# LANDFILL ENGINEERING REPORT

## TRENCH 13

**US Ecology Nevada, Inc.**
**Hazardous Waste Management Facility**
**Beatty, Nevada**

USEPA ID #NVT330010000
Nevada Hazardous Waste Treatment, Storage and Disposal
Permit NEV HW0025

**Prepared for**

**Prepared by**

**with Assistance from**

**Revision 0: October 2015**
**Revision 1: March 2016**

## CERTIFICATION

**LANDFILL ENGINEERING REPORT**
**TRENCH 13**
**REVISION 1**

**US Ecology Nevada, Inc.**
**Hazardous Waste Management Facility**
**Beatty, Nevada**

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

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# 1. INTRODUCTION

This report presents the design for a new land disposal unit at the US Ecology Nevada, Inc. (USEN) hazardous waste disposal Facility, located about 11 miles south of Beatty, Nevada, in Nye County. The new unit, Trench 13, is planned as a RCRA Subtitle C land disposal unit with the capacity (and authorization) to also accept Toxic Substances Control Act (TSCA)-regulated wastes.

This Design Report has been prepared and is submitted in compliance with the requirements of 40 Code of Federal Regulations (CFR) Section 264, Subpart N: Landfills and regulations at 40 CFR Part 761.75. This Design Report addresses:

- Regulatory Requirements;
- Landfill Operating Procedures, Responsibility, and Authority;
- Site Preparation (including shallow surface soil excavation and replacement, disposal Trench excavation, excavated sidewall stability, sump construction, and placement of compacted subgrade on the Trench floor);
- Liner System Design and Performance (including liner system components, exposure protection, and stresses);
- Leachate Handling (including LCRS and LDS);
- Above-Grade Disposal Design (including slopes, heights, and stability);
- Final Cover Design and Performance;
- Run-on/Run-off Control Systems and Facility Surface-Water Management; and
- Surface Erosion.

Design drawings for Trench 13 are provided in **Appendix 1** of this Design Report. Engineering Calculations are provided in **Appendix 2**. Supplemental Documents and Plans are included as various appendices of this Design Report to support the engineering design; facilitate proper construction, use, and monitoring; and insure appropriate closure and post-closure care. The Documents and Plans included as appendices to this Design Report include:

- Construction Quality Assurance Plan;
- Response Action Plan;
- Geotechnical Evaluation;
- Surface-Water Run-on and Run-off Control Demonstration;
- Environmental Monitoring and Reporting Plan; and
- Closure and Post-Closure Care Plans.

## 1.1 FACILITY INFORMATION

The USEN Hazardous Waste Management Facility is operated under Hazardous Waste Management Permit NEV HW0025 (July 2015 RCRA Permit) and a separate Toxic Substances Control Act (TSCA) approval (issued by USEPA on November 5, 2012). The Facility is permitted to manage wastes regulated under the Resource Conservation and Recovery Act (RCRA) and polychlorinated biphenyl (PCB) wastes regulated by TSCA. At the time of preparation of this Design Report, the active waste disposal unit is Trench 12. Trench 13 is planned as the next waste disposal unit on property provided to USEN under agreement with the State of Nevada.

## 1.2 LOCATION

The Facility is located in a remote and arid desert region of southern Nevada at Latitude 36.77N and Longitude 116.69W. The agreement between USEN and the State of Nevada (land owner) for the property occupied by the USEN Hazardous Waste Management Facility is expected to be modified in 2016[1]. The land use agreement modification is expected to add an additional 400 acres to USEN's current operation on 80 acres of State Land. A 47.3 acre portion of the newly added 400 acres will be the location of Trench 13.

In accordance with 40 CFR 264.18 and/or 40 CFR 761.75, Trench 13 is sited in a location where:

- Based on site reconnaissance and review of available literature, there is no known active fault (i.e., fault with movement more recent than the previous 10,000 years) located within

[1] Final approval of the transfer of the 400-acre tract from USBLM to the State of Nevada was completed on June 8, 2015. A land use agreement between the State of Nevada and USEN for 400 acres was not finalized at the time of submittal of this report, but is expected to be completed in 2016.

200 feet of the Trench 13 disposal area. The Cararra Fault is known to cross that USEN Site and is mapped in the Trench 13 area. The Cararra Fault does not show movement in Quaternary sediments and recurrence is greater than 10,000 years (Taylor, 2010);

- The limits of the nearest 100-year floodwater crest elevation are approximately 1,400 feet to the southwest. Trench 13 is not located within a 100-year floodwater elevation;
- There is no hydraulic connection between the Facility and standing or flowing surface water; and
- There is no recharge to groundwater originating within the limits of the USEN Facility.

In addition, Trench 13 is sited in a location where:

- The seasonally highest groundwater level is more than 200 feet below the lowest point of the disposal Trench;
- USEN's non-potable water supply well is the nearest water supply well, and is located approximately 1,800 feet to the north-northwest;
- The site is in an area of low to moderate relief, minimizing erosion; and
- A minimum 300-feet wide buffer is maintained from the vertical plane that defines the limits of waste disposed in Trench 13 and adjoining Bureau of Land Management (BLM) property - waste placement on west side of Trench13 will be 150 feet from USGS "property", but this might be subject to change in the future.

## 1.3 SITE CONDITIONS

The natural site topography generally slopes toward the south at less than one percent grade. Steeper slopes exist over short distances in the vicinity of natural gullies. Existing vegetation consists of native arid region plants. Surface and shallow subsurface materials primarily consist of sand, gravel and silt. The subsurface conditions and site geology, modeled in this Design Engineering Report, are based on past site investigations, as supplemented by the geotechnical investigation conducted specifically for Trench 13 in September 2015. The arid location of the USEN Facility receives an average of 4.33 inches of precipitation per year (Amargosa Farms-Garey Station, NOAA 2004).

## 1.4 PROJECT DESCRIPTION

USEN is proposing to construct a new hazardous waste disposal unit, to be designated "Trench 13", on property owned by the State of Nevada and used by USEN for waste treatment and disposal. The new Trench design has dimensions of 2,190 feet wide (east to west) and 940 feet long (north to south) and will be located south and southeast of the area of previous Facility operations. The new Trench will be developed in five Phases, each including a dedicated leachate collection and leak detection sump and riser system, to be located on the south side of each Phase. Total waste disposal capacity for Trench 13 is estimated at 8.6 million cubic yards, with approximately 4.2 million cubic yards as below-grade disposal and 4.4 million cubic yards as above-grade disposal. Based on current waste receivables, USEN anticipates that approximately 7%, or 0.6 million cubic yards, will be TSCA-permitted PCB wastes. Based on recent waste receivable rates as high as approximately 18,000 cubic yards per month, Trench 13 should provide sufficient waste disposal capacity for approximately 40 years.

The first Phase of construction (Phase A) will provide approximately 0.7 million cubic yards of capacity and will provide approximately three years of operational capacity. The capacity of the first Phase of landfill operations assumes a 2H:1V layback of waste away from future Phase development and assumes waste placement does not extend above-grade; however, above-grade waste placement is not restricted. Phases B, C, and D will provide approximately 1.7 million cubic yards of landfill operational capacity each, assuming 2H;1V layback of waste away from future Phase development and assumes above grade waste placement to final waste grades. Phase E will provide approximately 2.8 million cubic yards of landfill operational capacity.

The placement of the sump (lowest point in the floor of the disposal Trench) on the south side of the planned Trenches, allows the Trench floor to mimic the natural surface topography with Trench floor grades sloping to the south.

As done for the most recently used land disposal units at the USEN Facility (Trenches 11 and 12), Trench 13 will extend no more than approximately 75 feet below the original ground surface and will be constructed with 0.5H:1V side slopes. A three-dimensional interpretation of the Trench 13 excavation is included as **Figure 1-1**. Also, upon completion, the crest of the closed disposal unit

the crest will not exceed an elevation of 2860 feet above the North American Vertical Datum of 1988 (ft NAVD88) a height of approximately 90 feet above ground surface. Trench 13 will have 3H:1V side slopes and an upper deck with five percent southward slopes. A three-dimensional interpretation of Trench 13, following completion is included as **Figure 1-2**. A minimum 80-feet wide area of natural soil will separate the horizontal limit of Trench 13 waste disposal from the previous southern boundary of the USEN Facility.

Trench 13 will utilize a multi-component floor liner system that incorporates primary and secondary geomembrane liners that comprise an upper leachate collection and recovery system (LCRS) and a lower leak detection system (LDS) in compliance with applicable RCRA and TSCA requirements.

At closure, Trench 13 will include an alternate final cover (AFC) that is appropriate to the arid setting, and that is similar to the permitted Trench 11 final cover and the final cover planned for closure of Trench 12. The Trench 11 final cover has been constructed and was given conditional approved by the Nevada Division of Environmental Protection (NDEP) Bureau of Waste Management. Trench 11 includes a performance monitoring system that is being used to monitor moisture movement through the cover. The Trench 11 performance monitoring system is expected to provide confirmation of acceptable performance of the final cover system and document the applicability of the final cover system to Trenches 12 and 13. Recognizing that variability of cover materials and orientations can exist, USEN will evaluate conditions of the Trench 13 cover for a suitable location for a second alternate final cover performance monitoring system. The installation of that system will not occur until after closure of Phase A at Trench 13. The location and design of the second alternate final cover performance monitoring system will be submitted for Agency approval prior to construction.

## 1.5 CORRELATION WITH PRIOR DESIGNS

To the extent practical and technically sound, the Trench 13 Design incorporates many of the design elements, specifications, procedures, and quality assurance methods that were approved and used for construction and operation of Trench 12 and closure of Trench 11. This approach maintains the applicability of many of the calculations, including predictive modeling, and

supporting technical information from the Trench 12 design and Trench 11 closure. These calculations, models, and supporting information are familiar to NDEP and previously have been reviewed and approved. These calculations and models are reproduced in this Design Report in sufficient detail to demonstrate their applicability to Trench 13. References to the original documents including these prior design calculations, models, and supporting information include the following.

- TRC Environmental Solutions. Trench 12 Design Report. March 1996.
- AquAeTer, Inc. Supplement – Landfill Report for Trench 12. October 2007.
- AquAeTer, Inc. Design Basis and Construction Specifications for Trench 11 and 12 Final Covers. April 2008.

Referenced documents above are included as electronic attachments in **Appendix 9**.

Based on experience from similar designs for Trenches 11 and 12, the following design modifications are incorporated into the Trench 13 design:

- Constant–radius curves of sidewall at Trench 12 corners and other necessary HCL bends were difficult to construct and added complexity to geosynthetic liner system panel layout and seaming. In an effort to simplify these aspects of sidewall construction, Trench 13 has been designed with square corners at the intersection of adjoining 0.5H:1V slopes.
- Where possible, tight corners in the leak detection sump were eliminated.
- Leachate collection sump depth and area were increased to manage the additional leachate volume possible with the larger size of each Phase, and also to facilitate leachate removal. USEN notes that leachate pumps used in Trench 12 sumps typically operated at their minimal activation levels because of the sump's shallow design.
- A second leachate collection sump riser is included in each LCRS sump design as a backup to be used in the event that the first riser cannot be used.

