utah Valley Solid Waste District	1986	P	502
[1] (C-9-1)20cdd-1	LDS Church	1964	I	532
(C-9-1)20ddd-1	LDS Church (No.7)	1963	I	788
(C-9-1)26bda-3	Burraston, B.	1915	S	56

selected wells

data available]

observation; P, public supply; Q, aquaculture; S, stock; U, unused; Z, other.
in the field. Finish: O, open end; P, perforated, where single depth is
Upper or lower limits of perforations or screen are given in feet below land surface.
when the well has been surveyed.

(table 4); C, chemical analysis (table 5).

Casing			Elevation of land surface (feet)	Water level			Other data available
Diameter (inches)	Finish (feet)			Above (-) or below land surface		Date	
8	O		4,495	22	R	03-05-79	
16	X	227-345	4,620	120.2	R	04-04-67	C
—	O		4,620	128	R	10-10-72	C
—	—		4,620	—		—	C
12	P	100-235	4,595	89.34		03-02-87	C
	P	307-595					
6	P	402	4,535	43.94		03-04-91	
4	O		4,489	-3.0	R	06-15-64	C
8	P	300-390	4,770	276	R	05-24-72	
18	P	190-205	4,510.36	17.08		03-04-91	L,W,C
	P	225-338					
	P	365-565					
16	P	240-405	4,620	128.76		03-14-91	W,C
	P	565-750					
18	P	200-683	4,570	81.01		03-04-91	L,W,C
16	P	280-390	4,640	163	R	03-30-70	C
	P	545-740					
4.5	S	49-70	4,670	69.18		03-07-91	
4.5	S	189-210	4,665	175.19		03-07-91	
4.5	S	145-166	4,635	136		03-07-91	
4.5	S	228-269	4,730	232.72		03-07-91	
4.5	S	260-301	4,745	241.19		03-07-91	
4.5	R	49-70	4,740	69.35		03-07-91	
4.5	R	280-300	4,740	243		03-07-91	
4.5	R	175-195	4,670	171.7		03-07-91	L
12	P	350-445	4,775	264	R	09-09-86	
	P	450-500					
20	P	275-521	4,701.40	200.34		03-04-91	L,W,C
18	P	300-490	4,640	137.98		03-05-91	L,W,C
	P	490-775					
1.5	O		4,496	-7.0		05-09-90	W,C

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(C-9-1)26dcd-1	Woodard, J.E.	1956	S	37
(C-9-1)28ccb-1	LDS Church	1962	I	802
(C-9-1)29acc-1	LDS Church	1963	I	700
(C-9-1)29bcc-1	LDS Church	1963	H	800
(C-9-1)29cdc-1	Town of Elberta	1977	P	400
(C-9-1)29cdc-2	Town of Elberta	1989	P	387
(C-9-1)34ccc-1	LDS Church	1951	I	650
[2] (C-9-1)34acd-1	Miller, H.	1961	S	265
(C-9-1)34ddc-1	Miller, A.	1964	H	256
(C-10-1)2bcd-1	Green, Duane	1981	S	100
(C-10-1)3ddb-1	White, G.T.	—	H	495
(C-10-1)4bbb-1	LDS Church (No. 2)	1962	I	882
(C-10-1)4cbb-1	LDS Church	1962	I	870
(C-10-1)9ccc-1	Wright, Bill	1961	I	474
(C-10-1)10ddc-3	Green, Duane	1979	H	162
(C-10-1)11ccd-1	Burraston, Carma	1980	—	160
[3] (C-10-1)15cca-1	Morgan, H.	1951	U	168
(C-10-1)17aaa-1	Town Of Elberta	1955	U	376
(C-10-1)17bba-1	Sunshine Mining Company	—	U	860
(C-10-1)17bba-2	Sunshine Mining Company	1986	U	320
(C-10-1)18ccc-1	Levering, Dean and Betty	—	U	450
(C-10-1)24ddc-1	Lunceford, Scott	1965	U	533
[4] (C-10-1)25abd-1	Lunceford, Scott	1951	I	645

selected wells—Continued

Casing		Elevation of land surface (feet)	Water level		Other data available
Diameter (inches)	Finish (feet)		Above (-) or below land surface	Date	
2	O	4,505	-1.33	03-07-91	
20	—	4,643	127.65	03-04-91	L,W,C
18	P 280-380	4,719	214.28	03-04-91	L,W,C
	P 380-405				
	P 426-700				
18	P 300-350	4,792	300.10	04-02-90	L,W,C
	P 350-675				
	P 700-775				
8	P 315-385	4,760	288	05-23-88	
10	P 270-340	4,760	256.55	06-29-89	
8	P 70-580	4,551	17.85	12-13-74	C
	P 587-650				
1.25	O	4,508	-6.90	03-07-91	C
2	O	4,517	-5.50	03-07-91	L,C
6	O	4,515	9.18	03-07-91	
6	—	4,555	18.86	04-24-67	C
18	P 525-880	4,672	147.04	03-05-91	L,W,C
12	S 406-550	4,664	135.86	03-04-91	L,W,C
	S 640-680				
	S 700-740				
	S 750-850				
16	P 255-346	4,681	131.68	03-08-77	C
	P 360-420				
	P 427-474				
6	O	4,555	6 R	03-07-91	C
6	P 150-157	4,550	4.37	03-05-91	
12.5	—	4,600	28.29	03-07-91	W,C
6	O	4,711	170.37	12-30-71	C
4	S 750-860	4,810	266.71	03-04-91	W
6	P 300-320	4,810.4	266.56	03-04-91	W
8	O	4,918	353.46	03-05-91	W
20	P 366-391	4,750	212.54	03-05-91	W
	P 422-428				
	P 462-482				
12	P 372-450	4,778	245.15	03-05-91	W,C
	P 461-492				
	P 507-550				
	P 568-575				
	P 585-600				

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(C-10-1)28ada-2	LDS Church	1979	H	775
(C-10-1)29cdd-1	LDS Church	1961	I	842
(C-10-1)29dcd-1	LDS Church	1954	H	460
(C-10-1)29ddd-1	LDS Church	1962	I	700
(C-10-1)30baa-1	Unknown	—	S	—
(C-10-1)31cdd-1	LDS Church	1963	I	603
(C-10-1)32ccc-1	LDS Church	1961	I	507
(C-10-1)33cbb-1	LDS Church	1961	U	567
(C-10-1)34bbb-1	Critchfield, Ross	1949	H	342
(C-10-2)13bcc-1	Bronson, Jonathan	—	—	300
(C-11-1)6abc-1	LDS Church	1963	I	679
(C-11-1)6bdd-1	LDS Church	1964	I	762
(C-11-1)6cab-1	LDS Church	1981	I	825
(D-7-2)32dad-1	Batty, Roy	1978	H	550
5 (D-7-2)33dcc-1	Banks, A.	—	S	400
(D-7-2)34dcd-1	Christofferson, B.	1959	S	194
(D-7-2)35ccd-1	Hales, G.	1900	I	300

selected wells—Continued

Casing		Elevation of land surface (feet)	Water level		Other data available
Diameter (inches)	Finish (feet)		Above (-) or below land surface	Date	
8	P 746-760	4,670	135 R	04-06-79	
16	P 185-189	4,680	151.3	03-29-66	C
	P 205-275				
	P 280-574				
	P 595-685				
	P 696-762				
	P 770-815				
6	O	4,670	129.06	03-07-91	
16	P 162-195	4,660	100.50	03-04-80	C
	P 228-246				
	P 408-411				
	P 420-428				
	P 532-695				
—	—	4,778	228.67	06-05-90	W
20	P 290-603	4,760	210.69	03-14-91	L,C
16	P 210-220	4,743	204.1	03-29-66	C
	P 263-324				
	P 352-356				
	P 367-398				
	P 420-505				
16	P 155-567	4,680	115.54	03-07-91	
—	O	4,660	89.39	03-07-91	W
6	P 180-220	5,140	172.24	03-05-91	W
18	P 315-322	4,770	229.99	12-11-75	L,C
	P 330-335				
	P 390-488				
	P 495-532				
	P 545-675				
18	P 425-500	4,780.9	234.39	04-06-90	L,W,C
	P 533-541				
	P 556-577				
	P 584-659				
	P 672-745				
20	P 474-807	4,795	262 R	09-18-81	
8	P 350-353	4,493	-22.7	03-04-91	L,W,D
	P 450-453				
2.5	P 370-400	4,495	—	—	D
2	O	4,505	-6.60	03-05-91	W,C
2	O	4,507.1	-7.4	03-23-61	D

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(D-7-2)35ccd-2	Hales, A.	1961	H	420
(D-7-2)36bbb-1	Money, W.	1943	S	147
(D-7-2)36ccb-1	Money, W.	1961	I	504
(D-7-2)36dad-1	Huntingdon, B.	—	S	100
(D-7-2)36dcc-2	Crandall, Condie	—	U	186
(D-7-3)18dcc-1	LDS Church	1962	H	322
(D-7-3)19aac-1	John Kuhni and Sons Animal By-Product Plant	1938	N	268
(D-7-3)20adb-1	Brigham Young University	1970	U	353
(D-7-3)20bcd-1	Pacific States Cast Iron Pipe	1926	N	308
(D-7-3)20bcd-3	Pacific States Cast Iron Pipe	1927	N	635
(D-7-3)28bdb-1	Utah Division of Wildlife Resources	1963	U	338
(D-7-3)28cab-1	Park Ro-She Corp. (H.J. Robbins, Pres.)	1961	U	285
(D-7-3)28dbb-1	Utah Division of Wildlife Resources	1988	U	37
(D-7-3)29bdb-1	Fibertek	1986	N	148
6 (D-7-3)29dcc-1	Sumsion, Howard C.	1953	I	136
(D-7-3)29ddd-1	Springville City	1986	U	413
(D-7-3)30aaa-1	Perry, Robert	1977	I	277
(D-7-3)30aac-3	Condie, A.	1953	S	125
(D-7-3)31cac-2	Childs, Neil	1964	S	135
(D-7-3)32bcc-1	Wood Springs Irrigation Company	1934	I	414
(D-7-3)32bcc-2	Metcalf, Harold	1972	H	164
(D-7-3)32bcd-1	Jensen, Clarence L.	1977	S	151
(D-7-3)33baa-6	Champerlain	1900	H	138
(D-7-3)33ccc-5	Vane, J.E.	—	U	140
(D-7-3)33ccc-6	Matson Springs Irrigation Company	1966	I	533
(D-7-3)34bcb-1	Springville City	1961	P	485
(D-7-3)34cdb-1	Springville City	1960	P	445
(D-8-1)2ccd-1	Hirst, Harold	—	H	55
(D-8-1)3dda-1	Unknown	1967	U	72
(D-8-1)10bcb-1	South Shore Fruit Farms	—	U	240
(D-8-1)10bcb-2	South Shore Fruit Farms	—	U	135
(D-8-1)11bac-1	Utah County	1981	P	300
(D-8-1)13aaa-1	Schaffer, S. B.	1906	H	358
(D-8-1)13bdd-1	Atwood, G.	1950	S	119
(D-8-1)13daa-3	Mecham, Darrell F.	1949	I	345
(D-8-1)14dad-1	C. B. Turkey, Inc.	1966	I	350
(D-8-1)20abb-1	Hi-Country Fruit Farms (Phil Belnap)	—	H	205

selected wells—Continued

Casing		Elevation of land surface (feet)	Water level		Other data available
Diameter (inches)	Finish (feet)		Above (-) or below land surface	Date	
4	O	4,507	-17	05-12-64	D
3	O	4,490	—	—	D
3	P 496-504	4,500	-35 R	10-01-61	D
—	—	4,500	-5.9	03-04-91	
2	O	4,503.1	-11.40	03-04-91	W,D
4	P 115-121	4,495	-18.9	03-05-91	L,W
3	O	4,493	-26.1	04-28-47	
16	P 115-350	4,520	-1 R	03-11-70	
4	O	4,495	-25.0	10-15-64	
4	O	4,494	-42.5	10-15-64	
16	P 270-330	4,520	-22.4	09-11-87	C
2	P 280-285	4,527	-14.8	03-04-91	L,W
2	O	4,550	8.43	04-18-89	
8	O	4,502	—	—	
2	O	4,515	-25 R	03-11-53	D
16	S 349-413	4,525	-28 R	01-15-87	
6	O	4,495	-40.9	03-09-82	C
2	O	4,496	-15.4	03-04-91	
4	P 130-135	4,503	-14.3	09-13-89	W,D
—	—	4,511	-5.4	03-04-91	
6	P 152-159	4,511	-14.5	03-26-81	L
6	O	4,518	-13.2	03-04-91	W
2	O	4,560	-4.7	03-04-91	W,D,C
2	O	4,567	-5.2	03-04-91	W,D
16	P 230-533	4,565	-14.3	03-08-91	W
16	P 410-475	4,580	2.0	04-22-64	
16	P 158-230 P 284-395 P 402-442	4,650	45.9	07-01-65	L,C
8	O	4,495	6.87	03-05-91	W
—	—	4,520	32.32	02-15-91	C
6	O	4,520	17.01	03-05-91	W,C
—	—	4,520	43.34	03-05-91	W
8	P 200-251	4,495	-7.7	03-04-91	C
4	O	4,499	-11.3	03-04-91	W,D
2	O	4,496	-1.5	03-05-91	W
8	P 285-328	4,499	-13.9	06-25-65	D
6	O	4,492	—	—	D
6	O	4,505	15.68	03-05-91	W

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(D-8-1)23bdd-1	Binning, Lester and Agnes	—	S	120
(D-8-1)25aad-1	Hansen, J.	1953	S	104
(D-8-1)25aba-1	Ludlow, W.	1944	I	173
(D-8-1)25cbb-1	Kelsey, C.	1964	S	300
(D-8-1)26bdd-1	Vannosdol, George	1977	S	126
(D-8-1)35cac-1	Hanson, Charles K.	1975	H	440
(D-8-1)35cac-2	Hanson, Charles K.	1962	I	351
(D-8-1)36bcc-1	Ercanbrack, L.	1963	S	231
(D-8-2)1baa-1	Finch, J.	1963	S	182
7 (D-8-2)2aac-1	Banks, L.	1961	I	336
(D-8-2)2caa-1	Thomas, G.	1951	S	338
(D-8-2)2cda-1	Roach, T.	1900	H	140
(D-8-2)2daa-1	Williams, R.D.	1948	S	346
(D-8-2)3aad-1	Monk, B.	1963	I	417
(D-8-2)3ccd-1	Banks, L.	1961	S	420
(D-8-2)4abb-1	Banks, L.M.	1900	S	150
(D-8-2)4abb-2	Sorensen, James Jr.	1895	H	—
(D-8-2)4abc-1	Sorenson, W.	1950	S	230
8 (D-8-2)4bab-1	Banks, L.	1963	H	324
(D-8-2)4cba-2	Sharp, Jeff	1909	I	330
9 (D-8-2)4cbb-1	Lakeside Irrigation Company	1934	I	500
(D-8-2)4cdc-1	Olsen, Chet	1908	H	80
(D-8-2)4cdc-4	Olsen, Chet	1945	H	143
(D-8-2)4dad-1	Sorensen, W.	1963	I	607
(D-8-2)7cab-1	Brooks, H. L.	1947	I	263
(D-8-2)7cbd-1	Nelson, Justin R.	1962	H	355
(D-8-2)7dda-1	Hall, M.	1956	S	276
(D-8-2)7ddd-1	Hall, M.	1913	H	520
(D-8-2)9aad-1	Banks, A.	1964	H	385
(D-8-2)10adb-1	Ottesen, H.	1966	H	588
(D-8-2)10bdd-1	Sorenson, F.	1955	H	411
(D-8-2)12ddc-1	Diamond, Harold	—	S	172
(D-8-2)12ddc-2	Diamond, Harold	1961	S	372
(D-8-2)13abc-1	Johns, K.	1961	I	378
(D-8-2)13bdd-1	Pace, R.	1962	H	378
(D-8-2)14cad-1	Elson, G.	1953	S	376
(D-8-2)14dcc-1	Johns, W.	1939	H	377
(D-8-2)16caa-1	Lewis, R.C.	1895	H	570

selected wells—**Continued**

Casing			Elevation of land surface (feet)	Water level			Other data available
Diameter (inches)		Finish (feet)		Above (-) or below land surface		Date	
2	O		4,500	-8.0		03-05-91	W,D
2	O		4,497	-9.9		03-05-91	D
2	X	163-173	4,498	-6.5		03-05-91	W
1.5	X	205-300	4,504	-11.8		03-04-91	W
6	O		4,620	77.86		03-06-91	
6	O		4,575	52.96		03-05-91	
8	P	100-345	4,578	60.7		06-29-65	C
4	—		4,518	-10.9		03-07-91	W
6	P	167-182	4,505	-10.3		08-08-89	W,D
2	O		4,511	-22.8	R	08-06-64	D
2	O		4,518	-11.6		09-21-89	W,D
2	O		4,524.4	-4.7		03-04-91	W,D
2.5	O		4,514.9	-25.7		04-02-90	W,D,C
2.5	P	412-417	4,512	-15.8		09-15-89	W,D
2.5	O		4,512	-8	R	11-01-61	D
1.25	O		4,494.1	-14.1		03-05-91	W,D
—	O		4,498.2	-6.0		09-12-89	D
2	O		4,496	-11.3		09-12-89	W,D
3	P	316-324	4,495	-4.4		09-12-89	W,D
2	O		4,501	-17.6		03-01-91	W,D,C
8	O		4,499	-6.1		09-15-89	W,D
2	O		4,500	-12.2		03-04-91	
2	O		4,500	-13.0		03-04-91	W
3	P	593-607	4,502	-13.4		09-28-89	W,D
2	O		4,493	-7.5		08-20-64	D
4	O		4,492	—		—	D
3	O		4,498	-4.9		03-04-91	W
1.25	O		4,498	-9.3		03-01-91	W
3	O		4,511	-8.7		03-05-91	D
3	O		4,520	-19.7		03-01-91	W,D
2.5	O		4,518	-4.0		09-28-89	D
2	O		4,540	-2.6		08-13-76	D,C
3	P	364-372	4,541	-48.6		09-10-84	D,C
3	P	368-378	4,548	-18.4		09-28-89	W,D,C
3	P	368-378	4,555	-28	R	04-02-64	D
2.5	O		4,547	-3.5		03-05-91	W
2	O		4,553	-14.2		07-09-65	D
3	O		4,525	-27.2		09-05-90	W,D,C

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(D-8-2)16dbb-2	Huff, J.	1962	H	168
(D-8-2)17ada-1	Hansen, B.	1964	H	466
(D-8-2)17add-5	Huff, E.	1962	H	105
(D-8-2)17add-6	Huff	1950	H	80
(D-8-2)17ccc-2	Clayson, Mrs. Allen	1959	H	363
(D-8-2)17dab-2	Beckstrom, J. L.	1959	H	100
(D-8-2)17dad-1	Evans, James S.	1975	H	110
(D-8-2)17ddd-1	Simmons, Steve	1944	H	94
(D-8-2)19add-1	Beckstrom, A.	1916	H	480
(D-8-2)20cad-2	Hawkins, C.	1900	H	420
(D-8-2)21aaa-1	Anderson, Mrs. John	—	H	498
(D-8-2)21bbb-2	Lee, Eddie	1956	H	110
(D-8-2)21ddd-1	Anderson, Bernell	1936	H	347
(D-8-2)22cdc-1	Salt Lake By-Products	1935	N	620
(D-8-2)22cdc-2	Salt Lake By-Products	1957	N	385
(D-8-2)23dbd-1	Ferto Corporation	1920	N	390
(D-8-2)23dbd-2	Ferto Corporation	1916	N	390
(D-8-2)23dbd-3	Ferto Corporation	—	H	—
(D-8-2)23dca-2	Ferto Corporation	1940	I	569
(D-8-2)24bdc-2	Thomas, R.	1963	H	352
(D-8-2)25bca-1	Valley Asphalt, Inc.	1978	N	246
(D-8-2)25dac-3	Spanish Fork City	1961	U	620
(D-8-2)26aad-3	Creer, R.	1961	H	223
(D-8-2)26aad-4	Leland Milling Company	1987	N	360
(D-8-2)26abb-3	Ludlow, A.	1946	H	371
(D-8-2)26adc-1	Unknown	1971	S	—
(D-8-2)27acd-1	Thomas, I.	1948	S	180
(D-8-2)28cbd-3	Hone, Melva	1944	H	92
(D-8-2)28cca-2	Thorton, S.	1951	S	200
(D-8-2)28daa-1	Larson, D.	1939	H	120
(D-8-2)29aaa-7	Hickman, Rex L.	1957	H	390
(D-8-2)29aab-5	Steele, Alice	1956	H	176
(D-8-2)29add-1	Reynolds, Reed	1935	H	222
(D-8-2)29bcb-1	Argyle, Bert	1966	H	165
(D-8-2)29bcd-2	Zieman, Jacob	1952	H	166
(D-8-2)29cab-1	Hansen, Arthur	1947	H	168

selected wells—Continued

Casing			Elevation of land surface (feet)	Water level			Other data available
Diameter (inches)	Finish (feet)			Above (-) or below land surface		Date	
2	—		4,522	-4.2		03-04-91	W
2	X	452-466	4,514	-5.4		03-01-91	W,L
2	P	84-105	4,517	7.74		03-17-70	D
2	O		4,515	8	R	06-07-50	D
2	O		4,509	-8.5		08-17-89	W,D
2	O		4,514	9.11		09-03-64	D
4	O		4,518	9.16		03-04-91	
2	X	83-94	4,522	8	R	07-13-44	D
2	—		4,514	-12.6		03-01-91	W
2	—		4,522	-2.7		03-01-91	W
3	O		4,536	-6.85		08-28-89	W
2	O		4,522	10	R	06-26-56	D
2	O		4,541	-12.5		10-02-89	W,D
2	O		4,545	-15.4		03-04-91	W,D
4	—		4,545	-10.9		03-04-91	W,D
3	P	380-390	4,565.1	-19.6		12-17-47	
4	P	380-390	4,561	-15.6		06-23-65	
2	—		4,560	-1.1		09-15-64	D
8	P	475-500	4,562	-18.2		10-05-73	C
3	P	327-352	4,570	-1.5		08-17-89	W,D
8	O		4,610	27	R	12-30-78	
16	P	505-508	4,622	38.42		03-05-91	W
	P	512-545					
	P	547-564					
	P	600-605					
4	O		4,595	35.45		03-06-91	W
6	O		4,595	8	R	09-25-87	
2.5	O		4,579	-3.9		03-04-91	W
8	O		4,550	-4.5	R	02-16-71	
2	O		4,546	-5.2		03-05-91	W
2	O		4,525	-6.6		07-31-89	W,D,C
3	O		4,525	-4.1		03-01-91	W
2	O		4,535	-2.6	R	09-25-64	D
2.5	O		4,530	-6.9		03-05-91	W
2.5	O		4,525	-4.6		03-01-91	
3.5	O		4,526	-3.8		08-10-77	C
4	O		4,508	-10.5		08-17-89	D
2.5	O		4,512	-19.6		08-17-89	W,D
2.5	O		4,513	-26.4		03-04-91	W,D

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(D-8-2)30bad-1	Stewart, I.	1944	I	32
(D-8-2)31bcd-1	Tanner, Art	1890	S	60
(D-8-2)31cbb-1	Schaerrer, Grant	1945	S	96
(D-8-2)31cda-1	Schearrer, Grant	—	I	450
(D-8-2)31cdb-1	Schearrer, Grant	1920	S	90
(D-8-2)31cdb-2	Schearrer, Grant	1963	I	435
(D-8-2)32aad-1	Young, K.	1934	H	117
(D-8-2)32daa-1	Benjamin Cemetery	1949	I	247
(D-8-2)33bcc-1	Mackey, Boley	—	I	—
(D-8-2)34acd-1	Ludlow, N.	1946	S	80
(D-8-2)34dda-1	Bearnson, Gill	1946	S	130
(D-8-2)36dbd-2	Gardner, L.	1952	H	260
(D-8-2)36dbd-3	Cloward, B.	1961	H	38
(D-8-3)2dcd-1	Mapleton City	1954	P	533
(D-8-3)2dcd-2	Dawn, Richard	1977	H	200
(D-8-3)3bca-1	Springville City	1990	P	428
(D-8-3)3cca-1	Snyder, Robert	1975	H	232
(D-8-3)3dcb-1	Fullmer, Richard	1978	H	305
(D-8-3)3dcd-1	Seal, Z.	1961	I	387
(D-8-3)4caa-2	Eddington Canning Company	1945	H	117
(D-8-3)4caa-3	Eddington Canning Company	1952	I	153
(D-8-3)4caa-4	Spanish Fork City	1965	U	—
(D-8-3)4cad-1	Eddington Canning Company	1935	—	231
(D-8-3)4daa-1	Springville City	1961	P	371
(D-8-3)5bca-1	Phillips, J.L.	1890	H	150
(D-8-3)6ddd-1	Unknown	—	U	—
(D-8-3)6ddd-2	Unknown	—	I	357
(D-8-3)6ddd-3	Unknown	1934	I	149
(D-8-3)6ddd-4	Unknown	1934	I	284
(D-8-3)6ddd-5	Springville Irrigation Company	1934	I	160
(D-8-3)7aad-1	Schwartz, Glade	1948	S	148
(D-8-3)7abc-1	Leftwich, Jack	1972	C	156
(D-8-3)7aca-2	Williams, Keith	1948	I	147
(D-8-3)8abd-1	Miner, F. Lee	1959	U	300
(D-8-3)10cba-1	Hjorth Brothers	1961	I	520
(D-8-3)10dac-1	Johnson, Kelly	1977	H	62

selected wells—**Continued**

Casing		Elevation of land surface (feet)	Water level		Other data available
Diameter (inches)	Finish (feet)		Above (-) or below land surface	Date	
2	O	4,500	-7.3	09-28-64	D
2	O	4,503.2	—	—	D
3	O	4,504	-14.8	08-28-89	W,D,C
12	P 150-450	4,510	—	—	D,C
22	O	4,510	-15.0	03-07-91	W,D,C
12	P 210-325	4,510	-30.2	03-07-91	W,D,C
	P 375-430				
2.5	O	4,520	-2.5 R	09-28-64	
5	O	4,545	11	11-10-49	C
—	—	4,525	—	—	
2	O	4,531	-7.4	03-05-91	W,D,C
2	O	4,528	-11.0	03-09-90	W,C
4	O	4,640	51.12	03-06-91	
6	—	4,640	9.13	03-06-91	W,C
10	P 238-243	4,805	221.70	03-19-65	
	P 246-533				
6	O	4,800	171.12	03-08-91	
16	P 280-420	4,640	70.23	03-05-91	L
6	P 200-232	4,702	114.17	03-05-91	L
6	P 285-305	4,725	148.69	03-05-91	
16	P 215-385	4,736	164	04-22-64	
4	O	4,560	-20 R	06-08-45	D
8	P 112	4,560	—	—	D
8	O	4,560	-25 R	07-19-65	D
4	O	4,580	-18.1	07-02-65	D
16	P 145-255	4,629	46.2	07-01-65	L
	P 280-370				
2	O	4,522.2	-9.7	03-04-91	WD
—	—	4,520	—	—	D
3	—	4,620	—	—	D
3	O	4,518	-2.7 R	11-04-64	
3	—	4,518	—	—	
3	—	4,518	—	—	
3	O	4,525	-25.1 R	03-31-64	D
8	P 132-156	4,519	-23.5	03-04-91	W,D
2.5	O	4,525	-25 R	07-14-48	D
4	O	4,560	6.14	03-04-91	L,W
8	P 395-520	4,714	127.6	06-30-65	L
6	O	4,725	34.44	03-05-91	L

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(D-8-3)10ddb-2	Porter, Rich D. & Lois G.	1977	H	203
(D-8-3)11abb-1	Edmonds, Paul K.	1986	I	242
(D-8-3)11caa-1	Perry, Fay L.	1983	I	215
(D-8-3)11ccc-1	Mapleton City	1961	P	500
(D-8-3)11ccc-2	Johnson, Frank	1977	H	70
(D-8-3)14acc-1	Orton, G.B.	1963	U	675
(D-8-3)14bab-1	Trojan Powder Corporation	1989	U	376
(D-8-3)14dab-1	Shurtleff, F.L.	1972	I	363
(D-8-3)14dca-1	Broadbent, J.	1965	I	395
(D-8-3)16aaa-1	Kimber and Johnson	1973	S	70
(D-8-3)16aaa-2	Rostron, Melvin	1977	H	275
(D-8-3)17ada-1	Garner, R.	1950	S	65
(D-8-3)17bad-1	Orton, G.B.	—	I	—
(D-8-3)17cdc-1	Pierce, L.	1960	H	127
(D-8-3)17cdc-2	Smith, F.	1960	H	295
(D-8-3)18aaa-3	Hanson, R.	1960	I	171
(D-8-3)18bdc-1	Spanish Fork City	1963	I	350
(D-8-3)19bbb-1	Spanish Fork City	1968	P	1,000
(D-8-3)19ccb-1	Spanish Fork City	1969	I	275
(D-8-3)19ccd-1	Christianson, H.	1890	H	25
(D-8-3)19cda-1	Spanish Fork City	1975	P	393
(D-8-3)19dca-1	Spanish Fork City	1970	P	603
(D-8-3)21bbd-1	Snyder, Paul	1977	H	358
(D-8-3)21cac-1	Storrs, Jan	1976	H	275
(D-8-3)22bab-1	Crandall, Condie	1972	H	26
[10](D-8-3)22cbd-3	Mapleton City	1961	P	541
(D-8-3)23baa-1	Dr. Orton	—	I	—
(D-8-3)23ccd-1	Biesinger, N.	1961	I	265
(D-8-3)23cdd-1	Whiting, R.W.	1973	H	381

selected wells—**Continued**

Casing		Elevation of land surface (feet)	Water level		Other data available
Diameter (inches)	Finish (feet)		Above (-) or below land surface	Date	
6	O	4,722	141.47	03-05-91	
8	P 210-215	4,790	200 R	04-01-86	C
8	O	4,770	185.60	03-05-91	W
12	P 383-405	4,730	140	03-06-91	W
	P 409-494				
6	P 65-67	4,735	46.16	03-07-91	W
8	P 189-200	4,775	177.05	03-05-91	W
	P 372-395				
	P 507-675				
4	R 351-371	4,729.1	144.85	12-22-89	W
8	P 200-363	4,800	210 R	02-25-72	
12.5	P 210-215	4,800	195 R	07-20-65	
	P 233-252				
	P 315-378				
6	P 55-65	4,710	14.68	03-05-91	L
6	O	4,705	123.43	03-05-91	L
4	O	4,700	24.53	03-07-91	W
—	—	4,600	—	—	
4	O	4,705	9.79	03-05-91	
4	O	4,710	142.22	03-05-91	W
4	O	4,550	-2.1	03-07-91	W
6	P 330-350	4,554	-23.9	06-22-65	
16	P 780-811	4,675	—	—	
	P 820-833				
	P 890-920				
	P 948-955				
12	P 170-250	4,585	10.7 R	10-19-69	
1.5	O	4,590	-6.4	03-04-91	W
12	P 160-179	4,660	88	11-05-75	
	P 303-332				
16	P 461-50	4,690	—	—	
6	X 330-358	4,719	135.24	03-06-91	
6	P 265-275	4,735	133.12	03-06-91	
4	P 15	4,720	11.32	03-06-91	
16	P 485-535	4,760	179.88	03-06-91	L,W
—	—	4,770	—	—	
8	O	4,960	220 R	09-29-61	L
6	P 360	4,980	182.96	03-07-91	

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(D-8-3)26bcd-1	Trojan Powder Corporation	1989	U	236
(D-8-3)26cbd-1	Trojan Powder Corporation	1989	U	302
(D-8-3)26cbd-2	Trojan Powder Corporation	1989	U	43
(D-8-3)26cca-2	Trojan Powder Corporation	1989	U	35
(D-8-3)26ccb-1	Trojan Powder Corporation	1940	N	399
(D-8-3)27adc-1	Trojan Powder Corporation	1989	U	188
(D-8-3)27adc-2	Trojan Powder Corporation	1989	U	395
(D-8-3)27bad-1	Trojan Powder Corporation	1989	U	276
(D-8-3)27bad-2	Trojan Powder Corporation	1989	U	468
(D-8-3)27cdc-1	Spanish Fork City	1963	P	630
(D-8-3)28abc-1	Jensen, J.	1961	I	470
(D-8-3)28bcd-1	Spanish Fork City	1961	P	410
(D-8-3)28bdc-1	Anderson, G.	1961	I	395
(D-8-3)29aaa-1	Farnsworth, Richard C.	1974	H	289
(D-8-3)30dba-1	Haderlie, P.	1970	U	285
(D-8-3)31ccd-1	Hendacka, H.	1970	H	246
(D-8-3)32add-1	Southeast Irrigation Company	—	I	—
(D-8-3)32baa-1	Vincent, W.	1960	H	276
(D-8-3)33aca-1	Spanish Fork City	1971	H	328
(D-8-3)33acb-1	Strawberry Water Users' Association	1910	H	50
(D-8-3)33cac-1	Hunter, W.	1958	H	100
(D-8-3)33cac-2	Shepherd, Lee	1973	H	693
(D-8-3)34aca-1	Trojan Powder Corporation	1940	N	261
(D-8-3)34bab-1	Spanish Fork City	—	U	470
(D-8-3)34bbb-1	Hurst, Harold	1973	S	151
(D-9-1)1bac-1	Powell, Lynn, and Young, Dallas	1976	I	600
(D-9-1)1bcb-2	Powell, L.M.	1973	H	416
(D-9-1)2ada-2	Farr, L.	1948	H	610
(D-9-1)2cab-1	Hi-Country Fruit Farm	1973	H	210
(D-9-1)2ccd-1	Critchfield, Gale	1980	—	280
(D-9-1)2ddd-1	Stewart, M.	1945	H	60
(D-9-1)11acc-1	Liddle, G.	1974	H	253
(D-9-1)11acc-2	Liddle, Parley	1981	S	85
(D-9-1)11baa-1	Bezzant, Clifford	1971	I	168

selected wells—Continued

Casing			Elevation of land surface (feet)	Water level			Other data available
Diameter (inches)		Finish (feet)		Above (-) or below land surface		Date	
4.5	S	216-236	4,965.6	189.04		03-08-91	W
—	—		5,012.6	231.16		03-08-91	W
—	—		4,991.1	36.13		03-08-91	W
—	—		4,983.9	21.86		03-08-91	W
8	P	365-399	5,000	266.1		03-23-65	
4	R	163-183	4,820.5	96.57		03-08-91	L,W
4.5	S	375-395	4,820.6	165.40		03-08-91	W
4	R	256-276	4,778.5	149.39		03-08-91	W
5	R	443-463	4,772.4	185.36		03-08-91	L,W
12	P	220-254	4,780	168.9		06-30-65	L
	P	377-432					
	P	515-520					
	P	541-546					
	P	583-589					
12	P	264-284	4,745	154.1		06-30-65	L
	P	425-465					
12.5	—		4,749	—		—	L
12	P	240-285	4,746	178.50		04-22-64	L
8	O		4,735	160	R	10-01-75	L
6	P	265-285	4,711	113.73		03-06-91	L,W
4	O		4,655	67.12		03-04-91	L
—	—		4,660	—		—	
5	O		4,720	164	R	03-03-65	
6	P	320	4,678	-40.6		03-04-91	
—	O		4,664	—		—	C
4	O		4,760	62.41		03-07-91	W
6	P	353-693	4,800	-13.5		03-08-91	
10	P	240-261	4,844	101.16		03-24-67	
16	—		4,797	142.75		03-06-91	W
8	P	135-146	4,720	70.87		03-06-91	W
6	—		4,520	-26.5		08-09-89	D
6	X	316-416	4,530	-6.4		03-05-91	
3	O		4,532	-3.1		03-05-91	
8	O		4,720	182.51		06-26-89	
8	O		4,730	205	R	06-22-80	
2	—		4,555	5.49		03-06-91	
6	P	175	4,610	73	R	07-01-74	
8	O		4,615	77.79		03-06-91	W
8	P	118-165	4,598	62.10		03-06-91	W

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(D-9-1)11bad-1	Bird, Terry	1971	H	160
(D-9-1)11ddc-1	Simpson, Leonard	1971	H	135
(D-9-1)12bbc-1	Bishop, A.	1947	H	70
(D-9-1)13bdb-1	McBeth, Clyde	1912	I	340
(D-9-1)13bdb-2	McBeth, Clyde	1920	I	340
(D-9-1)14aad-1	Wayman, Reid L.	1961	I	360
(D-9-1)14aad-2	Wayman, Craig	1971	I	300
(D-9-1)14ada-1	Stewart, D.	1945	H	55
(D-9-1)14ada-2	LDS Church	1961	I	363
(D-9-1)14ddd-1	Nay, C.	1950	H	125
(D-9-1)23acc-2	Payson Fruit Growers	1977	N	363
(D-9-1)23ada-1	Hi-Country Fruit Farm	1959	I	323
[11](D-9-1)23adb-1	Rowley Brothers	1959	H	290
(D-9-1)23daa-1	Meredity, V.	1963	H	86
(D-9-1)23dcb-1	Rowley Brothers	1970	H	201
[12](D-9-1)24acb-1	Daveport, L.	1962	H	100
(D-9-1)25aac-1	Spring Creek Irrigation Company	1934	I	34
(D-9-1)25aad-1	Holladay Field	1934	I	79
(D-9-1)25aad-2	Spring Creek Irrigation Company	1934	I	75
(D-9-1)25aca-1	Unknown	1934	I	160
(D-9-1)25ada-1	Spring Creek Irrigation Company	1934	I	124
(D-9-1)25ada-2	Unknown	—	I	—
(D-9-1)25ada-3	Holladay Field	—	I	90
(D-9-1)25ada-4	Unknown	—	—	—
(D-9-1)25ada-5	Unknown	—	I	—
(D-9-1)26aaa-1	McMullin, Dave	1973	I	380
(D-9-1)26aab-1	Rowley Brothers	1959	U	340
(D-9-1)26add-1	McMullin, Dave	1984	I	200
[13](D-9-1)26dda-1	McMullin, Dave	1961	I	307
(D-9-1)27aca-1	Keigley Quarry	—	K	310
(D-9-1)27aca-2	Keigley Quarry	1949	N	365
(D-9-1)32bbd-1	Oberg, Martin	—	U	80
[14](D-9-1)35abb-1	Strawberry Highline Canal Company	1963	I	435
(D-9-1)35bcd-1	Rowley	1957	S	190
(D-9-1)35bcd-2	Thompson, F.	1963	I	278

selected wells—Continued

Casing			Elevation of land surface (feet)	Water level			Other data available
Diameter (inches)		Finish (feet)		Above (-) or below land surface		Date	
8	P	126-160	4,615	80	R	07-20-71	
8	O		4,608	64.81		03-07-91	
4	O		4,562	3.63		03-06-91	
6	O		4,605.8	—		—	
12	O		4,605.8	-7	R	11-04-64	D
12	P	90-360	4,619	57.57		03-06-91	L,W
8	P	97-100	4,605	28.70		01-23-91	L,W,C
	P	190-300					
4	O		4,620	15	R	01-27-45	C
12	P	110-360	4,620	42.10		03-25-67	C
4	O		4,649	30.60		03-06-91	W
10	P	120-170	4,770	243	R	05-15-77	
	P	220-355					
12	P	44-308	4,667	23.04		03-06-91	W,C
12	—		4,695	50.09		03-06-91	
6	—		4,687	39.71		03-06-91	W
8	P	126-198	4,760	114	R	10-22-70	
6	O		4,659	3.41		03-08-91	W
4	O		4,695	-1.6	R	10-14-64	D
4	O		4,682	-3.1	R	05-28-64	D
4	O		4,680	-5.0		03-07-91	D
3	O		4,705	-2.6		08-30-89	D
4	O		4,680	-7.6		03-07-91	W,D
—	—		4,680	-12.5		07-20-89	D
—	—		4,680	-12.8		07-20-89	W,D
—	—		4,680	-9.4		07-20-89	D
—	—		4,680	—		—	D
10	P	100-380	4,705	53	R	06-26-73	C
12	P	70-340	4,715	61.92		03-06-91	W,C
10	P	100-200	4,735	45	R	07-31-84	C
14	P	90-300	4,741	51.4		06-29-65	
8.25	O		4,765	226.96		10-25-89	W
8.5	P	220-365	4,760	224	R	01-01-50	
3	—		4,530	15.95		03-05-91	W
16	P	145-430	4,800	103	R	03-29-67	C
6	O		4,822	151.23		03-06-91	
6	P	160-210	4,822	160		10-14-64	C
	P	218-275					

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(D-9-1)36acb-1	Ferguson, Bill	1975	I	415
(D-9-1)36bbc-1	Strawberry Highline Canal Company	1961	I	386
(D-9-1)36cdb-1	Miller, M.	1962	H	185
(D-9-1)36cdd-1	Shaw, W.E.	1955	I	325
(D-9-2)1bcb-1	LDS Church	1966	I	733
(D-9-2)2add-1	Davis, Frank	1936	H	188
(D-9-2)2dad-1	Culmer, E.	1967	I	196
(D-9-2)2dad-2	Culmer, E.	1956	I	227
(D-9-2)3aba-4	Taylor, R.	1964	S	138
(D-9-2)4cdc-1	Island Ranch Company	1943	H	310
(D-9-2)5acc-1	Jones, H. Max	—	I	165
(D-9-2)5acc-2	Jones, H. Max	—	I	—
(D-9-2)5acc-3	Jones, H. Max	—	H	—
(D-9-2)5bcc-1	Depew, Max	1953	H	133
(D-9-2)5bcc-2	Depew, Max	1956	I	142
(D-9-2)5bcd-1	Depew, Max	1967	H	146
(D-9-2)5bcd-2	Maurin, Charles	1970	I	156
(D-9-2)5bdd-1	Jones, H. Max	1915	I	60
(D-9-2)5bdd-2	Jones, H.	1915	I	162
(D-9-2)5bdd-3	Depew, Max	—	I	—
(D-9-2)5bdd-4	Jones, H.M.	—	I	363
(D-9-2)5cbb-3	Stickney, Donna	1961	I	121
(D-9-2)5ccc-1	Wilson, Sherol	1900	I	160
(D-9-2)5ccd-2	Unknown	1990	U	32.5
(D-9-2)5dcd-3	Payson City	1934	—	166
(D-9-2)5ddb-1	Brown, Wayne L.	1974	H	40
(D-9-2)5ddc-2	Payson City	1934	U	170
(D-9-2)5ddd-1	Unknown	1990	U	32.5
(D-9-2)6add-4	Christiansen, G.	1961	H	112
(D-9-2)6add-5	Walker, James	1962	H	310
(D-9-2)6ddb-1	Wilson, Shirley	1970	I	158
[15](D-9-2)6ddb-2	Wilson, C.	1964	I	302

selected wells—**Continued**

Casing		Elevation of land surface (feet)	Water level		Other data available
Diameter (inches)	Finish (feet)		Above (-) or below land surface	Date	
10	P 200-265	4,820	102.41	03-06-91	W,C
	P 365-415				
16	P 80-370	4,807	102.2	03-06-91	W,C
4	O	4,862	167.64	03-08-91	W
12	P 192-325	4,890	187.52	03-06-91	W,C
16	P 540-618	4,580	-7.2	03-05-91	W,D
	P 645-730				
2.5	O	4,570	-1.6	08-17-89	W,D
4	O	4,570	-.6	03-05-91	W
2	O	4,570	-9.6	03-04-91	W,D
4	O	4,528	-15.4	03-04-91	W
8.4	O	4,582	-13	03-06-91	W
2	—	4,536	-32.3	03-06-91	W,D
—	—	4,542	—	—	
—	—	4,542	—	—	
4	O	4,537	-20 R	04-26-53	D
4	O	4,537	-14.2	08-09-89	W,D
6	P 136-146	4,537	-8.1	08-09-89	W,D
4	P 147-156	4,537	—	—	D
2	O	4,541.6	-13.1 R	09-23-64	
2	O	4,542	-27.9 R	09-23-64	D
—	—	4,540	—	—	
6	P 67-75	4,541	-40.0	01-02-69	D
	P 170-180				
	P 192-355				
4	O	4,541	-21.1	03-06-91	W,D
2	O	4,560.8	-8.3	12-04-64	D
1	O	4,562	3.44	07-02-90	W
3	O	4,576.8	-12.4	10-10 66	
—	O	4,565	-5.3	06-22-89	D,C
3	O	4,576.99	-15.2	03-11-74	D
1	O	4,576	5.96	03-06-91	W
6	O	4,534	-23.3	07-19-89	W,D
8	P 177	4,535	-31.2	07-19-89	W,D
8	P 85-90	4,546	-18.0	03-07-91	W,D,C
	P 100-105				
	P 121-126				
	P 146-152				
8	O	4,552	-17.9	03-07-91	W

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(D-9-2)7bdd-1	Peart, M.	1963	S	66
[16](D-9-2)7cda-2	Cornaby, B.	1962	S	16
(D-9-2)7dcc-1	Spencer, S.	1956	H	310
(D-9-2)8ccb-1	Unknown	1990	U	46.5
(D-9-2)9bac-1	LDS Church	1961	I	445
(D-9-2)10cad-2	Woodhouse, Ralph	1936	H	400
(D-9-2)10cad-4	Woodhouse, Mike	—	H	49
(D-9-2)10dac-1	Christensen, Don H.	1966	H	360
(D-9-2)11aaa-1	Wilson	1933	I	320
(D-9-2)11aca-3	Cole, Don	1958	H	285
(D-9-2)11adc-1	Salem City	1932	P	150
(D-9-2)13dbc-1	Johnson, Hal C.	1976	I	445
(D-9-2)13dca-1	Unknown	—	H	—
(D-9-2)14baa-1	Turpin, W.T.	1971	H	186
(D-9-2)14bdd-1	Vachea, Dan	1970	H	133
(D-9-2)15adb-1	Gasser, P.	1960	H	130
(D-9-2)15bbb-1	Payson City	1961	P	195
(D-9-2)15bcc-1	Reynaud, A.L.	1971	H	100
(D-9-2)15cda-1	Allred, Rey	1970	I	218
(D-9-2)16cbb-1	Payson City	1970	P	500
[17](D-9-2)17aaa-1	Payson City	1961	P	195
(D-9-2)17ada-1	Brimhall, Reed	—	U	165
(D-9-2)17bbb-1	Unknown	1990	U	31.5
(D-9-2)17cbc-1	Payson City	—	P	600
(D-9-2)17daa-1	Payson City	1954	P	225
(D-9-2)18aab-1	Unknown	1990	U	31.5
(D-9-2)18aca-1	Unknown	1934	H	278
(D-9-2)18dad-1	Haitt, W.	1949	H	92
(D-9-2)19aca-1	Emerald Turf Farm	1977	I	343

selected wells—Continued

Casing		Elevation of land surface (feet)	Water level		Other data available
Diameter (inches)	Finish (feet)		Above (-) or below land surface	Date	
6	O	4,594	20.16	03-06-91	W
—	P 13-16	4,600	8.02	03-06-91	W
6	O	4,603	7.94	03-06-91	W
1	O	4,606	5.5	07-02-90	
16	P 50-169	4,608	37.47	03-06-91	W,C
	P 202-252				
	P 288-337				
	P 377-427				
	O	4,585	-16.1	03-04-91	
—	—	4,585	3.63	03-04-91	
6	O	4,598	-20.9	03-04-91	W,D
3	P 175-185	4,584.63	-28.8	03-04-91	W,C
	P 310-320				
4	O	4,595	-22.3	03-04-91	W,D
3	O	4,596.9	-8.4 R	12-04-64	
6	P 347-445	4,960	346 R	07-17-76	
—	—	5,020	404.96	10-25-89	
4	O	4,690	72.20	03-06-91	
6	O	4,750	128.25	03-06-91	
4	O	4,695	77.48	03-06-91	
16	—	4,611	21.41	03-06-91	
6	O	4,665	64.84	03-06-91	
8	P 25-180	4,750	104 R	05-11-70	C
12	P 250-500	4,760	156 R	04-04-71	
16	P 100-195	4,682	74.9	06-28-65	
6	O	4,720	117.42	03-06-91	W
	O	4,623	14.2	07-02-90	
16	P 235-300	4,650	40 R	04-24-89	
	P 380-415				
	P 450-518				
12	P 160-220	4,764	158.50	01-18-67	
1	O	4,613	6.16	07-02-90	
3	O	4,620	17.15	03-06-91	W
4	O	4,645	37.01	03-07-91	
16	P 160-300	4,650	40.46	03-05-91	C
	P 323-343				

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(D-9-2)19acb-1	Emerald Turf Farm	1976	I	311
(D-9-2)20baa-1	Hardman, H.T.	1971	I	175
(D-9-2)20bbc-2	Mount Loafer Irrigation Company	1961	I	275
(D-9-2)20bdc-1	Revel, James M.	1974	I	445
(D-9-2)20cca-1	Peay, G.	1946	H	60
(D-9-2)20ccc-1	Spring Lake Water Works Company	1962	P	145
(D-9-2)22add-1	Haskel, F.E.	1972	H	272
(D-9-2)22bad-1	Allred, Rey	1957	Z	855
(D-9-2)22cad-1	Brunson, Reed A.	1976	I	220
(D-9-2)22dac-1	Goosenest Water Company	1970	P	500
(D-9-2)23abb-1	Elk Ridge Corporation	1979	P	957
(D-9-2)24aca-1	Hanks, Ted	1971	I	450
(D-9-2)24bda-1	Hanks, Ted	—	U	300
(D-9-2)25bbb-1	Elk Ridge Corporation	1970	P	340
(D-9-2)25bbc-1	Elk Ridge Corporation	1969	P	132
(D-9-2)26add-1	Elk Ridge Corporation	—	P	500
(D-9-2)26baa-1	Elk Ridge Corporation	1971	P	530
(D-9-2)29acd-1	Judd, Steve	1950	Q	70
(D-9-2)29acd-2	Judd, Steve	—	Q	—
(D-9-2)29acd-3	Judd, Steve	—	Q	—
(D-9-2)29acd-4	Judd, Steve	—	Q	—
(D-9-2)29bba-1	Mountain View Dairy	1972	S	250
(D-9-2)29cda-1	Spring Lake Water Works Company	1961	P	116
(D-9-2)29dbd-2	Spring Lake Water Works Company	1989	P	183
(D-9-2)30bcb-2	Unknown	—	I	—
(D-9-2)30cbb-2	Helm, Andrew	1957	H	95
(D-9-2)31cda-2	Thorvaldson, A.	1962	H	167
(D-9-2)32bac-1	Ashton, C.	1953	I	367
(D-9-2)32bbb-1	Jarvis, Marvin	1970	I	505
(D-9-2)36acd-1	Loafer Water Users' Association	1980	S	340

selected wells—**Continued**

Casing		Elevation of land surface (feet)	Water level		Other data available
Diameter (inches)	Finish (feet)		Above (-) or below land surface	Date	
12	P 157-309	4,645	35.61	03-05-91	C
—	X 175	4,740	136.81	03-05-91	
16	P 85-265	4,670	55.90	03-29-67	
8	P 190-440	4,740	120 R	09-27-74	
4	O	4,725	4.99	03-06-91	
12	P 95-110	4,716	20.40	03-05-91	L,W
	P 120-135				
8	P 262-272	4,960	248 R	09-01-72	
6	P 235	4,840	185 R	04-19-58	
8	P 160-200	5,020	140.26	03-06-91	W
12	P 185-415	5,035	190.60	04-28-89	
8	S 250-330	4,900	255 R	09-27-79	
	S 380-400				
	S 425-465				
	S 530-605				
	S 690-730				
	S 810-840				
	S 845-955				
8	P 305	5,140	266 R	11-01-71	L
4	O	5,100	286.90	03-04-91	W
6	P 150-340	5,290	158 R	04-20-70	
8	P 70-87	5,340	80.03	03-06-91	W
	P 100-130				
10	P 295-495	5,470	265 R	10-23-70	L
10	P 335-530	5,190	335 R	07-31-71	
4	O	4,780	-12.6	08-09-89	W,D
—	—	4,780	-11.8	08-09-89	
—	—	4,780	-11.1	08-09-89	
—	—	4,780	—	—	
8	X 155-250	4,730	67 R	10-01-72	
10	O	4,780	36.43	03-07-91	L
8	P 105-120	4,850	63.0	03-07-91	L
	P 140-150				
—	—	4,680	-8.6	08-03-89	D
4	O	4,705	7.74	08-03-89	W,D
6	O	4,832	140.1	06-28-65	
10	P 255-307	5,200	252.9	06-28-65	
10	P 127-500	4,800	87 R	12-01-70	
8	X 130-340	6,120	119	05-11-89	C

Table 1.—*Records of*

Well number	Owner	Year drilled	Use of water	Well depth (feet)
(D-9-3)5bbb-2	Brigham Young University	1959	H	276
(D-9-3)5bbd-1	Brigham Young University	1962	I	601
(D-9-3)5cdc-1	Koyle, J.	1946	H	105
(D-9-3)6abb-1	Cloward, R.	1904	S	14
(D-9-3)6cbc-1	Guss, P.	1965	S	280
(D-9-3)7aab-1	Tanner, Paul	1973	H	190
(D-9-3)18bbb-1	Salem City	1971	P	584
(D-9-3)19bba-1	Woodland Hills	—	P	—
(D-9-3)19bba-2	Woodland Hills	—	—	—
(D-10-1)1acd-2	East Santaquin Irrigation Company	1965	I	650
(D-10-1)1cbb-1	Santaquin City	1956	P	456
(D-10-1)2adb-1	Summit Creek Irrigation Company	1961	I	580
(D-10-1)2bba-1	Genola	1960	P	527
(D-10-1)2ddd-1	Summit Creek Irrigation Company	1969	I	694
(D-10-1)4ddc-1	Ekins, Shirl	1976	H	400
(D-10-1)10aab-1	Beardall, Norman	1974	H	333
(D-10-1)11bbd-1	Rowley, Claude	1964	H	475
(D-10-1)17cca-1	D.S. Powelson & Sons	1955	U	102
(D-10-1)19bad-1	Unknown	—	—	—
(D-10-1)19bdc-1	Ekins, Shirl	1970	I	455
(D-10-1)30bac-1	Lunceford, Scott	1983	I	600

---

[1] Previously reported as (C-9-1)20dcc-1 (Cordova, 1969, table 1).
[2] Previously reported as (C-9-1)34dba-1 (Cordova, 1969, table 1).
[3] Previously reported as (C-10-1)15cdd-1 (Cordova, 1969, table 1).
[4] Previously reported as (C-10-1)25aab-1 (Cordova, 1969, table 1).
[5] Previously reported as (D-8-2)4aab-1 (Cordova, 1969, table 1).
[6] Previously reported as (D-7-3)29dcb-1 (Cordova, 1969, table 1).
[7] Previously reported as (D-8-2)2abd-1 (Cordova, 1969, table 1).
[8] Previously reported as (D-8-2)4baa-1 (Cordova, 1969, table 1).
[9] Previously reported as (D-8-2)4bcb-1 (Cordova, 1969, table 1).

selected wells—Continued

Casing		Elevation of land surface (feet)	Water level		Other data available
Diameter (inches)	Finish (feet)		Above (-) or below land surface	Date	
8	—	4,675	94.9 R	09-01-64	
12	P 300-340	4,684	91.10	03-08-73	L,C
	P 515-586				
6	O	4,820	40.74	03-04-91	W
20	X 1-20	4,661	9.60	03-04-91	W
6	—	4,675	86.23	03-05-91	W
6	P 175	4,705	91.50	03-04-91	W
16	P 406-566	4,870	256.66	02-15-91	
—	—	5,160	—	—	
—	—	5,160	—	—	
16	P 190-643	4,920	229.85	08-09-65	C
16	P 280-454	4,973	270.14	03-07-91	W
12	P 259-548	4,938	234.90	02-15-67	C
12	P 189-520	4,880	144.70	03-14-73	
12	P 212-496	5,015	313 R	02-14-70	C
	P 506-694				
8	X 120-400	5,040	—	—	
8	P 233-245	4,960	186 R	03-22-74	
	P 273-300				
6	P 335-470	5,020	311	11-04-64	
12	—	4,563	31.22	03-05-91	W
—	—	4,580	—	—	C
16	P 200-420	4,650	125 R	08-31-70	C
	X 431-455				
12	P 300-400	4,840	257.30	03-19-90	C
	P 482-501				
	P 520-538				
	P 556-572				

---

[10] Previously reported as (D-8-3)22cac-1 (Cordova, 1969, table 1).
[11] Previously reported as (D-9-1)23aac-1 (Cordova, 1969, table 1).
[12] Previously reported as (D-9-1)24acc-1 (Cordova, 1969, table 1).
[13] Previously reported as (D-9-1)26daa-1 (Cordova, 1969, table 1).
[14] Previously reported as (D-9-1)35aba-1 (Cordova, 1969, table 1).
[15] Previously reported as (D-9-2)6ddc-1 (Cordova, 1969, table 1).
[16] Previously reported as (D-9-2)7dbc-1 (Cordova, 1969, table 1).
[17] Previously reported as (D-9-2)16bbb-1 (Cordova, 1969, table 1).

Table 2.—*Drillers' logs of selected wells*

Well number: See figure 1 for explanation of the numbering system for hydrologic-data sites.

Thickness: In feet.

Depth: Depth to bottom of interval, in feet below land surface. Total depth may be deeper than well depth reported in table 1.

Material	Thickness	Depth
(C-9-1)3ddb-1		
Log by Robinson Drilling Company		
Clay, sand, and gravel	98	98
Clay, yellow	17	115
Clay and gravel	30	145
Clay and sand	35	180
Clay, yellow	10	190
Sand and gravel	15	205
Clay, yellow	10	215
Sand and gravel	55	270
Clay and gravel	60	330
Clay, yellow	10	340
Clay, sand, and gravel	213	553
Clay, yellow	22	575
(C-9-1)4ddc-1		
Log by Robinson Drilling Company		
Clay and sand	80	80
Sand and gravel (water)	32	112
Clay and sand	78	190
Clay and gravel	170	360
Clay and gravel	120	480
Clay, sand, and gravel	128	608
Sand and gravel	82	690
(C-9-1)17cdd-1		
Log by Dave's Drilling Company		
Sand, gravel, and cobbles	75	75
Sand, gravel, and boulders	75	150
Sand and gravel	45	195
[1](C-9-1)20cdd-1		
Log by Robinson Drilling Company		
Silt and sand	14	14
Clay and gravel	124	138
Clay and sand	20	158
Clay and gravel (water)	52	210
Clay and sand	35	245
Sand and gravel	11	256
Clay, tan	4	260
Sand and gravel	30	290
Conglomerate	30	320
Clay, sand, and gravel	230	550
Clay, red	25	575
(C-9-1)20ddd-1		
Log by Robinson Drilling Company		
Gravel and boulders	23	23
Clay, sand, and gravel	127	150
(C-9-1)20ddd-1—Continued		
Gravel (water)	8	158
Clay and gravel	32	190
Gravel	59	249
Clay and gravel	229	478
Conglomerate	24	502
Clay and gravel	225	727
Conglomerate	2	729
Clay and gravel (red)	69	798
(C-9-1)28ccb-1		
Log by Robinson Drilling Company		
Clay and sand	16	16
Gravel and boulders	2	18
Clay, sand, and gravel	57	75
Boulders	4	79
Clay and gravel	46	125
Sand and gravel (water)	47	172
Clay, sand, and gravel	65	237
Sand and gravel	26	263
Clay, gravel, and boulders	35	298
Sand and gravel	80	378
Conglomerate	6	384
Clay and gravel	204	588
Sand and gravel	32	620
Clay and gravel	92	712
Conglomerate	18	730
Clay and gravel	72	802
(C-9-1)29acc-1		
Log by Robinson Drilling Company		
Silt	2	2
Clay and boulders	13	15
Clay, sand, and gravel	39	54
Clay, gravel, and boulders	31	85
Sand and gravel	30	115
Sand, gravel, and boulders	68	183
Clay and gravel	27	210
Sand and gravel (water)	22	232
Sand, gravel, and boulders	20	252
Sand and gravel	102	354
Clay and gravel (yellow)	62	416
Sand	8	424
Clay and gravel	208	632
Clay and sand	68	700

Table 2.—*Drillers' logs of selected wells*—Continued

Material	Thickness	Depth
(C-9-1)29bcc-1		
Log by Robinson Drilling Company		
Silt	1	1
Clay, sand, and boulders	39	40
Clay, gravel, and boulders	127	167
Sand	20	187
Clay, sand, and gravel	100	287
Gravel and cobbles	43	330
Clay, sand, and gravel	36	366
Clay and silt	8	374
Sand	13	387
Clay	59	446
Gravel	2	448
Clay, sand, and gravel	314	762
Sand and gravel	25	787
Clay and sand	13	800
(C-9-1)34ddc-1		
Log by Angus Hales		
Clay and silt	100	100
Gravel	1	101
Silt and sand	56	157
Gravel	1	158
Silt and sand	38	196
Clay	12	208
Silt and sand	57	265
(C-10-1)4bbb-1		
Log by Robinson Drilling Company		
Clay and sand	45	45
Clay, sand, and gravel	330	375
Conglomerate	20	395
Clay, gravel, and boulders	5	400
Conglomerate	23	423
Clay, sand, and gravel	50	473
Conglomerate	5	478
Clay, sand, and gravel	46	524
Clay and gravel	238	762
Clay, sand, and gravel	118	880
Unknown	2	882
(C-10-1)4cbb-1		
Log by Layne-Texas Company		
Clay, sand, and gravel	90	90
Sand and gravel	54	144
Gravel and boulders	22	166
Sand and gravel	88	254
Clay and gravel	40	294
Gravel and shale	8	302
Shale	8	310
Gravel	30	340
Sand and gravel	69	409
Gravel	120	529
(C-10-1)4cbb-1—Continued		
Shale and rybite	50	579
Clay, sand, and gravel	608	1,187
Gravel and hard rock	13	1,200
Shale	18	1,218
(C-10-1)31cdd-1		
Log by Robinson Drilling Company		
Clay and silt	10	10
Sand and gravel	20	30
Clay, sand, and gravel	180	210
Clay and volcanic ash (water)	45	255
Sand and gravel	38	293
Clay, brown	19	312
Volcanic cinders	6	318
Clay, sand, and gravel	132	450
Conglomerate	55	505
Clay and sand	5	510
Sand and gravel	18	528
Volcanic ash	8	536
Clay, conglomerate, and volcanic ash	9	545
Clay and volcanic cinders	3	548
Clay, sand, and gravel	55	603
(C-11-1)6abc-1		
Log by Eldon Comer		
Clay, sand, and gravel	21	21
Clay and cobbles	109	130
Gravel and boulders	8	138
Clay, sand, and gravel (water)	248	386
Sand, gravel, and cobbles (water)	74	460
Clay, sand, and gravel	36	496
Sand and gravel (water)	36	532
Clay, sand, and gravel	103	635
Sand and gravel (water)	42	677
Clay and gravel	11	688
(C-11-1)6bdd-1		
Log by Eldon Comer		
Clay, sand, and gravel	23	23
Gravel and boulders	19	42
Clay, tan	6	48
Clay, gravel, and boulders	17	65
Clay, sand, and gravel	213	278
Sand, gravel, and cobbles (water)	26	304
Clay, sand, and gravel	20	324
Sand, gravel, and cobbles	60	384

Table 2.—*Drillers' logs of selected wells*—Continued

Material	Thickness	Depth
(C-11-1)6bdd-1—Continued		
Clay, sand, and gravel (water)	288	672
Sand, gravel, and boulders (water)	68	740
Clay, sand, and gravel	35	775
(D-7-2)32dad-1		
Log by Jensen Construction and Drilling Company		
Clay and sand	190	190
Clay	160	350
Sand (water)	10	360
Clay, sand, and gravel (water)	190	550
(D-7-3)18dcc-1		
Log by Eldon Comer		
Sand	26	26
Clay, blue	89	115
Gravel	6	121
Clay, tan	37	158
Sand	70	228
Clay	50	278
Gravel	4	282
Clay	7	289
Sand	33	322
(D-7-3)28cab-1		
Log by Technical Services Inc.		
Silt, sand, and gravel	20	20
Clay (gray)	17	37
Sand (water)	4	41
Clay	33	74
Silt, sand, and gravel	93	167
Clay and gravel	16	183
Hardpan	4	187
Silt, sand, and gravel	21	208
Boulders	1	209
Sand and gravel	41	250
Gravel and hardpan	35	285
Boulders	5	290
(D-7-3)32bcc-2		
Log by Jensen Construction and Drilling Company		
Clay	25	25
Silt and sand	8	33
Clay	72	105
Sand	3	108
Clay	36	144
Sand, gravel, and cobbles (water)	18	162
Clay	2	164

Material	Thickness	Depth
(D-7-3)34cdb-1		
Log by J.S. Lee and Sons		
Gravel and boulders	9	9
Sand	14	23
Clay and gravel (water)	29	52
Sand and gravel	28	80
Clay and sand	60	140
Sand and gravel	115	255
Clay and gravel	190	445
(D-8-2)17ada-1		
Log by Christopherson and Simmons		
Soil	10	10
Sand	26	36
Clay	41	77
Clay (red) and sand	132	209
Clay, blue	6	215
Clay (red) and sand	23	238
Clay, blue	38	276
Clay (white) and sand	93	369
Clay, blue	9	378
Clay (red) and sand	23	401
Clay (white) and sand	33	434
Clay (blue) and sand	32	466
(D-8-3)3bca-1		
Log by Lee Drilling Inc.		
Fill	3	3
Gravel, cobbles, and boulders	15	18
Clay, sand, and gravel	5	23
Sand	45	68
Clay, gray	70	138
Gravel (water)	75	213
Sand and gravel	32	245
Clay	28	273
Sand and gravel (water)	12	285
Conglomerate	18	303
Gravel (water)	125	428
(D-8-3)3cca-1		
Log by Jensen Construction and Drilling Company		
Top soil	5	5
Sand and boulders	5	10
Hardpan	3	13
Clay and sand	186	199
Gravel (water)	33	232
(D-8-3)4daa-1		
Log by J.S. Lee and Sons		
Clay, sand, and boulders	40	40
Clay and sand	103	143

Table 2.—*Drillers' logs of selected wells*—Continued

Material	Thickness	Depth
(D-8-3)4daa-1–Continued		
Gravel	112	255
Clay, blue	19	274
Gravel	94	368
Clay and sand	3	371
(D-8-3)8abd-1		
Log by Woodhouse Drilling		
Top soil	2	2
Clay and gravel	58	60
Sand (water)	20	80
Clay, blue	40	120
Sand and gravel	93	213
Sand (water)	57	270
Clay, red	15	285
Sand and gravel	10	295
Sand	5	300
(D-8-3)10cba-1		
Log by J.S. Lee and Sons		
Sand and gravel	17	17
Sand	118	135
Clay and sand	45	180
Clay, blue	52	232
Gravel	78	310
Clay, brown	2	312
Unknown	208	520
(D-8-3)10dac-1		
Log by Basin and Range Drilling Company		
Silt and sand	4	4
Sand	7	11
Gravel and cobbles	17	28
Sand and gravel	18	46
Gravel and cobbles (water)	16	62
(D-8-3)16aaa-1		
Log by Jensen Construction and Drilling Company		
Top soil	6	6
Gravel	9	15
Clay and silt	35	50
Gravel (water)	20	70
(D-8-3)16aaa-2		
Log by Basin and Range Drilling Company		
Silt	2	2
Gravel	6	8
Sand (water)	24	32
Clay, brown	17	49
Sand and gravel	13	62
Silt, sand, and gravel	22	84
Silt and sand	53	137
Clay and sand	107	244

Material	Thickness	Depth
(D-8-3)16aaa-2–Continued		
Sand	27	271
Gravel (water)	4	275
[1](D-8-3)22cbd-3		
Log by Eldon Comer		
Clay	250	250
Clay and sand	40	290
Sand, gravel, and cobbles	21	311
Clay	134	445
Clay and sand	37	482
Gravel and cobbles	59	541
(D-8-3)23ccd-1		
Log by Woodhouse Drilling		
Top soil	3	3
Clay, brown	17	20
Clay and sand	110	130
Clay and gravel	30	160
Sand	101	261
Gravel (water)	4	265
(D-8-3)27adc-1		
Log by Dave's Drilling		
Sand and silt	40	40
Sand and gravel	15	55
Sand and silt	20	75
Sand	15	90
Sand and silt	10	100
Sand (water)	20	120
Sand and gravel (water)	15	135
Silt and sand	12	147
Shale	8	155
Sand and gravel	30	185
Sand and silt	15	200
Sand	22	222
(D-8-3)27bad-2		
Log by Engineering Science, Inc.		
Sand	10	10
Clay and sand	15	25
Gravel	5	30
Sand	20	50
Clay and sand	15	65
Silt and sand	5	70
Clay and sand	35	105
Silt and sand	30	135
Clay, silt, and sand (water)	115	250
Silt, sand, and gravel	15	265
Gravel	20	285
Sand and gravel	10	295
Clay, silt, and sand	139	434

Table 2.—*Drillers' logs of selected wells*—Continued

Material	Thickness	Depth
(D-8-3)27bad-2 —Continued		
Sand and gravel	16	450
Gravel	10	460
Sand and gravel	5	465
Gravel	10	475
(D-8-3)27cdc-1		
Log by Eldon Comer		
Gravel and cobbles	18	18
Clay and sand	151	169
Sand	25	194
Clay, sand, and gravel	17	211
Sand, gravel, and cobbles (water)	35	246
Clay, sand, and gravel	127	373
Sand, gravel, and cobbles (water)	62	435
Clay, gravel, and boulders	16	451
Clay	14	465
Clay, gravel, and cobbles	7	472
Clay	42	514
Sand and gravel	6	520
Clay	20	540
Sand and gravel (water)	6	546
Clay and sand	36	582
Sand, gravel, and cobbles	2	584
Clay and sand	56	640
(D-8-3)28abc-1		
Log by Eldon Comer		
Gravel	19	19
Clay	183	202
Sand and gravel (water)	82	284
Clay and sand	137	421
Sand and gravel (water)	49	470
(D-8-3)28bcd-1		
Log by Woodhouse Drilling		
Gravel and boulders	30	30
Clay, blue	139	169
Sand (water)	85	254
Gravel (water)	37	291
Sand and clay	49	340
Conglomerate	40	380
Sand (water)	30	410
(D-8-3)28bdc-1		
Log by Woodhouse Drilling		
Gravel	25	25
Clay	175	200
Sand	35	235
Gravel	50	285

Material	Thickness	Depth
(D-8-3)28bdc-1–Continued		
Clay	93	378
Gravel	4	382
Sand and gravel (water)	13	395
(D-8-3)29aaa-1		
Log by Burt Drilling Company		
Clay, silt, and sand	22	22
Sand and gravel	45	67
Clay	203	270
Gravel (water)	19	289
(D-8-3)30dba-1		
Log by Jensen Drilling Company		
Clay, brown	7	7
Gravel and boulders	5	12
Clay and gravel	15	27
Clay and sand (water)	91	118
Clay, blue	11	129
Clay and sand	4	133
Clay, blue	24	157
Clay and sand	58	215
Clay, sand, and hardpan	6	221
Clay and sand	42	263
Gravel (water)	22	285
(D-8-3)31ccd-1		
Log by Basin and Range Drilling		
Sand and gravel (water)	35	35
Silt and sand (water)	30	65
Clay, gray	22	87
Silt and sand	18	105
Clay and sand (water)	60	165
Sand and hardpan	7	172
Clay and sand (water)	46	218
Sand and gravel (water)	5	223
Clay, silt, and sand	22	245
Hardpan	5	250
Sand, gravel, and cobbles (water)	25	275
Silt, sand, and gravel	12	287
Clay, silt, and gravel	28	315
Silt and sand (water)	2	317
(D-8-3)32baa-1		
Log by Reda Pump Co.		
Clay	10	10
Gravel	10	20
Sand	22	42
Clay	98	140
Silt (water)	20	160
Sand	55	215

Table 2.—*Drillers' logs of selected wells*—Continued

Material	Thickness	Depth
(D-8-3)32baa-1—Continued		
Clay	25	240
Silt	20	260
Hardpan	11	271
Sand and gravel (water)	5	276
(D-9-1)14aad-1		
Log by Eldon Comer		
Clay	60	60
Clay and gravel (water)	25	85
Clay	40	125
Clay and gravel	235	360
(D-9-1)14aad-2		
Log by Binning Drilling Company		
Top soil	6	6
Clay and gravel	91	97
Gravel (water)	3	100
Clay, sand, and gravel	47	147
Clay and gravel (water)	173	320
(D-9-2)20ccc-1		
Log by Reda Pump Company		
Gravel and cobbles	55	55
Clay and sand	35	90
Gravel (water)	20	110
Clay and gravel	12	122
Gravel (water)	3	125
Clay and gravel	20	145
(D-9-2)24aca-1		
Log by Binning Drilling Company		
Top soil	8	8
Clay, gravel, and cobbles	32	40
Clay, gravel, and boulders	40	80
Clay, gravel, and cobbles	69	149
Solid rock	5	154
Clay, gravel, and cobbles	13	167
Solid rock	10	177
Clay and gravel	63	240
Clay, gravel, and boulders	20	260
Clay and gravel	13	273
Solid rock	4	277
Clay, gravel, and cobbles	23	300
Clay and boulders	5	305
Gravel (water)	10	315
Clay and gravel	34	349
Solid rock	7	356
Clay, gravel, and boulders	44	400
Clay and cobbles	37	437
Clay and gravel	5	442
Solid rock	8	450
Clay, brown	2	452

Material	Thickness	Depth
(D-9-2)26add-1		
Log by Binning Drilling Company		
Clay	10	10
Clay and gravel	90	100
Clay, gravel, and boulders	35	135
Conglomerate	13	148
Clay, gravel, and boulders	22	170
Conglomerate (water)	10	180
Clay, gravel, and boulders	50	230
Conglomerate (water)	8	238
Clay, cobbles, and boulders	27	265
Clay	20	285
Conglomerate	8	293
Clay and gravel	172	465
Conglomerate	58	523
(D-9-2)29cda-1		
Log by Woodhouse Drilling		
Boulders	20	20
Clay and gravel	20	40
Sand and gravel	38	78
Gravel (water)	38	116
(D-9-2)29dbd-2		
Log by Binning Drilling Company		
Silt and gravel	5	5
Hardpan	15	20
Clay, brown	20	40
Clay and boulders	40	80
Clay, brown	25	105
Gravel (water)	15	120
Sand	10	130
Gravel (water)	20	150
Clay	15	165
Boulders (water)	35	200
(D-9-3)5bbd-1		
Log by Eldon Comer		
Top soil	3	3
Gravel and cobbles	12	15
Sand and gravel	18	33
Clay and sand	227	260
Clay, gravel, and hardpan	30	290
Sand, gravel, and cobbles (water)	50	340
Clay, tan	8	348
Clay and gravel	4	352
Clay	81	433
Clay and sand	64	497
Clay and gravel	3	500
Sand, gravel, and cobbles	89	589
Clay, tan	31	620

---

[1] Actual location is different from historic records. See footnote, table 1.

Table 3.—*Water levels in selected wells*

Well number: See figure 1 for explanation of the numbering system for hydrologic-data sites.

Water level: In feet above (-) or below land surface.

Well number	Date	Water level
(C-9-1)3ddb-1	07-01-1964	19.0
	10-01-1964	16.94
	11-02-1964	18.90
	12-07-1964	18.65
	11-02-1965	19.91
	12-02-1965	18.19
	11-05-1966	18.53
	12-19-1966	20.20
	12-08-1967	19.28
	12-21-1968	19.92
	12-19-1969	21.09
	12-09-1970	22.00
	10-11-1971	22.87
	12-15-1971	20.59
	10-03-1972	21.13
	10-14-1973	21.10
	10-13-1974	21.39
	03-04-1991	17.08
(C-9-1)4ccc-1	03-03-1974	135.00
	03-11-1975	136.52
	03-09-1976	137.39
	03-10-1977	136.67
	03-10-1978	136.74
	03-12-1979	138.79
	03-03-1980	138.61
	03-04-1981	138.62
	09-17-1981	148.26
	03-01-1982	138.13
	09-20-1982	139.90
	03-02-1983	136.04
	09-21-1983	135.74
	03-10-1984	133.17
	09-11-1984	133.24
	03-04-1985	131.29
	03-11-1986	131.30
	09-08-1986	135.05
	03-02-1987	132.67
	09-15-1987	133.84
	03-01-1988	130.43
	09-14-1988	135.80
	03-01-1989	131.09
	09-15-1989	131.72
	03-08-1990	129.86
	03-14-1991	128.76
	09-10-1991	138.60
	03-11-1992	130.68
(C-9-1)4ddc-1	04-15-1964	78.96
	05-12-1964	78.04
(C-9-1)4ddc-1	09-08-1964	82.20
Continued	10-02-1964	82.80
	11-05-1964	81.10
	12-07-1964	80.81
	02-03-1965	83.94
	03-02-1965	80.37
	03-25-1966	81.94
	04-05-1966	81.76
	12-19-1966	84.04
	03-08-1967	83.00
	04-05-1967	82.82
	03-21-1968	83.71
	03-19-1969	83.87
	03-20-1970	84.00
	03-15-1971	84.20
	03-03-1972	85.42
	03-14-1973	89.32
	03-13-1974	85.69
	03-11-1975	86.29
	03-09-1976	87.34
	03-10-1977	86.65
	03-10-1978	86.32
	03-12-1979	86.1
	03-03-1980	86.55
	03-04-1981	86.93
	03-01-1982	87.03
	03-02-1983	85.24
	03-10-1984	82.60
	03-04-1985	81.19
	03-11-1986	81.54
	03-02-1987	82.73
	03-01-1988	81.57
	12-15-1988	82.26
	01-23-1989	81.82
	02-27-1989	81.59
	03-09-1989	80.90
	06-22-1989	88.70
	07-18-1989	84.72
	08-15-1989	83.16
	09-15-1989	82.66
	10-23-1989	82.27
	11-17-1989	82.15
	12-20-1989	81.94
	02-15-1990	81.53
	03-08-1990	81.37
	04-02-1990	81.34
	05-09-1990	81.13
	07-05-1990	85.11
	08-03-1990	82.82
	09-07-1990	82.88
(C-9-1)4ddc-1	10-18-1990	81.67
Continued	11-20-1990	81.44
	12-18-1990	81.29
	01-22-1991	81.27
	03-04-1991	81.01
	03-11-1992	80.86
[1](C-9-1)20cdd-1	03-25-1964	195.1
	04-29-1964	193.3
	05-12-1964	194.0
	06-02-1964	194.2
	07-01-1964	195.1
	09-29-1964	203.2
	10-06-1964	202.3
	11-06-1964	200.5
	12-07-1964	199.77
	03-04-1965	198.40
	05-18-1965	199.71
	06-03-1965	199.1
	03-10-1967	207.33
	04-05-1967	207.01
	04-02-1990	199.82
	03-04-1991	200.34
(C-9-1)20ddd-1	02-07-1964	135.60
	03-11-1964	134.90
	04-29-1964	134.40
	05-12-1964	134.40
	06-02-1964	134.80
	07-01-1964	135.90
	08-18-1964	138.20
	09-04-1964	138.50
	10-06-1964	139.90
	11-05-1964	139.20
	12-07-1964	139.45
	01-06-1965	139.63
	02-03-1965	138.81
	03-02-1965	138.52
	04-07-1965	138.21
	05-04-1965	140.79
	06-09-1965	140.68
	07-01-1965	141.39
	10-15-1965	143.50
	12-30-1965	145.30
	03-25-1966	141.73
	04-05-1966	141.73
	08-11-1966	147.93
	12-19-1966	146.73
	03-08-1967	145.28

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(C-9-1)20ddd-1 Continued	04-05-1967	144.76
	03-21-1968	146.92
	03-19-1969	152.32
	03-20-1970	151.30
	09-09-1970	161.48
	03-15-1971	157.20
	10-06-1971	159.19
	03-03-1972	155.29
	09-27-1972	161.55
	03-14-1973	160.22
	03-13-1974	159.05
	03-11-1975	159.48
	03-09-1976	159.45
	03-10-1977	160.45
	03-10-1978	161.23
	03-12-1979	158.70
	03-04-1980	163.25
	03-04-1981	149.10
	03-01-1982	149.72
	03-02-1983	148.18
	03-10-1984	143.80
	03-04-1985	141.72
	03-11-1986	142.71
	03-02-1987	140.96
	03-01-1988	139.75
	03-09-1989	138.66
	05-12-1989	138.39
	06-22-1989	138.74
	07-18-1989	139.21
	08-15-1989	139.50
	10-23-1989	139.76
	12-20-1989	138.90
	01-30-1990	138.20
	03-08-1990	137.94
	04-02-1990	137.80
	04-06-1990	137.73
	06-05-1990	138.32
	08-03-1990	139.25
	09-07-1990	139.70
	10-18-1990	139.64
	12-18-1990	138.74
	03-05-1991	137.98
	09-10-1991	139.42
	03-11-1992	137.57
(C-9-1)26bda-3	04-09-1964	-4.5
	05-26-1964	-5.0
	10-09-1964	-5.3
	03-17-1965	-3.9
	06-28-1965	-5.3
	12-13-1988	-7.0
	05-15-1989	-6.2
(C-9-1)26bda-3 Continued	06-22-1989	-7.0
	07-18-1989	-6.2
	08-15-1989	-5.7
	09-15-1989	-5.7
	10-23-1989	-5.7
	12-20-1989	-5.5
	04-09-1990	-9.3
	05-09-1990	-7.0
(C-9-1)28ccb-1	01-10-1963	126.60
	02-13-1963	126.50
	03-14-1963	126.50
	06-10-1963	129.00
	10-29-1963	133.00
	11-14-1963	132.40
	12-19-1963	131.80
	01-17-1964	131.10
	02-24-1964	130.10
	03-23-1964	130.60
	04-28-1964	130.20
	05-11-1964	130.20
	09-29-1964	136.40
	10-06-1964	136.20
	12-07-1964	137.29
	01-06-1965	135.59
	02-03-1965	135.34
	03-02-1965	135.05
	04-07-1965	134.42
	06-09-1965	137.55
	10-15-1965	141.50
	12-30-1965	148.20
	03-25-1966	138.13
	12-19-1966	143.13
	03-08-1967	142.05
	04-05-1967	140.60
	03-21-1968	142.53
	03-19-1969	142.69
	03-20-1970	148.32
	03-14-1973	150.56
	03-13-1974	139.50
	03-11-1975	139.25
	03-09-1976	138.25
	03-10-1977	138.30
	03-10-1978	136.30
	03-12-1979	135.91
	03-04-1980	137.13
	03-04-1981	138.67
	03-01-1982	139.30
	03-02-1983	137.22
	03-10-1984	133.94
	03-04-1985	132.09
	03-11-1986	132.91
(C-9-1)28ccb-1 Continued	03-02-1987	130.98
	03-01-1988	133.53
	03-03-1989	128.43
	03-08-1990	127.79
	03-04-1991	127.65
	03-11-1992	127.62
(C-9-1)29acc-1	04-03-1963	205.50
	05-10-1963	205.70
	06-10-1963	216.70
	09-11-1963	214.50
	10-28-1963	211.20
	11-14-1963	210.80
	12-19-1963	210.30
	01-16-1964	209.90
	02-24-1964	209.50
	03-25-1964	209.70
	04-29-1964	209.20
	05-12-1964	209.20
	06-05-1964	213.60
	09-04-1964	216.60
	11-06-1964	216.20
	12-07-1964	217.29
	03-04-1965	215.40
	03-29-1966	221.20
	03-10-1967	222.30
	04-05-1967	221.86
	03-21-1968	227.00
	03-19-1969	228.40
	03-20-1970	230.34
	03-15-1971	231.10
	03-03-1972	235.02
	03-14-1973	227.95
	03-13-1974	226.85
	03-11-1975	228.52
	03-09-1976	228.16
	03-10-1977	227.64
	03-10-1978	227.19
	03-12-1979	226.59
	03-04-1980	227.00
	03-04-1981	227.98
	03-01-1982	228.37
	03-02-1983	225.17
	03-10-1984	220.78
	03-04-1985	218.53
	03-11-1986	219.59
	03-02-1987	217.57
	03-01-1988	216.40
	03-09-1989	214.97
	03-08-1990	214.50
	04-02-1990	214.26
	03-04-1991	214.28
	03-11-1992	213.37

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(C-9-1)29bcc-1	05-10-1963	287.0
	06-10-1963	287.7
	07-11-1963	288.5
	08-12-1963	289.9
	09-11-1963	290.7
	10-29-1963	292.0
	11-14-1963	291.9
	12-19-1963	292.0
	01-16-1964	291.9
	02-24-1964	291.4
	03-25-1964	292.0
	04-29-1964	291.1
	05-12-1964	291.1
	06-02-1964	291.13
	03-04-1965	296.6
	03-10-1967	304.6
	04-06-1967	304.6
	03-20-1970	309.6
	03-21-1990	298.64
	04-02-1990	300.10
(C-10-1)4bbb-1	07-23-1962	168.30
	08-16-1962	172.50
	09-14-1962	151.00
	10-15-1962	151.50
	12-03-1962	150.30
	01-10-1963	149.90
	02-13-1963	149.80
	03-11-1963	150.20
	10-28-1963	159.70
	11-14-1963	155.60
	12-19-1963	154.30
	01-17-1964	153.60
	02-24-1964	152.90
	03-23-1964	152.70
	04-28-1964	152.30
	05-11-1964	152.40
	06-01-1964	152.90
	09-04-1964	162.20
	10-06-1964	161.20
	12-07-1964	165.51
	01-06-1965	161.75
	02-03-1965	157.72
	03-02-1965	156.01
	07-01-1965	162.95
	12-30-1965	163.59
	03-24-1966	158.51
	12-19-1966	163.85
	03-08-1967	161.00
	04-05-1967	160.46
	03-21-1968	163.02
(C-10-1)4bbb-1 Continued	03-19-1969	169.58
	03-20-1970	161.62
	03-03-1972	161.96
	03-14-1973	152.24
	03-13-1974	149.29
	03-11-1975	151.45
	03-30-1977	147.16
	03-12-1979	148.08
	03-04-1980	151.44
	03-04-1981	153.57
	03-01-1982	155.87
	03-02-1983	154.89
	03-10-1984	152.22
	03-04-1985	150.66
	03-11-1986	151.80
	03-02-1987	150.06
	03-01-1988	151.13
	12-15-1988	147.61
	02-23-1989	147.17
	03-03-1989	147.35
	05-12-1989	146.95
	06-22-1989	146.74
	07-18-1989	146.93
	08-18-1989	146.89
	09-15-1989	146.97
	11-17-1989	147.17
	01-30-1990	146.71
	03-08-1990	146.76
	05-09-1990	146.70
	07-05-1990	147.42
	09-07-1990	147.25
	11-20-1990	147.18
	01-22-1991	147.13
	03-05-1991	147.04
	03-11-1992	147.15
(C-10-1)4cbb-1	04-10-1962	143.78
	03-08-1967	149.82
	04-05-1967	151.88
	03-21-1968	150.52
	03-19-1969	157.17
	03-20-1970	154.38
	03-15-1971	153.45
	03-03-1972	143.52
	03-14-1973	140.78
	03-13-1974	142.39
	03-11-1975	140.06
	03-09-1976	135.05
	03-10-1977	134.28
	03-10-1978	131.78
	03-12-1979	134.05
(C-10-1)4cbb-1 Continued	03-04-1980	138.53
	03-04-1981	148.75
	03-01-1982	150.06
	03-02-1983	149.91
	03-10-1984	147.45
	03-04-1985	141.20
	03-11-1986	141.44
	03-02-1987	139.01
	03-01-1988	138.41
	03-03-1989	138.16
	05-12-1989	135.40
	03-08-1990	135.28
	03-04-1991	135.86
	03-11-1992	136.06
[1](C-10-1)15cca-1	10-30-1984	31.80
	02-14-1991	28.47
	03-07-1991	28.29
(C-10-1)17bba-1	04-21-1989	265.56
	05-16-1989	265.83
	06-22-1989	265.93
	07-17-1989	266.24
	08-16-1989	266.31
	09-18-1989	266.41
	10-23-1989	266.19
	12-18-1989	266.02
	01-30-1990	265.69
	03-07-1990	265.71
	05-09-1990	265.81
	07-05-1990	266.42
	08-08-1990	266.64
	09-07-1990	266.75
	10-18-1990	266.93
	11-20-1990	266.82
	12-18-1990	266.85
	01-22-1991	266.99
	03-04-1991	266.71
	09-10-1991	267.71
	03-11-1992	268.04
(C-10-1)17bba-2	02-23-1989	271.90
	05-16-1989	272.66
	06-22-1989	265.68
	07-17-1989	266.03
	08-16-1989	266.08
	09-18-1989	266.23
	10-23-1989	266.00
	12-18-1989	265.87
	01-30-1990	265.47
	03-07-1990	265.46

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(C-10-1)17bba-2	05-09-1990	265.54
Continued	08-08-1990	266.41
	09-07-1990	266.52
	10-18-1990	266.74
	11-20-1990	266.65
	12-18-1990	266.63
	01-22-1991	266.75
	03-04-1991	266.56
	09-10-1991	267.71
	03-11-1992	267.75
(C-10-1)18ccc-1	01-20-1989	352.16
	02-23-1989	352.01
	04-21-1989	351.83
	05-16-1989	351.91
	06-22-1989	351.89
	07-17-1989	352.08
	09-18-1989	351.99
	11-17-1989	352.17
	01-24-1990	352.37
	03-07-1990	352.27
	04-05-1990	352.06
	06-05-1990	352.13
	08-08-1990	352.49
	09-07-1990	352.69
	10-18-1990	352.97
	11-19-1990	352.73
	01-22-1991	353.58
	03-05-1991	353.46
	03-11-1992	355.42
(C-10-1)24ddc-1	12-20-1966	217.8
	01-05-1967	217.28
	02-05-1967	217.06
	03-05-1967	216.54
	04-05-1967	216.29
	05-05-1967	216.61
	07-10-1967	219.59
	08-05-1967	223.15
	09-05-1967	224.55
	10-05-1967	222.73
	11-05-1967	219.22
	12-05-1967	217.57
	03-21-1968	215.90
	04-05-1968	215.3
	05-05-1968	214.92
	06-05-1968	216.47
	07-05-1968	217.31
	08-05-1968	217.88
	09-05-1968	222.59
	10-05-1968	226.26
	11-05-1968	225.29
(C-10-1)24ddc-1	12-05-1968	220.78
Continued	03-19-1969	216.30
	03-20-1970	222.70
	03-15-1971	214.34
	03-12-1974	212.30
	03-10-1975	212.60
	03-08-1976	212.51
	03-09-1977	210.66
	08-12-1977	231.63
	03-10-1978	212.64
	08-25-1978	220.10
	03-12-1979	212.67
	09-17-1979	212.70
	03-03-1980	211.32
	09-03-1980	217.59
	03-04-1981	211.09
	09-17-1981	218.80
	03-01-1982	212.26
	09-20-1982	217.27
	03-02-1983	210.54
	09-21-1983	211.35
	03-10-1984	206.60
	09-11-1984	210.37
	03-04-1985	205.18
	09-10-1985	212.92
	03-11-1986	206.60
	09-08-1986	215.02
	03-02-1987	208.14
	09-11-1987	218.29
	03-01-1988	209.65
	09-14-1988	219.21
	12-12-1988	212.59
	01-20-1989	211.37
	03-09-1989	210.59
	04-21-1989	212.52
	05-12-1989	217.62
	06-22-1989	220.28
	07-17-1989	220.40
	08-16-1989	220.12
	09-18-1989	219.98
	10-23-1989	217.18
	11-17-1989	214.92
	12-18-1989	214.25
	01-24-1990	212.84
	02-15-1990	212.16
	03-07-1990	211.93
	05-09-1990	213.94
	06-05-1990	215.54
	07-02-1990	223.73
	08-08-1990	224.36
	09-07-1990	222.00
	10-18-1990	217.98
(C-10-1)24ddc-1	11-20-1990	214.89
Continued	12-18-1990	214.04
	01-22-1991	213.30
	03-05-1991	212.54
	09-10-1991	222.32
	09-13-1991	223.16
[1](C-10-1)25abd-1	02-04-1964	259.8
	07-01-1964	263.4
	08-19-1964	266.8
	05-18-1965	295.8
	06-10-1965	280.8
	03-30-1966	252.5
	03-21-1990	242.82
	03-05-1991	245.15
(C-10-1)30baa-1	09-18-1989	226.10
	11-17-1989	225.96
	01-24-1990	225.93
	02-15-1990	225.71
	03-07-1990	225.58
	05-09-1990	225.74
	06-05-1990	228.67
(C-10-1)34bbb-1	03-24-1964	96.1
	05-14-1964	96.5
	06-10-1964	96.5
	07-02-1964	97.4
	08-19-1964	96.8
	09-04-1964	96.8
	10-09-1964	97.0
	12-07-1964	96.70
	01-06-1965	96.56
	02-03-1965	96.79
	03-02-1965	96.82
	04-07-1965	96.88
	05-04-1965	97.01
	06-09-1965	97.33
	07-01-1965	99.15
	10-15-1965	95.60
	03-25-1966	99.58
	08-29-1966	96.76
	12-19-1966	99.15
	03-08-1967	97.47
	12-08-1967	97.47
	12-21-1968	97.60
	12-19-1969	97.53
	12-20-1970	95.86
	03-03-1972	90.59
	12-03-1972	94.59
	03-09-1973	94.29
	12-09-1973	98.29

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(C-10-1)34bbb-1 Continued	03-12-1974	87.03
	12-12-1974	91.03
	03-07-1991	89.39
(C-10-2)13bcc-1	01-20-1989	161.62
	02-24-1989	162.37
	04-21-1989	163.52
	05-15-1989	164.19
	06-22-1989	164.74
	07-17-1989	165.32
	08-16-1989	165.74
	09-18-1989	166.29
	10-23-1989	166.88
	11-17-1989	167.15
	12-18-1989	166.99
	01-24-1990	168.27
	03-07-1990	168.71
	04-05-1990	168.93
	06-05-1990	169.60
	07-05-1990	170.00
	08-08-1990	170.35
	10-18-1990	171.24
	11-20-1990	171.21
	01-22-1991	172.02
	03-05-1991	172.24
(C-11-1)6bdd-1	04-15-1964	244.68
	05-15-1964	246.50
	06-05-1964	247.10
	07-02-1964	247.60
	08-19-1964	253.00
	09-28-1964	249.70
	10-08-1964	253.60
	11-03-1964	249.40
	12-07-1964	248.63
	03-02-1965	247.68
	05-04-1965	249.73
	06-09-1965	281.53
	07-01-1965	277.10
	10-15-1965	267.00
	11-03-1965	257.48
	03-25-1966	250.71
	03-11-1967	256.20
	04-05-1967	255.77
	03-21-1968	258.00
	03-19-1969	258.42
	03-20-1970	257.10
	09-09-1970	271.64
	03-16-1971	254.60
	10-06-1971	261.44
	03-03-1972	254.34
	03-13-1974	249.74
(C-11-1)6bdd-1 Continued	03-10-1975	259.40
	03-09-1976	256.60
	03-10-1977	249.31
	03-19-1990	232.96
	04-06-1990	234.39
(D-7-2)32dad-1	12-12-1980	-32.4
	02-26-1981	-32.7
	03-09-1982	-33.3
	03-04-1991	-22.7
(D-7-2)34dcd-1	09-21-1959	-9.8
	04-02-1964	-8.9
	05-13-1964	-8.0
	08-03-1964	-7.3
	10-20-1964	-6.2
	03-05-1965	-8.3
	06-23-1965	-7.6
	03-11-1969	-9.2
	03-17-1970	-9.8
	03-24-1970	-9.6
	03-17-1971	-9.7
	03-09-1972	-10.2
	03-07-1973	-9.9
	03-26-1981	-8.4
	03-12-1982	-9.4
	03-01-1983	-10.4
	03-09-1984	-11.0
	03-04-1985	-10.9
	03-10-1986	-11.3
	03-04-1987	-11.0
	03-02-1988	-8.8
	03-09-1989	-7.1
	03-05-1990	-8.7
	03-05-1991	-6.6
	03-13-1992	-9.1
(D-7-2)36dcc-2	09-07-1938	-13.0
	12-12-1938	-13.4
	01-30-1939	-14.2
	03-17-1939	-15.0
	04-13-1939	-15.3
	06-13-1939	-15.0
	08-03-1939	-11.9
	10-17-1939	-12.3
	01-04-1940	-15.0
	02-28-1940	-16.2
	04-13-1940	-16.1
	05-02-1940	-17.0
	06-17-1940	-13.6
	01-21-1941	-14.3
	03-18-1941	-15.6
(D-7-2)36dcc-2 Continued	12-11-1941	-13.8
	03-27-1942	-15.4
	06-27-1942	-13.9
	12-26-1942	-15.2
	03-29-1943	-17.0
	12-29-1943	-14.7
	03-24-1944	-15.3
	12-27-1944	-14.0
	03-30-1945	-15.2
	12-17-1945	-16.4
	03-07-1946	-17.0
	12-17-1946	-18.4
	04-07-1947	-18.0
	12-17-1947	-17.2
	03-30-1948	-17.9
	12-23-1948	-15.7
	03-17-1949	-17.2
	12-16-1949	-17.1
	03-23-1950	-17.1
	12-19-1950	-16.7
	04-04-1951	-18.5
	12-26-1951	-18.3
	04-08-1952	-18.1
	12-11-1952	-18.2
	04-21-1953	-18.8
	12-08-1953	-15.1
	03-24-1954	-17.4
	12-29-1954	-14.5
	04-22-1955	-15.3
	12-22-1955	-13.8
	03-30-1956	-16.9
	12-19-1956	-14.9
	04-01-1957	-17.2
	12-06-1957	-16.5
	03-18-1958	-18.1
	12-04-1958	-15.3
	03-18-1959	-16.3
	12-24-1959	-14.5
	03-23-1960	-15.6
	12-09-1960	-14.1
	03-23-1961	-15.9
	01-05-1962	-14.2
	03-06-1962	-14.6
	12-06-1962	-15.6
	03-12-1963	-16.9
	08-27-1963	-10.4
	12-16-1963	-15.0
	03-11-1964	-15.9
	04-09-1964	-14.6
	06-01-1964	-15.1
	07-09-1964	-13.6
	08-03-1964	-12.7

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-7-2)36dcc-2 Continued	09-01-1964	-8.6
	12-03-1964	-12.1
	03-01-1965	-15.9
	10-06-1965	-14.4
	12-28-1965	-6.5
	03-24-1966	-6.2
	08-17-1966	-3.4
	12-20-1966	-3.4
	03-27-1967	-6.2
	10-02-1968	-10.9
	03-26-1981	-12.8
	03-11-1982	-13.3
	03-01-1983	-14.8
	03-09-1984	-15.9
	03-04-1985	-16.0
	03-10-1986	-16.3
	03-04-1987	-15.9
	03-03-1988	-14.2
	12-13-1988	-13.0
	01-27-1989	-11.6
	03-01-1989	-12.6
	04-19-1989	-9.8
	05-12-1989	-10.0
	06-20-1989	-10.3
	07-18-1989	-9.0
	08-15-1989	-9.2
	08-24-1989	-7.9
	09-15-1989	-9.7
	10-23-1989	-10.3
	11-14-1989	-11.0
	12-19-1989	-12.2
	01-23-1990	-13.1
	02-12-1990	-12.5
	03-05-1990	-14.1
	04-09-1990	-14.2
	05-08-1990	-13.8
	06-04-1990	-13.8
	07-03-1990	-10.1
	08-02-1990	-11.9
	09-05-1990	-11.1
	10-18-1990	-12.1
	11-19-1990	-12.3
	12-17-1990	-12.2
	01-24-1991	-12.5
	03-04-1991	-11.4
	03-13-1992	-13.5
(D-7-3)18dcc-1	12-11-1980	-35.5
	03-26-1981	-33.6
	03-09-1982	-31.9
	02-04-1991	-18.8
	03-05-1991	-18.9
(D-7-3)28cab-1	03-01-1961	-15.0
	03-30-1964	-16.4
	05-12-1964	-17.0
	09-15-1964	-18.5
	06-19-1989	-17.8
	07-19-1989	-17.6
	08-24-1989	-12.4
	09-20-1989	-16.6
	10-26-1989	-16.5
	12-19-1989	-16.1
	01-23-1990	-15.5
	02-13-1990	-15.9
	03-05-1990	-15.7
	04-09-1990	-15.3
	05-10-1990	-15.3
	06-04-1990	-16.2
	07-03-1990	-14.9
	08-02-1990	-15.9
	09-05-1990	-15.5
	10-16-1990	-15.4
	11-19-1990	-15.3
	12-17-1990	-15.3
	01-24-1991	-15.2
	03-04-1991	-14.8
(D-7-3)31cac-2	11-02-1964	-11.2
	09-13-1989	-14.3
(D-7-3)32bcd-1	12-04-1980	-12.8
	03-26-1981	-11.8
	03-09-1982	-13.5
	02-06-1991	-13.1
	03-04-1991	-13.2
(D-7-3)33baa-6	08-31-1935	-6.8
	03-02-1936	-6.4
	10-03-1936	-8.7
	03-03-1937	-7.2
	09-23-1937	-9.0
	05-17-1938	-8.6
	09-14-1938	-9.6
	03-24-1939	-8.0
	09-21-1939	-8.1
	03-16-1940	-8.1
	09-24-1940	-8.2
	03-18-1941	-8.2
	12-10-1941	-10.6
	03-27-1942	-8.8
	06-27-1942	-12.4
	12-26-1942	-11.3
	03-29-1943	-9.7
	12-29-1943	-9.0
(D-7-3)33baa-6 Continued	03-24-1944	-8.4
	12-27-1944	-10.7
	03-29-1945	-9.8
	12-17-1945	-11.7
	03-07-1946	-10.7
	12-17-1946	-11.5
	04-07-1947	-10.6
	12-17-1947	-11.3
	03-30-1948	-10.0
	12-23-1948	-10.9
	03-17-1949	-9.6
	12-16-1949	-11.1
	03-22-1950	-9.9
	12-19-1950	-11.3
	04-04-1951	-9.7
	12-28-1951	-11.3
	04-08-1952	-10.5
	12-11-1952	-17.3
	04-21-1953	-14.0
	12-08-1953	-12.5
	03-24-1954	-11.7
	12-29-1954	-10.0
	04-22-1955	-9.6
	12-22-1955	-9.6
	03-30-1956	-9.2
	12-19-1956	-9.5
	04-01-1957	-9.9
	12-06-1957	-11.6
	03-18-1958	-11.0
	12-04-1958	-13.8
	03-18-1959	-11.9
	12-24-1959	-8.9
	03-23-1960	-8.6
	12-09-1960	-8.7
	03-23-1961	-7.1
	01-05-1962	-6.8
	03-06-1962	-7.1
	12-06-1962	-9.7
	03-07-1963	-8.9
	08-27-1963	-5.6
	12-16-1963	-7.7
	04-09-1964	-6.2
	05-28-1964	-7.2
	07-09-1964	-7.3
	08-03-1964	-7.4
	09-01-1964	-6.4
	10-05-1964	-7.0
	11-02-1964	-7.7
	12-03-1964	-7.9
	01-05-1965	-8.0
	02-01-1965	-8.3
	03-01-1965	-7.9

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-7-3)33baa-6	04-05-1965	-7.7
Continued	05-03-1965	-7.9
	06-07-1965	-10.1
	07-02-1965	-11.3
	10-06-1965	-12.0
	12-28-1965	-10.3
	03-24-1966	-8.8
	08-17-1966	-5.3
	10-02-1968	-11.3
	03-11-1969	-10.4
	09-03-1969	-11.4
	03-17-1970	-10.7
	09-08-1970	-9.1
	03-17-1971	-9.4
	10-06-1971	-11.7
	03-09-1972	-9.9
	09-26-1972	-7.4
	03-07-1973	-8.9
	09-05-1973	-11.5
	03-07-1974	-11.1
	03-06-1975	-9.8
	08-18-1975	-14.4
	03-04-1976	-11.6
	08-12-1976	-6.2
	03-07-1977	-8.9
	08-10-1977	-3.2
	03-08-1978	-5.5
	08-22-1978	-7.9
	03-15-1979	-8.3
	09-18-1979	-9.7
	03-06-1980	-8.3
	09-03-1980	-10.6
	03-02-1981	-9.2
	09-03-1981	-6.8
	03-02-1982	-9.0
	09-20-1982	-14.5
	03-01-1983	-12.1
	09-21-1983	-17
	03-09-1984	-15.4
	09-10-1984	-19.4
	03-04-1985	-16.5
	09-10-1985	-16.4
	03-10-1986	-14.2
	09-08-1986	-16.5
	03-04-1987	-13.9
	09-11-1987	-9.9
	03-02-1988	-7.3
	09-14-1988	-5.8
	03-10-1989	-8.6
	06-19-1989	-7.3
	07-19-1989	-5.0
	08-24-1989	-5.0
(D-7-3)33baa-6	09-19-1989	-5.5
Continued	10-24-1989	-5.6
	11-13-1989	-5.5
	12-19-1989	-6.0
	03-05-1990	-7.0
	03-04-1991	-4.7
	09-12-1991	-4.9
	03-13-1992	-6.2
(D-7-3)33ccc-5	03-15-1938	-3.6
	09-25-1938	-8.7
	03-24-1939	-7.2
	09-21-1939	-7.3
	02-29-1940	-7.7
	10-01-1940	-7.1
	06-07-1964	-9.5
	09-01-1964	-5.5
	10-05-1964	-5.9
	03-01-1965	-8.0
	04-05-1965	-8.3
	05-03-1965	-7.9
	06-07-1965	-9.5
	07-02-1965	-10.7
	10-05-1965	-13.8
	12-28-1965	-12.0
	03-24-1966	-10.5
	08-13-1966	-4.2
	12-20-1966	-7.9
	01-21-1967	-7.6
	02-21-1967	-6.2
	03-27-1967	-7.1
	03-19-1968	-8.1
	03-11-1969	-11.3
	03-24-1970	-12.1
	03-17-1971	-10.9
	03-09-1972	-10.9
	03-12-1973	-10.5
	03-07-1974	-12.2
	03-07-1975	-11.7
	03-04-1976	-13.4
	03-07-1977	-10.2
	03-08-1978	-3.5
	03-15-1979	-9.1
	03-06-1980	-9.2
	03-02-1981	-10.6
	03-02-1982	-10.2
	03-01-1983	-14.1
	03-09-1984	-18.0
	03-04-1985	-19.0
	03-10-1986	-16.3
	03-04-1987	-15.9
	03-03-1988	-9.8
(D-7-3)33ccc-5	12-13-1988	-8.5
Continued	01-26-1989	-9.9
	03-01-1989	-9.9
	04-18-1989	-8.2
	05-15-1989	-8.7
	06-19-1989	-6.4
	07-19-1989	-5.7
	08-24-1989	-5.3
	09-19-1989	-5.7
	10-26-1989	-6.7
	11-14-1989	-6.6
	12-19-1989	-7.6
	01-23-1990	-8.0
	02-13-1990	-8.0
	03-05-1990	-8.3
	04-09-1990	-7.8
	05-10-1990	-5.9
	06-04-1990	-6.4
	07-03-1990	-2.2
	08-02-1990	-2.5
	09-05-1990	-1.8
	10-16-1990	-3.5
	11-19-1990	-4.6
	12-17-1990	-4.7
	01-24-1991	-4.7
	03-04-1991	-5.2
	03-13-1992	-7.1
(D-7-3)33ccc-6	01-21-1967	-21.8
	03-08-1991	-14.3
(D-8-1)2ccd-1	11-01-1988	5.94
	12-12-1988	5.95
	01-23-1989	5.90
	02-24-1989	5.76
	04-19-1989	5.52
	05-12-1989	5.66
	06-20-1989	5.92
	08-15-1989	6.34
	12-20-1989	6.48
	02-12-1990	6.49
	03-06-1990	6.26
	04-02-1990	6.32
	05-08-1990	6.36
	07-05-1990	6.70
	09-06-1990	7.00
	11-18-1990	7.11
	12-17-1990	7.07
	01-24-1991	7.01
	02-15-1991	7.10
	03-05-1991	6.87
	04-05-1991	6.99

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-8-1)2ccd-1 Continued	05-08-1991	6.92
	06-14-1991	6.80
	08-12-1991	7.04
	09-30-1991	7.01
	01-15-1992	6.96
	03-13-1992	6.76
(D-8-1)10bcb-1	11-22-1988	14.11
	12-12-1988	14.28
	01-23-1989	14.38
	02-24-1989	14.50
	04-19-1989	14.62
	05-12-1989	14.63
	06-20-1989	14.68
	07-18-1989	14.85
	08-15-1989	14.86
	09-15-1989	14.99
	10-23-1989	15.00
	11-14-1989	15.18
	12-20-1989	15.49
	01-23-1990	15.62
	02-12-1990	15.65
	03-06-1990	15.78
	04-02-1990	15.93
	05-08-1990	16.08
	06-05-1990	16.14
	07-03-1990	16.20
	08-03-1990	16.34
	09-06-1990	16.50
	10-18-1990	16.70
	11-19-1990	16.83
	12-17-1990	17.00
	01-24-1991	17.06
	03-05-1991	17.01
	07-03-1991	17.07
	08-21-1991	17.06
	10-01-1991	17.02
	01-15-1992	17.15
(D-8-1)10bcb-2	11-22-1988	42.58
	12-12-1988	42.39
	01-23-1989	41.92
	02-24-1989	41.45
	04-19-1989	40.65
	05-12-1989	40.88
	06-20-1989	41.63
	07-18-1989	42.31
	08-18-1989	42.88
	09-15-1989	43.25
	10-23-1989	43.26
	11-14-1989	43.20
	12-20-1989	43.07
(D-8-1)10bcb-2 Continued	01-23-1990	42.78
	02-12-1990	42.60
	03-06-1990	42.30
	04-02-1990	42.10
	05-08-1990	42.27
	06-05-1990	42.80
	07-05-1990	43.02
	08-03-1990	43.33
	09-06-1990	43.34
	10-18-1990	43.24
	11-19-1990	43.30
	12-17-1990	43.31
	01-24-1991	43.17
	03-05-1991	43.34
	07-03-1991	43.47
	08-21-1991	43.53
	10-01-1991	43.42
	01-15-1992	43.35
(D-8-1)13aaa-1	05-02-1936	-13.4
	12-01-1936	-13.8
	03-03-1937	-14.7
	09-23-1937	-13.0
	04-06-1938	-18.0
	09-12-1938	-13.2
	03-24-1939	-17.3
	09-21-1939	-15.4
	03-19-1940	-17.5
	09-20-1940	-14.0
	03-18-1941	-16.7
	11-27-1941	-15.2
	03-27-1942	-16.2
	12-26-1942	-14.0
	03-29-1943	-15.0
	12-29-1943	-15.8
	03-24-1944	-16.1
	12-27-1944	-14.6
	03-30-1945	-14.6
	12-17-1945	-16.3
	03-07-1946	-16.7
	12-17-1946	-17.0
	04-07-1947	-16.7
	12-17-1947	-15.0
	03-30-1948	-16.4
	12-23-1948	-15.3
	03-17-1949	-16.3
	12-16-1949	-15.9
	03-22-1950	-14.9
	12-19-1950	-15.3
	04-04-1951	-15.8
	12-26-1951	-15.6
	12-08-1953	-15.5
(D-8-1)13aaa-1 Continued	09-01-1964	-6.6
	10-05-1964	-9.5
	11-02-1964	-10.9
	12-03-1964	-11.9
	09-20-1989	-10.8
	03-04-1991	-11.3
(D-8-1)13bdd-1	07-07-1964	-2.0
	03-05-1991	-1.5
(D-8-1)20abb-1	11-01-1988	12.64
	12-12-1988	12.92
	01-23-1989	12.88
	02-24-1989	12.83
	04-19-1989	11.50
	05-12-1989	12.65
	06-20-1989	13.19
	07-18-1989	13.71
	08-15-1989	14.10
	09-15-1989	14.50
	10-23-1989	14.68
	11-14-1989	14.67
	12-20-1989	14.68
	01-23-1990	14.51
	02-12-1990	14.41
	03-06-1990	14.22
	04-02-1990	14.15
	05-08-1990	14.17
	07-05-1990	14.80
	08-03-1990	15.20
	09-06-1990	15.67
	10-18-1990	16.02
	11-19-1990	15.98
	01-24-1991	15.75
	03-05-1991	15.68
(D-8-1)23bdd-1	06-09-1937	-7.3
	12-13-1988	-11.9
	01-26-1989	-11.9
	03-01-1989	-12.0
	04-19-1989	-10.3
	05-12-1989	-10.2
	06-20-1989	-10.6
	07-18-1989	-11.0
	08-15-1989	-10.8
	08-24-1989	-10.8
	09-15-1989	-11.1
	10-26-1989	-10.7
	11-14-1989	-10.2
	12-20-1989	-9.6
	01-23-1990	-9.4
	02-12-1990	-9.5

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-8-1)23bdd-1 Continued	03-06-1990	-10.1
	04-02-1990	-9.1
	05-08-1990	-9.1
	06-05-1990	-9.2
	07-03-1990	-9.3
	08-03-1990	-9.1
	09-05-1990	-7.9
	10-18-1990	-9.3
	11-19-1990	-9.3
	12-17-1990	-8.6
	01-24-1991	-9.0
	03-05-1991	-8.0
(D-8-1)25aba-1	03-24-1967	-12.9
	02-20-1991	-6.6
	03-05-1991	-6.5
(D-8-1)25cbb-1	07-21-1964	-15.2
	02-20-1991	-11.0
	03-04-1991	-11.8
(D-8-1)36bcc-1	07-21-1964	-15.9
	03-07-1991	-10.9
(D-8-2)1baa-1	04-08-1964	-11.0
	08-06-1964	-14.6
	08-08-1989	-10.3
(D-8-2)2caa-1	11-12-1951	-16
	08-06-1964	-16.7
	09-21-1989	-11.6
(D-8-2)2cda-1	08-06-1964	-6.2
	09-21-1989	-5.5
	03-04-1991	-4.7
(D-8-2)2daa-1	08-06-1964	-25.8
	04-19-1989	-26.7
	05-16-1989	-24.4
	06-22-1989	-23.6
	07-18-1989	-24.0
	08-15-1989	-22.8
	08-24-1989	-22.5
	09-15-1989	-22.9
	10-23-1989	-23.2
	11-14-1989	-24.6
	12-20-1989	-24.5
	01-23-1990	-24.8
	02-12-1990	-25.1
	03-05-1990	-25.5
	04-02-1990	-25.7
(D-8-2)3aad-1	05-01-1964	-10.0
	09-15-1989	-15.8
(D-8-2)4abb-1	08-20-1964	-8.8
	09-12-1989	-12.4
	03-05-1991	-14.1
(D-8-2)4abc-1	04-06-1964	-12.5
	05-12-1964	-12.7
	08-04-1964	-12.2
	03-05-1965	-12.5
	06-23-1965	-12.7
	09-12-1989	-11.3
[1](D-8-2)4bab-1	03-25-1963	-22.0
	08-20-1964	-15.2
	09-12-1989	-4.4
(D-8-2)4cba-2	03-03-1937	-26.1
	09-23-1937	-24.8
	03-14-1938	-28.1
	09-27-1938	-24.8
	03-24-1939	-29.4
	09-21-1939	-26.8
	04-12-1940	-29.5
	09-20-1940	-25.8
	03-18-1941	-29.8
	12-29-1941	-27.9
	03-27-1942	-27.6
	12-26-1942	-29.7
	03-29-1943	-29.9
	12-29-1943	-29.5
	03-24-1944	-30.8
	12-27-1944	-30.7
	03-30-1945	-32.1
	12-17-1945	-31.6
	03-07-1946	-32.5
	12-17-1946	-31.6
	04-07-1947	-34.1
	12-17-1947	-33.3
	03-30-1948	-35.2
	03-17-1949	-34.5
	12-16-1949	-35.1
	03-23-1950	-36.8
	12-19-1950	-35.8
	04-04-1951	-35.0
	12-26-1951	-34.4
	04-09-1952	-35.0
	12-16-1952	-38.1
	04-21-1953	-37.8
	03-24-1954	-37.4
	12-29-1954	-35.1
(D-8-2)4cba-2 Continued	04-22-1955	-34.7
	12-22-1955	-33.4
	03-30-1956	-33.4
	12-19-1956	-34.2
	04-01-1957	-35.6
	12-06-1957	-35.8
	03-18-1958	-36.7
	12-04-1958	-35.5
	03-18-1959	-36.5
	12-24-1959	-32.9
	03-23-1960	-35.1
	12-09-1960	-32.6
	03-23-1961	-35.1
	01-05-1962	-28.1
	03-06-1962	-29.9
	12-06-1962	-28.4
	03-07-1963	-26.3
	08-27-1963	-17.6
	12-16-1963	-20.2
	03-11-1964	-21.3
	04-09-1964	-20.6
	05-28-1964	-19.3
	07-09-1964	-18.9
	08-03-1964	-18.2
	09-01-1964	-17.0
	10-05-1964	-18.4
	11-02-1964	-19.6
	12-03-1964	-19.8
	01-05-1965	-20.8
	02-02-1965	-21.7
	03-01-1965	-21.7
	04-05-1965	-22.3
	05-03-1965	-19.6
	06-07-1965	-19.8
	07-02-1965	-19.9
	10-21-1965	-20.8
	12-28-1965	-22.1
	03-25-1966	-20.2
	08-23-1966	-18.0
	12-30-1966	-19.7
	01-27-1967	-20.9
	02-10-1967	-20.0
	03-01-1967	-21.0
	03-16-1967	-21.0
	04-13-1967	-21.0
	04-27-1967	-20.6
	03-19-1968	-21.8
	10-02-1968	-20.5
	03-11-1969	-23.4
	09-04-1969	-19.4
	03-24-1970	-22.4
	09-08-1970	-21.1

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-8-2)4cba-2 Continued	03-17-1971	-22.7
	10-06-1971	-21.2
	03-09-1972	-22.4
	09-26-1972	-20.3
	03-07-1973	-22.5
	09-05-1973	-21.5
	03-08-1974	-25.8
	03-07-1975	-24.6
	03-05-1976	-25.6
	08-13-1976	-16.4
	03-08-1977	-22.6
	08-10-1977	-21.2
	03-09-1978	-19.2
	08-28-1978	-14.6
	03-15-1979	-23.2
	09-18-1979	-18.8
	03-05-1980	-21.1
	09-04-1980	-20.9
	03-02-1981	-23.9
	09-03-1981	-19.6
	03-02-1982	-22.1
	09-20-1982	-20.5
	03-01-1983	-23.6
	09-21-1983	-21.0
	03-09-1984	-23.7
	09-10-1984	-14.2
	03-04-1985	-24.8
	09-10-1985	-20.9
	03-10-1986	-24.2
	09-08-1986	-19.1
	03-04-1987	-23.0
	09-11-1987	-19.5
	03-02-1988	-19.5
	09-14-1988	-17.9
	12-13-1988	-18.7
	01-26-1989	-20.3
	03-01-1989	-20.3
	04-19-1989	-17.9
	05-12-1989	-17.6
	06-20-1989	-16.5
	07-18-1989	-15.8
	08-15-1989	-15.9
	08-24-1989	-15.3
	09-15-1989	-15.5
	10-23-1989	-15.5
	11-14-1989	-16.1
	12-19-1989	-16.2
	01-23-1990	-16.4
	03-05-1990	-17.0
	04-02-1990	-16.7
	05-08-1990	-14.7
	06-04-1990	-14.7
(D-8-2)4cba-2 Continued	07-03-1990	-11.9
	08-03-1990	-13.3
	09-05-1990	-14.7
	10-18-1990	-14.8
	11-19-1990	-16.6
	03-01-1991	-17.6
	09-10-1991	-14.6
	03-13-1992	-16.3
[1](D-8-2)4cbb-1	04-28-1964	-39.0
	09-15-1989	-6.1
(D-8-2)4cdc-4	08-20-1964	-12.7
	03-04-1991	-13.0
(D-8-2)4dad-1	04-03-1964	-43.8
	05-19-1964	-43.7
	08-04-1964	-43.7
	10-08-1964	-42.7
	03-08-1965	-45.4
	06-23-1965	-45.2
	09-28-1989	-13.4
(D-8-2)7dda-1	03-30-1965	-7.7
	03-04-1991	-4.9
(D-8-2)7ddd-1	12-16-1963	-10.9
	03-01-1991	-9.3
(D-8-2)10adb-1	09-28-1989	-20.1
	03-01-1991	-19.7
(D-8-2)13abc-1	08-30-1961	-22.0
	04-02-1964	-28.1
	05-13-1964	-28.5
	08-25-1964	-18.7
	10-07-1964	-22.5
	03-04-1965	-29.5
	06-22-1965	-26.6
	09-28-1989	-18.4
(D-8-2)14cad-1	09-02-1964	-4.5
	02-20-1990	-3.4
	03-05-1991	-3.5
(D-8-2)16caa-1	04-13-1937	-37.3
	09-23-1937	-32.4
	04-06-1938	-41.9
	09-13-1938	-36.0
	03-24-1939	-39.2
	10-13-1939	-35.7
	04-04-1940	-40.6
(D-8-2)16caa-1 Continued	01-21-1941	-39.8
	09-02-1964	-33.5
	10-05-1964	-33.4
	11-02-1964	-34.7
	12-03-1964	-35.8
	01-05-1965	-36.0
	02-02-1965	-36.8
	03-01-1965	-37.4
	04-05-1965	-37.6
	05-03-1965	-37.6
	06-07-1965	-37.7
	07-02-1965	-36.7
	10-21-1965	-39.6
	12-29-1965	-38.8
	03-25-1966	-38.6
	08-23-1966	-35.4
	12-20-1966	-36.1
	01-20-1967	-36.4
	02-20-1967	-36.9
	03-27-1967	-37.5
	03-19-1968	-38.4
	10-02-1968	-37.5
	03-11-1969	-41.6
	09-03-1969	-39.5
	03-15-1970	-42.7
	09-08-1970	-38.7
	03-17-1971	-40.7
	10-06-1971	-38.4
	03-10-1972	-40.4
	09-26-1972	-36.6
	03-08-1973	-40.6
	09-05-1973	-37.8
	03-08-1974	-42.2
	03-07-1975	-41.4
	03-05-1976	-43.0
	08-13-1976	-36.4
	03-08-1977	-39.5
	08-10-1977	-34.2
	03-09-1978	-37.4
	08-23-1978	-33.8
	03-15-1979	-38.9
	09-17-1979	-35.1
	03-05-1980	-38.7
	09-04-1980	-36.3
	03-03-1981	-39.4
	09-03-1981	-35.9
	03-02-1982	-37.8
	09-20-1982	-39.6
	03-03-1983	-42.3
	09-21-1983	-44
	03-09-1984	-47.4
	09-10-1984	-48.4

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-8-2)16caa-1 Continued	03-05-1985	-50.1
	09-10-1985	-46.0
	03-10-1986	-47.0
	09-08-1986	-41.1
	03-04-1987	-44.2
	09-11-1987	-37.4
	03-02-1988	-38.0
	09-14-1988	-32.1
	12-13-1988	-31.0
	01-26-1989	-36.4
	03-01-1989	-36.3
	04-19-1989	-33.8
	05-12-1989	-32.4
	06-20-1989	-29.9
	07-18-1989	-29.0
	08-15-1989	-28.3
	09-15-1989	-28.3
	10-26-1989	-28.9
	11-14-1989	-29.3
	12-19-1989	-28.3
	01-23-1990	-32.9
	02-12-1990	-33.1
	03-05-1990	-33.7
	04-02-1990	-33.4
	06-04-1990	-32.6
	07-03-1990	-29.6
	08-03-1990	-27.7
	09-05-1990	-27.2
(D-8-2)16dbb-2	09-02-1964	-5.0
	03-04-1991	-4.2
(D-8-2)17ada-1	09-03-1964	-6.3
	03-01-1991	-5.4
(D-8-2)17ccc-2	04-03-1964	-20.6
	05-19-1964	-19.7
	07-23-1964	-17.3
	09-03-1964	-15.4
	10-08-1964	-18.9
	03-08-1965	-20.8
	06-24-1965	-17.4
	08-17-1989	-8.5
(D-8-2)19add-1	09-03-1964	-13.8
	03-01-1991	-12.6
(D-8-2)20cad-2	03-28-1967	-10.7
	03-01-1991	-2.7
(D-8-2)21aaa-1	03-03-1937	-25.6
	09-14-1964	-20.0
	08-28-1989	-6.8
(D-8-2)21ddd-1	04-02-1964	-18.4
	05-18-1964	-17.5
	09-15-1964	-14.8
	03-24-1965	-18.5
	06-24-1965	-19.2
	10-02-1989	-12.5
(D-8-2)22cdc-1	09-15-1964	-15.2
	07-19-1989	-15.1
	03-04-1991	-15.4
(D-8-2)22cdc-2	09-15-1964	-11.4
	07-19-1989	-7.8
	03-04-1991	-10.9
(D-8-2)24bdc-2	03-25-1963	-12.0
	04-08-1964	-9.7
	05-20-1964	-9.3
	09-17-1964	-3.7
	03-17-1965	-11.4
	06-24-1965	-6.6
	08-17-1989	-1.5
(D-8-2)25dac-3	08-15-1961	30.00
	03-19-1970	28.17
	03-17-1971	29.88
	10-12-1971	30.14
	03-06-1972	31.02
	03-08-1973	30.90
	03-11-1974	26.24
	03-07-1975	26.80
	03-05-1976	26.13
	03-08-1977	29.54
	03-09-1978	34.48
	03-15-1979	32.06
	03-05-1980	34.40
	03-03-1981	30.20
	03-02-1982	31.24
	03-03-1983	24.24
	03-12-1984	16.51
	03-05-1985	14.38
	03-10-1986	19.95
	03-02-1987	22.74
	03-02-1988	28.72
	11-02-1988	35.15
	12-14-1988	33.21
	01-17-1989	32.76
	02-23-1989	33.85
	03-03-1989	33.51
	04-18-1989	35.13
	05-15-1989	35.77
(D-8-2)25dac-3 Continued	06-20-1989	37.27
	07-17-1989	40.07
	08-16-1989	41.51
	09-19-1989	40.18
	10-24-1989	39.10
	11-13-1989	37.20
	12-19-1989	35.89
	01-25-1990	35.60
	02-13-1990	35.32
	03-06-1990	35.44
	04-09-1990	36.38
	05-08-1990	38.29
	06-04-1990	38.79
	07-03-1990	41.87
	08-02-1990	43.70
	09-04-1990	43.56
	10-22-1990	40.45
	11-19-1990	39.15
	12-18-1990	38.65
	01-23-1991	38.88
	03-05-1991	38.42
	09-12-1991	43.76
	03-12-1992	37.47
(D-8-2)26aad-3	03-25-1964	38.1
	05-22-1964	37.2
	09-17-1964	43.9
	10-14-1964	42.1
	03-22-1965	39.9
	07-01-1965	39.8
	01-31-1991	35.80
	03-06-1991	35.45
(D-8-2)26abb-3	09-23-1964	-2.9
	03-04-1991	-3.9
(D-8-2)27acd-1	09-23-1964	-2.5
	02-20-1991	-5.2
	03-05-1991	-5.2
(D-8-2)28cbd-3	11-04-1944	-4
	09-25-1964	-5.7
	07-31-1989	-6.6
(D-8-2)28cca-2	09-25-1964	-1.0
	03-01-1991	-4.1
(D-8-2)29aaa-7	09-27-1957	-12.0
	09-25-1964	-11.9
	11-02-1964	-12.7
	12-03-1964	-12.8

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-8-2)29aaa-7 Continued	01-05-1965	-13.1
	02-02-1965	-13.8
	03-01-1965	-14.2
	04-05-1965	-14.1
	05-03-1965	-13.2
	06-07-1965	-12.0
	10-21-1965	-14.8
	12-30-1965	-16.2
	03-25-1966	-14.2
	04-13-1966	-14.5
	08-23-1966	-12.1
	03-24-1967	-14.9
	03-19-1968	-16.3
	03-11-1969	-16.1
	03-24-1970	-16.4
	03-18-1971	-16.1
	03-10-1972	-16.0
	03-07-1973	-14.0
	03-11-1974	-16.0
	03-07-1975	-14.0
	03-05-1976	-12.1
	03-08-1977	-11.6
	03-09-1978	-9.4
	03-15-1979	-11.2
	03-05-1980	-7.8
	03-03-1981	-9.1
	03-02-1982	-8.7
	03-03-1983	-11.0
	03-09-1984	-10.6
	03-05-1985	-10.8
	03-10-1986	-10.6
	03-04-1987	-9.2
	03-02-1988	-7.3
	03-10-1989	-7.9
	03-06-1990	-7.5
	03-05-1991	-6.9
	03-12-1992	-6.6
(D-8-2)29bcd-2	04-06-1964	-24.0
	05-19-1964	-24.4
	09-25-1964	-22.7
	10-08-1964	-22.9
	03-08-1965	-24.4
	06-24-1965	-23.7
	08-17-1989	-19.6
(D-8-2)29cab-1	09-25-1964	-25.3
	08-17-1989	-22.0
	03-04-1991	-26.4
(D-8-2)31cbb-1	09-28-1964	-12.5
	08-01-1989	-14.4
	08-28-1989	-14.8
(D-8-2)31cdb-1	08-04-1964	-6.3
	09-01-1964	-5.8
	10-01-1964	-5.8
	11-02-1964	-6.5
	12-03-1964	-6.5
	01-05-1965	-7.2
	02-02-1965	-7.2
	03-01-1965	-7.7
	04-05-1965	-7.8
	05-03-1965	-8.0
	06-07-1965	-7.4
	07-02-1965	-7.9
	10-21-1965	-8.9
	12-29-1965	-9.5
	03-25-1966	-8.5
	08-24-1966	-6.8
	12-20-1966	-7.2
	03-24-1967	-8.8
	03-20-1968	-8.2
	03-21-1969	-8.4
	03-24-1970	-15.3
	03-18-1971	-13.3
	03-11-1972	-15.4
	03-08-1973	-14.6
	03-11-1974	-12.9
	03-10-1975	-10.9
	03-08-1976	-8.3
	08-09-1989	-5.6
	04-09-1990	-13.0
	05-08-1990	-7.2
	06-05-1990	-5.6
	07-03-1990	-5.6
	08-03-1990	-5.6
	09-05-1990	-5.0
	10-18-1990	-7.1
	11-19-1990	-14.3
	12-17-1990	-14.2
	01-24-1991	-14.3
	03-07-1991	-15.0
	09-10-1991	-5.9
	03-12-1992	-14.8
(D-8-2)31cdb-2	09-27-1968	-18
	03-12-1970	-31.7
	03-18-1971	-31.3
	03-11-1972	-29.4
	03-08-1973	-28.4
	03-11-1974	-30.2
	03-10-1975	-29.8
	03-08-1976	-30.7
	11-14-1989	-30.0
(D-8-2)31cdb-2 Continued	01-23-1990	-29.7
	03-06-1990	-29.9
	11-19-1990	-28.9
	12-17-1990	-28.9
	01-24-1991	-28.8
	03-07-1991	-30.2
	03-12-1992	-28.8
(D-8-2)34acd-1	06-20-1946	-3.0
	09-28-1964	-3.7
	07-31-1989	-4.4
	03-05-1991	-7.4
(D-8-2)34dda-1	09-29-1964	-12.4
	11-03-1964	-13.3
	12-04-1964	-13.9
	01-05-1965	-14.6
	02-02-1965	-14.5
	03-01-1965	-14.9
	04-05-1965	-14.7
	05-03-1965	-14.5
	06-07-1965	-14.2
	07-02-1965	-13.6
	10-20-1965	-15.0
	12-29-1965	-15.0
	03-25-1966	-14.3
	04-18-1966	-14.8
	08-23-1966	-10.9
	03-24-1967	-15.0
	03-20-1968	-15.8
	03-17-1969	-17.1
	03-24-1970	-18.7
	03-18-1971	-17.4
	03-10-1972	-17.3
	03-08-1973	-18.0
	03-11-1974	-18.0
	03-07-1975	-18.1
	03-05-1976	-16.8
	03-08-1977	-13.8
	03-15-1979	-14.9
	03-05-1980	-13.7
	03-03-1981	-15.5
	03-02-1982	-15.7
	03-03-1983	-16.2
	03-12-1984	-17.6
	03-05-1985	-18.9
	03-10-1986	-17.7
	03-04-1987	-15.8
	12-13-1988	-9.8
	01-26-1989	-13.2
	03-01-1989	-13.4

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-8-2)34dda-1 Continued	04-18-1989	-9.9
	05-15-1989	-9.0
	06-20-1989	-8.3
	07-18-1989	-6.5
	08-16-1989	-5.9
	09-19-1989	-6.5
	10-26-1989	-6.5
	11-14-1989	-8.1
	12-19-1989	-8.4
	02-13-1990	-10.5
	03-09-1990	-11.0
(D-8-2)36dbd-3	09-29-1964	6.9
	02-06-1991	9.6
	03-06-1991	9.1
((D-8-3)5bca-1	11-04-1964	-14.5
	09-14-1989	-7.0
	03-04-1991	-9.7
(D-8-3)7abc-1	08-03-1989	-16.0
	03-04-1991	-23.5
(D-8-3)8abd-1	03-26-1964	6.41
	05-13-1964	6.40
	10-14-1964	10.5
	03-05-1965	6.3
	06-30-1965	8.6
	03-19-1967	6.15
	03-19-1968	6.05
	03-08-1969	4.56
	03-19-1970	3.83
	03-07-1971	4.47
	03-08-1973	2.95
	03-11-1974	2.95
	03-10-1975	5.43
	03-05-1976	3.39
	03-09-1977	4.46
	03-09-1978	5.60
	03-15-1979	4.34
	03-06-1980	4.45
	03-02-1981	3.17
	03-02-1982	3.67
	03-03-1983	.65
	03-09-1984	flowing
	03-04-1985	flowing
	03-10-1986	flowing
	03-04-1987	flowing
	03-02-1988	2.32
	03-02-1989	3.98
	04-19-1989	4.94
(D-8-3)8abd-1 Continued	05-15-1989	7.00
	06-22-1989	12.59
	07-17-1989	10.14
	08-16-1989	12.97
	09-19-1989	12.21
	10-24-1989	11.25
	11-13-1989	7.23
	12-19-1989	5.23
	01-23-1990	4.77
	02-13-1990	4.46
	03-06-1990	4.31
	04-09-1990	5.37
	05-08-1990	8.68
	06-04-1990	10.02
	07-02-1990	13.18
	08-02-1990	14.05
	09-04-1990	14.05
	10-16-1990	8.96
	11-19-1990	7.30
	12-17-1990	6.73
	01-23-1991	6.55
	03-04-1991	6.14
	03-13-1992	5.35
(D-8-3)11caa-1	06-19-1989	180.39
	07-19-1989	182.5
	09-19-1989	184.50
	11-13-1989	182.60
	01-23-1990	181.19
	02-14-1990	181.39
	03-05-1990	181.67
	05-08-1990	182.65
	07-02-1990	185.08
	10-22-1990	187.76
	12-17-1990	185.67
	03-05-1991	185.60
(D-8-3)11ccc-1	06-08-1965	138.13
	07-02-1965	136.42
	03-27-1967	143.50
	02-04-1991	137.00
	03-06-1991	140.00
(D-8-3)11ccc-2	01-30-1991	45.05
	03-07-1991	46.16
(D-8-3)14acc-1	08-19-1963	165.30
	04-01-1964	171.0
	05-12-1964	171.4
	10-14-1964	171.1
	03-19-1965	169.7
	06-30-1965	167.0
(D-8-3)14acc-1 Continued	10-20-1965	165.1
	12-28-1965	165.62
	03-23-1966	168.00
	04-13-1966	168.82
	08-25-1966	175.52
	02-21-1967	172.56
	03-27-1967	172.34
	12-15-1988	170.76
	01-17-1989	169.82
	02-23-1989	170.53
	04-18-1989	171.48
	05-15-1989	171.47
	06-19-1989	172.27
	08-24-1989	175.46
	10-24-1989	174.41
	01-23-1990	172.18
	03-06-1990	172.39
	04-09-1990	172.86
	05-31-1990	175.23
	08-02-1990	179.75
	09-05-1990	180.70
	10-22-1990	178.84
	11-19-1990	177.49
	01-23-1991	177.36
	03-05-1991	177.05
	09-13-1991	178.60
	03-13-1992	175.37
(D-8-3)14bab-1	10-09-1989	146.45
	10-31-1989	145.93
	11-24-1989	145.02
	12-22-1989	144.85
(D-8-3)17ada-1	04-13-1965	23.60
	02-25-1991	24.11
	03-07-1991	24.43
(D-8-3)17cdc-2	03-23-1964	143.70
	03-05-1991	142.22
(D-8-3)18aaa-3	03-07-1991	-2.1
(D-8-3)19ccd-1	04-13-1965	-2.7
	02-26-1991	-6.7
	03-04-1991	-6.4
[1](D-8-3)22cbd-3	01-08-1962	180
	02-13-1962	175.5
	03-14-1962	175.4
	04-11-1962	175.4
	04-03-1964	176.1
	05-12-1964	176.1

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-8-3)22cbd-3 Continued	10-14-1964	176.3
	12-04-1964	175.7
	03-19-1965	173.9
	06-30-1965	172.1
	03-06-1991	179.88
(D-8-3)26bcd-1	03-30-1989	175.64
	06-28-1989	177.89
	07-31-1989	178.22
	08-30-1989	178.91
	09-29-1989	179.47
	10-31-1989	179.91
	11-24-1989	180.54
	12-22-1989	180.91
	03-08-1991	189.04
(D-8-3)26cbd-1	07-31-1989	222.45
	08-30-1989	223.02
	09-29-1989	223.68
	10-31-1989	223.88
	11-24-1989	224.29
	12-22-1989	224.77
	03-08-1991	231.16
(D-8-3)26cbd-2	03-29-1989	34.72
	06-29-1989	36.69
	07-31-1989	36.96
	08-30-1989	37.22
	09-29-1989	37.46
	10-31-1989	37.36
	11-24-1989	37.02
	12-21-1989	36.58
	03-08-1991	36.13
(D-8-3)26cca-2	03-29-1989	20.43
	06-29-1989	21.32
	07-31-1989	21.67
	08-30-1989	22.06
	09-28-1989	22.49
	10-31-1989	22.77
	11-24-1989	22.72
	12-21-1989	22.70
	03-08-1991	21.86
(D-8-3)27adc-1	10-10-1989	90.13
	10-31-1989	90.62
	11-24-1989	91.05
	12-22-1989	91.34
	03-08-1991	96.57
(D-8-3)27adc-2	03-30-1989	156.15
	06-28-1989	158.59
(D-8-3)27adc-2 Continued	07-31-1989	159.41
	08-30-1989	160.15
	09-29-1989	160.71
	10-31-1989	160.58
	11-24-1989	160.32
	12-26-1989	160.17
	03-08-1991	165.40
(D-8-3)27bad-1	10-31-1989	151.52
	11-24-1989	149.61
	12-22-1989	148.76
	03-08-1991	149.39
(D-8-3)27bad-2	01-05-1990	180.29
	03-08-1991	185.36
(D-8-3)30dba-1	05-24-1989	114.46
	03-06-1991	113.73
(D-8-3)33cac-1	10-15-1964	58.00
	03-07-1991	62.41
(D-8-3)34bab-1	11-13-1961	153.50
	12-06-1961	153.50
	01-22-1962	153.40
	02-14-1962	154.20
	03-14-1962	154.50
	04-11-1962	154.50
	03-27-1964	161.20
	04-22-1964	160.68
	05-21-1964	160.70
	07-23-1964	164.20
	10-14-1964	163.10
	12-04-1964	161.29
	01-05-1965	160.36
	02-01-1965	160.09
	03-03-1965	159.44
	04-06-1965	159.05
	05-03-1965	158.81
	06-08-1965	157.86
	07-02-1965	158.08
	10-20-1965	155.82
	12-29-1965	154.05
	01-25-1966	154.37
	02-15-1966	154.38
	03-10-1966	154.31
	04-05-1966	154.83
	05-05-1966	155.35
	06-05-1966	155.70
	07-05-1966	163.48
	08-05-1966	161.58
	09-10-1966	162.35
(D-8-3)34bab-1 Continued	10-05-1966	161.44
	11-15-1966	159.44
	12-15-1966	158.52
	01-10-1967	158.48
	02-05-1967	158.11
	03-05-1967	158.41
	04-05-1967	158.01
	05-05-1967	158.28
	07-10-1967	158.63
	08-05-1967	159.07
	09-05-1967	159.03
	10-05-1967	157.82
	11-05-1967	156.91
	12-05-1967	156.15
	01-05-1968	155.80
	02-05-1968	155.85
	03-05-1968	155.48
	04-05-1968	155.60
	05-05-1968	155.30
	06-05-1968	154.67
	07-05-1968	157.65
	08-05-1968	156.25
	09-05-1968	154.85
	10-05-1968	153.38
	11-05-1968	152.72
	12-05-1968	151.89
	01-05-1969	151.51
	02-05-1969	151.10
	03-05-1969	151.01
	04-05-1969	150.64
	05-05-1969	150.02
	06-05-1969	149.80
	07-05-1969	148.80
	08-05-1969	150.00
	09-05-1969	149.00
	10-05-1969	148.52
	11-05-1969	147.21
	12-20-1969	147.19
	01-05-1970	147.22
	02-05-1970	147.40
	03-05-1970	147.57
	04-05-1970	148.28
	05-05-1970	148.69
	06-05-1970	149.30
	07-05-1970	149.19
	08-05-1970	150.38
	09-05-1970	155.05
	10-05-1970	150.50
	11-05-1970	150.06
	12-05-1970	150.09
	01-05-1971	149.80
	02-05-1971	149.57

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-8-3)34bab-1	03-05-1971	149.57
Continued	04-05-1971	150.83
	05-15-1971	150.15
	06-05-1971	150.38
	07-05-1971	152.04
	08-05-1971	153.30
	09-05-1971	152.53
	10-05-1971	150.94
	11-05-1971	149.05
	12-05-1971	148.58
	01-05-1972	148.52
	02-05-1972	148.54
	03-05-1972	149.41
	04-05-1972	148.88
	05-05-1972	149.14
	06-05-1972	151.38
	07-05-1972	153.36
	08-05-1972	154.98
	09-05-1972	153.72
	10-05-1972	153.11
	11-05-1972	151.58
	12-05-1972	150.88
	01-05-1973	150.85
	02-05-1973	150.70
	03-05-1973	150.37
	04-05-1973	150.47
	05-05-1973	150.00
	06-05-1973	150.76
	07-05-1973	151.85
	08-05-1973	150.63
	09-05-1973	150.51
	10-05-1973	148.62
	11-05-1973	147.61
	12-05-1973	147.02
	01-05-1974	146.48
	02-05-1974	146.10
	03-05-1974	146.03
	04-05-1974	146.11
	05-05-1974	146.09
	06-05-1974	146.94
	07-05-1974	147.83
	08-05-1974	149.16
	09-05-1974	148.78
	10-05-1974	147.84
	11-05-1974	146.40
	12-05-1974	145.28
	01-05-1975	144.76
	02-05-1975	144.67
	03-05-1975	144.55
	04-05-1975	145.08
	05-05-1975	145.26
	06-05-1975	144.94
(D-8-3)34bab-1	07-05-1975	144.45
Continued	08-05-1975	144.65
	09-05-1975	145.42
	10-05-1975	143.30
	11-05-1975	142.37
	12-05-1975	141.11
	01-05-1976	141.94
	02-05-1976	141.69
	03-05-1976	142.31
	04-05-1976	142.25
	05-05-1976	142.59
	06-05-1976	145.20
	07-05-1976	146.62
	08-05-1976	148.12
	09-05-1976	149.93
	10-05-1976	148.15
	11-05-1976	146.60
	12-05-1976	145.90
	01-05-1977	145.90
	02-05-1977	145.91
	03-05-1977	146.18
	04-05-1977	145.74
	05-05-1977	147.30
	06-05-1977	148.41
	07-05-1977	154.47
	08-05-1977	152.67
	09-05-1977	152.91
	10-05-1977	153.01
	11-05-1977	151.45
	12-05-1977	151.00
	01-05-1978	150.73
	02-05-1978	150.48
	03-05-1978	150.34
	04-05-1978	150.77
	05-05-1978	150.21
	06-05-1978	150.08
	07-05-1978	152.68
	08-05-1978	152.83
	09-05-1978	152.42
	10-05-1978	149.70
	11-05-1978	148.51
	12-05-1978	147.77
	01-05-1979	147.85
	02-05-1979	147.77
	03-05-1979	148.05
	04-05-1979	147.98
	05-05-1979	147.93
	06-05-1979	149.00
	07-05-1979	150.87
	08-05-1979	151.28
	09-05-1979	149.43
	10-05-1979	149.07
(D-8-3)34bab-1	11-05-1979	147.85
Continued	12-05-1979	147.10
	01-05-1980	146.77
	02-05-1980	146.69
	03-05-1980	146.59
	04-05-1980	146.73
	05-05-1980	146.09
	06-05-1980	146.02
	07-05-1980	146.02
	08-05-1980	146.44
	09-05-1980	145.45
	10-05-1980	144.37
	11-05-1980	143.31
	12-05-1980	143.16
	01-05-1981	143.42
	02-05-1981	143.84
	03-05-1981	144.21
	04-05-1981	144.83
	05-05-1981	145.23
	06-05-1981	145.24
	07-05-1981	146.96
	08-05-1981	149.56
	09-05-1981	148.34
	10-05-1981	147.70
	11-05-1981	146.33
	12-05-1981	146.15
	01-05-1982	146.05
	02-05-1982	146.51
	03-05-1982	146.53
	04-05-1982	146.56
	05-05-1982	146.09
	06-05-1982	144.62
	07-05-1982	144.45
	08-05-1982	143.79
	09-05-1982	143.21
	03-10-1983	139.47
	03-04-1985	124.22
	03-10-1986	130.40
	03-02-1987	126.81
	03-02-1988	135.79
	11-02-1988	143.39
	12-14-1988	141.98
	01-17-1989	142.16
	02-23-1989	143.09
	03-03-1989	142.99
	04-18-1989	144.26
	05-15-1989	144.91
	06-19-1989	145.52
	07-19-1989	149.10
	08-16-1989	148.64
	09-19-1989	148.07
	10-24-1989	147.02

