February 12, 2016

RB&G
ENGINEERING, INC.

SW137
Div of Waste Management
and Radiation Control
FEB 22 2016
DSHW-2016-006967

Scott Anderson, Director
Division of Waste Management and Radiation Control
195 North 1950 West
Salt Lake City, Utah 84114

Re: JRDA Landfill Permit Renewal Application Review Response

Dear Scott,

Please find enclosed one copy of the Permit Renewal for Juab Rural Development Agency Class II and Class IV Landfill and one copy of the Evaluation of Evapotranspiration Cover for Juab Rural Development Agency Class II and Class IV Landfill. Electronic copies of both reports have been sent through email. The reports have been updated to address your review comments. The following responses refer to the numbering of the review comments from your letter dated November 9, 2015.

1) Section 2.3.6 of the application has been updated to indicate that furniture and appliances will only be accepted in the Class II waste cell of the landfill.

2) Section 5.2 has been updated to indicate that post-closure inspections will occur quarterly.

3) It is agreed that the entire 18-inch clay cover should be modeled with a K value of $1x10^{-5}$ cm/s. See response number 5 below.

4) The scaling factors are intended to compensate for the difference in laboratory soil samples and actual field application. The processes that occur in the field, including freeze-thaw and wet-dry cycling, root growth and death, and burrowing fauna, generally result in lower available storage capacity in field applications, and the scaling factors are intended to correct for this difference. Covers studied in the US Environmental Protection Agency's Alternative Cover Assessment Project (ACAP) showed significant changes in the unsaturated soil properties when compared to laboratory conditions. A correction method to account for the differences between field and laboratory conditions was developed using data from ACAP (see Albright 2010). This method consists of applying the noted scaling factors of 1.3 and 1.1 to the alpha and n parameters respectively. This is intended to be conservative (allowing an increase in infiltration through the cover when the factors are applied).

However, this is not always the case for every simulation. When the scaling factors are not used for the covers studied in this analysis, infiltration decreases as expected for the 82% compacted ET cover (by 5 cm) and the 18-inch clay cover (by 8 cm), but it increases slightly (by 2 cm) for the 88% compacted ET cover.

1435 WEST 820 NORTH, PROVO, UTAH 84601-1343
PROVO 801-374-5771 SALT LAKE CITY 801-521-5771 FAX 801-374-5773

It is our engineering judgment that the scaling factors should be used for all the covers in this analysis and they were retained in the models discussed below.

5) In the analysis of the ET cover, the total potential infiltration into the cover is 615 cm. 387 cm is lost through evaporation, and 228 cm enters the soil profile. 186 cm is lost through transpiration and 42 cm infiltrates through the bottom of the cover. 30% of the potential infiltration into the ET cover is lost through transpiration and 63% is lost through evaporation.

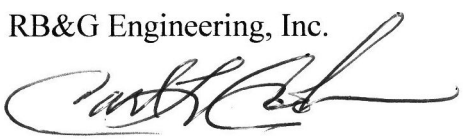
It is agreed that ignoring transpiration losses on the ET covers would be a more conservative modeling approach. However, transpiration is critical to the functioning of an ET cover and in our engineering judgment, transpiration should be included in the ET analysis. In order to create a better comparison of the ET and standard clay covers, the original ET cover analysis, with vegetation, was retained, and a 6-inch vegetated soil layer was added to the clay model to represent the required erosion control vegetation layer. In addition, the clay cover was modeled with the entire 18-inch depth having a K value of $1x10^{-5}$ cm/s.

Based on these criteria, the evapotranspiration (ET) cover allows 42 cm infiltration with less than 1 cm runoff when compacted to the desired 85% compaction level. The revised clay cover allows 47 cm infiltration with 7 cm runoff. Paradoxically, including a vegetation layer increases infiltration through the clay cover. This is likely because the vegetation layer stores water directly against the clay layer, allowing more of it to infiltrate into the cover, rather than running off. In addition, bare clay allows more evaporation than other soil types, so evaporation is reduced and infiltration increases when a vegetation layer is added.

Based on this analysis, the ET cover with vegetation is slightly superior to the standard cover with a 6-inch vegetation layer when considering both infiltration and runoff.

Sincerely,

RB&G Engineering, Inc.



Carl L. Cook, P.E.
Principal

Enclosures

cc: Mike Seely, Juab Rural Development Agency

# PERMIT RENEWAL

# FOR

# JUAB RURAL DEVELOPMENT AGENCY
# CLASS II AND CLASS IV LANDFILL

**Prepared for:**
**Juab Rural Development Agency**
**21 East 100 North**
**Nephi, Utah 84648**

**February 2016**

**Prepared by:**
**RB&G Engineering, Inc.**
**1435 W. 820 N.**
**Provo, UT 84601**

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# Utah Class II Landfill Permit Application Form

| | | | | | |
|---|---|---|---|---|---|
| ***Part I* General Information** | APPLICANT: PLEASE COMPLETE ALL SECTIONS. | | | | |
| ***I.* Landfill Type** | ☑ Class II | ***II.* Application Type** | ☐ New Application<br>☑ Renewal Application | ☐ Facility Expansion<br>☐ Modification | |
| For Renewal Applications, Facility Expansion Applications and Modifications Enter Current Permit Number | 9809 | | | | |
| ***III.* Facility Name and Location** | | | | | |
| Name of Facility | Juab Rural Development Agency Landfill | | | | |
| Site Address (street or directions to site) | From SR-91 (Main St.) in Nephi, Utah, travel 4.8 miles west on SR-132. Turn south at the entrance road and travel 0.9 miles to the gate. | | | County | Juab |
| City | | | Zip Code | Telephone | N/A |
| Township 13S | Range 1W | Section(s) 15 | Quarter/Quarter Section | Quarter Section | |
| Main Gate Latitude 39 degrees | 41 minutes | 24 seconds | Longitude 111 degrees | 55 minutes | 31 seconds |
| ***IV.* Facility Owner(s) Information** | | | | | |
| Name of Facility Owner | Juab Rural Development Agency | | | | |
| Address (mailing) | 160 North Main Street | | | | |
| City Nephi | State UT | Zip Code 84648 | Telephone (435) 623-3408 | | |
| ***V.* Facility Operator(s) Information** | | | | | |
| Name of Facility Operator | Juab County | | | | |
| Address (mailing) | 160 North Main Stret | | | | |
| City Nephi | State UT | Zip Code 84648 | Telephone (435) 623-3408 | | |
| ***VI.* Property Owner(s) Information** | | | | | |
| Name of Property Owner | Juab Rural Development Agency | | | | |
| Address (mailing) | 160 North Main Street | | | | |
| City Nephi | State UT | Zip Code 84648 | Telephone (435) 623-3408 | | |
| ***VII.* Contact Information** | | | | | |
| Owner Contact Mike Seely | | | Title Secretary to the Board | | |
| Address (mailing) | 160 North Main Street | | | | |
| City Nephi | State UT | Zip Code 84648 | Telephone (435) 623-3408 | | |
| Email Address mikes@juabcounty.com | | | Alternative Telephone (cell or other) | | |
| Operator Contact Mike Seely | | | Title Administrator Assistant | | |
| Address (mailing) | 160 North Main Street | | | | |
| City Nephi | State UT | Zip Code 84648 | Telephone (435) 623-3408 | | |
| Email Address mikes@juabcounty.com | | | Alternative Telephone (cell or other) | | |
| Property Owner Contact Mike Seely | | | Title Secretary to the Board | | |
| Address (mailing) | 160 North Main Street | | | | |
| City Nephi | State UT | Zip Code 84648 | Telephone (435) 623-3408 | | |
| Email Address mikes@juabcounty.com | | | Alternative Telephone (cell or other) | | |

# Utah Class II Landfill Permit Application Form

## *Part I* General Information (continued)

### *VIII.* Waste Types (check all that apply)

☑ All non-hazardous solid waste **OR** the following specific waste types:

| Waste Type | Combined Disposal Unit | Monofill Unit |
|---|---|---|
| ☐ Municipal Waste | ☐ | ☐ |
| ☐ Construction & Demolition | ☐ | ☐ |
| ☐ Industrial | ☐ | ☐ |
| ☐ Incinerator Ash | ☐ | ☐ |
| ☐ Animals | ☐ | ☐ |
| ☐ Asbestos | ☐ | ☐ |
| ☐ Other _____ | ☐ | ☐ |

### *IX.* Facility Area

| | | |
|---|---|---|
| Facility Area | 56.6 | acres |
| Disposal Area | 56.6 | acres |
| Design Capacity | | |
| Years | 82 | |
| Cubic Yards | 4,360,000 | |
| Tons | 1,635,000 | |

### *X.* Fee and Application Documents

Indicate Documents Attached To This Application ☐ Application Fee: Amount $

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

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

| | | |
|---|---|---|
| Signature of Authorized Owner Representative<br>Name typed or printed | Title | Date |
| | Address | |
| Email Address | Alternative Telephone (cell or other) | |
| Signature of Authorized Land Owner Representative (if applicable)<br>Name typed or printed | Title | Date |
| | Address | |
| Email Address | Alternative Telephone (cell or other) | |
| Signature of Authorized Operator Representative (if applicable)<br>Name typed or printed | Title | Date |
| | Address | |
| Email Address | Alternative Telephone (cell or other) | |

# Utah Class II Landfill Permit Application Checklist

**Important Note:** The following checklist is for the permit application and addresses only the requirements of the Division of Solid and Hazardous Waste. Other federal, state, or local agencies may have requirements that the facility must meet. The applicant is responsible to be informed of, and meet, any applicable requirements. Examples of these requirements may include obtaining a conditional use permit, a business license, or a storm water permit. The applicant is reminded that obtaining a permit under the *Solid Waste Permitting and Management Rules* does not exempt the facility from these other requirements. Please take note of the heading of each section for the facilities that the section applies to.

An application for a permit to construct and operate a landfill is the documentation that the landfill will be located, designed, constructed, operated, and closed in compliance with the requirements of Utah Administrative Code R315-301 through 320 (*Utah Solid Waste Permitting and Management Rules*) and Utah Code Annotated 19-6-101 through 123 (*Utah Solid and Hazardous Waste Act*). The application should be written to be understandable by regulatory agencies, landfill operators, and the general public. The application should also be written so that the landfill operator, after reading it, will be able to operate the landfill according to the requirements with a minimum of additional training.

Copies of the *Solid Waste Permitting and Management Rules*, the *Utah Solid and Hazardous Waste Act*, along with many other useful guidance documents can be obtained by contacting the Division of Solid and Hazardous Waste at 801-536-0200. Most of these documents are available on the Division's web page at www.hazardouswaste.utah.gov. Guidance documents can be found at the solid waste section portion of the web page.

When the Director has determined that the application is complete, submit two paper copies of the application as determined complete by the Director, and an electronic copy of the application.

***Part II*** **Application Checklist**

| ***I.* Facility General Information** | |
|---|---|
| Description of Item | Location In Document |
| *Ia.* General Information for All Facilities | |
| Completed Part I General information form above | iv |
| General description of the facility (R315-310-3(1)(b)) | 1.1 |
| Legal description of property (R315-310-3(1)(c)) | Appendix A |
| Proof of ownership, lease agreement, or other mechanism (R315-310-3(1)(c)) | Appendix A |
| Area served by the facility including population (R315-310-3(1)(d)) | 1.3, 7.7.3 |
| A demonstration that the landfill is not a commercial facility | 1.4 |
| Waste type and anticipated daily volume (R315-310-3(1)(d)) | 7.7.2, 2.3 |
| ***Ib.*** Information Required for All New Or Laterally Expanding Facilities | |
| Intended schedule of construction (R315-302-2(2)(a)) | 2.2, 7.3 |
| Name and address of all property owners within 1000 feet of the facility boundary (R315-310-3(2)(i)) | 1.0, Appendix A |
| 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)) | 1.0, Appendix A |

| *I.* **Facility General Information** | |
|---|---|
| Description of Item | Location In Document |
| Name of the local government with jurisdiction over the facility site (R315-310-3(2)(iii)) | 1.2 |
| *Ic.* Location Standards for All New And Expanding Facilities | |
| Documentation that the facility has met the historical survey requirement of R315-302-1(2)(f) | N/A |
| Land use compatibility (R315-302-1(2)(a)) | |
| Maps showing the existing land use, topography, residences, parks, monuments, recreation areas or wilderness areas within 1000 feet of the site boundary | Figure D-1 |
| Certifications that no ecologically or scientifically significant areas or endangered species are present in site area | N/A |
| List of airports within five miles of facility and distance to each | N/A (7.2.1) |
| Geology (R315-302-1(2)(b)) | |
| Geologic maps showing significant geologic features, faults, and unstable areas | 6.1, 7.2.2 |
| Maps showing site soils | 6.2 |
| Surface water (R315-302-1(2)(c)) | |
| Magnitude of 24 hour 25 year and 100 year storm events | 6.5 |
| Average annual rainfall | 6.5 |
| Maximum elevation of flood waters proximate to the facility | N/A (7.2.3) |
| Maximum elevation of flood water from 100 year flood for waters proximate to the facility | N/A (7.2.3) |
| Wetlands (R315-302-1(2)(d)) | N/A |
| Ground water (R315-302-1(2)(e)) | 6.4 |
| *Id.* Plan of Operations for All Facilities (R315-310-3(1)(e) and R315-302-2(2)) | |
| Forms and other information as required in R3315-302-2(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)) | 2.3, Appendix B |
| 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)) | 2.5, 7.5, 2.3.14.1, 2.3.14.3, App. B |
| Contingency plans in the event of a fire or explosion (R315-302-2(2)(d)) | 2.7.1 |
| Corrective action programs to be initiated if ground water is contaminated (R315-302-2(2)(e)) | 6.5, 7.4 |
| Contingency plans for other releases, e.g. explosive gases or failure of run-off collection system (R315-302-2(2)(f)) | 2.7.2, 2.7.4 |

| ***I.* Facility General Information** | |
|---|---|
| Description of Item | Location In Document |
| Plan to control fugitive dust generated from roads, construction, general operations, and covering the waste (R315-302-2(2)(g)) | 2.12 |
| Plan for litter control and collection (R315-302-2(2)(h)) | 2.12 |
| Description of maintenance of installed equipment (R315-302-2(2)(i)) | 2.5, 2.8 |
| Procedures for excluding the receipt of prohibited hazardous or PCB containing wastes (R315-302-2(2)(j)) | 2.3.13, 2.3.14 |
| Procedures for controlling disease vectors (R315-302-2(2)(k)) | 2.9 |
| A plan for alternative waste handling (R315-302-2(2)(l)) | 2.7.5 |
| A general training plan for site operations (R315-302-2(2)(o)) | 2.3.13, 2.3.14.2 |
| Any recycling programs planned at the facility (R315-303-4(6)) | 2.11 |
| Closure and post-closure care Plan (R315-302-2(2)(m)) | 4.0, 5.0 |
| Procedures for the handling of special wastes (R315-315) | 2.3.14 |
| Plans and operation procedures to minimize liquids (R315-303-3(1)) | 2.3.13 |
| Plans and procedures to address the requirements of R315-303-3(7)(c) through (i) and R315-303-4 | Various |
| Any other site-specific information pertaining to the plan of operation required by the Director (R315-302-2(2)(p)) | N/A |

| ***II* Facility Technical Information** | |
|---|---|
| Description of Item | Location In Document |
| *IIa.* Maps for All Facilities | |
| Topographic map drawn to the required scale with contours showing the boundaries of the landfill unit, gas monitoring points, and the borrow and fill areas (R315-310-4(2)(a)(i)) | D-2 (Appendix D) |
| 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)) | D-1 (Appendix D) |
| *IIb.* Geohydrological Assessment for All Facilities (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)) | 6.1, 7.2.2 |
| Evaluation of bedrock and soil types and properties including permeability rates (R315-310-4(2)(b)(ii)) | 6.2, Appendix E |
| Depth to ground water (R315-310-4(2)(b)(iii)) | 6.4 |
| 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)) | 6.3 |

| ***II* Facility Technical Information** | |
|---|---|
| Description of Item | Location In Document |
| 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)) | 6.3 |
| Identification and description of all surface waters on-site and within one mile of the facility boundary (R315-310-4(2)(b)(vii)) | 6.3 |
| For an existing facility, identification of impacts upon the ground water and surface water from leachate discharges (R315-310-4(2)(b)(viii)) | 6.5 |
| Calculation of site water balance (R315-310-4(2)(b)(ix)) | N/A |
| *IIc.* Engineering Report - Plans, Specifications, And Calculations for All Facilities | |
| Documentation that the facility will meet all of the performance standards of R315-303-2 | 6.3, 6.4, 6.5, 7.5, 2.7.3. 5.1 |
| 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)) | N/A |
| Anticipated facility life and the basis for calculating the facility's life (R315-310-4(2)(c)(ii)) | 7.7.1 - 7.7.5 |
| Unit design to include cover design; fill methods; and elevation of final cover including plans and drawings signed and sealed by a professional engineer registered in the State of Utah, when required (R315-303-3(3), R315-303-3(6) and (7)(a), R315-310-3(1)(b) and R315-310-4(2)(c)(iii)) | 4.1, 4.2, 7.3, D-3 (Appendix D), D-5 |
| Equipment requirements and availability (R315-310-4(2)(c)(iii)) 2.3.14.1 | 2.4, 2.7.4, 2.12, 7.3 |
| Identification of borrow sources for daily and final cover and for soil liners (R315-310-4(2)(c)(iv)) | 2.4, D-2 |
| Run-On and run-off diversion designs (R315-303-3(1)(c), (d) and (e)) | 7.6, D-3 |
| Landfill gas monitoring and control plan that meets the requirements of Subsection R315-303-3(5) (R315-310-4(2)(c)(vii)) | 7.5 |
| 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)) | N/A |
| Design and location of run-on and run-off control systems (R315-310-4(2)(c)(viii)) | 7.6, D-3, D-4 |
| *IId.* Closure Plan for All Facilities (R315-310-3(1)(h)) | |
| Closure Plan (R315-302-3(2) and (3)) | 4.0 |
| Closure schedule (R315-310-4(2)(d)(i)) | 4.4 |
| Design of final cover (R315-310-4(2)(c)(iii)) | 4.2, D-5 |
| Capacity of site in volume and tonnage (R315-310-4(2)(d)(ii)) | 4.3 |
| Final inspection by regulatory agencies (R315-310-4(2)(d)(iii)) | 4.6 |
| *IIe.* Post-Closure Care Plan for All Facilities (R315-310-3(1)(h)) | |
| Post-Closure Plan (R315-302-3(5) and (6)) | 5.0 |
| Site monitoring of landfill gases, and surface water, if required (R315-310-4(2)(e)(i)) | 5.1 |

| ***II* Facility Technical Information** | |
|---|---|
| Description of Item | Location In Document |
| Changes to record of title, land use, and zoning restrictions (R315-310-4(2)(e)(v)) | 5.3 |
| Maintenance activities to maintain cover and run-on/run-off control systems (R315-310-4(2)(e)(iii)) | 5.2 |
| 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)) | 5.5 |
| *IIf.* Financial Assurance for All Facilities (R315-310-3(1)(j)) | |
| Identification of closure costs including cost calculations (R315-310-4(2)(d)(iv)) | 3.1.1, 4.5, App. C |
| Identification of post-closure care costs including cost calculations (R315-310-4(2)(e)(iv)) | 3.1.2, 5.4, App. C |
| 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)) | 3.2 |

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# PART II - GENERAL REPORT

## 1.0 INTRODUCTION

The Juab Rural Development Agency (JRDA) Landfill, formerly known as the Nephi City Landfill, is currently permitted as a Class II facility as defined in the Utah Solid Waste Permitting and Management Rules (Utah Administrative Code R513-301-2). The landfill also operates a Class IV (construction/demolition) waste cell at its present site. The landfill accepts less than 20 tons of municipal waste per day as required by its classification. In addition, the landfill accepts less than 20 tons per day of construction/demolition waste. Based on current growth rates, incoming municipal waste to the JRDA Landfill is not expected to exceed 20 tons per day until the year 2037. In accordance with regulatory rules this permit renewal application has been prepared and submitted to renew the license to operate the landfill. A notice of intent to apply for a permit renewal has been sent to the Bureau of Land Management, the only property owner within 1000 feet of the facility boundary. A copy of the notice is included in Appendix A.

### 1.1 General Facility Description

The JRDA Landfill is a canyon type landfill. The geographic boundary of the canyon (canyon walls) encompasses approximately 75 acres. The current surface area of the waste mass covers approximately 13.1 acres with a potential to reach 14.95 acres. This area has been used since 1983 as a Class II landfill. The original site was leased from the Bureau of Land Management (BLM), and was subsequently purchased with additional land described below.

The site has no liner or leachate collection system. Solid waste has been deposited in the bottom of the canyon and covered with soil excavated from the canyon walls.

### 1.2 Property Description and Ownership

The landfill site is located approximately 5 miles west of Nephi City in a lateral portion of Hall Canyon. The land surrounding the site is open range administered by the BLM. The facility gate is located at approximately 39°41'24" N latitude and 111°55'31" W longitude. The entire site includes approximately 300 acres purchased from the BLM in 1995. Access to the site was secured from the BLM by a Right-of-Way Grant/Temporary Use Permit. Copies of the Land Patent including the site legal description (Patent Number 43-95-0035, recorded as Entry No. 205112, Book 371, Page 533), Patent Presentation, and Temporary Use Permit are provided in Appendix A. Juab County has jurisdiction over the facility site.

### 1.3 Area Served

The JRDA Landfill accepts solid waste generated in the eastern Juab County towns of Levan, Mona, and Nephi City, and farms and ranches adjacent to these communities. Population estimates for these areas are shown in Section 7.7.3 of this application.

### 1.4 Non-Commercial Facility

The JRDA Landfill is a non-commercial facility. The landfill does not generate enough income to cover operating costs, and the budget is supplemented from Juab County funds.

## 2.0 PLAN OF OPERATION

In accordance with the Utah Solid Waste Permitting and Management Rules, R315-301 through 320 of the Utah Administrative Code (UAC), the JRDA is submitting the following Plan of Operation for a Class II municipal landfill with a Class IV construction/demolition waste cell. This plan is submitted to the Utah Department of Environmental Quality (UDEQ) as part of the application to operate a Class II landfill.

### 2.1 Hours of Operation

The hours of operation shall be posted at the landfill site and may be adjusted from time to time to best suit the needs of the communities. Landfill hours will also be posted on the County web site and in any other public location as seen fit by County administrators. During the posted hours of operation a landfill attendant will be on site at all times.

### 2.2 Intended Schedule of Construction

Nephi City began landfill operations at the present location in 1983. The JRDA subsequently assumed responsibility of the landfill operation. The site is in a narrow and relatively short canyon which runs south to north. Solid waste is deposited across the breadth of the canyon while daily cover is excavated along the sides of the canyon. Separate cells for household waste and construction/demolition waste are maintained in close proximity along the active face.

Current plans call for the northern end of the site to remain stationary when it meets the main portion of Hall Canyon. The landfill will continue to progress vertically, expanding to the canyon walls. Excavation from the eastern, western, and southern boundaries of the landfill active area will result in expansion laterally, yet remaining within existing boundaries. Final cover shall be placed in phases. Due to the topography of the canyon, the north end of the landfill will reach design elevation and receive final cover first. The final cover shall be graded to have a maximum slope of 3 horizontal to 1 vertical.

### 2.3 Waste Handling Procedures

The JRDA Landfill accepts the following types of waste for disposal:

- Household Waste
- Commercial Solid Waste
- Yard Waste
- Industrial Solid Waste
- Construction/Demolition Waste
- Furniture and Appliances
- Automobile Bodies
- Waste Tires
- Dead Animals
- Asbestos
- Medical Wastes

An example of the form used to record the weights/volumes of waste received is included in Appendix B.

### 2.3.1 Household Waste

Household waste includes any solid waste derived from households including garbage, trash, and sanitary wastes. Sources for this type of waste include single and multiple residences, motels, hotels, schools, bunkhouses, ranger stations, campgrounds, picnic grounds and day-use recreation areas. These wastes will be deposited on the working face at the site, and covered on a daily basis.

### 2.3.2 Commercial Solid Waste

Commercial solid waste includes all types of solid waste generated by stores, offices, restaurants, warehouses, and other non-manufacturing activities, excluding household waste and industrial wastes. These wastes will be deposited on the working face at the site, and covered on a daily basis.

### 2.3.3 Yard Waste

Yard waste includes plant and tree trimmings derived from landscaping, land clearing and seasonal landscaping maintenance. Yard waste does not include garbage, paper, plastic, processed wood, sludge, septage, or manure.

Yard wastes will be placed in the Class IV waste cell at the landfill. The Class IV cell will be located on the same level as the active face of the landfill and will progress with the active face as the landfill is constructed. The Class IV cell will alternate locations on the active face and will be moved and covered on a monthly basis, or when the height of the Class IV cell equals the cell height of the adjoining cells of household wastes. The Class IV cell shall be covered more often if required to eliminate litter and fire hazards.

At the discretion of the operator, yard waste may also be placed in a separate location away from all active and inactive cells, to be burned according to the requirements of Section 2.12 of this application.

### 2.3.4 Industrial Solid Waste

Industrial solid waste includes any solid waste generated at a manufacturing or other industrial facility which is non-hazardous and non-liquid. Acceptance of industrial solid waste is contingent upon the type, quantity, and verification of the waste. Industrial wastes shall be separated as to Class II or Class IV wastes and disposed of in the appropriate cell. Hazardous or liquid waste generators must use the services of a permitted hazardous waste facility. Industrial solid waste does not include mining waste, oil and gas waste, or other hazardous wastes.

### 2.3.5 Construction/Demolition Waste

Construction/demolition waste includes waste from building materials, packaging and rubble resulting from construction, remodeling, repair, renovation and demolition operations on pavements, houses, commercial buildings and other structures. Construction/demolition waste includes: untreated wood, tree stumps, concrete, brick, masonry materials, soil, rock, non-asbestos insulation, glass, wallboard, waste asphalt, rebar contained in concrete, etc. Construction/demolition debris shall be placed in the Class IV waste cell. Compaction and cover of the Class IV waste shall occur as described in Section 2.3.3.

Construction/demolition waste does not include regulated quantities of hazardous PCB's, liquid wastes or asbestos wastes generated by construction or demolition activities. Nor does it include contaminated soils and tanks resulting from remediation or clean-up at any spill or release.

### 2.3.6 Furniture and Appliances

Furniture and appliances are to be disposed of in the Class II waste cell. Appliances shall be crushed and placed in the working face. Appliances must have any Freon removed by a private contractor. A sticker stating the Freon has been removed must accompany the appliance. Recycling may take place in the future at the agency's direction. Compaction and cover of this waste shall occur as described in Section 2.3.3.

### 2.3.7 Automobile Bodies

Automobile bodies are to be disposed of in the Class II waste cell. Automobiles shall be crushed and placed onto the working face near the bottom of the cell. Automobiles must have all fluids removed, and a dismantlement permit or clear title from the State of Utah must be provided before acceptance. Compaction and cover of the automobile bodies shall occur as described in Section 2.3.3.

### 2.3.8 Waste Tires

Automobile tires will be accepted four (4) at a time in accordance with UAC R315-320-3. The tires shall be placed at the bottom of the working face of the Class II or Class IV cell. Commercial tire haulers and individuals wishing to dispose of more than four tires shall be excluded.

### 2.3.9 Dead Animals

Dead animals are accepted at the JRDA Landfill in accordance with UAC R315-315-6. Dead animals shall be managed and disposed of in a manner that minimizes odors and the attraction, harborage, or propagation of insects, rodents, birds, or other animals. The carcass shall be placed at the bottom of the Class II cell and immediately covered with a minimum of two feet of other waste. The active face will be covered daily.

### 2.3.10 Asbestos Waste

Asbestos waste is accepted at the JRDA Landfill provided the following conditions are met in accordance with UAC R315-315-2:

- Asbestos waste is handled and transported in a manner that does not permit the release of asbestos fibers into the air and complies with R307-1-4.12, R307-1-8 and 40 CFR Part 61, Subpart M, 1995 ed.

- Asbestos waste is adequately wetted and containerized to prevent fiber release.

- Containers are labeled showing the name of the waste generator, location where the waste was generated, and tagged with a warning label indicating the containers hold asbestos.

Upon receipt of the asbestos waste the operator shall:

- Require the transport vehicle to be marked with warning signs in accordance with 40 CFR Part 61.149(d)(1)(iii), 1995 ed.

- Inspect the load to ensure the asbestos waste is properly contained in leak proof containers and labeled appropriately.

- Place the containers at the bottom of the daily covered face with sufficient care so as to not rupture the container.

- Cover the unruptured container within 18 hours of placement with a minimum of six inches of material containing no asbestos. If rupture occurs, or the asbestos is improperly containerized, it shall immediately be covered with a minimum of six inches of material containing no asbestos and shall not be compacted until cover is in place.

- Limit access to the area of the active face where the asbestos is located until a minimum of six inches of cover material containing no asbestos is in place.

If the operator believes the asbestos waste is in a condition that may cause significant fiber release during disposal, the operator shall notify the health department and the executive secretary. If the operator accepts improperly containerized asbestos waste the operator shall thoroughly soak the waste with water spray prior to unloading, rinse the truck, and immediately cover the waste with non-waste material which prevents fiber release prior to compacting the waste.

Access to the asbestos management site will be restricted by limiting access to the landfill to only one gate that will be locked when left unattended. Warning signs will be placed at the landfill entrance and at intervals not to exceed 200 feet along the perimeter of the landfill. All warning signs will comply with the requirements of 40 CFR Part 61.154(b), 1995 ed.

### 2.3.11 Infectious/Medical Waste

Infectious wastes that have not been incinerated will be accepted at the JRDA Landfill if properly containerized in accordance with R315-316-5. The transporter of infectious waste shall notify the landfill operator that the load contains infectious waste. When received at the landfill, the landfill operator shall place the containers at the bottom of the daily covered cell in such a manner as to avoid breaking them and immediately cover the containers with 12 inches of earth or waste material containing no infectious waste. The containers shall not be compacted until completely covered.

Currently, the medical and infectious wastes generated by the Central Valley Medical Center located in Nephi are disposed of by BFI Medical Waste Systems of North Salt Lake. If, in the future, these medical wastes are disposed of in the JRDA landfill, all requirements of UAC R315-316-5 must be met.

### 2.3.12 Household Hazardous Wastes

Juab County does not have a household hazardous waste program. Household cleaning agents and solvent residuals are accepted and managed in the solid waste stream. The containers must be household size (5 gallons or less), purchased and generated by individual residences.

### 2.3.13 Waste Exclusion Program

The JRDA Landfill does not accept the following types of waste:

- automobile batteries, motor oil, antifreeze
- liquid waste
- hazardous/PCB wastes
- radioactive wastes

Automobile batteries, used motor oil and antifreeze are not accepted at the landfill. These items can be taken to service stations and auto parts stores where arrangements are in place with licensed recyclers to periodically pick up the waste.

In accordance with UAC R315-303-3, disposal of containerized liquids larger than household size, non-containerized liquids, sludge containing free liquids, or any waste containing free liquids in containers larger than household size (5 gallons or less) is prohibited.

Sanitation workers and haulers are the first line of defense against household hazardous waste and liquid wastes which do not meet landfill standards. Landfill attendants and operators provide a second screening for these items. Landfill staff are trained to recognize liquid filled containers which may require segregation from the waste stream. Upon observation of a suspect container, the attendant shall determine whether or not the container is empty. Only empty, vented containers that do not contain hazardous materials shall be accepted for disposal. The generator must be able to produce documentation of the non-hazardous nature of the container upon request. The accepted containers may not have more than two percent grease in them. Containers shall not be opened by the operator without checking with the field supervisor and having knowledge of the hazardous contents of the container.

Containers not meeting the above criteria shall be refused by the landfill attendant and returned to the generator. If suspect containers are found at the landfill and the generator is unknown, and the container is not empty, the container shall be stored in a designated area until it can be determined to be non-hazardous by trained personnel. If the contents are determined to be non-hazardous, the contents shall be mixed with soil and disposed of on site. If the contents are found to be hazardous, a licensed transport and disposal facility shall be contacted by the operator to remove the container from the landfill. Notations shall be made in the operating record as to the nature of the containers, actions taken, and the final disposal method for the container and contents. If possible, the record will also include a description of the generator, transport vehicle description and license number. In the event of a hazardous waste determination, the Division of Solid and Hazardous Waste, and if possible, the hauler and generator shall be notified within 24 hours.

### 2.3.14 Hazardous/PCB Waste Exclusion Program

Hazardous wastes and PCB wastes are not accepted at the JRDA Landfill. The landfill attendants and operators are trained to recognize regulated quantities of hazardous or PCB containing wastes which cannot be disposed of at the JRDA Landfill. Incoming loads are met by the operator and visually inspected as they arrive at the active face. If regulated quantities of hazardous waste or PCB containing wastes or suspicious wastes are identified, the load shall be refused and the Utah Division of Environmental Quality (UDEQ) notified.

Incoming loads shall be randomly inspected by the landfill attendant for free liquids and hazardous or PCB containing wastes. The number of loads inspected will be one out of every 100

incoming loads. The inspections shall occur prior to unloading of the waste at the active face. Loads known to be non-hazardous yet suspected of containing a high liquid content shall be tested on site by EPA Method 9095, paint filter test. Loads failing this test shall be rejected. Loads identified as containing hazardous or PCB containing waste shall be rejected.

The operator shall make notation in the waste screening inspection form and operating record of all loads turned away and why they were refused.

**2.3.14.1 Waste Screening Procedure**

Random load inspections and loads suspected of containing prohibited waste, requiring a more thorough inspection, shall be accepted only after the following steps are performed:

1. Waste shall be unloaded in a designated inspection area convenient to the active face. The hauler shall remain on site until load verification is completed.

2. Protective gear shall be worn (gloves, goggles, coveralls, and a respirator).

3. Waste shall be carefully spread and visually examined using the front end loader or hand-tools.

4. The structural integrity of all potentially hazardous containers shall be determined by visual inspection, and if possible contents of container shall be determined by visual inspection of outside labels or markings. Unmarked or unidentifiable containers shall be opened and inspected only by properly trained personnel.

5. All wastes suspected of being hazardous shall be handled and stored as a hazardous waste until proven otherwise.

6. If the content of the load is determined to be non-hazardous, the load can be transferred to the active face for disposal.

7. If non-hazardous yet prohibited wastes are revealed during the screening process, the following steps may be necessary:

   a) Wastes can be loaded back on the hauler's vehicle, and the hauler informed of proper disposal options.

   b) If the hauler or generator is no longer on site and is known, they will be asked to retrieve the waste and be directed to a proper disposal facility.

8. Inspection form shall be completed, including written description of final disposition of any prohibited wastes in log book.

If wastes stored temporarily at the site are identified as being hazardous, and the source of the waste is unknown, the Juab County Sheriff's Office shall be notified, and shall be responsible for proper disposal of the waste. Hazardous waste to be transported from the facility must be: 1) stored

in accordance with generator requirements; 2) manifested; 3) transported by a licensed transporter; and 4) disposed of at a permitted hazardous waste facility. UDEQ shall be notified of the characterization of the rejected load. UDEQ shall be contacted to provide instruction on the proper procedures for notifying the generator and instructions for proper disposal.

#### 2.3.14.2 Training of Landfill Personnel

Each attendant and equipment operator has been trained to recognize labels commonly used to identify hazardous and PCB containing wastes. JRDA Landfill personnel have attended screening of hazardous waste training which addresses waste handling, safety precautions and record keeping. Ongoing education and training of landfill personnel will maintain the necessary level of skill and knowledge to operate an effective hazardous waste screening program at the JRDA Landfill. Documentation of personnel training will be maintained in the operating record and will be submitted with each annual report.

#### 2.3.14.3 Inspection Records

Records of inspections shall be maintained and made available upon request of UDEQ. Appendix B contains an example Annual Report form, Site Inspection Record, Landfill Gas Monitoring Record, and Random Load Inspection Record. Included on the Random Load Inspection Record shall be the following items:

1. Date and time of inspection
2. Inspector's name
3. Transporter including license number and driver identification
4. Load description
5. Generator of waste
6. Observations made by inspector
7. Reason for rejecting load
8. Driver's signature
9. Inspector's signature

#### 2.3.14.4 Handling Procedures for Hazardous Waste

Hazardous waste identified on incoming loads from independent haulers will be refused as stated above in the Hazardous Waste Exclusion Program. If regulated quantities of hazardous or PCB waste are detected on incoming County or commercial haul vehicles or at the active face, the Juab County Sheriff's Office shall be notified and public access to the contaminated area (or temporary storage location of the waste if it can be safely removed to the storage area) restricted. If the landfill can safely remain open, the working face shall be moved as far as possible from the hazardous material.

The Sheriff's Office shall implement and manage their Hazardous Materials Response Plan. The Sheriff's Office shall oversee containment, transportation, storage, and ultimate disposal of the hazardous material in accordance with state and federal regulations. JRDA Landfill personnel shall not participate except as directed by the Sheriff's Office.

Wastes which are determined to be hazardous may be stored at the JRDA Landfill for a maximum of 180 days provided the following conditions are met:

- Waste is placed in 55-gallon containers or suitable tanks
- Tanks or containers are marked "Hazardous Waste"
- Tanks or containers are clearly marked with the date of packaging
- Tanks or containers shall be clearly marked with the name and telephone number of the emergency response coordinator

When waste is transported off site by a hazardous waste disposal company, a provisional US EPA identification number will be obtained. The waste will be properly packaged, transported and manifested to its destination. All applicable federal and state regulations shall be followed.

PCB containing wastes identified at the JRDA Landfill shall be managed by the Juab County Sheriff's Office. The wastes shall be stored and disposed of in accordance with all applicable state and federal standards. At minimum the following steps must occur:

1. An EPA PCB identification number must be obtained
2. The PCB waste will be properly stored until transported
3. The containers shall be marked with the words, "Caution: Contains PCBs"
4. The container will be manifested for shipment to a permitted disposal facility

#### 2.3.14.5 Notification

In accordance with UAC R315-303-5, the Utah Department of Environmental Quality, the hauler and the generator shall be notified within 24 hours of the discovery of suspected hazardous or PCB containing wastes at the JRDA Landfill. A report will be submitted to UDEQ indicating the time and date of discovery, type of hazardous material, probable hauler, quantity of waste, and actions or proposals for removal of the waste. The record of notification shall also be entered upon the operating record of the JRDA landfill.

## 2.4 Daily and Interim Cover

The soil excavated from the sides of the canyon shall be stockpiled near the working face. Incoming municipal waste shall be deposited along the working face on the landfill. Accumulations of waste shall be spread and compacted into the working face and covered with, at minimum, a six-inch (6") layer of soil on a daily basis. Compaction will be accomplished using a steel wheeled compactor and a track loader. The intermediate cover at the landfill will be native materials from the site. The material will typically be GM or GC type material. The optimum moisture for the material at the site ranges between 9% and 16%. Incoming loads at the Class IV waste cell will be compacted and covered as described in Section 2.3.3.

## 2.5 Monitoring and Self Inspections

One or more JRDA Board members, or someone appointed by the board, shall inspect the landfill on a quarterly basis. Inspection will include observation of run-off and run-on control structures, sidewalls of any excavations, active disposal area, perimeter fencing, infiltration layer of completed cells, and on site structures. In accordance with UAC R315-302-2 the following items shall be included in the written inspection report:

- Date and time of inspection
- Printed name and handwritten signature of inspector

- Observations made and recommended repairs or corrective action
- Date and nature of any repairs or corrective action

In addition to the quarterly inspection by the JRDA, the operator shall perform a weekly inspection of the landfill, observing those items outlined in the quarterly inspection.

Records shall be kept on site for a period of three years from the date of inspection. Inspection records shall be available to the Executive Secretary or his/her authorized representative upon request.

## 2.6 Record Keeping

The operating record shall be maintained on site and on a periodic basis these records shall be turned over to the JRDA office for permanent filing.

The record shall include the following:

- Estimated volume of waste received each day
- Number of vehicles entering the landfill each day
- The types of waste received each day
- Deviations from approved plan of operation
- Training and notification procedures
- Gas monitoring results
- Incident reports
- Inspection log
- This application document
- Other information pertaining to the landfill

## 2.7 Contingency Plans

In accordance with UAC R315-302-2 (2)(d, f, j) the following sub-sections outline contingency plans which may need to be implemented from time to time at the JRDA Landfill. Potential contingencies include fire or explosion, release of hazardous or toxic materials, release of explosive gasses, and equipment breakdown.

### 2.7.1 Contingency for Fire or Explosion

In the event of fire, extinguishers are available in each piece of landfill equipment. If fire is discovered in the active face, it shall be extinguished or smothered with stockpiled cover soil. Water will not be applied to the active face unless absolutely necessary. If the fire becomes uncontrolled and cannot be managed by on site personnel, the operator will call 911 or radio for help. If for some reason the phone and radio do not work, the operator shall evacuate the landfill then go to the nearest phone to call the Sheriff's Office. The operator shall immediately notify the JRDA.

After notifying the Sheriff's Office, the operator shall remain in the vicinity of the landfill to inform the fire chief of the type of waste that is burning and other hazards which may be encountered. UDEQ shall be notified immediately, and within 14 days the operator shall submit a written report of the incident of UDEQ.

### 2.7.2 Release of Hazardous or Toxic Materials

In the case of a hazardous waste spill or leak at the JRDA Landfill, the Juab County Sheriff's Office shall be notified and shall act as the emergency response team. Upon arrival at the landfill, the Juab County Sheriff's Office shall assume responsibility for all subsequent activities related to the containment, handling and off site transportation of the hazardous material. Landfill employees shall not handle hazardous materials spills.

### 2.7.3 Landfill Gas

Landfill gas monitoring shall be performed quarterly as described in Section 7.5 of this application. If landfill gas levels are detected above 25% of the lower explosive limit (LEL) in facility structures (excluding gas control or recovery system components), or if levels at the LEL are detected elsewhere (including at the property boundary or beyond), operations shall be halted and steps taken to ensure protection of human health and the environment. The executive secretary will be notified. Within seven days of detection the methane gas levels detected and the steps taken to protect human health shall be entered into the operating record. Within 60 days of detection a plan for remediation and release of the methane gas shall be implemented, a copy of the remediation plan shall be placed in the operating record, and the executive secretary notified of plan implementation.

### 2.7.4 Equipment Breakdown

Equipment breakdowns shall be reported to the Juab County Road Maintenance Department. The Department has qualified heavy equipment mechanics available to service the JRDA Landfill equipment and the ability to service the equipment in the field or transport it to a maintenance facility. In the event the repairs require an unacceptable amount of time, additional equipment is available on an emergency basis.

### 2.7.5 Alternative Waste Handling

During periods when the facility is unable to compact and cover waste due to equipment breakdown, the waste shall be stockpiled at the active face until the equipment is repaired or temporary replacement equipment arrives. In the event of a complete closure of the entire landfill, wastes may be temporarily long-hauled to the Utah County Landfill west of Utah Lake.

## 2.8 Installed Equipment Maintenance

The site has no liner or leachate collection system and no temporary or permanent equipment has been installed. Maintenance of on-site equipment will be performed by the Juab County Road Department.

## 2.9 Vector Control

Daily compaction of the working face will limit the access into, and harborage of vectors and rodents in the waste mass. Daily cover will further reduce or eliminate the attraction of vectors by minimizing entry spaces, nesting sites and food sources.

Accumulations of stagnant water in bulky waste, tires, or from run-on control measures will be addressed and eliminated on a case by case basis as discovered. Dead rodents, putrescible waste, and other randomly occurring potential vector attractions will be minimized through "good housekeeping" practices at the site.

## 2.10 Training and Safety Program

The operator will read the Plan of Operation and Permit after they are approved by the state. Each new employee will also read these documents prior to working at the site. These documents provide basic operation and safety training specific to the JRDA Landfill. Additional training and refresher courses are available from various professional organizations.

The current landfill operator and attendants have attended a landfill operations course presented by the Solid Waste Association of North America (SWANA). The course was specifically tailored to rural arid landfill operations such as exists at the JRDA Landfill. The course included general landfill operations and hazardous waste identification, handling, fire prevention and health and safety concerns unique to landfills. Future employees of the landfill will attend similar training courses. Training of personnel is an ongoing process, and the JRDA Landfill will continue to pursue educational opportunities for its personnel including basic first aid and safety training.

Communications via two-way radio enable landfill personnel to contact outside emergency services in the event of an accident. Each Juab County vehicle is equipped with a first aid kit. Depending on the severity of the injury, the workers may treat themselves or summon assistance from the Juab County Sheriff's Office or ambulance. The worker is given discretion on whom to call and at what point to call. The County shall be notified in the case of severe injury and will ensure availability of appropriate medical care. If emergency services are summoned to the site, an incident report shall be prepared which includes the following:

- Time and date of accident
- Type of injury
- Actions taken
- Response time of EMS

## 2.11 Recycling Program

At present, the communities using the JRDA Landfill do not have a curbside recycling program. Aluminum and newspapers are recycled through efforts of individuals in the community. Larger items such as junk cars, white goods, and scrap metal may be stockpiled on site for pick up by a licensed crusher/recycler.

## 2.12 Additional Operational Procedures

Several other standards for maintenance and operation are outlined in UAC R135-303-5. It shall be the responsibility of the operator to ensure these standards, outlined below, are met and maintained during the daily operation of the site.

Control Road Dust: Access to the landfill site from Highway 132 is provided by a 5,500-foot unpaved roadway. Current plans are to hard surface this road. Until this is done, the road will be watered as required to minimize excessive dust generation which could create nuisance problems.

Open Burning: No open burning shall be allowed except during the "burn window" designated by the local fire marshal. The burn window is typically 30 days in the spring, and occurs sometime between March 30 and May 30. The burn window in the fall is determined by the state forester as conditions allow. Approval of the local fire marshal must be obtained before burning.

Collect Scattered Litter: Care shall be taken to ensure litter is controlled at the active face. Stray litter shall be collected as required to eliminate aesthetic nuisance and blowing of the litter beyond the disturbed landfill site.

Prohibit Scavenging: No scavenging is allowed at the JRDA Landfill.

On Site Reclamation: On site reclamation shall be conducted in an orderly, sanitary manner which does not interfere with the disposal site operation. Reclamation efforts at the JRDA Landfill will begin some years into the future as lower portions of the landfill reach final grade. These efforts will continue periodically as the entire site is brought up to final grade.

Landfill Attendant: An attendant shall be on site during all times when the site is open to the public.

Vector Control: Daily vector control operations shall be conducted as described in Section 2.9.

Reserve Equipment: The JRDA Landfill is operated by Juab County as agent of JRDA and as such, backup equipment is available to ensure minimal disruption to daily operational procedures.

Boundary Posts: The corners of the site are delineated by six boundary posts. In addition, posts have been placed at strategic locations along the boundary lines. The entrance to the facility is clearly posted.

Daily Cover: Daily cover shall be maintained as described in Section 2.4.

Monitoring Systems: Groundwater monitoring systems are not included in the design of the JRDA Landfill.

Recycling: At this time no containers for recycling are planned for at the JRDA Landfill. If at a future time demand develops for recyclable items for which individual recycling efforts are inadequate, containers for these items will be provided as required by UAC R135-303-5.

Hazardous Wastes: Disposal of hazardous waste is prohibited at the JRDA Landfill. Section 2.3.9 of this application describes the program for exclusion of hazardous waste.

Firearms: No discharging of firearms is allowed at the landfill.

# 3.0 FINANCIAL ASSURANCE PLAN

## 3.1 Financial Assurance Cost Estimates

### 3.1.1 Closure Costs

The maximum area of landfill exposed before final cover is placed is estimated to be 14.95 acres. An estimate for the maximum cost to close the largest exposed area (14.95 acres) is included in Appendix C1. A summary of the items included in this cost is outlined below, entitled "Calculation of Total Closure Cost of Largest Area."

The final occupied area of the landfill at the current capacity limit (see Section 4.3) is 56.6 acres. Using seven final cover closure cycles requires 8.6 acres to be closed for the first phase, 6.9 acres to be covered for each of the second through sixth cycles, and 13.4 acres closed for the last cycle. An explanation of how the acreages for each phase were calculated is shown in Section 4.4. Since the landfill will be closed in phases, a summary sheet of closure costs by phase and cost estimates for each of the planned seven phases are included in Appendix C2. All cost estimates are calculated using 2015 prices.

The cover soil will be obtained from adjacent property owned by JRDA, so the primary cost will be to excavate and place the soil. Soil tests and modeling indicate this material obtained from the adjacent property is suitable for construction of the final cover (see Section 4.2). The cover layer will be revegetated using native type plants. In addition to earthwork and revegetation, the closure cost estimate includes site grading and drainage and site fencing to enclose the disturbed portion of the landfill site.

**CALCULATION OF TOTAL CLOSURE COST OF LARGEST AREA**

| | |
|---|---|
| Engineering Total: | $67,342 |
| Construction Total: | $461,333 |
| 2.5% Contract Performance Bond: | $13,217 |
| **SUBTOTAL:** | **$541,892** |
| Legal Fees: | $7,900 |
| **TOTAL CLOSURE COSTS INCLUDING LEGAL FEES:** | **$549,792** |

### 3.1.2 Post-closure Costs

Appendix C1 contains a maximum (at any one time) post-closure cost estimate for the JRDA facility. The estimate is based on monitoring an area ranging from 14.95 to 34.16 acres for a 30-year post-closure period. Since the landfill is closed in phases over a period of 58 years, part of the landfill will have gone through the 30-year post-closure period before the last phases are ready to be

closed, and 34.16 acres is the maximum area ever included in any 30-year monitoring period. The area being monitored will periodically decrease to the final 13.4-acre closure cycle area. It is anticipated that post-closure care requirements will be fairly minimal. The site is to be re-seeded with native vegetation requiring no irrigation. Anticipated post-closure tasks include quarterly general inspections and gas monitoring, record keeping, maintaining cover integrity and maintaining erosion control measures. It is assumed that occasional maintenance projects will be necessary. These projects have been included in the post-closure cost estimate.