**Figure 1-1 Three Dimensional Interpretation of the Planned Trench 13 Excavation**

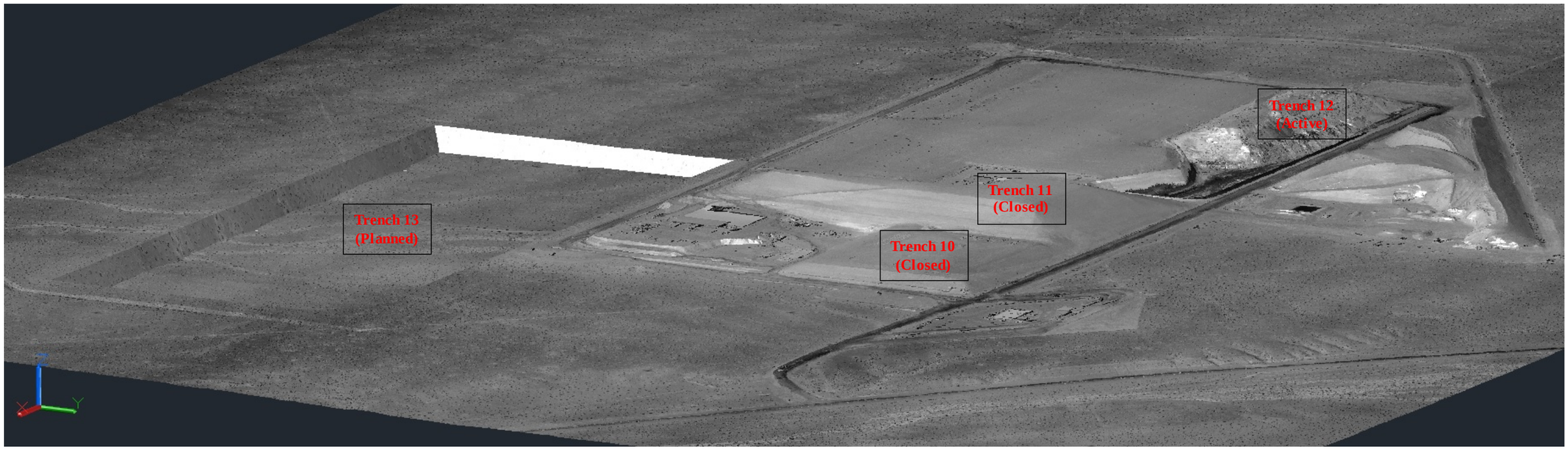

**Figure 1-2 Three-Dimensional Interpretation of Trench 13 at Completion**

# 2. REGULATIONS

Local, state, and federal permits or approvals are applicable to the operations at the USEN Facility. In accordance with 40 CFR 270.61 and 40 CFR 761.75(c)(1)(viii), **Table 2-1** summarizes the applicable permits or approvals.

## 2.1 FEDERAL REGULATORY REQUIREMENTS

Requirements for a RCRA Part B Permit Renewal application applicable to a new landfill design are provided in 40 CFR Section 270.21. **Table 2-2** lists these requirements and shows where they are addressed within this Design Report.

This Trench 13 design was prepared in a manner that is in compliance with 40 CFR 264, Subpart N. In particular, the requirements in 40 CFR 264.301, design and operating requirements, and 40 CFR 264.302, action leakage rate, were used as controlling principles.

The design also was prepared in a manner that is in compliance with 40 CFR 761. In particular, the design incorporates the chemical waste landfill design requirements from 40 CFR 761.75, which includes technical, design, and location requirements, as summarized in **Table 2-3**. These requirements did not conflict with the previously stated RCRA regulations, which generally are more restrictive than TSCA requirements.

## 2.2 STATE REGULATORY REQUIREMENTS

In general, the applicable State of Nevada regulatory requirements mirror the federal requirements. Section 444.8632 of the Nevada Administrative Code adopts (by reference) the applicable portions of the federal Title 40 regulations. Accordingly, this Design Report conforms to State of Nevada requirements via its conformance with federal regulatory requirements, as summarized in **Table 2-2**.

The State of Nevada Division of State Lands owns the land upon which the USEN Facility is located, and allows use of that land by USEN. The land use agreement includes requirements for hazardous waste disposal offsets and applicable buffer zones.

## 2.3 LOCAL REGULATORY REQUIREMENTS

Local regulatory requirements have not been identified that would have an impact on the design of Trench 13.

**Table 2-1 Summary of Local, State, and Federal Permits or Approvals**

| Permit | Agency | Permit Number | Issue Date |
|---|---|---|---|
| Air | NDEP-Bureau of Air Pollution Control/Quality | AP4953-02 and FIN A0557 | 8/5/2010 |
| Hazardous Materials | Nevada State Fire Marshall and NDPS | 56416 | 2/22/2016 |
| Haz Mat-Transportation | USDOT | 080411005016TV | 2014 |
| TSCA | EPA, Region 9 | NVT330010000 | 11/5/2012 |
| RCRA | NDEP, Bureau of Waste Management | NEVHW0025 | 2011 |
| Stormwater General Permit | NDEP-Division Water Pollution Control | NVR50000 | 2008 |
| Water | NV Division of Water Resources | 77066 | 2013 |
| Federal Explosives | US Bureau of ATF | 9-NV-023-33-4M-00199 | |
| Soil | USDA | 67939 | 2015 |
| Mineral Material Free Use | NV Division of State Lands | NVN-94282 | 2015 |

**Table 2-2 RCRA Permit Application Requirements Applicable to Landfill Design**

| Regulatory Requirement | | Location in Design Report |
|---|---|---|
| **40 CFR 270 Citation** | **Subject** | |
| 270.21(b)(1)(i) | Liner system | **Section 5** |
| 270.21(b)(1)(ii) | Double-liner and leachate detection system | **Sections 5 and 6** |
| 270.21(b)(1)(iii) | Leachate detection system in saturated zone | **Not applicable, LDS not in saturated zone** |
| 270.21(b)(1)(iv) | Construction Quality Assurance Plan | **Appendix 3** |
| 270.21(b)(1)(v) | Response Action Plan and Action Leakage Rate | **Appendix 4** |
| 270.21(b)(2) | Control of run-on | **Section 8** |
| 270.21(b)(3) | Control run-off | **Section 8** |
| 270.21(b)(4) | Management of surface water collection and holding facilities | **Appendix 6** |
| 270.21(b)(5) | Control of wind dispersal of particulate matter | **Section 3.2.10** |
| 270.21(c) and (d) | Inspection Plans | **USEN RCRA Permit Application – Section 5** |
| 270.21(e) | Closure and Post Closure | **Appendix 8** |
| 270.21(f) to (j) | Operating Procedures and Management Plans | **Section 3** |

**Table 2-3 TSCA Regulatory Requirements Applicable to Chemical Waste Landfills**

| Regulatory Requirement | | Location in Design Report |
|---|---|---|
| **40 CFR 761 Citation** | **Subject** | |
| 761.75(b)(1) | Soils | **Not included in this Report** |
| 761.75(b)(2) | Synthetic Membrane Liners | **Section 5** |
| 761.75(b)(3) | Hydrologic Conditions | **Section 1 and Appendix 7** |
| 761.75(b)(4) | Flood Protection | **Sections 1, 8, and 9** |
| 761.75(b)(5) | Topography | **Section 1** |
| 761.75(b)(6) | Monitoring Systems | **Appendix 7** |
| 761.75(b)(7) | Leachate Collection | **Section 6** |
| 761.75(b)(8) | Chemical Waste Landfill Operations | **Section 3** |
| 761.75(b)(9) | Support Facilities | **Section 3.1.11** |

# 3. LANDFILL OPERATING PROCEDURES, MANAGEMENT PLANS, RESPONSIBILITY, AND AUTHORITY

## 3.1 OPERATING PROCEDURES AND MANAGEMENT PLANS

### 3.1.1 Management of Containerized Waste

Waste containers intended for disposal will be inspected to ensure they are greater than 90 percent full or crushed, shredded, or similarly reduced in volume to the maximum practical extent before burial in the landfill. Typically, empty containers will be placed in the landfill and crushed by landfill equipment (e.g.; dozer, compactor). Also, poly containers usually are physically cut or crushed and buried to reduce their volumes. Containers with labpacks or loosepacks will be segregated and not crushed.

### 3.1.2 Procedures to Prevent Disposal of Bulk or Containerized Liquids

Incoming waste shipments are subject to inspection and verification sampling and analysis to ensure the absence of free liquids. The presence of free liquids in a waste shipment is evaluated by visual inspection for free standing liquids or by using the Paint Filter Liquids Test (PFLT), as described in the USEN waste analysis plan (WAP). Free liquids present in containerized shipments will be absorbed with a non-biodegradable absorbent (e.g.; cement kiln dust, clay). Absence of free liquids will be confirmed prior to disposal using visual inspections or the PFLT.

Absorbed bulk liquid hazardous waste is not accepted for direct disposal. Solidified liquid waste may be accepted if the generator provides data demonstrating the liquid portion of the waste was chemically transformed into a solid.

Bulk or containerized shipments arriving at the Facility containing free-standing liquids may be stabilized using appropriate stabilization reagents as described in the WAP.

### 3.1.3 Exceptions to Containerized Liquid Disposal Prohibition

Provisions are made in the regulations (40 CFR §264.314) to allow for the disposal of containerized liquids on specific situations. These situations are:

- The container is a lab pack;
- The container is very small, such as an ampule; or
- The container is a non-storage type container, designed to hold free liquids (e.g., capacitors, batteries).

3.1.3.1 Lab Packs

Lab packs may be accepted for disposal at USEN after evaluation of the lab pack inventory to ensure it complies with these guidelines as established in 40 CFR §264.316:

a. Hazardous waste must be packaged in non-leaking inside containers. The inside containers must be of a design and constructed of material that will not react dangerously with, be decomposed by, or be ignited by the contained waste. Inside containers must be tightly and securely sealed. The inside containers must be of the size and type specified in the DOT hazardous materials regulations (49 CFR Parts 173, 178, & 179), if those regulations specify a particular inside container for the waste;

b. The inside containers must be overpacked in an open head DOT-specification metal shipping container (49 CFR Parts 178 & 179) of no more than 416-liter (110 gallon) capacity and surrounded by, at a minimum, a sufficient quantity of sorbent material, determined to be nonbioderadable in accordance with 40 CFR §264.314(e), to completely sorb all of the liquid contents of the inside containers. The metal outer container must be full after it has been packed with inside containers and sorbent material;

c. The sorbent material used must not be capable of reacting dangerously with, being decomposed by, or being ignited by the contents of the inside containers, in accordance with 40 CFR §264.17(b);

d. Incompatible wastes, as defined in 40 CFR §260.10, must not be placed in the same outer container;

e. Reactive wastes, other than cyanide- or sulfide-bearing waste as defined in 40 CFR §261.23(a)(5), must be treated or rendered non-reactive prior to packaging in accordance with paragraphs (a) through (d) of this section. Cyanide- and sulfide-bearing reactive waste may be packed in accordance with paragraphs (a) through (d) of this section without first being treated or rendered non-reactive; and

f. Such disposal is in compliance with the requirements of 40 CFR Part 268.