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-8-3)34bab-1 Continued	11-13-1989	145.84
	12-19-1989	143.98
	01-25-1990	142.24
	02-14-1990	141.39
	03-06-1990	141.07
	04-09-1990	140.99
	07-02-1990	146.40
	08-03-1990	147.93
	09-05-1990	147.11
	10-22-1990	146.09
	11-19-1990	144.99
	12-17-1990	144.28
	01-22-1991	143.44
	03-06-1991	142.75
	09-10-1991	147.47
	03-19-1992	144.98
(D-8-3)34bbb-1	06-02-1989	72.52
	07-19-1989	75.13
	09-18-1989	74.93
	10-24-1989	74.07
	11-13-1989	73.12
	12-19-1989	71.73
	01-25-1990	70.32
	02-14-1990	69.66
	03-06-1990	69.41
	04-09-1990	69.25
	05-10-1990	69.98
	06-04-1990	70.73
	07-02-1990	72.81
	08-02-1990	74.18
	09-05-1990	74.38
	10-22-1990	73.52
	11-19-1990	72.55
	12-17-1990	72.01
	01-23-1991	71.42
	03-06-1991	70.87
	09-12-1991	74.43
	03-13-1992	72.38
(D-9-1)11acc-2	06-20-1989	69.74
	03-06-1991	77.79
(D-9-1)11baa-1	01-23-1989	59.93
	06-20-1989	58.98
	09-18-1989	57.05
	11-14-1989	58.17
	02-14-1990	60.33
	03-06-1990	60.72
	04-09-1990	61.28
	05-08-1990	61.77
	06-04-1990	61.89
(D-9-1)11baa-1 Continued	08-02-1990	59.77
	09-05-1990	58.59
	10-18-1990	58.83
	11-19-1990	59.68
	12-17-1990	60.48
	01-23-1991	61.31
	03-06-1991	62.10
(D-9-1)14aad-1	01-06-1965	60.02
	02-01-1965	59.77
	03-02-1965	59.48
	04-05-1965	59.37
	05-03-1965	59.16
	06-08-1965	65.15
	07-01-1965	66.90
	10-21-1965	57.06
	12-30-1965	56.00
	03-23-1966	55.95
	04-11-1966	56.68
	12-19-1966	57.24
	03-30-1967	57.34
	03-20-1968	56.25
	03-20-1969	55.46
	03-19-1970	55.78
	03-16-1971	55.89
	03-06-1972	55.14
	03-09-1973	57.49
	03-12-1974	56.81
	03-10-1975	58.74
	03-08-1976	57.86
	03-09-1977	63.23
	03-09-1978	61.00
	03-21-1979	59.94
	03-05-1980	59.12
	03-03-1981	57.54
	03-01-1982	58.37
	03-02-1983	55.20
	03-12-1984	53.22
	03-04-1985	53.75
	03-11-1986	54.87
	03-02-1987	55.40
	03-01-1988	57.49
	03-03-1989	58.66
	03-06-1990	57.22
	10-18-1990	57.35
	11-19-1990	56.74
	12-17-1990	57.04
	01-23-1991	57.37
	03-06-1991	57.57
	09-10-1991	65.90
	03-12-1992	57.24
(D-9-1)14aad-2	03-14-1990	26.40
	03-21-1990	26.39
	10-18-1990	29.50
	11-19-1990	28.49
	12-17-1990	28.60
	01-23-1991	28.70
(D-9-1)14ddd-1	10-15-1964	34.70
	01-31-1991	30.58
	03-06-1991	30.60
(D-9-1)23ada-1	11-14-1961	24.20
	12-21-1961	24.50
	01-18-1962	24.70
	03-05-1962	24.80
	04-03-1962	24.80
	05-15-1962	25.20
	06-05-1962	24.90
	09-10-1962	27.30
	10-18-1962	25.40
	11-15-1962	24.20
	12-28-1962	23.10
	01-30-1963	22.50
	02-26-1963	22.10
	03-22-1963	22.50
	03-26-1964	27.25
	05-15-1964	26.90
	06-01-1964	27.2
	10-12-1964	28.30
	12-04-1964	26.77
	01-06-1965	25.97
	02-01-1965	25.56
	04-05-1965	24.68
	05-03-1965	24.45
	10-21-1965	22.05
	12-30-1965	20.27
	03-23-1966	19.49
	04-11-1966	19.34
	04-12-1966	19.57
	08-24-1966	26.03
	12-19-1966	22.08
	03-25-1967	22.02
	03-20-1968	16.77
	03-18-1969	12.20
	03-19-1970	11.85
	03-16-1971	12.30
	03-06-1972	11.87
	03-09-1973	18.12
	03-12-1974	9.28
	03-10-1975	15.09
	03-08-1976	11.45
	03-09-1977	17.49

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-9-1)23ada-1 Continued	03-09-1978	24.39
	03-15-1979	17.58
	03-05-1980	16.75
	03-03-1981	10.78
	03-01-1982	15.76
	03-02-1983	5.88
	03-12-1984	2.70
	03-04-1985	3.59
	03-11-1986	7.35
	03-02-1987	6.63
	03-01-1988	11.58
	03-03-1989	15.53
	03-06-1990	19.29
	03-06-1991	23.04
	03-12-1992	21.60
(D-9-1)23daa-1	10-14-1964	44.80
	03-06-1991	39.71
[1](D-9-1)24acb-1	10-14-1964	7.20
	03-08-1991	3.41
(D-9-1)25ada-1	12-02-1937	-14.4
	12-21-1937	-13.6
	02-25-1938	-11.6
	04-06-1938	-10.9
	06-02-1938	-10.4
	08-26-1938	-13.7
	10-09-1938	-13.4
	12-23-1938	-14.3
	03-17-1939	-13.4
	04-14-1939	-12.8
	06-19-1939	-10.5
	08-25-1939	-10.5
	10-13-1939	-10.7
	01-04-1940	-10.8
	07-20-1989	-12.4
	03-07-1991	-7.6
(D-9-1)25ada-3	04-14-1964	-5.7
	05-27-1964	-5.4
	07-09-1964	-6.5
	08-03-1964	-7.4
	08-31-1964	-6.4
	10-01-1964	-5.7
	11-03-1964	-6.4
	12-04-1964	-7.0
	01-06-1965	-7.3
	02-01-1965	-8.0
	03-02-1965	-8.0
	04-05-1965	-7.9
	05-03-1965	-8.1
(D-9-1)25ada-3 Continued	06-08-1965	-9.0
	07-01-1965	-10.7
	10-21-1965	-10.8
	12-30-1965	-12.3
	03-28-1966	-10.2
	08-24-1966	-7.7
	03-28-1967	-8.0
	03-20-1968	-10.6
	03-18-1969	-13.7
	03-24-1970	-14.4
	03-18-1971	-14.8
	03-11-1972	-15.0
	07-20-1989	-12.8
(D-9-1)26aab-1	11-14-1961	63.50
	12-21-1961	63.90
	01-18-1962	63.70
	03-05-1962	64.20
	04-03-1962	64.40
	06-05-1962	65.60
	09-10-1962	67.30
	10-18-1962	65.10
	11-15-1962	64.00
	12-28-1962	62.30
	01-30-1963	61.70
	02-26-1963	61.30
	03-22-1963	61.50
	05-15-1964	66.70
	10-12-1964	68.70
	12-04-1964	66.60
	01-06-1965	65.49
	02-01-1965	65.14
	03-02-1965	64.53
	04-05-1965	63.81
	05-03-1965	63.77
	07-01-1965	65.62
	10-21-1965	61.21
	12-30-1965	58.80
	03-23-1966	57.86
	04-11-1966	57.82
	12-19-1966	61.95
	01-18-1967	61.55
	02-15-1967	61.33
	03-18-1967	61.02
	03-20-1968	54.58
	03-18-1969	49.00
	03-19-1970	48.37
	03-16-1971	48.80
	03-06-1972	47.81
	03-09-1973	56.45
	03-12-1974	44.80
	03-10-1975	52.02
(D-9-1)26aab-1 Continued	03-08-1976	47.20
	03-09-1977	54.93
	03-09-1978	63.60
	03-15-1979	55.58
	03-05-1980	54.70
	03-03-1981	46.37
	03-01-1982	53.49
	03-02-1983	40.78
	03-12-1984	33.38
	03-04-1985	33.28
	03-11-1986	40.39
	03-02-1987	38.82
	03-01-1988	47.45
	11-22-1988	51.28
	12-14-1988	51.42
	01-23-1989	52.02
	02-24-1989	52.36
	03-03-1989	52.53
	04-19-1989	52.82
	05-16-1989	53.30
	06-20-1989	54.91
	07-17-1989	56.22
	08-18-1989	57.19
	09-18-1989	58.46
	10-25-1989	56.89
	11-14-1989	56.93
	12-18-1989	56.85
	01-23-1990	57.06
	02-14-1990	57.01
	03-06-1990	57.21
	04-06-1990	57.28
	05-08-1990	58.41
	06-04-1990	58.64
	07-03-1990	59.92
	08-03-1990	60.43
	09-05-1990	61.41
	10-17-1990	62.20
	11-19-1990	61.84
	12-17-1990	61.88
	01-23-1991	61.88
	03-06-1991	61.92
	03-12-1992	60.28
(D-9-1)27aca-1	02-14-1967	230.94
	03-18-1967	231.14
	03-20-1968	230.64
	03-20-1969	229.61
	03-19-1970	229.00
	12-14-1988	228.29
	01-23-1989	226.67
	02-27-1989	230.87
	04-21-1989	227.30

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-9-1)27aca-1 Continued	05-16-1989	227.12
	06-20-1989	226.72
	07-17-1989	226.80
	08-24-1989	226.65
	10-25-1989	226.96
(D-9-1)32bbd-1	12-12-1988	13.70
	01-23-1989	14.30
	02-24-1989	14.82
	04-19-1989	15.43
	05-12-1989	15.60
	06-20-1989	15.07
	07-18-1989	14.33
	08-15-1989	13.76
	09-15-1989	13.73
	10-23-1989	12.99
	11-17-1989	13.19
	12-20-1989	13.47
	01-23-1990	13.75
	02-14-1990	13.98
	03-06-1990	14.21
	04-09-1990	14.56
	05-08-1990	14.84
	06-05-1990	15.04
	07-03-1990	15.13
	08-03-1990	15.13
	09-06-1990	15.12
	10-18-1990	15.12
	12-17-1990	15.22
	03-05-1991	15.95
	03-12-1992	14.39
(D-9-1)36acb-1	05-18-1989	97.41
	03-06-1991	102.41
(D-9-1)36bbc-1	07-09-1961	104
	10-12-1961	106.00
	11-13-1961	106.70
	12-22-1961	106.80
	01-19-1962	107.10
	03-05-1962	107.30
	04-04-1962	107.50
	05-14-1962	106.30
	06-05-1962	102.40
	07-31-1962	105.60
	10-22-1962	100.00
	11-15-1962	99.10
	12-28-1962	98.90
	01-29-1963	99.90
	02-26-1963	100.50
	05-03-1963	106.00
	06-17-1963	112.20
(D-9-1)36bbc-1 Continued	08-05-1963	112.40
	09-19-1963	113.80
	10-17-1963	110.80
	11-26-1963	108.20
	12-18-1963	107.70
	01-24-1964	107.40
	04-02-1964	106.50
	05-14-1964	107.70
	10-08-1964	111.90
	03-23-1965	102.20
	06-29-1965	125.40
	03-18-1967	103.69
	03-20-1968	96.80
	03-18-1969	93.24
	03-19-1970	92.57
	03-16-1971	90.35
	03-14-1972	91.30
	03-09-1973	97.51
	03-12-1974	87.77
	03-10-1975	92.73
	03-08-1976	90.09
	03-09-1977	95.93
	03-10-1978	104.27
	03-15-1979	96.02
	03-12-1980	96.60
	03-03-1981	89.88
	03-02-1982	96.04
	03-02-1983	84.29
	03-12-1984	76.68
	03-04-1985	76.32
	03-11-1986	84.99
	03-02-1987	82.38
	03-01-1988	91.69
	03-10-1989	95.58
	05-16-1989	96.31
	06-22-1989	95.78
	07-17-1989	97.57
	08-18-1989	99.16
	09-18-1989	100.54
	10-25-1989	98.83
	11-14-1989	98.40
	01-25-1990	98.74
	02-14-1990	98.95
	03-07-1990	99.29
	04-06-1990	99.75
	05-08-1990	100.17
	06-04-1990	103.63
	08-08-1990	111.28
	09-05-1990	106.52
	10-17-1990	103.92
	11-19-1990	102.53
	12-18-1990	102.23
(D-9-1)36bbc-1 Continued	01-23-1991	102.55
	03-06-1991	102.20
	09-12-1991	100.91
	03-12-1992	100.96
(D-9-1)36cdb-1	10-14-1964	170.10
	03-08-1991	167.64
(D-9-1)36cdd-1	03-02-1962	190.50
	04-03-1962	191.30
	05-14-1962	189.50
	06-04-1962	185.40
	07-24-1962	181.00
	10-17-1962	182.50
	11-14-1962	181.30
	12-17-1962	181.60
	01-29-1963	182.70
	02-25-1963	183.60
	03-22-1963	184.60
	05-03-1963	187.70
	06-14-1963	189.80
	08-05-1963	206.80
	09-19-1963	195.10
	10-18-1963	193.70
	11-22-1963	191.50
	12-18-1963	191.00
	01-03-1964	191.00
	01-22-1964	190.60
	03-24-1964	191.07
	05-15-1964	191.60
	10-08-1964	190.80
	12-04-1964	186.87
	01-06-1965	189.19
	02-01-1965	189.30
	03-02-1965	188.86
	04-05-1965	187.42
	05-03-1965	187.13
	06-08-1965	199.40
	10-21-1965	179.00
	12-30-1965	180.09
	03-23-1966	182.52
	12-19-1966	186.99
	03-25-1967	187.87
	03-20-1968	181.14
	03-20-1969	176.89
	03-19-1970	176.35
	03-16-1971	174.48
	03-06-1972	173.52
	03-09-1973	183.65
	03-12-1974	173.23
	03-10-1975	183.87
	03-08-1976	172.65

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-9-1)36cdd-1 Continued	03-09-1977	178.93
	03-09-1978	189.05
	03-15-1979	179.96
	03-05-1980	180.52
	03-03-1981	172.83
	03-01-1982	179.49
	03-02-1983	165.95
	03-12-1984	157.25
	03-04-1985	156.19
	03-11-1986	166.42
	03-02-1987	153.49
	03-01-1988	177.55
	11-01-1988	175.71
	12-22-1988	183.09
	01-17-1989	185.19
	02-23-1989	178.37
	03-10-1989	185.19
	05-18-1989	189.66
	03-07-1990	187.86
	03-06-1991	187.52
	03-12-1992	185.57
(D-9-2)1bcb-1	10-10-1966	-6
	04-04-1967	-9.5
	03-05-1991	-7.2
(D-9-2)2add-1	09-30-1964	-12.0
	08-17-1989	-1.6
(D-9-2)2dad-1	04-10-1967	-14.8
	03-05-1991	-.6
(D-9-2)2dad-2	11-29-1956	-16
	09-30-1964	-6.0
	03-20-1967	-15.2
	03-20-1968	-15.1
	03-17-1969	-18.4
	03-24-1970	-19.5
	03-18-1971	-19.1
	03-10-1972	-20.5
	03-08-1973	-17.4
	03-11-1974	-21.4
	03-07-1975	-21.2
	03-05-1976	-18.7
	03-08-1977	-16.2
	03-09-1978	-14.2
	03-15-1979	-14.8
	03-05-1980	-3.5
	03-03-1981	-14.3
	03-01-1982	-14.4
	03-03-1983	-19.2
	03-12-1984	-24.3
(D-9-2)2dad-2 Continued	03-05-1985	-28.6
	03-10-1986	-24.6
	03-02-1987	-22.9
	03-01-1988	-15.6
	03-01-1989	-14.4
	04-18-1989	-11.7
	05-15-1989	-9.8
	06-19-1989	-7.2
	07-19-1989	-3.0
	09-19-1989	-6.0
	11-13-1989	-9.2
	12-18-1989	-9.9
	01-25-1990	-10.1
	03-06-1990	-10.7
	04-09-1990	-10.6
	05-09-1990	-7.9
	06-04-1990	-6.6
	07-02-1990	-3.9
	08-02-1990	-2.9
	09-04-1990	-3.2
	10-17-1990	-6.6
	11-19-1990	-7.5
	12-17-1990	-8.5
	01-23-1991	-8.8
	03-04-1991	-9.6
	03-12-1992	-10.2
(D-9-2)3aba-4	11-03-1964	-11.30
	02-20-1991	-15.5
	03-04-1991	-15.4
(D-9-2)4cdc-1	02-10-1967	-11.70
	02-22-1991	12.90
	03-06-1991	13.00
(D-9-2)5acc-1	01-10-1967	-36.00
	08-09-1989	-26.4
	03-06-1991	-32.3
(D-9-2)5bcc-2	09-30-1964	-19.6
	08-09-1989	-14.2
(D-9-2)5bcd-1	02-25-1967	-18
	08-09-1989	-8.1
(D-9-2)5cbb-3	09-30-1964	-19.8
	08-28-1989	-17.5
	03-06-1991	-21.1
(D-9-2)5ccd-2	06-21-1990	3
	07-02-1990	3.44
(D-9-2)5ddd-1	06-21-1990	5
	07-02-1990	5.27
	02-06-1991	6.35
	03-06-1991	5.96
(D-9-2)6add-4	04-01-1964	-22.9
	07-19-1989	-23.3
(D-9-2)6add-5	04-10-1963	-15.0
	07-19-1989	-31.2
(D-9-2)6ddb-1	09-30-1964	-16.8
	03-07-1991	-18.0
(D-9-2)7bdd-1	10-05-1964	15.50
	03-06-1991	20.16
(D-9-2)7cda-2	10-05-1964	7.50
	01-30-1991	8.66
	03-06-1991	8.02
(D-9-2)7dcc-1	10-05-1964	12.30
	02-22-1991	8.20
	03-06-1991	7.94
(D-9-2)9bac-1	09-18-1961	43.00
	10-12-1961	40.40
	11-14-1961	39.70
	12-27-1961	39.60
	01-19-1962	39.70
	03-06-1962	39.30
	04-04-1962	39.10
	05-15-1962	37.50
	06-11-1962	35.70
	07-02-1962	35.20
	09-11-1962	41.00
	10-22-1962	36.80
	11-19-1962	36.50
	12-28-1962	36.10
	01-30-1963	35.20
	02-27-1963	37.50
	03-26-1963	38.70
	05-03-1963	40.00
	06-17-1963	40.20
	09-20-1963	40.10
	10-17-1963	38.20
	11-26-1963	37.50
	12-20-1963	36.60
	01-15-1964	35.80
	03-19-1964	35.60
	06-25-1964	36.80
	10-01-1964	38.20

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-9-2)9bac-1 Continued	06-28-1965	34.90
	10-10-1966	36.81
	03-25-1967	38.39
	03-07-1968	35.55
	03-13-1969	34.61
	03-05-1970	33.98
	02-25-1971	33.70
	03-10-1972	34.40
	03-08-1973	35.65
	03-11-1974	32.30
	03-07-1975	31.23
	03-05-1976	32.55
	03-08-1977	33.97
	08-11-1977	63.20
	03-09-1978	35.67
	03-15-1979	35.14
	03-01-1982	33.96
	09-20-1982	32.55
	03-02-1983	30.95
	09-21-1983	27.67
	03-12-1984	27.67
	09-10-1984	26.12
	03-05-1985	27.62
	09-10-1985	28.33
	03-10-1986	28.98
	09-08-1986	28.77
	03-02-1987	30.20
	09-11-1987	29.63
	03-01-1988	35.05
	09-14-1988	32.30
	03-03-1989	34.61
	09-18-1989	33.96
	03-06-1990	36.29
	03-06-1991	37.47
	09-12-1991	36.85
	03-12-1992	37.90
(D-9-2)10dac-1	08-31-1966	-23.0
	09-20-1989	-27.5
	03-04-1991	-20.9
(D-9-2)11aaa-1	08-31-1935	-25.4
	10-08-1935	-25.6
	11-19-1935	-25.5
	12-14-1935	-25.4
	01-23-1936	-25.6
	03-05-1936	-25.3
	05-02-1936	-25.2
	06-20-1936	-26.7
	08-08-1936	-28.2
	10-03-1936	-29.2
	11-30-1936	-29.4
(D-9-2)11aaa-1 Continued	02-03-1937	-29.0
	03-03-1937	-28.5
	04-13-1937	-28.4
	06-10-1937	-27.9
	08-01-1937	-29.0
	09-23-1937	-29.1
	11-02-1937	-29.6
	12-12-1937	-29.8
	02-14-1938	-29.5
	04-06-1938	-29.2
	05-05-1938	-29.1
	06-02-1938	-29.1
	08-26-1938	-30.7
	10-29-1938	-31.8
	12-23-1938	-31.8
	03-17-1939	-32.9
	04-14-1939	-31.2
	06-19-1939	-30.8
	08-25-1939	-30.0
	10-13-1939	-30.0
	01-04-1940	-30.0
	04-12-1940	-25.2
	05-01-1940	-25.3
	06-14-1940	-28.2
	01-21-1941	-29.5
	11-14-1941	-30.0
	12-29-1941	-31.3
	01-29-1942	-31.4
	03-26-1942	-31.2
	06-27-1942	-29.8
	03-29-1943	-39.0
	12-29-1943	-38.2
	03-24-1944	-37.0
	12-27-1944	-41.4
	03-29-1945	-40.7
	12-17-1945	-43.0
	03-07-1946	-41.5
	12-17-1946	-42.3
	04-07-1947	-40.9
	12-19-1947	-39.2
	03-30-1948	-41.4
	03-17-1949	-43.7
	12-16-1949	-43.3
	03-22-1950	-42.8
	12-19-1950	-44.5
	04-04-1951	-42.7
	07-19-1951	-41.9
	12-26-1951	-41.9
	04-09-1952	-39.8
	12-16-1952	-55.3
	04-21-1953	-53.5
	12-08-1953	-50.4
(D-9-2)11aaa-1 Continued	03-24-1954	-48.0
	12-29-1954	-43.0
	04-22-1955	-40.2
	12-22-1955	-39.8
	03-30-1956	-39.4
	12-19-1956	-37.6
	04-01-1957	-36.0
	12-06-1957	-41.4
	03-18-1958	-41.7
	12-04-1958	-40.3
	03-18-1959	-46.1
	12-24-1959	-41.0
	03-23-1960	-39.8
	12-09-1960	-36.0
	01-05-1962	-34.2
	03-06-1962	-31.2
	12-06-1962	-31.3
	03-12-1963	-30.9
	08-27-1963	-27.9
	12-16-1963	-28.2
	04-09-1964	-27.1
	05-28-1964	-26.8
	07-09-1964	-26.2
	08-03-1964	-25.9
	08-31-1964	-25.8
	10-01-1964	-26.2
	11-03-1964	-26.9
	12-04-1964	-27.0
	01-05-1965	-27.5
	02-02-1965	-27.5
	03-01-1965	-28.0
	04-05-1965	-28.1
	05-03-1965	-28.2
	06-07-1965	-28.1
	07-02-1965	-28.6
	10-21-1965	-31.8
	12-29-1965	-33.2
	03-25-1966	-33.0
	08-25-1966	-33.1
	12-19-1966	-32.5
	03-25-1967	-31.4
	03-20-1968	-35.0
	10-02-1968	-36.9
	03-17-1969	-40.8
	09-03-1969	-42.1
	03-24-1970	-42.3
	09-09-1970	-40.5
	03-18-1971	-40.9
	10-06-1971	-42.6
	03-10-1972	-42.1
	09-26-1972	-40.4
	03-08-1973	-40.5

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-9-2)11aaa-1	09-06-1973	-44.5
Continued	03-11-1974	-50.0
	03-07-1975	-50.7
	03-05-1976	-49.0
	08-16-1976	-45.5
	03-11-1977	-42.8
	08-10-1977	-37.0
	03-09-1978	-35.2
	03-15-1979	-36.7
	08-23-1979	-32.8
	03-05-1980	-36.1
	09-04-1980	-39.2
	03-03-1981	-41.0
	09-03-1981	-39.0
	03-01-1982	-39.0
	09-20-1982	-48.6
	03-03-1983	-53.8
	03-12-1984	-67.8
	09-10-1984	-74.3
	03-05-1985	-72.1
	09-10-1985	-67.3
	03-10-1986	-58.7
	09-08-1986	-59.7
	03-02-1987	-56.6
	09-11-1987	-50.9
	03-01-1988	-44.9
	09-14-1988	-39.2
	03-10-1989	-37.6
	07-19-1989	-34
	09-19-1989	-34.9
	03-06-1990	-31.6
	03-04-1991	-28.8
	09-12-1991	-26.6
	03-12-1992	-27.7
(D-9-2)11aca-3	10-06-1964	-19.3
	07-19-1989	-22.5
	03-04-1991	-22.3
(D-9-2)17ada-1	11-03-1964	112.79
	12-04-1964	113.25
	01-06-1965	113.80
	02-01-1965	114.50
	03-03-1965	114.93
	04-05-1965	115.31
	05-03-1965	115.20
	06-07-1965	112.90
	07-01-1965	113.66
	10-21-1965	108.05
	12-29-1965	109.92
	03-23-1966	111.95
	08-23-1966	115.30
(D-9-2)17ada-1	12-20-1966	112.45
Continued	03-27-1967	113.39
	03-20-1968	110.80
	03-18-1969	109.70
	03-19-1970	110.07
	03-16-1971	110.62
	03-06-1972	115.57
	03-08-1973	111.68
	03-12-1974	109.82
	03-07-1975	110.75
	03-05-1976	111.23
	03-08-1977	112.08
	03-09-1978	114.88
	03-15-1979	112.78
	03-05-1980	112.72
	03-03-1981	110.56
	03-01-1982	110.59
	03-02-1983	106.07
	03-12-1984	105.90
	03-05-1985	106.13
	03-10-1986	108.39
	03-02-1987	108.83
	03-01-1988	113.43
	11-02-1988	112.04
	12-22-1988	111.96
	01-17-1989	112.16
	02-23-1989	112.41
	03-03-1989	112.63
	04-19-1989	113.77
	05-15-1989	116.57
	06-20-1989	116.89
	07-17-1989	117.19
	08-16-1989	116.87
	10-25-1989	113.92
	11-14-1989	113.70
	12-18-1989	113.74
	01-25-1990	114.01
	02-14-1990	114.28
	03-07-1990	114.59
	04-06-1990	115.35
	05-08-1990	117.01
	06-04-1990	117.73
	07-03-1990	119.02
	08-02-1990	118.70
	09-04-1990	119.17
	10-17-1990	117.43
	11-19-1990	116.50
	12-17-1990	116.58
	01-23-1991	117.20
	03-06-1991	117.42
	03-12-1992	118.17
(D-9-2)18aca-1	10-07-1964	17.20
	02-22-1991	17.42
	03-06-1991	17.15
(D-9-2)20ccc-1	05-09-1962	23.0
	10-17-1962	21.5
	11-15-1962	21.8
	12-17-1962	20.2
	01-29-1963	21.9
	02-26-1963	21.5
	03-22-1963	21.4
	12-24-1963	20.5
	03-01-1964	22.00
	03-24-1964	21.7
	05-21-1964	21.1
	07-24-1964	21.6
	10-09-1964	21.3
	03-23-1965	21.2
	06-28-1965	21.1
	02-15-1991	20.49
	03-05-1991	20.40
(D-9-2)22cad-1	04-20-1989	136.05
	07-10-1989	134.11
	09-18-1989	137.20
	10-25-1989	138.24
	11-13-1989	138.50
	01-25-1990	139.45
	02-14-1990	139.72
	03-06-1990	139.87
	04-06-1990	139.97
	06-04-1990	133.17
	09-05-1990	137.52
	10-17-1990	138.74
	11-19-1990	139.36
	12-18-1990	139.74
	01-23-1991	139.63
	03-06-1991	140.26
	09-12-1991	136.08
	03-12-1992	138.96
(D-9-2)24bda-1	03-02-1989	283.55
	04-20-1989	284.16
	05-15-1989	284.26
	06-19-1989	284.50
	08-18-1989	284.76
	10-25-1989	284.94
	01-25-1990	285.05
	03-07-1990	285.35
	05-09-1990	285.68
	10-22-1990	286.44
	01-23-1991	286.73
	03-04-1991	286.90

Table 3.—*Water levels in selected wells*—Continued

Well number	Date	Water level
(D-9-2)25bbc-1	05-01-1989	72.51
	03-06-1991	80.03
(D-9-2)29acd-1	06-18-1964	-12.5
	07-09-1964	-11.7
	08-03-1964	-11.6
	08-31-1964	-11.3
	10-01-1964	-11.2
	11-03-1964	-11.4
	12-04-1964	-11.8
	01-06-1965	-11.9
	02-01-1965	-12.7
	03-02-1965	-12.5
	04-05-1965	-12.6
	05-03-1965	-12.9
	06-08-1965	-12.8
	08-09-1989	-12.6
(D-9-2)30cbb-2	03-25-1967	13.25
	03-20-1968	9.00
	03-18-1969	6.46
	03-19-1970	6.04
	03-16-1971	5.05
	03-06-1972	5.02
	03-09-1973	9.44
	03-12-1974	2.52
	03-10-1975	5.90
	03-08-1976	3.93
	03-09-1977	8.02
	03-09-1978	14.10
	03-15-1979	8.04
	03-05-1980	8.11
	03-03-1981	4.08
	03-01-1982	8.00
	03-02-1983	Flowing
	03-12-1984	Flowing
	03-04-1985	Flowing
	08-03-1989	7.74
(D-9-3)5cdc-1	10-01-1964	40.98
	12-04-1964	41.17
	03-01-1965	41.23
	06-08-1965	41.29
	12-29-1965	40.12
	03-23-1966	39.56
	12-19-1966	40.19
(D-9-3)5cdc-1 Continued	02-25-1991	40.68
	03-04-1991	40.74
(D-9-3)6abb-1	03-11-1964	8.10
	02-08-1991	10.39
	03-04-1991	9.60
(D-9-3)6cbc-1	10-13-1965	80.50
	03-05-1991	86.23
(D-9-3)7aab-1	04-01-1973	80.00
	02-20-1991	91.49
	03-04-1991	91.50
(D-10-1)1cbb-1	02-13-1962	273.6
	03-02-1962	273.0
	04-03-1962	275.4
	05-14-1962	270.6
	06-04-1962	276.7
	07-03-1962	253.4
	08-06-1962	263.7
	09-10-1962	269.4
	10-17-1962	265.7
	11-14-1962	264.6
	12-17-1962	265.2
	01-29-1963	266.2
	02-25-1963	268.8
	03-22-1963	269.2
	01-07-1964	274.6
	03-24-1964	275.2
	05-15-1964	275.5
	07-27-1964	266.2
	10-09-1964	273.7
	03-23-1965	269.4
	06-28-1965	254.0
	02-21-1991	269.98
	03-07-1991	270.14
(D-10-1)17cca-1	03-19-1964	32.40
	04-15-1964	32.52
	06-01-1964	32.62
	07-09-1964	32.53
	08-03-1964	32.52
	08-31-1964	32.35
	10-01-1964	32.40
	11-03-1964	32.46
(D-10-1)17cca-1 Continued	12-02-1964	32.53
	01-06-1965	32.64
	02-02-1965	32.63
	03-02-1965	32.59
	04-07-1965	32.73
	05-04-1965	32.68
	06-09-1965	32.56
	07-01-1965	32.35
	11-02-1965	32.10
	12-30-1965	32.07
	03-25-1966	32.26
	08-22-1966	31.91
	12-19-1966	32.08
	03-08-1967	32.23
	03-21-1968	31.97
	03-20-1969	31.46
	03-20-1970	31.18
	03-15-1971	31.46
	03-03-1972	31.15
	03-09-1973	31.72
	03-12-1974	30.90
	03-10-1975	31.40
	03-08-1976	31.00
	03-09-1977	32.18
	02-14-1991	32.16
	03-05-1991	31.22

---

[1] Actual location is different from historic records. See footnotes, table 1.

Table 4.—*Discharge of selected wells*

Well number: See figure 1 for explanation of the numbering system for hydrologic-data sites.
Discharge: Natural flow except where noted P, pumped; flow measured except where noted e, estimated.

Well number	Date	Discharge (gallons per minute)
(C-9-1)26bda-3	11-15-39	1.0
	08-18-89	.8
	09-15-89	.8
	10-23-89	1.0
	12-20-89	1.0
(D-7-2)32dad-1	03-24-78	40
[1] (D-7-2)33dcc-1	04-03-67	33
	08-10-89	30
(D-7-2)35ccd-1	04-13-37	1.8
	06-11-37	2.0
	08-01-37	1.7
	09-23-37	1.6
	11-02-37	1.4
	12-23-37	1.9
	02-14-38	2.1
	04-06-38	2.4
	05-05-38	2.5
	06-02-38	2.5
	06-13-38	2.3
	08-25-38	1.6
	02-28-40	2.4
	04-13-40	2.0
	05-01-40	2.6
(D-7-2)35ccd-2	07-18-61	90
	07-18-61	150 P
	09-13-89	0
(D-7-2)36bbb-1	10-30-43	30
	03-17-65	60
(D-7-2)36ccb-1	10-01-61	300
	07-07-89	112
(D-7-2)36dcc-2	05-02-40	1.7
	06-01-64	.5
	07-09-64	.5
	09-01-64	2.0
	03-24-66	12
(D-7-2)36dcc-2	08-24-89	.1
	09-15-89	.1
	10-23-89	.1
	11-14-89	.1
	12-00-89	.1
	01-23-90	.1
[1] (D-7-3)29dcc-1	03-11-53	70
	08-04-64	35

Table 4.—*Discharge of selected wells*—Continued

Well number	Date	Discharge (gallons per minute)
(D-7-3)31cac-2	10-08-64	38
	11-02-64	35
	09-13-89	24
(D-7-3)33baa-6	10-07-35	12
	03-02-36	11
	05-02-36	14
	06-20-36	19
	08-08-36	19
	10-03-36	15
	12-01-36	14
	02-03-37	12
	06-11-37	19
	08-01-37	20
	09-23-37	16
	06-02-38	19
	12-23-38	15
	02-21-39	12
	03-24-39	9.6
	04-13-39	10
	04-13-40	11
	05-02-40	13
	07-09-64	7.5
	07-00-89	3.5
	11-13-89	4.4
	12-00-89	4.0
(D-7-3)33ccc-5	04-01-05	65
	07-00-89	12
	08-24-89	11
	10-26-89	11
	11-14-89	10
	12-00-89	12
	01-23-90	12
(D-8-1)13aaa-1	05-02-36	30
	04-12-40	21
	05-01-40	25
(D-8-1)13daa-3	07-06-64	48
(D-8-1)14dad-1	05-14-66	30
	05-14-66	80 P
	01-31-67	25
(D-8-1)23bdd-1	03-00-18	3.0
	08-24-89	1.1
	09-15-89	.9
	11-14-89	.9
	12-20-89	1.0
	01-23-90	.9
(D-8-1)25aad-1	02-07-53	6.5
	07-21-64	2.0
	08-01-89	.6

Table 4.—*Discharge of selected wells*—Continued

Well number	Date	Discharge (gallons per minute)
(D-8-2)1baa-1	05-12-63	50
	08-06-64	60
[1] (D-8-2)2acc-1	06-30-61	50
	08-06-64	45
(D-8-2)2caa-1	11-12-51	40
	08-06-64	30 P
	09-21-89	.8
(D-8-2)2cda-1	08-06-64	15 P
	09-21-89	3.0
(D-8-2)2daa-1	04-12-48	80
	08-06-64	72
	08-24-89	.7
	09-15-89	.9
	10-23-89	.9
	01-23-90	1.4
(D-8-2)3aad-1	03-17-65	30
	03-17-65	30
	09-15-89	6
(D-8-2)3ccd-1	12-07-61	40
(D-8-2)4abb-1	08-20-64	35
	09-12-89	3.0
(D-8-2)4abb-2	08-20-64	.5
	09-12-89	.2
(D-8-2)4abc-1	05-23-50	35
	07-09-64	30
	09-12-89	.8
[1] (D-8-2)4bab-1	03-25-63	80
	08-20-64	75
	09-12-89	.5
(D-8-2)4cba-2	04-01-36	30
	08-24-89	4.8
	09-15-89	5
	10-23-89	5.4
	11-14-89	5.8
	12-19-89	6.0
	01-23-90	5.64
[1] (D-8-2)4cbb-1	07-06-64	36
	09-15-89	.2
(D-8-2)4dad-1	03-00-63	60
	08-00-64	70
	09-28-89	5.4
(D-8-2)7cab-1	05-07-47	35
	08-20-64	30
(D-8-2)cbd-1	04-15-62	35
	08-20-64	30
(D-8-2)9aad-1	08-24-64	35
	09-28-89	7.2
(D-8-2)10adb-1	05-31-66	80
	06-06-66	60
	09-28-89	7.5

Table 4.—*Discharge of selected wells*—Continued

Well number	Date	Discharge (gallons per minute)
(D-8-2)10bdd-1	12-00-55	40
	09-28-89	4.5
(D-8-2)12ddc-1	09-08-61	225
(D-8-2)13abc-1	08-30-61	250
	08-25-64	88
	09-28-89	2.5
(D-8-2)13bdd-1	12-20-62	175
	08-25-64	135
(D-8-2)14dcc-1	08-05-39	30
	09-02-64	10
(D-8-2)16caa-1	09-15-89	7.1
	11-14-89	7.3
	12-00-89	6.9
	01-23-90	7.6
(D-8-2)17add-5	11-04-62	12 P
(D-8-2)17add-6	06-07-50	4 P
(D-8-2)17ccc-2	10-21-59	10
	09-03-64	60
(D-8-2)17dab-2	07-02-59	5 P
(D-8-2)17ddd-1	07-13-44	6.0 P
(D-8-2)21bbb-2	06-26-56	6.0 P
(D-8-2)21ddd-1	10-15-36	45
	09-15-64	30
(D-8-2)22cdc-1	05-22-35	60 P
	07-00-89	11
(D-8-2)22cdc-2	05-17-57	100
	07-00-89	1.0
(D-8-2)23dbd-3	04-12-40	1.0
	05-01-40	1.0
	09-15-64	.5
(D-8-2)24bdc-2	03-25-63	45
	09-17-64	30
(D-8-2)28cbd-3	11-04-44	1.0
	09-25-64	1.3
	07-31-89	.2
(D-8-2)28daa-1	06-20-39	5.0
	09-25-64	1.0 P
(D-8-2)29bcb-1	12-22-66	25
	03-27-67	50
(D-8-2)29bcd-2	07-10-52	35
	09-25-64	10
(D-8-2)29cab-1	07-28-47	35
	09-25-64	63
(D-8-2)30bad-1	12-04-44	3.0
	09-28-64	1.5
(D-8-2)31bcd-1	08-04-64	38
	11-14-89	22

Table 4.—*Discharge of selected wells*—Continued

Well number	Date	Discharge (gallons per minute)
(D-8-2)31cbb-1	08-28-89	46
(D-8-2)31cda-1	07-21-89	72
(D-8-2)31cdb-1	08-04-64	6.0
	10-21-65	5.5
	12-29-65	8.0
(D-8-2)31cdb-1	03-25-66	5.8
	08-24-66	5.4
	03-24-67	5.8
	08-31-67	4.6
	08-09-89	2.6
(D-8-2)31cdb-2	09-27-68	700
	07-21-89	264
(D-8-2)34acd-1	06-20-46	2.5
	09-28-64	1.3
	07-31-89	.7
(D-8-3)4caa-2	1945	30
	06-08-45	120
	08-06-64	30
(D-8-3)4caa-3	03-31-65	140
(D-8-3)4cad-1	06-18-35	300
	03-06-36	325
	05-27-64	15
(D-8-3)5bca-1	11-04-64	40
	09-14-89	1.0
(D-8-3)6ddd-1	07-07-89	47
(D-8-3)6ddd-2	10-01-64	25
	07-07-89	105
(D-8-3)7aad-1	09-02-48	140
	03-31-65	87
(D-8-3)7abc-1	06-20-72	450
(D-8-3)7aca-2	07-14-48	120
	03-31-65	125
(D-9-1)1bac-1	11-10-76	130
(D-9-1)13bdb-2	11-04-64	30
	08-04-89	18
(D-9-1)25aac-1	06-15-34	39
	10-14-64	3.0
	06-12-90	14
(D-9-1)25aad-1	05-27-64	50
	08-03-89	69
(D-9-1)25aad-2	05-27-64	10
	08-03-89	13
(D-9-1)25aca-1	1938	14
	08-30-89	1.1
(D-9-1)25ada-1	07-05-34	70
	02-25-38	36
	06-02-38	30
	07-09-64	10
	07-20-89	12

Table 4.—*Discharge of selected wells*—Continued

Well number	Date	Discharge (gallons per minute)
(D-9-1)25ada-2	07-09-64	30
	07-20-89	12
(D-9-1)25ada-3	07-09-64	15
	10-21-65	23
	12-30-65	19
	03-28-66	15
	08-24-66	12
	03-28-67	14
	07-20-89	14
(D-9-1)25ada-4	07-09-64	30
	07-20-89	22
(D-9-1)25ada-5	07-09-64	30
	07-20-89	14
(D-9-2)1bcb-1	10-10-66	300
	10-10-66	900 P
	07-00-89	44
(D-9-2)2add-1	12-00-36	45
	09-30-64	30
	08-17-89	.5
(D-9-2)2dad-2	11-29-56	35
	09-00-89	16
	11-13-89	21
	12-18-89	16
	01-25-90	17
(D-9-2)5acc-1	08-09-89	10
(D-9-2)5bcc-1	04-26-53	38
(D-9-2)5bcc-2	11-23-56	30
	09-30-64	30
	08-09-89	8.0
(D-9-2)5bcd-1	02-25-67	70
(D-9-2)5bcd-2	04-07-70	125
	08-09-89	251
(D-9-2)5bdd-2	09-23-64	6.0
(D-9-2)5bdd-4	09-11-64	220
	03-17-67	92
	01-02-69	450
(D-9-2)5cbb-3	05-11-61	25
	09-30-64	45
	08-28-89	23
(D-9-2)5ccc-1	08-04-64	30
	08-17-89	10
(D-9-2)5ddb-1	05-11-74	15
(D-9-2)5ddc-2	08-01-34	450
	10-08-35	25
	07-09-64	15
(D-9-2)6add-4	05-20-61	130
	09-11-64	100 P
	07-00-89	100

Table 4.—*Discharge of selected wells*—Continued

Well number	Date	Discharge (gallons per minute)
(D-9-2)6add-5	04-10-63	450
(D-9-2)6ddb-1	10-05-70	150
(D-9-2)10dac-1	08-31-66	41
(D-9-2)11aca-3	12-13-58	250
(D-9-2)29acd-1	03-21-50	7
	06-18-64	75
	07-09-64	75
	08-31-64	70
	08-09-89	100
(D-9-2)30bcb-2	07-09-64	30
	08-03-89	15
(D-9-2)30cbb-2	06-29-57	40 P

[1] Actual location is different from historic records. See footnotes, table 1.

Table 5.—*Chemical analyses of*

[mg/L, milligrams per liter;

Well number: See figure 1 for explanation of the numbering system for hydrologic-data sites.
Date sampled: Except R, date received by laboratory (Cordova, 1969, table 5).
Specific conductance: µS/cm, microsiemens per centimeter at 25 degrees Celsius, measured in the
Temperature: ° C, degrees Celsius.

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dis-solved (mg/L as Ca)	Magnesium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
(C-8-1)20cdb-2	07-13-81	1,300	—	26.5	—	—	—	—
	07-07-89	1,340	7.7	26.0	340	76	37	130
	06-13-90	1,310	6.3	24.0	—	—	—	—
	08-19-91	1,260	7.6	25.5	—	—	—	—
(C-8-1)20cdb-3	07-30-80	1,290	—	24.0	—	—	—	—
	07-25-83	1,260	—	25.5	—	—	—	—
	07-12-89	1,350	7.7	25.0	—	—	—	—
(C-8-1)20cdb-4	07-12-89	1,340	7.7	25.0	—	—	—	—
(C-8-1)29dda-1	07-25-83	2,870	—	18.0	—	—	—	—
	08-23-89	3,550	7.9	22.5	—	—	—	—
	07-11-90	3,480	7.7	18.5	—	—	—	—
(C-8-1)35dcb-1	07-06-60	1,700	—	—	370	88	36	170
	06-15-64	1,630	—	20.5	410	88	45	170
	04-28-66	1,590	—	14.0	490	130	43	170
	08-08-90	1,840	—	19.5	450	120	36	160
(C-9-1)3ddb-1	05-04-65	1,340	7.9	14.5	270	60	29	180
	04-28-66	1,260	7.6	14.5	230	56	22	170
	07-13-81	1,300	—	15.5	—	—	—	—
	07-12-89	1,790	7.6	14.5	—	—	—	—
	08-23-89	1,400	7.6	14.5	—	—	—	—
	07-11-90	1,300	7.8	17.5	—	—	—	—
(C-9-1)4ccc-1	08-21-75	750	6.8	14.5	160	40	15	92
	08-16-76	790	7.4	14.0	170	46	14	100
	07-12-77	800	6.6	14.0	180	44	16	98
	08-24-78	900	6.8	14.0	210	54	19	100
	07-17-79	1,000	—	16.0	—	—	—	—
	08-01-79	1,100	7.7	16.0	250	62	23	110
	07-31-80	1,210	—	15.5	—	—	—	—
	09-03-80	1,200	7.6	15.0	270	66	25	130
	07-15-81	1,220	7.9	14.5	280	70	26	120

water from selected wells

—, no data; <, less than]

field.

Potassium, dissolved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
—	—	—	—	—	—	—	—
—	—	100	210	.60	20	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
22	—	68	390	—	—	863	—
22	—	130	400	—	—	913	—
27	—	120	400	—	—	1,010	—
20	—	65	370	<.10	71	1,020	.80
—	176	95	280	—	61	810	—
15	—	98	240	—	—	712	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
8.1	148	59	110	.30	58	477	1.30
8.1	144	62	130	.30	58	512	1.60
8.0	140	59	140	.30	56	505	—
9.2	140	64	160	.30	56	558	2.60
—	—	—	—	—	—	—	—
11	130	87	210	.30	60	658	3.80
—	—	—	—	—	—	—	—
11	140	80	240	.30	60	717	4.70
8.6	—	84	240	.20	62	703	6.00

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dis-solved (mg/L as Ca)	Magnesium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
(C-9-1)4ccc-1	07-07-82	1,230	—	14.0	—	—	—	—
	08-16-85	1,460	8.0	13.0	380	93	36	150
	06-30-86	1,400	—	14.0	—	—	—	—
	07-02-87	—	7.7	14.0	350	86	34	290
	06-15-88	1,390	7.5	14.0	—	—	—	—
	08-07-90	1,050	7.7	14.0	240	61	22	99
(C-9-1)4ddc-1	05-28-64	980	8.5	16.5	200	55	16	120
	06-09-64	980	8.4	16.5	210	54	18	120
	06-17-65	1,050	8.3	16.5	230	59	21	130
	04-28-66	1,070	7.6	18.5	220	55	21	130
	07-16-79	1,750	—	17.0	—	—	—	—
	07-31-80	1,800	—	16.5	—	—	—	—
	08-07-90	1,320	7.6	20.0	310	80	26	120
(C-9-1)5ddc-1	08-29-90	790	7.7	15.0	180	45	16	81
[1](C-9-1)20cdd-1	08-19-64	720	8.2	16.0	130	34	11	—
	04-27-66	730	7.5	14.0	130	34	11	110
	06-22-81	810	—	16.5	—	—	—	—
	07-28-86	800	—	16.0	—	—	—	—
	07-05-89	1,090	7.9	18.0	220	56	19	110
	06-13-90	1,080	6.9	18.5	—	—	—	—
	07-23-90	1,060	7.8	17.0	—	—	—	—
(C-9-1)20ddd-1	06-23-65	720	—	17.0	144	32	15	91
	05-09-66	740	8.0	16.5	150	37	14	90
	07-10-73	690	7.9	17.0	130	34	12	85
	07-16-79	700	—	19.0	—	—	—	—
	07-31-80	720	—	17.0	—	—	—	—
	08-07-90	710	7.8	17.5	130	34	11	88
(C-9-1)26bda-3	01-25-61	2,130	7.8	—	370	81	41	280
	04-06-61	2,030	8.1	—	330	56	45	280
	05-26-64	2,200	7.9	11.0	450	100	46	280
	07-07-89	2,320	7.4	12.5	400	81	48	270
(C-9-1)28ccb-1	04-05-63	800	—	—	191	48	17	94
	09-11-63	830	—	—	223	62	17	101
	06-09-64	940	—	18.5	219	35	20	104
	06-17-65	980	—	18.5	235	63	19	107

water from selected wells—**Continued**

Potassium, dissolved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
—	—	—	—	—	—	—	—
9.9	—	110	320	.30	60	895	9.80
—	—	—	—	—	—	—	—
8.5	—	210	300	.30	58	1,110	9.20
—	—	—	—	—	—	—	—
9.1	—	63	170	.10	60	581	3.90
15	—	78	190	—	—	549	—
14	—	74	180	—	—	551	—
14	—	100	200	—	—	609	—
17	—	95	200	—	—	598	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
15	—	59	290	.20	77	759	2.10
9.7	—	61	110	.20	67	484	1.10
—	—	73	100	—	58	—	—
8.2	—	84	100	—	—	434	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	69	150	.30	59	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
10	—	84	98	—	—	—	—
10	—	73	94	—	—	408	—
8.9	152	53	86	—	64	434	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
8.4	—	53	87	.20	67	459	1.60
34	—	110	460	—	—	1,150	—
34	—	99	470	—	—	1,110	—
37	—	150	490	—	—	1,270	—
—	—	100	530	.40	66	—	—
11	—	80	112	—	—	—	—
11	—	102	146	—	—	—	—
13	—	98	151	—	—	—	—
13	—	115	165	—	—	—	—

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dis-solved (mg/L as Ca)	Magnesium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
(C-9-1)28ccb-1	04-27-66	960	—	14.5	243	64	20	107
	07-31-80	1,120	—	19.5	—	—	—	—
	07-15-81	1,170	7.7	18.0	300	77	25	100
	07-07-82	1,120	—	18.5	—	—	—	—
	07-17-84	1,140	7.5	18.5	280	71	24	100
	07-03-85	2,310	8.0	17.5	310	81	26	110
	06-12-86	1,120	7.6	18.5	—	—	—	—
	08-07-90	810	7.9	19.0	180	50	14	81
(C-9-1)29acc-1	05-23-63	760	8.5	—	120	29	11	110
	05-28-64	770	8.4	—	150	37	13	110
	06-18-65	760	8.5	15.0	170	38	18	100
	04-27-66	710	7.7	15.0	150	36	14	100
	07-31-80	960	—	17.0	—	—	—	—
	06-22-81	950	—	16.5	—	—	—	—
(C-9-1)29bcc-1	06-19-65	930	8.1	17.0	290	73	26	71
	05-06-66	860	7.5	17.0	350	89	32	71
	07-02-85	740	—	15.5	—	—	—	—
(C-9-1)34ccc-1	08-21-75	1,400	6.6	17.5	520	110	59	93
	07-17-79	1,550	—	17.0	—	—	—	—
	08-01-79	1,600	7.6	19.0	—	—	—	—
	09-03-80	1,700	7.1	17.5	590	130	65	100
	07-02-86	1,510	—	17.5	—	—	—	—
[1](C-9-1)34acd-1	10-09-62	1,120	8.2	—	350	60	48	78
	04-27-66	1,050	7.8	11.5	410	82	49	80
	08-17-72	1,200	7.7	12.0	390	77	48	77
(C-9-1)34ddc-1	04-27-66	930	7.6	13.0	330	66	40	69
	10-12-71	1,050	7.5	12.5	330	63	42	69
	06-04-91	1,040	7.5	15.0	320	61	41	67
(C-10-1)3ddb-1	10-09-62	2,140	—	—	400	61	60	320
	08-05-70	2,760	—	13.0	560	91	81	—
	08-11-72	4,010	—	14.0	910	150	130	560
	09-09-74	1,560	—	19.5	530	120	57	100
(C-10-1)4bbb-1	11-01-62	690	—	—	107	30	10	98
	04-03-63	670	8.3	—	110	26	10	98
	09-11-63	800	8.1	—	150	36	14	110

***water from selected wells*—Continued**

Potassium, dissolved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
15	—	118	166	—	—	—	—
—	—	—	—	—	—	—	—
12	—	110	210	.20	70	695	4.30
—	—	—	—	—	—	—	—
14	—	110	210	.30	65	694	5.20
12	—	110	220	.30	68	728	5.80
—	—	—	—	—	—	—	—
11	—	64	100	.40	74	474	1.60
6.3	—	78	100	—	—	426	—
7.0	—	96	100	—	—	446	—
7.0	—	110	110	—	—	462	—
8.6	—	82	110	—	—	439	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
9.0	—	150	170	—	—	533	—
9.0	—	170	170	—	—	603	—
—	—	—	—	—	—	—	—
14	199	100	300	.20	65	864	.75
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
14	190	120	360	.30	65	983	3.20
—	—	—	—	—	—	—	—
11	—	84	240	—	—	583	—
12	—	99	240	—	—	654	—
11	143	96	250	—	60	705	—
12	—	33	230	—	—	531	—
9.2	144	35	220	—	—	525	—
8.4	—	25	220	.50	65	572	—
3.5	—	200	400	—	—	1,240	—
30	351	310	550	—	35	1,680	—
6.3	405	620	830	—	51	2,590	—
17	195	100	320	.20	63	898	.73
9.3	—	42	82	—	—	—	—
9.3	—	44	83	—	—	371	—
10	—	70	130	—	—	448	—

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dis-solved (mg/L as Ca)	Magnesium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
(C-10-1)4bbb-1	06-16-65	1,330	8.1	18.5	430	100	42	100
	04-27-66	1,340	7.4	15.5	420	100	41	110
	07-10-73	1,320	7.7	19.0	380	92	37	110
	08-03-73	1,230	—	18.5	—	—	—	—
	09-05-74	1,350	—	19.0	—	—	—	—
	08-30-76	1,160	—	19.5	—	—	—	—
	08-25-78	1,100	—	20.0	—	—	—	—
	08-01-80	1,200	—	19.5	—	—	—	—
	08-07-90	2,460	7.5	18.0	—	—	—	—
(C-10-1)4cbb-1	04-05-62	1,770	8.5	—	440	110	39	180
	08-06-62	1,440	8.2	—	370	94	34	140
	09-14-62	1,390	7.5	—	400	120	25	130
	06-07-63	1,310	8.3	—	420	130	22	120
	09-11-63	1,280	7.8	—	390	100	33	110
	06-09-64	1,300	8.2	19.0	380	100	31	120
	10-02-64	1,350	—	—	447	123	34	118
	06-16-65	1,320	8.3	19.0	670	190	49	110
	04-27-66	1,330	7.5	19.5	410	100	39	110
	09-05-69	1,230	7.7	17.0	400	93	40	—
	08-05-70	1,290	7.9	18.0	420	100	39	150
	10-07-71	1,260	7.6	16.5	370	89	35	100
	08-11-72	1,110	—	18.5	—	—	—	—
	08-03-73	1,100	7.7	19.0	330	82	30	97
	09-06-74	1,150	—	19.0	—	—	—	—
	08-16-76	1,050	7.2	19.0	320	82	27	97
	07-12-77	1,000	6.5	20.0	270	68	25	92
	07-17-79	1,100	—	19.0	—	—	—	—
	08-01-79	1,150	7.9	19.0	330	83	31	95
	08-01-80	1,510	—	19.0	—	—	—	—
	09-03-80	1,500	7.6	—	480	120	43	110
	07-13-81	1,750	7.8	19.0	530	130	49	120
	07-07-82	1,900	—	19.5	—	—	—	—
	07-18-84	1,740	7.4	17.5	610	130	69	110
	07-03-85	1,830	—	18.5	—	—	—	—
	06-30-86	2,490	7.6	19.0	900	220	84	150

water from selected wells—**Continued**

Potassium, dissolved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
12	—	200	240	—	—	768	—
14	—	200	240	—	—	778	—
11	135	140	230	—	—	701	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
15	—	300	310	—	—	1,020	—
14	—	220	240	—	—	831	—
13	—	240	230	—	—	839	—
13	—	240	220	—	—	825	—
11	—	200	220	—	—	755	—
13	—	230	230	—	—	777	—
13	—	338	235	—	—	—	—
13	—	260	230	—	—	906	—
15	—	210	220	—	—	788	—
—	162	160	200	—	60	767	—
—	149	300	190	—	—	896	—
10	148	180	180	—	—	683	—
—	—	—	—	—	—	—	—
9.0	153	160	160	—	64	693	—
—	—	—	—	—	—	—	—
11	158	120	160	.20	60	669	3.80
9.7	160	100	150	.20	64	602	—
—	—	—	—	—	—	—	—
11	140	99	220	.20	68	706	3.30
—	—	—	—	—	—	—	—
12	140	88	360	.20	65	898	3.60
11	—	95	420	.20	68	988	3.70
—	—	—	—	—	—	—	—
13	—	140	380	.30	62	1,040	5.20
—	—	—	—	—	—	—	—
15	—	100	710	.20	67	1,440	3.50

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dis-solved (mg/L as Ca)	Magnesium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
(C-10-1)4cbb-1	08-07-90	740	7.5	20.5	200	52	18	61
(C-10-1)9ccc-1	06-13-61	2,710	7.8	—	1,200	270	120	86
	09-06-62	2,670	7.7	—	1,100	250	110	99
	06-06-63	2,540	7.8	—	1,100	260	110	100
	09-24-63	2,320	7.5	—	930	210	99	94
	05-28-64	2,530	8.1	16.5	1,100	250	110	100
	08-07-64	2,280	8.0	16.5	1,000	230	110	100
	04-28-66	2,200	7.4	18.5	920	210	94	110
	08-11-72	1,920	7.3	17.0	740	170	77	100
	09-09-74	1,940	—	18.0	740	170	77	100
	07-17-79	2,000	—	18.0	—	—	—	—
	08-04-80	2,100	—	17.0	—	—	—	—
	07-25-83	2,020	—	18.0	—	—	—	—
	07-28-86	1,670	—	18.0	—	—	—	—
	07-12-89	1,980	7.3	17.5	—	—	—	—
	08-18-89	1,960	7.4	18.0	690	160	70	120
(C-10-1)10ddc-3	06-04-91	2,800	—	14.5	960	170	130	220
[1](C-10-1)15cca-1	06-04-91	3,000	7.2	15.0	710	140	88	380
(C-10-1)17aaa-1	04-27-65	770	7.5	19.5	320	84	26	30
	10-12-71	1,390	7.3	18.0	560	140	50	45
	08-17-72	1,550	7.6	20.0	630	160	57	47
	07-10-73	1,620	7.5	20.0	730	190	63	54
	09-09-74	1,780	—	20.0	730	180	69	53
	08-21-75	1,800	6.8	18.5	830	210	73	55
	08-16-76	2,120	6.9	19.5	980	250	86	58
	07-12-77	2,180	6.8	19.5	1,100	290	95	61
[1](C-10-1)25abd-1	06-06-61	1,560	8.0	—	480	110	52	130
	07-07-61	1,570	8.3	—	490	110	50	140
	08-09-61	1,540	7.9	—	490	110	50	140
	08-31-62	1,460	7.8	—	380	75	47	150
	06-01-64	1,700	8.1	17.0	410	64	61	190
	08-04-80	2,150	—	17.5	—	—	—	—
	07-15-81	2,300	—	18.5	—	—	—	—
	07-02-86	2,100	—	17.5	—	—	—	—
	07-11-90	2,090	7.2	18.5	520	110	60	230

water from selected wells—**Continued**

Potassium, dissolved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
11	—	38	73	.20	78	455	2.70
16	—	580	480	—	—	1,610	—
17	—	560	490	—	—	1,560	—
15	—	610	460	—	—	1,600	—
17	—	490	410	—	—	1,360	—
17	—	630	430	—	—	1,580	—
16	—	580	380	—	—	1,480	—
18	—	510	370	—	—	1,390	—
12	134	310	330	—	60	1,140	—
14	136	290	300	.20	62	1,210	25.0
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	370	310	.10	61	—	—
14	—	190	790	.30	59	1,710	—
8.7	—	370	650	.40	41	1,860	—
—	145	67	99	—	59	484	—
12	126	140	200	—	—	663	—
12	117	170	230	—	59	805	—
14	113	200	250	—	58	897	—
16	112	230	260	.10	58	1,120	43.0
14	107	330	260	.10	56	1,250	42.0
15	109	420	300	.10	57	1,460	46.0
16	98	530	310	.10	55	1,420	—
11	—	110	250	—	—	861	—
11	—	130	250	—	—	875	—
11	—	130	260	—	—	884	—
12	—	120	260	—	—	813	—
18	—	160	360	—	—	962	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
14	—	120	340	.60	51	1,120	<.10

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)
(C-10-1)25abd-1	07-31-90	2,130	7.2	18.5	—	—	—	—
(C-10-1)29cdd-1	04-14-61	1,430	7.6	—	630	110	87	71
	07-10-61	570	8.1	—	210	54	19	28
	04-04-63	480	8.4	—	150	29	20	30
	08-07-64	590	8.0	23.0	220	62	16	26
	04-28-66	580	7.6	21.0	220	58	18	26
	07-16-79	600	—	20.0	—	—	—	—
	07-10-90	780	7.5	23.0	300	78	26	27
	07-31-90	770	7.4	22.5	—	—	—	—
	08-20-91	690	6.9	22.5	—	—	—	—
(C-10-1)29ddd-1	04-04-63	3,180	7.9	—	1,000	210	130	110
	09-10-63	1,710	8.0	—	1,000	250	100	100
	07-24-64	2,710	8.0	20.0	1,100	240	110	110
	08-07-64	3,340	8.0	18.0	1,400	330	140	120
	04-28-66	3,650	7.1	17.0	1,700	410	170	130
	08-20-91	3,460	6.9	21.5	—	—	—	—
(C-10-1)31cdd-1	06-21-63	450	8.4	—	150	28	19	26
	09-26-63	600	7.9	—	180	41	19	38
	06-03-64	470	8.3	—	180	40	19	24
	10-08-64	470	8.3	19.0	180	38	20	25
	04-28-66	580	8.0	18.5	230	59	21	26
	07-16-79	750	—	18.5	—	—	—	—
	07-13-81	800	—	21.0	—	—	—	—
	07-31-90	880	7.4	18.5	—	—	—	—
(C-10-1)32ccc-1	06-06-61	690	8.1	—	260	66	22	36
	07-10-61	650	7.8	—	240	63	20	36
	09-06-62	680	7.7	—	250	67	20	37
	04-03-63	630	8.3	—	220	54	21	37
	09-10-63	580	8.1	—	190	45	19	37
	06-16-64	560	8.3	20.0	190	47	17	36
	08-07-64	700	8.0	20.0	260	65	23	38
	06-15-66	740	8.0	20.0	280	73	24	36
	07-17-79	1,150	—	19.5	—	—	—	—
	08-04-80	1,150	—	19.5	—	—	—	—
(C-11-1)6abc-1	07-10-63	510	8.2	—	170	43	16	30

water from selected wells—**Continued**

Potassium, dis- solved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dis- solved (mg/L as SO_4)	Chloride, dis- solved (mg/L as Cl)	Fluoride, dis- solved (mg/L as F)	Silica, dis- solved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
—	—	—	—	—	—	—	—
19	—	44	370	.30	46	811	—
9.8	—	36	63	—	—	306	—
5.9	—	41	69	—	—	249	—
9.8	—	46	58	—	—	315	—
9.4	—	40	62	—	—	308	—
—	—	—	—	—	—	—	—
9.4	—	31	100	.30	70	511	17.0
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
22	—	670	570	—	—	1,740	—
23	—	420	560	—	—	1,490	—
24	—	480	560	—	—	1,560	—
24	—	790	590	—	—	2,020	—
27	—	950	660	—	—	2,400	—
—	—	—	—	—	—	—	—
6.3	—	26	56	—	—	224	—
10	—	57	83	—	—	309	—
6.3	—	40	54	—	—	255	—
6.3	—	47	63	—	—	260	—
5.9	—	44	67	—	—	317	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
9.4	—	83	83	—	—	385	—
10	—	62	75	—	—	362	—
10	—	64	79	—	—	375	—
9.4	—	71	78	—	—	347	—
10	—	74	83	—	—	322	—
9.8	—	64	77	—	—	310	—
10	—	83	87	—	—	393	—
9.9	—	55	86	.50	62	440	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
7.0	—	67	58	—	—	279	—

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dis-solved (mg/L as Ca)	Magnesium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
(C-11-1)6abc-1	07-24-64	520	8.3	18.0	180	42	18	33
	06-10-65	470	8.3	18.5	160	36	16	29
	08-21-75	580	7.0	18.0	230	62	18	28
	07-12-77	620	7.0	19.0	240	68	18	28
	07-13-81	610	—	20.5	—	—	—	—
	07-11-89	590	7.7	19.0	—	—	—	—
	07-18-90	610	7.6	19.5	—	—	—	—
(C-11-1)6bdd-1	08-31-64	520	7.6	18.5	210	57	16	32
	06-11-65	460	8.2	19.0	170	43	15	25
	07-13-81	560	—	20.5	—	—	—	—
	07-18-90	550	7.6	19.5	220	57	18	25
	07-31-90	560	7.7	19.5	—	—	—	—
(D-7-2)34dcd-1	05-13-64	710	8.5	13.5	240	46	30	73
	06-22-65	570	8.6	14.0	160	16	29	75
	03-26-81	640	—	13.5	—	—	—	—
(D-7-3)28bdb-1	06-21-63	1,490	7.5	—	730	190	63	—
	06-24-63	1,340	8.0	—	590	130	63	60
	05-11-64	1,470	8.0	18.0	760	190	68	60
	10-14-68	1,120	7.8	—	470	73	69	—
	09-03-69	1,170	7.9	—	530	81	80	—
	10-08-71	1,000	—	—	—	—	—	—
	06-18-72	1,120	8.0	—	450	73	64	63
	06-18-73	1,120	8.0	—	450	73	64	63
	09-09-74	1,160	—	—	460	77	64	60
	08-18-75	1,050	—	—	—	—	—	—
	08-12-76	1,150	—	—	—	—	—	—
	07-12-77	1,150	—	—	—	—	—	—
	08-22-78	1,150	—	—	—	—	—	—
	07-30-79	1,200	7.9	—	480	82	66	60
	09-03-80	1,120	8.4	—	—	—	—	—
	07-30-81	1,180	—	—	—	—	—	—
(D-7-3)30aaa-1	08-28-81	490	—	14.0	170	44	15	33
(D-7-3)33baa-6	02-11-59	540	7.8	12.0	270	71	22	—
	04-21-60	540	8.1	12.0	260	69	22	—
	09-15-60	500	8.3	12.0	250	69	20	15

water from selected wells—**Continued**

Potassium, dissolved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
7.4	—	50	65	—	—	285	—
7.0	—	51	58	—	—	253	—
7.2	159	35	60	—	57	363	—
7.3	160	43	66	.20	57	386	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	27	58	—	57	—	—
6.6	—	29	55	—	—	248	—
—	—	—	—	—	—	—	—
7.1	—	26	58	.30	62	374	1.00
—	—	—	—	—	—	—	—
5.9	—	5.3	43	—	—	404	—
5.5	—	11	44	—	—	334	—
—	—	—	—	—	—	—	—
—	212	540	78	—	14	1,080	—
7.0	—	520	86	—	—	910	—
5.1	—	560	82	—	—	1,080	—
—	52	440	87	—	1.4	786	—
—	70	410	80	—	—	733	—
—	—	—	—	—	—	—	—
5.7	30	430	84	—	.70	738	—
5.7	30	430	84	—	.70	738	—
7.2	—	430	86	—	1.0	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
6.8	34	450	85	.30	1.0	772	<.10
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
2.5	—	<5.0	28	.30	5.8	248	.11
—	235	43	13	—	11	318	—
—	230	45	14	—	10	314	—
1.1	222	46	14	.20	9.8	311	—

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dis-solved (mg/L as Ca)	Magnesium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
(D-7-3)33baa-6	05-26-61	530	7.7	12.0	270	74	21	—
	08-12-76	560	—	12.5	—	—	—	—
	08-10-77	540	—	13.0	—	—	—	—
	08-22-78	540	—	13.5	—	—	—	—
	09-03-80	580	—	13.0	—	—	—	—
	09-03-81	580	—	12.5	—	—	—	—
	09-20-82	580	—	13.0	—	—	—	—
	07-29-83	560	7.2	13.5	260	68	22	14
	07-17-84	530	7.4	12.5	260	68	22	14
	08-02-85	880	7.5	13.5	—	—	—	—
	07-03-86	580	7.2	13.0	270	68	24	20
	07-29-87	—	—	13.0	260	68	22	14
	06-15-88	550	—	13.0	—	—	—	—
	06-09-89	560	7.2	13.0	270	70	22	13
	07-19-90	540	7.4	12.5	—	—	—	—
	07-22-91	540	7.4	—	—	—	—	—
(D-7-3)34cdb-1	10-14-60R	—	—	—	270	72	23	17
	09-09-74	460	8.2	18.5	220	56	20	8.8
	08-18-75	350	6.7	16.5	190	47	18	3.6
	08-12-76	590	6.8	15.5	300	72	28	16
	07-12-77	600	6.7	17.0	290	70	29	17
	08-25-78	590	6.8	19.0	300	74	27	18
	07-30-79	500	7.8	18.5	250	61	24	11
	09-02-80	540	—	17.0	—	—	—	—
	07-30-81	630	8.2	14.0	290	69	28	17
	09-20-82	600	—	12.5	—	—	—	—
	06-15-88	580	7.7	13.0	290	69	29	17
	07-20-89	580	—	26.5	—	—	—	—
	07-19-90	590	7.5	17.5	—	—	—	—
	07-22-91	600	6.2	13.0	290	70	27	16
(D-8-1)3dda-1	05-06-91	7,960	—	25.0	1,300	360	97	1,200
(D-8-1)10bcb-1	07-03-91	9,400	6.3	36.0	1,600	440	110	1,500
(D-8-1)11bac-1	06-14-91	740	7.7	16.0	210	50	20	50
(D-8-1)35cac-2	09-04-80	850	—	15.5	—	—	—	—
(D-8-2)2daa-1	08-06-64	450	7.7	16.0	210	51	21	—

water from selected wells—**Continued**

Potassium, dissolved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
—	228	45	14	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
1.6	—	47	14	.20	11	314	.76
1.7	—	45	10	.20	11	313	1.00
—	—	—	—	—	—	—	—
2.1	—	64	19	.20	12	348	.80
1.9	—	43	12	.20	11	310	.91
—	—	—	—	—	—	—	—
—	—	41	11	.10	11	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
5.2	224	55	26	.10	11	345	—
1.8	202	31	11	.20	9.3	263	.92
.50	179	14	3.3	—	6.8	200	—
2.3	236	59	19	.20	12	356	1.30
2.2	240	58	15	.20	12	346	—
2.4	220	57	20	.10	12	350	1.40
1.8	210	46	12	.20	10	296	1.00
—	—	—	—	—	—	—	—
2.1	—	57	14	.20	13	349	1.10
—	—	—	—	—	—	—	—
3.2	—	54	15	.30	13	354	1.40
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
2.1	—	55	15	.20	12	344	—
140	—	820	2,200	2.9	20	5,190	—
190	—	1,000	2,700	3.0	24	6,340	—
14	—	20	140	.90	52	424	—
—	—	—	—	—	—	—	—
—	—	17	12	—	25	—	—

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (^{o}C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dis-solved (mg/L as Ca)	Magnesium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
(D-8-2)2daa-1	06-09-89	480	7.8	15.0	220	52	21	15
(D-8-2)4cba-2	08-13-76	440	—	15.0	—	—	—	—
	09-20-82	440	—	15.5	—	—	—	—
(D-8-2)12ddc-1	05-03-65	630	7.7	12.0	190	30	27	75
	10-14-68	790	8.1	14.0	280	56	35	—
	09-03-69	740	7.8	12.0	260	30	44	—
	08-05-70	770	8.7	13.0	280	—	—	—
	10-14-71	780	—	14.0	—	—	—	—
	08-11-72	720	—	13.0	—	—	—	—
	06-18-73	800	8.0	—	270	62	29	71
	09-12-74	870	—	14.0	—	—	—	—
	08-13-76	750	—	12.5	—	—	—	—
(D-8-2)12ddc-2	05-27-64	440	—	16.5	200	46	20	25
	08-25-64	460	8.4	15.0	230	53	24	—
	09-03-69	480	8.0	14.0	240	49	28	—
	08-05-70	490	8.2	12.5	240	—	—	—
	10-14-71	490	—	15.5	—	—	—	—
	08-11-72	460	—	14.5	—	—	—	—
	06-18-73	470	—	14.0	—	—	—	—
	09-12-74	520	—	16.0	—	—	—	—
	08-13-76	500	—	15.5	—	—	—	—
	08-01-79	500	7.9	14.0	250	57	25	12
	09-04-80	530	—	15.0	—	—	—	—
	07-29-81	520	7.8	16.0	240	54	25	13
	09-20-82	520	—	16.0	—	—	—	—
	07-26-83	510	—	15.5	—	—	—	—
	07-17-84	510	7.6	16.0	240	55	26	13
(D-8-2)13abc-1	05-13-64	450	8.3	14.0	230	49	25	12
	08-17-90	520	7.9	15.5	250	59	25	11
(D-8-2)16caa-1	08-13-76	390	—	15.5	—	—	—	—
	09-17-79	360	—	15.0	—	—	—	—
	09-20-82	400	—	16.5	—	—	—	—
(D-8-2)23dca-2	05-27-64	440	—	16.5	200	46	20	25
	10-14-68	410	8.0	15.0	170	38	18	—
	07-30-70	390	8.6	14.0	170	—	—	—

water from selected wells—Continued

Potassium, dis-solved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dis-solved (mg/L as SO_4)	Chloride, dis-solved (mg/L as Cl)	Fluoride, dis-solved (mg/L as F)	Silica, dis-solved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
—	—	17	9.1	.20	26	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	262	7.0	54	—	12	366	—
—	338	26	58	—	24	477	—
—	312	26	53	—	—	412	—
—	332	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
7.9	338	25	52	—	26	475	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
27	—	36	9.9	—	38	—	—
—	—	22	10	—	25	—	—
—	232	21	15	—	—	270	—
—	237	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
3.3	220	30	16	.20	28	304	.04
—	—	—	—	—	—	—	—
3.0	—	25	17	.20	29	298	0
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
3.1	—	25	15	.20	27	300	<.10
2.3	—	40	17	—	—	257	—
2.4	—	30	11	1.1	27	308	<.10
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	16	14	—	25	—	—
—	200	6.5	10	—	24	239	—
—	203	—	—	—	—	—	—

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dis-solved (mg/L as Ca)	Magnesium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
(D-8-2)28cbd-3	08-30-89	980	—	22.0	—	—	—	—
(D-8-2)29add-1	05-03-65	510	—	14.0	240	54	25	17
	08-13-76	540	—	15.5	—	—	—	—
(D-8-2)31cbb-1	08-30-89	650	—	13.5	—	—	—	—
(D-8-2)31cda-1	06-06-89	500	7.5	20.0	—	—	—	—
(D-8-2)31cdb-1	08-30-89	1,270	—	19.0	—	—	—	—
(D-8-2)31cdb-2	08-04-64	430	7.7	19.0	150	34	17	—
	07-21-65	360	8.7	—	120	19	18	30
	06-06-89	3,050	6.9	28.0	—	—	—	—
(D-8-2)32daa-1	09-05-80	850	—	16.5	—	—	—	—
(D-8-2)34acd-1	07-21-65	660	8.8	13.5	280	43	41	40
	08-30-89	710	—	14.0	—	—	—	—
(D-8-2)34dda-1	05-03-65	610	7.9	13.5	270	55	31	36
	07-12-89	660	7.6	19.0	260	53	31	35
(D-8-2)36dbd-3	08-23-89	1,190	—	17.0	—	—	—	—
(D-8-3)11abb-1	06-27-89	500	7.6	—	—	—	—	—
(D-8-3)33acb-1	06-03-64	750	—	9.0	280	49	38	56
	08-22-89	900	—	13.0	—	—	—	—
	07-27-90	900	—	18.0	360	85	37	48
(D-9-1)14aad-2	07-25-83	470	—	14.0	—	—	—	—
(D-9-1)14ada-1	07-27-90	870	—	12.0	370	86	37	34
(D-9-1)14ada-2	06-03-64	600	8.3	13.5	250	46	33	30
	09-04-80	760	—	13.0	—	—	—	—
	07-25-83	760	—	13.0	—	—	—	—
	08-09-85	780	—	12.0	—	—	—	—
	07-23-90	840	7.7	12.0	—	—	—	—
(D-9-1)23ada-1	07-05-62	380	7.7	—	170	40	17	5.5
	08-07-62	410	7.8	—	210	48	21	6.4
	06-11-63	380	8.8	—	150	20	25	16
	08-28-63	420	8.1	—	170	27	26	16
	07-27-79	650	—	12.5	—	—	—	—
(D-9-1)26aaa-1	07-05-89	660	7.4	11.5	300	74	27	18
	08-22-89	650	—	11.0	—	—	—	—
(D-9-1)26aab-1	06-03-64	500	8.4	14.5	220	37	30	24
	09-04-80	750	—	15.5	—	—	—	—

water from selected wells—**Continued**

Potassium, dissolved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
—	—	—	—	—	—	—	—
—	225	33	12	—	49	325	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	29	15	—	63	—	—
10	—	41	12	—	—	215	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
24	—	1.9	19	—	—	388	—
—	—	—	—	—	—	—	—
—	307	3.9	19	—	26	362	—
—	—	3.0	19	.40	30	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
3.5	—	160	54	—	—	456	—
—	—	—	—	—	—	—	—
4.0	—	98	51	.30	17	531	.60
—	—	—	—	—	—	—	—
2.6	—	94	37	.20	25	522	7.80
2.3	—	100	46	—	—	349	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
1.2	—	8.6	7.1	—	—	178	—
1.2	—	16	8.2	—	—	216	—
2.0	—	43	20	—	—	196	—
1.6	—	44	21	—	—	218	—
—	—	—	—	—	—	—	—
—	—	29	19	.20	19	—	—
—	—	—	—	—	—	—	—
2.3	—	75	26	—	—	286	—
—	—	—	—	—	—	—	—

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dis-solved (mg/L as Ca)	Magnesium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
(D-9-1)26aab-1	07-11-89	580	7.5	13.0	—	—	—	—
(D-9-1)26add-1	08-09-85	680	—	13.5	—	—	—	—
	07-31-90	620	7.4	11.0	—	—	—	—
[1](D-9-1)35abb-1	06-03-63	460	8.4	—	230	58	21	6.4
	08-29-63	330	7.9	—	150	26	21	6.7
	07-02-65	290	8.5	—	140	19	23	7.1
	07-15-81	530	—	11.5	—	—	—	—
	07-23-90	530	7.5	11.0	270	66	26	6.7
(D-9-1)35bcd-2	07-16-81	700	—	14.0	—	—	—	—
	07-02-87	520	—	13.0	—	—	—	—
	08-01-90	660	7.8	18.0	—	—	—	—
(D-9-1)36acb-1	05-18-89	500	7.8	19.5	—	—	—	—
	07-10-89	470	7.7	12.0	—	—	—	—
(D-9-1)36bbc-1	07-05-62	470	7.5	—	220	56	20	6.2
	08-07-62	480	7.7	—	250	52	28	6.4
	07-01-63	330	8.5	—	160	30	21	6.2
	08-29-63	480	7.4	—	240	60	22	6.2
	07-13-64	480	7.5	10.0	250	63	23	6.4
	07-02-65	290	7.7	9.5	140	21	22	5.5
	07-29-65	300	8.3	9.5	150	24	22	6.4
	09-03-69	500	7.9	9.0	260	61	26	—
	08-11-72	520	—	10.0	—	—	—	—
	09-12-74	520	—	10.5	—	—	—	—
	08-16-76	520	7.3	10.0	280	75	23	5.9
	07-12-77	480	6.5	10.0	270	70	23	6.1
	07-15-81	530	7.6	11.0	270	69	23	6.7
	08-25-89	500	—	10.0	250	62	22	5.9
	07-23-90	490	7.4	10.0	260	63	24	6.0
(D-9-1)36cdd-1	07-13-64	560	7.5	9.5	300	78	26	7.1
	07-31-81	590	—	11.5	—	—	—	—
	07-11-89	520	7.7	12.0	—	—	—	—
	08-16-89	690	7.7	12.0	—	—	—	—
	07-27-90	500	7.5	10.0	260	68	21	6.4
(D-9-2)5ddb-1	05-24-89	1,000	7.0	14.0	—	—	—	—
(D-9-2)6ddb-1	05-24-89	800	7.4	14.0	—	—	—	—

water from selected wells—**Continued**

Potassium, dis- solved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dis- solved (mg/L as SO_4)	Chloride, dis- solved (mg/L as Cl)	Fluoride, dis- solved (mg/L as F)	Silica, dis- solved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
1.2	—	14	12	—	—	240	—
1.2	—	24	8.9	—	—	168	—
1.2	—	31	9.9	—	—	159	—
—	—	—	—	—	—	—	—
1.6	—	18	26	.30	19	293	2.20
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
1.2	—	18	11	—	—	289	—
1.2	—	26	9.2	—	—	255	—
1.6	—	24	7.8	—	—	173	—
1.2	—	24	8.2	—	—	252	—
1.2	—	31	8.2	—	—	267	—
.80	—	24	11	—	—	153	—
.80	—	31	8.9	—	—	164	—
—	239	14	12	—	15	288	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
1.4	230	21	14	.20	15	303	2.20
1.5	220	22	13	.20	16	285	—
1.5	—	22	28	.20	17	309	2.20
1.3	—	15	25	.30	16	276	1.50
1.3	—	13	25	.30	17	298	1.70
1.2	—	41	9.6	—	—	321	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
1.2	—	20	13	.30	14	297	1.50
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dis-solved (mg/L as Ca)	Magnesium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
(D-9-2)9bac-1	07-05-62	490	8.3	—	140	21	21	40
	08-07-62	570	8.0	—	210	42	25	34
	07-02-63	550	8.1	—	210	41	25	34
	08-01-63	690	7.7	—	290	73	26	33
	08-22-63	680	7.4	—	250	59	26	31
	07-14-64	520	8.3	14.5	190	31	27	34
	07-27-65	550	8.2	14.0	200	34	27	35
	07-30-70	680	8.1	12.5	290	67	29	—
	08-11-72	660	—	14.5	—	—	—	—
	07-30-73	730	—	14.5	—	—	—	—
	09-12-74	560	—	17.0	—	—	—	—
	08-13-76	700	7.3	14.0	310	78	27	30
	07-12-77	650	6.5	14.5	300	73	28	30
	08-23-78	650	6.8	14.0	290	71	27	29
	07-27-79	670	—	14.5	—	—	—	—
	08-01-79	670	—	14.5	—	—	—	—
	07-30-81	690	7.4	14.5	280	66	27	30
	09-20-82	650	—	14.5	—	—	—	—
	08-09-84	640	7.4	14.0	290	69	28	32
	07-02-87	580	7.3	14.0	270	67	26	180
	08-23-89	640	—	15.0	—	—	—	—
	09-04-90	610	7.5	14.5	230	56	21	36
	08-19-91	630	7.5	14.5	—	—	—	—
(D-9-2)11aaa-1	05-17-64	520	7.8	14.0	240	61	22	—
	08-16-76	570	—	14.0	—	—	—	—
	09-20-82	550	—	—	—	—	—	—
	07-19-90	550	7.5	14.5	270	66	26	15
(D-9-2)15cda-1	07-30-81	600	—	14.5	—	—	—	—
	07-10-89	540	7.6	14.0	—	—	—	—
(D-9-2)19aca-1	07-02-87	420	—	13.0	—	—	—	—
	07-10-89	690	8.0	14.0	—	—	—	—
(D-9-2)19acb-1	09-05-80	490	—	14.5	—	—	—	—
	07-26-83	510	—	14.5	—	—	—	—
	07-02-86	570	—	16.0	—	—	—	—
(D-9-2)36acd-1	05-11-89	540	6.9	12.0	—	—	—	—

water from selected wells—Continued

Potassium, dis-solved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dis-solved (mg/L as SO_4)	Chloride, dis-solved (mg/L as Cl)	Fluoride, dis-solved (mg/L as F)	Silica, dis-solved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
12	—	50	37	—	—	265	—
9.4	—	49	37	—	—	309	—
9.0	—	61	37	—	—	314	—
9.0	—	52	42	—	—	386	—
8.6	—	33	41	—	—	344	—
9.8	—	83	36	—	—	294	—
9.4	—	66	35	—	—	307	—
—	268	41	33	—	51	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
9.0	261	48	32	.30	49	448	4.00
8.3	250	51	31	.20	49	423	—
8.2	250	45	29	.20	45	417	3.40
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
8.1	—	44	25	.20	53	423	3.00
—	—	—	—	—	—	—	—
9.1	—	47	30	.30	51	440	3.40
8.5	—	110	25	.30	50	644	3.40
—	—	—	—	—	—	—	—
10	—	34	33	.20	56	402	2.90
—	—	—	—	—	—	—	—
—	—	27	24	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
1.2	—	28	19	.20	13	307	1.10
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—

Table 5.—*Chemical analyses of*

Well number	Date sampled	Specific conductance (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dis-solved (mg/L as Ca)	Magnesium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)
(D-9-3)5bbd-1	07-14-64	380	8.5	12.0	170	27	26	14
	09-03-69	560	7.9	11.0	270	65	27	—
	10-14-71	530	—	12.5	—	—	—	—
	08-11-72	650	7.5	12.5	320	73	33	18
	07-31-73	550	—	12.0	—	—	—	—
	08-17-76	670	7.2	12.5	300	75	28	16
	07-12-77	620	6.5	12.5	310	75	31	19
	08-23-78	590	6.8	12.5	300	72	29	18
	08-01-79	650	—	12.5	—	—	—	—
	09-04-80	600	—	15.5	—	—	—	—
(D-10-1)1acd-2	07-14-89	730	7.2	15.0	—	—	—	—
(D-10-1)2adb-1	07-29-65	—	—	—	170	—	—	—
	07-05-66	530	7.8	9.5	280	75	22	5.3
	07-30-80	530	—	11.0	—	—	—	—
	07-14-89	500	7.6	12.0	—	—	—	—
	08-17-90	540	7.9	10.5	270	71	22	6.4
(D-10-1)2ddd-1	08-22-89	570	7.3	10.0	—	—	—	—
(D-10-1)19bad-1	07-15-81	2,100	—	23.0	—	—	—	—
	06-30-86	2,060	—	21.0	—	—	—	—
(D-10-1)19bdc-1	09-04-80	2,000	—	21.5	—	—	—	—
	07-02-86	2,130	—	21.5	—	—	—	—
(D-10-1)30bac-1	08-09-85	3,800	—	22.0	—	—	—	—
	07-12-89	3,550	7.1	23.5	—	—	—	—
	08-29-90	3,410	7.4	24.0	500	110	54	460

---

[1] Actual location is different than historic record. See footnote, table 1.

water from selected wells—**Continued**

Potassium, dissolved (mg/L as K)	Alkalinity, field (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen NO_2+NO_3, dissolved (mg/L as N)
1.2	—	44	16	—	—	212	—
—	248	35	19	—	13	327	—
—	—	—	—	—	—	—	—
1.6	261	55	22	—	15	374	—
—	—	—	—	—	—	—	—
1.3	253	53	19	.20	12	360	.90
1.5	250	56	21	.10	13	369	—
1.6	200	54	28	.20	13	338	.94
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
.80	—	30	17	—	—	291	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
1.3	—	21	21	1.1	13	296	2.10
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
38	—	120	860	.30	36	1,860	.50

Table 6.—*Measurements of discharge, temperature, and specific conductance of water from selected springs*

[—, no data]

Location of spring or measurement site: See figure 1 for explanation of the numbering system for hydrologic-data sites.
Discharge: ft³/s, cubic feet per second.
Temperature: °C, degrees Celsius.
Specific conductance: µS/cm, microsiemens per centimeter at 25 degrees Celsius.

Location of spring	Location of measurement site	Name of spring	Date of measurement	Discharge (ft³/s)	Temperature (°C)	Specific conductance (µS/cm)
(D-7-3)28d-S1	(D-7-3)28bcd	Spring Creek	07-02-90	15	15.5	—
			10-16-90	16	14.0	—
			04-02-91	15	—	—
(D-7-3)30a-S1	(D-7-3)30abb	Unnamed springs	11-14-90	.12	11.0	840
(D-7-3)32dba-S1	(D-7-3)31add	Wood Springs	05-31-90	[1]3.8	15.5	—
			10-16-90	[1]3.9	15.0	—
			04-02-91	[2]2.9	—	—
(D-8-3)3a-S1	(D-8-3)3abc	Wheeler Springs	05-31-90	1.1	14.0	—
			10-16-90	.89	14.0	—
			04-02-91	[3]1	—	—
(D-8-3)3dbb-S1	(D-8-3)3dbb	Clyde Springs	05-31-90	.55	13.0	—
			10-16-90	.72	13.0	—
			04-02-91	.02	—	—
(D-8-3)9d-S1	(D-8-3)9bac	Holley Springs	05-25-90	3.4	18.5	—
			10-22-90	4.1	9.0	—
			04-02-91	2.4	—	—
(D-9-2)11abd-S1	(D-9-2)11abd	Salem Lake Springs	06-01-90	5.0	16.0	—
			10-22-90	6.1	10.0	—
(D-9-2)29ac-S1	(D-9-2)29acc	Unnamed springs	08-22-89	[4]1.0	—	—
(D-9-2)29cbb-S1	(D-9-2)29cbb	Spring Lake Springs	06-01-90	[4]3.3	14.0	—
			10-17-90	[4]2.4	13.0	—
(D-9-1)25aac-S1	(D-9-1)24ddc	North Holladay Springs	06-12-90	1.1	13.5	—
			10-17-90	.78	8.0	—
(D-9-1)25adb-S1	(D-9-1)25ada	South Holladay Springs	06-12-90	.67	16.0	—
			10-17-90	.46	8.5	—

---

[1] Includes about 0.5 ft³/s from Matson Springs.
[2] Includes 0.14 ft³/s from Matson Springs.
[3] Estimated.
[4] Includes about 0.4 ft³/s from flowing wells.

Table 7.—*Measurements of discharge, temperature, and specific conductance of water from selected springs, drains, and sloughs during seepage studies*

[—, no data]

Location of measurement site: See figure 1 for explanation of the numbering system for hydrologic-data sites. Listed in downstream order.

Inflow and outflow: Measured inflow to or outflow from the spring channel.

Discharge: ft^3/s, cubic feet per second. Used to determine ground-water discharge to springs and drains. Upstream measurement plus inflow minus outflow may not equal downstream measurement because of stream leakage, ground water discharge, or measurement error.

Temperature: °C, degrees Celsius.

Specific conductance: µS/cm, microsiemens per centimeter at 25 degrees Celsius.

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)
Spring Creek north channel, November 14, 1990				
(D-7-3)28bca		15	13.0	890
(D-7-3)20bda		15	12.5	1,070
(D-7-3)20bbd	Inflow from industrial effluent	.43	38.0	880
(D-7-3)19bda		15	15.0	1,180
Spring Creek south channel, November 14, 1990				
(D-7-3)28bcb		2.1	12.0	1,050
(D-7-3)20cdb	Inflow from flowing well	.22	—	—
(D-7-3)20cdb	Inflow from waste-water treatment plant	5.1	—	—
(D-7-3)20cdb		9.4	12.5	780
Wood Springs channel, November 14, 1990				
(D-7-3)31add		[1]3.9	13.5	620
(D-7-3)30cdd		6.4	8.0	760
Matson Springs channel, November 14, 1990				
(D-7-3)32ddd	Inflow from flowing well	1.1	16.0	560
(D-7-3)32cda		2.6	14.0	470
(D-7-3)32cda	Outflow to Wood Springs area	1.5	—	—
(D-7-3)31cdb		1.6	14.0	610

Table 7.—*Measurements of discharge, temperature, and specific conductance of water from selected springs, drains, and sloughs during seepage studies*—Continued

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)
Dry Creek, November 15, 1990				
(D-8-3)5cdc		1.9	9.0	840
(D-8-3)5cdc	Inflow from Holley Springs	4.5	8.0	900
(D-8-3)5ccc	Inflow from unnamed springs	4.8	8.0	940
(D-8-3)6ddd	Inflow from flowing wells	.20	—	—
(D-8-3)6ccd	Inflow from waste-water treatment plant	3.7	—	—
(D-8-2)1dda	Inflow from unnamed drains	.38	10.5	580
(D-7-2)36dcc		16	9.5	1,070
Holley Springs channel, November 15, 1990				
(D-8-3)9bac		5.0	10.0	910
(D-8-3)5cdc		4.5	8.0	900
Unnamed channel, November 15, 1990				
(D-8-3)18add		1.2	7.0	1,070
(D-8-3)8cbd		1.4	8.0	1,130
(D-8-3)5ccc		4.8	8.0	940
Spring Creek (near Payson), March 28, 1991				
(D-9-2)29cbb		[2]2.8	8.5	470
(D-9-2)30dad	Inflow from unnamed field drain	.06	9.0	1,020
(D-9-2)30daa	Outflow to West Ditch area	.18	10.5	485
(D-9-2)19bba		4.1	—	—
(D-9-2)18ccd	Inflow from West Ditch	1.0	—	—
(D-9-1)13ddd	Inflow from South Holladay Springs	.61	—	—
(D-9-1)13ddc	Inflow from North Holladay Springs	1.4	—	—
(D-9-2)7bba		6.8	8.0	710
(D-8-1)36dba		7.9	9.0	760

Table 7.—*Measurements of discharge, temperature, and specific conductance of water from selected springs, drains, and sloughs during seepage studies*—Continued

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)
Beer Creek and Benjamin Slough, March 28, 1991				
(D-8-1)36aad	Beer Creek	22	12.5	1,040
(D-8-1)36dba	Inflow from Spring Creek	7.9	9.0	760
(D-8-1)36dba	Inflow from Dry Hollow	1.2	11.5	1,400
(D-8-1)23aba	Benjamin Slough	33	12.0	1,060
North Holladay Springs channel, March 28, 1991				
(D-9-1)24ddc		.82	15.0	700
(D-9-1)13ddc		1.4	—	—
South Holladay Springs channel, March 28, 1991				
(D-9-1)25ada		[3].59	12.0	750
(D-9-1)25ada	Inflow from flowing wells	14	—	—
(D-9-1)13ddd		.61	—	—
Dry Hollow, March 28, 1991				
(D-9-1)12bdd		.36	—	—
(D-8-1)36dba		1.2	11.5	1,400
Beer Creek, March 29, 1991				
(D-8-2)35cdd		1.9	4.5	1,350
(D-8-2)35cdc	Inflow from waste-water treatment plant	.62	7.5	1,110
(D-9-2)3abc	Inflow from Salem Lake	6.4	10.5	770
(D-9-2)3bca		10	7.0	940
(D-8-2)33bbc		14	9.0	990
(D-8-2)32aac	Inflow from waste-water treatment plant	1.3	—	—
(D-8-2)31bb	Inflow from flowing wells	1.2	[4]14.0	[4]880
(D-8-1)36aad		20	—	—

---

[1] Includes 1.5 ft^3/s from Matson Springs.
[2] Includes about 0.4 ft^3/s from flowing wells.
[3] Includes 0.11 ft^3/s from flowing wells.
[4] Average of two flowing wells.

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*

[—, no data]

Location of measurement site: See figure 1 for explanation of the numbering system for hydrologic-data sites. Listed in downstream order. Unknown, exact location not known, is between known listed locations.

Inflow and outflow: Measured inflow to and outflow from the stream. Calculated inflow or outflow was determined by measuring the stream above and below the inflow or outflow. Diversion number refers to system used by the Strawberry Highline Canal Company.

Discharge: ft^3/s, cubic feet per second. Used to determine interaction between streams and ground-water system. Upstream measurement plus inflow minus outflow may not equal downstream measurement because of stream leakage, ground-water discharge, or measurement error.

Temperature: °C, degrees Celsius.

Specific conductance: µS/cm, microsiemens per centimeter at 25 degrees Celsius.

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)
	Spanish Fork River, August 30, 1965			
(D-8-3)33acc		11	—	—
(D-8-3)32daa	Inflow from Mill Race Canal	1.0	—	—
(D-8-3)32cac		9.7	—	—
	Spanish Fork River, September 3, 1965			
(D-8-3)34cda		3.8	—	—
(D-8-3)34bbc	Inflow from springs	1.1	—	—
(D-8-3)34bbb		7.4	—	—
	Spanish Fork River, September 13, 1965			
(D-8-3)34bbb		8.9	11.5	—
(D-8-3)28ddc	Inflow from industrial effluent	.48	—	—
(D-8-3)33acb		7.4	—	—
	Spanish Fork River, October 5, 1965			
(D-8-2)25ada		18	11.5	—
(D-8-2)25bab	Inflow from ditch	.48	—	—
(D-8-2)23dca		23	13.5	—
	Spanish Fork River, October 8, 1965			
(D-8-2)23dca		32	—	—
(D-8-2)22dad	Inflow from South Field Canal	4.0	—	—
(D-8-2)22da	Inflow from ditch	.06	—	—
(D-8-2)22add		33	—	—

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—**Continued**

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)
Spanish Fork River, October 12, 1965				
(D-8-2)15dcd		25	—	—
(D-8-2)15d	Inflow from ditch	.28	—	—
(D-8-2)15cab		22	—	—
Spanish Fork River, October 13, 1965				
(D-8-2)15cab		38	—	—
Unknown	Inflow from drains	.22	—	—
(D-8-2)9aad		31	—	—
Spanish Fork River, June 1, 1966				
(D-9-3)2cab		107	—	—
(D-8-3)35ccc	Outflow to East Bench Canal	103	—	—
(D-8-3)34cdd		18	—	—
(D-8-3)34bbb		20	—	—
(D-8-3)28ddc	Inflow from industrial effluent	.03	—	—
(D-8-3)33acb		21	—	—
Spanish Fork River, June 2, 1966				
(D-8-3)33acc		31	—	—
(D-8-3)31acd	Inflow from drain	1.1	—	—
(D-8-3)30ccc	Inflow from ditch	.60	—	—
(D-8-2)25add		31	—	—
Spanish Fork River, June 3, 1966				
(D-8-2)25ada		18	—	—
(D-8-2)25ada	Inflow from drains	.03	—	—
(D-8-2)23dca		21	—	—
(D-8-2)22dad	Inflow from South Field Canal	.39	—	—
(D-8-2)22da	Inflow from ditch	.31	—	—
(D-8-2)22da	Inflow from ditch	.05	—	—
(D-8-2)22add		21	—	—

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—Continued

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)
	Spanish Fork River, September 29, 1966			
(D-8-3)34cda		3.9	—	—
(D-8-3)34bbb		7.2	15.5	—
(D-8-3)33acb		6.7	—	—
	Spanish Fork River, September 30, 1966			
(D-8-3)33acc		20	—	—
(D-8-3)32cac		22	—	—
(D-8-3)31baa		21	—	—
(D-8-3)30c	Inflow	1.1	—	—
(D-8-2)25add		23	15.5	—
	Spanish Fork River, October 3, 1966			
(D-8-2)25ada		77	11.0	500
(D-8-2)23dca		78	12.0	520
Unknown	Inflow from ditches	.33	—	—
(D-8-2)22aba	Outflow to South Ditch	27	—	—
(D-8-2)15dca		49	13.0	520
Unknown	Inflow from ditches and well	.60	—	—
(D-7-2)32ddd		39	—	—

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—Continued

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)
Mapleton Lateral, May 26, 1966				
(D-8-3)34cda		43	11.0	—
(D-8-3)34acc		40	—	—
(D-8-3)34aba		41	—	—
(D-8-3)27acc		39	13.0	—
(D-8-3)23bdd		40	—	—
(D-8-3)23bdd	Outflow to ditch	6.8	—	—
(D-8-3)14aac		34	15.0	—
(D-8-3)14aac	Outflow to pump	.97	—	—
(D-8-3)11ddb		33	—	—
(D-8-3)11ddb	Calculated inflow from Maple Creek	7.5	—	—
(D-8-3)11ddb	Outflow to ditch	11	—	—
(D-8-3)11adb		30	—	—
(D-8-3)11aac	Outflow to ditch	11	—	—
(D-8-3)11aac		17	—	—
(D-8-3)11aba		17	16.0	—
(D-8-3)11aba	Calculated outflow to Fullmer Ditch	8.6	—	—
(D-8-3)2dcd		7.9	—	—
(D-8-3)2dca		7.7	—	—
Mapleton Lateral, September 29, 1966				
(D-8-3)34acc		18	11.0	—
(D-8-3)34aba		17	—	—
(D-8-3)27acc		18	—	—
(D-8-3)23bdd		18	—	—
(D-8-3)14aac		19	—	—
(D-8-3)11ddb	Outflow to ditch	.14	—	—
(D-8-3)11ddb		18	—	—
(D-8-3)11aac	Outflow to ditch	.88	—	—
(D-8-3)2dcd		18	—	—

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—Continued

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)
Strawberry Highline Canal, September 28, 1965				
(D-8-3)33dbb		44	—	—
Unknown	Inflow	.17	—	—
Unknown	Outflow	3.3	—	—
(D-9-2)16adc		37	—	—
Strawberry Highline Canal, May 31, 1966				
(D-9-2)31acc		79	—	—
(D-9-2)31cbd	Outflow to diversion #24A	2.4	—	—
(D-9-1)36dad	Outflow to diversion #25	2.1	—	—
(D-9-1)36dad		70	—	—
(D-9-1)36acb	Outflow to diversion #26	3.7	—	—
(D-9-1)36bbc		66	—	—
(D-9-1)36bbc	Inflow from well	4.4	—	—
(D-9-1)35aaa	Outflow to diversion #27	3.6	—	—
(D-9-1)35aaa		70	—	—
(D-9-1)35abb	Inflow from well	8.7	—	—
(D-9-1)26cbb		78	15.5	—
Strawberry Highline Canal, June 1, 1966				
(D-8-3)33dbb		139	14.0	—
(D-9-3)5aaa	Outflow to diversion #3	13	—	—
(D-9-3)5adb		124	—	—
(D-9-3)7dbc		121	—	—
(D-9-3)7dbc	Calculated outflow to diversion #7	5.1	—	—
(D-9-3)7cdb	Outflow to diversion #8	.01	—	—
(D-9-2)13abc		111	—	—
(D-9-2)13bad	Calculated outflow to diversion #10	3.1	—	—
(D-9-2)13bd	Outflow to diversion #10-1	4.4	—	—
(D-9-2)14daa	Outflow to diversion #11	2.8	—	—
(D-9-2)14ccc		100	—	—

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—**Continued**

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)
Strawberry Highline Canal, June 2, 1966				
(D-9-2)14ccc		85	12.0	—
(D-9-2)22bba	Outflow to diversion #14.5	.65	—	—
(D-9-2)22bbb		77	13.0	—
(D-9-2)21bab	Outflow to diversion #18	1.4	—	—
(D-9-2)21bba	Outflow to diversion #19	5.2	—	—
(D-9-2)21bb	Outflow to diversion #19.5	1.1	—	—
(D-9-2)21bcb	Outflow to diversion #20	27	—	—
(D-9-2)21bcb	Outflow to diversion #20B	3.2	—	—
(D-9-2)31acc		41	16.0	—
Strawberry Highline Canal, September 26, 1966				
(D-8-3)33dbb		73	—	—
(D-9-3)5aaa	Outflow to diversion #3	.19	—	—
(D-9-3)5adb		73	—	—
(D-9-3)7dbc		72	14.0	—
(D-9-2)13abc		71	14.5	—
(D-9-2)14cda	Outflow to diversion #12	2.8	—	—
(D-9-2)14ccc		68	—	—

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—Continued

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (μS/cm)
	Strawberry Highline Canal, September 27, 1966			
(D-9-2)14ccc		64	—	—
(D-9-2)22bba		64	13.0	—
(D-9-2)21bab	Outflow to diversion #18	7.0	—	—
(D-9-2)21bcb	Outflow to diversion #20A	6.0	—	—
(D-9-2)20ddb	Outflow to diversion #21	.20	—	—
(D-9-2)31acc		48	14.0	—
(D-9-2)31cbd	Outflow to diversion #24A	.01	—	—
(D-9-1)36dad	Outflow to diversion #25	1.5	—	—
(D-9-1)36bbc		45	14.5	—
(D-9-1)35aaa	Outflow to diversion #27	4.0	—	—
(D-9-1)35a	Outflow to diversion #27.5	2.4	—	—
(D-9-1)26cbb		44	15.5	—
	South Field Canal, September 13, 1965			
(D-8-3)32dda		10	—	—
(D-8-2)25dbc		10	15.5	—
	South Field Canal, June 8, 1966			
(D-8-3)32dda		33	12.0	—
(D-8-3)31cdd		32	—	—
(D-8-2)36acd		35	15.0	—
(D-8-2)36acb	Outflow	4.9	—	—
(D-8-2)25dbc		30	—	—
	South Field Canal, October 3, 1966			
(D-8-3)32dda		17	—	—
(D-8-3)32c	Outflow	4.3	—	—
(D-8-3)31cdd		13	11.5	—
(D-8-3)36acd		14	—	—
(D-8-3)25dbc		13	11.5	—

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—Continued

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)
South Field Canal, October 5, 1966				
(D-8-2)25dbc		4.9	—	—
(D-8-2)23ccc		4.6	12.0	—
Mill Race Canal, August 30, 1965				
(D-8-3)33acc		56	14.5	—
(D-8-3)33cab	Outflow	8.9	—	—
(D-8-3)32add	Outflow to Spanish Fork River	1.0	—	—
(D-8-3)19cdc		45	16.5	—
Mill Race Canal, June 9, 1966				
(D-8-3)33acc		51	—	—
(D-8-3)32bab		57	13.0	—
(D-8-3)30ddd		55	15.0	—
(D-8-3)30dbb		59	—	—
(D-8-3)30b	Outflow	.61	—	—
(D-8-3)19cdc		55	15.0	—
(D-8-3)19cca	Outflow	3.0	—	—
(D-8-2)24dca		50	—	—
Mill Race Canal, September 30, 1966				
(D-8-3)33acc		39	—	—
(D-8-3)32bab		38	—	—
(D-8-3)32bb	Outflow	5.7	—	—
(D-8-3)30dbb		34	—	—
(D-8-3)19cdc		34	—	—
(D-8-3)19cca	Outflow	2.5	—	—
(D-8-2)24dca		34	—	—

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—Continued

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)
East Bench Canal, August 25, 1965				
(D-8-3)34ddd		14	—	—
(D-8-3)27ccb		12	—	—
East Bench Canal, June 15, 1966				
(D-8-3)34ddd		78	—	—
(D-8-3)27ccb		75	18	—
(D-8-3)27cbc	Outflow	9.0	—	—
(D-8-3)28dac	Outflow	16	—	—
(D-8-3)28dac	Outflow	2.6	—	—
(D-8-3)28dbb	Outflow	8.6	—	—
(D-8-3)28bbd	Outflow	8.3	—	—
(D-8-3)29aaa		32	—	—
East Bench Canal, October 6, 1966				
(D-8-3)34ddd		17	—	—
(D-8-3)27ccb		15	9.0	—
(D-8-3)28dac	Outflow	9.3	—	—
(D-8-3)29aaa		5.7	9.5	—
South Ditch, June 17, 1966				
(D-8-2)22aba		52	15.0	—
(D-8-2)15caa	Outflow	18	15.5	—
(D-8-2)16dad	Outflow	15	16.0	—
(D-8-2)16dcc		17	16.5	—
(D-8-2)21bbd	Outflow	1.9	—	—
(D-8-2)20caa		14	16.5	—

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—Continued

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)
	Hobble Creek, August 17, 1965			
(D-8-3)1dbc		.77	—	—
(D-8-3)1cac		5.4	—	—
(D-8-3)1cca		5.2	—	—
(D-8-3)1ccb	Inflow from canal	1.7	—	—
(D-8-3)2ddb		6.7	—	—
(D-8-3)2dca	Inflow from Mapleton Lateral	11	—	—
(D-8-3)2dca	Outflow to canal	7.7	—	—
(D-8-3)2dca		5.3	—	—
(D-8-3)2ccb	Outflow to irrigation ditch	5.0	—	—
(D-8-3)3dda	Calculated inflow from pipe	.48	—	—
(D-8-3)3dda		2.8	—	—
	Hobble Creek, August 18, 1965			
(D-8-3)3dda		2.8	—	—
(D-8-3)3acc	Inflow from springs	.20	—	—
(D-8-3)3bbd	Inflow from drains	.87	—	—
(D-8-3)4aaa		13	—	—
	Hobble Creek, August 19, 1965			
(D-8-3)3dda		4.7	—	—
(D-8-3)4aaa		18	—	—
	Hobble Creek, August 23, 1965			
(D-8-3)3dda		1.5	—	—
(D-8-3)4aaa		9.9	—	—
	Hobble Creek, September 22, 1965			
(D-8-3)4aaa		26	11.5	—
(D-7-3)29dcc		29	12.0	—

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—Continued

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (μS/cm)
Hobble Creek, May 24, 1966				
(D-8-3)1cac		18	8.5	—
(D-8-3)2ddb		20	9.5	—
(D-8-3)2dca	Outflow	8.4	—	—
(D-8-3)2	Outflow	7.6	—	—
(D-8-3)3d	Calculated inflow from pipe	2.6	—	—
(D-8-3)3b	Inflow from springs	1.6	—	—
(D-8-3)4aaa		19	—	—
Hobble Creek, September 23, 1966				
(D-8-3)1cac		3.8	10.5	—
(D-8-3)2ddb		2.8	11.5	—
Hobble Creek, September 27, 1966				
(D-8-3)2dca		1.2	—	—
(D-8-3)2ccb	Outflow to irrigation ditch	1.9	—	—
(D-8-3)3dda		1.0	13.0	410
(D-8-3)3dbb		4.8	13.0	600
(D-8-3)3b	Inflow from Wheeler Springs	.64	—	—
(D-8-3)4aaa		7.5	13.5	560
Hobble Creek, October 4, 1966				
(D-8-3)4aaa		5.2	11.5	540
(D-7-3)29dcc		5.4	12.0	540
Hobble Creek, May 23, 1990				
(D-8-4)6abb		17	14.5	—
Hobble Creek, November 14, 1990				
(D-7-3)29dcc		19	8.5	520
(D-7-3)30acc	Outflow	.04	—	—
(D-7-3)30bda		21	9.0	540

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—Continued

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)
Springville Highline Canal, June 3, 1965				
(D-8-3)1acc		8.3	—	—
(D-8-3)2adb		7.5	—	—
Springville Highline Canal, July 23, 1965				
(D-8-3)1acc		8.0	—	—
Unknown	Outflow	.09	—	—
(D-8-3)2adb		6.1	—	—
Springville Highline Canal, May 23, 1966				
(D-8-4)6bab		6.7	—	—
(D-8-3)1acc		6.4	—	—
Springville Highline Canal, September 28, 1966				
(D-8-4)6bab		11	11.0	420
(D-8-3)1acc		8.8	10.5	430
Swenson Ditch, September 29, 1966				
(D-8-3)4aaa		7.9	—	—
(D-8-3)4bbd		7.1	—	—
Fullmer Ditch, May 25, 1966				
(D-8-3)12bbb		9.4	—	—
(D-8-3)11aba	Inflow from Mapleton Lateral	10	—	—
(D-8-3)11baa		18	—	—
Fullmer Ditch, October 5, 1966				
(D-8-3)1cdc		13	9.0	440
Unknown	Outflow	1.3	—	—
(D-8-3)3cdc		7.5	—	—

Table 8.—*Measurements of discharge, temperature, and specific conductance of water from selected streams and canals*—Continued

Location of measurement site	Inflow and outflow	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)
Area of West Fields Irrigation Company, November 15, 1990				
(Measurements given below include all known surface inflow and outflow from the West Fields Irrigation Company area)				
(D-8-2)24acc	Inflow from Mill Race Canal	9.6	7.5	930
(D-8-2)23dba	Unnamed inflow	[1].05	—	—
(D-8-2)9aad	Unnamed outflow	.08	11.5	485
(D-8-2)4aab	Unnamed outflow	.42	9.0	[2]2,460
(D-7-2)34ddc	Unnamed outflow	2.8	8.0	895
(D-7-2)35ccc	Unnamed outflow	1.4	9.0	925
(D-7-2)35ccd	Unnamed outflow	1.8	8.5	930
(D-8-2)2abb	Unnamed outflow	.03	12.0	410
(D-8-2)1bbb	Unnamed outflow	.8	9.5	990
Peteetneet Creek West Ditch, March 28, 1991				
(D-9-2)21bbc		3.4	—	—
(D-9-2)20bc	Inflow	.18	—	—
(D-9-2)18ccd		.96	—	—
Summit Creek, May 23, 1990				
(D-10-1)13d		17	12.0	—
Kimball Creek, May 25, 1990				
(C-11-2)13cdc		.15	17.5	—

---

[1] Estimated.

[2] Specific conductance is higher than other values because the flow at this site is composed mainly of ground-water discharge.

★ U.S. GOVERNMENT PRINTING OFFICE: 1993 - 786 - 348

APPENDIX H

Lineament Study

SUVSWD Bayview Class I Landfill
Permit Application

EVALUATION OF LINEAMENTS AT THE
PROPOSED PROVO CITY LANDFILL,
GOSHEN VALLEY, UTAH

by

ROBERT M. ROBISON
UTAH COUNTY GEOLOGIST

APRIL 20, 1987

CONTENTS

INTRODUCTION

The proposed Provo City landfill is located in Goshen Valley, Utah, in Sec. 17, T. 9 S., R. 1 W., SLB&M (Fig. 1). The site is about 2 miles west of the southern end of Utah Lake and approximately 2 miles east of the Tintic Mountains. Elberta City is approximately 5.5 miles to the south.

The purpose of this investigation was to evaluate lineaments in Section 17 to determine if they were formed by surface fault rupture. Several lineaments were identified by the Utah County Geologist (Robison, 1986a) and Environmental Science and Engineering (ESE, Whiting, 1986) which may have been produced by faulting. The Utah County Board of Adjustments (minutes dated January 13, 1987) authorized an investigation of all lineaments. The Utah County Geologist had the responsibility to locate exploratory trenches and make the interpretation as to the presence/location of any faults found.

The scope of this investigation included a review of pertinent literature and aerial photographs, field reconnaissance, and the excavation, logging, photographing, and interpretation of eight trenches (Fig. 2). Trench locations were selected during a field reconnaissance on March 6, 1987, by the Utah County Geologist. Duane Whiting of ESE, Steve Sevier of Elberta Farms, and Dale Stephenson and Carl Carpenter of Provo City were present when the trenches were sited.

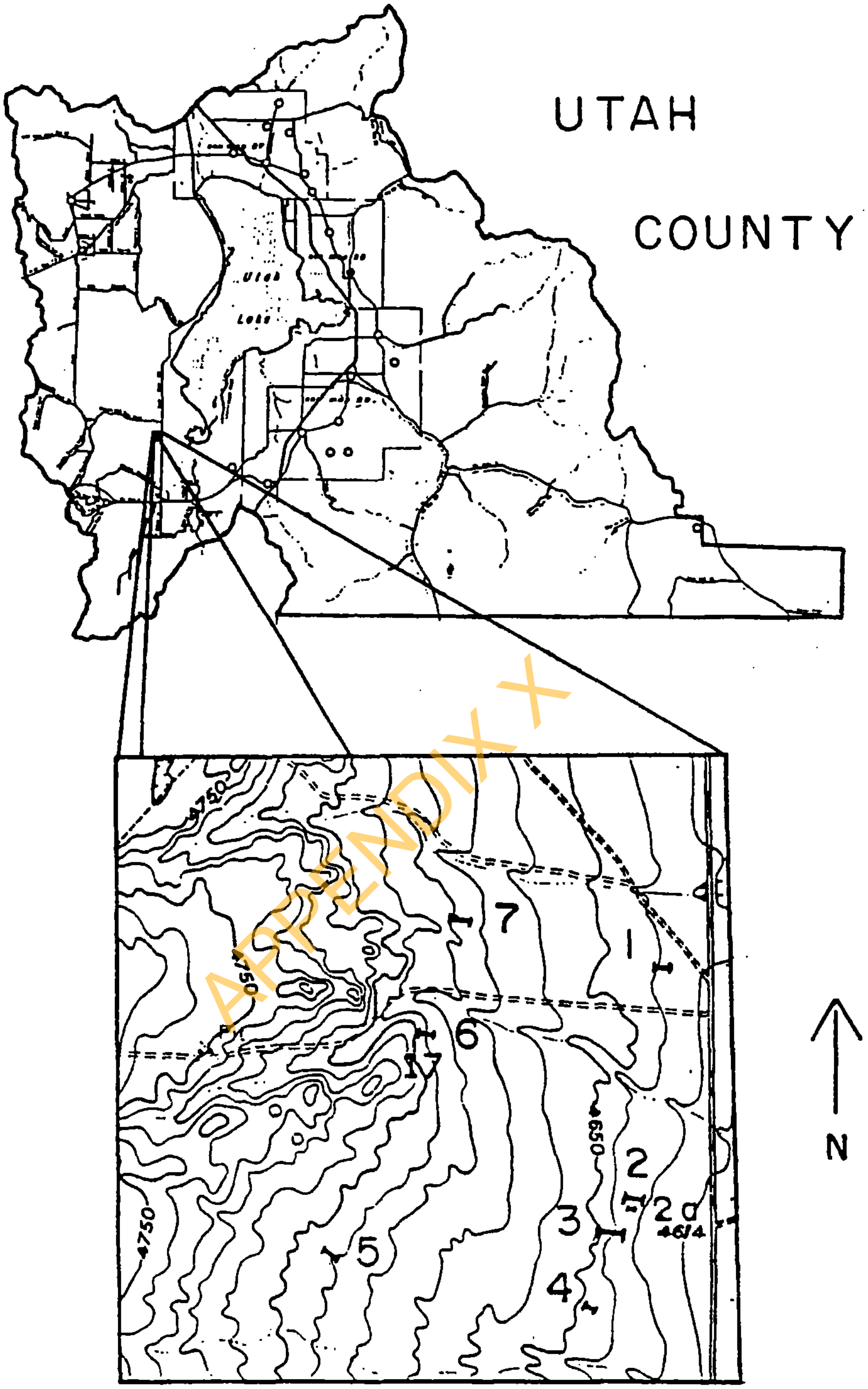


Figure 1. Map showing the location of the study area, Section 17, T. 9 S., R. 1 W., SLB&M, Goshen Valley, Utah. Single digit numbers refer to trenches. See text for logs and descriptions of trenches.

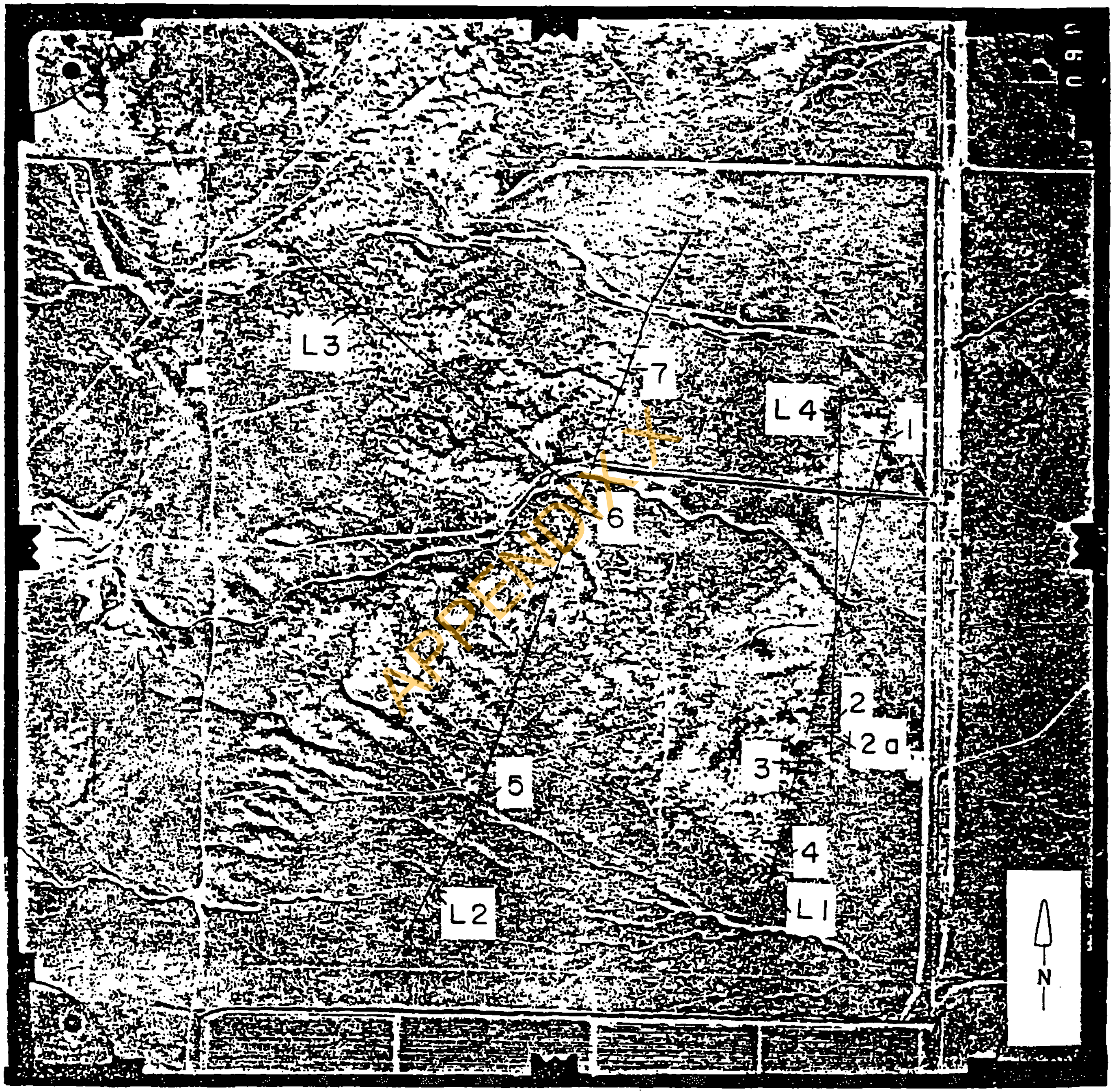


Figure 2. December, 1986, aerial photograph of the study area. Lineaments are labeled L1 to L4. Trench locations are labeled 1 to 7. Scale is approximately 1:11,500.

Eight trenches were excavated on March 24, 25, and 26, 1987 (Fig. 2) across lineaments L1, L2, and L4. Lineament L3 had no surface expression or traceable linear features, and hence was not trenched. Kimm Harty and Suzanne Hecker of the Utah Geological and Mineral Survey logged trench # 1 (Fig. 2). Robert M. Robison (Utah County Geologist) and John D. Garr (EarthFax Consultants) logged the other trenches. EarthFax Consultants were hired by Environmental Science and Engineering to participate in the investigation.

TRENCH LOCATIONS AND DESCRIPTIONS

Trenches were numbered from north-to-south on the eastern lineament (L1, trenches numbered 1 to 4, Fig.2) and from south-to-north on the western lineament (L2, trenches numbered 5 to 7, Fig. 2). The eighth trench (number 2a, Fig. 2) was parallel to trench number 2 to verify continuity of the sediments through a disturbed area. Horizontal level lines were used for elevation control and reference to bedding and features in logging trenches. The original scale of the trench logs was 1:50.

Five units were recognized in trench number 1 and were correlated in all of the trenches. A detailed explanation of each unit giving the type of deposit, thickness, color, texture and features, and genesis, is included in the appendix. A summary of the location and principal features in each trench is given below:

Trench Number 1. This trench was across the north end of lineament L1 (Fig. 2, Appendix A). Five stratigraphic units were delineated in this trench. The continuity of the beds can be seen in trench log #1 (Appendix A). Stringers of sand can be traced through the deposits. The fractures in the clayey sediments may be the result of shrinking from desiccation, or from liquefaction.

Trench Number 2. This trench was along lineament L4 (Fig.2). A total of 4 sedimentary units were logged in the trench. A large burrow(?) in the central portion of the trench made linear continuity of deposits unclear. A second trench (2a, Fig. 2) was excavated parallel to trench 2 which had continuous bedding in the region of the burrow. No logs were made of trench 2a, but photos (not included in this report) were taken.

Trench Number 3. A 5+ m high scarp was present at the site of trench number 3. A 36 m long trench was excavated across this scarp to ensure that any faults would be discovered (trench #3, Appendix A). Five stratigraphic units were logged in this trench.

Trench Number 4. This trench was located at the south end of lineament L1 (Fig. 2). Three continuous stratigraphic units were found.

Trench Number 5. Trench 5 was located at the south end of lineament L2 (Fig. 2). Three sedimentary units were identified. Unit 1 was subdivided into units 1 and 1a because of the presence of lacustrine(?) gastropods in unit 1a (Appendix A). Sand filled fissures were common.

Trench Number 6. Trench number 6 was located in the central portion of lineament L2 (Fig. 2). Three sedimentary units were found (Appendix A). Fissures were common and most were filled with sand. Several small (< 2 cm) fissures were open within unit 3.

Trench Number 7. Trench 7 (Fig. 2) was located on the north end of lineament L2. A 3 m (9 foot) scarp was trenched approximately 11 feet deep, which revealed only eolian sand. The scarp was apparently a dune slip face (lee slope). The trench walls were very unstable and no logs were made of the trench. Photographs were taken of the trench but were not included in this report.

DISCUSSION

Sediments and features of Pleistocene Lake Bonneville dominate the study area. The western margin of the site is approximately at the Provo shoreline of the lake occupied 14,000 - 15,000 years ago. Shoreline deposits are chiefly gravel which grades eastward to offshore facies of sand, silt, and clay. Most of the lake sediments are beneath a thin covering of sandy Holocene alluvium and eolian material. In addition to these surficial deposits, trenches exposed sand and gravel. Deposits representing the transgression of Lake Bonneville about 25 thousand years ago (unit 5, Appendix); deep lake clays of the highstand about 15 to 16 thousand years ago (units 3 and 4) and the drop to the Provo Shoreline 15 thousand years ago, and the regression of the lake out of the study area about 13 to 14 thousand years ago (unit 1a and 2). For a more complete discussion of the history of Lake Bonneville see Currey and Oviatt (1985).

The lineaments identified for study varied in surficial expression and probable origin. The aerial photographs used by Robison (1986) to identify lineaments were taken in 1959, and the photos used by ESE were taken in 1986 photos. Lineament number 1 (Fig. 2) was less visible on the 1986 photo as compared to the 1959 photo, and was at a slightly different orientation. Lineament number 2 (Fig. 2) was more evident on the 1986 photos. In addition to surface faulting, possible origins of the lineaments include grazing patterns, animal trails, fence lines, abandoned canals or ditches, differential erosion of surficial material, or natural drainage lines. The change in the character of the lineaments in the 27 years between the photos may be the result of stabilization after previous land uses, continued erosion of natural features. Also, several sand dunes are present roughly parallel to the lineaments.

No existing geologic or surficial maps indicate surface fault ruptures in this area, and none were found in the investigation. Faulting at depth has been inferred by Cordova (1970), but no faults were extended to the ground surface. Several trenches exhibited layers of sediments with sand-filled fissures with little or no offset. These fissures trended roughly parallel to lineaments, but none were found which reached the ground surface and are not the cause of the lineaments. The sand-filled fractures may be the result of either liquefaction or desiccation. If they resulted from earthquake-induced liquefaction, the earthquake causing the liquefaction would not necessarily have had an epicenter at the location of the liquefaction. A large earthquake on the Wasatch Fault, about 12 miles east, would shake the study area sufficiently hard to induce liquefaction when ground-water conditions were favorable. The earthquake would have had to occur after deposition of the clayey sediments (unit 3, Appendix A) about 13,000 to 12,000 years ago, but before the water table had dropped, possibly about 10,000 years ago.

If the sand-filled features are the result of desiccation, then a triggering earthquake is not necessary. The fissures could have formed any time following the retreat of Lake Bonneville from this level about 12 ka. Surface water or wind could have carried the sand into the fissures. Locally, some of the fissures were open (+/-1 cm) within unit 3.

CONCLUSIONS AND RECOMMENDATIONS

The trenches revealed no features which could be interpreted as tectonic faults. The trenches were sufficiently deep to encounter well-bedded late Pleistocene (Lake Bonneville age) and Holocene sediments in which offsets due to faulting would have been readily apparent. The lineaments must be the result of past land uses, meandering drainages, and/or wind erosion and deposition.

Small sand filled fractures in trenches may be result of liquefaction during times of higher ground-water or from desiccation as sediments dried. Under present conditions, the liquefaction potential for this area is very low (Anderson and others, 1986). There appears to be no surface fault rupture hazard at the site, however, trenches or other excavations produced from the construction of the landfill should be periodically inspected by the Utah County Geologist to check for possible faults in areas not covered by this investigation.

SELECTED REFERENCES

Anderson, L.R., Keaton, J.R., and Bischoff, J.E., 1986, Liquefaction potential map for Utah County, Utah: Utah State University and Dames and Moore unpublished report for the U.S. Geological Survey, 46 p.

Cordova, R.M., 1970, Ground water conditions in Southern Utah Valley and Goshen Valley, Utah: Utah Department of Natural Resources Technical Publication No. 28, 79 p.

Currey, D.R., and Oviatt, C.G., 1985, Durations, average rates, and probable causes of Lake Bonneville expansions, still stands, and contractions during the last deep-lake cycle, 32,000 to 10,000 years ago: in Kay, P.A., and Diaz, H.F., eds. Problems of and prospects for predicting Great Salt Lake levels, Conference Proceedings, Center for Public Affairs and Administration, University of Utah, p. 9-24.

Robison,R.M., 1986a, Elberta landfill site: Unpublished Utah County Planning Commission Letter, 2 p.

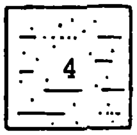
__________, 1986b, Elberta landfill site (Provo, Utah): Unpublished Utah County Planning Commission Letter, Dec., 1986, 4 p.

Whiting, Duane, 1986, Evaluation of hydrologic and seismic conditions, proposed sanitary landfill site in Goshen Valley, Utah: Unpublished report by Environmental Science and Engineering to Elberta Farms, Inc., Elberta, Utah, 55 p.

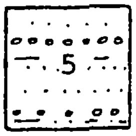
APPENDIX

EXPLANATION FOR TRENCH LOGS

UNIT	DESCRIPTION
1	Sand, silt (SP, SM, ML): some organic material, gravel present locally; unit may be >1 m thick; light brown to tan, Munsell color is 2.5Y 7/2 (dry) to 2.5Y 6/4 (damp); if sand is predominant, color may be 10YR 5/3 . Material is eolian sand, loess and/or alluvium, roots are present and burrows are abundant. This unit is the present ground surface and is probably still being deposited.
1a	Unit 1a has sand with features and color similar to unit 1. This unit is bedded with pockets of gastropods, indicating that it may be lacustrine in origin and older than unit 1, possibly 13,000 to 14,000 years ago.
2	Interbedded clay, silty clay and clayey silt, fine sand, (CL, CL-ML, SM): clay content increases toward bottom of unit, sand increases toward top of unit; unit thickness may be 2.6 m; color is green to gray, lower unit is 5Y 5.5 to 6.1 with laminations of 2.5Y 8/2 , unit grades upward to 5Y 7/2; laminated, may have sand filled fractures locally; probably represents the regressive deposits of Lake Bonneville, about 15,000 - 14,000 years ago.
3	Blocky clay (CH): homogeneous, maximum thickness about 1 m; brown to reddish brown 10YR 5/2-3; some laminations or mottling present; may locally have sand filled fissures. $CaCO_3$ horizon may be present at the top of unit; these deposits may represent the deep water cycle of Lake Bonneville, about 18,000 years ago.

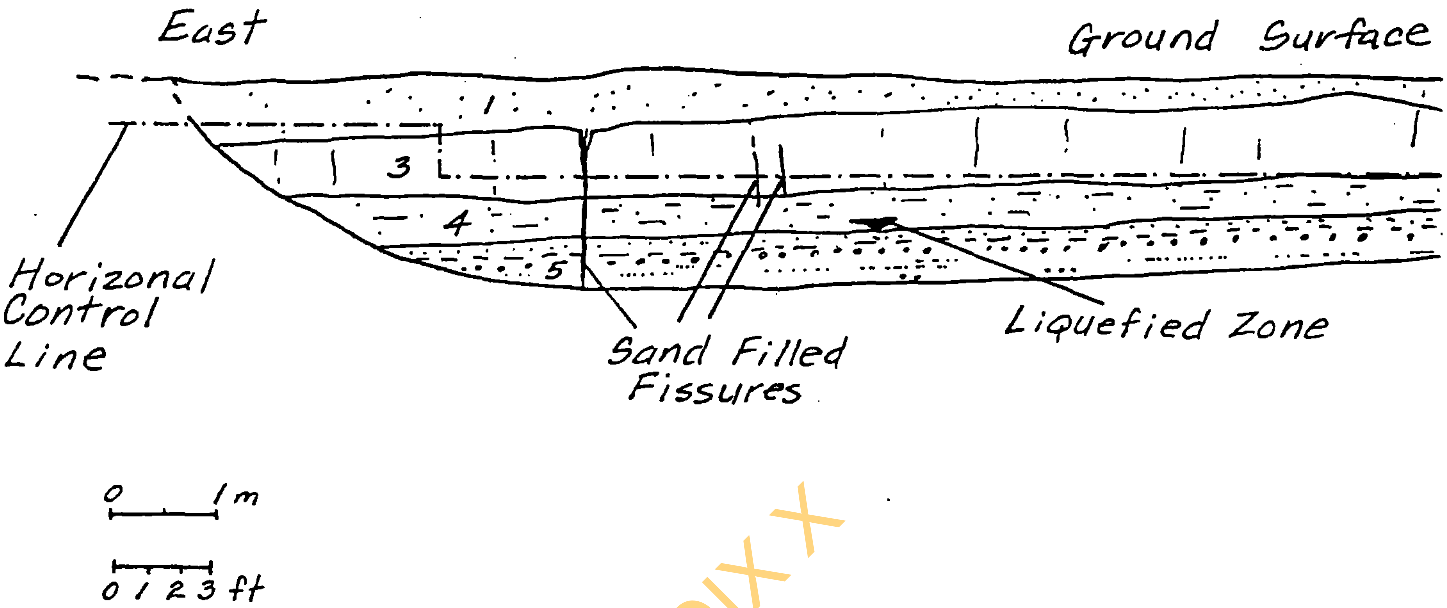


Interbedded clay, silty clay and clayey silt, some fine sand (CL, CL-ML, SM): clay content decreases at the base of unit; resembles unit 2; thickness is about .9 m maximum; laminated, color is green to gray, 5Y 6/1 with streaks of 5Y 8/1 to 7/2; some sand filled fissures present; this unit was probably deposited in the deepening waters of the transgression of Lake Bonneville, about 19,000 to 20,000 years ago.

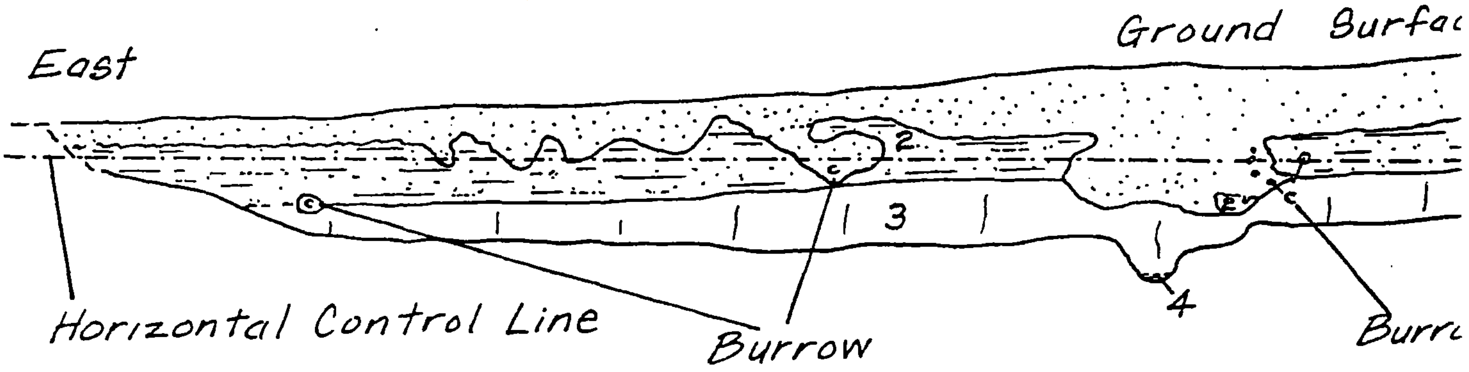


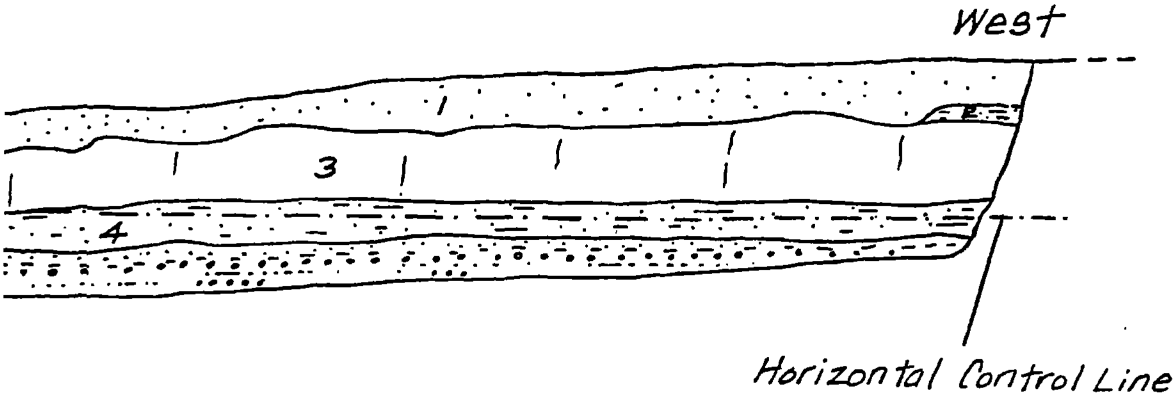
Interbedded gravel, sand, (GM, SM): bedded gravel, moderately to well sorted in places, maximum clast size 10 cm; unit thickness exceeds 1.2 m; light brown, 10YR 5/4 , a layer of red sand (oxidized iron stain) may be present at the contact between unit 4; liquefaction features (small diapirs) may be present at the upper contact; this unit may represent the transgressive gravels of Lake Bonneville, about 20,000 years ago.