MAXIMUM TOTAL POST-CLOSURE COSTS (AT ANY ONE TIME): $220,770

TOTAL FINANCIAL ASSURANCE (INCLUDING LEGAL FEES): $770,562

### 3.2 Financial Assurance Mechanism

The JRDA has established an account at the state treasury into which $48,108 is deposited annually in equal monthly payments of $4,009. These deposits will be made until December 2018. The current account balance (March 2015) is approximately $565,000. The account has been earning a minimum of 0.5% interest annually. With 0.5% projected interest included, the account will reach the required financial assurance amount of $762,662 by the end of 2018. This amount is equal to the estimated maximum closure and post-closure costs less the legal fees. The JRDA proposes to use in-house legal services to cover legal costs associated with landfill closure.

After 2018 and continuing through 2085 (the final full year the landfill is accepting waste), the required annual deposit will be reduced to $25,540. This deposit schedule will leave the account with enough funds to pay for each closure phase, as well as the reserve required to pay for the largest area needing final cover and post-closure costs. It is assumed that all legal services will be performed in-house. The required annual deposit will be recalculated yearly as part of the annual report submitted to the State. This calculation will consider inflation and interest earned. A schedule of deposits, withdrawals, and balances for the financial account is included in Appendix C2.

The interest earned by the closure account must outpace construction cost inflation in order for the balance in the closure account to exceed the estimated closure cost in any given year. If for any reason the estimated closure costs begin to exceed the balance in the closure account, additional payments will be made to ensure adequate funds are available for closure.

# 4.0 CLOSURE PLAN

The closure plan contained herein has been prepared in accordance with UAC R315-302-3. The plan will be performed in such a manner so as to:

1. Minimize the need for future maintenance;
2. Eliminate threats to human health and the environment for post-closure escape of solid waste constituents, leachate, landfill gases, contaminated run-off or waste decomposition products to the ground, groundwater, surface water, or the atmosphere; and
3. Prepare the facility or unit for the post-closure period.

## 4.1 Elements of Closure

The following closure steps are based on current regulations. Negotiations with the state may be required at the actual time of closure to verify compliance with future regulations in place at the time of closure.

JRDA Landfill shall perform placement of final cover periodically during the active life of the landfill. Placement of final cover shall begin at the northern end of the site where the active portion of the landfill site reaches the main drainage of Hall Canyon. Rough contouring of the landfill will occur on a daily basis. Upon reaching final grade, interim cover shall be placed on that portion of the waste mass. When sufficient area of the landfill has reached final grade, final contouring shall occur. Closure will occur in one 8.6-acre phase, five 6.9-acre phases, and a final phase of 13.4 acres. An explanation of how the acreages for each phase were calculated is shown in Section 4.4.

The final contouring operation shall use native soils to establish a suitable foundation for placement of the final cover layer. The site shall be surveyed to establish base elevations for proper contouring of the foundation layer. The grade of all slopes shall be between 2% and 33%. After final contouring of the foundation layer, placement of an evapotranspiration final cover layer shall begin.

The evapotranspiration layer shall be constructed in such a manner so as to minimize infiltration of surface precipitation into the waste mass, and the layer shall meet design standards described in Section 4.2. The soil material for the evapotranspiration cover is produced from selected deposits on adjacent property owned by JRDA. Placement of the evapotranspiration layer shall occur immediately after final contouring. When sufficient area has received the evapotranspiration layer, the layer shall be inspected and any deficiencies due to erosion, settlement, and non-compaction shall be repaired.

Appendix D of this report contains drawings D-1 through D-6, pertaining to the location, conceptual design, daily progression, final contouring and final cover design of the JRDA Landfill. Drainage diversions shall be constructed in the locations illustrated on Drawing D-3 of Appendix D. The diversions shall control surface run-off of precipitation and minimize erosion of the vegetation and evapotranspiration layer.

## 4.2 Closure Design

The final closure design is illustrated on Drawing D-3 in Appendix D. As described above, the closure and final placement of cover shall occur when portions of the landfill reach their final elevations. Due to the topography of the canyon, the northern end of the landfill site will reach final grade first. The final grade of the remaining portions of the landfill shall progress from the north to the south as the landfill climbs up the canyon.

An evapotranspiration final cover shall be constructed in accordance with UAC R315-303-3(4)(c). The final cover design incorporates a 30-inch evapotranspiration cover constructed with soils found on adjacent property owned by JRDA. The sufficiency of the cover design is verified by a mathematical model, as demonstrated in a report submitted to the Division of Solid and Hazardous Waste separately. The 30-inch evapotranspiration cover will consist of a 24-inch select soil layer overlain by a 6-inch vegetation layer. Drawing D-6 shows the proposed cover design.

Soil investigations were conducted within the property owned by JRDA with the intent of locating material that would be suitable for use as the primary layer in an evapotranspiration cover system. A total of fourteen test pits were excavated within two areas. The locations of the excavated test pits are shown on Figure 2 in Appendix E. The soils were analyzed, and it was determined that soil from the vicinity of test pits 12-04, 14-04, 14-05, 14-06, 12-06, and 14-07 are appropriate for use in constructing the evapotranspiration cover (see test pit logs in Appendix E). Approximately 240,000 cubic yards of material will be needed in order to provide a 30-inch evapotranspiration cover depth over the final closed landfill area. Using the depth of potentially acceptable material from the test pit excavations as shown on the logs, and an approximate area where the material is available, it is estimated that 250,000 to 300,000+ cubic yards of material can be obtained. The approximate area where the material is located is shown on Figure 3 in Appendix E.

Soil used to construct the evapotranspiration cover will be compacted to no more than 90%, with 85% being the optimum compaction level. To avoid overcompaction, light compaction equipment, thicker loose lifts (12"), and fewer passes of the compactor may be required. The 6-inch vegetation layer shall be prepared for seeding by ripping and discing. A mixture of native plants, including warm-season and cool-season species (grasses and shrubs) shall be planted. Every effort shall be made to ensure that the vegetation grows well and that a minimum of 75% coverage is achieved. Following construction of the final cover, the site shall be surveyed and inspected to ensure adequate depth and function of the cover, including appropriate vegetation growth.

## 4.3 Site Capacity

The JRDA Landfill utilizes a narrow, relatively short canyon which runs south to north. Solid waste is deposited across the breadth of the canyon while daily cover is excavated along the sides of the canyon. The depth of the canyon starts at approximately 120 feet which gradually diminishes as the head of the canyon is approached. At the crest of the sidewalls, the canyon encompasses approximately 75 acres of area. The estimated useful volume of the canyon between the sidewalls is approximately 4,600,000 cubic yards. UAC R307-221 requires municipal solid waste landfills with design capacities greater than 2,755,750 tons and 3,270,000 cubic yards to be subject to emission inventory requirements. The capacity for the JRDA landfill is administratively limited to 3,270,000 cubic yards of waste. Based on an assumed waste to soil ratio of 3:1, this

results in a total volumetric capacity of 4,360,000 cubic yards. All life and capacity calculations are based on this volume. The total area occupied by the landfill at this volume is 56.6 acres.

The following assumptions have been made in order to estimate the anticipated life of the site:

| | |
|---|---|
| Uncompacted Waste Density | = 300 lbs./$yd^3$ |
| Compacted Waste Density | = 750 lbs./$yd^3$ |
| Waste to Soil Ratio | = 3:1 |
| Municipal Waste Received Per Week (beginning 2014) | = 100 tons |
| Construction & Demolition Waste Received Per Week (beginning 2014) | = 55 tons |
| Population Growth Rate (Annual) | = 1.50% |

Using the above assumptions, the soil and waste volume will reach the estimated capacity limit of 4,360,000 cubic yards (1,635,000 compacted tons of waste) in approximately 2086. Because the cover soil is removed from the sides of the canyon, the actual volume of the canyon increases. Due to the sifting of the cover material into the waste mass, and compaction effects of truck traffic over the cover, the volume of the in-place cover could be assumed to be the volume of the excavation from which it was taken. The increased volume of the canyon due to cover material excavation has not been accounted for in this analysis, thereby resulting in a conservative life-span estimate. If included, the additional volume may extend the life of the facility beyond the year 2086. Higher compaction levels at the landfill can also provide additional years to the useful life of the landfill. If the volume of the landfill ever exceeds the volumetric capacity limit of 4,360,000 cubic yards (waste capacity of 3,270,000 cubic yards), the permit will be updated to include the additional emission inventory requirements as stated in UAC R307-221.

### 4.4 Closure Schedule

As required by UAC R315-302-3, the executive secretary shall be notified of intent to close the landfill at least 60 days prior to the projected final receipt of waste. JRDA will initiate closure procedures for each phase within 30 days of receipt of the final volume of waste into that phase. The closure activities shall be completed within 180 days from their starting. Upon completion of closure, JRDA shall submit to the executive secretary as-built closure plan sheets signed by a professional engineer registered in the State of Utah and certification by JRDA and a registered professional engineer that the unit has been closed in accordance with the approved closure plan.

The JRDA landfill will be closed in seven phases. The area and volume of each phase were calculated as follows. The area of the first phase, 8.6 acres, was chosen in order to close the entire face of the proposed 3:1 slope at the north end of the landfill (See Drawing D-3, elevations 5340 through 5480. The remainder of the landfill, elevations 5480 through 5702, is set at approximately a 10:1 slope.) This first closure also then decreases the current existing disturbed area (the 14.95-acre maximum) down to the minimum area still needed to conduct landfill operations (approximately 6.4 acres). Bentley InRoads was used to calculate the total volume in the landfill at the time of the first 8.6-acre closure. This volume was determined to be approximately 1,073,000 cubic yards. Since the volume of waste brought into the landfill will be constantly increasing, the time between closure cycles of equal area will decrease. The final closure was selected to occur six

years after the previous closure. Therefore, the size of the final phase was based on six years of volume. The calculated volume brought into the landfill during the last six years of landfill life is approximately 493,000 cubic yards. Bentley InRoads was used to calculate the acreage associated with this final closure phase volume. The area was found to be 13.4 acres. Using 8.6 acres as the first closure area and 13.4 acres as the final closure area leaves 34.6 acres to be closed in the intermediate phases. It was determined that five additional closures of 6.92 acres each would be the approximate amount required to cycle between a maximum disturbed area of 13.2 acres and the minimum operating area of 6.4 acres. Since the second through sixth closure phases all have the same cover slope of approximately 10:1, they were assumed to have roughly equal areas and volumes. Based on this, the volume available for each of these five phases is approximately 559,000 cubic yards. The landfill will then occupy a cumulative total of 4,360,000 cubic yards at the time of the final 13.4-acre closure.

Based on the large footprint currently open and the 3:1 north face slope of the final cover design, the first 8.6-acre phase will not be ready for closure until 2028. At the time this phase is closed, the landfill will contain a total volume of approximately 1,073,000 cubic yards. The next five 6.92-acre closure cycle phases containing approximately 559,000 cubic yards each will be ready for closure in approximately 2042, 2054, 2064, 2073, and 2080. The final phase will cover 13.4 acres and contain approximately 493,000 cubic yards. It will be ready for closure in approximately 2086.

### 4.5 Closure Costs

Closure funds will be withdrawn from the account discussed in Section 3.2 as each phase is ready for closure. Appendix C1 contains an estimate of the largest closure cost at any time. Appendix C2 contains a summary sheet of closure costs by phase, detailed closure cost estimates for each of the planned seven phases, and a schedule of deposits and withdrawals from the financial assurance account. The estimates have been prepared in accordance with UAC R315-309, following the guidelines from the Division of Solid and Hazardous Waste. Unit costs are based on recent bid tabulations for similar work and conversations with contractors and suppliers. A 10% contingency budget has been included for unforeseen construction difficulties or adjustments in unit costs for materials. 2015 dollars are used in each estimate.

### 4.6 Final Inspection

Upon completion of closure activities, a final report will be prepared by an engineer registered in the State of Utah. This report will document conformance of the final cover and closure procedures with state solid waste regulations and the approved closure plan for the JRDA Landfill. Included in this report will be the facility closure plan as-built drawings of the site upon final inspection. Upon completion of closure activities, the executive secretary shall be notified and arrangements made for UDEQ final inspection of the facility. After acceptance by UDEQ of the closure, the approved Post-Closure Plan shall be implemented as contained in the following Section.

## 5.0 POST-CLOSURE PLAN

In accordance with UAC R315-302-3, the following post-closure plan shall be implemented at the JRDA Landfill upon closure. This plan provides for continued facility maintenance and monitoring of landfill gas.

### 5.1 Monitoring

Surface and Groundwater: The design of the JRDA Landfill does not include a groundwater monitoring or leachate collection system. The nearest potential surface water is West Creek located 1.6 miles east of the site. This reach of West Creek has a low volume seasonal flow. The post-closure plan does not include ground or surface water monitoring requirements. This permit application includes no provisions for ground or surface water monitoring, leachate collection, or leachate treatment.

Landfill Gas: Monitoring of landfill gas by the Nephi City Gas Department will continue on a quarterly basis at points established during the active life of the facility. If monitoring results indicate the landfill has stabilized and does not represent a threat to human health and safety, the owner or operator may petition the executive secretary for a decrease in the length of the post-monitoring period.

### 5.2 Post-Closure Schedule

JRDA Landfill shall perform post-closure activities for 30 years or as long as the executive secretary determines is necessary for the facility to become stabilized and protect human health and the environment. The 30-year post-closure period for each phase will begin when closure for that phase is completed. If post-closure monitoring indicates the site has stabilized and poses no threat to health and safety, JRDA may petition the executive secretary for a decrease in the length of the post-closure monitoring period.

Following closure of each phase of the facility, the final cover and drainage control systems shall be inspected quarterly by a designated representative of the JRDA. The inspection shall identify sites of erosion, subsidence, or other events which could compromise the integrity of the final cover or drainage system. Any deficiencies identified shall be repaired at the earliest practicable date to maintain the effectiveness of the systems.

Upon completion of the post-closure activities or as determined by the executive secretary, JRDA shall submit to the executive secretary certification signed by a professional engineer registered in Utah stating why post-closure activities are no longer necessary.

### 5.3 Record Modifications

In accordance with UAC R315-302-2(6), plats and a statement of fact concerning the location of the disposal site shall be recorded as part of the record of title with the County Recorder not later than 60 days after final certification of complete landfill closure. The notation will serve to notify any potential purchaser of the property that the site has been used as a landfill and may be subject to certain zoning and restricted use.

## 5.4 Post-Closure Costs

A maximum (at any one time) post-closure cost estimate for the JRDA landfill facility prepared in accordance with UAC R315-309 is included in Appendix C1. The estimate is based on monitoring an area ranging from 14.95 to 34.16 acres for a 30-year post-closure period. Since the landfill is closed in phases over a period of 58 years, part of the landfill will have gone through the 30-year post-closure period before the last phases are ready to be closed, and 34.16 acres is the maximum area ever included in any 30-year monitoring period. The area being monitored will periodically decrease to the final 13.4-acre closure cycle area. The estimate is based on assumptions which include monitoring of landfill gas, annual general inspections of the site, record keeping, maintaining cover integrity, and maintaining erosion control measures. It is assumed that occasional maintenance projects will be necessary. The cost estimate is based on 2015 dollars. A ten percent contingency budget has been added to cover unforeseen monitoring work. The total maximum (at any one time) post-closure costs, including contingencies, are $220,770.

Appendix C2 contains a schedule of deposits and withdrawals from the financial assurance account. The schedule assumes that lump sum post-closure costs other than the cost to demonstrate stability for each phase are withdrawn in the same year each of the seven phases is closed and that yearly post-closure costs are distributed over the entire 88-year post-closure period. The cost to demonstrate stability is withdrawn after the 30-year post-closure period for each phase.

## 5.5 Contact Information

The office to contact about the facility during the post-closure care period is:

Juab Rural Development Agency
Attn: Mike Seely
160 North Main
Nephi, Utah 84648
435-623-3408

# PART III - TECHNICAL DATA

## 6.0 GEOHYDROLOGICAL ASSESSMENT

As required by UAC 315-310-4, the geohydrological assessment addresses the following items:

- Faults, Unstable Slopes, and Subsidence Areas
- Bedrock and Soil Types
- Wells, Water Rights, and Surface Water
- Ground and Surface Water Quality
- Ground and Surface Water Monitoring Systems

### 6.1 Faults, Unstable Slopes, and Subsidence Areas

The nearest fault is located approximately one-third mile west of the landfill site. A second fault is located approximately one-half mile west of the site. Both faults are unnamed and preceded the Holocene Epoch. The major active Holocene fault in the area is the Wasatch fault located six miles east of the JRDA Landfill in Nephi City.

The slopes surrounding the landfill consist of conglomerate material which is excavated for daily cover with some degree of difficulty. Excavation of daily cover indicates the undisturbed material is capable of sustaining vertical slopes with no rotational or translational failure. The natural slopes surrounding the landfill are between 10 degrees and 25 degrees. No unstable slopes are evident on the landfill site.

No areas of subsidence are evident on the landfill site.

### 6.2 Bedrock and Soil Types

Geologic maps (Irving J. Witkind and Malcolm P. Weiss) of the West Hills at the location of the JRDA Landfill indicate the area consists of volcanistic and pyroclastic rocks including ash-flow and welded tuff, stream deposited conglomerate and sandstone of the Oligocene to Eocene Epoch. The landfill site is located outside the basin fill deposits of the Juab Valley in consolidated rock.

The USDA Soil Survey of the Nephi area defines the soil located at the landfill site as SbF Sandall. This soil is very cobbly loam from 0 to 5 inches, very cobbly loam and very gravelly loam from 5 to 32 inches, and unweathered bedrock at depths greater than 32 inches. This soil is moderately permeable with medium run-off and moderate hazard of water erosion. The USDA places the clay content of the soil at 20% to 25%. Available water capacity is 0.07 to 0.15 inches per inch. Excavation of daily cover at the landfill verifies this description of the soil. Soil tests performed during the preparation of the original application indicate the soils at the landfill site are characterized as Gravel – clayey, sandy (GC) and Sand - clayey gravely (SC) having a permeability of $1.18 \times 10^{-6}$ to $7.08 \times 10^{-7}$ cm/s. Additional testing at the landfill site found soils classified as Silty sand with gravel (SM). See Appendix E for test pit logs and soil test results, including the 1997 testing of the north liner, south liner, east liner, and west liner, and the more recent testing from Test Pits 12-01, 12-02, and 12-03 (see Figure 2 in Appendix E for test pit locations).

## 6.3 Wells, Water Rights, and Surface Water

No culinary, stock watering, or irrigation wells exist within 2,000 feet of the JRDA Landfill boundary.

Data provided by the Utah Division of Water Rights defines two water rights located within 2,000 feet of the JRDA Landfill site. Both rights are delineated by two surface diversion points which serve to define a water right at and between the diversion points. Both water rights are owned by the BLM for stock watering directly on an intermittent stream. One water right lies within the JDRA Landfill site. The upper diversion point for this right is located at the site of active cell construction at the landfill. The lower diversion point is located northeast of the landfill. The access road to the landfill approximately follows the intermittent stream between the two diversion points.

The second water right lies directly east of the JRDA Landfill. This water right is defined by two diversion points located on an intermittent tributary to West Creek. Both water rights and their descriptions are listed below.

| Water Right Number | Description |
|---|---|
| 53-1219 | SW>NW> Sec 15, T13S, R1W, SLBM to a point in SW>SE Sec 10, T13S, R1W, SLBM |
| 53-1220 | SE>SE> Sec 15, T13S, R1W, SLBM to a point in SE>NE> Sec 15, T13S,R1W,SLBM |

No surface water exists within a one-mile radius of the landfill site. Several small ephemeral streams originating within one mile do exist. These streams flow east into West Creek. Run-on control measures constructed around the active landfill site will redirect heavy precipitation around the landfill. No surface water is threatened by contamination due to run-on passing through the landfill.

## 6.4 Ground and Surface Water Quality

Recent USGS hydrological studies of the Juab Valley indicate the recharge of the groundwater is by seepage from streams, unconsumed irrigation water, precipitation, and seepage from consolidated rocks which surround the valley. Most of the recharge occurs from the eastern side of the valley. The ephemeral streams which enter the valley from the West Hills produce approximately 10% of the eastern mountains' recharge volume. In addition, recharge occurs only after periods of greater than average precipitation and intense rain storms.

The JRDA landfill is located in a drainage area of approximately 75 acres. This drainage area is part of Hall Canyon which is a small ephemeral drainage. The landfill may eventually encompass the entire 75-acre site, however until that time drainage channels shall be maintained to direct storm discharges from the upper portions of the site around the actual landfill cells.

Depth to groundwater within the basin fill deposits at the mouth of Hall Canyon (approximately 3,000 feet northeast of the toe of the landfill, and 180 feet in elevation below the toe of the landfill) has been modeled by the USGS and is estimated to be between 5,020 and 5,040 feet in elevation. The ground surface elevation at this location is approximately 5,200 feet. The direction of groundwater flow in this area is northward.

## 6.5 Ground and Surface Water Monitoring Systems

Precipitation records compiled by the Utah Climate Center indicate Nephi City, at the base of Mt. Nebo, averages 14.5 inches of annual precipitation, while Delta, located west of the landfill site, receives 8.1 inches of annual precipitation. The site of the landfill is located between these two weather stations (closer to Nephi) and most likely has an annual precipitation level somewhere between those indicated.

Based on NOAA Atlas 14 Point Precipitation Frequency Estimates for Utah 39.69° N 111.925278° W 5344 feet, the 24-hour 25-year storm event magnitude is 2.06 inches and the 24-hour 100-year storm event magnitude is 2.51 inches. The NOAA Atlas printouts are included in Appendix F.

No evidence of groundwater contamination is apparent at the site. The landfill has no existing groundwater monitoring wells and plans to install wells only when size of the landfill requires the wells, or the executive secretary directs the operator to do so.

# 7.0 ENGINEERING REPORT

## 7.1 Maps, Drawings and Specifications

Appendix D of this report contains the maps and drawings pertaining to the location, conceptual design, daily progression, final contouring and final cover design of the JRDA Landfill.

Drawing D-1 is a 7.5-minute USGS quadrangle map showing the facility boundary, property boundary, surface drainage channels, existing utilities, direction of prevailing winds, and any structures (none) within one-quarter mile of the facility.

Drawing D-2 is a topographic map of the JRDA Landfill unit drawn to a scale of 400 feet to the inch with five-foot contour intervals. The drawing shows the boundaries of the unit and current borrow and fill areas.

Drawing D-3 represents final configuration of the landfill upon closure. Included on this drawing are run-on and run-off control ditch locations, access road alignment, and final elevations of cover.

Drawing D-4 shows proposed cross-sections for the run-on and run-off control ditches.

Drawing D-5 shows the future access road section.

Drawing D-6 shows daily, intermediate, and final cover designs.

## 7.2 Location Standards

In accordance with UAC R315-302-1 Location Standards for Disposal Facilities, location criteria must be considered for the location of the JRDA Landfill. Due to the existing facility status of the JRDA Landfill, it is exempt from some of the location requirements; however, the following location standards must be met.

### 7.2.1 Airports

The JRDA Landfill is not located with 10,000 feet of an airport runway end.

### 7.2.2 Unstable Areas

No geologic or geomorphologic features exist at the landfill site which could compromise the structural integrity of the landfill. Soil and subsurface studies performed by the USDA and USGS indicate the landfill is located in an area of shallow native soils underlain by unweathered bedrock as described in Section 6.2. Significant differential settling is not expected to occur due to differential settling of the native soils or unweathered bedrock.

The waste mass already in place at the JRDA Landfill does present opportunity for differential settlement. The equipment used to place and compact the waste was a small, antiquated traxcavator. Compaction of the waste mass was minimal and placement of daily cover was not regular. As additional cells have been constructed, and will be constructed on top of the relatively uncompacted waste, some settling is expected to occur. The uncompacted waste will be located near the center and bottom of the completed landfill. The full extent of the settling may not be realized until that portion of the landfill approaches final elevation. Final contouring of the landfill will account for the possibility of continued, higher than average settlement over that portion of the site.

### 7.2.3 Floodplains

No FEMA maps have been prepared for the location of the JRDA Landfill. No large washes or drainages intersect or lie uphill of the landfill site. USGS surface maps of the area indicate an

absence of surface water, streams, and springs or seeps within a 3,000-foot radius of the site. The landfill will eventually encompass the entire drainage in which it is located. The site does drain toward the active cells of the landfill and potential run-on must be redirected away from the waste mass by drainage channels.

## 7.3 Design and Operation

Drawing D-3 illustrates the progression of daily cell construction, run-on and run-off control measures, and the general boundary limits of the JRDA Landfill.

The location of future cell construction will be both on top of and downhill (north) from the existing cells which have been constructed. Current plans call for the northern end of the site to remain stationary when it meets the main portion of Hall Canyon. The new cells will be constructed using proper compaction equipment and regular daily cover. The slope of the active face should be maintained at approximately three horizontal to one vertical. Due to the size and slope of the existing northern face of the landfill, new cells will be constructed alongside the existing northern face. The new cells will abut the existing northern face and eventually rise to the same elevation. When the new cells reach the elevation of the existing northern face, the operator can spread construction of new cells onto the top of the existing fill. The landfill will continue to progress vertically, expanding to the canyon walls. Excavation from the eastern, western, and southern boundaries of the landfill active area will result in expansion laterally, yet remaining within existing boundaries. As new cell construction approaches final grade, the operator shall carefully place cells to correspond with the final design elevations. Final cover shall be placed in phases. Due to the topography of the canyon, the north end of the landfill will reach design elevation and receive final cover first. The final cover shall be graded to have a maximum slope of three horizontal to one vertical.

Daily volumes of solid waste will be received at either the top or the bottom of the active face depending on the judgment of the operator and condition of the access roads. The operator shall spread the waste onto the active face at a depth of two feet. After spreading the waste, the operator shall compact the waste. Near the end of the day the operator shall cover the waste with a minimum of six inches of soil taken from the canyon walls, thereby completing a daily cell. Care shall be taken during cell placement and construction to minimize potential ponding and run-on to the surface of the solid waste.

As the entire breadth of the canyon begins to be filled, the existing access road will require relocation. Drawing D-3 shows the location of the road on the west side of the canyon. If at some point the road is placed on the refuse, approximately 3 feet of backfill shall be required for the road base. Drawing D-5 shows a section of the proposed road if it is placed on refuse.

## 7.4 Groundwater Monitoring, Leachate Collection and Treatment

Based on criteria outlined in Section 6.5, this permit application is submitted for approval of continued operation of the JRDA Landfill without a groundwater monitoring, leachate collection, or leachate treatment system.

## 7.5 Landfill Gas Control and Monitoring

Landfill gas monitoring will be performed by the Nephi City Gas Department on a quarterly basis. Monitoring shall be performed at designated locations for which a history of gas levels shall be compiled. These locations shall continue to be used for post-closure monitoring purposes. The monitoring shall be performed using hand-held detectors capable of indicating the concentration of

landfill gas in the air. The instrument shall be able to detect gas levels which are at 25% of the lower explosive limit (LEL). If landfill gas levels are detected above 25% of the LEL in facility structures (excluding gas control or recovery system components), or if levels at the LEL are detected elsewhere (including at the property boundary or beyond), the contingency plan outlined in Section 2.7.3 of this application will be used.

## 7.6 Run-on/Run-off Control Systems

Run-on/run-off control systems shall be constructed and maintained during both the active life of the landfill and during the post-closure period. Run-on control ditches shall be constructed up slope from the active portion of the landfill. These ditches shall be located so as to capture the maximum amount of potential run-on and redirect it around the waste mass. As the landfill rises in elevation, new run-on ditches must be constructed as the existing ditches become buried by new cell construction.

Run-off from the surface of the active portion of the landfill shall be controlled using berms and stockpiles of daily cover. During cell construction care shall be taken to eliminate potential ponding sites on top of the cells. The surface of the cells shall be contoured to redirect excess precipitation to the perimeter of the active portion of the landfill. At the perimeter the run-off shall be directed around the waste mass.

Post-closure run-off control ditches shall be constructed across the entire face of the landfill. The ditches redirect the run-off into adjacent natural drainages. The ditches shall minimize velocity and segregate run-off from the various sections of the final cover into more manageable volumes. Drawing D-3 illustrates the alignment of the final run-off control ditches. The ditches are designed to control a 25-year, 24-hour storm event. The calculations for sizing the ditches for a 25-year, 24-hour storm event are included in Appendix F. A detail of a ditch is included as Drawing D-4.

The run-on control ditch dimensions are based on the tributary area of the entire west side of the landfill. The south and east sides will utilize the same size run-on control ditches even though the tributary areas are smaller. Run-off control ditches shall be constructed to the same dimensions as the run-on control ditches.

## 7.7 Facility Life

The facility life was analyzed using estimated site volume, current volume of waste received, anticipated population growth rates and expected in-place density of solid waste.

### 7.7.1 Site Volume

During preparation of this application, topographic survey of the landfill was completed. The site was then analyzed using Bentley InRoads software to determine an accurate volume for a specified elevation of the landfill surface. Volumes were estimated for intermediate profiles the landfill will reach and for the final anticipated elevation of the site. The total useful volume of the canyon is estimated to be 4,600,000 cubic yards. UAC R307-221 requires municipal solid waste landfills with design capacities greater than 2,755,750 tons and 3,270,000 cubic yards to be subject to emission inventory requirements. The capacity for the JRDA landfill is administratively limited to 3,270,000 cubic yards of waste. Based on an assumed waste to soil ratio of 3:1, this results in a total volumetric capacity of 4,360,000 cubic yards. All life and capacity calculations are based on this volume.

### 7.7.2 Current Volume of Waste Received

The JRDA Landfill currently (2014) accepts an estimated 100 tons of municipal waste per week and 55 tons of construction and demolition waste per week. These values are averages based on actual tonnage history records from 1996 to 2004.

### 7.7.3 Population Growth Rate

Census data from 1980, 1990, and 2010, and population data from 1994 for the major communities using the JRDA Landfill are as follows:

| | *1980* | *Annual % Change* | *1990* | *Annual % Change* | *1994* | *Annual % Change* | *2000* | *Annual % Change* | *2010* | *Avg. Annual Rate of Growth* | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | *1994 - 2000* | *2000 - 2010* |
| Nephi | 3,285 | 0.68% | 3,515 | 1.23% | 3,691 | 4.23% | 4733 | 1.32% | 5394 | 4.71% | 1.40% |
| Mona | 536 | 0.86% | 584 | 4.60% | 699 | 3.54% | 861 | 6.05% | 1549 | 3.86% | 7.99% |
| Levan | 453 | -0.85% | 416 | 3.43% | 476 | 6.33% | 688 | 2.04% | 842 | 7.42% | 2.24% |
| Service Area | 4,274 | 0.55% | 4,515 | 1.89% | 4,866 | 4.32% | 6,271 | 0.98% | 6,914 | 4.81% | 1.03% |

Using the 2000 to 2010 growth rates, a weighted annual average growth rate of 1.03% can be obtained for the above communities using the JRDA Landfill. For purposes of estimating the life of the landfill, 1.50% per year will be used for the long-term growth rate of the waste volume received.

### 7.7.4 In-place Density of Solid Waste

For estimating the site life, an in-place density of 750 lbs/yd$^3$ has been selected as the minimum acceptable density. If higher densities are achieved, the life of the facility may be extended. In addition, daily and intermediate cover is assumed to occupy a volume equal to one-third of the in-place and compacted waste material.

### 7.7.5 Estimated Facility Life

Given the above criteria, the estimated facility life using compacted density of 750 lbs/yd$^3$ ends in 2086. Due to population growth, waste received at the JRDA Landfill is expected to exceed 20 tons per day in approximately 2037.

Table 7.75 on the next page outlines the estimated volumes of waste expected to be received at the JRDA Landfill for the remaining life of the facility. The total volumes in 2005, 2006, and 2014 are based on actual survey data. The remaining values are calculated. The cumulative compacted volumes shown include a waste-to-cover ratio of 3:1 and a compaction level of 750 lbs/yd$^3$. The full table is included in Appendix G.

## 7.8 Closure and Post-Closure Design, Construction, and Maintenance

Sections 4 and 5 of this application contain details of closure design, construction, and maintenance. The post-closure use of the site will be limited due to the location of the landfill, and the projected topography of the final cover. Open range is the most probable post-closure use of the land.

**TABLE 7.75**
**JRDA LANDFILL ESTIMATED FACILITY LIFE**

| | |
|---|---|
| Current Tons of Waste Received Per Week | 100 tons household and 55 tons C&D |
| Compacted Density of Waste (lbs/yd$^3$) | 750 |
| Estimated Annual Population Growth Rate | 1.50% |
| Site Capacity (yd$^3$) | 4,360,000 |

| Year | Annual Household Waste Received (Tons) | Annual C&D Waste Received (Tons) | Compacted Waste Volume (yd$^3$) | Daily Cover Volume (yd$^3$) | Cumulative Waste + Cover Volume (yd$^3$) |
|---|---|---|---|---|---|
| 1 (2005) | 4,800 | 3,267 | 21,512 | 7,171 | 210,625 |
| 5 (2009) | 5,712 | 1,681 | 19,714 | 6,571 | 490,261 |
| 10 (2014) | 5,200 | 2,860 | 21,493 | 7,164 | 627,923 |
| 15 (2019) | 5,602 | 3,081 | 23,154 | 7,718 | 777,790 |
| 20 (2024) | 6,035 | 3,319 | 24,944 | 8,315 | 939,240 |
| 25 (2029) | 6,501 | 3,576 | 26,872 | 8,957 | 1,113,167 |
| 30 (2034) | 7,004 | 3,852 | 28,948 | 9,649 | 1,300,536 |
| 33 (2037) | 7,324* | 4,028 | 30,271 | 10,090 | 1,419,838 |
| 40 (2044) | 8,128 | 4,470 | 33,596 | 11,199 | 1,719,835 |
| 45 (2049) | 8,756 | 4,816 | 36,192 | 12,064 | 1,954,089 |
| 50 (2054) | 9,433 | 5,188 | 38,989 | 12,996 | 2,206,448 |
| 55 (2059) | 10,162 | 5,589 | 42,003 | 14,001 | 2,478,310 |
| 60 (2064) | 10,947 | 6,021 | 45,249 | 15,083 | 2,771,183 |
| 65 (2069) | 11,793 | 6,486 | 48,746 | 16,249 | 3,086,690 |
| 70 (2074) | 12,705 | 6,988 | 52,513 | 17,504 | 3,426,581 |
| 75 (2079) | 13,687 | 7,528 | 56,571 | 18,857 | 3,792,739 |
| 80 (2084) | 14,744 | 8,109 | 60,943 | 20,314 | 4,187,196 |
| 82 (2086) | 15,190 | 8,355 | 62,785 | 20,928 | 4,353,387 |

* Class I status

# Appendix

***Appendix A – Property Information***
***Appendix B – Forms and Records***
***Appendix C1 – Required Cost Estimates***
***Appendix C2 – Financial Information and Additional Cost Estimates***
***Appendix D – Drawings***
***Appendix E – Soil Testing***
***Appendix F – Hydrology and Hydraulics***
***Appendix G – Capacity Calculations***

# Appendix A – Property Information

RB&G
ENGINEERING, INC.

June 8, 2007

U.S. Department of the Interior
Bureau of Land Management
Fillmore Field Office
35 East 500 North
Fillmore, Utah 84631

Re: Juab Rural Development Agency Permit Renewal

Dear Sir or Madam,

The Juab Rural Development Agency (JRDA) Landfill, formerly the Nephi City Landfill, is currently permitted as a Class II facility as defined in the Utah Solid Waste Permitting and Management Rules (UAC R513-301-2). The landfill also operates a Class IV (construction/demolition) waste cell at its present site. The landfill accepts solid waste generated in the eastern Juab County towns of Levan, Mona, and Nephi City, and farms and ranches adjacent to these communities. The area has been operated as a landfill since 1983.

The landfill site is located approximately 5 miles west of Nephi City in a lateral portion of Hall Canyon. The land surrounding the site is open range administered by the Bureau of Land Management. The facility gate is located at approximately 39°41'24" N latitude and 111°55'31" W longitude. The site includes approximately 300 acres purchased from the BLM in 1995. Access to the site was secured from the BLM by a Right-of-Way Grant/Temporary Use Permit.

The BLM manages land within a 1000-foot boundary of the JRDA Landfill facility boundary, as shown on the attached map. We have spoken to Matt Rajala from your office about the land within the boundary. He confirmed that it is currently being used for grazing. According to UAC R315-310-3(2)(ii), a notice of intent to apply for a permit must be sent to all property owners within 1000 feet of the facility boundary. This letter will serve as notice of intent to apply for a renewal of the current permit.

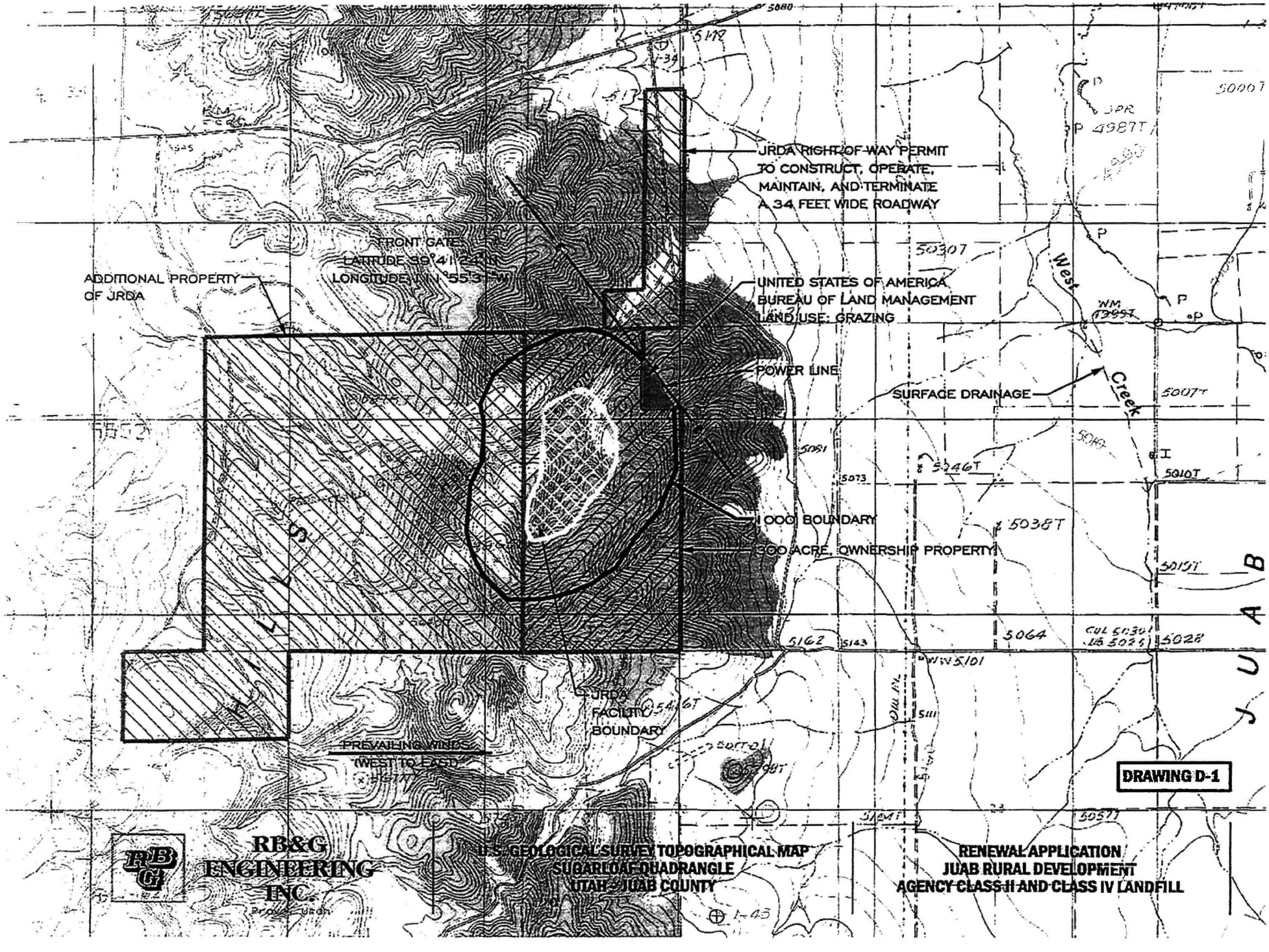
Please contact us if you have any questions or concerns.

Sincerely,

RB&G ENGINEERING, INC.

Scott Hendricks, P.E.
Project Manager

1435 WEST 820 NORTH ▪ PROVO UTAH 84601
Provo 801 374 5771 ▪ Salt Lake City 801 521-5771 ▪ Fax 801 374 5775


JRDA RIGHT-OF-WAY PERMIT
TO CONSTRUCT, OPERATE,
MAINTAIN, AND TERMINATE
A 34 FEET WIDE ROADWAY
FRONT GATE
LATITUDE 39°41'24" N
LONGITUDE 113°55'3" W
ADDITIONAL PROPERTY
OF JRDA
UNITED STATES OF AMERICA
BUREAU OF LAND MANAGEMENT
LAND USE: GRAZING
POWER LINE
SURFACE DRAINAGE
1000' BOUNDARY
640 ACRE OWNERSHIP PROPERTY
JRDA
FACILITY
BOUNDARY
PREVAILING WINDS
(WEST TO EAST)
West
Creek
JUAB
DRAWING D-1
RB&G
ENGINEERING
INC.
U.S. GEOLOGICAL SURVEY TOPOGRAPHICAL MAP
SUGARLOAF QUADRANGLE
UTAH - JUAB COUNTY
RENEWAL APPLICATION
JUAB RURAL DEVELOPMENT
AGENCY CLASS II AND CLASS IV LANDFILL

Form 1860-9
(January 1988)

# The United States of America

To all to whom these presents shall come, Greeting:

U-68991

WHEREAS,

Nephi City Corporation, Utah

is entitled to a land patent pursuant to Sections 203 and 209 of the Act of October 21, 1976 (43 U.S.C. 1713 and 1719, respectively), for the following described land:

Salt Lake Meridian, Utah

T. 13 S., R. 1 W.,

sec. 15, W½NE¼NW¼, NW¼NW¼,
S½NW¼, SW¼.

containing 300.00 acres

NOW KNOW YE, that there is, therefore, granted by the UNITED STATES, unto the above named claimant, the land described above; TO HAVE AND TO HOLD the said land with all the rights, privileges, immunities, and appurtenances, of whatsoever nature, thereunto belonging, unto the said claimant, its heirs and assigns, forever; and

EXCEPTING AND RESERVING TO THE UNITED STATES:

1. A right-of-way thereon for ditches or canals constructed by the authority of the United States. Act of August 30, 1890 (43 U.S.C. 945).

2. All of the oil and gas in the land described above, with the right to prospect for, mine, and remove the same under applicable law and such regulations as the Secretary may prescribe.

Pursuant to the authority contained in Section 3(d) of Executive Order 11988 of May 24, 1977 (42 F.R. 26951) and Sections 203 and 209 of the Act of October 21, 1976 (43 U.S.C. 1713 and 1719, respectively), this patent is subject to a permanent restriction which constitutes a covenant running with the land, that the land may not be used for buildings containing valuable documents or data or instruments, or materials dangerous to the public if released by flooding; power installations needed in emergencies; hospitals and like institutions; and similar type use and structures below elevations of 5600 feet.

Nephi City Corporation, Utah, its successors or assigns, shall comply with all Federal and State laws applicable to the disposal, placement, or release of hazardous substances (substances as defined in 40 CFR 302).

Nephi City Corporation, Utah, its successors or assigns, assumes all liability for and shall defend, indemnify, and save harmless the United States and its officers, agents, representatives, and employees (hereinafter referred to in this clause as the United States), from all claims, loss, damage, actions, causes of action, expense, and liability (hereinafter

00205112 Bk0371 Pg0533

CRAIG J. SPERRY, JUAB COUNTY RECORDER
1995 OCT 04 16:25 PM FEE $.00 BY HMJ
FOR: NEPHI CITY, A MUNICIPAL CORPORATION

Patent Number 43-95-0035

FORM 2800-14
(August 1985)

Issuing Office
Richfield District Office

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
RIGHT-OF-WAY GRANT/TEMPORARY USE PERMIT

SERIAL NUMBER UTU-72965

1. A right-of-way is hereby granted pursuant to Title V of the Federal Land Policy and Management Act of October 21, 1976 (90 Stat. 2776; 43 U.S.C. 1761).

2. Nature of Interest:

a. By this instrument, the holder:

Nephi City Corporation
21 East 100 North
Nephi, Utah 84648

receives a right to construct, operate, maintain, and terminate a(n) Access Road, on public lands described as follows:

Salt Lake Meridian
T. 13 S., R. 1 W.,
Sec. 10, E½SE¼NW¼, E½NE¼SW¼,
NE¼SE¼SW¼, S½SE¼SW¼.

b. The right-of-way or permit area granted herein is 34' feet wide (17' from centerline), 1,500' feet long and contains 1.17 acres, more or less. If a site type facility, the facility contains _____ acres.

c. This instrument shall terminate on September 18, 2025, 30 years from the effective date of this grant unless, prior thereto, it is relinquished, abandoned, terminated, or modified pursuant to the terms and conditions of this instrument or of any applicable Federal law or regulation.

d. This instrument may be renewed. If renewed, the right-of-way or permit shall be subject to the regulations existing at the time of renewal and any other terms and conditions that the authorized officer deems necessary to protect the public interest.

# NEPHI CITY CORPORATION PATENT PRESENTATION

OCTOBER 3, 1995

**BLM Fillmore Office:** Rex Rowley, Area Manager
Nancy DeMille, Realty Specialist
(801) 743-6811

Close coordination and cooperation was maintained between the BLM and Nephi City Mayor, Administration and Planning and Zoning throughout the processing of the patent for the Nephi City landfill site, resulting in the successful issuance of the patent on September 19, 1995.

## General History:

On August 31, 1982, Nephi City Corporation submitted a petition-application for a Recreation and Public (R&PP) lease for a 20 acre sanitary landfill site. The landfill site was selected on public land at Sec. 15, E½SW¼NW¼, T. 13 S., R. 1 W., SLM, Utah, which is located approximately 5.5 miles west of Nephi, Utah.

After considerable public input, the lands were classified for lease under the R&PP Act and on May 5, 1983, a 25-year R&PP lease was issued to the City of Nephi for the sanitary landfill-waste disposal site.

Based on the new EPA rules and regulations, it became necessary to improve waste management facilities. On March 12, 1993, the Fillmore Bureau of Land Management (BLM) office received Nephi City Corporation's request to purchase the existing 20 acre landfill site and the adjacent 280 acres to accomodate immediate and foreseeable future landfill needs. Due to the historical use and the value added to the land by Nephi City Corporation the direct sale method was selected. This method also afforded Nephi City's continued and uninterrupted operation of the landfill. Therefore, the landfill site includes approximately 300 acres which are described as follows:

T. 13 S., R. 1 W., SLM, Utah
Sec. 15, W½NE¼NW¼, NW¼NW¼, S½NW¼, SW¼.

Access to the Nephi City landfill site was initially authorized as part of the R&PP lease, however, a portion of this road is located outside the patented land. Therefore, an access road right-of-way grant was issued simultaneously with the patent to provide uninterrupted access to the landfill site.

# Appendix B – Forms and Records

# JRDA LANDFILL
# LOAD WEIGHT RECORD

Date:_____

| | Driver's Name | Size of Truck | Estimated Weight of Load |
|---|---|---|---|
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |
| 19 | | | |
| 20 | | | |
| 21 | | | |
| 22 | | | |
| 23 | | | |
| 24 | | | |
| 25 | | | |

# Instructions for Completing Landfill Annual Report Form

The Division of Solid and Hazardous Waste is not currently able to accept e-mailed form submissions. The attached form must be printed, signed as required by Utah Administrative Code R315-310-2(4), and mailed to the Division. Annual reports must be received by the Division on or before March 2, 2015 and should contain data for the calendar year 2014.

Complete all applicable sections of the form and save it. When printing, please print only the form pages. The instruction page should not be printed and mailed.