3.1.3.2 Small Containers

USEN considers small ampules to be similar to lab waste, and requires that they be packaged in the same manner. If all the ampules contain the same waste (e.g., quality control samples) and all other guidelines are observed, a drum inventory sheet is not required.

3.1.3.3 Non-Storage Containers

Non-storage containers (e.g.; capacitors, batteries) may be accepted, regardless of size, for disposal without meeting the over-pack criteria established for lab waste, provided that the containers are in good condition.

### 3.1.4 Special Requirements for PCB Wastes

PCBs and PCB items are in the landfill in a manner that will prevent damage to containers or articles. Other wastes placed in the landfill that are not chemically compatible with PCBs and PCB items including organic solvents are segregated from the PCBs throughout the waste handling and disposal process.

The Facility Operations Plan has been updated as required in 40 CFR§761.75(c). Bulk liquids not exceeding 500 ppm PCBs can be disposed of provided such waste is pretreated and/or stabilized (e.g., chemically fixed, evaporated, mixed with dry inert absorbent) to reduce liquid content or increase solid content so that a non-flowing consistency is achieved to eliminate the presence of free liquids prior to final disposal in a landfill.

Records will be maintained for all PCB disposal operations and must include information on the PCB concentration in liquid wastes and the three dimensional burial coordinates for PCBs and PCB Items. Additional records will be developed and maintained as required in 40 CFR§761.180.

### 3.1.5 Special Requirements for Ignitable or Reactive Wastes

Ignitable or reactive wastes will not be placed in the landfill, unless the waste has been processed to remove the ignitability or reactivity characteristic (in accordance with 40 CFR §261.23), and the wastes meet all applicable requirements and treatment standards under 40 CFR Part 268. In accordance to 40 CFR §264.313 incompatible wastes and materials must not be placed in the same landfill cell unless 40 CFR §264.17(b) is complied with. When ignitable or reactive waste

treatment is required, USEN takes precautions such as small batch treatment to prevent violent reactions and/or generation of extreme heat, toxic mists, fumes or gases.

### 3.1.6 Special Requirements for RCRA Debris

RCRA debris typically is treated by an alternate treatment method of encapsulation. Microencapsulation typically occurs in other permitted units (e.g.; tank systems), but it is often preferable to perform macroencapsulation in the landfill to maintain the integrity of the outer barrier. When performed in the landfill, the debris is staged on an acceptable outer encapsulant (e.g.; polyethylene, HDPE) and wrapped or the debris, especially large debris, may be staged and encapsulated in place (e.g.; liquid clay, pozzolonic materials) to reduce contaminant leachability.

### 3.1.7 Special Requirements for Management of F020, F021, F022, F023, F026, F027 Wastes

Regulated dioxin-containing wastes may be disposed of on-site when the LDR treatment standards are met. Compliance with LDR requirements ensures that disposal of such waste will be protective of human health and the environment. In addition, USEN provides geologic and climatic conditions that are exceptional for the safe disposal of these and other waste streams. The extremely low rainfall, high evaporation rates, Facility location in a desert area (isolated from population sources), waste characterization and handling procedures, and Facility design and operation minimize the potential for migration of these wastes through the soil, or volatilization into the atmosphere.

### 3.1.8 Special Requirements for Interim Processing Loads

Interim processing loads are loads of treated waste awaiting results from post-treatment testing. These loads may be staged within the lined area of Trench 13, provided that the treated waste is not placed on or adjacent to final cover. Up to 10 batches of waste may be placed at any one time. Treated waste awaiting test results are contained and controlled in the following manner:

- Wastes are placed in segregated piles, physically separated and distinguishable from other waste placed into the landfill.

- Wastes are placed in bulk in individual piles above an impermeable membrane. The impermeable membrane shall be at least 6 mil PVC, PPE or High Density Polyethylene and shall be placed within a lined area of the Trench.

- No free liquids will be present as determined through visual inspection or a paint filter test,

- Wastes will be protected from wind erosion and dispersal by topping with an anchored impermeable membrane or covering with a spray-on asphaltic emulsion. The spray-on emulsion will be applied at the end of the working day. Other covers providing equal protection will also be used.

- Interim processing loads will be moved within ten days of placement, either by disposal following successful confirmation testing or by retrieval for additional treatment or containerized storage.

Each waste pile will be accompanied by the following information:

- Date and time of placement
- Unique waste batch identification
- Compatibility Group
- Approximate weight
- Hazardous waste label

Information accompanying treated waste will be placed within a weatherproof container directly placed within the interim processing load. (Weatherproof containers are customarily metal "rockets" holding information within an enclosed tube which is affixed to a long rod that is placed within the waste pile.)

Compliance with the conditions stated above will be verified during weekly landfill inspections.

### 3.1.9 Surveying and Record Keeping Procedures

USEN maintains records of waste locations within the Trench using a grid coordinate system established in reference to elevation and horizontal benchmarks. Irregularly-shaped loads and bulk loads will be defined by the grid block that most completely captures the load, noting that waste is moved by non-precise equipment such as bulldozers and can cross several grids. Shipments containing more than one waste stream of compatible waste may be buried and located in the same

area, but need to be identified. Waste location information will be recorded in the Operating Record.

### 3.1.10 Wind Dispersal Control

To control wind dispersal of particulates during landfilling operations, USEN evaluates candidate waste streams during the waste stream evaluation process (as described in the WAP) to determine the waste stream's potential to generate excessive fugitive off-site particulate emissions during unloading. Specified packaging and handling arrangements contain the dust during unloading and disposal. If the potential for off-site fugitive particulate emissions is excessive, USEN will place the roll-off box near the active face, use a liquid spray or take other measures to reduce fugitive particulate emissions. Wind dispersal potential is routinely reduced by using liquids to suppress dust, by daily cover and by spray foam. Non-hazardous liquids, Non-RCRA liquids and leachate generated from Trench sumps may be used for the purpose of dust suppression. Leachate generated within Trench sumps can only be used for dust suppression in the landfill sub-cell (Phase) from which it was generated. For TSCA approval, the leachate also must be tested for PCBs and have concentrations below 0.5 ug/L before used as dust suppression, in accordance with the TSCA permit.

### 3.1.11 Supporting Facilities

A six foot high woven mesh fence or similar device will be placed around the Trench 13 operations to prevent unauthorized persons and animals from entering. In addition, the entire USEN Facility will be surrounded by special fencing to prevent entry by the endangered desert tortoise.

Roads at the USEN Facility will be maintained to support the operation and maintenance of the Facility without causing safety or nuisance problems or hazardous conditions.

The USEN Facility will be operated and maintained in a manner to prevent safety problems or hazardous conditions resulting from spilled liquids.

## 3.2 RESPONSIBILITY

The following parties were involved in the Trench 13 Design.

Permitting Agency: The Nevada Division of Environmental Protection (NDEP) has the responsibility and authority to review all design aspects of Trench 13 pertaining to the RCRA requirements of 40 CFR 264 and 270 and ensure compliance with pertinent federal and State requirements identified in **Sections 2.1** and **2.2** of this Report. NDEP will be the issuing agency of the modified RCRA Permit, if accepted.

The U.S. Environmental Protection Agency (USEPA) has responsibility and authority associated with adherence of the design to TSCA requirements of 40 CFR 761 as specified in **Section 2.1** of this Report.

Owner/Operator: USEN has overall responsibility for the Facility and authority to select and dismiss organizations charged with design, construction, and quality assurance activities.

## 3.3 AUTHORITY

The owner/operator and/or its representatives have the authority to accept or reject all design elements, construction activities, quality assurance, and reports/certifications associated with Trench 13.

# 4. SITE GRADING AND EXCAVATION

## 4.1 GENERAL

Trench 13 site preparation activities include removal and replacement of an upper, cohesionless soil layer; Trench excavation; Trench slope preparation (including slope riser excavation); Trench floor (subgrade) removal and replacement; and various ancillary construction preparation activities.

The design of Trench 13 was developed to facilitate construction of the landfill in five Phases, with the easternmost portion of the Trench recommended as the initial Phase, and a progression of development from east to west. If the easternmost portion of Trench 13 is constructed as the initial landfill Phase, construction staging likely will occur to the west of that Phase. As such, a portion of the adjoining Phase at each stage of development will require excavation to facilitate construction and operational traffic routes "into" and "out of" the active Trench Phase.

As shown on **Drawings 003** and **004**[2], the removal and replacement of the surface soil stratum will encircle the Trench 13 perimeter (also called the Horizontal Control Limit or HCL) of the Trench 13 excavation. In replacing this soil layer, wide compacted soil berms will be constructed along the boundaries of Trench 13. A level northern berm will be constructed at an elevation of 2772 feet NAVD and a level southern berm will be constructed at an elevation of 2768 feet NAVD. By making the HCL (i.e., modified natural ground surface) the same elevation on the north and south side of each Trench 13 Phase, the subsurface design elements of each of the five Phases are identical. Northern and southern slope elevations, Trench floor elevations, and all aspects of LCRS/LDS liner and sump design details are identical with the exception of the eastern excavation slope of the first Phase (Phase 13A) and the western excavation slope of the final Phase (Phase 13E). This consistency in design is intended to facilitate Phase construction, including excavation and LCRS/LDS construction.

[2] In this report, all Trench 13 Design Drawings are included in **Appendix 1**.

## 4.2 LOW-COHESION SOIL REMOVAL AND REPLACEMENT

Removal and replacement of a loose, low-cohesion surface soil stratum must be completed prior to excavation at depths below this upper layer. The estimated extent of the surface soil removal and replacement is shown on **Drawings 003** and **004**.

Trench 13 includes excavated sidewalls at a 0.5H: 1 V slope extending to a maximum depth of approximately 75 feet (vertical) below ground surface. Based on the *Geotechnical Investigation/or Trench 12 at the US Ecology Hazardous Waste Management Facility, Beatty, Nevada* (Grant Environmental 1994) and a subsurface exploration conducted specifically for Trench 13 (**Appendix 5)**, an uppermost native soil layer (i.e., the surface soil stratum) is considered to be low-cohesion or cohesionless (i.e., loose and non-cemented) and, as such, unstable at the planned excavated slope. Based on information provided from previous investigations and soil borings at the USEN Facility, this upper soil layer is estimated to extend from the natural ground surface to between five and 10 feet in depth. Natural geologic materials (i.e., primarily cemented and non-cemented dense sands and gravels) that will be present in the excavated 0.5H:1V side slopes at depths below this surface soil stratum (i.e., below the upper five to 10 feet of excavation) are considered to be stable at the planned slopes. This stability has been clearly demonstrated by the performance of Trench 11 and 12 slopes.