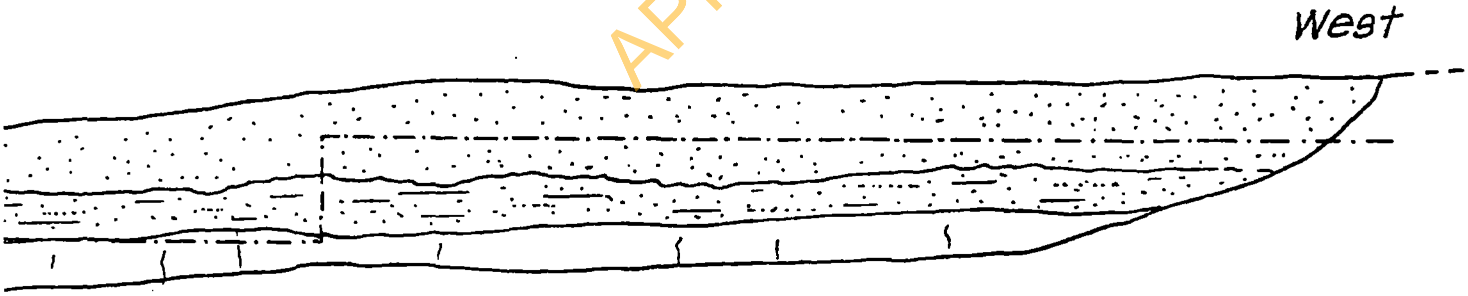
TRENCH #1

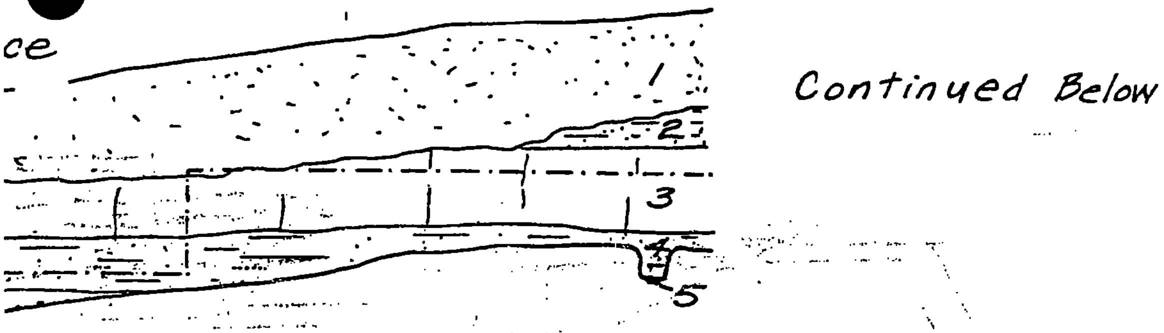


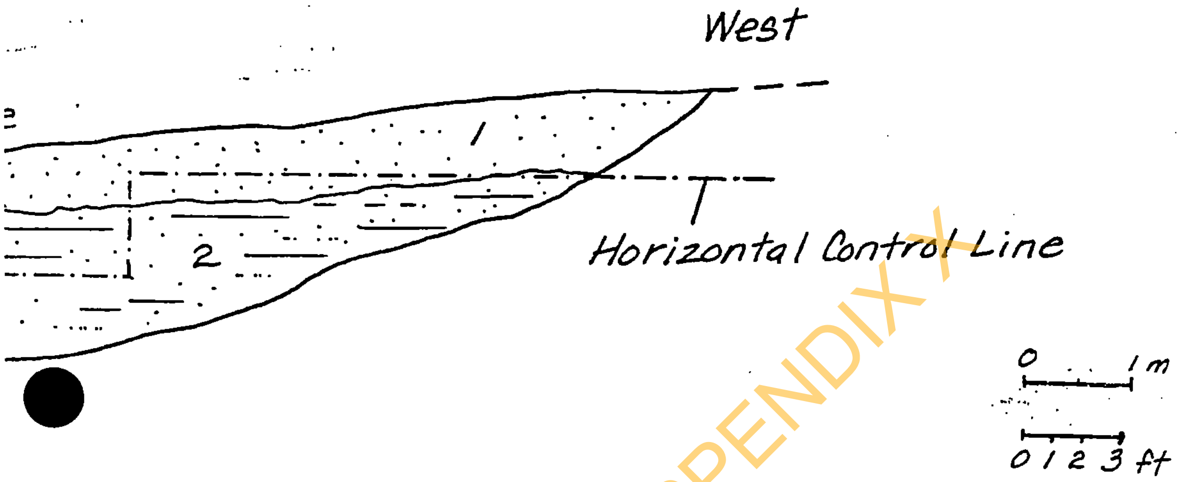
TRENCH #2

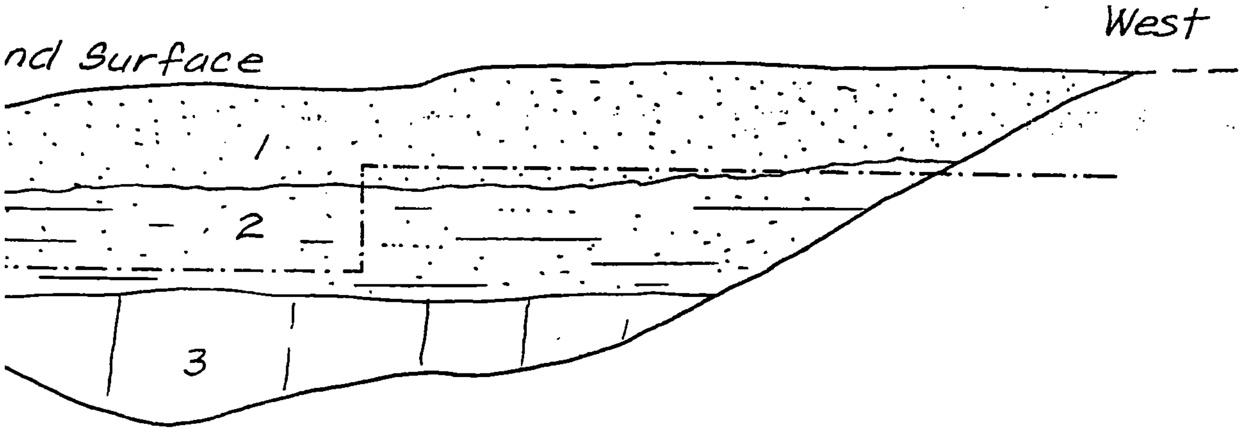



West
1
2
3
4
Horizontal Control Line

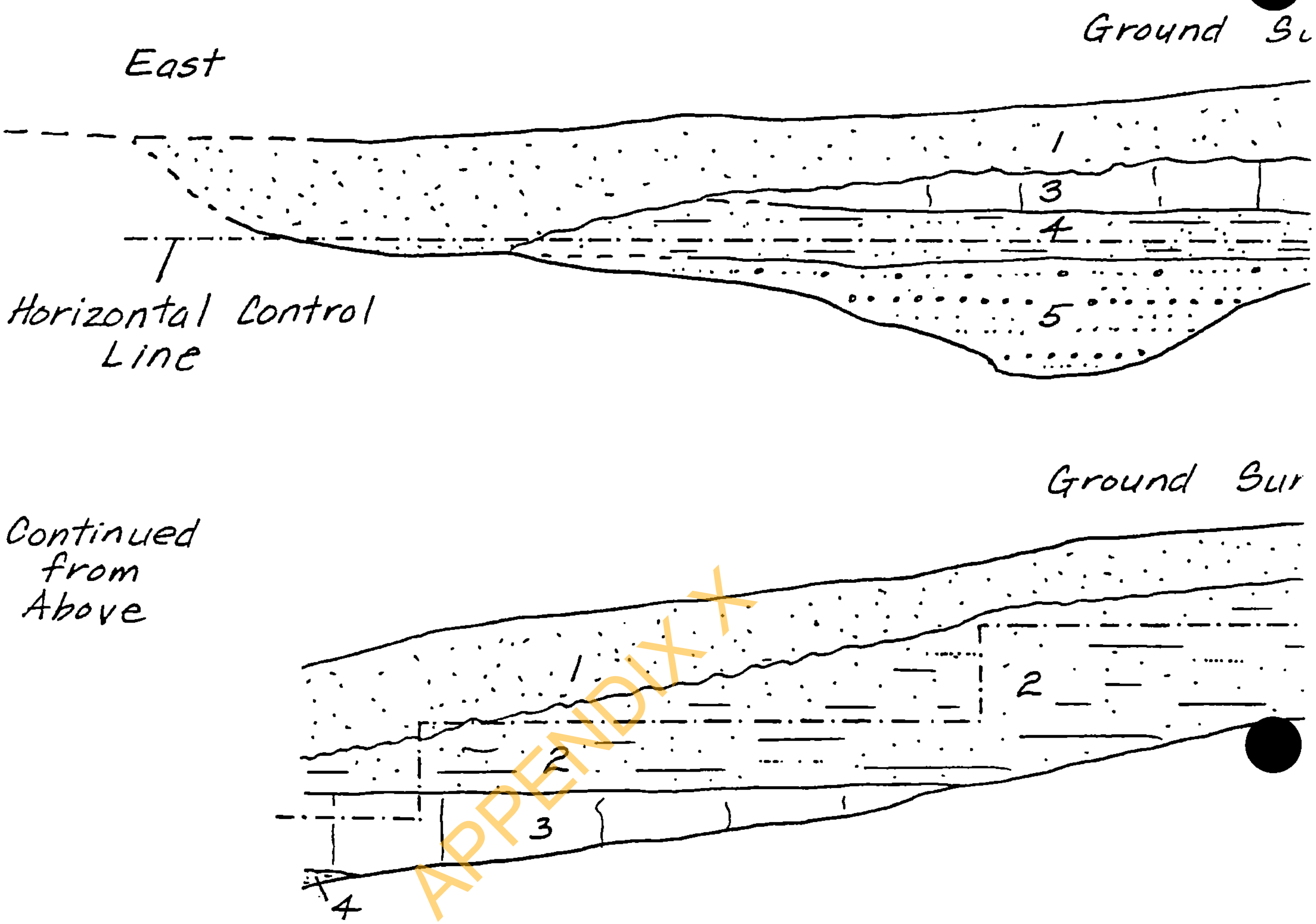

West


ce
1
2
3
4
5
Continued Below

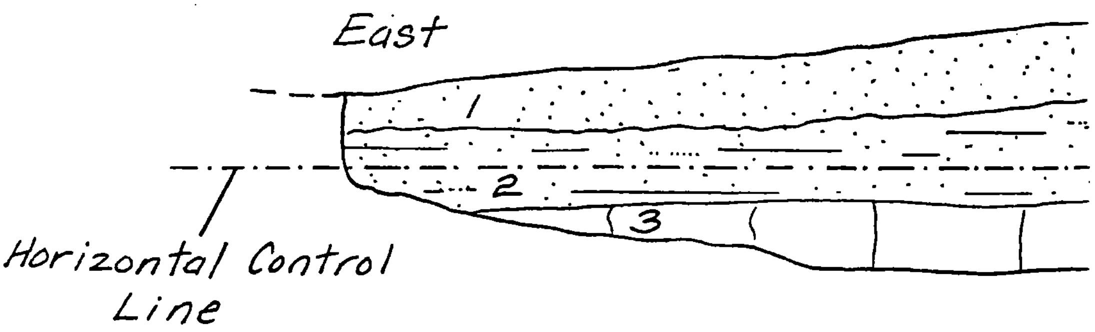

West
1
2
Horizontal Control Line
0 1 m
0 1 2 3 ft


West
nd Surface
1
2
3

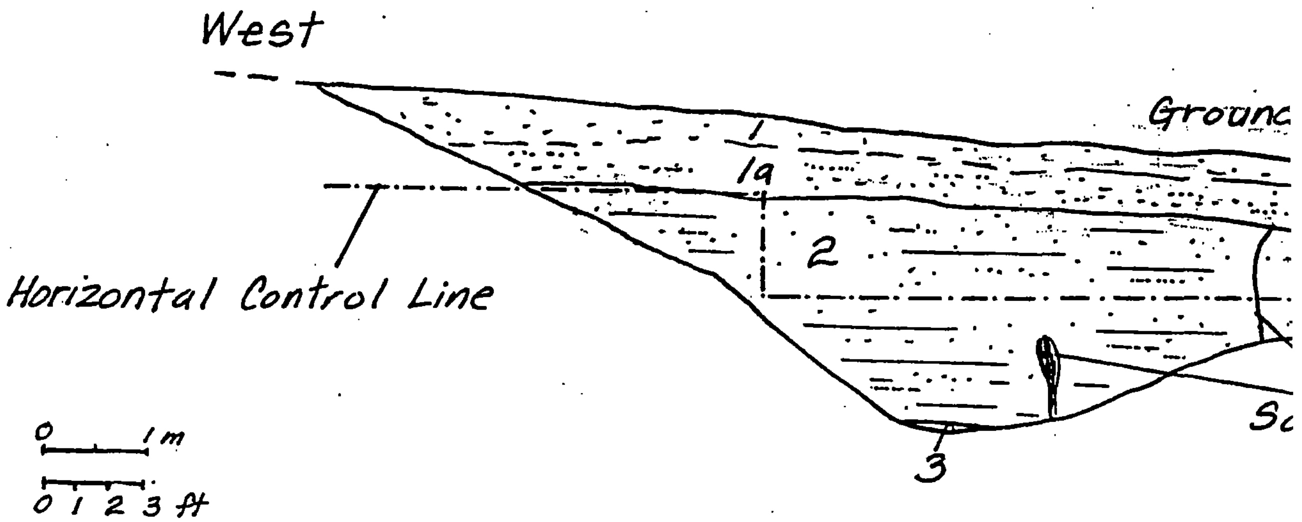
TRENCH # 3



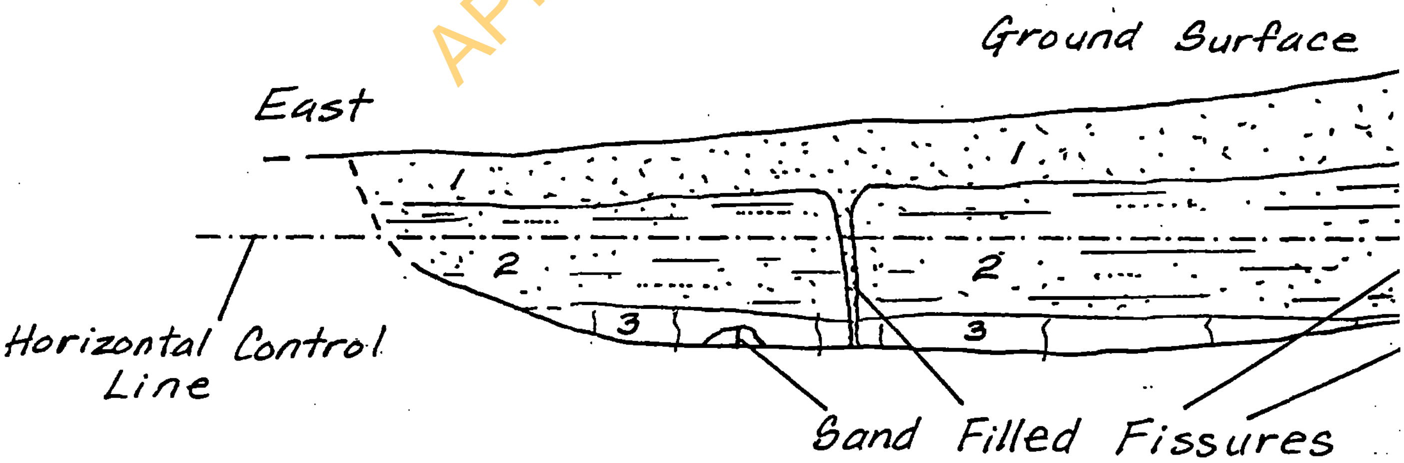
TRENCH # 4

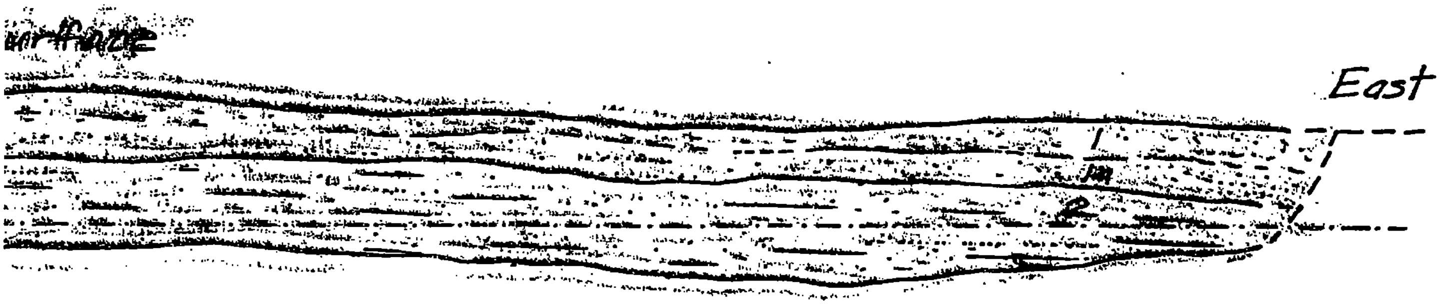


TRENCH # 5

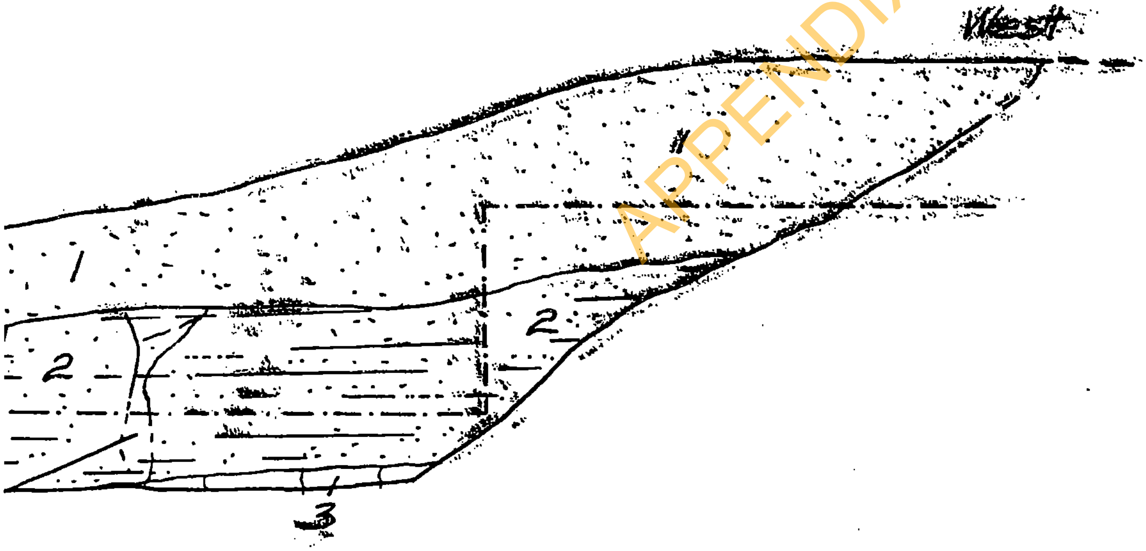


TRENCH # 6





Filled Fissures



Appendix I

APPENDIX I

Inspection Forms

SUVSWD Bayview Class I Landfill
Permit Application

Bayview Landfill Inspection Report

South Utah Valley Solid Waste District

Type of Inspection: Daily/Weekly/Monthly/Quarterly/Semiannually (circle one)

Performed by:______________________________ **Date:** ______________

	Overall Condition	
	Satisfactory	Needs Work*
1. Structures & Roads		
Fences & Gates		
Access Roads		
Ditches		
Screening Berm		
2. Landfill Operations		
Fence & Gates		
Litter Control		
Protective Cover		
Daily Cover		
Intermediate Cover		
Final Cover		
Equipment		
Stormwater Ditches		
3. Leachate Pond		
Fence & Gates		
Depth Gage		
Liner System		
Influent Pipe		
Gravity Sewer		
4. Monitoring Facilities		
Weed Control		
Groundwater Wells		
Gas "Wells"		

*Specify the work needed and the timeframe.

Other Comments:

Appendix J

APPENDIX J

Seismic Analysis

SUVSWD Bayview Class I Landfill
Permit Application

APPENDIX J

SEISMIC ANALYSIS FOR

SOUTH UTAH VALLEY SOLID WASTE DISTRICT
BAYVIEW LANDFILL, CELL 1

ISSUED JULY 1996

PREPARED BY

HDR ENGINEERING, INC.

TABLE OF CONTENTS

REFERENCES

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

A - Design Earthquake Motions
B - Static and Pseudo Static Stability Analyses
C - Site Seismic Response Analyses
D - Seismic Deformation Analyses

SECTION 1.0
INTRODUCTION

1.1 Purpose

The Bayview Landfill (the Site) is located in a Seismic Impact Zone, as defined by the State of Utah Administrative Rules (Utah Department of Environmental Quality, 1996).

This report provides analyses demonstrating that, "...all containment structures...and surface water control systems are designed to resist the maximum horizontal acceleration in lithified earth material for the site."

These analyses have been conducted in accordance with the State of Utah Administrative Rules and EPA guidance presented in *RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities*, (EPA, 1995).

1.2 Scope

The scope of this report includes a literature review of regional and local seismicity, demonstration analyses of the seismic performance of the Site features and a report of findings and conclusions. This report is divided into the following sections:

- Section 2 - Site Conditions - presents soils, geology and seismicity data for the Site.
- Section 3 - Static and Pseudo-Static Stability Analyses - presents stability analyses for Cell 1 components; run-on/run-off controls; and the stormwater-leachate basin.
- Section 4 - Site Specific Ground Motions - presents site specific seismic response of the Site soils and landfill features
- Section 5 - Deformation Analyses - presents estimates of deformations of the Site soils and landfill features
- Section 6 - Findings and Conclusions - discusses the impact of the estimated deformations on the function of the landfill features.

SECTION 2.0
SITE CONDITIONS

2.1 Location

The Site is located in Sections 17 and 18, T9S, R1W, of Utah County. The site is approximately 5.5 miles north of Elberta, Utah and directly west of state Highway 68. The approximate latitude and longitude of the site are 40°02'N by 111°58'W.

2.2 Soils

Information on the site soils has been obtained from regional references, on-site soil borings and on-site monitoring well logs. The locations of the on-site borings and monitoring wells are shown on the Boring Location Plan, Figure 2-1.

The surficial soils consist of mostly Lake Bonneville Group, Provo Formation gravel, sand, silt and clay that were deposited in Lake Bonneville during Pleistocene time (Bissell, 1963). These soils were derived from erosion of the East Tintic Mountains and carried by streams into the ancient lake where they were deposited as beach, bar and spit deposits along the fluctuating shoreline (Hintze and Fuhriman, 1983). This fluctuating lakeshore environment created cycles of saturation and dessication, resulting in well consolidated deposits, commonly cemented with calcium carbonate (Chen and Associates, Inc., 1980).

Nine 50 feet deep soil borings were made on the site during site selection (Chen and Associates, Inc.) and site development (Rollins, Brown and Gunnell, Inc., 1983). The site-specific soil borings in the vicinity of Cell 1 indicate the soils consist of interbedded layers of dense to very dense sand (SW, SP, SC); medium dense to very dense gravel (GM, GW); and firm to very hard, low plasticity silt (ML) and clay (CL). Standard Penetration blow counts range from 13 to refusal in the silts and clays; 30 to 110 in the sands; and 85 to 125 in the gravels. No stratigraphic continuity was noted among the borings (Hintze and Fuhriman, 1983).

The six shallow monitoring wells shown on Figure 2-1 were advanced to nominal depths of 75 feet (Roy F. Weston, Inc., 1994). The soil types and discontinuous stratigraphy were similar to those observed in the soil borings.

The six deep monitoring wells shown on Figure 2-1 were advanced to depths ranging from 165 to 520 feet deep to encounter the "Shallow Pleistocene Aquifer." None of the borings encountered bedrock. These deeper borings indicated a trend to a more cemented soil structure and coarser gravel sizes at depths below 100 feet. The boring logs and gradation data (Bissell, 1963) indicate that cobble and boulder size materials are present.

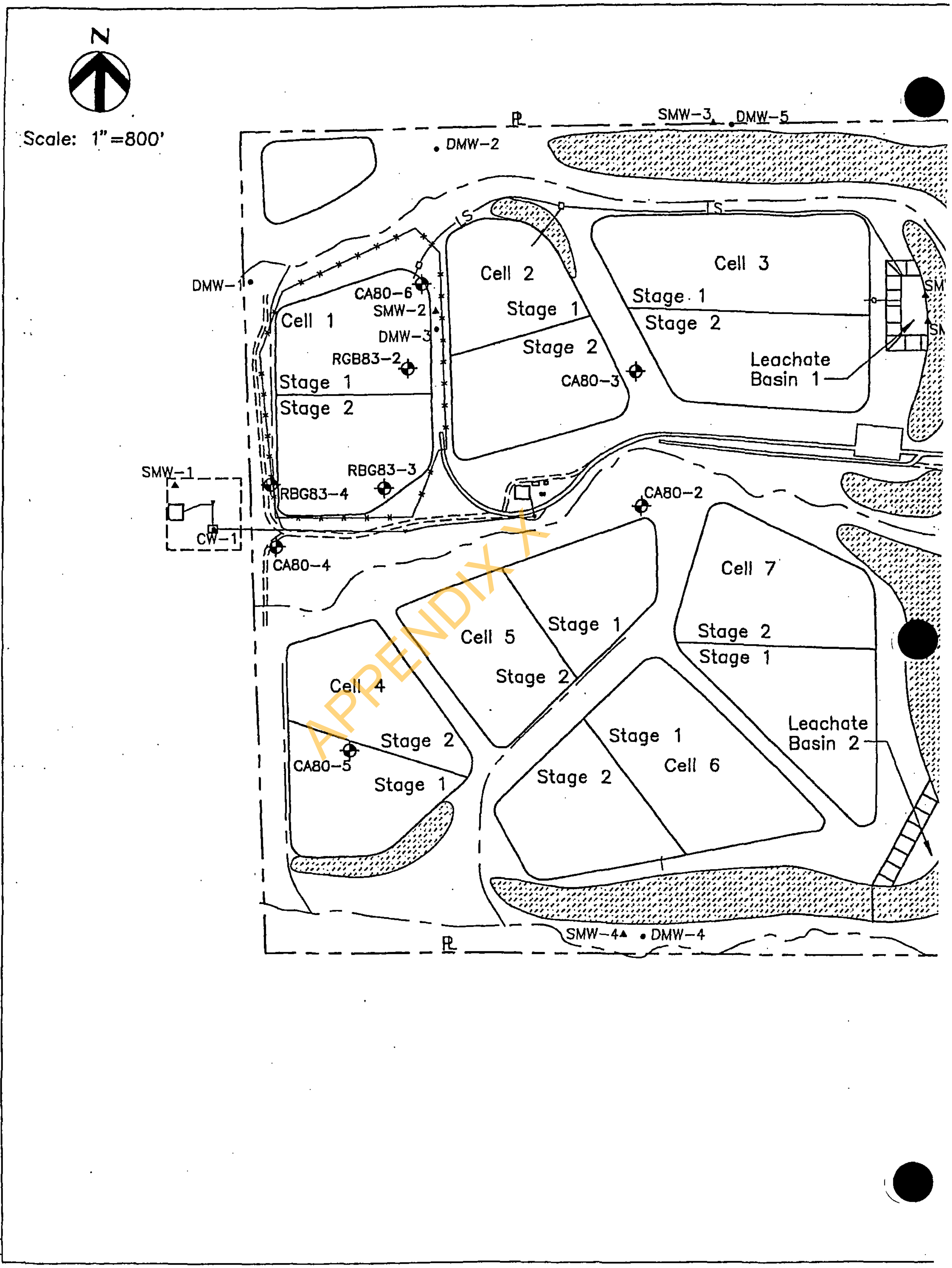


FIG2-1
BAYVIEW
5/7/96

Review of well logs summarized by the United States Geologic Survey (USGS, 1993) indicates that wells in nearby sections have been drilled to 800 feet without encountering bedrock.

Perched water table aquifers have been encountered within the Lake Bonneville Group deposits (Dustin and Merritt, 1980). However, culinary wells are advanced hundreds of feet deep to obtain adequate yield (USGS, 1993).

2.3 Geology

The Site is located in northwestern Goshen Valley, in the Great Basin portion of the Basin and Range Physiographic Province (Figure 2-2, after Dustin and Merritt, 1980). The eastern boundary of the Basin and Range Province is formed by the Wasatch Range, approximately 25 km east of the site (Hecker, 1993).

This Province is characterized by block faulting that has produced roughly parallel fault-block mountains that are separated by flat valley bottoms filled with alluvial and lake deposits.

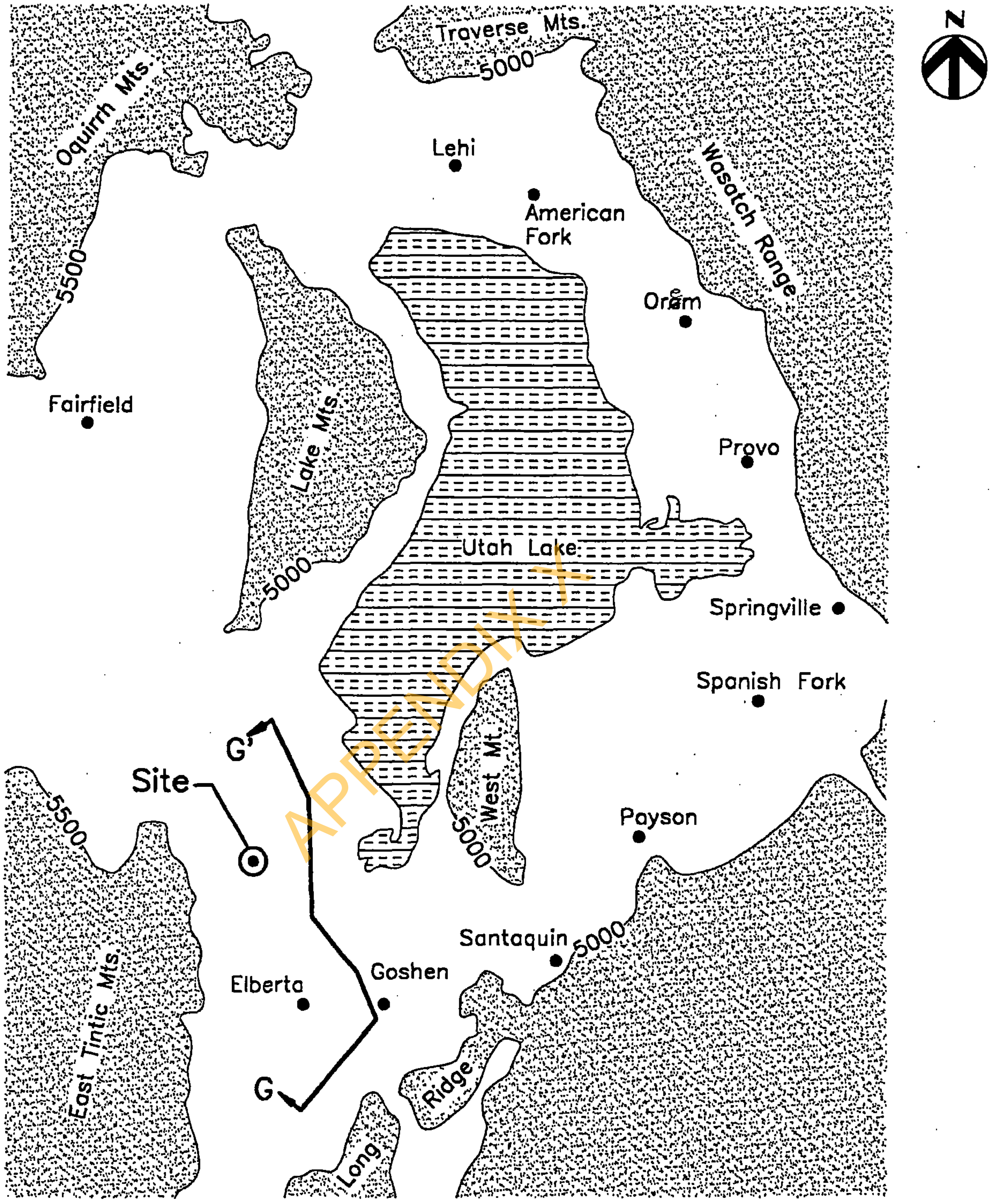
The Goshen Valley is bounded by the East Tintic Mountains on the west, Utah Lake on the north, West Mountain on the east, and Long Ridge on the south.

A cross-section of Goshen Valley, cut as shown on Figure 2-2, is presented on Figure 2-3 (Dustin and Merritt, 1980). The bedrock at the site is interpreted to consist of Miocene Epoch conglomerates, overlying Ogliocene Epoch volcanic flow materials and conglomerates, overlying Paleozoic Era limestones and dolomites.

2.4 Seismicity

The probabilistic bedrock acceleration at the Bayview site is 0.5g (490 cm/sec^2) as determined from the U.S. Geological Survey Map MF-2120 (Figure 2-4, after Algermissen et.al., 1990). The associated probabilistic maximum earthquake magnitude is 7.3 (Algermisson, et.al., 1982). An overview of state-wide seismicity is presented on Figure 2-5 (after Hecker, 1993). Earthquake magnitudes (M) greater than 2, as recorded during the time period 1962-1989, are also shown on this figure.

The maximum credible earthquake (MCE) for the Bayview site cannot be determined from the probabilistic maps. These map accelerations have been established on a probability basis and often eliminate peak accelerations that are judged as having the smallest chance of occurrence.



After Dustin and Merritt, 1980

HDR

HDR Engineering, Inc.

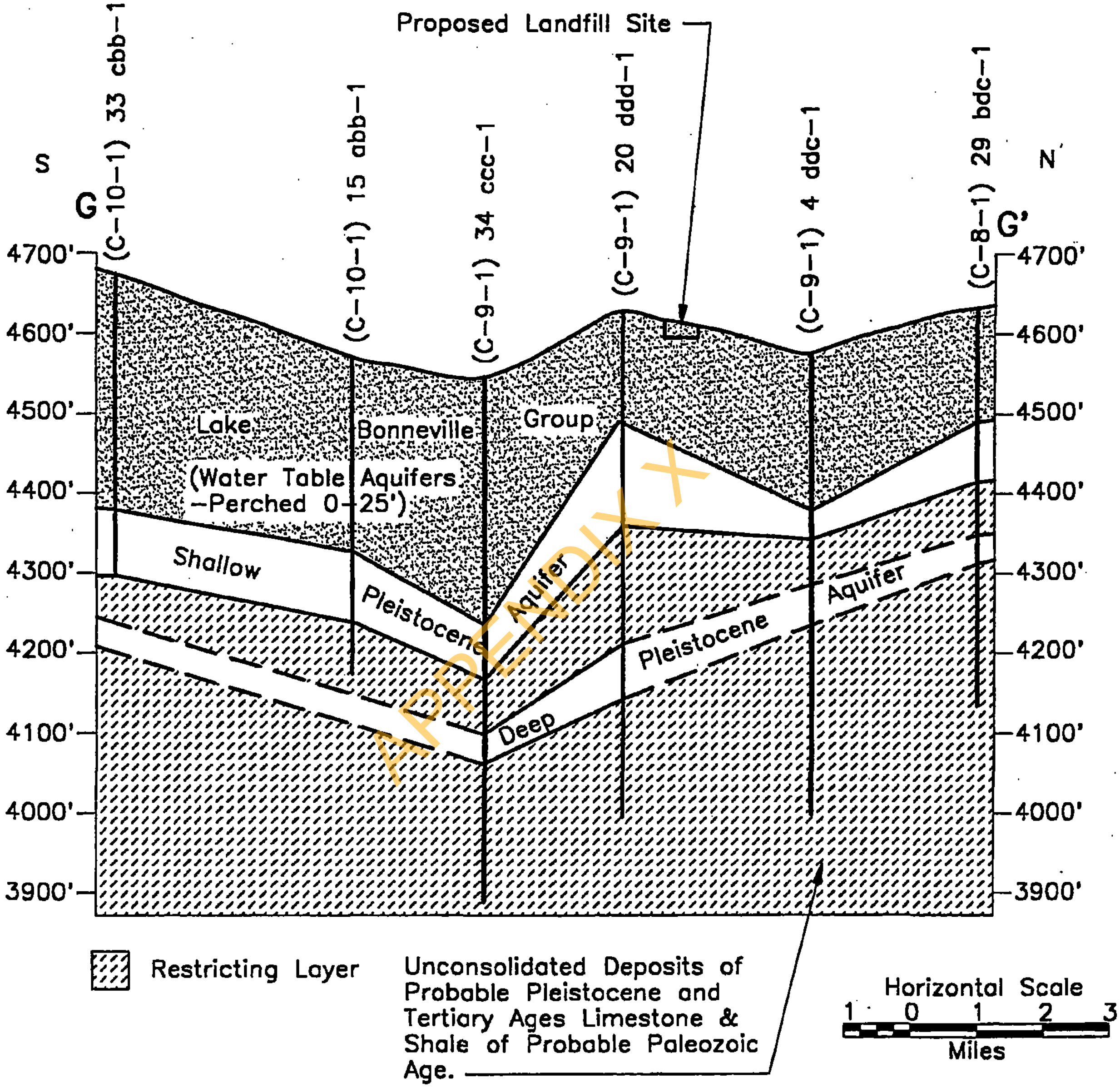
Geographic Location

South Utah Valley Solid Waste District
Bayview Landfill

Date
May 1996

Figure
2-2

FIG2-2
BAYVIEW
5/6/96



Atfer Dustin and Merritt, 1980

HDR Engineering, Inc.

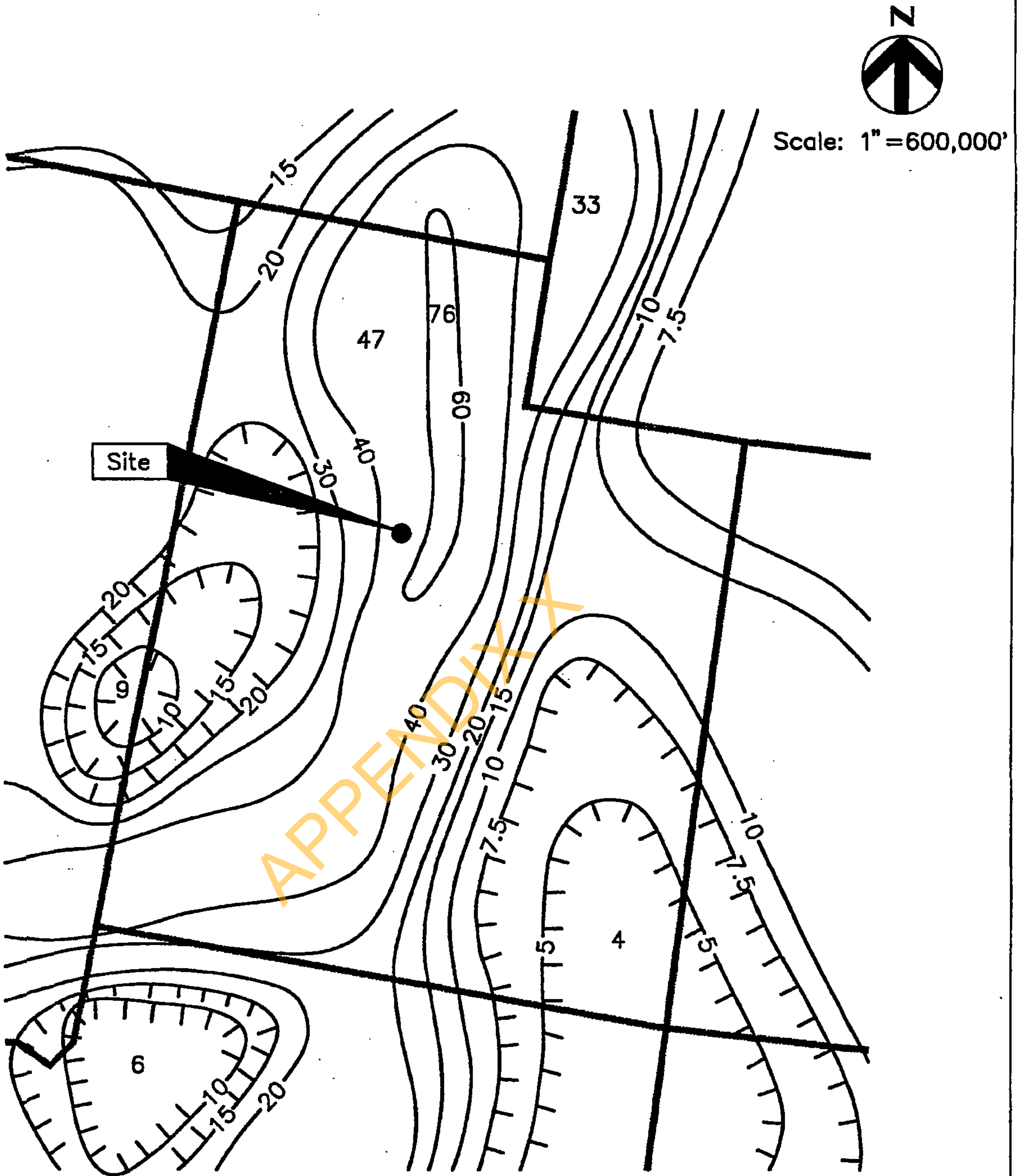
Aquifer Cross Section G-G
Goshea Valley, Utah

South Utah Valley Solid Waste District
Bayview Landfill

Date
May 1996

Figure
2-3

FIG2-3
BAYVIEW
5/6/96



After Algermissen, et.al., 1990

HDR

HDR Engineering, Inc.

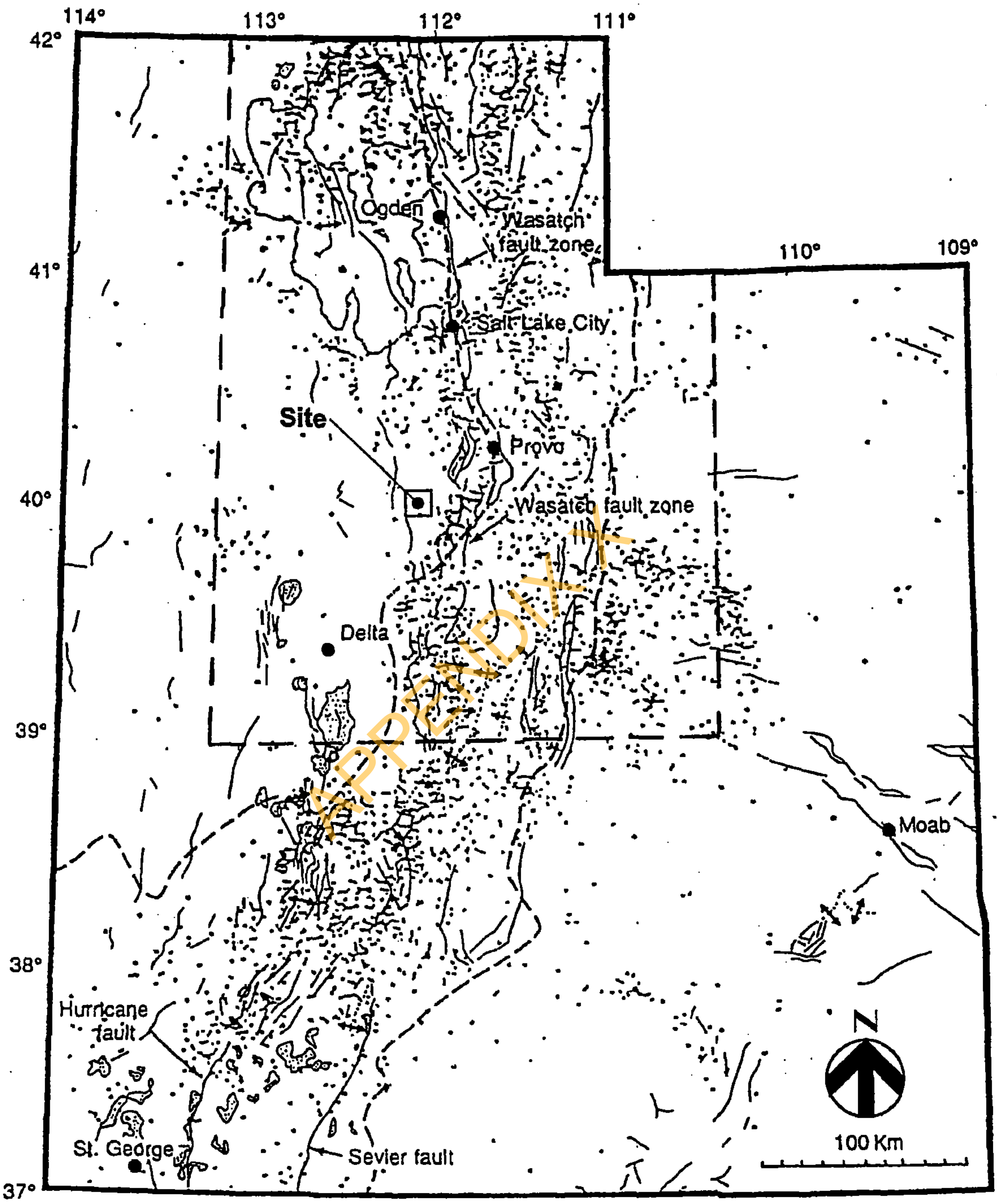
Probabalistic Earthquake Acceleration

South Utah Valley Solid Waste District
Bayview Landfill

Date
May 1996

Figure
2–4

FIG2-4
BAYVIEW
5/6/96



Notes:
1. After Hecker, 1993
2. Dots Represent M>2 Earthquakes
3. Dashed Area Represents Wasatch Fault Region

HDR

HDR Engineering, Inc.

Quaternary Tectonic Features and Seismicity of Utah

South Utah Valley Solid Waste District
Bayview Landfill

Date
May 1996

Figure
2-5

TECTFALT
BAYVIEW
5/8/96

Krinitsky (1989) has proposed a deterministic method, which considers the capability of a fault to produce an earthquake, independent of the probability of occurrence or return period. This method is based on the following premises:

- All earthquakes are caused by movement on faults.
- Whether or not a fault will produce earthquakes can be judged by the recency of previous fault movement.
- The size of the potential earthquake is in proportion to the size of the fault.
- Faults tend to produce earthquakes that are characteristic of each fault.

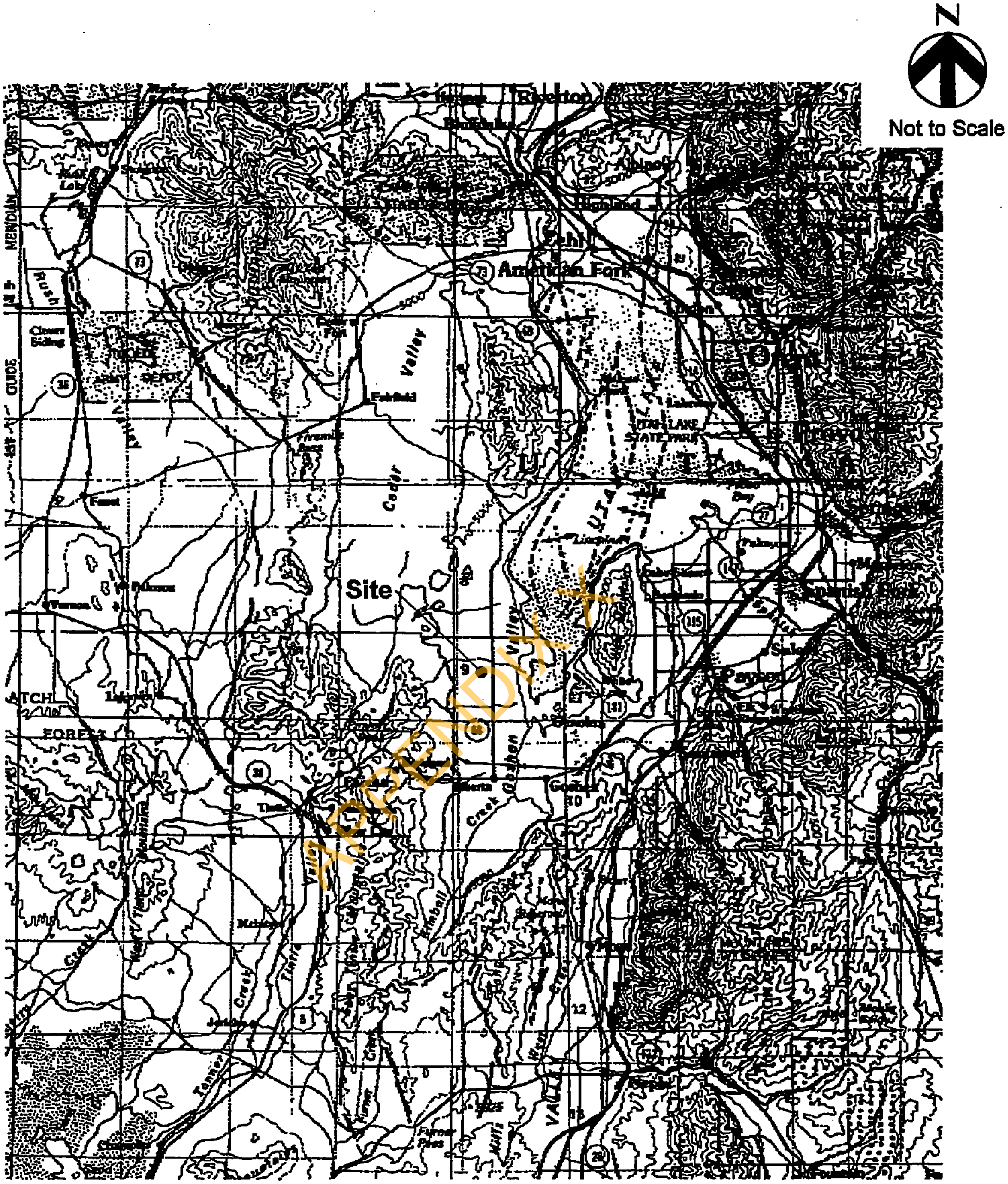
The MCE for a fault can be determined from measurements of fault length and surface displacement. The intensity and acceleration at the site can then be determined from source-to-site distance-attenuation relationships.

The Site is located in the "Wasatch Front region," defined as the geographical area from latitude 38°55'N to 42°30'N, and from longitude 110°25'W to 113°10'W (Hecker, 1993). The average regional recurrence interval for surface-faulting earthquakes (M>6 to 6.5) within the Wasatch Front region is 125 to 300 years. However, earthquakes below this M = 6.5 threshold for surface faulting may be capable of producing damaging ground motions. Faults in the vicinity of the Site are shown on Figure 2-6 (after Hecker, 1993).

The design earthquakes for the Bayview site were determined using the following steps, after Krinitsky (1989):

- Determine capable faults in the site vicinity. Capable faults are active faults judged capable of generating felt earthquakes. The criteria established by the Nuclear Regulatory Commission (Krinitsky, 1989) and the historic tectonic data (Hecker, 1993) were used to screen the potential faults.
- Determine the Maximum Credible Earthquake (MCE) for each capable fault. As discussed previously, the size of the potential earthquake is in proportion to the size of the fault. Relationships presented in Krinitsky (1989) were used to determine the source magnitude (M_0) from fault rupture length and displacement.

Determine the Modified Mercali Intensity (MMI) and maximum horizontal acceleration (MHA) of the MCE at the Bayview site. Source-to-site attenuation, intensity and acceleration at the Bayview site were determined in accordance with Krinitsky (1989).



After Hecker, 1993

HDR

HDR Engineering, Inc.

Quaternary Faults and Folds, Utah

South Utah Valley Solid Waste District
Bayview Landfill

Date
May 1996

Figure
2-6

QUATFALT
BAYVIEW
5/6/96

Details of these analyses are presented in Attachment A. The results of these analyses are presented on Table 2.1.

Table 2.1
Summary of Regional and Site Seismicity

FAULT DATA			SITE DATA	
Fault Name	Distance to Site (Km)	MCE (M_0)	MMI (-)	MHA (%g)
Topliff Hill	22	6.8	VIII	0.30
Mecur	24	7.0	IX	0.30
East Tintic Mountains	18	6.7	VIII	0.38
Wasatch - Provo segment	24-36	7.2	IX	0.40
Long Ridge	14	6.8	VIII	0.47
Wasatch - Nephi segment	18-21	7.2	IX	0.50

2.5 Adopted Design Values

The regional soil stratigraphy and site-specific boring logs were reviewed to establish a design profile for use in subsequent stability analyses. Soil shear strengths were based on the laboratory soil testing program and correlations with the Standard Penetration Test results (Department of the Navy, 1982). Waste shear strengths were based on EPA data (EPA, 1995). The adopted stratigraphy and corresponding physical properties are summarized on Table 2.2.

Table 2.2
Soil Stratigraphy and Physical Properties

DEPTH	UNIT WEIGHT (pcf)	COHESION (c) (psf)	FRICTION (ϕ) (degrees)
Waste	50	150	22
0-100	110	0	40
100-800	120	0	45
800+	120	0	45

The adopted design earthquake for the Bayview landfill site is a MMI = IX, with a corresponding MHA of 0.50g. This deterministic value is consistent with the probabilistic values of $M_0 = 7.3$ and MHA = 0.50g presented by Algermisson (1982, 1990).

SECTION 3.0
STATIC AND PSEUDO-STATIC STABILITY ANALYSES

3.1 Cases Considered

Stability analyses were conducted to determine the factor of safety against slope failures under static and pseudo-static loading conditions. The following landfill features, shown on Figure 2-1, were considered:

3.1.1 Cell 1, Stage 1 Excavation

Stage 1 of Cell 1 was constructed in 1989. The cell was excavated at 1V:4H (25 percent) slopes, to a maximum depth of nominally 40 feet. There was approximately 20 feet of relief in the original ground surface topography, resulting in higher slopes in the northern and western portions of the cell. These higher slopes are broken with a nominal 10 feet wide drainage bench approximately midway on the slope.

3.1.2 Cell 1, Stage 1 Liner and Leachate Collection System

The exisiting liner system for this stage consists of a 40-mil smooth High Density Polyethylene (HDPE) geomembrane sandwiched between two layers of 12 ounce per square yard nonwoven geotextile. The lower geotextile was used to provide a cushion against puncture from the underlying granular subgrade. The upper geotextile was used to provide the tensile strength necessary to resist the forces generated by the 2 feet thick leachate collection/protective cover layer sliding down the 1V:4H smooth HDPE surface.

3.1.3 Cell 1, Stage 2 Excavation

Stage 2 of Cell 1 is proposed for development. The proposed side slopes will match the Stage 1 grades and will consist of 1V:4H (25%) slopes, to a maximum depth of nominally 40 feet along the western and southern portions of the cell. These slopes are consistent with Utah Administrative Code R315-303-4 (3), (UDEQ, 1996).

3.1.4 Cell 1, Stage 2 Liner and Leachate Collection System

The proposed Stage 2 system will consist of a 60 mil smooth HDPE geomembrane over a cushion geotextile or a sand cushion layer.

The leachate collection/protective cover layer will consist of 2 feet of native dune sand. The side slope portions of the leachate collection/protective cover layer will be reinforced with a high strength geotextile to provide cushioning and increased side slope stability under both static and seismic loading.

3.1.5 Cell 1, Stage 2 Operational Filling

It is anticipated that the Stage 2 waste fills will be placed in 10 feet thick lifts, similar to the current operations for Stage 1. Fill slopes typically vary, with steeper slopes occuring at the working face. Two fill heights will be considered: 1) El. 4760±, representing a waste backfill to the initial ground surface, and 2)El. 4780, representing approximately 20 feet of waste above the initial ground surface.

3.1.6 Cell 1, Filled

The proposed waste fill slopes average 5 percent from the crest at El. 4812 to a variable slope break, ranging from El. 4800 to 4780. The side slopes are 1V:4H (25%) from the slope break to original grade. Maximum waste fill heights in Cell 1 are 90 feet above the cell bottom and 50 feet above original grade. These slopes are consistent with Utah Administrative Code R315-303-4 (4) (UDEQ, 1996).

3.1.7 Cell 1, Closure Cap

The proposed Cell 1 final cover liner will consist of a 60 mil Low Density Polyethylene (LDPE) smooth geomembrane; overlain by 12 inches of native sand drainage material; overlain by 6 inches of vegetative cover soil. This liner system will overlay a 12 inch gas transmission layer composed of native sand soils.

3.1.8 Stormwater-Leachate Basin

The Stormwater-Leachate Basin was constructed in 1989. The basin was excavated at 1V:3H slopes, to a maximum depth of nominally 24 feet. The basin is lined with a geotextile cushion layer and a 60 mil smooth HDPE geomembrane. A second, sacrificial 40 mil HDPE geomembrane is used for weather protection on the sideslopes. Six inches of concrete is used on the basin floor.

3.1.9 Adopted Design Cases

These features were consolidated into the following cases for analysis:

- Cell 1, excavation slopes, considering global soil stability.

  Cell 1, liner and leachate collection system (LCRS), considering side slope stability

- Cell 1, Stage 2 operational filling, considering sliding on cell floor liner and LCRS.

- Cell 1, final waste fill slopes, considering waste fill stability.
- Cell 1, closure cap, considering side slope stability
- Stormwater-leachate basin, considering global soil stability.

3.2 Methodology

Both static and pseudo-static conditions were evaluated. The generalized factor of safety against a slope failure is defined as: F.S. = s/τ, where s is the available shear strength of the slope and τ is the shear strength required for just-stable equilibrium.

The Simplified Bishop circular arc method was used to evaluate the global stability of the excavated and filled slopes. The computer program REAME (EPA, 1986) was used to conduct these analyses. This program searches for the potential failure surface which produces the lowest factor of safety. The location of this failure surface is a function of the site geometry (slope angle and height); material stratigraphy and physical properties; and loadings (weight of soil and/or waste above the failure surface).

The sliding block (wedge) method (USACE, 1970) was used to evaluate the sliding stability along the bottom liner and the LCRS system. The computer program UTEXAS3 (Wright, 1991) was used to conduct these analyses. The failure surface is defined by the bottom of the cell.

The infinite slope method (USACE, 1970) was used to evaluate the stability of the cell liner and LCRS system and the closure cap system. Generally, the failure surfaces for these features are defined by planar interfaces with the geosynthetic components.

For a given slope geometry, the interface friction angle, δ, between adjacent materials normally control slope stability, with the lowest interface friction angle controlling overall slope stability. Adopted friction values for the geosynthetic interfaces are presented on Table 3.1.

A minimum static safety factor of 1.3 was adopted (EPA, 1993). The pseudo-static seismic coefficient (k_s) was iterated for both the circular arc and the infinite slope analyses to determine the yield acceleration (k_y) corresponding to a factor of safety of 1.0. This yield acceleration is used to estimate the cell liner, cell leachate collection system and closure cap deformations (Section 5).

Table 3.1

Adopted Interface Friction Values

INTERFACE		FRICTION
LOWER	UPPER	ANGLE (δ)
	LINER AND LCRS	
Soil Subgrade	Cushion Geotextile -or-Sand Cushion	27° 27°
Cushion Geotextile -or- Sand Cushion	Smooth 60 mil HDPE	9° 17°
Smooth 60 mil HDPE	Granular LCRS	17°
	CLOSURE CAP	
Granular Gas Vent	Smooth 60 mil LDPE	25°
Smooth 60 mil LDPE	Granular Cap Drain	25°

The results of the static and pseudo-static stability analyses for the excavations and waste fills are presented in Attachment B and summarized on Table 3.2. The results indicate that the static factor of safety is adequate for the existing and proposed cut and fill slope geometry. The yield accelerations at a safety factor of 1.0 are near the the adopted peak bedrock acceleration, suggesting minimal permanent deformation (EPA, 1995). The estimated magnitude of this deformation is quantified in Section 5.

Table 3.2
Global Stability of Cut and Fill Slopes

FEATURE	STATIC FACTOR OF SAFETY	YIELD ACCELERATION
Cell 1, 1V:4H Excavation Slopes	2.5+	0.52g
Cell 1, 1V:4H Waste Fill Slopes	2.5+	0.44g
Stormwater-Leachate Basin, 1V:3H Slopes	2.5+	0.52g

The results of the static and pseudo-static stability analyses for the cell liner and LCRS and the closure cap are presented in Attachment B and summarized on Table 3.3.

Table 3.3
Stability of Cell 1 Liner and Closure Cap Slopes

FEATURE	δ	F.S.	k_y	T_{reqd}
Side slope liner and LCRS	9	Fig 3-1A	Fig 3-1A	Fig 3-1A
	17	Fig 3-1B	Fig 3-1B	Fig 3-1B
Bottom liner and LCRS	9	3.25	0.15	None
	17	5.18	0.25	None
Closure Cap	25	1.87	0.21	None

Infinite slope analyses at the liner - LCRS interface indicate that the 9° and 17° interfaces will not meet the minimum static factor of safety on a 1V:4H (14 degrees) slope.

Tensile reinforcement, similar to that used in the Stage 1 construction, is required to provide additional resistance against both static and pseudo-seismic forces. Higher reinforcement levels will increase both the static safety factor and the yield acceleration at which permanent displacements begin. The relationship among the interface friction angle (δ), static factor of safety (FS), yield acceleration (k_y) and the required reinforcement strength (T_{reqd}) is shown on Figure 3-1.

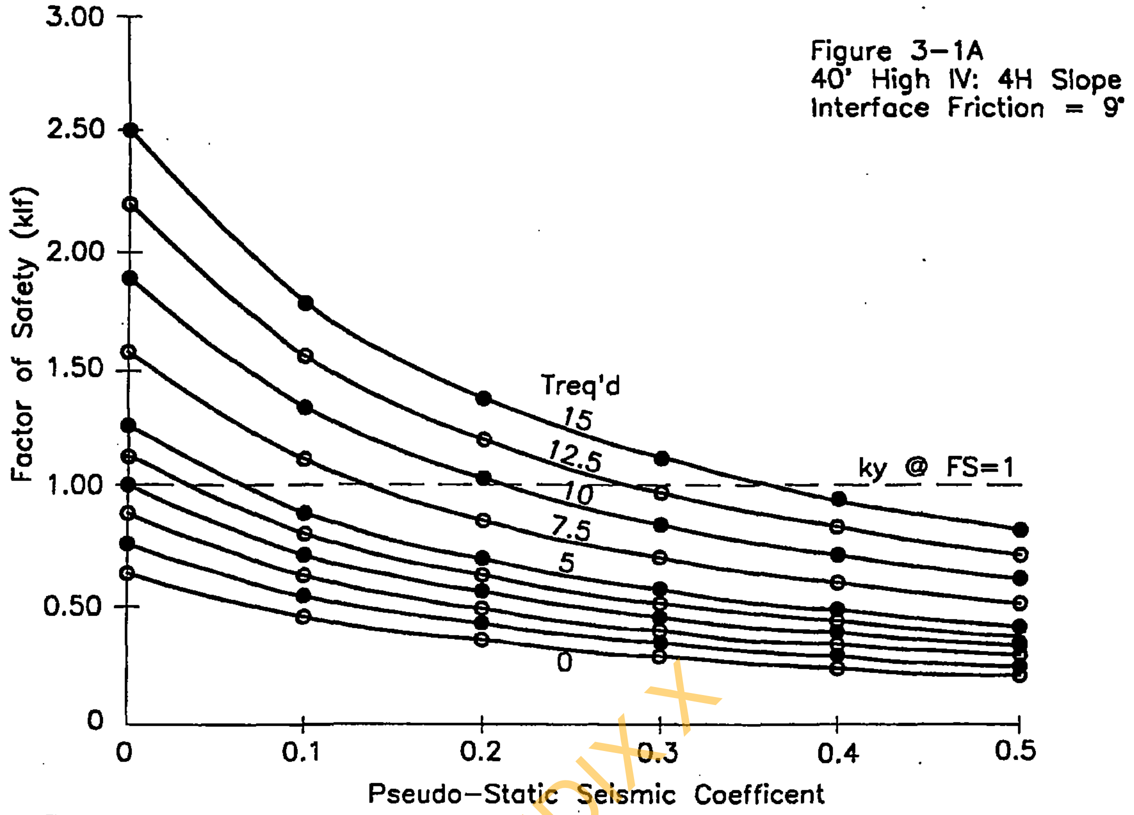


Figure 3–1A
40' High IV: 4H Slope
Interface Friction = 9°

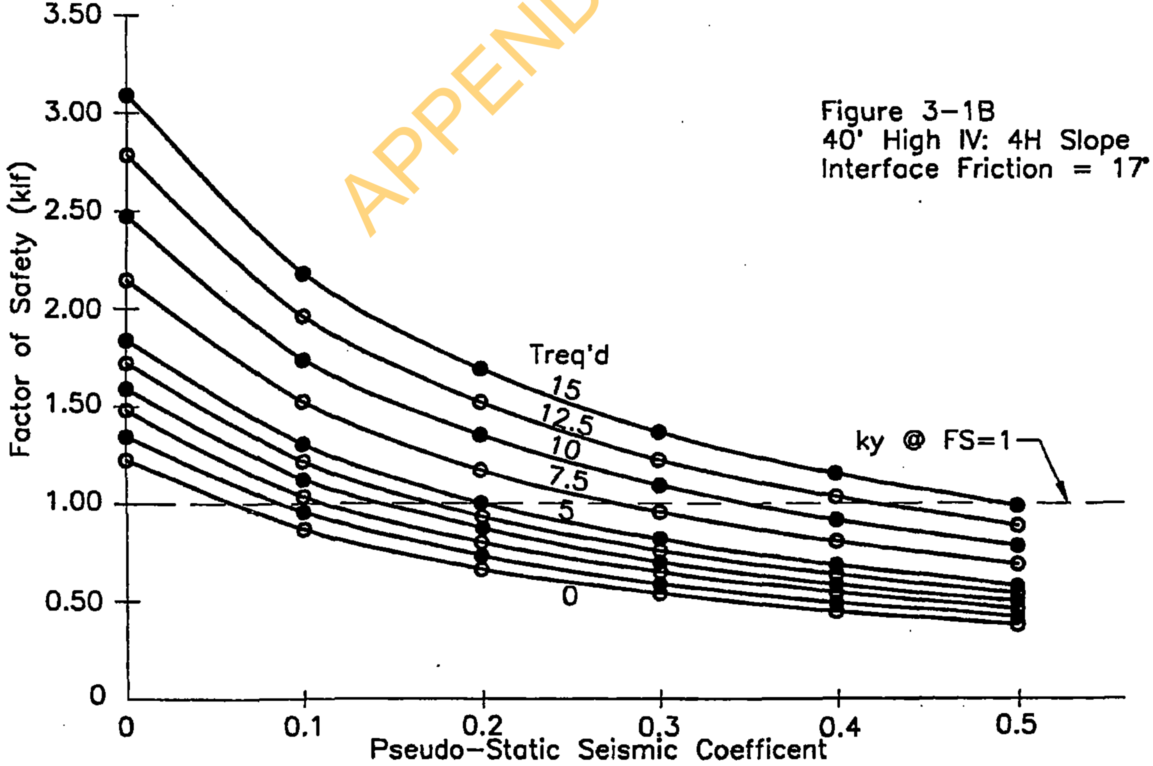


Figure 3–1B
40' High IV: 4H Slope
Interface Friction = 17°

HDR Engineering, Inc.

Cell 1 Liner and LCRS Stability

South Utah Valley Solid Waste District
Bayview Landfill

Date
May 1996

Figure
3–1

fig3–1
BAYVIEW
5/14/96

SECTION 4.0
SITE SPECIFIC GROUND MOTIONS

4.1 Approach

The MHA selected in Section 2 is the maximum horizontal acceleration in the Site bedrock and does not reflect the effect of the overlying soils on the horizontal acceleration developed at the ground surface or at the top of the closed Cell 1.

These ground motions were determined using the "Simplified Analysis" presented in EPA, 1995. This Simplified Analysis is considered appropriate for the Site, based on considerations of the soil stratigraphy and geology. The Simplified Analysis consists of the following steps:

- Classify the site, based on shear wave velocity in the upper 100 feet of the soil column.
- Estimate the free field peak ground surface acceleration (PGA), based on the site classification and the MHA in the bedrock.
- Estimate the peak acceleration at the top of the landfill, based on the PGA and the seismic response of the waste.

Details of this Simplified Analysis are presented in Attachment C.

4.2 Site Classification

The shear wave velocity was based on Utah Geologic Survey (UGS) experience in the area (Christensen, 1996) and the Site-specific soil borings.

The UGS has classified this area of Utah County as a "hard site," generally considered as having a shear wave velocity greater than 400 meters per second (m/s).

Site-specific shear wave velocities were computed from the Standard Penetration Test data (N values) reported in the geotechnical investigations (Department of the Navy, 1982). The computed average shear wave velocity in the upper 100 feet was 386 m/s.

Based on this range in shear wave velocity, the site was classified as a medium stiff (200 to 375 m/s) to stiff (375 to 700 m/s) site (EPA, 1995). Both classifications were carried forward for further analysis.

4.3 Free Field Acceleration

The PGA was determined from the site classification and the MHA (Section 2). Both the medium stiff and stiff classification ranges were considered. The results are presented on Table 4.1.

Table 4.1
Free Field Acceleration (PGA)

SITE CLASSIFICATION	MHA	PGA
Medium Stiff	0.50	0.50
Stiff	0.50	0.50

The results of this analysis indicate the Site soils provide little attenuation or amplification to the MHA. This is a function of both the site soils and the high MHA (EPA, 1995).

4.4 Peak Acceleration at Top of Landfill

The peak acceleration at the top of the landfill was determined from the PGA and the seismic response of the waste mass, using the recommended "soft-soil site" amplification curve of Idriss (EPA, 1995).

The results of this analysis indicate a peak acceleration of 0.42 g at the top of the landfill, suggesting a slight attenuation through the waste mass.

SECTION 5.0
DEFORMATION ANALYSIS

5.1 Approach

Permanent deformations resulting from the adopted design seismic event were estimated for each of the landfill features identified in Section 3. Chart solutions, based on the "Newmark sliding block" method, were used to quantify these deformations.

The Newmark method is based on the premise that permanent deformations (U) accumulate along a failure surface when the acceleration in the failure mass (a_{max}) exceeds the yield acceleration (k_y) along the failure surface. The yield acceleration and the mass acceleration for each feature are presented in Sections 3 and 4, respectively.

The results of these analyses are presented in Attachment D and discussed in the following.

5.2 Allowable Deformation

An upper limit of 30 cm.(1 foot) was established as the maximum tolerable deformation for the geosynthetic components (EPA, 1995). For a 40 feet high 1V:4H slope with a slope length of 165 feet, the elongation from this maximum 1 foot of deformation would be 0.6 percent (1ft ÷ 165ft, as a percent). The yield elongation for 60 mil smooth HDPE is nominally 12 percent (NSF, 1991), indicating adequate reserve elongation capacity.

5.3 Excavations and Fills

The permanent deformations for the Cell 1 excavations, the stormwater-leachate basin and the Cell 1 waste fill were estimated from the Makdisi and Seed chart version of the Newmark method (EPA, 1995). These estimates are presented in Table 5.1.

Table 5.1
Estimated Permanent Deformations

FEATURE	k_y	a_{max}	U
Cell 1 excavations	0.52g	0.50g	<1 cm.
Cell 1 waste fill	0.44g	0.50g	<1 cm
Stormwater-leachate basin	0.52g	0.50g	<1 cm

The estimated deformations are minor and reflect the high yield strength along the failure surface relative to the mass acceleration from the design earthquake event.

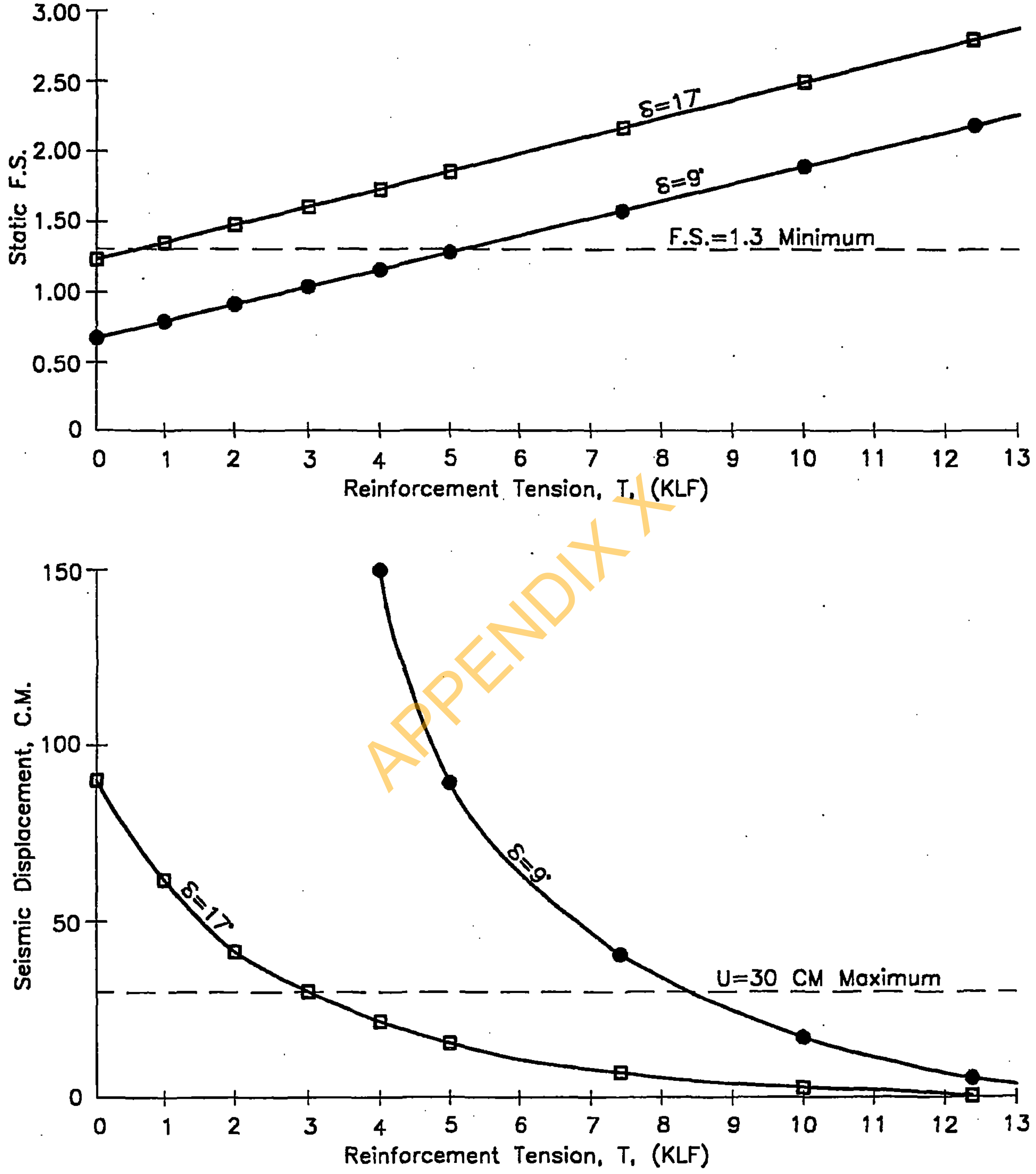
5.4 Liner and LCRS Systems

The permanent deformations for the Cell 1 liner and LCRS were estimated from the Makdisi and Seed chart version of the Newmark method (EPA, 1995). These estimates are presented on Figure 5-1.

As shown on Figure 5-1, the 9° cushion geotextile - smooth HDPE interface requires a minimum tensile reinforcement of 8.2 kips per linear foot (klf) to limit permanent deformations to less than 30 cm. The 17° sand cushion - smooth HDPE interface requires a minimum tensile reinforcement of 3.5 kips per linear foot (klf) to limit permanent deformations to less than 30 cm.

5.5 Closure Cap System

The permanent deformations for the Cell 1 closure cap were estimated from the Hynes and Franklin chart version of the Newmark method (EPA, 1995). None of the estimated deformations exceeded 10 cm. No reinforcement is required for this proposed clossure cap.



HDR Engineering, Inc.

Cell 1 Liner and LCRS Deformations

South Utah Valley Solid Waste District
Bayview Landfill

Date
May 1996

Figure
5–1

fig5-1
BAYVIEW
5/14/96

SECTION 6.0
FINDINGS AND CONCLUSIONS

6.1 Findings

The Bayview Landfill site is located in a Seismic Impact Zone. Both deterministic and probabilistic methods indicate a peak bedrock acceleration of 0.5g. The dense granular soils offer little amplification or attenuation of the bedrock acceleration through the overlying soil column.

The cut and fill slopes and run-on/run-off structures have adequate static factor of safety and indicate minimal permanent deformations (U<1 cm) in response to the design seismic event.

The side slope liner and LCRS system will require a geosynthetic reinforcement to increase the static factor of safety and limit permanent deformations in response to the design seismic event. Either sand or a geotextile can be used as a cushion beneath the geomembrane.

The closure cap system has an adequate static factor of safety and indicates acceptable permanent deformation (U<10 cm) in response to the design seismic event. No reinforcement is required.

6.2 Conclusions

These demonstration analyses indicate that the proposed Bayview landfill components are designed to resist the "maximum horizontal acceleration" at the site.

REFERENCES

Bissell, H.J., (1963), *Lake Bonneville: Geology of Southern Utah Valley, Utah*, Geological Survey Professional Paper 257-B.

Algermissen S.T. et.al., (1982), *Probablilistic Estimates of Maximum Acceleration and Velocity in Rock in the Contiguous United States*, Open-File Report 82-1033, U.S. Geological Survey.

Algermissen S.T. et.al., (1990), *Probablilistic Earthquake Acceleration and Velocity Maps for the United States and Puerto Rico*, Map MF-2120, U.S. Geological Survey.

Chen and Associates, Inc, (1980), "Proposed Sanitary Landfill Site, City of Provo, Utah," Job No. 130U, Chen and Associates, Inc. Salt Lake City.

Christensen, G.E., (1996), Utah Geological Survey, personal communication.

Department of the Navy, (1982), *Soil Mechanics Design Manual 7.1*, NAVFAC DM-7.1, Department of the Navy, Naval Facilities Engineering Command, Alexandria, VA.

Dustin, J.D. and Merritt, L.B., (1980), *Hydrogeology of Utah Lake with Emphasis on Goshen Bay*, Water Resources Bulletin 23, Utah Geological and Mineral Survey, Salt Lake City, UT.

Environmental Protection Agency, (1986), *Geotechnical Analysis for Review of Dike Stability (GARDS)*, EPA 1600/2-86-109a, Office of Research and Development, Cincinnati, OH.

Environmental Protection Agency, (1993), *Solid Waste Disposal Facility Criteria*, EPA/530/R-93-017, Office of Solid Waste and Emergency Response, Washington, DC.

Environmental Protection Agency, (1995), *RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities*, EPA/600/R-95/051, Office of Research and Development, Washington, DC.

Hecker, S., (1993), *Quaternary Tectonics of Utah With Emphasis on Earthquake-Hazard Characterization*, Bulletin 127, Utah Geological Survey, Salt Lake City, Utah.

Hintze, L.F. and Fuhriman, D.K., (1983), "Geohydrology Study of Proposed West Lake Landfill Site."

Krinitsky, E.L., (1989), " Empirical Earthquake Ground Motions for an Engineering Site with Fault Sources: Tooele Army Deport, Utah," *Bulletin of the Association of Engineering Geologists*, Vol. XXVI, No. 3, pps. 283-308.

National Sanitation Foundation, (1991), *Flexible Membrane Liners*, ANSI/NSF 54-1991, NSF International, Ann Arbor, MI.

Rollins, Brown and Gunnell, (1983), Letter report of Subsoil Investigation Submitted to Provo City Department of Engineers. Rollins, Brown and Gunnell, Inc., Provo, Utah..

U.S. Army Corps of Engineers, (1970), *Stability of Earth and Rock-Fill Dams*, Engineer Manual EM 1110-2-1902, Department of the Army, Corps of Engineers, Office of the Chief of Engineers, Washington, DC.

U. S. Geological Survey, (1993). *Selected Hydrologic Data For Southern Utah and Goshen Valleys, Utah, 1890-1922*, Utah Hydrologic Data Report No. 50: prepared in cooperation with the Utah Department of Natural Resources, Division of Water Rights.

Utah Department of Environmental Quality, (1996), *Solid Waste Permitting and Management Rules*, Utah Administrative Code (R315-301 through 320), Revised as of February 15, 1996, State of Utah, Department of Environmental Quality, Division of Solid and Hazardous Waste, Salt Lake City, UT.

Roy F. Weston, Inc., (1994), *Application For A Permit To Operate A Class I Landfill. Bayview Landfill, South Utah SW District,* Roy F. Weston, Inc., Denver, CO.

Wright, S.G., (1991), *UTEXAS3, A Computer Program for Slope Stability Calculations*, Shinoak Software, Austin, TX.

ATTACHMENT A
DESIGN EARHTQUAKE MOTIONS

Job No.

No.

HDR Computation

Project BAYVIEW LANDFILL	Computed RLD	Date 4-29-96
Subject LANDFILL SEISMIC EVALUATION	Checked PHP	Date 6-4-96
Task SELECT DESIGN EQ & MOTIONS	Sheet 1	Of

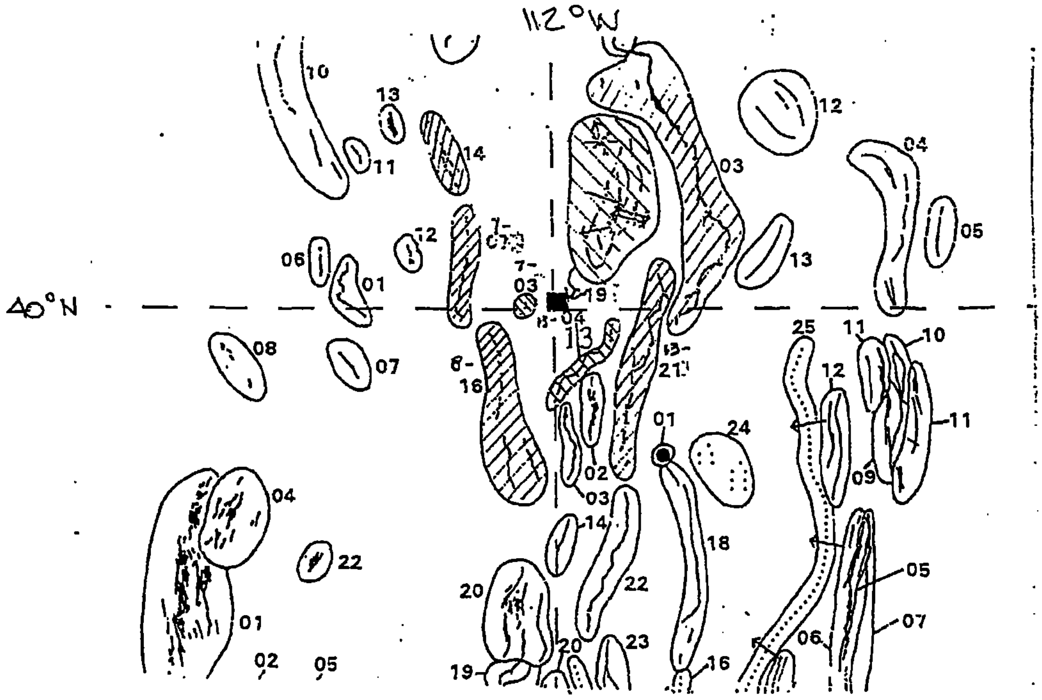
OBJECTIVES : 1) DETERMINE CAPABLE FAULTS AROUND SITE
2) DETERMINE MAXIMUM CREDIBLE EARTHQUAKE (MCE) OF CAPABLE FAULTS
3) DETERMINE MMI, a_g AT SITE

REFERENCES : 1) HECKER, S., (1993), "QUATERNARY TECTONICS OF UTAH WITH EMPHASIS ON EARTHQUAKE-HAZARD CHARACTERIZATION," BULLETIN 127, UTAH GEOLOGICAL SURVEY, SALT LAKE CITY, UT.
2) KRINITSKY, E.L., (1989), "EMPIRICAL EARTHQUAKE GROUND MOTIONS FOR AN ENGINEERING SITE WITH FAULT SOURCES: TOOELE ARMY DEPOT, UTAH," BULLETIN OF THE ASSOCIATION OF ENGINEERING GEOLOGISTS, VOL. 26, NO. 3, 1989, PPS 283-308.

---

1. DETERMINE CAPABLE FAULTS AROUND SITE

USE REF 1, APPENDIX C INDEX MAP, BELOW
SELECTED FAULTS SHOWN AS HATCHED



Job No.

No.

HDR Computation

Project

Computed

Date

Subject

Checked

Date

Task

Sheet 2

Of

1.2 EVALUATE FOR "CAPABLE" OR 'ACTIVE FAULTS

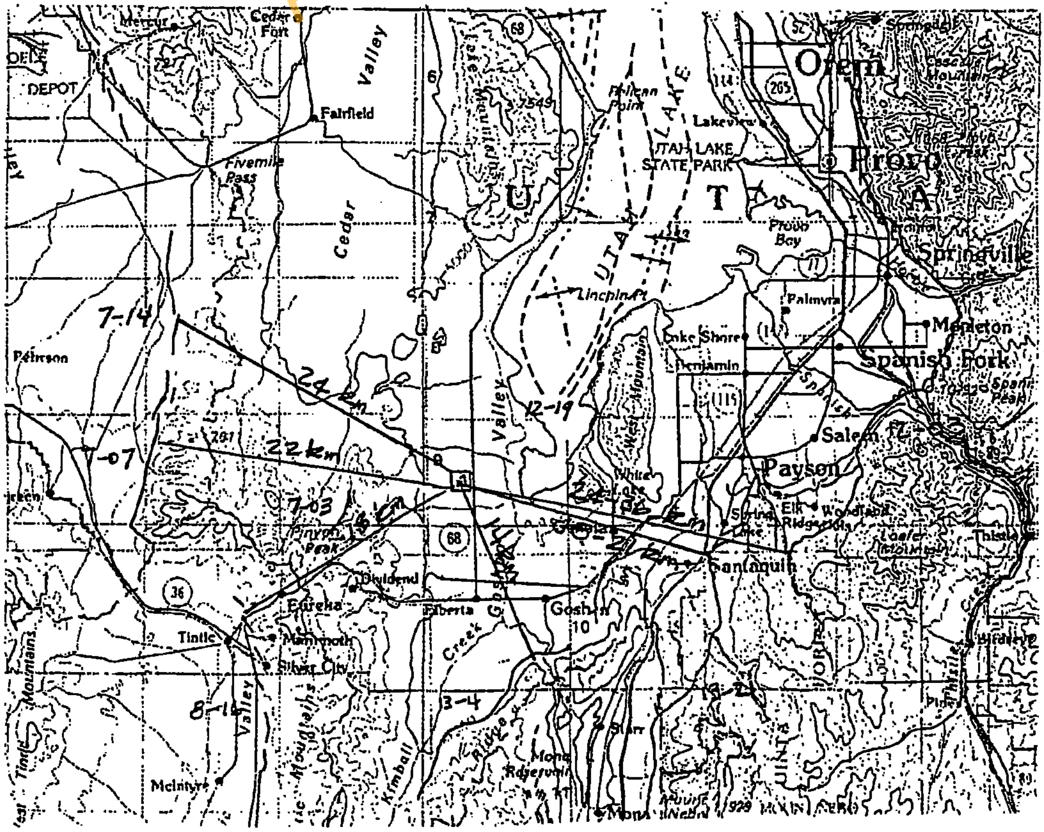
CRITERIA (REF 2, APPENDIX E) BASED ON NRC TITLE 10, CHPT 1, PART 100

- MOVEMENT AT/NEAR GROUND SURFACE WITHIN PAST 35,000 YR, AND/OR
- MACROSEISMIC INSTRUMENTATION TO DEMONSTRATE DIRECT RELATIONSHIP W/FAULT, &/
- STRUCTURAL RELATIONSHIP TO ANOTHER CAPABLE FAULT

FROM REF 1, APPENDIX A (PORTIONS ATTACHED)

CAPABLE FAULTS:

TOPLIFF HILL	(7-7)	SHOWN BELOW, FROM REF 1, PLATE 16.
MERCUR	(7-14)	
EAST TINTIC	(8-16)	
WASATCH-PROVO	(12-3)	
LONG RIDGE	(13-4)	
WASATCH-NEPHI	(13-21)	



NAME OR LOCATION OF FEATURE (Location No.)	AGE OF MOST RECENT MOVEMENT $X10^3$ years	SLIP RATE mm/yr (Time Period $X10^3$ years ago)	RECURRENCE INTERVAL $X10^3$ years (Time Period $X10^3$ years ago)	DISPLACEMENT PER EVENT meters	RUPTURE LENGTH kilometers
Goose Creek Mountains (faults) (6-18)					
Parameter values:	Quaternary(?)				

Age Criteria : fault control of bedrock-alluvium contact
References : Doelling and others, 1980

NAME OR LOCATION OF FEATURE (Location No.)	AGE OF MOST RECENT MOVEMENT $X10^3$ years	SLIP RATE mm/yr (Time Period $X10^3$ years ago)	RECURRENCE INTERVAL $X10^3$ years (Time Period $X10^3$ years ago)	DISPLACEMENT PER EVENT meters	RUPTURE LENGTH kilometers
Grouse Creek and Dove Creek Mountains (faults) (6-19)					
Parameter values:	middle to late Pleistocene(?)				

Age Criteria : faulted colluvium
References : Compton, 1972
Comments : Faults are mapped as Quaternary(?) (plate 1) where faulting has uplifted Pliocene to early Pleistocene gravels, and where lineaments and aligned springs suggest active faulting (Todd, 1973; this study).

NAME OR LOCATION OF FEATURE (Location No.)	AGE OF MOST RECENT MOVEMENT $X10^3$ years	SLIP RATE mm/yr (Time Period $X10^3$ years ago)	RECURRENCE INTERVAL $X10^3$ years (Time Period $X10^3$ years ago)	DISPLACEMENT PER EVENT meters	RUPTURE LENGTH kilometers
Sheeprock fault zone (7-1)					
Parameter values:	late Pleistocene(?)				

Age Criteria : scarp morphology
References : Barnhard and Dodge, 1988
Comments : From scarp-profile data, the Sheeprock scarps appear to be older than the Topliff Hill, Stansbury, and Mercur scarps (location nos. 7-7, 7-10, and 7-14). Diffusion-equation modeling of the scarps, which probably represent multiple events (with a cumulative displacement of <11.5 meters), yielded an age of about 53,000 years (Hanks and others, 1984). In contrast, Everitt and Kaliser (1980) concluded that scarp morphology suggests a possible Holocene age for latest faulting. The embayed character of the range front suggests a long period of inactivity preceding the recent episode of faulting (Everitt and Kaliser, 1980).

NAME OR LOCATION OF FEATURE (Location No.)	AGE OF MOST RECENT MOVEMENT $X10^3$ years	SLIP RATE mm/yr (Time Period $X10^3$ years ago)	RECURRENCE INTERVAL $X10^3$ years (Time Period $X10^3$ years ago)	DISPLACEMENT PER EVENT meters	RUPTURE LENGTH kilometers
Silver Island Mountains - southeast side (fault) (7-2)					
Parameter values:	3 - 5 ?			0.6 ?	

Age Criteria : artifacts
References : D.B. Madsen, written and verbal communication, 1987, 1988
Comments : Lake Bonneville deposits are vertically displaced 0.6 meters across the fault. Diagnostic artifacts in faulted sediments near fault-line springs and correlations between basal spring-related peat layers and Holocene lake levels provide an estimate of the time of origin of the springs and, presumably, the time of faulting.

NAME OR LOCATION OF FEATURE (Location No.)	AGE OF MOST RECENT MOVEMENT $X10^3$ years	SLIP RATE mm/yr (Time Period $X10^3$ years ago)	RECURRENCE INTERVAL $X10^3$ years (Time Period $X10^3$ years ago)	DISPLACEMENT PER EVENT meters	RUPTURE LENGTH kilometers
Cedar Valley - south end (fault) (7-3)					
Parameter values:	late Quaternary(?) 0-500,000 yr				

Age Criteria : range-front morphology
References : Anderson and Miller, 1979
Comments : Anderson and Miller (1979) indicated that Quaternary(?) alluvium may be displaced, and they mapped the fault as late Pleistocene (<500,000 years old), although an aerial photo check for this study yielded no clear evidence of faulted alluvium.

NAME OR LOCATION OF FEATURE (Location No.)	AGE OF MOST RECENT MOVEMENT X10^3 years	SLIP RATE mm/yr (Time Period X10^3 years ago)	RECURRENCE INTERVAL X10^3 years (Time Period X10^3 years ago)	DISPLACEMENT PER EVENT meters	RUPTURE LENGTH kilometers
Silver Island Mountains - west side (fault) (7-4)					
Parameter values:	Quaternary(?)				

Age Criteria : fault control of bedrock-alluvium contact
References : Moore and Sorensen, 1979

Lakeside Mountains - west side (fault) (7-5)					
Parameter values:	Quaternary(?)				

Age Criteria : fault control of bedrock-alluvium contact
References : Moore and Sorensen, 1979; Young, 1955
Comments : Arabasz and others (1989) included the fault (queried as to state of activity) in a compilation of seismic sources in the region. They reference T.P. Barnhard as having identified the feature as a lineament that he feels is probably not related to faulting because it parallels topographic contours, and thus may be a shoreline feature.

Lookout Pass - south side (fault) (7-6)					
Parameter values:	Quaternary(?)				

Age Criteria : fault control of bedrock-alluvium contact
References : Moore and Sorensen, 1979

Topliff Hill fault zone (7-7)					
Parameter values:	late Pleistocene(?) 10,000—130,000 yr				12 *

Age Criteria : scarp morphology; shoreline relations
References : Barnhard and Dodge, 1988
Comments : Everitt and Kaliser (1980) interpreted a faulted alluvial fan as younger than the Bonneville shoreline, whereas Barnhard and Dodge (1988) mapped the same surface as wave-etched and older than the Bonneville shoreline. From scarp-profile data, the Topliff Hill scarps appear to be younger than the Sheeprock, Stansbury, and Mercur fault scarps (location nos. 7-1, 7-10, and 7-14). The Topliff Hill scarps show evidence for recurrent movement, with a cumulative maximum displacement of 5.8 meters. South of the scarps, the range-front (mapped as a Quaternary(?) fault, plate 1) rises in elevation, is linear and faceted, and has an active alluvial apron (Everitt and Kaliser, 1980).

* FROM KRINITSKY, REF 2.

NAME OR LOCATION OF FEATURE (Location No.)	AGE OF MOST RECENT MOVEMENT X10^3 years	SLIP RATE mm/yr (Time Period X10^3 years ago)	RECURRENCE INTERVAL X10^3 years (Time Period X10^3 years ago)	DISPLACEMENT PER EVENT meters	RUPTURE LENGTH kilometers

Saint John Station fault zone
(7-13)

Parameter values:	late Pleistocene				

Age Criteria : presence of scarps on alluvium; relations to lacustrine features
References : Barnhard and Dodge, 1988; Everitt and Kaliser, 1980
Comments : Small-displacement faults in alluvium (not shown on plate 1) lie several kilometers southeast of the Saint John Station fault zone within a portion of the Tooele Army Depot and are buried beneath an unfaulted soil estimated to be older than 125,000 years (Krinitzsky, 1989: U.S. Department of the Army, 1989).

Mercur fault zone
(7-14)

Parameter values:	late Pleistocene(?) 10,000 - 130,000 yr			0.9-1.9 *	16 *

Age Criteria : scarp morphology; lacustrine stratigraphy
References : Barnhard and Dodge, 1988
Comments : Reinterpretation of a trench log that was presented by Everitt and Kaliser (1980) as evidence for post-Bonneville faulting shows a pre-existing fault scarp buried by Bonneville transgressive deposits. A shallow trench excavated across a feature identified by Everitt and Kaliser (1980) as a fault scarp in a post-lake terrace likewise revealed a buried pre-Bonneville fault scarp. From scarp profile data, the Mercur scarps record displacements of 1.8-5.6 meters and appear to be younger than the Sheeprock and Stansbury scarps (location nos. 7-1 and 7-10), but older than the Topliff Hill scarps (location no. 7-7). Faulted alluvium exposed in a mining shaft, together with an uplifted bedrock pediment, suggest a minimum of 60 meters of Quaternary displacement on the fault (Everitt and Kaliser, 1980).

northern Oquirrh fault zone
(7-15)

Parameter values:	9 - 13.5	0.21 - 0.53 *dm (<9 - 13.5)		2.9 - 4.8 h	

Age Criteria : scarp morphology; shoreline relations
References : Barnhard and Dodge, 1988; Everitt and Kaliser, 1980
Comments : Scarp morphology is more similar to the Bonneville shoreline scarps than to the Drum Mountains fault scarps (location no. 8-1), which have been dated at about 9,000 years old. This suggests an age close to but not greater than the Provo shoreline, which has been offset across the fault. Compound scarps, with as much as twice the height of the single-event scarps (and with surface displacements of up to 7.3 meters), record an older, pre-Bonneville displacement modified by lacustrine erosion. Hanks and others (1984) considered the Oquirrh Mountain fault scarps to be older than the Bonneville shoreline and tentatively assigned them a poorly constrained diffusion-model age of 32,000 years. The southern half of the mapped fault is expressed as a prominent break in slope at the base of the range front, where Barnhard and Dodge (1988) found no direct evidence of post-Bonneville faulting. However, Tooker and Roberts (1988) mapped several short faults in Bonneville and post-Bonneville(?) deposits at the north end of the range-front embayment. Because the calculated slip rate is based on scarp height rather than displacement, the values may be too high by a factor of two. Youngs and others (1987, in press) inferred a slip rate of 0.1-0.2 mm/yr for the fault.

* FROM KRINITSKY, REF 2.

NAME OR LOCATION OF FEATURE (Location No.)	AGE OF MOST RECENT MOVEMENT X10³ years	SLIP RATE mm/yr (Time Period X10³ years ago)	RECURRENCE INTERVAL X10³ years (Time Period X10³ years ago)	DISPLACEMENT PER EVENT meters	RUPTURE LENGTH kilometers

East Tintic Mountains
- west side (faults)
(8-16)

Parameter values: middle to late Pleistocene | | | | 4-9 (PLATE 1) ←
10,000 - 750,000 yr

Age Criteria : scarp morphology
References : Bucknam and Anderson, 1979a
Comments : Alluvial scarps appear on aerial photos as isolated, highly dissected remnants surrounded by several different ages of unfaulted alluvium and appear to be among the oldest in western Utah. Steep faceted bedrock spurs north and south of Silver City (Goode, 1959) suggest active uplift north of the scarps. In addition, faults in alluvium (not shown on plate 1) were observed northwest of Eureka, about 2 kilometers east of the range front (Goode, 1959). Anderson and Miller (1979) mapped buried Quaternary(?) faults extending to the north and south of the alluvial scarps. These faults and faults that form bedrock-alluvium contacts at the south end of the East Tintic Mountains (Morris, 1987) are mapped as Quaternary(?) on plate 1. On the east side of the mountain range, faults in pre-Bonneville alluvium (not shown on plate 1) were recognized in a tunnel at the south end of Goshen Valley (Goode, 1959).

Maple Grove (faults)
(8-17)

Parameter values: late Pleistocene(?) | | |

Age Criteria : scarp morphology; fault control of bedrock-alluvium contact
References : Bucknam and Anderson, 1979a; Oviatt, 1992
Comments : Crestal rounding and dissection suggest that fault scarps are older than the Bonneville shoreline. The steepness of scarp slopes (up to 47°) is attributed to the coarseness of the alluvium. Evidence of Holocene faulting, present in scarps to the north and south, was not noted for the Maple Grove scarps. The scarps represent displacements of up to 12 meters.

Scipio (faults)
(8-18)

Parameter values: late Pleistocene | | |

Age Criteria : scarp morphology
References : Bucknam and Anderson, 1979a; Oviatt, 1992
Comments : Evidence of Holocene faulting, present in scarps to the north and south, is not seen in the subdued morphology of the Scipio fault scarps. Faults mapped as Quaternary(?) in age on plate 1 are concealed valley-fill structures.

NAME OR LOCATION OF FEATURE (Location No.)		AGE OF MOST RECENT MOVEMENT X10^{3} years	SLIP RATE mm/yr (Time Period X10^{3} years ago)	RECURRENCE INTERVAL X10^{3} years (Time Period X10^{3} years ago)	DISPLACEMENT PER EVENT meters	RUPTURE LENGTH kilometers
Towanta Flat graben (12-2)						
	Parameter values:	130 - 500		60 (130-500)	0 n	

Age Criteria : soil development; cobble weathering

References : Martin and others, 1985; Nelson and Weisser, 1985

Comments : Some workers (Hansen, 1969a, 1969b; Utah Geological and Mineral Survey, 1977) have assigned late Pleistocene and Holocene ages to the scarps, based on estimated ages of faulted deposits and the freshness of the scarps. Nelson and Weisser (1985) concluded that there is no significant net tectonic displacement across the graben (although the throw across individual scarps has been 2.1-2.6 meters per event). This lack of net slip, together with an orientation that differs from planes defined by microseismicity, the limited extent of the scarps, and an average recurrence interval that is less than half as long as the time since the most recent event, suggests that the faults may not have a seismogenic origin and may not be capable of significant future surface-rupturing events. A reported late Pleistocene fault east of Tabiona that lies along the projected strike of the Towanta Flat faults (Ritzma, referenced in Anderson and Miller, 1979) shows no displacement in bedrock. An anomalous linear drainage used to infer the presence of the fault (Ritzma, referenced in Martin and others, 1985) is apparently a strike stream.

Wasatch fault zone - Provo segment (12-3)						
	Parameter values:	0.5 - 0.6 e 500-600 yr	1.1 - 1.3 (<5.3) 1.0 - 1.7 (<15)	2.4 (<5.3)	1.5 - 3.0 n	69.5

Age Criteria : ^{14}C; TL; lacustrine stratigraphy

References : Lund and others, 1991; Machette, 1989, in press; Machette and others, 1991, 1992

Comments : Based on fault geometry and apparent recency of movement as indicated by scarp morphology, Machette and others (1986) tentatively subdivided the Provo segment (as originally proposed by Schwartz and Coppersmith, 1984) into three subsegments (from north to south, the American Fork, Provo "restricted sense," and Spanish Fork). However, based on the timing of the last two events deciphered from trench studies, the entire length of the Wasatch fault zone in Utah Valley appears to be a single segment (Machette, 1989, in press; Lund and others, 1991; Machette and others, 1991). The penultimate event occurred about 2,600-3,000 years ago; based on results from the northern end of the segment (at American Fork), the prior two events occurred about 5,300 and 5,500-8,000 years ago. A conflicting chronology of faulting from a site near the southern boundary of the segment (at Water Canyon, where two events have occurred in the last 1,000 years) may be explained by spatial overlap of the Nephi and Provo segments, whereby events from both segments are recorded at the site (Machette, 1989, in press; Ostenaa, 1990). The slip-rate and recurrence data are from the American Fork site, where rates of activity appear to have been constant during post-Bonneville time. However, at the Hobble Creek site (east of Spanish Fork), there is two-to-three times more displacement recorded in Bonneville transgressive deposits than in Provo-age regressive deposits. Twenty to thirty meters of displacement in just a few thousand years represents slip rates as high as 10 mm/yr and may be related to the presence of Lake Bonneville. Six or seven post-Provo events are inferred to have occurred at the site, yielding an average recurrence interval of 1,700-2,600 years. The Woodland Hills splay of the Spanish Fork subsegment has evidence for three or four events, totaling 3 meters of displacement, in about the past 130,000 years, yielding a slip rate of 0.01-0.02 mm/yr and an average recurrence interval of about 40,000-65,000 years. Movement on the splay apparently occurs during only some of the events on the main fault, although the most recent event on the splay occurred about 1,000 years ago and may be correlative with the most recent event on the main fault. Movement on a couple of short subsidiary faults at the northern end of Utah Valley appears to have occurred during, and may be related to, the recession of Lake Bonneville.

NAME OR LOCATION OF FEATURE (Location No.)	AGE OF MOST RECENT MOVEMENT X10^3 years	SLIP RATE mm/yr (Time Period X10^3 years ago)	RECURRENCE INTERVAL X10^3 years (Time Period X10^3 years ago)	DISPLACEMENT PER EVENT meters	RUPTURE LENGTH kilometers
East Canyon fault - southern segment (12-17)					
Parameter values:	late Quaternary(?)				12 ?

Age Criteria : range-front morphology

References : Sullivan, Nelson, and others, 1988

Comments : For the purpose of seismic-hazard assessment, values for slip rate, recurrence interval, and single-event displacement are inferred to be similar to those calculated for the Morgan fault (location no. 11-18), based on similarities in fault length and escarpment morphology. The estimated maximum credible earthquake for the fault is 6.5-6.75 (M_s).

Bear River fault zone (12-18)					
Parameter values:	2.4 ? e	0.8 - 2.7 ? (<4.6)	2.3 - 2.4+ ? (<4.6)	<1 - 5+ n	34-40

Age Criteria : ^{14}C

References : West, 1988 , 1989, in press

Comments : The Bear River fault zone (BRFZ) extends from southeast of Evanston, Wyoming to the Uinta Mountains in Utah, where it ends at a complex juncture with the North Flank fault. The trend of scarps at the southern end of the zone is sharply discordant with the main, northerly trend of faulting, perhaps due to the buttressing effect of the Uinta Mountains. The fault lies between the leading edges of the Absaroka and Darby-Hogsback thrust faults and appears to be a new (Holocene) feature superimposed on older thrust-belt structure. The independent seismic potential of the Absaroka and Darby-Hogsback faults is unclear. A 5-kilometer-long Holocene scarp (the Martin Ranch scarp), together with at least 10 kilometers of related surface warping, lies west of the BRFZ in Wyoming and is coincident with the Absaroka thrust. The age of most recent movement on this fault is consistent with that on the BRFZ, suggesting that it represents movement that is simultaneous and sympathetic with that on the main fault zone. Scarp heights and tectonic displacements increase markedly from north to south along the BRFZ. The southernmost scarp, which displaces Pinedale glacial deposits, is 15+ meters high, suggesting that it may have formed from more than two Holocene events. The range in slip rates reflects the range in displacement along the fault zone. *Fault-activity parameters for the BRFZ are comparable to values for the Wasatch fault zone (see location nos. 6-6, 11-22, 12-3, 12-6, and 13-21).* There is no evidence to suggest that the BRFZ is segmented. Documented ages of faulting (4,600 and ~2,400 years ago) are considered to be maximum estimates because the residence times of organic matter in the dated soils have not been incorporated into the ages. The youthfulness of faulting is demonstrated by the presence of beheaded and reversed drainages, sag ponds, and displacements in the youngest flood-plain deposits. Northern portions of the BRFZ in Utah are expressed only as drainage lineaments or are obscured by recent landsliding. Assuming that it is planar and basement-penetrating, the BRFZ may be capable of producing earthquakes as large as 7.5 (M_s).

Utah Lake (faults and folds) (12-19)					
Parameter values:	latest Pleistocene to Holocene(?) 0 – 30,000 yr				

Age Criteria : lacustrine stratigraphy; depth to faulted sediments

References : Brimhall and Merritt, 1981

Comments : Fault locations, based on widely spaced seismic-reflection transects, are uncertain. Acoustical profiles show a persistent 8-15 meter-deep layer identified as the Provo Formation that is displaced from <2 to 5 meters across individual faults and folds beneath the lake. Machette (1989, in press) interpreted the layer as lake bottom sediments probably deposited during the regressive phase of Lake Bonneville. The reflection profiles suggest that displacements decrease upward in strata above the marker horizon and occur within several meters of the lake bottom.

NAME OR LOCATION OF FEATURE (Location No.)	AGE OF MOST RECENT MOVEMENT $X10^3$ years	SLIP RATE mm/yr (Time Period $X10^3$ years ago)	RECURRENCE INTERVAL $X10^3$ years (Time Period $X10^3$ years ago)	DISPLACEMENT PER EVENT meters	RUPTURE LENGTH kilometers
Salt Creek area (fold) (13-1)					
Parameter values:	Quaternary(?)				

Age Criteria : deposit characteristics
References : Witkind and Sprinkel, 1982
Comments : *Pleistocene(?) deposits are tilted northwestward on the flank of a small diapiric fold.*

Juab Valley - west side (faults) (13-2)					
Parameter values:	late Quaternary				

Age Criteria : presence of scarps on alluvium
References : R.M. Robison, written communication, 1989; Sullivan and Baltzer, 1986
Comments : The scarps, which show a cumulative displacement of ~1 meter, are most likely tectonic, but alternatively may be related to lateral spreading. Although not defined by a bedrock escarpment, a fault has been inferred along the east side of Juab Valley near the contact between Tertiary volcanic rocks and unconsolidated valley fill. The east-dipping fault is thought to intersect the Wasatch fault zone well above the seismogenic crust and thus to be antithetic to the Wasatch fault zone and not an independent seismic source.

Long Ridge - west side (fault) (13-3)					
Parameter values:	middle to late Pleistocene(?)				

Age Criteria : presence of scarps on alluvium
References : Meibos, 1983
Comments : The fault both cuts and is covered by "older" unconsolidated alluvium and forms the contact between bedrock and alluvium along much of its length.

Long Ridge - northwest side (fault) (13-4)					
Parameter values:	Quaternary(?) 0 - 1,650,000 yr				10 (PLATE 1)

Age Criteria : range-front morphology
References : Sullivan and Baltzer, 1986

NAME OR LOCATION OF FEATURE (Location No.)	AGE OF MOST RECENT MOVEMENT X10^3 years	SLIP RATE mm/yr (Time Period X10^3 years ago)	RECURRENCE INTERVAL X10^3 years (Time Period X10^3 years ago)	DISPLACEMENT PER EVENT meters	RUPTURE LENGTH kilometers

Price River area (faults)
(13-19)

Parameter values:	Quaternary(?)				

Age Criteria : geomorphic position; structural setting; presence of lineaments
References : Howard and others, 1978; Osterwald and others, 1981
Comments : Some faults within the zone displace pre-Wisconsin-age pediments less than 2 meters. Most are normal faults that dip steeply or vertically. Structural relations indicate that the fault zone forms the crest of a broad, collapsed anticline. The fault zone is similar in trend, pattern, and length to faults along the crest of the Moab-Spanish Valley anticline (primarily location no. 18-2), although it is not as strongly developed. The faults are inferred to be related to a salt anticline at the northern margin of the Paradox basin. Early to middle Pleistocene pediments north of the fault zone steepen sharply at the base of the Book Cliffs and may be warped due to elastic rebound of the Mancos Shale during erosional unloading and/or monoclinal folding (not indicated on plate 1). The ancestral course of Whitmore Canyon (near Sunnyside) also appears to be warped.

Japanese and Cal Valleys (faults)
(13-20)

Parameter values:	middle to late Pleistocene				

Age Criteria : scarp morphology; fault control of bedrock-alluvium contact; basin closure
References : Anderson and others, 1978; Oviatt, 1992; Willis, 1991; Witkind and others, 1987
Comments : Alluvial scarps are up to 4 meters high. The pattern of faulting in Japanese Valley suggested to Witkind and others (1987) that the graben-formed valley may be a collapse feature, perhaps related to dissolution of salt from the underlying Arapien Shale. However, Willis (1991) interpreted the faults as basin-range-type extensional faults.

Wasatch fault zone
- Nephi segment
(13-21)

Parameter values:	0.3 - 0.5 ? e 300-500 yr	0.8 - 1.3 ? (<5.5 ?)	1.7 - 2.7 ? (<5.5 ?)	1.4 - 2.5 n	42.5

Age Criteria : ^{14}C; scarp morphology
References : Jackson, 1991; Machette and others, 1991, 1992; Schwartz and Coppersmith, 1984
Comments : Scarp morphology and continuity suggest very recent displacement (~300-500 years ago), although a combination of ^{14}C and TL dates suggest an age of about 1,200 years for the most recent event. Schwartz and Coppersmith (1984) determined that the penultimate event occurred before about 4,000 years ago, whereas Jackson (1991) constrained the event between about 3,000 and 3,500 years ago. The third-to-last event may have occurred between 4,000 and 4,500 years ago (Jackson, 1991). Thus, actual middle to late Holocene recurrence intervals may vary from less than 1,000 years to more than 3,000 years. Three middle to late Holocene events post-date a late Pleistocene(?) fan at the southern end of the segment (at Red Canyon), suggesting a possible hiatus in faulting activity during latest Pleistocene to early Holocene time (Jackson, 1991). The range in displacement-per-event and slip-rate values reflects a systematic decrease in slip between the middle (larger values) and southern end (smaller values) of the segment. The Benjamin fault, which extends into Utah Valley, may be the northern extension of the Nephi segment (which would then total about 50 kilometers in length). Sediments of the Provo phase of the Bonneville lake cycle are offset as much as 2 meters along this fault (Machette, 1989, in press). There is a 15-kilometer-long gap in Holocene faulting between the Nephi segment and the Levan segment to the south. Faults associated with young scarps north of the town of Nephi are probably continuous with near-surface faults in the town identified from seismic-reflection data (Crone and Harding, 1984b). A number of small faults in Quaternary deposits have been identified on the western flank of the Gunnison Plateau east of Nephi (not shown on plate 1; Biek, 1991).

Job No.
No.

HDR Computation

Project
Subject
Task

Computed
Checked
Sheet 3

Date
Date
Of

2. DETERMINE MCE OF CAPABLE FAULTS

2.1 USE REF 2, FIGS 4-1 ＋ 4-2, BELOW

FAULT ID	FAULT NAME	LENGTH (km)	DISPL (m)	MAGNITUDE, M_0 LENGTH	MAGNITUDE, M_0 DISPL	ADOPTED M_0	ADOPTED MMI_0	DIST TO SITE (km)
7-7	TOPLIFF HILL	12	NA	6.8	NA	6.8	IX	22
7-14	MERCUR	16	0.9-1.9	6.9	6.9-7.2	7.0	X	24
8-16	EAST TINTIC MTNS	4-9	NA	6.7	NA	6.7	IX	18
12-3	WASATCH-PROVO	70	1.5-3.0	7.3	7.1-7.3	7.2	X	24-36
13-4	LONG RIDGE	10	NA	6.7	NA	6.7	IX	14
13-21	WASATCH-NEPHI	42	1.4-2.5	7.2	7.1-7.2	7.2	X	18-21

↑ ALL NEAR FIELD

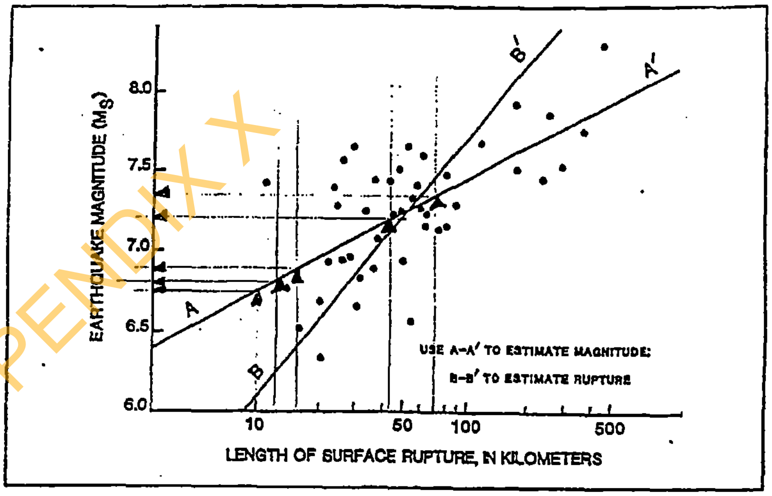


Figure 4-1. Relation of length of surface rupture to earthquake magnitude (Bonilla, Mark, and Lienkaemper 1984)

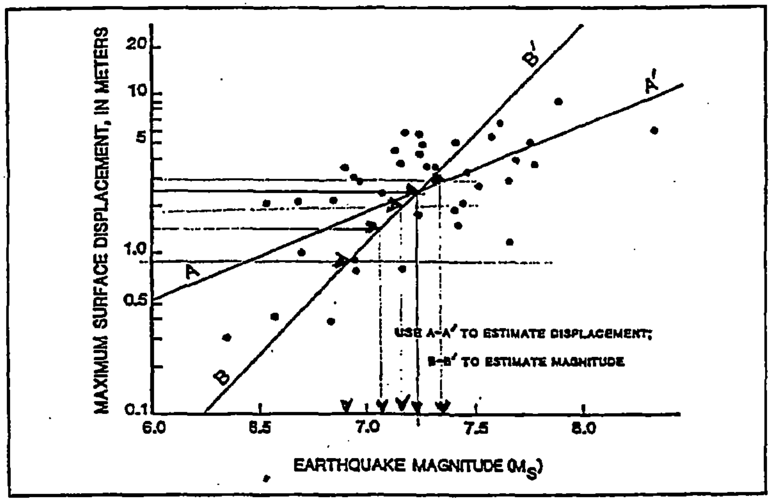


Figure 4-2. Relation of maximum surface displacement to earthquake magnitude (Bonilla, Mark, and Lienkaemper 1984)

Job No.	No.

HDR Computation

HDR

Project	Computed	Date
Subject	Checked	Date
Task	Sheet 4	Of

3 DETERMINE a_g AT SITE

HARD SITE CONDITIONS

$V_s > 400$ m/sec BASED on SPT BLOW COUNTS + GEOLOGIC DESCRIPTION

JOYNER + BOORE CURVES OF REF 2, BELOW:

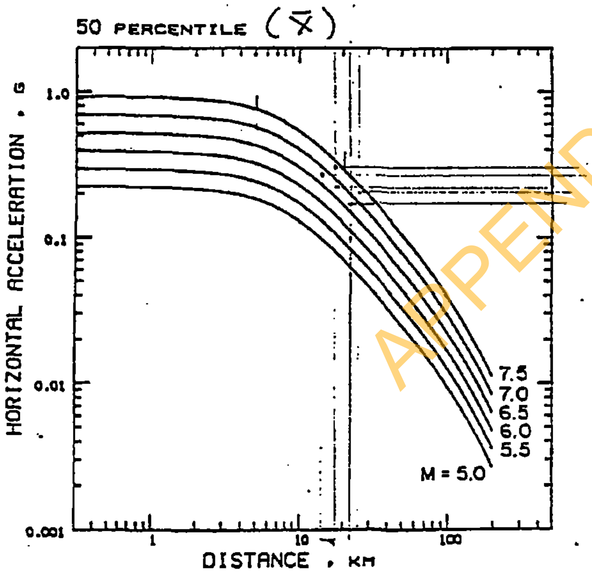


Figure 31. Joyner and Boore (1981) magnitude-distance chart: acceleration, mean.

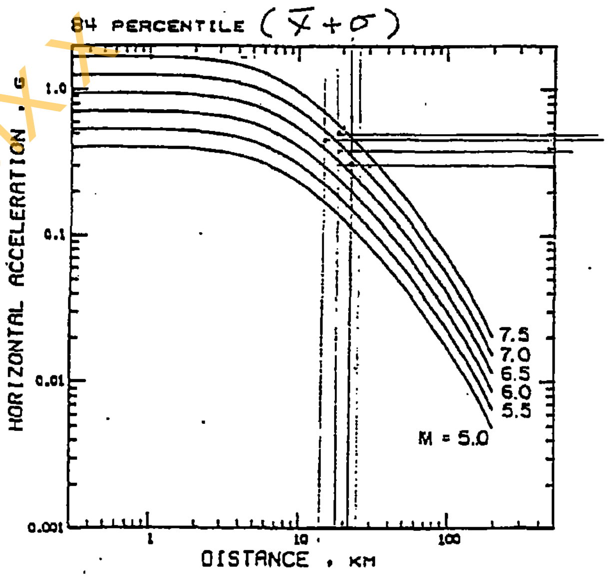


Figure 33. Joyner and Boore (1981) magnitude-distance chart: acceleration, mean and SD.

FAULT DATA				SITE DATA	
FAULT ID / NAME		DISTANCE	MO	a_g ($\bar{x}$)	a_g ($\bar{x}+\sigma$)
	TOPLIFF HILL	22	6.8	0.18	0.30
	MERCUR	24	6.9	0.18	0.30
	EAST TINTIC	18	6.7	0.22	0.38
	WASATCH-PROVO	24 MIN	7.3	0.20	0.40
	LONG RIDGE	14	6.7	0.27	0.47
	WASATCH-NEPHI	18 MIN	7.2	0.30	0.50 ←

USE $a_g = 0.50g$ (490 cm/sec²) AT BAYVIEW SITE ←

ATTACHMENT B
STATIC AND PSEUDO STATIC STABILITY ANALYSES

Job No.
No.

HDR Computation

HDR

Project BAYVIEW LANDFILL		Computed RLD	Date 5-01-96
Subject LANDFILL SEISMIC EVALUATION		Checked PWP	Date 6-4-96
Task STATIC AND PSEUDO-STATIC STABILITY ANALYSES		Sheet 1	Of

OBJECTIVE : DETERMINE STATIC F.S. AND SEISMIC YIELD ACCELERATION (k_y) FOR:

- CELL 1 CUT-SLOPE GEOMETRY
- CELL 1 LINER & LCRS SYSTEM
- CELL 1 WASTE FILL (CLOSED + OPERATIONAL FILLS)
- CELL 1 CLOSURE CAP
- STORMWATER - LEACHATE BASIN

REFERENCES : A) CORPS OF ENGINEERS, "STABILITY OF EARTH AND ROCK-FILL DAMS", EM 1110-2-1902, DEPARTMENT OF THE ARMY, 1970

B) GEOSYNTHETIC RESEARCH INSTITUTE, "STABILITY OF MULTI-LINED SLOPES IN LANDFILL APPLICATIONS", GRI REPORT Nº 8.

C) EPA, "GEOTECHNICAL ANALYSIS AND REVIEW OF DIKE STABILITY (GARDS),"

D) "BAYVIEW LANDFILL, CELL 1 STAGE 1, PHASE 2" PLANS & SPECS, BY HDR ENGINEERING, INC

E) GEOTECHNICAL REPORTS BY CHEN & ASSOCIATES, 1980 AND ROLLINS, BROWN AND GUNNELL, 1983.

F) EPA, 'RCRA SUBTITLE D SEISMIC DESIGN GUIDANCE FOR MSWLF', 1995.

G) UTEXAS 3 SLOPE STABILITY PROGRAM, SHINOAK SOFTWARE, S.G. WRIGHT, 1991

1 SOIL PROFILE & MATERIAL PROPERTIES

1.1 SOILS, FROM REFS E & F

DEPTH	ELEV	γ	c	ϕ	MATL DESCRIPTION
0-100	4760-4660	110 pcf	0 psf	40°	INTERBEDDED DENSE, DRY SANDS, SILTS, GRAVEL
100-800	4660-3960	120 pcf	0 psf	45°	AS ABOVE W/ COBBLES, BOULDERS, CEMENTED
800-?	3960-?	NA	NA	NA	AS ABOVE ?, BASED ON GEOLOGY
WASTE	4812-4712±	50 pcf	150 psf	22°	SINGH + MURPHY REF CITED IN REF F
LCRS	2' THICK	100 pcf	0	32°	SM, TESTED FROM STOCKPILE

1.2 GEOSYNTHETIC INTERFACE FRICTION VALUES, FROM PUBLISHED LIT & FILES

COMPONENT	LOWER INTERFACE	UPPER INTERFACE	δ	
LINER & LCRS	SOIL SUBGRADE	CUSHION GEOTEXTILE	27°	
↓	CUSHION GEOTEXTILE	60 MIL SMOOTH HDPE	9°	← CONTROLS
	60 MIL SMOOTH HDPE	GRANULAR LCRS	17°	
CLOSURE CAP	GRAN. GAS VENT SOIL	60 MIL SMOOTH LDPE	25°	← CONTROLS
↓	60 MIL SMOOTH LDPE	GRAN DRAIN SOIL	25°	

Job No.
No.

HDR Computation

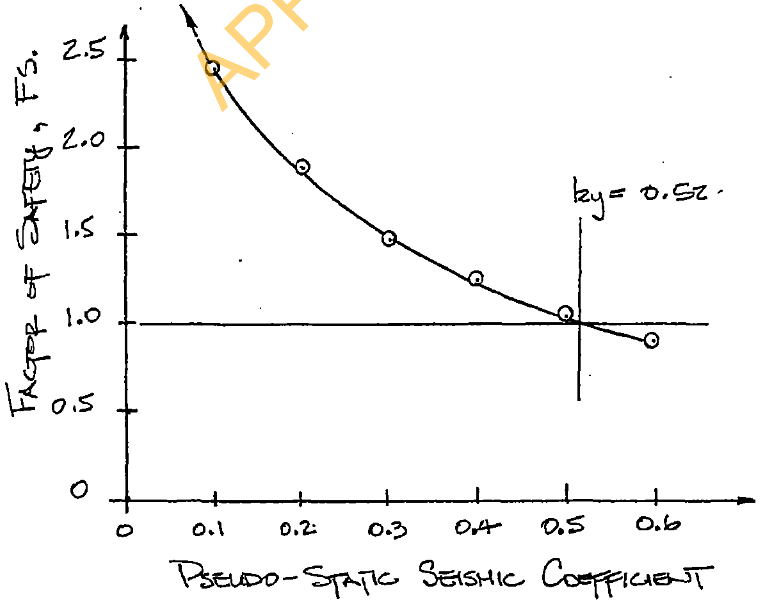
Project
Computed
Date
Subject
Checked ✓
Date
Task
Sheet 2
Of

2. CUT SLOPE STABILITY

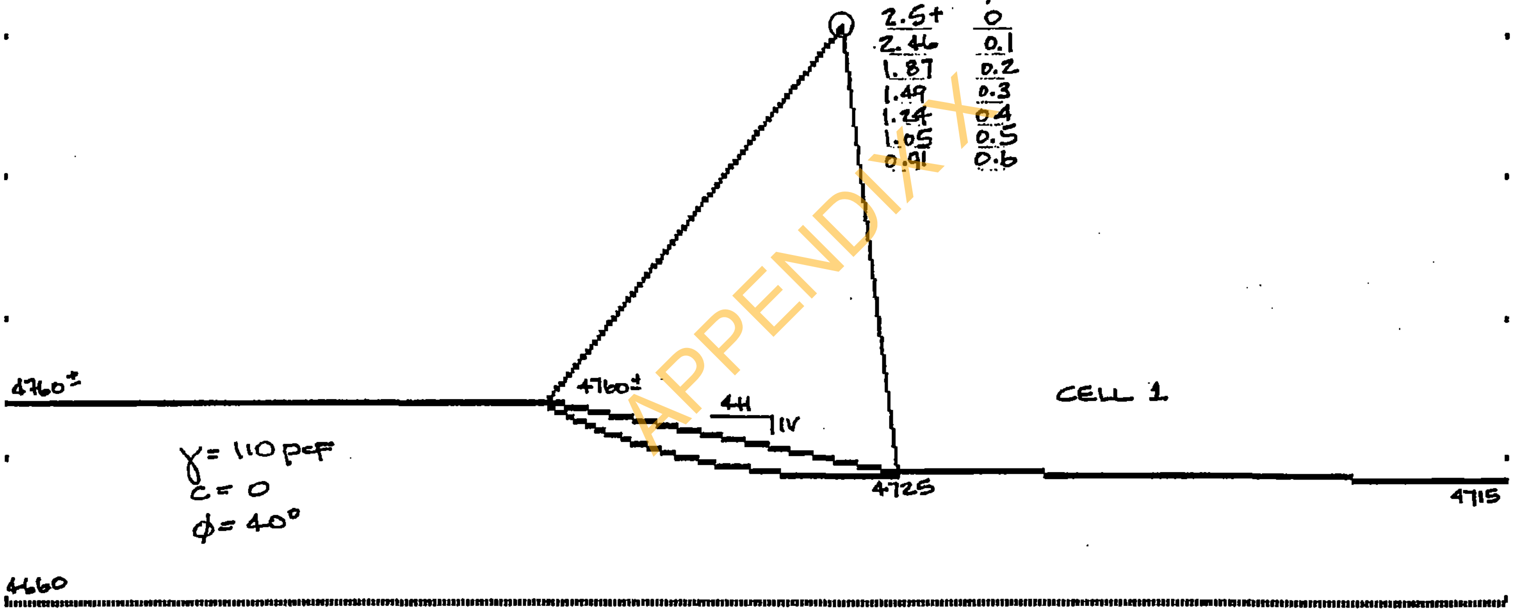
2.1 DETERMINE STATIC F.S. FOR:
1V : 4H CUT SLOPE EL. 4760 – 4725±
SOIL PROPERTIES FROM P 1.1
SECTION ATTACHED
F.S. = 2.5+ , ANALYSIS ATTACHED

2.2 DETERMINE PSEUDO-STATIC F.S. FOR SAME CONDITIONS AS 2.1 w/ SEISMIC COEFFICIENT, ψ, VARYING FROM 0.1 TO 0.6 BY 0.1 INC.

F.S. = 0.9 – 2.46, SEE BELOW & ATTACHED ANALYSES



BAYVIEW LANDFILL CELL 1 PHASE 2 CUT SLOPE STABILITY File: PH2CSS
Hydraulic Condition 7: User Defined
Consolidated Drained Soil Parameters
Factor of Safety = 2.46, Failure Center: (620 , 4948), Radius: 224



FS	ψ
2.5+	0
2.46	0.1
1.87	0.2
1.49	0.3
1.24	0.4
1.05	0.5
0.91	0.6

(273 , 4590) SCALE : 1 inch = 70.00001 feet

```
************************************************************************
*                                                                      *
*                      G A R D S   S U M M A R Y                       *
*                                                                      *
*    Project:  BAYVIEW LANDFILL CELL 1 PHASE 2 CUT SLOPE STABILITY     *
*       File:  PH2CSS                                                  *
*                                                                      *
*                         GARDS  Version 2.00                          *
*                            developed by                              *
*          Department of Civil and Environmental Engineering           *
*                      University of Cincinnati                        *
*                          under contract to                           *
*                U.S. Environmental Protection Agency                  *
*                  Land Pollution Control Division                     *
*           Hazardous Waste Engineering Research Laboratory            *
*                                                                      *
************************************************************************
```

```
************************************************************************
*                        Site Characteristics                          *
************************************************************************
*                                                                      *
*      The seismic coefficient is. . . . . . . . . . . . . . . 0.10    *
*                                                                      *
*      The design earthquake magnitude is. . . . . . . . . . . 7.20    *
*                                                                      *
*      The maximum flood elevation in this case is . . . . .      0    *
*                                                                      *
*      The elevation of the seasonal high ground water is. . .    0    *
*                                                                      *
*      The design waste elevation in the cell is . . . . . .      0    *
*                                                                      *
*      The soil number representing the clay liner is. . . .     0    *
*                                                                      *
************************************************************************
```

ITERATE
0-0.60
BY 0.10

```
***************************************************************************
*                             Section Geometry                            *
***************************************************************************
*                                                                         *
*      The number of soil boundary lines for this section is   2          *
*-------------------------------------------------------------------------*
*     Line   1          Point          X              Y                   *
*                       -----        -----          -----                 *
*                         1              0           4660                 *
*                         2           1140           4660                 *
*-------------------------------------------------------------------------*
*     Line   2          Point          X              Y                   *
*                       -----        -----          -----                 *
*                         1              0           4760                 *
*                         2            500           4760                 *
*                         3            640           4725                 *
*                         4           1140           4715                 *
***************************************************************************
```

```
************************************************************************
*                        Soil   1 Properties                           *
************************************************************************
*                                                                      *
*             Unconsolidated  Consolidated  Consolidated               *
*                Undrained     Undrained       Drained                 *
*               ------------  ------------  ------------               *
*   Cohesion               0             0             0  (lb/sq.ft)   *
*   Phi Angle              0             0            40   (degrees)   *
*----------------------------------------------------------------------*
*                                                                      *
*        Unit Weight . . . . . . . . . . .  110.000   (lb/cu.ft)       *
*        Clay Content  . . . . . . . . . .    0.000   (%)              *
*        Overconsolidation Ratio . . . . .    0.000                    *
*        Initial Void Ratio  . . . . . . .    0.000                    *
*        Compression Index . . . . . . . .    0.000                    *
*        Recompression Index . . . . . . .    0.000                    *
*        Permeability  . . . . . . .          0.000   (ft/yr)          *
*        Median Grain Size . . . . . . . .    0.000   (mm)             *
*        Plasticity Index  . . . . . . . .    0.000   (%)              *
*        Liquid Limit  . . . . . . . . . .    0.000   (%)              *
*        Standard Penetration Number . .      0.000   (blows/ft)       *
************************************************************************
```

```
******************************************************************
*                         User Defined                           *
*            Piezometric Surface for Hydraulic Condition         *
*            7: User Defined                                     *
******************************************************************
*                                                                *
*                 Point        X           Y                     *
*                 -----      ------      ------                  *
*                   1           0         4660                   *
*                   2        1140         4660                   *
******************************************************************
```

```
************************************************************************
*                                                                      *
*        R O T A T I O N A L   F A I L U R E   R E S U L T S           *
*                                                                      *
*                        Automatic Grid Search                         *
*                                                                      *
*     The slopes were analyzed for failure arcs having centers in      *
*     areas defined by the following parallelograms:                   *
************************************************************************
*                                                                      *
*                              Slope   1                               *
*                                                                      *
*    Co-ord.       Point 1       Point 2       Point 3       Point 4   *
*    -------       -------       -------       -------       -------   *
*       X            500           640           675           535     *
*       Y           4769          4734          4795          4830     *
*----------------------------------------------------------------------*
*                                                                      *
*       The number of divisions between points 1 and 2 were   4        *
*       The number of divisions between points 2 and 3 were   4        *
*       The X-increment used in the search was  . . . . . . . 10       *
*       The Y-increment used in the search was  . . . . . . . 10       *
*                                                                      *
************************************************************************
```

```
***********************************************************************
*                                                                     *
*         R O T A T I O N A L   F A I L U R E   R E S U L T S         *
*                                                                     *
***********************************************************************
*                                                                     *
*             Hydraulic Condition 7: User Defined                     *
*                                                                     *
*                     Consolidated Drained (CD) Case                  *
*                     Seismic Coefficient = 0.10                      *
*---------------------------------------------------------------------*
*         Safety        Failure         X-            Y-              *
*         Factor        Radius        Co-ord        Co-ord            *
*        --------      --------      --------      --------           *
*           2.46         223.8         620.0        4947.5            *
*           2.46         221.3         620.0        4945.0            *
*           2.46         226.2         620.0        4950.0            *
*           2.46         218.9         620.0        4942.5            *
*           2.46         216.4         620.0        4940.0            *
*           2.46         224.3         622.5        4947.5            *
*           2.46         214.0         620.0        4937.5            *
*           2.47         211.6         620.0        4935.0            *
*           2.47         209.1         620.0        4932.5            *
*           2.47         223.2         617.5        4947.5            *
*           2.47         208.6         617.5        4932.5            *
*           2.47         208.1         615.0        4932.5            *
*           2.47         217.9         615.0        4942.5            *
*           2.48         198.4         615.0        4922.5            *
*           2.48         209.6         622.5        4932.5            *
*           2.48         188.6         615.0        4912.5            *
*           2.49         178.9         615.0        4902.5            *
*           2.49         210.1         625.0        4932.5            *
*           2.50         169.1         615.0        4892.5            *
***********************************************************************
```

Job No.

No.

HDR Computation

Project

Computed

Date

Subject

Checked ✓

Date

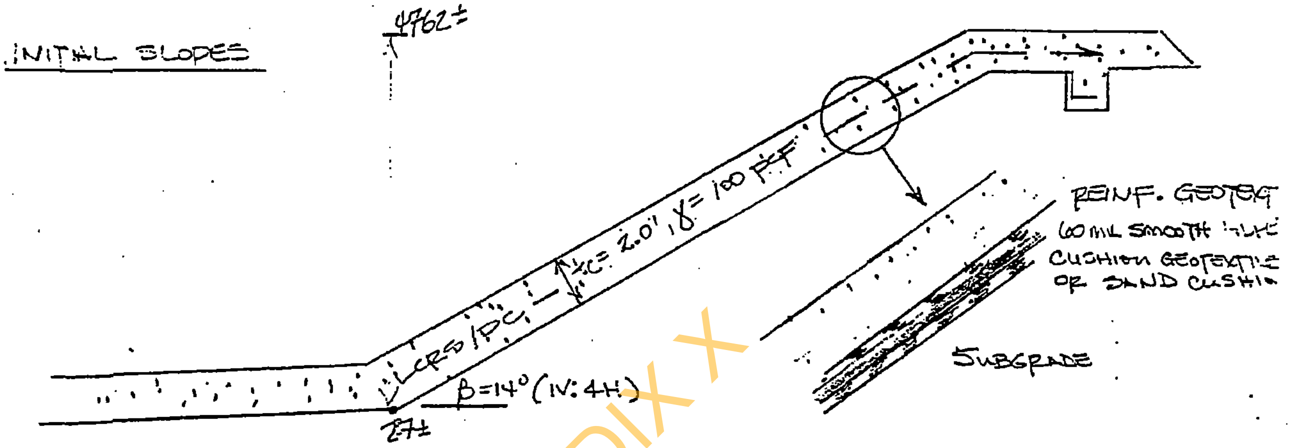
Task

Sheet

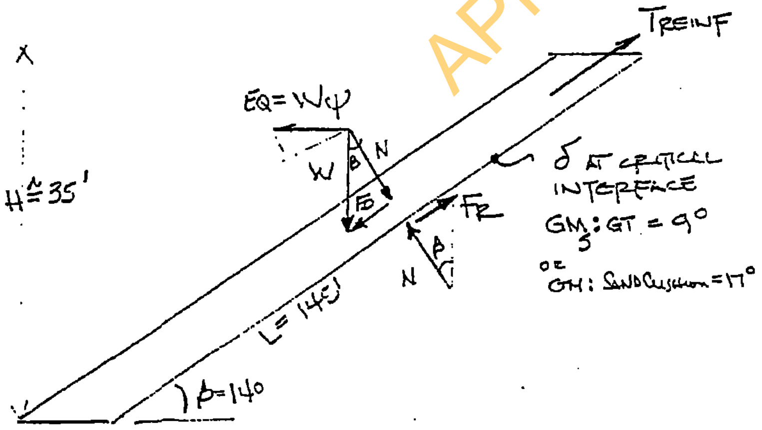
Of

3. CELL LINER & LCRS STABILITY

3.1 INITIAL SLOPES



USE INFINITE SLOPE METHOD, CONSIDER SEISMICITY w/ PSEUDO-STATIC COEFF.



$W = \gamma t_c L \div 1000$
$= 100 \frac{\#}{CF} * 2FT * 145' \div 100$
$= 29.0^{KLF}$

$F_D = W \sin\beta + W k_y$
$= (29.0^{KLF} * \sin 14°) + (29.0^{KLF} * \psi)$
$= 7.0^{KLF} + 29.0\psi$

$F_R = N \tan\delta + T_{REINF}$
$= (W \cos\beta)\tan\delta + T_{REINF}$
$= (29.0^{KLF} * \cos 14°)\tan\delta° + T_{REINF}$
$= 28.1 \tan\delta + T_{REINF}$

NOTE: EQ FORCE HORIZONTAL IS CONSERVATIVE SINCE DOWNSLOPE COMPONENT = Wψ cosβ < Wψ WHERE ψ = PSEUDO-STATIC SEISMIC COEFFICIENT

$FS_{STATIC\ (k_y=0)} = \frac{F_R}{F_D} = \frac{(28.1 \tan\delta + T_{REINF})^{KLF}}{7.0^{KLF}}$

$FS_{P-S\ (k_y>0)} = \frac{F_R}{F_D} = \frac{(28.1 \tan\delta + T_{REINF})^{KLF}}{(7.0 + 29.0\psi)^{KLF}}$

} ITERATE FOR TREQD & ψ, ATTACHED

Job No.

No.

HDR Computation

HDR

Project

Computed

Date

Subject

Checked

Date

Task

Sheet

Of

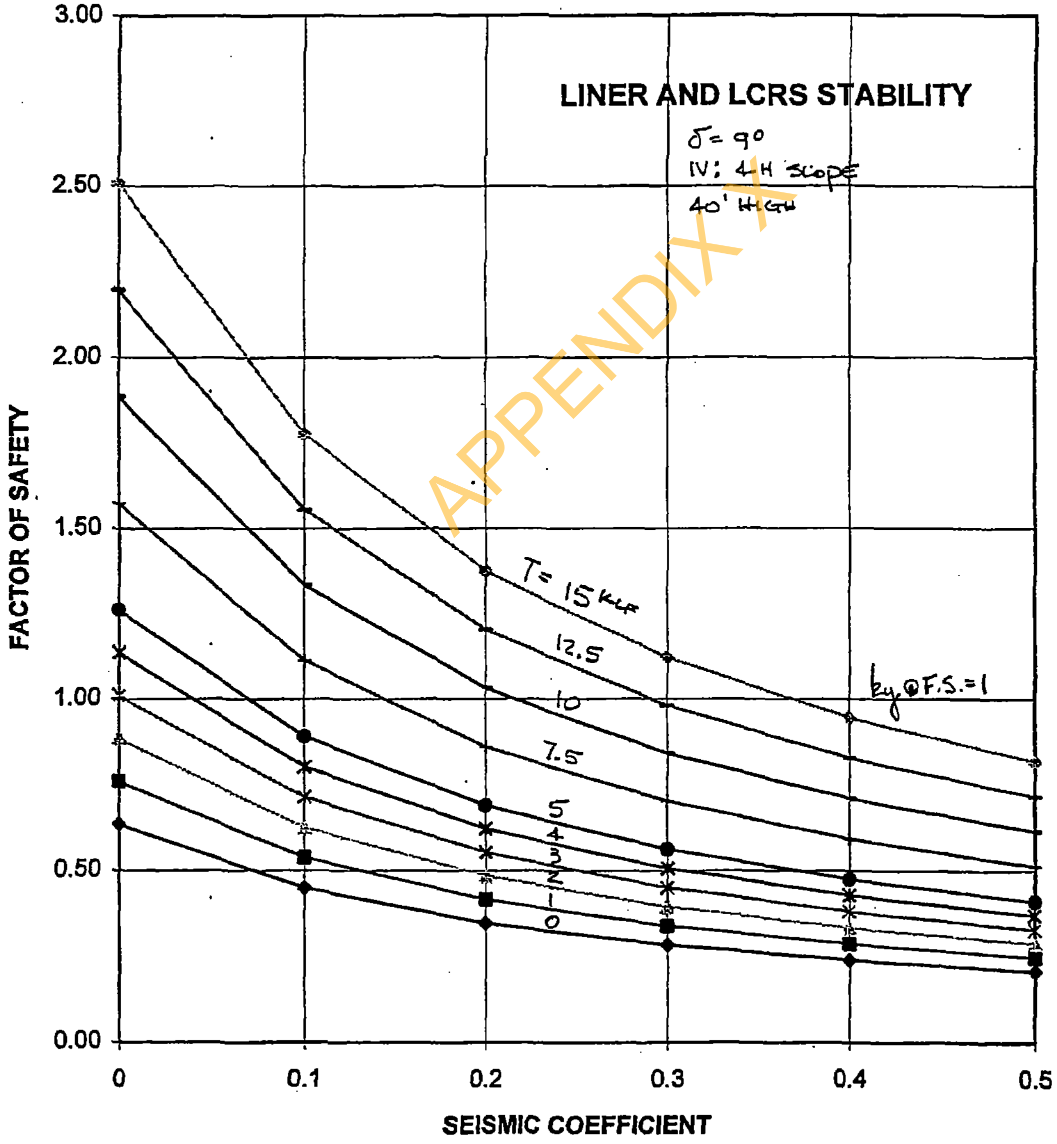
BAYVIEW LANDFILL CELL 1 PHASE 2
LINER & LCRS SLOPE STABILITY
STATIC AND PSEUDO-STATIC ANALYSES
(INFINITE SLOPE METHOD)

SLOPE PROPERTIES						
	height	40.0	(ft.)			
	slope	14.0	(degrees)			
	length	165.3	(ft)			
LCRS PROPERTIES						
	thickness	2.0	(ft)			
	density	100.0	(pcf)			
INTERFACE FRICTION						
	friction	9.0	(degrees)	GEOTEXTILE cushion		
FACTOR OF SAFETY						
Treinf	Seismic Coefficient, (-)					
(klf)	0	0.1	0.2	0.3	0.4	0.5
0.0	0.64	0.45	0.35	0.28	0.24	0.21
1.0	0.76	0.54	0.42	0.34	0.29	0.25
2.0	0.89	0.63	0.48	0.40	0.33	0.29
3.0	1.01	0.71	0.55	0.45	0.38	0.33
4.0	1.14	0.80	0.62	0.51	0.43	0.37
5.0	1.26	0.89	0.69	0.56	0.47	0.41
7.5	1.57	1.11	0.86	0.70	0.59	0.51
10.0	1.89	1.33	1.03	0.84	0.71	0.61
12.5	2.20	1.55	1.20	0.98	0.83	0.72
15.0	2.51	1.78	1.37	1.12	0.95	0.82

Job No.	No.

HDR Computation

Project	Computed	Date
Subject	Checked	Date
Task	Sheet	Of



Job No.

No.

HDR Computation

HDR

Project

Computed

Date

Subject

Checked

Date

Task

Sheet

Of

BAYVIEW LANDFILL CELL 1						
LINER AND LCRS CAP SLOPE STABILITY						
STATIC AND PSEUDO-STATIC ANALYSES						
(INFINITE SLOPE METHOD)						
SLOPE PROPERTIES						
	height	40.0	(ft.)			
	slope	14.0	(degrees)			
	length	165.3	(ft)			
LCRS PROPERTIES						
	thickness	2.0	(ft)			
	density	100.0	(pcf)			
INTERFACE FRICTION						
	friction	17.0	(degrees)	SAND CUSHION		
FACTOR OF SAFETY						
Treinf	Seismic Coefficient, (-)					
(klf)	0	0.1	0.2	0.3	0.4	0.5
0.0	1.23	0.87	0.67	0.55	0.46	0.40
1.0	1.35	0.96	0.74	0.60	0.51	0.44
2.0	1.48	1.04	0.81	0.66	0.56	0.48
3.0	1.60	1.13	0.88	0.71	0.60	0.52
4.0	1.73	1.22	0.94	0.77	0.65	0.56
5.0	1.85	1.31	1.01	0.83	0.70	0.60
7.5	2.16	1.53	1.18	0.97	0.82	0.71
10.0	2.48	1.75	1.36	1.11	0.93	0.81
12.5	2.79	1.97	1.53	1.24	1.05	0.91
15.0	3.10	2.19	1.70	1.38	1.17	1.01

Job No.

No.

HDR Computation

HDR

Project

Computed

Date

Subject

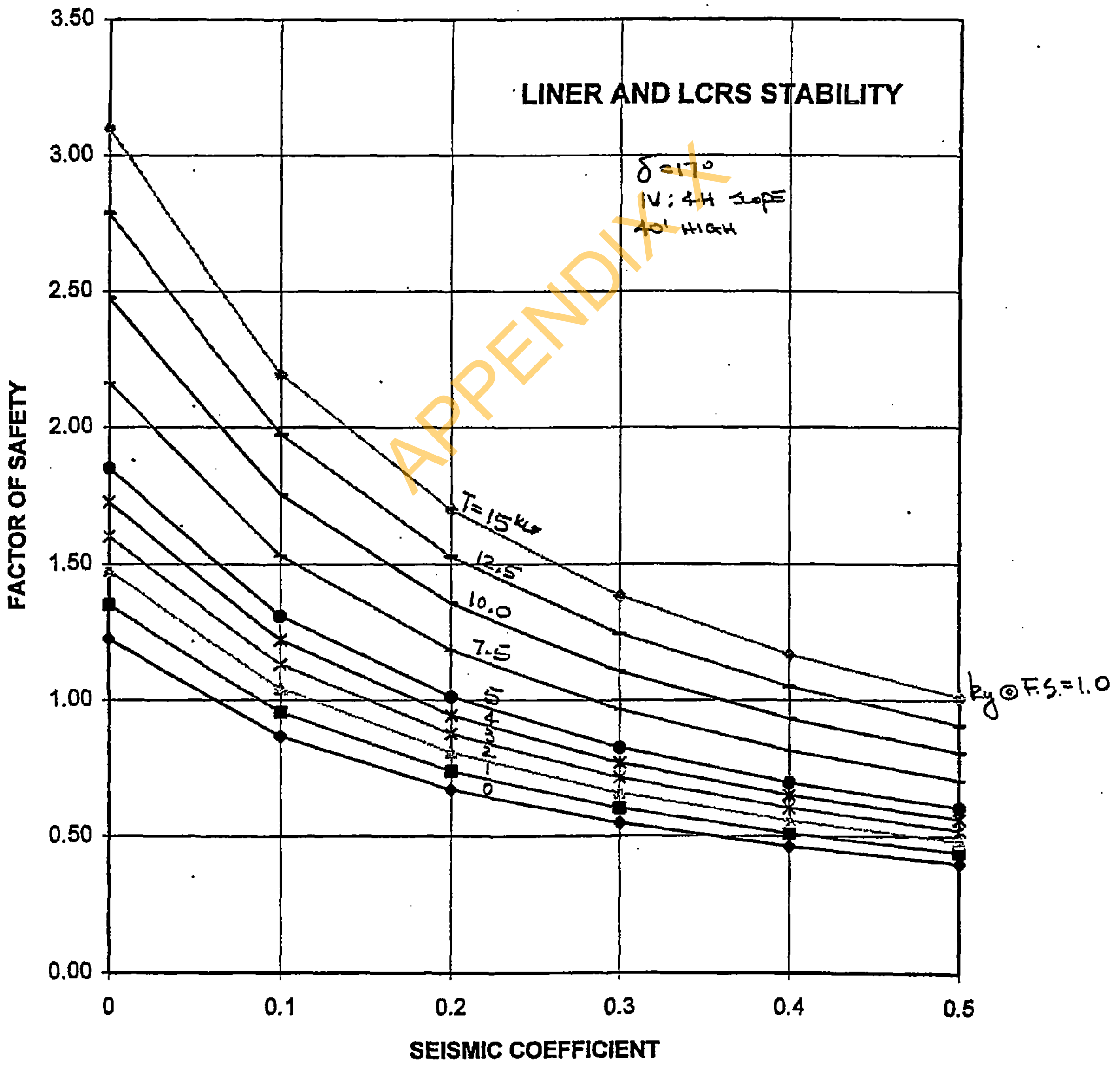
Checked

Date

Task

Sheet

Of



Job No.

No.

HDR Computation

HDR

Project

Computed

Date

Subject

Checked ✓

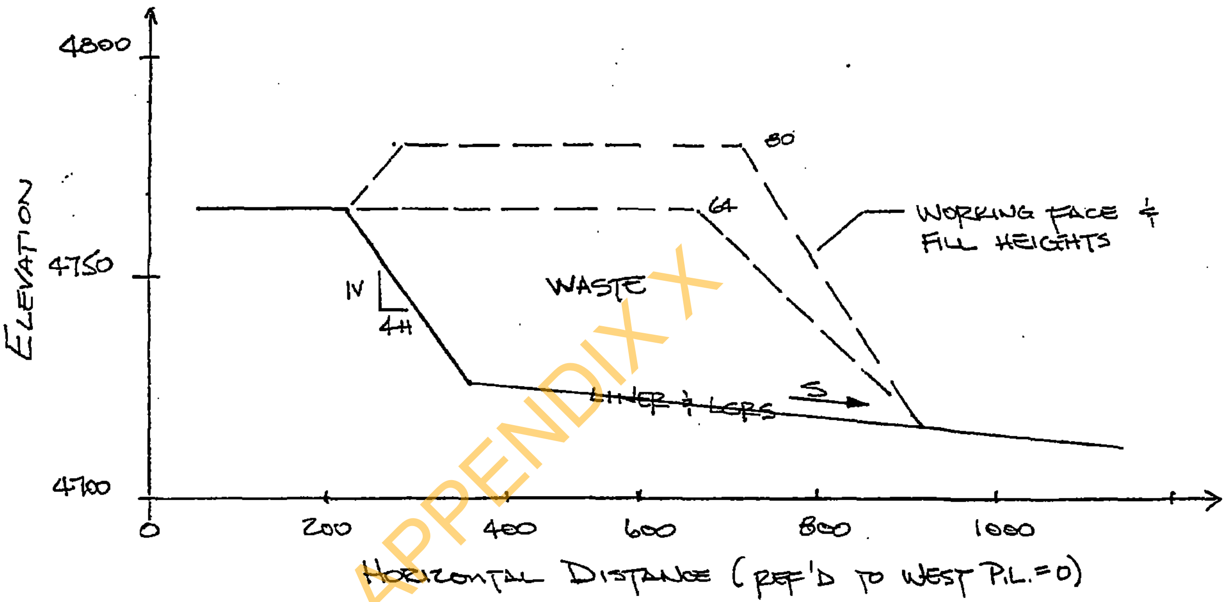
Date

Task

Sheet

Of

3.2 Operational Slopes During Filling



Section Cut W-E @ Sta N8000

Use sliding-block method (UTEXAS 3, ref 6)

Evaluate potential sliding on bottom LCRS

operational fill hts 1464

1480

Iterate ψ to determine F.S = 1.0

Consider

$\delta = 9°$ for geomembrane - geotextile cushion

$\delta = 17°$ for geomembrane - sand cushion

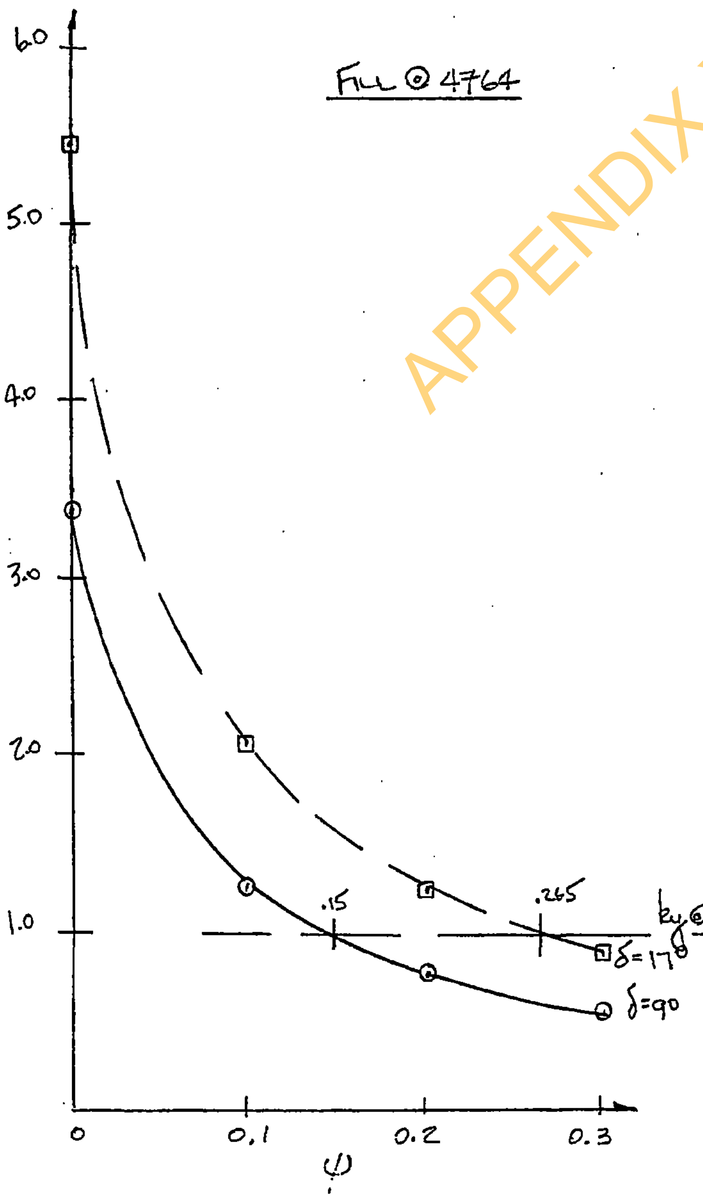
Job No.
No.