Completed forms should be mailed to:

**Scott T. Anderson, Director**
**Division of Solid and Hazardous Waste**
**P.O. Box 144880**
**Salt Lake City, Utah 84114-4880**

Additional copies for the form can be obtained on the Division web page at http://www.deq.utah.gov/forms/waste/index.htm#swp

# LANDFILL ANNUAL REPORT

For Calendar year 2014

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

Facility Name:_____

Facility Mailing Address:_____
(Number & Street, Box and/or Route)

City:_____ Zip Code:_____

County:_____ Permit No.:_____

Owner

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:_____

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

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

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 | | | | ☐ | ☐ |
| Industrial | | | | ☐ | ☐ |
| C/D[1] | | | | ☐ | ☐ |

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

## Conversion Factor Used

☐ 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 $_____ C/D $_____
Industrial $_____ Annual $_____

(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:_____ Acres:_____

Acres Currently Open:_____ Acres Currently Closed:_____

## Financial Assurance

Current Closure Cost Estimate:_____
Current Post-Closure Cost Estimate:_____
Current Amount or Balance in Mechanism:_____
(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:_____
(ie. Bond, Trust Fund, Corporate or government Test etc.)
Mechanism Holder and Account Number:_____
(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 ☐

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 ☐ If yes please briefly describe use of gas, e.g., flared or used for electricity generation. _____

**Signature:**_____ **Date:**_____
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:_____Title:_____

# JRDA LANDFILL

# SITE INSPECTION RECORD

## INSPECTION INFORMATION

Inspectors Name: _____ Date: _____ Time: _____

## STRUCTURES AND ROADS

| | Overall Condition | |
|---|---|---|
| | Satisfactory | Needs Work* |
| Access Road: | ☐ | ☐ _____ |
| Fence and Gate: | ☐ | ☐ _____ |
| Signage: | ☐ | ☐ _____ |
| On-Site Roads: | ☐ | ☐ _____ |
| Ash Pit Structure: | ☐ | ☐ _____ |
| Run-on Control: | ☐ | ☐ _____ |

* Specify needed repairs or work

_____

_____

_____

_____

## OPERATIONS

| | Overall Condition | |
|---|---|---|
| | Satisfactory | Needs Work* |
| Traffic Control: | ☐ | ☐ _____ |
| Access to Active Face: | ☐ | ☐ _____ |
| Litter &Weed Control: | ☐ | ☐ _____ |
| Daily Cover: | ☐ | ☐ _____ |
| Bulky Waste Piles: | ☐ | ☐ _____ |
| Recyclable Storage: | ☐ | ☐ _____ |
| Prohibited Wastes: | ☐ | ☐ _____ |
| Vector Control: | ☐ | ☐ _____ |
| Heavy Equipment: | ☐ | ☐ _____ |

* Specify needed repairs or work

_____

_____

_____

JRDA LANDFILL

# LANDFILL GAS MONITORING RECORD

## INSPECTION INFORMATION

Nephi City Gas Department

Inspectors Name: _____

Date: _____

Time: _____

Detection Equipment: _____

_____

## INSPECTION RESULTS

| Inspection Station | Gas Detected | | Detected Gas Level |
|---|---|---|---|
| 1 | No ☐ | Yes ☐ | _____ |
| 2 | No ☐ | Yes ☐ | _____ |
| 3 | No ☐ | Yes ☐ | _____ |
| 4 | No ☐ | Yes ☐ | _____ |
| 5 | No ☐ | Yes ☐ | _____ |
| 6 | No ☐ | Yes ☐ | _____ |
| 7 | No ☐ | Yes ☐ | _____ |
| 8 | No ☐ | Yes ☐ | _____ |

# JRDA LANDFILL

# RANDOM LOAD INSPECTION RECORD

## INSPECTION INFORMATION

Inspectors Name: _____ Date: _____ Time: _____

## VEHICLE INFORMATION

Drivers Name: _____

Vehicle Type: _____

Vehicle License #: _____

Description Of Waste: _____

_____

_____

## WASTE GENERATOR INFORMATION

Company Name: _____

Address: _____

_____

Phone Number: (801) - _____

## OBSERVATIONS AND ACTION TAKEN

Observations: _____

_____

_____

_____

Load Accepted : ☐

Load Rejected : ☐

Drivers Signature*: _____ Date: _____

Inspectors Signature: _____ Date: _____

* Drivers signature hereon indicates his presence during inspection and does not admit, confirm, or identify liability.

# Appendix C1 – Required Cost Estimates

## CLOSURE COST ESTIMATE
## EVAPOTRANSPIRATION COVER (30")
## JUAB RURAL DEVELOPMENT AGENCY LANDFILL
### FOR EXISTING DISTURBED AREA (14.95 ACRES)

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 1.0 | Engineering Computer Model | lump sum | $ 18,500.00 | 1 | $ 18,500.00 |
| 1.1 | Topographic Survey | hr | $ 120.00 | 20 | $ 2,400.00 |
| 1.2 | Boundary Survey for Affidavit | hr | $ 120.00 | 16 | $ 1,920.00 |
| 1.3 | Site Evaluation and Soil Testing | lump sum | $ 5,900.00 | 1 | $ 5,900.00 |
| 1.4 | Development of Plans | lump sum | $ 6,800.00 | 1 | $ 6,800.00 |
| 1.5 | Contract Administration, Bidding and Award | lump sum | $ 3,400.00 | 1 | $ 3,400.00 |
| 1.6 | Administrative Costs | lump sum | $ 1,400.00 | 1 | $ 1,400.00 |
| 1.7 | Project Management | week | $ 3,500.00 | 5 | $ 17,500.00 |
| 1.8 | Monitor Well Consultant Cost | | | | |
| 1.9 | NPDES Construction Storm Water Permit, and other Permits | lump sum | $ 3,400.00 | 1 | $ 3,400.00 |
| 1.10 | Disposal of Final Wastes | | | | |
| 1.11 | Remove Temporary Buildings | | | | |
| 1.12 | Remove Equipment | | | | |
| 1.13 | Repair/Replace Perimeter Fencing | | | | |
| 1.14 | Clean Leachate Lines | | | | |
| | **SUBTOTAL** | | | | $ 61,220.00 |
| | **10% CONTINGENCY** | | | | $ 6,122.00 |
| | **ENGINEERING TOTAL** | | | | $ 67,342.00 |

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 2.0 | Construction | | | | |
| 2.1 | Final Cover System | cu yd | $ 4.00 | 60300 | $ 241,200.00 |
| 2.1.1 | Completion of Sidewall Liner | | | | |
| 2.1.1a | Soil Placement | | | | |
| 2.1.1b | Soil Processing | | | | |
| 2.1.1c | Soil Amendment | | | | |
| 2.1.1d | Soil Purchase | | | | |
| 2.1.1e | Transportation | | | | |
| 2.1.2 | Drainage Layer on Sidewall | | | | |
| 2.1.2a | Geotextile Filter Fabric | | | | |
| 2.1.2b | Geonet/Geotextile Composite | | | | |
| 2.1.2c | Geomembrane Sidewall Liner | | | | |
| 2.2 | Completion of Top Cover | | | | |
| 2.2.1 | Infiltration Layer | | | | |
| 2.2.1a | Soil Placement | | | | |
| 2.2.1b | Soil Processing | | | | |
| 2.2.1c | Soil Amendment | | | | |
| 2.2.1d | Soil Purchase | | | | |
| 2.2.1e | Transportation | | | | |
| 2.2.2 | Geosynthetic Clay Layer | | | | |
| 2.2.2a | Geosynthetic Clay Installation | | | | |
| 2.2.3 | Flexible Membrane Cover | | | | |
| 2.2.3a | Flexible Membrane Installation | | | | |
| 2.2.4 | Drainage Layer | | | | |
| 2.2.4a | Geonet/Geotextile | | | | |
| 2.2.4b | Sand Layer | | | | |
| 2.2.4c | Soil Cover | | | | |
| 2.2.4d | Geonet/Geotextile Composite | | | | |
| 2.3 | Erosion Layer Placement | | | | |
| 2.3.1 | Soil Purchase | | | | |
| 2.3.2 | Soil Transportation | | | | |
| 2.3.3 | Soil Processing | | | | |
| 2.3.4 | Soil Amendment | | | | |
| 2.3.5 | Soil Placement | | | | |

## CLOSURE COST ESTIMATE
## EVAPOTRANSPIRATION COVER (30")
## JUAB RURAL DEVELOPMENT AGENCY LANDFILL
### FOR EXISTING DISTURBED AREA (14.95 ACRES)

| | | | | | |
|---|---|---|---|---|---|
| 2.4 | Revegetation | acre | $ 840.00 | 14.95 | $ 12,558.00 |
| 2.4.1 | Seeding | | | | |
| 2.4.2 | Fertilize | | | | |
| 2.4.3 | Mulch | | | | |
| 2.5 | Site Grading and Drainage | acre | $ 900.00 | 14.95 | $ 13,455.00 |
| 2.6 | Site Fencing and Security | ft | $ 28.00 | 5435 | $ 152,180.00 |
| 2.7 | Leachate Collection System Completion | | | | |
| | **SUBTOTAL** | | | | $ 419,393.00 |
| | **10% CONTINGENCY** | | | | $ 41,940.00 |
| | **CONSTRUCTION TOTAL** | | | | $ 461,333.00 |

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 3.0 | Gas Collection System | | | | |
| 3.1 | System Design | | | | |
| 3.2 | Completion of Gas Collection System | | | | |
| 3.3 | Equipment and Installation | | | | |
| 3.3.1 | Place Sand | | | | |
| 3.3.2 | Install Geonet and Geotextile | | | | |
| 3.3.3 | Install Passive Vents | | | | |
| 3.3.4 | Install, Rework or Replace Gas Control Equipment | | | | |
| | **SUBTOTAL** | | | | $ - |
| | **10% CONTINGENCY** | | | | $ - |
| | **GAS COLLECTION TOTAL** | | | | $ - |

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 4.0 | Monitor Well Installation Cost | | | | |
| 4.1 | Ground Water Monitoring, Well Installation, Reworking or Replacement | | | | |
| 4.2 | Install, Rework, or Replace Methane Probes | | | | |
| 4.3 | Monitor Well or Methane Probe Plugging | | | | |
| | **SUBTOTAL** | | | | $ - |
| | **10% CONTINGENCY** | | | | $ - |
| | **MONITOR WELL INSTALLATION TOTAL** | | | | $ - |

**SUBTOTAL** $ 528,675.00

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 5.0 | 2.5% Contract Performance Bond | | | | $ 13,217.00 |

**SUBTOTAL** $ 541,892.00

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 6.0 | Legal Fees | lump sum | $ 7,900.00 | 1 | $ 7,900.00 |

**TOTAL CLOSURE COSTS** **$ 549,792.00**

1 - 2015 dollars

## POST-CLOSURE COST ESTIMATE
## EVAPOTRANSPIRATION COVER (30")
## JUAB RURAL DEVELOPMENT AGENCY LANDFILL
### MAXIMUM EXPECTED COST AT ANY POINT IN TIME

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 1.0 | Engineering Costs | | | | |
| 1.1 | Post-Closure Plan and Permits | lump sum | $ 2,800.00 | 1 | $ 2,800.00 |
| 1.2 | Site Inspection and Record Keeping (Quarterly) | quarter | $ 240.00 | 120 | $ 28,800.00 |
| 1.3 | Correctional Plans and Specifications | ea | $ 2,800.00 | 3 | $ 8,400.00 |
| 1.4 | Site Monitoring | | | | |
| 1.4.1 | Ground Water Monitoring | | | | |
| 1.4.1a | Ground Water Sample Collection | | | | |
| 1.4.1b | Ground Water Sample Analysis | | | | |
| 1.4.1c | Ground Water Sample Analysis Review and Reporting | | | | |
| 1.4.2 | Landfill Gas Monitoring | | | | |
| 1.4.2a | Gas Monitoring Data Collection | quarter | $ 170.00 | 120 | $ 20,400.00 |
| 1.4.2b | Gas Monitoring Data Review and Reporting | quarter | $ 170.00 | 120 | $ 20,400.00 |
| 2.0 | Maintenance Costs | | | | |
| 2.1 | Cover Maintenance Costs | | | | |
| 2.1.1 | Soil Replacement | year | $ 1,700.00 | 30 | $ 51,000.00 |
| 2.1.2 | Vegetation Reseeding | year | $ 560.00 | 30 | $ 16,800.00 |
| 2.2 | Equipment Maintenance | | | | |
| 2.2.1 | Ground Water Well Maintenance and Replacement | | | | |
| 2.2.2 | Methane Probe Maintenance and Replacement | | | | |
| 2.2.3 | Gas Collection System Operation | | | | |
| 2.2.4 | Gas Collection System Maintenance and Repair | | | | |
| 2.2.5 | Leachate Collection System | | | | |
| 2.2.5a | Leachate Collection System Repair and Maintenance | | | | |
| 2.2.5b | Clean Leachate Lines | | | | |
| 3.0 | Final Plugging of Monitoring Wells | | | | |
| 3.1 | Final Plugging of Methane Probes | | | | |
| 3.2 | Final Plugging of Ground Water Monitoring Wells | | | | |
| 3.3 | Gas Control Equipment Removal | | | | |
| 4.0 | Leachate Disposal | | | | |
| 5.0 | Site Maintenance | | | | |
| 5.1 | Repair of Surface Water Diversion Structures | year | $ 560.00 | 30 | $ 16,800.00 |
| 5.2 | Repair of Fences and Gates | year | $ 560.00 | 30 | $ 16,800.00 |
| 5.3 | General Maintenance | year | $ 560.00 | 30 | $ 16,800.00 |
| 6.0 | Demonstration of Stability | lump sum | $ 1,700.00 | 1 | $ 1,700.00 |
| | **SUBTOTAL** | | | | $ 200,700.00 |
| | **10% CONTINGENCY** | | | | $ 20,070.00 |
| | **POST-CLOSURE CARE TOTAL** | | | | $ 220,770.00 |

1 - 2015 dollars

# Appendix C2 – Financial Information and Additional Cost Estimates

## COST SUMMARY
## EVAPOTRANSPIRATION COVER (30")
## JUAB RURAL DEVELOPMENT AGENCY LANDFILL

| PHASE | ACRES | CLOSURE COST[1] | POST CLOSURE COST[1] |
|---|---|---|---|
| 1 | 8.6 | $341,664 | $98,170 |
| 2 | 6.9 | $218,267 | $80,560 |
| 3 | 6.9 | $218,267 | $80,560 |
| 4 | 6.9 | $218,267 | $80,560 |
| 5 | 6.9 | $218,267 | $80,560 |
| 6 | 6.9 | $218,267 | $80,560 |
| 7 | 13.4 | $379,509 | $148,480 |
| | 56.6 | $1,812,508 | $649,418 |
| | | | |
| **TOTAL CLOSURE AND POST-CLOSURE COSTS** | | | $2,461,958 |

1 - 2015 dollars

2 - post-closure costs per phase depends on how many phases are open during each phase's post-closure period

**FINANCIAL ASSURANCE MECHANISM**
**SCHEDULE OF DEPOSITS, WITHDRAWALS, AND BALANCES**
**EVAPOTRANSPIRATION COVER (30")**
**JUAB RURAL DEVELOPMENT AGENCY LANDFILL**

| Year | Area Closed | Σ Area Closed | Area Open | Area to Monitor | Deposit | Closure Withdrawal | Post Closure Withdrawal | End of Year Balance |
|---|---|---|---|---|---|---|---|---|
| 2007 | | | 14.95 | | | | | $210,000 |
| 2008 | | | 14.95 | | $20,000 | | | $230,000 |
| 2009 | | | 14.95 | | $20,000 | | | $250,000 |
| 2010 | | | 14.95 | | $20,000 | | | $270,000 |
| 2011 | | | 14.95 | | $70,410 | | | $340,410 |
| 2012 | | | 14.95 | | $70,410 | | | $410,820 |
| 2013 | | | 14.95 | | $70,410 | | | $481,230 |
| 2014 | | | 14.95 | | $70,410 | | | $551,640 |
| 2015 | | | 14.95 | | $48,108 | | | $599,748 |
| 2016 | | | 14.95 | | $48,108 | | | $647,856 |
| 2017 | | | 14.95 | | $48,108 | | | $695,964 |
| 2018 | | | 14.95 | | $48,108 | | | $744,072 |
| 2019 | | | 14.95 | | $25,541 | | | $769,613 |
| 2020 | | | 14.95 | | $25,541 | | | $795,153 |
| 2021 | | | 14.95 | | $25,541 | | | $820,694 |
| 2022 | | | 14.95 | | $25,541 | | | $846,235 |
| 2023 | | | 14.95 | | $25,541 | | | $871,776 |
| 2024 | | | 14.95 | | $25,541 | | | $897,316 |
| 2025 | | | 14.95 | | $25,541 | | | $922,857 |
| 2026 | | | 14.95 | | $25,541 | | | $948,398 |
| 2027 | | | 14.95 | | $25,541 | | | $973,939 |
| 2028 | 8.6 | 8.6 | 6.84 | | $25,541 | $336,564 | | $662,915 |
| 2029 | | | 7.34 | 8.6 | $25,541 | | $13,307.08 | $675,149 |
| 2030 | | | 7.83 | 8.6 | $25,541 | | $7,147.08 | $693,543 |
| 2031 | | | 8.33 | 8.6 | $25,541 | | $7,147.08 | $711,936 |
| 2032 | | | 8.82 | 8.6 | $25,541 | | $7,147.08 | $730,330 |
| 2033 | | | 9.32 | 8.6 | $25,541 | | $7,147.08 | $748,724 |
| 2034 | | | 9.81 | 8.6 | $25,541 | | $7,147.08 | $767,117 |
| 2035 | | | 10.30 | 8.6 | $25,541 | | $7,147.08 | $785,511 |
| 2036 | | | 10.80 | 8.6 | $25,541 | | $7,147.08 | $803,905 |
| 2037 | | | 11.29 | 8.6 | $25,541 | | $7,147.08 | $822,298 |
| 2038 | | | 11.79 | 8.6 | $25,541 | | $7,147.08 | $840,692 |
| 2039 | | | 12.28 | 8.6 | $25,541 | | $7,147.08 | $859,086 |
| 2040 | | | 12.78 | 8.6 | $25,541 | | $7,147.08 | $877,479 |
| 2041 | | | 13.27 | 8.6 | $25,541 | | $7,147.08 | $895,873 |
| 2042 | 6.92 | 15.52 | 6.93 | 8.6 | $25,541 | $213,167 | $7,147.08 | $701,100 |
| 2043 | | | 7.50 | 15.52 | $25,541 | | $7,147.08 | $719,493 |
| 2044 | | | 8.08 | 15.52 | $25,541 | | $7,147.08 | $737,887 |
| 2045 | | | 8.66 | 15.52 | $25,541 | | $7,147.08 | $756,281 |
| 2046 | | | 9.23 | 15.52 | $25,541 | | $7,147.08 | $774,674 |
| 2047 | | | 9.81 | 15.52 | $25,541 | | $7,147.08 | $793,068 |
| 2048 | | | 10.39 | 15.52 | $25,541 | | $7,147.08 | $811,462 |
| 2049 | | | 10.96 | 15.52 | $25,541 | | $7,147.08 | $829,855 |
| 2050 | | | 11.54 | 15.52 | $25,541 | | $7,147.08 | $848,249 |
| 2051 | | | 12.12 | 15.52 | $25,541 | | $7,147.08 | $866,642 |
| 2052 | | | 12.69 | 15.52 | $25,541 | | $7,147.08 | $885,036 |
| 2053 | | | 13.27 | 15.52 | $25,541 | | $7,147.08 | $903,430 |
| 2054 | 6.92 | 22.44 | 7.04 | 15.52 | $25,541 | $213,167 | $7,147.08 | $708,656 |
| 2055 | | | 7.73 | 22.44 | $25,541 | | $13,307.08 | $720,890 |
| 2056 | | | 8.43 | 22.44 | $25,541 | | $7,147.08 | $739,284 |
| 2057 | | | 9.12 | 22.44 | $25,541 | | $7,147.08 | $757,677 |
| 2058 | | | 9.81 | 22.44 | $25,541 | | $9,017.08 | $774,201 |
| 2059 | | | 10.50 | 13.84 | $25,541 | | $7,147.08 | $792,595 |
| 2060 | | | 11.19 | 13.84 | $25,541 | | $7,147.08 | $810,988 |
| 2061 | | | 11.89 | 13.84 | $25,541 | | $7,147.08 | $829,382 |
| 2062 | | | 12.58 | 13.84 | $25,541 | | $7,147.08 | $847,776 |
| 2063 | | | 13.27 | 13.84 | $25,541 | | $7,147.08 | $866,169 |
| 2064 | 6.92 | 29.36 | 7.12 | 13.84 | $25,541 | $213,167 | $7,147.08 | $671,396 |
| 2065 | | | 7.89 | 20.76 | $25,541 | | $13,307.08 | $683,630 |
| 2066 | | | 8.66 | 20.76 | $25,541 | | $7,147.08 | $702,023 |
| 2067 | | | 9.43 | 20.76 | $25,541 | | $7,147.08 | $720,417 |

## FINANCIAL ASSURANCE MECHANISM
## SCHEDULE OF DEPOSITS, WITHDRAWALS, AND BALANCES
## EVAPOTRANSPIRATION COVER (30")
## JUAB RURAL DEVELOPMENT AGENCY LANDFILL

| Year | Area Closed | Σ Area Closed | Area Open | Area to Monitor | Deposit | Closure Withdrawal | Post Closure Withdrawal | End of Year Balance |
|---|---|---|---|---|---|---|---|---|
| 2068 | | | 10.19 | 20.76 | $25,541 | | $7,147.08 | $738,811 |
| 2069 | | | 10.96 | 20.76 | $25,541 | | $7,147.08 | $757,204 |
| 2070 | | | 11.73 | 20.76 | $25,541 | | $7,147.08 | $775,598 |
| 2071 | | | 12.50 | 20.76 | $25,541 | | $7,147.08 | $793,992 |
| 2072 | | | 13.27 | 20.76 | $25,541 | | $9,017.08 | $810,515 |
| 2073 | 6.92 | 36.28 | 7.34 | 13.84 | $25,541 | $213,167 | $7,147.08 | $615,742 |
| 2074 | | | 8.33 | 20.76 | $25,541 | | $13,307.08 | $627,976 |
| 2075 | | | 9.32 | 20.76 | $25,541 | | $7,147.08 | $646,369 |
| 2076 | | | 10.30 | 20.76 | $25,541 | | $7,147.08 | $664,763 |
| 2077 | | | 11.29 | 20.76 | $25,541 | | $7,147.08 | $683,157 |
| 2078 | | | 12.28 | 20.76 | $25,541 | | $7,147.08 | $701,550 |
| 2079 | | | 13.27 | 20.76 | $25,541 | | $7,147.08 | $719,944 |
| 2080 | 6.92 | 43.2 | 7.53 | 20.76 | $25,541 | $213,167 | $7,147.08 | $525,170 |
| 2081 | | | 8.71 | 27.68 | $25,541 | | $13,307.08 | $537,404 |
| 2082 | | | 9.89 | 27.68 | $25,541 | | $7,147.08 | $555,798 |
| 2083 | | | 11.07 | 27.68 | $25,541 | | $7,147.08 | $574,191 |
| 2084 | | | 12.25 | 27.68 | $25,541 | | $9,017.08 | $590,715 |
| 2085 | | | 13.43 | 20.76 | $25,541 | | $7,147.08 | $609,109 |
| 2086 | 13.4 | 56.6 | 0.00 | 20.76 | | $373,909 | $7,147.08 | $228,053 |
| 2087 | | | | 34.16 | | | $13,307.08 | $214,746 |
| 2088 | | | | 34.16 | | | $7,147.08 | $207,599 |
| 2089 | | | | 34.16 | | | $7,147.08 | $200,451 |
| 2090 | | | | 34.16 | | | $7,147.08 | $193,304 |
| 2091 | | | | 34.16 | | | $7,147.08 | $186,157 |
| 2092 | | | | 34.16 | | | $7,147.08 | $179,010 |
| 2093 | | | | 34.16 | | | $7,147.08 | $171,863 |
| 2094 | | | | 34.16 | | | $9,017.08 | $162,846 |
| 2095 | | | | 27.24 | | | $7,147.08 | $155,699 |
| 2096 | | | | 27.24 | | | $7,147.08 | $148,552 |
| 2097 | | | | 27.24 | | | $7,147.08 | $141,405 |
| 2098 | | | | 27.24 | | | $7,147.08 | $134,258 |
| 2099 | | | | 27.24 | | | $7,147.08 | $127,111 |
| 2100 | | | | 27.24 | | | $7,147.08 | $119,964 |
| 2101 | | | | 27.24 | | | $7,147.08 | $112,816 |
| 2102 | | | | 27.24 | | | $7,147.08 | $105,669 |
| 2103 | | | | 27.24 | | | $9,017.08 | $96,652 |
| 2104 | | | | 20.32 | | | $7,147.08 | $89,505 |
| 2105 | | | | 20.32 | | | $7,147.08 | $82,358 |
| 2106 | | | | 20.32 | | | $7,147.08 | $75,211 |
| 2107 | | | | 20.32 | | | $7,147.08 | $68,064 |
| 2108 | | | | 20.32 | | | $7,147.08 | $60,917 |
| 2109 | | | | 20.32 | | | $7,147.08 | $53,770 |
| 2110 | | | | 20.32 | | | $9,017.08 | $44,753 |
| 2111 | | | | 13.4 | | | $7,147.08 | $37,606 |
| 2112 | | | | 13.4 | | | $7,147.08 | $30,458 |
| 2113 | | | | 13.4 | | | $7,147.08 | $23,311 |
| 2114 | | | | 13.4 | | | $7,147.08 | $16,164 |
| 2115 | | | | 13.4 | | | $7,147.08 | $9,017 |
| 2116 | | | | 13.4 | | | $9,017.08 | $0 |

All currencies are 2015 dollars.

## CLOSURE COST ESTIMATE
## EVAPOTRANSPIRATION COVER (30")
## JUAB RURAL DEVELOPMENT AGENCY LANDFILL
### FOR PHASE 1 OF CLOSURE (8.6 ACRES)

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 1.0 | Engineering Computer Model | lump sum | $ 18,500.00 | 1 | $ 18,500.00 |
| 1.1 | Topographic Survey | hr | $ 120.00 | 20 | $ 2,400.00 |
| 1.2 | Boundary Survey for Affidavit | hr | $ 120.00 | 16 | $ 1,920.00 |
| 1.3 | Site Evaluation and Soil Testing | lump sum | $ 5,900.00 | 1 | $ 5,900.00 |
| 1.4 | Development of Plans | lump sum | $ 6,800.00 | 1 | $ 6,800.00 |
| 1.5 | Contract Administration, Bidding and Award | lump sum | $ 2,800.00 | 1 | $ 2,800.00 |
| 1.6 | Administrative Costs | lump sum | $ 1,400.00 | 1 | $ 1,400.00 |
| 1.7 | Project Management | week | $ 3,500.00 | 3 | $ 10,500.00 |
| 1.8 | Monitor Well Consultant Cost | | | | |
| 1.9 | NPDES Construction Storm Water Permit, and other Permits | lump sum | $ 3,400.00 | 1 | $ 3,400.00 |
| 1.10 | Disposal of Final Wastes | | | | |
| 1.11 | Remove Temporary Buildings | | | | |
| 1.12 | Remove Equipment | | | | |
| 1.13 | Repair/Replace Perimeter Fencing | | | | |
| 1.14 | Clean Leachate Lines | | | | |
| | **SUBTOTAL** | | | | $ 53,620.00 |
| | **10% CONTINGENCY** | | | | $ 5,362.00 |
| | **ENGINEERING TOTAL** | | | | $ 58,982.00 |

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 2.0 | Construction | | | | |
| 2.1 | Final Cover System | cu yd | $ 4.00 | 34680 | $ 138,720.00 |
| 2.1.1 | Completion of Sidewall Liner | | | | |
| 2.1.1a | Soil Placement | | | | |
| 2.1.1b | Soil Processing | | | | |
| 2.1.1c | Soil Amendment | | | | |
| 2.1.1d | Soil Purchase | | | | |
| 2.1.1e | Transportation | | | | |
| 2.1.2 | Drainage Layer on Sidewall | | | | |
| 2.1.2a | Geotextile Filter Fabric | | | | |
| 2.1.2b | Geonet/Geotextile Composite | | | | |
| 2.1.2c | Geomembrane Sidewall Liner | | | | |
| 2.2 | Completion of Top Cover | | | | |
| 2.2.1 | Infiltration Layer | | | | |
| 2.2.1a | Soil Placement | | | | |
| 2.2.1b | Soil Processing | | | | |
| 2.2.1c | Soil Amendment | | | | |
| 2.2.1d | Soil Purchase | | | | |
| 2.2.1e | Transportation | | | | |
| 2.2.2 | Geosynthetic Clay Layer | | | | |
| 2.2.2a | Geosynthetic Clay Installation | | | | |
| 2.2.3 | Flexible Membrane Cover | | | | |
| 2.2.3a | Flexible Membrane Installation | | | | |
| 2.2.4 | Drainage Layer | | | | |
| 2.2.4a | Geonet/Geotextile | | | | |
| 2.2.4b | Sand Layer | | | | |
| 2.2.4c | Soil Cover | | | | |
| 2.2.4d | Geonet/Geotextile Composite | | | | |
| 2.3 | Erosion Layer Placement | | | | |
| 2.3.1 | Soil Purchase | | | | |
| 2.3.2 | Soil Transportation | | | | |
| 2.3.3 | Soil Processing | | | | |
| 2.3.4 | Soil Amendment | | | | |
| 2.3.5 | Soil Placement | | | | |

## CLOSURE COST ESTIMATE
## EVAPOTRANSPIRATION COVER (30")
## JUAB RURAL DEVELOPMENT AGENCY LANDFILL
### FOR PHASE 1 OF CLOSURE (8.6 ACRES)

| | | | | | |
|---|---|---|---|---|---|
| 2.4 | Revegetation | acre | $ 840.00 | 8.6 | $ 7,224.00 |
| 2.4.1 | Seeding | | | | |
| 2.4.2 | Fertilize | | | | |
| 2.4.3 | Mulch | | | | |
| 2.5 | Site Grading and Drainage | acre | $ 900.00 | 8.6 | $ 7,740.00 |
| 2.6 | Site Fencing and Security | ft | $ 19.00 | 4800 | $ 91,200.00 |
| 2.7 | Leachate Collection System Completion | | | | |
| | **SUBTOTAL** | | | | $ 244,884.00 |
| | **10% CONTINGENCY** | | | | $ 24,489.00 |
| | **CONSTRUCTION TOTAL** | | | | $ 269,373.00 |

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 3.0 | Gas Collection System | | | | |
| 3.1 | System Design | | | | |
| 3.2 | Completion of Gas Collection System | | | | |
| 3.3 | Equipment and Installation | | | | |
| 3.3.1 | Place Sand | | | | |
| 3.3.2 | Install Geonet and Geotextile | | | | |
| 3.3.3 | Install Passive Vents | | | | |
| 3.3.4 | Install, Rework or Replace Gas Control Equipment | | | | |
| | **SUBTOTAL** | | | | $ - |
| | **10% CONTINGENCY** | | | | $ - |
| | **GAS COLLECTION TOTAL** | | | | $ - |

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 4.0 | Monitor Well Installation Cost | | | | |
| 4.1 | Ground Water Monitoring, Well Installation, Reworking or Replacement | | | | |
| 4.2 | Install, Rework, or Replace Methane Probes | | | | |
| 4.3 | Monitor Well or Methane Probe Plugging | | | | |
| | **SUBTOTAL** | | | | $ - |
| | **10% CONTINGENCY** | | | | $ - |
| | **MONITOR WELL INSTALLATION TOTAL** | | | | $ - |

**SUBTOTAL** $ 328,355.00

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 5.0 | 2.5% Contract Performance Bond | | | | $ 8,209.00 |

**SUBTOTAL** $ 336,564.00

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 6.0 | Legal Fees | lump sum | $ 5,100.00 | 1 | $ 5,100.00 |

**TOTAL CLOSURE COSTS** **$ 341,664.00**

1 - 2015 dollars

## CLOSURE COST ESTIMATE
## EVAPOTRANSPIRATION COVER (30")
## JUAB RURAL DEVELOPMENT AGENCY LANDFILL
### FOR PHASES 2 THROUGH 6 OF CLOSURE (6.92 ACRES EACH)

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 1.0 | Engineering Computer Model | lump sum | $ 6,800.00 | 1 | $ 6,800.00 |
| 1.1 | Topographic Survey | hr | $ 120.00 | 20 | $ 2,400.00 |
| 1.2 | Boundary Survey for Affidavit | hr | $ 120.00 | 16 | $ 1,920.00 |
| 1.3 | Site Evaluation and Soil Testing | lump sum | $ 5,900.00 | 1 | $ 5,900.00 |
| 1.4 | Development of Plans | lump sum | $ 6,800.00 | 1 | $ 6,800.00 |
| 1.5 | Contract Administration, Bidding and Award | lump sum | $ 2,800.00 | 1 | $ 2,800.00 |
| 1.6 | Administrative Costs | lump sum | $ 1,400.00 | 1 | $ 1,400.00 |
| 1.7 | Project Management | week | $ 3,500.00 | 2 | $ 7,000.00 |
| 1.8 | Monitor Well Consultant Cost | | | | |
| 1.9 | NPDES Construction Storm Water Permit, and other Permits | lump sum | $ 3,400.00 | 1 | $ 3,400.00 |
| 1.10 | Disposal of Final Wastes | | | | |
| 1.11 | Remove Temporary Buildings | | | | |
| 1.12 | Remove Equipment | | | | |
| 1.13 | Repair/Replace Perimeter Fencing | | | | |
| 1.14 | Clean Leachate Lines | | | | |
| | **SUBTOTAL** | | | | $ 38,420.00 |
| | **10% CONTINGENCY** | | | | $ 3,842.00 |
| | **ENGINEERING TOTAL** | | | | $ 42,262.00 |

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 2.0 | Construction | | | | |
| 2.1 | Final Cover System | cu yd | $ 4.00 | 27900 | $ 111,600.00 |
| 2.1.1 | Completion of Sidewall Liner | | | | |
| 2.1.1a | Soil Placement | | | | |
| 2.1.1b | Soil Processing | | | | |
| 2.1.1c | Soil Amendment | | | | |
| 2.1.1d | Soil Purchase | | | | |
| 2.1.1e | Transportation | | | | |
| 2.1.2 | Drainage Layer on Sidewall | | | | |
| 2.1.2a | Geotextile Filter Fabric | | | | |
| 2.1.2b | Geonet/Geotextile Composite | | | | |
| 2.1.2c | Geomembrane Sidewall Liner | | | | |
| 2.2 | Completion of Top Cover | | | | |
| 2.2.1 | Infiltration Layer | | | | |
| 2.2.1a | Soil Placement | | | | |
| 2.2.1b | Soil Processing | | | | |
| 2.2.1c | Soil Amendment | | | | |
| 2.2.1d | Soil Purchase | | | | |
| 2.2.1e | Transportation | | | | |
| 2.2.2 | Geosynthetic Clay Layer | | | | |
| 2.2.2a | Geosynthetic Clay Installation | | | | |
| 2.2.3 | Flexible Membrane Cover | | | | |
| 2.2.3a | Flexible Membrane Installation | | | | |
| 2.2.4 | Drainage Layer | | | | |
| 2.2.4a | Geonet/Geotextile | | | | |
| 2.2.4b | Sand Layer | | | | |
| 2.2.4c | Soil Cover | | | | |
| 2.2.4d | Geonet/Geotextile Composite | | | | |
| 2.3 | Erosion Layer Placement | | | | |
| 2.3.1 | Soil Purchase | | | | |
| 2.3.2 | Soil Transportation | | | | |
| 2.3.3 | Soil Processing | | | | |
| 2.3.4 | Soil Amendment | | | | |
| 2.3.5 | Soil Placement | | | | |

## CLOSURE COST ESTIMATE
## EVAPOTRANSPIRATION COVER (30")
## JUAB RURAL DEVELOPMENT AGENCY LANDFILL
### FOR PHASES 2 THROUGH 6 OF CLOSURE (6.92 ACRES EACH)

| | | | | | |
|---|---|---|---|---|---|
| 2.4 | Revegetation | acre | $ 840.00 | 6.92 | $ 5,812.80 |
| 2.4.1 | Seeding | | | | |
| 2.4.2 | Fertilize | | | | |
| 2.4.3 | Mulch | | | | |
| 2.5 | Site Grading and Drainage | acre | $ 900.00 | 6.92 | $ 6,228.00 |
| 2.6 | Site Fencing and Security | ft | $ 15.00 | 1800 | $ 27,000.00 |
| 2.7 | Leachate Collection System Completion | | | | |
| | **SUBTOTAL** | | | | $ 150,641.00 |
| | **10% CONTINGENCY** | | | | $ 15,065.00 |
| | **CONSTRUCTION TOTAL** | | | | $ 165,706.00 |

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 3.0 | Gas Collection System | | | | |
| 3.1 | System Design | | | | |
| 3.2 | Completion of Gas Collection System | | | | |
| 3.3 | Equipment and Installation | | | | |
| 3.3.1 | Place Sand | | | | |
| 3.3.2 | Install Geonet and Geotextile | | | | |
| 3.3.3 | Install Passive Vents | | | | |
| 3.3.4 | Install, Rework or Replace Gas Control Equipment | | | | |
| | **SUBTOTAL** | | | | $ - |
| | **10% CONTINGENCY** | | | | $ - |
| | **GAS COLLECTION TOTAL** | | | | $ - |

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 4.0 | Monitor Well Installation Cost | | | | |
| 4.1 | Ground Water Monitoring, Well Installation, Reworking or Replacement | | | | |
| 4.2 | Install, Rework, or Replace Methane Probes | | | | |
| 4.3 | Monitor Well or Methane Probe Plugging | | | | |
| | **SUBTOTAL** | | | | $ - |
| | **10% CONTINGENCY** | | | | $ - |
| | **MONITOR WELL INSTALLATION TOTAL** | | | | $ - |

**SUBTOTAL** $ 207,968.00

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 5.0 | 2.5% Contract Performance Bond | | | | $ 5,199.00 |

**SUBTOTAL** $ 213,167.00

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 6.0 | Legal Fees | lump sum | $ 5,100.00 | 1 | $ 5,100.00 |

**TOTAL CLOSURE COSTS** **$ 218,267.00**

1 - 2015 dollars

## CLOSURE COST ESTIMATE
## EVAPOTRANSPIRATION COVER (30")
## JUAB RURAL DEVELOPMENT AGENCY LANDFILL
### FOR PHASE 7 CLOSURE (13.4 ACRES)

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 1.0 | Engineering Computer Model | lump sum | $ 6,800.00 | 1 | $ 6,800.00 |
| 1.1 | Topographic Survey | hr | $ 120.00 | 20 | $ 2,400.00 |
| 1.2 | Boundary Survey for Affidavit | hr | $ 120.00 | 16 | $ 1,920.00 |
| 1.3 | Site Evaluation and Soil Testing | lump sum | $ 5,900.00 | 1 | $ 5,900.00 |
| 1.4 | Development of Plans | lump sum | $ 6,800.00 | 1 | $ 6,800.00 |
| 1.5 | Contract Administration, Bidding and Award | lump sum | $ 2,800.00 | 1 | $ 2,800.00 |
| 1.6 | Administrative Costs | lump sum | $ 1,400.00 | 1 | $ 1,400.00 |
| 1.7 | Project Management | day | $ 3,500.00 | 4.5 | $ 15,750.00 |
| 1.8 | Monitor Well Consultant Cost | | | | |
| 1.9 | NPDES Construction Storm Water Permit, and other Permits | lump sum | $ 3,400.00 | 1 | $ 3,400.00 |
| 1.10 | Disposal of Final Wastes | | | | |
| 1.11 | Remove Temporary Buildings | | | | |
| 1.12 | Remove Equipment | | | | |
| 1.13 | Repair/Replace Perimeter Fencing | | | | |
| 1.14 | Clean Leachate Lines | | | | |
| | **SUBTOTAL** | | | | $ 47,170.00 |
| | **10% CONTINGENCY** | | | | $ 4,717.00 |
| | **ENGINEERING TOTAL** | | | | $ 51,887.00 |

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 2.0 | Construction | | | | |
| 2.1 | Final Cover System | cu yd | $ 4.00 | 54050 | $ 216,200.00 |
| 2.1.1 | Completion of Sidewall Liner | | | | |
| 2.1.1a | Soil Placement | | | | |
| 2.1.1b | Soil Processing | | | | |
| 2.1.1c | Soil Amendment | | | | |
| 2.1.1d | Soil Purchase | | | | |
| 2.1.1e | Transportation | | | | |
| 2.1.2 | Drainage Layer on Sidewall | | | | |
| 2.1.2a | Geotextile Filter Fabric | | | | |
| 2.1.2b | Geonet/Geotextile Composite | | | | |
| 2.1.2c | Geomembrane Sidewall Liner | | | | |
| 2.2 | Completion of Top Cover | | | | |
| 2.2.1 | Infiltration Layer | | | | |
| 2.2.1a | Soil Placement | | | | |
| 2.2.1b | Soil Processing | | | | |
| 2.2.1c | Soil Amendment | | | | |
| 2.2.1d | Soil Purchase | | | | |
| 2.2.1e | Transportation | | | | |
| 2.2.2 | Geosynthetic Clay Layer | | | | |
| 2.2.2a | Geosynthetic Clay Installation | | | | |
| 2.2.3 | Flexible Membrane Cover | | | | |
| 2.2.3a | Flexible Membrane Installation | | | | |
| 2.2.4 | Drainage Layer | | | | |
| 2.2.4a | Geonet/Geotextile | | | | |
| 2.2.4b | Sand Layer | | | | |
| 2.2.4c | Soil Cover | | | | |
| 2.2.4d | Geonet/Geotextile Composite | | | | |
| 2.3 | Erosion Layer Placement | | | | |
| 2.3.1 | Soil Purchase | | | | |
| 2.3.2 | Soil Transportation | | | | |
| 2.3.3 | Soil Processing | | | | |
| 2.3.4 | Soil Amendment | | | | |
| 2.3.5 | Soil Placement | | | | |

## CLOSURE COST ESTIMATE
## EVAPOTRANSPIRATION COVER (30")
## JUAB RURAL DEVELOPMENT AGENCY LANDFILL
### FOR PHASE 7 CLOSURE (13.4 ACRES)

| | | | | | |
|---|---|---|---|---|---|
| 2.4 | Revegetation | acre | $ 840.00 | 13.4 | $ 11,256.00 |
| 2.4.1 | Seeding | | | | |
| 2.4.2 | Fertilize | | | | |
| 2.4.3 | Mulch | | | | |
| 2.5 | Site Grading and Drainage | acre | $ 900.00 | 13.4 | $ 12,060.00 |
| 2.6 | Site Fencing and Security | ft | $ 21.00 | 2140 | $ 44,940.00 |
| 2.7 | Leachate Collection System Completion | | | | |
| | **SUBTOTAL** | | | | $ 284,456.00 |
| | **10% CONTINGENCY** | | | | $ 28,446.00 |
| | **CONSTRUCTION TOTAL** | | | | $ 312,902.00 |

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 3.0 | Gas Collection System | | | | |
| 3.1 | System Design | | | | |
| 3.2 | Completion of Gas Collection System | | | | |
| 3.3 | Equipment and Installation | | | | |
| 3.3.1 | Place Sand | | | | |
| 3.3.2 | Install Geonet and Geotextile | | | | |
| 3.3.3 | Install Passive Vents | | | | |
| 3.3.4 | Install, Rework or Replace Gas Control Equipment | | | | |
| | **SUBTOTAL** | | | | $ - |
| | **10% CONTINGENCY** | | | | $ - |
| | **GAS COLLECTION TOTAL** | | | | $ - |

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 4.0 | Monitor Well Installation Cost | | | | |
| 4.1 | Ground Water Monitoring, Well Installation, Reworking or Replacement | | | | |
| 4.2 | Install, Rework, or Replace Methane Probes | | | | |
| 4.3 | Monitor Well or Methane Probe Plugging | | | | |
| | **SUBTOTAL** | | | | $ - |
| | **10% CONTINGENCY** | | | | $ - |
| | **MONITOR WELL INSTALLATION TOTAL** | | | | $ - |

**SUBTOTAL** $ 364,789.00

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 5.0 | 2.5% Contract Performance Bond | | | | $ 9,120.00 |

**SUBTOTAL** $ 373,909.00

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 6.0 | Legal Fees | lump sum | $ 5,600.00 | 1 | $ 5,600.00 |

**TOTAL CLOSURE COSTS** **$ 379,509.00**

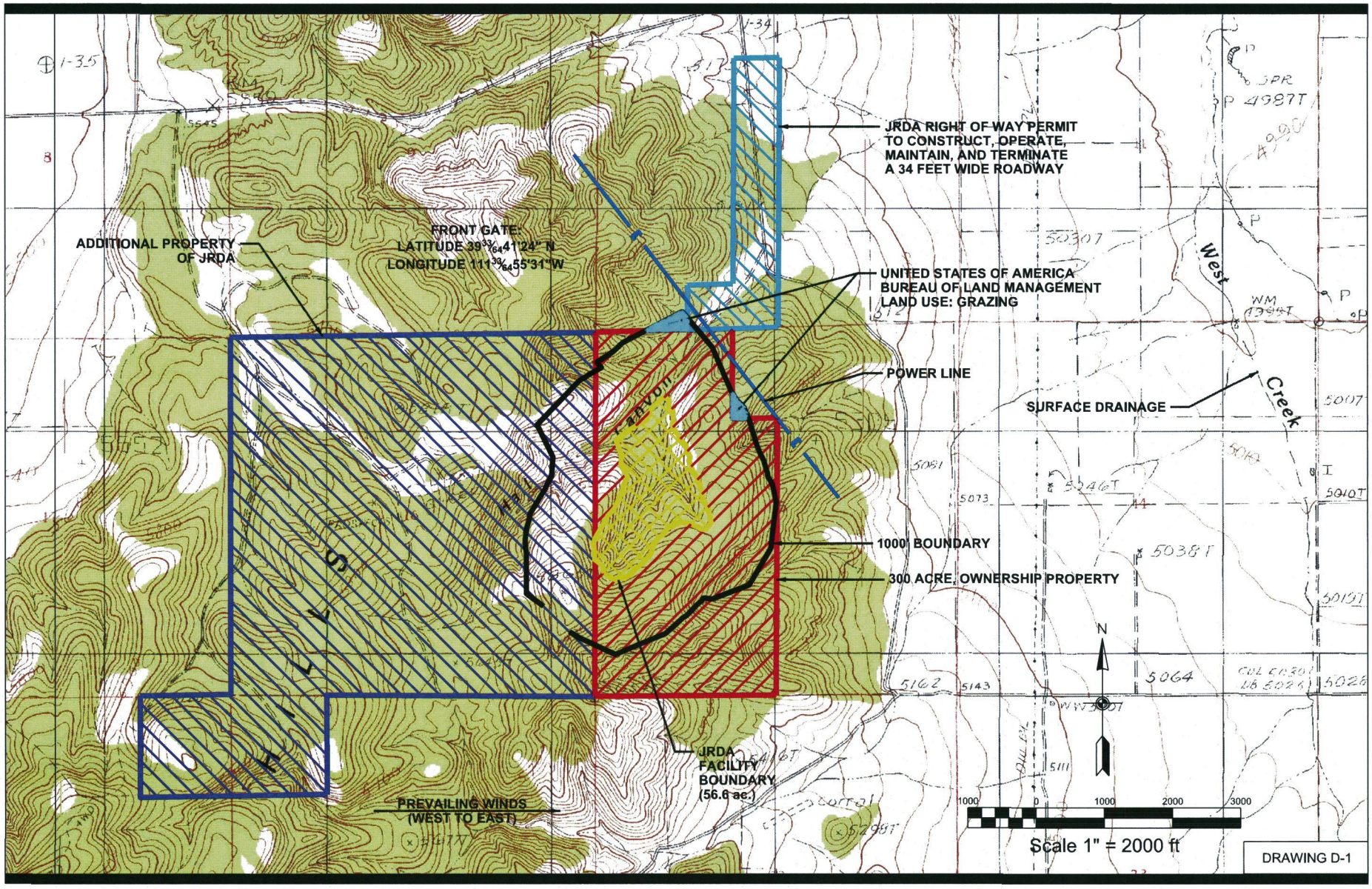
1 - 2015 dollars

# POST-CLOSURE COST ESTIMATE
# EVAPOTRANSPIRATION COVER (30")
# JUAB RURAL DEVELOPMENT AGENCY LANDFILL
## TOTAL EXPECTED COST (OVER 88 YEARS)

| | ITEM | UNIT | UNIT COST[1] | QUANTITY | TOTAL COST[1] |
|---|---|---|---|---|---|
| 1.0 | Engineering Costs | | | | |
| 1.1 | Post-Closure Plan and Permits | lump sum | $ 2,800.00 | 7 | $ 19,600.00 |
| 1.2 | Site Inspection and Record Keeping (Quarterly) | quarter | $ 240.00 | 352 | $ 84,480.00 |
| 1.3 | Correctional Plans and Specifications | ea | $ 2,800.00 | 7 | $ 19,600.00 |
| 1.4 | Site Monitoring | | | | |
| 1.4.1 | Ground Water Monitoring | | | | |
| 1.4.1a | Ground Water Sample Collection | | | | |
| 1.4.1b | Ground Water Sample Analysis | | | | |
| 1.4.1c | Ground Water Sample Analysis Review and Reporting | | | | |
| 1.4.2 | Landfill Gas Monitoring | | | | |
| 1.4.2a | Gas Monitoring Data Collection | quarter | $ 170.00 | 352 | $ 59,840.00 |
| 1.4.2b | Gas Monitoring Data Review and Reporting | quarter | $ 170.00 | 352 | $ 59,840.00 |
| 2.0 | Maintenance Costs | | | | |
| 2.1 | Cover Maintenance Costs | | | | |
| 2.1.1 | Soil Replacement | year | $ 1,700.00 | 88 | $ 149,600.00 |
| 2.1.2 | Vegetation Reseeding | year | $ 560.00 | 88 | $ 49,280.00 |
| 2.2 | Equipment Maintenance | | | | |
| 2.2.1 | Ground Water Well Maintenance and Replacement | | | | |
| 2.2.2 | Methane Probe Maintenance and Replacement | | | | |
| 2.2.3 | Gas Collection System Operation | | | | |
| 2.2.4 | Gas Collection System Maintenance and Repair | | | | |
| 2.2.5 | Leachate Collection System | | | | |
| 2.2.5a | Leachate Collection System Repair and Maintenance | | | | |
| 2.2.5b | Clean Leachate Lines | | | | |
| 3.0 | Final Plugging of Monitoring Wells | | | | |
| 3.1 | Final Plugging of Methane Probes | | | | |
| 3.2 | Final Plugging of Ground Water Monitoring Wells | | | | |
| 3.3 | Gas Control Equipment Removal | | | | |
| 4.0 | Leachate Disposal | | | | |
| 5.0 | Site Maintenance | | | | |
| 5.1 | Repair of Surface Water Diversion Structures | year | $ 560.00 | 88 | $ 49,280.00 |
| 5.2 | Repair of Fences and Gates | year | $ 560.00 | 88 | $ 49,280.00 |
| 5.3 | General Maintenance | year | $ 560.00 | 88 | $ 49,280.00 |
| 6.0 | Demonstration of Stability | lump sum | $ 1,700.00 | 7 | $ 11,900.00 |
| | **SUBTOTAL** | | | | $ 601,980.00 |
| | **10% CONTINGENCY** | | | | $ 60,198.00 |
| | **POST-CLOSURE CARE TOTAL** | | | | $ 662,178.00 |