Slope stability calculations included in **Appendix 2** of this Design Report conclude that the surface soil stratum, when removed and replaced with compacted native soil, can to achieve a cohesion value of 300 pounds (or more) per square foot (PSF) and will be stable at the 0.5H:1V slopes.

## 4.3 EXCAVATION

The excavation plan and horizontal limits of grading for Trench 13, corresponding with the Horizontal Control Line, are provided in **Drawings 003** and **004**. The excavation slope stability is discussed in **Section 4.9.** Key excavation plan design features are discussed in the paragraphs that follow.

The maximum depth of waste disposal (i.e., the base of the LCRS/LDS sump) is approximately 75 feet below the original ground surface. The maximum excavation depth points are located at

the bottom of each of the five Leachate Detection System (LDS) sumps. As noted above, the elevations and geometric layout of all five sumps are identical.

The maximum excavation depth conforms to the requirements of the USEN land use agreement with the State of Nevada. The maximum excavation depth is also well above the ground water table, which is located approximately 300 feet below the original ground surface (or greater than 200 feet below the bottom of LDS sumps in Trench 13).

The lateral limits are determined from constraints on the lateral extent of waste placement, which are defined in the USEN land use agreement with the State of Nevada.

Sidewalls are designed with 0.5H:1V slopes. Based on experience with Trench 12, the constant–radius curves of sidewalls at Trench 12 corners and other necessary HCL bends were difficult to construct and added complexity to geosynthetic liner system panel layout and seaming. In an effort to simplify these aspects of sidewall construction, Trench 13 has been designed with square corners at the intersection of adjoining 0.5H:1V slopes.

Trench floor grading is controlled by the elevation of the five LDS sumps and Trench floor slopes that are fixed at 2.0 percent along each Trench Phase centerline. The design of the LCRS/LDS liquid collection system is depicted in **Drawings 005** and **006**, and includes Trench floor slopes of 2.8 percent that direct liquid flow to each Phase centerline. Floor slopes facilitate leachate drainage into each of the five sumps. As noted above, all five Phases have identical floor geometries and elevations, and LDS and LCRS sumps.

Grades shown on **Drawings 005** and **006** are those for the top of the subgrade which also corresponds approximately to the top of the liner (excluding the operations layer which will overlie the liner system).

Excavation spoil materials will be used (such as for surface soil stratum replacement, Trench floor compacted subgrade, north and south leveling berms, other soil features directing surface-water flow, and interim and final covers for completed landfill phases) or stockpiled in appropriate locations, as designated by USEN.

## 4.4 TRENCH FLOOR SUB GRADE PREPARATION

A 9-inch thick layer of compacted fine-grained soil (i.e., prepared subgrade) will be placed across the excavated subgrade of the entire Trench floor (all Phases), except in sump areas described in **Section 4.5**. The elevation of the top of the 9-inch prepared subgrade is shown on **Drawings 005** and **006** (thickness of floor liner components is not considered). The purpose of this 9-inch prepared soil layer is to provide: (1) a hydraulic conductivity of 1 x $10^{-5}$ centimeters per second (cm/sec); (2) a smooth bearing surface for the remaining geosynthetic components of the liner system; and (3) leachate adsorption capacity to supplement that of the geosynthetic clay liner (GCL) component.

Natural soil material excavated from Trench 13 will be used to construct the 9-inch prepared subgrade layer. The material will be screened to achieve a gradation per the specifications in **Appendix 3** and **Table 4-2**. Subgrade placement and quality control criteria are presented in **Appendix 3**.

## 4.5 LEACHATE COLLECTION AND LEAK DETECTION SUMP SUBGRADE

The leachate collection and leak detection sumps will be underlain by 36-inches of screened prepared subgrade soil material (graded and compacted per specifications in **Appendix 3** and **Table 4-2**. The prepared subgrade is amended with Portland cement within the vicinity of the LDS sump and along the sump sidewalls to improve field grading capability. The purposes of this 36-inch prepared soil subgrade layer is to provide: (1) a smooth bearing surface for the sump components; and (2) leachate adsorption capacity to supplement that of the GCL component in an area expected to have fluid head buildup. As further discussed in **Section 5.3**, the subgrade materials located in the vicinity of the sumps are amended with Portland cement for the purpose of improving constructability of the LDS, thereby facilitating the ability to construct the unique geometry required within these locations.

## 4.6 SUMP SIDEWALL PREPARATION (SUMP SIDEWALL BERM)

At the base of the sidewalls, and within the boundaries of the sumps, three feet of prepared subgrade will be applied to the sidewalls to provide: (1) a smooth bearing surface for the sump components; and (2) leachate adsorption capacity to supplement that of the GCL component in an

area expected to have fluid head buildup. The sidewall prepared soil materials will be amended with Portland cement to improve field grading.

## 4.7 TRENCH SIDEWALL SUBGRADE PREPARATION

The subgrade forming Trench sidewalls will be excavated to provide the desired final slope (i.e., 0.5H:1.0V). The final sidewall surface might include angular or irregular surfaces that require additional attention to prevent stress concentrations that could locally compromise the performance of the liner system. Where measures to fill or cover such surface irregularities are judged to be necessary, these measures will include one or more of the following: covering or masking the irregularity with additional geotextile or geocomposite panels, or filling the irregularity with gunite/shotcrete materials. Such masking/cushioning will be done before placement of the lowest component of the liner systems (i.e., the GCL layer). The extent and degree of irregularity masking materials will be determined by the CQA Engineer. Masking materials are not considered integral components of the LCRS/LDS liner system. These masking/cushioning sub-liner geosynthetic panels will extend from the anchor trench, where they will be beneath the GCL liner layer, down the sidewall to positions at least five-feet vertically below the identified sidewall irregularities. Sufficient masking/cushioning material panels will be used to cover the full horizontal dimension of the irregularity.

## 4.8 SLOPE RISER RECESSES

Recesses (i.e., shallow linear slots) will be cut into Trench sidewalls to hold the LDS riser pipes which extend up the sidewalls from each of the five LDS sumps (see **Section 6.2.1**) as shown on **Drawing 010**. The recesses allow the primary (LCRS) liner system to be installed flush with the sidewall above the secondary (LDS) liner system at these locations. These recesses will be cut by an appropriate excavator as Trench excavation proceeds. Gunite (or similar material) will be used as necessary to anchor the LDS riser into place and create a suitable Trench sidewall surface over which to place the primary (LCRS) liner system. Details regarding construction of the liner system and placement of the riser pipes are provided in **Sections 5.2.2** and **6.2.1,** respectively.

## 4.9 STABILITY ANALYSES

The Trench 13 design utilizes below-grade excavation configuration that is identical in most respects to that used (and approved by NDEP) for Trench 12. The computer modeling program WinSTABL Version 3.00 (2002) using the Modified Bishop Method of analysis, was used to assess slope stability. This approach is consistent with the approach used, and approved by NDEP, for Trench 12. The model accepts as input the material properties (principally unit weight, cohesive strength, and angle of internal friction) and a set of coordinates defining the position of the materials in typical Trench 13 cross-sections. The properties of subsurface materials considered in these calculations, including layer thicknesses and strength properties, are consistent with site-specific laboratory testing results, technical literature, and assumptions made for previous slope stability calculations for the USEN Facility.

Stability analyses were run for several example conditions, representing worst case scenarios and are included in **Appendix 2.** Factors of safety for failure surfaces at each distinct soil layer within the slope walls were determined. The excavated slopes were evaluated under static loading conditions and under seismic loading conditions.

To be acceptable, the factors of safety against slope failure under static loading and seismic (i.e., pseudo-static) loading conditions should equal or exceed 1.5 and 1.0, respectively. The pseudo-static loading condition considered was 0.42 g, which simulated the maximum horizontal acceleration value with a 90 percent or greater probability of not being exceeded in 250 years (as required by Nevada Administrative Code (NAC) 444.6793). The source of these safety factor criteria are previous Trench 11 and Trench 12 slope stability calculations approved by NDEP, RCRA regulations/guidance based on Federal and Nevada requirements for municipal solid waste landfills (40 CFR 258.14), and NDEP Trench 12 direction (provided on December 17, 1996). Safety factor criteria from USEPA and other guidance also were considered.

Maximum excavation depth and three corresponding combined thicknesses of recompacted surface soil and leveling fill berm, were considered under static and pseudo-static loading conditions.

a. 16-feet thick recompacted surface soil and leveling berm

b. 21-feet thick recompacted surface soil and leveling berm

c. 26-feet thick recompacted surface soil and leveling berm

d. 26-feet thick recompacted surface soil and leveling berm, with increased cohesion

In addition, subsequent to completion of the Subsurface Exploration and Testing Report for Trench 13 (**Appendix 5**), the excavation slope stability calculations were amended to include surface soil replacement scenarios with 10 feet of replaced low-cohesion soil and 10 feet of leveling fill berm and compacted fill strength properties based on Trench 13 area soil materials.

Varying the thickness of the combination of recompacted surface soil and leveling berm was considered because the actual thickness of the cohesionless surface soil layer to be replaced could vary along the Trench 13 perimeter. If this soil layer is more than 15 feet thick, additional measures might likely be required to increase the cohesive strength in the recompacted soil layer. A separate evaluation of a combined thickness of 26 feet thick was made and determined that the slope would be acceptably stable if localized measures, such as addition of Portland cement or other additive, are taken where thicker surface soil replacement is needed.

The results of the initial and amended slope stability calculations for the various slope and material configurations are provided in **Appendix 2**

**Table 4-1 Excavation Slope Stability Evaluation**

| Slope considered | Minimum SF Static | Minimum SF 0.42 g | Comment |
|---|---|---|---|
| Initial Analyses | | | |
| a. 16-ft combined | 2.01 | 1.18 | |
| b. 21-ft combined | 1.90 | 1.01 | |
| c. 26-ft combined | 1.68 | 0.90 | SF<1.0, requires increased cohesion or decreased thickness |
| d. 26-ft combined, increased cohesion | -- | 1.00 | Cohesion in combined layer increased to 900 PSF |
| Amended Analyses | | | |
| a. 20-ft combined, shallow failure plane | 2.49 | 1.30 | |
| b. 20-ft combined, deeper failure plane | 1.97 | 1.21 | |

Determination of locations, if any, where special measures are required to increase the strength of the surface soil replacement layer will be a construction-period determination. Such determination

will be made by the USEN representative providing construction observation. Documentation of soil improvement steps taken by the Trench construction contractor will be made by the USEN representative and confirmed by the Professional Engineer certifying Trench construction.