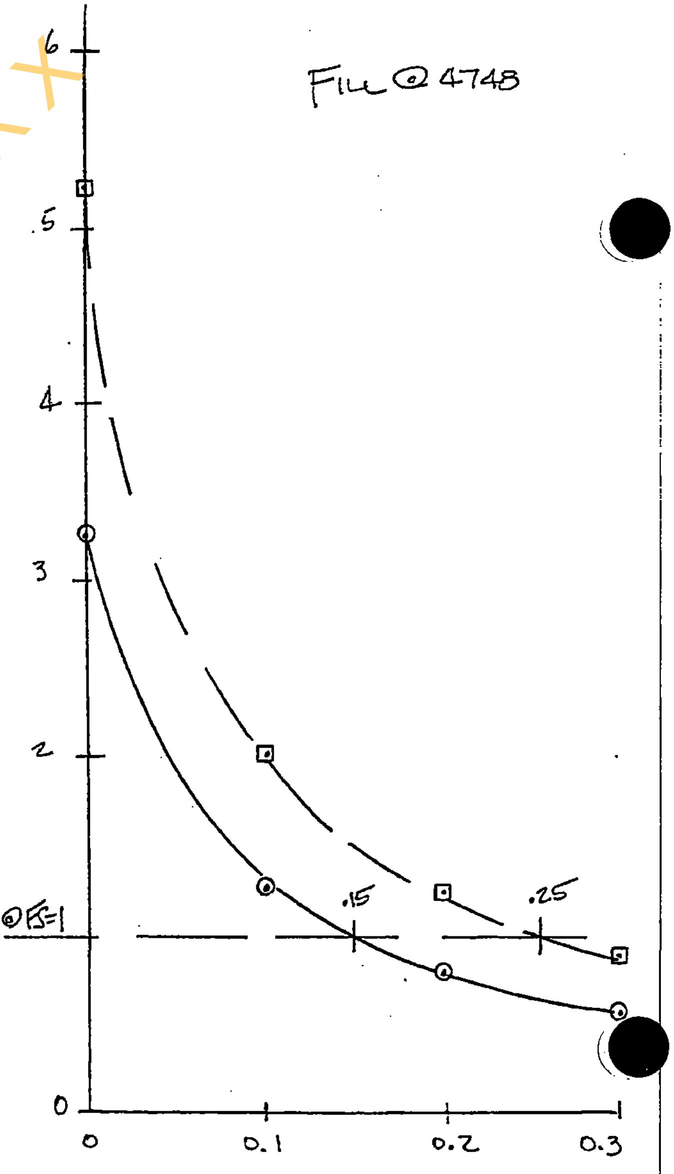
HDR Computation

HDR

Project
Computed
Date
Subject
Checked ✓
Date
Task
Sheet
Of

FILL @ 4764		ψ	FILL @ 4780	
δ = 9°	δ = 17°		δ = 9°	δ = 17°
3.36	5.40	0	3.25	5.18
1.25	2.03	0.1	1.25	2.00
0.76	1.24	0.2	0.76	1.24
0.54	0.89	0.3	0.54	0.89





```
HEADING
 Bayview Landfill Cell 1
 Sliding During Operational Filling @ 4764
 Geotextile Interface/Seismic Coeff varies/OF64G.DAT
PROFILE LINES
 1  1  Waste Fill to 4764
 225  4764
 615  4764
 865  4714

 2  2  Side Slope LCRS
  0    4764
 225  4764
 365  4724

 3  3  Bottom LCRS
 365  4724
 865  4714
 999  4714


MATERIAL PROPERTIES
 1  Waste Fill
 50
 C
   150  22
 N
 2  Side Slope LCRS     (INCLUDES SIDE SLOPE T)
 100
 C
   0  24
 N
 3  Bottom LCRS     (GEOTEXTILE CUSHION)
 100
 C
   0  9
 N

ANALYSIS  (SLIDING ALONG LCRS)
 N
 217  4764
 365  4722
 863  4712
 865  4714

 Seismic  ψ
   0.4    ←  ITERATE FOR FS≤1.00
 Procedure
   C
   0.0

COMPUTE
```

```
1     UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
      Date: 5:16:1996  Time: 10:46:18  Input file: of64g.dat


      TABLE NO. 1
      *******************************************
      * COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
      * Originally Coded By Stephen G. Wright  *
      * Version No. 1.107                      *
      * Last Revision Date 10/13/91            *
      * (C) Copyright 1985-1991 S. G. Wright   *
      * All Rights Reserved                    *
      *******************************************

      ***************************************************************
      *                                                             *
      *   RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
      * PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
      * HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL  *
      * DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE  *
      * ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER *
      * PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS     *
      * PROGRAM BEFORE ATTEMPTING ITS USE.                        *
      *                                                             *
      *   NEITHER THE UNIVERSITY OF TEXAS NOR STEPHEN G. WRIGHT *
      * MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR *
      * IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS *
      * OR ADAPTABILITY OF THIS COMPUTER PROGRAM.                 *
      *                                                             *
      ***************************************************************
1     UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
      Date: 5:16:1996  Time: 10:46:18  Input file: of64g.dat
       Bayview Landfill Cell 1
       Sliding During Operational Filling @ 4764
       Geotextile Interface/Seismic Coeff varies/OF64G.DAT

      TABLE NO. 2
      *************************
      * NEW PROFILE LINE DATA *
      *************************

      PROFILE LINE  1 - MATERIAL TYPE =  1
      Waste Fill to 4764

         Point    X          Y

           1    225.000    4764.000
           2    615.000    4764.000
           3    865.000    4714.000

      PROFILE LINE  2 - MATERIAL TYPE =  2
      Side Slope LCRS

         Point    X          Y
```

```
         1      .000     4764.000
         2    225.000    4764.000
         3    365.000    4724.000

     PROFILE LINE  3 - MATERIAL TYPE =  3
     Bottom LCRS

        Point    X          Y

         1    365.000    4724.000
         2    865.000    4714.000
         3    999.000    4714.000

     All new profile lines defined - No old lines retained
1     UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
     Date:  5:16:1996   Time: 10:46:18   Input file: of64g.dat
      Bayview Landfill Cell 1
      Sliding During Operational Filling @ 4764
      Geotextile Interface/Seismic Coeff varies/OF64G.DAT

     TABLE NO.  3
     **************************************************************************
     * NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS
*
     **************************************************************************

     DATA FOR MATERIAL TYPE  1
     Waste Fill

        Unit weight of material =   50.000

        CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
        Cohesion - - - - - - - -      150.000
        Friction angle - - - - -  22.000 degrees

        No (or zero) pore water pressures

     DATA FOR MATERIAL TYPE  2
     Side Slope LCRS

        Unit weight of material =  100.000

        CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
        Cohesion - - - - - - - -        .000
        Friction angle - - - - -  24.000 degrees

        No (or zero) pore water pressures

     DATA FOR MATERIAL TYPE  3
     Bottom LCRS

        Unit weight of material =  100.000
```

```
    CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
    Cohesion - - - - - - - -      .000
    Friction angle - - - - -   9.000 degrees

    No (or zero) pore water pressures

  All new material properties defined - No old data retained
1  UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
  Date: 5:16:1996   Time: 10:46:18   Input file: of64g.dat
   Bayview Landfill Cell 1
   Sliding During Operational Filling @ 4764
   Geotextile Interface/Seismic Coeff varies/OF64G.DAT

  TABLE NO. 15
  **********************************
  * NEW ANALYSIS/COMPUTATION DATA *
  **********************************

  Noncircular Shear Surface(s)

  Computations Performed for Single Shear Surface


  Shear Surface Coordinates -

     Point      X          Y

       1      217.000     4764.000
       2      365.000     4722.000
       3      863.000     4712.000
       4      865.000     4714.000

  Procedure used to compute the factor of safety: CORPS
  Specified side force inclination =    .00 degrees

  ----------------------------------------------------------------
  THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

  Initial trial estimate for the factor of safety =   3.000

  Maximum number of iterations allowed for
  calculating the factor of safety =   40

  Allowed force imbalance for convergence =     100.000

  Allowed moment imbalance for convergence =     100.000

  Number of increments for slice subdivision =  30

  Depth of water in crack =       .000

  Unit weight of water in crack =    62.400

  Seismic coefficient =  .000
```

```
  Conventional (single-stage) computations to be performed
1  UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
  Date: 5:16:1996  Time: 10:46:18  Input file: of64g.dat
   Bayview Landfill Cell 1
   Sliding During Operational Filling @ 4764
   Geotextile Interface/Seismic Coeff varies/OF64G.DAT

  TABLE NO. 16
  ****************************
  * NEW SLOPE GEOMETRY DATA *
  ****************************

  NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA
  WERE GENERATED BY THE PROGRAM

  Slope Coordinates -

     Point    X        Y

       1     .000   4764.000
       2   225.000   4764.000
       3   615.000   4764.000
       4   865.000   4714.000
       5   999.000   4714.000
1  UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
  Date: 5:16:1996  Time: 10:46:18  Input file: of64g.dat
   Bayview Landfill Cell 1
   Sliding During Operational Filling @ 4764
   Geotextile Interface/Seismic Coeff varies/OF64G.DAT

  TABLE NO. 26
  ****************************************************************
  * Coordinate, Weight, Strength and Pore Water Pressure      *
  * Information for Individual Slices for Conventional        *
  * Computations or First Stage of Multi-Stage Computations.  *
  * (Information is for the Critical Shear Surface in the     *
  * Case of an Automatic Search.)                             *
  ****************************************************************

  Slice              Slice  Matl.      Friction  Pore
   No.    X      Y    Weight  Type  Cohesion  Angle  Pressure

        217.0  4764.0
    1   221.0  4762.9     908.2   2      .00   24.00     .0
        225.0  4761.7
    2   235.0  4758.9    7359.9   2      .00   24.00     .0
        245.0  4756.1
    3   255.0  4753.2   12997.1   2      .00   24.00     .0
        265.0  4750.4
    4   275.0  4747.5   18634.3   2      .00   24.00     .0
        285.0  4744.7
    5   295.0  4741.9   24271.5   2      .00   24.00     .0
        305.0  4739.0
```

```
  6  315.0  4736.2   29908.7  2    .00  24.00    .0
     325.0  4733.4
  7  335.0  4730.5   35545.9  2    .00  24.00    .0
     345.0  4727.7
  8  355.0  4724.8   41182.1  2    .00  24.00    .0
     365.0  4722.0
  9  375.4  4721.8   46051.6  3    .00   9.00    .0
     385.8  4721.6
 10  396.3  4721.4   46490.5  3    .00   9.00    .0
     406.7  4721.2
 11  417.1  4721.0   46927.4  3    .00   9.00    .0
     427.5  4720.7
 12  437.9  4720.5   47365.8  3    .00   9.00    .0
     448.3  4720.3
 13  458.8  4720.1   47802.8  3    .00   9.00    .0
     469.2  4719.9
 14  479.6  4719.7   48241.7  3    .00   9.00    .0
     490.0  4719.5
 15  500.4  4719.3   48678.1  3    .00   9.00    .0
     510.8  4719.1
 16  521.3  4718.9   49117.1  3    .00   9.00    .0
     531.7  4718.7
 17  542.1  4718.4   49553.9  3    .00   9.00    .0
     552.5  4718.2
 18  562.9  4718.0   49992.3  3    .00   9.00    .0
     573.3  4717.8
 19  583.8  4717.6   50429.2  3    .00   9.00    .0
     594.2  4717.4
 20  604.6  4717.2   50866.1  3    .00   9.00    .0
     615.0  4717.0
 21  625.3  4716.8   48754.4  3    .00   9.00    .0
     635.7  4716.6
1     UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
     Date:  5:16:1996   Time: 10:46:18   Input file: of64g.dat
      Bayview Landfill Cell 1
      Sliding During Operational Filling @ 4764
      Geotextile Interface/Seismic Coeff varies/OF64G.DAT

     TABLE NO. 26
     **********************************************************
     * Coordinate, Weight, Strength and Pore Water Pressure    *
     * Information for Individual Slices for Conventional     *
     * Computations or First Stage of Multi-Stage Computations. *
     * (Information is for the Critical Shear Surface in the  *
     * Case of an Automatic Search.)                          *
     **********************************************************

     Slice             Slice   Matl.         Friction   Pore
      No.    X      Y    Weight  Type  Cohesion  Angle   Pressure

     635.7  4716.6
 22  646.0  4716.4   44913.7  3    .00   9.00    .0
     656.3  4716.1
 23  666.7  4715.9   41073.5  3    .00   9.00    .0
```

```
     677.0  4715.7
  24   687.3  4715.5   37232.8   3     .00    9.00      .0
     697.7  4715.3
  25   708.0  4715.1   33392.6   3     .00    9.00      .0
     718.3  4714.9
  26   728.7  4714.7   29551.9   3     .00    9.00      .0
     739.0  4714.5
  27   749.3  4714.3   25711.8   3     .00    9.00      .0
     759.7  4714.1
  28   770.0  4713.9   21871.1   3     .00    9.00      .0
     780.3  4713.7
  29   790.7  4713.5   18030.9   3     .00    9.00      .0
     801.0  4713.2
  30   811.3  4713.0   14190.2   3     .00    9.00      .0
     821.7  4712.8
  31   832.0  4712.6   10350.0   3     .00    9.00      .0
     842.3  4712.4
  32   852.7  4712.2    6509.2   3     .00    9.00      .0
     863.0  4712.0
  33   864.0  4713.0    222.0   3     .00    9.00      .0
     865.0  4714.0
1      UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
       Date: 5:16:1996   Time: 10:46:18   Input file: of64g.dat
        Bayview Landfill Cell 1
        Sliding During Operational Filling @ 4764
        Geotextile Interface/Seismic Coeff varies/OF64G.DAT

       TABLE NO. 27
       ***************************************************************
       *  Seismic Forces and Forces Due to Surface Pressures for   *
       *  Individual Slices for Conventional Computations or the   *
       *  First Stage of Multi-Stage Computations.                  *
       *  (Information is for the Critical Shear Surface in the     *
       *  Case of an Automatic Search.)                              *
       ***************************************************************

                                  FORCES DUE TO SURFACE PRESSURES
                     Y for
       Slice      Seismic  Seismic   Normal   Shear
        No.    X    Force    Force    Force    Force      X       Y

         1   221.0     0.    4763.4     0.      0.      .0      .0
         2   235.0     0.    4761.0     0.      0.      .0      .0
         3   255.0     0.    4757.9     0.      0.      .0      .0
         4   275.0     0.    4754.9     0.      0.      .0      .0
         5   295.0     0.    4752.1     0.      0.      .0      .0
         6   315.0     0.    4749.2     0.      0.      .0      .0
         7   335.0     0.    4746.3     0.      0.      .0      .0
         8   355.0     0.    4743.5     0.      0.      .0      .0
         9   375.4     0.    4742.0     0.      0.      .0      .0
        10   396.3     0.    4741.8     0.      0.      .0      .0
        11   417.1     0.    4741.6     0.      0.      .0      .0
        12   437.9     0.    4741.4     0.      0.      .0      .0
        13   458.8     0.    4741.1     0.      0.      .0      .0
```

```
     14   479.6    0.   4740.9    0.    0.    .0    .0
     15   500.4    0.   4740.7    0.    0.    .0    .0
     16   521.3    0.   4740.5    0.    0.    .0    .0
     17   542.1    0.   4740.3    0.    0.    .0    .0
     18   562.9    0.   4740.1    0.    0.    .0    .0
     19   583.8    0.   4739.9    0.    0.    .0    .0
     20   604.6    0.   4739.7    0.    0.    .0    .0
     21   625.3    0.   4738.4    0.    0.    .0    .0
     22   646.0    0.   4736.2    0.    0.    .0    .0
     23   666.7    0.   4733.9    0.    0.    .0    .0
     24   687.3    0.   4731.6    0.    0.    .0    .0
     25   708.0    0.   4729.4    0.    0.    .0    .0
     26   728.7    0.   4727.1    0.    0.    .0    .0
     27   749.3    0.   4724.9    0.    0.    .0    .0
     28   770.0    0.   4722.6    0.    0.    .0    .0
     29   790.7    0.   4720.4    0.    0.    .0    .0
     30   811.3    0.   4718.2    0.    0.    .0    .0
     31   832.0    0.   4716.0    0.    0.    .0    .0
     32   852.7    0.   4714.0    0.    0.    .0    .0
     33   864.0    0.   4713.6    0.    0.    .0    .0
1     UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
     Date:  5:16:1996   Time: 10:46:18   Input file: of64g.dat
      Bayview Landfill Cell 1
      Sliding During Operational Filling @ 4764
      Geotextile Interface/Seismic Coeff varies/OF64G.DAT

     TABLE NO. 29
     ******************************************************************
     * INFORMATION GENERATED DURING ITERATIVE SOLUTION FOR THE FACTOR *
     * OF SAFETY BY THE CORPS OF ENGINEERS MODIFIED SWEDISH PROCEDURE *
     ******************************************************************

               Trial Factor   Force Imbalance
     Iteration    of Safety       (lbs.)      DELTA-F

         1        3.00000       -.790E+04    .323

         2        3.32297       -.758E+03    .379E-01

         3        3.36087       -.843E+01    .431E-03

         4        3.36130       -.219E-02   .112E-06

     Factor of Safety - - - - - - - -    3.361
     Side Force Inclination - - - - -      .00
     Number of Iterations - - - - - -    4
1     UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
     Date:  5:16:1996   Time: 10:46:18   Input file: of64g.dat
      Bayview Landfill Cell 1
      Sliding During Operational Filling @ 4764
      Geotextile Interface/Seismic Coeff varies/OF64G.DAT

     TABLE NO. 38
     ****************************************************************
```

```
* Final Results for Stresses Along the Shear Surface        *
* (Results for Critical Shear Surface in Case of a Search.) *
*****************************************************************

CORPS OF ENGINEERS' PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety =   3.361

     -------- VALUES AT CENTER OF BASE OF SLICE---------

                           Total   Effective
Slice                     Normal   Normal    Shear
 No.  X-center  Y-center  Stress   Stress    Stress

  1    221.0    4762.9    109.4    109.4     14.5
  2    235.0    4758.9    354.7    354.7     47.0
  3    255.0    4753.2    626.3    626.3     83.0
  4    275.0    4747.5    898.0    898.0    118.9
  5    295.0    4741.9   1169.6   1169.6    154.9
  6    315.0    4736.2   1441.3   1441.3    190.9
  7    335.0    4730.5   1712.9   1712.9    226.9
  8    355.0    4724.8   1984.5   1984.5    262.9
  9    375.4    4721.8   2208.4   2208.4    104.1
 10    396.3    4721.4   2229.4   2229.4    105.1
 11    417.1    4721.0   2250.4   2250.4    106.0
 12    437.9    4720.5   2271.4   2271.4    107.0
 13    458.8    4720.1   2292.4   2292.4    108.0
 14    479.6    4719.7   2313.4   2313.4    109.0
 15    500.4    4719.3   2334.3   2334.3    110.0
 16    521.3    4718.9   2355.4   2355.4    111.0
 17    542.1    4718.4   2376.3   2376.3    112.0
 18    562.9    4718.0   2397.4   2397.4    113.0
 19    583.8    4717.6   2418.3   2418.3    114.0
 20    604.6    4717.2   2439.3   2439.3    114.9
 21    625.3    4716.8   2356.9   2356.9    111.1
 22    646.0    4716.4   2171.2   2171.2    102.3
 23    666.7    4715.9   1985.5   1985.5     93.6
 24    687.3    4715.5   1799.9   1799.9     84.8
 25    708.0    4715.1   1614.2   1614.2     76.1
 26    728.7    4714.7   1428.6   1428.6     67.3
 27    749.3    4714.3   1242.9   1242.9     58.6
 28    770.0    4713.9   1057.3   1057.3     49.8
 29    790.7    4713.5    871.6    871.6     41.1
 30    811.3    4713.0    686.0    686.0     32.3
 31    832.0    4712.6    500.3    500.3     23.6
 32    852.7    4712.2    314.7    314.7     14.8
 33    864.0    4713.0    116.5    116.5      5.5

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION    =      .02  (= .215E-01)
   SHOULD NOT EXCEED     .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION  =      .00  (= .179E-02)
   SHOULD NOT EXCEED     .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM   =      .01  (= .999E-02)
```

```
        SHOULD NOT EXCEED      .100E+03
1      UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
       Date: 5:16:1996  Time: 10:46:18  Input file: of64g.dat
        Bayview Landfill Cell 1
        Sliding During Operational Filling @ 4764
        Geotextile Interface/Seismic Coeff varies/OF64G.DAT

       TABLE NO. 39
       ******************************************************************
       * Final Results for Side Forces and Stresses Between Slices.  *
       * (Results for Critical Shear Surface in Case of a Search.)   *
       ******************************************************************

       CORPS OF ENGINEERS' PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
       Factor of Safety =   3.361

          ----- VALUES AT RIGHT SIDE OF SLICE ----

                         Side Force
       Slice          Side    Inclination
        No.  X-Right  Force    (degrees)

         1   225.0     132.     .00
         2   245.0    1206.     .00
         3   265.0    3102.     .00
         4   285.0    5819.     .00
         5   305.0    9359.     .00
         6   325.0   13721.     .00
         7   345.0   18906.     .00
         8   365.0   24910.     .00
         9   385.8   23666.     .00
        10   406.7   22411.     .00
        11   427.5   21143.     .00
        12   448.3   19864.     .00
        13   469.2   18573.     .00
        14   490.0   17270.     .00
        15   510.8   15955.     .00
        16   531.7   14629.     .00
        17   552.5   13290.     .00
        18   573.3   11940.     .00
        19   594.2   10578.     .00
        20   615.0    9201.     .00
        21   635.7    7884.     .00
        22   656.3    6671.     .00
        23   677.0    5561.     .00
        24   697.7    4555.     .00
        25   718.3    3653.     .00
        26   739.0    2855.     .00
        27   759.7    2161.     .00
        28   780.3    1570.     .00
        29   801.0    1083.     .00
        30   821.7     700.     .00
        31   842.3     420.     .00
        32   863.0     244.     .00
```

```
33     865.0      0.     .00

END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED
```

```
HEADING
 Bayview Landfill Cell 1
 Sliding During Operational Filling @ 4764
 Sand Interface/Seismic Coeff varies/OF64S.DAT
PROFILE LINES
 1  1  Waste Fill to 4764
 225  4764
 615  4764
 865  4714

 2  2  Side Slope LCRS
  0    4764
 225  4764
 365  4724

 3  3  Bottom LCRS
 365  4724
 865  4714
 999  4714


MATERIAL PROPERTIES
 1  Waste Fill
 50
 C
   150  22
 N
 2  Side Slope LCRS  (INCLUDES SIDE SLOPE T)
 100
 C
   0  24
 N
 3  Bottom LCRS    (SAND CUSHION)
 100
 C
   0  17
 N

ANALYSIS    (SLIDING ALONG LCRS)
 N
 217  4764
 365  4722
 863  4712
 865  4714

 Seismic (ψ)
   0.3     ← ITERATE 0, 0.1, ETC TO FS ≤ 1.00
 Procedure
   C
   0.0

COMPUTE
```

```
1     UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
      Date:  5:16:1996   Time: 10:59:10   Input file: of64s.dat


      TABLE NO. 1
      *******************************************
      * COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
      * Originally Coded By Stephen G. Wright  *
      * Version No. 1.107                     *
      * Last Revision Date 10/13/91           *
      * (C) Copyright 1985-1991 S. G. Wright  *
      * All Rights Reserved                   *
      *******************************************

      *************************************************************
      *                                     *
      *    RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
      * PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
      * HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL  *
      * DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE  *
      * ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER *
      * PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS     *
      * PROGRAM BEFORE ATTEMPTING ITS USE.               *
      *                                     *
      *    NEITHER THE UNIVERSITY OF TEXAS NOR STEPHEN G. WRIGHT *
      * MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR *
      * IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS *
      * OR ADAPTABILITY OF THIS COMPUTER PROGRAM.             *
      *                                     *
      *************************************************************
1     UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
      Date:  5:16:1996   Time: 10:59:10   Input file: of64s.dat
       Bayview Landfill Cell 1
       Sliding During Operational Filling @ 4764
       Geotextile Interface/Seismic Coeff varies/OF64G.DAT

      TABLE NO.  2
      **************************
      * NEW PROFILE LINE DATA *
      **************************

      PROFILE LINE  1 - MATERIAL TYPE =  1
      Waste Fill to 4764

         Point    X          Y

           1     225.000    4764.000
           2     615.000    4764.000
           3     865.000    4714.000

      PROFILE LINE  2 - MATERIAL TYPE =  2
      Side Slope LCRS

         Point    X          Y
```

```
      1     .000     4764.000
      2    225.000    4764.000
      3    365.000    4724.000

   PROFILE LINE  3 - MATERIAL TYPE =  3
   Bottom LCRS

     Point     X          Y

      1    365.000    4724.000
      2    865.000    4714.000
      3    999.000    4714.000

   All new profile lines defined - No old lines retained
1   UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
   Date:  5:16:1996   Time: 10:59:10   Input file: of64s.dat
    Bayview Landfill Cell 1
    Sliding During Operational Filling @ 4764
    Geotextile Interface/Seismic Coeff varies/OF64G.DAT

   TABLE NO.  3
   ***************************************************************************
   * NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS
*
   ***************************************************************************

   DATA FOR MATERIAL TYPE  1
   Waste Fill

      Unit weight of material =   50.000

      CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
      Cohesion - - - - - - - -      150.000
      Friction angle - - - - -  22.000 degrees

      No (or zero) pore water pressures

   DATA FOR MATERIAL TYPE  2
   Side Slope LCRS

      Unit weight of material =  100.000

      CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
      Cohesion - - - - - - - -       .000
      Friction angle - - - - -  24.000 degrees

      No (or zero) pore water pressures

   DATA FOR MATERIAL TYPE  3
   Bottom LCRS

      Unit weight of material =  100.000
```

```
   CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
   Cohesion - - - - - - - -        .000
   Friction angle - - - - -  17.000 degrees

   No (or zero) pore water pressures

 All new material properties defined - No old data retained
1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
 Date:  5:16:1996   Time: 10:59:10   Input file: of64s.dat
  Bayview Landfill Cell 1
  Sliding During Operational Filling @ 4764
  Geotextile Interface/Seismic Coeff varies/OF64G.DAT

 TABLE NO. 15
 ***********************************
 * NEW ANALYSIS/COMPUTATION DATA *
 ***********************************

 Noncircular Shear Surface(s)

 Computations Performed for Single Shear Surface


 Shear Surface Coordinates -

   Point      X            Y

     1     217.000     4764.000
     2     365.000     4722.000
     3     863.000     4712.000
     4     865.000     4714.000

 Procedure used to compute the factor of safety: CORPS
 Specified side force inclination =    .00 degrees

 ----------------------------------------------------------------
 THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

 Initial trial estimate for the factor of safety =  3.000

 Maximum number of iterations allowed for
 calculating the factor of safety =  40

 Allowed force imbalance for convergence =    100.000

 Allowed moment imbalance for convergence =    100.000

 Number of increments for slice subdivision =  30

 Depth of water in crack =        .000

 Unit weight of water in crack =   62.400

 Seismic coefficient =  .000
```

```
    Conventional (single-stage) computations to be performed
1    UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
    Date:  5:16:1996   Time: 10:59:10   Input file: of64s.dat
      Bayview Landfill Cell 1
      Sliding During Operational Filling @ 4764
      Geotextile Interface/Seismic Coeff varies/OF64G.DAT

    TABLE NO. 16
    ****************************
    * NEW SLOPE GEOMETRY DATA *
    ****************************

    NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA
    WERE GENERATED BY THE PROGRAM

    Slope Coordinates -

       Point      X          Y

         1      .000    4764.000
         2    225.000    4764.000
         3    615.000    4764.000
         4    865.000    4714.000
         5    999.000    4714.000
1    UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
    Date:  5:16:1996   Time: 10:59:10   Input file: of64s.dat
      Bayview Landfill Cell 1
      Sliding During Operational Filling @ 4764
      Geotextile Interface/Seismic Coeff varies/OF64G.DAT

    TABLE NO. 26
    *************************************************************
    * Coordinate, Weight, Strength and Pore Water Pressure       *
    * Information for Individual Slices for Conventional         *
    * Computations or First Stage of Multi-Stage Computations.   *
    * (Information is for the Critical Shear Surface in the      *
    * Case of an Automatic Search.)                              *
    *************************************************************

    Slice                Slice  Matl.       Friction  Pore
     No.    X      Y     Weight  Type  Cohesion  Angle  Pressure

         217.0  4764.0
      1   221.0  4762.9     908.2   2      .00    24.00      .0
         225.0  4761.7
      2   235.0  4758.9    7359.9   2      .00    24.00      .0
         245.0  4756.1
      3   255.0  4753.2   12997.1   2      .00    24.00      .0
         265.0  4750.4
      4   275.0  4747.5   18634.3   2      .00    24.00      .0
         285.0  4744.7
      5   295.0  4741.9   24271.5   2      .00    24.00      .0
         305.0  4739.0
```

```
   6  315.0  4736.2   29908.7  2     .00   24.00      .0
      325.0  4733.4
   7  335.0  4730.5   35545.9  2     .00   24.00      .0
      345.0  4727.7
   8  355.0  4724.8   41182.1  2     .00   24.00      .0
      365.0  4722.0
   9  375.4  4721.8   46051.6  3     .00   17.00      .0
      385.8  4721.6
  10   396.3  4721.4   46490.5  3     .00   17.00      .0
      406.7  4721.2
  11   417.1  4721.0   46927.4  3     .00   17.00      .0
      427.5  4720.7
  12   437.9  4720.5   47365.8  3     .00   17.00      .0
      448.3  4720.3
  13   458.8  4720.1   47802.8  3     .00   17.00      .0
      469.2  4719.9
  14   479.6  4719.7   48241.7  3     .00   17.00      .0
      490.0  4719.5
  15   500.4  4719.3   48678.1  3     .00   17.00      .0
      510.8  4719.1
  16   521.3  4718.9   49117.1  3     .00   17.00      .0
      531.7  4718.7
  17   542.1  4718.4   49553.9  3     .00   17.00      .0
      552.5  4718.2
  18   562.9  4718.0   49992.3  3     .00   17.00      .0
      573.3  4717.8
  19   583.8  4717.6   50429.2  3     .00   17.00      .0
      594.2  4717.4
  20   604.6  4717.2   50866.1  3     .00   17.00      .0
      615.0  4717.0
  21   625.3  4716.8   48754.4  3     .00   17.00      .0
      635.7  4716.6
1    UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
     Date:  5:16:1996   Time: 10:59:10   Input file: of64s.dat
      Bayview Landfill Cell 1
      Sliding During Operational Filling @ 4764
      Geotextile Interface/Seismic Coeff varies/OF64G.DAT

     TABLE NO. 26
     ***********************************************************
     *  Coordinate, Weight, Strength and Pore Water Pressure      *
     *  Information for Individual Slices for Conventional       *
     *  Computations or First Stage of Multi-Stage Computations.  *
     *  (Information is for the Critical Shear Surface in the     *
     *  Case of an Automatic Search.)                            *
     ***********************************************************

     Slice              Slice  Matl.       Friction   Pore
      No.    X      Y     Weight  Type  Cohesion  Angle  Pressure

          635.7  4716.6
      22   646.0  4716.4   44913.7  3     .00   17.00      .0
          656.3  4716.1
      23   666.7  4715.9   41073.5  3     .00   17.00      .0
```

```
      677.0  4715.7
   24   687.3  4715.5   37232.8   3      .00   17.00       .0
      697.7  4715.3
   25   708.0  4715.1   33392.6   3      .00   17.00       .0
      718.3  4714.9
   26   728.7  4714.7   29551.9   3      .00   17.00       .0
      739.0  4714.5
   27   749.3  4714.3   25711.8   3      .00   17.00       .0
      759.7  4714.1
   28   770.0  4713.9   21871.1   3      .00   17.00       .0
      780.3  4713.7
   29   790.7  4713.5   18030.9   3      .00   17.00       .0
      801.0  4713.2
   30   811.3  4713.0   14190.2   3      .00   17.00       .0
      821.7  4712.8
   31   832.0  4712.6   10350.0   3      .00   17.00       .0
      842.3  4712.4
   32   852.7  4712.2    6509.2   3     .00   17.00       .0
      863.0  4712.0
   33   864.0  4713.0     222.0   3     .00   17.00       .0
      865.0  4714.0
1      UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
      Date:  5:16:1996   Time: 10:59:10   Input file: of64s.dat
       Bayview Landfill Cell 1
       Sliding During Operational Filling @ 4764
       Geotextile Interface/Seismic Coeff varies/OF64G.DAT

      TABLE NO. 27
      ***************************************************************
      *  Seismic Forces and Forces Due to Surface Pressures for    *
      *  Individual Slices for Conventional  Computations or the   *
      *  First Stage of Multi-Stage Computations.                  *
      *  (Information is for the Critical Shear Surface in the     *
      *  Case of an Automatic Search.)                             *
      ***************************************************************

                          FORCES DUE TO SURFACE PRESSURES
                        Y for
      Slice          Seismic   Seismic   Normal   Shear
       No.     X      Force     Force    Force    Force     X      Y

        1   221.0     0.    4763.4    0.     0.     .0     .0
        2   235.0     0.    4761.0    0.     0.     .0     .0
        3   255.0     0.    4757.9    0.     0.     .0     .0
        4   275.0     0.    4754.9    0.     0.     .0     .0
        5   295.0     0.    4752.1    0.     0.     .0     .0
        6   315.0     0.    4749.2    0.     0.     .0     .0
        7   335.0     0.    4746.3    0.     0.     .0     .0
        8   355.0     0.    4743.5    0.     0.     .0     .0
        9   375.4     0.    4742.0    0.     0.     .0     .0
       10   396.3     0.    4741.8    0.     0.     .0     .0
       11   417.1     0.    4741.6    0.     0.     .0     .0
       12   437.9     0.    4741.4    0.     0.     .0     .0
       13   458.8     0.    4741.1    0.     0.     .0     .0
```

```
   14  479.6   0.  4740.9   0.   0.   .0   .0
   15  500.4   0.  4740.7   0.   0.   .0   .0
   16  521.3   0.  4740.5   0.   0.   .0   .0
   17  542.1   0.  4740.3   0.   0.   .0   .0
   18  562.9   0.  4740.1   0.   0.   .0   .0
   19  583.8   0.  4739.9   0.   0.   .0   .0
   20  604.6   0.  4739.7   0.   0.   .0   .0
   21  625.3   0.  4738.4   0.   0.   .0   .0
   22  646.0   0.  4736.2   0.   0.   .0   .0
   23  666.7   0.  4733.9   0.   0.   .0   .0
   24  687.3   0.  4731.6   0.   0.   .0   .0
   25  708.0   0.  4729.4   0.   0.   .0   .0
   26  728.7   0.  4727.1   0.   0.   .0   .0
   27  749.3   0.  4724.9   0.   0.   .0   .0
   28  770.0   0.  4722.6   0.   0.   .0   .0
   29  790.7   0.  4720.4   0.   0.   .0   .0
   30  811.3   0.  4718.2   0.   0.   .0   .0
   31  832.0   0.  4716.0   0.   0.   .0   .0
   32  852.7   0.  4714.0   0.   0.   .0   .0
   33  864.0   0.  4713.6   0.   0.   .0   .0
1   UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
   Date:  5:16:1996   Time: 10:59:10   Input file: of64s.dat
    Bayview Landfill Cell 1
    Sliding During Operational Filling @ 4764
    Geotextile Interface/Seismic Coeff varies/OF64G.DAT

   TABLE NO. 29
   ********************************************************************
   * INFORMATION GENERATED DURING ITERATIVE SOLUTION FOR THE FACTOR *
   * OF SAFETY BY THE CORPS OF ENGINEERS MODIFIED SWEDISH PROCEDURE *
   ********************************************************************

             Trial Factor   Force Imbalance
   Iteration   of Safety        (lbs.)      DELTA-F

       1      3.00000        -.527E+05    1.34
   Reduced value - Delta was too large ............ .500

       2      3.50000        -.358E+05    1.23
   Reduced value - Delta was too large ............ .500

       3      4.00000        -.231E+05    1.04
   Reduced value - Delta was too large ............ .500

       4      4.50000        -.132E+05    .749
   Reduced value - Delta was too large ............ .500

       5      5.00000        -.526E+04    .368

       6      5.36843        -.359E+03    .290E-01

       7      5.39738        -.193E+01    .157E-03

       8      5.39754         .360E-01   -.294E-05
```

```
Factor of Safety --------     5.398
Side Force Inclination -----      .00
Number of Iterations ------     8
1     UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date:  5:16:1996   Time: 10:59:10   Input file: of64s.dat
 Bayview Landfill Cell 1
 Sliding During Operational Filling @ 4764
 Geotextile Interface/Seismic Coeff varies/OF64G.DAT

TABLE NO. 38
*******************************************************************
*  Final Results for Stresses Along the Shear Surface          *
*  (Results for Critical Shear Surface in Case of a Search.)  *
*******************************************************************

CORPS OF ENGINEERS' PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety =    5.398

   -------- VALUES AT CENTER OF BASE OF SLICE--------

                         Total    Effective
Slice                    Normal   Normal    Shear
 No.  X-center Y-center  Stress   Stress    Stress

  1    221.0   4762.9    110.9    110.9      9.2
  2    235.0   4758.9    359.6    359.6     29.7
  3    255.0   4753.2    635.0    635.0     52.4
  4    275.0   4747.5    910.4    910.4     75.1
  5    295.0   4741.9   1185.8   1185.8     97.8
  6    315.0   4736.2   1461.2   1461.2    120.5
  7    335.0   4730.5   1736.6   1736.6    143.3
  8    355.0   4724.8   2012.0   2012.0    166.0
  9    375.4   4721.8   2208.0   2208.0    125.1
 10    396.3   4721.4   2229.0   2229.0    126.3
 11    417.1   4721.0   2250.0   2250.0    127.4
 12    437.9   4720.5   2271.0   2271.0    128.6
 13    458.8   4720.1   2291.9   2291.9    129.8
 14    479.6   4719.7   2313.0   2313.0    131.0
 15    500.4   4719.3   2333.9   2333.9    132.2
 16    521.3   4718.9   2354.9   2354.9    133.4
 17    542.1   4718.4   2375.9   2375.9    134.6
 18    562.9   4718.0   2396.9   2396.9    135.8
 19    583.8   4717.6   2417.9   2417.9    137.0
 20    604.6   4717.2   2438.8   2438.8    138.1
 21    625.3   4716.8   2356.4   2356.4    133.5
 22    646.0   4716.4   2170.8   2170.8    123.0
 23    666.7   4715.9   1985.2   1985.2    112.4
 24    687.3   4715.5   1799.5   1799.5    101.9
 25    708.0   4715.1   1613.9   1613.9     91.4
 26    728.7   4714.7   1428.3   1428.3     80.9
 27    749.3   4714.3   1242.7   1242.7     70.4
 28    770.0   4713.9   1057.1   1057.1     59.9
 29    790.7   4713.5    871.5    871.5     49.4
```

```
   30    811.3  4713.0    685.8    685.8    38.8
   31    832.0  4712.6    500.2    500.2    28.3
   32    852.7  4712.2    314.6    314.6    17.8
   33    864.0  4713.0    117.7    117.7     6.7


 CHECK SUMS - (ALL SHOULD BE SMALL)
 SUM OF FORCES IN VERTICAL DIRECTION   =      .03  (= .259E-01)
    SHOULD NOT EXCEED     .100E+03
 SUM OF FORCES IN HORIZONTAL DIRECTION  =      .00  (= .218E-02)
    SHOULD NOT EXCEED     .100E+03
 SHEAR STRENGTH/SHEAR FORCE CHECK-SUM   =      .06  (= .564E-01)
    SHOULD NOT EXCEED     .100E+03
1     UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
 Date:  5:16:1996   Time: 10:59:10   Input file: of64s.dat
  Bayview Landfill Cell 1
  Sliding During Operational Filling @ 4764
  Geotextile Interface/Seismic Coeff varies/OF64G.DAT

 TABLE NO. 39
 ********************************************************************
 *  Final Results for Side Forces and Stresses Between Slices.  *
 *  (Results for Critical Shear Surface in Case of a Search.)  *
 ********************************************************************

 CORPS OF ENGINEERS' PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
 Factor of Safety =   5.398

    ----- VALUES AT RIGHT SIDE OF SLICE ----

                      Side Force
 Slice           Side    Inclination
  No.   X-Right   Force    (degrees)

   1    225.0     179.      .00
   2    245.0    1626.      .00
   3    265.0    4183.      .00
   4    285.0    7848.      .00
   5    305.0   12622.      .00
   6    325.0   18505.      .00
   7    345.0   25497.      .00
   8    365.0   33595.      .00
   9    385.8   31914.      .00
  10    406.7   30216.      .00
  11    427.5   28503.      .00
  12    448.3   26773.      .00
  13    469.2   25028.      .00
  14    490.0   23266.      .00
  15    510.8   21489.      .00
  16    531.7   19695.      .00
  17    552.5   17886.      .00
  18    573.3   16060.      .00
  19    594.2   14219.      .00
  20    615.0   12358.      .00
```

```
21    635.7   10577.    .00
22    656.3    8937.   .00
23    677.0    7437.   .00
24    697.7    6078.   .00
25    718.3    4858.   .00
26    739.0    3779.   .00
27    759.7    2840.   .00
28    780.3    2041.   .00
29    801.0    1383.   .00
30    821.7     865.  .00
31    842.3     487.  .00
32    863.0     249.  .00
33    865.0       0.   .00

END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED
```

```
HEADING
 Bayview Landfill Cell 1
 Sliding During Operational Filling @ 4780
 Geotextile Interface/Seismic Coeff varies/OF80G.DAT
PROFILE LINES
 1  1  Waste Fill to 4764
 225  4764
 275  4780
 665  4780
 865  4714

 2  2  Side Slope LCRS
  0    4764
 225  4764
 365  4724

 3  3  Bottom LCRS
 365  4724
 865  4714
 999  4714


MATERIAL PROPERTIES
 1  Waste Fill
 50
 C
   150  22
 N
 2  Side Slope LCRS
 100
 C
   0  24
 N
 3  Bottom LCRS
 100
 C
   0  9
 N

ANALYSIS
 N
 217  4764
 365  4722
 863  4712
 865  4714

 Seismic
   0.2
 Procedure
   C
   0.0

COMPUTE
```

```
1      UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
       Date:  5:16:1996   Time: 11:13:51   Input file: of80g.dat


       TABLE NO. 1
       ********************************************
       * COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
       * Originally Coded By Stephen G. Wright  *
       * Version No. 1.107                      *
       * Last Revision Date 10/13/91            *
       * (C) Copyright 1985-1991 S. G. Wright   *
       * All Rights Reserved                    *
       ********************************************

       *****************************************************************
       *                                                               *
       *     RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
       * PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
       * HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL   *
       * DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE   *
       * ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER  *
       * PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS      *
       * PROGRAM BEFORE ATTEMPTING ITS USE.                         *
       *                                                               *
       *     NEITHER THE UNIVERSITY OF TEXAS NOR STEPHEN G. WRIGHT *
       * MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR  *
       * IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS  *
       * OR ADAPTABILITY OF THIS COMPUTER PROGRAM.                  *
       *                                                               *
       *****************************************************************
1      UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
       Date:  5:16:1996   Time: 11:13:51   Input file: of80g.dat
        Bayview Landfill Cell 1
        Sliding During Operational Filling @ 4780
        Geotextile Interface/Seismic Coeff varies/OF80G.DAT

       TABLE NO.  2
       **************************
       * NEW PROFILE LINE DATA *
       **************************

       PROFILE LINE  1 - MATERIAL TYPE =  1
       Waste Fill to 4764

          Point    X          Y

            1    225.000    4764.000
            2    275.000    4780.000
            3    665.000    4780.000
            4    865.000    4714.000

       PROFILE LINE  2 - MATERIAL TYPE =  2
       Side Slope LCRS
```

```
      Point    X          Y

        1     .000     4764.000
        2   225.000    4764.000
        3   365.000    4724.000

  PROFILE LINE  3 - MATERIAL TYPE =  3
  Bottom LCRS

      Point    X          Y

        1   365.000    4724.000
        2   865.000    4714.000
        3   999.000    4714.000

  All new profile lines defined - No old lines retained
1  UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
  Date: 5:16:1996   Time: 11:13:51   Input file: of80g.dat
   Bayview Landfill Cell 1
   Sliding During Operational Filling @ 4780
   Geotextile Interface/Seismic Coeff varies/OF80G.DAT

  TABLE NO.  3
  ************************************************************************
* * NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS
  ************************************************************************

  DATA FOR MATERIAL TYPE  1
  Waste Fill

     Unit weight of material =   50.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -       150.000
     Friction angle - - - - -   22.000 degrees

     No (or zero) pore water pressures

  DATA FOR MATERIAL TYPE  2
  Side Slope LCRS

     Unit weight of material =  100.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -         .000
     Friction angle - - - - -   24.000 degrees

     No (or zero) pore water pressures

  DATA FOR MATERIAL TYPE  3
  Bottom LCRS

     Unit weight of material =  100.000
```

```
   CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
   Cohesion - - - - - - - -      .000
   Friction angle - - - - -  9.000 degrees

   No (or zero) pore water pressures

 All new material properties defined - No old data retained
1  UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
 Date:  5:16:1996   Time: 11:13:51   Input file: of80g.dat
  Bayview Landfill Cell 1
  Sliding During Operational Filling @ 4780
  Geotextile Interface/Seismic Coeff varies/OF80G.DAT

 TABLE NO. 15
 ***********************************
 * NEW ANALYSIS/COMPUTATION DATA *
 ***********************************

 Noncircular Shear Surface(s)

 Computations Performed for Single Shear Surface


 Shear Surface Coordinates -

   Point     X          Y

     1     217.000    4764.000
     2     365.000    4722.000
     3     863.000    4712.000
     4     865.000    4714.000

 Procedure used to compute the factor of safety: CORPS
 Specified side force inclination =    .00 degrees

 -------------------------------------------------------------
 THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

 Initial trial estimate for the factor of safety =  3.000

 Maximum number of iterations allowed for
 calculating the factor of safety =  40

 Allowed force imbalance for convergence =   100.000

 Allowed moment imbalance for convergence =   100.000

 Number of increments for slice subdivision =  30

 Depth of water in crack =       .000

 Unit weight of water in crack =   62.400
```

```
      Seismic coefficient =  .000

      Conventional (single-stage) computations to be performed
1      UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
      Date:  5:16:1996   Time: 11:13:51   Input file: of80g.dat
        Bayview Landfill Cell 1
        Sliding During Operational Filling @ 4780
        Geotextile Interface/Seismic Coeff varies/OF80G.DAT

      TABLE NO. 16
      ****************************
      * NEW SLOPE GEOMETRY DATA *
      ****************************

      NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA
      WERE GENERATED BY THE PROGRAM

      Slope Coordinates -

         Point      X          Y

           1       .000    4764.000
           2    225.000    4764.000
           3    275.000    4780.000
           4    665.000    4780.000
           5    865.000    4714.000
           6    999.000    4714.000
1      UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
      Date:  5:16:1996   Time: 11:13:51   Input file: of80g.dat
        Bayview Landfill Cell 1
        Sliding During Operational Filling @ 4780
        Geotextile Interface/Seismic Coeff varies/OF80G.DAT

      TABLE NO. 26
      *************************************************************
      *  Coordinate, Weight, Strength and Pore Water Pressure     *
      *  Information for Individual Slices for Conventional       *
      *  Computations or First Stage of Multi-Stage Computations.  *
      *  (Information is for the Critical Shear Surface in the     *
      *  Case of an Automatic Search.)                            *
      *************************************************************

      Slice                  Slice  Matl.         Friction   Pore
       No.     X       Y     Weight  Type  Cohesion  Angle  Pressure

             217.0  4764.0
        1    221.0  4762.9     908.2   2      .00    24.00      .0
             225.0  4761.7
        2    233.3  4759.4    7963.5   2      .00    24.00      .0
             241.7  4757.0
        3    250.0  4754.6   16322.0   2      .00    24.00      .0
             258.3  4752.3
        4    266.7  4749.9   24681.8   2      .00    24.00      .0
             275.0  4747.5
```

```
       5   284.0  4745.0   33453.4   2      .00   24.00       .0
          293.0  4742.4
       6   302.0  4739.9   38018.0   2      .00   24.00       .0
          311.0  4737.3
       7   320.0  4734.8   42584.3   2      .00   24.00       .0
          329.0  4732.2
       8   338.0  4729.7   47149.4   2      .00   24.00       .0
          347.0  4727.1
       9   356.0  4724.6   51715.7   2      .00   24.00       .0
          365.0  4722.0
      10   375.7  4721.8   64516.4   3      .00    9.00       .0
          386.4  4721.6
      11   397.1  4721.4   64979.9   3      .00    9.00       .0
          407.9  4721.1
      12   418.6  4720.9   65441.9   3      .00    9.00       .0
          429.3  4720.7
      13   440.0  4720.5   65905.4   3      .00    9.00       .0
          450.7  4720.3
      14   461.4  4720.1   66366.8   3      .00    9.00       .0
          472.1  4719.8
      15   482.9  4719.6   66830.8   3      .00    9.00       .0
          493.6  4719.4
      16   504.3  4719.2   67292.4   3      .00    9.00       .0
          515.0  4719.0
      17   525.7  4718.8   67755.9   3      .00    9.00       .0
          536.4  4718.6
      18   547.1  4718.3   68217.3   3      .00    9.00       .0
          557.9  4718.1
      19   568.6  4717.9   68681.4   3      .00    9.00       .0
          579.3  4717.7
      20   590.0  4717.5   69142.8   3      .00    9.00       .0
          600.7  4717.3
      21   611.4  4717.1   69606.3   3      .00    9.00       .0
          622.1  4716.8
1      UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
      Date:  5:16:1996   Time: 11:13:51   Input file: of80g.dat
       Bayview Landfill Cell 1
       Sliding During Operational Filling @ 4780
       Geotextile Interface/Seismic Coeff varies/OF80G.DAT

      TABLE NO. 26
      ***************************************************************
      * Coordinate, Weight, Strength and Pore Water Pressure      *
      * Information for Individual Slices for Conventional        *
      * Computations or First Stage of Multi-Stage Computations.  *
      * (Information is for the Critical Shear Surface in the     *
      * Case of an Automatic Search.)                             *
      ***************************************************************

      Slice              Slice   Matl.        Friction  Pore
       No.     X       Y    Weight  Type  Cohesion  Angle  Pressure

          622.1  4716.8
      22   632.9  4716.6   70068.2   3      .00    9.00       .0
```

```
      643.6  4716.4
   23  654.3  4716.2  70532.6  3    .00   9.00    .0
      665.0  4716.0
   24  674.9  4715.8  62350.1  3    .00   9.00    .0
      684.8  4715.6
   25  694.7  4715.4  56276.7  3    .00   9.00    .0
      704.6  4715.2
   26  714.5  4715.0  50202.8  3    .00   9.00    .0
      724.4  4714.8
   27  734.3  4714.6  44128.9  3    .00   9.00    .0
      744.2  4714.4
   28  754.1  4714.2  38055.5  3    .00   9.00    .0
      764.0  4714.0
   29  773.9  4713.8  31981.6  3    .00   9.00    .0
      783.8  4713.6
   30  793.7  4713.4  25907.7  3    .00   9.00    .0
      803.6  4713.2
   31  813.5  4713.0  19834.3  3    .00   9.00    .0
      823.4  4712.8
   32  833.3  4712.6  13760.4  3    .00   9.00    .0
      843.2  4712.4
   33  853.1  4712.2   7689.0  3    .00   9.00    .0
      863.0  4712.0
   34  864.0  4713.0    235.0  3    .00   9.00    .0
      865.0  4714.0
1     UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
  Date:  5:16:1996   Time: 11:13:51   Input file: of80g.dat
   Bayview Landfill Cell 1
   Sliding During Operational Filling @ 4780
   Geotextile Interface/Seismic Coeff varies/OF80G.DAT

  TABLE NO. 27
  ************************************************************
  * Seismic Forces and Forces Due to Surface Pressures for    *
  * Individual Slices for Conventional  Computations or the   *
  * First Stage of Multi-Stage Computations.                  *
  * (Information is for the Critical Shear Surface in the     *
  * Case of an Automatic Search.)                             *
  ************************************************************

                         FORCES DUE TO SURFACE PRESSURES
                Y for
  Slice       Seismic  Seismic   Normal  Shear
   No.    X    Force    Force    Force   Force     X      Y

    1   221.0    0.    4763.4     0.      0.      .0     .0
    2   233.3    0.    4762.4     0.      0.      .0     .0
    3   250.0    0.    4762.5     0.      0.      .0     .0
    4   266.7    0.    4762.7     0.      0.      .0     .0
    5   284.0    0.    4761.5     0.      0.      .0     .0
    6   302.0    0.    4759.0     0.      0.      .0     .0
    7   320.0    0.    4756.4     0.      0.      .0     .0
    8   338.0    0.    4753.9     0.      0.      .0     .0
    9   356.0    0.    4751.3     0.      0.      .0     .0
```

```
        10  375.7   0.  4750.0   0.   0.   .0   .0
        11  397.1   0.  4749.7   0.   0.   .0   .0
        12  418.6   0.  4749.5   0.   0.   .0   .0
        13  440.0   0.  4749.3   0.   0.   .0   .0
        14  461.4   0.  4749.1   0.   0.   .0   .0
        15  482.9   0.  4748.9   0.   0.   .0   .0
        16  504.3   0.  4748.7   0.   0.   .0   .0
        17  525.7   0.  4748.4   0.   0.   .0   .0
        18  547.1   0.  4748.2   0.   0.   .0   .0
        19  568.6   0.  4748.0   0.   0.   .0   .0
        20  590.0   0.  4747.8   0.   0.   .0   .0
        21  611.4   0.  4747.6   0.   0.   .0   .0
        22  632.9   0.  4747.4   0.   0.   .0   .0
        23  654.3   0.  4747.1   0.   0.   .0   .0
        24  674.9   0.  4745.3   0.   0.   .0   .0
        25  694.7   0.  4741.8   0.   0.   .0   .0
        26  714.5   0.  4738.4   0.   0.   .0   .0
        27  734.3   0.  4734.9   0.   0.   .0   .0
        28  754.1   0.  4731.5   0.   0.   .0   .0
        29  773.9   0.  4728.0   0.   0.   .0   .0
        30  793.7   0.  4724.6   0.   0.   .0   .0
        31  813.5   0.  4721.2   0.   0.   .0   .0
        32  833.3   0.  4717.8   0.   0.   .0   .0
        33  853.1   0.  4714.6   0.   0.   .0   .0
        34  864.0   0.  4713.6   0.   0.   .0   .0
1       UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
       Date:  5:16:1996   Time: 11:13:51   Input file: of80g.dat
        Bayview Landfill Cell 1
        Sliding During Operational Filling @ 4780
        Geotextile Interface/Seismic Coeff varies/OF80G.DAT

       TABLE NO. 29
       ******************************************************************
       * INFORMATION GENERATED DURING ITERATIVE SOLUTION FOR THE FACTOR *
       * OF SAFETY BY THE CORPS OF ENGINEERS MODIFIED SWEDISH PROCEDURE *
       ******************************************************************

                    Trial Factor    Force Imbalance
       Iteration     of Safety          (lbs.)      DELTA-F

           1         3.00000          -.846E+04     .237

           2         3.23701          -.611E+03     .199E-01

           3         3.25688          -.368E+01     .121E-03

           4         3.25700           .283E-01    -.933E-06

       Factor of Safety - - - - - - - -     3.257
       Side Force Inclination - - - - -       .00
       Number of Iterations - - - - - -     4
1       UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
       Date:  5:16:1996   Time: 11:13:51   Input file: of80g.dat
        Bayview Landfill Cell 1
```

```
Sliding During Operational Filling @ 4780
Geotextile Interface/Seismic Coeff varies/OF80G.DAT

TABLE NO. 38
*****************************************************************
* Final Results for Stresses Along the Shear Surface          *
* (Results for Critical Shear Surface in Case of a Search.)   *
*****************************************************************

CORPS OF ENGINEERS' PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety =   3.257

    -------- VALUES AT CENTER OF BASE OF SLICE--------

                          Total   Effective
Slice                     Normal   Normal    Shear
 No.  X-center Y-center   Stress   Stress    Stress

  1    221.0   4762.9    109.3    109.3     14.9
  2    233.3   4759.4    460.0    460.0     62.9
  3    250.0   4754.6    942.8    942.8    128.9
  4    266.7   4749.9   1425.6   1425.6    194.9
  5    284.0   4745.0   1789.1   1789.1    244.6
  6    302.0   4739.9   2033.2   2033.2    277.9
  7    320.0   4734.8   2277.5   2277.5    311.3
  8    338.0   4729.7   2521.6   2521.6    344.7
  9    356.0   4724.6   2765.8   2765.8    378.1
 10    375.7   4721.8   3007.8   3007.8    146.3
 11    397.1   4721.4   3029.4   3029.4    147.3
 12    418.6   4720.9   3051.0   3051.0    148.4
 13    440.0   4720.5   3072.6   3072.6    149.4
 14    461.4   4720.1   3094.1   3094.1    150.5
 15    482.9   4719.6   3115.7   3115.7    151.5
 16    504.3   4719.2   3137.2   3137.2    152.6
 17    525.7   4718.8   3158.9   3158.9    153.6
 18    547.1   4718.3   3180.4   3180.4    154.7
 19    568.6   4717.9   3202.0   3202.0    155.7
 20    590.0   4717.5   3223.5   3223.5    156.8
 21    611.4   4717.1   3245.1   3245.1    157.8
 22    632.9   4716.6   3266.7   3266.7    158.9
 23    654.3   4716.2   3288.3   3288.3    159.9
 24    674.9   4715.8   3145.9   3145.9    153.0
 25    694.7   4715.4   2839.5   2839.5    138.1
 26    714.5   4715.0   2533.0   2533.0    123.2
 27    734.3   4714.6   2226.6   2226.6    108.3
 28    754.1   4714.2   1920.1   1920.1     93.4
 29    773.9   4713.8   1613.7   1613.7     78.5
 30    793.7   4713.4   1307.2   1307.2     63.6
 31    813.5   4713.0   1000.8   1000.8     48.7
 32    833.3   4712.6    694.3    694.3     33.8
 33    853.1   4712.2    387.9    387.9     18.9
 34    864.0   4713.0    123.5    123.5      6.0
```

```
CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION   =      .03  (= .335E-01)
   SHOULD NOT EXCEED     .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION =      .00  (= .316E-02)
   SHOULD NOT EXCEED     .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM  =      .06  (= .625E-01)
   SHOULD NOT EXCEED     .100E+03
1  UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 5:16:1996  Time: 11:13:51  Input file: of80g.dat
 Bayview Landfill Cell I
 Sliding During Operational Filling @ 4780
 Geotextile Interface/Seismic Coeff varies/OF80G.DAT

TABLE NO. 39
*******************************************************************
* Final Results for Side Forces and Stresses Between Slices.  *
* (Results for Critical Shear Surface in Case of a Search.)   *
*******************************************************************

CORPS OF ENGINEERS' PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety =   3.257

   ----- VALUES AT RIGHT SIDE OF SLICE ----

                   Side Force
Slice         Side   Inclination
 No.  X-Right  Force   (degrees)

  1   225.0    129.    .00
  2   241.7   1256.    .00
  3   258.3   3567.    .00
  4   275.0   7062.    .00
  5   293.0  11798.    .00
  6   311.0  17181.    .00
  7   329.0  23210.    .00
  8   347.0  29886.    .00
  9   365.0  37210.    .00
 10   386.4  35370.    .00
 11   407.9  33516.    .00
 12   429.3  31650.    .00
 13   450.7  29770.    .00
 14   472.1  27876.    .00
 15   493.6  25970.    .00
 16   515.0  24050.    .00
 17   536.4  22118.    .00
 18   557.9  20172.    .00
 19   579.3  18212.    .00
 20   600.7  16240.    .00
 21   622.1  14254.    .00
 22   643.6  12256.    .00
 23   665.0  10248.    .00
 24   684.8   8470.    .00
 25   704.6   6864.    .00
 26   724.4   5432.    .00
```

```
27    744.2    4173.    .00
28    764.0    3088.    .00
29    783.8    2175.    .00
30    803.6    1436.    .00
31    823.4     870.    .00
32    843.2     478.    .00
33    863.0     259.    .00
34    865.0       0.    .00

END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED
```

```
HEADING
 Bayview Landfill Cell 1
 Sliding During Operational Filling @ 4780
 Sand Interface/Seismic Coeff varies/OF80S.DAT
PROFILE LINES
 1  1  Waste Fill to 4764
 225  4764
 275  4780
 665  4780
 865  4714

 2  2  Side Slope LCRS
  0    4764
 225  4764
 365  4724

 3  3  Bottom LCRS
 365  4724
 865  4714
 999  4714


MATERIAL PROPERTIES
 1  Waste Fill
 50
 C
   150  22
 N
 2  Side Slope LCRS
 100
 C
   0  24
 N
 3  Bottom LCRS
 100
 C
   0  17
 N

ANALYSIS
 N
 217  4764
 365  4722
 863  4712
 865  4714

Seismic
   0.30
Procedure
   C
   0.0

COMPUTE
```

```
1     UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
      Date:  5:16:1996   Time: 11:18:48   Input file: of80s.dat


      TABLE NO. 1
      ********************************************
      * COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
      * Originally Coded By Stephen G. Wright  *
      * Version No. 1.107                  *
      * Last Revision Date 10/13/91           *
      * (C) Copyright 1985-1991 S. G. Wright   *
      * All Rights Reserved                *
      ********************************************

      *****************************************************************
      *                                *
      *    RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
      * PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
      * HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL   *
      * DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE   *
      * ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER  *
      * PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS      *
      * PROGRAM BEFORE ATTEMPTING ITS USE.           *
      *                                *
      *    NEITHER THE UNIVERSITY OF TEXAS NOR STEPHEN G. WRIGHT *
      * MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR  *
      * IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS  *
      * OR ADAPTABILITY OF THIS COMPUTER PROGRAM.          *
      *                                *
      *****************************************************************
1     UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
      Date:  5:16:1996   Time: 11:18:48   Input file: of80s.dat
       Bayview Landfill Cell 1
       Sliding During Operational Filling @ 4780
       Sand Interface/Seismic Coeff varies/OF80S.DAT

      TABLE NO.  2
      **************************
      * NEW PROFILE LINE DATA *
      **************************

      PROFILE LINE  1 - MATERIAL TYPE =  1
      Waste Fill to 4764

        Point    X          Y

          1    225.000    4764.000
          2    275.000    4780.000
          3    665.000    4780.000
          4    865.000    4714.000

      PROFILE LINE  2 - MATERIAL TYPE =  2
      Side Slope LCRS
```

```
     Point    X          Y

       1    .000     4764.000
       2  225.000     4764.000
       3  365.000     4724.000

 PROFILE LINE  3 - MATERIAL TYPE =  3
 Bottom LCRS

     Point    X          Y

       1  365.000     4724.000
       2  865.000     4714.000
       3  999.000     4714.000

 All new profile lines defined - No old lines retained
1  UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
 Date:  5:16:1996   Time: 11:18:48   Input file: of80s.dat
  Bayview Landfill Cell 1
  Sliding During Operational Filling @ 4780
  Sand Interface/Seismic Coeff varies/OF80S.DAT

 TABLE NO.  3
 ***********************************************************************
 * NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS
*
 ***********************************************************************

 DATA FOR MATERIAL TYPE  1
 Waste Fill

     Unit weight of material =   50.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -     150.000
     Friction angle - - - - -  22.000 degrees

     No (or zero) pore water pressures

 DATA FOR MATERIAL TYPE  2
 Side Slope LCRS

     Unit weight of material =  100.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -        .000
     Friction angle - - - - -  24.000 degrees

     No (or zero) pore water pressures

 DATA FOR MATERIAL TYPE  3
 Bottom LCRS

     Unit weight of material =  100.000
```

```
    CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
    Cohesion - - - - - - - -       .000
    Friction angle - - - - -  17.000 degrees

    No (or zero) pore water pressures

 All new material properties defined - No old data retained
1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
 Date:  5:16:1996   Time: 11:18:48   Input file: of80s.dat
  Bayview Landfill Cell 1
  Sliding During Operational Filling @ 4780
  Sand Interface/Seismic Coeff varies/OF80S.DAT

 TABLE NO. 15
 ***********************************
 * NEW ANALYSIS/COMPUTATION DATA *
 ***********************************

 Noncircular Shear Surface(s)

 Computations Performed for Single Shear Surface


 Shear Surface Coordinates -

    Point      X           Y

      1     217.000     4764.000
      2     365.000     4722.000
      3     863.000     4712.000
      4     865.000     4714.000

 Procedure used to compute the factor of safety: CORPS
 Specified side force inclination =    .00 degrees

 -----------------------------------------------------------
 THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

 Initial trial estimate for the factor of safety =  3.000

 Maximum number of iterations allowed for
 calculating the factor of safety =  40

 Allowed force imbalance for convergence =     100.000

 Allowed moment imbalance for convergence =    100.000

 Number of increments for slice subdivision =  30

 Depth of water in crack =        .000

 Unit weight of water in crack =    62.400
```

```
     Seismic coefficient =  .000

     Conventional (single-stage) computations to be performed
1     UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
     Date:  5:16:1996   Time: 11:18:48   Input file: of80s.dat
      Bayview Landfill Cell 1
      Sliding During Operational Filling @ 4780
      Sand Interface/Seismic Coeff varies/OF80S.DAT

     TABLE NO. 16
     ****************************
     * NEW SLOPE GEOMETRY DATA *
     ****************************

     NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA
     WERE GENERATED BY THE PROGRAM

     Slope Coordinates -

        Point     X         Y

          1      .000    4764.000
          2    225.000    4764.000
          3    275.000    4780.000
          4    665.000    4780.000
          5    865.000    4714.000
          6    999.000    4714.000
1     UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
     Date:  5:16:1996   Time: 11:18:48   Input file: of80s.dat
      Bayview Landfill Cell 1
      Sliding During Operational Filling @ 4780
      Sand Interface/Seismic Coeff varies/OF80S.DAT

     TABLE NO. 26
     ****************************************************************
     * Coordinate, Weight, Strength and Pore Water Pressure        *
     * Information for Individual Slices for Conventional          *
     * Computations or First Stage of Multi-Stage Computations.   *
     * (Information is for the Critical Shear Surface in the       *
     * Case of an Automatic Search.)                               *
     ****************************************************************

     Slice               Slice   Matl.       Friction   Pore
      No.    X      Y    Weight  Type  Cohesion  Angle  Pressure

           217.0  4764.0
       1   221.0  4762.9    908.2   2     .00    24.00      .0
           225.0  4761.7
       2   233.3  4759.4   7963.5   2     .00    24.00      .0
           241.7  4757.0
       3   250.0  4754.6  16322.0   2     .00    24.00      .0
           258.3  4752.3
       4   266.7  4749.9  24681.8   2     .00    24.00      .0
           275.0  4747.5
```

```
 5  284.0  4745.0   33453.4  2    .00  24.00    .0
    293.0  4742.4
 6  302.0  4739.9   38018.0  2    .00  24.00    .0
    311.0  4737.3
 7  320.0  4734.8   42584.3  2    .00  24.00    .0
    329.0  4732.2
 8  338.0  4729.7   47149.4  2    .00  24.00    .0
    347.0  4727.1
 9  356.0  4724.6   51715.7  2    .00  24.00    .0
    365.0  4722.0
10  375.7  4721.8   64516.4  3    .00  17.00    .0
    386.4  4721.6
11  397.1  4721.4   64979.9  3    .00  17.00    .0
    407.9  4721.1
12  418.6  4720.9   65441.9  3    .00  17.00    .0
    429.3  4720.7
13  440.0  4720.5   65905.4  3    .00  17.00    .0
    450.7  4720.3
14  461.4  4720.1   66366.8  3    .00  17.00    .0
    472.1  4719.8
15  482.9  4719.6   66830.8  3    .00  17.00    .0
    493.6  4719.4
16  504.3  4719.2   67292.4  3    .00  17.00    .0
    515.0  4719.0
17  525.7  4718.8   67755.9  3    .00  17.00    .0
    536.4  4718.6
18  547.1  4718.3   68217.3  3    .00  17.00    .0
    557.9  4718.1
19  568.6  4717.9   68681.4  3    .00  17.00    .0
    579.3  4717.7
20  590.0  4717.5   69142.8  3    .00  17.00    .0
    600.7  4717.3
21  611.4  4717.1   69606.3  3    .00  17.00    .0
    622.1  4716.8
1    UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
    Date:  5:16:1996   Time: 11:18:48  Input file: of80s.dat
     Bayview Landfill Cell 1
     Sliding During Operational Filling @ 4780
     Sand Interface/Seismic Coeff varies/OF80S.DAT

    TABLE NO. 26
    ***********************************************************
    * Coordinate, Weight, Strength and Pore Water Pressure    *
    * Information for Individual Slices for Conventional      *
    * Computations or First Stage of Multi-Stage Computations. *
    * (Information is for the Critical Shear Surface in the   *
    * Case of an Automatic Search.)                           *
    ***********************************************************

    Slice              Slice  Matl.       Friction  Pore
     No.    X      Y   Weight  Type  Cohesion  Angle  Pressure

          622.1  4716.8
     22   632.9  4716.6   70068.2  3    .00  17.00    .0
```

```
     643.6  4716.4
 23  654.3  4716.2  70532.6  3    .00  17.00    .0
     665.0  4716.0
 24  674.9  4715.8  62350.1  3    .00  17.00    .0
     684.8  4715.6
 25  694.7  4715.4  56276.7  3    .00  17.00    .0
     704.6  4715.2
 26  714.5  4715.0  50202.8  3    .00  17.00    .0
     724.4  4714.8
 27  734.3  4714.6  44128.9  3    .00  17.00    .0
     744.2  4714.4
 28  754.1  4714.2  38055.5  3    .00  17.00    .0
     764.0  4714.0
 29  773.9  4713.8  31981.6  3    .00  17.00    .0
     783.8  4713.6
 30  793.7  4713.4  25907.7  3    .00  17.00    .0
     803.6  4713.2
 31  813.5  4713.0  19834.3  3    .00  17.00    .0
     823.4  4712.8
 32  833.3  4712.6  13760.4  3    .00  17.00    .0
     843.2  4712.4
 33  853.1  4712.2   7689.0  3   .00  17.00   .0
     863.0  4712.0
 34  864.0  4713.0    235.0  3   .00  17.00  .0
     865.0  4714.0
1    UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
    Date:  5:16:1996   Time: 11:18:48   Input file: of80s.dat
     Bayview Landfill Cell 1
     Sliding During Operational Filling @ 4780
     Sand Interface/Seismic Coeff varies/OF80S.DAT

    TABLE NO. 27
    ***************************************************************
    *  Seismic Forces and Forces Due to Surface Pressures for   *
    *  Individual Slices for Conventional  Computations or the  *
    *  First Stage of Multi-Stage Computations.                 *
    *  (Information is for the Critical Shear Surface in the    *
    *  Case of an Automatic Search.)                            *
    ***************************************************************

                          FORCES DUE TO SURFACE PRESSURES
                Y for
    Slice    Seismic  Seismic  Normal  Shear
     No.   X   Force    Force   Force   Force    X     Y

      1  221.0    0.   4763.4    0.     0.    .0    .0
      2  233.3    0.   4762.4    0.     0.    .0    .0
      3  250.0    0.   4762.5    0.     0.    .0    .0
      4  266.7    0.   4762.7    0.     0.    .0    .0
      5  284.0    0.   4761.5    0.     0.    .0    .0
      6  302.0    0.   4759.0    0.     0.    .0    .0
      7  320.0    0.   4756.4    0.     0.    .0    .0
      8  338.0    0.   4753.9    0.     0.    .0    .0
      9  356.0    0.   4751.3    0.     0.    .0    .0
```

```
     10   375.7    0.   4750.0    0.    0.    .0    .0
     11   397.1    0.   4749.7    0.    0.    .0    .0
     12   418.6    0.   4749.5    0.    0.    .0    .0
     13   440.0    0.   4749.3    0.    0.    .0    .0
     14   461.4    0.   4749.1    0.    0.    .0    .0
     15   482.9    0.   4748.9    0.    0.    .0    .0
     16   504.3    0.   4748.7    0.    0.    .0    .0
     17   525.7    0.   4748.4    0.    0.    .0    .0
     18   547.1    0.   4748.2    0.    0.    .0    .0
     19   568.6    0.   4748.0    0.    0.    .0    .0
     20   590.0    0.   4747.8    0.    0.    .0    .0
     21   611.4    0.   4747.6    0.    0.    .0    .0
     22   632.9    0.   4747.4    0.    0.    .0    .0
     23   654.3    0.   4747.1    0.    0.    .0    .0
     24   674.9    0.   4745.3    0.    0.    .0    .0
     25   694.7    0.   4741.8    0.    0.    .0    .0
     26   714.5    0.   4738.4    0.    0.    .0    .0
     27   734.3    0.   4734.9    0.    0.    .0    .0
     28   754.1    0.   4731.5    0.    0.    .0    .0
     29   773.9    0.   4728.0    0.    0.    .0    .0
     30   793.7    0.   4724.6    0.    0.    .0    .0
     31   813.5    0.   4721.2    0.    0.    .0    .0
     32   833.3    0.   4717.8    0.    0.    .0    .0
     33   853.1    0.   4714.6    0.    0.    .0    .0
     34   864.0    0.   4713.6    0.    0.    .0    .0
1    UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
    Date: 5:16:1996  Time: 11:18:48  Input file: of80s.dat
     Bayview Landfill Cell 1
     Sliding During Operational Filling @ 4780
     Sand Interface/Seismic Coeff varies/OF80S.DAT

    TABLE NO. 29
    ********************************************************************
    * INFORMATION GENERATED DURING ITERATIVE SOLUTION FOR THE FACTOR *
    * OF SAFETY BY THE CORPS OF ENGINEERS MODIFIED SWEDISH PROCEDURE *
    ********************************************************************


              Trial Factor    Force Imbalance
    Iteration    of Safety        (lbs.)      DELTA-F

        1        3.00000        -.719E+05    1.27
    Reduced value - Delta was too large ............  .500

        2        3.50000        -.476E+05    1.14
    Reduced value - Delta was too large ............  .500

        3        4.00000        -.292E+05    .910
    Reduced value - Delta was too large ............  .500

        4        4.50000        -.149E+05    .588
    Reduced value - Delta was too large ............  .500

        5        5.00000        -.349E+04    .169
```

```
       6      5.16912       -.113E+03   .587E-02

       7      5.17499       -.141E+00   .734E-05

    Factor of Safety --------    5.175
    Side Force Inclination -----      .00
    Number of Iterations ------     7
1    UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
    Date:  5:16:1996   Time: 11:18:48   Input file: of80s.dat
     Bayview Landfill Cell 1
     Sliding During Operational Filling @ 4780
     Sand Interface/Seismic Coeff varies/OF80S.DAT

    TABLE NO. 38
    ******************************************************************
    *  Final Results for Stresses Along the Shear Surface        *
    *  (Results for Critical Shear Surface in Case of a Search.)  *
    ******************************************************************

    CORPS OF ENGINEERS' PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
    Factor of Safety =   5.175

         -------- VALUES AT CENTER OF BASE OF SLICE--------

                           Total    Effective
    Slice                  Normal    Normal     Shear
     No.  X-center Y-center  Stress    Stress     Stress

      1    221.0   4762.9    110.8     110.8       9.5
      2    233.3   4759.4    466.4     466.4      40.1
      3    250.0   4754.6    956.0     956.0      82.2
      4    266.7   4749.9   1445.6    1445.6     124.4
      5    284.0   4745.0   1814.2    1814.2     156.1
      6    302.0   4739.9   2061.8    2061.8     177.4
      7    320.0   4734.8   2309.4    2309.4     198.7
      8    338.0   4729.7   2557.0    2557.0     220.0
      9    356.0   4724.6   2804.6    2804.6     241.3
     10    375.7   4721.8   3007.2    3007.2     177.7
     11    397.1   4721.4   3028.8    3028.8     178.9
     12    418.6   4720.9   3050.3    3050.3     180.2
     13    440.0   4720.5   3071.9    3071.9     181.5
     14    461.4   4720.1   3093.5    3093.5     182.8
     15    482.9   4719.6   3115.1    3115.1     184.0
     16    504.3   4719.2   3136.6    3136.6     185.3
     17    525.7   4718.8   3158.2    3158.2     186.6
     18    547.1   4718.3   3179.7    3179.7     187.9
     19    568.6   4717.9   3201.3    3201.3     189.1
     20    590.0   4717.5   3222.8    3222.8     190.4
     21    611.4   4717.1   3244.4    3244.4     191.7
     22    632.9   4716.6   3266.0    3266.0     192.9
     23    654.3   4716.2   3287.6    3287.6     194.2
     24    674.9   4715.8   3145.3    3145.3     185.8
     25    694.7   4715.4   2838.9    2838.9     167.7
     26    714.5   4715.0   2532.5    2532.5     149.6
```

```
 27    734.3   4714.6   2226.1    2226.1    131.5
 28    754.1   4714.2   1919.7    1919.7    113.4
 29    773.9   4713.8   1613.3    1613.3     95.3
 30    793.7   4713.4   1306.9    1306.9     77.2
 31    813.5   4713.0   1000.5    1000.5     59.1
 32    833.3   4712.6    694.1     694.1     41.0
 33    853.1   4712.2    387.9     387.9     22.9
 34    864.0   4713.0    124.9     124.9      7.4


CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION    =        .04  (= .383E-01)
   SHOULD NOT EXCEED      .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION  =          .00  (= .304E-02)
   SHOULD NOT EXCEED      .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM   =            .13  (= .130E+00)
   SHOULD NOT EXCEED      .100E+03
1       UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date:  5:16:1996   Time: 11:18:48   Input file: of80s.dat
 Bayview Landfill Cell 1
 Sliding During Operational Filling @ 4780
 Sand Interface/Seismic Coeff varies/OF80S.DAT

TABLE NO. 39
*******************************************************************
*  Final Results for Side Forces and Stresses Between Slices.  *
*  (Results for Critical Shear Surface in Case of a Search.)   *
*******************************************************************

CORPS OF ENGINEERS' PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety =   5.175

    ----- VALUES AT RIGHT SIDE OF SLICE -----

                    Side Force
Slice            Side    Inclination
 No.   X-Right    Force     (degrees)

  1     225.0      175.      .00
  2     241.7     1712.      .00
  3     258.3     4863.      .00
  4     275.0     9628.      .00
  5     293.0    16085.      .00
  6     311.0    23424.      .00
  7     329.0    31643.      .00
  8     347.0    40745.      .00
  9     365.0    50730.      .00
 10      386.4    48216.      .00
 11      407.9    45685.      .00
 12      429.3    43135.      .00
 13      450.7    40568.      .00
 14      472.1    37982.      .00
 15      493.6    35379.      .00
 16      515.0    32757.      .00
```

```
17   536.4  30118.   .00
18   557.9  27460.   .00
19   579.3  24784.   .00
20   600.7  22091.   .00
21   622.1  19379.   .00
22   643.6  16650.   .00
23   665.0  13907.   .00
24   684.8  11478.   .00
25   704.6   9285.  .00
26   724.4   7329.  .00
27   744.2   5610.  .00
28   764.0   4127.  .00
29   783.8   2881.  .00
30   803.6   1872.  .00
31   823.4   1099.  .00
32   843.2    563.  .00
33   863.0    264.  .00
34   865.0      0.  .00

END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED
```

HDR Computation

Project

Subject

Task

Job No.

Computed

Checked

Sheet

Date

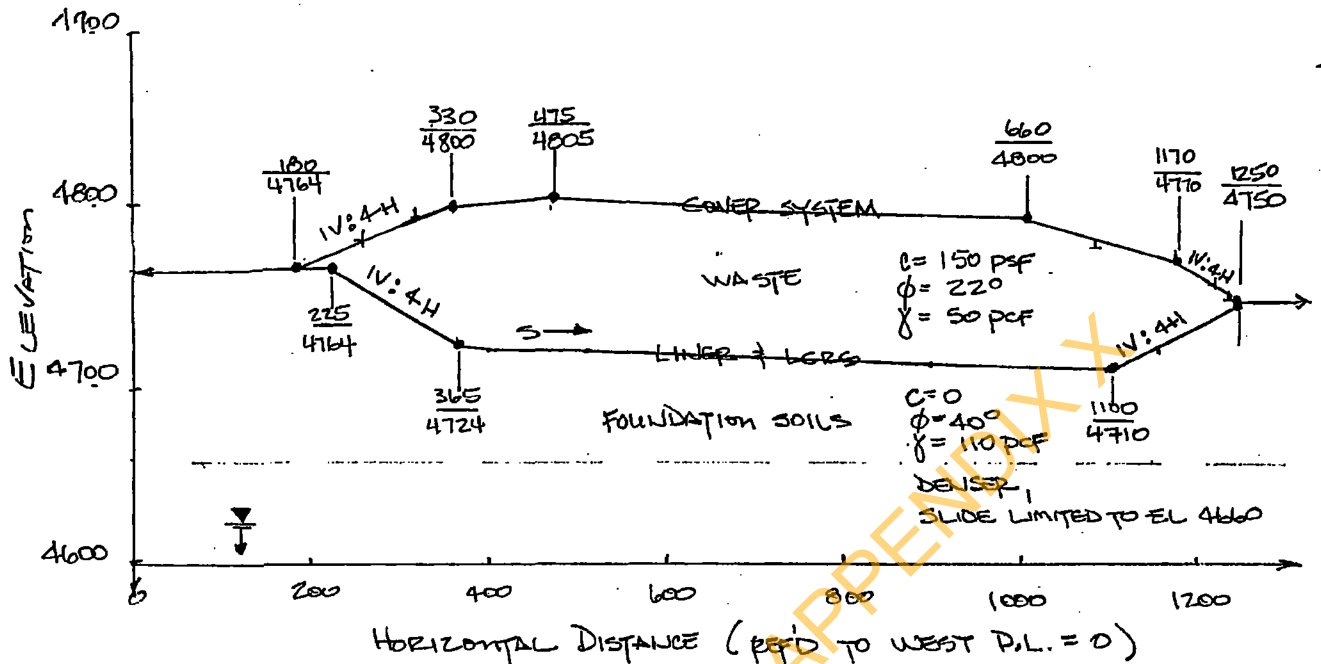
Date

Of

No.

4 WASTE FILL

4.1 SKETCH



SECTION CUT W-E, @ STA N 8450

V: 1" = 100'
H: 1" = 200'

Job No.

No.

HDR Computation

Project

Computed

Date

Subject

Checked

Date

Task

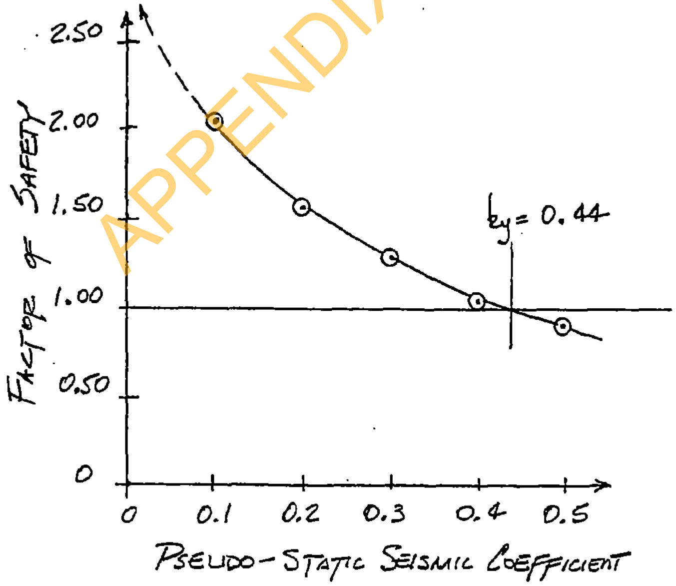
Sheet

Of

4.2 Determine Static F.S. for
section shown on 4.1 ; attached
FS = 2.5+ , analysis attached

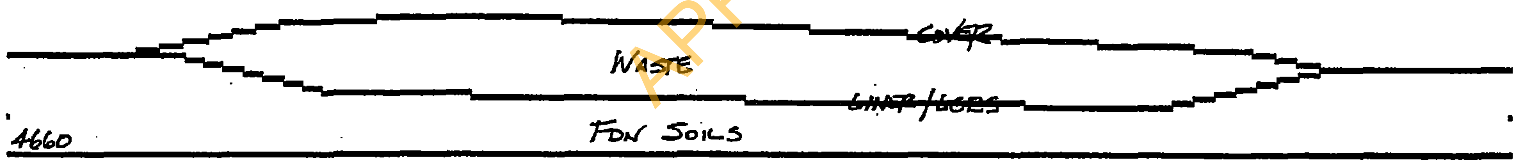
4.3 Determine Pseudo-Static F.S for same conditions as 4.1.1 w/ seismic coefficient, ψ, varying from 0.1 to 0.50 by 0.1 inc.

FS = 0.9 - 2.08, see below + attached analysis



BAYVIEW LANDFILL CELL 1 CLOSURE CAP
Hydraulic Condition 7: User Defined

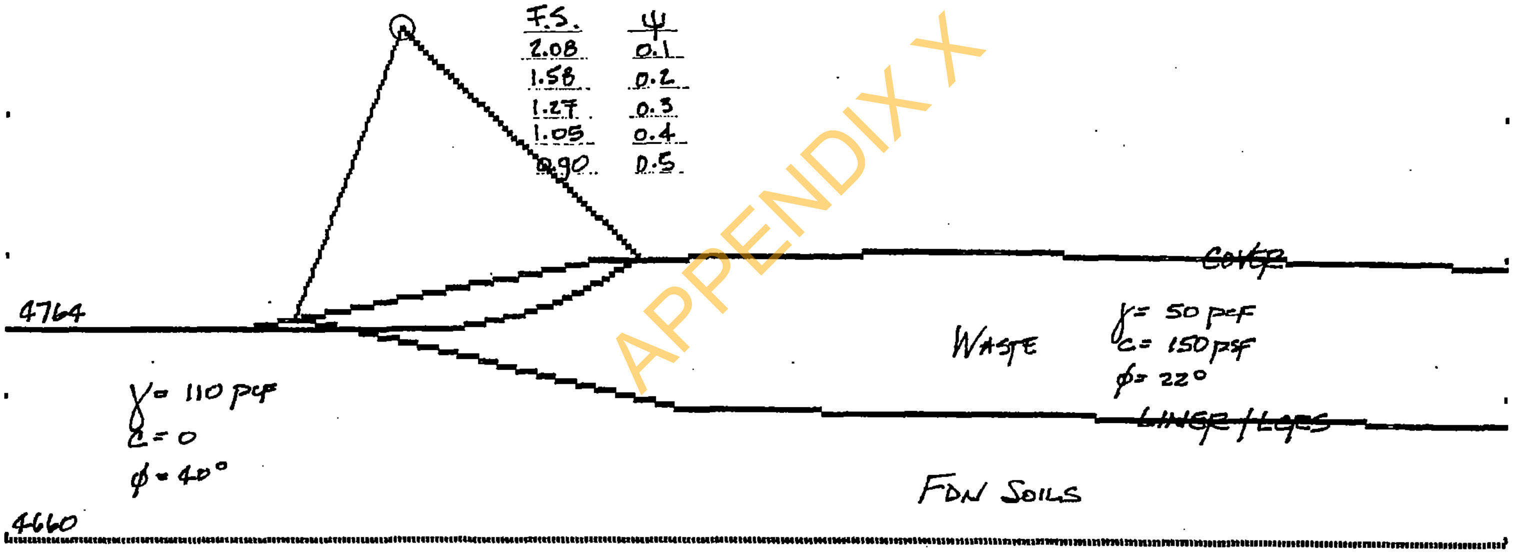
File: C1CCS1



(78 , 4394)

SCALE : 1 inch = 150 feet

BAYVIEW LANDFILL CELL 1 CLOSURE CAP **File: C1CCS1**
Hydraulic Condition 7: User Defined
Consolidated Drained Soil Parameters
Factor of Safety = 2.08, Failure Center: (247 , 4913), Radius: 150



F.S.	ψ
2.08	0.1
1.58	0.2
1.27	0.3
1.05	0.4
0.90	0.5

(83 , 4590) SCALE : 1 inch = 70.00001 feet

```
**********************************************************************
*                                                                    *
*                      G A R D S   S U M M A R Y                     *
*                                                                    *
*    Project:  BAYVIEW LANDFILL CELL 1 CLOSURE CAP                   *
*       File:  C1CCS1                                                *
*                                                                    *
*                         GARDS  Version 2.00                        *
*                            developed by                            *
*          Department of Civil and Environmental Engineering         *
*                      University of Cincinnati                      *
*                          under contract to                         *
*                U.S. Environmental Protection Agency                *
*                  Land Pollution Control Division                   *
*           Hazardous Waste Engineering Research Laboratory          *
*                                                                    *
**********************************************************************
```

```
**********************************************************************
*                        Site Characteristics                        *
**********************************************************************
*                                                            INCR    *
*      The seismic coefficient is. . . . . . . . . . . . . 0.10 BY 0.10 *
*                                                           TO 0.50  *
*      The design earthquake magnitude is. . . . . . . . . . 7.20    *
*                                                                    *
*      The maximum flood elevation in this case is . . . . .    0    *
*                                                                    *
*      The elevation of the seasonal high ground water is. .    0    *
*                                                                    *
*      The design waste elevation in the cell is . . . . . .    0    *
*                                                                    *
*      The soil number representing the clay liner is. . . .    0    *
*                                                                    *
**********************************************************************
```

```
*******************************************************************
*                        Section Geometry                         *
*******************************************************************
*                                                                 *
*     The number of soil boundary lines for this section is  3    *
*-----------------------------------------------------------------*
*    Line  1      Point        X            Y                   *
*                 ------       ------       ------                *
*                    1             0         4660                 *
*                    2          1500         4660                 *
*-----------------------------------------------------------------*
*    Line  2      Point        X            Y                   *
*                 ------       ------       ------                *
*                    1           180         4764                 *
*                    2           225         4764                 *
*                    3           365         4724                 *
*                    4          1100         4710                 *
*                    5          1250         4750                 *
*-----------------------------------------------------------------*
*    Line  3      Point        X            Y                   *
*                 ------       ------       ------                *
*                    1             0         4764                 *
*                    2           180         4764                 *
*                    3           330         4800                 *
*                    4           475         4805                 *
*                    5           660         4800                 *
*                    6          1170         4770                 *
*                    7          1250         4750                 *
*                    8          1500         4750                 *
*******************************************************************
```

```
*************************************************************************
*                          Soil  1 Properties                           *
*************************************************************************
*                                                                       *
*              Unconsolidated  Consolidated  Consolidated               *
*                 Undrained      Undrained      Drained                 *
*               ------------   ------------  ------------               *
*    Cohesion          0             0             0       (lb/sq.ft)   *
*    Phi Angle         0             0            40        (degrees)   *
*-----------------------------------------------------------------------*
*                                                                       *
*         Unit Weight . . . . . . . . . .  110.000   (lb/cu.ft)         *
*         Clay Content  . . . . . . . . .    0.000   (%)                *
*         Overconsolidation Ratio . . . .    0.000                      *
*         Initial Void Ratio  . . . . . .    0.000                      *
*         Compression Index . . . . . . .    0.000                      *
*         Recompression Index . . . . . .    0.000                      *
*         Permeability  . . . . . . .        0.000   (ft/yr)            *
*         Median Grain Size . . . . . . .    0.000   (mm)               *
*         Plasticity Index  . . . . . . .    0.000   (%)                *
*         Liquid Limit  . . . . . . . . .    0.000   (%)                *
*         Standard Penetration Number . .    0.000   (blows/ft)         *
*************************************************************************


*************************************************************************
*                          Soil  2 Properties                           *
*************************************************************************
*                                                                       *
*              Unconsolidated  Consolidated  Consolidated               *
*                 Undrained      Undrained      Drained                 *
*               ------------   ------------  ------------               *
*    Cohesion          0             0           150       (lb/sq.ft)   *
*    Phi Angle         0             0            22        (degrees)   *
*-----------------------------------------------------------------------*
*                                                                       *
*         Unit Weight . . . . . . . . . .   50.000   (lb/cu.ft)         *
*         Clay Content  . . . . . . . . .    0.000   (%)                *
*         Overconsolidation Ratio . . . .    0.000                      *
*         Initial Void Ratio  . . . . . .    0.000                      *
*         Compression Index . . . . . . .    0.000                      *
*         Recompression Index . . . . . .    0.000                      *
*         Permeability  . . . . . . .        0.000   (ft/yr)            *
*         Median Grain Size . . . . . . .    0.000   (mm)               *
*         Plasticity Index  . . . . . . .    0.000   (%)                *
*         Liquid Limit  . . . . . . . . .    0.000   (%)                *
*         Standard Penetration Number . .    0.000   (blows/ft)         *
*************************************************************************
```

```
************************************************************************
*                           User Defined                               *
*             Piezometric Surface for Hydraulic Condition              *
*             7: User Defined                                          *
************************************************************************
*                                                                      *
*                   Point           X             Y                    *
*                  ------        ------        ------                  *
*                      1             0          4660                   *
*                      2          1500          4660                   *
************************************************************************
```

```
************************************************************************
*                                                                      *
*         R O T A T I O N A L   F A I L U R E   R E S U L T S          *
*                                                                      *
*                       Automatic Grid Search                          *
*                                                                      *
*     The slopes were analyzed for failure arcs having centers in      *
*     areas defined by the following parallelograms:                   *
************************************************************************
*                                                                      *
*                              Slope  1                                *
*                                                                      *
*    Co-ord.       Point 1      Point 2      Point 3      Point 4      *
*    -------       -------      -------      -------      -------      *
*       X            330          180          144          294        *
*       Y           4809         4773         4836         4872        *
*----------------------------------------------------------------------*
*                              Slope  2                                *
*                                                                      *
*    Co-ord.       Point 1      Point 2      Point 3      Point 4      *
*    -------       -------      -------      -------      -------      *
*       X           1170         1250         1270         1190        *
*       Y           4775         4755         4790         4810        *
*----------------------------------------------------------------------*
*                                                                      *
*       The number of divisions between points 1 and 2 were   4       *
*       The number of divisions between points 2 and 3 were   4       *
*       The X-increment used in the search was . . . . . . . 10       *
*       The Y-increment used in the search was . . . . . . . 10       *
*                                                                      *
************************************************************************
```

```
*****************************************************************
*                                                               *
*        R O T A T I O N A L   F A I L U R E   R E S U L T S    *
*                                                               *
*****************************************************************
*                                                               *
*          Hydraulic Condition 7: User Defined                  *
*                                                               *
*                Consolidated Drained (CD) Case                 *
*                Seismic Coefficient = 0.10                     *
*---------------------------------------------------------------*
*         Safety      Failure       X-           Y-             *
*         Factor      Radius       Co-ord       Co-ord          *
*         -------     -------      -------      -------         *
*          2.08        150.0        246.5       4913.0          *
*          2.08        147.5        246.5       4910.5          *
*          2.08        152.4        246.5       4915.5          *
*          2.08        159.7        246.5       4923.0          *
*          2.08        140.2        246.5       4903.0          *
*          2.09        149.5        249.0       4913.0          *
*          2.09        150.5        244.0       4913.0          *
*          2.10        130.4        246.5       4893.0          *
*          2.12        120.7        246.5       4883.0          *
*          2.13        148.0        256.5       4913.0          *
*          2.14        110.9        246.5       4873.0          *
*          2.18        101.1        246.5       4863.0          *
*          2.19         99.2        256.5       4863.0          *
*          2.19         99.2        256.5       4863.0          *
*          2.21         97.2        266.5       4863.0          *
*          2.24        151.9        236.5       4913.0          *
*          2.27         82.0        265.5       4847.3          *
*          2.36         90.8       1215.0       4835.0          *
*          2.36         93.2       1215.0       4837.5          *
*          2.36         88.4       1215.0       4832.5          *
*          2.39         91.3       1217.5       4835.0          *
*          2.39         90.3       1212.5       4835.0          *
*          2.42         89.8       1210.0       4835.0          *
*          2.42         80.0       1210.0       4825.0          *
*          2.42         64.9        274.5       4831.5          *
*          2.43         99.6       1210.0       4845.0          *
*          2.45         70.3       1210.0       4815.0          *
*          2.47        100.7        294.0       4872.0          *
*          2.49         60.5       1210.0       4805.0          *
*          2.49         60.5       1210.0       4805.0          *
*****************************************************************
```

```
*************************************************************************
*                                                                       *
*                     G A R D S   S U M M A R Y                         *
*                                                                       *
*    File:  C1CCS1              Date: 05-02-1996    Time: 19:15:57      *
*    Project:  BAYVIEW LANDFILL CELL 1 CLOSURE CAP                      *
*    Hydraulic Condition 7: User Defined                                *
*                                                                       *
*-----------------------------------------------------------------------*
*             Rotational Failure Analysis Safety Factor                 *
*-----------------------------------------------------------------------*
*       Unconsolidated Undrained Case . . . . . . . . . . Not Run       *
*       Consolidated Undrained Case . . . . . . . . . . . Not Run       *
*       Consolidated Drained Case . . . . . . . . . . . .   2.08        *
*-----------------------------------------------------------------------*
*             Translational Failure Analysis. . . . . . . Not Run       *
*-----------------------------------------------------------------------*
*             Settlement Analysis . . . . . . . . . . . . Not Run       *
*-----------------------------------------------------------------------*
*             Liquefaction Analysis . . . . . . . . . . . Not Run       *
*************************************************************************
```

Job No.

No.

HDR Computation

Project

Computed

Date

Subject

Checked

Date

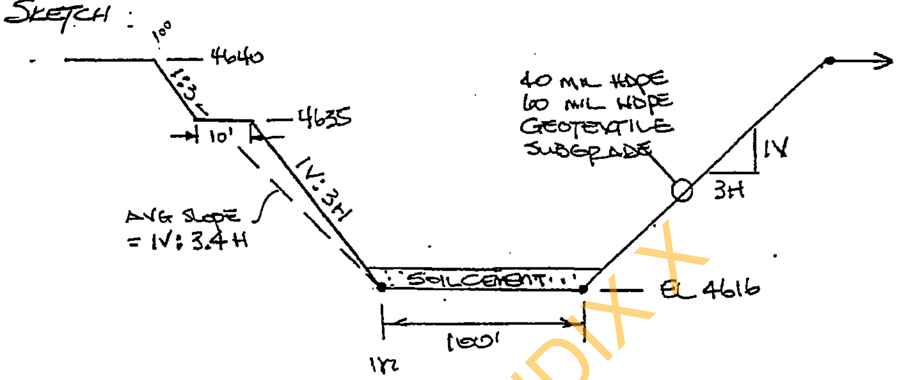
Task

Sheet

Of

6 Storm-Water Leachate Basin

6.1 Sketch:

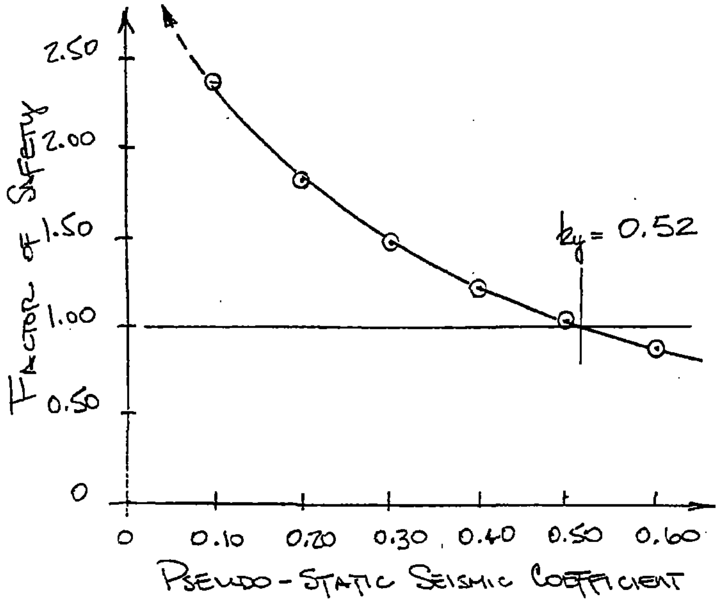


c = 0
$\phi = 40^{\circ}$
$\gamma = 110$ PCF

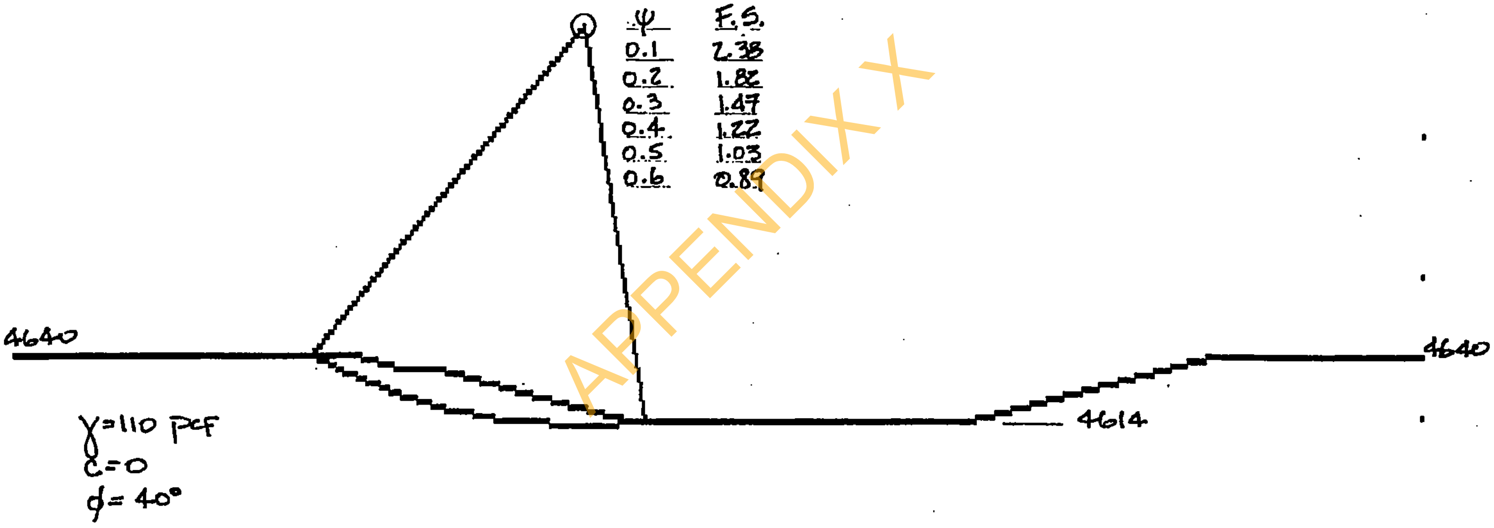
6.2 Determine Static F.S. for

1V: 3H slope EL 4640-4616
Soil properties from TP 1.1
FS = 2.50+ , analysis attached

6.3 Determine Pseudo-Static F.S. for same conditions as 5.1 w/ seismic coefficient, ψ, varying from 0.1 to 0.6



BAYVIEW LANDFILL LEACHATE POND STABILITY **File: LPCSS1**
Hydraulic Condition 7: User Defined
Consolidated Drained Soil Parameters
Factor of Safety = 2.38, Failure Center: (168 , 4756), Radius: 141



ψ	F.S.
0.1	2.38
0.2	1.82
0.3	1.47
0.4	1.22
0.5	1.03
0.6	0.89

(-28 , 4517) SCALE : 1 inch = 50 feet

```
************************************************************************
*                                                                      *
*                       G A R D S   S U M M A R Y                      *
*                                                                      *
*    Project:  BAYVIEW LANDFILL LEACHATE POND STABILITY                *
*       File:  LPCSS1                                                  *
*                                                                      *
*                          GARDS  Version 2.00                         *
*                             developed by                             *
*          Department of Civil and Environmental Engineering           *
*                      University of Cincinnati                        *
*                          under contract to                           *
*                U.S. Environmental Protection Agency                  *
*                    Land Pollution Control Division                   *
*           Hazardous Waste Engineering Research Laboratory            *
*                                                                      *
************************************************************************
```

```
************************************************************************
*                         Site Characteristics                         *
************************************************************************
*                                                        INC BY        *
*      The seismic coefficient is. . . . . . . . . . . . 0.10{ 0.10 TO  *
*                                                          0.60        *
*      The design earthquake magnitude is. . . . . . . . 7.20          *
*                                                                      *
*      The maximum flood elevation in this case is . . . . .   0       *
*                                                                      *
*      The elevation of the seasonal high ground water is. .   0       *
*                                                                      *
*      The design waste elevation in the cell is . . . . . .   0       *
*                                                                      *
*      The soil number representing the clay liner is. . . .   0       *
*                                                                      *
************************************************************************
```

```
***********************************************************************
*                          Section Geometry                           *
***********************************************************************
*                                                                     *
*     The number of soil boundary lines for this section is   2      *
*---------------------------------------------------------------------*
*     Line   1          Point          X             Y                *
*                       ------       ------        ------             *
*                          1             0          4500              *
*                          2           500          4500              *
*---------------------------------------------------------------------*
*     Line   2          Point          X             Y                *
*                       ------       ------        ------             *
*                          1             0          4640              *
*                          2           100          4640              *
*                          3           115          4635              *
*                          4           125          4635              *
*                          5           182          4616              *
*                          6           282          4616              *
*                          7           354          4640              *
*                          8           500          4640              *
***********************************************************************
```

```
************************************************************************
*                         Soil  1 Properties                           *
************************************************************************
*                                                                      *
*             Unconsolidated  Consolidated  Consolidated               *
*                 Undrained     Undrained     Drained                  *
*               ------------  ------------  ------------               *
*   Cohesion           0             0             0       (lb/sq.ft)  *
*   Phi Angle          0             0            40        (degrees)  *
*----------------------------------------------------------------------*
*                                                                      *
*        Unit Weight . . . . . . . . . .  110.000   (lb/cu.ft)         *
*        Clay Content  . . . . . . . . .    0.000   (%)                *
*        Overconsolidation Ratio . . . .    0.000                      *
*        Initial Void Ratio. . . . . . .    0.000                      *
*        Compression Index . . . . . . .    0.000                      *
*        Recompression Index . . . . . .    0.000                      *
*        Permeability  . . . . . . .        0.000   (ft/yr)            *
*        Median Grain Size . . . . . . .    0.000   (mm)               *
*        Plasticity Index  . . . . . . .    0.000   (%)                *
*        Liquid Limit  . . . . . . . . .    0.000   (%)                *
*        Standard Penetration Number . .    0.000   (blows/ft)         *
************************************************************************
```

```
*************************************************************************
*                           User Defined                                *
*             Piezometric Surface for Hydraulic Condition               *
*             7: User Defined                                           *
*************************************************************************
*                                                                       *
*                   Point           X              Y                    *
*                  ------        ------         ------                  *
*                       1             0          4500                   *
*                       2           500          4500                   *
*************************************************************************
```

```
*************************************************************************
*                                                                       *
*         R O T A T I O N A L   F A I L U R E   R E S U L T S           *
*                                                                       *
*                      Automatic Grid Search                            *
*                                                                       *
*     The slopes were analyzed for failure arcs having centers in       *
*     areas defined by the following parallelograms:                    *
*************************************************************************
*                                                                       *
*                               Slope  1                                *
*                                                                       *
*    Co-ord.       Point 1       Point 2       Point 3       Point 4    *
*    -------       -------       -------       -------       -------    *
*       X            100           115           120            105     *
*       Y           4641          4636          4645           4650     *
*-----------------------------------------------------------------------*
*                               Slope  2                                *
*                                                                       *
*    Co-ord.       Point 1       Point 2       Point 3       Point 4    *
*    -------       -------       -------       -------       -------    *
*       X            125           182           201            144     *
*       Y           4640          4621          4654           4673     *
*-----------------------------------------------------------------------*
*                               Slope  3                                *
*                                                                       *
*    Co-ord.       Point 1       Point 2       Point 3       Point 4    *
*    -------       -------       -------       -------       -------    *
*       X            354           282           258            330     *
*       Y           4646          4622          4664           4688     *
*-----------------------------------------------------------------------*
*                                                                       *
*        The number of divisions between points 1 and 2 were  4        *
*        The number of divisions between points 2 and 3 were  4        *
*        The X-increment used in the search was . . . . . . . 10        *
*        The Y-increment used in the search was . . . . . . . 10        *
*                                                                       *
*************************************************************************
```

```
*********************************************************************
*                                                                   *
*        R O T A T I O N A L   F A I L U R E   R E S U L T S        *
*                                                                   *
*********************************************************************
*                                                                   *
*           Hydraulic Condition 7: User Defined                     *
*                                                                   *
*                   Consolidated Drained (CD) Case                  *
*                   Seismic Coefficient = 0.10                      *
*-------------------------------------------------------------------*
*           Safety        Failure         X-            Y-          *
*           Factor        Radius        Co-ord        Co-ord        *
*          --------      --------      --------      --------       *
*             2.38         140.9         168.3        4755.8        *
*             2.38         143.1         168.3        4758.3        *
*             2.38         138.7         168.3        4753.3        *
*             2.38         144.1         170.8        4758.3        *
*             2.38         137.7         167.5        4752.5        *
*             2.38         145.3         168.3        4760.8        *
*             2.38         139.9         167.5        4755.0        *
*             2.38         135.5         167.5        4750.0        *
*             2.38         141.9         170.8        4755.8        *
*             2.38         133.3         167.5        4747.5        *
*             2.39         138.7         170.0        4752.5        *
*             2.39         134.3         168.3        4748.3        *
*             2.39         131.1         167.5        4745.0        *
*             2.39         152.0         168.3        4768.3        *
*             2.40         128.9         167.5        4742.5        *
*             2.40         127.9         165.0        4742.5        *
*             2.40         125.7         165.0        4740.0        *
*             2.40         123.5         165.0        4737.5        *
*             2.40         130.1         165.0        4745.0        *
*             2.40         121.3         165.0        4735.0        *
*             2.40         139.9         165.8        4755.8        *
*             2.41         142.1         165.8        4758.3        *
*             2.41         136.7         165.0        4752.5        *
*             2.41         119.1         165.0        4732.5        *
*             2.41         125.5         168.3        4738.3        *
*             2.41         117.0         165.0        4730.0        *
*             2.42         115.9         162.5        4730.0        *
*             2.42         118.1         162.5        4732.5        *
*             2.42         113.8         162.5        4727.5        *
*             2.42         129.9         170.0        4742.5        *
*             2.42         111.6         162.5        4725.0        *
*             2.43         112.6         165.0        4725.0        *
*             2.44         118.0         167.5        4730.0        *
*             2.44         110.6         160.0        4725.0        *
*             2.45         119.3         160.0        4735.0        *
*             2.45         101.9         160.0        4715.0        *
*             2.46         116.8         168.3        4728.3        *
*             2.46         112.7         158.3        4728.3        *
*             2.47         104.0         158.3        4718.3        *
*             2.47         121.4         158.3        4738.3        *
*             2.48          95.4         158.3        4708.3        *
*             2.48          93.3         160.0        4705.0        *
*********************************************************************
```

```
************************************************************************
*                                                                      *
*                      G A R D S   S U M M A R Y                       *
*                                                                      *
*    File:  LPCSS1                Date: 05-02-1996    Time: 19:36:43   *
*    Project:  BAYVIEW LANDFILL LEACHATE POND STABILITY                *
*    Hydraulic Condition 7: User Defined                               *
*                                                                      *
*----------------------------------------------------------------------*
*             Rotational Failure Analysis Safety Factor                *
*----------------------------------------------------------------------*
*       Unconsolidated Undrained Case . . . . . . . . . . Not Run      *
*       Consolidated Undrained Case . . . . . . . . . . . Not Run      *
*       Consolidated Drained Case . . . . . . . . . . . .   2.38       *
*----------------------------------------------------------------------*
*             Translational Failure Analysis. . . . . . . Not Run      *
*----------------------------------------------------------------------*
*             Settlement Analysis . . . . . . . . . . . . Not Run      *
*----------------------------------------------------------------------*
*             Liquefaction Analysis . . . . . . . . . . . Not Run      *
************************************************************************
```

Job No.
No.

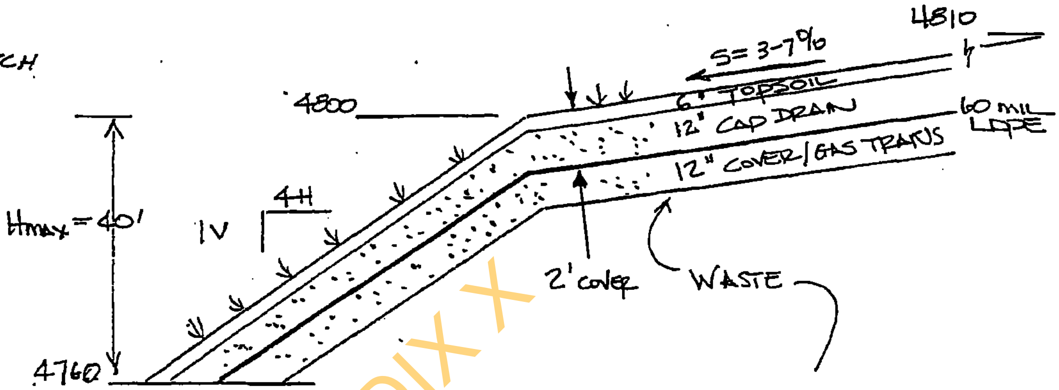
HDR Computation

HDR

Project	Computed	Date
Subject	Checked	Date
Task	Sheet	Of

5. CAP STABILITY

5.1 SKETCH



5.2 USE INFINITE SLOPE METHOD, CONSIDER SEISMICITY W/ ψ

- CONSIDER 1V:4H SLOPE EL 4800 - EL 4760
- δ GM: GRAN SOIL = 25°
- SEE PARA 3.2 FOR SLOPE STATICS
- ITERATE FOR TREQD & ψ, SEE ATTACHED

Job No.

No.

HDR Computation

Project

Computed

Date

Subject

Checked

Date

Task

Sheet

Of

BAYVIEW LANDFILL CELL 1						
CLOSURE CAP SLOPE STABILITY						
STATIC AND PSEUDO-STATIC ANALYSES						
(INFINITE SLOPE METHOD)						
SLOPE PROPERTIES						
	height	40.0	(ft.)			
	slope	14.0	(degrees)			
	length	165.3	(ft)			
LCRS PROPERTIES						
	thickness	1.5	(ft)			
	density	100.0	(pcf)			
INTERFACE FRICTION						
	friction	25.0	(degrees)			
FACTOR OF SAFETY						
Treinf	Seismic Coefficient, (-)					
(klf)	0	0.1	0.2	0.3	0.4	0.5
0.0	1.87	1.32	1.02	0.83	0.70	0.61
1.0	2.04	1.44	1.12	0.91	0.77	0.66
2.0	2.20	1.56	1.21	0.98	0.83	0.72
3.0	2.37	1.68	1.30	1.06	0.89	0.77
4.0	2.54	1.79	1.39	1.13	0.96	0.83
5.0	2.70	1.91	1.48	1.21	1.02	0.88
7.5	3.12	2.21	1.71	1.39	1.18	1.02
10.0	3.54	2.50	1.94	1.58	1.33	1.15
12.5	3.95	2.80	2.16	1.76	1.49	1.29
15.0	4.37	3.09	2.39	1.95	1.65	1.43

Job No.

No.

HDR Computation

Project

Computed

Date

Subject

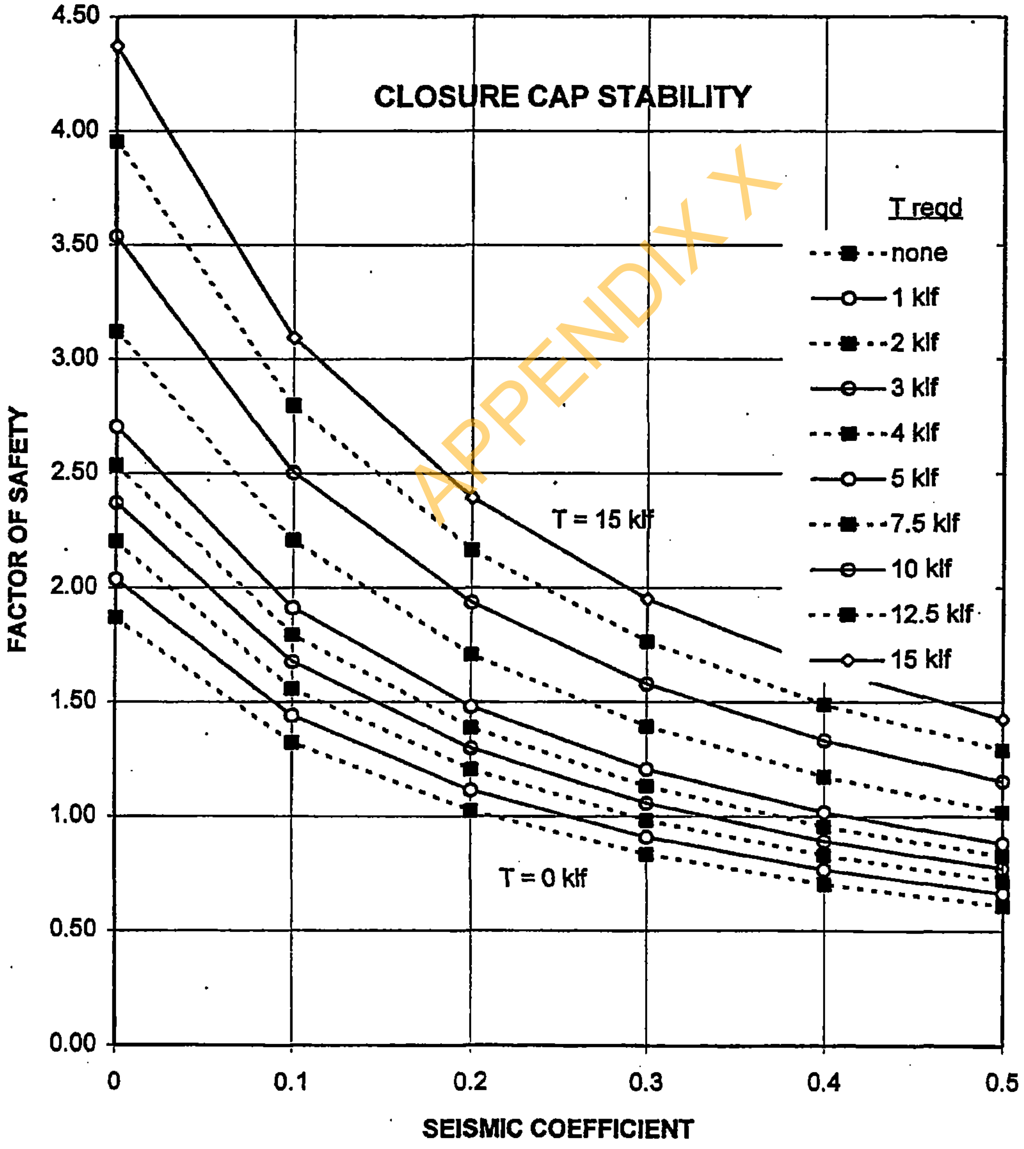
Checked

Date

Task

Sheet

Of



ATTACHMENT C
SITE SEISMIC RESPONSE ANALYSES

Job No.

No.

HDR Computation

HDR

Project: BAYVIEW LANDFILL

Subject: LANDFILL SEISMIC EVALUATION

Task: SITE SEISMIC RESPONSE ANALYSES

Computed: R.L.D.

Date: 3-8-96

Checked: PHP

Date: 6-4-96

Sheet: 1

Of

OBJECTIVE: DETERMINE SEISMIC RESPONSE FROM PEAK BEDROCK ACCELERATION OF ADOPTED DESIGN EQ ($a_g = 0.50g$) FOR:

- BASE OF LINER / LCRS SYSTEM FOR CELL 1
- CLOSURE CAP FOR CELL 1

REFERENCES: A) EPA, "RCRA SUBTITLE D (258) SEISMIC DESIGN GUIDANCE FOR MUNICIPAL SOLID WASTE LANDFILLS, EPA/600/R-95/051

B) GEOTECHNICAL REPORTS BY CHEN & ASSOCIATES, 1980; ROLLINS, BROWN AND GUNNELL, 1983

C) NAVDOCKS DM-7.3, "SOIL DYNAMICS ..."

---

1 CLASSIFY SITE

1.1 DETERMINE SHEAR WAVE VELOCITY, V_s, IN TOP 100' OF FDN.

- UTAH G.S. CLASSIFIES SITE AS "HARD SITE", i.e. $V_s \geq 400$ m/sec
- BASED ON REFS B:

  $SPT\ N_{AVG} = 50$

  $\gamma_{AVG} = 110$ pcf

- FROM REF C:

  $G_{T/SF} = 120 N^{0.8} = 120 \cdot 50^{0.8}$

  $= 2744\ ^{T}/_{SF} \cdot 2000\ ^{\#}/_{T} = 5.49 \times 10^{6}\ ^{\#}/_{SF}$

- FROM REF A:

$$V_s^2 = \sqrt{\frac{G}{\gamma/g}} = \sqrt{\frac{5.49 \times 10^6\ \#/SF}{110\ \#/CF / 32.2\ FT/sec^2}}$$

$$= 1270\ FT/sec,\ 386\ m/sec$$

Project		Computed	Date
Subject		Checked	Date
Task		Sheet 2	Of

1.2 From Ref A:

CLASSIFICATION	AVERAGE SHEAR WAVE VELOCITY	
Special Study	Less than 100 m/s	(330ft/s)
Soft	100 to 200 m/s	(330 to 660 ft/s)
Medium Stiff	200 to 375 m/s	(600 to 1,230 ft/s) ← Vs
Stiff	375 to 700 m/s	(1,230 to 2,300 ft/s)
Rock	Greater than 700 m/s	(2,300 ft/s)

∴ Check site response w/ medium stiff + stiff response
Use simplified analysis

2. Determine Acceleration at Base of Landfill

2.1 For medium stiff soil (Ref A)

MHA (max horizontal acceleration in bedrock) = 0.50g
PGA (peak horizontal acceleration at ground surf) = 0.50g

2.2 For stiff soil (Ref A)

MHA = 0.50 g
PGA = 0.50 g

2.3 ∴ Use PGA = 0.50g for liner & LCRS evaluation

Job No. No.

HDR Computation

HDR

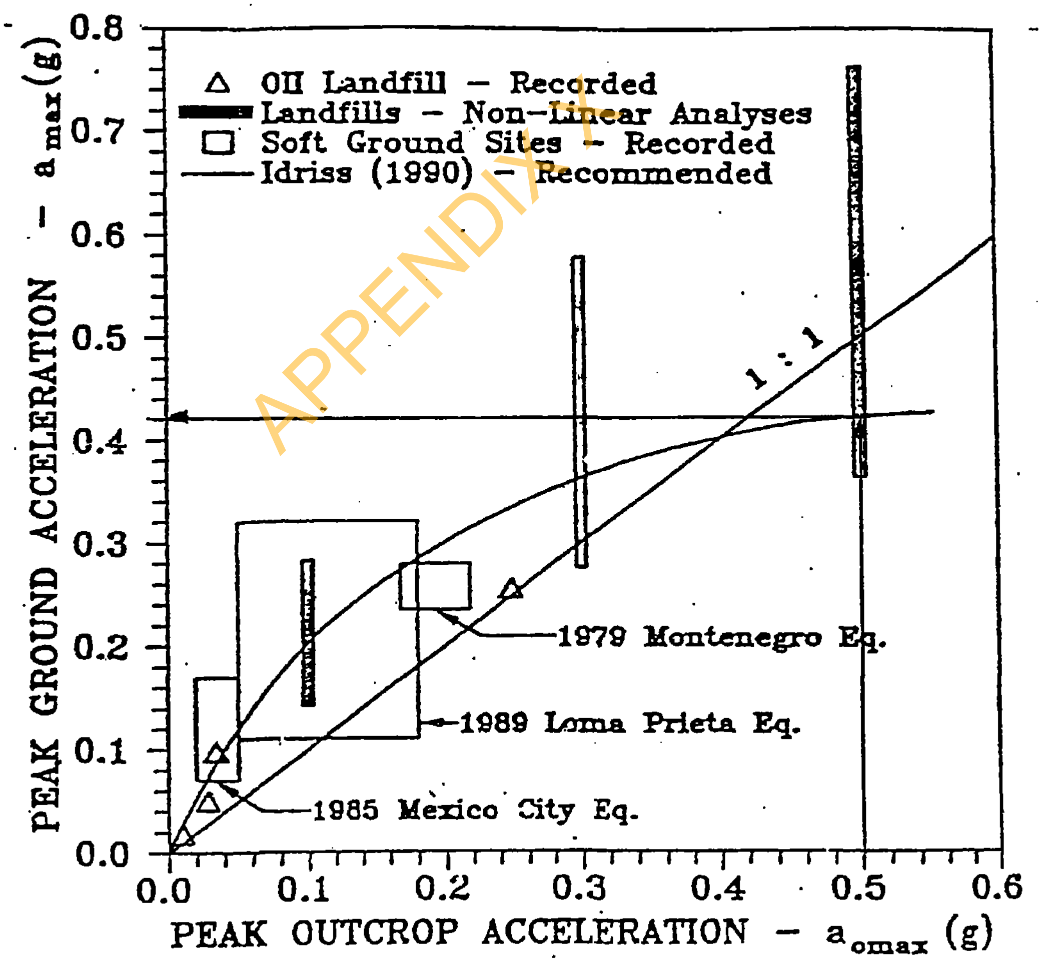
Project Computed Date

Subject Checked Date

Task Sheet 3 Of

3. DETERMINE ACCELERATION AT TOP OF LANDFILL

USE PGA AT BASE AND ATTENUATE THROUGH WASTE MASS USING "IDRISS (1990)" CURVE, FIGURE 4-5 OF REF A



∴ USE PGA = 0.42g FOR CLOSURE CAP EVALUATION

ATTACHMENT D
SEISMIC DEFORMATION ANALYSES

Job No.

No.

HDR Computation

HDR

Project BAYVIEW LANDFILL

Computed R.L.D.

Date -

Subject LANDFILL SEISMIC EVALUATION

Checked DHP

Date 6-4-96

Task SEISMIC DEFORMATION ANALYSES

Sheet 1

Of

OBJECTIVE : ESTIMATE SEISMIC DISPLACEMENTS FOR

- CELL 1 EXCAVATION
- CELL 1 LINER & LCRS
- CELL 1 WASTE FILL
- CELL 1 CLOSURE CAP
- STORMWATER-LEACHATE BASIN

REFERENCES : A) EPA, "RCRA SUBTITLE D SEISMIC DESIGN GUIDANCE FOR MSWLF, EPA/600/R-95/051, 1995.

APPROACH : 1. DETERMINE YIELD ACCELERATION, k_y, FOR F.S. = 1.0 FROM PSEUDO-STATIC STABILITY ANALYSES (ATTACHMENT B)

2. COMPUTE RATIO k_y / a_{max}

WHERE a_{max} FROM SITE RESPONSE ANALYSES (ATTACHMENT C)

= 0.50g FOR EXCAVATIONS, LINER, LCRS & WASTE MASS

= 0.42g FOR CLOSURE CAP

3. ESTIMATE DISPLACEMENTS FROM REF A

- USE MAKDISI & SEED PERMANENT DISPLACEMENT CHART (FIG 6-6 OF REF A) FOR EXCAVATIONS, LINER, LCRS & WASTE MASS

  USE CURVE FOR $M_0 \doteq 7.2$

- USE HYNES & FRANKLIN PERMANENT DISPLACEMENT CHART (FIG 6-5 OF REF A) FOR CLOSURE CAP

  USE "MEAN + σ" CURVE

4. EVALUATE DISPLACEMENTS

Job No.
No.

HDR Computation

HDR

Project
Computed
Date
Subject
Checked
Date
Task
Sheet 2
Of

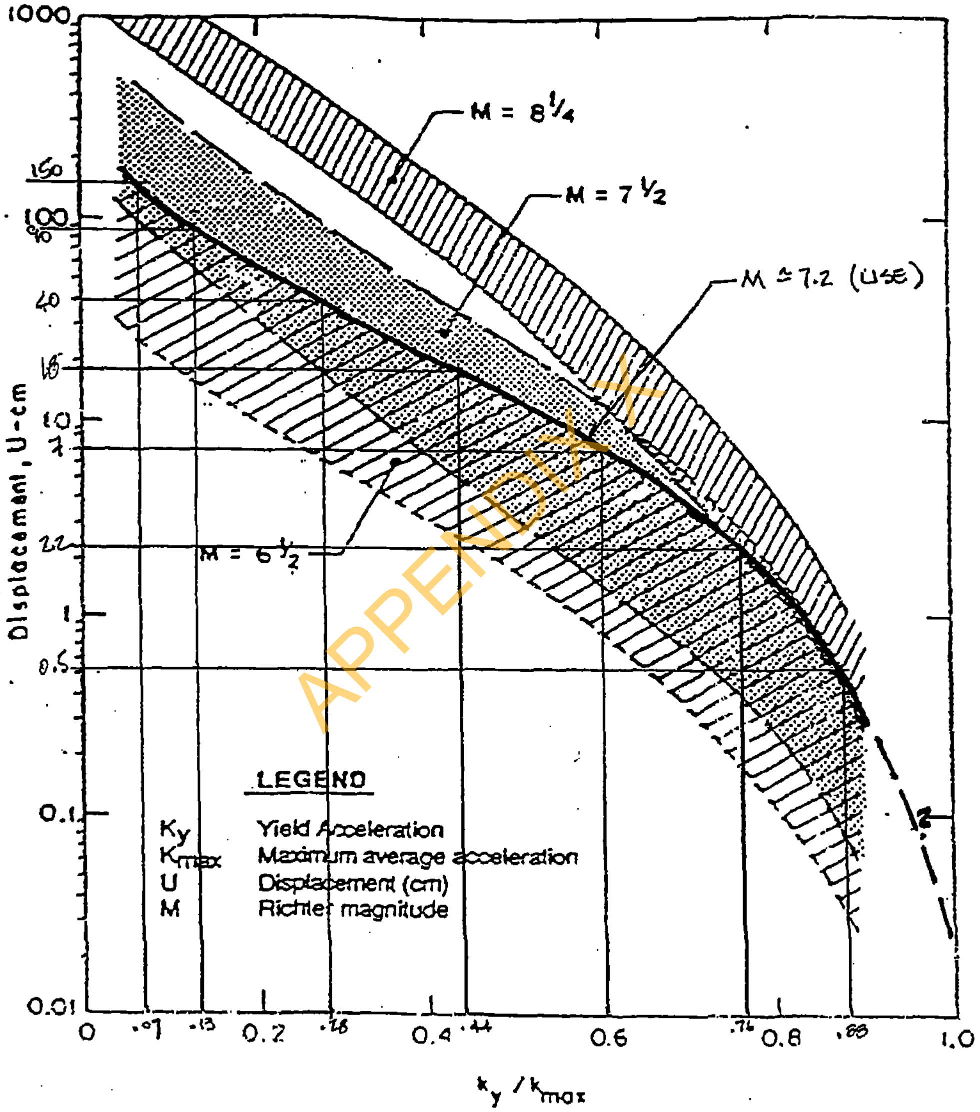


Figure 6.6 Makdisi and Seed Permanent Displacement Chart (Makdisi and Seed, 1978). FOR LINER + WASTE MASS

Job No.

No.

HDR Computation

HDR

Project

Computed

Date

Subject

Checked

Date

Task

Sheet 3

Of

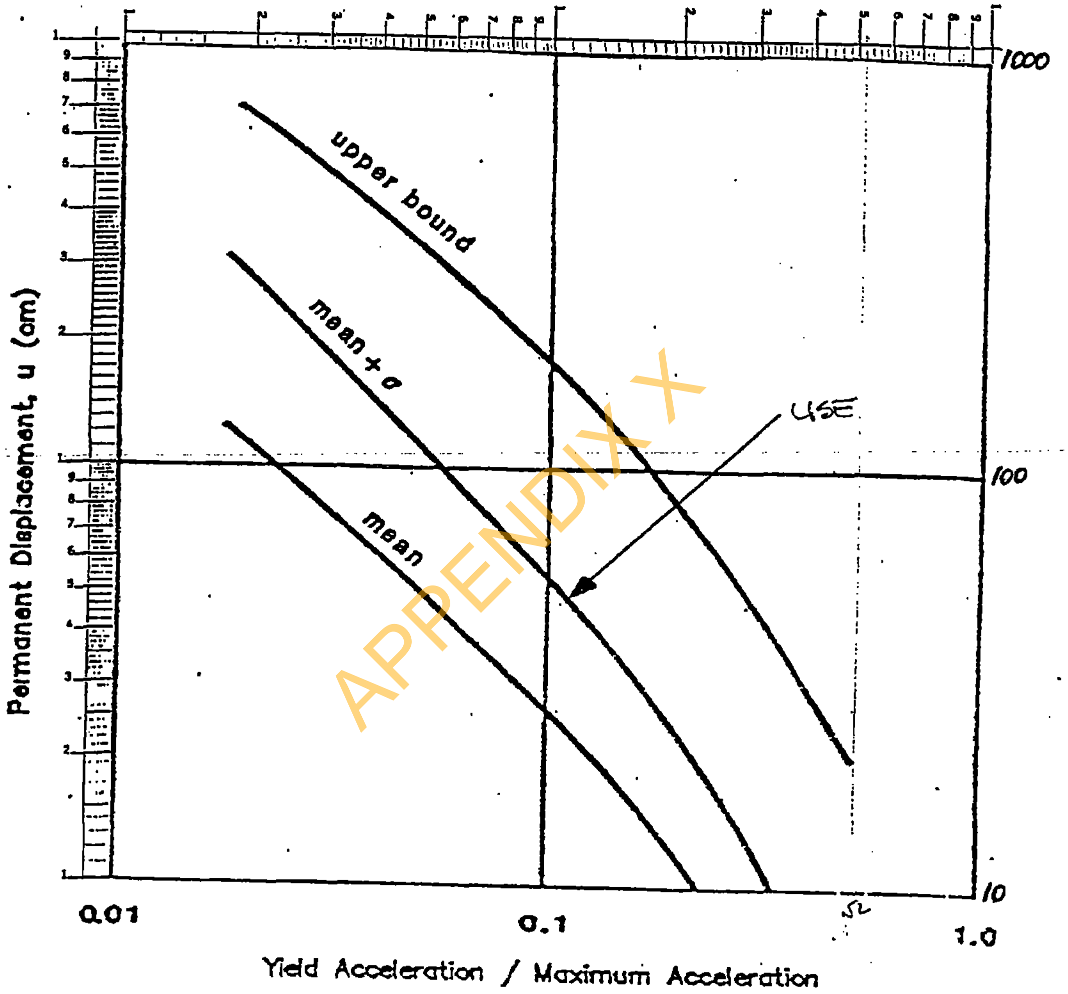


Figure 6.5 Hynes and Franklin Permanent Seismic Displacement Chart (Hynes and Franklin, 1984). FOR COVER SYSTEM

Job No.	No.

HDR Computation

HDR

Project	Computed	Date
Subject	Checked	Date
Task	Sheet 4	Of

1.0 CELL 1 EXCAVATION

$k_y = 0.52g$ (ATTACHMENT B, ¶ 2.2)

$a_{max} = 0.50g$ (ATTACHMENT C, ¶ 2.2)

$$\frac{k_y}{a_{max}} = \frac{0.52}{0.50} = 1.04$$

$U \cong 1$ cm < 30 cm (MAKDISI & SEED CURVE FOR $M \simeq 7.2$) OK

2.0 LINER + LCRS

k_y = TABULATED BELOW (ATTACHMENT B, ¶ 2.1)

$a_{max} = 0.50g$ (ATTACHMENT C, ¶ 2.2)

$\delta = 9^0$

T_{REQD}	FS_{STATIC}	k_y	k_y/a_{max}	U^* (cm)	REMARKS
0 K/f	0.64	NA	–	–	NOT STABLE UNDER STATIC LOADS (FS<1.0)
1	0.76	NA	–	–	
2	0.89	NA	–	–	
3	1.01	NA	–	–	
4	1.14	0.035	0.07	150	SEE ATTACHED PLOT.
5	1.26	0.065	0.13	90	
7.5	1.57	0.14	0.28	40	
10	1.89	0.22	0.44	18	
12.5	2.20	0.30	0.60	7	
15	2.51	0.38	0.76	2+	

* FROM MAKDISI & SEED CURVE FOR $M \simeq 7.2$

Job No. No.

HDR Computation

Project
Subject
Task
Computed
Checked
Sheet 5
Date
Date
Of

$\delta = 17°$

T_{REQD}	FS_{STATIC}	k_y	k_y/a_{max}	U_{cm}	REMARKS
0 KLF	1.23	0.065	0.13	90	STABLE, BUT FS<1.3
1	1.35	0.09	0.18	60	SEE ATTACHED PLOT
2	1.48	0.125	0.25	40	
3	1.60	0.16	0.32	30	
4	1.73	0.185	0.37	22	
5	1.85	0.22	0.44	16	
7.5	2.16	0.30	0.60	7	
10	2.48	0.355	0.71	3	
12.5	2.79	0.45	0.90	1<	
15.0	3.10	0.53	1.06	1<	

3.0 OPERATIONAL FILLS

3.1 @ EL 4764

$\delta = 9°$
$k_y = 0.15$
$a_{max} = 0.50$

$$\frac{k_y}{a_{max}} = \frac{0.15}{0.50} = 0.30$$

$U = 30\ cm = 30\ cm$

$\delta = 17°$
$k_y = 0.265$
$a_{max} = 0.50$

$$\frac{k_y}{a_{max}} = 0.53$$

$U = 10\ cm \leq 30\ cm$ OK

3.2 @ EL 4780

$\delta = 9°$
$k_y = 0.15$
$a_{max} = 0.50$

$k_y/a_{max} = 0.15/0.50 = 0.30$

$U = 30\ cm = 30\ cm$

$\delta = 17°$
$k_y = 0.25$
$a_{max} = 0.50$

$k_y/a_{max} = 0.25/0.50 = 0.50$

$U = 13\ cm \leq 30\ cm$ OK

Job No.

No.

HDR Computation

Project

Computed

Date

Subject

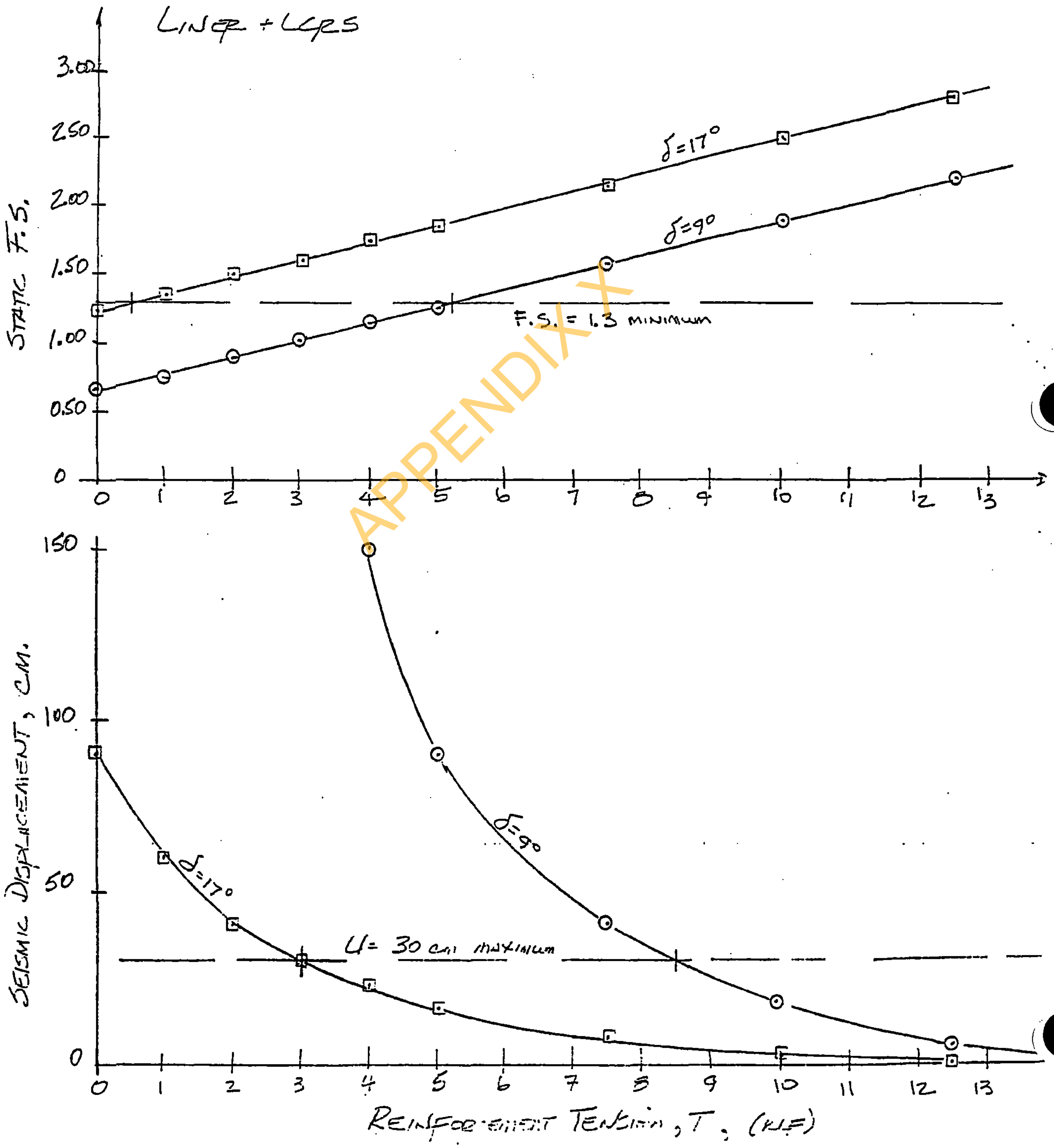
Checked

Date

Task

Sheet 6

Of



Job No. | No.

HDR Computation

HDR

Project | Computed | Date
Subject | Checked | Date
Task | Sheet 7 | Of

4.0 WASTE FILL

$k_y = 0.44g$ (ATTACHMENT B, ¶ 4.3)

$a_{max} = 0.50\,g$ (ATTACHMENT C, ¶ 2.3)

$$\frac{k_y}{a_{max}} = \frac{0.44g}{0.50} = 0.88$$

$U \doteq 1$ cm $<$ 30 cm (MAKDISI + SEED CURVE FOR $M \doteq 7.2$) ⓄK

5.0 CLOSURE CAP

k_y = TABULATED BELOW (ATTACHMENT B, ¶ 5.2)

$a_{max} = 0.42g$ (ATTACHMENT C, ¶ 3)

T_{REQD}	FS_{STATIC}	k_y	k_y/a_{max}	U^* (cm)	REMARKS
0 KLF		0.22	0.52	<10	ALL PERM. DEFORMATIONS < 10 cm ≪ 30 cm ⓄK
1		0.26	0.62	↓	
2		0.30	0.71	↓	
3		0.34	0.81	↓	
4		0.38	0.90	↓	
5		0.42	1.00	↓	
7.5		0.5+	1+	↓	
10		↓	↓	↓	
12.5		↓	↓	↓	
15		↓	↓	↓	

* FROM HYNES + FRANKLIN CURVE FOR MEAN + σ

Job No.

No.

HDR Computation

HDR

Project	Computed	Date
Subject	Checked	Date
Task	Sheet 8	Of

6.0 STORMWATER – LEACHATE BASIN

$k_y = 0.52\,g$ (ATTACHMENT B, P 6.2)

$a_{max} = 0.50\,g$ (ATTACHMENT C, P 2.3)

$$\frac{k_y}{a_{max}} = \frac{0.52}{0.50} = 1.04$$

$u \leq 1\ cm < 30\ cm$ (MAKDISI + SEED CURVE FOR $M \simeq 7.2$) ⓄK

Appendix K

APPENDIX K

Leachate Generation Calculations

SUVSWD Bayview Class I Landfill
Permit Application

APPENDIX K

LEACHATE GENERATION CALCULATIONS

SUVSWD Bayview
Class I Landfill Permit Application

Submitted March 2009

Prepared By:
HDR ENGINEERING, INC.

APPENDIX K – LEACHATE GENERATION CALCULATIONS

INTRODUCTION

All assumptions and calculations used to obtain the hydraulic head on top of the Flexible Membrane Liner (FML) are included in this appendix, as well as the Hydrologic Evaluation of Landfill Performance (HELP) model results. Leachate includes stormwater that has come into contact with waste or daily cover.

The following is a list of attachments:
K-1: Accumulated Run-off from Cell 2, Stage 1 and Stage 2
K-2: Leachate Generation/Hydraulic Head on Liner
K-3: Flow Capacity of the Leachate Collection Pipe

APPENDIX K

ATTACHMENT 1:
ACCUMULATED RUN-OFF FROM CELL 2,
STAGE 1 AND STAGE 2

Job No.

No.

HDR Computation

HDR

Project Bayview Landfill

Computed KDG

Date 6/23/03

Subject Site Drainage

Checked mo

Date 6/24/03

Task Accumulated run-off from Stage 1&2 Cell 2

Sheet 1

Of 5

Based on boring logs, the texture of material used for intermediate cover for Cell 2 is a sandy loam; Resulting in a hydrologic soil group of "A." (See REF. 2)

Since the hydrologic soil group is "A," the curve number (CN) for bare soil is 77 (see REF. 2). Use CN of 80 which increases run-off.

Rainfall from a 25-year 24-hour storm at Bayview Landfill is 2.10" (See pg. 4 Isopluvial of 25-year 24-hour precipitation).