1 - 2015 dollars

# Appendix D – Drawings

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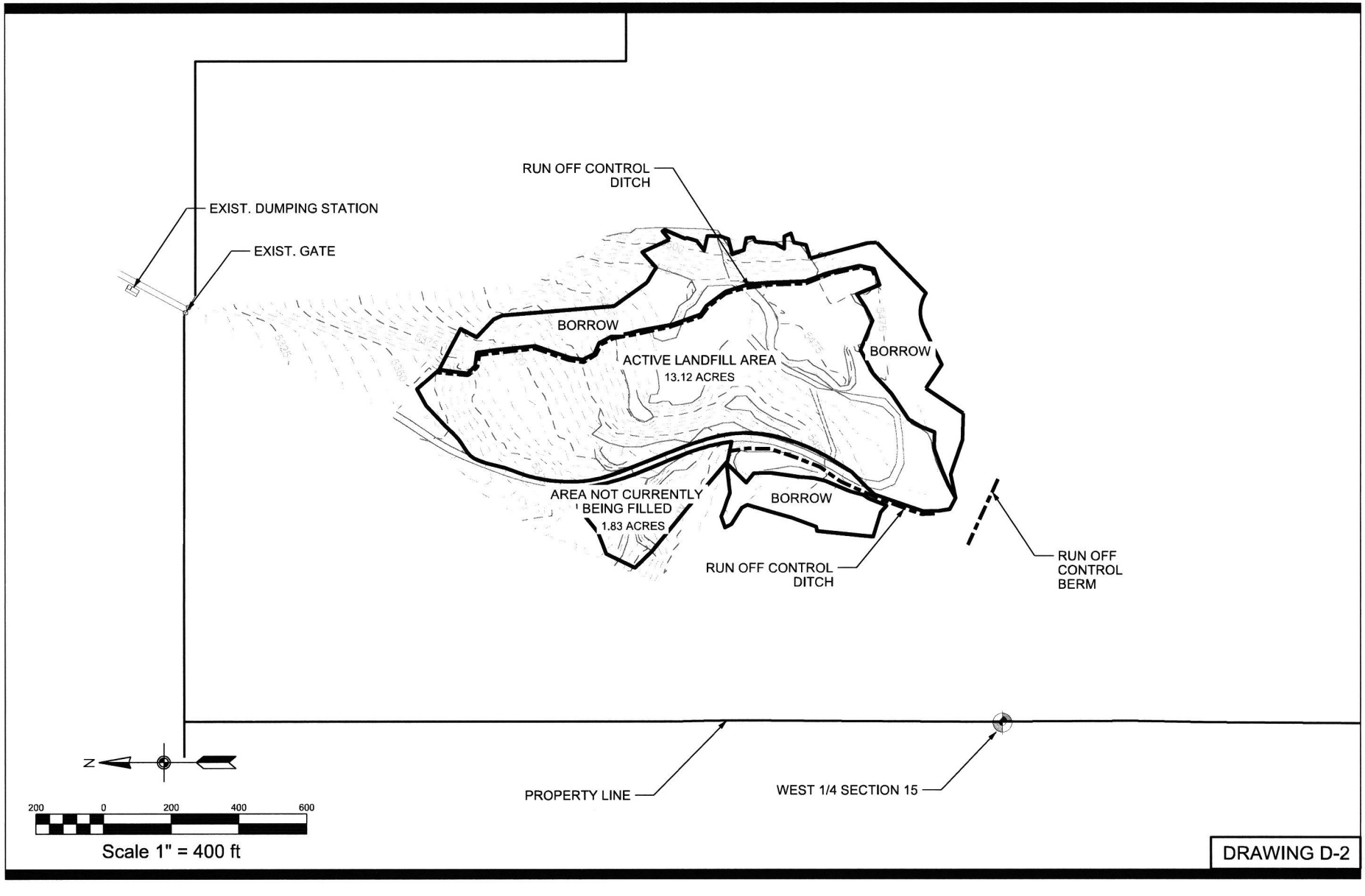
U.S. GEOLOGICAL SURVEY TOPOGRAPHICAL MAP
SUGARLOAF QUADRANGLE
UTAH - JUAB COUNTY

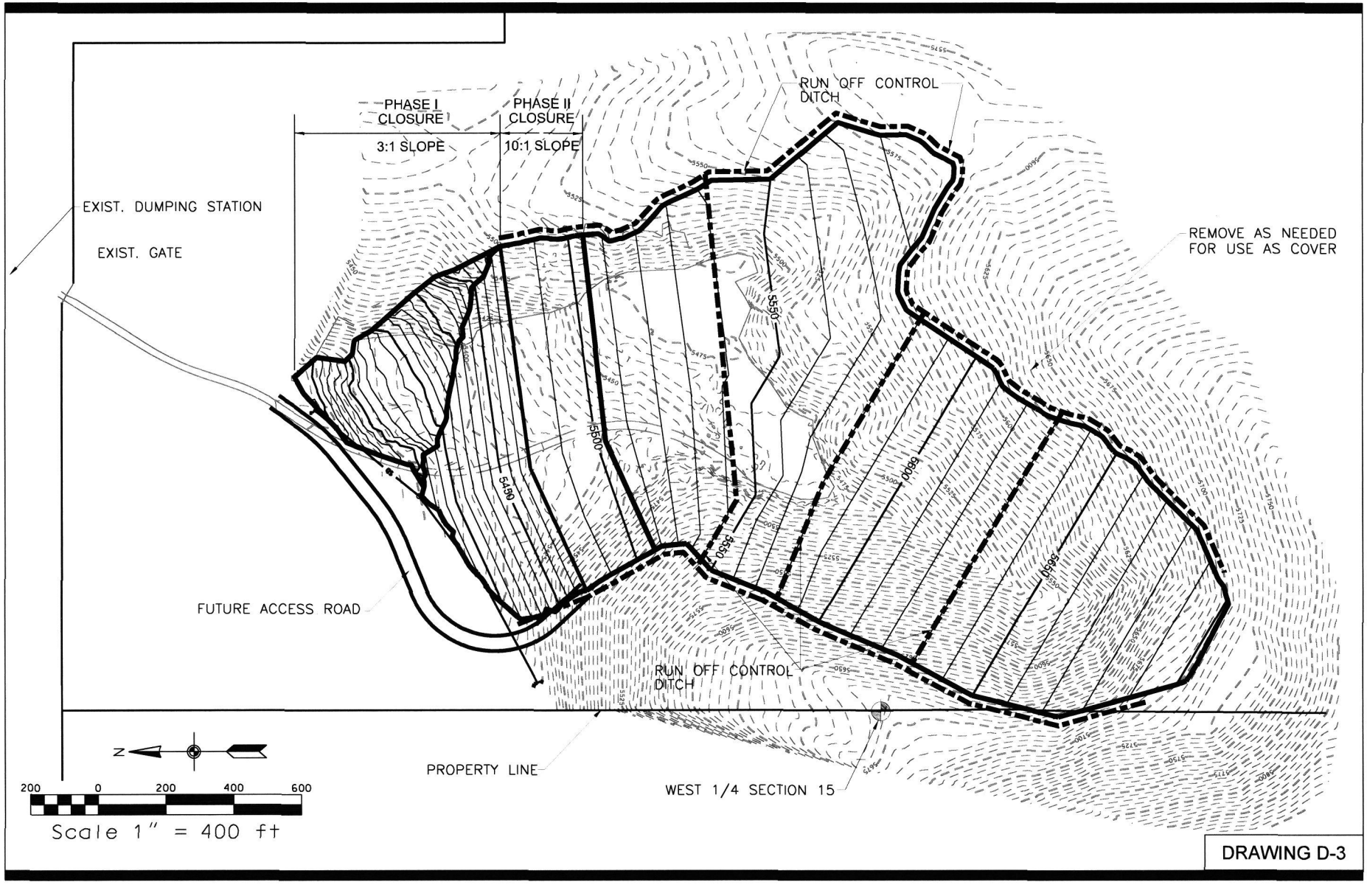
**RENEWAL APPLICATION**
**JUAB RURAL DEVELOPMENT AGENCY**
**CLASS II AND CLASS IV LANDFILL**




RB&G ENGINEERING, INC.

EXISTING LANDFILL & BORROW AREAS

**RENEWAL APPLICATION**
**JUAB RURAL DEVELOPMENT AGENCY**
**CLASS II AND CLASS IV LANDFILL**

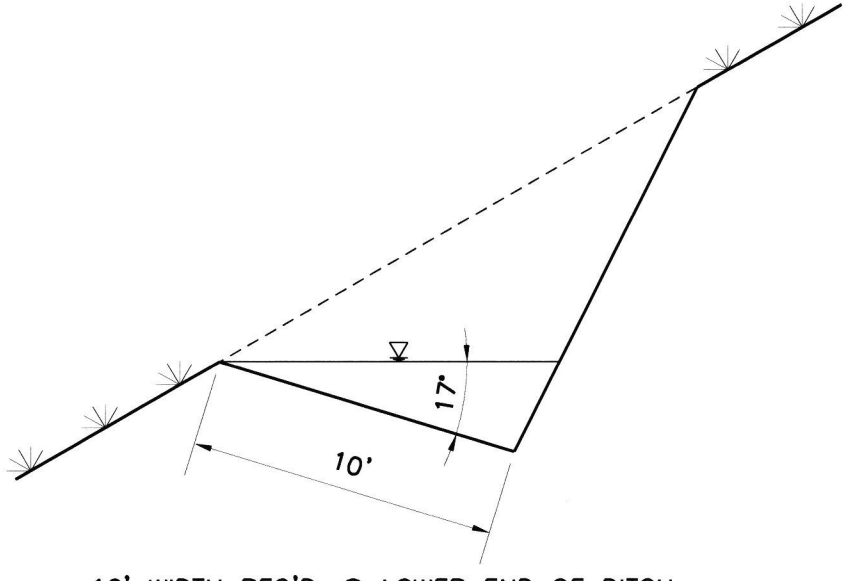



DRAWING D-3

RB&G ENGINEERING, INC.

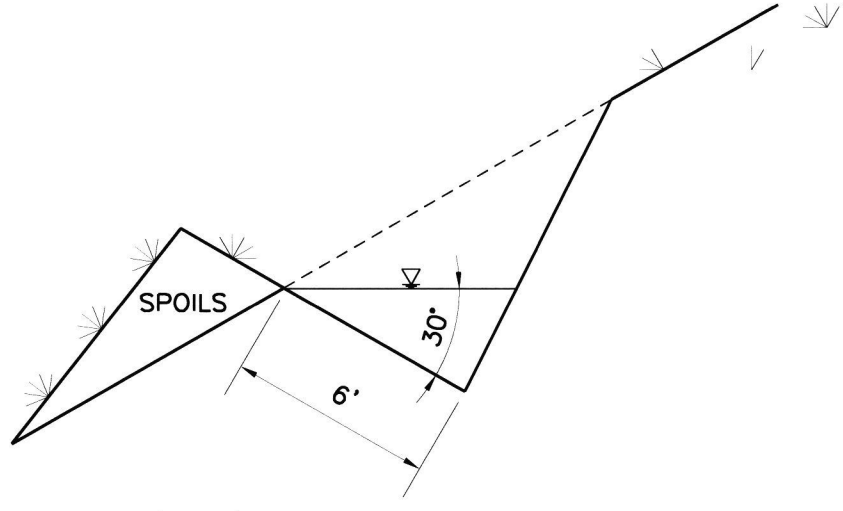
FINAL CLOSURE DESIGN

**RENEWAL APPLICATION**
**JUAB RURAL DEVELOPMENT AGENCY**
**CLASS II AND CLASS IV LANDFILL**




10' WIDTH REQ'D. @ LOWER END OF DITCH.
7' WIDTH REQ'D. @ UPPER END OF DITCH.

## RUN OFF CONTROL




6' REQ'D. @ LOWER END OF DITCH

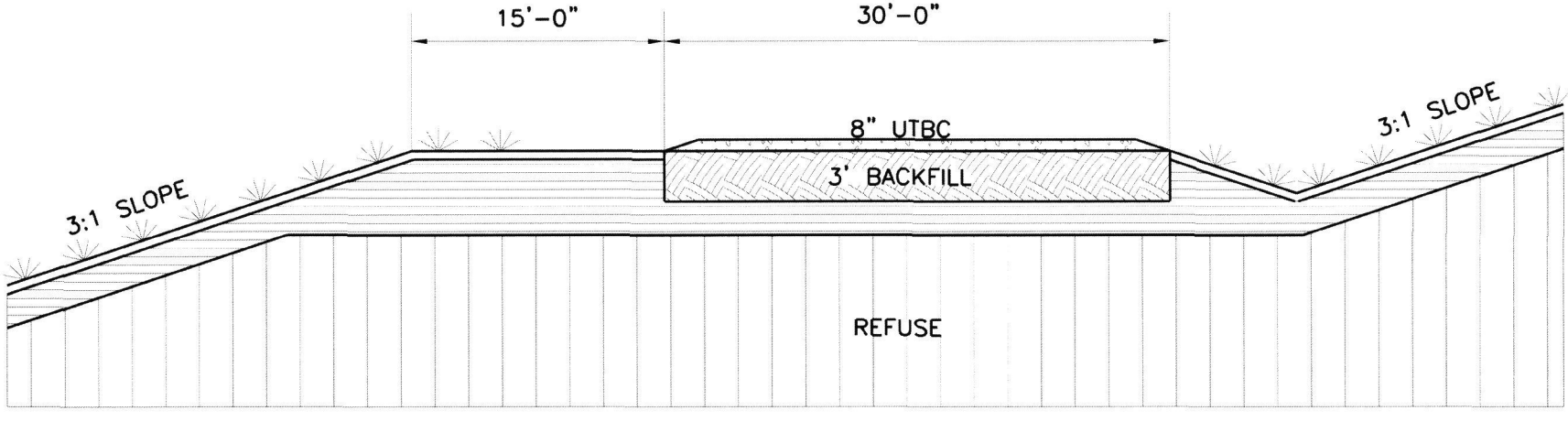
## RUN ON CONTROL

DRAWING D-4

RB&G ENGINEERING, INC.

RUN ON/ RUN OFF CONTROL DITCHES

**RENEWAL APPLICATION**
**JUAB RURAL DEVELOPMENT AGENCY**
**CLASS II AND CLASS IV LANDFILL**




# FUTURE ACCESS ROAD
# OVER REFUSE

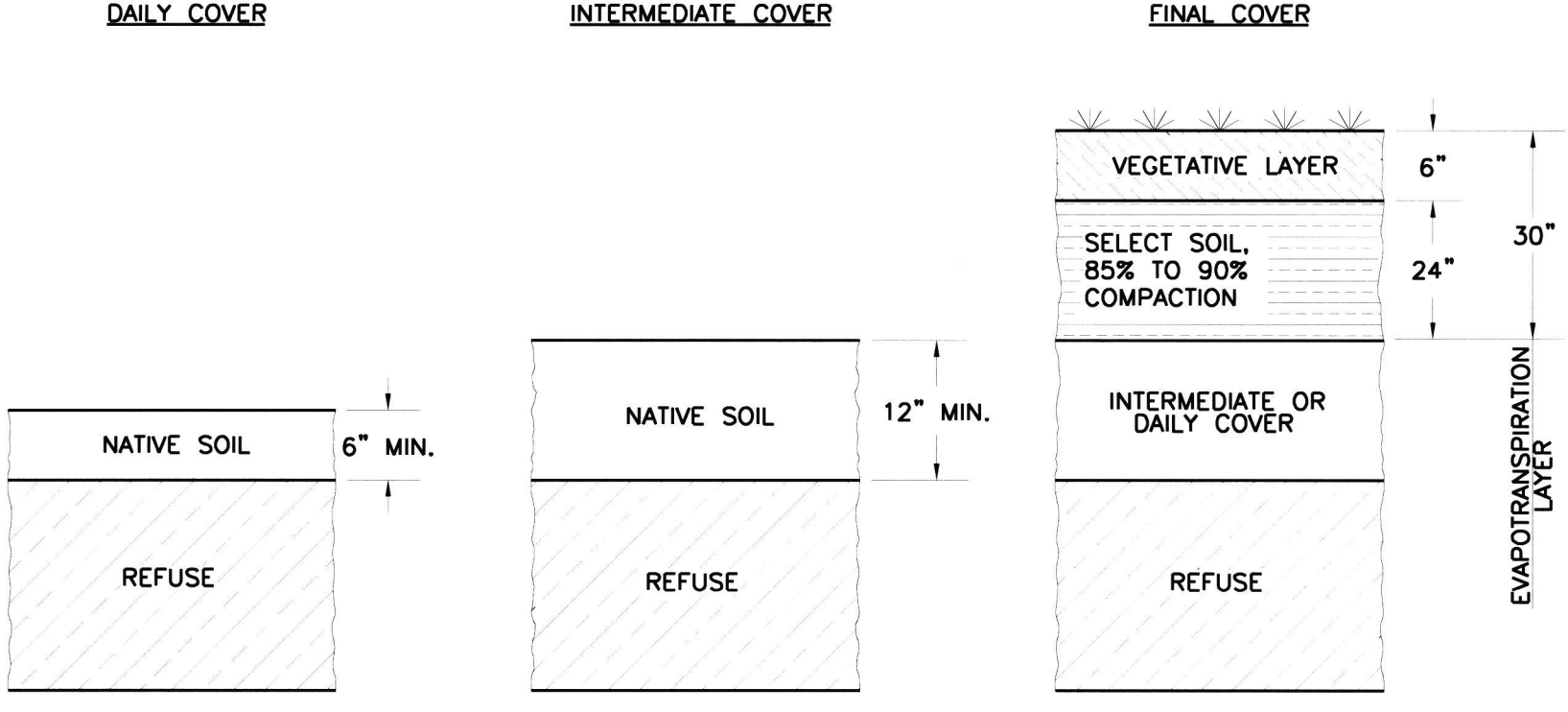
DRAWING D-5

RB&G
ENGINEERING, INC.

FUTURE ACCESS ROAD SECTION

**RENEWAL APPLICATION**
**JUAB RURAL DEVELOPMENT AGENCY**
**CLASS II AND CLASS IV LANDFILL**

# COVER DESIGN



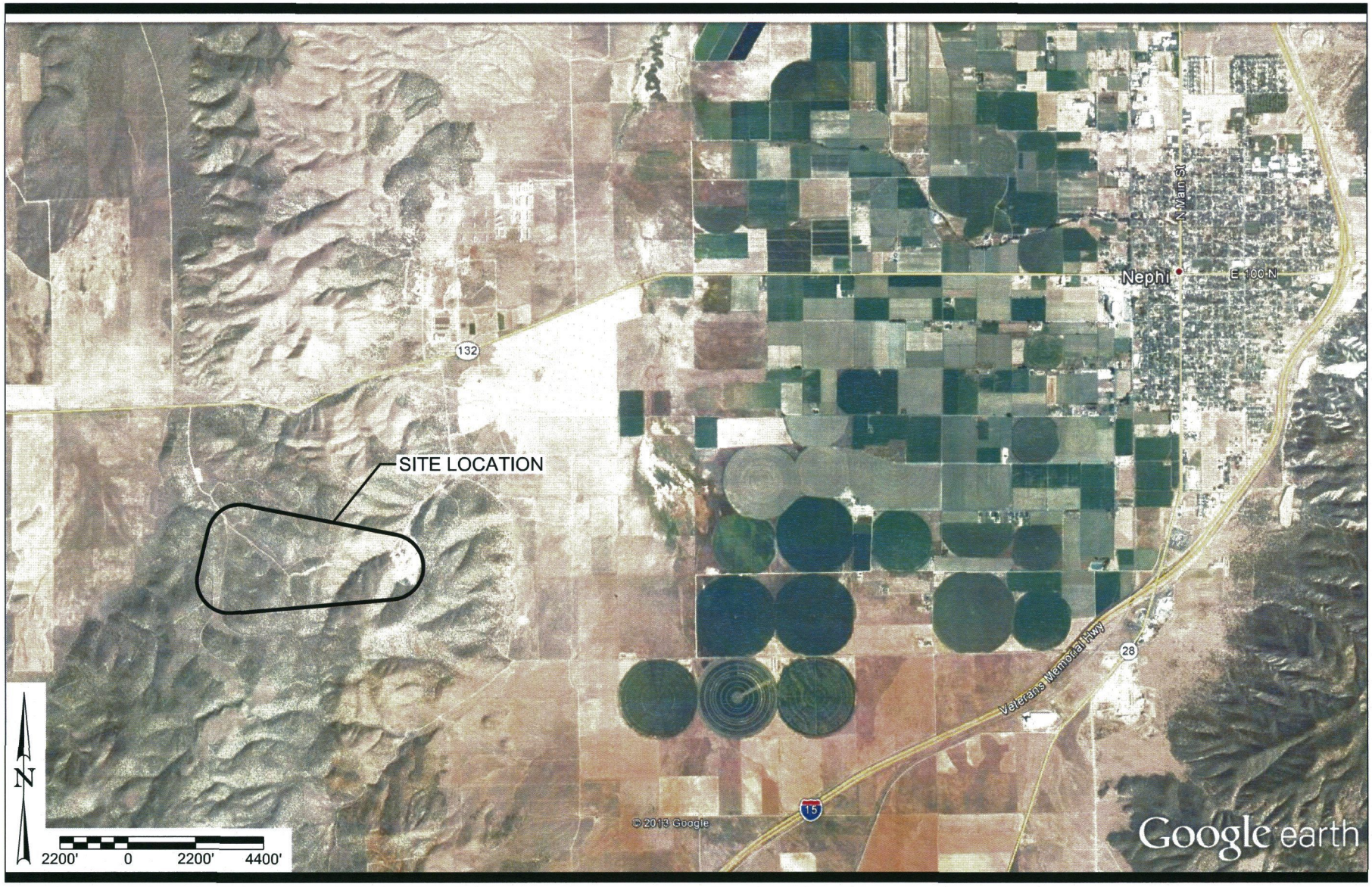

DRAWING D-6

RB&G ENGINEERING, INC.

COVER DESIGN

**RENEWAL APPLICATION**
**JUAB RURAL DEVELOPMENT AGENCY**
**CLASS II AND CLASS IV LANDFILL**

# Appendix E – Soil Testing

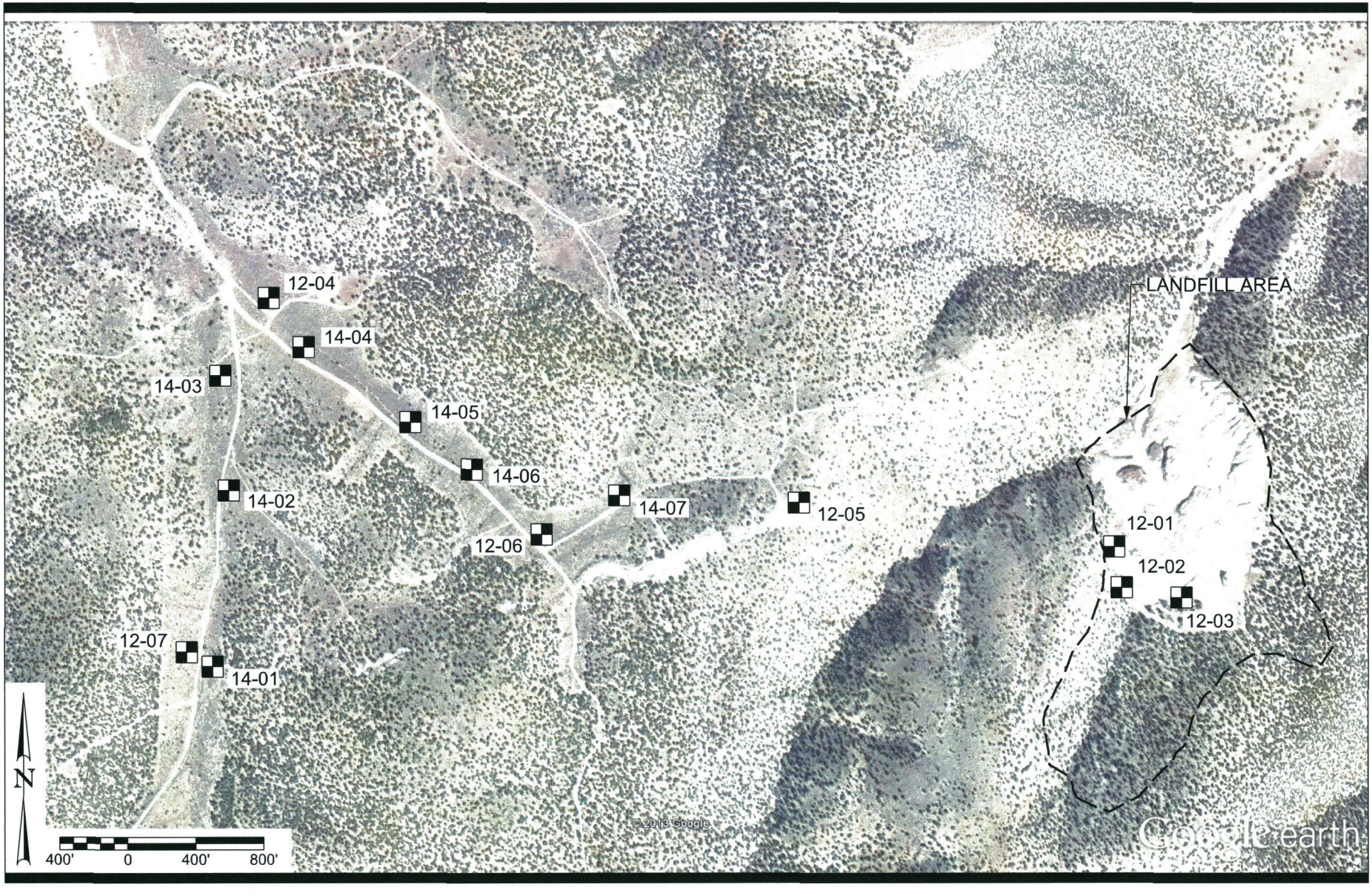



RB&G ENGINEERING, INC.

Figure 1 VICINITY MAP

*Juab RDA Landfill*

*Nephi, Juab County, Utah*




RB&G ENGINEERING, INC.

Figure 2 SITE PLAN & TEST HOLE LOCATIONS

*Juab RDA Landfill*

*Nephi, Juab County, Utah*

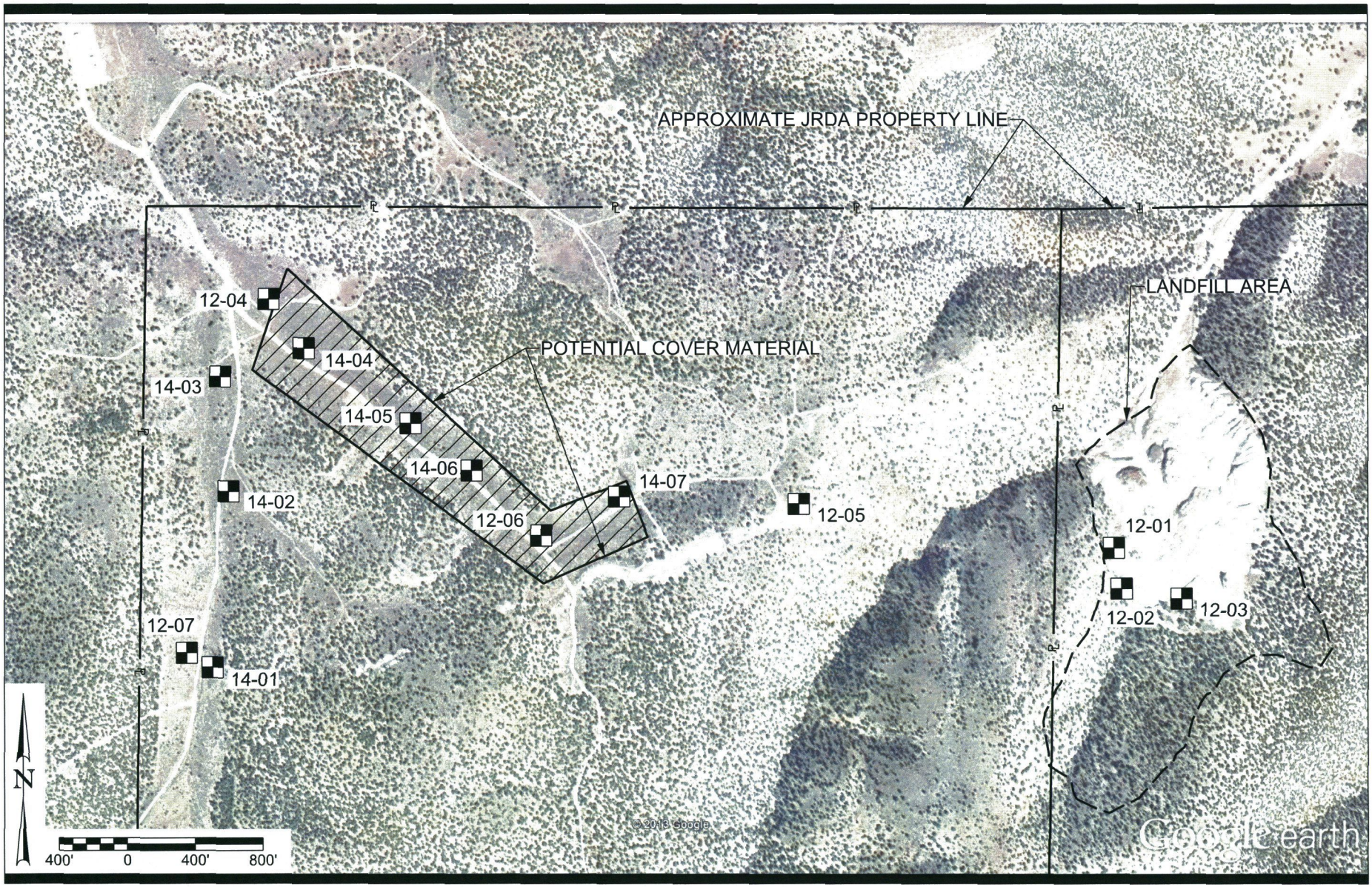



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Figure 3 LOCATION OF POTENTIAL COVER MATERIAL

*Juab RDA Landfill*

*Nephi, Juab County, Utah*

RB&G
ENGINEERING, INC.

**Table 1**

# SUMMARY OF TEST DATA

PROJECT Juab County Landfill
LOCATION Nephi, UT
PROJECT NO.
FEATURE Test Pits

| HOLE NO. | DEPTH BELOW GROUND SURFACE (ft) | IN-PLACE | | Permeability @ Approx. 89% compaction of ASTM D-698 | ATTERBERG LIMITS | | | MECHANICAL ANALYSIS | | | PERCENT FINER THAN 0.005 mm | UNIFIED SOIL CLASSIFICATION SYSTEM / (AASHTO CLASSIFICATION) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | DRY UNIT WEIGHT (pcf) | MOISTURE (%) | | LIQUID LIMIT (%) | PLASTIC LIMIT (%) | PLASTICITY INDEX (%) | PERCENT GRAVEL | PERCENT SAND | PERCENT SILT & CLAY | | |
| TP 12-01 | 1-3 | | 8.8 | | | | NP | 36 | 36 | 28 | | SM |
| TP 12-02 | 1-3 | | 9.6 | | | | NP | 26 | 61 | 13 | | SM |
| TP 12-03 | 1-3 | | 8.4 | | | | NP | 39 | 46 | 15 | | SM |
| | | | | | | | | | | | | |
| TP 12-04 | 2-3 | | 10.1 | 3.25 ft/yr 3.14 X 10e6 cm/sec | 27 | 20 | 7 | 2 | 31 | 67 | 22.1 | CL-ML |
| TP 12-06 | 2-3 | | 10.5 | 2.03 ft/ yr 1.96 X 10e6 cm/ sec | 29 | 19 | 10 | 1 | 28 | 71 | 28.1 | CL |
| TP 12-07 | 2-3 | | 10.2 | | | | NP | 35 | 44 | 21 | | SM |

NP=Non-Plastic

# TEST PIT LOG

## TEST PIT NO. 12-01

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** DOZER
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 11/1/12
**DATE COMPLETED:** 11/1/12
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | ML | brown, dry — SANDY SILT organics | | | | | | | | |
| | 1 | | | | | | | | | | | | | | |
| | 2 | | | | | SM | lt. brown, moist — SILTY SAND W/GRAVEL becoming slightly cemented w/depth | | 8.8 | | NP | 36 | 36 | 28 | |
| | 3 | | | | | | | | | | | | | | |
| | 4 | | | | | | BOH | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE — Bucket ← Sample Type
0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

## TEST PIT NO. 12-02

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** DOZER
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 11/1/12
**DATE COMPLETED:** 11/1/12
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | ML | brown, dry — SANDY SILT organics | | | | | | | | |
| | 1 | | | | | | | | | | | | | | |
| | 2 | | | | | SM | lt. brown, moist — SILTY SAND W/GRAVEL becoming slightly cemented w/depth | | 9.6 | | NP | 26 | 61 | 13 | |
| | 3 | | | | | | | | | | | | | | |
| | 4 | | | | | | BOH | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE — Bucket ← Sample Type; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

## TEST PIT NO. 12-03

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** DOZER
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 11/1/12
**DATE COMPLETED:** 11/1/12
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | Sample USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | | | | | | | | | | | | | |
| | 2 | | | | | | SILTY SAND W/GRAVEL<br>becoming slightly cemented w/depth | | | | | | | | |
| | 3 | | | | | SM | lt. brown, moist | | 8.4 | | NP | 39 | 46 | 15 | |
| | 4 | | | | | | | | | | | | | | |
| | 5 | | | | | | BOH | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE
UNDISTURBED SAMPLE
Bucket ← Sample Type
0.45 ← Torvane (tsf)

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

## TEST PIT NO. 12-04

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** RUBBER TIRE BACKHOE
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 11/1/12
**DATE COMPLETED:** 11/1/12
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | CL | dk. brown, moist — LEAN CLAY W/SAND organics | | | | | | | | |
| | 1 | | | | | | | | | | | | | | |
| | 2 | | | | | | SANDY SILTY CLAY | | | | | | | | |
| | | | | | | CL-ML | brown, slightly moist | | 10.1 | 27 | 7 | 2 | 31 | 67 | |
| | 3 | | | | | | | | | | | | | | |
| | | | | | | CL-ML | lt. brown, slightly moist — SANDY SILTY CLAY W/GRAVEL gravels increasing w/depth | | | | | | | | |
| | 4 | | | | | | | | | | | | | | |
| | | | | | | GM | lt. brown, slightly moist — SILTY GRAVEL W/SAND | | | | | | | | |
| | 5 | | | | | | BOH | | | | | | | | |

TP_UDOT_LOGV1_NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE — Bucket ← Sample Type
0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

## TEST PIT NO. 12-05

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** RUBBER TIRE BACKHOE
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 11/1/12
**DATE COMPLETED:** 11/1/12
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | SM | brown, slightly moist SILTY SAND W/GRAVEL | | | | | | | | |
| | 1 | | | | | | BEDROCK | | | | | | | | |
| | 2 | | | | | | BOH | | | | | | | | |
| | 3 | | | | | | | | | | | | | | |
| | 4 | | | | | | | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE — Bucket ← Sample Type
0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

# TEST PIT NO. 12-06

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** RUBBER TIRE BACKHOE
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 11/1/12
**DATE COMPLETED:** 11/1/12
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | CL | dk. brown, moist — LEAN CLAY W/SAND organics | | | | | | | | |
| | 1 | | | | | | | | | | | | | | |
| | 2 | | | | | CL | brown, slightly moist — LEAN CLAY W/SAND | | 10.5 | 29 | 10 | 1 | 28 | 71 | |
| | 3 | | | | | | | | | | | | | | |
| | 4 | | | | | | | | | | | | | | |
| | 5 | | | | | CL | lt. brown, slightly moist | | | | | | | | |
| | 6 | | | | | | SANDY LEAN CLAY | | | | | | | | |
| | 7 | | | | | | | | | | | | | | |
| | 8 | | | | | CL | lt. brown, slightly moist | | | | | | | | |
| | | | | | | GM | lt. brown, slightly moist — SILTY GRAVEL W/SAND | | | | | | | | |
| | 9 | | | | | | BOH | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE — Bucket ← Sample Type; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

# TEST PIT NO. 12-07

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** RUBBER TIRE BACKHOE
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 11/1/12
**DATE COMPLETED:** 11/1/12
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | CL | dk. brown, moist — SANDY LEAN CLAY organics | | | | | | | | |
| | 1 | | | | | | | | | | | | | | |
| | 2 | | | | | | SILTY SAND W/GRAVEL | | | | | | | | |
| | | | | | | SM | lt. brown, moist | | 10.3 | | NP | 35 | 44 | 21 | |
| | 3 | | | | | | BOH | | | | | | | | |
| | 4 | | | | | | | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE — Bucket ← Sample Type
0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

## TEST PIT NO. 14-01

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** 120 TRACKHOE
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 3/6/14
**DATE COMPLETED:** 3/6/14
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | CL | dk. brown, moist — LEAN CLAY W/SAND organics | | | | | | | | |
| | 1 | | | | | | | | | | | | | | |
| | 2 | | | | | CL | lt. brown, slightly moist — LEAN CLAY W/SAND | | | | | | | | |
| | 3 | | | | | | | | | | | | | | |
| | 4 | | | | | SM | lt. brown, slightly moist — SILTY SAND W/GRAVEL | | | | | | | | |
| | 5 | | | | | | BOH | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE — Bucket ← Sample Type; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

## TEST PIT NO. 14-02

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** 120 TRACKHOE
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 3/6/14
**DATE COMPLETED:** 3/6/14
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | | | | CL | dk. brown, moist — LEAN CLAY W/SAND organics | | | | | | | | |
| | 2 | | | | | CL | lt. brown, slightly moist — SANDY LEAN CLAY W/GRAVEL | | | | | | | | |
| | 3 | | | | | GM | lt. brown, slightly moist — SILTY GRAVEL W/SAND | | | | | | | | |
| | 4 | | | | | | BOH | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE — Bucket ← Sample Type; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

## TEST PIT NO. 14-03

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** 120 TRACKHOE
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 3/6/14
**DATE COMPLETED:** 3/6/14
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | Sample USCS (AASHTO) | Material Description | | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | | | | CL | dk. to lt. brown, moist to slightly moist | LEAN CLAY W/SAND organics in top 12" | | | | | | | | |
| | 2 | | | | | GM | lt. brown, slightly moist | SILTY GRAVEL W/SAND | | | | | | | | |
| | | | | | | | | BOH | | | | | | | | |
| | 3 | | | | | | | | | | | | | | | |
| | 4 | | | | | | | | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE
UNDISTURBED SAMPLE
Bucket ← Sample Type
0.45 ← Torvane (tsf)

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

## TEST PIT NO. 14-04

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** 120 TRACKHOE
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 3/6/14
**DATE COMPLETED:** 3/6/14
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | CL | dk. brown, moist — LEAN CLAY W/SAND organics | | | | | | | | |
| | 1 | | | | | | | | | | | | | | |
| | 2 | | | | | CL | lt. brown, slightly moist — LEAN CLAY W/SAND | | | | | | | | |
| | 3 | | | | | | | | | | | | | | |
| | 4 | | | | | | | | | | | | | | |
| | 5 | | | | | CL-ML | lt. brown, slightly moist — SANDY SILTY CLAY W/GRAVEL gravels increasing w/depth | | | | | | | | |
| | 6 | | | | | | BOH | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE — Bucket ← Sample Type
0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

## TEST PIT NO. 14-05

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** 120 TRACKHOE
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 3/6/14
**DATE COMPLETED:** 3/6/14
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | | | | CL | dk. brown, moist — LEAN CLAY W/SAND organics | | | | | | | | |
| | 2 | | | | | CL | brown, slightly moist — LEAN CLAY W/SAND | | | | | | | | |
| | 3 | | | | | | | | | | | | | | |
| | 4 | | | | | | | | | | | | | | |
| | 5 | | | | | CL | lt. brown, slightly moist | | | | | | | | |
| | 6 | | | | | | SANDY LEAN CLAY more sandy w/depth | | | | | | | | |
| | 7 | | | | | | | | | | | | | | |
| | 8 | | | | | CL | lt. brown, slightly moist | | | | | | | | |
| | | | | | | GM | lt. brown, slightly moist — SILTY GRAVEL W/SAND cobbles | | | | | | | | |
| | 9 | | | | | | BOH | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE
UNDISTURBED SAMPLE
Bucket ← Sample Type
0.45 ← Torvane (tsf)

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

## TEST PIT NO. 14-06

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** 120 TRACKHOE
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 3/6/14
**DATE COMPLETED:** 3/6/14
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | CL | dk. brown, moist — LEAN CLAY W/SAND organics | | | | | | | | |
| | 1 | | | | | | | | | | | | | | |
| | 2 | | | | | CL | brown, slightly moist | | | | | | | | |
| | 3 | | | | | | | | | | | | | | |
| | 4 | | | | | | SANDY LEAN CLAY | | | | | | | | |
| | 5 | | | | | | | | | | | | | | |
| | 6 | | | | | CL | lt. brown, slightly moist | | | | | | | | |
| | 7 | | | | | | | | | | | | | | |
| | 8 | | | | | GM | lt. brown, slightly moist — SILTY GRAVEL W/SAND cobbles | | | | | | | | |
| | | | | | | | BOH | | | | | | | | |
| | 9 | | | | | | | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE
UNDISTURBED SAMPLE
Bucket ← Sample Type
0.45 ← Torvane (tsf)

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

## TEST PIT NO. 14-07

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** 120 TRACKHOE
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 3/6/14
**DATE COMPLETED:** 3/6/14
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | CL | dk. brown, moist — SANDY LEAN CLAY organics | | | | | | | | |
| | 1 | | | | | | | | | | | | | | |
| | 2 | | | | | CL | lt. brown, slightly moist — SANDY LEAN CLAY | | | | | | | | |
| | 3 | | | | | | | | | | | | | | |
| | 4 | | | | | | | | | | | | | | |
| | 5 | | | | | | | | | | | | | | |
| | 6 | | | | | | | | | | | | | | |
| | 7 | | | | | | SANDY SILTY CLAY trace gravels | | | | | | | | |
| | 8 | | | | | CL-ML | lt. brown, slightly moist | | | | | | | | |
| | 9 | | | | | GM | lt. brown, slightly moist — SILTY GRAVEL W/SAND | | | | | | | | |
| | 10 | | | | | | BOH | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE — Bucket ← Sample Type, 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# Earthtec Testing, Inc.

133 North 1330 West
Orem, Utah 84057
225-5711

3534 Eccles Ave
Ogden, Utah 84403
399-9516

May 08, 1997

Sunrise Engineering
% Joe Santos
25 East 500 North
Fillmore, Utah 84631

Subject: Results of Laboratory Tests
Samples brought to our office 04-15-97
Job No. 97T-109

Gentlemen:

The results of laboratory test conducted on the samples submitted to our office are as follows:

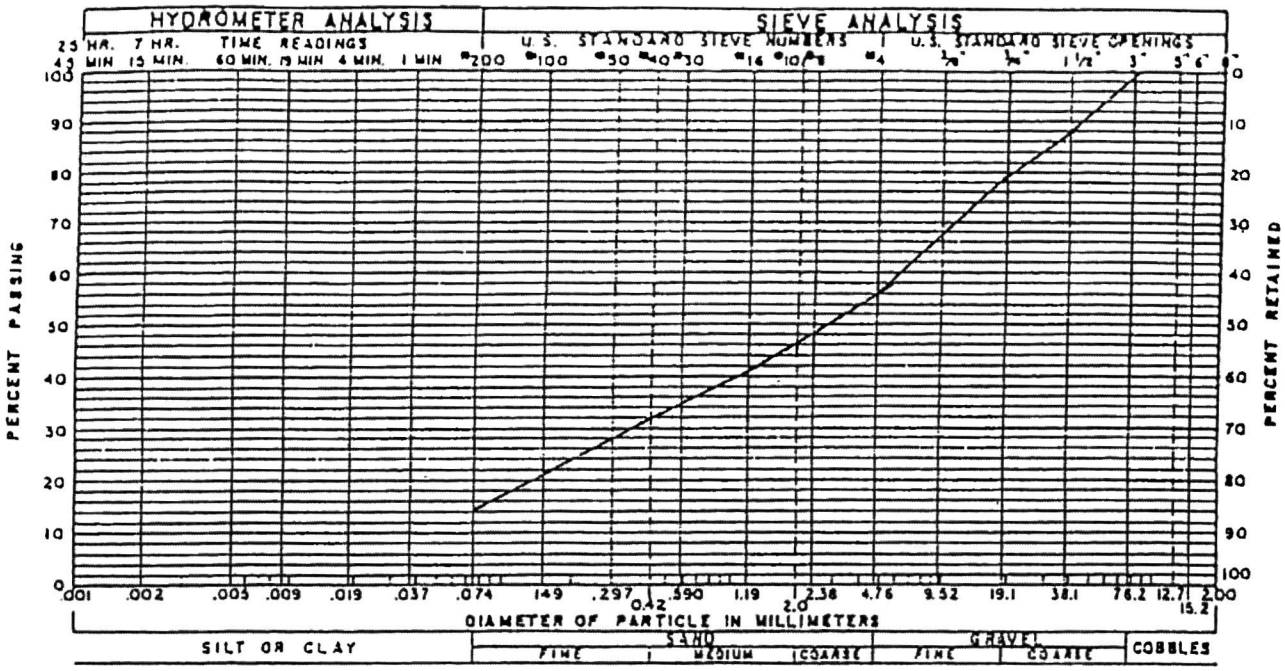
| SIEVE SIZE | NORTH LINER | SOUTH LINER | EAST LINER | WEST LINER |
|---|---|---|---|---|
| 1 ½" | | 83 | 78 | 89 |
| 3/4" | 94 | 77 | 75 | 80 |
| 3/8" | 86 | | | |
| No. 4 | 80 | 58 | 64 | 56 |
| No. 16 | 69 | 42 | 55 | 40 |
| No. 40 | | 35 | 51 | 31 |
| No. 50 | 55 | | | |
| No. 100 | 42 | | | |
| No. 200 | 30 | 22 | 38 | 14 |
| GRAVEL % | 20 | 42 | 37 | 44 |
| SAND % | 50 | 36 | 25 | 42 |
| FINES % | 30 | 22 | 38 | 14 |
| LIQUID LIMIT | 60 | 48 | 43 | 43 |
| PLASTICITY INDEX | 39 | 22 | 14 | 16 |
| PERMEABILITY | $K_{sv}$=1.07 x $10^{-4}$ cm/s | $K_{sv}$=8.19 x $10^{-7}$ cm/s | $K_{sv}$=1.18 x $10^{-4}$ cm/s | $K_{sv}$=7.08 x $10^{-7}$ cm/s |

If you have any questions, please call.

Sincerely,
EARTHTEC TESTING, INC.