## 4.10 CONSTRUCTION AND OPERATIONS CONSIDERATIONS

The design of Trench 13 was developed to facilitate construction of the landfill in five major Phases. Each Phase will have its own LCRS/LDS sump as shown on **Drawings 005** and **006**. The easternmost portion of the Trench is expected to be the first constructed (Phase 13A), followed by construction phasing progressing to the west with Phases 13B through 13E. Construction of the Trench in Phases is practical in that it allows landfill capacity to best match disposal demand. Additional Phase and Trench capacity information is provided in **Section 1.4**

Construction and operations access to Phase 13A will be provided by an access route cut through Phase 13B. After construction of Phase 13A is completed, and as it approaches ultimate waste fill height, access to Phase 13A and subsequent Phases for waste disposal operations can be provided across waste, first across Phase 13A and later across waste in other Phases. Construction access to later Phases (except Phase 13E) can be provided by excavated access routes. In this manner, future Phase construction roads and waste operations routes can remain separate.

It is not expected that all of Trench 13 will be constructed as a non-phased effort; therefore, no evaluation of this possibility is provided in this Design Report.

Below-grade filling will occur in an appropriate fashion to maintain Trench stability and manage precipitation. Below-grade waste fill slopes at the edges of Phase lines (e.g., 13A/13B; 13B/13C; etc.) will be established at a maximum 2H:IV. Above-grade filling is discussed in **Section 7**.

The final Phase of Trench 13 below-grade construction, Phase E, will require the abandonment of monitoring well MW-327. This well extends below the base of Trench 13. To prevent future issues with the foundation of Trench 13, the monitoring well will be abandoned with a neat cement grout backfill in accordance with requirements included in the Construction Quality Assurance Plan included in **Appendix 3**.

**Table 4-2 Subgrade Construction-Observation and Material Specifications**

| Inspection Task | Inspection/Test Method Reference | Sample/Test Quantity/Frequency | Observation/Sample Locations | | |
|---|---|---|---|---|---|
| | | | Excavation | ~~Soil~~ Stockpile | Fill Area |
| **FIELD INSPECTION OF SOIL EXCAVATION AND PLACEMENT OPERATIONS** | | | | | |
| General project observations | Visual observations, plus basic measurements and recordkeeping | Continuous observation, during trench construction (excavation, soil screening and amendment and soil placement) | Yes | Yes | Yes |
| Trench feature layout | Observation of survey staking | Continuous observation, during excavation | Yes | NA | Yes |
| Soil material observation | Observation of excavated and imported soil material | Continuous observation, during construction | Yes | Yes | Yes |
| **SOIL TESTS TO BE DONE DURING TRENCH CONSTRUCTION** | | | | | |
| Particle-size analysis | ASTM C 136 | 3 tests per material type, reconfirmed as needed | Yes | Yes | Yes |
| Moisture/density curve | ASTM D1557, Modified proctor moisture-density relation | 3 tests per material type, reconfirmed as needed | Yes | Yes | Yes |
| Lift thickness | Observation/measurement before and during compaction | Random locations | NA | No | Yes |
| In-place density and moisture content | ASTM D6938 (or approved alternative method) | As specified | No | No | Yes |

| Inspection Task | Inspection/Test Method Reference | Sample/Test Quantity/Frequency | Sample Location | | Acceptance Criteria |
|---|---|---|---|---|---|
| | | | Source/ Stockpile | Fill Area | |
| **SURFACE SOIL LAYER REPLACEMENT** | | | | | |
| Direct shear strength of compacted fill | ASTM D3080[3] | 3 tests per material type, reconfirmed as needed | Yes | No | cohesion ≥ 300 PSF |
| Particle-size analysis | ASTM C 422 | 3 tests per material type, reconfirmed as needed | Yes | No | 95% <3.0" sieve between 5% and 20% passing #200 sieve |
| Moisture/density relation | ASTM D1557 | 3 tests per material type, reconfirmed as needed | Yes | No | NA |
| In-place density | ASTM D6938 (after compaction) | 1 per lift minimum, or 1 per 2,000 $yd^3$ (placed), or as specified | No | Yes | 95% MDD (min) by ASTM D 1557 |
| Moisture content | ASTM D6938 (after compaction) | 1 per lift minimum, or 1 per 2,000 $yd^3$ (placed), or as specified | No | Yes | OMC to OMC +2% |
| **TRENCH FLOOR AND SUMP SUBGRADE** | | | | | |
| Hydraulic conductivity of compacted subgrade | ASTM D5084 | 3 tests per material type, reconfirmed as needed | Yes | No | $\leq 1 \times 10^{-5}$ cm/sec |
| Particle-size analysis | ASTM D422 | 3 tests per material type, reconfirmed as needed | Yes | No | ≤10% >1.0" ≥10% pass #200 sieve |
| Moisture/density relation | ASTM D1557, Modified proctor moisture-density relation | 3 tests per material type, reconfirmed as needed | Yes | No | NA |
| Hydraulic conductivity (K) of constructed subgrade, trench and sump bottom | ASTM D5084 (remolded sample) | 1 test for every 40,000 square feet of constructed bottom and sump subgrade (200-ft grid and at least one test in each sump), remold to density target (±2 PCF) and moisture target (±1%). Each sample will be of the full thickness of floor subgrade or a 12 inch lift of sump subgrade. | No | Yes | $K \leq 1 \times 10^{-5}$ cm/sec |

[3] ASTM D3080 run at normal stresses of 0.5, 1.0, and 2.0 KSF for specimens remolded at 95% MDD (min) and OMC±2%.

| Inspection Task | Inspection/Test Method Reference | Sample/Test Quantity/Frequency | Sample Location | | Acceptance Criteria |
|---|---|---|---|---|---|
| | | | Source/ Stockpile | Fill Area | |
| In-place density and moisture content, trench floor | ASTM D1557 (after compaction) | one test per each one test for every 10,000 square feet of subgrade placed (placed) | No | Yes | 95% MDD<br>OMC to OMC +2% |
| Thickness, after compaction, trench floor | Measurement after compaction | The vertical control criterion for survey accuracy should be at least 0.1 feet, and comparison of actual and design grade should done on a 50-feet grid. All locations verified to include 9 inches of subgrade materials | NA | Yes | Thickness ≥ 9.0” |
| In-place density and moisture content, sump bottom | ASTM D6938 (after compaction) | 1 test per lift, not less than 3 tests per sump | No | Yes | 95% MDD<br>OMC to OMC +2% |
| Lift thickness, sump bottom | Measurement after compaction | Maximum lift thickness of 12 inches and not less than 3 measurements per lift in each sump. For final sump thickness confirmation, the vertical control criterion for survey accuracy should be at least 0.1 feet, and comparison of actual and design grade should be done on a 10-feet grid. All locations verified to include 36-inches of subgrade material | NA | Yes | Total compacted lift thickness at same location ≥36.0” |
| **SUMP AND LCRS DRAIN ROCK AND PIPING BEDDING** | | | | | |
| Hydraulic conductivity of gravel | ASTM D 2434 | 3 tests per material type, reconfirmed as needed | Yes | No | Minimum hydraulic conductivity = 1 cm/sec |
| Particle-size analysis | ASTM C136 | 3 tests per material type, reconfirmed as needed | Yes | No | 100% <2.0” sieve<br>90%<1-1/2” sieve<br>≥85% >3/4” sieve<br>≤5% passing #4 sieve |

MDD = Standard Proctor (ASTM D1557) maximum dry density.
OMC = Standard Proctor (ASTM D1557) optimum moisture content
TBD = to be determined by soil testing laboratory
PSF = pounds per square foot

# 5. LINER SYSTEM DESIGN AND PERFORMANCE

## 5.1 GENERAL

This section presents the results of calculations and design evaluations for the LCRS/LDS liner system. Calculations related to the leachate flow capacities of the liner system drainage layers are described in **Section 6.**

## 5.2 LINER SYSTEM COMPONENT DESCRIPTIONS AND RATIONALE

### 5.2.1 Floor Liner System Components

The cross-section of the floor liner system is shown in **Detail 3** of **Drawing 008**, and includes the following components, listed sequentially from top to bottom:

- 30-inch-thick operations layer;
- 300-mil double-sided geocomposite LCRS drainage layer (locally includes 4.0-inch diameter perforated pipes and coarse drain rock);
- 80-mil HDPE geomembrane liner (FML), textured on both sides;
- 300-mil double-sided geocomposite LDS drainage layer;
- 60-mil HDPE FML, textured on both sides;
- Geosynthetic clay liner (GCL); and
- 9-inch prepared subgrade.

<u>Operations layer</u>: The 30 inch-thick operations layer will be clean soil and/or select waste, with the purpose of protecting the underlying liner components from damage that might be caused by passage of heavy equipment or other operations activities. The layer will not contain large or angular elements which could damage the underlying liner system. The first 12 inches of material placed will be relatively small particle size material (e.g., sand and gravel not exceeding 1.0 inch particle size). The overlying 18 inches of material can have larger particles (e.g., up to 6 inches in diameter) provided they are encompassed in a soil matrix. No angular waste or drums are to be placed in this layer. Additional specifications for this layer are provided in **Appendix 3**.

LCRS drainage layer: The upper, 300-mil, double-sided geocomposite is the drainage layer of the LCRS. The 4.0-inch diameter leachate collection pipes (and coarse drain rock) locally augment flow capacity to accommodate infiltration and movement of liquid from the 25-year, 24-hour storm event. **Details 12** and **13** of **Drawing 010** shows the horizontal layout of these pipes and cross-sections are provided as **Details 10** and **11** of **Drawing 010**. Supporting calculations evaluating the performance of this layer are found in **Appendix 2**. The geocomposite drainage layer and pipes discharge into the LCRS sumps. Further discussion of the LCRS sump and riser pipe is provided in **Section 6.1**.

80-mil geomembrane: The 80-mil HDPE FML is the low-permeability component of the primary (LCRS) liner system. The selected thickness is intended to provide puncture resistance. HDPE is selected for its demonstrated resistance to chemical degradation. The 80-mil HDPE FML will be textured on both sides to provide additional interface strength.

LDS drainage layer: The lower, 300-mil, double-sided geocomposite is the drainage layer for the secondary (LDS) liner system. Its function is to facilitate collection of leachate and drainage of leachate to the LDS sump for detection. Supporting calculations evaluating the performance of this layer are found in **Appendix 2**. Further discussion of the LDS sump and riser pipe is provided in **Section 6.2**.

60-mil geomembrane: The 60-mil HDPE FML is the upper low-permeability component of the secondary (LDS) liner system. It is less thick than the primary FML as it is protected from possible puncture by other liner system components above and below. Textured HDPE on both sides is selected for the reasons stated above for the primary FML.