The run-off depth from a 25-year 24-hour storm for Cell 2 is estimated using Table 3.21 (REF. 2, Pg. 5). The run-off depth is interpolated to be:

$$D = 0.56 + \frac{.1}{.5}(.89 - .56)$$

$$= .626 \text{ inches}$$

$$\approx .63 \text{ inches}$$

REF. 2

Group	Minimum Infiltration Rate (in./hr)	Texture[a]
A	0.3–0.45	Sand, loamy sand, or sandy loam
B	0.15–0.30	Silt loam or loam
C	0.05–0.15	Sandy clay loam
D	0–0.05	Clay loam, silty clay loam, sandy clay, silty clay, or clay

[a] Reproduced from U.S. Soil Conservation Service (1986).

pg. 3/5

TABLE 3.19 CURVE NUMBERS FOR ANTECEDENT MOISTURE CONDITION II

REF. 2

Use	Cover Type	Treatment	Hydrologic Condition	Hydrologic soil group A	B	C	D
Urban	Fully developed						
	Open space (lawns, parks)		Poor (cover <50%)	68	79	86	89
			Fair	49	69	79	84
			Good (grass cover >75%)	39	61	74	80
	Impervious areas (paved parking, roofs, driveways, paved roads)			98	98	98	98
	Dirt roads			72	82	87	89
	Urban districts						
	Commercial and business			89	92	94	95
	Industrial			81	88	91	93
	Developing areas			77	86	91	94
Cultivated agriculture lands	Fallow	Bare soil	. . .	77	86	91	94
	Row crops	Straight row	Poor	72	81	88	91
		Straight row	Good	67	78	85	89
		Contoured	Poor	70	79	84	88
		Contoured	Good	65	75	82	86
		Contoured and terraced	Poor	66	74	80	82
		Contoured and terraced	Good	62	71	78	81
	Small grain	Straight row	Poor	65	76	84	88
		Straight row	Good	63	75	83	87
		Contoured	Poor	63	74	82	85
		Contoured	Good	61	73	81	84
		Contoured and terraced	Poor	61	72	79	82
		Contoured and terraced	Good	59	70	78	81
	Close-seeded legumes or rotation meadow	Straight row	Poor	66	77	85	89
		Straight row	Good	58	72	81	85
		Contoured	Poor	64	75	83	85
		Contoured	Good	55	69	78	83
		Contoured and terraced	Poor	63	73	80	83
		Contoured and terraced	Good	51	67	76	80

CN

pg. 5/5

REF. 2

Table 3.21

	Runoff Depth (in.) for Curve Number of:												
Rainfall	40	45	50	55	60	65	70	75	80 ✓	85	90	95	98
1.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.08	0.17	0.32	0.56	0.79
1.2	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.07	0.15	0.27	0.46	0.74	0.99
1.4	0.00	0.00	0.00	0.00	0.00	0.02	0.06	0.13	0.24	0.39	0.61	0.92	1.18
1.6	0.00	0.00	0.00	0.00	0.01	0.05	0.11	0.20	0.34	0.52	0.76	1.11	1.38
1.8	0.00	0.00	0.00	0.00	0.03	0.09	0.17	0.29	0.44	0.65	0.93	1.29	1.58
2.0	0.00	0.00	0.00	0.02	0.06	0.14	0.24	0.38	$\boxed{0.56}$	0.80	1.09	1.48	1.77
2.5	0.00	0.00	0.02	0.08	0.17	0.30	0.46	0.65	$\boxed{0.89}$	1.18	1.53	1.96	2.27
3.0	0.00	0.02	0.09	0.19	0.33	0.51	0.71	0.96	1.25	1.59	1.98	2.45	2.77
3.5	0.02	0.08	0.20	0.35	0.53	0.75	1.01	1.30	1.64	2.02	2.45	2.94	3.27
4.0	0.06	0.18	0.33	0.53	0.76	1.03	1.33	1.67	2.04	2.46	2.92	3.43	3.77
4.5	0.14	0.30	0.50	0.74	1.02	1.33	1.67	2.05	2.46	2.91	3.40	3.92	4.26
5.0	0.24	0.44	0.69	0.98	1.30	1.65	2.04	2.45	2.89	3.37	3.88	4.42	4.76
6.0	0.50	0.80	1.14	1.52	1.92	2.35	2.81	3.28	3.78	4.30	4.85	5.41	5.76
7.0	0.84	1.24	1.68	2.12	2.60	3.10	3.62	4.15	4.69	5.25	5.82	6.41	6.76
8.0	1.25	1.74	2.25	2.78	3.33	3.89	4.46	5.04	5.63	6.21	6.81	7.40	7.76
9.0	1.71	2.29	2.88	3.49	4.10	4.72	5.33	5.95	6.57	7.18	7.79	8.40	8.76
10.0	2.23	2.89	3.56	4.23	4.90	5.56	6.22	6.88	7.52	8.16	8.78	9.40	9.76
11.0	2.78	3.52	4.26	5.00	5.72	6.43	7.13	7.81	8.48	9.13	9.77	10.39	10.76
12.0	3.38	4.19	5.00	5.79	6.56	7.32	8.05	8.76	9.45	10.11	10.76	11.39	11.76
13.0	4.00	4.89	5.76	6.61	7.42	8.21	8.98	9.71	10.42	11.10	11.76	12.39	12.76
14.0	4.65	5.62	6.55	7.44	8.30	9.12	9.91	10.67	11.39	12.08	12.75	13.39	13.76
15.0	5.33	6.36	7.35	8.29	9.19	10.04	10.85	11.63	12.37	13.07	13.74	14.39	14.76

[a] Interpolate the values shown to obtain runoff depths for CNs or rainfall amounts not shown.

Source: U.S. Soil Conservation Service (1986).

APPENDIX K

ATTACHMENT 2:

LEACHATE GENERATION / HYDAULIC HEAD ON LINER

Job No.
No.

HDR Computation

Project Bayview Landfill
Computed KDG
Date 6/23/03
Subject Leachate Collection System
Checked
Date 6/24/03
Task Leachate Generation/Hydraulic Head on Liner
Sheet 1
Of 25

1.0 Progression of Cell 2 (Stage 1 and 2)

Cell 2 has a total area of approximately 82 acres, however only the first 30 acres to be filled were considered in the Hydrologic Evaluation of Landfill Performance (HELP) model. The first 30 acres of Cell 2 will have a life of approximately 15 years. Therefore, the following progression is used:

(1) one acre with an initial lift of 10 feet and 6" of daily cover for 1 year

(2) one acre with 130 feet of waste and 12" of intermediate cover for 30 years

(One acre is used as the default area for all HELP model runs. The results may be extrapolated to obtain results for any area.)

For condition one, the HELP model used a user specified precipitation file that contained the five wettest years at the landfill location.

For condition two, the HELP model used synthetic precipitation data for Salt Lake City, Utah to simulate 30 years of rainfall falling on the landfill.

Job No.

No.

HDR Computation

HDR

Project Bayview Landfill

Computed KDG

Date 6/23/03

Subject Leachate Collection System

Checked

Date 6/24/03

Task

Sheet 2

Of 25

2.0 Climatologic and Rainfall Data

The five wettest year precipitation file was used to simulate precipitation for the first year of life for Cell 2.

The synthetic rainfall generator (SRG) was used for Salt Lake City, Utah for 30 years. The SRG was then adjusted to Bayview Landfill using monthly temperature and precipitation data (REF. 4) for Fairfield, Utah.

The maximum leaf area index for Bare Ground and poor stand of grass is 0 and 1, respectively.

Evaporative zone depth for bare ground for Salt Lake City is 16 inches.

Pg. 3/25

REF 4

Fairfield

County: Utah **Latitude:** 40°16' **Longitude:** 112°05' **Elevation:** 4880 feet **Period:** 1950-1992*

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Normal max temp	37.1	43.4	52.4	62.2	71.8	81.8	88.9	87.2	78.9	65.7	50.4	38.6	63.2
Normal min temp	10.2	16.9	24.2	29.2	36.1	43.7	50.9	48.8	39.5	29.3	21.2	12.2	30.2
Normal mean temp	23.6	30.1	38.3	45.7	54.0	62.7	69.9	68.0	59.2	47.5	35.8	25.4	46.7
Record high temp	63	70	77	85	91	99	100	99	95	88	78	65	100
Record low temp	-29	-36	-11	10	16	17	32	27	18	4	-20	-29	-36
Normal pcpn	0.98	0.96	1.11	1.01	1.06	0.79	1.09	1.15	1.09	1.25	0.99	0.91	12.39
Record mly pcpn	2.37	3.29	3.86	2.53	3.41	2.90	5.23	4.77	5.29	3.02	2.70	3.08	5.29
Record dly pcpn	0.85	1.03	1.31	1.01	2.00	0.98	1.50	1.26	1.13	1.55	0.87	0.77	2.00
Normal snowfall	9.2	6.2	5.8	2.1	0.3	0.0	0.0	0.0	0.0	1.2	4.6	8.8	38.2
Record mly snow	27.0	28.5	13.0	20.0	4.0	0.0	0.0	0.0	0.5	6.0	18.0	32.0	32.0
Record dly snow	12.0	12.0	7.0	6.0	4.0	0.0	0.0	0.0	0.5	4.0	10.0	10.5	12.0
Evapotranspiration	0.86	1.38	2.62	4.17	6.08	7.43	8.38	7.31	5.06	3.07	1.40	0.83	48.57

*Percentage of period with data: 89 % for temperature, 92 % for precipitation, 89 % for snowfall.

✓

Job No.
No.

HDR Computation

HDR

Project Bayview Landfill
Computed KDG
Date 6/23/03
Subject Leachate Collection System
Checked
Date 6/24/03
Task
Sheet 4
Of 25

3.0 Soil and Layer Data

Default layer types and soil textures in the HELP model were used for the following conditions:

Condition 1

6" of daily cover	(Texture 6)
10" of waste	(Texture 18)
24" of lateral drainage	(Texture 6)
Flexible Membrane Liner	(Texture 35)
Bentonite Mat	(Texture 17)

Condition 2

12" of intermediate cover	(Texture 6)
1560" of waste	(Texture 18)
24" of lateral drainage	(Texture 6)
Flexible Membrane Liner	(Texture 35)
Bentonite Mat	(Texture 17)

To be conservative, the intermediate cover, daily cover, lateral drainage layer and the barrier soil liner were all assumed to be saturated at the beginning of the simulation for both conditions. Based on Davis County Solid Waste Management and Energy Recovery Special Service District records, the solid waste moisture content for this area averaged 16 to 18% by weight.

Job No. | No.

HDR Computation

Project Bayview Landfill | Computed KDG | Date 6/23/03
Subject Leachate Collection System | Checked | Date 6/24/03
Task | Sheet 5 | of 25

Using 17% moisture by weight (weight of water by weight of waste), initial moisture content by volume (volume of water per volume of waste) for incorporation into the HELP model was estimated as follows:

$\Theta \equiv$ moisture content by volume $= w(\gamma_d/\rho_w)$

$w \equiv$ moisture content by weight $= 17\%$
$\gamma_d \equiv$ dry density of waste $= 41\ \mathrm{lb/ft^3}$
$\rho_w \equiv$ density of water @ 50°F $= 62.4\ \mathrm{lb/ft^3}$

$$\Theta = .17\left(\frac{41}{62.4}\right) = .11$$

4.0 Landfill Profiles and Layer Properties

Condition 1

6" daily cover } Type 1
10' of waste }
* 24" of Lateral Drainage - Type 2
** 60-mil FML - Type 4
*** .25" Bentonite Mat - Type 3

Job No. | No.

HDR Computation

HDR

Project Bayview Landfill	Computed KDG	Date 6/23/03
Subject Leachate Collection System	Checked mwo	Date 6/24/03
Task	Sheet 6	Of 25

Condition 2

12" Intermediate cover } Type 1
130' of Waste } Type 1
*24" Lateral Drainage Layer - Type 2
** 60-mil FML - Type 4
***.25" Bentonite Mat - Type 3

Type 1 ≡ vertical percolation layer
Type 2 ≡ lateral drainage layer
Type 3 ≡ Bentonite mat
Type 4 ≡ FML

* Geotextile used as filter layer for leachate collection track was not considered as a vertical drainage layer; resulting in a conservative impingement rate.

** Assumed pinhole density = 0.75 holes/acre; Installed defects = 2 holes/acre; good placement quality

*** Geotextile used as cushion underneath barrier soil was not considered as a vertical drainage layer.

pg. 7/25

TABLE 4. DEFAULT SOIL, WASTE, AND GEOSYNTHETIC CHARACTERISTICS

REF. 1

Classification			Total Porosity	Field Capacity	Wilting Point	Saturated Hydraulic Conductivity
HELP	USDA	USCS	vol/vol	vol/vol	vol/vol	cm/sec
1	CoS	SP	0.417	0.045	0.018	1.0x10^{-2}
2	S	SW	0.437	0.062	0.024	5.8x10^{-3}
3	FS	SW	0.457	0.083	0.033	3.1x10^{-3}
4	LS	SM	0.437	0.105	0.047	1.7x10^{-3}
5	LFS	SM	0.457	0.131	0.058	1.0x10^{-3}
6	SL	SM	0.453	0.190	0.085	7.2x10^{-4}
7	FSL	SM	0.473	0.222	0.104	5.2x10^{-4}
8	L	ML	0.463	0.232	0.116	3.7x10^{-4}
9	SiL	ML	0.501	0.284	0.135	1.9x10^{-4}
10	SCL	SC	0.398	0.244	0.136	1.2x10^{-4}
11	CL	CL	0.464	0.310	0.187	6.4x10^{-5}
12	SiCL	CL	0.471	0.342	0.210	4.2x10^{-5}
13	SC	SC	0.430	0.321	0.221	3.3x10^{-5}
14	SiC	CH	0.479	0.371	0.251	2.5x10^{-5}
15	C	CH	0.475	0.378	0.265	1.7x10^{-5}
16	Barrier Soil		0.427	0.418	0.367	1.0x10^{-7}
17	Bentonite Mat (0.6 cm)		0.750	0.747	0.400	3.0x10^{-9}
18	Municipal Waste (900 lb/yd^3 or 312 kg/m^3)		0.671	0.292	0.077	1.0x10^{-3}
19	Municipal Waste (channeling and dead zones)		0.168	0.073	0.019	1.0x10^{-3}
20	Drainage Net (0.5 cm)		0.850	0.010	0.005	1.0x10^{+1}
21	Gravel		0.397	0.032	0.013	3.0x10^{-1}
22	L*	ML	0.419	0.307	0.180	1.9x10^{-5}
23	SiL*	ML	0.461	0.360	0.203	9.0x10^{-6}
24	SCL*	SC	0.365	0.305	0.202	2.7x10^{-6}
25	CL*	CL	0.437	0.373	0.266	3.6x10^{-6}
26	SiCL*	CL	0.445	0.393	0.277	1.9x10^{-6}
27	SC*	SC	0.400	0.366	0.288	7.8x10^{-7}
28	SiC*	CH	0.452	0.411	0.311	1.2x10^{-6}
29	C*	CH	0.451	0.419	0.332	6.8x10^{-7}
30	Coal-Burning Electric Plant Fly Ash*		0.541	0.187	0.047	5.0x10^{-5}
31	Coal-Burning Electric Plant Bottom Ash*		0.578	0.076	0.025	4.1x10^{-3}
32	Municipal Incinerator Fly Ash*		0.450	0.116	0.049	1.0x10^{-2}
33	Fine Copper Slag*		0.375	0.055	0.020	4.1x10^{-2}
34	Drainage Net (0.6 cm)		0.850	0.010	0.005	3.3x10^{-1}

* Moderately Compacted

(Continued)

pg. 8/25

TABLE 4 (continued). DEFAULT SOIL, WASTE, AND GEOSYNTHETIC CHARACTERISTICS

REF. 1

Classification		Total Porosity	Field Capacity	Wilting Point	Saturated Hydraulic Conductivity
HELP	Geomembrane Material	vol/vol	vol/vol	vol/vol	cm/sec
35	High Density Polyethylene (HDPE)				2.0×10^{-13}
36	Low Density Polyethylene (LDPE)				4.0×10^{-13}
37	Polyvinyl Chloride (PVC)				2.0×10^{-11}
38	Butyl Rubber				1.0×10^{-12}
39	Chlorinated Polyethylene (CPE)				4.0×10^{-12}
40	Hypalon or Chlorosulfonated Polyethylene (CSPE)				3.0×10^{-12}
41	Ethylene-Propylene Diene Monomer (EPDM)				2.0×10^{-12}
42	Neoprene				3.0×10^{-12}

(concluded)

Job No.
No.

HDR Computation

Project Bayview Landfill
Computed KDG
Date 6/23/03
Subject Leachate Collection System
Checked MWO
Date 6/24/03
Task
Sheet 9
Of 25

The maximum drainage pathway is 1400 feet; 230 feet at 25% slope and 1170 feet at 3% slope (page 10). Since two slopes contribute to the drainage pathway, the maximum drainage pathway is estimated as follows:

$$L_E' = L_E + L_E(Q_1/Q_2)$$

$L_E' \equiv$ maximum drainage pathway
$L_E \equiv$ 1400 feet
$Q_1 \equiv$ leachate flowrate at 25% slope
$Q_2 \equiv$ leachate flowrate at 3% slope

Based on impingment rates from a 25% slope, Q_1 is estimated as zero.

$$\Rightarrow L_E' = 1400' + \cancel{1400'(Q_1/Q_2)}^{\to 0} = 1400'$$

For HELP Model, 1170 feet at 3% slope will be used.

5.0 Leachate Generation

From the HELP model, the following leachate generations were estimated:

Condition 1

1 acre area with 10' of waste and 6" of daily cover for a drainage pathway of 1170' at a 3% slope = 0 in/day (page 17).

Job No.	No.

HDR Computation

HDR

Project Bayview Landfill	Computed KDG	Date 6/23/03
Subject Leachate Collection System	Checked mwd	Date 6/24/03
Task	Sheet 11	Of 25

Condition 2

1 acre area with 130' of waste and 12" of intermediate cover for a drainage pathway of 1170' at a 3% slope = 0 in/day (page 24).

6.0 Maximum Depth of Hydraulic Head on Liner System

Since the maximum lateral drainage rate (pg. 17 and 24) is approximately 0 in/day for each condition, the maximum head on the liner system approaches 0 feet. This is less than the 12 inch limit established in R315 - Environmental Quality, Solid and Hazardous waste.

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07   (1 NOVEMBER 1997)               **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:     C:\HELP3\SUV\WET5_AV.D4
TEMPERATURE DATA FILE:       C:\HELP3\SUV\FAIRFIED.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\SUV\SLCDFLT.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\SUV\SLCDFLT.D11
SOIL AND DESIGN DATA FILE:   C:\HELP3\SUV\BVIEW1YR.D10
OUTPUT DATA FILE:            C:\HELP3\SUV\BVIEW1YR.OUT


TIME:  11:14     DATE:   6/26/2003


******************************************************************************

     TITLE:  Bayview Cell#2  Year 1

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                  LAYER  1
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER    6
           THICKNESS                     =       6.00    INCHES
           POROSITY                      =       0.4530 VOL/VOL
           FIELD CAPACITY                =       0.1900 VOL/VOL
           WILTING POINT                 =       0.0850 VOL/VOL
           INITIAL SOIL WATER CONTENT    =       0.1900 VOL/VOL
           EFFECTIVE SAT. HYD. COND.     =   0.720000011000E-03 CM/SEC
```

p. 12/25

```
                              LAYER  2
                              --------

               TYPE 1 - VERTICAL PERCOLATION LAYER
                   MATERIAL TEXTURE NUMBER  18
THICKNESS                        =     120.00    INCHES
POROSITY                         =       0.6710 VOL/VOL
FIELD CAPACITY                   =       0.2920 VOL/VOL
WILTING POINT                    =       0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT       =       0.1100 VOL/VOL
EFFECTIVE SAT. HYD. COND.        =   0.100000005000E-02 CM/SEC


                              LAYER  3
                              --------

                 TYPE 2 - LATERAL DRAINAGE LAYER
                   MATERIAL TEXTURE NUMBER   6
THICKNESS                        =      24.00    INCHES
POROSITY                         =       0.4530 VOL/VOL
FIELD CAPACITY                   =       0.1900 VOL/VOL
WILTING POINT                    =       0.0850 VOL/VOL
INITIAL SOIL WATER CONTENT       =       0.1900 VOL/VOL
EFFECTIVE SAT. HYD. COND.        =   0.720000011000E-03 CM/SEC
SLOPE                            =       3.00    PERCENT
DRAINAGE LENGTH                  =    1170.0     FEET


                              LAYER  4
                              --------

                 TYPE 4 - FLEXIBLE MEMBRANE LINER
                   MATERIAL TEXTURE NUMBER  35
THICKNESS                        =       0.06    INCHES
POROSITY                         =       0.0000 VOL/VOL
FIELD CAPACITY                   =       0.0000 VOL/VOL
WILTING POINT                    =       0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT       =       0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.        =   0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY              =       0.75    HOLES/ACRE
FML INSTALLATION DEFECTS         =       2.00    HOLES/ACRE
FML PLACEMENT QUALITY            =   3 - GOOD
```

```
                          LAYER  5
                          --------

                 TYPE 3 - BARRIER SOIL LINER
                 MATERIAL TEXTURE NUMBER  17
  THICKNESS                      =        0.25    INCHES
  POROSITY                       =        0.7500 VOL/VOL
  FIELD CAPACITY                 =        0.7470 VOL/VOL
  WILTING POINT                  =        0.4000 VOL/VOL
  INITIAL SOIL WATER CONTENT     =        0.7500 VOL/VOL
  EFFECTIVE SAT. HYD. COND.      =    0.300000003000E-08 CM/SEC


            GENERAL DESIGN AND EVAPORATIVE ZONE DATA
            ----------------------------------------

  NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

 SCS RUNOFF CURVE NUMBER            =  77.00
 FRACTION OF AREA ALLOWING RUNOFF   =   0.0     PERCENT
 AREA PROJECTED ON HORIZONTAL PLANE =   1.000   ACRES
 EVAPORATIVE ZONE DEPTH             =  16.0     INCHES
 INITIAL WATER IN EVAPORATIVE ZONE  =   2.240   INCHES
 UPPER LIMIT OF EVAPORATIVE STORAGE =   9.428   INCHES
 LOWER LIMIT OF EVAPORATIVE STORAGE =   1.280   INCHES
 INITIAL SNOW WATER                 =   2.000   INCHES
 INITIAL WATER IN LAYER MATERIALS   =  19.087   INCHES
 TOTAL INITIAL WATER                =  21.087   INCHES
 TOTAL SUBSURFACE INFLOW            =   0.00    INCHES/YEAR


             EVAPOTRANSPIRATION AND WEATHER DATA
             -----------------------------------

  NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
           SALT LAKE CITY        UTAH

     STATION LATITUDE                           =  40.76 DEGREES
     MAXIMUM LEAF AREA INDEX                    =   0.00
     START OF GROWING SEASON (JULIAN DATE)      =    117
     END OF GROWING SEASON (JULIAN DATE)        =    289
     EVAPORATIVE ZONE DEPTH                     =  16.0  INCHES
     AVERAGE ANNUAL WIND SPEED                  =   8.80 MPH
     AVERAGE 1ST QUARTER RELATIVE HUMIDITY      =  67.00 %
     AVERAGE 2ND QUARTER RELATIVE HUMIDITY      =  48.00 %
     AVERAGE 3RD QUARTER RELATIVE HUMIDITY      =  39.00 %
     AVERAGE 4TH QUARTER RELATIVE HUMIDITY      =  65.00 %


  NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
           COEFFICIENTS FOR     SALT LAKE CITY       UTAH
```

```
                 NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

     JAN/JUL      FEB/AUG      MAR/SEP      APR/OCT      MAY/NOV      JUN/DEC
     -------      -------      -------      -------      -------      -------
       1.37         1.63         2.06         1.07         1.30         1.12
       2.07         1.40         2.21         1.30         1.50         1.20


          NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR     SALT LAKE CITY        UTAH

               NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

     JAN/JUL      FEB/AUG      MAR/SEP      APR/OCT      MAY/NOV      JUN/DEC
     -------      -------      -------      -------      -------      -------
      25.20        30.30        38.50        45.70        54.20        62.70
      69.80        68.50        59.50        47.90        35.30        26.30


          NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                   COEFFICIENTS FOR     SALT LAKE CITY        UTAH
                     AND STATION LATITUDE   =  40.27 DEGREES



*******************************************************************************

          AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH    1
-------------------------------------------------------------------------------

                       JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                       -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS               0.45     0.93     1.84     0.47     0.63     0.46
                         1.42     2.50     1.91     2.28     1.20     1.21

    STD. DEVIATIONS      0.00     0.00     0.00     0.00     0.00     0.00
                         0.00     0.00     0.00     0.00     0.00     0.00

  RUNOFF
  ------
    TOTALS               0.000    0.000    0.000    0.000    0.000    0.000
                         0.000    0.000    0.000    0.000    0.000    0.000

    STD. DEVIATIONS      0.000    0.000    0.000    0.000    0.000    0.000
                         0.000    0.000    0.000    0.000    0.000    0.000

  EVAPOTRANSPIRATION
  ------------------
    TOTALS               0.736    0.869    2.260    1.548    0.488    0.356
```

```
                         0.831     2.814     1.653     2.151     1.039     0.679

    STD. DEVIATIONS      0.000     0.000     0.000     0.000     0.000     0.000
                         0.000     0.000     0.000     0.000     0.000     0.000

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  ----------------------------------------
    TOTALS               0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
                         0.0000    0.0000    0.0000    0.0000    0.0000    0.0000

    STD. DEVIATIONS      0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
                         0.0000    0.0000    0.0000    0.0000    0.0000    0.0000

  PERCOLATION/LEAKAGE THROUGH LAYER  5
  ------------------------------------
    TOTALS               0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
                         0.0000    0.0000    0.0000    0.0000    0.0000    0.0000

    STD. DEVIATIONS      0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
                         0.0000    0.0000    0.0000    0.0000    0.0000    0.0000

-------------------------------------------------------------------------------
               AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------

  DAILY AVERAGE HEAD ON TOP OF LAYER  4
  -------------------------------------
    AVERAGES             0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
                         0.0000    0.0000    0.0000    0.0000    0.0000    0.0000

    STD. DEVIATIONS      0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
                         0.0000    0.0000    0.0000    0.0000    0.0000    0.0000

*******************************************************************************


*******************************************************************************

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS     1 THROUGH     1
-------------------------------------------------------------------------------
                                        INCHES              CU. FEET    PERCENT
                                  -------------------     ----------   ---------
 PRECIPITATION                      15.30   (   0.000)      55539.0     100.00

 RUNOFF                              0.000  (  0.0000)          0.00      0.000

 EVAPOTRANSPIRATION                 15.423  (  0.0000)      55986.77    100.806

 LATERAL DRAINAGE COLLECTED          0.00000 (  0.00000)        0.000    0.00000
   FROM LAYER  3

 PERCOLATION/LEAKAGE THROUGH         0.00000 (  0.00000)        0.000    0.00000
   LAYER  5
```

p.16/25

```
AVERAGE HEAD ON TOP              0.000 (     0.000)
  OF LAYER  4

CHANGE IN WATER STORAGE        -0.123    (  0.0000)       -447.75      -0.806

*******************************************************************************


******************************************************************************

                PEAK DAILY VALUES FOR YEARS     1 THROUGH     1
  ------------------------------------------------------------------------
                                                    (INCHES)      (CU. FT.)
                                                   ----------    -------------
     PRECIPITATION                                   0.89          3230.700

     RUNOFF                                          0.000            0.0000

     DRAINAGE COLLECTED FROM LAYER  3                0.00000          0.00000

     PERCOLATION/LEAKAGE THROUGH LAYER  5            0.000000         0.00000

     AVERAGE HEAD ON TOP OF LAYER  4                 0.000

     MAXIMUM HEAD ON TOP OF LAYER  4                 0.000

     LOCATION OF MAXIMUM HEAD IN LAYER  3
           (DISTANCE FROM DRAIN)                     0.0 FEET

     SNOW WATER                                      2.00          7260.0000


     MAXIMUM VEG. SOIL WATER (VOL/VOL)                       0.2600

     MINIMUM VEG. SOIL WATER (VOL/VOL)                       0.0999


      ***  Maximum heads are computed using McEnroe's equations.  ***

           Reference:  Maximum Saturated Depth over Landfill Liner
                       by Bruce M. McEnroe, University of Kansas
                       ASCE Journal of Environmental Engineering
                       Vol. 119, No. 2, March 1993, pp. 262-270.

******************************************************************************
```

```
******************************************************************************

            FINAL WATER STORAGE AT END OF YEAR     1
    ----------------------------------------------------------------------
             LAYER           (INCHES)        (VOL/VOL)
             -----           --------        ---------
               1              1.5758           0.2626

               2             14.4955           0.1208

               3              4.5600           0.1900

               4              0.0000           0.0000

               5              0.1875           0.7500

           SNOW WATER         0.145

******************************************************************************
******************************************************************************
```

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07   (1 NOVEMBER 1997)               **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:      C:\HELP3\SUV\BVPRECP.D4
TEMPERATURE DATA FILE:        C:\HELP3\SUV\BVTEMP.D7
SOLAR RADIATION DATA FILE:    C:\HELP3\SUV\BVRAD.D13
EVAPOTRANSPIRATION DATA:      C:\HELP3\SUV\BVEVAP.D11
SOIL AND DESIGN DATA FILE:    C:\HELP3\SUV\BAYVIEW3.D10
OUTPUT DATA FILE:             C:\HELP3\SUV\BAYVIEW3.OUT


TIME:  11:20     DATE:   6/26/2003


******************************************************************************

     TITLE:  Bayview Cell#2 Year 5

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                  LAYER  1
                                  --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   6
          THICKNESS                     =      12.00    INCHES
          POROSITY                      =       0.4530 VOL/VOL
          FIELD CAPACITY                =       0.1900 VOL/VOL
          WILTING POINT                 =       0.0850 VOL/VOL
          INITIAL SOIL WATER CONTENT    =       0.1900 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =   0.720000011000E-03 CM/SEC
```

```
                              LAYER  2
                              --------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER  18
THICKNESS                        =   1560.00    INCHES
POROSITY                         =      0.6710 VOL/VOL
FIELD CAPACITY                   =      0.2920 VOL/VOL
WILTING POINT                    =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT       =      0.1100 VOL/VOL
EFFECTIVE SAT. HYD. COND.        =  0.100000005000E-02 CM/SEC


                              LAYER  3
                              --------

                   TYPE 2 - LATERAL DRAINAGE LAYER
                     MATERIAL TEXTURE NUMBER   6
THICKNESS                        =     24.00    INCHES
POROSITY                         =      0.4530 VOL/VOL
FIELD CAPACITY                   =      0.1900 VOL/VOL
WILTING POINT                    =      0.0850 VOL/VOL
INITIAL SOIL WATER CONTENT       =      0.1900 VOL/VOL
EFFECTIVE SAT. HYD. COND.        =  0.720000011000E-03 CM/SEC
SLOPE                            =      3.00    PERCENT
DRAINAGE LENGTH                  =   1170.0     FEET


                              LAYER  4
                              --------

                   TYPE 4 - FLEXIBLE MEMBRANE LINER
                     MATERIAL TEXTURE NUMBER  35
THICKNESS                        =      0.06    INCHES
POROSITY                         =      0.0000 VOL/VOL
FIELD CAPACITY                   =      0.0000 VOL/VOL
WILTING POINT                    =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT       =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.        =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY              =      0.75    HOLES/ACRE
FML INSTALLATION DEFECTS         =      2.00    HOLES/ACRE
FML PLACEMENT QUALITY            =  3 - GOOD
```

```
                               LAYER  5
                               --------

                        TYPE 3 - BARRIER SOIL LINER
                        MATERIAL TEXTURE NUMBER  17
         THICKNESS                      =       0.25   INCHES
         POROSITY                       =       0.7500 VOL/VOL
         FIELD CAPACITY                 =       0.7470 VOL/VOL
         WILTING POINT                  =       0.4000 VOL/VOL
         INITIAL SOIL WATER CONTENT     =       0.7500 VOL/VOL
         EFFECTIVE SAT. HYD. COND.      =     0.300000003000E-08 CM/SEC


                  GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                  ----------------------------------------

       NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

      SCS RUNOFF CURVE NUMBER                 =    77.00
      FRACTION OF AREA ALLOWING RUNOFF        =     0.0     PERCENT
      AREA PROJECTED ON HORIZONTAL PLANE      =     1.000   ACRES
      EVAPORATIVE ZONE DEPTH                  =    16.0     INCHES
      INITIAL WATER IN EVAPORATIVE ZONE       =     2.720   INCHES
      UPPER LIMIT OF EVAPORATIVE STORAGE      =     8.120   INCHES
      LOWER LIMIT OF EVAPORATIVE STORAGE      =     1.328   INCHES
      INITIAL SNOW WATER                      =     2.000   INCHES
      INITIAL WATER IN LAYER MATERIALS        =   178.628   INCHES
      TOTAL INITIAL WATER                     =   180.628   INCHES
      TOTAL SUBSURFACE INFLOW                 =     0.00    INCHES/YEAR


                   EVAPOTRANSPIRATION AND WEATHER DATA
                   -----------------------------------

       NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                SALT LAKE CITY        UTAH

           STATION LATITUDE                             =  40.76 DEGREES
           MAXIMUM LEAF AREA INDEX                      =   0.00
           START OF GROWING SEASON (JULIAN DATE)        =    117
           END OF GROWING SEASON (JULIAN DATE)          =    289
           EVAPORATIVE ZONE DEPTH                       =  16.0  INCHES
           AVERAGE ANNUAL WIND SPEED                    =   8.80 MPH
           AVERAGE 1ST QUARTER RELATIVE HUMIDITY        =  67.00 %
           AVERAGE 2ND QUARTER RELATIVE HUMIDITY        =  48.00 %
           AVERAGE 3RD QUARTER RELATIVE HUMIDITY        =  39.00 %
           AVERAGE 4TH QUARTER RELATIVE HUMIDITY        =  65.00 %


       NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
                COEFFICIENTS FOR     SALT LAKE CITY       UTAH
```

p.21/25

```
              NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

 JAN/JUL      FEB/AUG      MAR/SEP      APR/OCT      MAY/NOV      JUN/DEC
 -------      -------      -------      -------      -------      -------
   1.35         1.33         1.72         2.21         1.47         0.97
   0.72         0.92         0.89         1.14         1.22         1.37


        NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
                 COEFFICIENTS FOR     SALT LAKE CITY       UTAH

          NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

 JAN/JUL      FEB/AUG      MAR/SEP      APR/OCT      MAY/NOV      JUN/DEC
 -------      -------      -------      -------      -------      -------
  28.60        34.10        40.70        49.20        58.80        68.30
  77.50        74.90        65.00        53.00        39.70        30.30


        NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                 COEFFICIENTS FOR     SALT LAKE CITY       UTAH
                   AND STATION LATITUDE  =  40.27 DEGREES


*******************************************************************************

        AVERAGE MONTHLY VALUES IN INCHES FOR YEARS     1 THROUGH   30
-------------------------------------------------------------------------------

                           JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                           -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                   1.16     1.20     1.95     2.04     1.30     1.03
                             0.69     0.85     0.84     1.05     1.31     1.46

    STD. DEVIATIONS          0.60     0.54     0.77     0.87     0.68     0.74
                             0.48     0.80     0.61     0.82     0.73     0.59

  RUNOFF
  ------
    TOTALS                   0.000    0.000    0.000    0.000    0.000    0.000
                             0.000    0.000    0.000    0.000    0.000    0.000

    STD. DEVIATIONS          0.000    0.000    0.000    0.000    0.000    0.000
                             0.000    0.000    0.000    0.000    0.000    0.000

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                   0.572    0.673    2.225    2.301    1.525    1.048
```

```
                         0.706    0.840    0.789    0.922    0.823    0.763

    STD. DEVIATIONS      0.258    0.379    0.644    0.918    0.694    0.719
                         0.495    0.809    0.590    0.662    0.363    0.199

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  ----------------------------------------
    TOTALS               0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

    STD. DEVIATIONS      0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

  PERCOLATION/LEAKAGE THROUGH LAYER  5
  ------------------------------------
    TOTALS               0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

    STD. DEVIATIONS      0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000


-------------------------------------------------------------------------------
              AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


  DAILY AVERAGE HEAD ON TOP OF LAYER  4
  -------------------------------------
    AVERAGES             0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

    STD. DEVIATIONS      0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

*******************************************************************************


*******************************************************************************

   AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH   30
-------------------------------------------------------------------------------
                                    INCHES            CU. FEET     PERCENT
                              -------------------  -------------  ---------
 PRECIPITATION                  14.88    (   2.435)    54009.6     100.00

 RUNOFF                          0.000   (  0.0000)        0.00      0.000

 EVAPOTRANSPIRATION             13.186   (  2.0492)    47864.84     88.623

 LATERAL DRAINAGE COLLECTED      0.00000 (  0.00000)        0.000    0.00000
   FROM LAYER  3

 PERCOLATION/LEAKAGE THROUGH     0.00000 (  0.00000)        0.000     0.00000
   LAYER  5
```

```
AVERAGE HEAD ON TOP            0.000 (     0.000)
  OF LAYER  4

CHANGE IN WATER STORAGE        1.693    (  1.1317)       6144.74      11.377

*******************************************************************************



*******************************************************************************

               PEAK DAILY VALUES FOR YEARS     1 THROUGH   30
  ------------------------------------------------------------------------
                                                     (INCHES)      (CU. FT.)
                                                    ----------    -------------
     PRECIPITATION                                    1.66          6025.800

     RUNOFF                                           0.000            0.0000

     DRAINAGE COLLECTED FROM LAYER   3                0.00000          0.00000

     PERCOLATION/LEAKAGE THROUGH LAYER   5            0.000000         0.00000

     AVERAGE HEAD ON TOP OF LAYER   4                 0.000

     MAXIMUM HEAD ON TOP OF LAYER   4                 0.000

     LOCATION OF MAXIMUM HEAD IN LAYER   3
            (DISTANCE FROM DRAIN)                     0.0 FEET

     SNOW WATER                                       2.96         10733.1621


     MAXIMUM VEG. SOIL WATER (VOL/VOL)                        0.4143

     MINIMUM VEG. SOIL WATER (VOL/VOL)                        0.0830

      ***  Maximum heads are computed using McEnroe's equations.  ***

           Reference:  Maximum Saturated Depth over Landfill Liner
                       by Bruce M. McEnroe, University of Kansas
                       ASCE Journal of Environmental Engineering
                       Vol. 119, No. 2, March 1993, pp. 262-270.

*******************************************************************************
```

```
***************************************************************************

              FINAL WATER STORAGE AT END OF YEAR   30
    ----------------------------------------------------------------------

               LAYER          (INCHES)         (VOL/VOL)
               -----          --------         ---------
                 1             2.6547           0.2212

                 2           224.0082           0.1436

                 3             4.5600           0.1900

                 4             0.0000           0.0000

                 5             0.1875           0.7500

             SNOW WATER        0.000

***************************************************************************
***************************************************************************
```

APPENDIX K

ATTACHMENT 3:

FLOW CAPACITY OF THE LEACHATE COLLECTION PIPE

Job No.	No.

HDR Computation

HDR

Project Bayview Landfill	Computed KDG	Date 6/23/03
Subject Leachate Collection System	Checked mmd	Date 6/24/03
Task Flow capacity of Leachate Collection Pipe	Sheet 1	Of 2

Based on Manning's equation, the flow capacity for a 8 inch leachate pipe on a 2% slope is 1.114 cubic feet per second (or 719,824 gallons per day). (See page 2).

The HELP model output (K-2; pgs. 12-25) indicates that negligible leachate will be generated for either condition analyzed. Therefore, a 8 inch pipe will be able to handle the peak flow with an ample factor of safety.

However, stormwater that comes into contact with solid waste or daily cover is typically allowed to infiltrate into the waste to be managed by the leachate collection system. Contaminated stormwater will be minimized by keeping the active face as small as possible and by placing soil cover on all waste-filled areas not currently being utilized for disposal.

Since the waste is not at field capacity when placed in the landfill and the soil cover is not saturated, there is a large potential for these components to absorb and hold any contaminated water that may infiltrate into the landfill cell. Historical practice at the site has shown that the leachate collection system is adequate to handle the minimal leachate generated as well as the contact stormwater

Additionally, soil berms will be maintained to divert non-contact stormwater around the area to drainage channels.

Job No.	3608	*Calc No.*	K-3

Computation

Project	Bayview Landfill	*Computed*	kdf
System	Leachate and Contaminated Water Plan	*Date*	Jul-03
Component	Leachate Collection System	*Reviewed*	MWD
Task	Pipe capacity	*Date*	8-20-03

Purpose

Using Manning's equation, calculate pipe capacity of leachate headers.

Find

Description	Variable	Units
Pipe capacity	Q	gal/day

Given

Description	Value	Source
Pipe diameter [in]	8	leachate pipe diameter
Slope [ft/ft]	0.02	design value
roughness coefficient	0.02	HDPE pipe

Solution

Description	Value	Comment
Pipe capacity	**719,824**	**gallons / day**

Assumptions

Use Manning's Equation

Equations

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

equation 1

A = cross-sectional area [ft^2]
n = Manning's roughness coefficient
R = hydraulic radius [ft]
S = slope [ft/ft]
Q = flow [cfs]

Calculation

Description	Equation	Comment	Value	Verification
solve for area	$A = \pi r^2$	[SF]	0.349	
solve for perimeter	$P = \pi d$	[ft]	2.094	
solve for R	R = A / P	[ft]	0.166666667	
solve for Q	equation 1 above	[cfs]	1.114	
convert to gal/day	1 cfs = 646,272 gpd	[gpd]	719,824	

Appendix L

APPENDIX L

STORMWATER / EVAPORATION POND

SUVSWD Bayview
Class I Landfill Permit Application

Submitted March 2009

Prepared By:

HDR ENGINEERING, INC.

INTRODUCTION

In its current design, runoff and leachate from Cell 1, Cell 2 Stage 1, and the windrow operation are contained in the existing leachate pond. However, the pond is not dual lined and does not have leak detection, both of which are now required for leachate ponds. Because of this, a new leachate pond will be constructed as part of the permit renewal. The new pond will take leachate and stormwater from all of Cell 1 and Cell 2, and the existing pond will continue to take runoff from the windrow operation due to the less stringent requirements of retaining runoff from windrow operations.

The new pond will be dual-lined with leak detection. The liner system will consist of (starting at surface of pond): 60-mil UV-resistant HDPE liner, geonet, second 60-mil HDPE liner, non-woven geotextile, and compacted subgrade. As part of the leak detection system, an 8" HPDE pipe will be installed below the top 60-mil liner and will extend to a sump which will be located in the bottom of pond. The pipe will have a perforated end at the sump so that moisture can enter and the pipe will be used for access to the sump to test for moisture.

The design for the new leachate pond was performed by assuming the largest of the three remaining stage areas in Cell 2, would be contributing runoff to the pond. This assumption was made because Stage 1 is already receiving waste and receives daily cover, decreasing the amount of runoff generated from that stage, and the remaining stages will be developed separately as the other stages are filled. The largest remaining stage in Cell 2 is Stage 3, which has an area of 23.5 acres. The design storm used for the pond design is the 25-year, 24-hour storm. Information for the rainfall amount of this storm was taken from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 rainfall data. From the NOAA 14 data, the 25-year, 24-hour precipitation amount is 1.81 inches. (See attached)

The bottom of the proposed pond is at elevation 4634 feet (NGVD '29 datum) and the top of the pond is at elevation 4646 feet. The invert elevation of the leachate drain line is 4642.0, which is 4 feet below the top of pond elevation. The pond volume was calculated using the average area method and calculating the volume below the invert of the leachate drain line. These calculations are included as part of Appendix L. Based on these calculations, the required pond volume is 154,008 ft^3 and the pond volume provided is 187,069 ft^3. Therefore, the pond is sufficient to hold the 25-year, 24-hour storm with 4 feet of freeboard.

HDR | ONE COMPANY
Many Solutions℠

Project: Bayview Landfill | Computed: RLR | Date: 1/9/2009
Subject: Hydrologic Analysis | Checked: | Date:
Task: Leachate Pond Volume Calculations
Job #:

Leachate pond volume required was calculated using the largest stage area in Cell 2 (Stage 3). The design storm for the leachate pond is the 25-year, 24-hour storm. The pond was designed to hold the entire 25-year, 24-hour storm.

25-yr, 24-hr Precip. = 1.81 in
From NOAA Altas 14 Point Precipitation Frequency Estimates (See attached)

Volume Required

Largest Stage	Area (Ac), A	25-yr, 24-hr Precip. (in.)	Volume Required(1) (ac-ft)	Volume Required (ft^3)
3	23.5	1.81	3.54	154,402

Volume Provided

Elevation	Area (ft^2)	Avg. Area (ft^2)	Depth (ft)	Volume Provided (ft^3)	Cumulative Volume Provided (ft^3)
4634	13,297				
		15,529	2	31,058	31,058
4636	17,761				
		20,306	2	40,612	71,670
4638	22,851				
		25,752	2	51,503	123,173
4640	28,652				
		31,948	2	63,896	187,069
4642	35,244				

Volume Provided	187,069	ft^3
Volume Required	154,402	ft^3
Balance	32,667	ft^3

Volume Provided > Volume Required

(1) $V_{required} = (P_{25,24} * A)/12$

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

Utah 40.036799 N 111.968129 W 4688 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M. Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006

Extracted: Thu Nov 20 2008

Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Docs

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	
1	0.12	0.17	0.22	0.29	0.36	0.44	0.49	0.62	0.77	0.94	1.04	1.20	1.36	1.49	1.93	2.26	2.80	3
2	0.15	0.22	0.28	0.37	0.46	0.55	0.62	0.77	0.94	1.16	1.27	1.46	1.67	1.83	2.37	2.77	3.41	3
5	0.20	0.31	0.39	0.52	0.64	0.73	0.79	0.95	1.15	1.38	1.52	1.75	1.99	2.16	2.79	3.27	3.99	4
10	0.26	0.39	0.48	0.65	0.80	0.90	0.95	1.11	1.31	1.57	1.72	2.00	2.25	2.44	3.13	3.66	4.44	5
25	0.34	0.51	0.63	0.85	1.05	1.16	1.20	1.33	1.55	1.81	2.00	2.34	2.59	2.79	3.55	4.17	4.99	5
50	0.41	0.62	0.77	1.04	1.28	1.39	1.41	1.53	1.73	2.00	2.21	2.60	2.86	3.05	3.85	4.54	5.37	6
100	0.49	0.75	0.93	1.25	1.55	1.66	1.67	1.76	1.93	2.19	2.42	2.88	3.12	3.30	4.13	4.90	5.72	6
200	0.59	0.90	1.11	1.50	1.86	1.98	2.00	2.04	2.17	2.38	2.64	3.16	3.38	3.55	4.39	5.24	6.03	6
500	0.74	1.13	1.41	1.89	2.34	2.47	2.50	2.52	2.57	2.62	2.92	3.54	3.72	3.86	4.71	5.66	6.36	7
1000	0.88	1.34	1.66	2.24	2.77	2.92	2.94	2.97	3.00	3.03	3.14	3.83	3.97	4.08	4.92	5.95	6.56	7

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting forces estimates near zero to appear as zero.

* Upper bound of the 90% confidence interval Precipitation Frequency Estimates (inches)

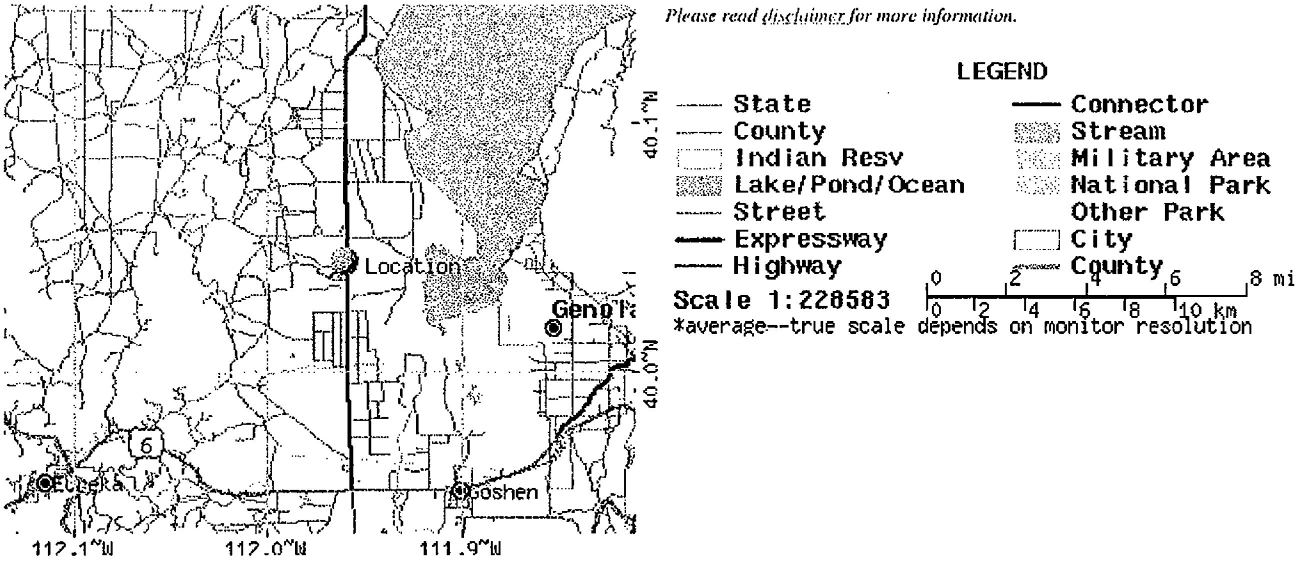
ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	
1	0.14	0.20	0.25	0.34	0.42	0.50	0.56	0.69	0.84	1.01	1.11	1.29	1.46	1.59	2.06	2.40	2.97	3
2	0.17	0.26	0.32	0.44	0.54	0.63	0.70	0.85	1.03	1.24	1.36	1.57	1.78	1.95	2.52	2.94	3.62	4
5	0.24	0.36	0.45	0.61	0.75	0.84	0.90	1.05	1.25	1.48	1.63	1.89	2.12	2.30	2.97	3.46	4.22	4
10	0.30	0.46	0.57	0.76	0.95	1.03	1.07	1.22	1.43	1.68	1.84	2.14	2.39	2.58	3.31	3.87	4.67	5
25	0.40	0.60	0.75	1.01	1.25	1.33	1.36	1.48	1.70	1.94	2.14	2.50	2.75	2.95	3.75	4.40	5.25	6
50	0.48	0.74	0.92	1.23	1.52	1.61	1.63	1.71	1.91	2.15	2.37	2.79	3.03	3.22	4.06	4.79	5.64	6
100	0.59	0.90	1.11	1.50	1.85	1.95	1.97	1.98	2.15	2.35	2.60	3.09	3.32	3.49	4.37	5.17	6.00	6
200	0.72	1.09	1.35	1.82	2.25	2.35	2.37	2.39	2.44	2.56	2.84	3.39	3.60	3.76	4.65	5.54	6.32	7
500	0.92	1.40	1.73	2.33	2.89	2.99	3.02	3.05	3.08	3.11	3.16	3.82	3.97	4.10	5.00	6.01	6.67	7
1000	1.10	1.68	2.08	2.81	3.47	3.60	3.64	3.67	3.71	3.75	3.78	4.15	4.25	4.35	5.23	6.33	6.87	7

* The upper bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are greater than.
** These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.

Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

* Lower bound of the 90% confidence interval Precipitation Frequency Estimates (inches)

ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day



Please read disclaimer for more information.

Other Maps/Photographs -

View USGS digital orthophoto quadrangle (DOQ) covering this location from TerraServer; **USGS Aerial Photograph** may also be available
from this site. A DOQ is a computer-generated image of an aerial photograph in which image displacement caused by terrain relief and camera tilts has been removed. It combines the image characteristics of a photograph with the geometric qualities of a map. Visit the USGS for more information.

Watershed/Stream Flow Information -

Find the Watershed for this location using the U.S. Environmental Protection Agency's site.

Climate Data Sources -

Precipitation frequency results are based on data from a variety of sources, but largely NCDC. The following links provide general information
about observing sites in the area, regardless of if their data was used in this study. For detailed information about the stations used in this study,
please refer to NOAA Atlas 14 Document.

Using the National Climatic Data Center's (NCDC) station search engine, locate other climate stations within:

+/-30 minutes ...OR... +/-1 degree of this location (40.036799/-111.968129). Digital ASCII data can be obtained directly from NCDC.

Find Natural Resources Conservation Service (NRCS) SNOTEL (SNOwpack TELemetry) stations by visiting the **Western Regional Climate Center's state-specific SNOTEL station maps.**

Hydrometeorological Design Studies Center
DOC/NOAA/National Weather Service
1325 East-West Highway
Silver Spring, MD 20910

(301) 713-1669
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Appendix M

APPENDIX M

Runon-Runoff Calculations

SUVSWD Bayview Class I Landfill
Permit Application

APPENDIX M

RUN-ON / RUN-OFF CALCULATIONS

SUVSWD Bayview
Class I Landfill Permit Application

Submitted March 2009

Prepared By:

HDR ENGINEERING, INC.

INTRODUCTION

The run-on/run-off calculations were performed to determine the size of drainage ditches required to control run-on and run-off flows. The run-on/run-off peak flows were calculated using the Rational Method:

$$Q = CiA$$

where Q = Run-off flow (ft^3/sec)
C = Run-off Coefficient
i = rainfall intensity (in/hr)
A = Area contributing to run-off (acres)

The run-off coefficient, C, was multiplied by the run-off coefficient adjustment factor, C_f, of 1.1 to adjust the rational method for a recurrence interval of 25 years.

Once the run-on/run-off flows were calculated, the capacity of the ditch designed to carry the run-on/run-off was calculated using Manning's Equation:

$$Q = \frac{1.49}{n} AR^{2/3} S^{1/2}$$

where Q = Maximum capacity of ditch (ft^3/sec)
n = Manning's roughness coefficient
A = Cross-sectional area of ditch (ft^2)
R = Hydraulic radius (A/wetted perimeter) (ft)
S = slope of ditch (ft/ft)

If the capacity of the ditch exceeds the run-on/run-off flow, then the ditch is adequate.

The first set of calculations shown in Appendix M, Attachment 1 is for the run-on from Cell 1 onto Cell 2 and from Cell 2 onto Cell 1. The map on page 4 of Attachment M-1 shows the portion of Cell 1 that is directed towards Cell 2 and the portion of Cell 2 that will be directed to Cell 1 after closure with final cover in place. The ditch that will be constructed to go between Cell 1 and Cell 2 will direct the run-on to the north and south to existing drainage channels. The final cover on Cell 1 and Cell 2 will be overlaid with short grass prairie, which has a Manning's roughness coefficient, n, of 0.15. This was considered to be cultivated land on a rural catchment, so a value of 0.30 was chosen as the basic factor for the run-off coefficient, *C*.

The second set of calculations shown in Appendix M, Attachment 2 is for the run-off from the areas of Stage 1 and Stage 2 in Cell 2 prior to installation of the final cap. The calculations were done for the design of drainage ditches which will be constructed around the perimeter of Stages 1 and 2. The run-off was calculated as if Cell 2 were filled to capacity prior to installation of the final cap as a worst-case scenario so that the ditches can be constructed as Cell 2 is filled and will not need to be redesigned. A Manning's roughness coefficient of 0.027 (earth with weeds) was used for the channel design and a run-off coefficient (C-value) of 0.30 was used for run-off calculations (undeveloped land). Because the diversion ditches around Stages 1 and 2 will not continue around Stages 3 and 4 until these stages are constructed, the ditches will outfall to the sump in Stage 2.

APPENDIX M

ATTACHMENT 1:
REQUIRED CAPACITY OF DRAINAGE DITCH FOR RUN-OFF

Job No.

No.

HDR Computation

HDR

oject Bayview Landfill

Computed

Date 5/03

Subject

Checked

Date

Task

Sheet 1

Of 21

Determine Peak Discharge to Drainage Ditches

$Q = CiA$

Based on the portion of Cell 1 and the proposed Cell 2 that will be draining into the ditch between them in the Northern direction, the maximum area that will be contributing to the ditch in either direction is 18.4 acres. (see page 1a)

Run-off Coefficient of Drainage Area, c.

Based on Ref. 1, a runoff coefficient of drainage area for cultivated land is 0.30. This is multiplied by a frequency factor of 1.1 for a recurrence interval of 25 years, so the coefficient of drainage, C, is 0.33.

Rainfall intensity, i

To determine rainfall intensity, time of concentration, t_c, is required.

Sheet Flow (Overland flow)

$$T_c = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, S^{0.4}}$$

n = Manning's roughness coefficient
L = Flow length (total < 300')
P_2 = 2-Year 24-hour Precipitation
S = Land Slope

REF. 1

Pg. 2/21

Table 5.6-3: Runoff coefficient adjustment factors for Rational Method

Recurrence Interval (years)	C_f
25	1.1
50	1.2
100	1.25

The Rational formula now becomes Equation 5.6-4.

$$Q = \frac{CC_f IA}{360} \qquad \text{5.6-4}$$

5.6.6 Procedure for Rational Method

The general procedure for estimating the peak discharge for a watershed using the Rational Method is as follows:

(1) Determine the watershed area in hectares.

(2) With consideration for future characteristics of the watershed, determine the time of concentration as defined in Section 5.5.

(3) Assure consistency with the assumptions and limitations for application of the Rational Method.

(4) According to the locality in Texas and the design frequency, extract the rainfall IDF coefficients e, b, and d values from the list shown in Appendix 5-2.

(5) Using Equation 5.6-2, calculate rainfall intensity.

(6) With consideration for future characteristics of the watershed, select or develop appropriate runoff coefficients for the watershed. Where the watershed comprises more than one characteristic, C values for each area segment must be estimated individually. A weighted C value then may be estimated using Equation 5.6-5.

$$C = \frac{\sum_{n=1}^{m} C_n A_n}{\sum_{n=1}^{m} A_n} \qquad \text{5.6-5}$$

where:

C = weighted runoff coefficient
n = nth subarea
m = number of subareas
C_n = runoff coefficient for nth subarea

Job No. ______ No. ______

HDR Computation

HDR

Project Bayview Landfill | Computed | Date 5/03

Subject | Checked | Date

Task | Sheet 3 | Of 21

Drainage Areas

Using Planix 6 (see page 4)

Northward Flow in Ditch

Cell 1

$$A_{1,N} = 24.85\ in^2 \left(\frac{120^2\ ft^2}{1\ in^2}\right) = 8.215\ acres$$

Cell 2

$$A_{2,N} = 13.24\ in^2 \left(\frac{150^2\ ft^2}{1\ in^2}\right) = 6.84\ acres$$

$$A_{3,N} = 3.65\ in^2 \left(\frac{200^2\ ft^2}{1\ in^2}\right) = 3.35\ acres$$

Total = 18.4 acres

Southward Flow in Ditch

Cell 1

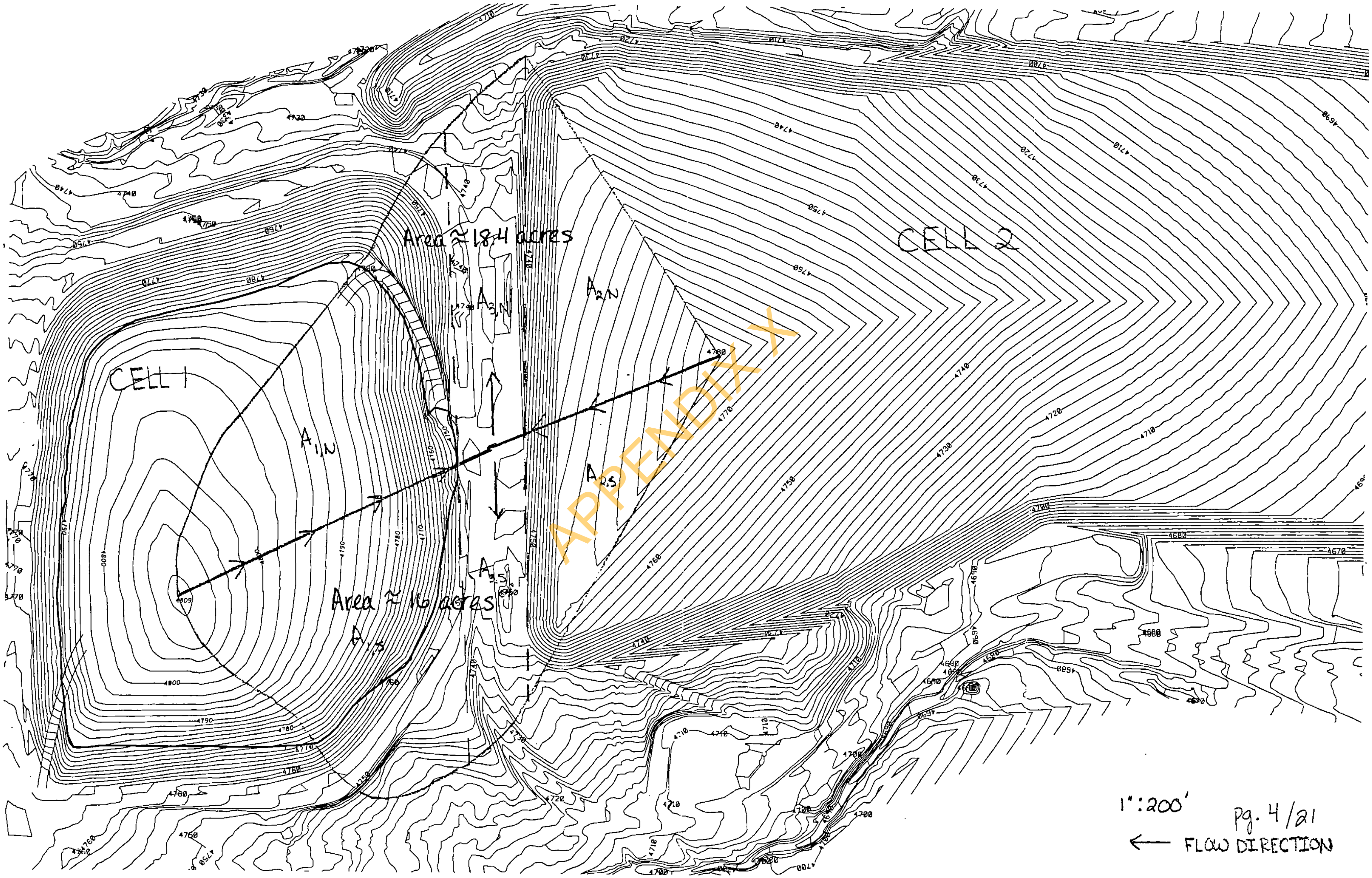
$$A_{1,S} = 27.48\ in^2 \left(\frac{120^2\ ft^2}{1\ in^2}\right) = 9.08\ acres$$

Cell 2

$$A_{2,S} = 8.56\ in^2 \left(\frac{150^2\ ft^2}{1\ in^2}\right) = 4.4215\ acres$$

$$A_{3,S} = 2.713\ in^2 \left(\frac{200^2\ ft^2}{1\ in^2}\right) = 2.49\ acres$$

Total = 16 acres



1":200'

← FLOW DIRECTION

Job No.
No.

HDR Computation **HDR**

Project Bayview Landfill
Computed
Date 5/03
Subject
Checked
Date
Task
Sheet 5
Of 21

Surface description - Short grass prairie

$n = 0.15$
$L = 300'$
$P_2 = 1''$
$S = 4\%$

$$T_c = \frac{0.007(0.15 * 300')^{0.8}}{(1'')^{.5}(.04)^{.4}} = .53$$

Shallow concentrated flow (swale flow)

Surface description - Short grass prairie

$L_{,1} = 276'$
$S_{,1} = 6.5\%$
$V =$ Average velocity $= 4.1$ ft/s (from REF. 2)
(using $S = .065$ for unpaved soil)

$$T_{c,1} = \frac{L}{3600V} = \frac{276'}{3600(4.1\text{ ft/s})} = .019$$

$L_{,2} = 156'$
$S_{,2} = 18.8\%$
$V = 7$ ft/sec (from REF. 2 using $S = .188$ for unpaved soil)

$$T_{c,2} = \frac{L}{3600V} = \frac{156'}{3600(7\text{ ft/s})} = .0062$$

Channel Slope

$S = 1\%$ ∴ $V = 1.6$ ft/sec from Ref. 2
Assuming average velocity for a channel is similar to average velocity for shallow concentrated flow

Job No. | No.

HDR Computation

roject Bayview Landfill | Computed | Date 5/03
Subject | Checked | Date
Task | Sheet 6 | Of 21

Channel Flow (continued)

$$T_c = \frac{L}{3600V} = \frac{1050\text{ ft}}{3600(1.6\text{ ft/s})} = .18$$

$$T_{c,TOTAL} = .53 + .019 + .0062 + .18 = .735\text{ hr}\left(\frac{60\text{ min}}{1\text{ hr}}\right) = 44.11\text{ min}$$
(for runoff from Cell 1)

Based on REF. 3, 2-year and 100-year 1-hour storm is estimated as:

$$Y_2 = 0.005 + 0.852[X_1(X_1/X_2)]$$

$$Y_{100} = 0.322 + 0.789[X_3(X_3/X_4)]$$

Y_2 = 2-yr 1-hr estimated value
Y_{100} = 100-yr 1-hr estimated value
X_1 = 2-yr 6-hr value from precipitation-frequency maps
X_2 = 2-yr 24-hr value from precipitation-frequency maps
X_3 = 100-yr 6-hr value from precipitation-frequency maps
X_4 = 100-yr 24-hr value from precipitation-frequency maps

X_1 = 0.7 in (see 2-yr 6-hr precipitation-frequency map)(p.12)
X_2 = 1.0 in (see 2-yr 24-hr precipitation-frequency map)(p.9)
X_3 = 1.8 in (see 100-yr 6 hr precipitation-frequency map)(p.13)
X_4 = 2.6 in (see 100-yr 24-hr precipitation-frequency map)(p.14)

$$Y_2 = 0.005 + 0.852[0.7(0.7/1.0)] = .4225\text{ inches}$$

$$Y_{100} = 0.322 + 0.789[1.8(1.8/2.6)] = 1.305\text{ inches}$$

pg. 7/21

REF. 1

TABLE 12.5 RATIONAL RUNOFF COEFFICIENT

a. Urban Catchments

General Description	C	Surface	
City	0.7–0.9	Asphalt paving	0.7–0.9
Suburban business	0.5–0.7	Roofs	0.7–0.9
Industrial	0.5–0.9	Lawn heavy soil	
		>7° slope	0.25–0.35
Residential multiunits	0.6–0.7	2–7°	0.18–0.22
Housing estates	0.4–0.6	<2°	0.13–0.17
Bungalows	0.3–0.5	Lawn sandy soil	
		>7°	0.15–0.2
Parks, cemeteries	0.1–0.3	2–7°	0.10–0.15
		<2°	0.05–0.10

b. Rural Catchments (less than 10 km^2)

Ground Cover	Basic Factor	Corrections: Add or Subtract
Bare surface	0.40	Slope < 5%: −0.05
Grassland	0.35	Slope > 10%: +0.05
Cultivated land	0.30	Recurrence interval < 20 yr: −0.05
Timber	0.18	Recurrence interval > 50 yr: +0.05
		Mean annual precipitation < 600 mm: −0.03
		Mean annual precipitation > 900 mm: +0.03

Table 3-1.—Roughness coefficients (Manning's n) for sheet flow.

REF. 2

Surface description	n[1]
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses[2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods:[3]	
Light underbrush	0.40
Dense underbrush	0.80

[1] The n values are a composite of information compiled by Engman (1986).

[2] Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.

[3] When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

Pg. 8/21

REF. 2

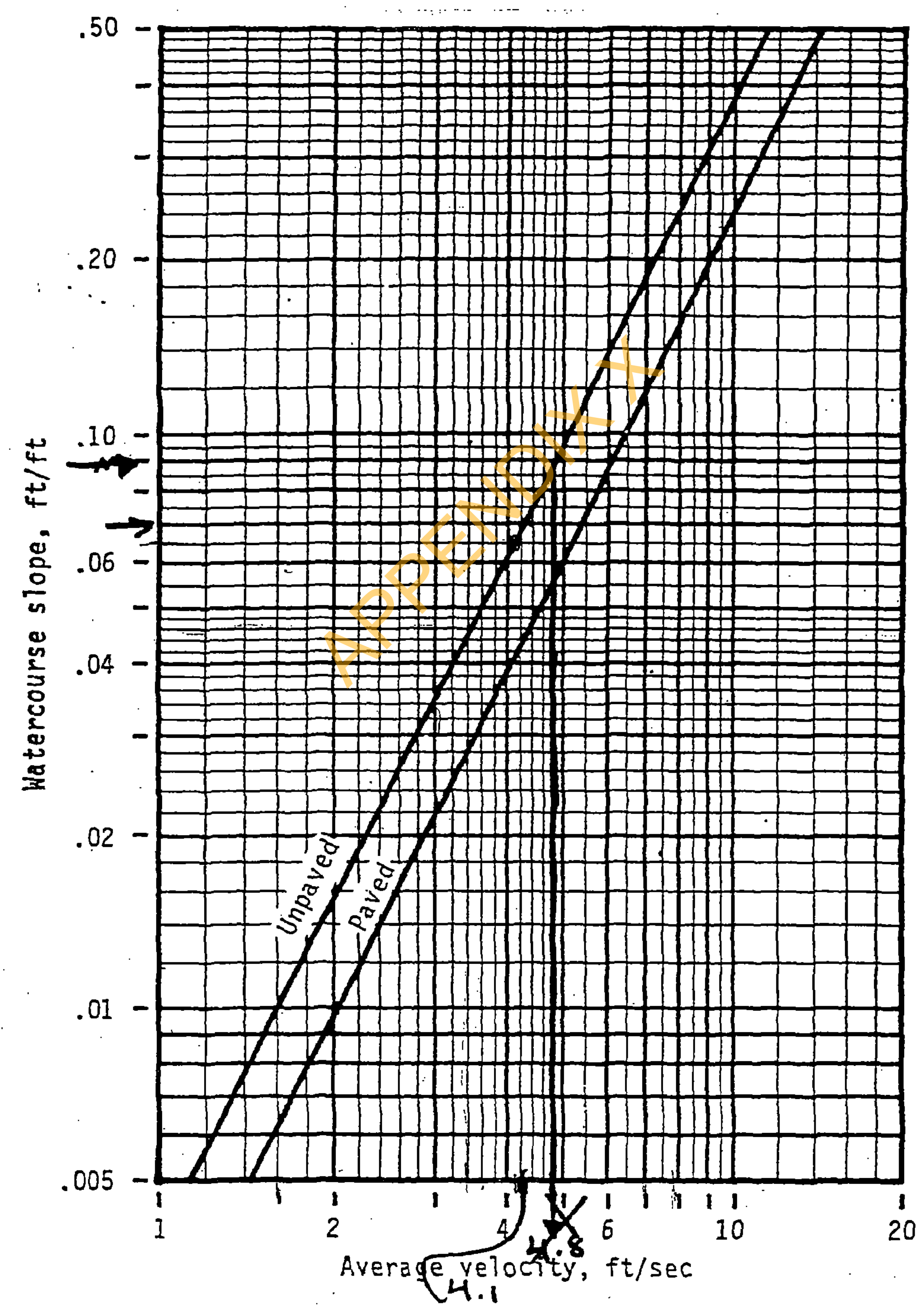
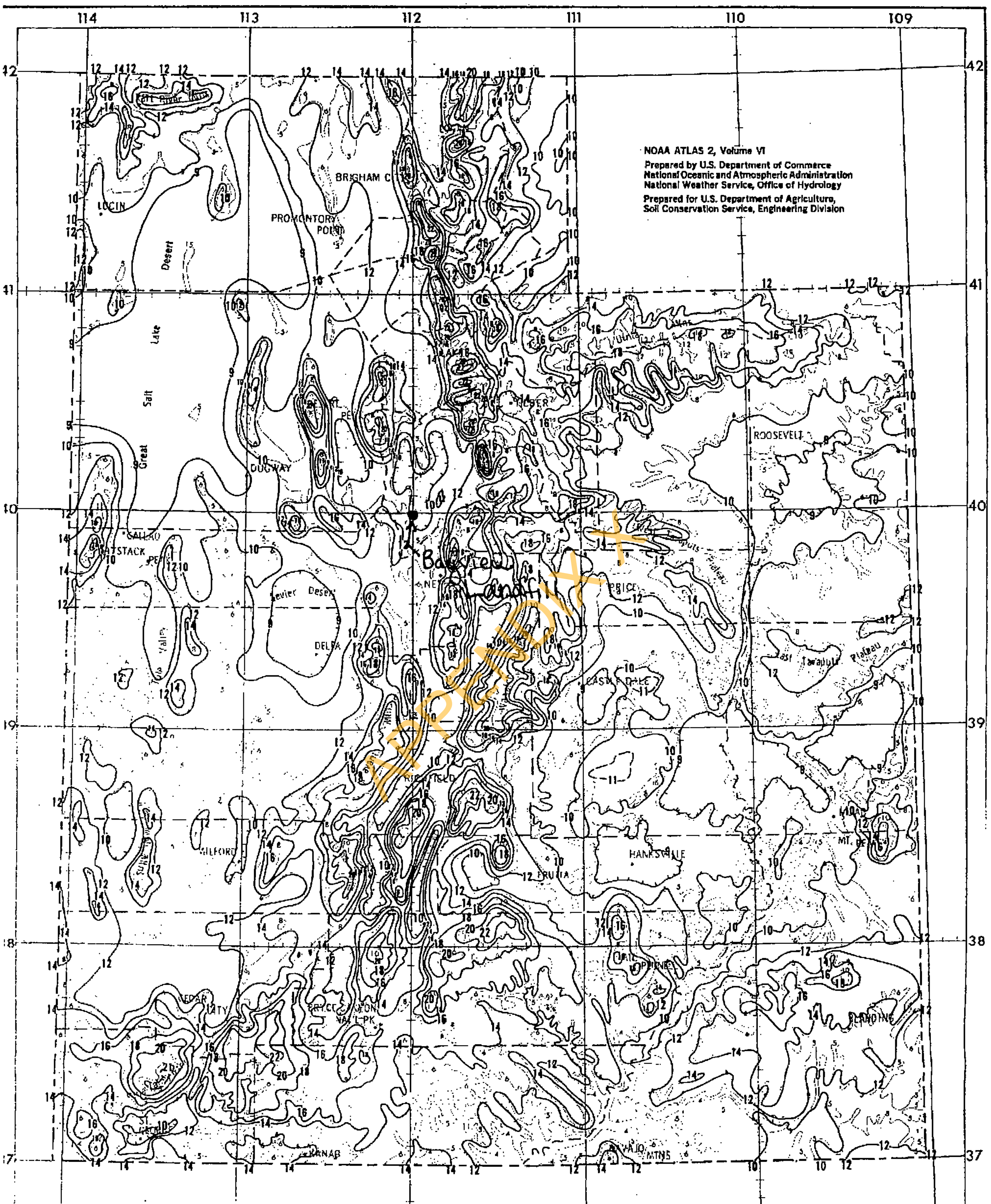


Figure 3-1.—Average velocities for estimating travel time for shallow concentrated flow.



NOAA ATLAS 2, Volume VI
Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

UTAH

10 0 10 20 30 40 MILES

Figure 25

ISOPLUVIALS OF 2-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

REF. 3
pg. 9/21

Region of applicability*	Equation	Corr. coeff.	No. of stations	Mean of computed stn. values (inches)	Standard error of estimate (inches)
Utah south of the Unitas east of Wasatch, and east and south of Boulder and Pine Valley Mountains (1)	$Y_2 = -0.011 + 0.942[(X_1)(X_1/X_2)]$	0.95	86	0.72	0.085
	$Y_{100} = 0.494 + 0.755[(X_3)(X_3/X_4)]$	.90	85	1.96	.290
Most of western Utah (2)	$Y_2 = 0.005 + 0.852[(X_1)(X_1/X_2)]$	.89	65	0.41	.047
	$Y_{100} = 0.322 + 0.789[(X_3)(X_3/X_4)]$	.87	65	1.25	.196
Northeast and northwest corners of Utah (3)	$Y_2 = 0.019 + 0.711[(X_1)(X_1/X_2)] + 0.001Z$	.82	98	0.40	.031
	$Y_{100} = 0.338 + 0.670[(X_3)(X_3/X_4)] + 0.001Z$	.80	79	1.04	.141

---

* Numbers in parentheses refer to geographic regions shown in figure 18. See text for more complete description.

List of variables

Y_2 = 2-yr 1-hr estimated value
Y_{100} = 100-yr 1-hr estimated value
X_1 = 2-yr 6-hr value from precipitation-frequency maps
X_2 = 2-yr 24-hr value from precipitation-frequency maps
X_3 = 100-yr 6-hr value from precipitation-frequency maps
X_4 = 100-yr 24-hr value from precipitation-frequency maps
Z = point elevation in hundreds of feet

REF. 3

p.10/21

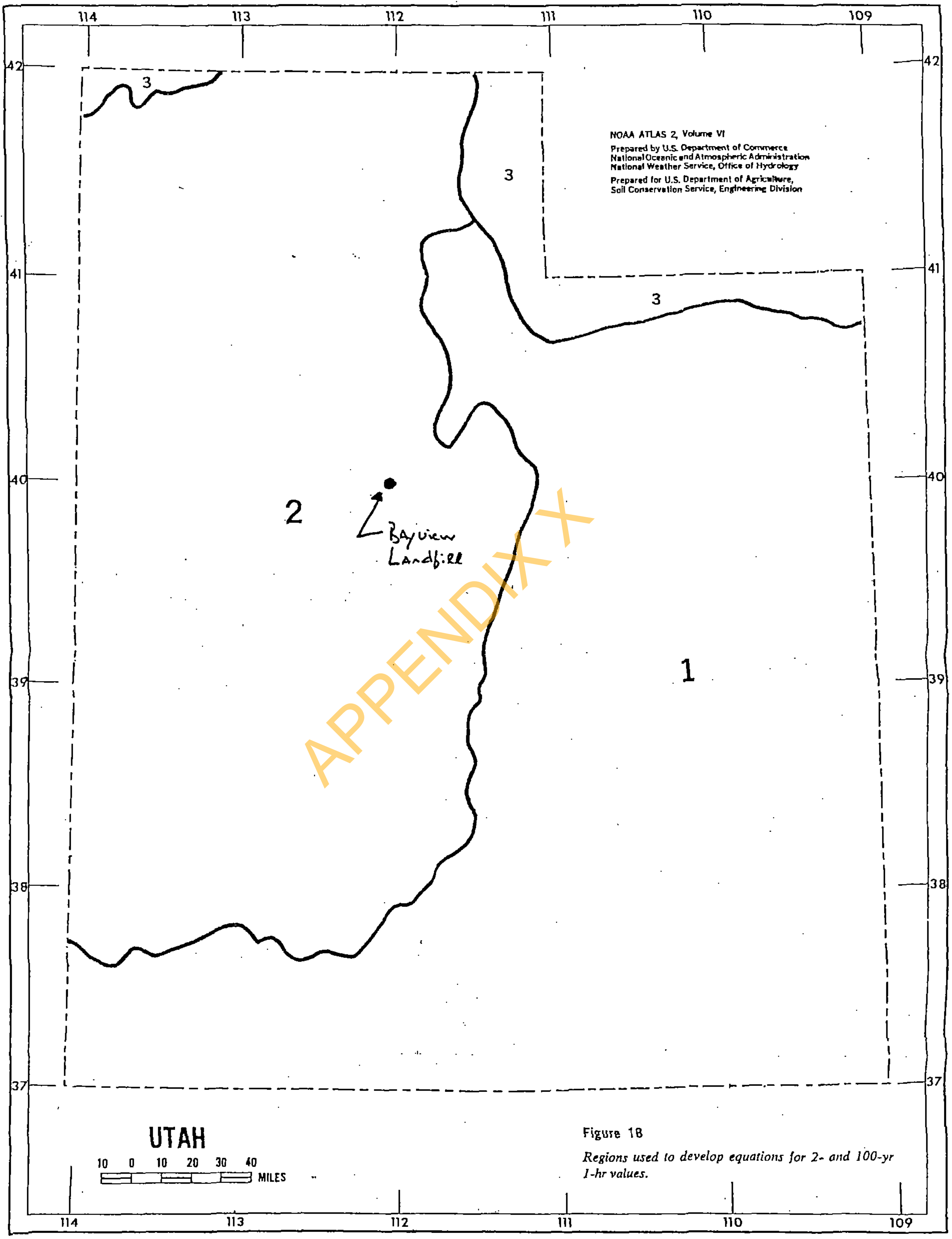
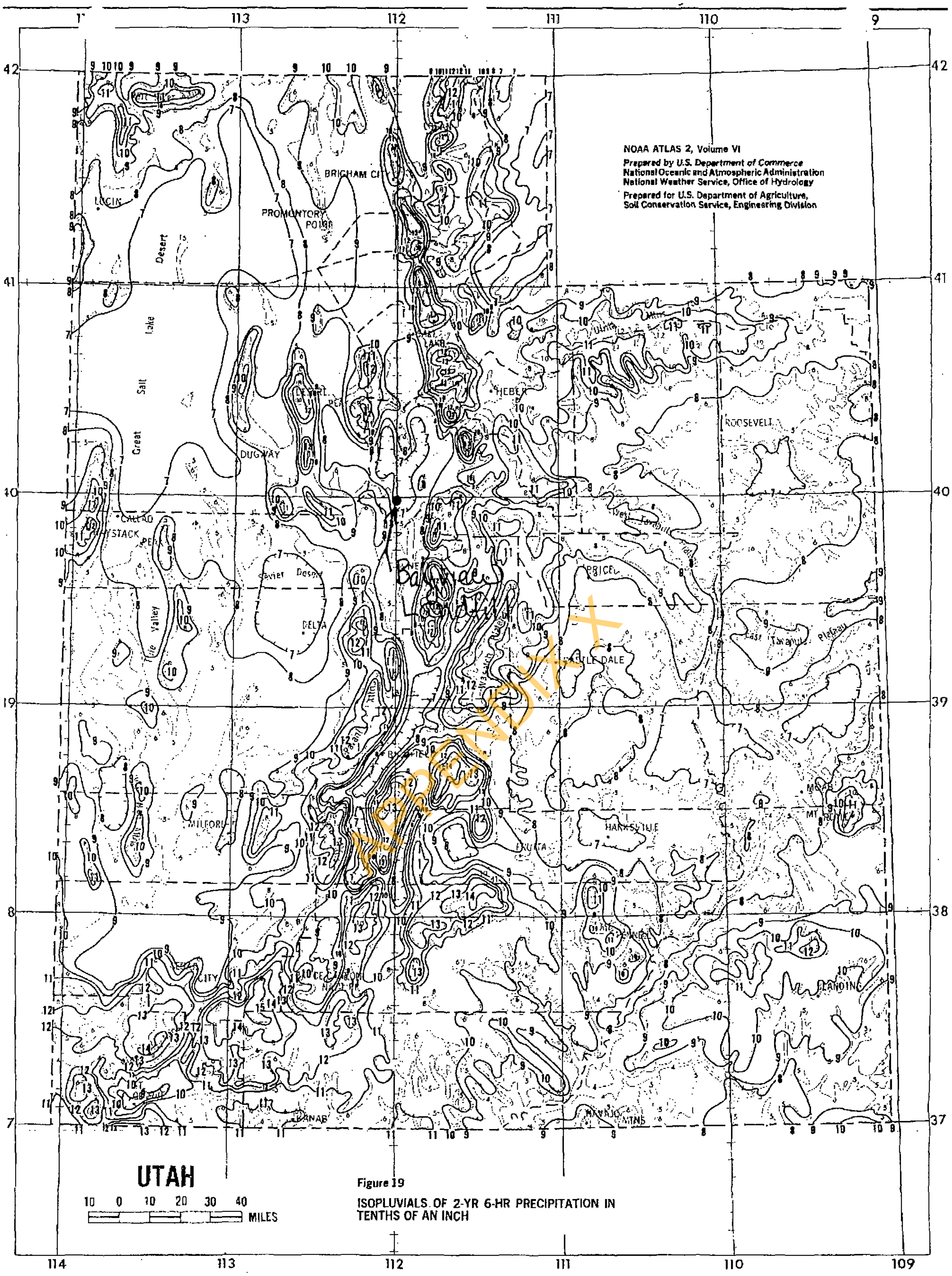


Figure 18

Regions used to develop equations for 2- and 100-yr 1-hr values.

REF. 3
P.11/21

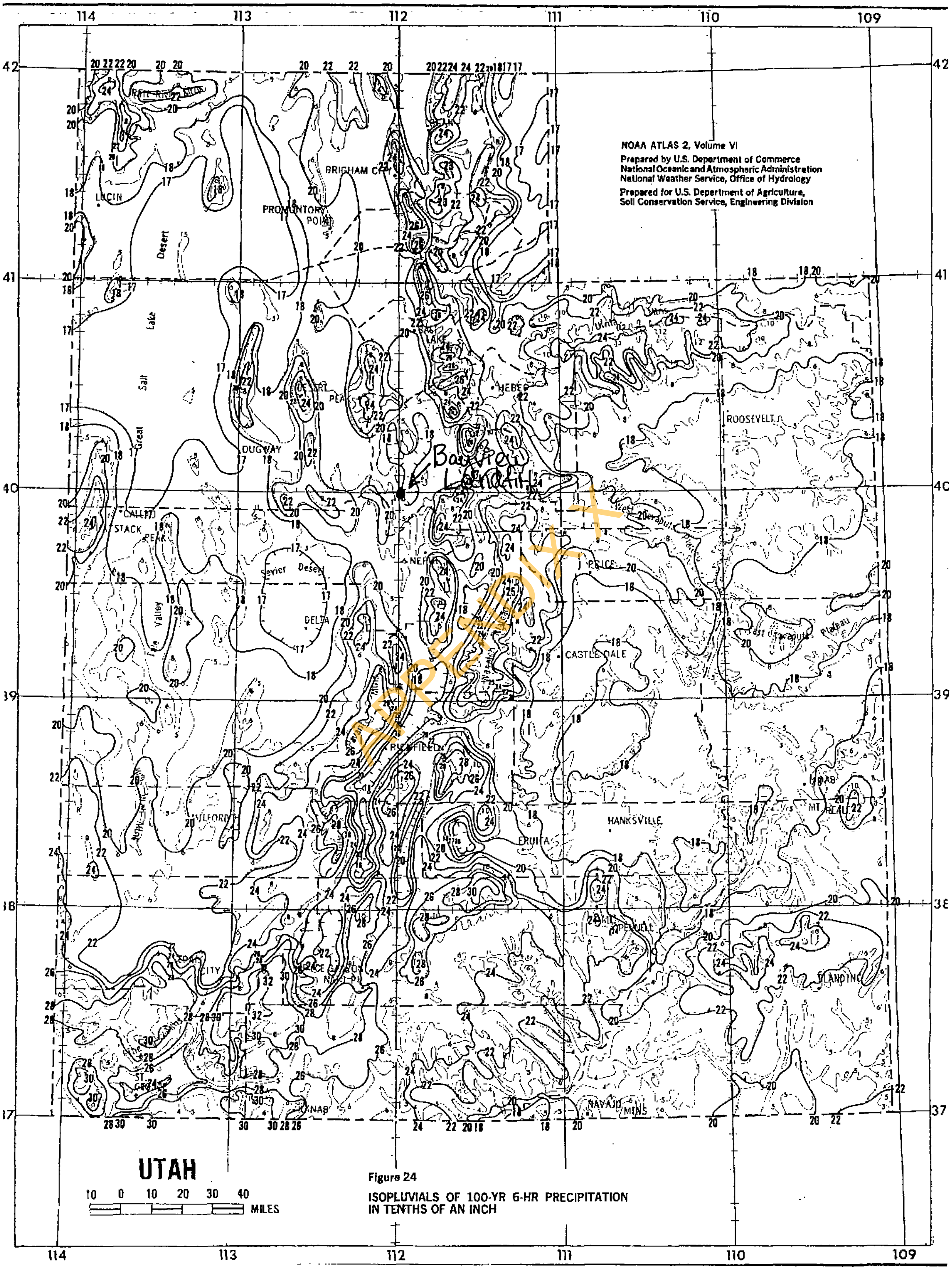


NOAA ATLAS 2, Volume VI
Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

Figure 19

ISOPLUVIALS OF 2-YR 6-HR PRECIPITATION IN TENTHS OF AN INCH

REF. 3
p. 12/21

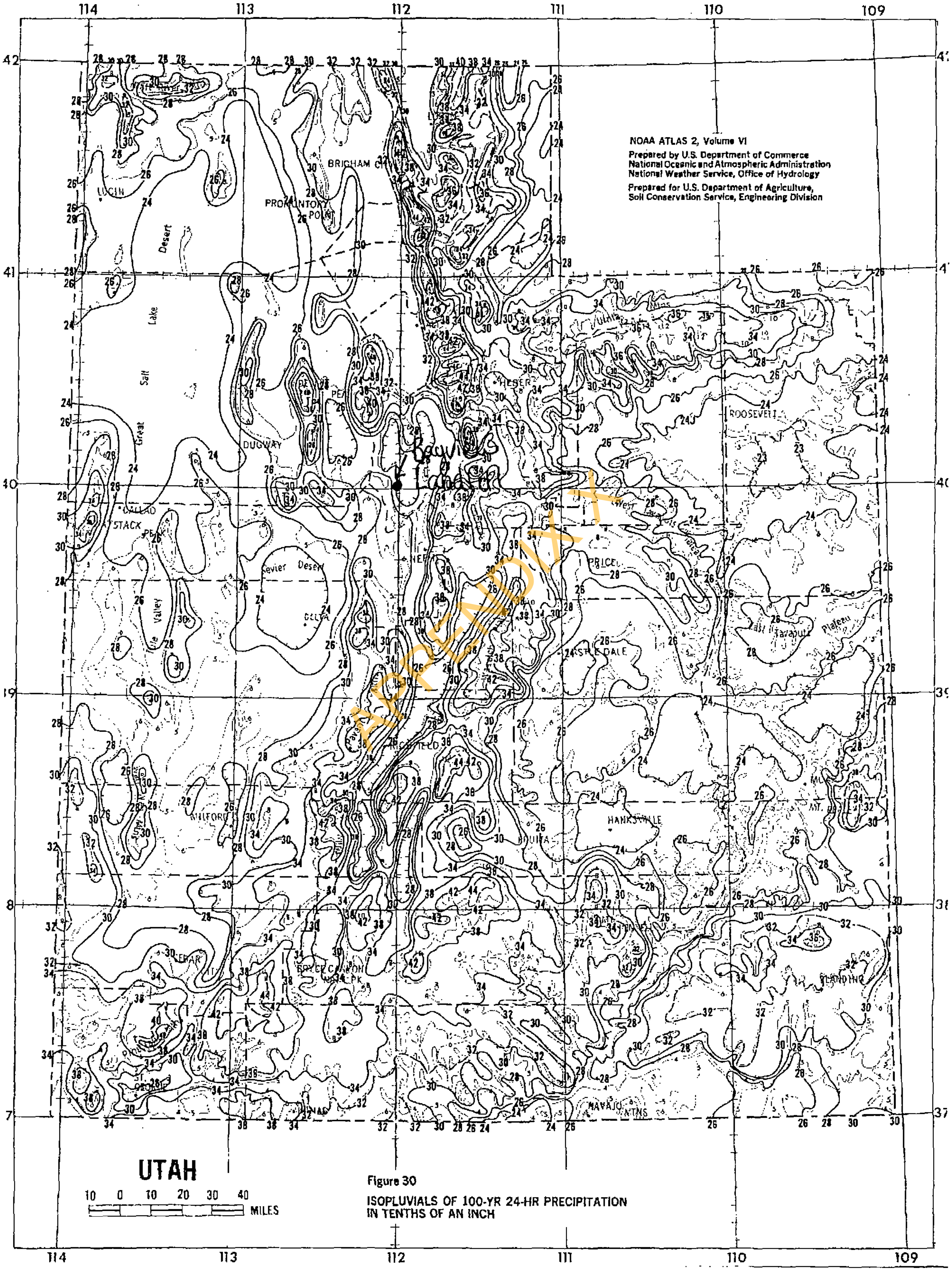


NOAA ATLAS 2, Volume VI
Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

Figure 24

ISOPLUVIALS OF 100-YR 6-HR PRECIPITATION
IN TENTHS OF AN INCH

REF. 3
p. 13/21



NOAA ATLAS 2, Volume VI

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

Figure 30

ISOPLUVIALS OF 100-YR 24-HR PRECIPITATION
IN TENTHS OF AN INCH

REF. 3
Pg. 14/21

Job No.
No.

HDR Computation

HDR

oject Bayview Landfill | Computed | Date 5/03

Subject | Checked | Date

Task Time of Concentration for Cell 2 | Sheet 15 | Of 21

Sheet Flow (overland flow)

Surface Description – Short grass prairie

$n = 0.15$

$L = 300'$

$P_2 = 1''$

$S = 0.05$

$$T_c = \frac{0.007(nL)^{0.8}}{P_2^{0.5}\, S^{0.4}} = \frac{.007(0.15 * 300')^{0.8}}{(1'')^{0.5}(.05)^{0.4}}$$

$T_c = 0.4876$

Shallow concentrated flow (swale flow)

Surface description – short grass prairie

$L_1 = 120'$

$S_1 = 0.05$

$V = 3.6$ ft/s (from REF. 2 using $S = 0.05$ for unpaved soil)

$$T_{c,1} = \frac{L}{3600V} = \frac{120'}{3600(3.6\ \text{ft/s})} = 0.0093$$

$L_2 = 100'$

$S_2 = .25$

$V = 8$ ft/sec (from REF. 2 using $S = .25$ for unpaved soil)

$$T_{c2} = \frac{L}{3600V} = \frac{100'}{3600(3.6\ \text{ft/s})} = 0.0077$$

Channel Slope

$S = 1\%$

$A = 6.75\ \text{ft}^2$

$n = .025$

$R = \frac{A}{P} = .7115\ \text{ft}$

$V = 4.75$ ft/s (from Manning's Equation $V = \frac{1.49}{n} R^{2/3} S^{1/2}$)

Job No.
No.

HDR Computation

Project Bayview Landfill
Computed
Date 5/03
Subject
Checked
Date
Task
Sheet 16
Of 21

Channel Flow (continued)

$$T_c = \frac{L}{3600V} = \frac{1050\text{ ft}}{3600(4.75\text{ ft/s})} = .0614$$

$$T_{c,TOTAL} = .4876 + .0093 + .0077 + .0614 = .5660\text{ hr}\left(\frac{60\text{ min}}{1\text{ hr}}\right)$$

$$T_c = 33.96\text{ min (for runoff from Cell 2)}$$

Since the time of concentration for Cell 1 is greater than the time of concentration for Cell 2, the time of concentration to be used is 44.11 min. (for Cell 1).

Based on REF. 3, Figure 6: Precipitation depth versus return period for partial-duration (see page 14), the 25 yr 1-hr storm is estimated to be 1.0 inch.

Based on REF. 3, to obtain estimates for a 25-year 30-min storm, the value of .79 must be applied to a 25-year 1-hour storm. Using linear interpolation, the value that must be applied to a 25-year 1-hour storm to obtain a depth for a 25-year 44-minute storm is 0.89.

∴ depth of a point for 25-year 44-min storm =

$$= .89 * 1'' = .89''$$

$$i = \frac{0.89''}{44\text{ min}}\left(\frac{60\text{ min}}{1\text{ hr}}\right) = 1.21\text{ in/hr}$$

REF. 3

p.17/21

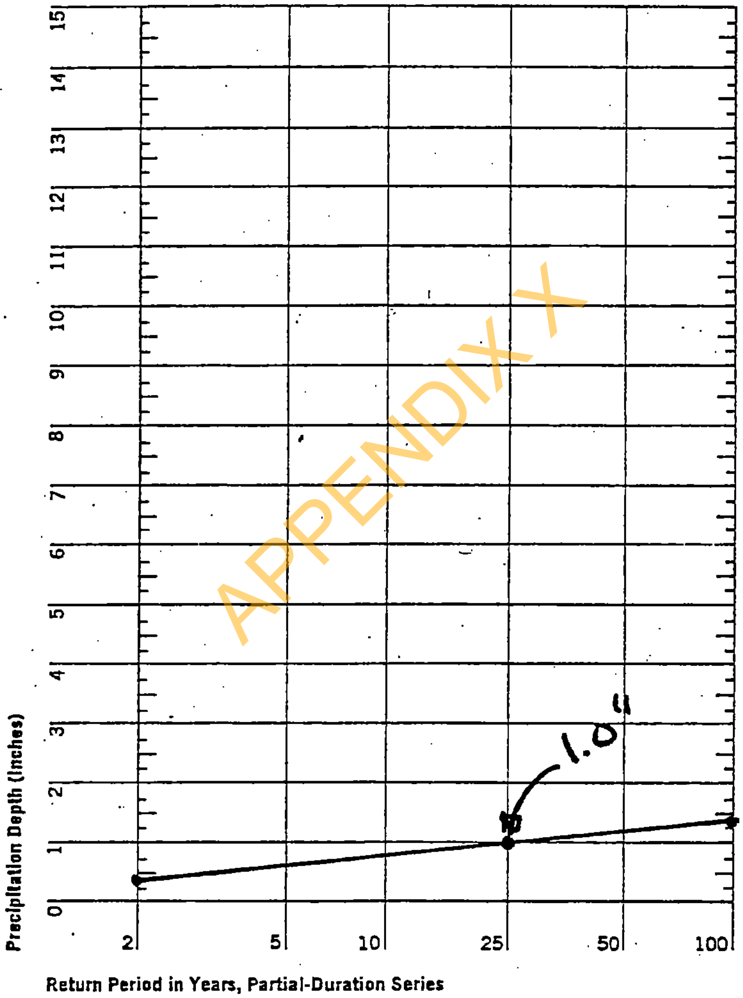


Figure 6. *Precipitation depth versus return period for partial-duration series.*

REF. 3

p. 18/21

Table 1.—Five, 10-, 15- and 30-minute ratios for 2- and 100-year return periods

Region No.	Region	Ratios to 1 Hour 2-Year Return Period 5 minutes	10	15	30	100-Year Return Period 5 minutes	10	15	30
1	Coastal Northwest	.30	.45	.56	.73	.36	.53	.64	.82
2	Interior Northwest	.35	.53	.64	.81	.37	.56	.67	.85
3	Rocky Mountains-North	.38	.57	.68	.84	.35	.55	.67	.84
4	Front Face and High Plains-North	.39	.58	.69	.85	.37	.56	.69	.87
5	Great Basin	.34	.51	.61	.81	.34	.52	.63	.84
6	Rocky Mountains-South	.35	.54	.65	.83	.32	.50	.62	.81
7	Front Face and High Plains-South	.33	.51	.62	.83	.29	.46	.59	.81
8	Southwest Deserts	.34	.51	.62	.82	.30	.46	.59	.80

The final consideration was comparability to information for locations adjacent to the study area. Taking such information into account accomplished two goals. First, it contributed to the degree of consistency and continuity between this study and other reports. Second, it provided additional insight into the variation of the ratios in this report, providing anchors, so to speak, at the study area boundaries. For areas east of the study region, we compared our results to Frederick et al. (1977) and for California we related our results to Frederick and Miller (1979). In addition, we developed frequency estimates for several stations with short-duration data in surrounding states. Fourteen stations were analyzed for this purpose, 10 in the Plains States and 4 in California. Most of these stations were close enough to be directly comparable to adjacent stations within the study area, while a few were chosen at greater distances from the boundaries to provide some idea of the trend in ratios leading up to the study area.

It was concluded that the ratios in this report were consistent with previous studies. The final ratios are listed in Table 1. A comparison between these ratios and those from NOAA Atlas 2 and Weather Bureau (1953, 1954) is shown in Table 2.

Table 2.—Ratios compared to other reports

Dur. (min)	This Report*	Ratio to 1 Hour NOAA Atlas 2	Weather Bur. (1953, 1954)*
5	.34	.29	.32
10	.52	.45	.49
15	.64	.57	.59
30	.82	.79	.78

*Averaged over all regions and for all return periods

Note: Comparisons are for illustrative purposes only. Each report covers a different geographic area, and averaging is done without regard to size of region or specific return periods involved.

Table 3.—Applicable elevations within regions

Region No.	Generally Applicable elevations (ft)
1	0-2500
2	50-3000 Columbia Basin to 2500-5500 SE
3	2000-5000 N to 4000-7000 S
4	2000-5000 N to 4000-7000 S
5	3500-7000
6	4500-8000 N to 3500-7000 S
7	4000-7500 N to 3500-7000 S
8	3000-6500 mountains to 100-3500 deserts

6. APPLICATION OF RATIOS

The ratios derived in the above analysis are based on stations whose elevations tended to be in the lower sections of each region. To extrapolate these statistics to much higher elevations would be a questionable undertaking, because of the complex effects of slope, funneling, and rain shadows that often occur in these areas. As such, the ratios are not applicable to all elevations within each region, but rather to a general range of elevations. The ranges of applicable elevation, approximately 3,000 to 3,500 ft in most areas, are summarized in table 3. In a few cases, areas are excluded that contain stations included in the analysis. The regional ratios were reviewed in light of this fact, and it was determined that no adjustments were necessary.

Areas of non-applicability, based on elevation and location considerations, are shown in figure 1 as shaded areas. These areas are based primarily on smoothed contour maps of the western states. Due to the generalized nature of the contours, there are isolated sections, primarily at the edge of shaded areas, where the ratios might be applicable. Conversely, there are isolated peaks and high elevations which are not shown as part of any shaded areas, but which may, in fact, be non-applicable areas.

Job No. ____ No. ____

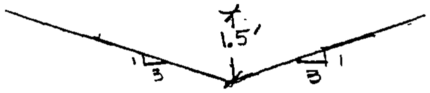
HDR Computation

oject Bayview Landfill	Computed	Date 5/03
Subject	Checked	Date
Task	Sheet 19	Of 21

$Q = CiA$
$= .33(1.21\ ^{in}/hr)(18.4\ acres)$
$= 7.37\ ft^3/sec$ (flow in drainage ditch)

This flow is only the portion of the flow that runs off of Cell 1 and 2 that travels in the Northern direction of the ditch. There will be run-off from Cells 1 and 2 that travels in the Southern direction of the ditch, but that flow has not been computed. The flow computed for the Northward direction is a conservative value for the flow heading southward since the south portion has less contributing area than the north portion. There will be less flow in the south portion, so the ditch designed for the flow in the north portion will be acceptable for both directions.

Drainage Ditch Capacity



$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

Q = peak discharge
A = Area
R = Hydraulic radius $(\frac{A}{P})$
n = Manning roughness coefficient
S = minimum slope

$A = \frac{1}{2}(1.5')(4.5') + \frac{1}{2}(1.5')(4.5') = 6.75\ ft^2$
$P = \sqrt{22.5} + \sqrt{22.5} = 9.49\ ft$
$R = 6.75\ ft^2 / 9.49\ ft = .7115\ ft$

Job No.
No.

HDR Computation

Project Bayview Landfill
Computed
Date 5/03
Subject
Checked
Date
Task
Sheet 20
Of 27

Drainage Ditch Capacity (continued)

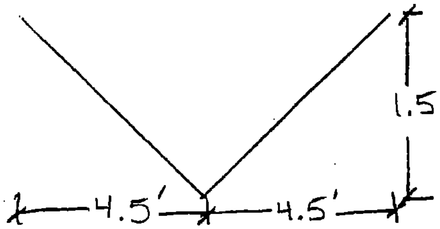
$S = 0.005$
$n = 0.025$ (for straight and uniform Earth that is clean and weathered)

$$Q = \frac{1.49}{0.025}(6.75\,ft^2)(.7115\,ft)^{2/3}(.005)^{1/2}$$

$$\underline{Q = 22.67\ cfs}$$

Since the capacity of the ditch is greater than the amount of flow that will be running off of Cell 1 and Cell 2, than this ditch configuration is adequate.

Drainage Ditch Configuration



*not drawn to scale

REF. 4 pg. 21/21

TABLE 5-6. VALUES OF THE ROUGHNESS COEFFICIENT *n* (*continued*)

Type of channel and description	Minimum	Normal	Maximum
C. EXCAVATED OR DREDGED			
a. Earth, straight and uniform			
1. Clean, recently completed	0.016	0.018	0.020
2. Clean, after weathering	0.018	0.022	0.025
3. Gravel, uniform section, clean	0.022	0.025	0.030
4. With short grass, few weeds	0.022	0.027	0.033
b. Earth, winding and sluggish			
1. No vegetation	0.023	0.025	0.030
2. Grass, some weeds	0.025	0.030	0.033
3. Dense weeds or aquatic plants in deep channels	0.030	0.035	0.040
4. Earth bottom and rubble sides	0.028	0.030	0.035
5. Stony bottom and weedy banks	0.025	0.035	0.040
6. Cobble bottom and clean sides	0.030	0.040	0.050
c. Dragline-excavated or dredged			
1. No vegetation	0.025	0.028	0.033
2. Light brush on banks	0.035	0.050	0.060
d. Rock cuts			
1. Smooth and uniform	0.025	0.035	0.040
2. Jagged and irregular	0.035	0.040	0.050
e. Channels not maintained, weeds and brush uncut			
1. Dense weeds, high as flow depth	0.050	0.080	0.120
2. Clean bottom, brush on sides	0.040	0.050	0.080
3. Same, highest stage of flow	0.045	0.070	0.110
4. Dense brush, high stage	0.080	0.100	0.140

APPENDIX M

ATTACHMENT 2:

REQUIRED CAPACITY FOR SURFACE WATER DIVERSION DITCH

HDR | **ONE COMPANY** *Many Solutions* ℠

Project:	Bayview Landfill	Computed:	RLR	Date:	1/9/2009
Subject:	Run-off calculations	Checked:		Date:	
Task:	Determine Flow Rates using Rational Method				
Job #:					

DA-1: Cell 2 - Diversion Ditch around Stage 1 (Final Contours)

Rational Equation Parameters

Drainage Area (A) = 12.61 ac

Time of Concentration

$$t_c = \sum_{i=1}^{k} T_{ti} = \sum_{i=1}^{k} \left(\frac{L_i}{60V_i} \right)$$

Eq. 7.11 from UDOT Manual: Roadway Drainage, Hydrology (See Attached)

$$V = kS^{0.5}$$

Eq. 7.12 from UDOT Manual: Roadway Drainage, Hydrology (See Attached)

where:

tc= Time of concentration (min)

L= Length of segment (ft)

k= Intercept coefficient from Table 7-10 from UDOT Manual: Roadway Drainage, Hydrology (See Attached)

V= Velocity (ft/s)

S= Slope (%)

Segment 1:

L= 395 ft

S= 9.5%

k= 1.61 (Assume shallow, concentrated flow)

V= 5.0 ft/s

Therefore, tc= 1.33 min

Segment 2:

L= 1770 ft

S= 3.3%

k= 1.61 (Assume shallow, concentrated flow)

V= 2.9 ft/s

Therefore, tc= 10.09 min

Total tc= 11.41 min

Rainfall intensity (i) for 25-year storm

For tc= 11.41 min

i_{25}= 3.00 in/hr (From IDF curves from NOAA Atlas 14 (See attached))

Rainfall Runoff Coefficient

C= 0.30 (C value for unimproved area from Table 7-24 from UDOT Manual of Instruction (See attached))

Frequency Factor for Rational Formula

C_f= 1.1 (Frequency Factor for 25-year recurrence internval, from Table 7-21 from UDOT Manual of Instruction)

Discharge Calculation

$Q=C*C_f*I*A$

$$\boxed{Q_{25}= \quad 12 \quad \text{cfs}}$$

HDR | ONE COMPANY *Many Solutions* ℠

Project:	Bayview Landfill	Computed:	RLR	Date:	1/9/2009
Subject:	Run-off calculations	Checked:		Date:	
Task:	Determine Flow Rates using Rational Method				
Job #:					

DA-2: Cell 2 - Diversion Ditch around Stage 2 (Final Contours)

Rational Equation Parameters

Drainage Area (A) = 20.96 ac

Time of Concentration

$$t_c = \sum_{i=1}^{k} T_{ti} = \sum_{i=1}^{k} \left(\frac{L_i}{60V_i} \right)$$

Eq. 7.11 from UDOT Manual: Roadway Drainage, Hydrology (See Attached)

$$V = kS^{0.5}$$

Eq. 7.12 from UDOT Manual: Roadway Drainage, Hydrology (See Attached)

where:
tc= Time of concentration (min)
V= Velocity (ft/s)
L= Length of segment (ft)
S= Slope (%)
k= Intercept coefficient from Table 7-10 from UDOT Manual: Roadway Drainage, Hydrology (See Attached)

Segment 1:
L= 400 ft
S= 9.5%
k= 1.61 (Assume shallow, concentrated flow)
V= 5.0 ft/s
Therefore, tc= 1.34 min

Segment 2:
L= 2275 ft
S= 2.3%
k= 1.61 (Assume shallow, concentrated flow)
V= 2.4 ft/s
Therefore, tc= 15.53 min

Total tc= 16.87 min

Rainfall intensity (i) for 25-year storm

For tc= 16.87 min
i_{25}= 2.50 in/hr (From IDF curves from NOAA Atlas 14 (See attached))

Rainfall Runoff Coefficient

C= 0.30 (C value for unimproved area from Table 7-24 from UDOT Manual of Instruction (See attached))

Frequency Factor for Rational Formula

C_f= 1.1 (Frequency Factor for 25-year recurrence internval, from Table 7-21 from UDOT Manual of Instruction (See attached))

Discharge Calculation

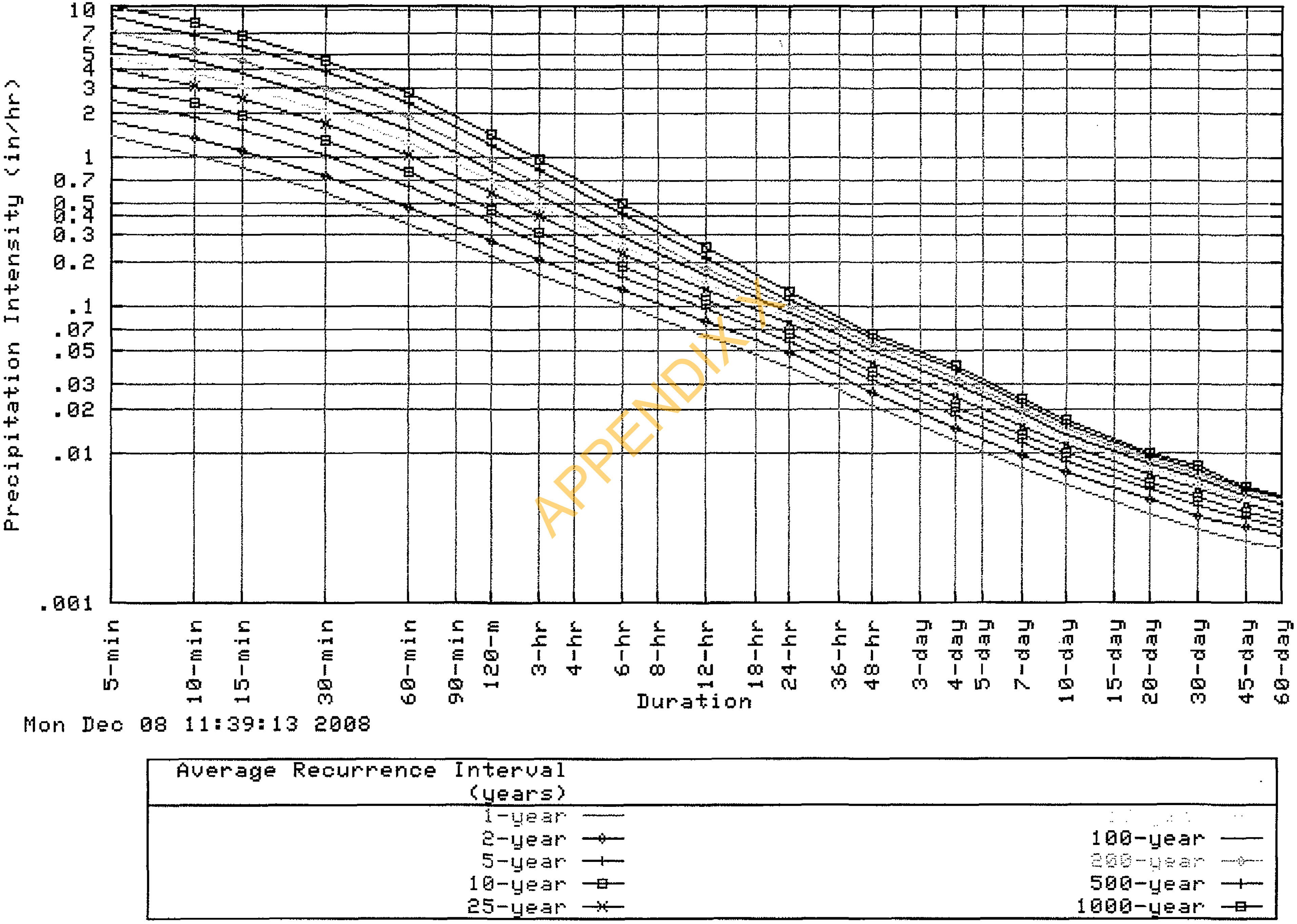
$Q=C*C_f*I*A$

Q_{25}= 17 cfs

Partial duration based Point IDF Curves - Version: 4

40.036799 N 111.968129 W 4688 ft

Source: NOAA Atlas 14



In Equation 7.9, i depends on t_c and t_c is not initially known. Therefore, the computation of t_c is an iterative process. An initial estimate of t_c is assumed and used to obtain i from the intensity-duration-frequency curve for the locality. The t_c is computed from Equation 7.9 and used to check the initial value of i. If they are not the same, then the process is repeated until two successive t_c estimates are the same.

7.18.4.2 Velocity Method

The velocity method can be used to estimate travel times for sheet flow, shallow concentrated flow, pipe flow or channel flow. It is based on the concept that the travel time (T_t) for a flow segment is a function of the length of flow (L) and the velocity (V):

$$T_t = \frac{L}{60V} \tag{7.10}$$

in which T_t, L and V have units of minutes, meters and meters/second, respectively. The travel time is computed for the principal flow path. Where the principal flow path consists of segments that have different slopes or land covers, the principal flow path should be divided into segments and Equation 7.10 used for each flow segment. The time of concentration is then the sum of travel times:

$$t_c = \sum_{i=1}^{k} T_{ti} = \sum_{i=1}^{k} \left(\frac{L_i}{60V_i} \right) \tag{7.11}$$

in which k is the number of segments and the subscript i refers to the flow segment.

The velocity of Equation 7.10 is a function of the type of flow (overland, sheet, rill and gully flow, channel flow, pipe flow), the roughness of the flow path, and the slope of the flow path. Some methods also include a rainfall index such as the 2-yr, 24-hour rainfall depth. A number of methods have been developed for estimating the velocity.

After short distances, sheet flow tends to concentrate in rills and then gullies of increasing proportions. Such flow is usually referred to as shallow concentrated flow. The velocity of such flow can be estimated using an empirical relationship between the velocity and the slope:

$$V = kS^{0.5} \tag{7.12}$$

in which V is the velocity (ft/s) and S is the slope (%). The value of k is a function of the land cover, with values for selected land covers given in Table 7-10.

7.18.4.3 Open Channels

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs or where blue lines (indicating streams) appear on USGS quadrangle sheets. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bankfull condition.

TABLE 7-10 Intercept Coefficients for Velocity vs. Slope Relationship of Equation 7.12

K	Land Cover/Flow Regime
0.25	Forest with heavy ground litter; hay meadow (overland flow)
0.5	Trash fallow or minimum tillage cultivation; contour or strip cropped; woodland (overland flow)
0.7	Short grass pasture (overland flow)
0.9	Cultivated straight row (overland flow)
1.0	Nearly bare and untilled (overland flow); alluvial fans in western mountain regions
1.5	Grassed waterway (shallow concentrated flow)
1.61	Unpaved (shallow concentrated flow)
2.0	Paved area (shallow concentrated flow); small upland gullies

Manning's equation is:

$$V = \frac{1.49\, R^{2/3}\, S^{1/2}}{n} \tag{7.13}$$

where:
V = average velocity, ft/s
R = hydraulic radius, ft (equal to A/WP)
A = cross sectional flow area, ft^2
WP = wetted perimeter, ft
S = slope of the hydraulic grade line, ft/ft
n = Manning's roughness coefficient

After average velocity is computed using Equation 7.13, T_t for the channel segment can be estimated using Equation 7.10.

7.18.4.4 Reservoir or Lake

Sometimes, it is necessary to compute a T_c for a watershed having a relatively large body of water in the flow path. In such cases, T_c is computed to the upstream end of the lake or reservoir and, for the body of water, the travel time is computed using the Equation:

$$V_w = (gD_m)^{0.5} \tag{7.14}$$

where:
V_w = the wave velocity across the water, ft/s
g = 32.2 ft/s^2
D_m = mean depth of lake or reservoir, ft

Generally, V_w will be high (8 to 30 ft/s).

One must not overlook the fact that Equation 7.14 only provides for estimating travel time across the lake and for the inflow hydrograph to the lake's outlet. It does not account for the

C = runoff coefficient representing a ratio of runoff to rainfall

I = average rainfall intensity for a duration equal to the time of concentration for a selected return period, in/h

A = drainage area tributary to the design location, ha

7.23.5 Infrequent Storm

The coefficients given in Tables 7-23 through 7-25 are applicable for storms of 5-yr to 10-yr frequencies. Less frequent, higher intensity storms will require modification of the coefficient because infiltration and other losses have a proportionally smaller effect on runoff Reference *(19)*. The adjustment of the Rational method for use with major storms can be made by multiplying the right side of the Rational formula by a frequency factor C_f. The Rational formula now becomes:

$$Q = CC_fIA \qquad (7.16)$$

C_f values are listed in Table 7-21.

TABLE 7-21 — Frequency Factors for Rational Formula

Recurrence Interval (years)	C_f
→ 25	1.1
50	1.2
100	1.25

The product of C_f times C shall not exceed 1.0.

TABLE 7-22 — Hydrologic Soils Groups For

Example for Orange County, North Carolina

Series Name	Hydrologic Groups	Series Name	Hydrologic Groups
Altavista	C	Herndon	B
Appling	B	Hiwassee	B
Cecil	B	Iredell	D
Chewacla	C	Lignum	C

TABLE 7-23 — Recommended Coefficient of Runoff for Pervious Surfaces (By Selected Hydrologic Soil Groupings and Slope Ranges)

Slope	A	B	C	D
Flat (0% – 1%)	0.04 – 0.09	0.07 – 0.12	0.11 – 0.16	0.15 – 0.20
Average (2% – 6%)	0.09 – 0.14	0.12 – 0.17	0.16 – 0.21	0.20 – 0.25
Steep (Over 6%)	0.13 – 0.18	0.18 – 0.24	0.23 – 0.31	0.28 – 0.38

Source: (Example from *Storm Drainage Design Manual*, Erie and Niagara Counties Regional Planning Board)

TABLE 7-24 — Recommended Coefficient of Runoff Values (For Various Selected Land Uses)

Description of Area	Runoff Coefficients
Business: Downtown areas	0.70 – 0.95
Neighborhood areas	0.50 – 0.70
Residential: Single-family areas	0.30 – 0.50
Multi units, detached	0.40 – 0.60
Multi units, attached	0.60 – 0.75
Suburban	0.25 – 0.40
Residential (0.5 ha lots or more)	0.30 – 0.45
Apartment dwelling areas	0.50 – 0.70
Industrial: Light areas	0.50 – 0.80
Heavy areas	0.60 – 0.90
Parks, cemeteries	0.10 – 0.25
Playgrounds	0.20 – 0.40
Railroad yard areas	0.20 – 0.40
Unimproved areas	0.10 – 0.30

Source: Reference *(3)*.

TABLE 7-25 — Coefficients for Composite Runoff Analysis

Surface	Runoff Coefficients
Streets: Asphalt	0.70 – 0.95
Concrete	0.80 – 0.95
Drives and walks	0.75 – 0.85
Roofs	0.75 – 0.95

Source: Reference *(3)*.

7.23.6 Procedures

The results of using the Rational formula to estimate peak discharges are very sensitive to the parameters used, especially time of concentration and runoff coefficient. The designer must use good engineering judgment in estimating values that are used in the method. Following is a discussion of the different variables used in the Rational method.

7.23.6.1 Time of Concentration

The time of concentration is the time required for water to flow from the hydraulically most remote point of the drainage area to the point under investigation. Use of the Rational formula requires the time of concentration (t_c) for each design point within the drainage basin. The duration of rainfall is then set equal to the time of concentration and is used to estimate the design average rainfall intensity (I). For a specific drainage basin, the time of concentration consists of an inlet time plus the time of flow in a closed conduit or open channel to the design point. Inlet time is the time required for runoff to flow over the surface to the nearest inlet and is primarily a function of the length of overland flow, the slope of the drainage basin and surface cover. Pipe or open channel flow time can be estimated from the hydraulic properties of the conduit or channel.

To obtain the total time of concentration, the pipe or open channel flow time must be calculated and added to the inlet time. After first determining the average flow velocity in the pipe or channel, the travel time is obtained by dividing velocity into the pipe or channel length.

Worksheet for Diversion Ditch around Cell 2

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.027	
Channel Slope	0.00500	ft/ft
Normal Depth	1.00	ft
Left Side Slope	50.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)

Results

Discharge	66.08	cfs
Flow Area	27.00	ft^2
Wetted Perimeter	54.13	ft
Top Width	54.00	ft
Critical Depth	0.82	ft
Critical Slope	0.01434	ft/ft
Velocity	2.45	ft/s
Velocity Head	0.09	ft
Specific Energy	1.09	ft
Froude Number	0.61	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.82	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.01434	ft/ft

Cross Section for Diversion Ditch around Cell 2

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.027	
Channel Slope	0.00500	ft/ft
Normal Depth	1.00	ft
Left Side Slope	50.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Discharge	66.08	cfs

Cross Section Image

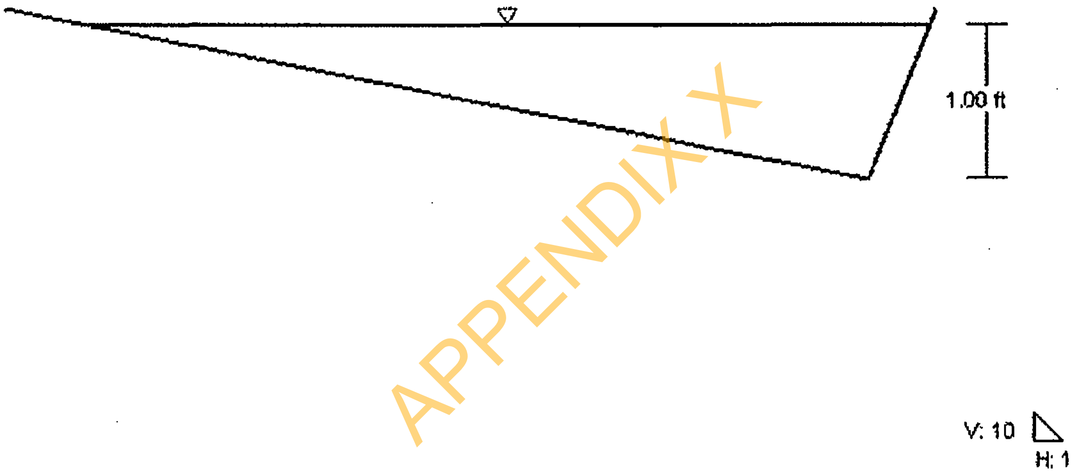
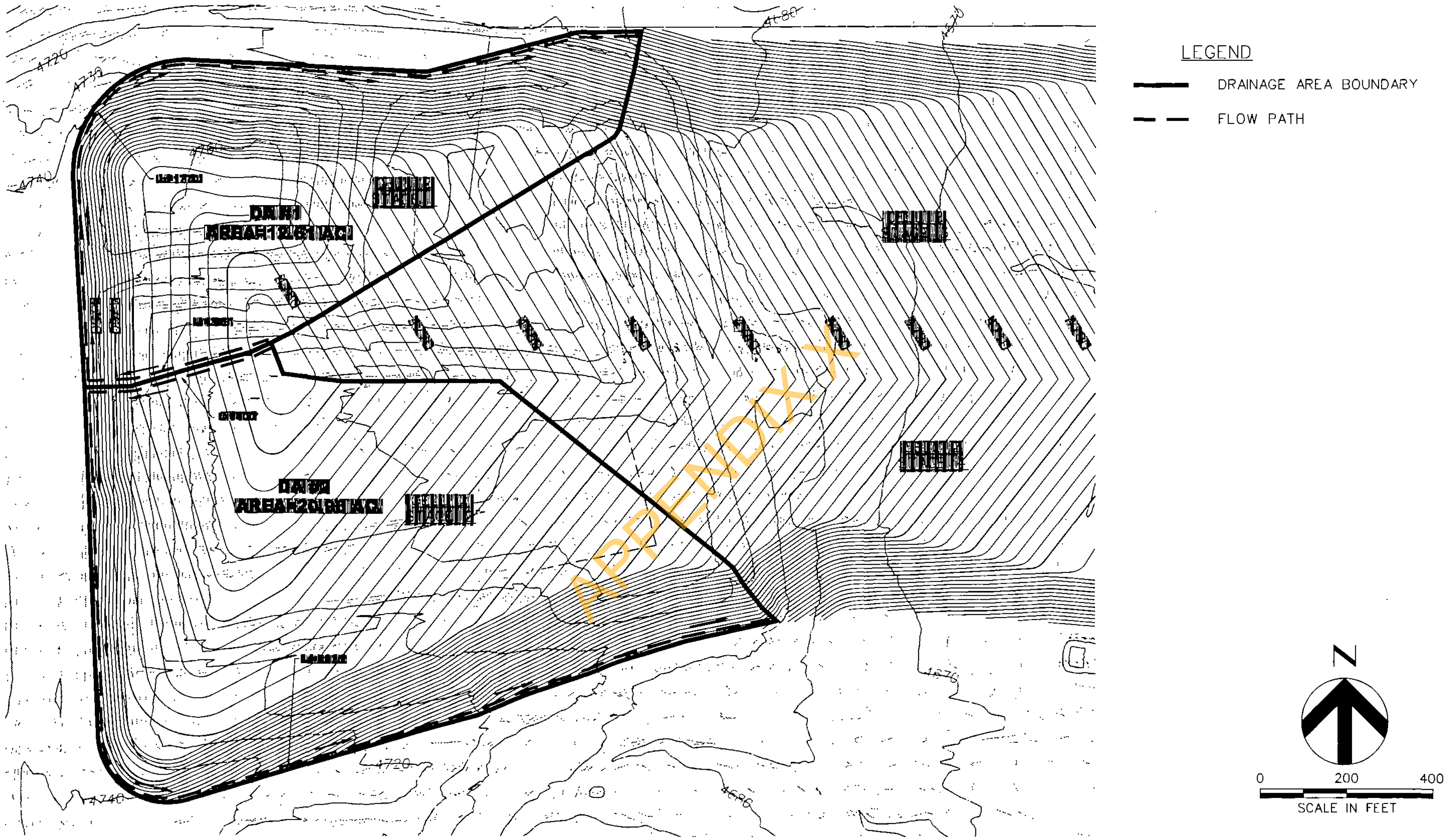


TABLE 8-2 — Values of Manning's Roughness Coefficient n (Uniform Flow)

Type of Channel and Description	Minimum	Normal	Maximum
EXCAVATED OR DREDGED			
1. Earth, straight and uniform			
a. Clean, recently completed	0.016	0.018	0.020
b. Clean, after weathering	0.018	0.022	0.025
c. Gravel, uniform section, clean	0.022	0.025	0.030
→ d. With short grass, few weeds	0.022	0.027	0.033
2. Earth, winding and sluggish			
a. No vegetation	0.023	0.025	0.030
b. Grass, some weeds	0.025	0.030	0.033
c. Dense weeds or aquatic plans in deep channels	0.030	0.035	0.040
d. Earth bottom and rubble sides	0.025	0.030	0.035
e. Stony bottom and weedy sides	0.025	0.035	0.045
f. Cobble bottom and clean sides	0.030	0.040	0.050
3. Dragline-excavated or dredged			
a. No vegetation	0.025	0.028	0.033
b. Light brush on banks	0.035	0.050	0.060
4. Rock cuts			
a. Smooth and uniform	0.025	0.035	0.040
b. Jagged and irregular	0.035	0.040	0.050
5. Channels not maintained, weeds and brush uncut			
a. Dense weeds, high as flow depth	0.050	0.080	0.120
b. Clean bottom, brush on sides	0.040	0.050	0.080
c. Same, highest stage of flow	0.045	0.070	0.110
d. Dense brush, high stage	0.080	0.100	0.140
NATURAL STREAMS			
1. Minor streams (top width at flood stage < 30 m)			
a. Streams on Plain			
1) Clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
2) Same as above, but more stones/weeds	0.030	0.035	0.040
3) Clean, winding, some pools/shoals	0.033	0.040	0.045
4) Same as above, but some weeds/stones	0.035	0.045	0.050
5) Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
6) Same as 4, but more stones	0.045	0.050	0.060
7) Sluggish reaches, weedy, deep pools	0.050	0.070	0.080
8) Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.075	0.100	0.150
b. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages			
1) Bottom: gravels, cobbles and few boulders	0.030	0.040	0.050
2) Bottom: cobbles with large boulders	0.040	0.050	0.070



HDR

SOUTH UTAH VALLEY
SOLID WASTE DISTRICT
CELL 2 FINAL CONTOURS DRAINAGE MAP

DATE
1-9-09

FIGURE
M-1

Appendix N

APPENDIX N

Closure Cap Equivalency

SUVSWD Bayview Class I Landfill
Permit Application

METEORIC WATER INFILTRATION STUDY
SOUTH UTAH VALLEY LANDFILL
(BAYVIEW LANDFILL)
UTAH COUNTY, UTAH

For: HDR

HDR Engineering, Inc.

September 9, 2003

A Report Prepared For:

Mr. Dick Sprague
HDR Engineering, Inc.
303 East 17th Avenue, Suite 300
Denver, CO 80203-1256

METEORIC WATER INFILTRATION STUDY
SOUTH UTAH VALLEY LANDFILL
(BAYVIEW LANDFILL)
UTAH COUNTY, UTAH

File No.: 26515.001

Prepared By:

RDZ for

Brian J. Peck, R.G.
Hydrogeologist

Renee Zollinger, P.G.
Senior Geologist

KLEINFELDER, INC.
849 West LeVoy Drive, Suite 200
Taylorsville, UT 84123
(801) 261-3336

September 9, 2003

TABLE OF CONTENTS

SECTION **PAGE**

TABLES

FIGURES

APPENDICES

1. INTRODUCTION

Bayview Landfill, also called the South Utah Valley Landfill, is located approximately 5 miles north of Elberta, Utah, along State Road 68 (Figure 1). This landfill is a Class I municipal solid waste landfill and began accepting solid waste in 1990. Cell 1 is scheduled for closure during the next year, and the South Utah Valley Solid Waste District wishes to consider modifying their permit to include closure with an evaporative cap. Recent studies have shown that appropriate evaporative caps out-perform standard clay caps in arid environments because they are less prone to desiccation, cracking, and frost damage when compared to traditional thin clay caps. South Utah Valley Solid Waste District would like to take advantage of long-term benefits offered by this type of alternative cap.

The following report describes our assessment of expected long-term meteoric water infiltration or seepage rates through an evaporative cap at Bayview Landfill constructed from on-site soils. Infiltration is defined as precipitation minus surface run-off, evaporation and plant transpiration. The net infiltration rate multiplied by the clay cap area is the net seepage volume that may contribute to formation of leachate. Expected infiltration rates were established by using the HYDRUS-2D saturated/unsaturated flow model (Version 2.0; Simunek and van Genuchten, 1999). Infiltration rates were determined for the standard regulatory prescribed cap and for the proposed site-specific cap materials. The prescriptive cap simulation was constructed using clay and silty clay materials, expected to have the lowest permeabilities. Infiltration processes are rarely saturated, however. Unsaturated soil hydraulic properties are highly non-linear functions of the pressure head (pressure head is also termed 'matric potential' and 'capillary suction'). Soil moisture or saturation and hydraulic conductivity are both a function of pressure head. These three variables interact to control the movement of soil moisture in the vadose or unsaturated zone. To simulate the behavior of a hypothetical prescriptive cap under the climatic conditions at the Bayview Landfill, a bracketing range of unsaturated soil parameters were selected. The resulting prescriptive cap infiltration rates are then compared to the infiltration rates modeled for the actual on-site materials.

2. MODEL CODE SELECTION

The U.S. Salinity Laboratory's HYDRUS-2D unsaturated flow code was used to predict infiltration through the Bayview Landfill's proposed evaporative cap. This model is a windows based platform for running the public domain SWMS_2D finite element code published by Simunek, Vogel and van Genuchten (1992, 1994).

This model code was chosen because it incorporates the Richard's equations for groundwater flow under conditions of partial saturation and can simulate hydraulic gradients and movement based on soil moisture retention characteristics. The code is widely used in arid regions research. A key factor of concern in arid environments is the upward capillary movement of water towards the drying atmospheric interface caused by soil suction or matric potential under changing conditions of surface soil moisture resulting from infrequent light precipitation events and the intervening relatively long duration desiccation periods. The EPA HELP3 model code developed for evaluation of infiltration into and leakage from landfills (Schroeder et al, 1994) only accounts for gravity drainage of rainfall and is therefore more appropriate for sites in the eastern U.S. where rainfall rates are much higher. In arid climates the HELP model tends to overestimate infiltration rates because it does not account for upward movement of soil moisture toward the land surface during drying intervals (Albright, 1997; Hart and Lassetter, 1999).

The HYDRUS-2D model reacts to heavy precipitation events by limiting surface infiltration to the maximum infiltration capacity of soil based on the unsaturated flow equations; precipitation amounts greater than this maximum rate are assumed to form runoff. The primary water budget processes that determine net infiltration rates occur in near surface materials that are transected by the evapotranspiration zone; the type and thickness of strata below the evapotranspiration depth do not significantly influence percolation rates if they are more transmissive than the near surface materials. The HELP model requires that the evapotranspiration depth be specified *a priori*. The HYDRUS-2D model handles evaporation by using maximum *potential* evaporation at the soil surface. The evaporation depth is implicitly computed by HYDRUS-2D during runtime according to the unsaturated flow equation. The user specifies the potential maximum evaporation rate and the simulation code computes movement of water based on saturated and/or unsaturated hydraulic gradients that depend on antecedent moisture conditions.

3. CLIMATIC CONDITIONS

The HYDRUS-2D model requires specification of daily rainfall and potential evaporation to simulate net infiltration. To obtain worst-case infiltration results, plant cover was excluded from all models prepared for this report, so potential transpiration was not quantified. It is assumed that the addition of plants will reduce infiltration approximately equally for each cap modeled. Potential evaporation at the Bayview Landfill site is a function of wind speed, relative humidity, temperature, precipitation, and insolation (solar energy). Daily precipitation and potential evapotranspiration values were obtained for the Elberta, Utah, weather station site from the Utah Climate Center, University of Utah.

The Utah Climate Center database precipitation values for the Elberta station have an annual average of 10.54 inches for the period of record (1928–1990). Monthly average precipitation amounts for Elberta are shown in Table 1.

For modeling a worst case scenario, the DSHW suggested running the five wettest years on record in sequence. The five wettest years in Elberta were 1983, 1982, 1941, 1967, and 1946, with precipitation rates of 19.34, 17.42, 14.28, 14.04, and 13.84 inches for these years, respectively. Monthly values for each of these years are shown in Table 1.

4. SOIL HYDRAULIC PROPERTIES

Partial saturation or unsaturated flow hydraulic properties include the effective porosity, the saturated and residual water capacity, the saturated hydraulic conductivity, and the matric potential versus water content curve that is summarized by the van Genuchten soil moisture retention parameters. Effective porosity is the maximum amount of water that fully saturated soil can store. Matric potential is the physical property of a porous medium to attract water as a result of capillary and adsorption processes. The residual capacity of a soil is the virtually irreducible amount of water in soil that has been exposed to desiccating conditions for a long period of time; it is defined as having a matric potential of −15 bar, which is a pressure of about −153 meters of water. The negative pressure is a convention for describing conditions of partial saturation; the pressure is equal to the absolute hydraulic pressure required to drive the water from a sample. The van Genuchten parameters describe the shape of the soil matric potential (capillary suction) curve as a function of volumetric soil moisture. From this is derived the hydraulic conductivity versus soil moisture curve using the equations of Mualem (1976).

4.1 PROPERTIES OF THE IN-PLACE CAP

Unsaturated hydraulic analyses were conducted on samples of potential cap materials collected from the Bayview Landfill site. Four soil samples were collected from representative locations on February 18, 2003. These samples were selected based on the range of observed soil types at the Landfill. The soil sample locations are shown on Figure 2. The samples are described as follows:

Sample ID	Location	Soil Description	General Compaction
BVLF-1	Soil berm	Red-yellow sandy silt (SM)	Uncompacted
BVLF-2	Soil stockpile	Olive-brown silty sand (SM)	Somewhat compacted by equipment during placement
BVLF-3	Soil stockpile	Olive-brown silty sand (SM)	Somewhat compacted by equipment during placement
BVLF-4	In-situ bottom of cell 2	Red-brown silty sand (SP-SM) referred to as "mud stone" or "hardpan"	In-situ compaction

The saturated hydraulic conductivity for the four samples ranges from 1.3 x 10^{-3} to 3.8 x 10^{-6} cm/sec, with the hydraulic conductivity of the olive-brown silty sand (BVL F-2 and -3) ranging from 1.3 x 10^{-5} to 3.8 x 10^{-6}. Other parameters are summarized in Table 2. The laboratory report is included in Appendix A.

4.2 PROPERTIES OF THE PRESCRIPTIVE CAP

Unsaturated flow parameters were estimated for the regulatory prescriptive cap assuming the prescriptive cap would be a clay material (see Table 3). Uncertainty regarding exactly which soil texture best approximates the low-permeability portion of the prescriptive cap material led to an approach involving three soil types which bracket the low-permeability portion of the most probable analogue. Three soil types were chosen that exhibited the lowest saturated hydraulic conductivities; these are silty clay, silty clay loam and sandy clay. The hydraulic parameters for these soils range from 5.6x10^{-6} to 3.3x10^{-5}. The low-permeability layer was then covered with a 28-inch sandy loam topsoil to protect the low permeability layer from frost damage. Site specific frost depth information is presented in Appendix B. Soil textures used for modeling are shown in Table 4.

The Solid Waste Rules also specify that the permeability of the prescriptive caps be lower than the permeability of the bottom liner. The bottom liner for Cell 1 consists of an HDPE synthetic liner placed on underlying native soil (a sandy silt to silty sand). The effective permeability of this liner system was calculated using equations developed by J.P. Giroud and R. Bonaparte, 1989. To be conservative, we assumed that the soil under the HDPE liner is a coarse sand, the liner makes good contact with the underlying soil, and that the installation quality was good to excellent (one small, circular hole per acre). We also assumed that up to 1 foot of leachate could be standing on the liner, creating a vertical head. These assumptions were input into Giroud and Bonaparte's equations, and the resulting predicted liner leakage rate is 470 gal/acre/day, or approximately 16 cm/year.

5. HYDRUS-2D MODEL DESIGN

The HYDRUS-2D finite element model was discretized in the manner of a soil column test, with one-dimensional flow from the atmospheric boundary condition at the top of the column to a free-drainage boundary at the bottom of the column. The height of the column was specified to be 215 cm using 50 rows and variable cell sizes from 0.5 to 5 cm. Row height was specified to be 0.5 cm at land surface, at the seepage face, and at each side of a soil texture interface. The uppermost boundary was specified to be an atmospheric boundary with daily time-variable records for rainfall and evaporation potential. Water leaves the model system by gravity drainage from the free drainage boundary when it is fully saturated. The amount of water draining from the drainage boundary was used to quantify the net amount of water infiltrating into the landfill waste.

The model for the prescriptive cap was designed to include a 71 cm (28 inch) thick topsoil layer at the surface, underlain by 45 cm (18 inches) of clay cap material, with the base of the model domain consisting of 94 cm (37.5 inches) of sand to simulate the landfill waste material. A summary of the materials used in the prescriptive cap simulations is shown in Table 5.

The model for the actual cap was designed to include a 5 cm (2 inch) thick topsoil layer consistent with normal surface disturbance, underlain by 81 cm (32 inches) of cap material, with the base of the model consisting of 130 cm (51 inches) of the sand/waste layer. The thickness of the evaporative cap was selected after running several models of various thicknesses to better understand the balance between promoting maximum evaporation (by using of a thinner cap to maintain moisture close to the evaporative surface) and providing sufficient storage for precipitation (by using of a thicker cap that doesn't become saturated and allow breakthrough.)

The initial soil moisture pressure, an important variable influencing short term seepage rates, was specified to be in equilibrium throughout the soil column with a –50 cm matric potential specified at the base of the model domain for all model runs. This pressure is slightly dryer than the subsequent dynamic equilibrium moisture at the base of the model. Net infiltration of rainfall at the land surface during the five wettest year sequence is more accurately quantified by having the water content at near-equilibrium levels at the base of the soil column. Model predictions of infiltration rates are sensitive to the initial soil moisture values, but the long-term dynamic equilibrium infiltration rates are not affected by antecedent soil moisture.

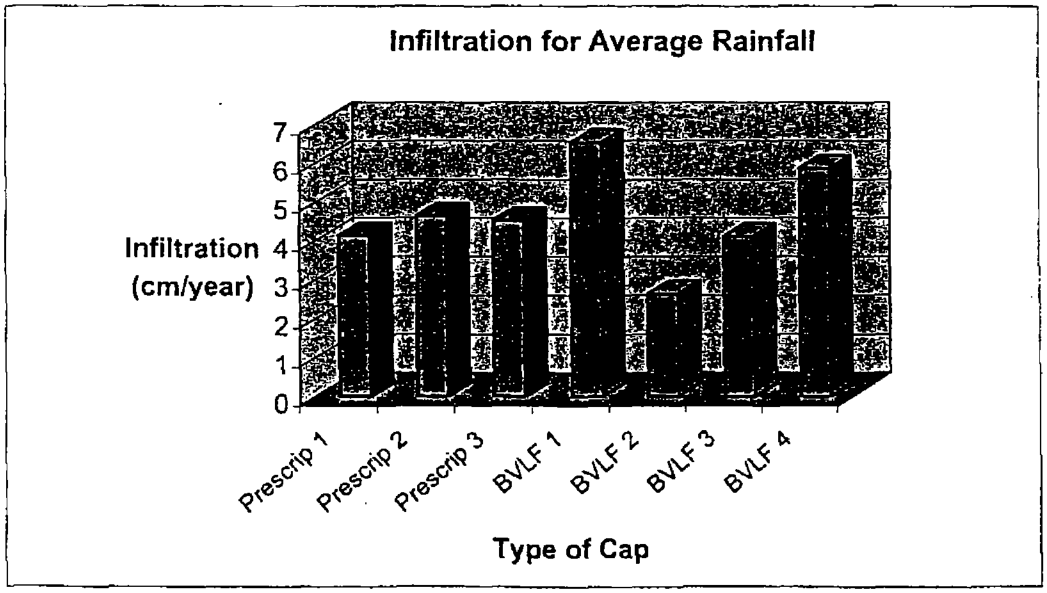
Transpiration was not included in the model due to the relatively small percentage that it constitutes relative to evaporation potential and the fact that parameters for soil moisture uptake rates for desert shrubs and grasses are poorly documented. One study reports plant transpiration as contributing three percent of the total evapotranspiration potential in Jean, Nevada, and 32 percent for good grass cover on a landfill in Elko, Nevada (Albright, 1997). Excluding plant transpiration is a conservative choice that tends to increase the predicted net infiltration rates. Similar plant growth is expected on both prescriptive and proposed evaporative caps, so making a comparison between performance of these caps should not be significantly affected by the presence or absence of vegetation.

6. HYDRUS-2D INFILTRATION SIMULATIONS

Three prescriptive cap design scenarios were evaluated based upon different soil textures for the 18-inch thick clay cap material. Four actual cap scenarios were evaluated based on measured soil properties. The models were run both for average climatic conditions, and for the five wettest years in sequence (beginning at equilibrium with the average years). Infiltration rates were calculated for both average conditions and each of the five wettest years.

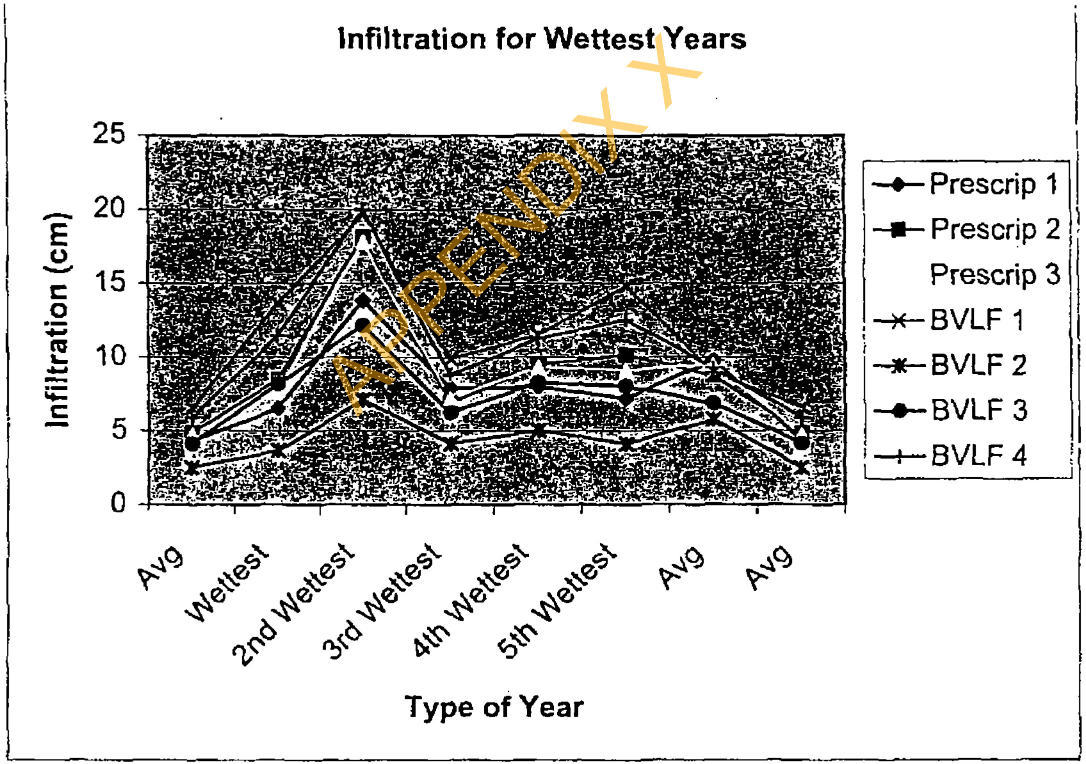
6.1 AVERAGE CLIMATIC CONDITIONS

Under average (normal) climatic conditions observed in nearby Elberta, Utah, the prescriptive caps allow an average of 4.14 to 4.65 cm of infiltration to occur each year. Under the same climatic conditions, evaporative caps constructed of the four potential soils assessed for use at Bayview Landfill allow 2.63 to 6.55 cm of infiltration to occur each year. The olive-brown silty sand material that has been stockpiled at the site (samples BVLF1 and BVLF2) is expected to allow infiltration rates of 2.63 to 4.12 cm/year. These results are shown on Table 5. A graph depicting these results is shown below.