Steven L. Smith, P.E.
Principal Engineer

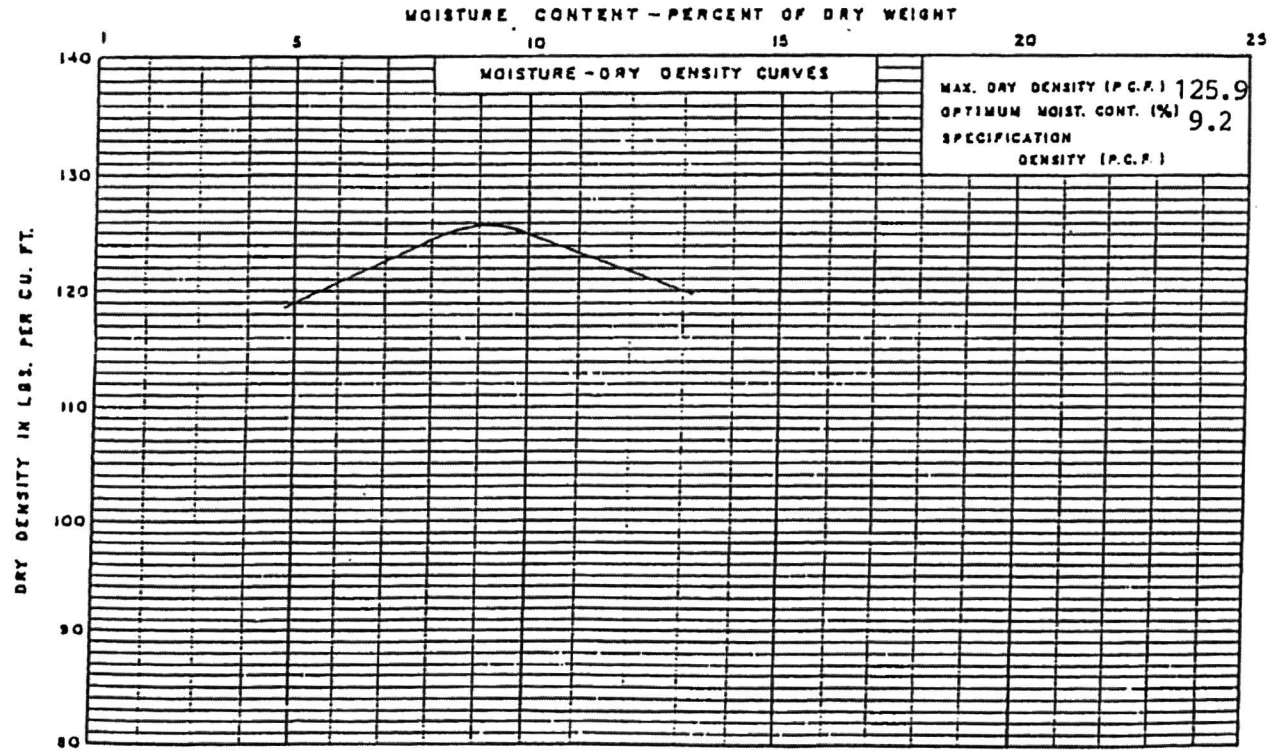
E/E




## GRADATION TEST RESULTS

GRAVEL 44 % SAND 42 % SILT AND CLAY 14 %

LIQUID LIMIT % PLASTICITY INDEX %




## COMPACTION TEST RESULTS

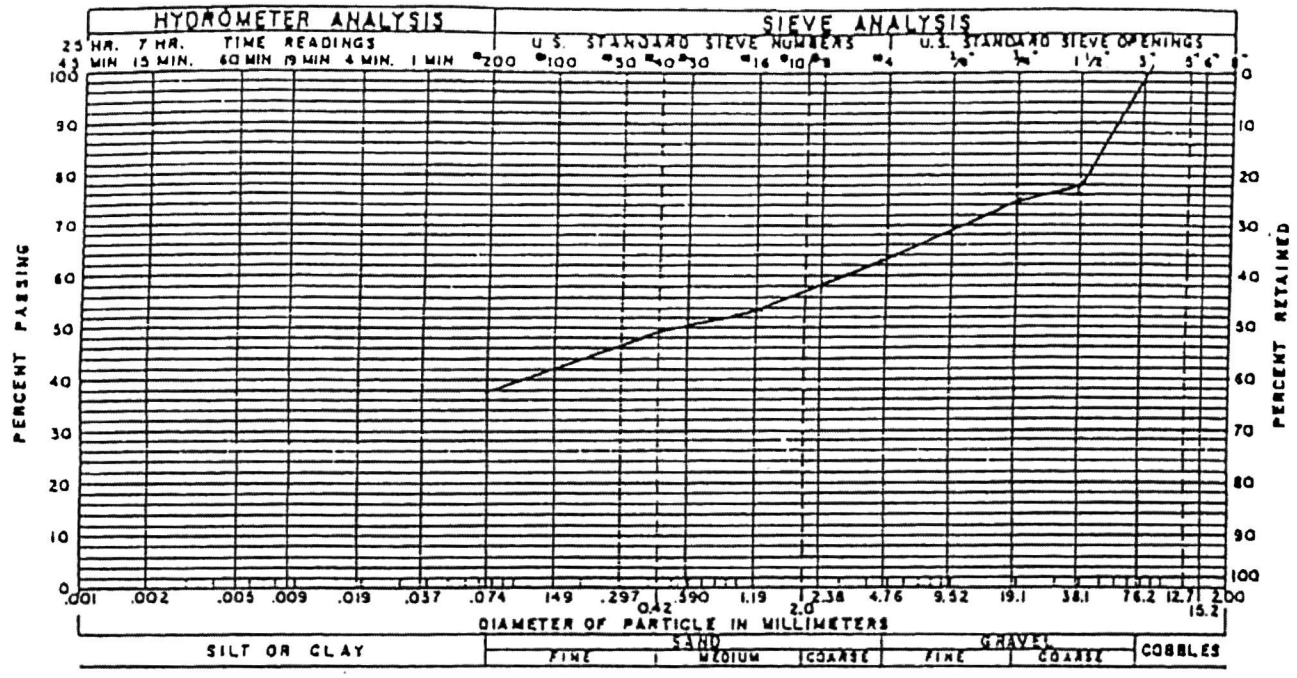
COMPACTION TEST PROCEDURE ASTM D 1557

SAMPLE OF GRAVEL (GM), sandy, silty

FROM West Liner Natural Moisture Content

97T-109 Sunrise 05-01-97

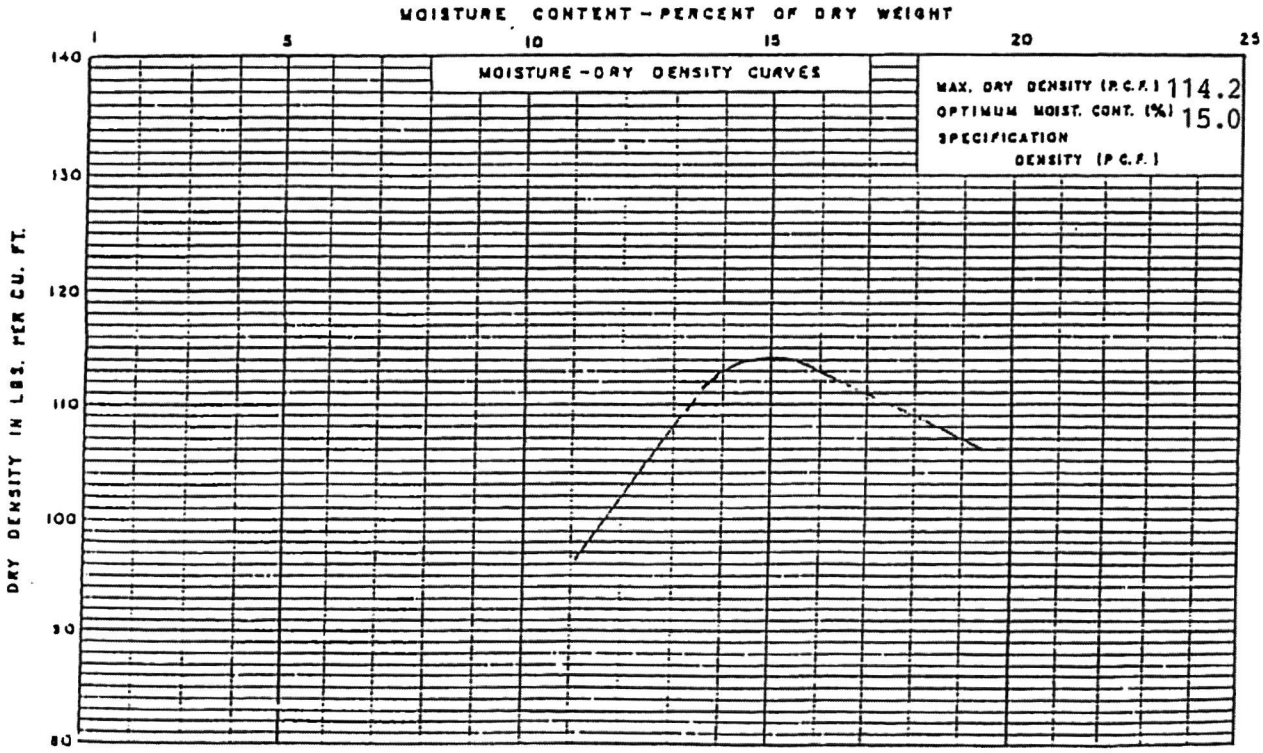
ETE




## GRADATION TEST RESULTS

GRAVEL 37 % SAND 25% SILT AND CLAY 38 %

LIQUID LIMIT % PLASTICITY INDEX %




## COMPACTION TEST RESULTS

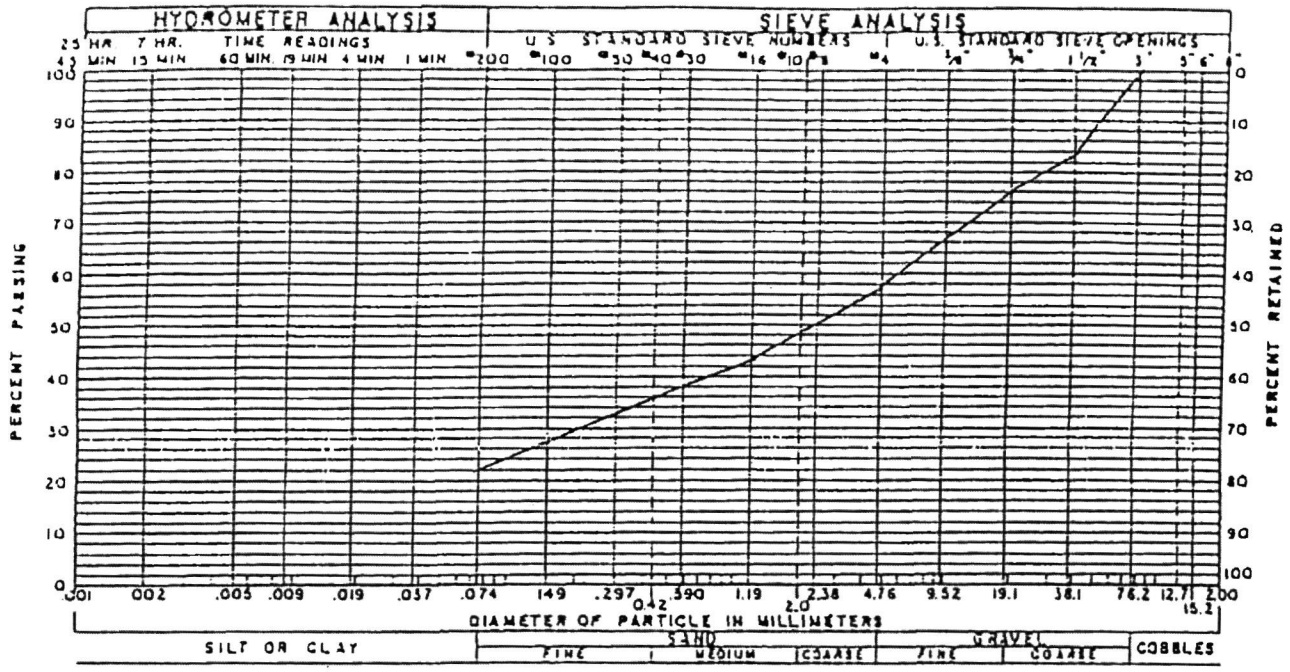
COMPACTION TEST PROCEDURE ASTM D 1557

SAMPLE OF GRAVEL (GC), clayey, sandy

FROM East Liner Natural Moisture Content

97T-109 Sunrise 05-01-97

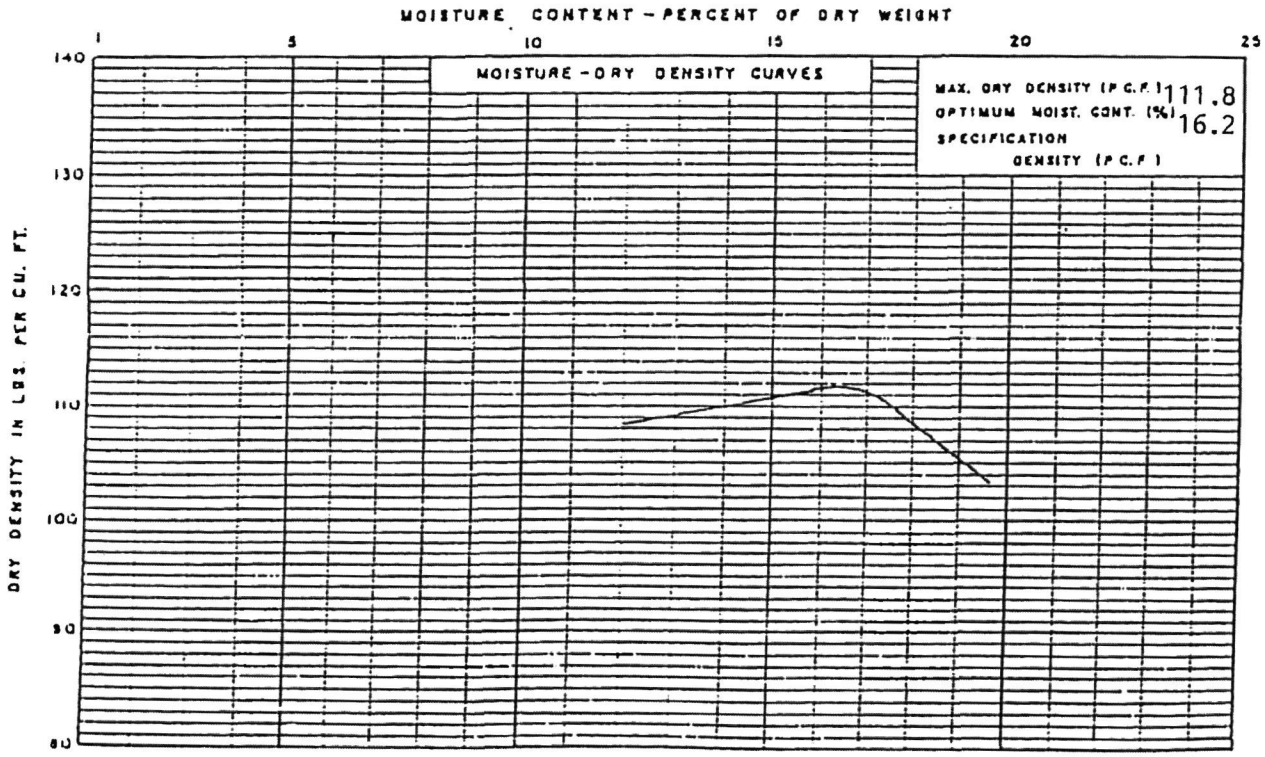
E/E




## GRADATION TEST RESULTS

GRAVEL 42 % SAND 36 % SILT AND CLAY 22 %

LIQUID LIMIT % PLASTICITY INDEX %




## COMPACTION TEST RESULTS

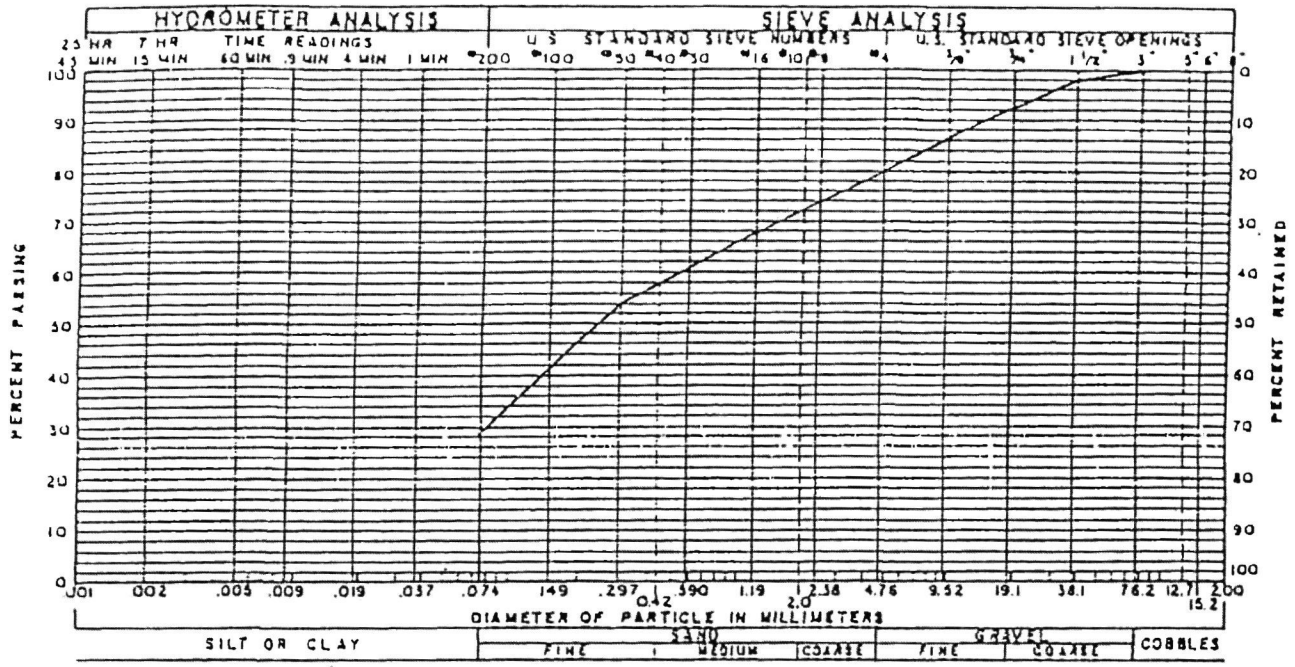
COMPACTION TEST PROCEDURE ASTM D 1557

SAMPLE OF GRAVEL (GC), sandy, clayey

FROM South Liner Natural Moisture Content

97T-109 Sunrise 05-01-97

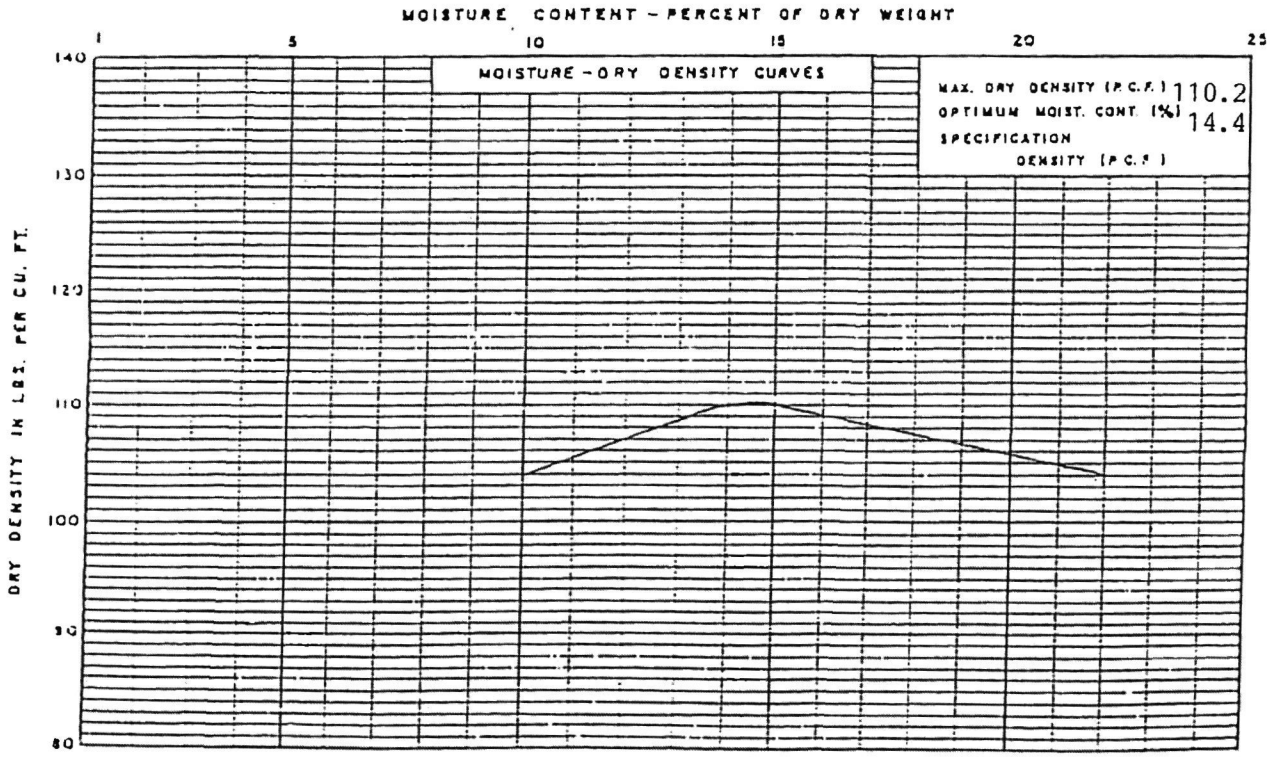
ETE




## GRADATION TEST RESULTS

GRAVEL 20 % SAND 50% SILT AND CLAY 30 %

LIQUID LIMIT % PLASTICITY INDEX %




## COMPACTION TEST RESULTS

COMPACTION TEST PROCEDURE ASTM D 1557

SAMPLE OF SAND (SC), clayey, gravelly

FROM North Liner Natural Moisture Content

97T-109 Sunrise

05-01-97

# Appendix F – Hydrology and Hydraulics

# POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

**Utah 39.69 N 111.925278 W 5344 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: Wed Apr 11 2007

Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Help | Docs | U.S. Map

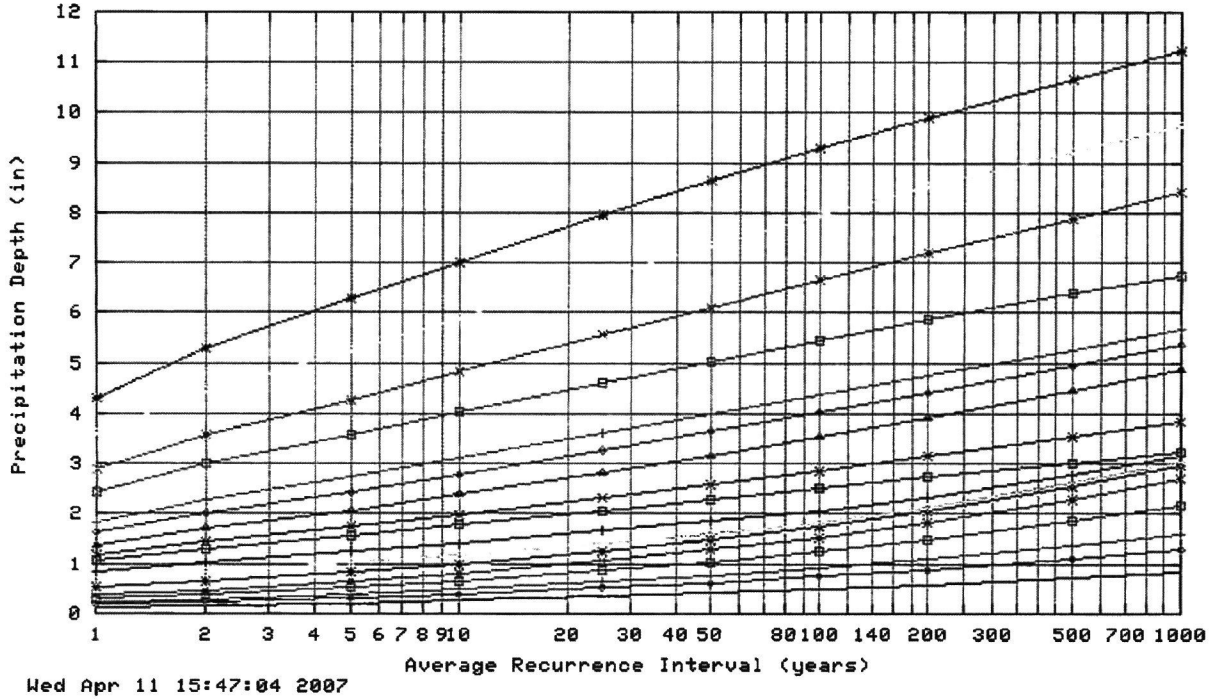
**Precipitation Frequency Estimates (inches)**

| 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 | 60 day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.12 | 0.18 | 0.22 | 0.30 | 0.37 | 0.46 | 0.52 | 0.67 | 0.84 | 1.06 | 1.18 | 1.39 | 1.64 | 1.85 | 2.43 | 2.90 | 3.63 | 4.32 |
| 2 | 0.15 | 0.23 | 0.28 | 0.38 | 0.47 | 0.58 | 0.65 | 0.82 | 1.03 | 1.30 | 1.45 | 1.71 | 2.02 | 2.27 | 2.99 | 3.57 | 4.45 | 5.30 |
| 5 | 0.21 | 0.32 | 0.39 | 0.53 | 0.65 | 0.77 | 0.84 | 1.02 | 1.25 | 1.56 | 1.74 | 2.08 | 2.44 | 2.74 | 3.57 | 4.27 | 5.27 | 6.27 |
| 10 | 0.26 | 0.40 | 0.49 | 0.66 | 0.82 | 0.94 | 1.01 | 1.18 | 1.43 | 1.78 | 1.99 | 2.39 | 2.79 | 3.11 | 4.03 | 4.83 | 5.92 | 7.02 |
| 25 | 0.34 | 0.52 | 0.64 | 0.86 | 1.06 | 1.21 | 1.26 | 1.42 | 1.68 | 2.06 | 2.33 | 2.83 | 3.28 | 3.61 | 4.61 | 5.56 | 6.74 | 7.96 |
| 50 | 0.41 | 0.62 | 0.77 | 1.04 | 1.29 | 1.45 | 1.47 | 1.61 | 1.87 | 2.29 | 2.60 | 3.18 | 3.65 | 3.99 | 5.04 | 6.11 | 7.35 | 8.64 |
| 100 | 0.49 | 0.74 | 0.92 | 1.24 | 1.54 | 1.71 | 1.74 | 1.84 | 2.07 | 2.51 | 2.87 | 3.54 | 4.04 | 4.38 | 5.46 | 6.65 | 7.95 | 9.29 |
| 200 | 0.58 | 0.89 | 1.10 | 1.48 | 1.83 | 2.03 | 2.05 | 2.13 | 2.31 | 2.73 | 3.15 | 3.92 | 4.44 | 4.76 | 5.87 | 7.19 | 8.52 | 9.92 |
| 500 | 0.73 | 1.11 | 1.37 | 1.85 | 2.29 | 2.51 | 2.54 | 2.62 | 2.76 | 3.03 | 3.54 | 4.44 | 4.97 | 5.27 | 6.39 | 7.90 | 9.24 | 10.68 |
| 1000 | 0.86 | 1.30 | 1.61 | 2.17 | 2.69 | 2.94 | 2.97 | 3.04 | 3.16 | 3.25 | 3.83 | 4.86 | 5.38 | 5.66 | 6.76 | 8.41 | 9.75 | 11.23 |

Text version of table

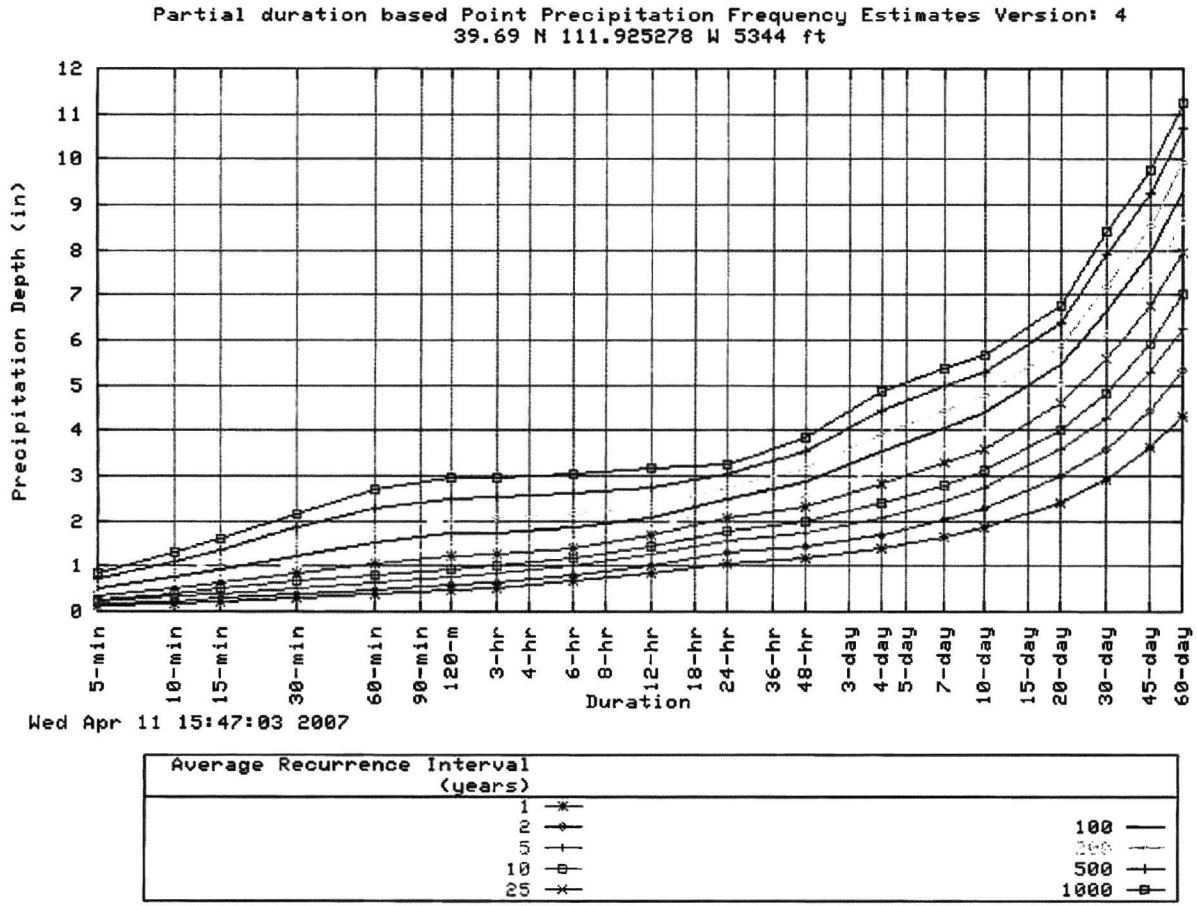
* These precipitation frequency estimates are based on a partial duration series. **ARI** is the Average Recurrence Interval. Please refer to the documentation for more information. NOTE: Formatting forces estimates near zero to appear as zero.

Partial duration based Point Precipitation Frequency Estimates Version: 4
39.69 N 111.925278 W 5344 ft




Wed Apr 11 15:47:04 2007

| Duration | | | |
|---|---|---|---|
| 5-min | | 48-hr | 30-day |
| 10-min | 3-hr | 4-day | |
| 15-min | | 7-day | 60-day |
| 30-min | 12-hr | 10-day | |
| 60-min | 24-hr | 20-day | |




## Confidence Limits -

*** 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 | 60 day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.14 | 0.20 | 0.25 | 0.34 | 0.42 | 0.53 | 0.58 | 0.73 | 0.92 | 1.15 | 1.27 | 1.50 | 1.77 | 1.99 | 2.61 | 3.12 | 3.88 | 4.62 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0.17 | 0.26 | 0.33 | 0.44 | 0.54 | 0.66 | 0.73 | 0.91 | 1.12 | 1.41 | 1.57 | 1.85 | 2.18 | 2.46 | 3.22 | 3.85 | 4.77 | 5.69 |
| 5 | 0.24 | 0.37 | 0.46 | 0.61 | 0.76 | 0.88 | 0.94 | 1.12 | 1.37 | 1.70 | 1.89 | 2.25 | 2.63 | 2.96 | 3.85 | 4.59 | 5.65 | 6.72 |
| 10 | 0.30 | 0.46 | 0.57 | 0.77 | 0.95 | 1.07 | 1.13 | 1.30 | 1.57 | 1.92 | 2.15 | 2.59 | 3.01 | 3.36 | 4.33 | 5.20 | 6.33 | 7.52 |
| 25 | 0.39 | 0.60 | 0.74 | 1.00 | 1.24 | 1.38 | 1.42 | 1.56 | 1.84 | 2.23 | 2.52 | 3.06 | 3.52 | 3.90 | 4.96 | 5.98 | 7.21 | 8.53 |
| 50 | 0.48 | 0.73 | 0.90 | 1.21 | 1.50 | 1.66 | 1.67 | 1.80 | 2.07 | 2.47 | 2.81 | 3.44 | 3.93 | 4.31 | 5.42 | 6.58 | 7.86 | 9.27 |
| 100 | 0.58 | 0.88 | 1.09 | 1.47 | 1.81 | 1.99 | 2.01 | 2.07 | 2.31 | 2.72 | 3.11 | 3.84 | 4.36 | 4.73 | 5.88 | 7.18 | 8.50 | 9.97 |
| 200 | 0.69 | 1.05 | 1.31 | 1.76 | 2.18 | 2.38 | 2.40 | 2.43 | 2.60 | 2.97 | 3.42 | 4.26 | 4.79 | 5.16 | 6.33 | 7.77 | 9.14 | 10.66 |
| 500 | 0.88 | 1.34 | 1.66 | 2.24 | 2.77 | 3.00 | 3.03 | 3.04 | 3.17 | 3.30 | 3.85 | 4.85 | 5.39 | 5.74 | 6.91 | 8.56 | 9.93 | 11.51 |
| 1000 | 1.05 | 1.61 | 1.99 | 2.68 | 3.32 | 3.58 | 3.62 | 3.66 | 3.66 | 3.70 | 4.19 | 5.33 | 5.85 | 6.18 | 7.33 | 9.14 | 10.52 | 12.13 |

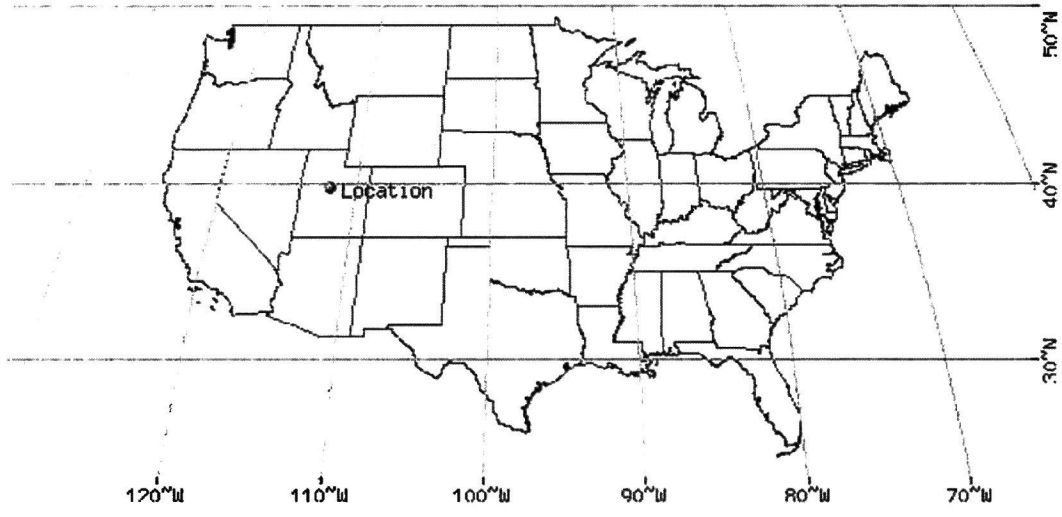
* The **upper** bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are **greater** than.
** These precipitation frequency estimates are based on a partial duration series. **ARI** is the Average Recurrence Interval.
Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

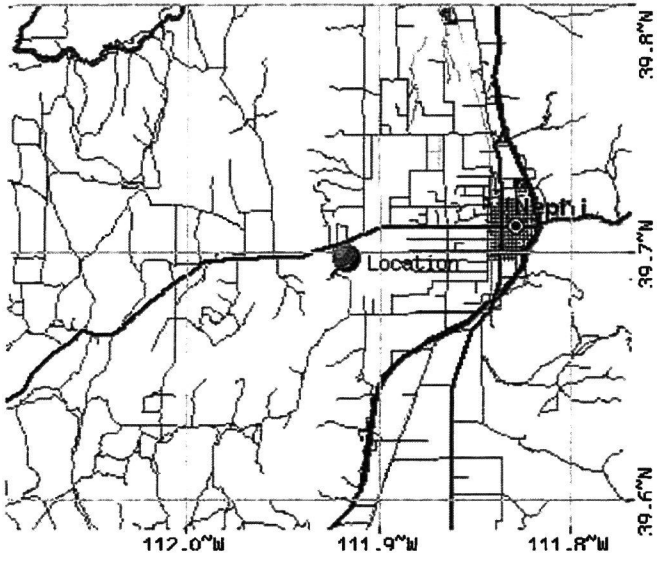
*** Lower bound of the 90% confidence interval Precipitation Frequency Estimates (inches)**

| 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 | 60 day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.10 | 0.15 | 0.19 | 0.26 | 0.32 | 0.41 | 0.47 | 0.61 | 0.77 | 0.98 | 1.09 | 1.29 | 1.53 | 1.71 | 2.26 | 2.69 | 3.38 | 4.03 |
| 2 | 0.13 | 0.20 | 0.25 | 0.33 | 0.41 | 0.52 | 0.59 | 0.75 | 0.95 | 1.20 | 1.34 | 1.59 | 1.88 | 2.11 | 2.79 | 3.32 | 4.15 | 4.95 |
| 5 | 0.18 | 0.28 | 0.34 | 0.46 | 0.57 | 0.69 | 0.76 | 0.93 | 1.15 | 1.45 | 1.62 | 1.93 | 2.27 | 2.54 | 3.33 | 3.96 | 4.91 | 5.85 |
| 10 | 0.23 | 0.34 | 0.42 | 0.57 | 0.71 | 0.83 | 0.90 | 1.08 | 1.31 | 1.64 | 1.84 | 2.22 | 2.59 | 2.88 | 3.74 | 4.48 | 5.51 | 6.54 |
| 25 | 0.29 | 0.43 | 0.54 | 0.73 | 0.90 | 1.04 | 1.11 | 1.27 | 1.53 | 1.90 | 2.15 | 2.62 | 3.03 | 3.33 | 4.27 | 5.14 | 6.27 | 7.40 |
| 50 | 0.34 | 0.52 | 0.64 | 0.86 | 1.06 | 1.22 | 1.27 | 1.43 | 1.69 | 2.10 | 2.38 | 2.93 | 3.36 | 3.67 | 4.66 | 5.63 | 6.82 | 8.02 |
| 100 | 0.40 | 0.60 | 0.75 | 1.01 | 1.25 | 1.42 | 1.47 | 1.60 | 1.85 | 2.29 | 2.62 | 3.24 | 3.70 | 4.01 | 5.04 | 6.11 | 7.35 | 8.60 |
| 200 | 0.46 | 0.70 | 0.86 | 1.16 | 1.44 | 1.63 | 1.70 | 1.83 | 2.02 | 2.48 | 2.86 | 3.56 | 4.04 | 4.34 | 5.39 | 6.58 | 7.85 | 9.15 |
| 500 | 0.55 | 0.83 | 1.03 | 1.39 | 1.72 | 1.93 | 2.02 | 2.18 | 2.38 | 2.73 | 3.18 | 3.99 | 4.48 | 4.76 | 5.84 | 7.17 | 8.46 | 9.81 |
| 1000 | 0.62 | 0.95 | 1.17 | 1.58 | 1.96 | 2.18 | 2.29 | 2.47 | 2.68 | 2.92 | 3.41 | 4.32 | 4.81 | 5.09 | 6.16 | 7.59 | 8.90 | 10.27 |

* The **lower** bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are **less** than.
** These precipitation frequency estimates are based on a partial duration maxima series. **ARI** is the Average Recurrence Interval.
Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

## Maps -




These maps were produced using a direct map request from the U.S. Census Bureau Mapping and Cartographic Resources **Tiger Map Server**.

*Please read disclaimer for more information.*

LEGEND

| | |
|---|---|
| State | Connector |
| County | Stream |
| Indian Resv | Military Area |
| Lake/Pond/Ocean | National Park |
| Street | Other Park |
| Expressway | City |
| Highway | County |

Scale 1:228583 (0 2 4 6 8 mi; 0 2 4 6 8 10 km)

*average—true scale depends on monitor resolution

## 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 our documentation.*

Using the **National Climatic Data Center's (NCDC)** station search engine, locate other climate stations within:
+/-30 minutes ...OR... +/-1 degree of this location (39.69/-111.925278). 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

173925

# SUNRISE ENGINEERING INC.

BY ..... DATE ..... SUBJECT ..... SHEET NO. ..... OF .....
CHKD. BY ..... DATE ..... JOB NO. .....

## Run On Control

$Q = FCiA$ $\quad F = 1.008$, $C = 0.25$, $A$ = Acres

Area A = 48.1 Acres

$t_c = 0.0078\ L^{0.77}\ S^{-0.385}$

where L = 3,880 ft
S = .072 ft/ft

$t_c$ = 12.4 min.

$i_{12.4} = 0.50$ in $= 2.42$ in/hr

$\therefore Q = 1.008(.25)(2.42)(48.1)$

$Q = 25.7$ ft³/sec.

Areas B & C combined = 34.9 Acres

where L = 2,850
S = 0.11 ft/ft

$t_c$ = 8.3 minutes

$i_{8.3m} = 0.40$ in $= 2.89$ in/hr

$\therefore Q_{B\&C} = 1.008(.25)(2.89)(34.9)$

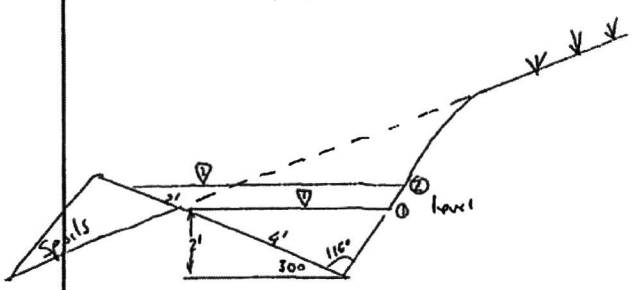
$Q = 29.7$ ft³/sec

Use 29.7 ft³/sec for Run-On Control

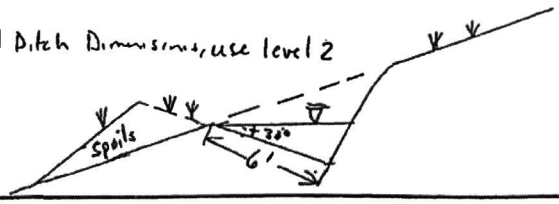
$V = \frac{K}{n} R_h^{2/3} S^{1/2}$ $\quad K = 1.49$, $n = 0.30$ ft/ft

$Q = \frac{K}{n} \frac{A^{5/3}}{P^{2/3}} S^{1/2}$ $\quad S = 0.10$

| level ① | level ② |
|---|---|
| $A = 7$ ft² | $A = 15.75$ ft² |
| $P = 7.5$ ft | $P = 11.25$ ft |
| $R_h = 0.933$ | $R_h = 1.4$ |
| $\therefore V = 1.5$ ft³/sec | $V = 1.97$ ft³/sec |
| $Q = 10.48$ ft³/sec | $Q = 31.0$ ft³/sec ✓ |
| Too Small, Try higher level | |




Final Ditch Dimensions, use level 2



173925

# SUNRISE ENGINEERING INC.

BY ..... DATE ..... SUBJECT ..... SHEET NO. ..... OF .....
CHKD. BY ..... DATE ..... ..... JOB NO. .....

Run Off Control, Main Ditch at NW end of site.

$Q = FCi A_d$

$C = .25$
$A = 40$ Acres
$F = 1.008$

$L = 2{,}850'$
$S = .25\ ft/ft$

$T_c = 0.0078 (2850)^{.77} (.25)^{-0.385}$

$T_c = 6.1$ minutes

From Chart $i_{6.1} = .30\ in = 2.95\ in/hr$

$Q = (1.008)(.25)(2.95)(40) = 29.7\ cfs$

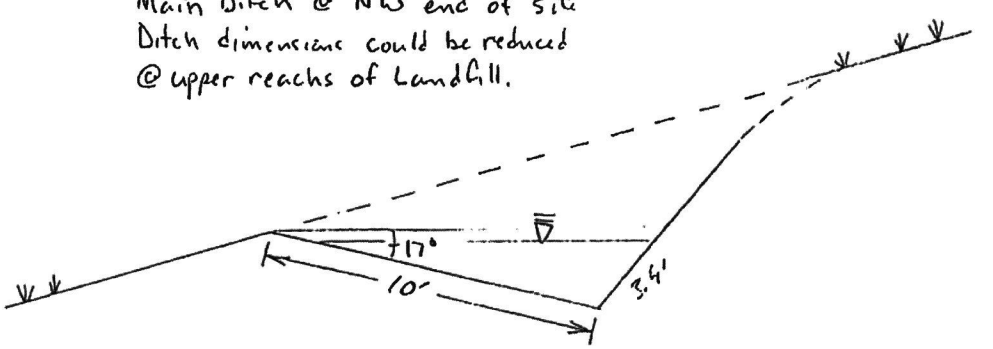
$V = \frac{K}{n} R_h^{2/3} S^{1/2}$

$K = 1.49$
$A = 14.5\ ft^2$ ← Trial & Error
$S = 0.02$
$n = 0.10$
$R_h = 1.16$ ← Trial & Error

$V = \frac{1.49}{0.1} (1.16)^{2/3} (0.02)^{1/2}$

$V = 2.3\ ft/sec \quad \therefore \quad Q = 2.3\ (14.5) = 33.7\ cfs$

Final Ditch Dimensions & Configuration
Main Ditch @ NW end of site
Ditch dimensions could be reduced
@ upper reaches of Landfill.



173925

# SUNRISE ENGINEERING INC.

BY ..... DATE ..... SUBJECT ..... SHEET NO. ..... OF .....
CHKD. BY ..... DATE ..... ..... JOB NO. .....

Run off control @ upper reaches of Landfill

$Q = F C i A_d$

A = 12.6 Acres
F = 1.008
C = 0.25

L = 1,700'
S = .25 ft/ft

$T_c = 0.0078\,(1700)^{.77}(.25)^{-.385}$

$T_c$ = 4.1 minutes

From Chart

$i_{4.1} = .22 = 3.22$ in hr.