GCL: The GCL is the lower low-permeability component of the secondary (LDS) liner system. It is selected because of the GCL's superior hydraulic barrier properties and suitability to an arid environment.

Prepared subgrade: The 9-inch prepared subgrade layer provides a smooth surface for installation of the geosynthetic materials. This layer works in conjunction with the GCL to enhance its function as a hydraulic barrier and provide additional leachate adsorption.

### 5.2.2 Side Slope Liner System Components

A cross-section of the LCRS/LDS liner system on the sidewall slopes of the Trench is shown in **Detail 2** on **Drawing 008**, and includes the following components listed sequentially from top to bottom:

- 30-inch operations layer (measured normal to sidewall and applied as waste fill is placed);
- Sacrificial 40-mil HDPE FML, smooth on both sides;
- Non-woven geotextile filter fabric;
- 200-mil geonet LCRS drainage layer;
- 80-mil HDPE FML, smooth on the top side and textured on the bottom side;
- 200-mil double-sided geocomposite LDS drainage layer;
- 60-mil HDPE FML, textured on both sides; and
- GCL (placed over subgrade).

A 10-foot wide, 3-foot deep anchor trench is provided at the top of each slope as shown in **Detail 1** on **Drawing 008**. Calculations supporting the configuration of the anchor trench are provided in **Appendix 2**. Following completion of the sidewall liner system installation, approximately one foot of additional soil will be added above the anchor trench and sloped away from the Trench to provide additional liner ballast and surface-water run-off control.

Operations layer: The 30-inch operations layer functions as a protective layer, as stated in **Section 5.2.1**. Along the sidewalls, it will be placed incrementally as the waste fill is placed. Since the slopes are steep (0.5H:1V) the operations layer should be incrementally advanced at a maximum height of five feet above the waste fill height.

Sacrificial geomembrane: The sacrificial 40-mil HDPE FML is specified to provide exposure protection (see **Section 5.3**) for underlying geosynthetic materials.

Other sidewall liner components: The remaining components of the sidewall slope liner system and their functions are identical to their counterparts in the floor liner system (see **Section 5.2.1**), with the following further explanation.

- Weak (i.e., low friction) interfaces are purposefully provided between the geonet and the non-textured surface of the 80-mil HDPE FML, and between the separate geotextile and the geonet of the primary liner system. Allowing differential movement between these layers prevents settlement related loads from being transferred directly to the underlying low-permeability components of the primary and secondary liner systems.
- Since it would be impractical to construct a compacted subgrade layer on the 0.5H:1V slopes, subgrade preparation on the sidewall consists of excavating to provide a relatively smooth surface without irregularities that might compromise the integrity of the liner system and special surface treatment where such irregularities are judged to be present, as discussed in **Section 4.6**.

### 5.2.3 Trench Floor/Sidewall Transition Liner System Components

The cross-section of the LCRS/LDS liner system at Trench floor/sidewall transition locations is depicted in **Detail 4** of **Drawing 008**. This detail shows how overlaps will be made for each drainage layer to assure hydraulic continuity of the LCRS and LDS components from the sidewall to the floor of the landfill. The overlap typically extends from three feet above the floor to three feet onto the Trench floor.

## 5.3 MINIMUM TECHNOLOGICAL REQUIREMENT

The precedence for utilizing a composite GCL bottom liner at the USEN Facility was established in connection with the design of Trench 12. The regulatory accommodation for this alternative design is provided in 40 CFR 264.301(d), which states, in part:

> *(d) The Regional Administrator may approve alternative design or operating practices to those specified in paragraph (c) of this section if the owner or operator demonstrates to the Regional Administrator that such design and operating practices, together with location characteristics:*

> *(1) Will prevent the migration of any hazardous constituent into the ground water or surface water at least as effectively as the liners and leachate collection and removal systems specified in paragraph (c) of this section;*

Minimum Technological Requirement (MTR) equivalence calculations were submitted and reviewed through several communications, which occurred between 1996 and 2002. In summary, the equivalency was evaluated based upon permeability, adsorption capacity (constituent breakthrough time), and puncture resistance. Consideration was also given to the unique arid climate conditions at the Facility and the high probability that a prescriptive compacted clay liner would eventually desiccate and crack.

Ultimately, it was demonstrated that the composite liner formed by the GCL and 9-inch prepared subgrade ($K<1x10^{-5}$ cm/sec) layer provided equivalent protection against a potential 12-inch head of leachate. In the sump locations, where the magnitude of the potential leachate head was considered to be greater, the thickness of the prepared subgrade layer was increased to 36 inches. The subgrade materials located within the sump area in the vicinity of the LDS sump are amended with cement, only for the purpose of improving constructability, thereby facilitating the ability to excavate the unique geometry required within these locations.

The legacy MTR equivalence calculations and related commentary include the key documents in **Table 5-1** and reference copies are provided in electronic format in **Appendix 9**.

**Table 5-1 Legacy MTR Documentation**

| Document | Date | Author | Description |
|---|---|---|---|
| 1 | 1995-12-07 | NDEP Letter | Conceptual Design of Cell 12 |
| 2 | 1996-03 | TRC Report | Cell 12 Design Report – Exhibit D – MTR Equivalence |
| 3 | 1996-04-04 | TRC Letter | MTR Equivalence Supplement |
| 4 | 1996-06-04 | NDEP Letter | Preliminary Review of MTR for Trench 12 |
| 5 | 1996-07-09 | USEN Letter | Cell 12 Design |
| 6 | 1996-09-13 | NDEP Letter | Part B Renewal Application NOD Comments |
| 7 | 1996-10-18 | TRC Letter | Response to NOD Comments |
| 8 | 1996-11-04 | NDEP Letter | Part B Renewal Application – Additional Comments |
| 9 | 1996-12-17 | HMA Letter | Response to NOD Comments |
| 10 | 1997-01-17 | HMA Letter | Draft Response to Verbal Comments |
| 11 | 2002-02-14 | AAT Letter | Final Trench Design Documents |
| 12 | 2002-03-20 | NDEP Letter | Cell 12 Design – Concurrence of MTR Equivalency |

## 5.4 LINER SYSTEM EXPOSURE PROTECTION

Exposure protection is necessary for the liner system components, both during construction as well as during Trench operations. Exposure protection for geosynthetic materials during construction is included in the specifications included in **Appendix 3**.

Geosynthetics on the Trench floor are expected to be covered by the operations layer within a reasonably short period of time (e.g., several weeks to a few months) after installation. No further protective measures are required for those elements.

The sidewall liner system incorporates a sacrificial 40-mil HDPE FML. The sacrificial liner is installed over the slope liner during construction. During waste placement 30-inches of operations layer is placed against the 40-mil HDPE FML prior to waste being filled against the slope. The sacrificial liner protects the slope liner prior to filling and specifically eliminates UV exposure of the upper (primary) non-woven geotextile filter-fabric. The sacrificial layer also prevents infiltration into the slope LCRS during direct precipitation, transferring management of direct precipitation to the floor liner components.

A gridwork of ropes/cables and weights will be necessary to secure the slope lining system and prevent uplift from wind. The sidewall weighting system will be specified by the liner or construction contractor, prior to liner installation. To eliminate strain on slope liner components, the gridwork of ropes/cables and weights may be cut loose, at the operator's discretion, once the waste placement reaches within 20 feet of the surface.

## 5.5 FOUNDATION SETTLEMENT ANALYSIS

Foundation settlement calculations for Trench 12 were done as part of the 1996 Design (TRC 1996). Those calculations showed that total settlement of the foundation from waste filling was expected to be negligible (e.g., about one inch). In addition, differential settlement of the foundation also was negligible and would not adversely affect the liner or cell bottom slope. The approach taken for the previous calculation remains applicable and is used to estimate Trench 13 foundation (cell floor) settlement. By this means of calculation, total Trench 13 foundation settlement is estimated to be less than 2.0 inches (evaluated in a settlement calculation included in **Appendix 2**).

## 5.6 LINER SYSTEM STRESSES

Provided in **Appendix 2** are evaluations of tension and elongation of the slope liner system; confirming that the liner system can withstand anticipated loading. The evaluation includes consideration of loads on the slopes during installation and operations including the following:

- Gravity elongation;
- Thermal expansion;
- Wind uplift; and
- Seismic deformation.

To evaluate the worst-case condition, the strains caused by each of the loading types indicated above are calculated and summed to determine the cumulative strain that could be experienced by each component. Stresses then are determined from the moduli of the materials. The calculated stresses then are compared to allowable stresses (e.g., ultimate strength reduced by appropriate

factors of safety) for each component. Calculated stresses must be smaller than allowable stresses for each component of the system to be acceptable.

Evaluations presented in **Appendix 2** indicate that calculated stresses in the selected components do not exceed the allowable stresses for those layers. The calculated strains caused by gravity elongation, thermal expansion, seismic deformations result in small stresses in comparison to allowable values. Stress generated by wind uplift are negligible since an anchor system will be used to hold down the slope liner system and no liner components are subject to wind stresses after waste placement. The largest strain (and corresponding stress) results from settlement. However, since a weak interface above the 80-mil HDPE FML layer is used, the effects of settlement are isolated to the geonet and geotextile layers of the LCRS.

# 6. LEACHATE HANDLING

## 6.1 LEACHATE COLLECTION AND REMOVAL SYSTEM SUMPS

### 6.1.1 Design Elements

The LCRS is associated with the primary liner system. The function of the LCRS is to intercept leachate draining through the waste and to discharge it into the sumps for removal from the landfill. The typical sump configuration is shown in **Drawing 009**. A grade break between 2 percent (centerline) and 2.8 percent (floor) to the 7 to 10 percent sump floor slopes occurs at the sump perimeter. The LCRS sump is 4.0 feet deep. Liquid is removed from the sump through a riser that is shown in **Sections A** and **B** on **Drawing 009**. The components of the LCRS sump are sized to accommodate the anticipated leachate flows while maintaining fluid head above the primary liner at or below 1.0 foot. Design flows, capacity, and pump sizing calculations for the LCRS sump are provided in **Appendix 2**.

Routine operations will require that the primary pump be capable of maintaining accumulated leachate within the limits of the sump (i.e., preventing leachate accumulation of more than 1.0 feet on the liner Floor or in the Sump). Although only needed under design storm conditions and when a new Phase is under initial operations, a secondary pump, capable of providing 114 feet of dynamic head at a rate of 23 gallons per minute, will be installed in the active Phase of Trench 13.

Components used in the Trench 13 LCRS sumps are shown on the typical sump layout, **Detail 6** on **Drawing 010** and **Sections A** and **B** on **Drawing 009**. The components include the following.

- Geocomposite (300-mil double-sided, or equivalent): This is the principal LCRS drainage component (at Trench floor locations, see **Section 5.2.1**) that discharges directly to the drain rock at the edge of the sump.
- 10-ounce LCRS filter geotextile: This geotextile is used to separate the operations layer from the drain rock (described below). It is used over the entire sump area within the sump perimeter.