6.2 WETTEST (WORST-CASE) CLIMATIC CONDITIONS

Under an assumed worst-case climatic condition where the five wettest years on record at Elberta, Utah were to occur sequentially, the three modeled prescriptive caps would allow infiltration at rates ranging from 6.49 to 18.12 cm/year. Under the same climatic conditions, evaporative caps constructed of the four potential soils assessed for use at Bayview Landfill allow 3.63 to 20 cm of infiltration per year. The olive-brown silty sand material that has been stockpiled at the site is associated with infiltration rates of 3.63 to 12.17 cm/year. These results are shown on Table 5. A graph depicting these results is shown below.



7. CONCLUSIONS

Based on unsaturated flow modeling, it appears that a 34-inch evaporative cap, constructed from the olive-brown silty sand material available at Bayview Landfill, will perform as well or better than the hypothetical prescriptive cap under the arid conditions that exist in the area. The proposed evaporative cap performed as well as the prescriptive cap during both the worst case "wet" years, and during normal (dry) years. Both the prescriptive cap and the proposed evaporative cap have much lower predicted infiltration rates (less than 7 cm/year) than the leakage rate of the bottom liner (16 cm/year). Therefore, both caps satisfy the requirement of the Solid Waste Rules that the cap be no more permeable than the liner.

To provide a more detailed description of the proposed capping material and provide quantitative criteria for identifying these materials in the field, Kleinfelder performed a source material investigation in May 2003 (Kleinfelder 2003). A summary of criteria that may be used to identify suitable material (materials that are represented by BVLF-2 and BVF-3) is included in Appendix C.

8. LIMITATIONS

The unsaturated groundwater model described in this report was used to predict infiltration rates based upon estimates of the regulatory prescriptive cap unsaturated hydraulic parameters and laboratory analyses of the on-site materials. The accuracy of infiltration rate estimates resulting from numerical models is entirely dependant upon the validity of the hydraulic parameters used to construct the model. The simulated infiltration rates are sensitive to the unsaturated flow parameters. These and other subsurface hydraulic parameters generally exhibit spatial heterogeneity. Therefore, simulated infiltration rates are considered to be best estimates and not precise predictions of actual field infiltration rates. No on-site hydraulic testing was performed for this project by Kleinfelder, Inc. Field tests are available which would reduce the level of uncertainty associated with estimating subsurface hydraulic properties.

This study was performed and findings obtained in substantial conformance with the engineering practice that exists within the area at the time of our investigation and includes professional opinions and judgements. We base this report on information derived from data in available literature and our knowledge of and experience in the local area. This report does not provide a warranty as to variable subsurface conditions which may exist and applies only to the specific area that was investigated. In addition, one should recognize that definition and evaluation of subsurface geologic and hydrogeologic conditions is a difficult and inexact art. Geologists and hydrogeologists must occasionally make general judgements leading to conclusions with incomplete knowledge of the geologic history, subsurface conditions and hydraulic characteristics present. No warranty, express or implied, is made.

9. REFERENCES

Albright, William, 1997, Application of the HYDRUS-2D Model to Landfill Cover Design in the State of Nevada, Water Resources Center, Desert Research Institute, Publication No. 41153, prepared for Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Solid Waste Branch, Bureau of Waste Management, January, 1997, 18 p.

Carsel, R.F., and Parrish, R.S., 1988, Developing Joint Probability Distributions of Soil-Water Retention Characteristics, Water Resources Research, 24 (5), pp. 755-769.

Daniel B. Stephens & Associates, Inc., 2003, laboratory analysis sheets for Bayview Landfill soil samples including: Predicted Water Retention Curves (Pressure Head vs. Moisture Content), Relative Hydraulic Conductivity vs. Moisture Content, Relative Hydraulic Conductivity vs. Pressure Head, Moisture Retention Data (Hanging Column/Pressure Plate/Thermocouple/Relative Humidity Box), Particle Size Characteristics, Particle Size Analyses (Dry Sieve, Wet Sieve and Hydrometer), Saturated Hydraulic Conductivity Tests, Atterburg Tests, Initial Moisture Content, Dry Bulk Density, Wet Bulk Density, Calculated Porosity, and Percent Saturation.

EPA, 1990, A Subtitle D Landfill Application Manual for the Multimedia Exposure Assessment Model (MultiMed), by Susan Sharp-Hansen, Constance Travers, Paul Hummel, AQUA TERRA Consultants, Mountain View, California, and Terry Allison, Computer Sciences Corporation, Athens Georgia, August, 1990; EPA Contract 68-03-3513, Project Monitor Gerard Laniak.

Giroud, J.P. and R. Bonaparte, 1989. "Leakage Through Liners Constructed with Geomembranes, Part 1," Geomembrane Liners, Geotextiles and Geomembranes, 8, 1:27-67.

Hart, B., and Lassetter, W., 1999, Numerical Modeling of Heap Leach, Tailings and Waste Rock Facility Cover Alternatives, In Closure, Remediation & Management of Precious Metals Heap Leach Facilities, edited by D. Kosich and G. Miller, Center for Environmental Sciences and Engineering, University of Nevada, Reno.

Kleinfelder, 2003. Source Material Investigation, South Utah Valley Landfill (Bayview Landfill), July 10, 2003. File No. 30268.001.

Mualem, Y., 1976, A new model for predicting the hydraulic conductivity of unsaturated porous media, Water Resources Research, 12(3), 513-522.

Schroeder, P.R., Dozier, T.S., Zappi, P.A., McEnroe, B.M., Sjostrom, J.W., and Peyton, R.L., 1994, The Hydrologic Evaluation of Landfill Performance (HELP) Model, Environmental Laboratory, U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS 39180-6199, with the Risk Reduction Engineering Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio, EPA/600/R-94/168b

Simunek, J.T. Vogel, T. and van Genuchten, M.T., 1992, The SWMS_2D code for simulating water flow and solute transport in two-dimensional variably saturated media, Version 1.1; Research Report No. 126, U.S. Salinity Laboratory, U.S. Department of Agriculture, Agriculture Research Station, Riverside, California.

Simunek, J.T. Vogel, T. and van Genuchten, M.T., 1994, The SWMS_2D code for simulating water flow and solute transport in two-dimensional variably saturated media, Version 1.1; Research Report No. 136, U.S. Salinity Laboratory, U.S. Department of Agriculture, Agriculture Research Station, Riverside, California.

Simunek, J.T., and van Genuchten, M.T., 1999, The HYDRUS-2D software package for simulating water flow and solute transport in two-dimensional variably saturated media, Version 2.0, U.S. Salinity Laboratory, U.S. Department of Agriculture, Agriculture Research Station, Riverside, California.

van Genuchten, M.T., 1980, A closed form equation for predicting the hydraulic conductivity of unsaturated soils, Soil Science Society of America Journal 44:892-898.

TABLE 1
Average Precipitation and Five Wettest Years on Record (inches)
Elberta, Utah

	Precipitation (inches)					
Month	**Average**	**1983**	**1982**	**1941**	**1967**	**1946**
Jan	.81	1.24	1.12	0.53	1.89	1.04
Feb	.84	2.00	0.33	1.42	0.23	0.11
Mar	.99	2.30	1.12	1.66	0.74	0.88
Apr	1.03	1.32	0.41	1.25	0.88	1.46
May	1.03	1.67	1.66	0.64	2.52	1.68
Jun	0.73	0.89	0.57	1.75	2.44	0
Jul	0.8	0.82	3.67	1.07	2.04	0.72
Aug	0.94	2.11	0.38	0.85	0.15	1.27
Sep	0.72	1.76	5.30	0.54	0.58	0
Oct	1.01	0.57	1.46	2.71	0.39	3.96
Nov	0.86	2.69	0.73	0.46	0.94	1.84
Dec	0.81	1.97	0.67	1.40	1.24	0.88
Sum:	**10.54**	**19.34**	**17.42**	**14.28**	**14.04**	**13.84**

Date from University of Utah, Utah Climate Center, Elberta Station
Period of Record (1/1/1928 to 12/31/90)
Station: Elberta, Utah

TABLE 2
Unsaturated Hydraulic Parameters for Bayview Landfill Samples

Sample Name	Sample Description	Other	Water Content		Saturated Hydraulic Conductivity	Calculated van Genuchten parameters	
			Saturation	Residual	(cm/sec)	Alpha (1/cm)	n
BVLF-1	Sandy Silt (MH)	Red yellow	0.6671	0.000	4.1 x10^{-5}	0.0051	1.35
BVLF-2	Silty Sand (SM)	Olive brown	0.4035	0.000	3.8 x10^{-6}	0.0062	1.30
BVLF-3	Silty Sand (SM)	Olive brown	0.3846	0.000	1.3 x10^{-5}	0.0071	1.27
BVLF-4	Silty Sand (SM)	Red to brown	0.5395	0.020	1.3 x10^{-3}	0.0470	1.36

Note: These values reported by Daniel B. Stephens and Associates, Inc.

TABLE 3
General Unsaturated Hydraulic Parameters from Literature

Soil Type	Water Content		Saturated Hydraulic Conductivity (cm/sec)	van Genuchten parameters	
	Saturation	Residual		Alpha (1/cm)	n
Sand	0.43	0.045	8.3 x10^{-3}	0.145	2.68
Loamy sand	0.41	0.057	4.1 x10^{-3}	0.124	2.28
Sandy loam	0.41	0.065	1.2 x10^{-3}	0.075	1.89
Sandy clay loam	0.39	0.100	3.6 x10^{-4}	0.059	1.48
Loam	0.43	0.078	2.9 x10^{-4}	0.036	1.56
Sandy clay	**0.36**	**0.070**	**3.3 x10^{-5}**	**0.027**	**1.23**
Silty loam	0.45	0.067	1.3 x10^{-4}	0.020	1.41
Clay loam	0.41	0.095	7.2 x10^{-5}	0.019	1.31
Silt	0.46	0.034	6.9 x10^{-5}	0.016	1.37
Silty Clay Loam	**0.43**	**0.089**	**1.9 x10^{-5}**	**0.010**	**1.23**
Clay	0.38	0.068	5.6 x10^{-5}	0.008	1.09
Silty Clay	**0.36**	**0.070**	**5.6 x10^{-6}**	**0.005**	**1.09**

Note: Source: Carsel and Parrish (1988)
Values are averages of hundreds of samples for each soil type.

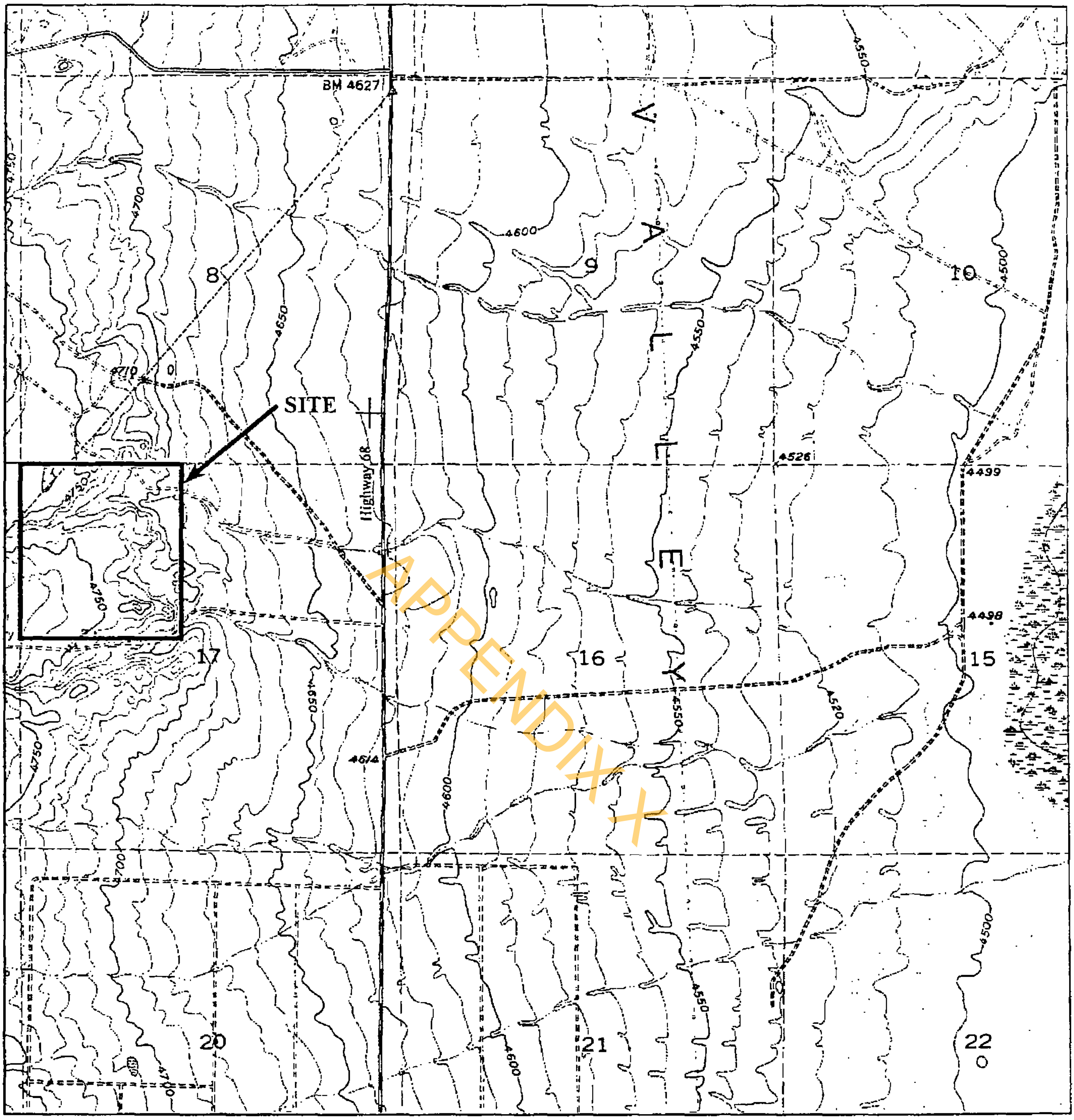
TABLE 4
Summary of Hydraulic Properties used for Prescriptive Cap Simulations

Material Description	Soil Type	Water Content		Saturated Hydraulic Conductivity (cm/sec)	van Genuchten parameters	
		Saturation	Residual		Alpha (1/cm)	n
Topsoil	Sandy loam	0.41	0.065	1.2×10^{-3}	0.075	1.89
Clay Cap(1)	Silty Clay	0.36	0.070	5.6×10^{-6}	0.005	1.09
Clay Cap(2)	Silty Clay Loam	0.43	0.089	1.9×10^{-5}	0.010	1.23
Clay Cap(3)	Sandy clay	0.36	0.070	3.3×10^{-5}	0.027	1.23
Fill material	Sand	0.43	0.045	8.3×10^{-3}	0.145	2.68

TABLE 5
Summary of Model Results

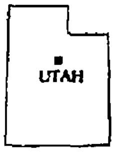
Scenario	Cap design	Annual Infiltration Rate for 5 wettest years		Average Annual Infiltration Rate for 5 normal years	
		(cm/year)	(inches/year)	(cm/year)	(inches/year)
Prescriptive Caps					
Presc-1	Sandy Loam (28") Silty Clay cap (18") Sand* (37.5")	6.49 to 13.85	2.56 to 5.45	4.14	1.63
Presc -2	Sandy Loam (28") Silty Clay Loam cap (18") Sand* (37.5")	6.84 to 18.12	2.69 to 7.13	4.65	1.83
Presc -3	Sandy Loam (28") Sandy Clay cap (18") Sand* (37.5")	7.22 to 17.78	2.84 to 7.00	4.53	1.78
Evaporative Cap					
BV-1	Sandy Loam (2") Sample T1-D (32") Sand* (51")	9.9 to 19.65	3.9 to 7.74	6.55	2.58
BV-2	Sandy Loam (2") Sample T2-Da (32") Sand* (51")	3.63 to 7.07	1.43 to 2.78	2.63	1.04
BV-3	Sandy Loam (2") Sample T2-Db (32") Sand* (51")	6.23 to 12.17	2.45 to 4.79	4.12	1.62
BV-4	Sandy Loam (2") Sample T5-D (32") Sand* (51")	8.78 to 19.99	3.46 to 7.87	5.88	2.31

* "Sand" layer simulates the porous waste materials in the landfill.



BASE MAP:
GOSHEN VALLEY NORTH, UTAH
U.S.G.S. 7.5 MINUTE QUADRANGLES
PHOTOREVISED 1975

0' 1000' 2000'
SCALE 1:24,000
1" = 2000'
CONTOUR INTERVAL 10 FEET



QUADRANGLE LOCATION

SLC3Q102.ppt

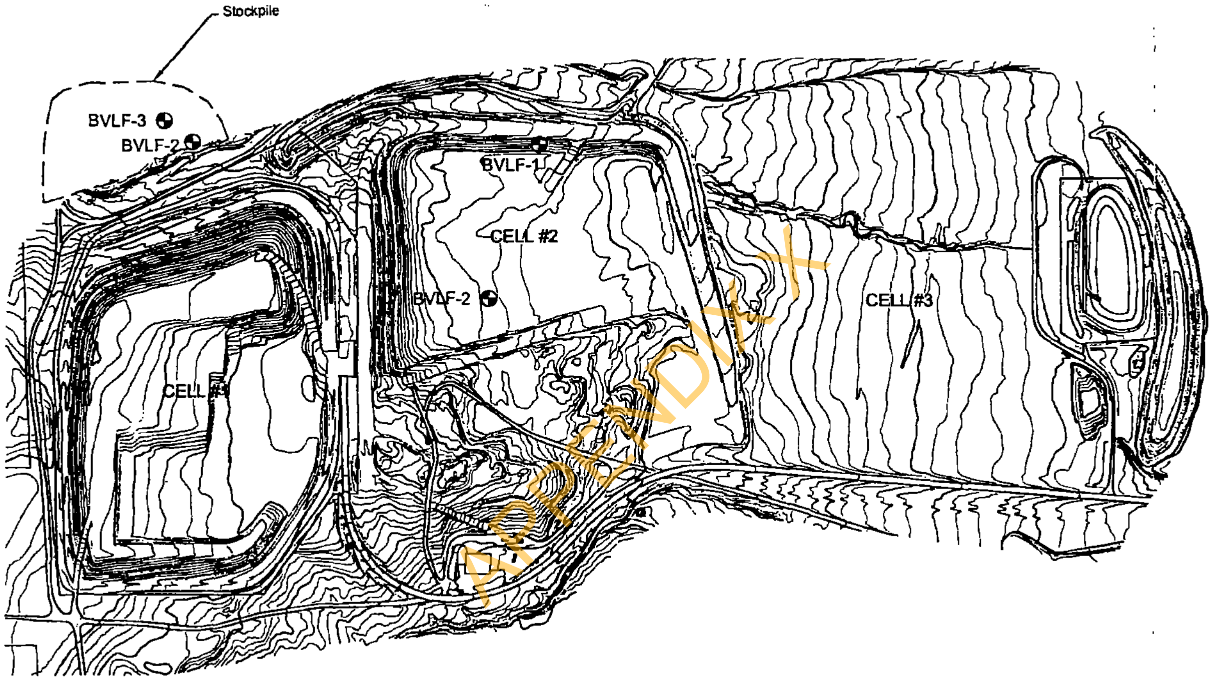
KLEINFELDER

Project Number 26515.001

South Utah Valley Landfill
Approximately 5.6 Miles North of
Elberta, Utah
on Highway 68

SITE LOCATION MAP

FIGURE
1



LEGEND

BVLF-3 ◐ Approximate Soil Sample Location

Approximate Scale: 1" = 500'

SLC3d155.dwg

KLEINFELDER

Project Number 26515.001

Bayview Meteoric Infiltration Study
Approximately 5.6 Miles North of Elberta
Elberta, Utah

SOIL SAMPLE LOCATION MAP

FIGURE

2

March 13, 2003

Ms. Renee Zollinger
Kleinfelder
2677 East Parley's Way
Salt Lake City, UT 84109-1617
(801) 466-6769

Dear Ms. Zollinger:

Enclosed is the final report for the Kleinfelder (Bayview LF) job #26515.001. Please review this report and provide any comments as samples will be held for a maximum of 30 days. After 30 days samples will be returned or disposed of in an appropriate manner.

All testing results were evaluated subjectively for consistency and reasonableness, and the results appear to be reasonably representative of the material tested. However, DBS&A does not assume any responsibility for interpretations or analyses based on the data enclosed, nor can we guarantee that these data are fully representative of the undisturbed materials at the field site. We recommend that careful evaluation of these laboratory results be made for your particular application.

We are pleased to provide this service to Kleinfelder and look forward to future laboratory testing on other projects. If you have any questions about the enclosed data, please do not hesitate to call.

Sincerely,

DANIEL B. STEPHENS & ASSOCIATES, INC.

Daniel O'Dowd
Enclosure

L:\Lab\WR03 0035 00 Kleinfelder-Bayview LF\Cover Letter.doc

Daniel B. Stephens & Associates, Inc.
6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

Summary of Tests Performed

Laboratory Sample Number	Initial Soil Properties[1] (θ, ρ_d, ϕ)	Saturated Hydraulic Conductivity[2]		Moisture Characteristics[3]					Unsaturated Hydraulic Conductivity	Particle Size[4]			Effective Porosity	Particle Density	Air Permeability	1/3, 15 Bar Points and Water Holding Capacity	Atterberg Limits	Proctor Compaction
		CH	FH	HC	PP	TH	WP	RH		DS	WS	H						
BLUF-1	X	X		X	X		X	X	X									
BLUF-2	X	X		X	X		X	X	X									
BLUF-3	X	X		X	X		X	X	X									
BLUF-4	X	X		X	X		X	X	X									

[1] θ = Initial moisture content, ρ_d = Dry bulk density, ϕ = Calculated porosity

[2] CH = Constant head, FH = falling head

[3] HC = Hanging column, PP = Pressure plate, TH = Thermocouple psychrometer, WP = Water activity meter, RH = Relative humidity box

[4] DS = Dry sieve, WS = Wet sieve, H = Hydrometer

Summary of Saturated Hydraulic Conductivity Tests

Sample Number	K_{sat} (cm/sec)	Method of Analysis Constant Head	Falling Head
BLUF-1	4.1E-05	X	
BLUF-2	3.8E-06	X	
BLUF-3	1.3E-05	X	
BLUF-4	1.3E-03	X	

Summary of Initial Moisture Content, Dry Bulk Density
Wet Bulk Density and Calculated Porosity

Sample Number	Initial Moisture Content Gravimetric (%, g/g)	Initial Moisture Content Volumetric (%, cm^3/cm^3)	Dry Bulk Density (g/cm^3)	Wet Bulk Density (g/cm^3)	Calculated Porosity (%)
BLUF-1	35.0	29.3	0.84	1.13	68.4
BLUF-2	18.6	27.2	1.46	1.74	44.7
BLUF-3	13.4	21.2	1.58	1.79	40.4
BLUF-4	17.1	21.7	1.27	1.49	52.0

Summary of Moisture Characteristics of the Initial Drainage Curve

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm^3/cm^3)
BLUF-1	0	66.9
	21	65.6
	49	63.4
	150	60.4
	510	43.4
	16623	15.3
	851293	2.5
BLUF-2	0	40.1
	21	39.6
	49	38.0
	150	37.3
	510	25.2
	7445	14.1
	851293	2.7
BLUF-3	0	38.2
	21	37.8
	49	36.3
	150	34.4
	510	24.6
	17541	11.7
	851293	2.5
BLUF-4	0	54.6
	10	48.3
	43	41.7
	80	30.8
	510	18.5
	9892	8.1
	851293	2.9

Summary of Calculated Unsaturated Hydraulic Properties

Sample Number	α (cm^{-1})	N (dimensionless)	θ_r	θ_s
BLUF-1	0.0051	1.3508	0.0000	0.6671
BLUF-2	0.0062	1.2957	0.0000	0.4035
BLUF-3	0.0071	1.2714	0.0000	0.3846
BLUF-4	0.0470	1.3613	0.0200	0.5395

APPENDIX X

Raw Laboratory Data and Graphical Plots

Summary of Initial Moisture Content, Dry Bulk Density Wet Bulk Density and Calculated Porosity

Sample Number	Initial Moisture Content Gravimetric (%, g/g)	Initial Moisture Content Volumetric (%, cm³/cm³)	Dry Bulk Density (g/cm³)	Wet Bulk Density (g/cm³)	Calculated Porosity (%)
BLUF-1	35.0	29.3	0.84	1.13	68.4
BLUF-2	18.6	27.2	1.46	1.74	44.7
BLUF-3	13.4	21.2	1.58	1.79	40.4
BLUF-4	17.1	21.7	1.27	1.49	52.0

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: Kleinfelder
Job Number: WR03.0035.00
Sample Number: BLUF-1
Ring Number: NA
Depth: NA

Test Date: 2-Feb-03

Field weight of sample* (g): 98.16
Tare weight, ring (g): 36.57
Tare weight, cap/plate/epoxy (g): 0.00

Dry weight of sample (g): 45.63
Sample volume (cm^3): 54.44
Assumed particle density: 2.65

Initial Volumetric Moisture Content (% vol): 29.3
Initial Gravimetric Moisture Content (% g/g): 35.0
Dry bulk density (g/cm^3): 0.84
Wet bulk density (g/cm^3): 1.13
Calculated Porosity (% vol): 68.4
Percent Saturation: 42.9

Comments:

* Weight including tares

Laboratory analysis by: M. Devine
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Daniel B. Stephens & Associates, Inc.

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: Kleinfelder
Job Number: WR03.0035.00
Sample Number: BLUF-2
Ring Number: NA
Depth: NA

Test Date: 2-Feb-03

Field weight of sample* (g): 122.60
Tare weight, ring (g): 34.07
Tare weight, cap/plate/epoxy (g): 0.00

Dry weight of sample (g): 74.67
Sample volume (cm^3): 50.99
Assumed particle density: 2.65

Initial Volumetric Moisture Content (% vol): 27.2
Initial Gravimetric Moisture Content (% g/g): 18.6
Dry bulk density (g/cm^3): 1.46
Wet bulk density (g/cm^3): 1.74
Calculated Porosity (% vol): 44.7
Percent Saturation: 60.8

Comments:

* Weight including tares

Laboratory analysis by: M. Devine
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: Kleinfelder
Job Number: WR03.0035.00
Sample Number: BLUF-3
Ring Number: NA
Depth: NA

Test Date: 2-Feb-03

Field weight of sample* (g): 156.11
Tare weight, ring (g): 41.93
Tare weight, cap/plate/epoxy (g): 0.00

Dry weight of sample (g): 100.70
Sample volume (cm^3): 63.72
Assumed particle density: 2.65

Initial Volumetric Moisture Content (% vol): 21.2
Initial Gravimetric Moisture Content (% g/g): 13.4
Dry bulk density (g/cm^3): 1.58
Wet bulk density (g/cm^3): 1.79
Calculated Porosity (% vol): 40.4
Percent Saturation: 52.4

Comments:

* Weight including tares

Laboratory analysis by: M. Devine
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: Kleinfelder
Job Number: WR03.0035.00
Sample Number: BLUF-4
Ring Number: NA
Depth: NA

Test Date: 2-Feb-03

Field weight of sample* (g): 128.63
Tare weight, ring (g): 39.39
Tare weight, cap/plate/epoxy (g): 0.00

Dry weight of sample (g): 76.24
Sample volume (cm^3): 59.97
Assumed particle density: 2.65

Initial Volumetric Moisture Content (% vol): 21.7
Initial Gravimetric Moisture Content (% g/g): 17.1
Dry bulk density (g/cm^3): 1.27
Wet bulk density (g/cm^3): 1.49
Calculated Porosity (% vol): 52.0
Percent Saturation: 41.7

Comments:

* Weight including tares

Laboratory analysis by: M. Devine
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Summary of Saturated Hydraulic Conductivity Tests

Sample Number	K_{sat} (cm/sec)	Method of Analysis	
		Constant Head	Falling Head
BLUF-1	4.1E-05	X	
BLUF-2	3.8E-06	X	
BLUF-3	1.3E-05	X	
BLUF-4	1.3E-03	X	

Saturated Hydraulic Conductivity
Constant Head Method

Job name: Kleinfelder
Job number: WR03.0035.00
Sample number: BLUF-1
Ring number: NA
Depth: NA

Type of water used: TAP
Collection vessel tare (g): 11.81
Sample length (cm): 2.97
Sample diameter (cm): 4.84
Sample x-sectional area (cm^2): 18.36

Date	Time	Temp (°C)	Head (cm)	Q + Tare (g)	Q (cm^3)	Elapsed time (sec)	Ksat (cm/sec)	Ksat @ 20°C (cm/sec)
Test # 1:								
26-Feb-03	12:50:43	18.5	12.8	13.6	1.8	561	4.0E-05	4.1E-05
26-Feb-03	13:00:04							
Test # 2:								
27-Feb-03	08:53:42	18.5	12.8	15.2	3.4	1089	3.9E-05	4.0E-05
27-Feb-03	09:11:51							
Test # 3:								
27-Feb-03	10:45:38	18.5	12.8	14.4	2.6	850	3.9E-05	4.0E-05
27-Feb-03	10:59:48							

Average Ksat (cm/sec): **4.1E-05**

Comments:

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Saturated Hydraulic Conductivity
Constant Head Method

Job name: Kleinfelder
Job number: WR03.0035.00
Sample number: BLUF-2
Ring number: NA
Depth: NA

Type of water used: TAP
Collection vessel tare (g): 11.81
Sample length (cm): 2.77
Sample diameter (cm): 4.84
Sample x-sectional area (cm^2): 18.42

Date	Time	Temp (°C)	Head (cm)	Q + Tare (g)	Q (cm^3)	Elapsed time (sec)	Ksat (cm/sec)	Ksat @ 20°C (cm/sec)
Test # 1:								
27-Feb-03	08:54:06	18.5	14.6	12.3	0.4	1119	4.1E-06	4.3E-06
27-Feb-03	09:12:45							
Test # 2:								
27-Feb-03	10:45:11	18.5	14.6	13.9	2.1	6055	3.6E-06	3.7E-06
27-Feb-03	12:26:06							
Test # 3:								
28-Feb-03	10:07:39	18.0	14.6	12.2	0.4	1303	3.4E-06	3.5E-06
28-Feb-03	10:29:22							

Average Ksat (cm/sec): 3.8E-06

Comments:

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Saturated Hydraulic Conductivity
Constant Head Method

Job name: Kleinfelder
Job number: WR03.0035.00
Sample number: BLUF-3
Ring number: NA
Depth: NA

Type of water used: TAP
Collection vessel tare (g): 10.71
Sample length (cm): 3.41
Sample diameter (cm): 4.88
Sample x-sectional area (cm^2): 18.67

Date	Time	Temp (°C)	Head (cm)	Q + Tare (g)	Q (cm^3)	Elapsed time (sec)	Ksat (cm/sec)	Ksat @ 20°C (cm/sec)
Test # 1:								
27-Feb-03	08:54:12	18.5	13.2	11.7	1.0	1085	1.2E-05	1.3E-05
27-Feb-03	09:12:17							
Test # 2:								
27-Feb-03	10:45:48	18.5	13.2	15.8	5.1	5873	1.2E-05	1.2E-05
27-Feb-03	12:23:41							
Test # 3:								
28-Feb-03	10:05:05	18.0	13.2	11.9	1.2	1265	1.3E-05	1.3E-05
28-Feb-03	10:26:10							

***Average Ksat* (cm/sec): 1.3E-05**

Comments:

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Saturated Hydraulic Conductivity
Constant Head Method

Job name:	Kleinfelder	*Type of water used:*	TAP
Job number:	WR03.0035.00	*Collection vessel tare* (g):	11.93
Sample number:	BLUF-4	*Sample length* (cm):	3.22
Ring number:	NA	*Sample diameter* (cm):	4.87
Depth:	NA	*Sample x-sectional area* (cm^2):	18.64

Date	Time	Temp (°C)	Head (cm)	Q + Tare (g)	Q (cm^3)	Elapsed time (sec)	Ksat (cm/sec)	Ksat @ 20°C (cm/sec)
Test # 1:								
27-Feb-03	08:54:23	18.5	6.8	59.7	47.7	939	1.3E-03	1.3E-03
27-Feb-03	09:10:02							
Test # 2:								
27-Feb-03	10:44:50	18.5	6.8	53.6	41.7	807	1.3E-03	1.3E-03
27-Feb-03	10:58:17							
Test # 3:								
28-Feb-03	10:04:07	18.0	6.8	43.0	31.1	655	1.2E-03	1.3E-03
28-Feb-03	10:15:02							

***Average Ksat* (cm/sec): 1.3E-03**

Comments:

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Summary of Moisture Characteristics of the Initial Drainage Curve

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm^3/cm^3)
BLUF-1	0	66.9
	21	65.6
	49	63.4
	150	60.4
	510	43.4
	16623	15.3
	851293	2.5
BLUF-2	0	40.1
	21	39.6
	49	38.0
	150	37.3
	510	25.2
	7445	14.1
	851293	2.7
BLUF-3	0	38.2
	21	37.8
	49	36.3
	150	34.4
	510	24.6
	17541	11.7
	851293	2.5
BLUF-4	0	54.6
	10	48.3
	43	41.7
	80	30.8
	510	18.5
	9892	8.1
	851293	2.9

Summary of Calculated Unsaturated Hydraulic Properties

Sample Number	α (cm^{-1})	N (dimensionless)	θ_r	θ_s
BLUF-1	0.0051	1.3508	0.0000	0.6671
BLUF-2	0.0062	1.2957	0.0000	0.4035
BLUF-3	0.0071	1.2714	0.0000	0.3846
BLUF-4	0.0470	1.3613	0.0200	0.5395

Moisture Retention Data

Hanging Column/Pressure Plate/Thermocouple

(Main Drainage Curve)

Job Name: Kleinfelder
Job Number: WR03.0035.00
Sample Number: BLUF-1
Ring Number: NA
Depth: NA

Dry wt. of sample (g): 45.63
Tare wt., screen & clamp (g): 25.32
Tare wt., ring (g): 36.57
Tare wt., epoxy (g): 0.00
Sample volume (cm^3): 54.44

Saturated weight at 0 cm tension* (g): 143.92
Volume of water† *in saturated sample* (cm^3): 36.40
Saturated moisture content (% vol): 66.86
Sample bulk density (g/cm^3): 0.84

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Hanging column:	28-Feb-03 / 14:00	143.92	0.00	66.86
	03-Mar-03 / 12:30	143.25	21.00	65.63
	05-Mar-03 / 15:30	142.04	49.00	63.41
	07-Mar-03 / 15:30	140.38	150.00	60.36
Pressure plate:	10-Mar-03 / 13:00	131.13	509.90	43.37

Comments:

* Weight including tares
† Assumed density of water is 1.0 g/cm^3

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Moisture Retention Data

Water Activity Meter/Relative Humidity Box

(Main Drainage Curve)

Job Name: Kleinfelder
Job Number: WR03.0035.00
Sample Number: BLUF-1
Ring Number: NA
Depth: NA

Dry weight of water activity meter sample* (g): 134.82
Tare weight, jar (g): 113.64
Sample bulk density (g/cm³): 0.84

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Water Activity Meter:	26-Feb-03 / 13:30	138.68	16622.7	15.28

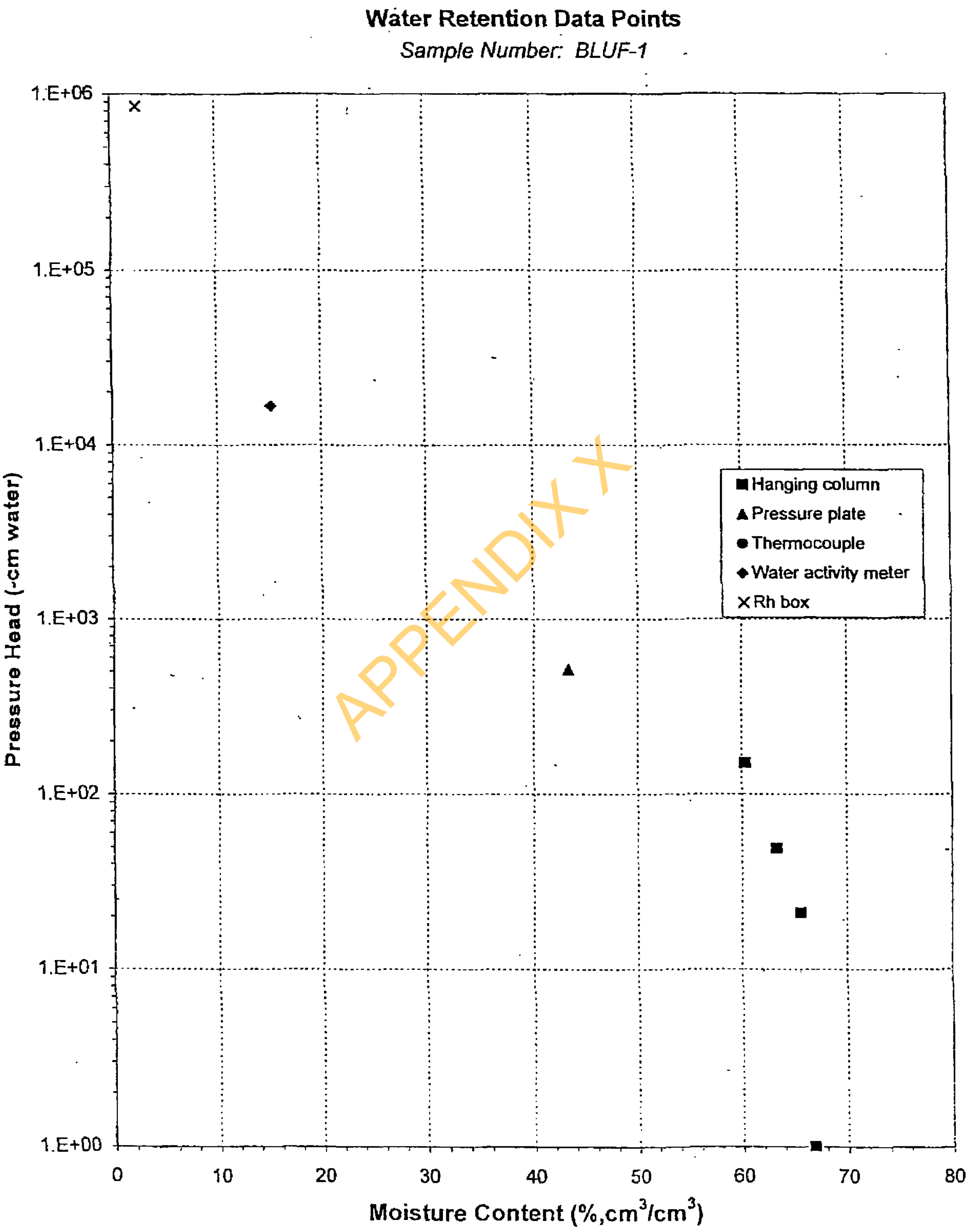
Dry weight of relative humidity box sample* (g): 65.04
Tare weight (g): 40.93
Sample bulk density (g/cm³): 0.84

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Relative humidity box:	03-Mar-03 / 12:30	65.75	851293	2.46

Comments:

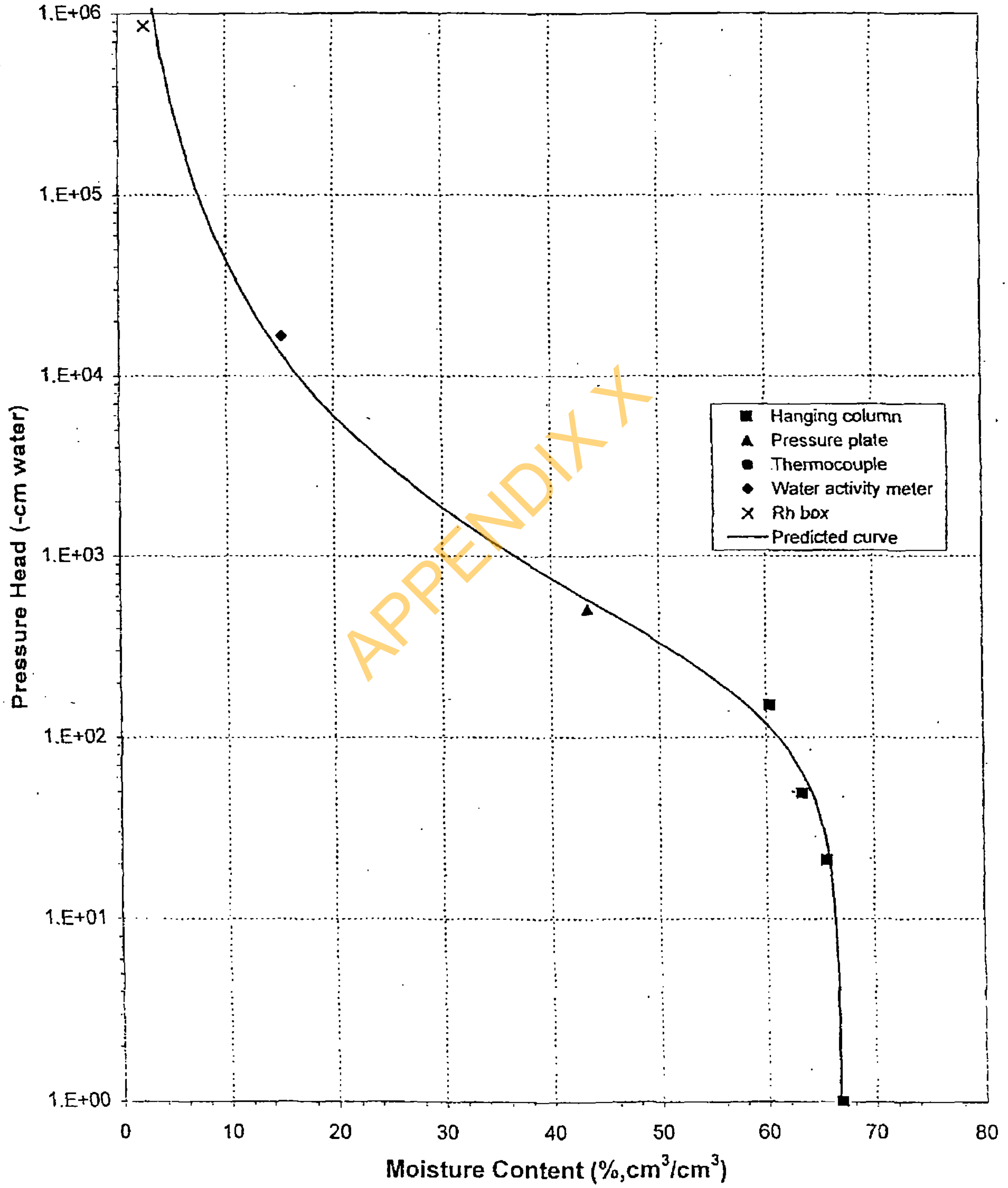
* Weight including tares
† Assumed density of water is 1.0 g/cm³

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd


Water Retention Data Points
Sample Number: BLUF-1
Pressure Head (-cm water)
1.E+06
1.E+05
1.E+04
1.E+03
1.E+02
1.E+01
1.E+00
0
10
20
30
40
50
60
70
80
Moisture Content (%,cm³/cm³)
■ Hanging column
▲ Pressure plate
● Thermocouple
◆ Water activity meter
✕ Rh box

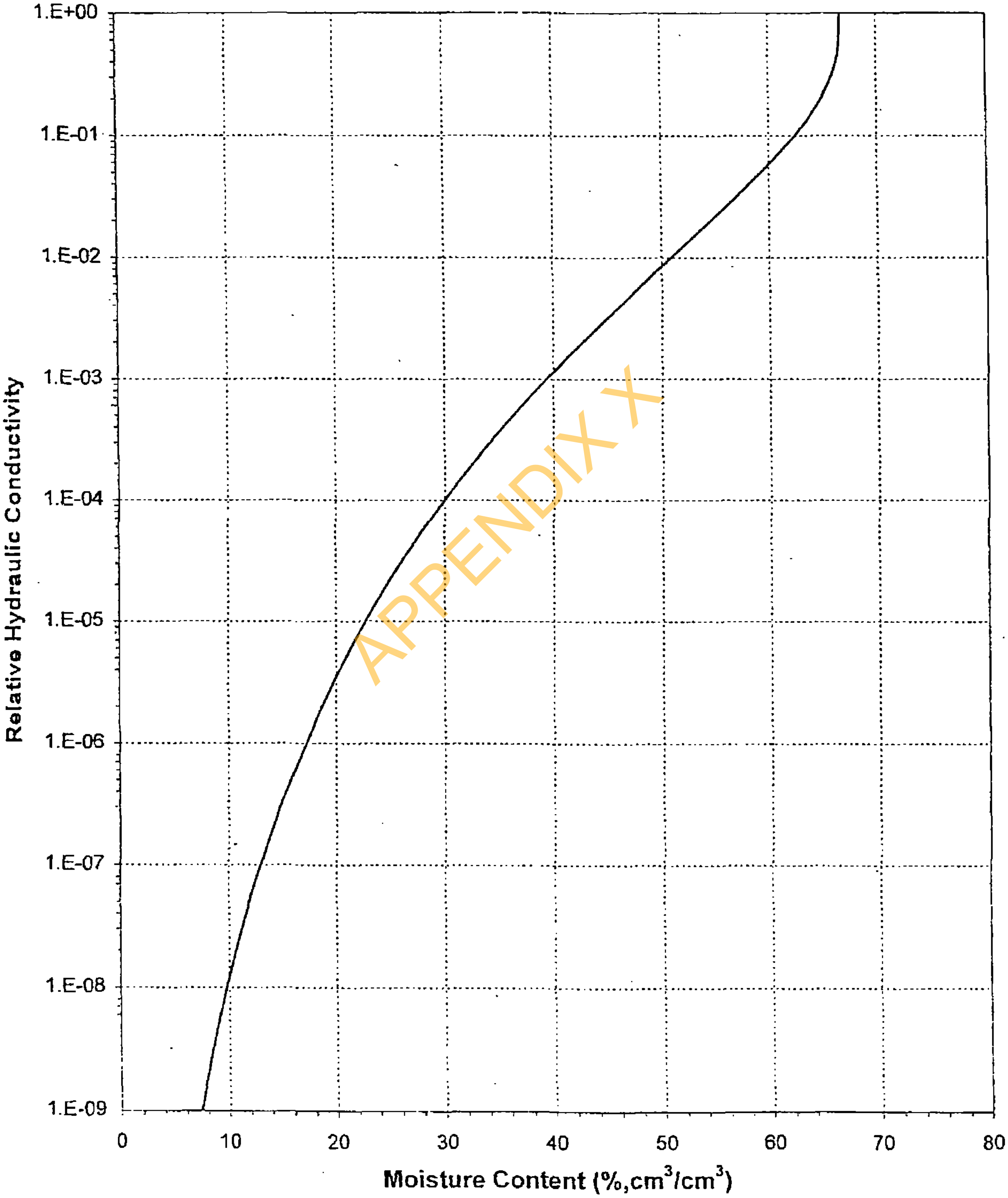
Predicted Water Retention Curve and Data Points

Sample Number: BLUF-1



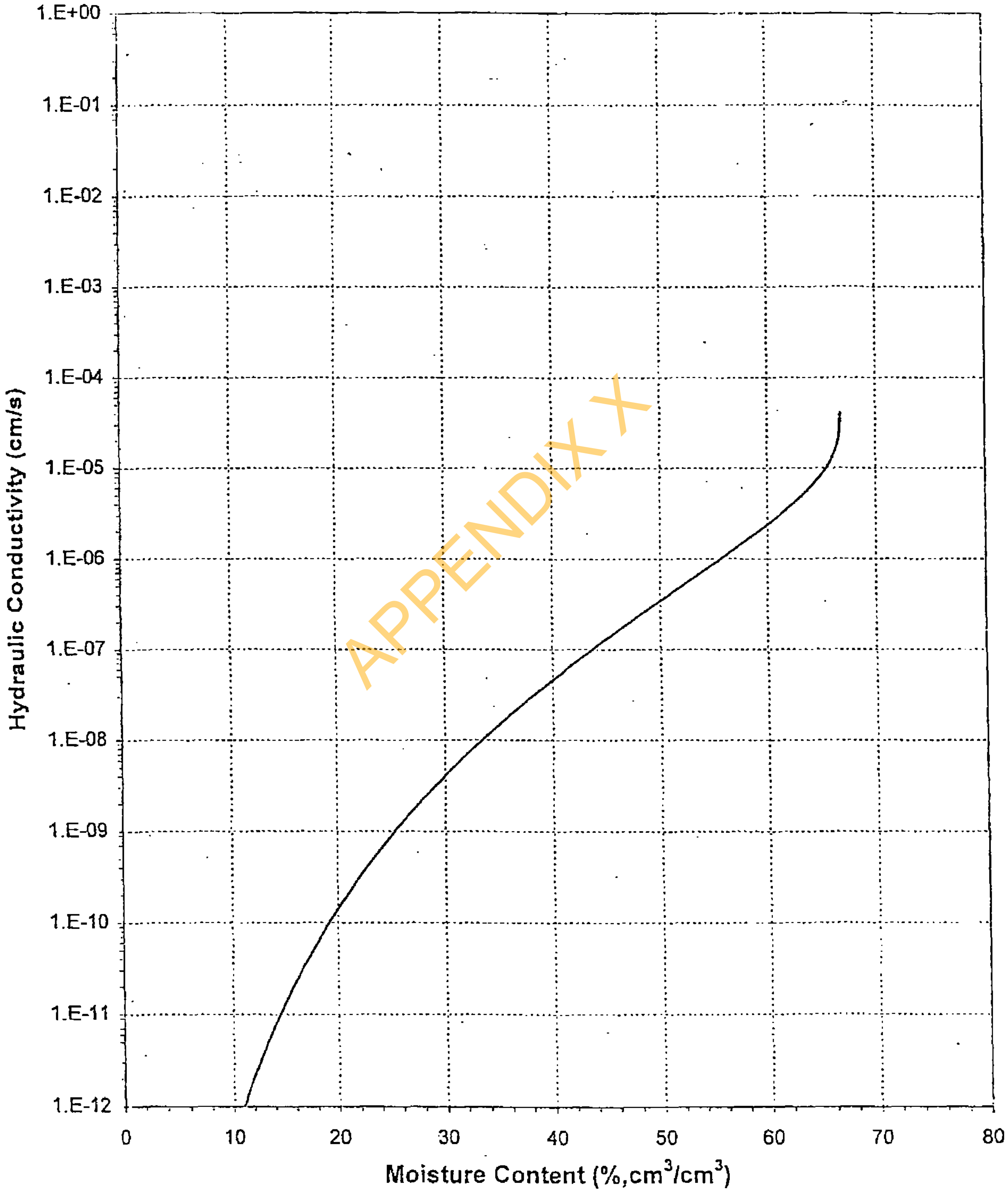
Plot of Relative Hydraulic Conductivity vs Moisture Content

Sample Number: BLUF-1



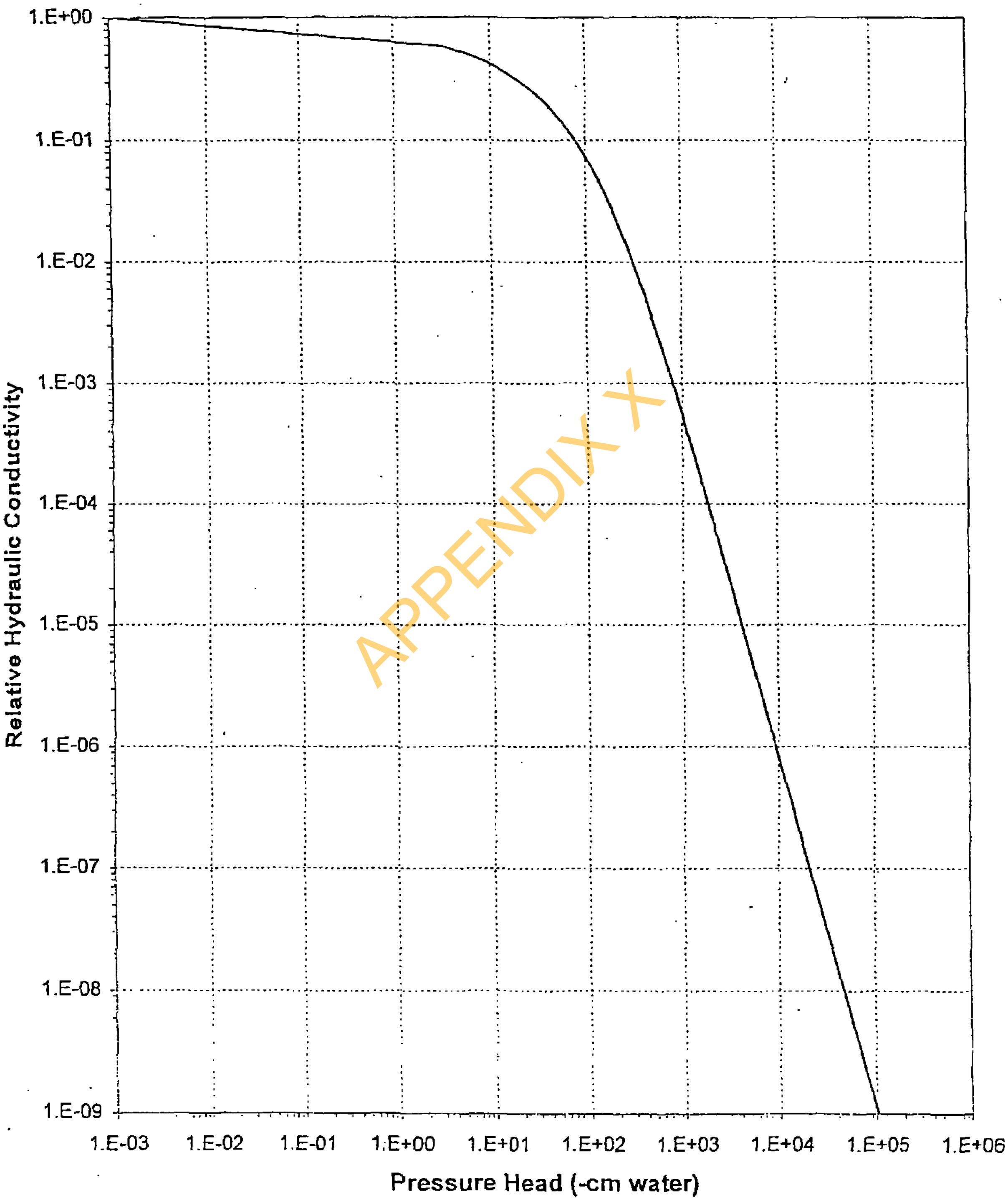
Plot of Hydraulic Conductivity vs Moisture Content

Sample Number: BLUF-1



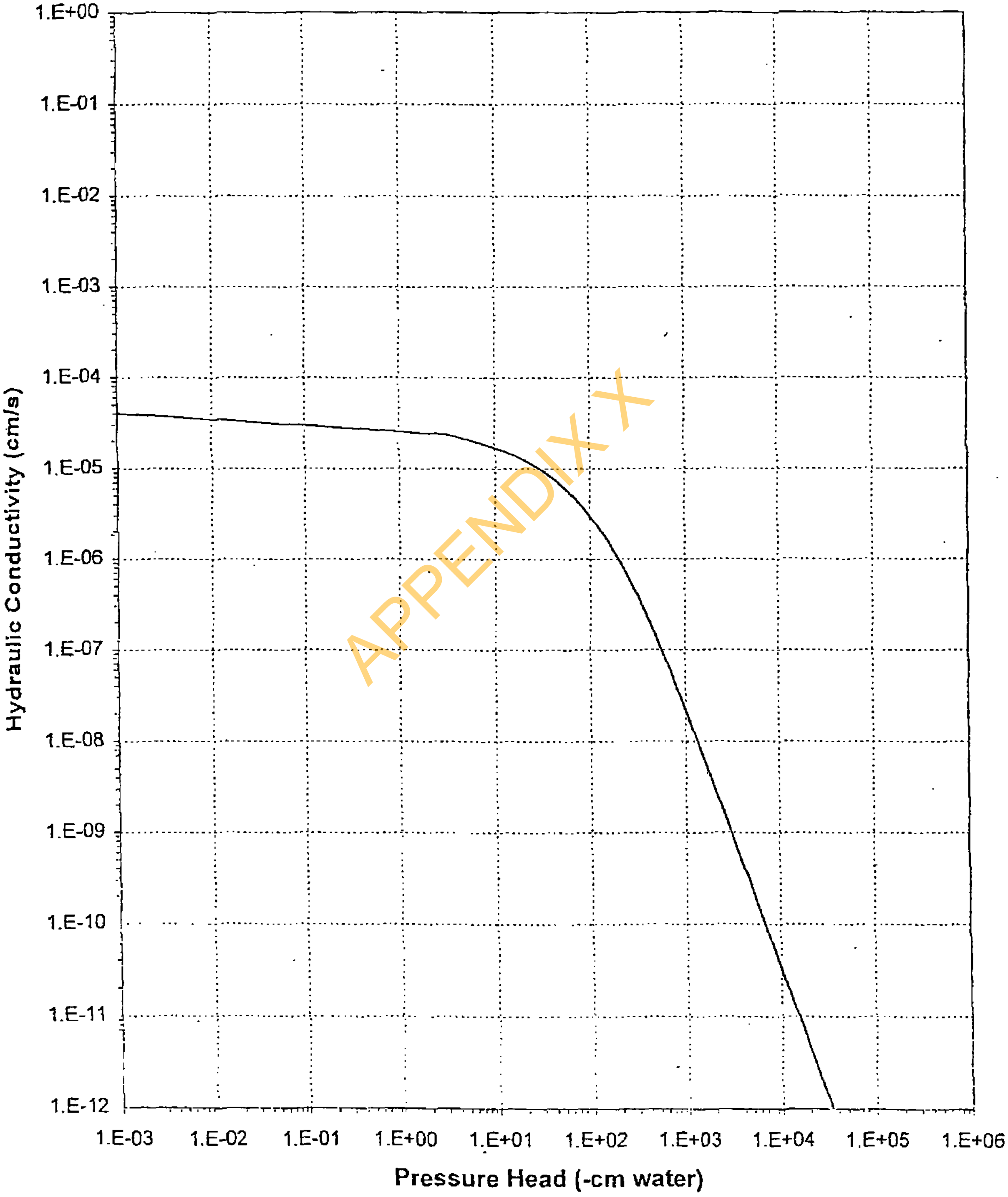
Plot of Relative Hydraulic Conductivity vs Pressure Head

Sample Number: BLUF-1



Plot of Hydraulic Conductivity vs Pressure Head

Sample Number: BLUF-1



Moisture Retention Data

Hanging Column/Pressure Plate/Thermocouple

(Main Drainage Curve)

Job Name: Kleinfelder
Job Number: WR03.0035.00
Sample Number: BLUF-2
Ring Number: NA
Depth: NA

Dry wt. of sample (g): 74.67
Tare wt., screen & clamp (g): 25.33
Tare wt., ring (g): 34.07
Tare wt., epoxy (g): 0.00
Sample volume (cm^3): 50.99

Saturated weight at 0 cm tension* (g): 154.52
Volume of water† *in saturated sample* (cm^3): 20.45
Saturated moisture content (% vol): 40.11
Sample bulk density (g/cm^3): 1.46

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Hanging column:	28-Feb-03 / 14:00	154.52	0.00	40.11
	03-Mar-03 / 12:30	154.24	21.00	39.56
	05-Mar-03 / 15:30	153.47	49.00	38.05
	07-Mar-03 / 15:00	153.07	150.00	37.26
Pressure plate:	10-Mar-03 / 13:00	146.94	509.90	25.24

Comments:

* Weight including tares
† Assumed density of water is 1.0 g/cm^3

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Moisture Retention Data

Water Activity Meter/Relative Humidity Box

(Main Drainage Curve)

Job Name: Kleinfelder
Job Number: WR03.0035.00
Sample Number: BLUF-2
Ring Number: NA
Depth: NA

Dry weight of water activity meter sample* (g): 154.86
Tare weight, jar (g): 121.47
Sample bulk density (g/cm^3): 1.46

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Water Activity Meter:	27-Feb-03 / 10:00	158.08	7444.5	14.12

Dry weight of relative humidity box sample* (g): 71.00
Tare weight (g): 42.11
Sample bulk density (g/cm^3): 1.46

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Relative humidity box:	03-Mar-03 / 12:30	71.53	851293	2.73

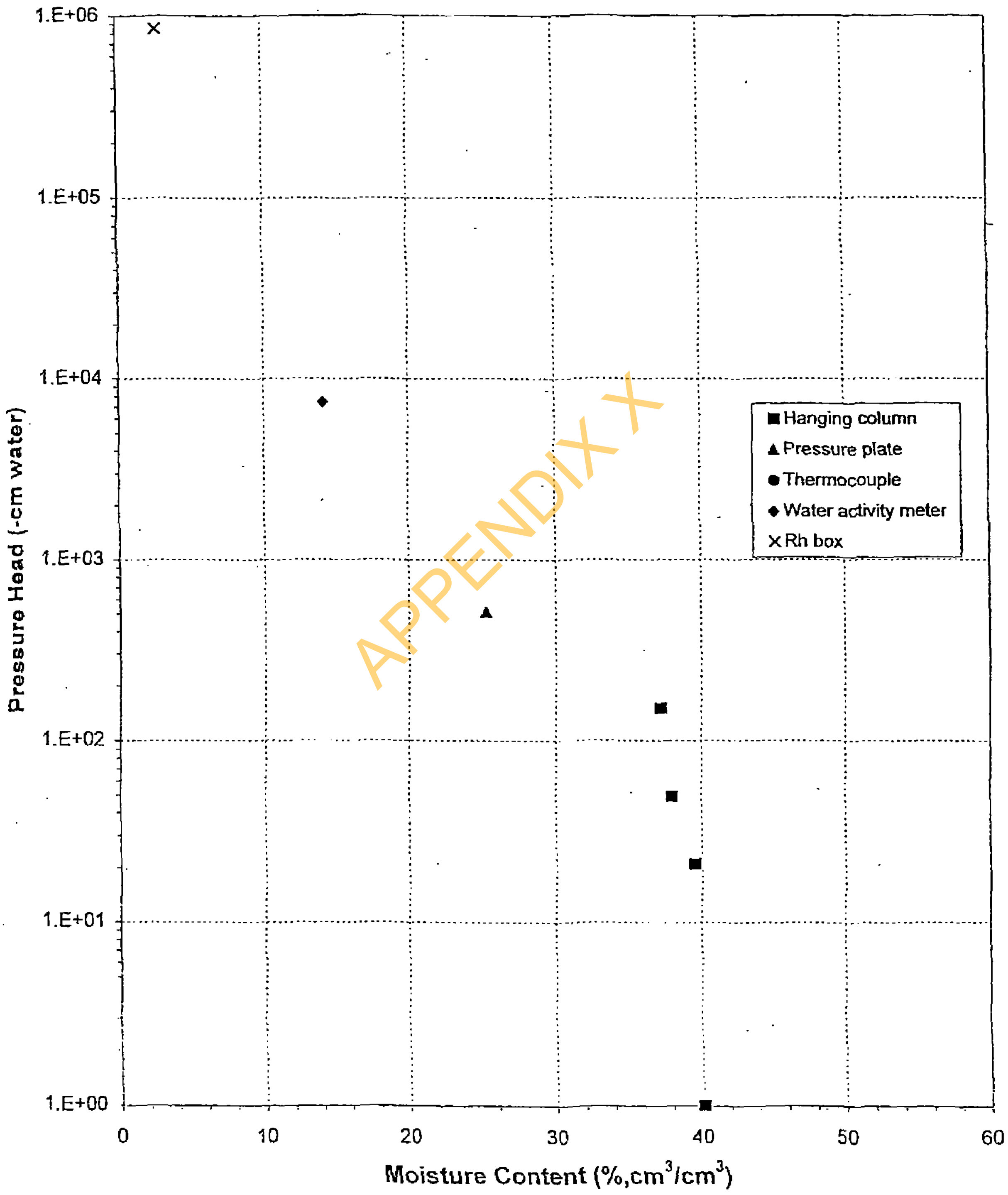
Comments:

* Weight including tares
† Assumed density of water is 1.0 g/cm^3

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

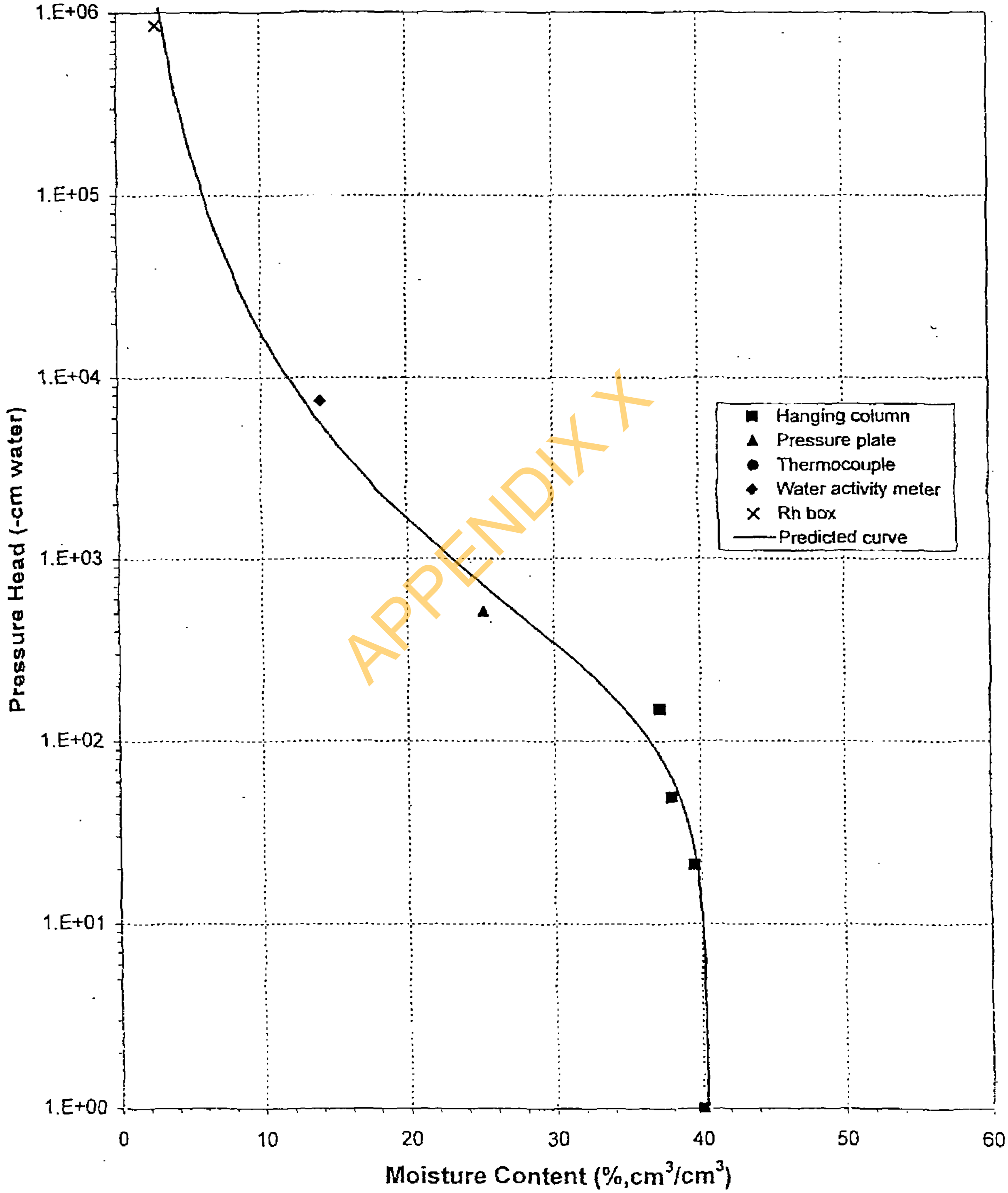
Water Retention Data Points

Sample Number: BLUF-2



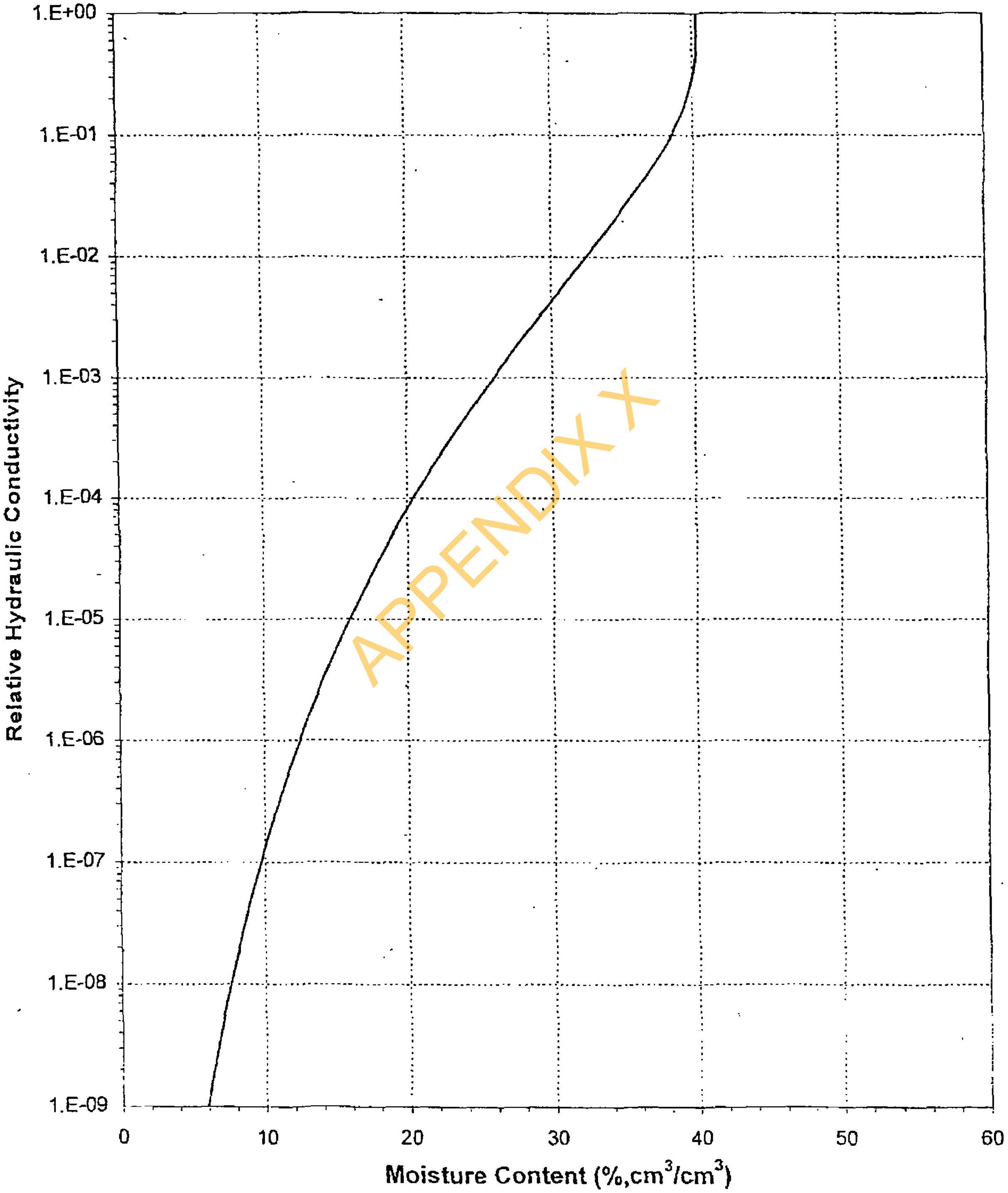
Predicted Water Retention Curve and Data Points

Sample Number: BLUF-2



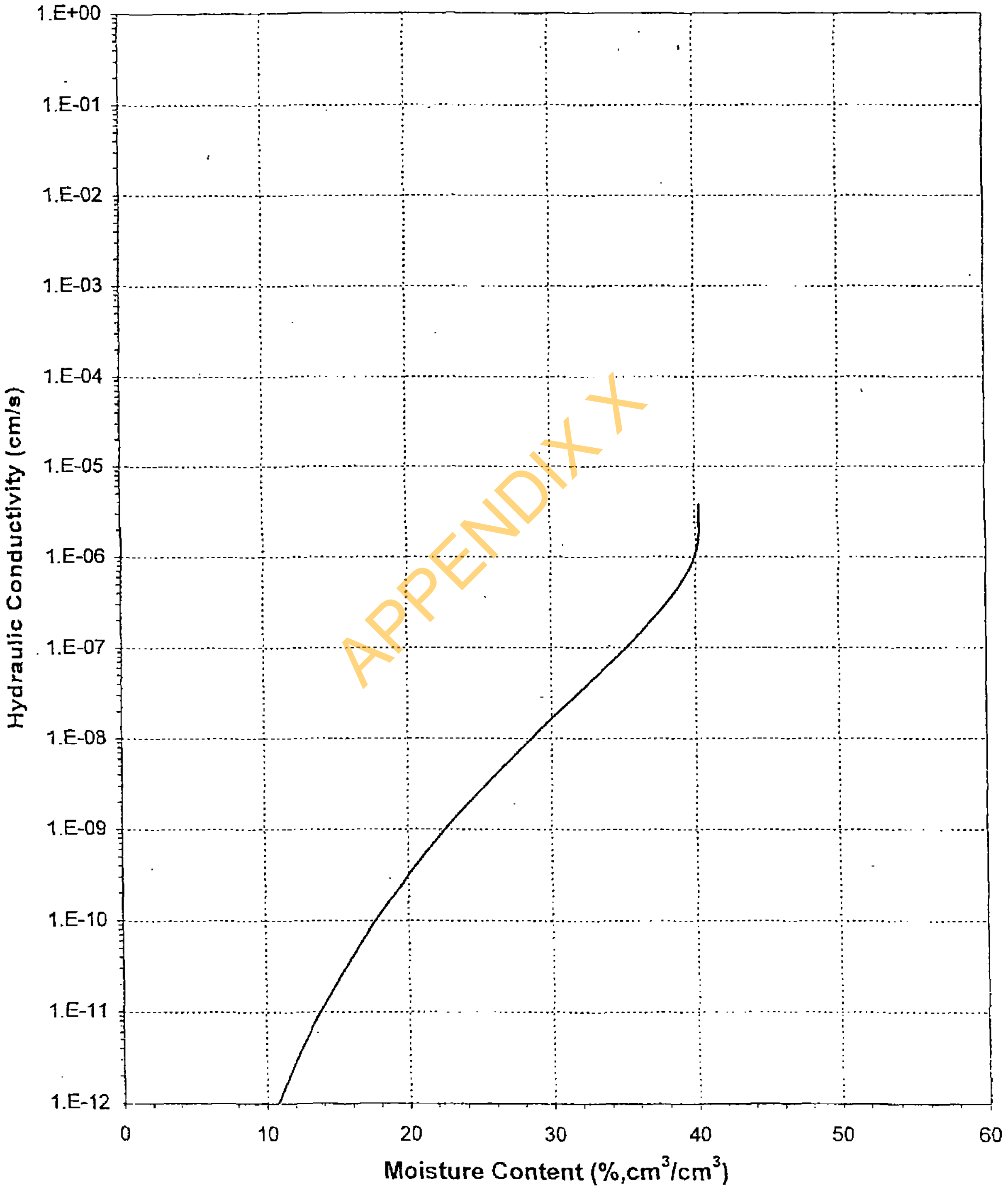
Plot of Relative Hydraulic Conductivity vs Moisture Content

Sample Number: BLUF-2



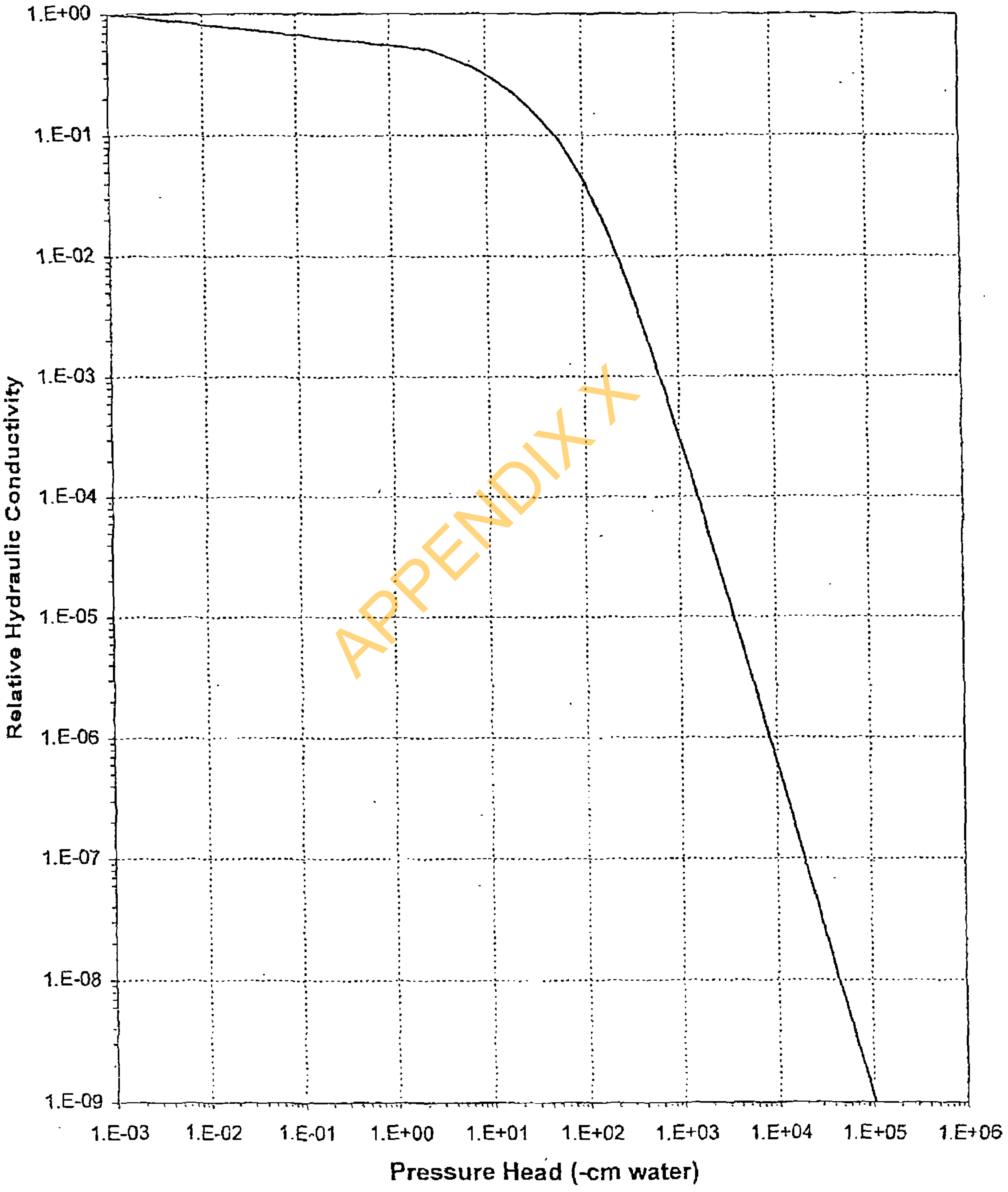
Plot of Hydraulic Conductivity vs Moisture Content

Sample Number: BLUF-2



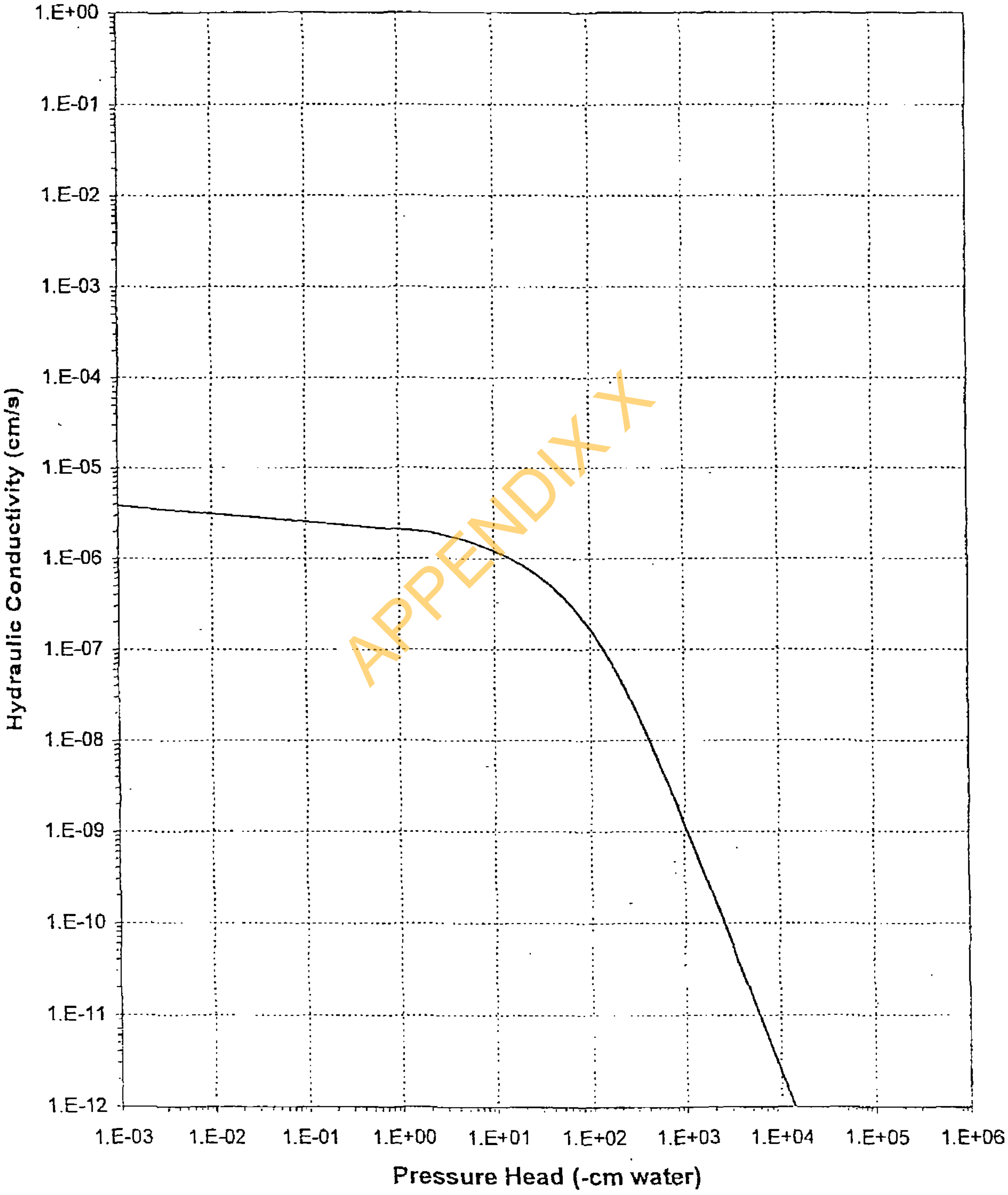
Plot of Relative Hydraulic Conductivity vs Pressure Head

Sample Number: BLUF-2



Plot of Hydraulic Conductivity vs Pressure Head

Sample Number: BLUF-2



Moisture Retention Data

Hanging Column/Pressure Plate/Thermocouple

(Main Drainage Curve)

Job Name: Kleinfelder
Job Number: WR03.0035.00
Sample Number: BLUF-3
Ring Number: NA
Depth: NA

Dry wt. of sample (g): 100.70
Tare wt., screen & clamp (g): 25.48
Tare wt., ring (g): 41.93
Tare wt., epoxy (g): 0.00
Sample volume (cm^3): 63.72

Saturated weight at 0 cm tension* (g): 192.47
Volume of water† *in saturated sample* (cm^3): 24.36
Saturated moisture content (% vol): 38.23
Sample bulk density (g/cm^3): 1.58

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Hanging column:	28-Feb-03 / 14:00	192.47	0.00	38.23
	03-Mar-03 / 12:30	192.17	21.00	37.76
	05-Mar-03 / 15:30	191.27	49.00	36.34
	07-Mar-03 / 15:00	190.00	150.00	34.35
Pressure plate:	10-Mar-03 / 13:00	183.80	509.90	24.62

Comments:

* Weight including tares
† Assumed density of water is 1.0 g/cm^3

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Moisture Retention Data

Water Activity Meter/Relative Humidity Box

(Main Drainage Curve)

Job Name: Kleinfelder
Job Number: WR03.0035.00
Sample Number: BLUF-3
Ring Number: NA
Depth: NA

Dry weight of water activity meter sample* (g): 141.82
Tare weight, jar (g): 111.56
Sample bulk density (g/cm^3): 1.58

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content[†] (% vol)
Water Activity Meter:	27-Feb-03 / 09:50	144.06	17540.6	11.70

Dry weight of relative humidity box sample* (g): 85.94
Tare weight (g): 40.78
Sample bulk density (g/cm^3): 1.58

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content[†] (% vol)
Relative humidity box:	03-Mar-03 / 12:30	86.67	851293	2.53

Comments:

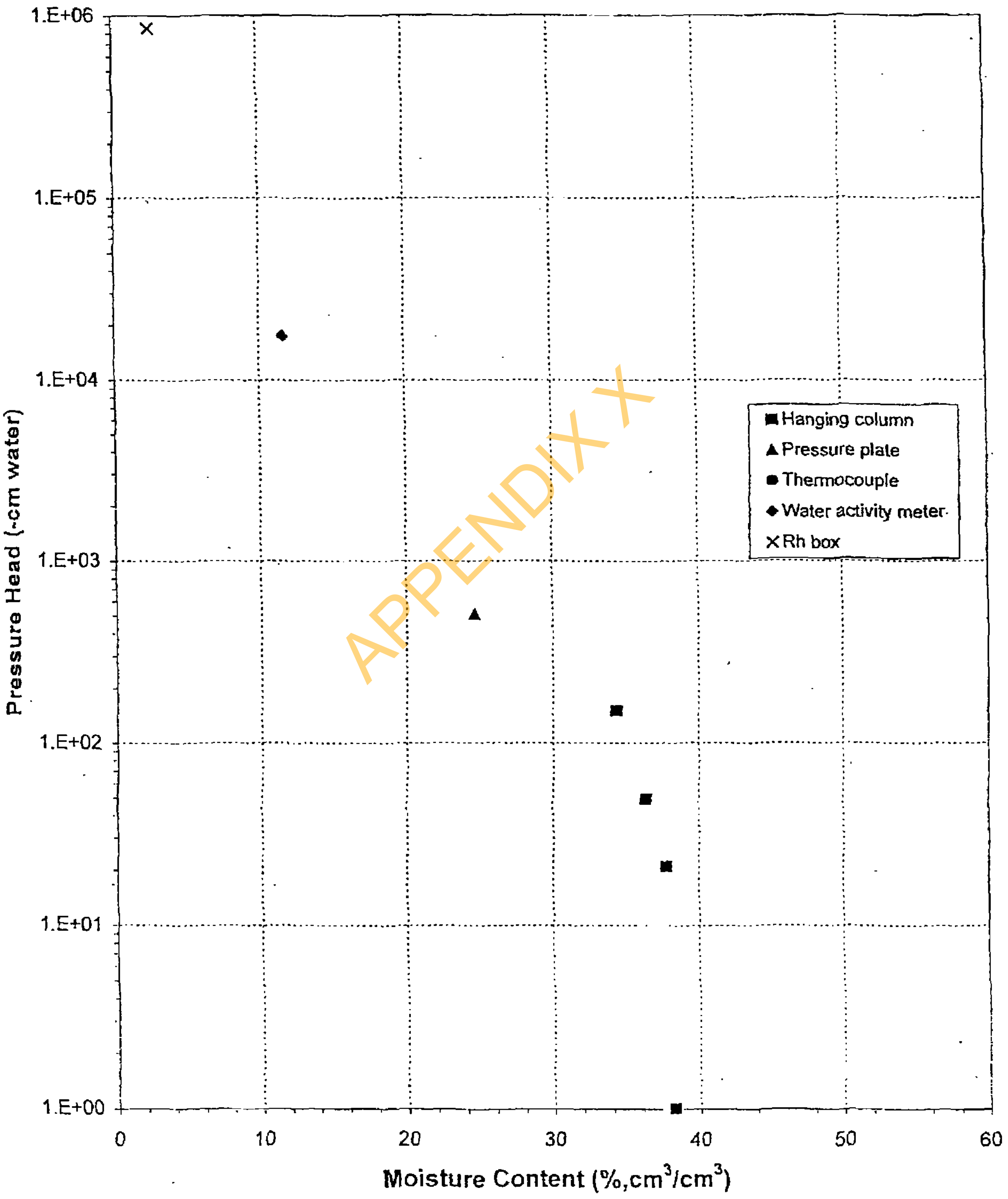
* Weight including tares

[†] Assumed density of water is 1.0 g/cm^3

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

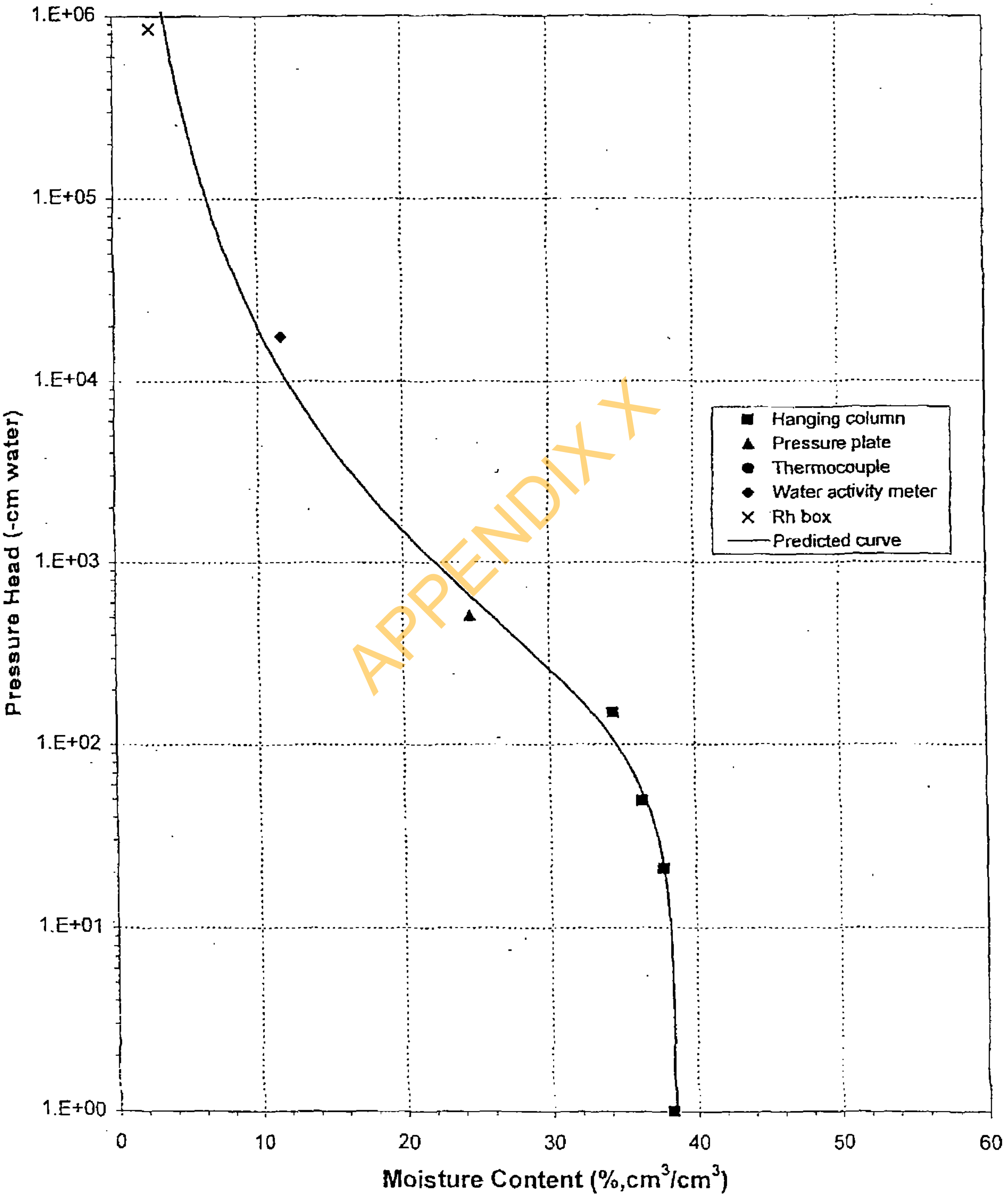
Water Retention Data Points

Sample Number: BLUF-3



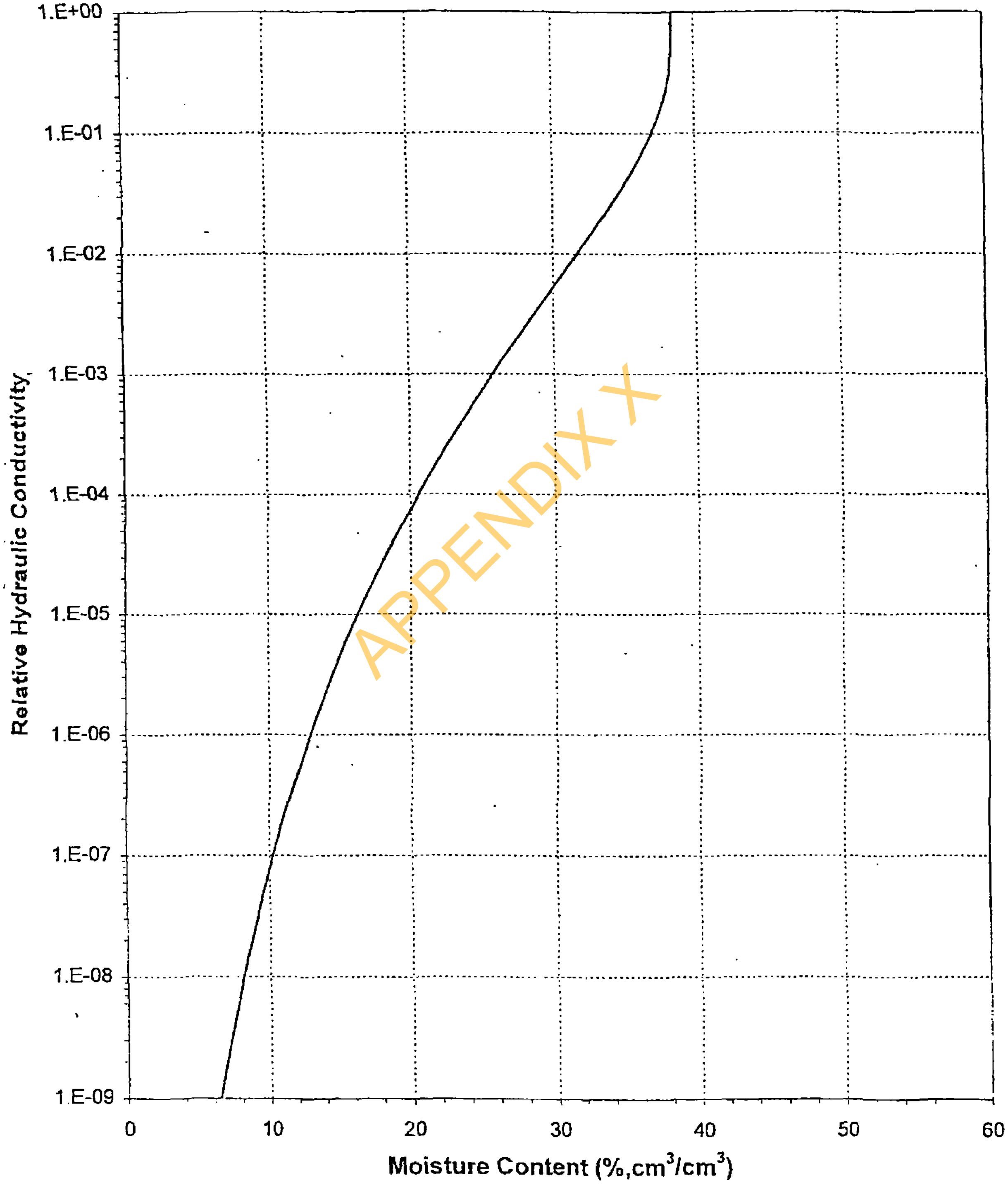
Predicted Water Retention Curve and Data Points

Sample Number: BLUF-3



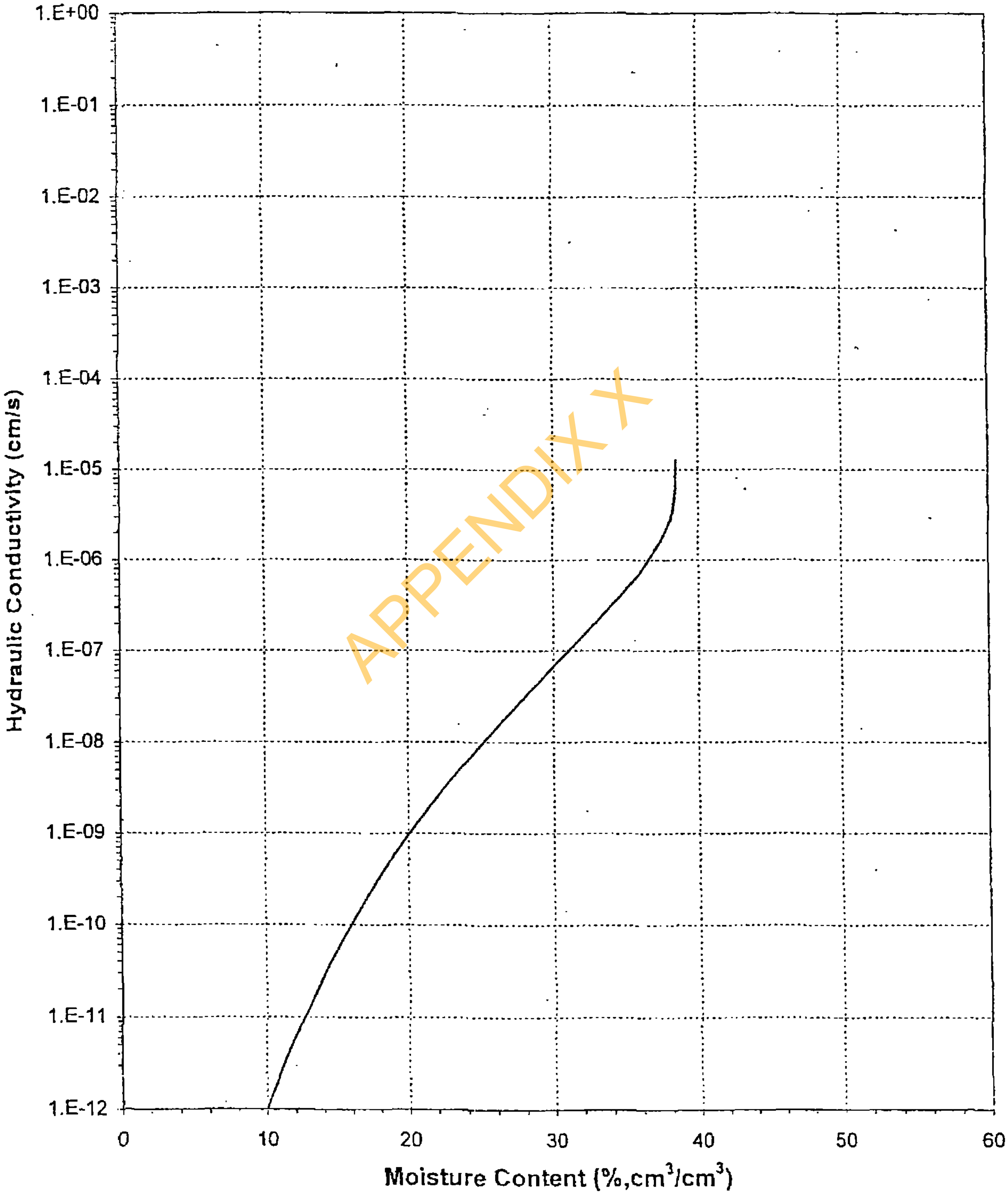
Plot of Relative Hydraulic Conductivity vs Moisture Content

Sample Number: BLUF-3



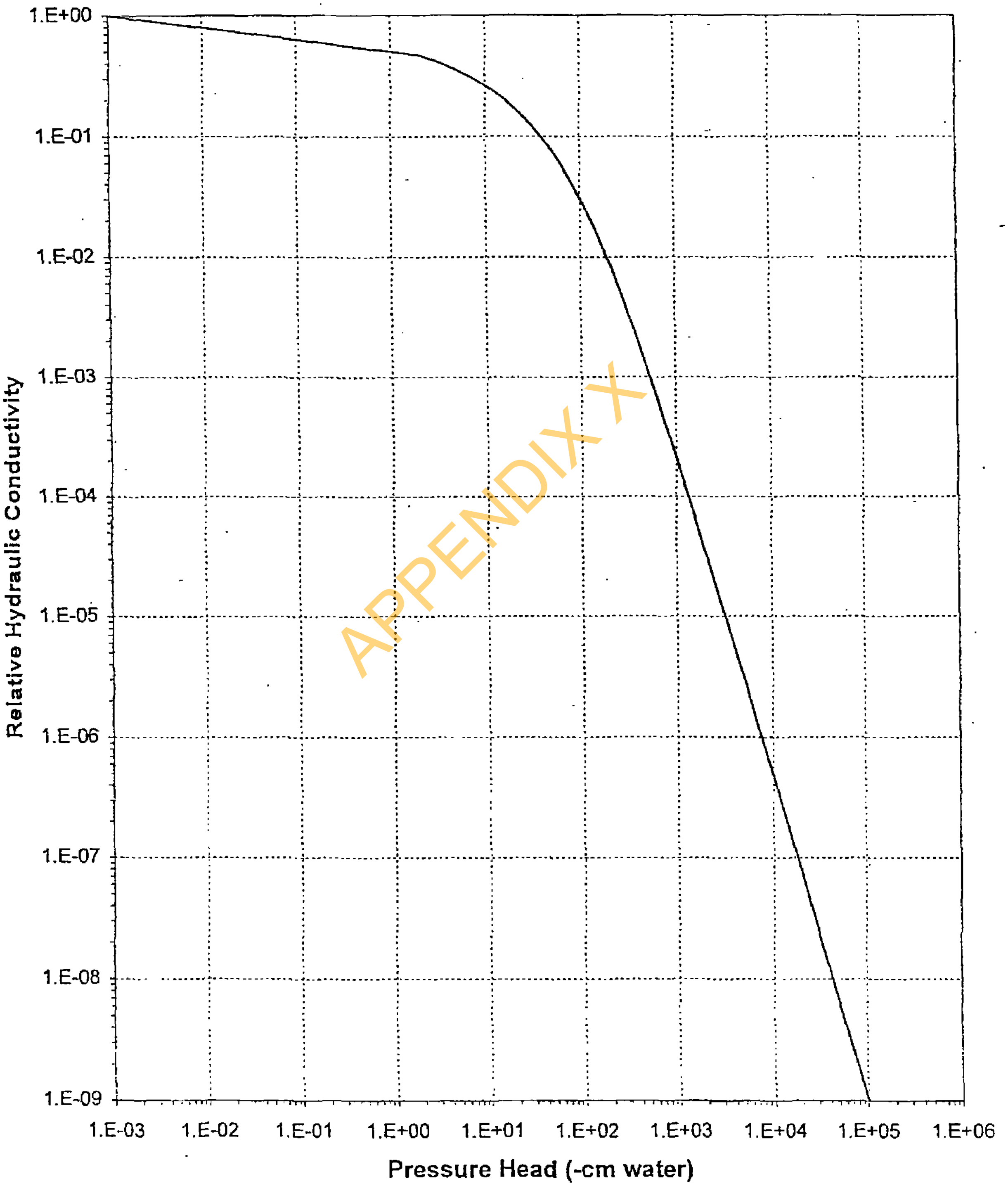
Plot of Hydraulic Conductivity vs Moisture Content

Sample Number: BLUF-3



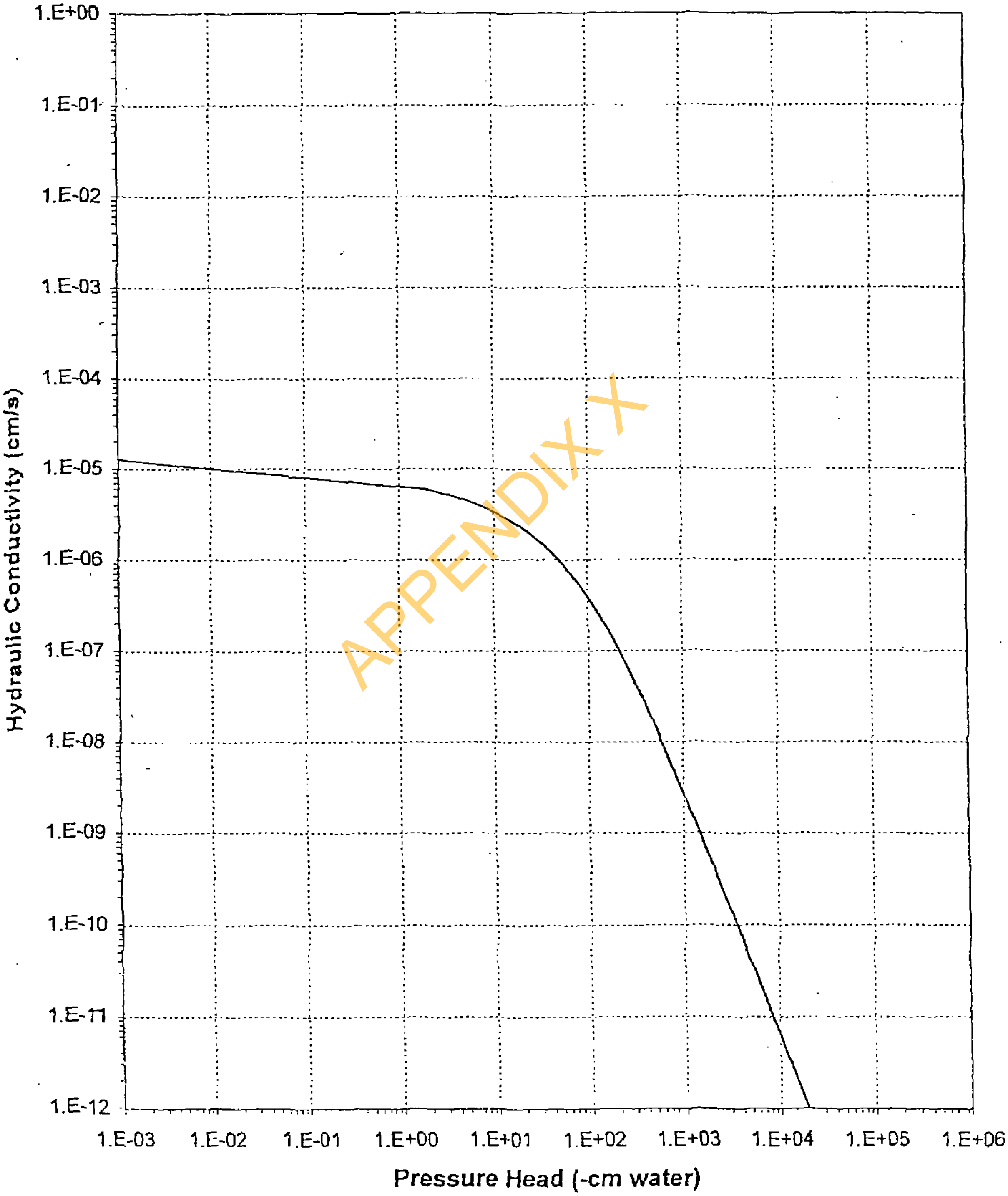
Plot of Relative Hydraulic Conductivity vs Pressure Head

Sample Number: BLUF-3



Plot of Hydraulic Conductivity vs Pressure Head

Sample Number: BLUF-3



Daniel B. Stephens & Associates, Inc.

Moisture Retention Data

Hanging Column/Pressure Plate/Thermocouple

(Main Drainage Curve)

Job Name: Kleinfelder
Job Number: WR03.0035.00
Sample Number: BLUF-4
Ring Number: NA
Depth: NA

Dry wt. of sample (g): 76.24
Tare wt., screen & clamp (g): 25.84
Tare wt., ring (g): 39.39
Tare wt., epoxy (g): 0.00
Sample volume (cm^3): 59.97

Saturated weight at 0 cm tension (g):* 174.24
Volume of water[†] in saturated sample (cm^3): 32.77
Saturated moisture content (% vol): 54.64
Sample bulk density (g/cm^3): 1.27

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content[†] (% vol)
Hanging column:	28-Feb-03 / 14:00	174.24	0.00	54.64
	03-Mar-03 / 12:30	170.46	10.00	48.34
	05-Mar-03 / 15:30	166.48	43.00	41.70
	07-Mar-03 / 15:00	159.94	80.00	30.80
Pressure plate:	10-Mar-03 / 13:00	152.54	509.90	18.46

Comments:

* Weight including tares
[†] Assumed density of water is 1.0 g/cm^3

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Moisture Retention Data

Water Activity Meter/Relative Humidity Box

(Main Drainage Curve)

Job Name: Kleinfelder
Job Number: WR03.0035.00
Sample Number: BLUF-4
Ring Number: NA
Depth: NA

Dry weight of water activity meter sample (g):* 140.98
Tare weight, jar (g): 116.07
Sample bulk density (g/cm^3): 1.27

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Water Activity Meter:	28-Feb-03 / 10:30	142.56	9892.1	8.06

Dry weight of relative humidity box sample (g):* 71.69
Tare weight (g): 44.95
Sample bulk density (g/cm^3): 1.27

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Relative humidity box:	03-Mar-03 / 12:30	72.31	851293	2.93

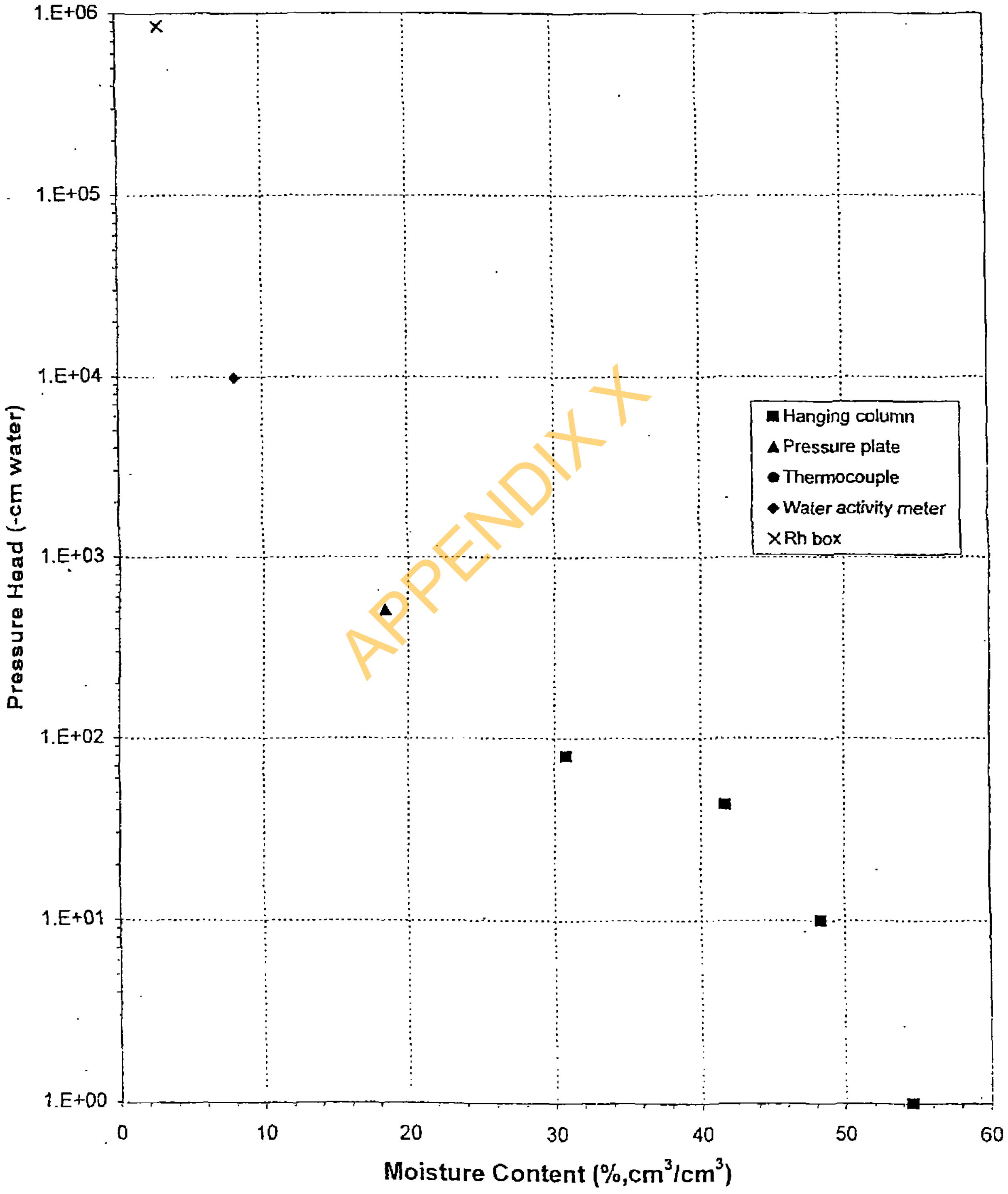
Comments:

* Weight including tares
† Assumed density of water is 1.0 g/cm^3

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

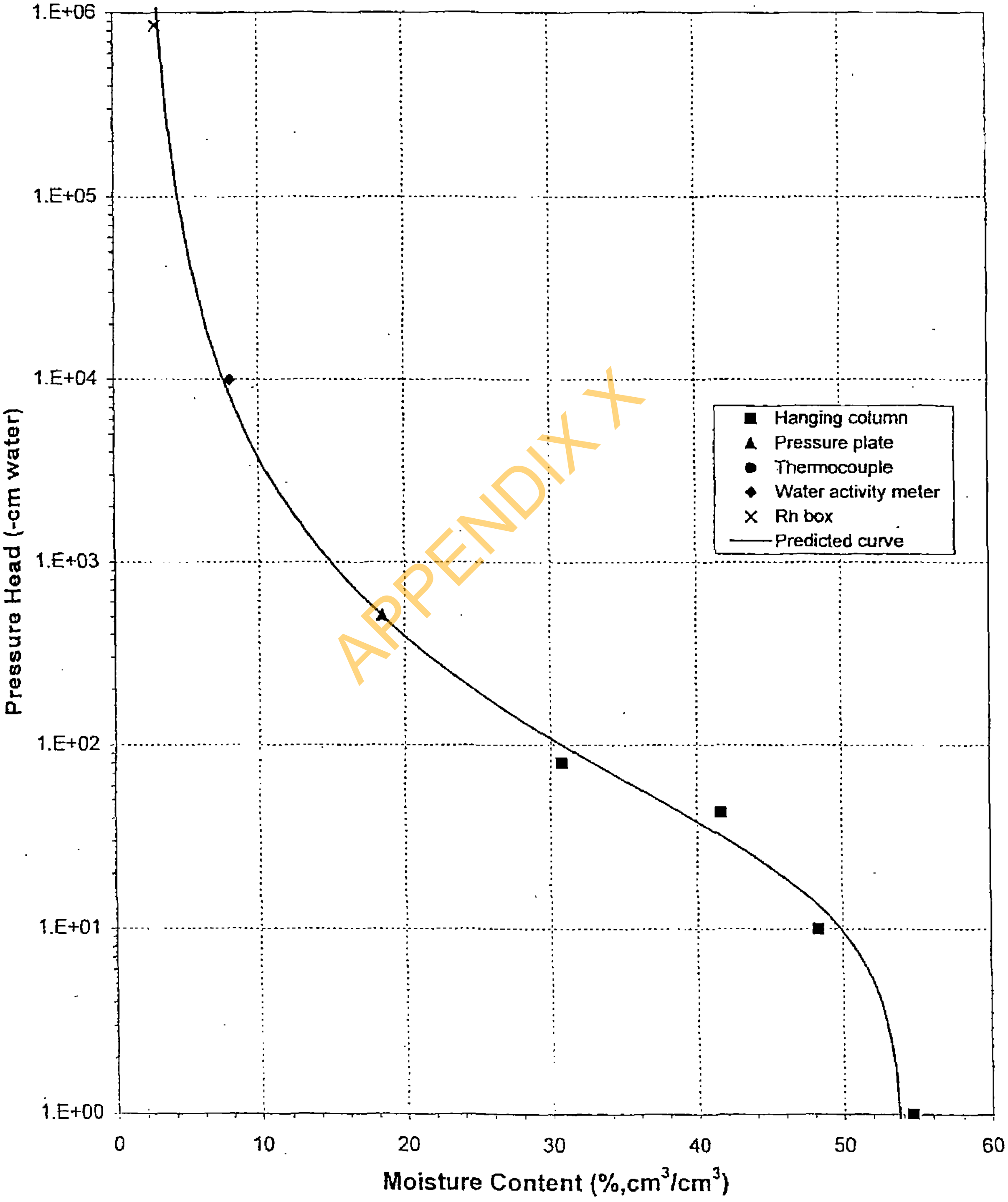
Water Retention Data Points

Sample Number: BLUF-4



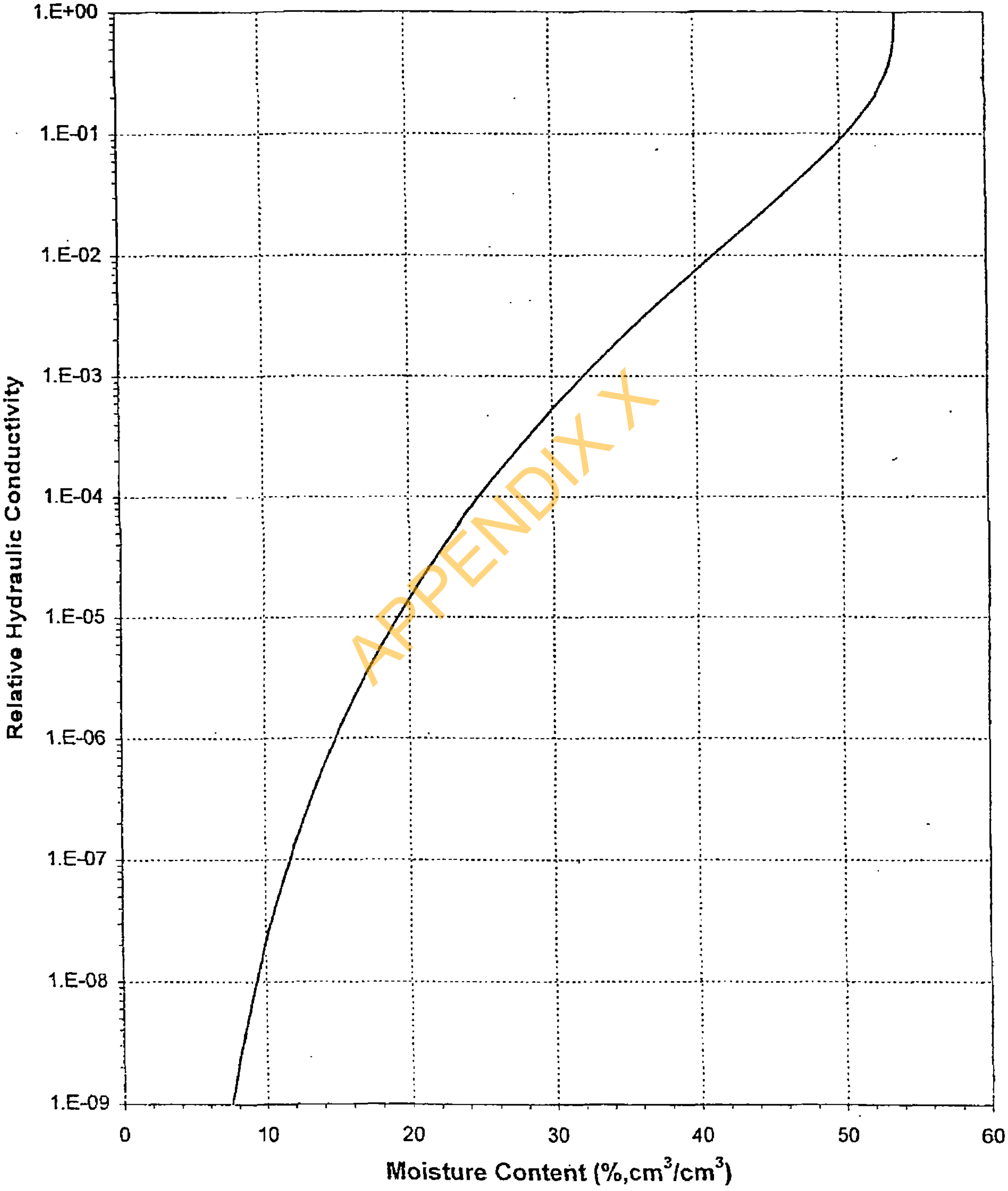
Predicted Water Retention Curve and Data Points

Sample Number: BLUF-4



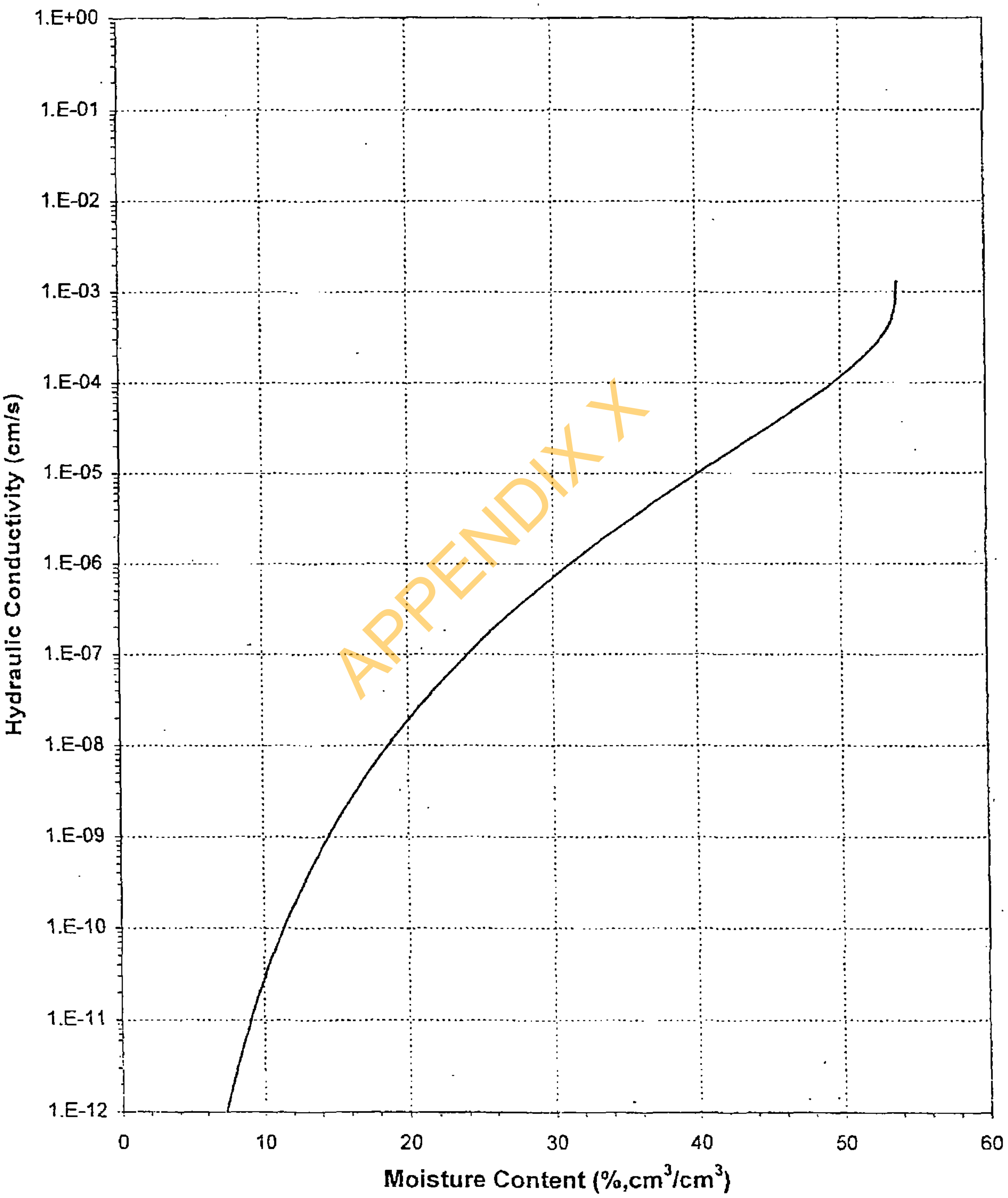
Plot of Relative Hydraulic Conductivity vs Moisture Content

Sample Number: BLUF-4



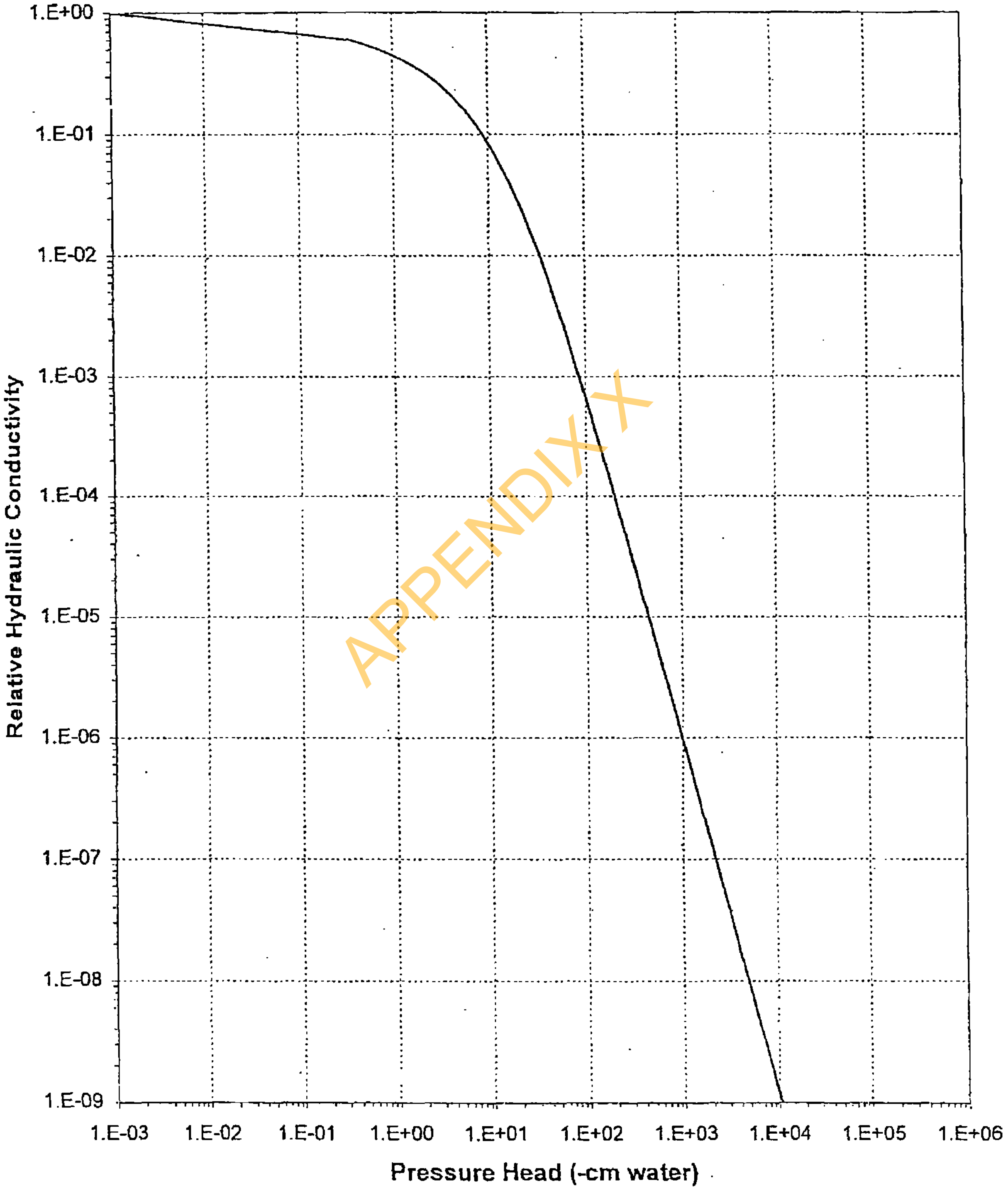
Plot of Hydraulic Conductivity vs Moisture Content

Sample Number: BLUF-4



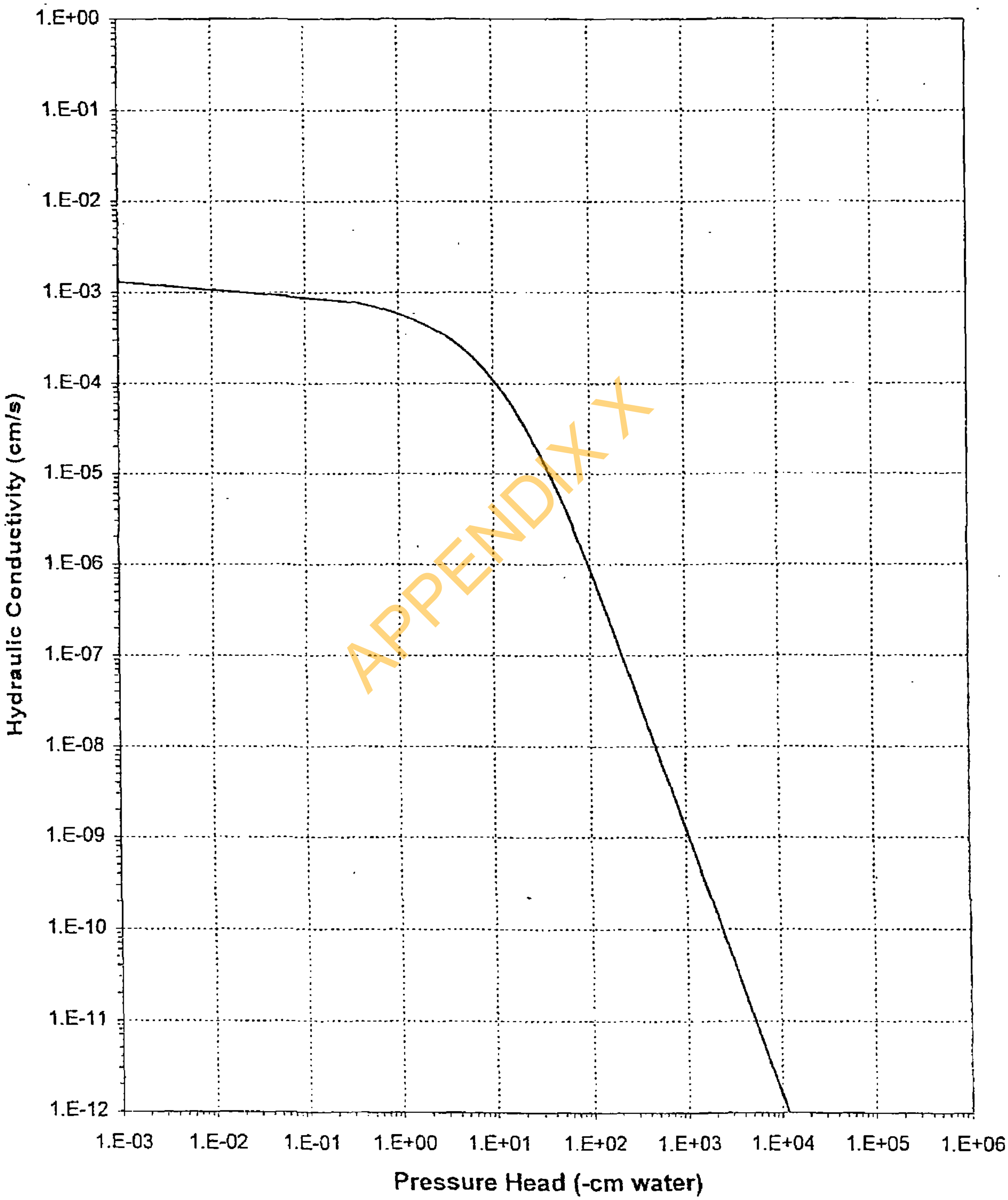
Plot of Relative Hydraulic Conductivity vs Pressure Head

Sample Number: BLUF-4



Plot of Hydraulic Conductivity vs Pressure Head

Sample Number: BLUF-4



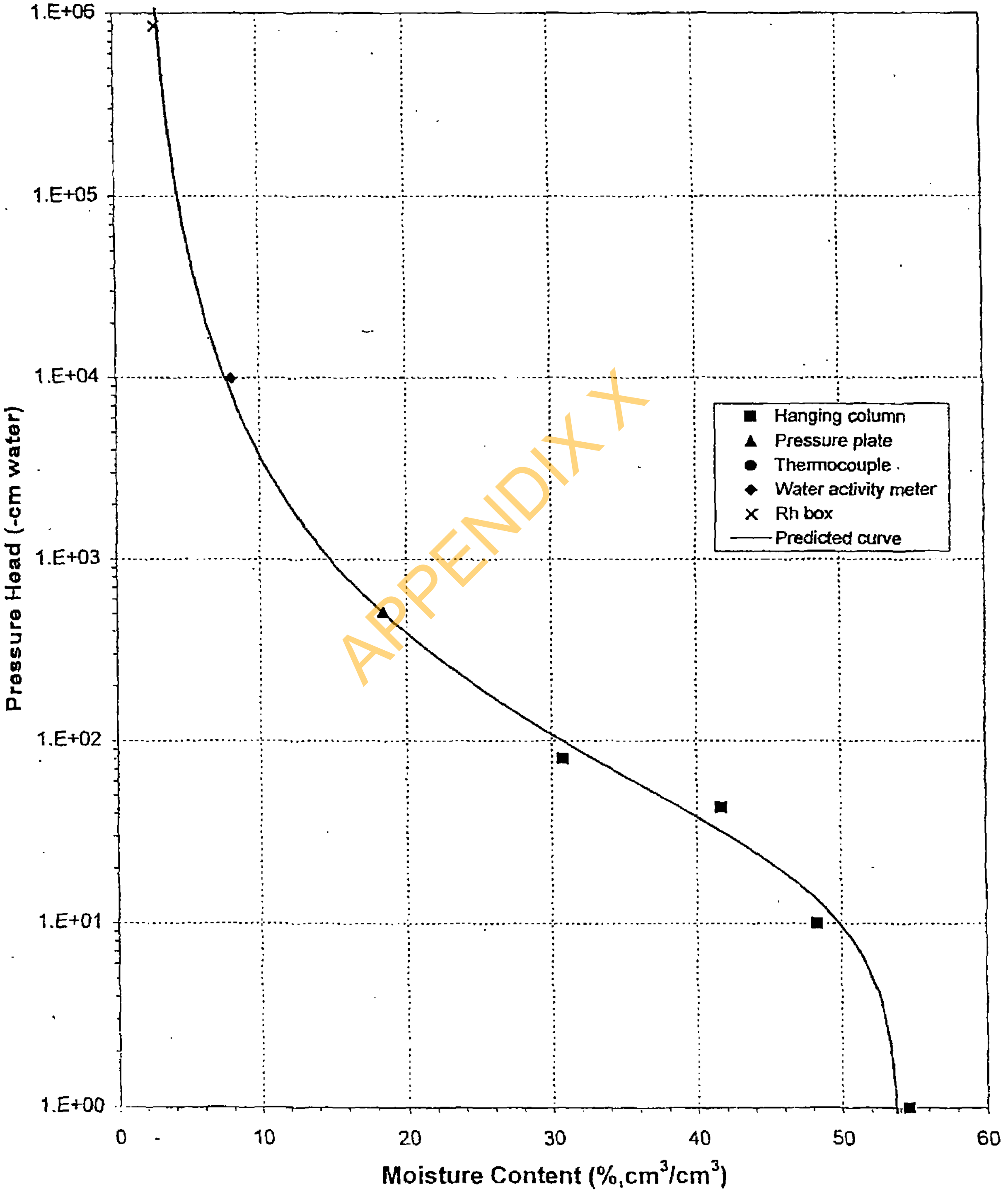
Laboratory Tests and Methods

Methods

Dry Bulk Density:	ASTM D 4531-91
Moisture Content:	ASTM D 2216-92
Calculated Porosity	Klute, A. 1986. Porosty. Chp.18-2.1, pp. 444-445, in A. Klute (ed.), Methods of Soil Analysis, American Society of Agronomy, Madison, WI
Ksat:	
Constant Head:	ASTM D 2434-68 (93)
Hanging Column Method	Klute, A. 1986. Porosty. Chp.26, in A. Klute (ed.), Methods of Soil Analysis, American Society of Agronomy, Madison, WI
Pressure Plate Method	ASTM D 2325-65 (94)
Water Potential Method	Dane, H. Jacob and G. Clark Topp. 2002. Chp.3. pp. 663-665, in J. H. Dane and G. C. Topp (ed.), Methods of Soil Analysis, American Society of Agronomy, Madison, WI
Relative Humidity Box	Klute, A. 1986. Porosty. Chp.26, in A. Klute (ed.), Methods of Soil Analysis, American Society of Agronomy, Madison, WI
Calc. Kunsat	Soil Sci. Soc. Am. J. 1980 44:892-898

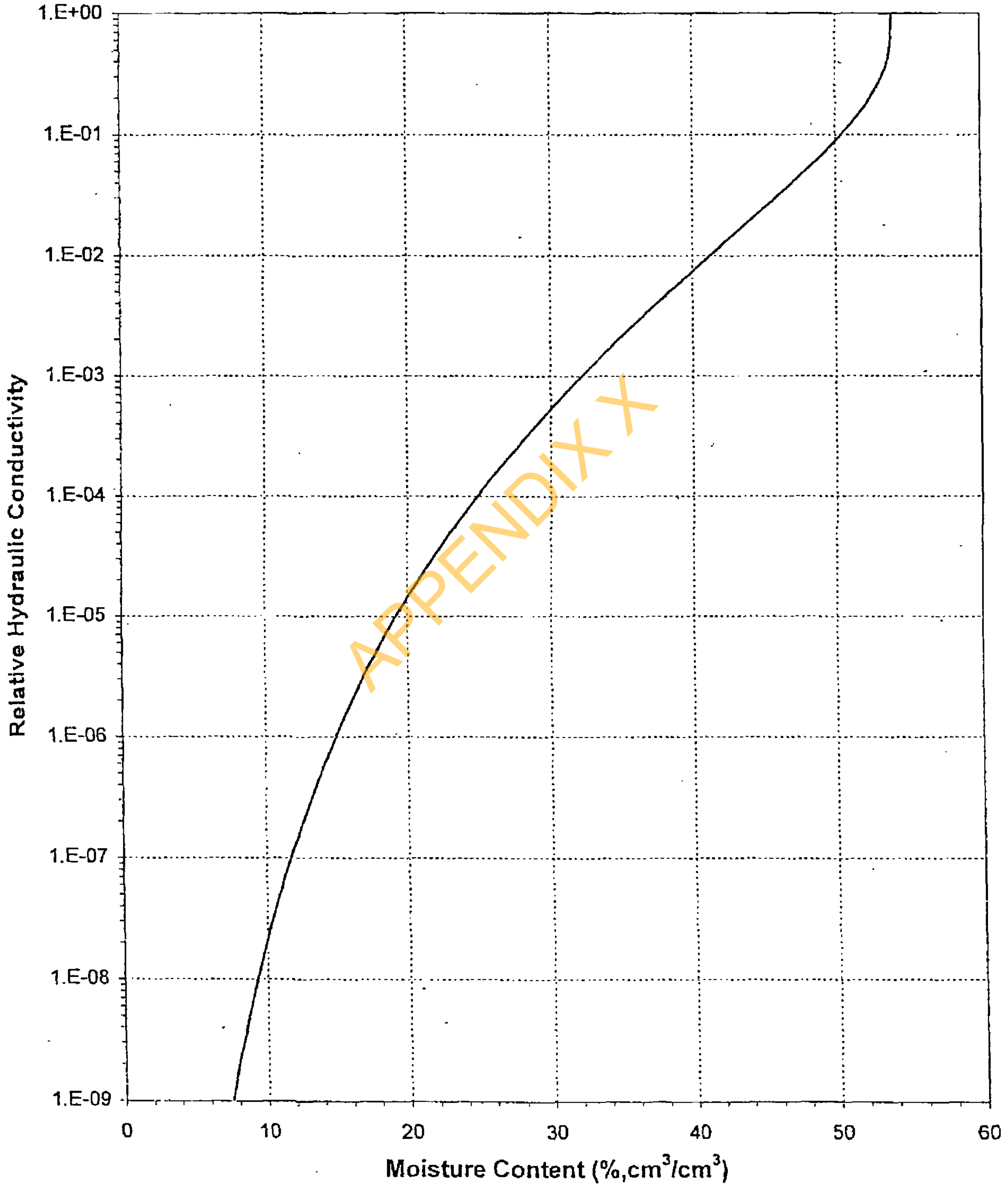
Predicted Water Retention Curve and Data Points

Sample Number: BLUF-4



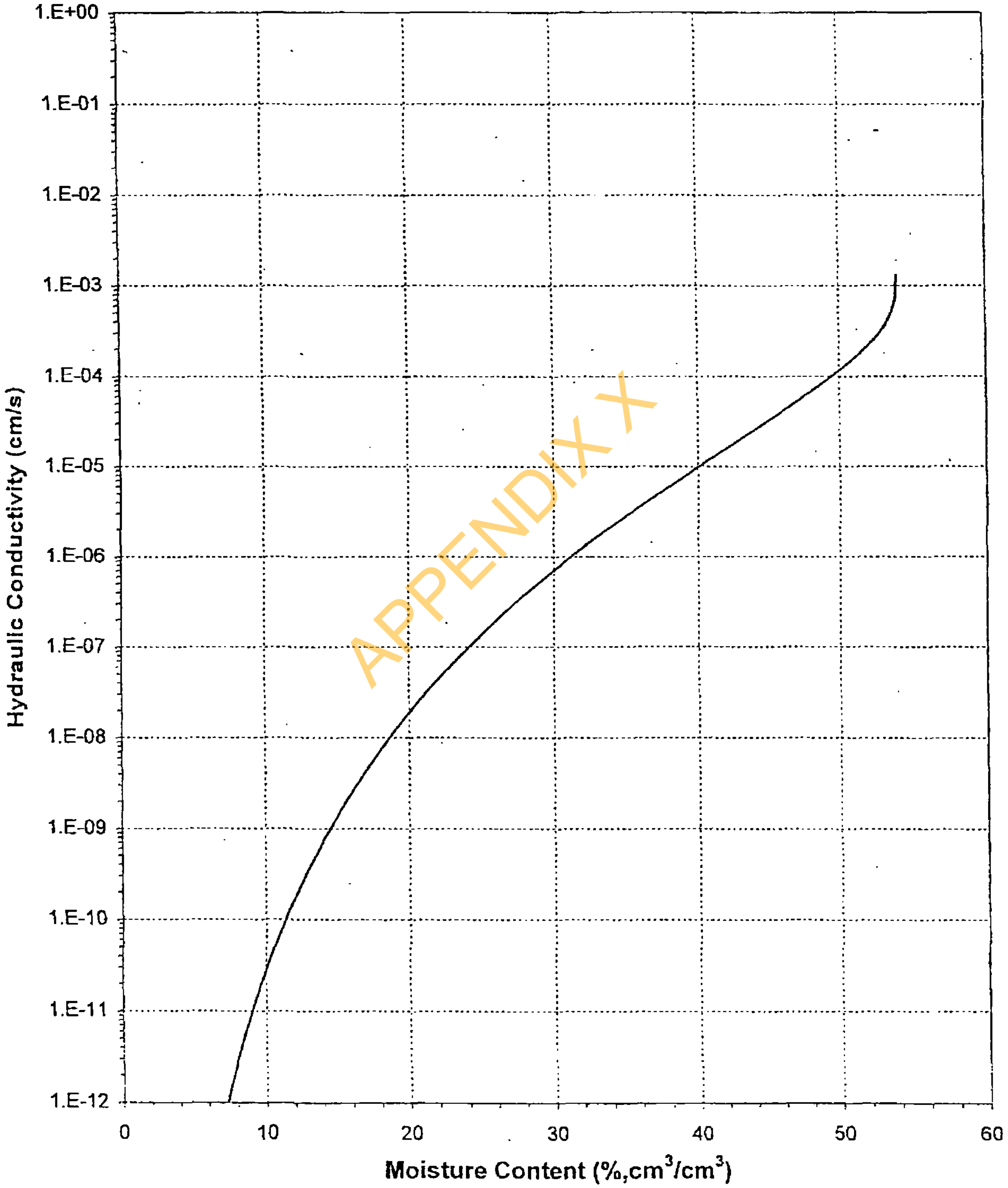
Plot of Relative Hydraulic Conductivity vs Moisture Content

Sample Number: BLUF-4



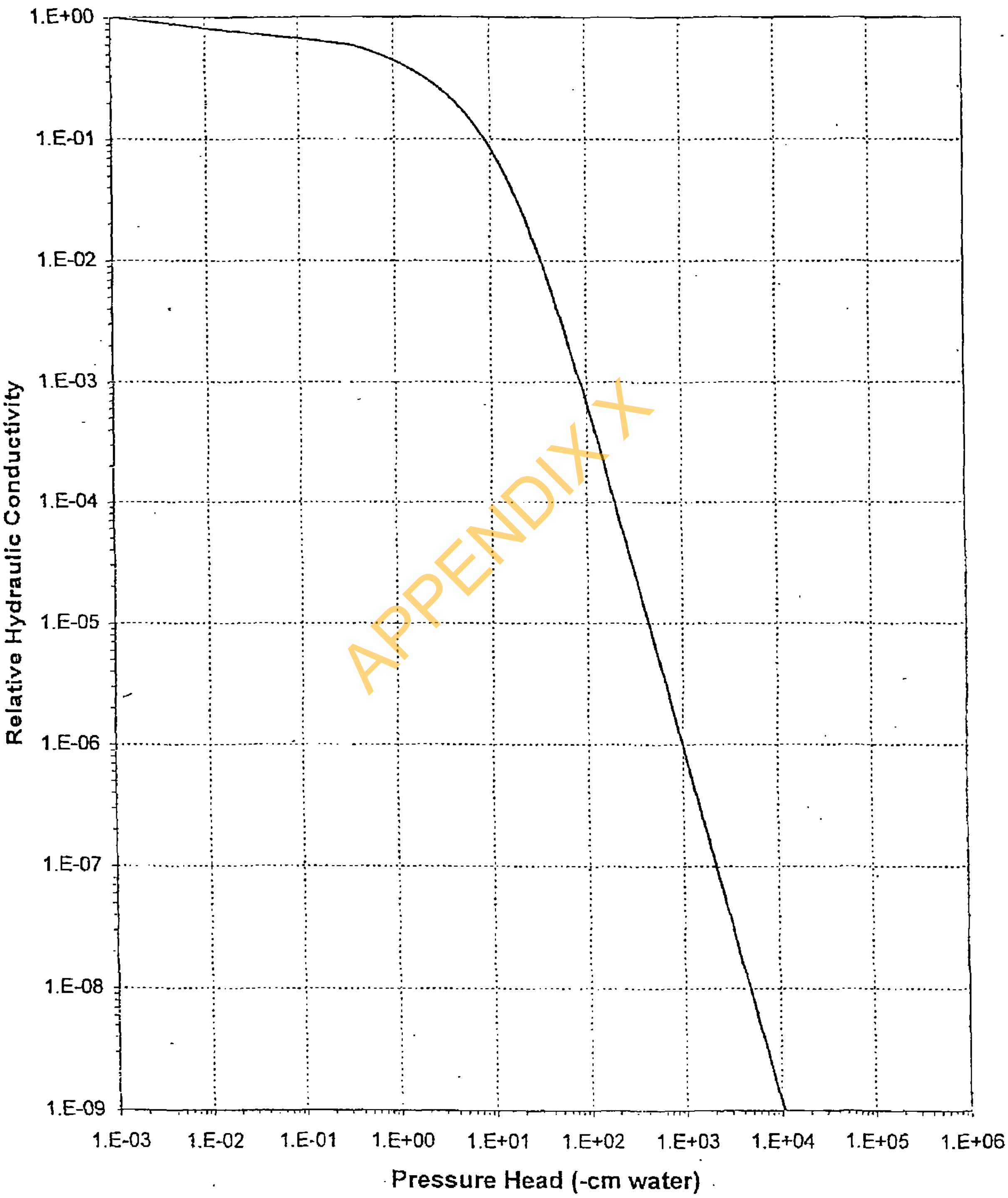
Plot of Hydraulic Conductivity vs Moisture Content

Sample Number: BLUF-4



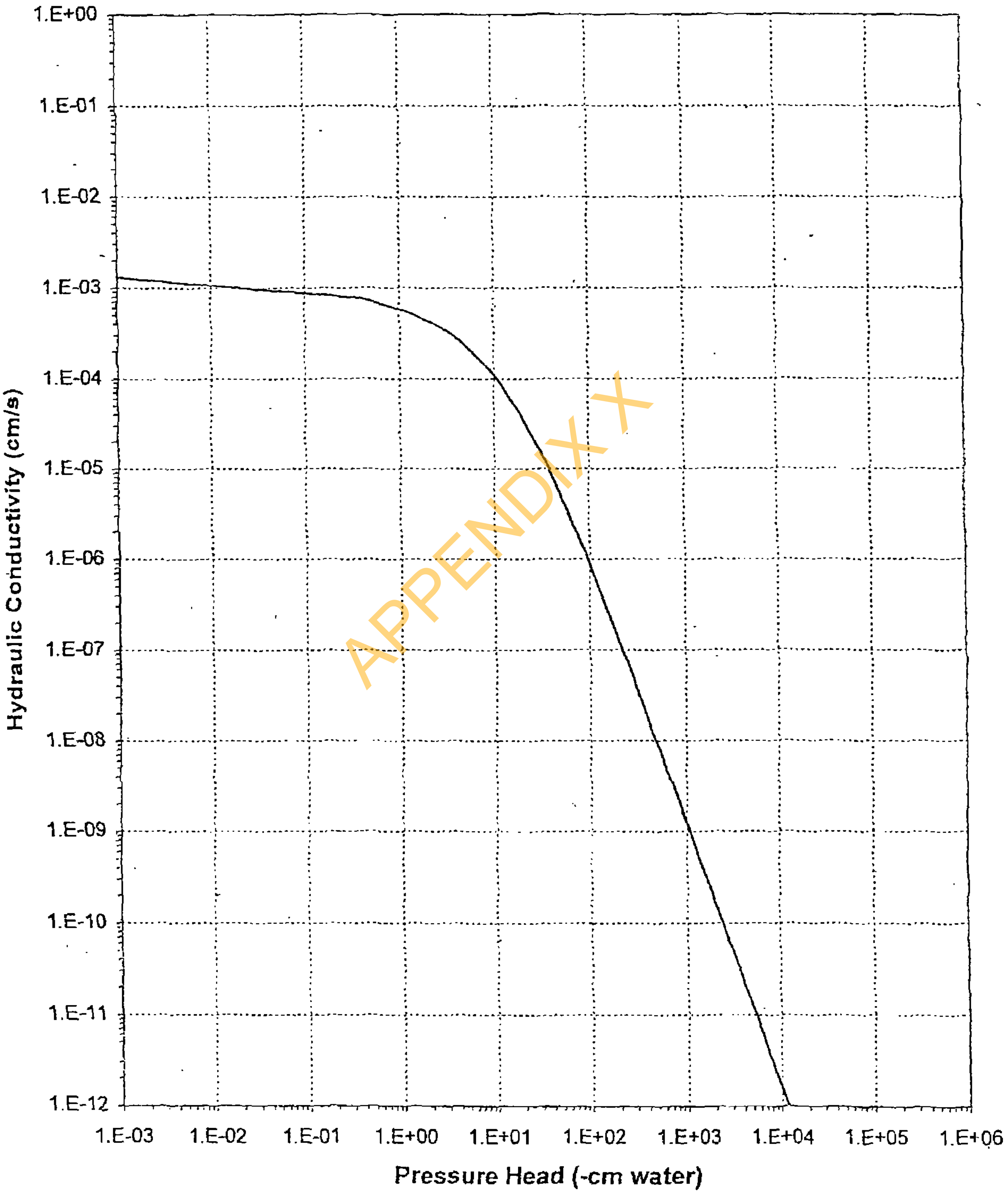
Plot of Relative Hydraulic Conductivity vs Pressure Head

Sample Number: BLUF-4



Plot of Hydraulic Conductivity vs Pressure Head

Sample Number: BLUF-4



Bayview Landfill
Frost Depth Calculation

Elberta, Utah NOAA Data
1951 - 1980

Dry Density	94	
Moisture Content	13	
Freezing Index (degree day)	880	
Mean Annual Air Temperature (deg F)	50.3	
Vo (deg F)	24.6	
Vs (deg F)	7.0	=freezing index/length of freezing
Length of Analysis Freezing Period (day)	125	
Latent Heat of Fustion "L" (Bty/ft^3)	1752.3	
Volumetric Heat "C" (Btu/ft/degF)	25.145	
Thermal Conductivity of Soil (Btu/ft^2/hr/degF/in)	0.6	
Alpha (Vo/Vs)	3.5	
Fusion Parameter "mu"	0.10	=C*Vs/L
Correction Coefficient "lambda"	0.62	chart

z = Lambda * ((48*F)/(L/k))^0.5

z = 2.36 feet

z = 28.3 inches

UDOT Map → 20 – 30 inches

Air Freezing Index- USA Method (Base 32^0 Fahrenheit)

State and Station Name	Station Number	Lat. (Deg. - Min.)	Long. (Deg. - Min.)	Elev. (feet)	Mean Annual Temp. (^{0} F)	Air Freezing Index Return Periods (^{0}F-Days) & Associated Probabilities (%)										
						1.1 Year (10%)	1.2 Year (20%)	2 Year (50%)	2.5 Year (60%)	3.3 Year (70%)	5 Year (80%)	10 Year (90%)	20 Year (95%)	25 Year (96%)	50 Year (98%)	100 Year (99%)
Utah																
BRYCE CANYON NP HDQ	421008	N3739	W11210	7915	41.1	606	743	1010	1090	1173	1270	1399	1503	1532	1615	1689
CAPITOL REEF NATL MON	421171	N3817	W11116	5500	53.3	60	100	217	263	317	387	493	590	620	708	791
CEDAR CITY FAA AP	421267	N3742	W11306	5620	50.3	80	125	248	293	345	411	509	596	622	699	771
COTTONWOOD WEIR //	421759	N4037	W11147	4950	53.6	50	80	165	198	235	283	355	420	439	497	551
COVE FORT //	421792	N3836	W11235	5980	47.8	158	231	407	468	537	621	743	847	878	968	1050
DEER CREEK DAM	422057	N4024	W11132	5270	43.5	464	614	936	1039	1150	1281	1464	1614	1658	1783	1895
DESERET	422101	N3917	W11239	4585	49.2	168	249	453	524	605	705	850	976	1014	1123	1223
DESERT EXP RANGE	422116	N3836	W11345	5252	49.0	136	212	416	491	578	686	849	992	1035	1162	1280
DUGWAY	422257	N4011	W11256	4340	51.4	114	178	344	405	475	562	693	807	842	943	1037
ECHO DAM	422385	N4058	W11126	5500	44.9	379	498	753	833	920	1023	1165	1282	1316	1413	1500
ELBERTA	422418	N3957	W11157	4690	50.3	113	177	347	410	482	572	708	828	864	969	1068
EPHRAIM SORENSENS FLD	422578	N3921	W11135	5580	47.0	297	405	650	730	818	923	1071	1195	1231	1335	1428
ESCALANTE	422592	N3746	W11136	5810	49.4	114	173	324	378	440	516	629	728	757	843	923
FAIRFIELD	422696	N4016	W11205	4876	46.6	271	375	614	692	779	883	1032	1156	1192	1297	1392
FARMINGTON USU FLD STA	422726	N4101	W11154	4340	51.2	76	123	253	302	360	432	543	641	671	760	842
FERRON	422798	N3905	W11108	5925	47.7	318	428	670	748	833	935	1077	1195	1229	1328	1416
FILLMORE	422828	N3857	W11219	5160	51.2	79	127	257	306	363	435	544	640	670	756	837
FORT DUCHESNE	422996	N4017	W10952	4990	44.7	627	846	1332	1489	1661	1866	2153	2392	2462	2662	2841
GARFIELD	423097	N4043	W11212	4310	53.0	68	109	223	266	316	379	475	560	586	663	734
GREEN RIVER AVN	423418	N3900	W11010	4070	51.5	180	274	516	603	702	826	1008	1167	1214	1354	1482
HANKSVILLE	423611	N3822	W11043	4308	53.1	122	194	390	463	548	655	817	961	1004	1132	1252
HEBER	423809	N4031	W11125	5580	44.4	414	544	822	910	1005	1117	1273	1401	1438	1543	1638
HIAWATHA	423896	N3929	W11101	7230	45.2	405	521	760	834	914	1007	1134	1238	1268	1354	1429
JENSEN	424342	N4022	W10921	4720	45.4	570	782	1261	1419	1592	1798	2091	2336	2408	2614	2800
KANAB	424508	N3703	W11232	4985	54.6	13	24	59	73	91	115	152	188	199	232	263
LAKETOWN	424856	N4149	W11119	5988	42.0	523	678	1001	1102	1211	1338	1514	1657	1699	1817	1921
LA VERKIN	424968	N3712	W11316	3200	58.6	3	6	20	26	33	44	61	78	83	100	116
LEVAN	425065	N3933	W11152	5300	49.1	175	254	445	511	584	674	804	915	948	1044	1131
LOA	425148	N3824	W11139	7045	43.2	397	513	754	830	911	1005	1136	1242	1273	1360	1438
LOGAN UTAH STATE UNIV	425186	N4145	W11149	4785	48.0	225	322	554	634	722	829	984	1116	1155	1268	1371
MANTI	425402	N3915	W11138	5740	47.6	214	297	485	547	616	698	815	914	943	1026	1101
MEXICAN HAT	425582	N3709	W10952	4270	56.3	15	35	118	159	212	289	422	558	602	740	880
MILFORD WSO //	425654	N3826	W11301	5028	49.1	149	226	420	489	568	666	811	936	974	1084	1185
MOAB 4 NW	425733	N3836	W10936	3965	56.6	36	68	176	222	278	355	478	595	831	743	850

30yr ≈ 88

Footnotes:

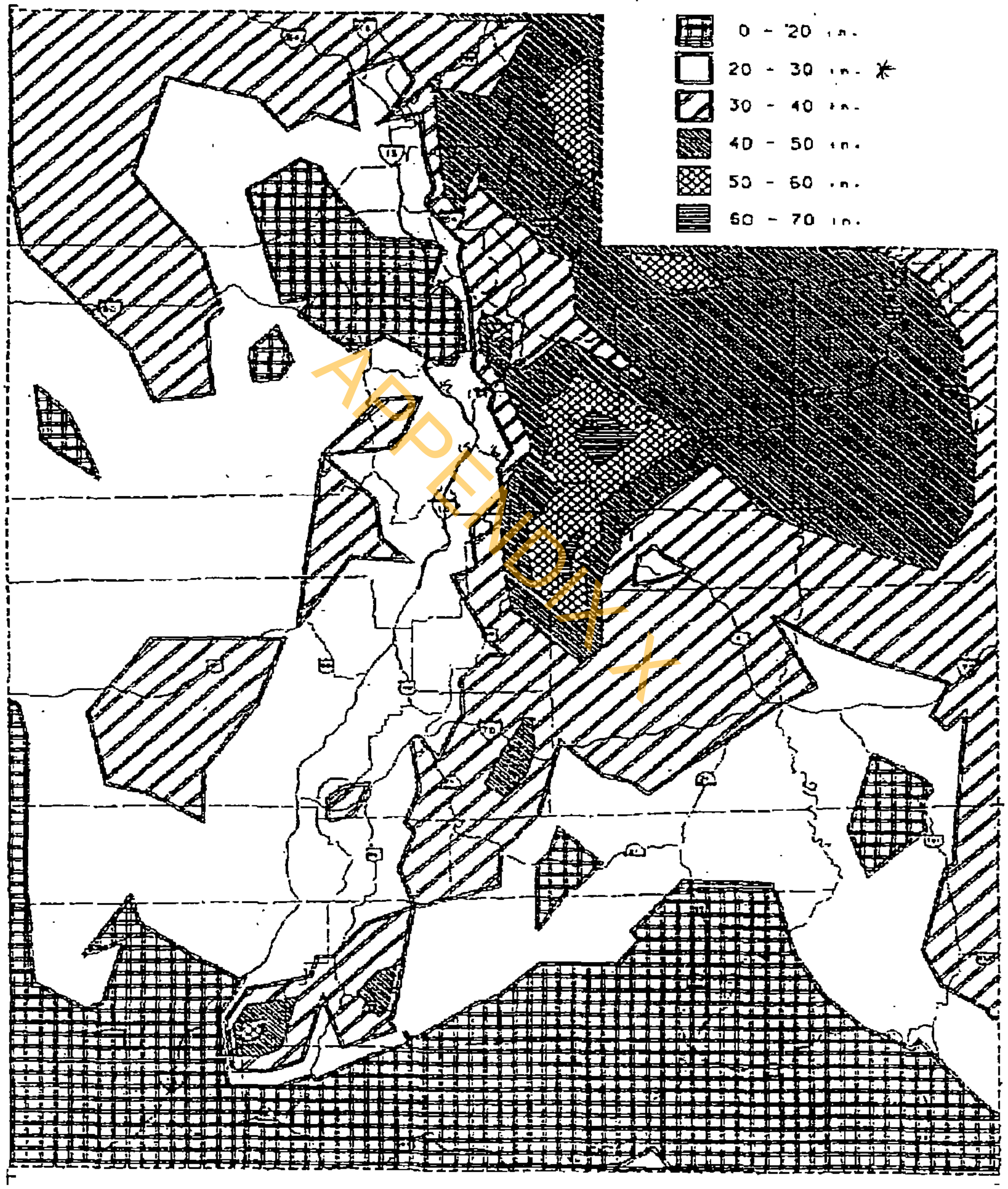
* Probability of occurrence less than indicated probability (Value=0)

** No Freezing Index Values Recorded during 1951-80 period (Value=0)

UDOT Map
from Pavement Design Manual

MAX. FROST PENETRATION DEPTH

Estimated Using Freezing Indices (Corps of Engineers Method)



KLEINFELDER
An employee owned company

July 31, 2003
File No.: 30268.001

Mr. Terry Warner
HDR Engineering, Inc.
3995 South 700 East, Suite 100
Salt Lake City, UT 84107

Subject: Source Material Investigation
South Utah Valley Landfill (Bayview Landfill)
Utah County, Utah

Dear Mr. Warner:

In conjunction with Kleinfelder's report dated July 1, 2003, we are providing the following information to summarize the findings of our report.