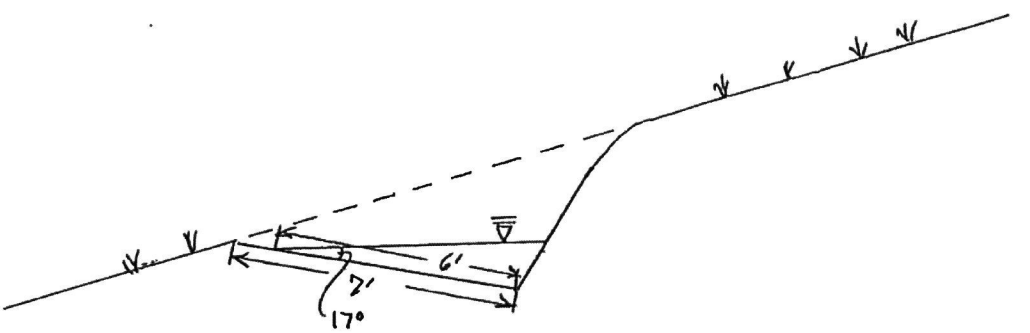
$Q = 1.008\,(.25)(3.22)(12.6) = 10.22$ cfs

$V = \frac{K}{n} R_h^{2/3} S^{1/2}$

K = 1.49
A = 6.43 ← Trial & Error
S = 0.02
n = 0.1
$R_h$ = 0.772 ← Trial & Error

$V = \frac{1.49}{0.1}(0.772)^{2/3}(0.02)^{1/2} = 1.77$ ft/sec

$Q = 1.77(6.43) = 11.4$ ft³/hr



# Appendix G – Capacity Calculations

## Juab Regional Development Agency Landfill Estimated Facility Life

| | | |
|---|---|---|
| Current tons of household waste received (tons/week) | 100 | (2014) |
| Current tons of C&D waste received (tons/week) | 55 | (2014) |
| Compacted density of waste (lbs/yd$^3$) | 750 | |
| Estimated annual population growth Rate (%) | 1.50% | |
| Site capacity (yd$^3$) | 4,360,000 | (3,270,000 yd$^3$ waste limit + daily cover at 3 parts waste to 1 part soil ratio) |

| End of Year | | Annual Tons of Household Waste Received[1] | Annual Tons of C&D Waste Received[1] | Compacted Waste Volume (yd$^3$) | Total Daily Cover Volume (yd$^3$) | Cumulative Waste + Cover Volume (yd$^3$) | Notes |
|---|---|---|---|---|---|---|---|
| 1 | 2005 | 4,800 | 3,267 | - | - | 210,625 | Based on 2005 topography |
| 2 | 2006 | 4,807 | 2,197 | - | - | 414,371 | Based on 2007 topography |
| 3 | 2007 | 3,719 | 1,442 | 13,763 | 4,588 | 433,969 | |
| 4 | 2008 | 5,446 | 1,986 | 19,817 | 6,606 | 462,189 | |
| 5 | 2009 | 5,712 | 1,681 | 19,714 | 6,571 | 490,261 | |
| 6 | 2010 | 4,661 | 1,267 | 15,807 | 5,269 | 512,770 | |
| 7 | 2011 | 4,767 | 2,394 | 19,097 | 6,366 | 539,963 | |
| 8 | 2012 | 5,114 | 2,113 | 19,272 | 6,424 | 567,407 | |
| 9 | 2013 | 5,128 | 2,748 | 21,005 | 7,002 | 597,317 | |
| 10 | 2014 | 5,200 | 2,860 | 21,493 | 7,164 | 627,923 | Based on 2015 topography |
| 11 | 2015 | 5,278 | 2,903 | 21,816 | 7,272 | 657,011 | |
| 12 | 2016 | 5,357 | 2,946 | 22,143 | 7,381 | 686,535 | |
| 13 | 2017 | 5,438 | 2,991 | 22,475 | 7,492 | 716,501 | |
| 14 | 2018 | 5,519 | 3,035 | 22,812 | 7,604 | 746,918 | |
| 15 | 2019 | 5,602 | 3,081 | 23,154 | 7,718 | 777,790 | |
| 16 | 2020 | 5,686 | 3,127 | 23,502 | 7,834 | 809,126 | |
| 17 | 2021 | 5,771 | 3,174 | 23,854 | 7,951 | 840,932 | |
| 18 | 2022 | 5,858 | 3,222 | 24,212 | 8,071 | 873,214 | |
| 19 | 2023 | 5,946 | 3,270 | 24,575 | 8,192 | 905,981 | |
| 20 | 2024 | 6,035 | 3,319 | 24,944 | 8,315 | 939,240 | |
| 21 | 2025 | 6,125 | 3,369 | 25,318 | 8,439 | 972,997 | |
| 22 | 2026 | 6,217 | 3,419 | 25,698 | 8,566 | 1,007,261 | |
| 23 | 2027 | 6,310 | 3,471 | 26,083 | 8,694 | 1,042,039 | |
| 24 | 2028 | 6,405 | 3,523 | 26,475 | 8,825 | 1,077,338 | 1,073,000 yd$^3$ - 1st closure |
| 25 | 2029 | 6,501 | 3,576 | 26,872 | 8,957 | 1,113,167 | |
| 26 | 2030 | 6,599 | 3,629 | 27,275 | 9,092 | 1,149,533 | |
| 27 | 2031 | 6,698 | 3,684 | 27,684 | 9,228 | 1,186,445 | |
| 28 | 2032 | 6,798 | 3,739 | 28,099 | 9,366 | 1,223,911 | |
| 29 | 2033 | 6,900 | 3,795 | 28,521 | 9,507 | 1,261,938 | |
| 30 | 2034 | 7,004 | 3,852 | 28,948 | 9,649 | 1,300,536 | |

| End of Year | | Annual Tons of Household Waste Received[1] | Annual Tons of C&D Waste Received[1] | Compacted Waste Volume ($yd^3$) | Total Daily Cover Volume ($yd^3$) | Cumulative Waste + Cover Volume ($yd^3$) | Notes |
|---|---|---|---|---|---|---|---|
| 31 | 2035 | 7,109 | 3,910 | 29,383 | 9,794 | 1,339,713 | |
| 32 | 2036 | 7,215 | 3,968 | 29,823 | 9,941 | 1,379,477 | |
| 33 | 2037 | 7,324 | 4,028 | 30,271 | 10,090 | 1,419,838 | household waste > 20 tons/day (Class I) |
| 34 | 2038 | 7,433 | 4,088 | 30,725 | 10,242 | 1,460,805 | |
| 35 | 2039 | 7,545 | 4,150 | 31,186 | 10,395 | 1,502,386 | |
| 36 | 2040 | 7,658 | 4,212 | 31,653 | 10,551 | 1,544,590 | |
| 37 | 2041 | 7,773 | 4,275 | 32,128 | 10,709 | 1,587,428 | |
| 38 | 2042 | 7,890 | 4,339 | 32,610 | 10,870 | 1,630,908 | 1,632,000 $yd^3$ - 2nd closure |
| 39 | 2043 | 8,008 | 4,404 | 33,099 | 11,033 | 1,675,040 | |
| 40 | 2044 | 8,128 | 4,470 | 33,596 | 11,199 | 1,719,835 | |
| 41 | 2045 | 8,250 | 4,537 | 34,100 | 11,367 | 1,765,301 | |
| 42 | 2046 | 8,374 | 4,606 | 34,611 | 11,537 | 1,811,449 | |
| 43 | 2047 | 8,499 | 4,675 | 35,130 | 11,710 | 1,858,290 | |
| 44 | 2048 | 8,627 | 4,745 | 35,657 | 11,886 | 1,905,833 | |
| 45 | 2049 | 8,756 | 4,816 | 36,192 | 12,064 | 1,954,089 | |
| 46 | 2050 | 8,888 | 4,888 | 36,735 | 12,245 | 2,003,070 | |
| 47 | 2051 | 9,021 | 4,961 | 37,286 | 12,429 | 2,052,784 | |
| 48 | 2052 | 9,156 | 5,036 | 37,845 | 12,615 | 2,103,245 | |
| 49 | 2053 | 9,293 | 5,111 | 38,413 | 12,804 | 2,154,462 | |
| 50 | 2054 | 9,433 | 5,188 | 38,989 | 12,996 | 2,206,448 | 2,191,000 $yd^3$ - 3rd closure |
| 51 | 2055 | 9,574 | 5,266 | 39,574 | 13,191 | 2,259,214 | |
| 52 | 2056 | 9,718 | 5,345 | 40,168 | 13,389 | 2,312,771 | |
| 53 | 2057 | 9,864 | 5,425 | 40,770 | 13,590 | 2,367,131 | |
| 54 | 2058 | 10,012 | 5,506 | 41,382 | 13,794 | 2,422,307 | |
| 55 | 2059 | 10,162 | 5,589 | 42,003 | 14,001 | 2,478,310 | |
| 56 | 2060 | 10,314 | 5,673 | 42,633 | 14,211 | 2,535,154 | |
| 57 | 2061 | 10,469 | 5,758 | 43,272 | 14,424 | 2,592,850 | |
| 58 | 2062 | 10,626 | 5,844 | 43,921 | 14,640 | 2,651,411 | |
| 59 | 2063 | 10,785 | 5,932 | 44,580 | 14,860 | 2,710,851 | |
| 60 | 2064 | 10,947 | 6,021 | 45,249 | 15,083 | 2,771,183 | 2,750,000 $yd^3$ - 4th closure |
| 61 | 2065 | 11,111 | 6,111 | 45,927 | 15,309 | 2,832,419 | |
| 62 | 2066 | 11,278 | 6,203 | 46,616 | 15,539 | 2,894,575 | |
| 63 | 2067 | 11,447 | 6,296 | 47,316 | 15,772 | 2,957,662 | |
| 64 | 2068 | 11,619 | 6,390 | 48,025 | 16,008 | 3,021,696 | |
| 65 | 2069 | 11,793 | 6,486 | 48,746 | 16,249 | 3,086,690 | |
| 66 | 2070 | 11,970 | 6,584 | 49,477 | 16,492 | 3,152,659 | |
| 67 | 2071 | 12,150 | 6,682 | 50,219 | 16,740 | 3,219,618 | |

| End of Year | | Annual Tons of Household Waste Received[1] | Annual Tons of C&D Waste Received[1] | Compacted Waste Volume ($yd^3$) | Total Daily Cover Volume ($yd^3$) | Cumulative Waste + Cover Volume ($yd^3$) | Notes |
|---|---|---|---|---|---|---|---|
| 68 | 2072 | 12,332 | 6,783 | 50,972 | 16,991 | 3,287,581 | |
| 69 | 2073 | 12,517 | 6,884 | 51,737 | 17,246 | 3,356,563 | 3,309,000 $yd^3$ - 5th closure |
| 70 | 2074 | 12,705 | 6,988 | 52,513 | 17,504 | 3,426,581 | |
| 71 | 2075 | 12,895 | 7,092 | 53,301 | 17,767 | 3,497,648 | |
| 72 | 2076 | 13,089 | 7,199 | 54,100 | 18,033 | 3,569,782 | |
| 73 | 2077 | 13,285 | 7,307 | 54,912 | 18,304 | 3,642,997 | |
| 74 | 2078 | 13,484 | 7,416 | 55,735 | 18,578 | 3,717,311 | |
| 75 | 2079 | 13,687 | 7,528 | 56,571 | 18,857 | 3,792,739 | |
| 76 | 2080 | 13,892 | 7,641 | 57,420 | 19,140 | 3,869,299 | 3,868,000 $yd^3$ - 6th closure |
| 77 | 2081 | 14,100 | 7,755 | 58,281 | 19,427 | 3,947,008 | |
| 78 | 2082 | 14,312 | 7,871 | 59,155 | 19,718 | 4,025,881 | |
| 79 | 2083 | 14,526 | 7,990 | 60,043 | 20,014 | 4,105,938 | |
| 80 | 2084 | 14,744 | 8,109 | 60,943 | 20,314 | 4,187,196 | |
| 81 | 2085 | 14,966 | 8,231 | 61,858 | 20,619 | 4,269,673 | |
| 82 | 2086 | 15,190 | 8,355 | 62,785 | 20,928 | 4,353,387 | 4,360,000 $yd^3$ - 7th (final) closure |

Notes:

1 - 2005-2013 values from JRDA records. 2014-2086 values estimated.

# EVALUATION OF EVAPOTRANSPIRATION COVER

# FOR

# JUAB RURAL DEVELOPMENT AGENCY CLASS II AND CLASS IV LANDFILL

Prepared for:
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February 2016

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## APPENDIX

## 1.0 INTRODUCTION

The Juab Rural Development Agency (JRDA) operates a landfill west of Nephi, south of Highway 132, on Sheeplane Road. The subject property is located in Section 15, Township 13 South, Range 1 West, Salt Lake Base and Meridian. JRDA owns 300 acres within this section. The location of the landfill site is presented in the Appendix as Figure 1. The landfill is permitted as a Class II and IV landfill with a standard (clay) cover design. JRDA is proposing that an evapotranspiration cover be used to close the landfill. The materials available at the site are better suited for an evapotranspiration cover than a clay cover, and evapotranspiration covers are generally able to withstand the local climatic conditions without the desiccation cracking commonly observed with clay covers.

This study evaluates whether an evapotranspiration cover, using on-site materials, will fulfill the requirements of Utah Administrative Code (UAC) R315-303-3(4) *Standards for Design.* The UAC states that an alternative cover such as an evapotranspiration cover must achieve an equivalent reduction in infiltration as achieved by the standard design and must provide equivalent protection from wind and water erosion as achieved by the standard design.

To demonstrate the equivalent reduction in infiltration, the expected performance of an alternative final cover design is required to be documented by the use of an appropriate mathematical model. To evaluate whether an evapotranspiration cover at the JRDA landfill meets the performance standards, RB&G Engineering collected soil samples from the landfill site, obtained hydraulic analysis of the soil samples, and performed site-specific modeling comparing the evapotranspiration cover to the standard cover.

## 2.0 CLIMATIC CONDITIONS

The climate data used in this analysis is derived from actual historical daily precipitation and potential evaporation data for Nephi, Utah. The analysis requires the wettest year, driest year, and average/typical year to be determined. Monthly precipitation data for 1905 to 1908 and 1942 to 2013 (all available years) was obtained from Utah State University's Utah Climate Center, GHCN (Global Historical Climatology Network), Nephi Station (Station ID USC00426135, 39.7122 degrees latitude, -111.832 degrees longitude, elevation 1563 meters/5131 feet). Seventy years included full data for every month. Table 1 and Table 2 below show a summary of precipitation for Nephi and yearly ranked precipitation.

**Table 1**
Precipitation Summary for Nephi, Utah (1905-1908 and 1942-2013)

| | Precipitation (inches/year) | Year |
|---|---|---|
| Average | 14.4 | (1987) |
| Maximum | 26.5 | 1983 |
| Minimum | 6.8 | 1976 |

**Table 2**
Ranked Precipitation in Nephi, Utah (1905-1908 and 1942-2013)

| Rank | Year | Precip. (in/yr) | Rank | Year | Precip. (in/yr) | Rank | Year | Precip. (in/yr) |
|---|---|---|---|---|---|---|---|---|
| 1 | 1983 | 26.54 | 25 | 1971 | 15.22 | 48 | 1988 | 12.52 |
| 2 | 1906 | 22.37 | 26 | 1996 | 14.98 | 49 | 1989 | 12.50 |
| 3 | 1982 | 22.26 | 27 | 1947 | 14.93 | 50 | 1960 | 12.41 |
| 4 | 1981 | 20.67 | 28 | 1965 | 14.93 | 51 | 2011 | 12.39 |
| 5 | 1998 | 19.55 | 29 | 1970 | 14.91 | 52 | 1966 | 12.37 |
| 6 | 1980 | 18.04 | 30 | 1953 | 14.70 | 53 | 1979 | 12.14 |
| 7 | 2005 | 18.04 | 31 | 1905 | 14.65 | 54 | 1949 | 11.89 |
| 8 | 1907 | 18.00 | 32 | 1992 | 14.49 | 55 | 1962 | 11.87 |
| 9 | 1997 | 17.86 | 33 | 1943 | 14.33 | 56 | 2009 | 11.52 |
| 10 | 1985 | 17.73 | 34 | 1987 | 14.27 | 57 | 2008 | 11.45 |
| 11 | 1957 | 17.43 | 35 | 1999 | 14.15 | 58 | 2002 | 11.30 |
| 12 | 1993 | 17.34 | 36 | 1969 | 13.94 | 59 | 2007 | 11.26 |
| 13 | 1946 | 17.32 | 37 | 1952 | 13.73 | 60 | 2001 | 11.22 |
| 14 | 1994 | 17.30 | 38 | 2006 | 13.69 | 61 | 1959 | 11.20 |
| 15 | 1995 | 17.03 | 39 | 1990 | 13.59 | 62 | 1977 | 10.65 |
| 16 | 1968 | 16.93 | 40 | 1967 | 13.55 | 63 | 1975 | 10.54 |
| 17 | 1908 | 16.84 | 41 | 1955 | 13.37 | 64 | 1956 | 9.76 |
| 18 | 1986 | 16.80 | 42 | 1954 | 13.24 | 65 | 1950 | 9.60 |
| 19 | 2000 | 16.77 | 43 | 2003 | 13.17 | 66 | 1942 | 9.58 |
| 20 | 1945 | 16.52 | 44 | 2004 | 13.07 | 67 | 1974 | 9.24 |
| 21 | 1951 | 16.35 | 45 | 1972 | 12.97 | 68 | 1958 | 8.73 |
| 22 | 1984 | 16.27 | 46 | 1961 | 12.89 | 69 | 2013 | 8.43 |
| 23 | 1973 | 15.61 | 47 | 1991 | 12.65 | 70 | 1976 | 6.82 |
| 24 | 1944 | 15.55 | | | | | | |

It was determined that the maximum precipitation year was 1983. The minimum precipitation year was 1976. Precipitation patterns were evaluated, and 1987 was chosen as the year that most closely represents an average precipitation year. Data from each of these years was used in the modeling analysis as described in Section 4.0 HYDRUS Model Design of this report.

## 3.0 SOIL INVESTIGATION AND HYDRAULIC PROPERTIES

Soil investigations were conducted within the property owned by the JRDA (see Vicinity Map, Figure 1, in the Appendix) with the intent of locating material that would be suitable for use as the primary layer in an evapotranspiration cover system as final cover for the landfill. The investigations were conducted by excavating test pits with a backhoe and obtaining soil samples for testing. Potential borrow sites were identified by reviewing soil survey maps prepared by the U.S. Department of Agriculture, Natural Resource Conservation Service (NRCS), formerly the Soil Conservation Service. The maps are presented in Soil Survey of Fairfield-Nephi Area Utah (1984). The generalized soil information identified in the mapping is primarily provided for the purpose of land planning and potential hazard identification. The NRCS soil survey map with its accompanying legend is included for reference in the Appendix.

Soils that are most appropriate for use in evapotranspiration covers support native plant growth that can be used to reduce the moisture that may infiltrate through the cover into the underlying landfill materials. Most plants grow best in soils that have relatively balanced proportions of sand, silt and clay, such as loams, clay loams and sandy loams. Review of the generalized soils maps, shows that the area is predominated by soils with loamy characteristics.

Two areas were selected for investigation. The first is the area immediately uphill and to the south of the current landfill. The second is approximately 3,000 to 6,000 feet west of the active landfill, where there are several relatively flat areas between the surrounding hills.

A total of fourteen test pits were excavated within the two areas. The locations of the excavated test pits are shown on Figure 2 in the Appendix. It will be observed that Test pits 12-01, 12-02 and 12-03 were located at the south limits of the active landfill, and the remaining excavations were conducted in the second, westerly investigation area. Copies of the test pit logs for each excavation are attached in the Appendix.

Soil testing was conducted on samples from six of the test pits, 12-01, 12-02, 12-03, 12-04, 12-06 and 12-07. Test Pit 12-05 encountered bedrock at a depth of 6-inches below the ground surface, so no testing was performed on this material. Tests performed on the samples obtained from the identified excavations included permeability, gradations, bulk densities, and moisture content. The results of the tests are presented in the Summary of Test Data included in the Appendix. It will be observed from the results that samples from Test Pits 12-01, 12-02, 12-03 and 12-07 classify as gravelly sands with about 25% of the materials being silts and clays. These materials are generally unsuitable for evapotranspiration landfill covers.

Samples obtained from Test Pits 12-04 and 12-06 classify as loam and loam to clay-loam materials, respectively, in accordance with the NRCS soil texture criteria. These soils showed

promise for use as the primary layer in an evapotranspiration cover. The remaining seven excavations, Test Pits 14-01 through 14-07, were performed in an attempt to determine the extent of the available soil material that might be used in the landfill cover.

**Soil Hydraulic Parameters**

Soil hydraulic parameters are required to model the evapotranspiration cover. The van Genuchten-Mualem model was used for this analysis. $Q_r$, $Q_s$, Alpha, n, and $K_s$ are unsaturated hydraulic parameters used in the van Genuchten-Mualem model and are defined as follows (Šimůnek, 2013):

$Q_r$ ($\theta_r$) - residual volumetric soil water content
$Q_s$ ($\theta_s$) - saturated volumetric soil water content
Alpha ($\alpha$) - van Genuchten fitting parameter, $L^{-1}$
n - van Genuchten fitting parameter, dimensionless
$K_s$ - saturated hydraulic conductivity, $LT^{-1}$

These parameters are obtained from the soil water characteristic curve, which shows the relationship between the water content ($\theta$) and the soil water potential ($\psi$). Material from Test Pit 12-04 was analyzed by the Daniel B. Stephens and Associates, Inc., Laboratory Testing Facility in Albuquerque, New Mexico using standard hydraulic tests and methods to determine the soil water characteristic curve and associated parameters. The soil sample was tested at two levels of compaction, 82% of maximum and 88% of maximum. The full results of the hydraulic conductivity analysis are shown in the Appendix. Hydraulic parameter values reported by Stephens & Associates are shown below in Table 3.

**Table 3**
Hydraulic Parameters for Soil from Test Pit 12-04

| Sample and Compaction Level | $\theta_r$ (% vol) | $\theta_s$ (% vol) | $\alpha$ ($cm^{-1}$) | N ( - ) | $K_s$ (cm/sec) |
|---|---|---|---|---|---|
| Test Pit 12-04 (82%, 87.8pcf) | 0.00 | 48.88 | 0.0459 | 1.2064 | 7.3E-04 |
| Test Pit 12-04 (88%, 94.3pcf) | 0.00 | 44.88 | 0.0194 | 1.2097 | 7.4E-05 |

It is estimated from previous calculations in the preparation of the JRDA landfill permit, that approximately 220,000 cubic yards of material will be needed in order to provide a 30-inch evapotranspiration cover depth over the final closed landfill area. Using the depth of potentially acceptable material from the test pit excavations as shown on the logs, and an approximate area where the material is available, it is estimated that 250,000 to 300,000+ cubic yards of material can be obtained. The approximate area where the material is located is shown on Figure 3 in the Appendix.

Soil for a standard clay cover is not available on-site at the JRDA landfill. The unsaturated hydraulic parameters shown in Table 4 are provided in the HYDRUS- 1D library (sourced from Carsel, 1988) as average parameters for clay (note that $K_s$ is given in cm/day below instead of cm/sec as in the reported values above). This material was chosen as the closest approximation to the clay typically used in standard covers.

**Table 4**
Hydraulic Parameters for Clay from HYDRUS-1D Library

| Material | $\theta_r$ (% vol) | $\theta_s$ (% vol) | $\alpha$ ($cm^{-1}$) | N ( - ) | $K_s$ (cm/day) |
|---|---|---|---|---|---|
| Clay | 0.068 | 0.38 | 0.008 | 1.09 | 4.8 |

UAC R315-303-3(4) requires that the clay used to construct a standard cover design have a permeability of 1 x $10^{-5}$ cm/sec or less. In order to match this permeability requirement, the library $K_s$ value of 4.8 cm/day for clay was changed to 0.864 cm/day (the equivalent of 1 x $10^{-5}$ cm/sec) for the standard cover simulation.

Scaling factors of 1.3 for Alpha ($\alpha$) and 1.1 for n were applied to these laboratory-obtained parameters to account for scaling effects, hysteresis, and alteration in soil structure caused by processes such as freeze-thaw and wet-dry cycling, root growth and death, and burrowing fauna. The final values used for each model are shown in Table 5.

**Table 5**
Hydraulic Parameters for All Soil Types Used

| Model | $\theta_r$ (% vol) | $\theta_s$ (% vol) | $\alpha$ ($cm^{-1}$) | N ( - ) | $K_s$ (cm/day) |
|---|---|---|---|---|---|
| ET Cover, 82% compaction | 0.00 | 0.4888 | 0.05967 | 1.32704 | 63.1 |
| ET Cover, 88% compaction | 0.00 | 0.4488 | 0.02522 | 1.33067 | 6.394 |
| Standard clay cover | 0.068 | 0.38 | 0.0104 | 1.199 | 0.864 |

## 4.0 HYDRUS MODEL DESIGN

**Model Selection**

The HYDRUS-1D modeling package was selected to model the performance of the evapotranspiration cover and compare it to the performance of the standard design. Two-dimensional models are often used to model similar situations; however, the developers of the HYDRUS-1D and HYDRUS-2D packages recommend using HYDRUS-1D "for engineering problems, such as multi seasonal simulations of the recharge through landfill cover." (HYDRUS-1D FAQ).

Four scenarios were modeled:

1) evapotranspiration cover, 82% compaction
2) evapotranspiration cover, 88% compaction
3) standard clay cover with 6-inch vegetated erosion control layer, 82% compaction
4) standard clay cover with 6-inch vegetated erosion control layer, 88% compaction

The optimum compaction level for the evapotranspiration cover and for the vegetated erosion control layer of the standard clay cover is approximately 85% of maximum. The 82% of maximum and 88% of maximum compaction levels were modeled to bound the optimum 85% level.

Key model input and parameters used in each of the model scenarios are described briefly as follows.

**Time**

The models were run for 15 years (5480 days). This includes 5 years at average rainfall conditions (1987, 14.4 inches per year), 5 years representing the driest year (1976, 6.8 inches per year), and 5 years representing the wettest year (26.5 inches per year). UAC requires the model to be run until stable with average rainfall conditions, and then to be run for 5 years representing the wettest conditions. Per instruction from the Division of Solid and Hazardous Waste, five years of the driest year (drought conditions) were added to the model to simulate a worst-case scenario that could potentially kill off the vegetation of the evapotranspiration cover and compromise its performance.

**Soil Hydraulic Parameters**

The van Genuchten-Mualem single porosity model was used for all model scenarios. Soil hydraulic parameters were discussed in detail in Section 3.0 Soil Investigation and Hydraulic Properties of this report. See Table 5 for a summary of the final values used for each model.

**Boundary and Initial Conditions**

An upper boundary condition of atmospheric with surface layer was used to allow up to 1 centimeter of water to pond at the landfill surface. A lower boundary condition of free drainage was used. A node spacing of 1 centimeter was used. The initial conditions for pressure head were set to -100 cm pressure (matric potential) at all depths in the profile. The pressure head at the surface node only was changed from -100 to 0 centimeters to simulate the boundary condition that water is ponding with no surface storage.

**Transpiration Parameters**

The Feddes root water uptake model was used for the evapotranspiration cover scenarios and for the vegetation layer of the standard clay cover. The local climate and growing conditions were considered in determining plant-related parameters.

The Feddes' parameters for grass were used to portray the vegetation on all simulations. The native vegetation at the JRDA landfill includes grasses, cedar trees, rabbitbrush, and sagebrush. When big sagebrush plants are removed prior to seeding grasses, the sagebrush often reinvades the grassed areas (Cook & Lewis, 1963, Hull & Klomp, 1974, and NRCS, 2011). Adequately maintained native shrubs and sagebrush can be appropriate vegetation for evapotranspiration covers if they are adequately maintained (Final Guidance, 2013 and Albright, 2010). These plants, particularly sagebrush, have many desirable features that may lead to better performance of the evapotranspiration cover, including greater rainfall interception, protection of grass understory, deeper and larger lateral spread of roots, and year-round transpiration from evergreen leaves. Invasive trees will be removed from the cover annually. If an evapotranspiration cover is used, native grasses, shrubs, and sagebrush that invade the landfill area will be accepted.

**Climate Data**

Daily temperature, precipitation, and evapotranspiration data for the years under consideration were obtained from Utah State University's Utah Climate Center, Nephi Station. Daily soil temperatures were obtained for the National Weather Service's Cooperative Network station in Salt Lake City (SLC NWSFO AP), which closely matched temperatures in Nephi. Precipitation data is discussed in more detail in Section 2.0 Climatic Conditions of this report. The total rainfall over the 15 years of the model simulation is 239 inches (606 cm). The daily potential transpiration was calculated using the leaf area index method. Calculated transpiration was subtracted from daily evapotranspiration to determine daily evaporation.

Relative humidity data for 2012-2014 was obtained from the USU Climate Center's AgMet/AgWeather network and used to calculate minimum allowed surface pressure head.

**Parameters Comparison**

Model input parameters that are different for the two cover types are summarized in Table 6.

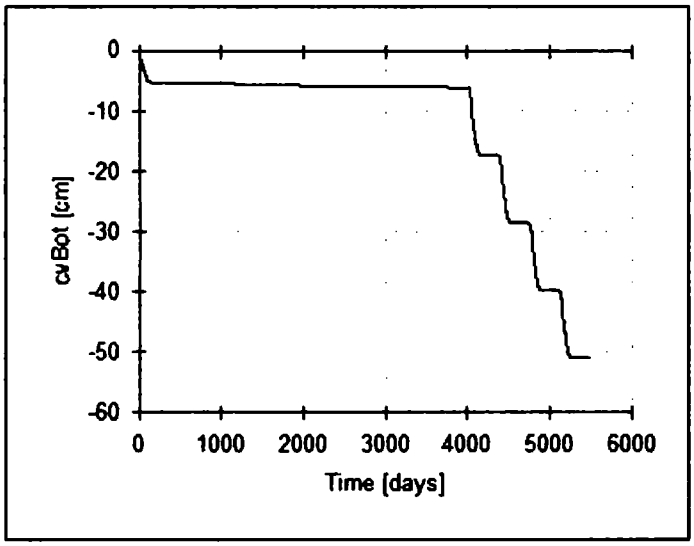
**Table 6**
Model Input Parameters Summary

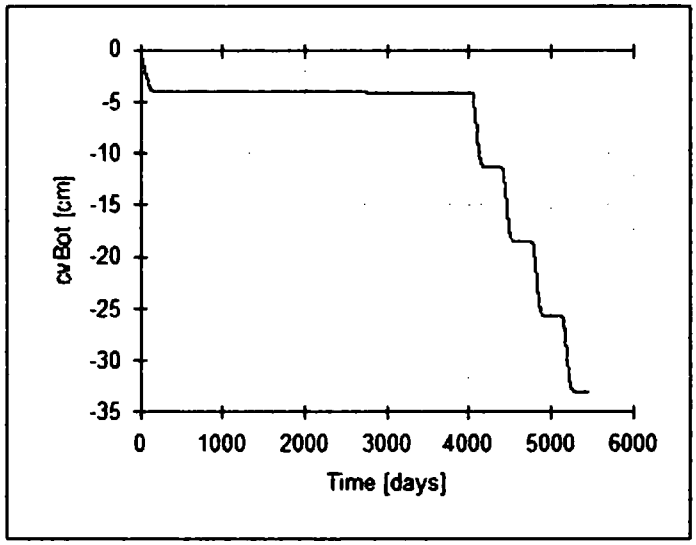
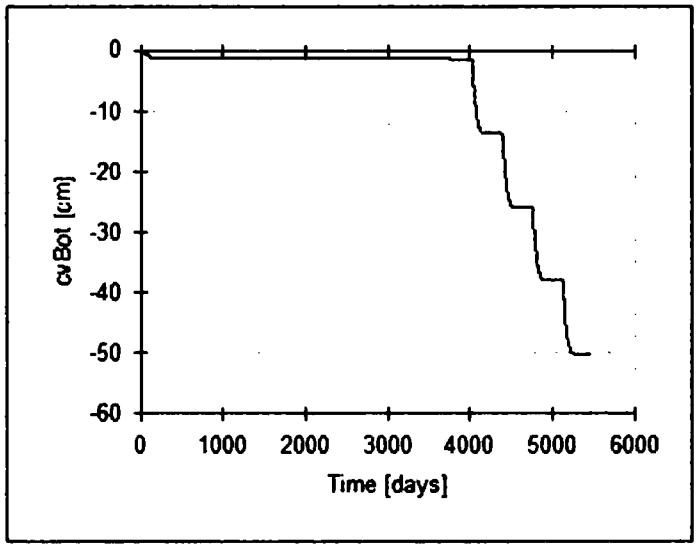
| **Model Input Parameter** | **ET Cover (82% compaction)** | **ET Cover (88% compaction)** | **Standard Clay Cover (82% compaction of vegetated layer)** | **Standard Clay Cover (88% compaction of vegetated layer)** |
|---|---|---|---|---|
| Depth of soil profile | 76 cm (30 inches) | 76 cm (30 inches) | 46 cm (18 inches) clay / 15 cm (6 inches) vegetated erosion layer | 46 cm (18 inches) clay / 15 cm (6 inches) vegetated erosion layer |
| Hydraulic model | van Genuchten-Mualem | van Genuchten-Mualem | van Genuchten-Mualem with air-entry value of -2 cm | van Genuchten-Mualem with air-entry value of -2 cm |
| $Q_r$, $\theta_r$ (% vol) | 0.00 | 0.00 | 0.0068/0.00 | 0.0068/0.00 |
| $Q_s$, $\theta_s$ (% vol) | 0.4888 | 0.4488 | 0.38/0.4888 | 0.38/0.4488 |
| Alpha, $\alpha$ ($cm^{-1}$) | 0.05967 | 0.02522 | 0.0104/0.05967 | 0.0104/0.02522 |
| n ( - ) | 1.32704 | 1.33067 | 1.199/1.32704 | 1.199/1.33067 |
| $K_s$ (cm/day) | 63.1 | 6.394 | 0.864/63.1 | 0.864/6.394 |

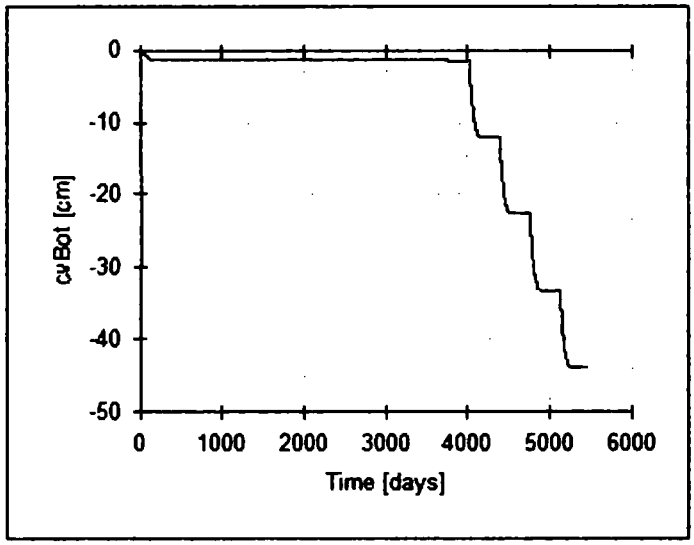
## 5.0 RESULTS

The results of each of the model simulations are shown in Table 7. The model output of cumulative flux through bottom of soil profile represents the cumulative infiltration through the landfill final cover. The model predicts a cumulative infiltration of 51 centimeters (20.1 inches) over 15 years for the evapotranspiration cover with 82% compaction, 33 centimeters (13.0 inches) for the evapotranspiration cover with 88% compaction, 50 centimeters (19.7 inches) for the clay cover with an 82% compacted vegetation erosion layer, and 44 centimeters (17.3 inches) for the clay cover with an 88% compacted vegetation erosion layer. Total rainfall over the 15-year model period is 606 cm (239 inches).

**Table 7**
HYDRUS-1D Model Simulation Results

| Model | Cumulative Flux Through Bottom of Soil Profile (cm) | Cumulative Runoff (cm) |
|---|---|---|
| Evapotranspiration Cover (82% compaction) | 51 cm   | 0.2 cm |

| Model | Cumulative Flux Through Bottom of Soil Profile (cm) | Cumulative Runoff (cm) |
|---|---|---|
| Evapotranspiration Cover (88% compaction) | 33 cm   | 0.8 cm |
| Standard Clay Cover with 82% compacted vegetation erosion control layer | 50 cm   | 3 cm |

| Model | Cumulative Flux Through Bottom of Soil Profile (cm) | Cumulative Runoff (cm) |
|---|---|---|
| Standard Clay Cover with 88% compacted vegetation erosion control layer | 44 cm   | 11 cm |

The ideal compaction of the evapotranspiration cover and the vegetation erosion layer of the standard cover lies midway between the modeled compaction values, at 85%. Interpolating between the results of each of the sets of two models gives a cumulative bottom flux of 42 centimeters (with <1 cm runoff) for an evapotranspiration cover optimally compacted to 85% of maximum, and 47 centimeters (with 7 cm runoff) for a standard clay cover with a vegetated erosion control layer optimally compacted to 85% of maximum.

The model results show that the evapotranspiration cover achieves a slightly greater reduction in infiltration than is achieved by the standard design.

## 6.0 CONCLUSION

An evapotranspiration cover, constructed using soils similar to those tested from test pit 12-04 and compacted to 82-88% of the maximum laboratory density, achieves a greater reduction in infiltration than is achieved by the standard design. In addition, the evapotranspiration cover provides equivalent protection from wind and water erosion as achieved by the standard design. Standard clay covers in the arid climate of Utah are typically prone to desiccation cracking, allowing water to infiltrate into the landfill. This phenomenon is not shown in the modeled simulation. It is often difficult to maintain vegetation on standard covers, and they become prone to wind and water erosion. The evapotranspiration cover utilizes vegetation well-suited to native conditions, or native vegetation, and it is more easily maintained, allowing the evapotranspiration cover to provide superior protection from wind and water erosion.

The proposed evapotranspiration cover, constructed of materials from the JRDA landfill site, meets the requirements for the performance of the standard clay cover and therefore satisfies the requirements of the Utah Administrative Code and the Division of Solid and Hazardous Waste.

## 7.0 REFERENCES

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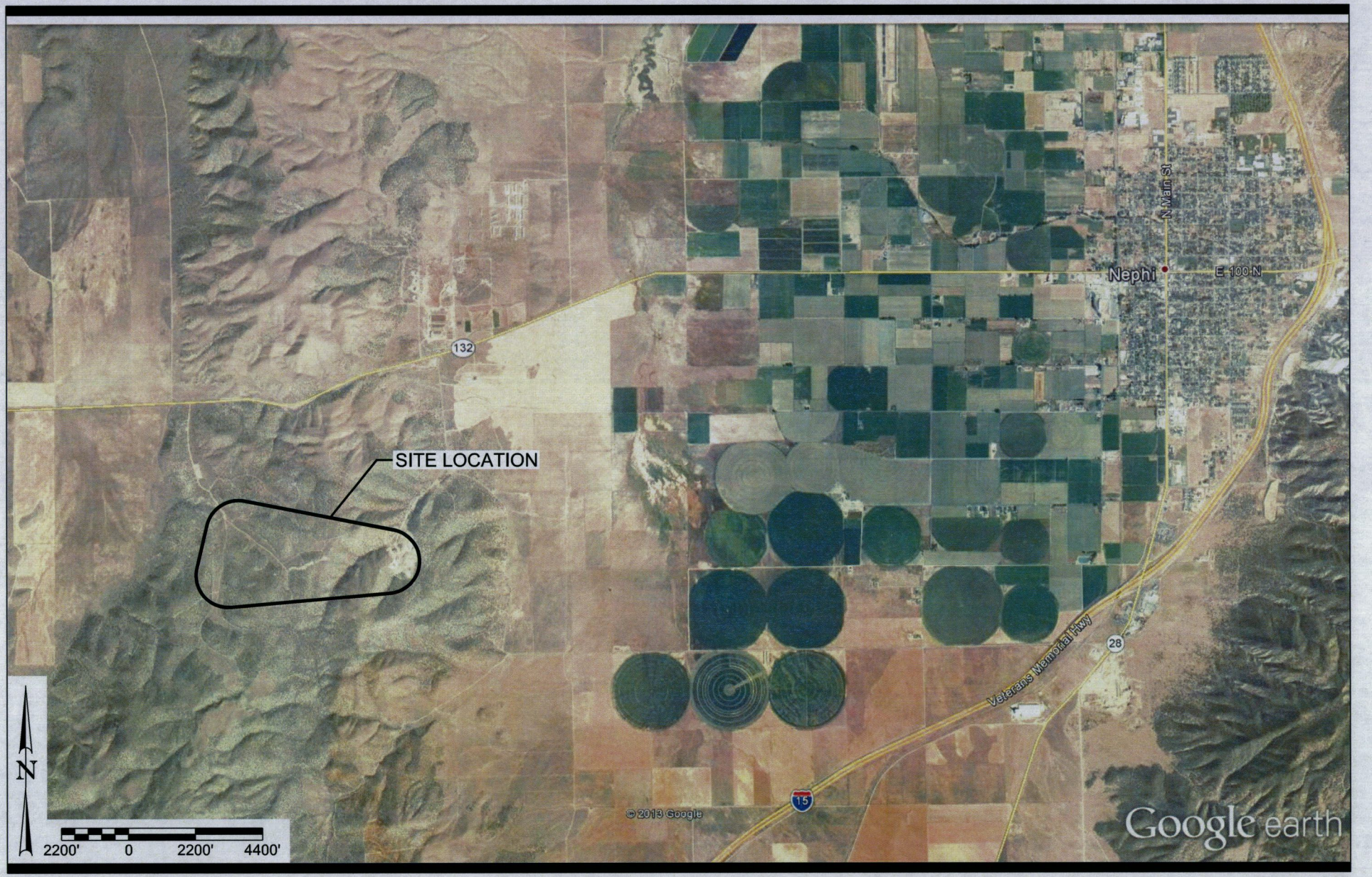
# Figures

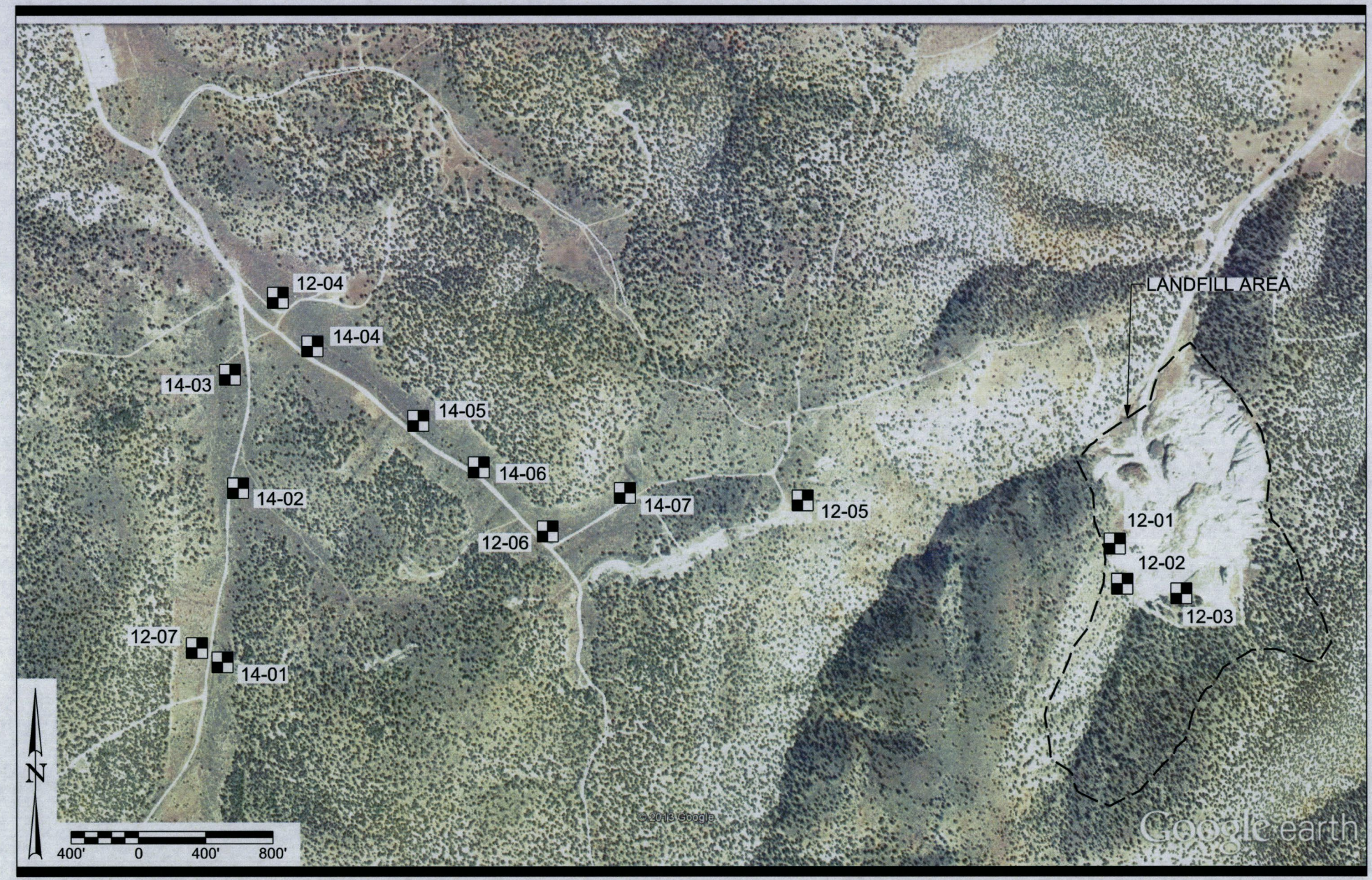



RB&G ENGINEERING, INC.

Figure 1 VICINITY MAP

*Juab RDA Landfill*

*Nephi, Juab County, Utah*

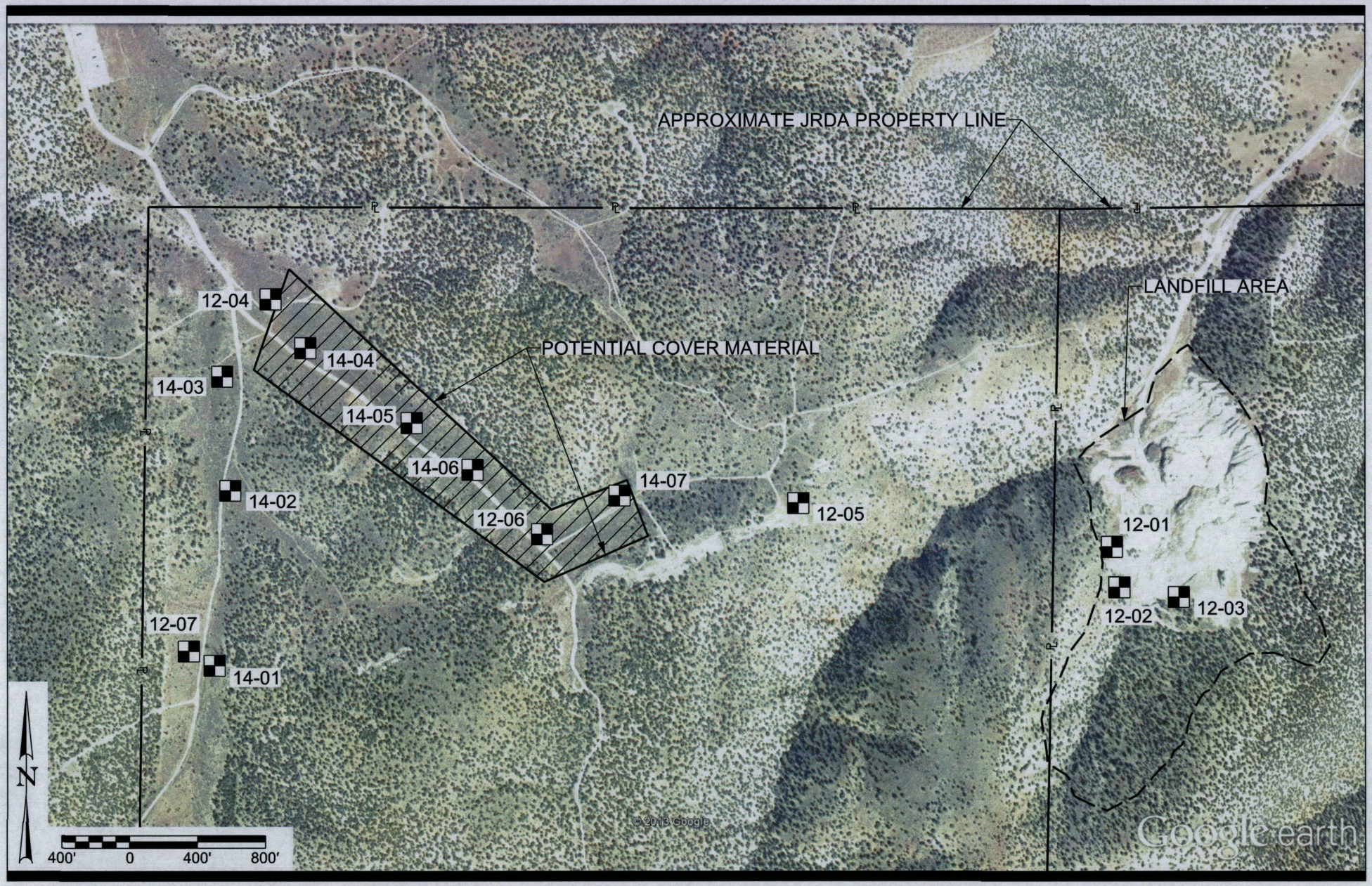



RB&G ENGINEERING, INC.

Figure 2 SITE PLAN & TEST HOLE LOCATIONS

*Juab RDA Landfill*

*Nephi, Juab County, Utah*




RB&G ENGINEERING, INC.

Figure 3 LOCATION OF POTENTIAL COVER MATERIAL

*Juab RDA Landfill*

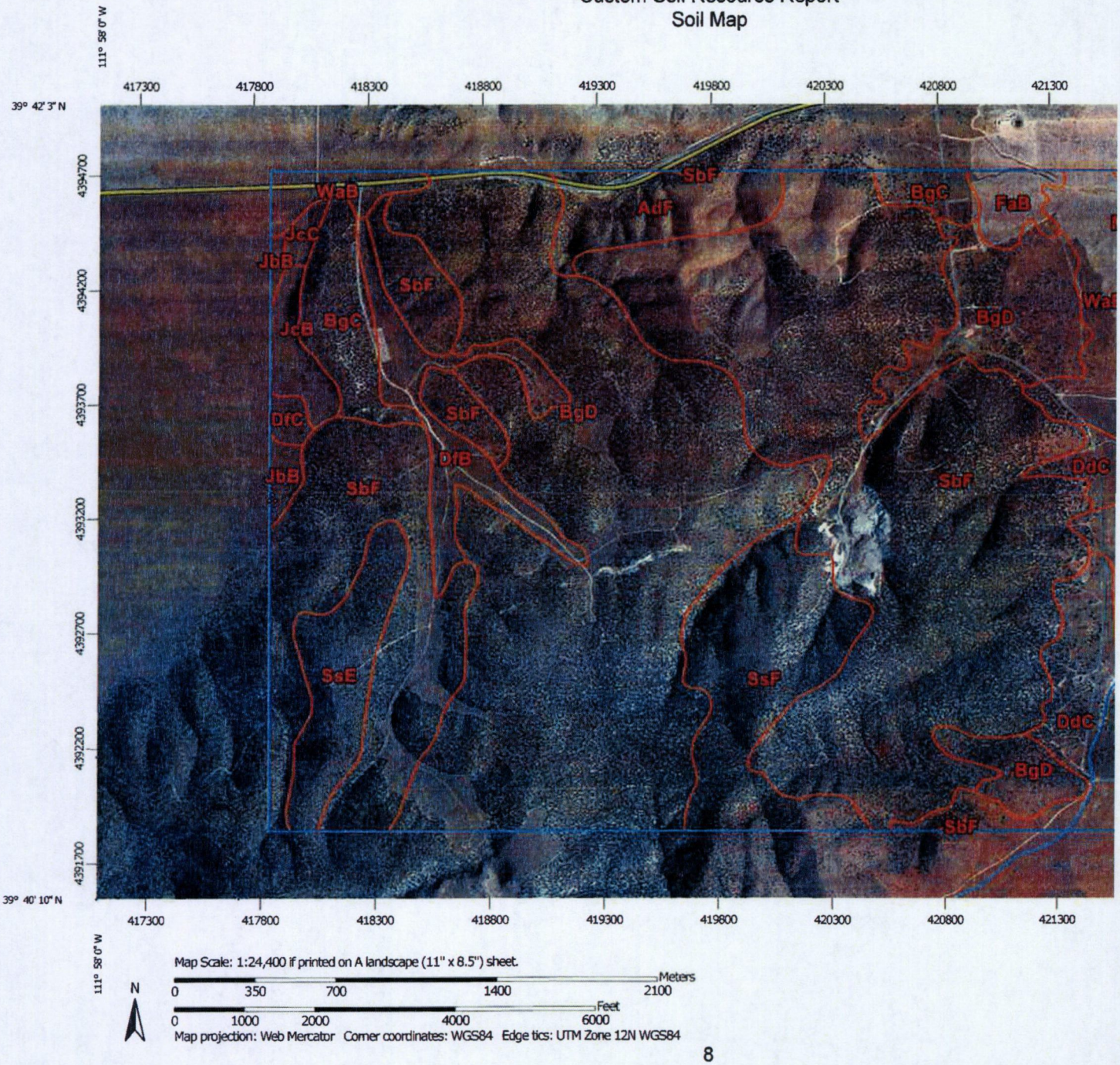
*Nephi, Juab County, Utah*

# Appendix

***NRCS Soil Map***
***Summary of Test Data***
***Test Pit Logs***
***Hydraulic Conductivity Testing Results***

# NRCS Soil Map

# Custom Soil Resource Report
## Soil Map



## MAP LEGEND

**Area of Interest (AOI)**
- Area of Interest (AOI)

**Soils**
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

**Special Point Features**
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

**Water Features**
- Streams and Canals

**Transportation**
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

**Background**
- Aerial Photography

## MAP INFORM

The soil surveys that comprise your AC

Please rely on the bar scale on each m measurements.