- 4.0-inch inside diameter perforated HDPE pipes: These pipes are secondary flow components that assist the LCRS in handling the maximum anticipated flow resulting from a 25-year, 24-hour storm event (see **Section 5.2.1**). The pipes discharge directly to the LCRS sump.
- Drain rock: This is a clean gravel conforming to the gradation included in the specifications included in **Appendix 3** and **Table 4-2**. The LCRS gravel fills the entire sump to the grade break.
- 16-ounce LCRS cushion geotextile: This is a nonwoven geotextile used to provide additional puncture protection to the liner system within the sump perimeter.

The LCRS riser system will include two identical risers, including a primary collection pipe and a redundant, secondary riser. Components of the LCRS riser system are shown on **Details 5, 6, 8,** and **9** of **Drawing 010** and **Sections A** and **B** of **Drawing 009** and include the following (starting at the sump).

- Slip joint: Settlement of the riser system is accommodated by a slip joint which is intended not to transfer stress to the liner system. The slip joint is a 12-inch diameter SDR 11 HDPE pipe that is extrusion-welded to a 1.0-inch thick, 20-inch square HDPE flatstock base. The pipe is perforated with 1/2-inch diameter holes 60 degrees apart on 3-inch centers (24 holes per foot). A 16-ounce geotextile cushion sheet is placed between the liner system and the slip joint base. The slip joint extends a minimum of 6.0 inches into a riser support (discussed below). The lip of the slip joint pipe in the riser support will be built up, such as with HDPE flatstock (or other alternative), and then chamfered to provide a smooth transition for a pump to be lowered into the sump.
- Riser pipe support: The riser pipe support consists of a concrete foundation block which transfers the pipe and potential down-drag loads to the LCRS gravel, thus preventing stress concentrations on the liner system. The riser pipe support is intended to be a cast-in-place unit built of 4,000 psi concrete, using Type V sulfate-resistant cement. A 14-inch diameter, Schedule 60, Type 316 stainless steel pipe extending at least 3.0-inches from the concrete will be cast in the concrete. The riser pipe will include a 20-inch O.D. by 14-inch I.D. by

0.5-inch thick type 316 stainless steel bearing plate. The bearing plate will include twelve 1.0-inch diameter by 6-inch long expansion type anchor bolts (or approved alternative) extending into the concrete foundation block. The riser pipe support will be positioned in the field such that the slip joint, support, and LCRS long radius bend (described below) are correctly aligned.

- LCRS reducer: The riser pipe support will be welded to a 14-inch by 12-inch stainless steel reducer. The riser pipe support will be welded to the 14-inch side. The 12-inch side of the reducer will be welded to a twelve-bolt stainless steel flange.
- LCRS long radius bend: This is a prefabricated bend that provides the 3.5 feet of deflection required to position the LCRS riser pipe in the center of the riser pipe support. The piece is 20-feet long and fabricated of 12-inch diameter, Schedule 40, stainless steel. Manufacture of the necessary sweeping bend must not compromise the strength of the stainless steel. The bottom of the LCRS long radius bend will be welded to a twelve bolt stainless steel flange.
- LCRS riser pipe: This is a 12-inch diameter, Schedule 40 stainless steel pipe butt-welded to the LCRS long radius bend. `
- Riser pipe slip cover: The function of this component is to minimize the transfer of friction and down-drag loads on the riser pipe caused by settlement of waste. The riser pipe slip cover will be fabricated from a 12-inch diameter corrugated polyethylene pipe that has been split longitudinally and placed over the riser. It is not necessary to join the individual pieces of the slip cover.
- Top of slope anchor: This is a concrete block with an adjustable U-bolt that is cast on-site, but not in-place. This component provides lateral restraint for the riser pipe while allowing vertical movement to accommodate settlement.

### 6.1.2 Maximum LCRS Flow

The design storm for this Facility is the 25-year, 24-hour event which yields 2.26 inches of precipitation at the USEN site (see **Appendix 2**). The critical operational time for the LCRS is after the 30-inch operations layer has been placed and before waste filling operations begin. At

that point, because there is some waste in the Trench (i.e., the operations layer), any collected precipitation is considered to be leachate (rather than surface water). At the same time, the small amount of waste present provides only a minimal amount of additional sorptive capacity and the potential for precipitation infiltration to the LCRS is greatest. This condition results in the largest potential infiltration into the LCRS.

The calculations in **Appendix 2** determine the rate and volume of precipitation infiltration. For the largest Phases of the landfill (Phases 13A and 13E), it is estimated that 1.86 acre-feet of water will infiltrate to be collected by the LCRS as a result of 25 year-24 hour precipitation event. As described in the LCRS infiltration calculation **(Appendix 2)**, the presence of the sacrificial liner on the east wall of Phase 13A and the west wall of Phase 13E cause those slopes to contribute infiltration to the LCRS, differentiating those Phases from other Phases that do not have long north-south sidewalls.

The infiltrated precipitation will be handled by the LCRS. The calculations conservatively assume that the 30-inch thick operations layer will contain sufficient moisture to be at field capacity, which means that any addition of moisture will cause gravity drainage.

However, since the design quantity of infiltration fills only 65 percent of the estimated available pore space in the operations layer, drainage is controlled by unsaturated flow. Based on the calculations, the maximum drainage rate results in a flow of 23 gpm to the sump for Phases 13A and 13E. A pump, such as the EPG Series 5 SurePump®, which has dimensions required for use in the LCRS sumps, will be used to provide sufficient capacity to meet these specifications.

## 6.2 LEACHATE DETECTION SYSTEM SUMPS

### 6.2.1 Design Elements

The LDS is associated with the secondary liner system. The functions of the LDS is to detect and remove liquid that passes through the primary liner system. The system is designed to accommodate flow up to the Action Leakage Rate (ALR, defined in **Section 6.2.2**), while fluid head above the secondary liner remains at or below 1.0 foot. Design flow, capacity and pump sizing calculations for the LDS sumps are provided in **Appendix 2**. A pump capable of extracting approximately 1.0 gpm at 114 feet of dynamic head is recommended for the LDS.

Components used in the Trench 13 LDS sumps are shown in the typical sump layout on **Sections A** and **B** on **Drawing 009,** and **Detail 007** on **Drawing 010**. The components include:

- Geocomposite (300-mil double-sided, or equivalent): This is the principal LDS drainage component (at the Trench floor locations, see **Section 5.2.1**) that discharges to the LDS sump. In the vicinity of the sumps
- Upper 16-ounce LDS cushion geotextile: This is a non-woven geotextile used to provide additional puncture protection to the liner system within the sump perimeter.
- Drain rock: A clean gravel conforming to the gradation included in the specifications (**Appendix 3**). The LDS gravel fills only the 18-inch deep sump area.
- LDS end caps, tee, collection pipes and elbow: These pieces are all 12-inch diameter SDR 11 HDPE that is perforated to collect flow into the LDS sump. The collection pipe is welded to a 1.0-inch thick by 12 inch wide piece of HDPE flatstock.
- Lower 16-ounce LDS cushion geotextile: This is a non-woven geotextile that provides puncture protection to the secondary liner system in the 18-inch deep portion of the sump.

Components of the LDS riser system are shown on **Details 7, 8,** and **9** of **Drawing 010** and include the following (starting at the sump):

- LDS riser: A 12-inch diameter SDR 11 HDPE pipe used for pump access.
- LDS riser recess and backfill: The LDS Riser (described above) is placed in a 24-inch wide by 18-inch deep recess cut into the sidewall during excavation. Backfill consists of sprayed concrete or gunite.
- Top of slope anchor: See the LCRS Top of Slope Anchor description in **Section 6.1.1** above since the units are identical.

### 6.2.2 Action Leakage Rate

As described in 40 CFR § 264.302(a), the ALR is " ... the maximum design flow rate the LDS can remove without the fluid head on the floor liner exceeding 1 foot." The ALR for each of the five sumps was determined by: (1) assuming a nominal design flow value; (2) determining a

configuration of the LDS components that could satisfy the design flow; and (3) calculating the actual ALR resulting from that configuration.

Drainage into the LDS sumps is controlled by the flow rate of the LDS geocomposite and the minimum effective flow width of the LDS sumps.

Calculations of the LDS flow rates and the establishment of an ALR is provided in **Appendix 2.** The resulting ALR for each of the sumps is shown below in **Table 6-1**.

**Table 6-1 Action Leakage Rates**

| Phase | Phase Area (acres) | ALR (gpad) |
|---|---|---|
| 13A | 9.88 | 150 |
| 13B | 9.16 | 150 |
| 13C | 9.16 | 150 |
| 13D | 9.16 | 150 |
| 13E | 9.88 | 150 |

*gpad = gallons per acre day*

## 6.3 RESPONSE ACTION PLAN

The USEPA promulgated rules on January 29, 1992, requiring Response Action Plans (RAP) for new hazardous waste landfill units that commence construction after January 29, 1992, or which expand existing units after July 29, 1992 (57 FR 3462). The prepared RAP included in **Appendix 4** meets the requirements of 40 CFR §264.304 and identifies actions to be taken if an action leakage rate is exceeded.

# 7. ABOVE-GRADE DESIGN AND FINAL COVER PERFORMANCE

## 7.1 WASTE PLACEMENT

Waste placement above grade forms the slope configuration for Trench 13 as shown on **Drawing 011**. From the HCL, waste will rise above grade at slopes of 2H:1V for approximately 15 feet. As shown on **Drawing 018**, a waste setback is to be maintained at the HCL. The setback includes a vertical off-set into the trench of approximately 3.0 feet and a corresponding horizontal off-set. In addition, an interim containment extension is specified, to maintain the waste off-set as waste placement progresses above grade. At approximately 15 feet above grade the waste slope will transition to a slope of 3H:1V. The waste will have a maximum elevation of 2857 ft NAVD88 and the Trench configuration will include an upper deck that slopes at 20H:1V to the south.

## 7.2 COVER DESIGN DESCRIPTION

The first layer of the final cover (Interim Cover Soil Layer) will be placed over the disposed waste. The Final Cover Soil Layer will be placed over the interim cover soil layer as the Phases of Trench 13 are completed, as presented in **Drawing 012**. As determined by USEN, the final cover soil layer might be placed over an area comprised of less than the surface area of a full Phase or over an area comprised of portions of more than one Phase. The Interim Cover Soil Layer and the Final Cover Soil Layer constitute the alternative final cover (AFC) that was modeled, evaluated for use on Trenches 11 and 12 at USEN in the 2008 *Design Basis and Construction Specifications for Trenches 11 and 12 Final Covers* (AquAeTer 2008) and was given conditional approval by NDEP in Revision 3 to RCRA Permit NEVHW0019 (Permit)[4]. Performance of the Trench 13 alternate final cover will be evaluated with the installation and monitoring of a new drainage lysimeter at an appropriate location on the Trench 13 final cover, installed following the initial phase of final cover completion.