Identification of Suitable Material
Based on laboratory testing and modeling, as presented in Kleinfelder's Meteoric Water Infiltration Study, one of the predominant soils at Bayview Landfill has been identified as an acceptable material for the Cell 1 protective cap. This soil is classified as a silty sand (SM) to sandy silt (ML), and is generally olive brown in color. Based on numerous tests performed on this proposed capping material, this material can generally be characterized by the following grain-sizes:

Sieve Size	Percent Passing
No. 4 (1/4 inch)	95 – 100%
No. 40	70 – 100%
No. 60	60 – 95%
No. 200	30 – 70%

Other materials present at the site differ significantly from this gradation criteria and are generally easy to screen out based on field logging and gradation tests.

Location of Suitable Material
The proposed suitable cap material was found in the stockpile north of Cell 1 and in the floor of the excavation for Cell 2. In the three borings drilled in the stockpile north of Cell 1, we found one 5-foot thick layer in B-3, and a few other pockets of material that did not meet these specifications.

We investigated the materials immediately below the stockpile north of Cell 1 and beneath the dune sand south of Cell 2 and found only some pockets of material suitable for construction of the protective cap layer in those locations.

Two test pits excavated within Cell 2 contained 6 to 7 feet of the suitable cap material.

We recommend that lenses or pockets encountered within the stockpile or under Cell 2 that do not fall within the gradation criteria identified above be excluded from use in the protective cap layer unless further testing and analysis is performed to evaluate their suitability.

Kleinfelder appreciates this opportunity to assist you. If you have any questions regarding this report please do not hesitate to contact us at (801) 466-6769.

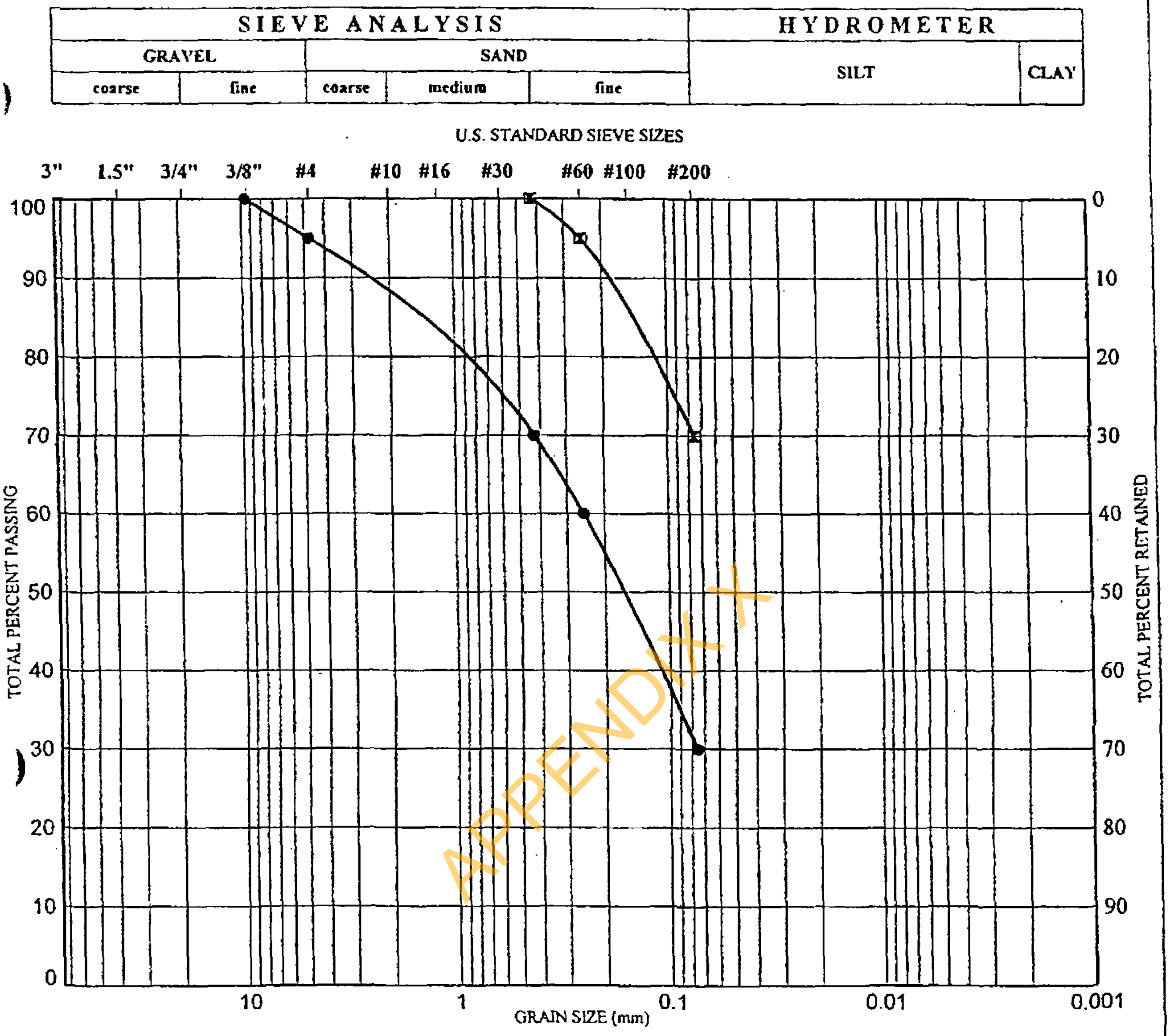
Respectfully,

KLEINFELDER, INC.

Renee Zollinger, P.G.
Senior Geologist

Scott Davis, P.E.
Geotechnical Division Manager

cc: Mike Oden, HDR Engineering
Richard Henry, South Utah Valley Solid Waste District



Symbol	Sample	Depth (ft)	USCS Soil Description	USCS Classification
●				
☒				

KLEINFELDER

PROJECT NO.

GRAIN SIZE DISTRIBUTION

FIGURE

B-1

KLEINFELDER

APPLICATION FOR AUTHORIZATION TO USE

Meteoric Water Infiltration Study
South Utah Valley Landfill (Bayview Landfill)
Utah County, Utah
Report originally prepared for *HDR Engineering, Inc.*

File Number: 26515.001 Report Date: September 9, 2003

KLEINFELDER, INC.
849 West LeVoy Drive, Suite 200
Taylorsville, UT 84123
(801) 261-3336
(801) 261-3306

To Whom It May Concern:

Applicant understands and agrees that the above-referenced report for the subject site is a copyrighted document, that Kleinfelder, Inc. is the copyright owner and that unauthorized use or copying of the report for the subject site is strictly prohibited without the express written permission of Kleinfelder, Inc. Applicant understands that Kleinfelder, Inc. may withhold such permission at its sole discretion, or grant permission upon such terms and conditions as it deems acceptable.

By signing below, the Relying Parties agree to the same terms and conditions as Kleinfelder's original client, including any limitations of liability or indemnity obligations. The original services agreement may be obtained from the original client identified above or from Kleinfelder, upon request.

To be Completed by Applicant

_______________ *(company name)*
_______________ *(address)*
_______________ *(city, state, zip)*
_______________ *(telephone)* _______________ *(FAX)*

By: _______________ *(Print Name)*
_______________ *(Signature)*
Title: _______________
Date: _______________

To be Completed by Kleinfelder, Inc.

______ Approved for reuse with applicant agreeing to above terms and concurrence by original client. Additional fees are estimated at $__________.
______ Disapproved, report needs to be updated.

By: _______________ Date: _______________
Kleinfelder, Inc.

RETURN COMPLETED FORM TO KLEINFELDER

APPENDIX N

Attachment N-1

Addendum to Closure Cap Equivalency Report

KLEINFELDER
An employee owned company

February 9, 2004
File No.: 26515.001

FEB 10 2004

Mr. Terry Warner
HDR Engineering, Inc.
3995 South 700 East, Suite 100
Salt Lake City, Utah 84107

Subject: **Estimate of Realistic Infiltration Rates**
South Utah Valley Landfill (Bayview Landfill)
Utah County, Utah

Dear Terry,

I have reviewed the Utah Division of Solid and Hazardous Waste (DSHW) Request for Additional Information dated November 12, 2003. I also attended a meeting at DSHW with you on December 9, 2003. This letter addresses the questions raised by DSHW in Item No. 3 (2nd bullet) of the Request for Additional Information.

DSHW QUESTION

The DSHW requested that we provide evidence that the proposed evaporative cap will perform as well as an actual cap that Stephen Dwyer tested and found exhibited a leakage rate less than 3 mm/year.

This question is addressed below.

EVIDENCE THAT PROPOSED CAP MEETS PERFORMANCE STANDARD

When the modeling study was performed last year, no performance standard existed for evaporative caps. Under DSHW guidance, our modeling study (Kleinfelder, 2003[1]) showed that the proposed evaporative cap out-performs the prescriptive cap under normal and worst-case weather conditions. However, all modeling was performed on a comparative basis (prescriptive versus evaporative). Our study did not include developing an estimate of "real" infiltration rates under site conditions.

Since we performed the required modeling, DSHW has begun to consider using an infiltration rate of 3 mm/year as a performance standard for evaporative caps. I assume DSHW will enforce this standard under normal weather conditions (possibly including realistic/historical worst case weather), since the standard appears to be based on actual field test cases conducted under real weather patterns, as well as modeling performed using normal climate conditions.

---

[1] Kleinfelder, 2003. *Meteoric Water Infiltration Study, South Utah Valley Landfill*, September 9, 2003, File No. SLC3R082.

I have looked at the studies of "real" infiltration rates suggested by DSHW, compared these studies to our modeling study, and have concluded that the proposed evaporative cap at Bayview Landfill will meet the performance standard being considered by DSHW for the following reasons:

1. All studies I reviewed demonstrated that the evaporative caps out-perform prescriptive caps. This information is in agreement with our modeling study, where, under identical worst-case (conservative) assumptions, the proposed evaporative cap allowed less infiltration than the prescriptive cap.

   This result is summarized below.

	Range of Infiltration Rates	
	Normal Climate	**Hypothetical Worst Case Rainfall**
Prescriptive Cap	41.4 to 46.5 mm/yr	138.5 to 181.2 mm/yr
Evaporative Cap	26.3 to 41.2 mm/yr	70.7 to 121.7 mm/yr

2. Field studies performed by Stephen Dwyer (Dwyer, 2000[2]) quoted "real" (observed) prescriptive cap infiltration rates that average 4.82 mm/year compared to "real" evaporative cap infiltration rates that average 0.19 mm/year. The observed (Dwyer) and modeled prescriptive (Kleinfelder) caps should have similar rates, but the rates measured in the field differ from our modeled rates by an order of magnitude because: our model omitted the mitigating effects of plant transpiration; our modeled rates are based on conservative choices for cell size, boundary types, initial saturation, etc., used in "building" the numerical model; our model used hypothetical high rainfall (greater than observed in historical records) to evaluate worst case performance; and our modeled "normal" rainfall is approximately 3 times higher than actual rainfall in the Dwyer study.

   If our conservative assumptions increased the modeled prescriptive cap infiltration rate by an order of magnitude over Dwyer's results, they probably also increased our evaporative cap infiltration rates by an order of magnitude. Therefore, it appears that under more realistic assumptions, our modeled infiltration rates for the evaporative cap would have been around 2 to 4 mm/year.

3. The studies we reviewed consistently demonstrate that, in practice, evaporative caps allow about 10 times less moisture to infiltrate than do prescriptive caps. We made one modeling assumption on our evaporative cap that "overruled" the model's predication for producing that result. We added a 2-inch hypothetical "topsoil" layer to the top of the modeled evaporative cap that allowed excess water storage in an attempt to simulate a loosened ground surface produced by wind erosion. In our experience, adding a loose, organic topsoil significantly

---

[2] Dwyer, et al., 2000. *Water Balance Data from the Alternative Landfill Cover Demonstration.*

increases the infiltration rate predicted by the model. Our approach in the modeling study was to add a conservative "worst-case" condition to the evaporative cap and compare it to the prescriptive cap. Even under this worst-case assumption, the evaporative cap allowed less infiltration than the prescriptive cap. In reality, we do not observe a 2-inch, loose, organic topsoil developing in the area around Bayview Landfill and do not expect the cap to develop a permanent layer comparable to the modeled topsoil layer.

Based on the results of the other studies I reviewed, especially Dwyer's work, I believe this hypothetical "topsoil effect" we included produced unrealistically high infiltration rates for the evaporative cap. Removing this topsoil from the model would decrease the modeled infiltration rate significantly, and would result in predicted performance that better matches the observed performance in Dwyer's study.

4. Several studies I reviewed (Mackey, 2002[3]; Forlina, 2003[4]; Zornberg, 2003[5]; and Thompson, 2003[6]), described the composition and texture of evaporative cap material that either met the 3 mm/year performance standard or exceeded the Subtitle C prescriptive cap performance. Accepted cap thicknesses range from 20 to 48 inches and, when specified at all, fines comprised at least 28 to 50 percent of the soil material. These soils and cap thicknesses are very similar to the Bayview Landfill proposed evaporative cap, and were applied in similar climatic settings (Montana, Colorado, and California).

CONCLUSION

For the four reasons discussed above, I believe the proposed evaporative cap at Bayview Landfill will perform better than the prescriptive cap described in the Solid Waste Rules will perform as well as the other evaporative caps being documented in the literatures and will meet the 3 mm/year performance criteria under the same conditions that other evaporative caps meet that criteria.

LIMITATIONS

The conclusions drawn above are based on the study modeling performed by Kleinfelder and the information available in cited literature. These conclusions are subject to limitations on the current accepted understanding of unsaturated flow processes and the limited field tests that have been performed and documented to date. No warranty, express or implied, is made.

---

[3] Mackey, et al., 2003. *RCRA Equivalent Cover Demonstration Project, Rocky Mountain Arsenal.*

[4] Forlina, Ron, 2003. *The Approval Process for an Alternative Final Cover System for the Denver Arapahoe Disposal Site, Colorado.*

[5] Zornberg, Jorge, 2003. *Operating Industries, Inc., Superfund Landfill.*

[6] Thompson, Rick, 2003, *Mr. M. Landfill, Alternative Cover, Fergas County, Montana.*

I appreciate this opportunity to assist you. Please do not hesitate to call me if you have questions or need additional information.

Sincerely,

KLEINFELDER, INC.

Renee Zollinger, R.G.
Regional Manager

cc. Mike Oden, HDR Engineering, Inc.
Dick Sprague, HDR Engineering, Inc.
Richard Henry, South Utah Valley Landfill

Appendix O

APPENDIX O

Construction Quality Assurance Plan

SUVSWD Bayview Class I Landfill
Permit Application

Appendix O: Construction Quality Assurance Plan

SUVSWD Bayview Class I Landfill
Permit Application

Prepared for
Bayview Landfill
South Utah Valley Solid Waste District
Springville, Utah

Prepared by
HDR Engineering, Inc.
3995 South 700 East, Suite 100
Salt Lake City, UT 84107

March 2009

Contents

Tables

Attachments

Attachment O-1: Example Forms for Cell Construction and Closure
Attachment O-2: Final Cover Grain Size Distribution

1.0 Introduction

The Construction Quality Assurance Plan (CQAP) will document that the constructed unit meets or exceeds all design criteria contained in the permit, issued by the Utah Department of Environmental Quality (UDEQ). The CQAP describes: 1) observations, inspections, tests and measurements to be performed; 2) roles and responsibilities of various parties in performing Construction Quality Assurance (CQA) and Construction Quality Control (CQC); and 3) documentation, record keeping and certifications.

The procedures described below are tailored to the Bayview Landfill Disposal Site (Site) and are in part excerpted or adopted from EPA/540/R-92/073 Technical Guidance Document, EPA 530-R-93-017 Technical Manual - Solid Waste Disposal Facility Criteria and EPA/600/R-93/182 Technical Guidance Document. The specific site components addressed include:

1. Subgrade;
2. Geotextiles;
3. Geosynthetic Clay Liners;
4. Geomembranes;
5. Leachate Collection Systems; and
6. Final Cover Systems.

CQA consists of a planned series of observations and tests used to provide quantitative criteria with which to accept the final product. CQC is an ongoing process of measuring and controlling the characteristics of the product in order to meet manufacturer or project specifications.

CQC is a production tool that is employed by the manufacturer of materials and by the contractor installing the materials at the site. CQA, by contrast, is a verification tool employed by the South Utah Valley Solid Waste District (SUVSWD) to ensure that the materials and installation meet project specifications. CQC is performed independently of the CQA. For example, while a geomembrane liner installer will perform CQC testing of field seams, the CQA program will require independent CQA testing of those same seams by a third-party inspector.

2.0 CQA and CQC Team

The CQAP will be implemented under the supervision of a Utah registered professional engineer. The SUVSWD will designate a registered professional engineer to oversee the execution of the CQAP and related field and testing activities. The SUVSWD will also designate a lead individual who will be identified as the CQA officer. The SUVSWD may elect to utilize contract firms for monitoring, observation and testing services.

The CQAP and CQC plan will be implemented through inspection activities that include visual observations, field testing, and evaluation of the test data. Inspection activities will typically be concerned with four separate functions:

- Quality Control (QC) inspection by the manufacturer to provide an in-process measure of the product quality and its conformance with the project plans and specifications. Typically, the manufacturer will be required to provide QC test results to certify that the product conforms to project plans and specifications.
- Construction Quality Control (CQC) inspection by the contractor to provide an in process measure of construction quality and conformance with the project plans and specifications, thereby allowing the contractor to correct the construction process if the quality of the product is not meeting the specifications and plans.
- Construction Quality Assurance (CQA) testing by the SUVSWD (Acceptance Inspection) performed usually through the third-party testing firm to provide a measure of the final product quality and its conformance with project plans and specifications.
- Regulatory Inspection or documentation review, if required, to verify that the final product conforms with all applicable codes and regulations.

The responsibilities of the SUVSWD's CQA officer and the CQA officer's staff vary by physical component being constructed. The personnel will be assigned responsibilities based upon knowledge and competence to perform CQA in a specific area. Prior to starting an activity, the CQA officers or individuals within the CQA officer's staff will be identified so that the SUVSWD, UDEQ or others can verify that individual's qualifications.

Activities of the CQA officer are essential to document quality of construction. The CQA officer's responsibilities and those of the CQA officer's staff members may include:

- Communicating with the contractor;
- Interpreting and clarifying project drawings and specifications with the designer, SUVSWD and contractor;

- Recommending acceptance or rejection by the SUVSWD of work completed by the construction contractor;
- Submitting blind samples (e.g., duplicates and blanks) for analysis by the contractor's testing staff or one or more independent laboratories, as applicable;
- Notifying SUVSWD of construction quality problems not resolved on-site in a timely manner;
- Observing the testing equipment, personnel, and procedures used by the construction contractor to check for detrimentally significant changes over time;
- Reviewing the construction contractor's quality control recording, maintenance, summary, and interpretations of test data for accuracy and appropriateness; and
- Reporting to the SUVSWD on monitoring results.

The SUVSWD will have the authority to stop work or reject work if problems or deficiencies are encountered.

3.0 Inspection, Sampling, and Testing

The following is an overview of CQA and CQC activities, by major physical components, to be undertaken before, during or after construction. Reference should be made throughout this discussion to Table O-1 for a more detailed list of major material testing methods and frequency. Table O-1 frequency for protective cover material may be adjusted based upon final material sources, field observations, and results of testing during construction. Additional QC, CQC, and CQA provisions and standards are anticipated to be included in final construction plans and specifications and for minor system components. Final construction plans and specifications will further delineate sampling strategies, including methods of determining sample locations, frequency of sampling, acceptance and rejection criteria, and methods of implementing corrective measures.

3.1 Subgrade

Final construction plans and specifications along with contractors CQC program will address preparation and compaction of subgrade material to the required bearing strength.

3.2 Geotextiles

Prior to installation, the contractor, material installer, and CQA person will inspect the subgrade to certify its adequacy. During construction, geotextile placement, including coverage and 12-inch minimum overlap and anchorage, will be observed and documented. In addition to field observations, geotextile sampling and testing for tensile strength and AOS may be performed to document that the geotextile meets the design specifications.

3.3 Geosynthetic Clay Liner (GCL)

This section includes the requirements for selection, installation, and protection of geosynthetic clay liner (GCL).

Table 3-1. Material Testing Methods and Frequency

Material Tested	Parameter	Test Method	Minimum Testing Frequency
Borrow Source for Protective Cover / Leachate Material	Hydraulic Conductivity	ASTM D2434	4 per material type
	Fines	ASTM D422	1 per 3,000 cubic yards

Granular Layers	% Coarse/Fines (Pipe Bedding Layer surrounding leachate collection pipe only)	ASTM C 136	1 per 1,500 yd^3
	Total Thickness	Measurement	4 per acre
	Soil Placement/Compaction	Visual Observation	Full Coverage
Geomembrane	Material Thickness	ASTM D 1593/D5199	once per roll
	Leaking Seam	Vacuum testing or pressure testing	100% of all field welded seams
	Defect/Punctures	Visual inspection	100% of all seams and liner surface
	Shear	GRI GM 13	Minimum 500 feet plus twice daily during installation
	Peel	GRI GM 13	Minimum 500 feet plus twice daily during installation
Piping	Leakage on non-pressure	Low pressure air	All non-slotted sections
	Alignment	Visual Observation	All sections of pipe

Notes: Tests listed are for major components. Additional material standards and CQC/CQA tests will be specified in final design including CQC and CQA for other components of the construction. Storage handling preservation and transport of soil samples will be done in accordance with ASTM D 4220.

3.3.1 Pre-installation

The following must be submitted to the CQA personnel for approval prior to GCL deployment.

- The supplier or GCL manufacturer results for standard tests described in Table O-2.
- Written verification that the GCL meets the properties listed in Table O-2.
- Written certification that the GCL manufacturer has continuously inspected each roll of GCL for the presence of needles and other defects and found GCL to be defect free.
- Written certification from the GCL manufacturer that the bentonite will not shift during transportation or installation thereby causing thin spots in the body of the GCL.
- Quality control certificates signed by a responsible party of the GCL manufacturer for each roll delivered to the site. Each certificate will include roll identification numbers and results of all quality control tests. At a minimum, results will be given for tests corresponding to Table O-2. The bentonite and textile suppliers will each certify the respective properties under the Manufacturer's Quality Control. The GCL manufacturer will also perform the

bentonite tests described under the Manufacturer's Quality Control and third-party tests.

Table 3-2. Standard Tests on GCL Material

TEST	ITEM	TYPE OF TEST	STANDARD TEST METHOD	FREQUENCY OF TESTING
Manufacturer's Quality Control	Bentonite(A)	Free Swell(A)	ASTM D 5890	per 50 tons and every truck or railcar
		Fluid Loss(A)	ASTM D 5891	per 50 tons and every truck or railcar
	Geotextile	Grab Tensile Strength(B)	ASTM D 4632	per 200,000 ft2
		Mass/Unit Area	ASTM D 5261	per 200,000 ft2
	GCL Product	Grab Tensile Strength(B)	ASTM D 4632	per 200,000 ft2
		Clay Mass/Unit Area(C)	ASTM D 5993	per 40,000 ft2
		Permeability(D)	ASTM D 5084	per week for each production line(E)
		Lap Joint Permeability(D)(F)	ASTM D 5084	Per each material and lap type
Conformance Testing by 3rd Party Independent Laboratory	GCL Product	Clay Mass/Unit Area(C)	ASTM D 5993	at least 1 test per 100,000 ft2 and ASTM D 4354 procedure A
		Permeability(D)(F)	ASTM D 5084	per 100,000 ft2
		Direct Shear (F)(G)	ASTM D 5321	Per GCL/adjoining material type

Notes:

A - Tests to be performed on bentonite before incorporation into GCL. Free swell shall have a minimum test value of 24 ml. Fluid loss will have a maximum value of 18 ml.

B - For geotextile backed products only. Geotextiles will meet minimum manufacturer's criteria.

C - Minimum test value of 0.8 lb./ft^2 on an oven dry basis (zero percent moisture).

D - 1 x 10^{-8} m^3/m^2/sec or as required by the permit.

E - Report last 20 permeability values, ending on production data of supplied GCL.

F - Test at confining/consolidating pressures simulating field conditions.

G - Not applicable for slopes of 7H: 1V or flatter. Testing must be on material in hydrated state unless GCL is to include geomembrane on both sides of GCL.

3.3.2 Delivery, Storage, and Handling

Packing and Shipping

The GCL will be supplied in rolls wrapped individually in relatively impermeable and opaque protective covers. The GCL rolls will be marked with the following information:

- Manufacturer's name;
- Product Identification;

- Roll number;
- Roll dimensions;
- Roll weight.

Storage and Protection

The rolls will be stored on-site by the Contractor until installed. After Contractor mobilization, he will store and protect GCL from dirt, water, ultraviolet light exposure, and other sources of damage. He will also preserve the integrity and readability of GCL roll labels. Rolls must not be stacked higher than recommended by the manufacturer to preclude thinning of bentonite at contact points.

3.3.3 Installation

The GCL will be handled in a manner to ensure that it is not damaged as recommended by the GCL manufacturer. At a minimum, the following will by complied with:

- On slopes, anchor the GCL securely and deploy it down the slope in a controlled manner.
- Weight the GCL with sandbags or equivalent in the presence of wind.
- Cut GCL with a cutter (hook blade), scissors, or other approved device. Protect adjacent materials from potential damage due to cutting of GCL.
- Prevent damage to underlying layers during placement of GCL.
- During GCL deployment, do not entrap in or beneath GCL, stones, trash, or moisture that could damage GCL.
- Visually examine entire GCL surface. Ensure no potentially harmful foreign objects, such as needles, are present.
- Do not place GCL in the rain or at times of impending rain.
- Do not place GCL in areas of ponded water.
- Replace GCL that is hydrated before placement of overlying geomembrane and cover soil.
- In general, only deploy GCL that can be covered during that day by geomembrane.
- For needle-punched GCLs, add granular bentonite to the overlapped areas at the manufacture's specified rate.
- Avoid dragging GCL on the subgrade.

- Vehicular traffic other than low contact pressure vehicles such as smooth-tired ATV's or golf carts must not be allowed on deployed GCL.
- Installation personnel must not smoke or wear damaging shoes when working on GCL.

Overlaps

The GCL must be overlapped to the manufacturer's recommendations, which will vary according to seam location and climatic conditions. For needle-punched GCLs, apply granular bentonite to overlapped area at a rate required by the manufacturer. At sumps, overlap GCLs at least 1 foot. At the bottom of the collection sumps, two layers of GCL and two layers of 60-mil HDPE are required as shown on the plans. Avoid placing seams on top of underlying seams.

In general, horizontal seams and mid-slope anchor trenches are not allowed on side slopes. However, if prohibitive slope lengths cannot otherwise be overcome, the CQA personnel may approve a glue-bonded seam.

Defects and Repairs

Repair all flaws or damaged areas by placing a patch of the same material extending at least 1 foot beyond the flaw or damaged area. Add granular bentonite to the overlapped edges of the patch at the manufacturer's specified rate.

3.4 Geomembranes

Source testing and material quality control testing will be performed prior to material installation. These CQC steps involve manufacture, fabrication, storage at the factory, shipment and storage at the Site of the geomembrane and geotextiles. Manufacturers will be required to certify thickness, width, length as well as chemical/resin formulation and material properties in accordance with GRI Test Method GM 13. Manufacturers will be required to submit information demonstrating testing of any factory fabricated seams. Information may be required on factory storage and shipment where concerns are identified. At the site, records will be maintained on any material received (especially material received in damaged condition) and on on-site storage and handling practices. Lining materials delivered to the site will be inspected for damage by the installer, unloaded, and stored. Materials will be stored in accordance with the manufacturer's recommendation. The storage will be such that:

- Unloading of rolls at the job site's temporary storage location will be such that no damage to the lining materials occur;
- Pushing, sliding or dragging of rolls of lining materials will not be permitted;
- Temporary storage at the job site will be in an area where standing water cannot accumulate at any time;

- The ground surface will be suitably prepared such that no stones or other rough objects which could damage the lining materials are present;
- Temporary storage of rolls of lining materials in the field will not be so high that crushing of the core or flattening of the rolls occur; and
- Suitable means of securing the rolls will be used such that shifting, abrasion or other adverse movement does not occur.

Prior to installation, the contractor, material installer, and CQA person will inspect the geomembrane to certify its adequacy. During deployment, the CQA personnel, the installer, and possibly the manufacturer's representative will observe the layout, ballasting, seaming and covering. Records will be maintained to verify proper panel layout, weather related impacts (e.g. wind) and material handling. Once deployed, the entire roll or panel will be inspected for blemishes, scratches, and imperfections. The CQA person will spot check material thickness and observe field seaming and seam testing.

Installation of geomembrane liners will be in conformance with a quality assurance/quality control plan. Tests performed to evaluate the integrity of geomembrane seams will be both "destructive" and "non-destructive." All seams failing the non-destructive or destructive tests will be repaired.

3.4.1 Trial Seams

Trial seams will be done twice daily during installation to demonstrate pre-qualifying experience for personnel, equipment and procedures. Trial seams will be performed on the identical geomembrane material under the same climatic conditions as the actual field production seams will be made. Trial seams will also be made whenever personnel or equipment are changed, and when climatic conditions reflect wide changes in geomembrane temperature or when other conditions occur that could affect seam quality.

3.4.2 Non-Destructive Seam Testing

Non-destructive test methods will be conducted in the field on an in-place geomembrane. These test methods determine the integrity of the geomembrane field seams. All seams will be non-destructively tested. Non-destructive test methods may include vacuum box, or pressurized dual seam tests. Seam sections that fail non-destructive tests will be carefully delineated, patched or re-seamed, and retested. For failing fusion welds, the outer seam lip may be extrusion fillet-welded to the parent sheet or cap stripped over the entire edge. For failing extrusion welds, a cap strip repair will be used. All repaired areas will be non-destructively tested by vacuum box methods. Large patches or re-seamed areas may be subjected to destructive test procedures for quality assurance purposes. The final plans and specifications will describe the degree to which non-destructive and destructive test methods will be used in evaluating failed portions of non-destructive seam tests. For the 60-mil HDPE, double-wedge thermal seams will be pressure tested at a maximum of 30 pounds per square inch (psi) with no more than a 3 psi pressure drop over a 5 minute time period. Tests will occur over a 100 to 1,000 foot distance. Other fusion-welded seams will be tested with a 2.5-psi vacuum box. Other testing will conform to recommendations of the Geosynthetic Research Institute, as applicable.

3.4.3 Destructive Seam Testing

Quality control testing of geomembranes generally includes peel and shear testing of trial weld sections prior to commencing seaming activities and at periodic intervals throughout the day. Additionally, destructive peel and shear field tests are performed on samples from portions of the installed seams. Whenever possible, samples will be taken from within the anchor trench area.

Quality assurance testing will generally require that an independent laboratory perform peel and shear tests of samples from installed seams. The samples will be collected from the anchor trench or in areas of suspect quality. HDPE seams will generally be tested at intervals equivalent to one sample per every 300 to 400 feet of installed seam for extrusion welds, and every 500 feet for fusion-welded seams.

For dual hot wedge seams in HDPE, both the inner and outer seam may be subjected to destructive shear tests at the independent laboratory. Destructive samples of installed seam welds will generally be cut into several pieces and distributed to:

- The installer to perform CQC testing;
- The SUVSWD to retain and appropriately catalog or archive; and
- An independent laboratory for CQA peel and shear testing.

Minimum shear strength based on five out of five samples tested for wedge and extrusion weld seams on the 60-mil HDPE will be 120 pounds per inch in width. Minimum peel strengths for wedge and extrusion weld seams on the 60-mil HDPE will be 78 pounds per inch of width. All failures on the five samples must be film tear bond (FTB).

If the test results for a seam sample do not pass the acceptance/rejection criteria, then samples will be cut from the same field seam on both sides of the rejected sample location. Samples will be collected and tested until the area limits of the low quality seam are defined. Failed seams will be cap-stripped over the length of the rejected seam. All re-seamed or patched areas will be non-destructively tested, and approximately 10 percent of all repairs will be destructively tested.

3.4.4 Geomembrane CQA Observation

The responsibilities of the construction quality assurance (CQA) personnel for the installation of the geomembrane are:

- Observation and documentation of the liner storage area and the liners in storage, and handling of the liner as the panels are positioned on site;

- Observation of seam overlap, seam preparation prior to seaming, and geotextile or GCL underlying the liner;
- Observation of destructive testing conducted on welds prior to seaming;
- Observation of destructive seam sampling, submission of the samples to an independent testing laboratory, and review of results for conformance to specifications;
- Observation of all seams and panels for defects due to manufacturing and/or handling and placement;
- Observation of all pipe penetrations, boots, and welds in the liner; and
- Preparation of reports indicating sampling conducted and sampling results, locations of destructive samples, locations of patches, locations of seams constructed, and any problems encountered during installation. The final panel plan indicating panel layout, seams, test locations and repairs will be provided by the geomembrane installer, as a CQC requirement.

Protective soil cover (including leachate collection media) will be placed over the geomembrane liner as soon as practicable.

3.5 Leachate Collection Systems

The purpose of leachate collection system CQA is to document that the system construction is in accordance with the design plans and specifications. Prior to construction, materials will be inspected to confirm that they meet the construction plans and specifications. These include:

- Protective cover/leachate collection and pipe bedding materials;
- Pipe size, materials, and perforations; and
- Mechanical, electrical, and monitoring equipment (if utilized).

3.5.1 Protective Cover/Leachate Collection and Pipe Bedding Materials

Source quality control testing will be performed on stockpiled materials proposed for use in the protective cover/leachate collection layer to define the material properties. Source testing includes grain size and laboratory hydraulic conductivity in accordance with ASTM D422 and ASTM D2434, respectively.

The Contractor will perform source quality control tests on each principal type or combination of material proposed for use as pipe bedding material to assure compliance with specified requirements.

Production testing of protective cover/leachate collection material and pipe bedding material will be in accordance with Table O-1.

3.5.2 Construction

The leachate collection system foundation will be inspected and surveyed upon its completion to verify that it has proper grading and is free of debris and liquids.

During construction, the following activities, as appropriate, will be observed and documented:

- Protective cover/leachate collection placement including material quality and thickness. Equipment operating on the final layer thickness will be limited to low ground pressures in accordance with the project specifications.
- Pipe installation including location, configuration, grades, joints, and final flushing.
- Pipe bedding placement including protection of underlying liners, thickness, overlap with filter fabrics, and weather conditions. Damage to the underlying geomembrane will be repaired and documented in accordance with the project specifications.
- Geotextile placement including coverage and 12-inch minimum overlap.

In addition to field observations, field and laboratory testing may be performed to document that the materials meet the design specifications. These activities will be documented and should include testing of pipes for leaks, obstructions, and alignments.

The protective cover/leachate collection layer and the pipe bedding material will not be compacted, except as a result of placement methods. No minimum density specification is required.

Upon completion of construction, each component will be inspected to identify any damage that may have occurred during its installation, or during construction of another component (e.g., pipe crushing during placement of Protective Cover/Leachate Collection layer). Any damage that does occur will be repaired; and these corrective measures documented in the CQA records.

Surveying techniques and visual observation will be used to determine total thickness of Protective Cover/Leachate Collection layer.

3.6 Electrical Integrity Survey

After the completion of the liner and protective cover/leachate collection system installation, an electrical integrity survey will be performed to locate potential leaks in the liner. For this test, an electric potential will be applied between the protective cover/leachate collection system and the subgrade beneath the liner components. If a leak is present, current will flow through the liner at the location of the leak. Holes as small as 2 mm can be detected within a few centimeters under two feet of cover. The entire lined area, bottom and sidewall, will be tested using this technique.

This testing method is especially useful in locating leaks or damage that occurs during placement of the protective cover. If any leaks are identified during this process, the protective cover/leachate collection material will be carefully removed, and the leak located and repaired using standard repair and testing procedures. The results of the electrical survey, including any repair documentation will be included in the Final Certification Report.

A qualified testing firm will be contracted to perform this survey. A detailed plan of operations will be prepared by the testing firm and presented to the CQA officer prior to commencing liner installation.

3.7 Final Cover Systems

A 34-inch evaporative cap constructed from moderately compacted olive-brown silty sand will be used as the final cover system for the Bayview landfill. One compaction test will be performed for each 10,000 square feet of surface area for each lift of the final cover. Compaction of the final cover material will be between 75% and 85% of the maximum dry density with a moisture content dry of optimum.

CQA personnel will also sample the soil to be used for the final cover and perform a grain size distribution analysis in advance of cover placement. If the grain size distribution falls within the range identified on Figure B-1 in the July 31, 2003 letter from Kleinfelder (see Attachment O-2 at the end of this Appendix), then the material will be considered suitable for use in the final cover. A grain size distribution test will be performed for every 5,000 cubic yards of cover material to be placed, and will be performed sufficiently in advance of placement so as to not hinder construction activities. Results of all tests will be recorded on forms similar to those found in Attachment O-1 at the end of Appendix O. Since the material to be used for final cover will be tested in advance for grain size, third-party CQA personnel will be present as needed to test for compaction on each lift at the frequency discussed above and so that cover placement operations are not interrupted.

The required thickness of the protective cover will be verified by survey methods on an established grid system with not less than one verification point per 10,000 square feet of surface.

3.8 Surveying

A SUVSWD surveying crew or an independent crew under the supervision of a registered land surveyor will perform all major construction staking activities. All construction staking will be performed utilizing conventional construction layout practices. Site control will be provided by the permanent site control points already established on site. All site control points are tied into the state plane coordinate system as well as the site project coordinate system. During construction, the survey crew will determine elevation and obtain locations and elevations of as-built features. No stakes will be allowed in the liner, protective cover or final cover systems except as required to document potential erosion of the final cover system as discussed in Section 6.1 of Part II.

Surveys will be used to confirm total thickness of layers during placement of cover materials. Surveying will include enough points to adequately determine the uniformity of the layer thickness.

The average distance between survey points will be 100 feet. For multi-lift/multi-layer construction, visual observation and field measurements will be used to confirm layer thickness. Measurements will be performed using surveying, excavated samples or other measuring techniques. At regular intervals, record drawings of the newly constructed features and the areas filled will be prepared. The record drawings will document the final location, size, and elevation of the constructed features within the site. The record drawings will become part of the final construction certification report.

4.0 DOCUMENTATION AND CORRECTIVE ACTION

Ongoing QC, CQC and CQA are designed to minimize deficient work and provide for corrective action prior to completion of an activity. The record-keeping and on-site observation activities are further designed to provide documentation of compliance or non-compliance, and corrective action.

4.1 Corrective Action

For work or physical components that do not satisfy plans and specifications, the general actions may include:

- Removal and replacement; and
- Alternate welding or patching for geosynthetic components.

Along with the final construction plans and specification, the CQC and CQA programs and personnel will identify the deficiency and its extent. They will also ultimately define the form or extent of corrective action required.

If materials are found to deviate from specified standards, they will either be rejected or their suitability demonstrated by additional testing and analysis. A goal of this CQAP is to prevent the inclusion and subsequent removal of defective or inappropriate materials by providing an orderly process of checks prior to final installation.

4.2 Documentation

Documentation will be used to demonstrate the quality of materials and the condition and manner of installation. The overall documentation will include:

- Detailed plans and specifications (final design);
- Contractor shop drawings and material certification reports, with an engineer's review;
- Records of on-site observation, via the CQA officer or the CQA officer's staff;
- Material laboratory test results, both by contractor and independent laboratory;
- On-site test results; and
- Final Certification Report.

The final certification report will include observations, test results, sampling locations, locations of blue tops in the final cover, corrective measures performed, and other information required to certify that the CQAP has been carried out and that construction meets or exceeds the design criteria and specifications in the permit. Example forms for recording observations and data collected during the QA/QC process for cell construction and closure are included as Attachment O-1 at the end of this Appendix. The final report will be submitted to the UDEQ.

APPENDIX O

ATTACHMENT O-1:
EXAMPLE FORMS FOR CELL CONSTRUCTION

CERTIFICATE OF ACCEPTANCE OF SOIL SUBGRADE

Geosynthetic
Installer ___________ _______Project: Bayview Landfill
Address _____________________________ Location: Utah County
_____________________________ Owner: South Utah Valley Solid Waste District

I, the Undersigned, the duly authorized representative of __________________________do hereby accept the soil subgrade surface bounded by_______________________________
____
____as an acceptable surface on which to install and shall be responsible for maintaining its integrity and suitability in accordance with the project specifications from this date to the completion of the installation.

Name	Signature	Title	Date

Certificate accepted by CQA Manager:

Name	Signature	Title	Date

Certificate accepted by Owner:

Name	Signature	Title	Date

Geotextile Panel Placement

Panel Number	Roll Number	Date Installed	Overlap Confirmation	
			Side	End

Project Name: **Bayview Landfill**

GCL Panel Placement

			Overlap Confirmation	
Panel Number	Roll Number	Date Installed	Side	End

Sheet No. ___ of ___

CQA PANEL INSPECTION FORM

PROJECT NAME: **Bayview Landfill**	PANEL NO.
PROJECT NO.:	GEOMEMBRANE TYPE:
CONTRACTOR:	INSTALLER:
DATE PLACED	SUBGRADE CONDITION
WEATHER CONDITIONS	
DEPLOYMENT METHOD:	

SHOW PROJECT NORTH ☐

Panel No.: ________

Date	Defect	Defect Description	Repair Date	Repair Type	Approved By

Panel Length	Technician Comments
Panel Width	
Panel Area	
Roll Number	

Date ____________

Page _____ **of** _____

SMOOTH / TEXTURED GEOMEMBRANE PANEL PLACEMENT SUMMARY

Date	Time	Panel Number	Roll Number	Length (feet)	Width (feet)	Area (SF)	Average Thickness (MILS)	Comments

Sheet No. ___ of ___

CQA SEAM INSPECTION FORM

PROJECT NAME **Bayview Landfill**	SEAM NO.
PROJECT NO.	SEAM LENGTH
CONTRACTOR	COMMENTS
INSTALLER	
WELDING TECH.	
TYPE OF WELDER	WELDING UNIT NO.
DATE WELDED	TIME WELDED

QUALITY ASSURANCE SUMMARY

1. VACUUM BOX TEST

Zone	Length	Date Tested	QC Technicians Initials	Numnber of Defects Found	Date Repairs Made	Date Retested	Date Inspected and Approved

2. AIR PRESSURE TESTING

Start	Start Pressure (psi)	End Time	End Pressure (psi)	Zone	Length (feet)	Pressure Loss (psi)	Approved (Y/N)	If No, Corrective Action	Approved By

LEGEND

	Zone 1 Air Pressure Zone
	Repair Needed
	Repair *Completed*
	Repair Tested
	Repair Approved
	Destructive Sample
	Cap Strip Repair

3. SEAM REPAIRS (PATCHES)

Repair No.	Defect Type	Date/NDT Type	Approved By

Panel No. ☐

Panel No. ☐

Client SUVSWD

Technician ______

Date ______

Project Bayview Landfill

Sheet: Textured ______ Smooth ______ Mil ______

Project Location ______

Density: HDPE ______ VLDPE ______ LLDPE ______

Project Number ______

Defect Code:

BO - Burn Out
BS - Boot Skirt
CO - Change of Overlap
CR - Crease
D - Installation Damage
DP - Destructive Sample
EE - Earthwork Equipment
Ext - Extension
FS - Failed Seam
IO - Insufficient Overlap

MD - Manufacturer's Damage
PT - Pressure Test Cut
SI - Soil Irregularity
SL - Slag on Textured
T - Panel Intersection
VL - Vacuum Test Leak
WD - Wind Damage
WR - Wrinkle
WS - Welder Restart
Other - ______

Repair Type:
B - Bead
C - Cap
P - Patch

Geomembrane Repair Log

Repair #	Seam / Panel	Location East/South	Code	Date	Machine #	Time	Type	Size	Tech	Test Date

APPENDIX O

ATTACHMENT O-2:
FINAL COVER GRAIN SIZE DISTRIBUTION
AND
EXAMPLE FORMS FOR FINAL COVER CONSTRUCTION

Final Cover Material – Grain Size Distribution

Test Location	Depth	Date	Test #	Pass or Fail

Attach copies of grain size distribution tests.

Project Name: Bayview Landfill

Final Cover Placement – Compaction Tests

Test Location	Lift	Date	Compaction %	Pass or Fail

Appendix P

APPENDIX P

Cell 2 Geosynthetic Analysis

SUVSWD Bayview Class I Landfill
Permit Application

APPENDIX P

STAGE 2 GEOSYNTHETIC ANALYSES

FOR

SOUTH UTAH VALLEY SOLID WASTE DISTRICT
BAYVIEW LANDFILL, CELL 1

ISSUED JULY 1996

PREPARED BY

HDR ENGINEERING, INC.

TABLE OF CONTENTS

ATTACHMENT P-1

LINER SLOPE STABILITY

Job No.
No.

HDR Computation

Project: BAYVIEW LANDFILL CELL 1, STAGE 2
Computed: RLD
Date: 6/96
Subject: LINER & LCRS DESIGN
Checked: PDP
Date: 7-19-96
Task: LINED SLOPE STABILITY
Sheet: 1
Of

.1 **Consideration:** <u>Stability of Soil Cover</u> - Verify that materials overlying the geosynthetic system will not slide. Use USACE 2-wedge slope stability method.

.2 **References:** (a) Richardson and Koerner, *Geosynthetic Design Guidance for Hazardous Waste Landfill Cells and Surface Impoundments*, EPA/600/2-87/097.

(b) Geosynthetic Research Institute, *Stability Analysis of Multilined Slopes in Landfill Applications*, GRI Report 8.

(c) Koerner, *Designing with Geosynthetics*, 3ed., 1994.

.3 Required Material Properties	Value	Test	Standard
GS:GS or GS:Soil friction, δ	SEE P6	Direct Shear	ASTM D5321

.4 **Analysis Procedure:**

(1) <u>DETERMINE CRITICAL INTERFACE & STRENGTH</u>

δ_{crit}

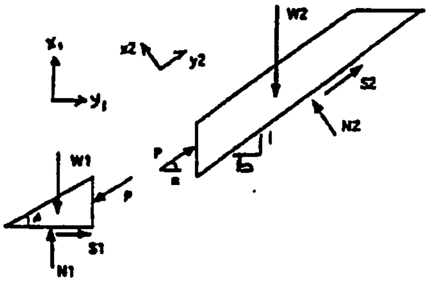
C_{crit} (GENERALLY = 0 FOR ANALYSIS)

(2) <u>SOLVE FOR F.S. BY TRIAL-AND-ERROR</u>

1. Assume FS

2. Find P from

$$P = \frac{W1(\tan\phi_{soil} / FS) + (c_{soil} / FS)(b / \sin\beta)}{\cos\alpha - \sin\alpha(\tan\phi_{soil} / FS)}$$



3. Find N2 from

$$N2 = (W2)\cos\beta - P\sin(\alpha - \beta)$$

4. Find S2 from

$$S2 = (W2)\sin\beta - P\cos(\alpha - \beta)$$

5. Calculate FS from

$$FS = \frac{(N2)\tan\delta_{crit} + c_{crit}(H / \sin\beta)}{S2}$$

6. Repeat Steps 2-5 with New FS, Checking for Convergence on FS

Job No.

No.

HDR Computation

HDR

Project

Computed

Date

Subject

Checked

Date

Task

Sheet 2

Of

.6 INTERFACE FRICTION VALUES

INT	UPPER COMPONENT	LOWER COMPONENT	REF	INTERFACE FRICTION	
1	GRANULAR LCRS	WOVEN REINF GEOTEXTILE	LIT	27°	
2	REINF GEOTEXTILE	60 MIL SMOOTH HDPE	LIT	9° *	
3	60 MIL SMOOTH HDPE	NW CUSHION GEOTEXTILE	LIT	9° *	
4	NW. CUSHION GEOTEXTILE	SOIL SUBGRADE	LIT	27°	
5					
6					
7					
8					
9					
10					

* Critical value for stability analysis

.7 PROGRAM INPUT

Parameter	Units	Trial No.							
		1	2	3	4	5	6	7	8
Height of cover soil	ft	40							
Width of cover soil at bottom	ft.	8.2							
Finished slope angle (1V: 4H)	deg	14							
Liner slope angle	deg	14							
Soil friction angle (1)	deg	32°							
Interface friction angle	deg	9°							
Unit weight of soil	pcf	100							
Saturated unit weight of soil	pcf	115							
Total surcharge load	plf	1500							
Thickness of submerged soil	ft.	1							
Seismic coefficient (2)	-	0.16							
Available tension force in system	plf	0							

(1) FROM WASATCH GEOTECH / PSI DIRECT SHEAR TESTS ON LCRS STOCKPILE

(2) FROM SEISMIC ANALYSES FOR $\mu = 30$ CM W/ T REINF = 8.2 KIP

Job No.

No.

HDR Computation

Project

Computed

Date

Subject

Checked

Date

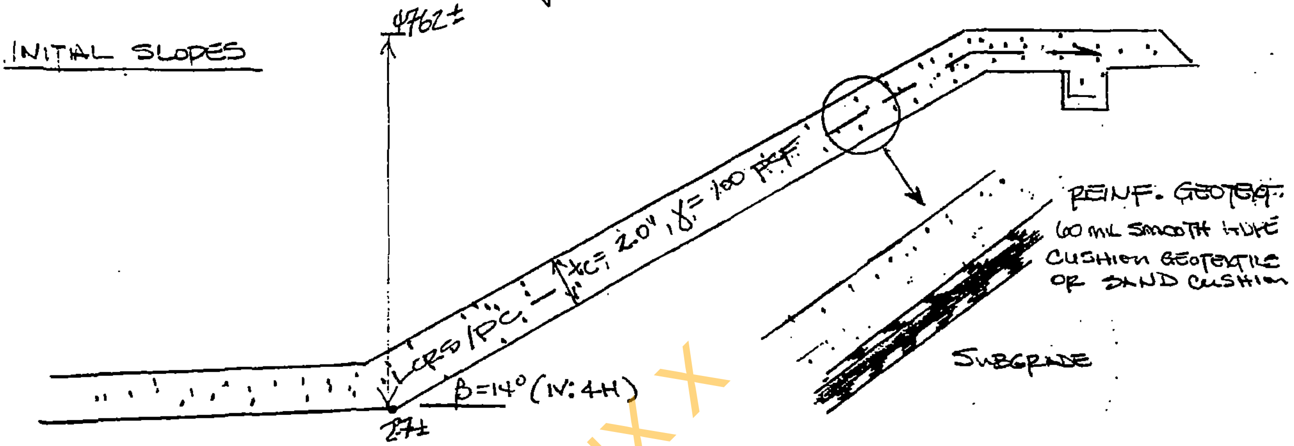
Task

Sheet 3

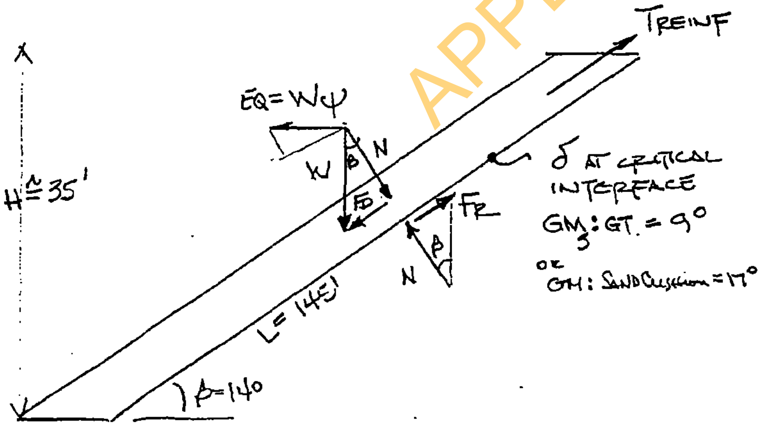
Of

.8 CHECK W/ INFINITE SLOPE ANALYSIS

INITIAL SLOPES



USE INFINITE SLOPE METHOD, CONSIDER SEISMICITY W/ PSEUDO-STATIC COEFF.



δ AT CRITICAL INTERFACE
GM$_3$: GT = 9°
OR
GM : SAND CUSHION = 17°

$$W = \gamma t_c L \div 1000$$
$$= 100\,\frac{\#}{CF} * 2\,FT * 145' \div 100$$
$$= 29.0^{KLF} \checkmark$$

$$F_D = W\sin\beta + Wk_y$$
$$= (29.0^{KLF} * \sin 14^\circ) + (29.0^{KLF} * \psi)$$
$$= 7.0^{KLF} + 29.0\psi \checkmark$$

NOTE: EQ FORCE HORIZONTAL IS CONSERVATIVE SINCE DOWNSLOPE COMPONENT = $W\psi \cdot \cos\beta < W\psi$.
WHERE ψ = PSEUDO-STATIC SEISMIC COEFFICIENT

$$F_R = N \tan\delta + T_{REINF}$$
$$= (W\cos\beta)\tan\delta + T_{REINF}$$
$$= (29.0^{KLF} * \cos 14^\circ)\tan\delta^\circ + T_{REINF}$$
$$= 28.1\tan\delta + T_{REINF} \checkmark$$

$$\underset{(k_y=0)}{FS_{STATIC}} = \frac{F_R}{F_D} = \frac{(28.1\tan\delta + T_{REINF})^{KLF}}{7.0^{KLF}}$$

$$\underset{(k_y>0)}{FS_{P\text{-}S}} = \frac{F_R}{F_D} = \frac{(28.1\tan\delta + T_{REINF})^{KLF}}{(7.0 + 29.0\psi)^{KLF}}$$

ITERATE FOR TREQD & ψ, ATTACHED

Job No.

No.

HDR Computation

Project

Computed

Date

Subject

Checked

Date

Task

Sheet 4

Of

BAYVIEW LANDFILL CELL 1						
LINER AND LCRS CAP SLOPE STABILITY						
STATIC AND PSEUDO-STATIC ANALYSES						
(INFINITE SLOPE METHOD)						
SLOPE PROPERTIES						
	height	40.0	(ft.)			
	slope	14.0	(degrees)			
	length	165.3	(ft)			
LCRS PROPERTIES						
	thickness	2.0	(ft)			
	density	100.0	(pcf)			
INTERFACE FRICTION						
	friction	9.0	(degrees)			
FACTOR OF SAFETY						
Treinf	Seismic Coefficient, (-)					
(klf)	0	0.1	0.2	0.3	0.4	0.5
0.0	0.64	0.45	0.35	0.28	0.24	0.21
1.0	0.76	0.54	0.42	0.34	0.29	0.25
2.0	0.89	0.63	0.48	0.40	0.33	0.29
3.0	1.01	0.71	0.55	0.45	0.38	0.33
4.0	1.14	0.80	0.62	0.51	0.43	0.37
5.0	1.26	0.89	0.69	0.56	0.47	0.41
7.5	1.57	1.11	0.86	0.70	0.59	0.51
10.0	1.89	1.33	1.03	0.84	0.71	0.61
12.5	2.20	1.55	1.20	0.98	0.83	0.72
15.0	2.51	1.78	1.37	1.12	0.95	0.82

Job No.

No.

HDR Computation

Project

Computed

Date

Subject

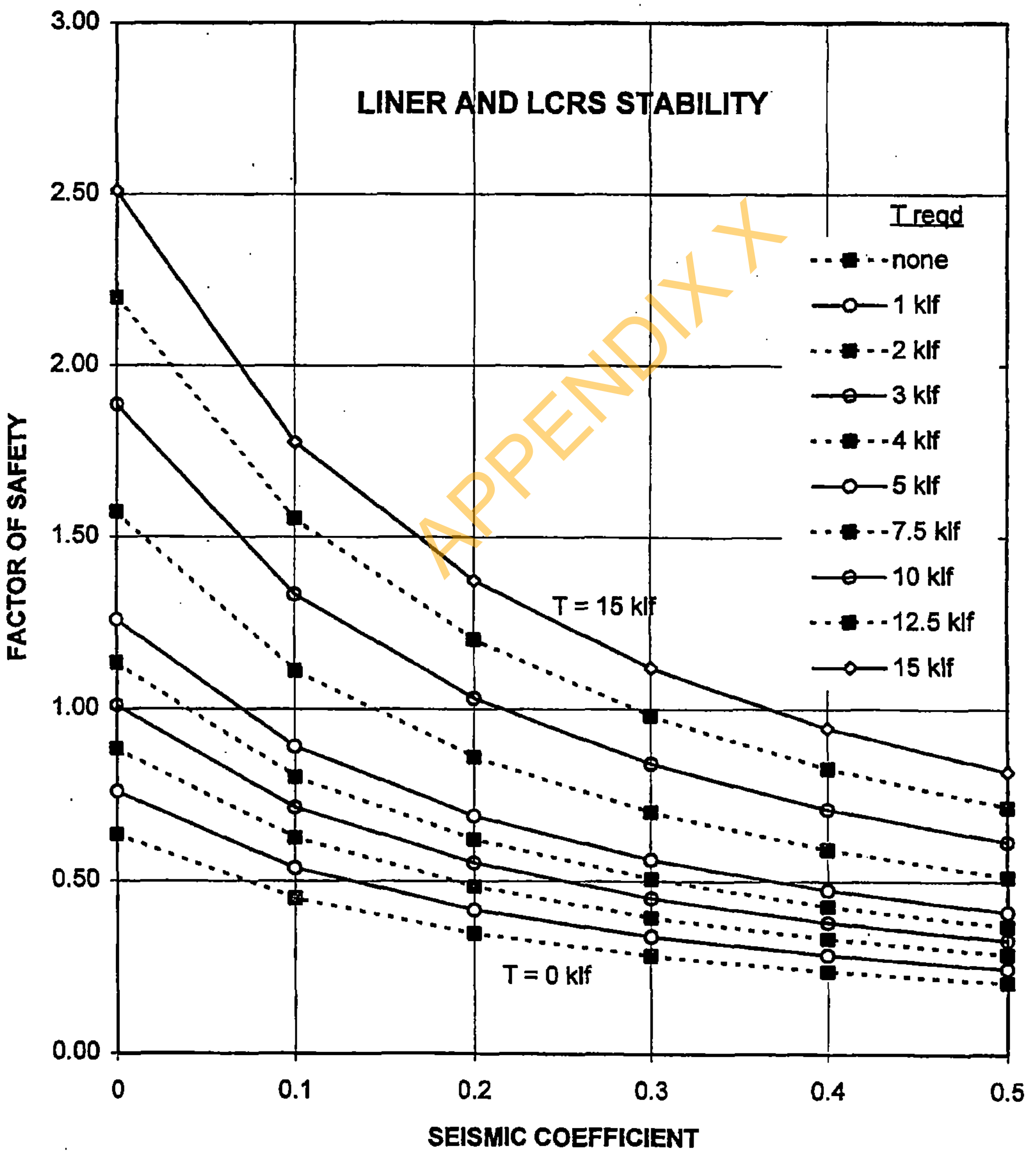
Checked

Date

Task

Sheet 5

Of



Job No.

No.

HDR Computation

Project

Computed

Date

Subject

Checked

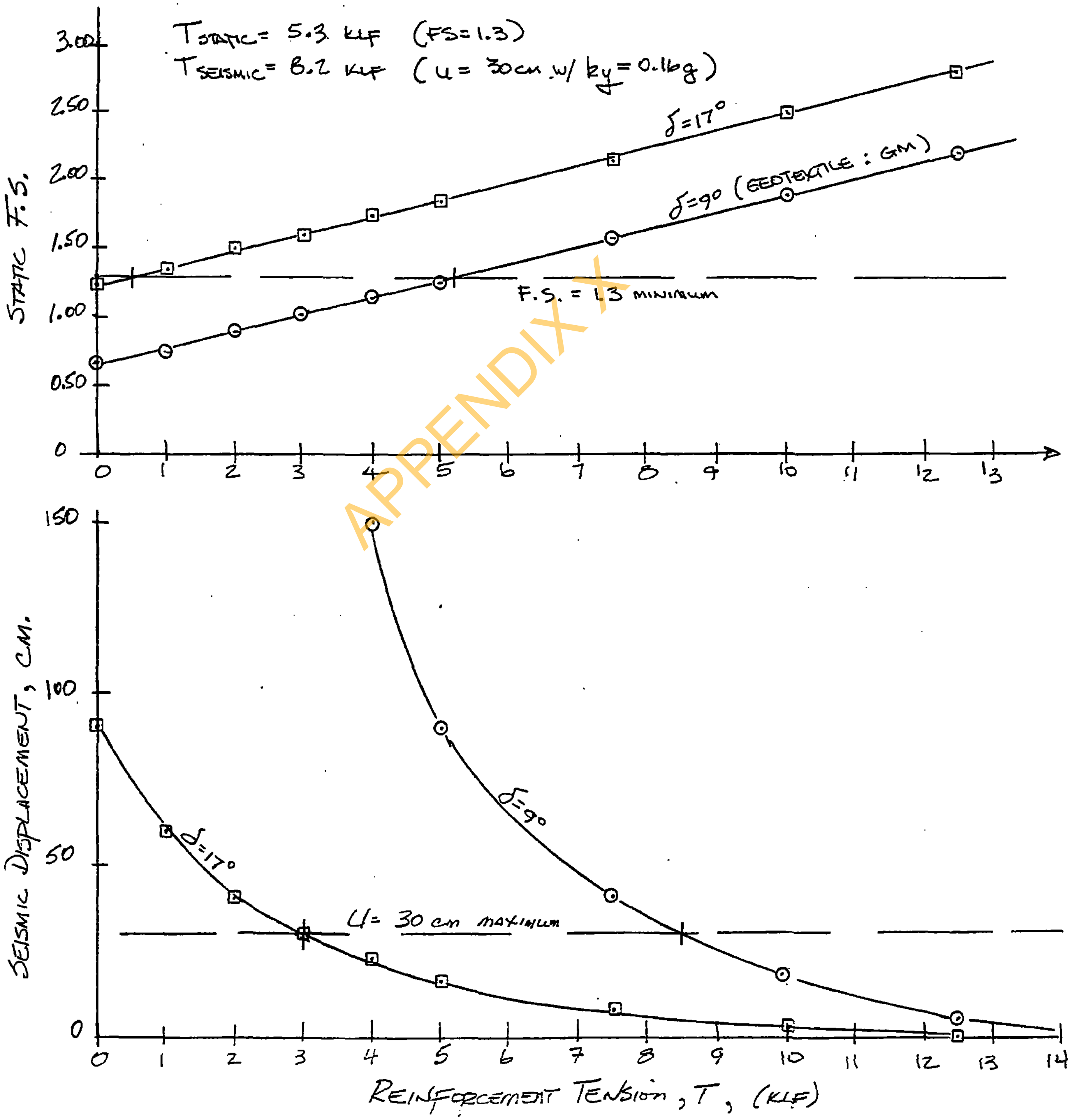
Date

Task

Sheet 6

Of

FROM SEISMIC STABILITY ANALYSES



T_{STATIC} = 5.3 KLF (FS=1.3)

$T_{SEISMIC}$ = 8.2 KLF (u = 30cm w/ k_y=0.16g)

Job No. | No.

HDR Computation

HDR

Project	Computed	Date
Subject	Checked	Date
Task	Sheet 7	Of

.9 CHECK w/ 2-WEDGE METHOD

```
****************************************************************
*******     LIMIT EQUILIBRIUM ANALYSIS OF COVER SOIL     *******
****************************************************************


****************************************************************
*************************      DATA     *************************
****************************************************************

HEIGHT OF COVER SOIL:          40
WIDTH OF COVER SOIL AT BOTTOM:                 8.2
FINISHED SLOPE ANGLE (DEGREES):                14
LINER SLOPE ANGLE (DEGREES):                   14
SOIL FRICTION ANGLE (DEGREES):                 32
INTERFACE FRICTION ANGLE(DEGREES):             9  ←—— GT : SMOOTH HDPE
UNIT WEIGHT OF SOIL (lb/cu ft):                100
SATURATED UNIT WEIGHT OF SOIL (lb/cu ft):                     115
TOTAL SURCHARGE LOAD (lb):     1500
THICKNESS OF SUBMERGED SOIL:                   1
SEISMIC COEFFICIENT:           .16  ———— FROM SEISMIC ANALYSIS FOR U=30cm
AVAILABLE TENSION FORCE IN LINER:              0 ←—


****************************************************************
********************  FACTORS OF SAFETY  ********************
****************************************************************

            CASE                                 FACTOR OF SAFETY
            ----                                 ----------------

SELF-WEIGHT OF SOIL                                   0.724  VS 0.64 FOR INFINITE
SELF-WEIGHT + SURCHARGE                               0.720     SLOPE w/ T=0
SELF-WEIGHT + SEEPAGE                                 0.528
SELF-WEIGHT + SURCHARGE + SEEPAGE                     0.532
SELF-WEIGHT + SEISMICITY                              0.431  VS 0.35+ FOR INF
SELF-WEIGHT + SURCHARGE + SEISMICITY                  0.428     SLOPE w/ T=0
SELF-WEIGHT + SURCHARGE + SEEPAGE + SEISMICITY        0.320
```

Job No.
No.

HDR Computation

Project
Computed
Date
Subject
Checked
Date
Task
Sheet 8
Of

```
**********************************************************

           CASE                                      FAILURE HEIGHT
           ----                                      --------------

SELF-WEIGHT OF SOIL                                       9.840
SELF-WEIGHT + SURCHARGE                                   8.010
SELF-WEIGHT + SEEPAGE                                     5.610
SELF-WEIGHT + SURSHARGE + SEEPAGE                         4.480
SELF-WEIGHT + SEISMICITY                                  3.350
SELF-WEIGHT + SURCHARGE + SEISMICITY                 <    2.044
SELF-WEIGHT + SURCHARGE + SEEPAGE + SEISMICITY       <    2.044

*****************************************************************
******  TENSION FORCES FOR SAFETY FACTORS EQUAL TO 1.0 ******
*****************************************************************

           CASE                                   TENSION FORCE (lb/ft)
           ----                                   ---------------------

SELF-WEIGHT OF SOIL                                    2180.926
SELF-WEIGHT + SURCHARGE                                2313.289
SELF-WEIGHT + SEEPAGE                                  4039.125
SELF-WEIGHT + SURCHARGE + SEEPAGE                      4171.489
SELF-WEIGHT + SEISMICITY                               7502.587
SELF-WEIGHT + SURCHARGE + SEISMICITY                   7877.018
SELF-WEIGHT + SURCHARGE + SEEPAGE + SEISMICITY        10136.543

*****************************************************************
*****************  CHOSEN FACTORS OF SAFETY  *****************
*****************************************************************

           CASE                                    FACTOR OF SAFETY
           ----                                    ----------------

SELF-WEIGHT OF SOIL                                       1.300  ←
SELF-WEIGHT + SURCHARGE                                   1.300
SELF-WEIGHT + SEEPAGE                                     1.300
SELF-WEIGHT + SURCHARGE + SEEPAGE                         1.300
```

HDR Computation

Project

Subject

Task

Computed

Date

Checked

Date

Sheet 9

Of

```
SELF-WEIGHT + SEISMICITY                          1.000  ← @ μ= 30 cm for ky = 0.16g
SELF-WEIGHT + SURCHARGE + SEISMICITY              1.000
SELF-WEIGHT + SURCHARGE + SEEPAGE + SEISMICITY    1.000

*********************************************************
****  MAXIMUM HEIGHTS FOR CHOSEN SAFETY FACTORS  *****
*********************************************************

        CASE                                   MAXIMUM HEIGHT
        ----                                   --------------

SELF-WEIGHT OF SOIL                                 5.670
SELF-WEIGHT + SURCHARGE                             3.840
SELF-WEIGHT + SEEPAGE                               3.853
SELF-WEIGHT + SURSHARGE + SEEPAGE                   2.530
SELF-WEIGHT + SEISMICITY                            3.350
SELF-WEIGHT + SURCHARGE + SEISMICITY           <    2.044
SELF-WEIGHT + SURCHARGE + SEEPAGE + SEISMICITY <    2.044

****************************************************************
******  TENSION FORCES FOR CHOSEN SAFETY FACTORS EQUAL TO 1.0 ******
****************************************************************

        CASE                                 TENSION FORCE (lb/ft)
        ----                                 ---------------------

SELF-WEIGHT OF SOIL                               3482.095   VS. 5,300  FOR INFINITE SLOPE
SELF-WEIGHT + SURCHARGE                           3667.654
SELF-WEIGHT + SEEPAGE                             5045.737
SELF-WEIGHT + SURCHARGE + SEEPAGE                 5231.296   ✓
SELF-WEIGHT + SEISMICITY                          7502.587   VS  8,200  FOR INFINITE SLOPE
SELF-WEIGHT + SURCHARGE + SEISMICITY              7877.018
SELF-WEIGHT + SURCHARGE + SEEPAGE + SEISMICITY   10136.543
```

(In the second title line "CHOSEN" is written in by hand and "EQUAL TO 1.0" is struck through: TENSION FORCES FOR CHOSEN SAFETY FACTORS ~~EQUAL TO 1.0~~)

10 Summary

2 WEDGE METHOD REQUIRES SLIGHTLY LESS REINFORCING TENSION THAN DOES INFINITE SLOPE ANALYSIS. THIS IS REASONABLE CONSIDERING MODERATE SLOPE LENGTH & TOE BUTTRESS EFFECT FROM 2' LCRS/P.C. COVER

USE T_{REQD} = 8200 #/LF ~~FOR SEISMIC + ANCHOR TRENCH~~ ←

= 5300 #/LF FOR STATIC @ F.S. = 1.3

Job No. No.

HDR Computation

Project Computed Date

Subject Checked Date

Task Sheet Of

.11 REQ'D CAPACITY

LONG TERM ALLOWABLE DESIGN STRENGTH (LTADS) CONTROLS SIZING OF GEOREINF FOR STATIC LOAD, USE:

$T_{LTADS} = 5,300$ #/LF w/ F.S. = 1.3

SHORT TERM WIDE WIDTH TENSILE STRENGTH CONTROLS SIZING OF GEOREINF FOR SEISMIC LOAD, USE

$T_{ULT} = 8,200$ #/LF

ATTACHMENT P-2

LINER SYSTEM STRESSES

HDR Computation

HDR

Project BAYVIEW LANDFILL CELL 1, STAGE 2
Subject LINER DESIGN
Task LINER SYSTEM STRESSES

Computed RLD
Date 6/96
Checked PWP
Date 7-19-96
Sheet 1
Of 3

.1 **Consideration:** Tensile stresses - Determine the Factor of Safety against tensile stresses developed in geosynthetics due to unbalanced friction forces.

.2 **References:** (a) Richardson and Koerner, *Geosynthetic Design Guidance for Hazardous Waste Landfill Cells and Surface Impoundments*, EPA/600/2-87/097.

(b) Koerner, *Designing with Geosynthetics*, 3ed., 1994

.3 Required Material Properties	Value	Test	Standard
GS:GS or GS:Soil friction, δ		Direct Shear	ASTM D5321
LCRS : REINF GT	27°		
GT : SMOOTH HDPE	9°		
HDPE : CUSHION GT	9°		
GT : SOIL SUBGRADE	27°		
Geosynthetic tensile strength, T		Wide-Width	ASTM D4885
REINF GT	8200 #/LF		
60 MIL SMOOTH HD	1400 #/LF		
CUSHION GT	1500 #/LF		

.4 **Analysis Procedure:**

(1) COMPUTE TENSILE STRESS IN GEOSYNTHETIC COMPONENT

$$T = \tau_U \cdot W \cdot L - \tau_L \cdot W \cdot L$$

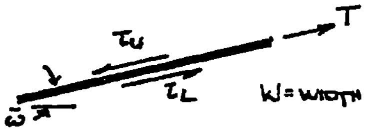
$$\frac{T}{W} = (\tau_U - \tau_L) \cdot L$$

$$\tau = C + \sigma_n \cdot \tan\phi, \sigma_n = \gamma \cdot H \cdot \cos\varpi$$

$$\tau_U = C_{aU} + \gamma \cdot H \cdot \cos\varpi \cdot \tan\delta_U$$

$$\tau_L = C_{aL} + \gamma \cdot H \cdot \cos\varpi \cdot \tan\delta_L$$

$$\frac{T}{W} = [(C_{aU} - C_{aL}) + \gamma \cdot H \cdot \cos\varpi \cdot (\tan\delta_U - \tan\delta_L)] \cdot L$$



$$FS = \frac{\text{Resisting Force}}{\text{Driving Force}} = \frac{T + \tau_L \cdot W \cdot L}{\tau_U \cdot W \cdot L} = \frac{\sigma_{ALLOW}}{\sigma_{REQD}}$$

(a) If $\tau_U = \tau_L$, FS > 1, pure shear @ $\tau_U = \tau_L$

(b) If $\tau_U < \tau_L$, FS > 1, pure shear = τ_U, rest of $(\tau_L - \tau_U)$ is not mobilized.

(c) If $\tau_U > \tau_L$, FS may be >, = or < 1, which depend on the T value

when FS = 1 ⇒ $\tau_U \cdot W \cdot L = T + \tau_L \cdot W \cdot L$

$$\sigma_{REQD} = \left(\frac{T}{W}\right) \cdot \left(\frac{1}{t}\right)$$

(2) DETERMINE ALLOWABLE TENSION IN GEOSYNTHETIC COMPONENT

$$\sigma_{ALL} = \left(\frac{T_{ULT}}{W}\right) \cdot \left(\frac{1}{t}\right)$$

(3) COMPUTE F.S.

$$FS = \frac{\sigma_{ALLOW}}{\sigma_{REQD}}$$

(4) REPEAT STEPS 1-3 FOR LOWER GEOSYN IN SYSTEM

Job No.

No.

HDR Computation

Project

Computed

Date

Subject

Checked

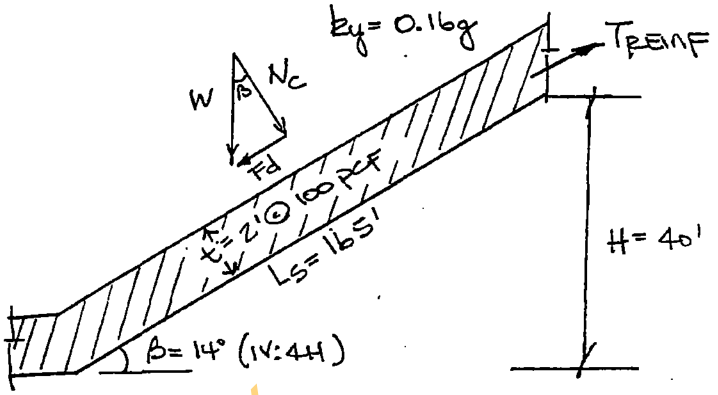
Date

Task

Sheet 2

Of 3

.5 SKETCH & COMPS



$W_{STATIC} = t_c L_S \gamma_c$

$= 2.0' \cdot 165' \cdot 100\ \#/\mathrm{LF}$

$= 33{,}000\ \#/\mathrm{LF}$ ✓

$N_c = W \cos\beta$

$= 33000\ \#/\mathrm{LF} \cdot \cos 14°$

$= 32{,}020\ \#/\mathrm{LF}$ ✓

$F_{D\,STATIC} = W \sin\beta$

$= 33{,}000\ \#/\mathrm{LF} \cdot \sin 14°$

$= 7{,}983\ \#/\mathrm{LF}$ ✓

$F_{D\,SEIS} = F_{D\,STATIC} + W k_y$

$= 7{,}983\ \#/\mathrm{LF} + 33{,}000\ \#/\mathrm{LF} \cdot 0.16$

$= 13{,}263\ \#/\mathrm{LF}$ ✓

$\Delta F_{STATIC} = \overset{\swarrow}{F_{D\,STATIC}} - \overset{\nearrow}{T_{REINF}}$

$= 7983 - 8200$

$= -217\ \#/\mathrm{LF}$ ✓

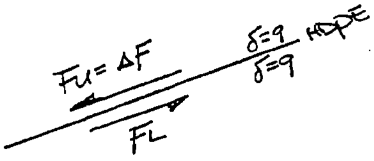
∴ ALL STATIC STRESSES FROM LCRS/PC HELD IN REINF G.T

$\Delta F_{SEIS} = \overset{\swarrow}{F_{D\,SEIS}} - \overset{\nearrow}{T_{REINF}}$

$= 13{,}263 - 8200$

$= 5{,}063\ \#/\mathrm{LF}$ ✓

- AT 60 MIL HDPE INTERFACE



$F_u = \Delta F = 0$ STATIC

$5{,}063\ \#/\mathrm{LF}$ SEISMIC

Job No. | No.

HDR Computation

HDR

Project | Computed | Date

Subject | Checked | Date

Task | Sheet 3 | Of 3

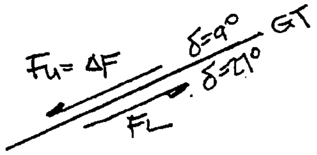
$$F_L = N_c \tan\delta$$
$$= 32{,}020\ ^{\#}/_{LF} \cdot \tan 9^\circ$$
$$= 5{,}071\ ^{\#}/_{LF}$$ ✓

$$F_L \hat{=} F_u$$

$\therefore$ NOMINALLY BALANCED

THIS IS CONSISTENT W/ STABILITY ANALYSIS W/
SEISMIC FS = 1.0 W/ $\delta = 9^\circ$ + $k_y = 0.16$

- AT CUSHION GEOTEXTILE INTERFACE



$F_u = \Delta F = 0$ STATIC
$5{,}063\ ^{\#}/_{LF}$ SEISMIC

$$F_L = N_c \tan\delta$$
$$= 32{,}020\ ^{\#}/_{LF} \cdot \tan 27^\circ$$
$$= 16{,}315\ ^{\#}/_{LF}$$ ✓

$$F_L \geq F_u$$

$\therefore$ NO TENSION IN LOWER CUSHION GEOTEXTILE

- AT SOIL INTERFACE

$F_u = \Delta F = 0$ STATIC
$= 5{,}063$ SEISMIC

$F_L = c + N_c \cdot \tan\phi$ WHERE c, ϕ ARE SOIL CHARACTERISTICS
$c = 0$, $\phi = 40$ – FROM SEIS. STAB ANAL

$$= 32{,}020\ ^{\#}/_{LF} \cdot \tan 40^\circ$$
$$= 26{,}867\ ^{\#}/_{LF}$$ ✓

$$F_L \geq F_u$$

$\therefore$ NO SHEAR FAILURE IN SUBGRADE SOILS.

ATTACHMENT P-3

ANCHOR TRENCH DESIGN

Job No.

No.

HDR Computation

HDR

Project Bayview Landfill Cell 1, Stage 2
Computed RLD
Date 6/96
Subject Liner Design
Checked PHP
Date 7-19-96
Task Anchor Trench
Sheet 1
Of 4

.1 Consideration: FML Anchorage - calculate anchor capacity for FML placed in various anchorage configurations.

.2 References:

(a) Richardson + Koerner, Geosynthetic Design Guidance for Hazardous Waste Landfill Cells and Surface Impoundments, EPA/600/2-87/097

(b) USEPA-RREL, User's Guide to GM System, Geosynthetic Modeling System, Version 1.1

(c) Koerner, Designing with Geosynthetics, 3rd ed.

.3 Required Material Properties

Required Material Properties	Range	Test	Standard
• Soil/~~FML~~ GT Friction Angle	27°	Direct Shear	ASTM D5321
• Soil Friction Angle	* 32° MIN	Triaxial Direct Shear	ASTM D4767 ASTM D3080
Draft MTG Minimum			

* From Wasatch/PSI site specific testing on LCRS/PC MATL

.4 Analysis Procedure:

(1) Define Anchor Variables

• Geometry
- Slope Angle β
- Embedment Length, L
- Soil Cover, d_{cs}
- Anchor Burial, d_{AT}

• Material
- Soil Friction Angle, ϕ
- Soil/FML Friction Angle, δ
- Soil Unit Weight, γ_{LS}

(2) Solve for Anchor Capacity

Horizontal Anchor

$$T = \frac{qL\tan\delta}{(DR)\cos\beta - \sin\beta\tan\delta}$$

'V' Anchor

$$T = \frac{\tan\delta\left[q\left(L - L_V + \frac{L_V}{\cos i}\right) + \frac{d_V L_V \gamma_{cs}}{2\sin i}\right]}{(DR)\cos\beta - \sin\beta\tan\delta}$$

Concrete Anchor

$$T = \frac{qL\tan\delta + (K_P\ K_A)[.5\gamma_{cs}d_{AT}^2 + q d_{AT}]}{(DR)\cos\beta - \sin\beta\tan\delta}$$

Anchor Trench

$$T = \frac{qL\tan\delta + (K' + K_A)\tan\delta[.5\gamma_{cs}d_{AT}^2 + q d_{AT}]}{(DR)\cos\beta - \sin\beta\tan\delta}$$

$K' = K_P$ or K_0

Job No.

No.

HDR Computation

Project

Subject

Task

Computed

Checked

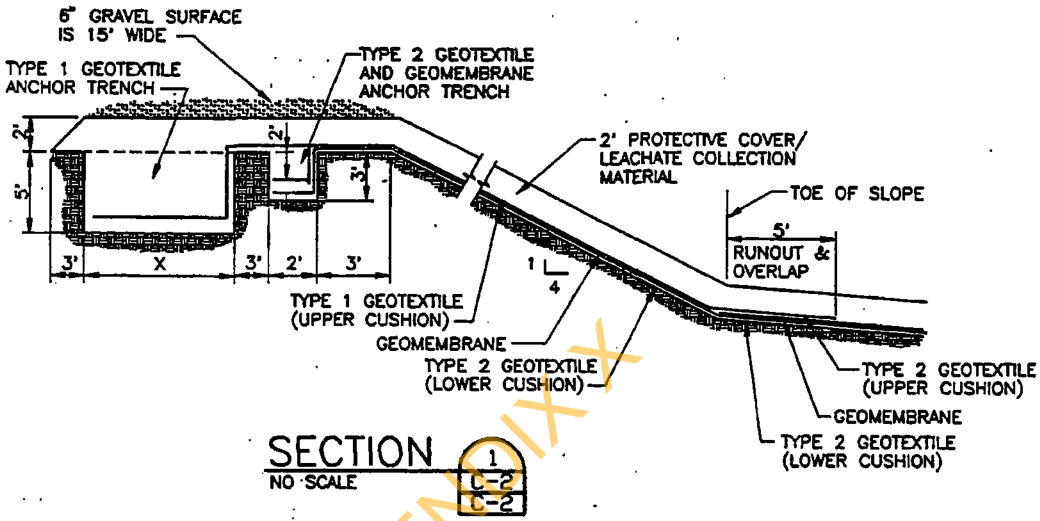
Sheet 2

Date

Date

Of 4

.5 SKETCH

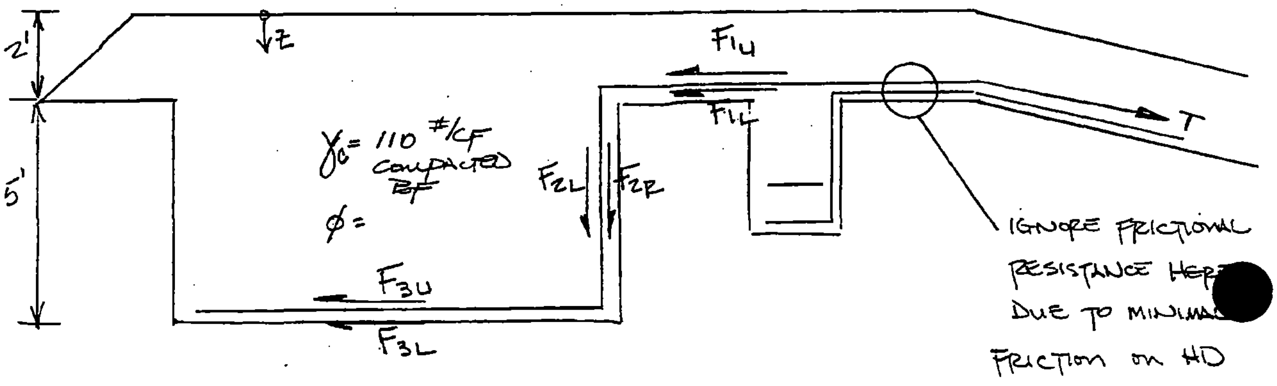


SECTION
NO SCALE

.6 Comps

(a) FOR TYPE 2 CUSHION GEOTEXTILE & 60 MIL HDPE GEOMEMBRANE, STRESS ANALYSES INDICATE MINIMAL STRESS IN GEOSYNTHETICS. USE MINIMAL ANCHOR TRENCH SHOWN ABOVE

(b) FOR TYPE 1 REINFORCING GEOTEXTILE, SIZE DIMENSION "X", HORIZONTAL RUNOUT, AS ABOVE



IGNORE FRICTIONAL RESISTANCE HERE DUE TO MINIMAL FRICTION ON HD

HDR Computation

Job No.
No.

Project
Computed
Date
Subject
Checked
Date
Task
Sheet 3
Of 4

$FS = \Sigma F / T_{REQD}$

$F_1 = F_{1U} + F_{1L}$

$F_{1U} = F_{1L}$ SAME SOIL & FRICTION BOTH SIDES OF REINF GT

$= 2F_{1U}$

$= 2(\gamma_c \cdot z \cdot \tan\delta \cdot L_1)$

$= 2(110\ \#/CF \cdot 2\,FT \cdot \tan 27° \cdot 5\,FT)$

$= 1{,}120$ PLF ✓

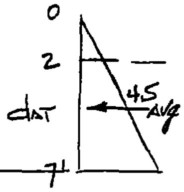
$F_2 = F_{2L} + F_{2R}$

$= 2F_{2L}$

$= 2(\sigma_{h\,avg} \cdot \tan\delta \cdot d_{AT})$

$= 2(232\ PSF \cdot \tan 27° \cdot 5\ FT)$

$= 1{,}182$ PLF ✓



	σ_v	σ_h
0		
2	220 PSF	103 PSF
d_{AT}	495 PSF	232 PSF
7'	770 PSF	362 PSF

$\sigma_v = \gamma_c \cdot z$

$\sigma_h = K_o \sigma_v$

$K_o = 1 - \sin\phi$ ✓

$= 1 - \sin 32° = 0.47$

$F_3 = F_{3U} + F_{3L}$

$= 2F_{3U}$

$= 2(\gamma_c \cdot z \cdot \tan\delta \cdot L_3)$

$= 2(110\ \#/CF \cdot 7\,FT \cdot \tan 27° \cdot L_3)$

$= 785 \cdot L_3$ PLF ✓

FOR $L_3 =$	$F_3 =$	
5 FT	3925 PLF	✓
7 FT	5495	✓
10 FT	7850	✓
12 FT	9420	✓

$\Sigma F =$	FOR $L_3 =$	
6,227	5'	✓
7,797	7'	✓
10,152	10'	✓
11,722	12'	✓

Job No. No.

HDR Computation

Project | Computed | Date

Subject | Checked | Date

Task | Sheet 4 | Of 4

T_{REQD} = 8,200 #/LF FOR SEISMIC CASE
5,200 #/LF FOR STATIC CASE

∴ SEISMIC CONTROLS

USE FS = 1.10 TO SIZE ANCHOR TRENCH AGAINST SEISMIC EVENT

$FS = \Sigma F / T_{REQD}$
$\Sigma F = FS * T_{REQD}$
$= 1.10 \cdot 8{,}200$ #/LF
$= 9020$ #/LF REQD ✓

USE 10' WIDE ANCHOR TRENCH

ATTACHMENT P-4

HDPE GEOMEMBRANE PUNCTURE RESISTANCE

Job No.

No.

HDR Computation

Project	BAYVIEW LANDFILL CELL 1, STAGE 2	Computed RLD	Date 7/96
Subject	LINER SYSTEM	Checked PMB	Date 7-19-96
Task	HDPE GEOMEMBRANE PUNCTURE RESISTANCE	Sheet 1	Of

.1 CONSIDERATION : PUNCTURE OF HDPE GEOMEMBRANE FROM GRANULAR LCRS MATERIALS

.2 REFERENCES : (a) Narejo, Koerner, and Wilson-Fahmy, Experimental Puncture Behavior of HDPE Geomembranes Without, Then With, Various Protection Materials. GRI Report 10

(b) Koerner, Designing with Geosynthetics, 3rd. ed.

.3

REQ'D. MATL PROP	VALUE	TEST	METHOD
Aggregate Max Size	~~ATTACHED~~	Sieve	ASTM C136/D422
Geotextile Mass/Area	TBD	—	ASTM D5261

.4 ANALYSIS PROCEDURE :

(1) DETERMINE MAX STRESS @ AGG : GM INTERFACE

(2) DETERMINE AGGREGATE M.S.A.

(3) DETERMINE GEOTEXTILE MASS/AREA.

FROM NOMOGRAPH OF REF (a)

WHERE : CH (CONE HEIGHT) ≐ MSA , UNITS ARE INCHES

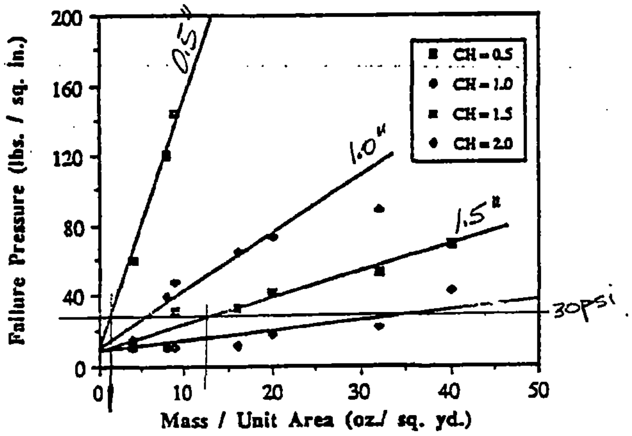
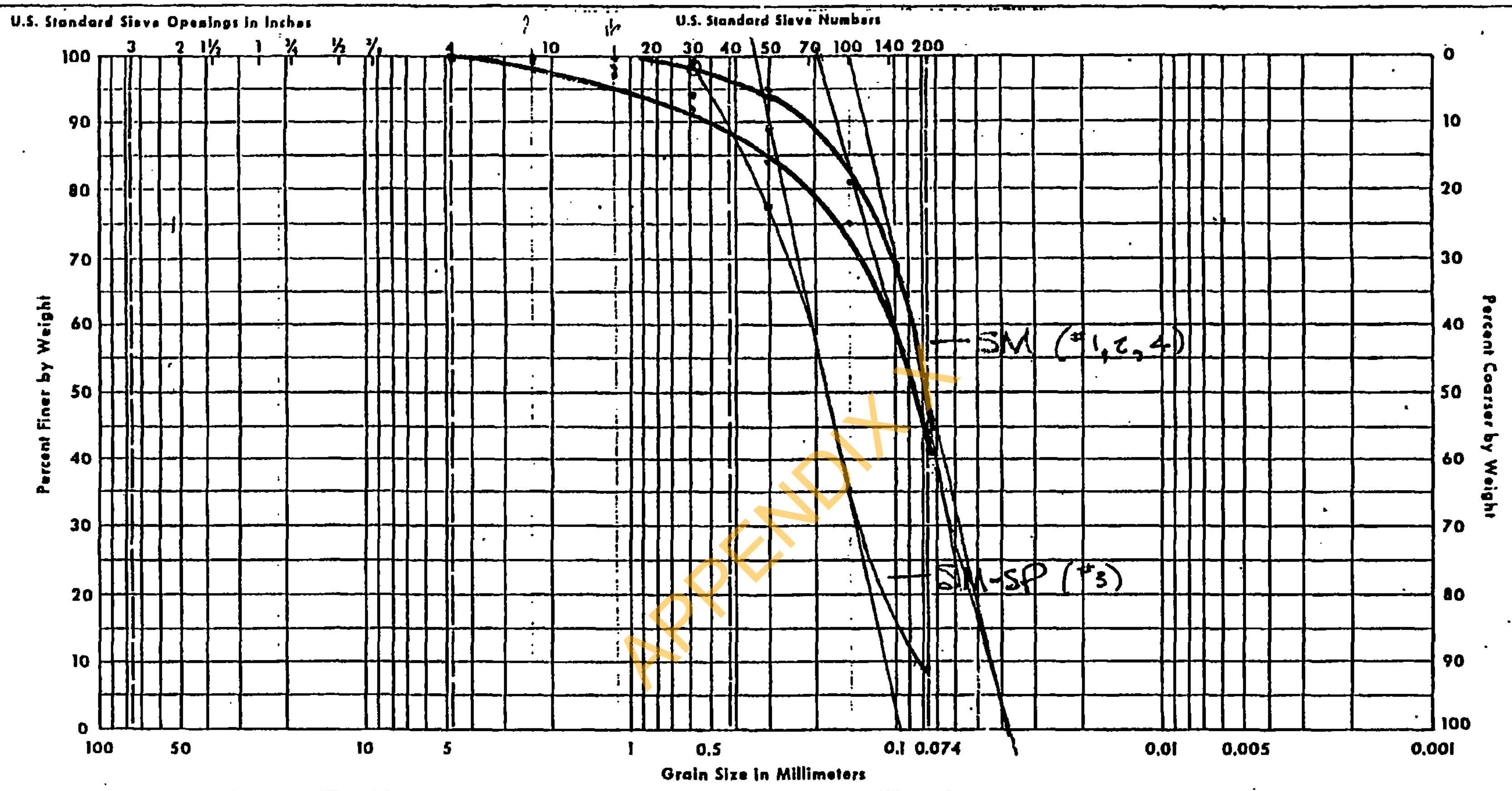


Figure 9(a) - Effect of Nonwoven Needle Punched Geotextile Mass / Unit Area on HPTC Behavior of 60 mil HDPE Geomembranes

GRAIN SIZE ANALYSIS CURVES



	Minimum Density	Maximum Density
Wet Unit Weight		
Dry Unit Weight		
Void Ratio		
Porosity		
Specific Gravity		
Hydraulic Gradient		
Coefficient of Permeability		

Remarks LAB DATA ATTACHED

Drill Hole No. STOCKPILE Sample No. 1-4, ALL

Sample Depth: GRAB SAMPLES

Field Blow Count NA

Project: BAYVIEW LANDFILL

Date: Job No.

Job No.
No.

HDR Computation

Project
Computed
Date
Subject
Checked
Date
Task
Sheet 3
Of

.5 ANALYSIS

A) DETERMINE MAX STRESS @ AGG & GM INTERFACE

FROM WASTE HEIGHT: 4810 @ CLOSURE
$- \underline{4720}$ @ BASE ✓

$\sigma_c =$ 90' WASTE × 50 pcf = $\frac{4500 \text{ psf}}{144}$, 31± psi

FROM VEHICLE OPERATIONS AT TOP OF 2' LCRS*:

CAT 826C WHEELED COMPACTOR 12.3 psi (CAT LIT.)
OR D8N DOZER 14.6 psi (" ")
DUAL WHEEL SINGLE AXLE TRAILER 27.5 psi
(W 11R22.5 TIRES)

* STRESSES WILL REDUCE THRU 2' LAYER, WORST CASE TO CONSIDER SAME σ AT GEOMEMBRANE

USE σ_c = 31 psi (FROM WASTE HEIGHT)

B) DETERMINE AGG MSA

FOR LCRS MATL = #4 SIEVE = 0.20 IN (GRAD, PG 2)
FOR NATIVE SUBGRADE = 1½" (FROM GEOTECH BORINGS)

C) DETERMINE REQUIRED GEOTEXTILE MASS/AREA FROM NOMOGRAPH

FOR UPPER GEOTEXTILE BTWN LCRS & HDPE
M/A = 3 oz/sy MIN ✓

FOR LOWER GEOTEXTILE BTWN HDPE & SUBGRADE
M/A = 12 oz/sy MIN ✓

ATTACHMENT P-5

GEOTEXTILE PERMEABILITY AND FILTRATION

Job No.
No.

HDR Computation

HDR

Project: Bayview Landfill Cell 1 Stage 2
Computed: RLD
Date: 7/96
Subject: Leachate Collection System
Checked: PMP
Date: 7-19-96
Task: LCRS Matl - Geotextile Permeability & Filtration
Sheet: 1
Of

.1 Consideration: Retention/Filtration/Permeability between soil : geotextiles.

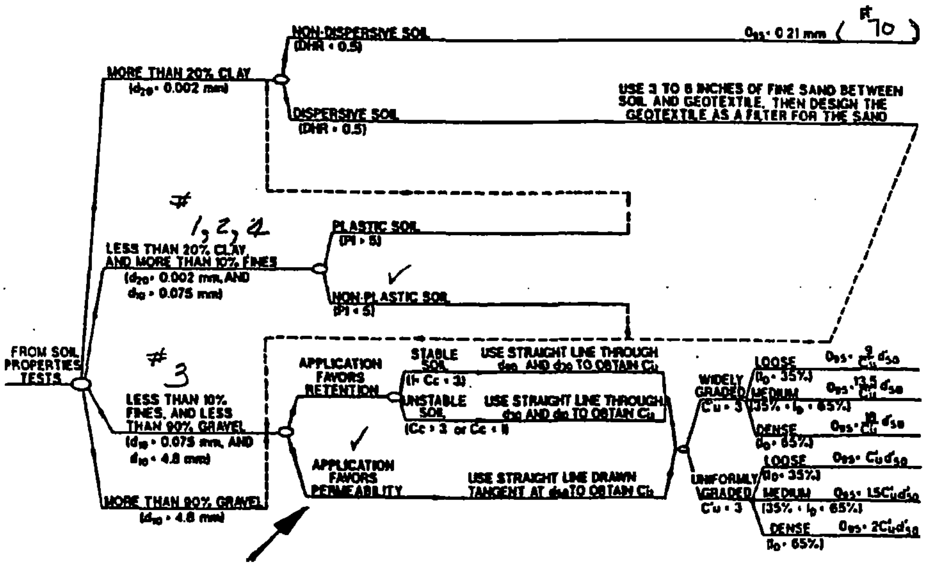
.2 References: (a) Luettich, Giroud, and Bachus, "Geotextile Filter Design Guide," Proceedings, 5th GRI Seminar, 1991.

.3 Req'd. Matl Prop.	Value	Test	Method
Soils			
gradation	attached	sieve/hydro	ASTM C136/D422
Atterberg Limits	Non plastic	LL, PI	ASTM D4318
dispersion	NA for SM/SP	hydrometer	ASTM D422
Geotextile			
Apparent Opening Size, O_{95}	TBD	sieve	ASTM D4751
Thickness, t_{gt}		—	ASTM D5199
Permittivity, ψ_{gt}		permeability	ASTM D5493

.4 Analysis Procedure:

(1) Obtain Physical Properties of Soils

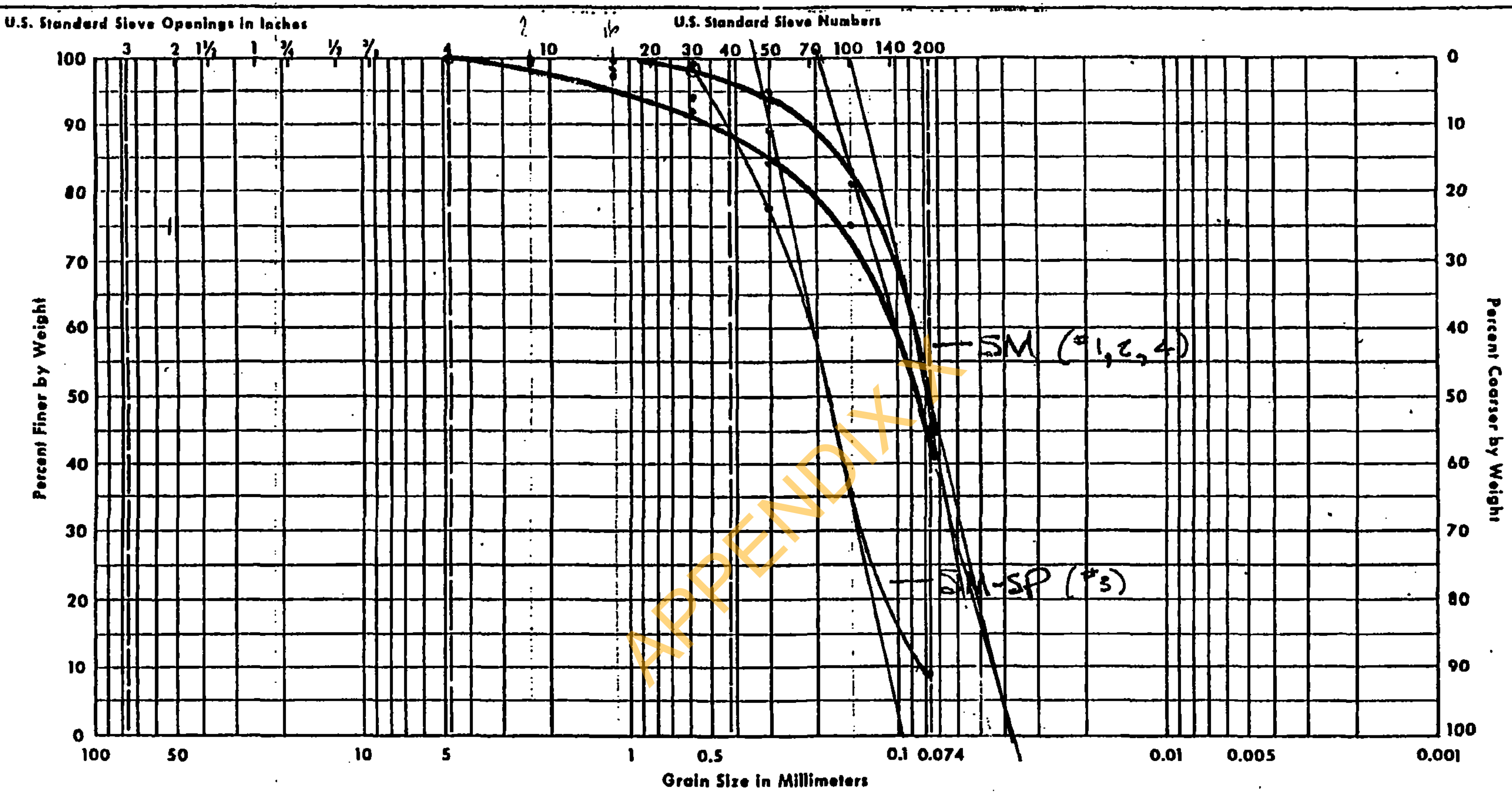
(2) Evaluate Retention/Filtration Criteria



(3) Evaluate Geotextile Permeability/Permittivity

$k_{gt} = i_s k_s$ (i_s = 1.5 for landfills)

GRAIN SIZE ANALYSIS CURVES



	Minimum Density	Maximum Density
Wet Unit Weight		
Dry Unit Weight		
Void Ratio		
Porosity		
Specific Gravity		
Hydraulic Gradient		
Coefficient of Permeability		

Remarks LAB DATA ATTACHED

Drill Hole No. STOCKPILE Sample No. 1-4, ATT.

Sample Depth: GRAB SAMPLES

Field Blow Count NA

Project: BAYVIEW LANDFILL

Date: Job No.

3/

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

TESTED FOR: Wasatch Environmental, Inc.
Mr. Les Pennington
2251 West California Ave.
Salt Lake City, UT 84104

PROJECT: Various Projects

DATE: May 13, 1996

PROJECT NO.: 706-60040-2

SUBJECT: Test of Samples submitted 5/7/96
LAB NO.: 706-2131

U.S. STAND. SIEVE SIZE	Percent Passing, by Weight				Project Specification
	SS #1	SS #2	SS #3	SS #4	
3/8"	100			100	
#4	100			100	
#8	99	100	100	99	
#16	97	100	100	98	
#30	94	98	98	92	
#50	88	95	78	84	
#100	81	83	35	76	
#200	41	43	8.8	44	
Liquid limit	NP	NP	NP	NP	
Plastic Limit	NP	NP	NP	NP	
Plastic Index	NP	NP	NP	NP	

	LOOSE	CONSOLIDATED
Permeability	1.906 ft/day 6.7×10^{-4} cm/sec	0.934 ft/day 3.3×10^{-4} cm/sec

	SS #1	SS #2	SS #3	SS #4
Shear Cohesion in tons/sq. ft.	c=0	c=0	c=0	c=0
Apparent Angle of Friction	φ=38°	φ=33°	φ=32°	φ=36°

⊖ loose D_r

Respectfully submitted,
Professional Service Industries, Inc.

Donald F. Kattelman
District Manager

Job No.
No.

HDR Computation HDR

Project
Computed
Date
Subject
Checked
Date
Task
Sheet 4
Of

.5 ANALYSIS

<u>EVALUATE RETENTION / FILTRATION CRITERIA</u>

FROM FLOW CHART, PG 1

LESS THAN 20% CLAY (BASED ON NON-PLASTIC ATTERBERGS)
MORE THAN 10% FINES (FROM GRAD #1, 2, 4)
LESS THAN 10% FINES (GRAD #3)
NON PLASTIC SOIL (FROM TEST RESULTS)

APPLICATION FAVORS PERMEABILITY

$C'_u = \sqrt{d_{100} / d_0}$ (d_{100}, d_0 FROM GRAD CURVES)

MATERIAL	GRADATION d_{100}	d_{50}	d_0	C'_u	$O_{95} \leq 1.5 C'_u d_{50}$	
SM (COARSE SIDE)	0.19 mm	0.085 mm	0.037 mm	2.3	0.29 mm	
SM (FINE SIDE)	0.15	0.08	0.037	2.0	0.24 mm	← CONTROLS
SM-SP	0.45	0.18	0.095	2.2	0.59 mm	

$C'_u < 3$ = UNIFORMLY GRADED

FOR MED. DENSITY (DUMPED, NO COMPACTION)

$O_{95} < 1.5 C'_u d_{50}$

USE $O_{95} \leq 0.24$ mm < #70 AOS (0.21 MM) ←

<u>EVALUATE GEOTEXTILE PERMEABILITY / PERMITTIVITY</u>

DETERMINE PERMEABILITY (k_s = 0.00067 cm/sec FROM TEST DATA ON LOOSE SAND, WORST CASE)

$k_g = 1.5\, k_s$

$= 1.5 \times 0.00067$ cm/sec

$= 0.001$ cm/sec

Job No.

No.

HDR Computation

Project

Computed

Date

Subject

Checked

Date

Task

Sheet 5

Of

DETERMINE PERMITTIVITY

$$\psi = \frac{k_{gt}}{t}$$

t = 100 MIL TYP FOR #70 AOS NON WOVEN
= 0.10 INCHES = 0.04 cm

$$= \frac{0.001 \text{ cm/sec}}{0.04 \text{ cm}}$$

$$= 0.025 \text{ sec}^{-1}$$ ✓ MINIMUM

TYPICAL #70 AOS NON WOVEN GEOTEXTILES HAVE $\psi = 0.5 \text{ sec}^{-1}$ or >

USE $\psi \geq 0.5 \text{ sec}^{-1}$ ←

OTHER PHYSICAL PROPERTIES PER AASHTO M288 ←

CLASS A SUBSURFACE DRAINAGE APPLICATION FOR
TYPE 2 CUSHION GEOTEXTILE

HIGH SURVIVABILITY SEPARATION APPLICATION FOR
TYPE 1 REINF GEOTEXTILE

ATTACHMENT P-6

PIPING STRENGTH/DEFLECTION

HDR Computation

HDR

Project: Bayview Landfill Cell 1, Stage 2
Subject: LCRS System
Task: Piping Strength / Deflection
Computed: RLD
Date:
Checked: PVP
Date: 7-19-96
Sheet: 1
Of:

.1 Consideration: LCRS Piping Strength / Deflection

.2 References:
(a) EPA SW-870, Lining of Waste Impoundment and Disposal Facilities
(b) Moser, Buried Pipe Design.
(c) Koerner, Designing with Geosynthetics
(d) ASTM D-2412, "External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading."

.3 Req'd. Mat'l Prop.	Value	Test	Method
Pipe Stiffness, F/Δy	SCH 80	Comp.	ASTM D-2412
Backfill Soil Modulus, E'	1000 psi	—	Ref b, c
Backfill Lat Pressure Kμ	0.165		Ref a, b

.4 Analysis Procedure:

(1) Compute Waste & Backfill Stresses on Pipe (Ref a)

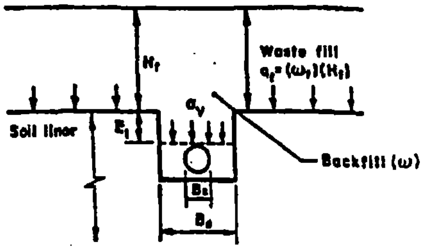
For TRENCH CONDITION:

$$\sigma_V = B_d \omega C_D + q_f C_{u.s.}$$

Where: $$C_D = \frac{\left[1 - e^{-2K\mu (Z/B_d)}\right]}{2K\mu}$$

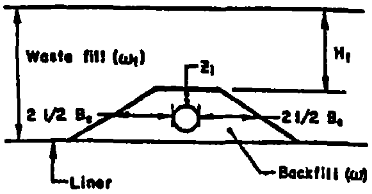
$$C_{u.s.} = e^{-2K\mu (Z/B_d)}$$

$K\mu = 0.165$ for gran. b.f.



For PROJECTING CONDITION:

$$\sigma_V = (\omega_f)(H_f) + \omega Z_1$$



For Perforated Pipe:

$$\sigma_{V(des)} = \frac{A_{pipe}}{A_{pipe} - ZA_{perf}} \sigma_V$$

(2) OBTAIN / COMPUTE PIPE STIFFNESS (REFS b & d)

- FROM SPECS OR MANUFACTURER'S LIT/RESULTS
- FROM PIPE MATERIALS & DIMENSIONS :

$$PS = 6.7 \frac{EI}{r^3} \qquad (\text{REF d, APP X2})$$

$$= 0.559E\left(\frac{t}{r}\right)^3$$

WHERE : E = modulus of elas., #/IN²
I = moment of inertia/in, IN³
$= t_{wall}^3 / 12$
r = mean radius, in
$= (B_c - t_{wall}) / 2$

- FROM SDR :

$$PS = \frac{4.47E}{(DR-1)^3} \qquad (\text{REF b, pg 174})$$

WHERE : E = 400,000 #/IN² for PVC
$DR = B_c / t_{wall}$

(3) COMPUTE DEFLECTION w/ MODIFIED IOWA EQN (REFS b, d)

$$\Delta y_{IN} = \frac{D \cdot K \cdot W_c}{0.149 PS + 0.061 E'} \qquad (\text{REF d, APP X1.})$$

FOR $D = 1.5$, $K = 0.10$ (TYP VALUES, REF c), $W_c = \sigma_v \cdot B_c$, SUBSTITUTE

$$\frac{\Delta y}{B_c} = \frac{1.005 \sigma_v}{PS + 0.41 E'}$$

WHERE : E' = Modulus of soil reaction:

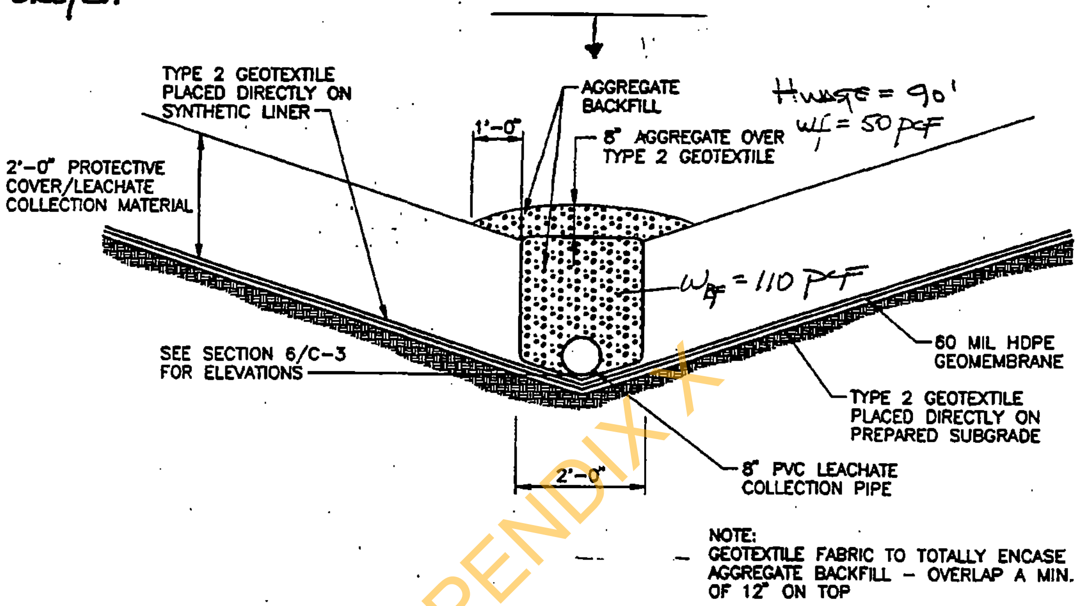
TABLE 3.4 Average Values of Modulus of Soil Reaction, E' (For Initial Flexible Pipe Deflection)

Soil type-pipe bedding material (Unified Classification System*)	E' for degree of compaction of bedding, lb/in²			
	Dumped	Slight, < 85% proctor, < 40% relative density	Moderate, 85%–95% proctor, 40%–70% relative density	High, >95% proctor, > 70% relative density
Fine-grained soils (LL > 50)† Soils with medium to high plasticity CH, MH, CH-MH	No data available; consult a competent soils engineer; Otherwise use E' = 0			
Fine-grained soils (LL < 50) Soils with medium to no plasticity CL, ML, ML-CL, with less than 25% coarse-grained particles	50	200	400	1000
Fine-grained soils (LL < 50) Soils with medium to no plasticity CL, ML, ML-CL, with more than 25% coarse-grained particles Coarse-grained soils with fines GM, GC, SM, SC contains more than 12% fines	100	400	1000	2000
Coarse-grained soils with little or no fines GW, GP, SW, SP‡ contains less than 12% fines	200	1000	2000	3000
Crushed rock	1000	3000	3000	3000
Accuracy in terms of percentage deflection§	± 2	± 2	± 1	± 0.5

(4) COMPARE VS. $\left(\frac{\Delta y}{B_c}\right)_{ALLOW}$

$$\left(\frac{\Delta y}{B_c}\right)_{ALLOW} = 7.5\ \%$$

.5 SKETCH



.6 CALCULATIONS

A) COMPUTE BACKFILL + WASTE STRESSES ON PIPE

$Z = 2'$, i.e. AT BOTTOM OF AGG. BACKFILL
$B_d = 2'$

$$C_D = \frac{1 - e^{-2 \cdot 0.165 \cdot (2/2)}}{2 \cdot 0.165} = 0.85 \checkmark$$

$$C_{us} = e^{-2 \cdot 0.165 \cdot (2/2)} = 0.72 \checkmark$$

$$\begin{aligned} \sigma &= B_d \, w_{BF} \, C_D + H_w \cdot w_f \cdot C_{us} \\ &= (2' \cdot 110 \text{ pcf} \cdot 0.85) + (90' \cdot 50 \text{ pcf} \cdot 0.72) \\ &= 3427 \text{ psf} \checkmark \end{aligned}$$

Job No.	No.

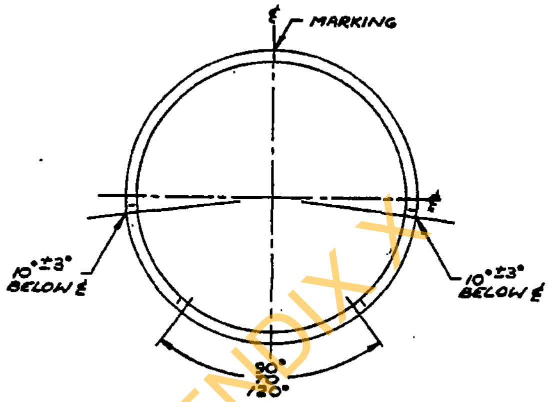
HDR Computation

HDR

Project	Computed	Date
Subject	Checked	Date
Task	Sheet 4	Of

ADJUST FOR PIPE PERFORATIONS

TABLE 5 Perforations[A]



Nominal Diameter, in.	Minimum Rows of Perforations	Hole Size[A]		Hole Spacing[A]	
		mm	in.	mm	in.
4	2	4.8 to 9.7	3/16 to 3/8	82.55 ± 6.35	3 1/4 ± 1/4
6	4	4.8 to 9.7	3/16 to 3/8	82.55 ± 6.35	3 1/4 ± 1/4
8	4	4.8 to 9.7	3/16 to 3/8	82.55 ± 6.35	3 1/4 ± 1/4 ←

[A] Combination of hole size and spacing of holes shall provide a minimum inlet area greater than 0.2200 in.^{2}/ft of pipe (that is, 3/16-in. holes at 3-in. center would permit a 0.2206-in.^{2} area). ←

$$\sigma_{V(des)} = \frac{A_{pipe}}{A_{pipe} - \Sigma A_{PERF}} \cdot \sigma_V$$

$$A_{pipe} \quad 8'' \text{ ID} = 9.00 \text{ O.D FOR SCH 80}$$

$$= \pi d \cdot L = 28.3 \ \text{IN}^2/\text{FT}$$

$$= \frac{28.3 \ \text{IN}^2/\text{FT}}{(28.3 - 0.22)\ \text{IN}^2/\text{FT}} * 3427 \text{ PSF}$$

$$= \overset{\checkmark}{3454 \text{ PSF}}, \quad \overset{\checkmark}{24.0 \text{ psi}}$$

Job No. No.

HDR Computation

HDR

Project Computed Date
Subject Checked Date
Task Sheet 5 Of

(b) Compute Pipe Stiffness

FOR SCH 80 PVC 8" ID

WALL $t = .50"$

$OD = B_c = 9.00"$

$E = 400{,}000$ psi for PVC

$I = t_{wall}^3 \div 12 = (0.50\,\text{in})^3 \div 12 = 0.010\,\text{in}^3$ ✓

$r = (B_c - t_{wall}) \div 2 = (9.00 - 0.50) \div 2 = 4.25\,\text{in}$ ✓

$$PS = 6.7\,\frac{EI}{r^3}$$

$$= 6.7 \cdot \frac{400{,}000\,\#/\text{in}^2 \cdot 0.010\,\text{in}^3}{(4.25\,\text{in})^3} = 349\,\#/\text{in}^2$$ ✓

(c) Compute Deflection

FOR CRUSHED ROCK AGG BF DUMPED LOOSE $E = 1000$ psi

$$\frac{\Delta y}{B_c} = \frac{1.005\,\sigma_v}{PS + 0.41E}$$

$$= \frac{1.005 \cdot 240\,\text{psi}}{349\,\text{psi} + (0.41 \cdot 1{,}000\,\text{psi})} * 100\%$$

$$= 3.2\% < 7.5$$ ✓ OK

USE SCHEDULE 80 PVC ✓

Appendix Q

APPENDIX Q

Conceptual Gas Extraction System

SUVSWD Bayview Class I Landfill
Permit Application

Appendix Q: Conceptual Gas Extraction System

SUVSWD Bayview Class I Landfill Permit Application

Prepared for
Bayview Landfill
South Utah Valley Solid Waste District
Springville, Utah

Prepared by
HDR Engineering, Inc.
3995 South 700 East, Suite 100
Salt Lake City, UT 84107

March 2009

Contents

Attachments

1.0 Background

Regulations require that landfills that produce over 50 Mg of non-methane organic compounds (NMOC) must have a landfill gas collection and control system installed. It is not anticipated that Cell 1 of the Bayview landfill will exceed this benchmark even when it is filled to capacity. (See calculation Q-1 at the end of this appendix.) At some future time, SUVSWD will collect the landfill gas with an active system utilizing a blower to create a negative pressure, or vacuum, in the landfill cell and extract the gas that is produced. The collected gas would then be combusted in a candlestick-type flare.

2.0 Gas Generation

Landfill gas generation is estimated for the landfill using the Scholl Canyon model. This model is a first order, single stage model that assumes that the gas production rate from a given mass of waste is at its peak upon initial waste placement, after a negligible lag time during which anaerobic conditions are established in the landfill. Therefore, peak gas generation from the landfill cell would occur at closure. Gas production is then assumed to decrease exponentially as the organic matter in the landfill decomposes. The following equation summarizes the model.

$$Q_{lfg} = 2L_O R\left(e^{-kc} - e^{-kt}\right) \qquad \text{Equation 2}$$

Where:

Q_{lfg} = landfill gas generation rate at time t, [m3/yr]

L_o = potential methane generation capacity of the refuse, [m3/Mg]

R = average annual refuse acceptance rate during active life, [Mg/yr]

k = methane generation constant, [1/yr]

c = time since landfill closure, [yrs], (c=0 for an active landfill)

t = time since initial refuse placement, [yr].

Using this equation, the landfill gas generation rate is 7,272,828 cubic meters / year, which equates to approximately 488 cubic feet / minute (cfm). (Since Cell 1 is not closed, c = 0, and e-kc = 1.0). The EPA's guidance document EPA-450/3-90-011a, Air Emissions from Municipal Solid Waste Landfills – Background Information for Proposed Standards and Guidelines suggests a conservative value of 100 for L_o and 0.04 for the k value for these calculations. A k value of 0.03 was used instead to account for the much drier climate at the Bayview Landfill site.

Calculation Q-2 is included at the end of this appendix. As a check, gas generation was calculated on a yearly basis for the waste received during that year. A first order decay rate was used to calculate gas generation from the waste for subsequent years. The gas generation for each year is then added to predict the total gas generated from all waste received. This calculation (Q-3) is included at the end of this appendix and predicts a peak flow of 494 cubic feet per minute (cfm), which is reasonably close to the amount of 488 cfm predicted in calculation Q-2.

An updated gas generation estimate was prepared by Klienfelder, Inc. in 2006 and is included in Attachment Q-4 at the end of this appendix. Their report modeled gas generation at the Bayview Landfill site through 2010. The actual in-place waste, plus two future growth scenarios were modeled. Gas production remained below the 50 Mg of NMOC threshold for all model runs through the year 2010. Therefore, the Bayview Landfill does not anticipate the need to install the gas extraction system during that period. The landfill, however, will continue gas monitoring and reporting to the State.

3.0 Gas Collection System

The first step to designing a gas collection system is determining the type of wells to be used to collect the landfill gas. Since the entire area of Cell 1 (approximately 33 acres) is near final grade, it was determined that the Cell 1 area would have vertical wells drilled through the waste.

The vertical well radius of influence (ROI) was calculated using techniques outlined in the EPA guidance document referenced above. The following equation is used to determine the radius of influence.

$$R_a = \left(\frac{Q_w \times DesignCap}{\pi L \rho_{refuse} Q_{gen} E_a} \right)^{1/2} \qquad \text{Equation 1}$$

Where:

R_a = Radius of Influence, [m]

Q_w = Gas flow rate / well, [m3/yr)

L = Landfill Depth, [m]

P_{ref} = Refuse Density, [Mg/m3]

Q_{gen} = Peak generation rate, [m3/yr]

E_a = Fractional collection efficiency

DesignCap = Design Capacity [Mg}

Using this equation, the ROI was determined to be 139 feet. This calculation (Equation 1 on Q-2), with assumptions, is provided at the end of this appendix. This radius determines the extraction well spacing. An effective landfill gas collection system will cover the entire area of Cell 1.

Using the calculated ROI, vertical wells were laid out as shown in Figure Q-1. The well radius was reduced along the side slopes to account for the more shallow depths encountered. This increases the well density along the side slopes. The size of the perforations along the well casing in the side slope wells may also be varied to achieve greater collection efficiency.

Flare location is the next issue to be resolved. The flare location is currently proposed to be in the vicinity of the existing leachate drain line in the northeast corner of Cell 1. This location will be convenient in the event that it is decided to use the same flare for Cell 2 when all or portions of it are closed. Additional blowers may be required to transmit landfill gas to the flare from Cell 2. This will be evaluated during subsequent design phases. See Figure 2 (Part IV) for the location of Cell 2 in relation to Cell 1.

Following well layout, the gas collection header was designed. The main design criterion for the header is to maintain a minimum 5% slope to promote positive drainage of gas condensate over the lifetime of the site. This slope takes into account the gradual settlement of the landfill over time. Utilizing the existing leachate collection system to manage gas condensate was another key concern. The header loops around Cell 1 and connects to the gas flare station.

Additional condensate sumps will be necessary at low points along the header. As mentioned, whenever possible, the condensate will be routed into the leachate collection system. However, some dedicated condensate sumps will be necessary in order to maintain a minimum of 5% slope on all gas collection lines.

Each well is designed to be connected to a gas collection node by a system of entrenched laterals. These small diameter laterals extend from the wellhead for several individual wells and are collected at a node for ease of monitoring and calibration. These nodes are then connected by a larger diameter sub-header to the main gas header system. Each lateral is also designed with a minimum 5% slope to promote condensate drainage. Whenever possible, each lateral should also be installed with a minimum two foot cover. It may be necessary during construction for some laterals to be installed with less than two feet of cover to maintain the 5% slope criteria. Figure Q-1 shows the proposed lateral/sub-header/header layout for the landfill.

All laterals, sub headers, and headers will be constructed of high-density polyethylene (HDPE) pipe. Gas collection wells will be constructed of either HDPE or PVC pipes. Pipes were sized to maintain a minimum head drop across the system to allow the blower to extract gas from the entire collection system. Should part of the collection system be disconnected for maintenance, the blower will still have the capacity to collect gas from the remainder of the system. A blower with a capacity to produce 60-inches of water column vacuum is proposed for the site.

Calculation Q-2 is included at the end of this appendix. As a check, gas generation was calculated on a yearly basis for the waste received during that year. A first order decay rate was used to calculate gas generation from the waste for subsequent years. The gas generation for each year is then added to predict the total gas generated from all waste received. This calculation (Q-3) is included at the end of this appendix and predicts a peak flow of 494 cubic feet per minute (cfm), which is reasonably close to the amount of 488 cfm predicted in calculation Q-2.

4.0 Pipe Sizing

When sizing the pipes for the gas system, the furthest point from the flare was chosen as the starting point. The cumulative flow from the starting point to the flare (in both directions) was used to size the header pipeline. The size of the header varies between sub-headers in order to handle the additional flow of gas at that location in the system. Then, the flow from each node was used to size each sub-header pipeline.

A form of the Mueller equation was used to calculate the pressure drop in each section of pipe:

$$\Delta P = L\left(\frac{G\,(60F)}{2971\left(d^{2.725}\right)}\right)^{\frac{1}{.575}}$$

Where:

ΔP = Change in Pressure

L = length of pipe (feet)

G = specific gravity (air = 1)

F = gas flow rate (ft3/hr)

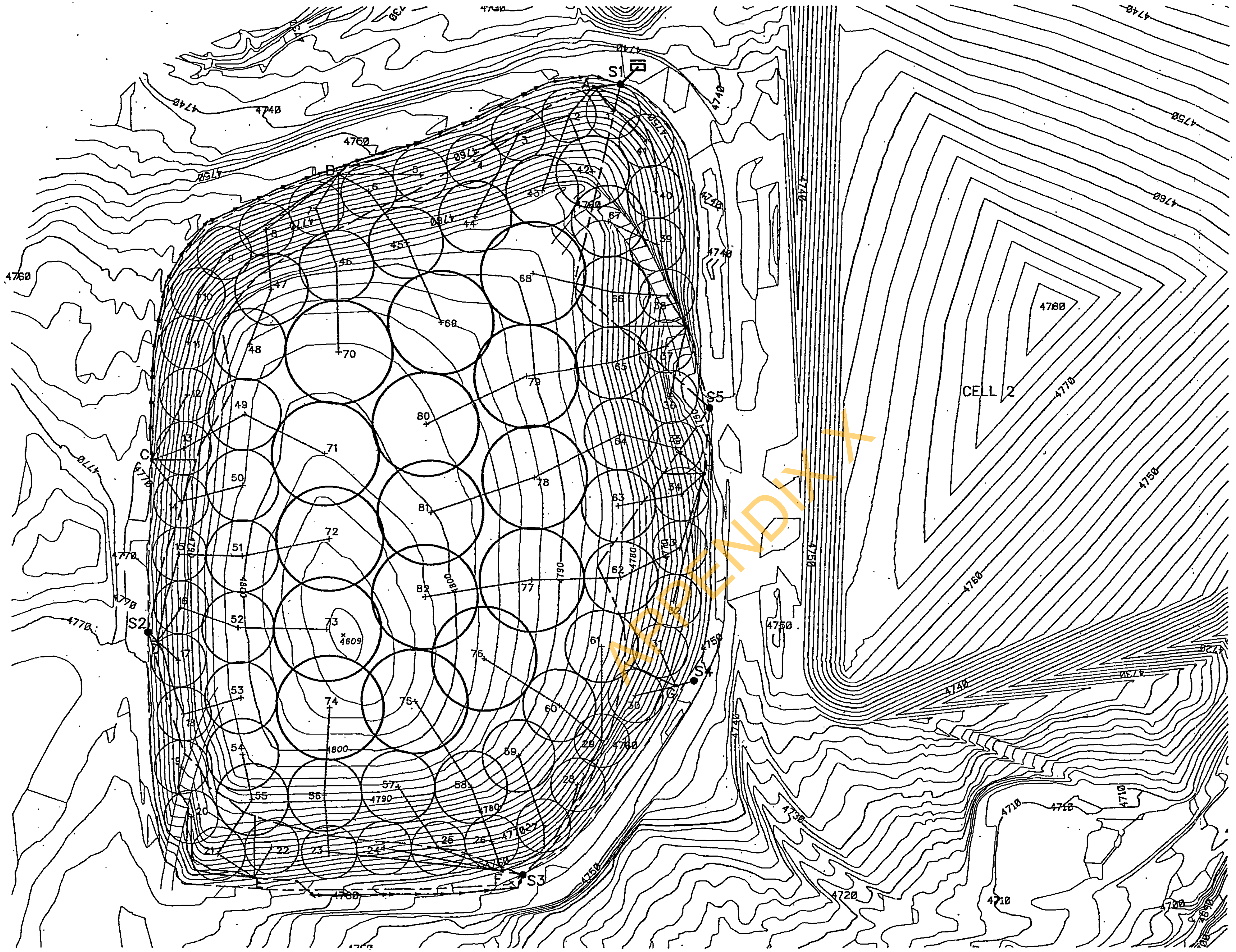
d = pipe internal diameter (inches)

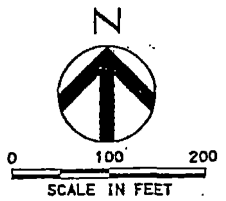
All pipes were designed to have a cumulative pressure drop of less than 30-inches, leaving 30-inches of vacuum at the farthest pipe location to extract gas from the cell. In the event that a pipe in the system malfunctions, the blower will still be able to collect gas from the majority of the system until repairs can be made.

APPENDIX Q

ATTACHMENT Q-1:

CELL 1 GAS COLLECTION SYSTEM LAYOUT





LEGEND

— — — —	HEADER
— — — — —	CELL BOUNDARY
———	LATERAL
—→—→—	FLOW OUTSIDE CELL BOUNDARY
———	SUBHEADER
—·—·—	CONDENSATE LINE
◯	WELL WITH 130' ROI
◯ 82 +	WELL WITH 72' ROI
◯	WELL WITH 50' ROI
⊟	FLARE LOCATION
● S5	CONDENSATE SUMP
▪	NODE

NOTES:

1. ROI - RADIUS OF INFLUENCE
2. CONTOURS SHOWN FOR CELLS 1 AND 2 ARE PROPOSED FINAL ELEVATIONS

FOR INFORMATION ONLY

HDR

HDR Engineering, Inc.
17111 Preston Road
Suite 200
Dallas, Texas 75248

Revision No.	Description	Date	Drwn.	Chkd.	Resp. Engr.	Proj. Mgr.