Source of Map: Natural Resources C
Web Soil Survey URL: http://websoil
Coordinate System: Web Mercator (

Maps from the Web Soil Survey are ba projection, which preserves direction a distance and area. A projection that pr Albers equal-area conic projection, sho calculations of distance or area are req

This product is generated from the USD the version date(s) listed below.

Soil Survey Area: Fairfield-Nephi Are
Survey Area Data: Version 7, Dec 2

Soil map units are labeled (as space allc or larger.

Date(s) aerial images were photograph 13, 2011

The orthophoto or other base map on v compiled and digitized probably differs imagery displayed on these maps. As of map unit boundaries may be eviden

# Map Unit Legend

| Fairfield-Nephi Area, Utah (UT608) | | | |
|---|---|---|---|
| **Map Unit Symbol** | **Map Unit Name** | **Acres in AOI** | **Percent of AOI** |
| AdF | Amtoft, moist-Rock outcrop complex, 30 to 70 percent slopes | 73.5 | 2.7% |
| BgC | Borvant cobbly loam, 2 to 8 percent slopes | 79.4 | 2.9% |
| BgD | Borvant cobbly loam, 8 to 25 percent slopes | 852.2 | 31.1% |
| DdC | Donnardo stony loam, 2 to 8 percent slopes | 133.7 | 4.9% |
| DfB | Doyce loam, 2 to 4 percent slopes | 82.0 | 3.0% |
| DfC | Doyce loam, 4 to 8 percent slopes | 8.5 | 0.3% |
| FaB | Firmage gravelly loam, dry, 2 to 4 percent slopes | 25.2 | 0.9% |
| JbB | Juab loam, 2 to 4 percent slopes | 13.6 | 0.5% |
| JcB | Juab loam, gravelly substratum, 2 to 4 percent slopes | 27.1 | 1.0% |
| JcC | Juab loam, gravelly substratum, 4 to 8 percent slopes | 7.9 | 0.3% |
| McB | Manassa silt loam, moderately saline, 0 to 2 percent slopes | 8.7 | 0.3% |
| SbF | Sandall very cobbly loam, 25 to 60 percent slopes | 1,036.9 | 37.8% |
| SsE | Sumine-Reywat-Rock outcrop complex, 10 to 30 percent slopes | 81.8 | 3.0% |
| SsF | Sumine-Reywat-Rock outcrop complex, 30 to 60 percent slopes | 168.2 | 6.1% |
| WaB | Wales loam, 2 to 4 percent slopes | 143.8 | 5.2% |
| **Totals for Area of Interest** | | **2,742.4** | **100.0%** |

# Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic

# Summary of Test Data

RB&G
ENGINEERING, INC.

# Table 1

## SUMMARY OF TEST DATA

PROJECT LOCATION: Juab County Landfill, Nephi, UT
PROJECT NO.:
FEATURE: Test Pits

| HOLE NO. | DEPTH BELOW GROUND SURFACE (ft) | IN-PLACE | | Permeability @ Approx. 89% compaction of ASTM D-698 | ATTERBERG LIMITS | | | MECHANICAL ANALYSIS | | | PERCENT FINER THAN 0.005 mm | UNIFIED SOIL CLASSIFICATION SYSTEM / (AASHTO CLASSIFICATION) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | DRY UNIT WEIGHT (pcf) | MOISTURE (%) | | LIQUID LIMIT (%) | PLASTIC LIMIT (%) | PLASTICITY INDEX (%) | PERCENT GRAVEL | PERCENT SAND | PERCENT SILT & CLAY | | |
| TP 12-01 | 1-3 | | 8.8 | | | | NP | 36 | 36 | 28 | | SM |
| TP 12-02 | 1-3 | | 9.6 | | | | NP | 26 | 61 | 13 | | SM |
| TP 12-03 | 1-3 | | 8.4 | | | | NP | 39 | 46 | 15 | | SM |
| | | | | | | | | | | | | |
| TP 12-04 | 2-3 | | 10.1 | 3.25 ft/yr 3.14 X 10e6 cm/sec | 27 | 20 | 7 | 2 | 31 | 67 | 22.1 | CL-ML |
| TP 12-06 | 2-3 | | 10.5 | 2.03 ft/ yr 1.96 X 10e6 cm/ sec | 29 | 19 | 10 | 1 | 28 | 71 | 28.1 | CL |
| TP 12-07 | 2-3 | | 10.2 | | | | NP | 35 | 44 | 21 | | SM |

NP=Non-Plastic

# Test Pit Logs

# TEST PIT LOG

## TEST PIT NO. 12-01

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** DOZER
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 11/1/12
**DATE COMPLETED:** 11/1/12
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | ML | brown, dry — SANDY SILT organics | | | | | | | | |
| | 1 | | | | | | | | | | | | | | |
| | 2 | | | | | SM | lt. brown, moist — SILTY SAND W/GRAVEL becoming slightly cemented w/depth | | 8.8 | | NP | 36 | 36 | 28 | |
| | 3 | | | | | | | | | | | | | | |
| | 4 | | | | | | BOH | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE — Bucket ← Sample Type
0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

## TEST PIT NO. 12-02

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** DOZER
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 11/1/12
**DATE COMPLETED:** 11/1/12
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | ML | brown, dry — SANDY SILT organics | | | | | | | | |
| | 1 | | | | | | | | | | | | | | |
| | 2 | | | | | SM | lt. brown, moist — SILTY SAND W/GRAVEL becoming slightly cemented w/depth | | 9.6 | | NP | 26 | 61 | 13 | |
| | 3 | | | | | | | | | | | | | | |
| | 4 | | | | | | BOH | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE — Bucket ← Sample Type; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

## TEST PIT NO. 12-03

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** DOZER
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 11/1/12
**DATE COMPLETED:** 11/1/12
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | Sample USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | | | | | | | | | | | | | |
| | 2 | | | | | | SILTY SAND W/GRAVEL<br>becoming slightly cemented w/depth | | | | | | | | |
| | 3 | | | | | SM | lt. brown, moist | | 8.4 | | NP | 39 | 46 | 15 | |
| | 4 | | | | | | | | | | | | | | |
| | 5 | | | | | | BOH | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE
UNDISTURBED SAMPLE
Bucket ← Sample Type
0.45 ← Torvane (tsf)

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

# TEST PIT NO. 12-04

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** RUBBER TIRE BACKHOE
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 11/1/12
**DATE COMPLETED:** 11/1/12
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | CL | dk. brown, moist — LEAN CLAY W/SAND, organics | | | | | | | | |
| | 1 | | | | | | | | | | | | | | |
| | 2 | | | | | | SANDY SILTY CLAY | | | | | | | | |
| | | | | | | CL-ML | brown, slightly moist | | 10.1 | 27 | 7 | 2 | 31 | 67 | |
| | 3 | | | | | | | | | | | | | | |
| | | | | | | CL-ML | lt. brown, slightly moist — SANDY SILTY CLAY W/GRAVEL, gravels increasing w/depth | | | | | | | | |
| | 4 | | | | | | | | | | | | | | |
| | | | | | | GM | lt. brown, slightly moist — SILTY GRAVEL W/SAND | | | | | | | | |
| | 5 | | | | | | BOH | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE — Bucket ← Sample Type; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

# TEST PIT NO. 12-05

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** RUBBER TIRE BACKHOE
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 11/1/12
**DATE COMPLETED:** 11/1/12
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | Sample USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | SM | brown, slightly moist SILTY SAND W/GRAVEL | | | | | | | | |
| | 1 | | | | | | BEDROCK | | | | | | | | |
| | 2 | | | | | | BOH | | | | | | | | |
| | 3 | | | | | | | | | | | | | | |
| | 4 | | | | | | | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE
UNDISTURBED SAMPLE
Bucket ← Sample Type
0.45 ← Torvane (tsf)

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

# TEST PIT NO. 12-06

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** RUBBER TIRE BACKHOE
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 11/1/12
**DATE COMPLETED:** 11/1/12
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | CL | dk. brown, moist — LEAN CLAY W/SAND organics | | | | | | | | |
| | 1 | | | | | | | | | | | | | | |
| | 2 | | | | | CL | brown, slightly moist — LEAN CLAY W/SAND | | 10.5 | 29 | 10 | 1 | 28 | 71 | |
| | 3 | | | | | | | | | | | | | | |
| | 4 | | | | | | | | | | | | | | |
| | 5 | | | | | CL | lt. brown, slightly moist | | | | | | | | |
| | 6 | | | | | | SANDY LEAN CLAY | | | | | | | | |
| | 7 | | | | | | | | | | | | | | |
| | 8 | | | | | CL | lt. brown, slightly moist | | | | | | | | |
| | 9 | | | | | GM | lt. brown, slightly moist — SILTY GRAVEL W/SAND | | | | | | | | |
| | | | | | | | BOH | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE — Bucket ← Sample Type; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

## TEST PIT NO. 12-07

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** RUBBER TIRE BACKHOE
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 11/1/12
**DATE COMPLETED:** 11/1/12
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | CL | dk. brown, moist — SANDY LEAN CLAY organics | | | | | | | | |
| | 1 | | | | | | | | | | | | | | |
| | 2 | | | | | | SILTY SAND W/GRAVEL | | | | | | | | |
| | | | | | | SM | lt. brown, moist | | 10.3 | | NP | 35 | 44 | 21 | |
| | 3 | | | | | | BOH | | | | | | | | |
| | 4 | | | | | | | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE — Bucket ← Sample Type; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

## TEST PIT NO. 14-01

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** 120 TRACKHOE
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 3/6/14
**DATE COMPLETED:** 3/6/14
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | Sample USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | CL | dk. brown, moist — LEAN CLAY W/SAND organics | | | | | | | | |
| | 1 | | | | | | | | | | | | | | |
| | 2 | | | | | CL | lt. brown, slightly moist — LEAN CLAY W/SAND | | | | | | | | |
| | 3 | | | | | | | | | | | | | | |
| | 4 | | | | | SM | lt. brown, slightly moist — SILTY SAND W/GRAVEL | | | | | | | | |
| | 5 | | | | | | BOH | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE — Bucket ← Sample Type; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

## TEST PIT NO. 14-02

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** 120 TRACKHOE
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 3/6/14
**DATE COMPLETED:** 3/6/14
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | | | | CL | dk. brown, moist — LEAN CLAY W/SAND, organics | | | | | | | | |
| | 2 | | | | | CL | lt. brown, slightly moist — SANDY LEAN CLAY W/GRAVEL | | | | | | | | |
| | 3 | | | | | GM | lt. brown, slightly moist — SILTY GRAVEL W/SAND | | | | | | | | |
| | 4 | | | | | | BOH | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE
UNDISTURBED SAMPLE
Bucket ← Sample Type
0.45 ← Torvane (tsf)

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

## TEST PIT NO. 14-03

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** 120 TRACKHOE
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 3/6/14
**DATE COMPLETED:** 3/6/14
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample: Type | Sample: Rec. (in) | Sample: See Legend | Sample: USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter.: Liquid Limit | Atter.: Plast. Index | Gradation: Gravel (%) | Gradation: Sand (%) | Gradation: Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | | | | CL | dk. to lt. brown, moist to slightly moist — LEAN CLAY W/SAND organics in top 12" | | | | | | | | |
| | 2 | | | | | GM | lt. brown, slightly moist — SILTY GRAVEL W/SAND | | | | | | | | |
| | | | | | | | BOH | | | | | | | | |
| | 3 | | | | | | | | | | | | | | |
| | 4 | | | | | | | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE — Bucket ← Sample Type
0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

## TEST PIT NO. 14-04

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** 120 TRACKHOE
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 3/6/14
**DATE COMPLETED:** 3/6/14
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | Sample USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | CL | dk. brown, moist — LEAN CLAY W/SAND organics | | | | | | | | |
| | 1 | | | | | | | | | | | | | | |
| | 2 | | | | | CL | lt. brown, slightly moist — LEAN CLAY W/SAND | | | | | | | | |
| | 3 | | | | | | | | | | | | | | |
| | 4 | | | | | | | | | | | | | | |
| | 5 | | | | | CL-ML | lt. brown, slightly moist — SANDY SILTY CLAY W/GRAVEL gravels increasing w/depth | | | | | | | | |
| | 6 | | | | | | BOH | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE — Bucket ← Sample Type; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

## TEST PIT NO. 14-05

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** 120 TRACKHOE
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 3/6/14
**DATE COMPLETED:** 3/6/14
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample Type | Sample Rec. (in) | Sample See Legend | USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Liquid Limit | Atter. Plast. Index | Gradation Gravel (%) | Gradation Sand (%) | Gradation Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | CL | dk. brown, moist — LEAN CLAY W/SAND organics | | | | | | | | |
| | 1 | | | | | | | | | | | | | | |
| | 2 | | | | | CL | brown, slightly moist — LEAN CLAY W/SAND | | | | | | | | |
| | 3 | | | | | | | | | | | | | | |
| | 4 | | | | | | | | | | | | | | |
| | 5 | | | | | CL | lt. brown, slightly moist | | | | | | | | |
| | 6 | | | | | | SANDY LEAN CLAY more sandy w/depth | | | | | | | | |
| | 7 | | | | | | | | | | | | | | |
| | 8 | | | | | CL | lt. brown, slightly moist | | | | | | | | |
| | 9 | | | | | GM | lt. brown, slightly moist — SILTY GRAVEL W/SAND cobbles | | | | | | | | |
| | | | | | | | BOH | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE — Bucket ← Sample Type; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

## TEST PIT NO. 14-06

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** 120 TRACKHOE
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 3/6/14
**DATE COMPLETED:** 3/6/14
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample: Type | Sample: Rec. (in) | Sample: See Legend | Sample: USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Limits: Liquid Limit | Atter. Limits: Plast. Index | Gradation: Gravel (%) | Gradation: Sand (%) | Gradation: Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | CL | dk. brown, moist — LEAN CLAY W/SAND organics | | | | | | | | |
| | 1 | | | | | | | | | | | | | | |
| | 2 | | | | | CL | brown, slightly moist | | | | | | | | |
| | 3 | | | | | | | | | | | | | | |
| | 4 | | | | | | SANDY LEAN CLAY | | | | | | | | |
| | 5 | | | | | | | | | | | | | | |
| | 6 | | | | | CL | lt. brown, slightly moist | | | | | | | | |
| | 7 | | | | | | | | | | | | | | |
| | 8 | | | | | GM | lt. brown, slightly moist — SILTY GRAVEL W/SAND cobbles | | | | | | | | |
| | | | | | | | BOH | | | | | | | | |
| | 9 | | | | | | | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE
UNDISTURBED SAMPLE
Bucket ← Sample Type
0.45 ← Torvane (tsf)

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# TEST PIT LOG

## TEST PIT NO. 14-07

SHEET 1 OF 1

**PROJECT:** JUAB RDA LANDFILL
**CLIENT:** JUAB RDA
**LOCATION:** SEE SITE PLAN
**EXCAVATION METHOD:** 120 TRACKHOE
**OPERATOR:** -
**DEPTH TO WATER - INITIAL:** ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

**PROJECT NUMBER:** 200521.000
**DATE STARTED:** 3/6/14
**DATE COMPLETED:** 3/6/14
**GROUND ELEVATION:** NOT MEASURED
**LOGGED BY:** J. BOONE

| Elev. (ft) | Depth (ft) | Lithology | Sample: Type | Sample: Rec. (in) | Sample: See Legend | USCS (AASHTO) | Material Description | Dry Density (pcf) | Moisture Content (%) | Atter. Limits: Liquid Limit | Atter. Limits: Plast. Index | Gradation: Gravel (%) | Gradation: Sand (%) | Gradation: Silt/Clay (%) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | CL | dk. brown, moist — SANDY LEAN CLAY organics | | | | | | | | |
| | 1 | | | | | | | | | | | | | | |
| | 2 | | | | | CL | lt. brown, slightly moist — SANDY LEAN CLAY | | | | | | | | |
| | 3 | | | | | | | | | | | | | | |
| | 4 | | | | | | | | | | | | | | |
| | 5 | | | | | | | | | | | | | | |
| | 6 | | | | | | | | | | | | | | |
| | 7 | | | | | CL-ML | lt. brown, slightly moist — SANDY SILTY CLAY trace gravels | | | | | | | | |
| | 8 | | | | | | | | | | | | | | |
| | 9 | | | | | GM | lt. brown, slightly moist — SILTY GRAVEL W/SAND | | | | | | | | |
| | 10 | | | | | | BOH | | | | | | | | |

TP_UDOT_LOGV1 NEPHILANDFILL.GPJ US EVAL.GDT 3/14/14

RB&G ENGINEERING, INC.

**LEGEND:**
DISTURBED SAMPLE — Bucket ← Sample Type; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE

**OTHER TESTS**
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
HYD = Hydrometer
SS = Soluble Salt
DC = Dispersive Clay

# Hydraulic Conductivity Testing Results

# Laboratory Report for
# RB&G Engineering, Inc.

## JRDA Landfill Project

**May 21, 2014**


*Daniel B. Stephens & Associates, Inc.*

4400 Alameda Blvd. NE, Suite C • Albuquerque, New Mexico 87113

May 21, 2014

Carl Cook
RB&G Engineering, Inc.
1435 West 820 North
Provo, UT 84601
(801) 374-5771

Re: DBS&A Laboratory Report for the RB&G Engineering JRDA Landfill Project

Dear Mr. Cook:

Enclosed is the report for the RB&G Engineering JRDA Landfill project. 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.

The testing utilized to generate the enclosed report employs methods that are standard for the industry. The results do not constitute a professional opinion by DBS&A, nor can the results affect any professional or expert opinions rendered with respect thereto by DBS&A. You have acknowledged that all the testing undertaken by us, and the report provided, constitutes mere test results using standardized methods, and cannot be used to disqualify DBS&A from rendering any professional or expert opinion, having waived any claim of conflict of interest by DBS&A.

We are pleased to provide this service to RB&G Engineering 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.
SOIL TESTING & RESEARCH LABORATORY

Joleen Hines
Laboratory Supervising Manager

Enclosure

*Daniel B. Stephens & Associates, Inc.*
*Soil Testing & Research Laboratory*
4400 Alameda Blvd. NE, Suite C
Albuquerque, NM 87113
505-889-7752
FAX 505-889-0258

# Summaries

# Summary of Tests Performed

| Laboratory Sample Number | Initial Soil Properties[1] | | | Saturated Hydraulic Conductivity[2] | | | Moisture Characteristics[3] | | | | | | | | Particle Size[4] | | | Specific Gravity[5] | | Air Perm-eability | Atterberg Limits | Proctor Compaction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | G | VM | VD | CH | FH | FW | HC | PP | FP | DPP | RH | EP | WHC | $K_{unsat}$ | DS | WS | H | F | C | | | |
| Test Pit 12-04 (82%, 87.8pcf) | X | X | | X | | | X | X | | X | X | | | X | | | | | | | | |
| Test Pit 12-04 (88%, 94.3pcf) | X | X | | X | | | X | X | | X | X | | | X | | | | | | | | |

[1] G = Gravimetric Moisture Content, VM = Volume Measurement Method, VD = Volume Displacement Method

[2] CH = Constant Head Rigid Wall, FH = Falling Head Rigid Wall, FW = Falling Head Rising Tail Flexible Wall

[3] HC = Hanging Column, PP = Pressure Plate, FP = Filter Paper, DPP = Dew Point Potentiometer, RH = Relative Humidity Box, EP = Effective Porosity, WHC = Water Holding Capacity, Kunsat = Calculated Unsaturated Hydraulic Conductivity

[4] DS = Dry Sieve, WS = Wet Sieve, H = Hydrometer

[5] F = Fine (<4.75mm), C = Coarse (>4.75mm)

## Notes

**Sample Receipt:**
One sample arrived on April 8, 2014, in two full 1-gallon Ziploc bags, double bagged. The bags arrived in a box with packing paper and were received in good order.

**Sample Preparation and Testing Notes:**
Two sub-samples were prepared for initial properties testing, saturated hydraulic conductivity testing, and the hanging column and pressure chamber portions of the moisture retention testing by remolding the material into testing rings to target 82% and 88% of the maximum dry bulk density, based on the client provided standard proctor compaction testing results. The density (in pcf) and the percent of maximum dry bulk density achieved were added to the sample ID's. Remaining bulk material was used to prepare sub-samples for the dewpoint potentiometer and relative humidity chamber portions of the moisture retention testing.

Total porosity calculations were performed using an assumed specific gravity value of 2.70.

## Summary of Sample Preparation/Volume Changes (g/cm$^3$ and pcf)

| | Proctor Data | | Target Remold Parameters[1] | | | Actual Remold Data | | | Volume Change Post Saturation[2] | | | Volume Change Post Drying Curve[3] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Number | Opt. Moist. Cont. (%, g/g) | Max. Dry Density (g/cm$^3$) | Moist. Cont. (%, g/g) | Dry Bulk Density (g/cm$^3$) | % of Max. Density (%) | Moist. Cont. (%, g/g) | Dry Bulk Density (g/cm$^3$) | % of Max. Density (%) | Dry Bulk Density (g/cm$^3$) | % Volume Change (%) | % of Max. Density (%) | Dry Bulk Density (g/cm$^3$) | % Volume Change (%) | % of Max. Density (%) |
| Test Pit 12-04 (82%, 87.8pcf) | 15.9 | 1.73 | 15.9 | 1.41 | 82% | 16.7 | 1.41 | 81.5% | 1.41 | --- | 81.5% | 1.41 | --- | 81.5% |
| Test Pit 12-04 (88%, 94.3pcf) | 15.9 | 1.73 | 15.9 | 1.52 | 88% | 16.7 | 1.51 | 87.5% | 1.51 | --- | 87.5% | 1.51 | --- | 87.5% |

| | Proctor Data | | Target Remold Parameters[1] | | | Actual Remold Data | | | Volume Change Post Saturation[2] | | | Volume Change Post Drying Curve[3] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Number | Opt. Moist. Cont. (%, g/g) | Max. Dry Density (pcf) | Moist. Cont. (%, g/g) | Dry Bulk Density (pcf) | % of Max. Density (%) | Moist. Cont. (%, g/g) | Dry Bulk Density (pcf) | % of Max. Density (%) | Dry Bulk Density (pcf) | % Volume Change (%) | % of Max. Density (%) | Dry Bulk Density (pcf) | % Volume Change (%) | % of Max. Density (%) |
| Test Pit 12-04 (82%, 87.8pcf) | 15.9 | 107.7 | 15.9 | 88.3 | 82% | 16.7 | 87.8 | 81.5% | 87.8 | --- | 81.5% | 87.8 | --- | 81.5% |
| Test Pit 12-04 (88%, 94.3pcf) | 15.9 | 107.7 | 15.9 | 94.8 | 88% | 16.7 | 94.3 | 87.5% | 94.3 | --- | 87.5% | 94.3 | --- | 87.5% |

[1]Target Remold Parameters: Provided by the client.

[2]Volume Change Post Saturation: Volume change measurements were obtained after saturated hydraulic conductivity testing.

[3]Volume Change Post Drying Curve: Volume change measurements were obtained throughout hanging column and pressure chamber testing. The 'Volume Change Post Drying Curve' values represent the final sample dimensions after the last hanging column or pressure chamber measurement.

Notes:

"+" indicates sample swelling, "-" indicates sample settling, and "---" indicates no volume change occurred.

## Summary of Initial Moisture Content, Dry Bulk Density Wet Bulk Density and Calculated Porosity

| Sample Number | Moisture Content | | | | Dry Bulk Density ($g/cm^3$) | Wet Bulk Density ($g/cm^3$) | Calculated Porosity (%) |
|---|---|---|---|---|---|---|---|
| | As Received | | Remolded | | | | |
| | Gravimetric (%, g/g) | Volumetric (%, $cm^3/cm^3$) | Gravimetric (%, g/g) | Volumetric (%, $cm^3/cm^3$) | | | |
| Test Pit 12-04 (82%, 87.8pcf) | 16.7 | 23.5 | --- | --- | 1.41 | 1.64 | 47.9 |
| Test Pit 12-04 (88%, 94.3pcf) | 16.7 | 25.2 | --- | --- | 1.51 | 1.76 | 44.1 |

NA = Not analyzed

--- = This sample was not remolded

## Summary of Saturated Hydraulic Conductivity Tests

| Sample Number | $K_{sat}$ (cm/sec) | Oversize Corrected $K_{sat}$ (cm/sec) | Method of Analysis | |
|---|---|---|---|---|
| | | | Constant Head | Falling Head |
| Test Pit 12-04 (82%, 87.8pcf) | 7.3E-04 | --- | X | |
| Test Pit 12-04 (88%, 94.3pcf) | 7.4E-05 | --- | X | |

--- = Oversize correction is unnecessary since coarse fraction < 5% of composite mass
NR = Not requested
NA = Not applicable

## Summary of Moisture Characteristics of the Initial Drainage Curve

| Sample Number | Pressure Head (-cm water) | Moisture Content (%, $cm^3/cm^3$) |
|---|---|---|
| Test Pit 12-04 (82%, 87.8pcf) | 0 | 48.0 |
| | 15 | 47.3 |
| | 29 | 41.2 |
| | 86 | 34.0 |
| | 337 | 28.7 |
| | 17643 | 12.9 |
| | 64145 | 9.3 |
| | 245466 | 6.7 |
| | 848426 | 5.1 |
| Test Pit 12-04 (88%, 94.3pcf) | 0 | 44.5 |
| | 18 | 43.7 |
| | 53 | 39.8 |
| | 126 | 34.2 |
| | 337 | 30.5 |
| | 13053 | 15.1 |
| | 41608 | 11.0 |
| | 141548 | 8.1 |
| | 376306 | 6.5 |
| | 848426 | 5.4 |

‡‡ Volume adjustments are applicable at this matric potential (see data sheet for this sample).

## Summary of Calculated Unsaturated Hydraulic Properties

| Sample Number | $\alpha$ ($cm^{-1}$) | N (dimensionless) | $\theta_r$ (% vol) | $\theta_s$ (% vol) | Oversize Corrected $\theta_r$ (% vol) | Oversize Corrected $\theta_s$ (% vol) |
|---|---|---|---|---|---|---|
| Test Pit 12-04 (82%, 87.8pcf) | 0.0459 | 1.2064 | 0.00 | 48.88 | --- | --- |
| Test Pit 12-04 (88%, 94.3pcf) | 0.0194 | 1.2097 | 0.00 | 44.88 | --- | --- |

--- = Oversize correction is unnecessary since coarse fraction < 5% of composite mass
NR = Not requested
NA = Not applicable

# Initial Properties

## Summary of Initial Moisture Content, Dry Bulk Density Wet Bulk Density and Calculated Porosity

| Sample Number | Moisture Content | | | | Dry Bulk Density ($g/cm^3$) | Wet Bulk Density ($g/cm^3$) | Calculated Porosity (%) |
|---|---|---|---|---|---|---|---|
| | As Received | | Remolded | | | | |
| | Gravimetric (%, g/g) | Volumetric (%, $cm^3/cm^3$) | Gravimetric (%, g/g) | Volumetric (%, $cm^3/cm^3$) | | | |
| Test Pit 12-04 (82%, 87.8pcf) | 16.7 | 23.5 | --- | --- | 1.41 | 1.64 | 47.9 |
| Test Pit 12-04 (88%, 94.3pcf) | 16.7 | 25.2 | --- | --- | 1.51 | 1.76 | 44.1 |

NA = Not analyzed

--- = This sample was not remolded

# Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

*Job Name:* RB&G Engineering, Inc.
*Job Number:* LB14.0073.00
*Sample Number:* Test Pit 12-04 (82%, 87.8pcf)
*Project:* JRDA Landfill Project
*Location:* NA

| | As Received | Remolded |
|---|---|---|
| *Test Date:* | 11-Apr-14 | --- |
| *Field weight* of sample* (g): | 498.17 | |
| *Tare weight, ring* (g): | 132.87 | |
| *Tare weight, pan/plate* (g): | 0.00 | |
| *Tare weight, other* (g): | 0.00 | |
| *Dry weight of sample* (g): | 312.97 | |
| *Sample volume* ($cm^3$): | 222.48 | |
| *Assumed particle density* ($g/cm^3$): | 2.70 | |
| *Gravimetric Moisture Content* (% g/g): | 16.7 | |
| *Volumetric Moisture Content* (% vol): | 23.5 | |
| *Dry bulk density* ($g/cm^3$): | 1.41 | |
| *Wet bulk density* ($g/cm^3$): | 1.64 | |
| *Calculated Porosity* (% vol): | 47.9 | |
| *Percent Saturation:* | 49.1 | |

*Laboratory analysis by:* D. O'Dowd
*Data entered by:* D. O'Dowd
*Checked by:* J. Hines

*Comments:*

* Weight including tares
NA = Not analyzed
--- = This sample was not remolded

# Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

*Job Name:* RB&G Engineering, Inc.
*Job Number:* LB14.0073.00
*Sample Number:* Test Pit 12-04 (88%, 94.3pcf)
*Project:* JRDA Landfill Project
*Location:* NA

| | As Received | Remolded |
|---|---|---|
| *Test Date:* | 11-Apr-14 | --- |
| *Field weight* of sample* (g): | 529.07 | |
| *Tare weight, ring* (g): | 133.72 | |
| *Tare weight, pan/plate* (g): | 0.00 | |
| *Tare weight, other* (g): | 0.00 | |
| *Dry weight of sample* (g): | 338.91 | |
| *Sample volume* ($cm^3$): | 224.39 | |
| *Assumed particle density* ($g/cm^3$): | 2.70 | |
| *Gravimetric Moisture Content* (% g/g): | 16.7 | |
| *Volumetric Moisture Content* (% vol): | 25.2 | |
| *Dry bulk density* ($g/cm^3$): | 1.51 | |
| *Wet bulk density* ($g/cm^3$): | 1.76 | |
| *Calculated Porosity* (% vol): | 44.1 | |
| *Percent Saturation:* | 57.1 | |

*Laboratory analysis by:* D. O'Dowd
*Data entered by:* D. O'Dowd
*Checked by:* J. Hines

*Comments:*

* Weight including tares
NA = Not analyzed
--- = This sample was not remolded

# Saturated Hydraulic Conductivity

## Summary of Saturated Hydraulic Conductivity Tests

| Sample Number | $K_{sat}$ (cm/sec) | Oversize Corrected $K_{sat}$ (cm/sec) | Method of Analysis | |
|---|---|---|---|---|
| | | | Constant Head | Falling Head |
| Test Pit 12-04 (82%, 87.8pcf) | 7.3E-04 | --- | X | |
| Test Pit 12-04 (88%, 94.3pcf) | 7.4E-05 | --- | X | |

--- = Oversize correction is unnecessary since coarse fraction < 5% of composite mass
NR = Not requested
NA = Not applicable

# Saturated Hydraulic Conductivity
## Constant Head Method

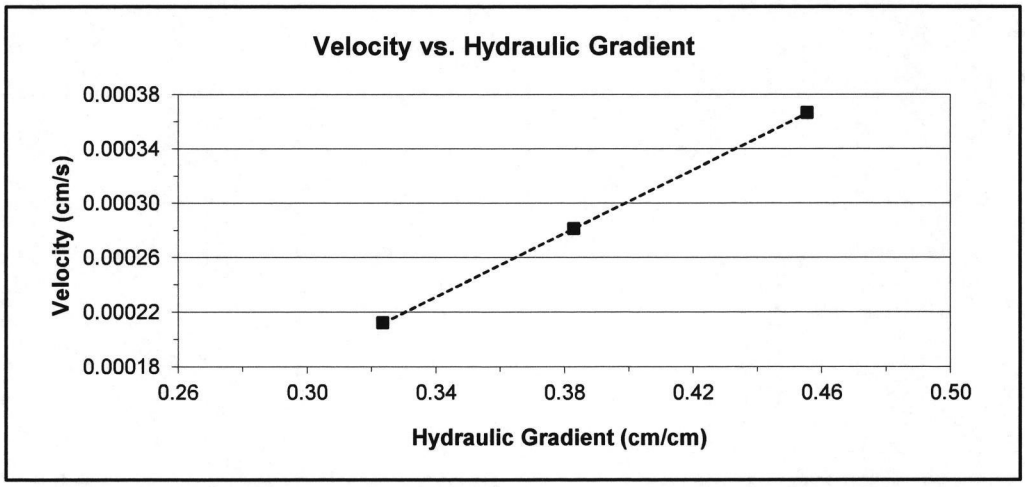
*Job Name:* RB&G Engineering, Inc.
*Job Number:* LB14.0073.00
*Sample Number:* Test Pit 12-04 (82%, 87.8pcf)
*Project:* JRDA Landfill Project
*Location:* NA

*Type of water used:* TAP
*Collection vessel tare* (g): 10.98
*Sample length* (cm): 7.57
*Sample diameter* (cm): 6.12
*Sample x-sectional area* ($cm^2$): 29.38

| 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: | | | | | | | | |
| 16-Apr-14 | 13:19:30 | 20.1 | 3.45 | 14.48 | 3.5 | 325 | 8.0E-04 | 8.1E-04 |
| 16-Apr-14 | 13:24:55 | | | | | | | |
| Test # 2: | | | | | | | | |
| 16-Apr-14 | 14:43:41 | 20.1 | 2.9 | 37.97 | 27.0 | 3268 | 7.3E-04 | 7.4E-04 |
| 16-Apr-14 | 15:38:09 | | | | | | | |
| Test # 3: | | | | | | | | |
| 16-Apr-14 | 15:53:01 | 20.1 | 2.45 | 13.28 | 2.3 | 369 | 6.6E-04 | 6.6E-04 |
| 16-Apr-14 | 15:59:10 | | | | | | | |

***Average Ksat* (cm/sec):** **7.3E-04**
***Oversize Corrected Ksat* (cm/sec):** **---**

*Comments:*
--- = Oversize correction is unnecessary since coarse fraction < 5% of composite mass




*Laboratory analysis by:* D. O'Dowd
*Data entered by:* D. O'Dowd
*Checked by:* J. Hines

# Saturated Hydraulic Conductivity
## Constant Head Method

*Job Name:* RB&G Engineering, Inc.
*Job Number:* LB14.0073.00
*Sample Number:* Test Pit 12-04 (88%, 94.3pcf)
*Project:* JRDA Landfill Project
*Location:* NA

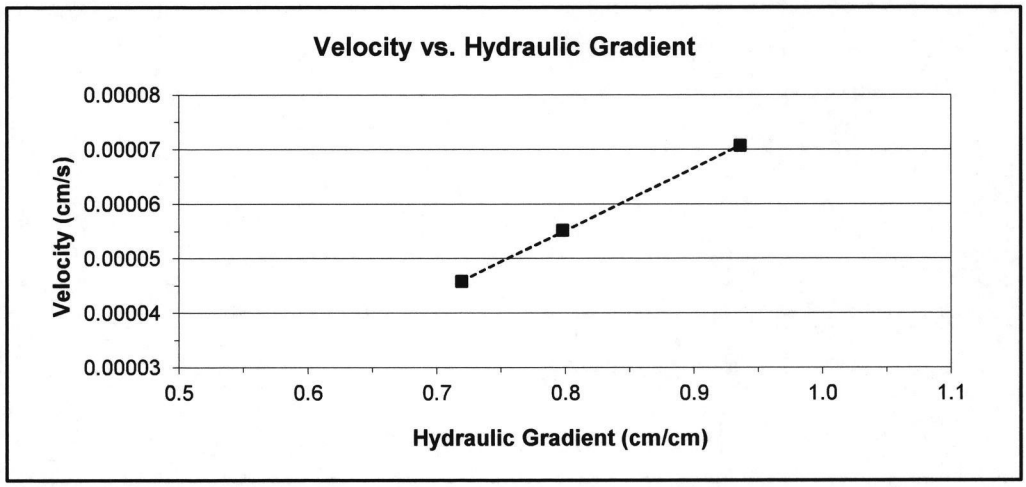
*Type of water used:* TAP
*Collection vessel tare* (g): 11.05
*Sample length* (cm): 7.62
*Sample diameter* (cm): 6.12
*Sample x-sectional area* ($cm^2$): 29.46

| 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: | | | | | | | | |
| 16-Apr-14 | 13:19:40 | 20.1 | 6.75 | 11.66 | 0.6 | 293 | 8.0E-05 | 8.0E-05 |
| 16-Apr-14 | 13:24:33 | | | | | | | |
| Test # 2: | | | | | | | | |
| 16-Apr-14 | 14:43:25 | 20.1 | 5.7 | 16.35 | 5.3 | 3259 | 7.4E-05 | 7.4E-05 |
| 16-Apr-14 | 15:37:44 | | | | | | | |
| Test # 3: | | | | | | | | |
| 16-Apr-14 | 15:52:38 | 20.1 | 5.1 | 12.11 | 1.1 | 786 | 6.8E-05 | 6.9E-05 |
| 16-Apr-14 | 16:05:44 | | | | | | | |

***Average Ksat* (cm/sec):** **7.4E-05**
***Oversize Corrected Ksat* (cm/sec):** **---**

*Comments:*

--- = Oversize correction is unnecessary since coarse fraction < 5% of composite mass




*Laboratory analysis by:* D. O'Dowd
*Data entered by:* D. O'Dowd
*Checked by:* J. Hines

# Moisture Retention Characteristics

## Summary of Moisture Characteristics of the Initial Drainage Curve

| Sample Number | Pressure Head (-cm water) | Moisture Content (%, $cm^3/cm^3$) |
|---|---|---|
| Test Pit 12-04 (82%, 87.8pcf) | 0 | 48.0 |
| | 15 | 47.3 |
| | 29 | 41.2 |
| | 86 | 34.0 |
| | 337 | 28.7 |
| | 17643 | 12.9 |
| | 64145 | 9.3 |
| | 245466 | 6.7 |
| | 848426 | 5.1 |
| Test Pit 12-04 (88%, 94.3pcf) | 0 | 44.5 |
| | 18 | 43.7 |
| | 53 | 39.8 |
| | 126 | 34.2 |
| | 337 | 30.5 |
| | 13053 | 15.1 |
| | 41608 | 11.0 |
| | 141548 | 8.1 |
| | 376306 | 6.5 |
| | 848426 | 5.4 |

‡‡ Volume adjustments are applicable at this matric potential (see data sheet for this sample).

## Summary of Calculated Unsaturated Hydraulic Properties

| Sample Number | $\alpha$ ($cm^{-1}$) | N (dimensionless) | $\theta_r$ (% vol) | $\theta_s$ (% vol) | Oversize Corrected $\theta_r$ (% vol) | Oversize Corrected $\theta_s$ (% vol) |
|---|---|---|---|---|---|---|
| Test Pit 12-04 (82%, 87.8pcf) | 0.0459 | 1.2064 | 0.00 | 48.88 | --- | --- |
| Test Pit 12-04 (88%, 94.3pcf) | 0.0194 | 1.2097 | 0.00 | 44.88 | --- | --- |

--- = Oversize correction is unnecessary since coarse fraction < 5% of composite mass

NR = Not requested

NA = Not applicable

# Moisture Retention Data

## Hanging Column / Pressure Plate

(Soil-Water Characteristic Curve)

*Job Name:* RB&G Engineering, Inc.
*Job Number:* LB14.0073.00
*Sample Number:* Test Pit 12-04 (82%, 87.8pcf)
*Project:* JRDA Landfill Project
*Location:* NA

*Dry wt. of sample* (g): 312.97
*Tare wt., ring* (g): 132.87
*Tare wt., screen & clamp* (g): 28.27
*Initial sample volume* ($cm^3$): 222.48
*Initial dry bulk density* ($g/cm^3$): 1.41
*Assumed particle density* ($g/cm^3$): 2.70
*Initial calculated total porosity* (%): 47.90

| | Date | Time | Weight* (g) | Matric Potential (-cm water) | Moisture Content† (% vol) |
|---|---|---|---|---|---|
| *Hanging column:* | 17-Apr-14 | 8:30 | 580.95 | 0 | 48.02 |
| | 24-Apr-14 | 13:15 | 579.33 | 14.5 | 47.29 |
| | 2-May-14 | 10:10 | 565.88 | 29.0 | 41.25 |
| | 9-May-14 | 14:30 | 549.73 | 86.0 | 33.99 |
| *Pressure plate:* | 19-May-14 | 8:15 | 537.89 | 337 | 28.67 |

Volume Adjusted Data [1]

| | Matric Potential (-cm water) | Adjusted Volume ($cm^3$) | % Volume Change [2] (%) | Adjusted Density ($g/cm^3$) | Adjusted Calculated Porosity (%) |
|---|---|---|---|---|---|
| *Hanging column:* | 0.0 | --- | --- | --- | --- |
| | 14.5 | --- | --- | --- | --- |
| | 29.0 | --- | --- | --- | --- |
| | 86.0 | --- | --- | --- | --- |
| *Pressure plate:* | 337 | --- | --- | --- | --- |

*Comments:*

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent each of the volume change measurements obtained after saturated hydraulic conductivity testing and throughout hanging column/pressure plate testing. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

† Assumed density of water is 1.0 $g/cm^3$

‡‡ Volume adjustments are applicable at this matric potential (see comment #1). Changes in volume, if applicable, are estimated based on obtainable measurements of changes in sample length and diameter.

*Technician Notes:*

*Laboratory analysis by:* D. O'Dowd
*Data entered by:* C. Krous
*Checked by:* J. Hines

# Moisture Retention Data

## Dew Point Potentiometer / Relative Humidity Box

(Soil-Water Characteristic Curve)

*Sample Number:* Test Pit 12-04 (82%, 87.8pcf)

*Initial sample bulk density* (g/cm$^3$): 1.41

*Fraction of test sample used (<2.00mm fraction) (%):* 91.43

*Dry weight* of dew point potentiometer sample* (g): 164.69

*Tare weight, jar* (g): 117.21

| | Date | Time | Weight* (g) | Water Potential (-cm water) | Moisture Content† (% vol) |
|---|---|---|---|---|---|
| *Dew point potentiometer:* | 25-Apr-14 | 11:39 | 169.47 | 17643 | 12.94 |
| | 24-Apr-14 | 9:54 | 168.13 | 64145 | 9.32 |
| | 23-Apr-14 | 10:45 | 167.18 | 245466 | 6.74 |

Volume Adjusted Data [1]

| | Water Potential (-cm water) | Adjusted Volume (cm$^3$) | % Volume Change [2] (%) | Adjusted Density (g/cm$^3$) | Adjusted Calc. Porosity (%) |
|---|---|---|---|---|---|
| *Dew point potentiometer:* | 17643 | --- | --- | --- | --- |
| | 64145 | --- | --- | --- | --- |
| | 245466 | --- | --- | --- | --- |

*Dry weight* of relative humidity box sample* (g): 62.59

*Tare weight* (g): 42.28

| | Date | Time | Weight* (g) | Water Potential (-cm water) | Moisture Content† (% vol) |
|---|---|---|---|---|---|
| *Relative humidity box:* | 25-Apr-14 | 12:20 | 63.39 | 848426 | 5.07 |

Volume Adjusted Data [1]

| | Water Potential (-cm water) | Adjusted Volume (cm$^3$) | % Volume Change [2] (%) | Adjusted Density (g/cm$^3$) | Adjusted Calc. Porosity (%) |
|---|---|---|---|---|---|
| *Relative humidity box:* | 848426 | --- | --- | --- | --- |

*Comments:*

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent the volume change measurements obtained after the last hanging column or pressure plate point. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

† Adjusted for >2.00mm (#10 sieve) material not used in DPP/RH testing. Assumed moisture content of material >2.00mm is zero, and assumed density of water is 1.0 g/cm$^3$.

‡‡ Volume adjustments are applicable at this matric potential (see comment #1). Changes in volume, if applicable, are estimated based on obtainable measurements of changes in sample length and diameter.

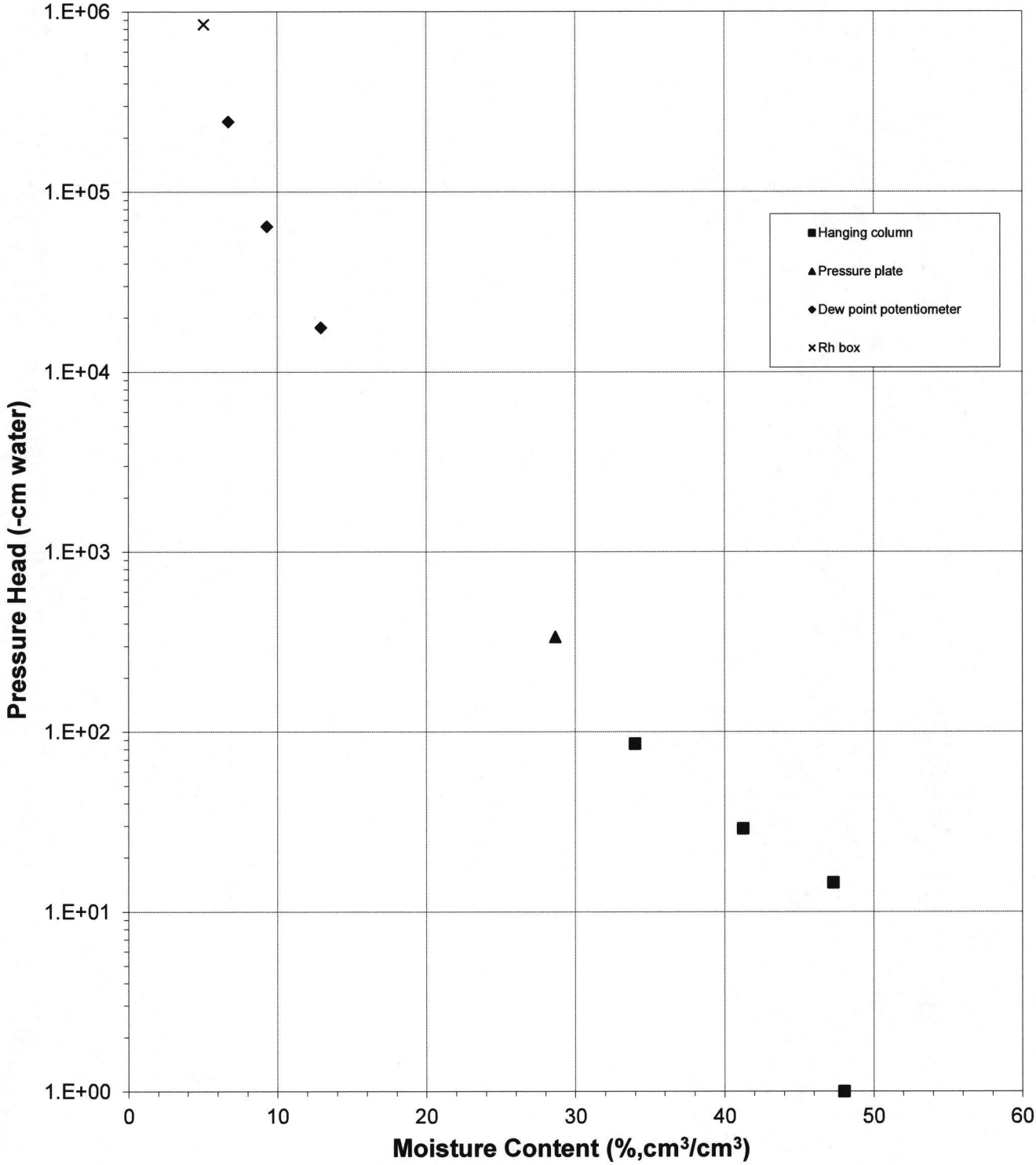
*Laboratory analysis by:* J. Hines/D. O'Dowd

*Data entered by:* C. Krous

*Checked by:* J. Hines

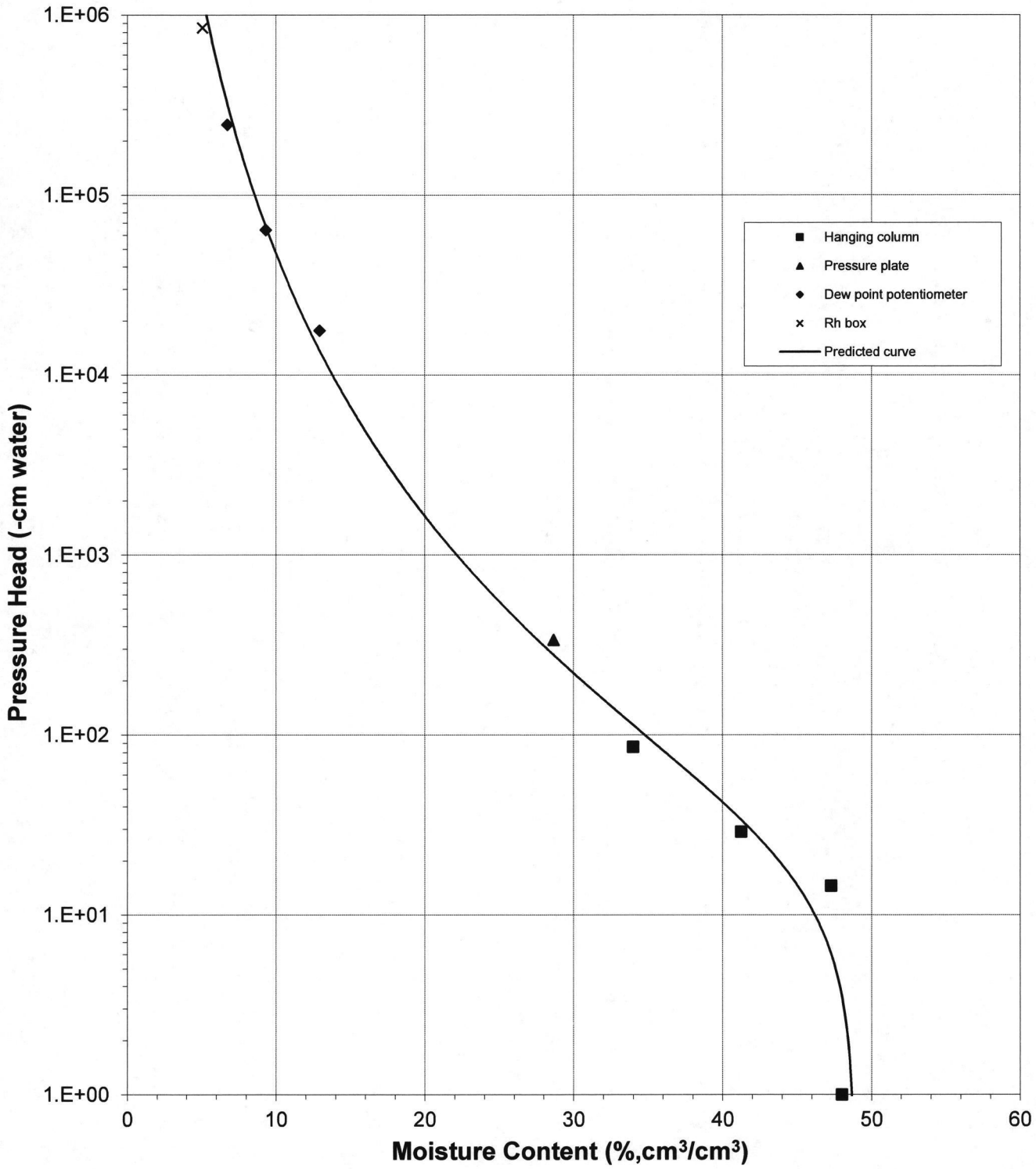
## Water Retention Data Points

*Sample Number: Test Pit 12-04 (82%, 87.8pcf)*



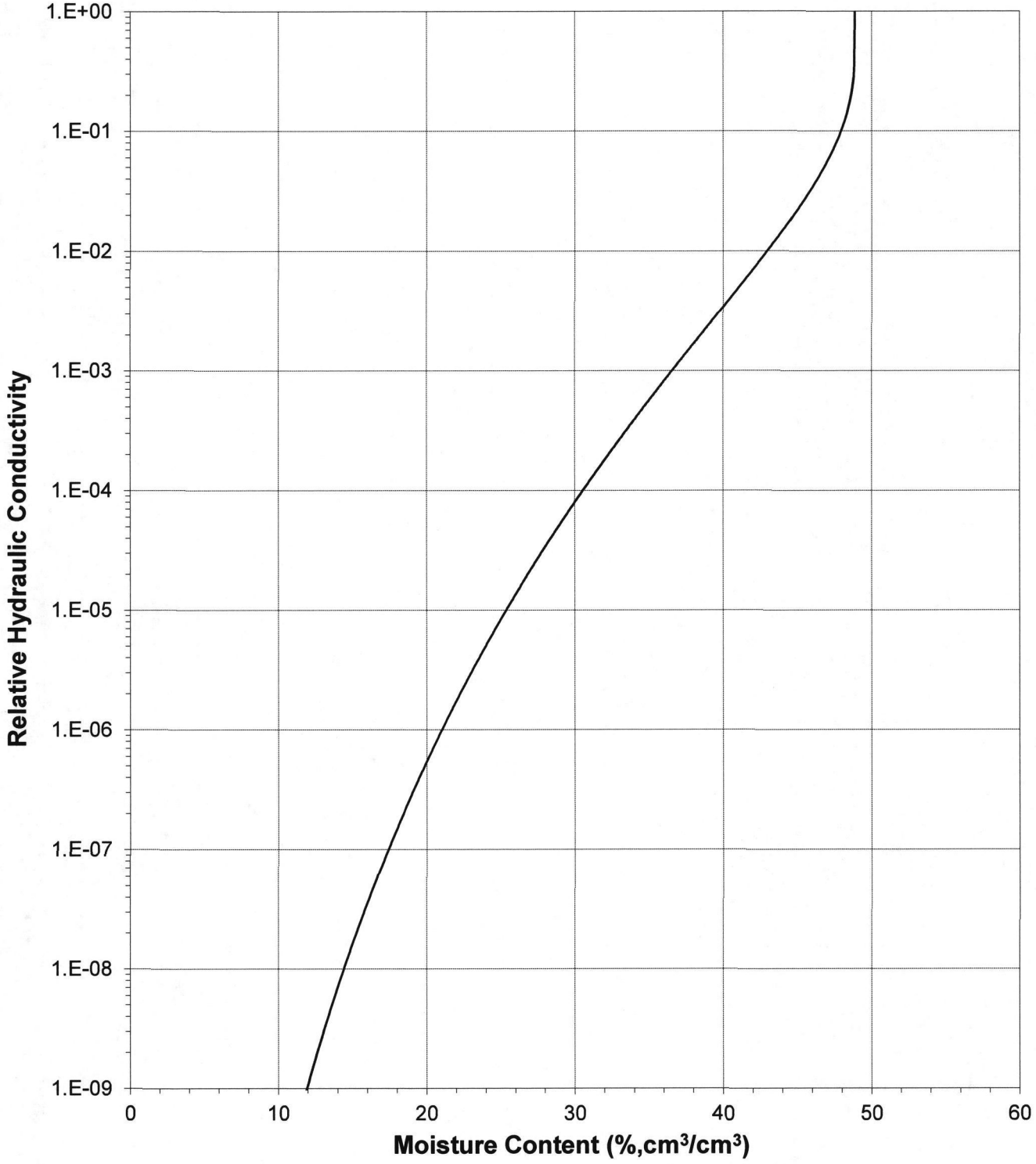
## Predicted Water Retention Curve and Data Points

*Sample Number: Test Pit 12-04 (82%, 87.8pcf)*



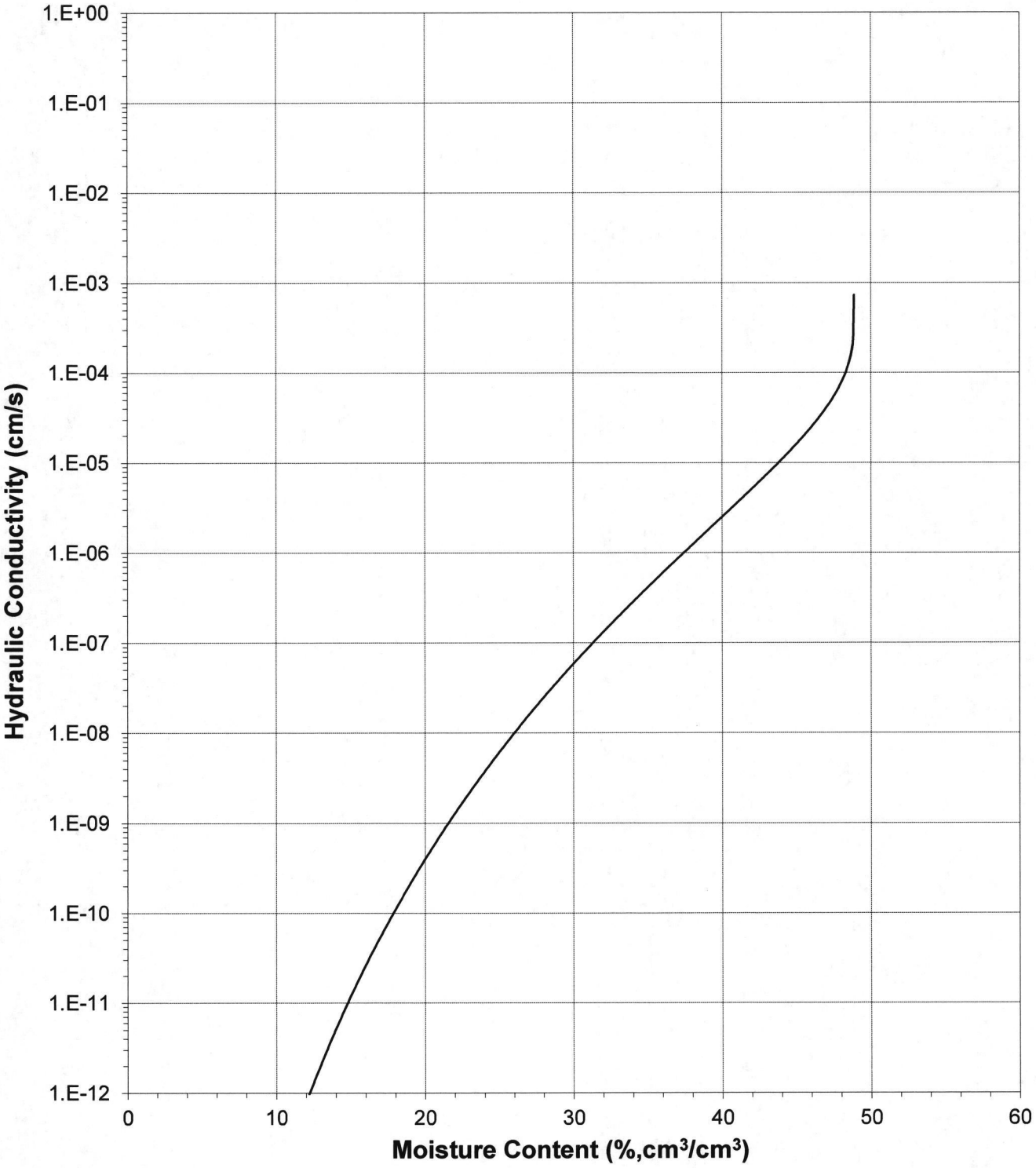
## Plot of Relative Hydraulic Conductivity vs Moisture Content

*Sample Number: Test Pit 12-04 (82%, 87.8pcf)*



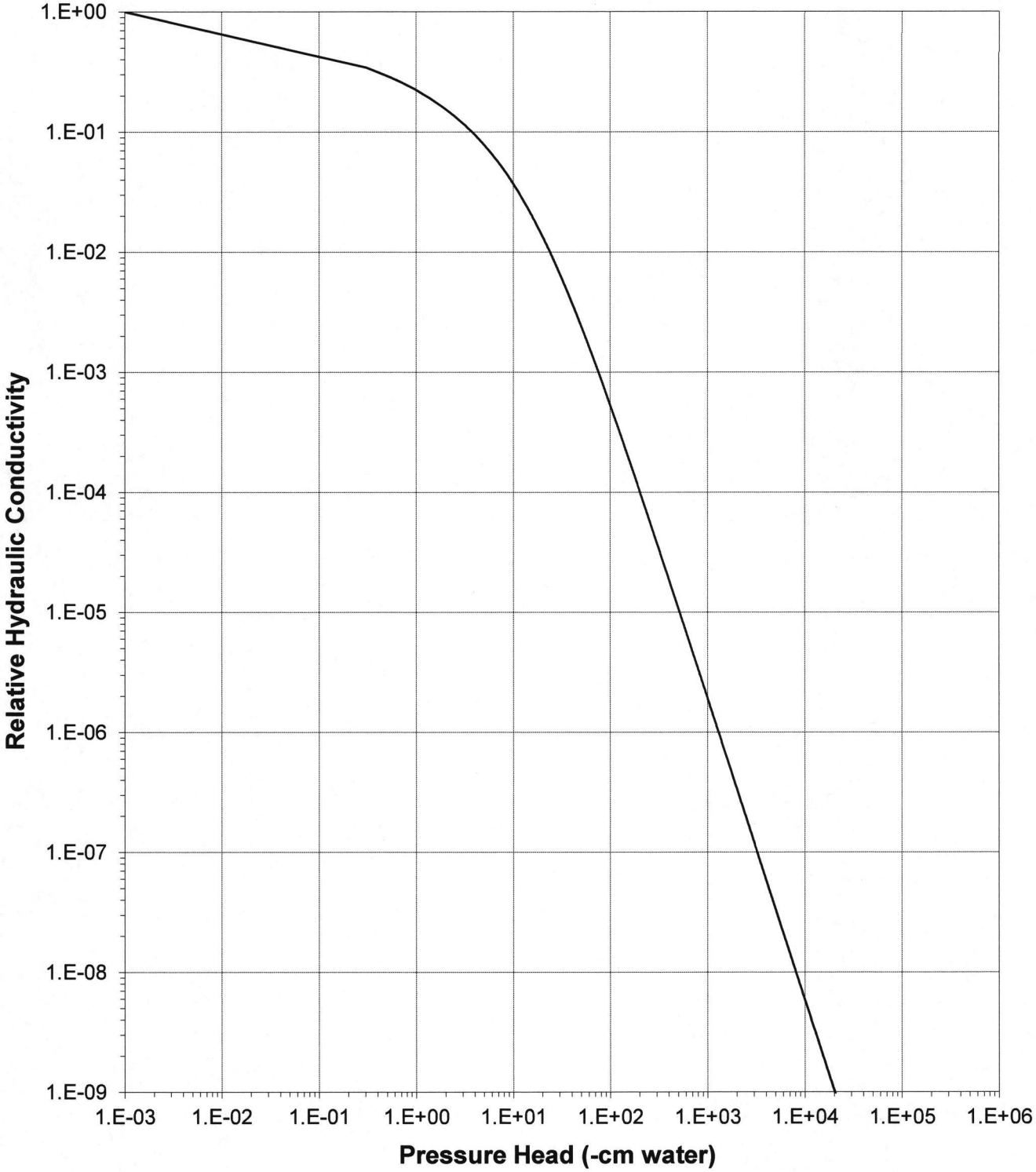
## Plot of Hydraulic Conductivity vs Moisture Content

*Sample Number: Test Pit 12-04 (82%, 87.8pcf)*



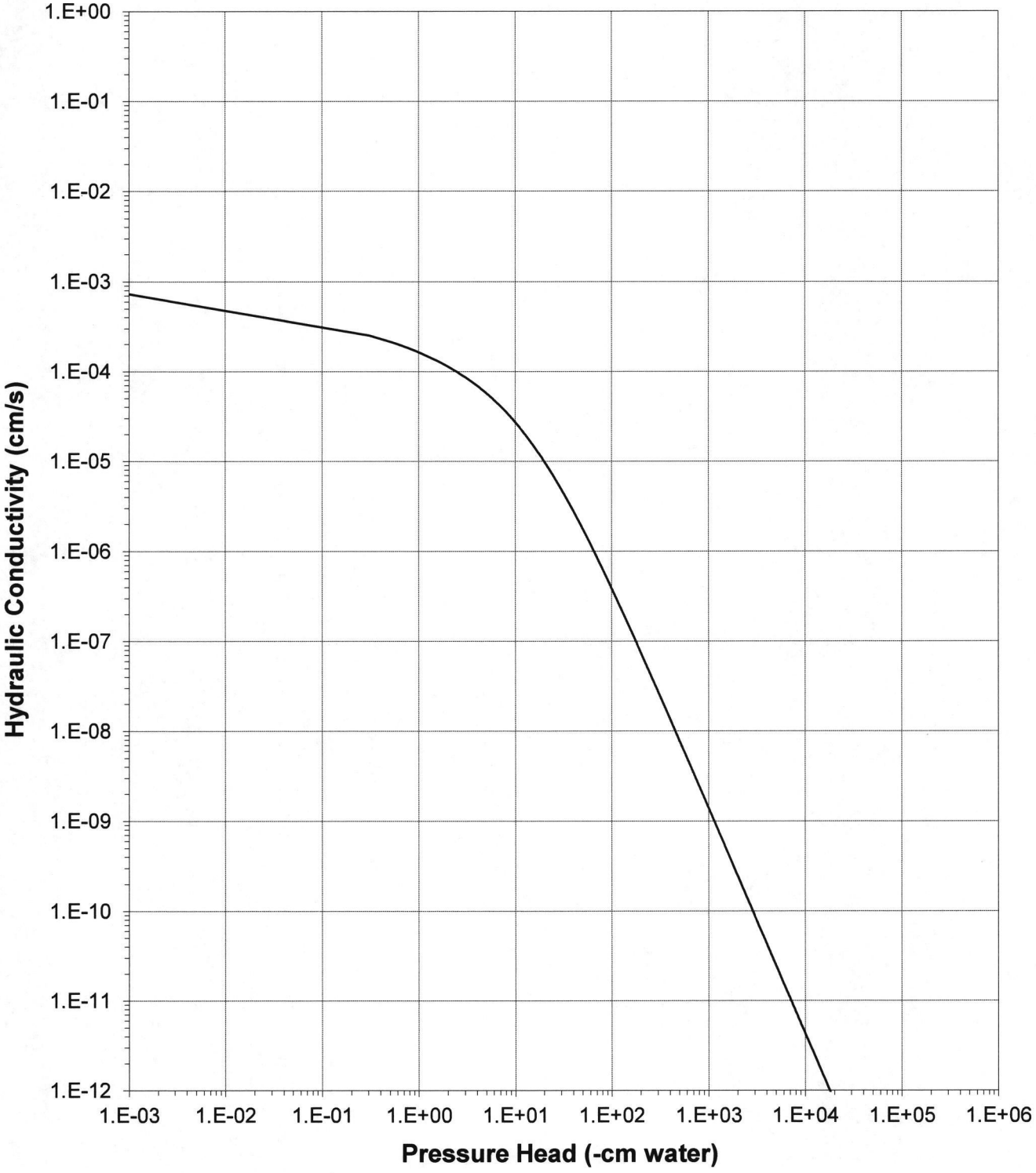
## Plot of Relative Hydraulic Conductivity vs Pressure Head

*Sample Number: Test Pit 12-04 (82%, 87.8pcf)*



## Plot of Hydraulic Conductivity vs Pressure Head

*Sample Number: Test Pit 12-04 (82%, 87.8pcf)*



# Moisture Retention Data

## Hanging Column / Pressure Plate

(Soil-Water Characteristic Curve)

*Job Name:* RB&G Engineering, Inc.
*Job Number:* LB14.0073.00
*Sample Number:* Test Pit 12-04 (88%, 94.3pcf)
*Project:* JRDA Landfill Project
*Location:* NA

*Dry wt. of sample* (g): 338.91
*Tare wt., ring* (g): 133.72
*Tare wt., screen & clamp* (g): 26.58
*Initial sample volume* ($cm^3$): 224.39
*Initial dry bulk density* ($g/cm^3$): 1.51
*Assumed particle density* ($g/cm^3$): 2.70
*Initial calculated total porosity* (%): 44.06

| | Date | Time | Weight* (g) | Matric Potential (-cm water) | Moisture Content† (% vol) |
|---|---|---|---|---|---|
| *Hanging column:* | 17-Apr-14 | 8:30 | 599.12 | 0 | 44.53 |
| | 24-Apr-14 | 15:00 | 597.23 | 18.0 | 43.68 |
| | 2-May-14 | 10:00 | 588.49 | 53.0 | 39.79 |
| | 9-May-14 | 14:30 | 575.85 | 126.0 | 34.15 |
| *Pressure plate:* | 19-May-14 | 8:15 | 567.54 | 337 | 30.45 |

Volume Adjusted Data[1]

| | Matric Potential (-cm water) | Adjusted Volume ($cm^3$) | % Volume Change[2] (%) | Adjusted Density ($g/cm^3$) | Adjusted Calculated Porosity (%) |
|---|---|---|---|---|---|
| *Hanging column:* | 0.0 | --- | --- | --- | --- |
| | 18.0 | --- | --- | --- | --- |
| | 53.0 | --- | --- | --- | --- |
| | 126.0 | --- | --- | --- | --- |
| *Pressure plate:* | 337 | --- | --- | --- | --- |

*Comments:*

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent each of the volume change measurements obtained after saturated hydraulic conductivity testing and throughout hanging column/pressure plate testing. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

† Assumed density of water is 1.0 $g/cm^3$

‡‡ Volume adjustments are applicable at this matric potential (see comment #1). Changes in volume, if applicable, are estimated based on obtainable measurements of changes in sample length and diameter.

*Technician Notes:*

*Laboratory analysis by:* D. O'Dowd
*Data entered by:* C. Krous
*Checked by:* J. Hines

# Moisture Retention Data

## Dew Point Potentiometer / Relative Humidity Box

(Soil-Water Characteristic Curve)

*Sample Number:* Test Pit 12-04 (88%, 94.3pcf)

*Initial sample bulk density* (g/cm$^3$)*:* 1.51

*Fraction of test sample used (<2.00mm fraction) (%):* 91.43

*Dry weight* of dew point potentiometer sample* (g)*:* 163.25

*Tare weight, jar* (g)*:* 116.24

| | Date | Time | Weight* (g) | Water Potential (-cm water) | Moisture Content† (% vol) |
|---|---|---|---|---|---|
| *Dew point potentiometer:* | 24-Apr-14 | 11:45 | 168.38 | 13053 | 15.08 |
| | 24-Apr-14 | 10:36 | 167.01 | 41608 | 11.03 |
| | 23-Apr-14 | 14:46 | 166.01 | 141548 | 8.11 |
| | 23-Apr-14 | 10:55 | 165.47 | 376306 | 6.51 |

Volume Adjusted Data[1]

| | Water Potential (-cm water) | Adjusted Volume (cm$^3$) | % Volume Change[2] (%) | Adjusted Density (g/cm$^3$) | Adjusted Calc. Porosity (%) |
|---|---|---|---|---|---|
| *Dew point potentiometer:* | 13053 | --- | --- | --- | --- |
| | 41608 | --- | --- | --- | --- |
| | 141548 | --- | --- | --- | --- |
| | 376306 | --- | --- | --- | --- |

*Comments:*

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent the volume change measurements obtained after the last hanging column or pressure plate point. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

† Adjusted for >2.00mm (#10 sieve) material not used in DPP/RH testing. Assumed moisture content of material >2.00mm is zero, and assumed density of water is 1.0 g/cm$^3$.

‡‡ Volume adjustments are applicable at this matric potential (see comment #1).

*Laboratory analysis by:* J. Hines/D. O'Dowd
*Data entered by:* C. Krous
*Checked by:* J. Hines

# Moisture Retention Data

## Dew Point Potentiometer / Relative Humidity Box

(Soil-Water Characteristic Curve)

*Sample Number:* Test Pit 12-04 (88%, 94.3pcf)

*Initial sample bulk density* (g/cm$^3$): 1.51

*Fraction of test sample used (<2.00mm fraction) (%):* 91.43

*Dry weight* of relative humidity box sample* (g): 60.91

*Tare weight* (g): 39.93

| | Date | Time | Weight* (g) | Water Potential (-cm water) | Moisture Content† (% vol) |
|---|---|---|---|---|---|
| *Relative humidity box:* | 25-Apr-14 | 12:20 | 61.73 | 848426 | 5.44 |

Volume Adjusted Data [1]

| | Water Potential (-cm water) | Adjusted Volume (cm$^3$) | % Volume Change [2] (%) | Adjusted Density (g/cm$^3$) | Adjusted Calc. Porosity (%) |
|---|---|---|---|---|---|
| *Relative humidity box:* | 848426 | --- | --- | --- | --- |

*Comments:*

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent the volume change measurements obtained after the last hanging column or pressure plate point. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

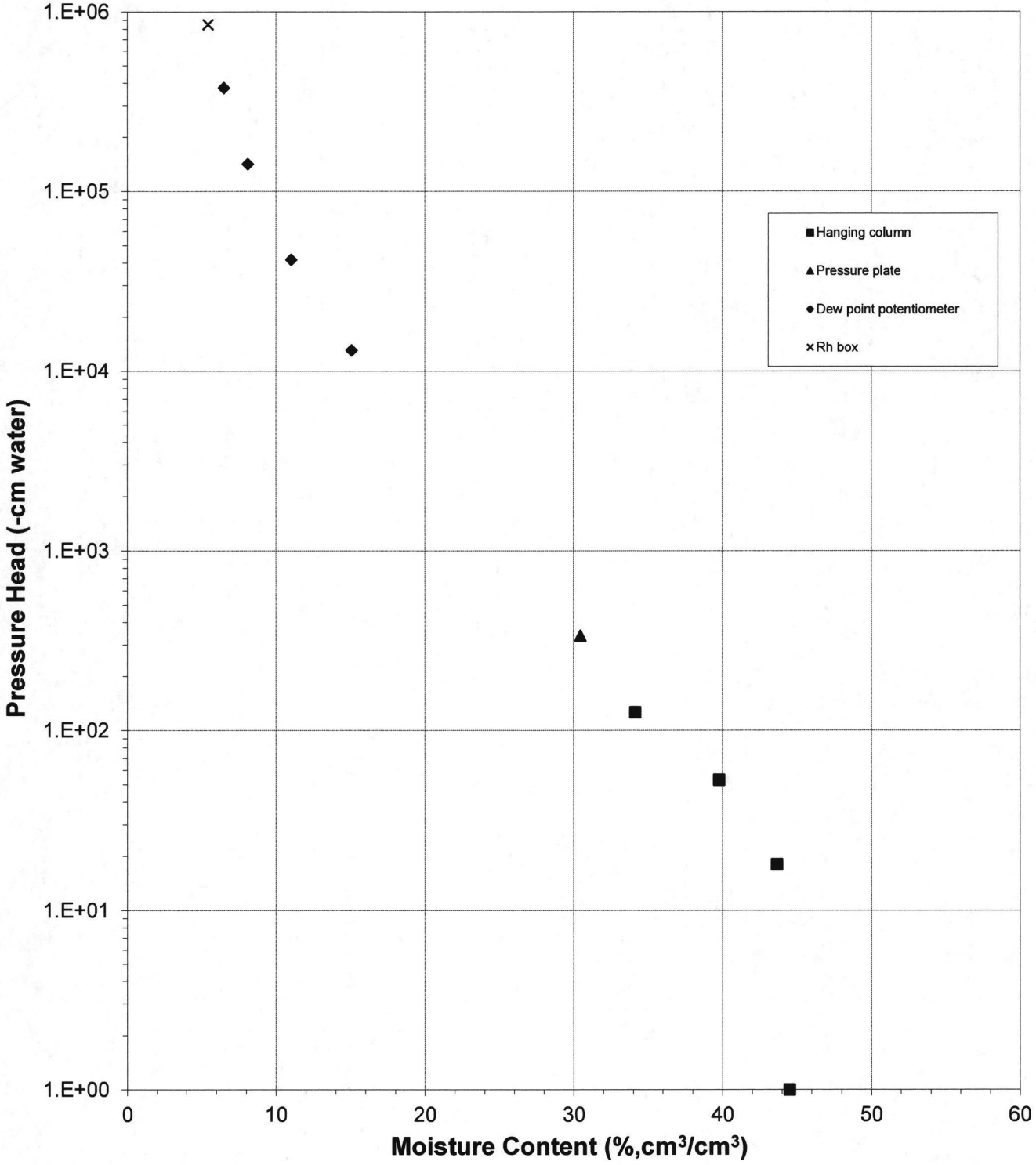
† Adjusted for >2.00mm (#10 sieve) material not used in DPP/RH testing. Assumed moisture content of material >2.00mm is zero, and assumed density of water is 1.0 g/cm$^3$.

‡‡ Volume adjustments are applicable at this matric potential (see comment #1). Changes in volume, if applicable, are estimated based on obtainable measurements of changes in sample length and diameter.

*Laboratory analysis by:* J. Hines/D. O'Dowd
*Data entered by:* C. Krous
*Checked by:* J. Hines

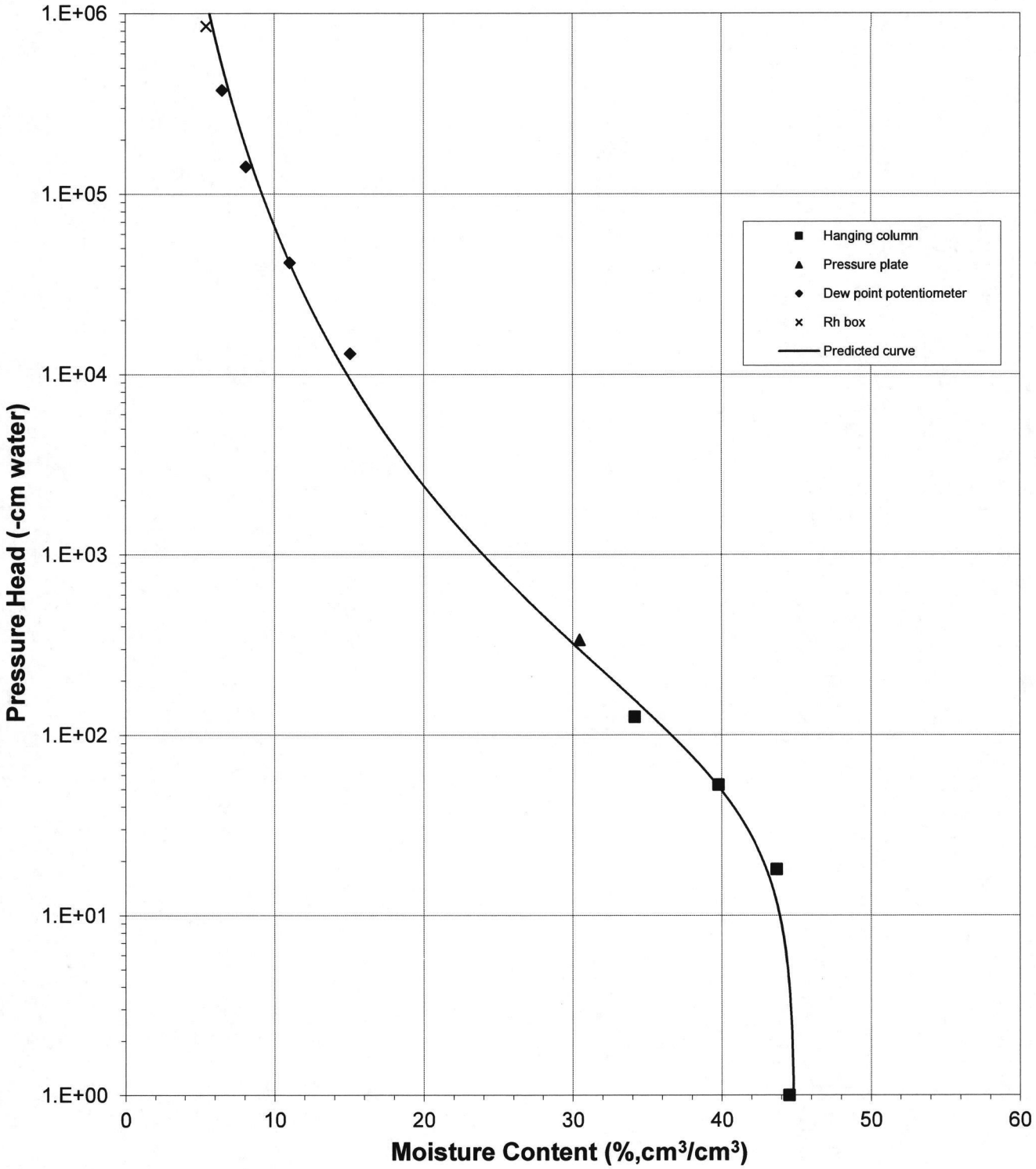
## Water Retention Data Points

*Sample Number: Test Pit 12-04 (88%, 94.3pcf)*



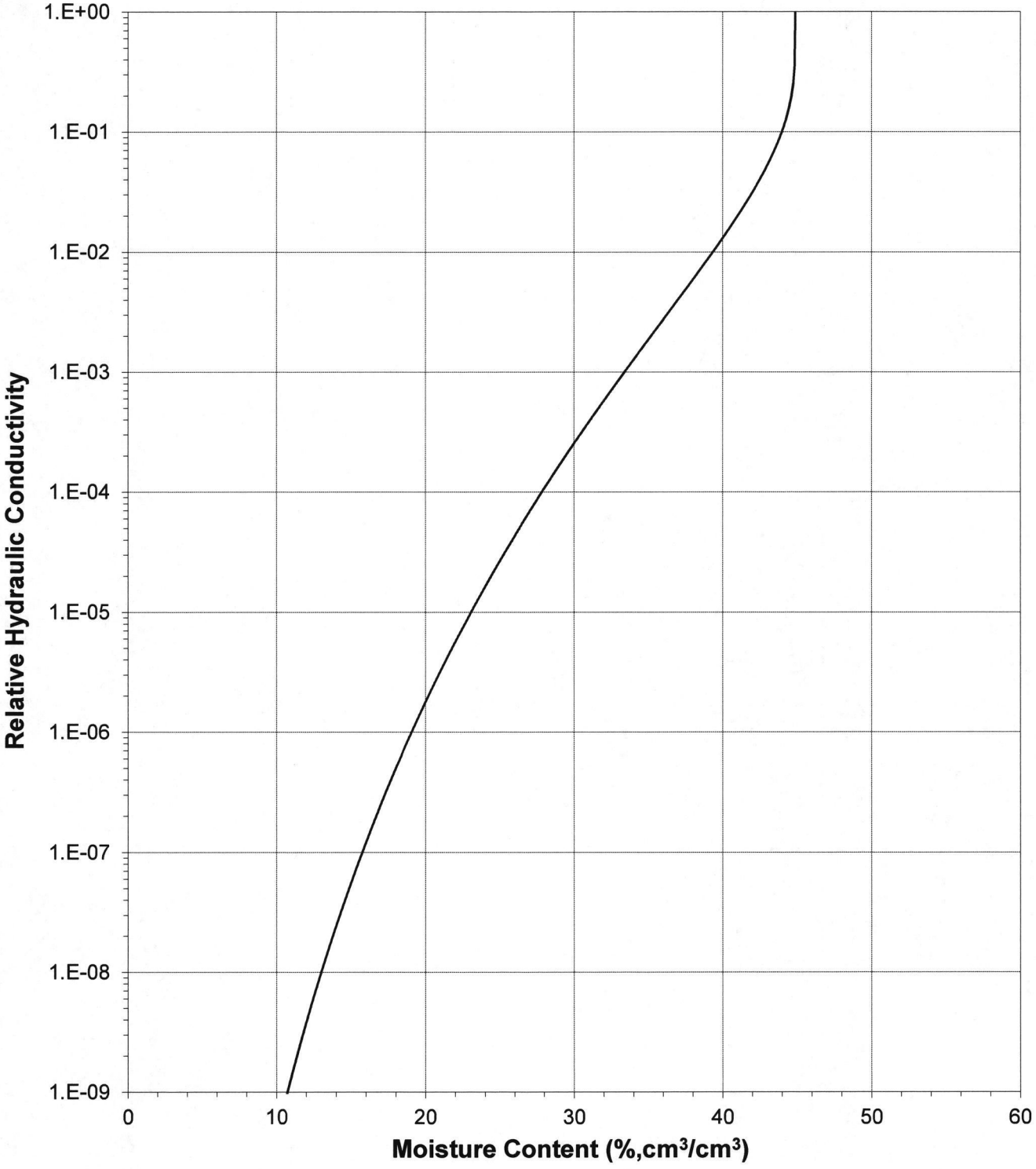
## Predicted Water Retention Curve and Data Points

*Sample Number: Test Pit 12-04 (88%, 94.3pcf)*



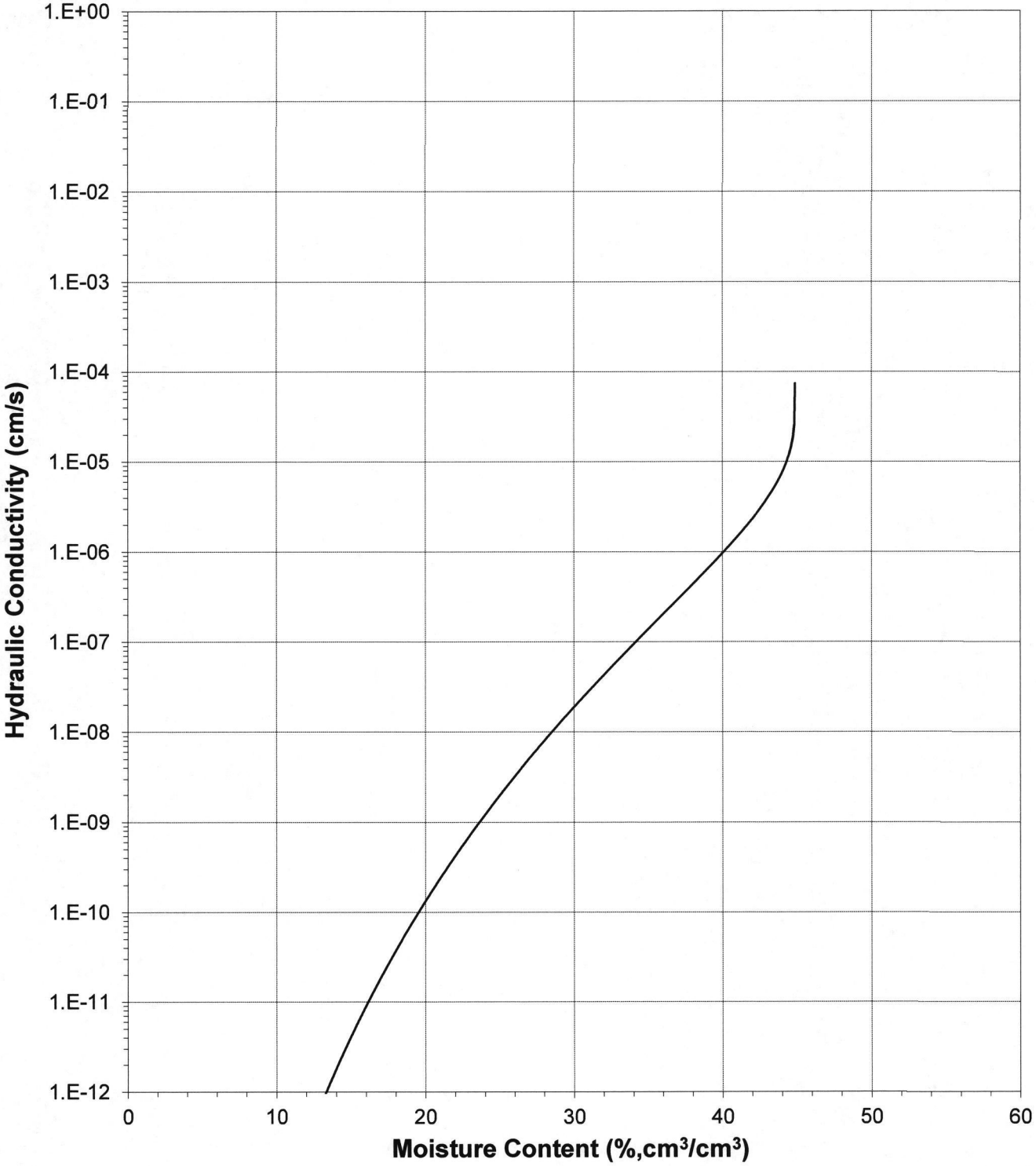
## Plot of Relative Hydraulic Conductivity vs Moisture Content

*Sample Number: Test Pit 12-04 (88%, 94.3pcf)*



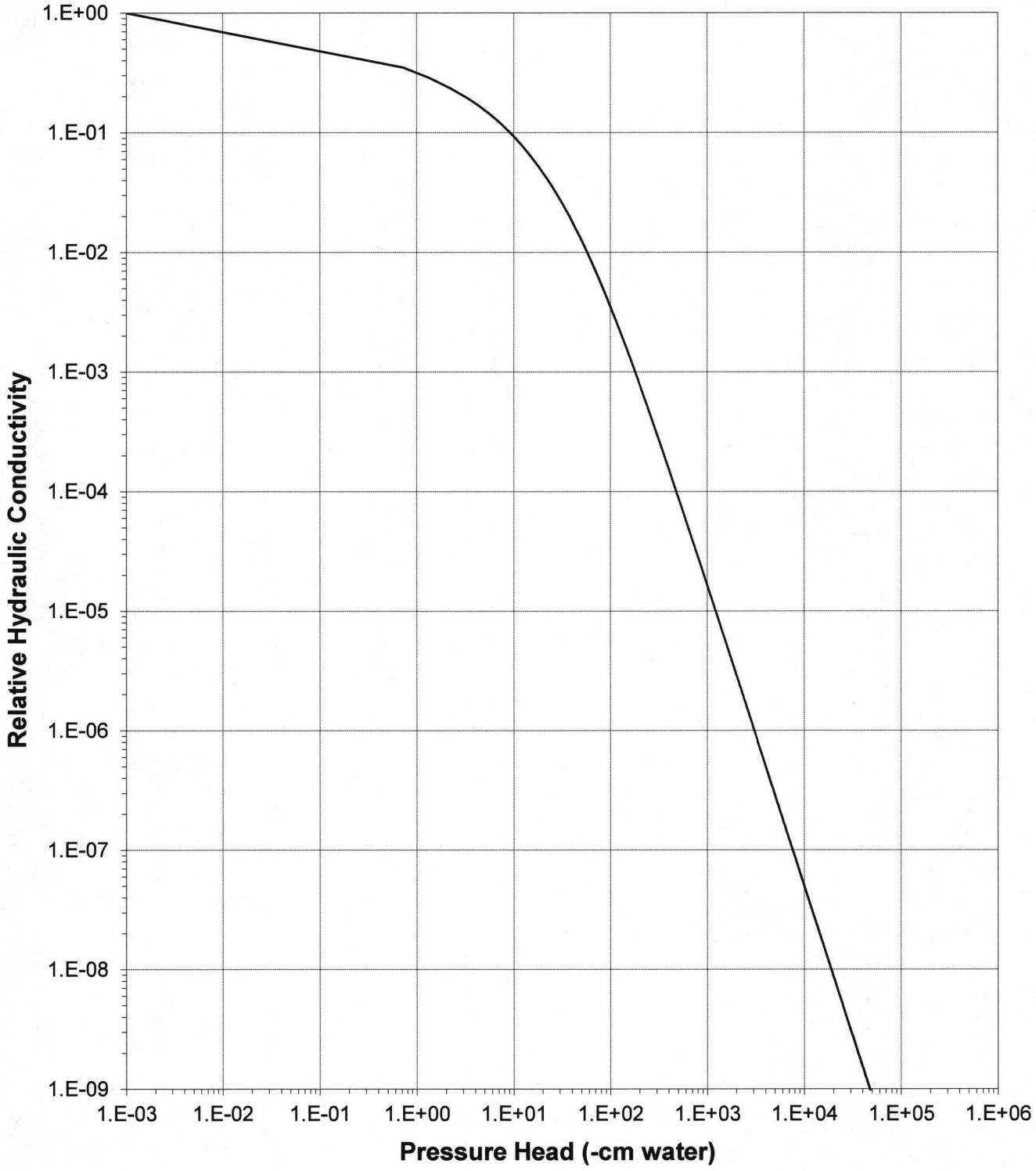
## Plot of Hydraulic Conductivity vs Moisture Content

*Sample Number: Test Pit 12-04 (88%, 94.3pcf)*



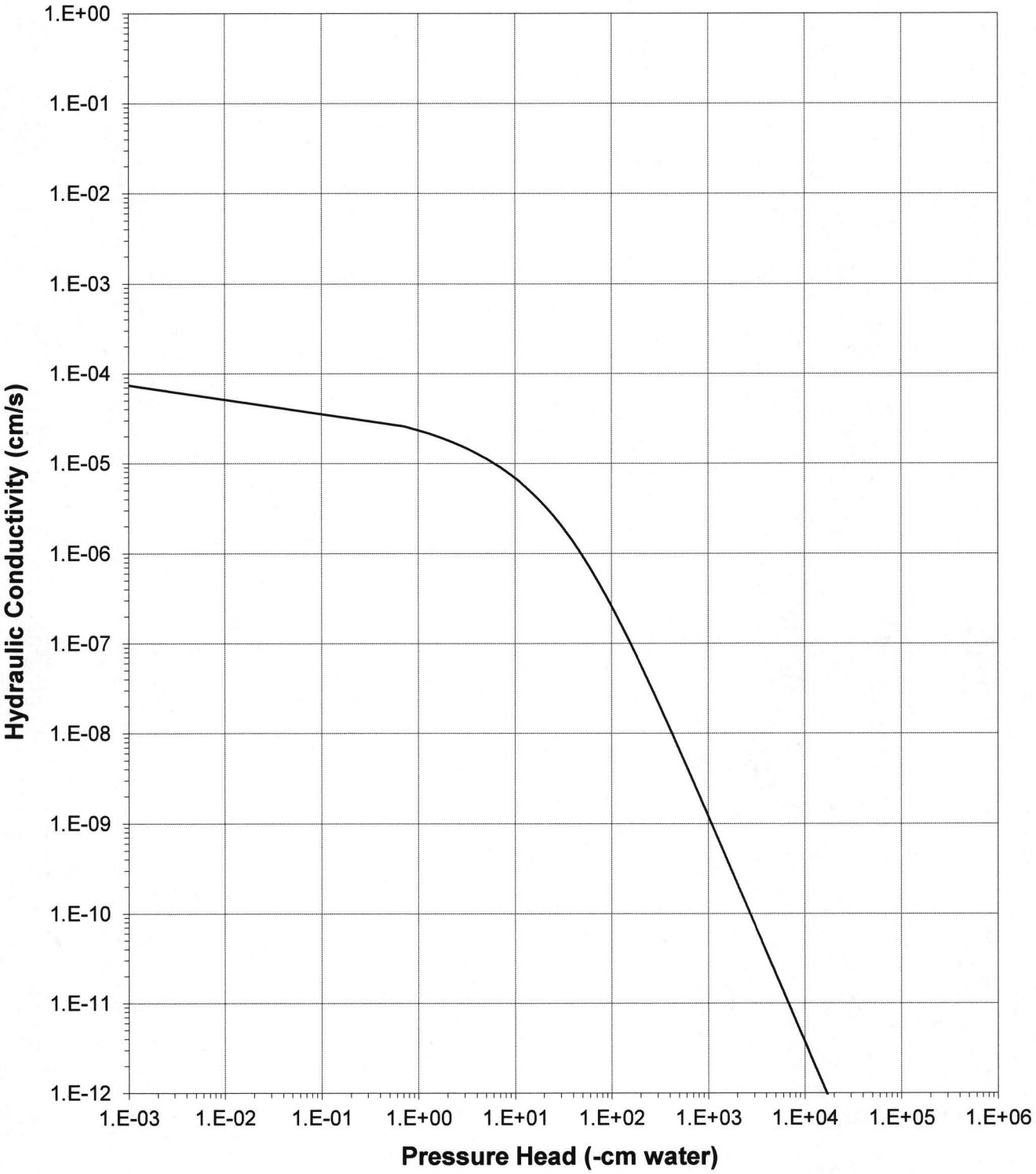
## Plot of Relative Hydraulic Conductivity vs Pressure Head

*Sample Number: Test Pit 12-04 (88%, 94.3pcf)*



## Plot of Hydraulic Conductivity vs Pressure Head

*Sample Number: Test Pit 12-04 (88%, 94.3pcf)*



# Laboratory Tests and Methods

## Tests and Methods

| | |
|---|---|
| Dry Bulk Density: | ASTM D7263 |
| Moisture Content: | ASTM D7263 |
| Calculated Porosity: | ASTM D7263 |
| Saturated Hydraulic Conductivity: | |
| Constant Head: (Rigid Wall) | ASTM D 2434 (modified apparatus) |
| Hanging Column Method: | ASTM D6836 (modified apparatus) |
| Pressure Plate Method: | ASTM D6836 (modified apparatus) |
| Water Potential (Dewpoint Potentiometer) Method: | ASTM D6836 |
| Relative Humidity (Box) Method: | Campbell, G. and G. Gee. 1986. Water Potential: Miscellaneous Methods. Chp. 25, pp. 631-632, in A. Klute (ed.), Methods of Soil Analysis. Part 1. American Society of Agronomy, Madison, WI; Karathanasis & Hajek. 1982. Quantitative Evaluation of Water Adsorption on Soil Clays. SSA Journal 46:1321-1325 |
| Moisture Retention Characteristics & Calculated Unsaturated Hydraulic Conductivity: | ASTM D6836; van Genuchten, M.T. 1980. A closed-form equation for predicting the hydraulic conductivity of unsaturated soils. SSSAJ 44:892-898; van Genuchten, M.T., F.J. Leij, and S.R. Yates. 1991. The RETC code for quantifying the hydraulic functions of unsaturated soils. Robert S. Kerr Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Ada, Oklahoma. EPA/600/2091/065. December 1991 |