Project Manager M. ODEN	
Architect	I&C/Process
Civil	Mechanical
Electrical	Structural
Designed K. GREEN	Drawn By K. GREEN

SOUTH UTAH VALLEY SOLID WASTE DISTRICT

BAYVIEW LANDFILL
PERMIT MODIFICATION

CELL 1 - GAS COLLECTION SYSTEM LAYOUT

Date	Project No.	Figure No.	Issue
AUGUST, 2003	03879-143	Q-1	0

Scale AS SHOWN

APPENDIX Q

ATTACHMENT Q-2:
RADIUS OF INFLUENCE CALCULATIONS

Job No.	3608	**Calc No.**	Q-2

Computation

HDR

Project	Bayview Landfill Cell 1 Gas Collection Design	**Computed**	kdf
System	Landfill Gas Collection System	**Date**	6/26/2003
Component	Vertical Well Spacing	**Reviewed**	
Task	Radius of Influence Calculation	**Date**	

Purpose

Solve for the gas well radius of influence using equations provided in EPA's document, *Air Emissions from Municipal Solid Waste Landfills - Background Information for Proposed Standards and Guidelines.*

Find

Description	Variable	Units
Radius of Influence	R_a	feet

Given

Description	Value	Source
Design Capacity	1,659,232	[tons], client supplied
Avg. Annual Acceptance, R	100,350	[Mg/yr], client supplied
Methane Gen. Potential, L_o	100	[m^3/Mg], test values
Gas Generation Constant, k	0.03	[1/yr], test values

Solution

Description	Value	Comment
Radius of Influence	139	feet

Assumptions

Waste in Place Density	1300	*lbs/cy, client supplied value*
Gas Flow Rate	0.04	m^3/min/ m of landfill depth, *EPA Gas Background Document*
Landfill age at closure	15	years, *client supplied value*
Collection Efficiency	100%	*assumed for purposes of this calculation*
Landfill Depth, L	1	*[m], unit convention for flow/meter*

Equations

$$R_a = \left(\frac{Q_w \times DesignCap}{\pi L \rho_{refuse} Q_{gen} E_a} \right)^{1/2}$$

Equation 1

Source: EPA Gas Background Doc.

Where: R_a = Radius of Influence, [m]

Q_w = Gas flow rate / well, [m^3/yr]

L = Landfill Depth, [m]

ρ_{ref} = Refuse Density, [Mg/m^3]

Q_{gen} = Peak generation rate, [m^3/yr]

E_a = Fractional collection efficiency

DesignCap = Design Capacity [Mg}

$$Q_{gen} = 2L_o R\left(1 - e^{-kt}\right)$$

Equation 2

Source: EPA Gas Background Doc.

Where: Q_{gen} = Peak generation rate [m^3/yr]

L_o = Methane generation potential [m^3/Mg refuse]

R = Average annual acceptance rate [Mg/yr]

k = Gas generation rate constant [1/yr]

t = landfill age at closure, [yr]

Job No.	3608	*Calc No.*	Q-2

Computation

Project	Bayview Landfill Cell 1 Gas Collection Design	*Computed*	kdf
System	Landfill Gas Collection System	*Date*	6/26/2003
Component	Vertical Well Spacing	*Reviewed*	
Task	Radius of Influence Calculation	*Date*	

Calculation

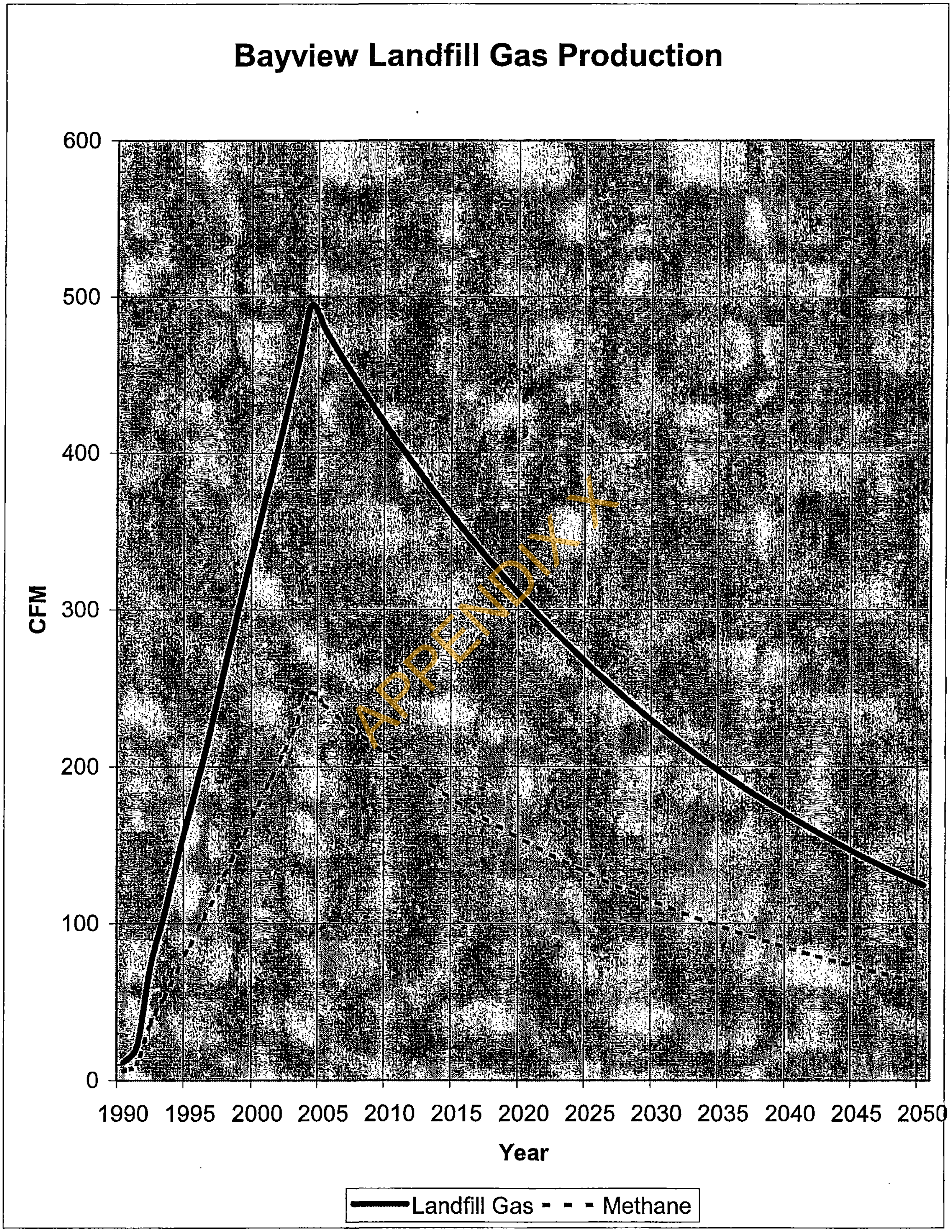
Description	Equation	Comment	Value	Units
Gas Flow Rate				
Assume Value	from EPA Gas Document		0.04	m^3/min-m
Convert to yearly	525,600 min/yr		21,024	m^3/yr-m
Design Capacity				
Design Capacity	Given Value		1,659,232	tons
Convert to Mg	1 ton = .9072 Mg		1,505,255	Mg
Refuse Density	Given value		1,300	lbs/cy
Convert to Mg/m^3	1 lb/cy = .000593 Mg/m^3		0.771	
Peak Generation Rate				
Determine peak rate	Equation 2 above		7,272,828	m^3/yr
Convert to cfm	1 ft^3/min = 14,895 m^3/yr		488	cfm
Radius of Influence				
Solve for R_a	Equation 1 above		42.4	m
Convert to feet	1 m = 3.28 ft		**139**	ft

APPENDIX Q

ATTACHMENT Q-3:
PEAK GAS PRODUCTION

Bayview Landfill
Gas Generation Estimates

	Year	Tons Received	Cumulative Tons	Megagrams Received	Cumulative Megagrams	Landfill Gas Produced (cfm)	Methane Produced (cfm)
0	1990	32,713	32,713	29,677	29,677	11.6	5.8
1	1991	82,841	115,554	75,153	104,831	21.4	10.7
2	1992	92,045	207,599	83,503	188,334	72.1	36.1
3	1993	96,899	304,498	87,907	276,241	104.4	52.2
4	1994	106,641	411,139	96,745	372,985	139.1	69.6
5	1995	105,746	516,885	95,933	468,918	172.6	86.3
6	1996	108,305	625,190	98,254	567,172	205.9	102.9
7	1997	119,391	744,581	108,312	675,484	242.2	121.1
8	1998	126,661	871,242	114,907	790,391	280.0	140.0
9	1999	124,286	995,528	112,752	903,143	315.8	157.9
10	2000	127,031	1,122,559	115,243	1,018,386	351.5	175.8
11	2001	126,664	1,249,223	114,910	1,133,295	386.1	193.1
12	2002	130,790	1,380,013	118,653	1,251,948	421.1	210.6
13	2003	136,584	1,516,597	123,909	1,375,857	457.1	228.6
14	2004	142,635	1,659,232	129,398	1,505,255	494.2	247.1
15	2005	0	1,659,232	0	1,505,255	479.6	239.8
16	2006	0	1,659,232	0	1,505,255	465.5	232.7
17	2007	0	1,659,232	0	1,505,255	451.7	225.9
18	2008	0	1,659,232	0	1,505,255	438.4	219.2
19	2009	0	1,659,232	0	1,505,255	425.4	212.7
20	2010	0	1,659,232	0	1,505,255	412.8	206.4
21	2011	0	1,659,232	0	1,505,255	400.6	200.3
22	2012	0	1,659,232	0	1,505,255	388.8	194.4
23	2013	0	1,659,232	0	1,505,255	377.3	188.6
24	2014	0	1,659,232	0	1,505,255	366.1	183.1
25	2015	0	1,659,232	0	1,505,255	355.3	177.7
26	2016	0	1,659,232	0	1,505,255	344.8	172.4
27	2017	0	1,659,232	0	1,505,255	334.6	167.3
28	2018	0	1,659,232	0	1,505,255	324.7	162.4
29	2019	0	1,659,232	0	1,505,255	315.1	157.6
30	2020	0	1,659,232	0	1,505,255	305.8	152.9


Bayview Landfill Gas Production
CFM
600
500
400
300
200
100
0
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Year
Landfill Gas
Methane

APPENDIX Q

ATTACHMENT Q-4:
FIVE-YEAR NON-METHANE ORGANIC COMPOUNDS EMISSIONS ESTIMATE REPORT (KLEINFELDER, 2006)

SOUTH UTAH VALLEY SOLID WASTE DISTRICT
BAYVIEW LANDFILL
FIVE-YEAR NON-METHANE ORGANIC COMPOUNDS EMISSIONS ESTIMATE REPORT

For: South Utah Valley Solid Waste District
P.O. Box 507
Springville, Utah 84663

September 11, 2006

A report prepared for:

South Utah Valley Solid Waste District
P.O. Box 507
Springville, Utah 84663-0507

SOUTH UTAH VALLEY SOLID WASTE DISTRICT BAYVIEW LANDFILL FIVE-YEAR NON-METHANE ORGANIC COMPOUNDS EMISSIONS ESTIMATE REPORT

File No.: 41232.008

Prepared by:

Mark Hooyer
Senior Scientist

Kerry L. Ruebelmann, P.G.
Environmental Division Manager

KLEINFELDER, INC.
849 West Levoy Drive, Suite 200
Taylorsville, UT 84123-2544
(801) 261-3336

September 11, 2006

TABLE OF CONTENTS

SECTION **PAGE**

TABLES

CHART

APPENDIX

A Report from the Scenario 3 LandGEM model run

1. EXECUTIVE SUMMARY

The South Utah Valley Solid Waste District (SUVSWD) is submitting this five-year estimate for non-methane organic compound (NMOC) emissions at the Bayview Landfill (Landfill) as required by the Utah Air Rules R307-221 and the Federal Regulations 40 CFR Part 60, Subpart WWW, *Standards of Performance for Municipal Solid Waste Landfills*, (Subpart WWW), Section 60.757(b)(1)(ii). If the estimated NMOC emission rate is less than 50 megagrams (Mg) per year in each of the next five consecutive years, the owner or operator of the landfill may submit an estimate of the NMOC emission rate for the next five-year period in lieu of annual reports. This report contains NMOC emissions estimates for the five-year period beginning January 1, 2006 and ending December 31, 2010.

The Landfill Gas Emissions Model (LandGEM) Version 3.02 was used to estimate NMOC emissions. As a variable for LandGEM, the estimated waste in place (WIP) for the next five years was calculated using three scenarios:

1. Projected WIP values based on historic waste acceptance data;
2. Projected WIP based on an expected county population growth rate of 3.9 percent annually; and
3. Projected WIP based on a conservative county population growth rate of 10 percent annually.

NMOC emissions were modeled with LandGEM with the WIP values from the three scenarios. NMOC emissions estimates from the three model runs are shown below.

TABLE 1
ESTIMATED NMOC EMISSIONS
(Mg)

Year	Scenario One: Best Fit Projection of Actual WIP	Scenario Two: Population Growth Rate = 3.9%	Scenario Three: Population Growth Rate = 10.0%
2006	35.1	35.1	35.1
2007	37.5	37.6	37.8
2008	39.8	40.2	40.8
2009	42.1	42.9	44.1
2010	44.4	45.6	47.7

NMOC emissions based upon a population growth rate of 10 percent resulted in the highest estimate; however, this estimate does not exceed 50 Mg/year for any of the next five years. Therefore, the estimated NMOC emissions indicate that NMOC emissions will be below 50 Mg/year for the years 2006 through 2010. Actual waste acceptance over the next five years is not expected to exceed the conservative value of the 10 percent growth rate presented in scenario three of this report. If waste acceptance rates exceed a 10 percent annual increase for any of the next five years, the Landfill will either revise this five-year estimate, or revert back to an annual report, either of which are allowed by Subpart WWW.

Tier 2 landfill gas testing results are valid for a five-year period, after which new data must be obtained. NMOC testing will be repeated in 2010, and another five-year estimate of NMOC emissions report will be generated in the year 2011.

2. INTRODUCTION

2.1 OVERVIEW

The South Utah Valley Solid Waste District (SUVSWD) is submitting this five-year estimate for non-methane organic compound (NMOC) emissions at the Bayview Landfill (Landfill) as required by Utah Air Rules R307-221 and the Federal Regulations 40 CFR Part 60, Subpart WWW, *Standards of Performance for Municipal Solid Waste Landfills*, (Subpart WWW), Section 60.757(b)(1)(ii). Subpart WWW states that "*if the estimated NMOC emission rate as reported in the annual report to the Administrator is less than 50 megagrams (Mg) per year in each of the next five consecutive years, the owner or operator may elect to submit and estimate of the NMOC emission rate for the next five-year period in lieu of the annual report.*" The SUVSWD has elected to submit a five-year estimate of projected NMOC emissions in lieu of the annual report. This report contains NMOC emissions estimates for the five-year period beginning January 1, 2006 and ending December 31, 2010. Historical waste in place and projected waste in place for 2006-2016 were used to estimate NMOC emissions for 2006 through 2010.

2.2 SOURCE DESCRIPTION

The Bayview Landfill is an active Class I municipal solid waste (MSW) landfill owned and managed by SUVSWD. The Landfill site is on approximately 600 acres (243 hectares) located at 10800 South State Route 68 in Elberta, Utah County, Utah. The facility has an estimated design capacity of 18.1 million Mg[1], and is therefore subject to provisions of Subpart WWW, Section 60.752, which applies to all landfills with a design capacity of 2.5 million Mg.

---

[1] *1 megagram is equivalent to 1 metric ton.*

The Landfill is currently comprised of two waste disposal cells, labeled as Cell 1 and Cell 2. Cell 1 covers 32 acres (12.9 hectares) and contains approximately 1.1 million Mg of potentially methane-producing waste. Cell 1 began receiving waste in February 1991, and is currently undergoing permanent closure. Cell 2 began receiving waste in January 2005. It covers 80 acres (32.4 hectares) and has an approximate overall design capacity of 6.4 million Mg. For this project, NMOC emissions are not estimated for Cell 2, because it does not contain waste over two years of age and therefore does meet the sampling requirements of Subpart WWW.

SUVSWD conducted Tier 2 landfill gas testing on Cell 1 on November 1 and 2, 2005, to calculate the site-specific value for the concentration of non-methane organic compounds (C_{NMOC}) contained in the landfill gas generated at the site. Sampling conformed to techniques and methods described in the Test Protocol approved for this project by the UDAQ (Kleinfelder, 2005a). The site-specific C_{NMOC} value was calculated using Tier 2 testing methodology as provided in Section 60.754(a)(3) of Subpart WWW. The site-specific value for C_{NMOC} as hexane calculated in this testing event is 1,017 parts per million by volume (ppmv). This value is used for NMOC emissions estimations for this report. A full test report describing test procedures and results was submitted to the UDAQ on December 16, 2005 (Kleinfelder, 2005b).

3. NMOC EMISSION ESTIMATE METHODOLOGY

3.1 EXISTING WASTE IN PLACE

Landfill emissions vary depending on site-specific characteristics, including the quantity of waste in place (WIP). The Bayview Landfill began accepting waste in 1991. Waste acceptance rates for the years 1991 through 2005 are shown in Table 2. These rates are based on scalehouse records of standard ("short") tons received per year, and converted to metric tons or Mg to be consistent with units used in Subpart WWW. The Bayview Landfill waste acceptance rate is increasing approximately 1 to 2 percent per year.

TABLE 2
HISTORIC WASTE ACCEPTANCE RATES
(1991-2005)

Year	Acceptance Rate	WIP* at Start of Year
	(Mg/year)	*(Mg)*
1991	65,500	0
1992	78,500	65,500
1993	86,000	144,000
1994	95,000	230,000
1995	100,000	325,000
1996	103,000	425,000
1997	105,000	528,000
1998	113,000	633,000
1999	122,000	746,000
2000	131,000	868,000
2001	119,686	999,000
2002	119,206	1,118,686
2003	124,234	1,237,892
2004	125,141	1,362,127
2005	126,049	1,487,268

* WIP estimated at the start of each calendar year.

3.2 PROJECTED WASTE IN PLACE

Future WIP amounts have been estimated using three scenarios:

1. Projected WIP values based on historic WIP data;
2. Projected WIP based on an expected county population growth rate; and
3. Projected WIP based on a conservative county population growth rate.

The WIP for each year is calculated by adding the waste acceptance rate to the existing WIP. The three future WIP estimates are used to calculate the NMOC emissions estimates generated for this report.

For scenario one, historic WIP data was plotted versus time represented as blue dots on Chart 1. A best-fit approximation of that data is a curve, which was projected through the year 2016, and is shown on Chart 1. The waste acceptance rate of this curve is increasing 5 percent per year, which is larger than the current waste acceptance rate of 1 to 2 percent. Projected WIP estimations calculated using this method are shown in the Table 3 and are represented by the blue line in Chart 1.

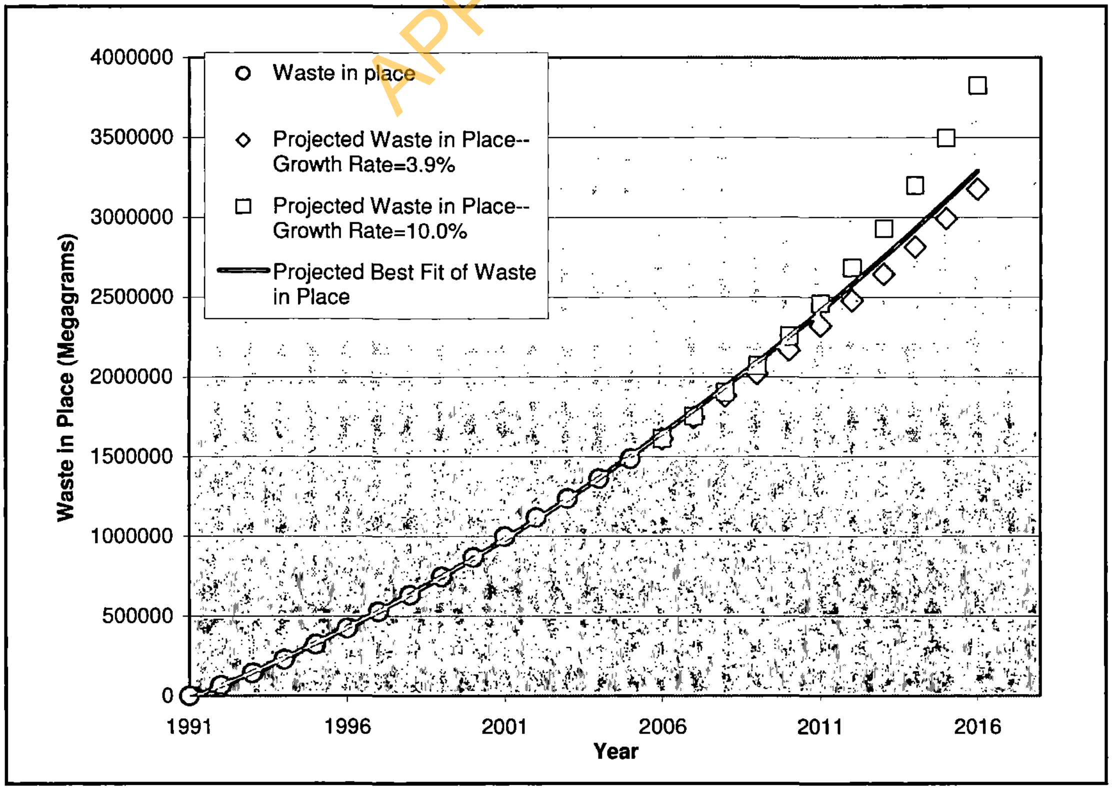
The second scenario for estimating waste acceptance rates was based on county population growth rates. Kleinfelder contacted the local municipal planning organization, Mountainland Association of Governments (MAG). MAG reported the population of Southern Utah County is expected to grow at an average annual rate of 3.9 percent per year for the next 25 years. Therefore, the waste acceptance rate was assumed to also increase at a rate of 3.9 percent per year. The projected WIP for this scenario is provided in Table 3 and is represented by the green diamonds on Chart 1.

The third scenario for estimating waste acceptance rates was based on an assumed county population growth rate of 10 percent per year to provide a highly conservative or "worst case" estimation of NMOC emissions from the Landfill. The projected WIP is provided in Table 3 and is represented by the red squares on Chart 1.

TABLE 3
ESTIMATED WASTE ACCEPTANCE RATE AND WASTE IN PLACE

Year	Scenario One: Best Fit Projection of Actual WIP		Scenario Two: Population Growth Rate = 3.9%		Scenario Three: Population Growth Rate = 10.0%	
	Waste Acceptance Rate (Mg/year)	Estimated WIP (Mg)	Waste Acceptance Rate (Mg/year)	Estimated WIP (Mg)	Waste Acceptance Rate (Mg/year)	Estimated WIP (Mg)
2006	145,214	1,702,668	130,965	1,613,317	138,654	1,613,317
2007	149,543	1,847,882	136,073	1,744,282	152,519	1,751,971
2008	153,872	1,997,425	141,379	1,880,354	167,771	1,904,490
2009	158,201	2,151,297	146,893	2,021,734	184,548	2,072,261
2010	162,529	2,309,498	152,622	2,168,627	203,003	2,256,810
2011	166,858	2,472,027	158,574	2,321,249	223,303	2,459,813
2012	171,187	2,638,885	164,759	2,479,823	245,634	2,683,116
2013	175,516	2,810,072	171,184	2,644,582	270,197	2,928,750
2014	179,845	2,985,588	177,860	2,815,766	297,217	3,198,947
2015	184,173	3,165,433	184,797	2,993,626	326,939	3,496,164
2016	188,502	3,349,606	192,004	3,178,423	359,633	3,823,103

CHART 1
WASTE IN PLACE ESTIMATES VS. TIME



3.3 DESCRIPTION OF LANDGEM MODEL

The Landfill Gas Emissions Model (LandGEM) Version 3.02 was used to estimate NMOC emissions. The following equation[2] is used by LandGEM to calculate the total NMOC emission rate from the Landfill:

$$M_{NMOC} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} k L_o \left(\frac{M_i}{10} \right) e^{-k t_{ij}} \left(C_{NMOC} \right) \left(3.6 \times 10^{-9} \right)$$

Definitions of the variables in the equation and the values used for each variable for this model are as follows:

- M_{NMOC} = Total NMOC emission rate from the Landfill, in Mg per year;

- k = methane generation rate constant, per year. The methane generation rate used for this report was 0.02 per year, which is the Clean Air Act (CAA) Arid Area default. The Bayview Landfill is considered an arid area landfill because it is located in a region that receives less than 25 inches of rainfall per year, as defined in section 60.754(a)(1) of Subpart WWW;

- L_o = methane generation potential in cubic meters per megagram (m^3/Mg) solid waste. The default value of 170 m^3/Mg was used for this model, as provided in section 60.754(a)(1) of Subpart WWW;

- M_i = mass of solid waste in the ith section in Mg. This is the WIP at the Landfill and includes estimated WIP as calculated using the three scenarios described above;

---

[2] *This equation is a modified version of the equation currently provided in Subpart WWW, and used in previous versions of LandGEM, which integrates NMOC emissions over each year. The modified equation shown above integrates emissions over a 0.1-year time increment. This revision is considered an improvement over previous calculation methodology. Approval to use this equation in place of the equation specified in Subpart WWW was obtained by Kleinfelder from Mr. James Chapman of the UDAQ on January 18, 2006.*

- t_i = age of the i^{th} section in years. The Landfill began accepting waste in 1991. NMOC estimations in this report are for the years 2006-2010, the 15th and 20th years of landfill operation, respectively. Therefore, for the model, a value of 20 years was used for t_i; and

- C_{NMOC} = Concentration of NMOC in ppmv as hexane. Tier 2 testing at the Landfill was conducted in November 2005. The value of C_{NMOC} calculated at that time was 1017 ppmv as hexane (Kleinfelder, 2005b).

4. NMOC EMISSION ESTIMATES

NMOC emissions were modeled with LandGEM for the three scenarios as described above. NMOC emissions estimates from the three model runs are shown below in Table 4.

TABLE 4
ESTIMATED NMOC EMISSIONS
(Mg)

Year	Scenario 1: Best Fit of Projected Historical Data	Scenario 2: Growth Rate = 3.9%	Scenario 3: Growth Rate = 10.0%
2006	35.1	35.1	35.1
2007	37.5	37.6	37.8
2008	39.8	40.2	40.8
2009	42.1	42.9	44.1
2010	44.4	45.6	47.7

A report from the LandGEM model run based on scenario three (10 percent growth rate) is provided in the Appendix A.

5. SUMMARY

NMOC emissions based upon a population growth rate of 10 percent resulted in the highest estimate; however, this estimate does not exceed 50 Mg/year for any of the five years. Therefore, the estimated NMOC emissions indicate that NMOC emissions will be below 50 Mg/year for the years 2006 through 2010. In accordance with section 60.757 (b) (1) (ii) of Subpart WWW, if the actual WIP exceeds the estimated WIP in any year reported in this estimate, a revised five-year estimate will be submitted to the administrator. Alternatively, SUVSWD may revert back to the filing of annual NMOC emission reports.

Tier 2 landfill gas testing data is valid for five years, and testing will be repeated again in 2010. Another five-year estimate of NMOC emissions will be generated for the 5-year period beginning January 1, 2011.

6. LIMITATIONS

The data and interpretations contained in this monitoring report have been presented in accordance with generally accepted standards of care and practice that currently exist within the industry in this geographic region at this time. It should be recognized that the evaluation of landfill gas is an inexact science. Judgments leading to conclusions and recommendations are generally made with an incomplete knowledge of the subsurface and/or historic conditions applicable to the site; Kleinfelder has relied upon information presented by SUVSWD in order to define the scope of work followed for this project. More detailed, focused, and/or extensive studies including additional subsurface assessments can tend to reduce the inherent uncertainties associated with evaluation of environmental conditions.

Since site activities and regulations beyond our control may change at any time after the completion of this report, our observations, findings, and opinions can be considered valid only as of the date of the field activities performed at the Landfill. Kleinfelder assumes no responsibility or liability whatsoever for any claim, loss of property value, damage, or injury that results from our identification of potentially detrimental conditions that may be presented in our findings. No warranty, either expressed or implied, is made.

7. REFERENCES

Kleinfelder. (2005). *Protocol for Tier 2 Landfill Gas Testing at Bayview Landfill, Elberta, Utah. Proposed Test Dates: November 1-2, 2005.* Salt Lake City, Utah. SUVSWD/41212.008/SLC5R153.

Kleinfelder. (2005). *Report of Tier 2 Landfill Gas Testing Sampling Dates: November 1-2, 2005 Bayview Landfill, Elberta, Utah.* Salt Lake City, Utah. SUVSWD/41212.008/SLC5R193.

Mountainland Association of Governments. (2006). *Utah Counties Population-2000//2005//2010//2015//2020//2030//2040//2050.* http://www.mountainland.org/Demographics/Population_Data/Future_Projections/Utah%20Counties%20-%20State.pdf

US Environmental Protection Agency. (1996). *New Source Performance Standards, Subpart WWW.* 40 CFR, Part 60.

Appendix R

APPENDIX R

Compost Operations Plan

SUVSWD Bayview Class I Landfill
Permit Application

Permanent Composting Facility Operating Plan

SUVSWD Bayview Class I Landfill

Permit Application

Prepared for
Bayview Landfill
South Utah Valley Solid Waste District
Springville, Utah

Prepared by
HDR Engineering, Inc.
3995 South 700 East, Suite 100
Salt Lake City, UT 84107

March 2009

Contents

1.0 Purpose of Plan

This Plan of Operations describes the methods for managing and operating the SUVSWD Permanent Composting Facility at the Bayview Landfill. This Plan of Operations is required for compliance with Utah Department of Environmental Quality (UDEQ) Solid and Hazardous Waste Division Regulation R315-312-2, Recycling and Composting Requirements. Once the Permanent Composting Facility is constructed, this plan will replace the Temporary Composting Facility Operation Plan currently included as Appendix R in the Permit Renewal Application submitted in October 2003.

This Plan of Operations presents a description of composting equipment, input material, and procedures utilized at the composting facility. The plan also addresses equipment, monitoring, composting schedules, odor and vector control, and special precautions. The Composting Facility will be located directly south of the existing leachate pond and east of the eastern-most boundary of proposed Cell 2, as shown in Figure R-1. Two types of composting are envisioned. One will combine biosolids, yard waste, waste beverages, and food products as the feedstock. The other will utilize only yard waste material, waste beverages and food products. The compost that includes biosolids will be constructed into windrows on an asphalt pad approximately 6 inches thick. The pad will be built in two phases, with the first phase being approximately 4 acres and the second phase being approximately 5 acres for a total of approximately 9 acres of area for windrows. Initially, the first 4 acres of the windrow pad will be paved and will be used for windrows containing biosolids. At that time, the majority of the remaining 5 acres will not be paved and will be used for windrows containing only non-biosolids feedstocks, or as a storage area for ground yard waste, or compost curing, or screening. This Operating Plan references the Plan of Operations for the Bayview Landfill which can be found as Appendix S in the Class I Landfill Permit Renewal Application submitted in October 2003.

2.0 Site Personnel

The Composting Facility will be open 44 hours per week, eight hours per day, Monday through Friday and one-half day on Saturday. The employees operating the Composting Facility will be the landfill foreman, one composting equipment operator, and one other full-time temporary employee during the summer. The actual number of employees utilized for composting operations will vary with the amount of feedstock material received. The landfill foreman will be responsible for training all employees in safety and fire protection practices. He or she will also be responsible for the training of employees in the inspection and identification of unauthorized wastes. There will be other on-site employees at the Bayview Landfill as described in Appendix S of the Permit Renewal application (October 2003), Section 2.3.3, Landfill Personnel. Landfill Personnel will assist as needed to maintain the site, including any regrading or repair of the compost operating surfaces. Communication and coordination between landfill and composting operations will be necessary to achieve uninterrupted operations of each facility, and will be the responsibility of the compost foreman and the landfill foreman.

3.0 Site Plan

A Site Plan for the Permanent Composting Facility is attached as Figure R-1. It includes the proposed location of the windrow area, curing area, ground yard waste storage, biosolids storage, future location of stormwater catch basin (if constructed) and waste liquids storage (if constructed). Basic drainage patterns are also reflected.

4.0 Windrow Process

The proposed composting operation will utilize a windrow process. Windrow processing is a method of controlled, aerobic decomposition of organic material. A carefully controlled windrow process balances oxygen, water, carbon and nitrogen (C:N) in the feedstocks to support beneficial microorganisms. The biological activity raises the temperature of the windrow to kill pathogens, seeds and spores. Compost operators must manage windrows to maintain conditions that meet state compost disinfection standards, and federal biosolids disinfection standards if biosolids are included in the feedstock. A typical windrow process consists of the following elements.

1. Feedstock receiving, grinding, blending, and misting (if necessary for dust control);
2. Windrow formation, turning, watering, and monitoring;
3. Addition of biosolids to biologically active windrows (optional);
4. Active windrow management to achieve disinfection standards;
5. Static pile curing and stabilization;
6. Product screening, and possible recycling of larger material, called "overs";
7. Product blending, coloring, and bagging (optional);
8. End product storage, sales, and distribution of bulk product, bagged product, or both.

Grinding of tree trimmings, grass clippings, and other wood material will continue to take place at either the (closed) Spanish Forks Landfill or the Springville Transfer Station using an existing tub grinder. If necessary, wood material will be debagged before it is ground so there will be little or no plastic material in the feedstock. A magnet located at the grinding operation pulls out all of the ferrous material (nails, wire, etc.) Spotters at the grinding area will visually inspect several randomly selected loads per day to watch for unacceptable material; therefore, the ground material will be free of unacceptable wastes and contamination when it arrives at the composting facility.

Biosolids will be delivered to the facility as needed to create windrows with a balanced C:N ratio. A paved area on the windrow pad will be available to store temporarily up to one weeks worth of biosolids if sufficient yard waste is not available to create a windrow. Only Class A or Class B biosolids will be utilized in the compost operation.

5.0 Equipment

Equipment utilized at the Permanent Composting Facility will be as follows, or equivalent. Alternate equipment may be used as conditions dictate.

- Windrow Turner - Scarab 1994- Model #18-450; VIN#0200SB, 2800 tons per hour
- Deck Screen - Roadrunner 1998- Model # CC514; 250 cubic yards per hour
- Front-end Loader – John Deere 2003- Model # TC544; VIN # DWTC54H586370; 1200 cubic yards per hour
- Water Truck- 4000 gallon tank; 200 gpm pump.

6.0 Windrow Construction

Windrows will be formed initially using the front-end loader. They will be turned periodically using the windrow turner. This model of windrow turner forms windrows that are approximately 18-feet wide, 8-feet tall, and have a 4-feet wide top. The cross-sectional area of the windrows will be approximately 88 square feet. The length of the windrows will vary, depending on the quantity of feedstock processed and processing time. Windrows will be arranged no closer than 15 feet apart to allow movement of the windrow turner, front-end loader and water truck.

7.0 Input Materials

The materials that will be used in the composting operation are tree trimmings, grass clippings, and wood material. Other non-hazardous organic waste materials such as agricultural waste and food processing waste may also be used. Class A or Class B biosolids from the Provo Wastewater Treatment Plant or other sources may also be included as a feedstock.

A balance of carbon and nitrogen is required to support proper biological activity to achieve good product without causing unacceptable odors during processing. A mix ratio by volume of between 1:2 and 1:5 biosolids to other organic high carbon materials such as wood is needed to achieve a proper balance of carbon to nitrogen (C:N) of at least 30:1 by weight. The method of measuring and proportioning input materials will be by a visual volume estimate (per bucket load).

The Class B biosolids hauled from the Provo Wastewater Treatment Plant will have been anaerobically digested, dewatered using polymers and centrifuges, and will contain approximately 21% to 23% solids for a total of approximately 1450 dry tons of biosolids per year and a total of approximately 8000 wet cubic yards per year or 6000 wet tons per year. If biosolids from any other source are accepted for processing, the estimated quantity and composition will be reported to the UDEQ DSHW prior to the acceptance of the material for composting.

Tree trimmings, grass clippings, wood material, and other similar high-carbon material will be solicited in quantities as appropriate to provide enough available carbon to maintain a high enough C:N ratio to support proper decomposition without nuisance conditions. Any excess wood may be used directly for erosion control and top dressing on the landfill. It may also be composted or removed from the site and sold.

Water used to add moisture will be provided from a storage tank on-site, which stores groundwater from the on-site culinary well. In the event that the stormwater catch basin and/or container crushing pad are constructed in the future, they will provide another source of liquid to be added to the windrows. Maintaining proper moisture in the windrows is important to support microbiological decomposition. When water is needed in the windrows, on-site staff will spray the windrows using a water truck. During and after the seven-day minimum period of pathogen reduction, only water from the culinary well or runoff that has not come in contact with biosolids will be used to add moisture to windrows or curing or storage piles.

Additionally, the District may construct a container-crushing pad in the future, which will be located directly to the south of the windrow area. The pad will be used to crush containers that contain liquid or semi-solid material brought to the landfill for disposal. This may be from product that does not meet specification for sale to consumers or that is out-of-date. The containers will be crushed, allowing the contents to drain into a buried storage tank for later withdrawal and used for adding moisture to aid in the compost process. Since this liquid has not been exposed to pathogens, it may be used before or after pathogen reduction. The crushed containers will then be taken to the landfill for disposal or recycled as appropriate.

Bulk liquids, which may be brought to the site, will be sprayed directly on the windrows or stored in on-site storage tanks for use at a later time. Bulk liquids are not permitted for disposal at the landfill.

8.0 Groundwater Monitoring

One deep groundwater monitoring well (DMW-6) is currently located downgradient of the Composting Facility, as shown in Figure R-1. The monitoring well will monitor the water quality after it passes beneath the windrow area. This groundwater monitoring well is designed to detect any contamination resulting from the composting operation.

9.0 Special Precautions

Rain will not be a hindrance to composting because composting requires the addition of moisture due to the fact that the process is exothermic. Heat generated by microbiological activity causes evaporation of water on a continual basis. Therefore, it will be necessary to add water. The heat of decomposition will mitigate the effects of snow and freezing weather on the material while it is being processed on-site. An operator will be available at all times when feedstocks are being delivered to monitor for unacceptable materials, and to take any action to maintain active, aerobic composting in cold weather, such as adjustments in feedstock ratios, frequency of turning or watering.

Windrows and curing piles will be crowned to shed rainfall. The windrow pad will be graded at approximately a 2% slope toward a northward-draining valley between the Phase I and Phase II areas. In addition, the pad will be sloped approximately 0.25% north toward the leachate pond located north of the windrow area. The northward draining valley will be sloped at 0.5% to convey the 25-year storm from both phases. Biosolids will be stored on Phase I of the asphalt pad. When needed, biosolids will be incorporated into the windrows as they are being formed.

10.0 Windrow Monitoring

As required by federal regulations, to achieve Class A pathogen reduction of biosolids using the windrow composting method, the biosolids must maintain a minimum temperature of 55 degrees Celsius or higher for a period of at least 15 days. During the time the windrow is maintained at a temperature of at least 55 degrees Celsius, it must be turned a minimum of 5 times. As required to achieve Class B pathogen reduction using the windrow composting method, the biosolids must maintain a minimum temperature of 40 degrees Celsius or higher for a period of at least 5 days. During at least 4 hours in that 5-day period, the temperature in the windrow must exceed 55 degrees Celsius. UDEQ regulations require the windrows to maintain a temperature between 60 and 71 degrees Celsius for a period of not less than seven days. In order to meet both of these requirements, it is proposed that the windrows maintain a minimum temperature of 40 degrees Celsius for at least 15 days. At some point during the 15 days, the temperature should exceed 55 degrees Celsius for at least 5 consecutive days and be turned at least 5 times during the same period.

It is anticipated that the complete composting cycle will entail approximately 45 to 60 days in the windrow process (active phase) and an additional 30 days in the curing process (curing phase). It is the intention of the SUVSWD to produce compost that meets standards for Class A biosolids disinfection when biosolids are included in the feedstock.

To meet the requirements for Class A pathogen reduction, the temperature in the windrows will be measured and recorded daily. Daily logs will be kept including the quantity and type of material processed. Moisture content may also be measured at a frequency necessary to support proper operations. Moisture can be checked just by feeling the material, or using a meter. An oxygen meter may also be used as needed to ensure that piles are not becoming anaerobic. Example forms to be used to record the monitoring information are included as Attachment R-1.

Once the compost has remained in the windrows for 45 – 60 days and has met the pathogen reduction requirements for time and temperature outlined above (active phase), it is considered stable. At that time, it will be placed in a static pile for final curing before being used. During the curing phase, the rate of oxygen consumption declines to the point where turning is no longer required. Also, organic materials continue to decompose and are converted to biologically stable humic substances. At that point, the compost is considered mature. Curing is not required to be on a lined area. Locations for static piles will be west of the leachate pond and possibly on areas that will be used for landfill cells in the future. Piles will be located so as to not interfere with ongoing compost or landfill operations.

11.0 FINISHED COMPOST USE/DISPOSAL

The final step in the production of compost is typically screening and/or coloring. Although not necessary, this is usually done to increase the value of the product by improving aesthetics. If these processes are undertaken, additional equipment will be rented, leased or purchased in order to perform the needed functions.

Finished compost and excess wood mulch will either be hauled off-site to be sold, or used on-site at the landfill for side-slope stabilization and to support vegetation as an amendment to native soils. Wood removed during screening may also be recycled to windrows, if necessary. Annual reports will be submitted to the Utah Department of Environmental Quality. A copy of the required forms is included as Attachment R-2.

12.0 DRAINAGE AND STORM WATER RUNOFF

In order to prevent stormwater from contaminating surface water or groundwater, all composting operations utilizing biosolids will take place on an asphalt pad. The first phase (Phase One) of the pad will be sloped to the east at a –2.0% slope and the second phase (Phase Two) will be graded toward the east at a +2.0% slope creating a valley for drainage between the two phases. Additionally, the entire pad will be sloped at a -0.25% slope to the north. The first phase of the asphalt pad will extend approximately 380 feet to the east, down the -2.0% slope, and then approximately 25 feet to the east, up the +2.0% slope, to create a valley for stormwater to be collected and directed to the existing leachate pond. If the catch basin is constructed in the future, then the valley will drain to the catch basin. The catch basin will be lined to prevent seepage into the ground. Excess runoff that is not contained in the catch basin, when constructed, will be directed, via an overflow pipe, to the existing leachate pond. The catch basin will be approximately 8 feet deep with 4H:1V sideslopes. A 6" HDPE pipe will be installed 1.0 foot below the top of the catch basin so that any excess runoff may drain to the existing leachate pond. A 6-inch curb or berm will be installed along the northern edge of the asphalt pad to direct runoff to the existing leachate pond or future catch basin. Drainage calculations for the peak flow can be found in Attachment R-3.

13.0 SAFETY

Safety training for personnel will be provided routinely and will be the responsibility of the landfill foreman. Training will consist of how to prevent, control and report fires, and proper use of equipment. See Appendix S in the Landfill Permit Renewal Application (October 2003), Section 2.0, Emergency Response, and Section 6.0, Contingency and Corrective Action Plans, for explosion, fire, and emergency response plans. The foreman will also enforce safety rules and policies and will investigate and report all accidents.

Lockout / tagout procedures will be followed for maintenance and cleaning of onsite equipment. Smoking and public access will be prohibited. Personal protective equipment will be provided to all on-site employees. This includes gloves, eye protection, and ear protection. All on-site employees will be required to wear steel-toed shoes and long pants. Dust masks will be available if needed.

Material Safety Data Sheets will be maintained on-site for all applicable materials used. Employees will have access to these sheets.

Emergency phone numbers will be posted in the landfill office. First Aid kits and fire extinguishers will be available in the office and on or near heavy equipment, as appropriate.

14.0 CLOSURE AND POST-CLOSURE

Should the District desire to cease compost operations, they will remove all compost piles, windrows, and any other compost material on site within 30 days of closure. If the catch basin is built, it will be completely drained and any solid material remaining will be properly disposed of. If necessary, any compost material remaining on site will be covered and vegetated. Once the site has been cleared, a plat and a statement of the fact that the property has been used as a composting facility will be submitted to the county recorder.

The post-closure care and monitoring period will last for five years after closure of the composting facility. During this time, any monitoring equipment used will be maintained and any sampling and testing schedules will be followed. If cover is placed over any remaining compost during closure, it will be inspected and maintained during this post-closure care period.

1

Attachment R-1: Example Forms for Record Keeping

South Utah Valley Solid Waste District

Bayview Landfill

Compost Data Form

Windrow Number / Location: ______________________________

Date(s) Created: ______________________________

Location	Date	Time	Temp	Comment

Location = distance along windrow; south or north side
Comment = turn date; water or liquid added; unusual conditions

Appendix S

APPENDIX S

LANDFILL OPERATIONS PLAN

SUVSWD Bayview
Class I Landfill Permit Application

Originally Submitted

February 2004

Modified

October 2009

Prepared By:

HDR ENGINEERING, INC.

SUVSWD Bayview
Class I Landfill Permit Application – Appendix S

Table of Contents

1.0 INTRODUCTION

The purpose of this Operations Plan is to assist the Landfill Foreman and Landfill Operating Personnel in conducting day-to-day operations in a manner that is consistent with the various permit requirements, and with the design of the Bayview Landfill. Section 2 describes the emergency response procedures applicable to the landfill, the permit conditions applicable to the landfill, the designed facilities at the landfill, and equipment and personnel requirements for proper operation of the landfill. Section 3 provides a discussion of landfill facilities at the site. Section 4 describes the procedures for handling wastes received at the landfill. Section 5 provides a schedule for conducting inspections, monitoring, and reporting for the landfill facilities. Section 6 provides contingency plans and corrective action programs to be implemented if emergency conditions (e.g., fire or explosion) exist, or if data indicate that containment systems have failed. Section 7 discusses alternative waste handling and disposal during inclement weather. Section 8 describes the maintenance of landfill monitoring equipment. Section 9 describes routine and non-routine procedures to be implemented to control disease vectors. Section 10 addresses waste screening to exclude regulated hazardous wastes. Sections 11 and 12 provide a discussion of the current and planned recycling and diversion of solid wastes at the landfill.

2.0 EMERGENCY RESPONSE AND BACKGROUND INFORMATION

2.1 Emergency Response Actions

Landfill emergencies include: injury, dismemberment, or death of personnel; and fire, explosion, or other catastrophic events. Because of its remote location, the landfill maintains its own fire protection equipment, and personnel are trained in the operation of this equipment. Also because of its remote location, injured personnel will be transported to medical facilities in District vehicles if their condition allows movement. The Landfill Foreman, or his designee, may request that ambulance and paramedical personnel meet the transporting vehicle enroute to the medical facility.

For other emergencies, the following list provides the phone number to access emergency services. This list will be posted directly adjacent to each phone on the facility site within a colorless, protective plastic cover.

Fire and Rescue	911	(801)375-3601
Hospital	911	
Utah Valley Regional Medical Center		(801) 371-7001
Mountain View		(801) 465-7190
County Fire Marshall		(801) 370-8885
Sheriff		(801) 375-3601
District Office		(801) 489-3027

In the event of any emergency, the following personnel will be notified:

Name	**Position/Title**	**Work Phone**
Richard Henry	District Manager	(801)489-3027
Scott Aitken	Landfill Foreman	(801)376-0197
Mark Loveless	Transfer Station Foreman	(801)489-3027
Dorothy Morse	Executive Secretary	(801)489-3027

2.2 Permit Requirements

The Bayview Landfill is subject to both State of Utah and local Utah County requirements controlling day-to-day operations at the landfill. The state and local requirements are discussed below.

2.2.1 State Requirements

On October 9, 1991, the U.S. Environmental Protection Agency (EPA) published revisions to the Criteria for Classification of Solid Waste Disposal Facilities. These regulations were developed in response to requirements of Subtitle D of the 1984 Hazardous and Solid Wastes Amendments (HSWA) to the Resource Conservation and Recovery Act (RCRA) of 1976. The Subtitle D regulations set forth minimum federal criteria for municipal solid waste landfills, including facility design and operational requirements. The Subtitle D regulations became effective on October 9, 1993.

Subtitle D establishes a framework for federal, state, and local government cooperation in controlling the management of non-hazardous solid wastes. The federal government's role within this framework is to establish the regulatory direction by providing minimum nationwide standards for protection of human health and the environment, and by providing technical assistance to states for planning and developing their own environmentally sound waste management practices. However, the actual planning, direct implementation, and enforcement of solid waste programs remains a state and local role under the Subtitle D framework.

On July 15, 1993, the Utah Department of Environmental Quality (UDEQ) issued final Administrative Rules implementing Subtitle D at the state level. These rules, entitled Solid Waste Permitting and Management, Rules (8315-301 through 320), have been reviewed by EPA, and the UDEQ has received authorization from EPA to implement and enforce the solid waste management program.

The UDEQ rules require that each landfill develop and comply with its approved Operations Plan. The rules further specify certain operational requirements including: excluding hazardous and bulk liquid wastes; controlling access; controlling disease vectors; controlling air discharges and explosive gases; controlling run-on, run-off, and surface water discharges; and maintaining records. This Operations Plan has been developed to include the requirements of the UDEQ rules.

2.2.2 Utah County Requirements

During the process of permitting the Bayview Landfill site, the Utah County Board of Adjustment enumerated 26 criteria that the landfill must meet to remain in compliance with the Board's Conditional Use Permit. These permit conditions include the following. (Note: These permit conditions are quoted directly from the Conditional Use Permit and are provided here to make the landfill operators aware of the District's obligations under the Conditional Use Permit.)

1. Compacted or baled garbage will be placed in trenches and covered at the end of each day.
2. The waste will be buried away from the gravel pit area.
3. A fence will be installed surrounding each trench area at least eight (8) feet in height and higher if found inadequate to control blowing papers.
4. After an area has been filled, it will be contoured, mulched, and reseeded as indicated by the State Agronomist and the State Extension Service.
5. There will be a watchman on site during normal working hours.
6. The gate will be closed any time it is unattended and it must be locked. (This is the main gate, not that around a particular area being filled.)
7. A new access road from the state highway into the deposit area will be provided as required by the Department of Transportation.
8. The size of the garbage trucks will meet the requirements of the Utah Department of Transportation and Utah Highway Patrol.
9. Provo City will cooperate with the State Highway Department and local residents to prevent inordinate damage to the road during periods when the road is saturated and subject to destruction, and comply with all state and local ordinances conforming to the same.
10. All municipal garbage will be collected and compacted at a location other than the landfill site and transported in covered trucks by Provo City.
11. No burning is to be allowed at the disposal site.
12. The trenching will be done in such a manner as to protect the drainage channels in the area as required by the State Department of Environmental Health.
13. No hazardous wastes will be deposited in the area.
14. All reasonable caution and prudence be exercised to not dispose of any waste during any unreasonable weather conditions.
15. All requirements in the "Code of Solid Waste Disposal Regulations" will be met.
16. Any terms of the lease held by Mr. Jacobs are protected and that Provo City cooperates with him during lambing season to minimize the impact on his operation.

17. No public dumping.
18. Landfill to be used only by Provo City, and if other cities were to use the landfill, approval from the Board of Adjustment would be necessary.
19. Personnel will police the grounds outside the fence, and keep litter and garbage picked up.
20. Rodent control must be in effect at all times as state law provides.
21. Water samples will be taken by the Department of Environmental Health from any wells within 1500' of the disposal site prior to any dumping to determine the water quality. Samples would be taken every six months or more often as determined by the Department of Environmental Health.
22. The area used to begin the operation of filling must be selected to minimize the impact on people in the surrounding area.
23. In constructing the road or roads required by the Department of Transportation to get access to the landfill, Provo City will minimize the amount of disruption to the environment of the area.
24. That Provo City maintain a buffer zone of at least 100' from existing state roads, homes and premises in dumping their compacted garbage.
25. Upon noncompliance with any of these provisions Utah County will revoke said right to the landfill.
26. Provo City will provide an annual report to the Board of Adjustment for their review as to the progress in the engineering of the landfill.

These conditions will be considered the minimum criteria that the landfill operations must meet to remain in compliance with the Conditional Use Permit.

2.3 Landfill Facilities

At the time of this permit application renewal, the Bayview Landfill consists of one 33-acre landfill cell almost at final grade, one stormwater/leachate evaporation pond, five screening berms, one maintenance building, and appurtenant roads, fences, and culinary and monitoring wells. In addition, an 82-acre cell is currently under design and will be constructed in 15-acre increments or stages. Figure 5 in Part IV provides a layout of the existing facilities at the Bayview

Landfill. Each of these facilities was anticipated in the Landfill Master Plan (HDR, 1988) developed for the site, and is described in the following paragraphs. The landfill is also currently equipped with various earthmoving and landfill operations equipment. The types and numbers of pieces of equipment necessary for proper operation of the landfill are described below.

2.3.1 Fixed Landfill Facilities

Cell 1 Stage 1 and Stage 2 have been constructed with a liner and leachate collection system. The liner consists of a 40-mil and 60-mil high density polyethylene (HDPE) geomembrane, respectively, sandwiched between two layers of 12-ounce polypropylene geotextile. At the time of its construction, the liner system was covered with a 2-foot layer of protective soil cover. The liner system and its protective soil cover are critical elements in the landfill leachate containment system; therefore, operators will take all possible precautions to protect the liner system. Damage to the protective soil cover will be inspected, and damage to the liner system will be reported to the District Manager for appropriate action.

Cell 2 will also be constructed with a liner and leachate collection system. The liner will consist of a geosynthetic clay liner (GCL), and a 60-mil high-density polyethylene (HDPE) geomembrane sandwiched between two layers of geotextile. The liner system will be covered by 2 feet of protective cover/leachate collection material.

For Cell 2, the leachate collection system will consist of 2 feet of permeable screened soil on the floor of the landfill cell and a leachate collection trench that is fitted with granular fill and a pipe. The granular fill is surrounded with filter fabric (geotextile). The leachate collected within this system flows by gravity to a sump at the low end of the cell and pumped to the surface, where it then flows by gravity to the on-site leachate sewer line and ultimately to the evaporation pond. The cleanout stations on the pipeline will be inspected on a regular basis to verify integrity.

The stormwater/leachate evaporation pond has been constructed with a liner and a protective cover system. The liner system consists of a 60-mil HDPE geomembrane sandwiched between two layers of 12-ounce polypropylene geotextile. The liner system was covered with a 6-inch concrete pad on the bottom and a 40-mil HDPE geomembrane on the side slopes. The concrete pad extends approximately 3 feet (measured vertically) up the side slopes, and a concrete access road has been constructed to provide equipment access into the bottom of the pond. The concrete pad is intended to allow landfill operators to enter the pond to remove accumulated sediments as required. The concrete bottom and access road will be inspected on a regular basis to verify the integrity of the concrete. Similarly, the 40-mil HDPE protective liner will be inspected on a regular basis to verify its integrity. Damage to either the concrete or HDPE protective cover materials will be reported to the District Manager for appropriate action.

The screening berms have been constructed to provide a visual barrier between State Highway 68 and the active landfill facilities. These screening berms also provide a partial visual barrier between properties north and south of the site and the active landfill facilities. The District constructed these berms to lessen the visual impact of the landfill facilities on the passersby, not as a condition of a permit.

The maintenance building consists of three equipment maintenance bays, a combined office/break room, and restroom facilities. This building is locked when landfill operations personnel are not on-site. The building is supplied with culinary water from the culinary well located in Section 18.

Fourteen wells have been constructed around the landfill property to provide stations for monitoring groundwater underlying the site. Eight of these wells were constructed to intercept the regional groundwater at a depth of approximately 250 feet below ground surface. The remaining six wells were constructed as "wet/dry" wells screened in the seasonal water table aquifer at a depth of approximately 70 feet below ground surface. These shallow wells are intended to provide early warning of leachate movement, if it should occur.

A 6-foot high chain link fence surrounds the site to control access to the facilities when landfill operations personnel are not present. The main access to the site is equipped with doublewide, locking gates. These gates are locked during nonworking hours. In addition, the stormwater/leachate evaporation pond is surrounded by a 6-foot high chain link fence and two doublewide, locking gates. The stormwater/leachate evaporation pond gates are locked unless landfill operations personnel are inside the fenced enclosure.

2.3.2 Landfill Equipment

The following equipment is maintained for use at the Bayview Landfill:

Equipment	Quantity	Size	Make/Model
Compactor, Landfill Blade	2	56,000 lb.	Cat 823C
Scraper	2	22 cu. yd.	Cat 623E
Dozer	1		Cat D8R
Grader	1		Cat 770
Water Truck	1	5,000 gal.	Ford
Pickup Truck	1	¾ ton	Ford 250
Pickup Truck	1	¾ ton	Dodge 2500

This equipment is sufficiently sized for operation of the Bayview Landfill. All equipment, with the exception of the pickup truck and fire truck, is required to have an OSHA-approved safety cab, a fire extinguisher, a first aid kit, and a backup alarm. Additional equipment may be purchased as existing equipment approaches the end of its useful life, or as operating conditions require.

2.3.3 Landfill Personnel

The following persons are responsible or available for on-site operations at the Bayview Landfill:

- **District Manager.** The District Manager is responsible for: planning, design, and construction of the landfill facilities; overall operation of the solid waste management system, including the landfill; and production of annual environmental and financial reports. The District Manager reports to the District's Board of Directors. The Landfill Foreman reports directly to the District Manager.
- **Landfill Foreman.** The Landfill Foreman is responsible for all day-to-day operations at the Bayview Landfill. He is responsible for: acceptance and placement of wastes at the landfill; routine inspection of the facilities for compliance with permit requirements; and coordination with the Transfer Station Foreman. The Landfill Foreman is a certified Manager of Landfill Operations with at least 10 years of professional experience related to landfill operations and earthwork. The Equipment Operator(s), Spotter/Laborer(s), and any visitors report directly to the Landfill Foreman.
- **Equipment Operators.** The Equipment Operator is responsible for: safe operation and daily maintenance of equipment; visual inspection of waste loads for unauthorized or hazardous wastes; and daily operations on the working face of the landfill. The Equipment Operators, with the exception of apprentices, typically have 2 years of professional experience related to landfill operations or earth work. As of July 2003, two of the operators have in excess of two years experience and a third is nearing completion of two years. The current apprentice operator has about one year of experience. Equipment Operators receive training on landfill operations within 2 years of employment. The Landfill Foreman may designate the Equipment Operator to act in his behalf in the foreman's absence.
- **Spotter/Laborer.** The Spotter/Laborer is responsible for: directing traffic to the working face; control of litter and dust generated from the landfilling operations; assistance to the Equipment Operators; and any other tasks assigned by the Landfill Foreman.

3.0 SCHEDULE OF FACILITIES CONSTRUCTION

Landfill Cell 1 - Stage 1, the first landfill half-cell, was excavated in 1988. The soils excavated from this half-cell were used to construct portions of the screening berms on the eastern and northern boundaries of the site. The geomembrane lining system for this half-cell was installed during the fall of 1989. Essentially, the construction consisted of: excavating the native soils, compacting the exposed soils to 95% of optimum density (Standard Proctor), installing a geotextile to cushion the overlying geomembrane from underlying soils, installing a 40-mil HDPE geomembrane liner, installing a geotextile to absorb side slope tensile stresses and to transmit leachate, and placing the protective soil cover. Provo City Corporation and design personnel (HDR Engineering, Inc.) provided construction quality assurance observation during the installation of the geosynthetics and during the placement of protective cover soils.

Stage 2 of Cell 1 was similarly constructed except that a 60-mil geomembrane was used. Cell 1 is nearing final waste grades, and closure is expected to occur in 2005.

Stage 1 of Cell 2 is anticipated to be constructed in early 2004 and is expected to last approximately 5 years. Soil excavation to be used as daily cover is ongoing in Cell 2, and select material will be used as final cover on Cell 1. A portion of this select material has already been stockpiled on-site.

As a general rule, landfill cells will be planned to be available no less than 3 months prior to the completion of filling in the operational cell. This will allow for construction delays due to weather, construction contractor difficulties, or other unanticipated delays. The design, permit review, and contractor negotiations will be planned to require approximately 1 year.

4.0 SOLID WASTE HANDLING

4.1 Waste Acceptance

All solid wastes entering the Bayview Landfill originate at the Springville Transfer Station or the City of Goshen Transfer Station. Wastes entering these transfer station facilities are pre-screened for unacceptable materials by transfer station personnel prior to compaction of the wastes. Operations at the transfer stations are not included in this landfill Operations Plan.

Private hauler and citizen self-hauled wastes are generally not accepted at the landfill. Occasionally special wastes will be received directly at the landfill after arrangement with the waste generator.

4.2 Waste Disposal

Transfer trailers entering the site will be directed by landfill operations personnel to the working face, where the driver will be instructed to discharge the load. Landfill operations personnel will push the solid waste up the working face using a compactor. The waste will be placed in lifts with a loose thickness of 2 - 3 feet. After the waste has been placed in loose lifts, the operator will run the compactor over all portions of the lift at least two times parallel with the slope (up slope), and at least one time across the slope. There may be times in operating the landfill when pushing uphill may be impractical or poor practice (i.e., when the first lift of waste is placed on protective cover soil.) Equipment operators will also maintain the working face so that it is as small as practical to allow for efficient unloading of transfer trucks, and placement and compaction of solid wastes.

4.3 Placement of Cover Soils

Cover soils or other approved material will be placed over solid wastes to minimize the potential for nuisance conditions, fire, and disease vector contact with solid wastes. Nuisance conditions include: odor generation and air discharges; blowing of plastic and paper wastes; and other conditions that impair the use of adjoining properties.

At the end of each working day, the landfill operations personnel will cover all solid wastes received during that day with daily cover. The daily cover will consist of a minimum of 6 inches of soil excavated from other portions of the landfill site. Daily cover will be placed to minimize the nuisance, fire, and disease vector potential attributable to each day's waste placement. On an infrequent basis, oversized wood chips that are generated from the composting operation are used as an alternative daily cover. The landfill operators will record the time that this alternative daily cover is use and monitor its effectiveness. This type of daily cover would only be placed on Mondays through Thursdays. The standard 6 inches of onsite soils will be used on Fridays.

Whenever a portion of the landfill cell will remain in an inactive condition for an extended period, landfill operations personnel will place an intermediate cover over the inactive portion. The intermediate cover will reduce the potential for wind- and water-induced erosion of the cover, and reduce the production of leachate and contact stormwater within the landfill cell. The intermediate cover will consist of an additional 6-inches of soil.

5.0 INSPECTIONS, MONITORING, AND REPORTING

5.1 Inspections

The Landfill Foreman is responsible for conducting and recording routine inspections of landfill facilities. The schedule for conducting routine inspections is provided in Table S-1. Forms for recording routine inspections are presented in Appendix I.

The District Manager is responsible for verifying the completeness of the inspection records on a quarterly basis.

5.2 Groundwater Monitoring

5.2.1 Detection Monitoring

The District has completed the 2-year program to determine the background water quality in each of the 12 monitoring wells constructed at the landfill site. The 2-year program consisted of bi-monthly sampling of each well. During the first year, the District sampled each well every other month; during the second year, the District also sampled every other month, skipping one month so that each calendar month was sampled during the 2-year program. The results of the 2-year program are used as a baseline for each well, and subsequent groundwater monitoring results for each well will be compared to this baseline data. Baseline data will be collected by 2 years of sampling following the construction of new wells.

The District will continue to conduct groundwater sampling on a semi-annual basis. The District Manager and the Landfill Foreman will coordinate the monitoring events, schedule the timing of groundwater sampling, sample or arrange for sampling of the wells, arrange for analysis of the groundwater samples, and arrange for interpretation of the analytical results. The groundwater samples will be analyzed for the constituents listed in UDEQ rules (R315-308-4) for detection monitoring. The semi-annual detection monitoring samples will be compared to the baseline data and to ongoing averages for each well to determine if the data is statistically different from either the baseline data or from ongoing average data for each well. If statistically significant increases are detected in the Detection Monitoring Program, the District will begin an Assessment Monitoring Program, as required by UDEQ rules. Appendix F contains the District's Groundwater Quality Report and Groundwater Monitoring Plan.

Table S-1: Recommended Frequency of Inspection of Landfill Facilities

Landfill Facility	Inspection	Frequency
Landfill Cell	Daily and intermediate cover integrity. Stormwater and leachate collection (ponding). Run-on/run-off control integrity. Cell perimeter fence integrity.	Daily Daily Daily Daily
Stormwater/Leachate Pond	Perimeter fence integrity. Water depth. Liner system integrity. Water volume.	Daily Weekly Weekly Quarterly
Other Appurtenances	Entrance/main gate integrity. Perimeter fence integrity. Monitoring well integrity. Equipment maintenance. Site road integrity. Berm integrity.	Daily Weekly Monthly Monthly Quarterly Quarterly

5.2.2 Assessment Monitoring

If a statistically significant increase in groundwater contaminants is detected as part of the Detection Monitoring Program, the District will initiate the following actions:

- Notify UDEQ in writing, within 14 days of obtaining laboratory results. The notification will include identification of the constituents that have shown a statistically significant increase.
- Enter the laboratory results into the operating record for the landfill.
- Immediately resample the groundwater in all wells, or a subset of the wells as specified by the Executive Secretary, for all constituents listed in R315-308-4. Determine whether a statistically significant change has occurred such that the groundwater protection has been compromised.
- Notify UDEQ within 7 days of receipt of the results of the resampling if a statistically significant change has occurred.

Figure S-1 summarizes the requirements imposed on the District by UDEQ regulations to define the nature and extent of groundwater contamination, and to take corrective action if the source of the groundwater contamination is the landfill.

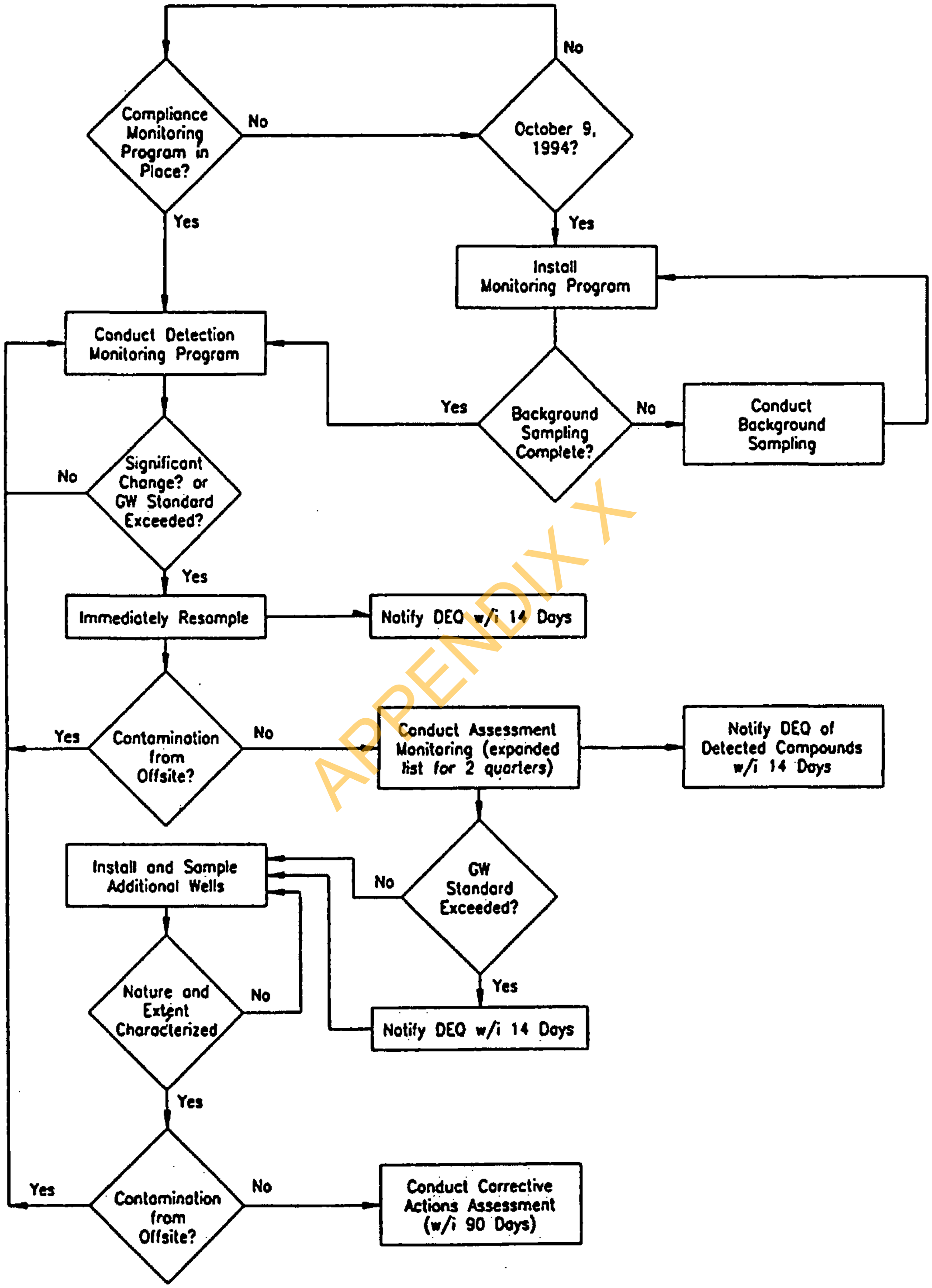
5.3 Landfill Gas Monitoring

The District began a landfill gas monitoring program by conducting an initial surface survey for combustible gases, and by purchasing a combustible gas indicator (CGI). During the initial survey, no measurable combustible gases were detected on the site, and landfill gas monitoring stations were established for future monitoring events.

The District will continue to conduct combustible gas monitoring at the established stations on a quarterly basis. The District Manager and the Landfill Foreman will coordinate the gas monitoring events with groundwater monitoring events, and will arrange for interpretation of the monitoring results if combustible gases are detected at any station.

If concentrations of combustible gasses exceed the standard set in the UDEQ Rules, the District will implement the requirements imposed on the District by UDEQ regulations in effect at the time of the permit or revisions of the permit.

Figure S-1: Utah Requirements for Groundwater Monitoring



6.0 CONTINGENCY AND CORRECTIVE ACTION PLANS

The following sections describe the contingency and corrective action plans that will be implemented if fire, explosion, failure of run-off/run-on structures, release of explosive gases, or contamination of groundwater occurs.

6.1 Fire

No burning of wastes is planned in the active landfill cell area. Limited burning may be planned, permitted, and accomplished during clearing of new landfill cell construction areas, and perimeter fence and drainage channel maintenance. No other burning activities are planned at the Bayview Landfill.

Two other types of fires, fires in loaded vehicles and fires in disposed wastes, must be anticipated and response activities planned. Each of these is discussed below. The preferred method of fighting fires in the Bayview Landfill will consist of smothering the fire with soil. Water will contribute to the formation of leachate, and should only be used as a last resort if the fire cannot be smothered.

6.1.1 Loaded Vehicle Fires

In the event that a transport vehicle enters the landfill site carrying a burning or smoldering load of waste, landfill operations personnel will take the following actions:

- Direct the vehicle to a designated section of the landfill away from the working face. Direct the driver to deposit his load and to clear the area as quickly as possible.
- Immediately cover the burning waste with sufficient soil to completely smother the fire. Allow the waste to cool for several days, or longer if necessary.
- If necessary, spray equipment and the transfer vehicle with water to cool the equipment while working the fire. This will not be necessary if the equipment is pushing or dumping soil on the burning wastes in front of the advancing equipment.

- If landfill operations personnel cannot control the fire, the County Fire Marshall will be contacted.
- Notify the UDEQ immediately and provide written documentation within 14 days of the fire.

6.1.2 Working Face/Below Cover Fire

In the event of a working face fire or a fire below cover, landfill operations personnel will take the following actions:

- Evacuate all non-essential personnel from the area of the fire. Non-essential personnel would include transfer truck drivers, laborers/spotters, and visitors.
- Isolate the burning material from other wastes to the extent possible. Use compactor blades and dozers to move the burning materials away from other wastes; this may not be possible if the fire is below cover soil.
- Immediately cover the burning waste with sufficient soil to completely smother the fire. Allow the waste to cool for several days, or longer if necessary.
- If necessary, spray equipment and the transfer vehicle with water to cool the equipment while working the fire. This will not be necessary if the equipment is pushing or dumping soil on the burning wastes in front of the advancing equipment.
- If landfill operations personnel cannot control the fire, the County Fire Marshall will be contacted.
- Notify the UDEQ immediately and provide written documentation within 14 days of the fire.

6.2 Explosion

In the event that an explosion should occur at the landfill or in any structure associated with the landfill, landfill operations personnel will take the following actions:

- Immediately evacuate the area surrounding the explosion, including any adjacent buildings. Shut down and abandon any equipment near the explosion that is hot and may provide an ignition source for additional explosions.

- Account for all personnel. Contact the County Fire Marshall and the emergency dispatcher (911). Contact the District Manager.
- Restrict the explosion area to any entry until emergency response personnel clear the area.
- Notify the UDEQ immediately and provide written documentation within 14 days of the explosion.

6.3 Failure of Run-Off/Run-On Structures

Failure of run-off structures may allow the release of contaminated water into the environment. Failure of run-on structures may allow stormwater to mingle with and become leachate. Neither of these conditions is desirable.

6.3.1 Failure of Run-Off Structures

In the event that a failure of run-off structures is discovered during routine or non-routine inspections, landfill operations personnel will take the following actions:

- As soon as practical, suspend acceptance of wastes at the landfill, if necessary, and inform the transfer stations of this suspension.
- Use landfill compactor and dozer equipment to construct temporary berms to contain the run-off. Divert the flow of run-off water away from surface water drainage channels.
- Resume landfilling operations as soon as possible after the run-off is contained. Inspect the temporary berms as frequently as possible, but not less frequently than once every 2 hours.
- Assess the impact of the release of run-off as soon as practicable following the event. Assess the need for permanent improvements in the temporary berms, or other run-off control structures, as soon as practicable following control of the run-off.
- Notify the UDEQ immediately and provide written documentation within 14 days of the release event.

6.3.2 Failure of Run-On Structures

Failure of run-on control structures may temporarily overload the leachate collection system, but is generally less serious than failure of run-off control structures. In the event that failure of run-on control structures is discovered during routine or non-routine inspections, landfill operations personnel will take the following actions:

- Immediately mobilize landfill compactor or dozer equipment to construct temporary berms, swales, or other structures to temporarily divert surface water run-on from the active landfill cell. Assess the need to suspend acceptance of waste.
- Assess the need for permanent run-on control structures as soon as practicable.
- Notify the UDEQ immediately and provide written documentation within 14 days of the failure event.

6.4 Release of Explosive Gases

It is unlikely that a release of explosive gas will occur from the lined Bayview Landfill cells. However, it is possible that landfill gas concentrations will exceed the regulatory requirements in one or more gas monitoring locations. For purposes of this contingency plan, a release is defined as the detection of more than 25% of the lower explosive limit (LEL) in a landfill building, or more than 100% LEL at the property boundary. The LEL is 5% by volume of methane in air. If a release of explosive gases is detected, landfill operations personnel will take the following actions:

- Immediately suspend landfilling operations and determine if landfill personnel or structures are threatened. If so, personnel will be evacuated immediately, and building doors will be opened to allow gases to escape. Notify the transfer stations of the suspension of operations.
- As soon as possible, determine if off-site buildings or other structures are threatened. If so, immediately notify the County Fire Marshall.
- Monitor the release area, and all other landfill gas monitoring locations, until the emergency condition has been eliminated.

- Determine temporary corrective actions as soon as possible, and permanent corrective actions as soon as practicable, following detection of the release.
- Notify the UDEQ immediately and provide written documentation within 14 days of the release event.

6.5 Groundwater Contamination

Contingency and corrective actions following the detection of groundwater contamination are described in Figure S-1.

7.0 ALTERNATIVE WASTE HANDLING PROCEDURES

Landfill operations have been adapted for wet weather by constructing an all-weather, asphalt-paved roadway from the site entrance to the active cell. The site soils, including those used as daily cover, consist primarily of sands and gravels. In the semi-arid climate of the Bayview Landfill site, experience has shown that precipitation has little effect on the operation of the landfill, especially given the nature of the cover soils. The District does not believe that alternate waste handling plans are necessary for this site with respect to wet weather operations.

All reasonable caution and prudence will be exercised to not dispose of wastes during any unreasonable weather conditions. If unforeseen weather conditions occur, the District Manager, or his designee, will be informed and will coordinate any changes in operations. The District Manager will consider the system-wide requirements (including transfer station requirements) in determining what changes, if any, need to be made in operations at the landfill.

8.0 MONITORING EQUIPMENT MAINTENANCE

8.1 General

The inspection schedule for groundwater monitoring wells and landfill gas monitoring stations is presented in Section 5. This section describes the more detailed inspection and maintenance of these landfill structures.

8.2 Groundwater Monitoring Wells

All groundwater monitoring wells will be thoroughly inspected during each sampling event. The detailed inspection will note signs of deterioration or failure of the protective steel casing, the concrete pad and bollards, and the polyvinyl chloride (PVC) well casing and screen. If damage is discovered, the nature of the problem will be recorded and reported to the District Manager who will make a decision to repair, replace, or abandon the well. This decision will be documented in the operating record for the landfill, and the required actions will be completed prior to the next scheduled monitoring event.

The monitoring well locations will be maintained on a routine basis. Weeds will be removed at least every 6 months, approximately 2 weeks prior to each scheduled sampling event. During the weed removal, landfill personnel will note any obvious indications that the well has been damaged to allow the Landfill Foreman and the District Manager to assess the situation.

Bollards and well casing materials will be inspected during each sampling event to determine whether painting or other routine maintenance is required.

8.3 Gas Monitoring Locations

Gas monitoring locations will be maintained on a routine basis. Weeds will be removed from the vicinity of each monitoring location at least every 3 months, approximately 2 weeks prior to each scheduled sampling event.

9.0 DISEASE VECTOR CONTROL

For landfills in Utah, disease vectors essentially consist of rodents and birds. This section describes the methods that the Bayview Landfill personnel will use to control rodents and birds.

9.1 Rodent Control

The primary method of rodent control is to eliminate conditions favorable for the reproduction of rodents through proper compaction of wastes and proper placement of daily cover. If landfill personnel observe the presence of rodents, more frequent application of cover soils will be considered.

If the primary method of rodent control does not produce satisfactory results, the District may employ poisoning. A poison control program must include the following conditions:

- Poison traps must be set by experienced, professional exterminators.
- Poison traps may only be set within areas with controlled access. This means that the trapped area must be within the site's security fencing, and the security gates must be locked for the duration of the poisoning program whenever landfill personnel are not on-site.
- Occupational Health and Safety Administration (OSHA) requires warning signs of acceptable color and size to be permanently fixed to the outside of the access gate and fencing, at spacings not to exceed 150 feet, for the duration of the poisoning program. A minimum of one sign per side of the fence is required.
- Landfill personnel must conduct a daily inspection of each poison trap, and notify the professional exterminator if disruptions of any traps are noted.
- The professional exterminator must conduct periodic inspections of the poison traps.
- Written documentation of the poisoning program must be maintained at the maintenance building. The documentation must include: the number and exact location(s) of the poison traps; the name of the poison(s) (including both chemical and brand name, and a listing of ingredients); the quantity of poison contained in each trap; and the medically accepted antidotes or treatments for the poison(s).
- The professional exterminator must submit monthly reports to the District Manager documenting the status of the poisoning program. The reports shall include the number and location of traps, the quantities of poison(s) used during the past month, and any changes in the program instituted during the past month.

- Poison supplies shall be stored on-site in a separate, locked, and properly labeled enclosure. Access to the poison shall be restricted to the professional exterminator and the Landfill Foreman, or his designee.

9.2 Bird Control

As with rodent control, the primary method of controlling birds is to control the conditions favorable to their existence. The following methods will be used as needed:

- Minimizing the size of the working face. This is the most effective method of controlling birds since it reduces the area available for feeding. More frequent cover and higher degrees of compaction of the wastes may also serve to minimize the opportunities for feeding.
- Minimizing the accumulation of water in depressions, ponds, or other features near the active working face. The lack of water makes a landfill a less attractive feeding area for birds.
- Use of noise or other frightening techniques. These techniques offer short-term reductions in the numbers of birds feeding at a landfill.

If the primary methods do not produce satisfactory results, a destructive method of control may need to be implemented. Destructive methods may cause harm or death to some birds, and authorization must be obtained from local officials prior to implementing a destructive program.

10.0 WASTE SCREENING

The primary location for screening of wastes will be the transfer stations. All transfer station personnel will receive periodic training in detecting wastes that are prohibited for disposal at the landfill. This training will consist of an initial training and annual refresher training. These personnel will conduct routine inspections and random load inspections as specified in the operations plan for the transfer stations.

The landfill equipment operators will also receive periodic training in detecting prohibited wastes. This training will consist of an initial training and annual refresher training; however, the landfill operational personnel will provide secondary waste screening only.

11.0 RECYCLING

The primary location for recycling will be the transfer stations. These locations are best suited for separating recyclable materials, and separation will be difficult or impossible after the wastes have been compacted and loaded into over-the-road trucks. The landfill operations personnel may segregate tires, large and bulky wooden wastes, and similar materials upon receipt at the landfill; however, this recycling activity is considered secondary to recycling at the transfer stations.

12.0 COMPOSTING

A compost program utilizing yard waste and biosolids is proposed for the Bayview Landfill. A plan of operations and permission to implement the compost operations has been submitted under separate cover. A copy of the Plan of Operations is included with this Permit Application as Appendix R.

Filed in the Office
of the Utah County Board
of Adjustment on
April 10, 1989.

ACTION BY THE BOARD OF ADJUSTMENT

Appeal No. 981 Applicant: South Utah Valley Solid Waste District

RULES FOR HEARING AND DECIDING APPEALS FOR SPECIAL EXCEPTIONS

When the Board of Adjustment acts under its power to hear and decide requests for special exceptions, the Board shall comply with all the following rules and standards (Section 4-7-21 of the "Utah County Zoning Ordinance"):

✓ A. The appellant shall have submitted a properly completed application for hearing.
✓ B. The zoning ordinance specifically identifies the special exception in question as one which the board is empowered to approve.
C. The following standards shall be met as a prerequisite to approving any special exception:

✓ 1. It shall promote the public health, safety, and welfare.
✓ 2. It shall conform to the "characteristics and purposes stated for the zoning district involved and the adopted county master plan.
✓ 3. It shall be compatible with the public interest and with the characteristics of the surrounding area.
✓ 4. It shall not adversely affect local property values.
___ 5. Any standards stated in Chapter 3, Supplementary Regulations, or Chapter 5, Regulations Within Zones, which apply to a specific special exception shall be met: ___
✓ 6. It shall not result in a situation which is cost ineffective, administratively infeasible, or unduly difficult for the provision of essential services, including, but not limited to: roads and access for emergency vehicles and residents; fire protection; police protection; schools and school busing; healthful water, sewer, and storm water facilities; and garbage removal.

D. The board shall attach conditions, when necessary, which work out an adjustment between the special exception and the surrounding area, including, but not limited to, the following:

___ 1. Parking;
___ 2. Traffic acceleration lanes;
___ 3. On-site storm water retention facilities;
___ 4. Special security or fire protection facilities;
___ 5. Water, sewer, and garbage facilities;
___ 6. Landscape screening to protect neighboring properties;
___ 7. Requirements for the management and maintenance of the above facilities;
___ 8. Limited hours of operation;
___ 9. Limited use of equipment emanating offensive noise, light, dust, or traffic.

___ E. The Board of Adjustment feels that the facts presented at the hearing, other than mere expressions of protest or support, warrant the granting of the appeal; the said findings of fact shall be made a part of the official record.

This request is Granted with Conditions for the following reasons:
(granted, denied, etc.)

The Board felt the facts presented at the hearing warranted granting the special exception to modify condition number 18 to allow Provo City to join with a special service district to process solid waste with a finding that there will be no change in impact by the addition of a special service district.

OVER

Vote Record:

	Aye	Nay	Abstained
1. Jess Green	X		
2. John Hall	X		
3. Rick Jackman	X		
4. Von Brockbank	X		
5. Ronald Last			X
6.			

I certify that the voting record shown hereon is correct.

Maria Brady
Secretary

APPENDIX

1. Compacted or baled garbage will be placed in trenches and covered at the end of each day.

2. The waste shall be buried away from the gravel pit area.

3. A fence shall be installed surrounding each trench area at least eight (8) feet in height and higher if found inadequate to control blowing papers.

4. After an area has been filled, it will be contoured, mulched, and reseeded as indicated by the State Agronomist and the State Extension Service.

5. There will be a watchman on site during work hours.

6. The gate will be closed any time it is unattended; and it must be locked. (This is the main gate, not that around the particular area being filled.)

7. A new access road from the state highway into the deposit area will be provided as required by the Department of Transportation.

8. The size of the garbage trucks shall meet requirements of the Utah Department of Transportation and Utah Highway Patrol.

9. Provo City will cooperate with the State Highway Department and local residents to prevent inordinate damage to the road during periods when the road is saturated and subject to destruction; and comply with all state and local ordinances conforming to same.

10. All garbage would be collected and compacted at a location other than the landfill site and transported in covered trucks by Provo City.

11. No burning is to be allowed at the disposal site.

12. The trenching shall be done in such a manner as to protect the drainage channels in the area as required by the State Department of Environmental Health.

13. No hazardous wastes shall be deposited in the area.

14. All reasonable caution and prudence be exercised to not dispose of any waste during any unreasonable weather conditions.

15. All requirements in the "Code of Solid Waste Disposal Regulations" be met.

16. Any terms of the lease held by Mr. Jacobs be protected and that Provo City cooperate with him during lambing season to minimize the impact on his operation.

17. No public dumping.

18. Landfill to be used only by Provo City and if other cities are to use the landfill, approval from the Board of Adjustment would be necessary.

19. Personnel will police the grounds outside of the fence, and keep litter and garbage picked up.

20. Rodent control must be in effect at all times as state law provides.

21. Water samples will be taken by the Department of Environmental Health from any wells within 1500' of the disposal site prior to any dumping to determine the water quality. Samples would be taken every six months or more often as determined by the Department of Environmental Health.

22. The area used to begin the operation of filling must be selected to minimize the impact on people in the surrounding area.

23. In constructing the road or roads required by the Department of Transportation to get access to the landfill; Provo City shall minimize the amount of disruption to the environment of the area.

NOT LEGIBLE
FOR MICROFILM

24. That Provo City maintain a buffer zone of at least 100' from existing state roads, homes and premises in dumping their compacted garbage.

25. Upon noncompliance with any of these provisions Utah County may revoke said right to the landfill.

26. Provo City will provide an annual report to the Board of Adjustment for their review, as to the progress in the engineering of the landfill.

Appendix T

APPENDIX T

DRAFT Cell 1 Closure Certification Letter

SUVSWD Bayview Class I Landfill
Permit Application

DRAFT

Mr. Richard Henry
District Manager
South Utah Valley Solid Waste District
P.O. Box 507
Springville, UT 84663-0507

Subject: Bayview Landfill Cell 1 Closure Status

Dear Mr. Henry:

This letter is to document the closure status of the Bayview Landfill Cell 1. Cell 1 was constructed per design and specifications and in accordance with the Construction Documents Project Manual (CDPM), submitted to the Division of Solid and Hazardous Waste on September 15, 2005 as a stand-alone document; "Bayview Landfill Cell 1 Closure – Construction Documents Project Manual." The CDPM stipulated several testing procedures to be performed on the final cover systems. These requirements included:

- One compaction test per 10,000 square feet of surface area for each lift and the final cover to ensure compaction is between 75% and 85% of the maximum dry density;
- One grain size distribution test for every 5,000 cubic yards of cover material placed;
- Cover cap thickness verification once every 10,000 square feet of surface;

In addition, the approved closure plan for the Bayview Landfill requires that the final cover be seeded with shallow-rooting grasses. It is our understanding that the final cover has not yet been seeded. The seed mix to be used on the Cell 1 final cover is listed in Table 1 below:

Table 1. Seed mix used on the final cover of Bayview Landfill Cell 1

% Mix	Type of Grass
0.50%	Sand Drop Seed
1.50%	Alkali Sacaton
3.50%	Blue Grama
17.50%	Blue Bunch Wheat Grass
17.50%	Indian Rice Grass
3.00%	Sandberg Blue Grass

% Mix	Type of Grass
4.00%	Sheep Fescue
16.25%	Slender Wheat Grass
16.25%	Stream Bank Wheat Grass
20.00%	Western Wheat Grass
100.00%	Total

It is our opinion that the Bayview Landfill Cell 1 has been successfully constructed and, pending seeding, will be closed per the approved design. This opinion is based on the following:

- The above seed mix will be broadcast on the final cover during 2009.
- Compaction and grain size distribution test results are enclosed with this letter. All testing results were within specifications.
- To ensure cover cap thickness was adequate, it is our understanding that PVC stands with marks indicating the required depth were inserted prior to placing final cover soil and that the methods outlined in the CDPM to indicate soil erosion stakes ("whiskers" or "blue-tops") were installed.

The CDPM included requirements for long-term maintenance. These include inspections of the cap weekly and after each major rain event to monitor for erosion until vegetation is established. Any erosion of 2 inches or more should be regraded and reseeded as soon as possible to minimize the size of equipment needed. Settlement and erosion of the final cap should be monitored by visually inspecting for evidence of "whiskers" or "blue-tops" showing through the cap and should be performed on a weekly basis. Any bare soil should be reseeded as necessary to establish vegetation on the cap. If any damage to the cap is detected, it should be regraded, mulched, and seeded as soon as possible.

If you have any questions or concerns, please call me at 801-743-7800.

Sincerely,

Terry R. Warner, P.E.

Enclosures

KLEINFELDER
Bright People. Right Solutions.

849 West Levoy Drive, Suite 200
Salt Lake City, UT
84123-2964

p| 801.261.3336
f | 801.261.3306

kleinfelder.com

October 13, 2008
File No.: 49816.001

Mr. Richard Henry
South Utah Valley Solid Waste District
P.O. Box 507
Springville, UT 84663

Subject: **Summary Report for September 2008**
Bayview Land Fill Cell #1 Closure
Materials Testing Services

Dear Mr. Henry,

Kleinfelder West, Inc., has completed the reports for field and laboratory testing services conducted on September 24, 2008, for the above-referenced project.

The following areas of testing/inspection were conducted during the time frame noted above.

- ASTM D 1557 proctor curve report;
- Sieve analysis reports;
- Daily report of observations and field testing; and
- Compaction testing of approximately 360,000 square-feet of Cell 1 covers material.

If you have any questions regarding the information presented, please feel free to contact us at (801) 261-3336.

Sincerely,

KLEINFELDER WEST, INC.

For: Mark Megeath
Operations Manager

Scott Biehn
Materials Division Manager

Attachments: Nuclear Density Test Results, Lab Tests, Daily Field Report

cc: Mr. Scott Aitkin
Mr. Terry Warner

KLEINFELDER
Bright People. Right Solutions.

REPORT of AGGREGATE PHYSICAL PROPERTIES

Project: Bayview Land Fill Cell #1 Closure
Client: SUVSWD
Material Tested: Cover material
Source: N=8645.6 E=4330 Z=4788.8
Specification: Per Engineer Report

Lab No.: T08-193-P
Report Date: 10/10/2008
Project No: 49816.001
Sampled by: TMM
Sample Date: 9/24/2008
Tested by : JDM
Test Date: 9/26/2008
Reviewed by:
Curtis Parker, Lab Manager

SIEVE ANALYSIS

ASTM C136 AASHTO T27

Sieve Size	Accum. % Passing	Specifications
450 mm (18")		
375 mm (15")		
300 mm (12")		
250 mm (10")		
225 mm (9")		
200 mm (8")		
150 mm (6")		
125 mm (5")		
100 mm (4")	100	
75.0 mm (3")	100	
63.0 mm (2-1/2")	100	
50.0 mm (2")	100	
37.5 mm (1-1/2")	100	
25.0 mm (1")	100	
19.0 mm (3/4")	100	
12.5 mm (1/2")	99	
9.5 mm (3/8")	99	
6.3 mm (1/4")		
4.75mm (No. 4)	99	95 - 100
2.36 mm (No. 8)	98	
2.00 mm (No. 10)	97	
1.18mm (No.16)	97	
0.600 mm (No.30)	94	
0.425mm (No. 40)	90	70 - 100
0.300mm (No. 50)	86	
0.180mm (No. 80)		60 - 95
0.150mm (No.100)	71	
0.075mm (No. 200)	49.2	30 - 70
ASTM C117 AASHTO T11		
Moisture Content, %		
ASTM C566 AASHTO T255		
Fractured Face, %		
2 faces		
Fineness Modulus (FM)		
ASTM C136 AASHTO T27		

TEST RESULTS

Standard	PHYSICAL PROPERTIES		Results	Specification
ASTM C 29 AASHTO T 19	Unit Weight & Voids	Unit Weight, lbs./cu.ft=		
		Voids, %=		
		☐ Jigged ☐ Loose ☑ Rodded		
ASTM C 127 AASHTO T 85	Coarse Specific Gravity & Absorption	Bulk Specific Gravity (dry)=		
		Bulk Specific Gravity, SSD=		
		Apparent Specific Gravity=		
		Absorption, %=		
ASTM C 128 AASHTO T 84	Fine Specific Gravity & Absorption	Bulk Specific Gravity (dry)=		
		Bulk Specific Gravity, SSD=		
		Apparent Specific Gravity=		
		Absorption, %=		
ASTM D 2419 AASHTO T 176	Sand Equivalent	Sand Equivalent, %=		
ASTM D 4791	Flat & Elongated	Flat & Elongated, %=		
		Ratio=		
ASTM C 131 AASHTO T 96	L. A. Abrasion	Small Coarse Loss, %=		
		Grading/ Revs.=		
ASTM C 535	L. A. Abrasion	Large Coarse Loss, %=		
		Grading/ Revs.=		
ASTM C 88 AASHTO T 104	Soundness	Coarse Soundness Loss, %=		
		Magnesium No. of Cycles=		
	Soundness	Fine Soundness Loss, %=		
		Magnesium No. of Cycles=		
ASTM C 142 AASHTO T 112	Clay/Friable Particles	Coarse Aggregate, %=		
		Fine Aggregate, %=		
ASTM C 40 AASHTO T 21	Organic Impurities	Coarse Aggregate, %=		
		Fine Aggregate, %=		
ASTM C 123 AASHTO T 113	Lightweight Pieces	Coarse Aggregate, %=		
		Fine Aggregate, %=		
ASTM D 3080 AASHTO T 236	Direct Shear CD	Friction Angle,=		
ASTM D 1557 AASHTO T 180	Compaction Modified Effort	Optimum Moisture, %=	14.5	
		Max. Density, lbs./cu.ft.=	110.2	
ASTM D 4318 AASHTO T 89/90	Liquid Limit, Plastic Limit & Plasticity Index	Liquid Limit=	NP	
		Plastic Limit=	NP	
		Plasticity Index=	NP	

KLEINFELDER
Bright People. Right Solutions.

REPORT of AGGREGATE PHYSICAL PROPERTIES

Project: Bayview Land Fill Cell #1 Closure
Client: SUVSWD
Material Tested: Cover material
Source: N=8750 E=4210.5 Z=4791.5
Specification: Per Engineer Report

Lab No.: T08-193-1
Project No: 49816.001
Sampled by: TMM
Tested by : JDM
Reviewed by:
Curtis Parker, Lab Manager

Report Date: 10/1/2008
Sample Date: 9/24/2008
Test Date: 9/26/2008

SIEVE ANALYSIS

ASTM C136	AASHTO T27	
Sieve Size	**Accum. % Passing**	**Specifications**
450 mm (18")		
375 mm (15")		
300 mm (12")		
250 mm (10")		
225 mm (9")		
200 mm (8")		
150 mm (6")		
125 mm (5")		
100 mm (4")	100	
75.0 mm (3")	100	
63.0 mm (2-1/2")	100	
50.0 mm (2")	100	
37.5 mm (1-1/2")	100	
25.0 mm (1")	100	
19.0 mm (3/4")	100	
12.5 mm (1/2")	100	
9.5 mm (3/8")	100	
6.3 mm (1/4")		
4.75mm (No. 4)	99	95 - 100
2.36 mm (No. 8)	98	
2.00 mm (No. 10)	98	
1.18mm (No.16)	97	
0.600 mm (No.30)	94	
0.425mm (No. 40)	91	70 - 100
0.300mm (No. 50)	87	
0.180mm (No. 60)		60 - 95
0.150mm (No.100)	75	
0.075mm (No. 200)	55.6	30 - 70
ASTM C117 AASHTO T11		
Moisture Content, %		
ASTM C566 AASHTO T255		
Fractured Face, %		
2 faces		
Fineness Modulus (FM)		
ASTM C136 AASHTO T27		

TEST RESULTS

Standard	**PHYSICAL PROPERTIES**		**Results**	**Specification**
ASTM C 29	Unit Weight	Unit Weight, lbs./cu.ft=		
AASHTO T 19	& Voids	Voids, %=		
		☐ Jigged ☐ Loose ☑ Rodded		
	Coarse	Bulk Specific Gravity (dry)=		
ASTM C 127	Specific	Bulk Specific Gravity, SSD=		
AASHTO T 85	Gravity &	Apparent Specific Gravity=		
	Absorption	Absorption, %=		
	Fine	Bulk Specific Gravity (dry)=		
ASTM C 128	Specific	Bulk Specific Gravity, SSD=		
AASHTO T 84	Gravity &	Apparent Specific Gravity=		
	Absorption	Absorption, %=		
ASTM D 2419	Sand	Sand Equivalent, %=		
AASHTO T 176	Equivalent			
ASTM D 4791	Flat &	Flat & Elongated, %=		
	Elongated	Ratio=		
ASTM C 131	L. A.	Small Coarse Loss, %=		
AASHTO T 96	Abrasion	Grading/ Revs.=		
ASTM C 535	L. A.	Large Coarse Loss, %=		
	Abrasion	Grading/ Revs.=		
	Soundness	Coarse Soundness Loss, %=		
ASTM C 88		Magnesium No. of Cycles=		
AASHTO T 104	Soundness	Fine Soundness Loss, %=		
		Magnesium No. of Cycles=		
ASTM C 142	Clay/Friable	Coarse Aggregate, %=		
AASHTO T 112	Particles	Fine Aggregate, %=		
ASTM C 40	Organic	Coarse Aggregate, %=		
AASHTO T 21	Impurities	Fine Aggregate, %=		
ASTM C 123	Lightweight	Coarse Aggregate, %=		
AASHTO T 113	Pieces	Fine Aggregate, %=		
ASTM D 3080	Direct Shear	Friction Angle,=		
AASHTO T 236	CD			
ASTM D 1557	Compaction	Optimum Moisture, %=		
AASHTO T 180	Modified Effort	Max. Density, lbs./cu.ft.=		
ASTM D 4318	Liquid Limit,	Liquid Limit=		
AASHTO T 89/90	Plastic Limit &	Plastic Limit=		
	Plasticity Index	Plasticity Index=		

KLEINFELDER
Bright People. Right Solutions.

REPORT of AGGREGATE
PHYSICAL PROPERTIES

Project:	Bayview Land Fill Cell #1 Closure	**Lab No.:**	T08-193-2	**Report Date:**	10/10/2008
Client:	SUVSWD	**Project No:**	49816.001		
Material Tested:	N8128.8	**Sampled by:**	TMM	**Sample Date:**	9/24/2008
Source:	N=8128.8 E=4103.2 Z=4802.2	**Tested by :**	JDM	**Test Date:**	9/26/2008
Specification:	Per Engineer Report	**Reviewed by:**	Curtis Parker, Lab Manager		

SIEVE ANALYSIS

ASTM C136	AASHTO T27	
Sieve Size	**Accum. % Passing**	**Specifications**
450 mm (18")		
375 mm (15")		
300 mm (12")		
250 mm (10")		
225 mm (9")		
200 mm (8")		
150 mm (6")		
125 mm (5")		
100 mm (4")	100	
75.0 mm (3")	100	
63.0 mm (2-1/2")	100	
50.0 mm (2")	100	
37.5 mm (1-1/2")	100	
25.0 mm (1")	100	
19.0 mm (3/4")	100	
12.5 mm (1/2")	100	
9.5 mm (3/8")	100	
6.3 mm (1/4")		
4.75mm (No. 4)	100	95 - 100
2.36 mm (No. 8)	99	
2.00 mm (No. 10)	99	
1.18mm (No.16)	98	
0.600 mm (No.30)	96	
0.425mm (No. 40)	92	70 - 100
0.300mm (No. 50)	87	
0.180mm (No. 60)		60 - 95
0.150mm (No.100)	67	
0.075mm (No. 200)	42.6	30 - 70
ASTM C117 AASHTO T11		
Moisture Content, %		
ASTM C566 AASHTO T255		
Fractured Face, %		
2 faces		
Fineness Modulus (FM)		
ASTM C136 AASHTO T27		

TEST RESULTS

Standard	PHYSICAL PROPERTIES		Results	Specification
ASTM C 29 AASHTO T 19	Unit Weight & Voids	Unit Weight, lbs./cu.ft=		
		Voids, %=		
		☐ Jigged ☐ Loose ☑ Rodded		
ASTM C 127 AASHTO T 85	Coarse Specific Gravity & Absorption	Bulk Specific Gravity (dry)=		
		Bulk Specific Gravity, SSD=		
		Apparent Specific Gravity=		
		Absorption, %=		
ASTM C 128 AASHTO T 84	Fine Specific Gravity & Absorption	Bulk Specific Gravity (dry)=		
		Bulk Specific Gravity, SSD=		
		Apparent Specific Gravity=		
		Absorption, %=		
ASTM D 2419 AASHTO T 176	Sand Equivalent	Sand Equivalent, %=		
ASTM D 4791	Flat & Elongated	Flat & Elongated, %=		
		Ratio=		
ASTM C 131 AASHTO T 96	L. A. Abrasion	Small Coarse Loss, %=		
		Grading/ Revs.=		
ASTM C 535	L. A. Abrasion	Large Coarse Loss, %=		
		Grading/ Revs.=		
ASTM C 88 AASHTO T 104	Soundness	Coarse Soundness Loss, %=		
		Magnesium No. of Cycles=		
	Soundness	Fine Soundness Loss, %=		
		Magnesium No. of Cycles=		
ASTM C 142 AASHTO T 112	Clay/Friable Particles	Coarse Aggregate, %=		
		Fine Aggregate, %=		
ASTM C 40 AASHTO T 21	Organic Impurities	Coarse Aggregate, %=		
		Fine Aggregate, %=		
ASTM C 123 AASHTO T 113	Lightweight Pieces	Coarse Aggregate, %=		
		Fine Aggregate, %=		
ASTM D 3080 AASHTO T 236	Direct Shear CD	Friction Angle,=		
ASTM D 1557 AASHTO T 180	Compaction Modified Effort	Optimum Moisture, %=		
		Max. Density, lbs./cu.ft.=		
ASTM D 4318 AASHTO T 89/90	Liquid Limit, Plastic Limit & Plasticity Index	Liquid Limit=		
		Plastic Limit=		
		Plasticity Index=		

KLEINFELDER
Bright People. Right Solutions.

REPORT of AGGREGATE PHYSICAL PROPERTIES

Project: Bayview Land Fill Cell #1 Closure
Client: SUVSWD
Material Tested: Cover material
Source: N=8649.6 E=4332.8 Z=4788.8
Specification: Per Engineer Report

Lab No.: T08-193-3
Project No: 49816.001
Sampled by: TMM
Tested by : CT
Reviewed by:
Curtis Parker, Lab Manager

Report Date: 10/10/2008
Sample Date: 9/24/2008
Test Date: 9/26/2008

SIEVE ANALYSIS

ASTM C136 AASHTO T27

Sieve Size	Accum. % Passing	Specifications
450 mm (18")		
375 mm (15")		
300 mm (12")		
250 mm (10")		
225 mm (9")		
200 mm (8")		
150 mm (6")		
125 mm (5")		
100 mm (4")	100	
75.0 mm (3")	100	
63.0 mm (2-1/2")	100	
50.0 mm (2")	100	
37.5 mm (1-1/2")	100	
25.0 mm (1")	100	
19.0 mm (3/4")	100	
12.5 mm (1/2")	100	
9.5 mm (3/8")	100	
6.3 mm (1/4")		
4.75mm (No. 4)	100	95 - 100
2.36 mm (No. 8)	98	
2.00 mm (No. 10)	98	
1.18mm (No.16)	97	
0.600 mm (No.30)	95	
0.425mm (No. 40)	91	70 - 100
0.300mm (No. 50)	87	
0.180mm (No. 80)		60 - 95
0.150mm (No.100)	73	
0.075mm (No. 200)	51.2	30 - 70
ASTM C117 AASHTO T11		
Moisture Content, %		
ASTM C566 AASHTO T255		
Fractured Face, %		
2 faces		
Fineness Modulus (FM)		
ASTM C136 AASHTO T27		

TEST RESULTS

Standard	PHYSICAL PROPERTIES		Results	Specification
ASTM C 29 AASHTO T 19	Unit Weight & Voids	Unit Weight, lbs./cu.ft=		
		Voids, %=		
		☐ Jigged ☐ Loose ☑ Rodded		
ASTM C 127 AASHTO T 85	Coarse Specific Gravity & Absorption	Bulk Specific Gravity (dry)=		
		Bulk Specific Gravity, SSD=		
		Apparent Specific Gravity=		
		Absorption, %=		
ASTM C 128 AASHTO T 84	Fine Specific Gravity & Absorption	Bulk Specific Gravity (dry)=		
		Bulk Specific Gravity, SSD=		
		Apparent Specific Gravity=		
		Absorption, %=		
ASTM D 2419 AASHTO T 176	Sand Equivalent	Sand Equivalent, %=		
ASTM D 4791	Flat & Elongated	Flat & Elongated, %=		
		Ratio=		
ASTM C 131 AASHTO T 96	L.A. Abrasion	Small Coarse Loss, %=		
		Grading/ Revs.=		
ASTM C 535	L. A. Abrasion	Large Coarse Loss, %=		
		Grading/ Revs.=		
ASTM C 88 AASHTO T 104	Soundness	Coarse Soundness Loss, %=		
		Magnesium No. of Cycles=		
	Soundness	Fine Soundness Loss, %=		
		Magnesium No. of Cycles=		
ASTM C 142 AASHTO T 112	Clay/Friable Particles	Coarse Aggregate, %=		
		Fine Aggregate, %=		
ASTM C 40 AASHTO T 21	Organic Impurities	Coarse Aggregate, %=		
		Fine Aggregate, %=		
ASTM C 123 AASHTO T 113	Lightweight Pieces	Coarse Aggregate, %=		
		Fine Aggregate, %=		
ASTM D 3080 AASHTO T 236	Direct Shear CD	Friction Angle,=		
ASTM D 1557 AASHTO T 180	Compaction Modified Effort	Optimum Moisture, %=		
		Max. Density, lbs./cu.ft.=		
ASTM D 4318 AASHTO T 89/90	Liquid Limit, Plastic Limit & Plasticity Index	Liquid Limit=		
		Plastic Limit=		
		Plasticity Index=		

KLEINFELDER
Bright People. Right Solutions.

REPORT of AGGREGATE PHYSICAL PROPERTIES

Project: Bayview Land Fill Cell #1 Closure
Client: SUVSWD
Material Tested: Cover material
Source: N=8722.8 E=4446.3 Z=4775.2
Specification: Per Engineer Report

Lab No.: T08-193-4
Project No: 49816.001
Sampled by: TMM
Tested by : CT
Reviewed by:
Curtis Parker, Lab Manager

Report Date: 10/10/2008
Sample Date: 9/24/2008
Test Date: 9/26/2008

SIEVE ANALYSIS

ASTM C136 AASHTO T27

Sieve Size	Accum. % Passing	Specifications
450 mm (18")		
375 mm (15")		
300 mm (12")		
250 mm (10")		
225 mm (9")		
200 mm (8")		
150 mm (6")		
125 mm (5")		
100 mm (4")	100	
75.0 mm (3")	100	
63.0 mm (2-1/2")	100	
50.0 mm (2")	100	
37.5 mm (1-1/2")	100	
25.0 mm (1")	100	
19.0 mm (3/4")	100	
12.5 mm (1/2")	100	
9.5 mm (3/8")	100	
6.3 mm (1/4")		
4.75mm (No. 4)	99	95 - 100
2.36 mm (No. 8)	97	
2.00 mm (No. 10)	97	
1.18mm (No.16)	96	
0.600 mm (No.30)	91	
0.425mm (No. 40)	87	70 - 100
0.300mm (No. 50)	82	
0.180mm (No. 80)		60 - 95
0.150mm (No.100)	69	
0.075mm (No. 200)	49.5	30 - 70
ASTM C117 AASHTO T11		
Moisture Content, %		
ASTM C566 AASHTO T255		
Fractured Face, %		
2 faces		
Fineness Modulus (FM)		
ASTM C136 AASHTO T27		

TEST RESULTS

Standard	PHYSICAL PROPERTIES		Results	Specification
ASTM C 29	Unit Weight	Unit Weight, lbs./cu.ft=		
AASHTO T 19	& Voids	Voids, %=		
		☐ Jigged ☐ Loose ☑ Rodded		
	Coarse	Bulk Specific Gravity (dry)=		
ASTM C 127	Specific	Bulk Specific Gravity, SSD=		
AASHTO T 85	Gravity &	Apparent Specific Gravity=		
	Absorption	Absorption, %=		
	Fine	Bulk Specific Gravity (dry)=		
ASTM C 128	Specific	Bulk Specific Gravity, SSD=		
AASHTO T 84	Gravity &	Apparent Specific Gravity=		
	Absorption	Absorption, %=		
ASTM D 2419	Sand	Sand Equivalent, %=		
AASHTO T 176	Equivalent			
ASTM D 4791	Flat &	Flat & Elongated, %=		
	Elongated	Ratio=		
ASTM C 131	L. A.	Small Coarse Loss, %=		
AASHTO T 96	Abrasion	Grading/ Revs.=		
ASTM C 535	L. A.	Large Coarse Loss, %=		
	Abrasion	Grading/ Revs.=		
	Soundness	Coarse Soundness Loss, %=		
ASTM C 88		Magnesium No. of Cycles=		
AASHTO T 104	Soundness	Fine Soundness Loss, %=		
		Magnesium No. of Cycles=		
ASTM C 142	Clay/Friable	Coarse Aggregate, %=		
AASHTO T 112	Particles	Fine Aggregate, %=		
ASTM C 40	Organic	Coarse Aggregate, %=		
AASHTO T 21	Impurities	Fine Aggregate, %=		
ASTM C 123	Lightweight	Coarse Aggregate, %=		
AASHTO T 113	Pieces	Fine Aggregate, %=		
ASTM D 3080	Direct Shear	Friction Angle,=		
AASHTO T 236	CD			
ASTM D 1557	Compaction	Optimum Moisture, %=		
AASHTO T 180	Modified Effort	Max. Density, lbs./cu.ft.=		
ASTM D 4318	Liquid Limit,	Liquid Limit=		
AASHTO T 89/90	Plastic Limit &	Plastic Limit=		
	Plasticity Index	Plasticity Index=		

KLEINFELDER
Bright People. Right Solutions.

REPORT of AGGREGATE PHYSICAL PROPERTIES

Project: Bayview Land Fill Cell #1 Closure
Client: SUVSWD
Material Tested: Cover material
Source: N=8577.6 E=4470.5 Z=4769.0
Specification: Per Engineer Report

Lab No.: T08-193-5
Report Date: 10/10/2008
Project No: 49816.001
Sampled by: TMM
Sample Date: 9/24/2008
Tested by : CT
Test Date: 9/26/2008
Reviewed by:
Curtis Parker, Lab Manager

SIEVE ANALYSIS

ASTM C136	AASHTO T27	
Sieve Size	**Accum. % Passing**	**Specifications**
450 mm (18")		
375 mm (15")		
300 mm (12")		
250 mm (10")		
225 mm (9")		
200 mm (8")		
150 mm (6")		
125 mm (5")		
100 mm (4")	100	
75.0 mm (3")	100	
63.0 mm (2-1/2")	100	
50.0 mm (2")	100	
37.5 mm (1-1/2")	100	
25.0 mm (1")	100	
19.0 mm (3/4")	100	
12.5 mm (1/2")	100	
9.5 mm (3/8")	100	
6.3 mm (1/4")		
4.75mm (No. 4)	100	95 - 100
2.36 mm (No. 8)	99	
2.00 mm (No. 10)	98	
1.18mm (No.16)	97	
0.600 mm (No.30)	93	
0.425mm (No. 40)	88	70 - 100
0.300mm (No. 50)	82	
0.180mm (No. 60)		60 - 95
0.150mm (No.100)	66	
0.075mm (No. 200)	37.8	30 - 70
ASTM C117 AASHTO T11		
Moisture Content, %		
ASTM C566 AASHTO T255		
Fractured Face, %		
2 faces		
Fineness Modulus (FM)		
ASTM C136 AASHTO T27		

TEST RESULTS

Standard	PHYSICAL PROPERTIES		Results	Specification
ASTM C 29	Unit Weight	Unit Weight, lbs./cu.ft=		
AASHTO T 19	& Voids	Voids, %=		
		☐ Jigged ☐ Loose ☑ Rodded		
	Coarse	Bulk Specific Gravity (dry)=		
ASTM C 127	Specific	Bulk Specific Gravity, SSD=		
AASHTO T 85	Gravity &	Apparent Specific Gravity=		
	Absorption	Absorption, %=		
	Fine	Bulk Specific Gravity (dry)=		
ASTM C 128	Specific	Bulk Specific Gravity, SSD=		
AASHTO T 84	Gravity &	Apparent Specific Gravity=		
	Absorption	Absorption, %=		
ASTM D 2419	Sand	Sand Equivalent, %=		
AASHTO T 176	Equivalent			
ASTM D 4791	Flat &	Flat & Elongated, %=		
	Elongated	Ratio=		
ASTM C 131	L. A.	Small Coarse Loss, %=		
AASHTO T 96	Abrasion	Grading/ Revs.=		
ASTM C 535	L. A.	Large Coarse Loss, %=		
	Abrasion	Grading/ Revs.=		
	Soundness	Coarse Soundness Loss, %=		
ASTM C 88		Magnesium No. of Cycles=		
AASHTO T 104	Soundness	Fine Soundness Loss, %=		
		Magnesium No. of Cycles=		
ASTM C 142	Clay/Friable	Coarse Aggregate, %=		
AASHTO T 112	Particles	Fine Aggregate, %=		
ASTM C 40	Organic	Coarse Aggregate, %=		
AASHTO T 21	Impurities	Fine Aggregate, %=		
ASTM C 123	Lightweight	Coarse Aggregate, %=		
AASHTO T 113	Pieces	Fine Aggregate, %=		
ASTM D 3080	Direct Shear	Friction Angle,=		
AASHTO T 236	CD			
ASTM D 1557	Compaction	Optimum Moisture, %=		
AASHTO T 180	Modified Effort	Max. Density, lbs./cu.ft.=		
ASTM D 4318	Liquid Limit,	Liquid Limit=		
AASHTO T 89/90	Plastic Limit &	Plastic Limit=		
	Plasticity Index	Plasticity Index=		

KLEINFELDER
Bright People. Right Solutions.

REPORT of AGGREGATE PHYSICAL PROPERTIES

Project: Bayview Land Fill Cell #1 Closure
Client: SUVSWD
Material Tested: Cover material
Source: N=8269.5 E=4491.3 Z=4774.8
Specification: Per Engineer Report

Lab No.: T08-193-6
Project No: 49816.001
Sampled by: TMM
Tested by : CT
Reviewed by:
Curtis Parker, Lab Manager

Report Date: 10/10/2008
Sample Date: 9/24/2008
Test Date: 9/26/2008

SIEVE ANALYSIS

ASTM C136	AASHTO T27	
Sieve Size	**Accum. % Passing**	**Specifications**
450 mm (18")		
375 mm (15")		
300 mm (12")		
250 mm (10")		
225 mm (9")		
200 mm (8")		
150 mm (6")		
125 mm (5")		
100 mm (4")	100	
75.0 mm (3")	100	
63.0 mm (2-1/2")	100	
50.0 mm (2")	100	
37.5 mm (1-1/2")	100	
25.0 mm (1")	100	
19.0 mm (3/4")	100	
12.5 mm (1/2")	100	
9.5 mm (3/8")	100	
6.3 mm (1/4")		
4.75mm (No. 4)	100	95 - 100
2.36 mm (No. 8)	100	
2.00 mm (No. 10)	100	
1.18mm (No.16)	99	
0.600 mm (No.30)	95	
0.425mm (No. 40)	90	70 - 100
0.300mm (No. 50)	86	
0.180mm (No. 80)		60 - 95
0.150mm (No.100)	75	
0.075mm (No. 200)	56.9	30 - 70
ASTM C117 AASHTO T11		
Moisture Content, %		
ASTM C566 AASHTO T255		
Fractured Face, %		
2 faces		
Fineness Modulus (FM)		
ASTM C136 AASHTO T27		

TEST RESULTS

Standard	**PHYSICAL PROPERTIES**		**Results**	**Specification**
ASTM C 29	Unit Weight	Unit Weight, lbs./cu.ft=		
AASHTO T 19	& Voids	Voids, %=		
		☐ Jigged ☐ Loose ☑ Rodded		
	Coarse	Bulk Specific Gravity (dry)=		
ASTM C 127	Specific	Bulk Specific Gravity, SSD=		
AASHTO T 85	Gravity &	Apparent Specific Gravity=		
	Absorption	Absorption, %=		
	Fine	Bulk Specific Gravity (dry)=		
ASTM C 128	Specific	Bulk Specific Gravity, SSD=		
AASHTO T 84	Gravity &	Apparent Specific Gravity=		
	Absorption	Absorption, %=		
ASTM D 2419	Sand	Sand Equivalent, %=		
AASHTO T 176	Equivalent			
ASTM D 4791	Flat &	Flat & Elongated, %=		
	Elongated	Ratio=		
ASTM C 131	L. A.	Small Coarse Loss, %=		
AASHTO T 96	Abrasion	Grading/ Revs.=		
ASTM C 535	L. A.	Large Coarse Loss, %=		
	Abrasion	Grading/ Revs.=		
	Soundness	Coarse Soundness Loss, %=		
ASTM C 88		Magnesium No. of Cycles=		
AASHTO T 104	Soundness	Fine Soundness Loss, %=		
		Magnesium No. of Cycles=		
ASTM C 142	Clay/Friable	Coarse Aggregate, %=		
AASHTO T 112	Particles	Fine Aggregate, %=		
ASTM C 40	Organic	Coarse Aggregate, %=		
AASHTO T 21	Impurities	Fine Aggregate, %=		
ASTM C 123	Lightweight	Coarse Aggregate, %=		
AASHTO T 113	Pieces	Fine Aggregate, %=		
ASTM D 3080	Direct Shear	Friction Angle,=		
AASHTO T 236	CD			
ASTM D 1557	Compaction	Optimum Moisture, %=		
AASHTO T 180	Modified Effort	Max. Density, lbs./cu.ft.=		
ASTM D 4318	Liquid Limit,	Liquid Limit=		
AASHTO T 89/90	Plastic Limit &	Plastic Limit=		
	Plasticity Index	Plasticity Index=		

KLEINFELDER
Bright People. Right Solutions.

REPORT of AGGREGATE PHYSICAL PROPERTIES

Project: Bayview Land Fill Cell #1 Closure
Client: SUVSWD
Material Tested: Cover material
Source: N=8367.1 E=4593.1 Z=4765.9
Specification: Per Engineer Report

Lab No.: T08-193-7
Project No: 49816.001
Sampled by: TMM
Tested by : CT
Reviewed by:
Curtis Parker, Lab Manager

Report Date: 10/10/2008
Sample Date: 9/24/2008
Test Date: 9/26/2008

SIEVE ANALYSIS

ASTM C136 AASHTO T27

Sieve Size	Accum. % Passing	Specifications
450 mm (18")		
375 mm (15")		
300 mm (12")		
250 mm (10")		
225 mm (9")		
200 mm (8")		
150 mm (6")		
125 mm (5")		
100 mm (4")	100	
75.0 mm (3")	100	
63.0 mm (2-1/2")	100	
50.0 mm (2")	100	
37.5 mm (1-1/2")	100	
25.0 mm (1")	100	
19.0 mm (3/4")	99	
12.5 mm (1/2")	99	
9.5 mm (3/8")	99	
6.3 mm (1/4")		
4.75mm (No. 4)	99	95 - 100
2.36 mm (No. 8)	97	
2.00 mm (No. 10)	96	
1.18mm (No.16)	95	
0.600 mm (No.30)	92	
0.425mm (No. 40)	89	70 - 100
0.300mm (No. 50)	86	
0.180mm (No. 80)		60 - 95
0.150mm (No.100)	79	
0.075mm (No. 200) ASTM C117 AASHTO T11	69.4	30 - 70
Moisture Content, % ASTM C566 AASHTO T255		
Fractured Face, % 2 faces		
Fineness Modulus (FM) ASTM C136 AASHTO T27		

TEST RESULTS

Standard	PHYSICAL PROPERTIES		Results	Specification
ASTM C 29 AASHTO T 19	Unit Weight & Voids	Unit Weight, lbs./cu.ft=		
		Voids, %=		
		☐ Jigged ☐ Loose ☑ Rodded		
ASTM C 127 AASHTO T 85	Coarse Specific Gravity & Absorption	Bulk Specific Gravity (dry)=		
		Bulk Specific Gravity, SSD=		
		Apparent Specific Gravity=		
		Absorption, %=		
ASTM C 128 AASHTO T 84	Fine Specific Gravity & Absorption	Bulk Specific Gravity (dry)=		
		Bulk Specific Gravity, SSD=		
		Apparent Specific Gravity=		
		Absorption, %=		
ASTM D 2419 AASHTO T 176	Sand Equivalent	Sand Equivalent, %=		
ASTM D 4791	Flat & Elongated	Flat & Elongated, %=		
		Ratio=		
ASTM C 131 AASHTO T 96	L. A. Abrasion	Small Coarse Loss, %=		
		Grading/ Revs.=		
ASTM C 535	L. A. Abrasion	Large Coarse Loss, %=		
		Grading/ Revs.=		
ASTM C 88 AASHTO T 104	Soundness	Coarse Soundness Loss, %=		
		Magnesium No. of Cycles=		
	Soundness	Fine Soundness Loss, %=		
		Magnesium No. of Cycles=		
ASTM C 142 AASHTO T 112	Clay/Friable Particles	Coarse Aggregate, %=		
		Fine Aggregate, %=		
ASTM C 40 AASHTO T 21	Organic Impurities	Coarse Aggregate, %=		
		Fine Aggregate, %=		
ASTM C 123 AASHTO T 113	Lightweight Pieces	Coarse Aggregate, %=		
		Fine Aggregate, %=		
ASTM D 3080 AASHTO T 236	Direct Shear CD	Friction Angle,=		
ASTM D 1557 AASHTO T 180	Compaction Modified Effort	Optimum Moisture, %=		
		Max. Density, lbs./cu.ft.=		
ASTM D 4318 AASHTO T 89/90	Liquid Limit, Plastic Limit & Plasticity Index	Liquid Limit=		
		Plastic Limit=		
		Plasticity Index=		

KLEINFELDER
Bright People. Right Solutions.

REPORT of AGGREGATE PHYSICAL PROPERTIES

Project:	Bayview Land Fill Cell #1 Closure	**Lab No.:**	T08-193-8	**Report Date:**	10/10/2008
Client:	SUVSWD	**Project No:**	49816.001		
Material Tested:	Cover material	**Sampled by:**	TMM	**Sample Date:**	9/24/2008
Source:	N=8899.2 E=4537.8 Z=4754.8	**Tested by :**	CT	**Test Date:**	9/26/2008
Specification:	Per Engineer Report	**Reviewed by:**	Curtis Parker, Lab Manager		

SIEVE ANALYSIS

ASTM C136 AASHTO T27

Sieve Size	Accum. % Passing	Specifications
450 mm (18")		
375 mm (15")		
300 mm (12")		
250 mm (10")		
225 mm (9")		
200 mm (8")		
150 mm (6")		
125 mm (5")		
100 mm (4")	100	
75.0 mm (3")	100	
63.0 mm (2-1/2")	100	
50.0 mm (2")	100	
37.5 mm (1-1/2")	100	
25.0 mm (1")	100	
19.0 mm (3/4")	100	
12.5 mm (1/2")	100	
9.5 mm (3/8")	100	
6.3 mm (1/4")		
4.75mm (No. 4)	100	95 - 100
2.36 mm (No. 8)	99	
2.00 mm (No. 10)	99	
1.18mm (No.16)	99	
0.600 mm (No.30)	97	
0.425mm (No. 40)	92	70 - 100
0.300mm (No. 50)	86	
0.180mm (No. 80)		60 - 95
0.150mm (No.100)	67	
0.075mm (No. 200)	42.9	30 - 70
ASTM C117 AASHTO T11		
Moisture Content, %		
ASTM C566 AASHTO T255		
Fractured Face, %		
2 faces		
Fineness Modulus (FM)		
ASTM C136 AASHTO T27		

TEST RESULTS

Standard	PHYSICAL PROPERTIES		Results	Specification
ASTM C 29	Unit Weight	Unit Weight, lbs./cu.ft=		
AASHTO T 19	& Voids	Voids, %=		
		☐ Jigged ☐ Loose ☑ Rodded		
	Coarse	Bulk Specific Gravity (dry)=		
ASTM C 127	Specific	Bulk Specific Gravity, SSD=		
AASHTO T 85	Gravity &	Apparent Specific Gravity=		
	Absorption	Absorption, %=		
	Fine	Bulk Specific Gravity (dry)=		
ASTM C 128	Specific	Bulk Specific Gravity, SSD=		
AASHTO T 84	Gravity &	Apparent Specific Gravity=		
	Absorption	Absorption, %=		
ASTM D 2419	Sand	Sand Equivalent, %=		
AASHTO T 176	Equivalent			
ASTM D 4791	Flat &	Flat & Elongated, %=		
	Elongated	Ratio=		
ASTM C 131	L. A.	Small Coarse Loss, %=		
AASHTO T 96	Abrasion	Grading/ Revs.=		
ASTM C 535	L. A.	Large Coarse Loss, %=		
	Abrasion	Grading/ Revs.=		
	Soundness	Coarse Soundness Loss, %=		
ASTM C 88		Magnesium No. of Cycles=		
AASHTO T 104	Soundness	Fine Soundness Loss, %=		
		Magnesium No. of Cycles=		
ASTM C 142	Clay/Friable	Coarse Aggregate, %=		
AASHTO T 112	Particles	Fine Aggregate, %=		
ASTM C 40	Organic	Coarse Aggregate, %=		
AASHTO T 21	Impurities	Fine Aggregate, %=		
ASTM C 123	Lightweight	Coarse Aggregate, %=		
AASHTO T 113	Pieces	Fine Aggregate, %=		
ASTM D 3080	Direct Shear	Friction Angle,=		
AASHTO T 236	CD			
ASTM D 1557	Compaction	Optimum Moisture, %=		
AASHTO T 180	Modified Effort	Max. Density, lbs./cu.ft.=		
ASTM D 4318	Liquid Limit,	Liquid Limit=		
AASHTO T 89/90	Plastic Limit &	Plastic Limit=		
	Plasticity Index	Plasticity Index=		

KLEINFELDER
Bright People. Right Solutions.

Nuclear Gauge Density Test Data Sheet

Job Name: Bayvew Land Fill Cell 1 Closure
Job Number: 49816.001
Technician: TM Megeath

Remarks:

Test No.	Test Date	Test Identification and Location	Wet Density	Elevation	Moisture Content (%)	Dry Density	Curve Number	Maximum Density (pcf)	Measured Compaction (%)	Specified Compaction (%)	Remarks
		Cell #1 Cover Material									
1A	9/24/2008	N8750 E4210.5 Mode 12"	92.7	4791.5	9.6	84.6	T08-193P	110.2	77	75-85	Pass
1B	9/24/2008	N8750 E4210.5 Mode 6"	95.0		9.9	86.4	T08-193P	110.2	78	75-85	Pass
2A	9/24/2008	N8610 E4230.8 Mode 12"	84.4	4793.9	10.2	76.6	T08-193P	110.2	70	75-85	Fail
2B	9/24/2008	N8610 E4230.8 Mode 6"	78.6		10.5	71.1	T08-193P	110.2	65	75-85	Fail
3A	9/24/2008	N8424.5 E4248.5 Mode 12"	95.7	4794.3	12.8	84.8	T08-193P	110.2	77	75-85	Pass
3B	9/24/2008	N8424.5 E4248.5 Mpde 6"	95.3		12.2	84.9	T08-193P	110.2	77	75-85	Pass
4A	9/24/2008	N8242.4 E4194.2 Mode 12"	109.7	4797.7	7.2	102.3	T08-193P	110.2	93	75-85	Pass
4B	9/24/2008	N8242.4 E4194.2 Mode 6"	105.6		7.9	97.9	T08-193P	110.2	89	75-85	Pass
5A	9/24/2008	N8128.8 E4103.2 Mode 12"	99.0	4802.2	8.5	90.4	T08-193P	110.2	82	75-85	Pass
5B	9/24/2008	N8128.8 E4103.2 Mode 6"	94.6		11.0	85.2	T08-193P	110.2	77	75-85	Pass
6A	9/24/2008	N8157 E 4283.8 Mode 12"	97.7	4792.8	9.2	89.4	T08-193P	110.2	81	75-85	Pass
6B	9/24/2008	N8157 E 4283.8 Mode 6"	92.9		10.0	84.4	T08-193P	110.2	77	75-85	Pass
7A	9/24/2008	N8239 E4354.6 Mode 12"	85.9	4788.9	11.5	77.0	T08-193P	110.2	70	75-85	Fail
7B	9/24/2008	N8239 E4354.6 Mode 6"	79.3		13.4	69.9	T08-193P	110.2	63	75-85	Fail
8A	9/24/2008	N8345.7 E4340.1 Mode 12"	87.1	4789.7	10.4	78.9	T08-193P	110.2	72	75-85	Fail
8B	9/24/2008	N8345.7 E4340.1 Mode 6"	82.2		10.7	74.3	T08-193P	110.2	67	75-85	Fail
9A	9/24/2008	N8486.1 E4343.5 Mode 12"	93.1	4789.2	9.0	85.5	T08-193P	110.2	78	75-85	Pass
9B	9/24/2008	N8486.1 E4343.5 Mode 6"	96.2		9.0	88.3	T08-193P	110.2	80	75-85	Pass
10A	9/24/2008	N8649.6 E4392.8 Mode 12"	97.7	4788.8	5.5	92.6	T08-193P	110.2	84	75-85	Pass
10B	9/24/2008	N8649.6 E4392.8 Mode 6"	95.9		5.8	90.7	T08-193P	110.2	82	75-85	Pass
11A	9/24/2008	N8843.2 E4392.4 Mode 12"	99.4	4783.9	10.1	90.4	T08-193P	110.2	82	75-85	Pass
11B	9/24/2008	N8843.2 E4392.4 Mode 6"	95.4		10.5	86.3	T08-193P	110.2	78	75-85	Pass
12A	9/24/2008	N8722.8 E4446.3 Mode 12"	90.0	4775.2	8.1	83.2	T08-193P	110.2	75	75-85	Pass
12B	9/24/2008	N8722.8 E4446.3 Mode 6"	94.2		8.1	87.2	T08-193P	110.2	79	75-85	Pass
13A	9/24/2008	N8577.6 E4470.5 Mode 12"	96.0	4769.0	7.6	89.2	T08-193P	110.2	81	75-85	Pass

KLEINFELDER
Bright People. Right Solutions.

Nuclear Gauge Density Test Data Sheet

Job Name: Bayvew Land Fill Cell 1 Closure
Job Number: 49816.001
Technician: TM Megeath

Remarks:

Test No.	Test Date	Test Identification and Location	Wet Density	Elevation	Moisture Content (%)	Dry Density	Curve Number	Maximum Density (pcf)	Measured Compaction (%)	Specified Compaction (%)	Remarks
13B	9/24/2008	N8577.6 E4470.5 Mode 6"	97.9		6.8	91.7	T08-193P	110.2	83	75-85	Pass
14A	9/24/2008	N8373.0 E4481.9 Mode 12"	98.0	4775.1	9.6	89.9	T08-193P	110.2	82	75-85	Pass
14B	9/24/2008	N8373.0 E4481.9 Mode 6"	95.6		10.3	86.7	T08-193P	110.2	79	75-85	Pass
15A	9/24/2008	N8269.5 E4491.3 Mode 12"	88.9	4774.8	10.6	80.4	T08-193P	110.2	73	75-85	Fail
15B	9/24/2008	N8269.5 E4491.3 Mode 6"	93.0		10.2	84.4	T08-193P	110.2	77	75-85	Pass
16A	9/24/2008	N8367.1 E4593.1 Mode 12"	94.0	4765.9	13.0	83.2	T08-193P	110.2	75	75-85	Pass
16B	9/24/2008	N8367.1 E4593.1 Mode 6"	92.6		13.2	81.8	T08-193P	110.2	74	75-85	Fail
17A	9/24/2008	N8508.4 E4539.1 Mode 12"	104.0	4758.1	6.6	97.6	T08-193P	110.2	89	75-85	Pass
17B	9/24/2008	N8508.4 E4539.1 Mode 6"	101.8		6.8	95.3	T08-193P	110.2	86	75-85	Pass
18A	9/24/2008	N8689.2 E4572.7 Mode 12"	103.3	4753.3	10.3	93.6	T08-193P	110.2	85	75-85	Pass
18B	9/24/2008	N8689.2 E4572.7 Mode 6"	99.9		10.9	90.0	T08-193P	110.2	82	75-85	Pass
19A	9/24/2008	N8791.3 E4555.6 Mode 12"	100.7	4753.9	8.3	93.0	T08-193P	110.2	84	75-85	Pass
19B	9/24/2008	N8791.3 E4555.6 Mode 6"	98.8		8.4	91.2	T08-193P	110.2	83	75-85	Pass
20A	9/24/2008	N8899.2 E4537.8 Mode 12"	100.7	4754.8	14.0	87.7	T08-193P	110.2	80	75-85	Pass
20B	9/24/2008	N8899.2 E4537.8 Mode 6"	98.1		15.4	85.0	T08-193P	110.2	77	75-85	Pass

Average 6" depth result: 77.7

Average 12" depth result: 79.4

KLEINFELDER
Bright People. Right Solutions.

Daily Field Report-Soils

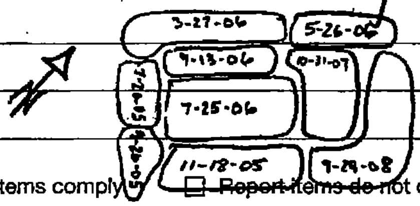
Project Name Bayview L.F Cell 1 Closure
Date 9/24/08
Project No. 49816.001
Bldg. Permit No.
DFR/Report No.
Project Address Elberta, Utah
Time Arrived 0930
Client SUVSWD
Contractor SUVSWD
Time Departed 1500
Equipment Observed
Travel Time 3.0
Weather Sunny, calm, mild; 60 - 80°F
Mileage 140
Reviewed By
Date Reviewed

Density Tests Performed On:
☐ Compacted Subgrade
☐ Excavated Subgrade
☐ Engineered Fill
☐ Trench Backfill
☐ Wall Backfill
☐ Pavement Subgrade
☐ Pavement Baserock
☑ Other (specify) Liner Cap

Number of Density Tests:
____ Performed
____ Passed
____ Failed
____ Requiring Retest
____ Pending Lab Results
____ Other (specify) ________

Possible Reason(s) for Failing Test(s):
☐ Insufficient Compaction
☐ Excessive Moisture
☐ Insufficient Moisture
☐ Unstable Subgrade
☐ Unsuitable Material
☐ Unknown
☐ Other (specify) ________

Observations/Remarks: I arrived on-site as scheduled w/ SUVSWD's Scott Aitken to perform nuclear moisture/density on the approx 360,000 sf of Cell 1 cover material placed approx. 3' thick along an approx area @ the covers eastern side. Testing performed @ 10,000s intervals @ the 12" + 6" transmission depths. KA's 705-1404 proctor curve value (107.3 pcf MDD @ 16.6 OMC) was utilized @ all 20 test locations. The Average 12" depth result was 81.6% @ 9.6% moisture. Ave 6" depth density result was 79.8% @ 10 % moisture. 75% - 85% Required. As required, cover material soil samples were obtained @ 5000 cy intervals for laboratory particle size analysis. Eight (8) samples were obtained on the approx. 40,000 cy installed. Samples SS # 18 - 25 were returned to KA's SLC Lab for this testing. Locations provided by SUVSWD and results reported to Scott Aitken. See attached field density reporting for specific locations and results.



Soil sample obtained @ test location # 3 For proctor determination

☐ Report items comply ☐ ~~Report items do not comply~~ ☐ Report items comply with exceptions ☐ In progress / Not complete

Acknowledged by Scott Aitken
Representing
Page 1 of 3

Kleinfelder Representative *Signature*
T. M. Megeath
Kleinfelder Representative *Print Name*

MAT-07 REV 05/08

KLEINFELDER
Bright People. Right Solutions.

Daily Field Report (DFR) (continued)

Project Name *Bayview L.F Cell 1 Closure* Date *9/24/08*

Project No. *49816.00* Contractor *SWUSWD* DFR/Report No.

Project Address *Elberta, UT* Bldg. Permit No.

Reviewed By Date Reviewed *DS= 30996* *Rqmt*

Observations/Remarks: *Curve 705-1404 107.3 pcf MDD @ 16.5% OMC* *MS: 12045* *75-85%*

Test#	Mode	Location		Elev	WD	DD	%M	% Comp
1A	12	N=8750	E=4210.5	4791.5	92.7	84.6	8.6	78.9 #1
1B	6	↓			95.0	86.4	9.9	80.6
2A	12	N=8610	E=4230.8	4793.9	84.4	76.6	10.2	71.4
2B	6	↓			78.6	71.1	10.5	66.3
3A	12	N 8424.5	E 4248.5	4794.3	95.7	84.8	12.8	79.1
3B	6	↓			95.3	84.9	12.2	79.2
4A	12	N 8242.4	E 4184.2	4797.7	109.7	102.3	7.2	95.4
4B	6	↓			105.6	97.9	7.9	91.2
5A	12	N 8128.8	E 4103.2	4802.2	99.0	90.4	8.5	84.3 #
5B	6	↓			94.6	85.2	11.0	79.[illegible]
6A	12	N 8157	E 4283.8	4792.8	97.7	89.4	9.2	83.4
6B	6	↓			92.9	84.4	10.6	78.7
7A	12	N 8239	E 4354.6	4788.9	85.9	77.0	11.5	71.8
7B	6	↓			79.3	69.9	13.4	65.2
8A	12	N 8345.7	E 4340.1	4789.7	87.1	78.9	10.4	73.6
8B	6	↓			82.2	74.3	10.7	69.3
9A	12	N 8486.1	E 4343.5	4789.2	93.1	85.5	9.0	79.7
9B	6	↓			96.2	88.3	9.0	82.3
~~10A~~	12	N 8649.6	E 4392.8	4788.8	82.3	76.4	7.7	~~71.5~~ #3
~~10B~~	6	↓			70.0	64.8	8.0	~~60.5~~
10A	12	N 8649.6	E=4332.8	4788.8	97.7	92.6	5.5	86.3 #3
10B	6	↓			95.9	90.7	5.8	84.5

Proctor sample site N=8645.6 E=4330 Z=4788.8

KLEINFELDER
Bright People. Right Solutions.

Daily Field Report (DFR) (continued)

Project Name Bayview L.F Cell 1 Closure
Date 9/2/08
Project No. 49816.001
Contractor SUVSWD
DFR/Report No.
Project Address Elberta, UT
Bldg. Permit No.
Reviewed By
Date Reviewed

Observations/Remarks:

TEST #	MODE	LOCATION		ELEV	WD	DD	% M	% Comp
11A	12	N 8843.2	E 4392.4	4783.9	99.4	90.4	10.1	84.2
11B	6	⊥			95.4	86.3	10.5	80.5
12A	12	N 8722.8	E 4446.3	4775.2	90.0	83.2	8.1	77.6 #
12B	6	⊥			94.2	87.2	8.1	81.3
13A	12	N 8577.6	E 4470.5	4769.0	96.0	89.2	7.6	83.1 #
13B	6	⊥			97.9	91.7	6.8	85.4
14A	12	N 8373.0	E 4481.9	4775.1	98.0	89.9	9.6	83.8
14B	6	⊥			95.6	86.7	10.3	80.8
[illegible]A	12	N 8269.5	E 4491.3	4774.8	88.9	80.4	10.6	74.9 #
15B	6	⊥			93.0	84.4	10.2	78.7
16A	12	N 8367.1	E 4593.1	4765.9	94.0	83.2	13.0	77.5 #7
16B	6	⊥			92.6	81.8	13.2	76.3
17A	12	N 8508.4	E 4539.1	4758.1	104.0	97.6	6.6	91.0
17B	6	⊥			101.8	95.3	6.8	88.8
18A	12	N 8689.2	E 4572.7	4753.3	103.3	93.6	10.3	87.2
18B	6	⊥			99.9	90.0	10.9	83.9
19A	12	N 8791.3	E 4555.6	4753.9	100.7	93.0	8.3	86.7
19B	6	⊥			98.8	91.2	8.4	85.0
20A	12	N 8899.2	E 4537.8	4754.8	100.7	87.7	14.0	82.8 #
20B	6	⊥			98.1	85.0	15.4	79.3

KLEINFELDER

Construction Observation Report

Project Name Bayview Landfill Cell 1 Cover closure

Date 7/28/05

Client SUVSWD

Project No. 48816.001

DFR No.

Project Location Elberta, UT

Time Arrived 11:00

Contractor SUVSWD

Bldg. Permit No.

Time Departed 14:30

Reviewed by

Date Reviewed

Travel Time 2.5

Type of Observations

☐ Masonry ☐ Welding ☐ Bolting

☐ Batch plant ☐ Reinforcement Steel ☐ Pre-Post Tensioned Tendon

☐ Foundations ☐ Fireproofing ☐ Metal Decking

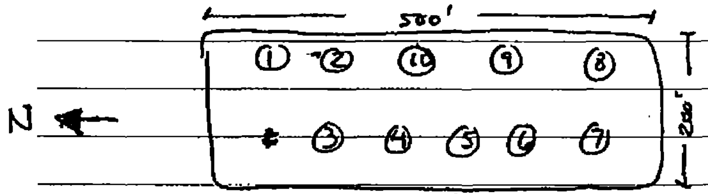
☐ Concrete ☑ Soil ☐ Other

Documents Referenced HDR Engineering Const Documents Manual dated Nov 2004

Summary Arrived on site to meet Richard Henry, Scott Aitken with SUVSWD and Terry Warner, Creighton Omer with HDR.

Performed ten (10) field nuclear density tests @ the 12" and 6" transmission depth on the installed Cell 1, west slope, cover material. Testing performed @ 100'x100' = 10,000 sf increments over the appx 200'x500' = 100,000 sf area installed. 12" + 6" tests averaged 84% with an individual high + low of 97% + 68% respectively noted. KA utilized curve # T05-1414 (107.3 pcf MDD @ 16.6% OMC) for density calculations. This curve was established per ASTM D1557 (modified) method. Please see attached nuclear density field form for specifics; Locations to be provided by SUVSWD. @ a future date.

Test location 8 was sampled to perform gradation #2 on cover material



☐ Report items comply ☑ Report items incomplete ☐ Report items comply with exceptions

Acknowledged by Scott Aitken

Representing SUVSWD

Kleinfelder Representative *Signature*

T. MARK MCGRATH

Kleinfelder Representative *Print Name*

Page 1 of 1

F-1 (9/93)

FILE NO. 4[illegible]816.002
JOB NAME B[illegible]ew Landfill Cell 1 Cover
DATE 7-29-05
TECH T MARK MEGEATH
TEST LOCATIONS SELECTED BY: TMM
COMPACTION CONTROL ☐ DENSITY TESTING ☑

NUCLEAR DENSIT FIELD FORM

KLEINFELDER

MILEAGE 180
HOURS 3.5
WEATHER P.C. So breeze

RESULTS REPORTED T
Scott Aitken
Tany Werner

STANDARD COUNT
Density 33228
Moisture 12392

Test No.	Mode	Approximate Location Cell 1 West slope 3' Cover	Wet Density	Depth below FSG (ft)	Moisture Percentage	Dry Density	Curve No.	Lab Maximum	% Compaction	Specified Compaction	Remarks
1	12"		101.6	0	7.9	94.2	705-1414	107.3	88	75-85 ~~95~~	Fail
↓	6"		102.6		8.1	94.9			88	75-85	Fail
2	12"		104.3		6.5	97.9			91		Fail
↓	6"		104.9		6.2	98.7			92		Fail
3	12"		84.1		10.5	76.1			71		Fail
↓	6"		80.5		10.2	73.1			68		Fail
4	12"		93.6		8.1	86.5			81		Pass
↓	6"		92.5		8.1	85.5			80		Pass
5	12"		92.6		6.8	86.7			81		Pass
↓	6"		90.3		6.2	85			79		Pass
6	12"		94.7		5.2	89.9			84		Pass
↓	6"		95.2		5.3	90.4			84		Pass
7	12"		91.5		7.7	87.8			80		Pass
↓	6"		89.7		8.7	82.5			77		Pass

SHEET 1 of 2

FILE NO. 49816.002
JOB NAME Bayview Landfill Cell 1 Cover
DATE 7-29-05
TECH T. MARK MEGEATH
TEST LOCATIONS SELECTED BY:
COMPACTION CONTROL ☐ DENSITY TESTING ☑

NUCLEAR DENSITY FIELD FORM

KLEINFELDER

MILEAGE 160
HOURS 3.5
WEATHER P.C. & breeze

RESULTS REPORTED TO
Scott Astleson
Terry Werner

STANDARD COUNT
Density 33228
Moisture 12392

Test No.	Mode	Approximate Location Cell 1 West Slope 3' Cover	Wet Density	Depth below FSG (ft)	Moisture Percentage	Dry Density	Curve No.	Lab Maximum	% Compaction	Specified Compaction	Remarks
8	12"		92.5	0	8.3	85.5	705-1414	107.3	80	75-85	Pass Gradation sampled-
↓	6"		91.7		8.8	84.4			79		Pass ↓
9	12"		96.4		4.8	91.9			86		Fail
↓	6"		96.6		5.2	91.8			86		Fail
10	12"		110.2	↓	6.1	103.9			97		Fail
↓	6"		107.7	↓	6.6	101.0	↓	↓	94	↓	Fail
~~11~~	~~12"~~										
~~↓~~	~~6"~~										
~~12~~	~~12"~~										
~~↓~~	~~6"~~									↓	
						12" Ave			84		
						6" Ave			83		

J-29

SHEET of 2