Control of percolation into the closed Trench will be provided by constructing the cover with materials that combine to provide a final cover system that holds precipitation water that infiltrates

[4] State of Nevada, Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Waste Management. Hazardous Waste Management RCRA Permit NEVHW0019. Revision 3. April 2009.

into the cover, and returns the majority of that water to the atmosphere through the combined processes of evaporation and plant transpiration. These combined processes will reduce the water that could percolate into the disposed waste to an amount that, given the thickness and relative dryness of disposed waste, is unlikely to result in generation of significant leachate volumes.

From bottom to top, the components of the arid region AFC are as follows.

- Interim cover soil layer: The first layer of the final cover is a lightly compacted native soil layer that provides waste containment during disposal operations and, in conjunction with the Final Cover Layer, retards the downward movement of infiltrating water by providing temporary water-storage, which allows stored water to be returned to the atmosphere by evaporation and plant transpiration. This layer will be at least 12-inches (1.0 foot) thick and extend across the cover to the natural ground surface on all sides of the Trenches.
- Final cover soil layer: This upper layer is a lightly compacted soil layer that resists erosion and, in conjunction with the Interim Cover Layer, retards the downward movement of infiltrating water by providing temporary water-storage, and allowing stored water to be returned to the atmosphere by evaporation and plant transpiration. This layer will vary in thickness to allow the cover to be shaped; however, the layer will be least 24-inches (2.0 feet) thick. This layer will extend across the cover to the natural ground surface on all sides of the Trenches.
- Drainage Features: The final cover design includes a series of lateral drainages and down-drains (flumes) that shed precipitation that does not infiltrate. The goal of the drainages is to collect sheet flow prior to development of concentrated flow. On 3H:1V sideslopes, this is accomplished with lateral drainages at a maximum spacing of 100 feet, over waste. On the 20V:1V upper deck this is accomplished with surface berms. Down-drains are protected flumes that are designed to remove water, once concentrated by the lateral drainages and berms, without causing erosion.

Trench closure will be considered complete when the final design slopes have been established on the Final Cover layer, as shown in **Drawing 012**.

### 7.2.1 Specification for Interim Cover Layer Soil

Soil materials for the Trench 13 interim soil layer should contain no materials larger than 6.0 inches[5]. If materials greater than 6.0 inches are included in the interim soil layer, it might be necessary to increase the thickness of the interim cover layer or the final cover layer to meet the objectives of the cover system. Suitable materials will be derived from direct excavation or stockpiles, non-hazardous soil materials, or from on-site screening of these materials. Typically, this layer will be placed in a single lift. Lift thickness will be measured and documented, but there is no compaction specification for this material, which will be placed as above-grade waste disposal proceeds.

A low density is desirable for this layer of the final cover, as this is important to the moisture holding capacity and vegetation establishment properties of the soil. Over-compaction could lead to reduced cover effectiveness and should be prevented.

Confirmation of appropriate gradation and thickness of interim cover materials will be determined by routine observation during the placement of these materials. Response to observation of overly coarse materials or insufficient layer thickness will be the placement of additional interim cover material and will be directed by USEN personnel responsible for such observations.

A schedule of the interim cover layer placement inspection requirements is attached as **Table 7-3**.

### 7.2.2 Specification for Final Cover Layer Soil

The goal during Final Cover Layer placement is to achieve a low initial in-place density, typically not exceeding 85 percent maximum dry density (MDD) as determined by ASTM D 1557. Specific testing will be done prior to placement of the Final Cover Layer as Phases are to be closed to determine MDD and optimum moisture content (OMC). The lower density compaction requirement of the soil cover is important for the moisture holding capacity of the soil. Over-compaction during initial construction could lead to reduced moisture holding effectiveness and inhibit establishment of vegetation, and should be prevented. Areas of the final cover layer that became overly compacted, such as from repeated vehicle or equipment passage, will be loosened

[5] Materials of 6.0 inch and larger dimension might be judged acceptable in the interim cover by the design or quality assurance engineer, if '*de minimis*' (or minimal) by visual observation and rarely, if ever, in grain-to-grain contact.

by shallow ripping. Over time, material in the final cover will reach a density similar to those of native materials.

The Final Cover Layer will consist of sand and gravel soils obtained from USEN stockpiles and from direct excavation. Natural soil materials present in excavations, are relatively coarse grained, alluvial valley-fill sands and gravels, with variably abundant clay and silt-size particles, common cobble-size particles (i.e., particles larger than 3.0 inches in dimension), and rare boulders (i.e., particles larger than 12 inches in dimension). Sand-size particles (i.e., particles between 0.003 and 0.2 inches in dimension) and gravel-size particles (i.e., particles between 0.2 and 3.0 inches in dimension) comprise the vast majority of almost any sample of soil materials from the uppermost 75 feet of the valley-fill deposits, and thus make up the majority of natural materials determined to be acceptable for final cover construction. It is these materials, and particularly those ranging in the sand and silt grain sizes, that provide most of the moisture-holding capacity that is needed for the proper long-term functioning of a water-balance type landfill cover. The coarser-grained components – gravels, cobbles, and even rare boulders – do not enhance the moisture holding capacity of the final cover, but do contribute to overall cover stability and capacity to resist erosion by wind and water. Thus, when in proper proportions, all textural components of the final cover soils contribute to the long-term performance of the landfill cover.

Soil materials for the final cover layer will contain only minimal materials larger than 6.0 inches, 90 percent smaller than 1.0 inch, and not less than 5.0 percent passing the #200 sieve[6]. In general, the 1.0-inch and less materials should contribute 90 percent or more to the necessary 24 inches of Final Cover Layer. There is no requirement for the thickness of lifts placed, only that the layer have a minimal achievable density. Coarse-grained materials, if present, should 'float' in a finer grained soil matrix and commonly not occur in grain-to-grain contact. The presence of particles exceeding 6.0 inches in the final cover layer, do not affect the long-term moisture holding and moisture-releasing capacity of these soil layer so long as such materials continue to be minimal constituents (by weight) of the final cover layers and are rarely, if ever, in grain-to-grain contact.

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[6] Materials of 6.0 inch and larger dimension might be judged acceptable in the final cover layer by the design or quality assurance engineer, if '*de minimis*' (or minimal) by visual observation and rarely, if ever, in grain-to-grain contact.

Confirmation of appropriate gradation of final cover materials, and acceptable physical separation of any overly coarse material, will be determined by routine observation during the placement of these materials. Response to observation of overly coarse materials, or grouping of such materials in grain-to-grain contact, will be grading to redistribute overly coarse materials or the placement of additional cover material and will be directed by USEN personnel responsible for such observations.

The lower density compaction requirement of the soil cover is important for the moisture holding capacity of the soil. Over-compaction could lead to reduced effectiveness, and should be prevented. Areas of the final cover layer that become overly compacted, such as could result from repeated vehicle or equipment passage, will be loosened by shallow ripping or disking.

Verification of the achievement of low density will be determined by in-situ density tests performed at a minimum of one test per each one test for every 10,000 square feet of cover placed. In the event that density testing indicates that the target density is not achieved, the area within 100 feet of the failing testing will be re-compacted and retested. Confirmation of satisfactory compaction in a re-compacted area will be by done by three satisfactory density tests, at locations selected to represent the entire 100 by 100 feet area, passing the density specification.

A schedule of the final cover layer placement inspection requirements is attached as **Table 7-3**.

### 7.2.3 Specification for Cover Drainage Features

The Trench 13 final cover system includes a series of drainage features designed to limit sheet flow to distances that prevent against rill and inter-rill erosion. Runoff control from the final cover slopes, at closure, will be provided by the following features:

- Lateral drainages integrated into the sideslopes of the final cover to limit the length of slopes exposed to sheet flow, as shown in Detail C on **Drawing 019**;
- Upper deck berms used to limit the length of sideslopes exposed to sheet flow, as shown in Detail D on **Drawing 019**;

- Flumes spaced along the cover slopes to discharge upper deck and lateral drain run off to the perimeter of Trench 13, as shown in Detail E on **Drawing 019**;
- Access road drainages to convey water off the sideslopes, as shown in Detail J on **Drawing 019**; and
- Perimeter ditches to convey flow from the flumes, bottom portions of the cover slopes, and immediately adjacent areas to the overall Facility drainage system.

Lateral drains are located on Trench 13 sideslopes to limit slope erosion to less than two tons per acre-year[7]. Calculation C.12 demonstrates that this requirement is satisfied with sideslope sheet flow runs limited to 100 feet. Lateral drains include sufficient capacity to provide at least 1.0 foot of freeboard when considering the 100-year, 24-hour precipitation event. Lateral drains are sloped at two percent and include a four foot wide outer ridge. The maximum calculated lateral drain flow for the system is estimated at 0.84 cubic feet per second (cfs), as shown in Calculation C.12. Each sideslope lateral will include protective ditch armoring for erosion and scour protection.

Upper deck berms are located on the Trench 13 20H:1V upper deck. These berms have been included to limit rill and inter-rill erosion and to decrease sheet flow lengths. The upper deck berms channelize and direct flow to the flumes for removal off of the Trench 13 final cover. Upper deck drains include sufficient capacity to provide at least 1.0 foot of freeboard when considering the 100-year, 24-hour precipitation event. Upper deck berms are sloped at one percent. Each upper deck berm will include protective armoring for erosion and scour protection.

The sideslope lateral drains and the upper deck berms discharge into flumes. The flumes are four feet in width and include sufficient capacity to provide at least 1.0 foot of freeboard when considering the 100-year, 24 hour precipitation event. Flumes on the upper deck are sloped at 20H:1V. Flumes on the sideslope primarily are sloped at 3H:1V, but include short sections at lesser slopes where sideslope laterals intersect. The maximum calculated upper deck flume flow for the system is estimated at 3.2 cfs and the maximum calculated sideslope flume flow for the

[7] USEPA. Design and Construction of RCRA/CERCLA Final Covers, EPA/625/4-91/025. 1991

system is estimated at 5.0 cfs, as shown in Calculation C.12. Each flume will include protective armoring for erosion and scour protection.

Access road drainages channelize and direct flow from east and west sideslope areas for removal off of the Trench 13 final cover. The drainages follow the road's grade at five and 10 percent and, are back-graded into the sideslope at five percent. The maximum calculated access drainage flow for the system is estimated at 1.5 cfs, as shown in Calculation C.12. Each access road drainage will include protective ditch armoring for erosion and scour protection.

Energy dissipation and scour protection will be provided at the bottom of flumes, where needed. A typical energy dissipation and splash wall design are included as Detail I on **Drawing 019**.

Perimeter ditches are shown on **Drawing 014**, **015**, and **016**. Perimeter ditches transport runoff to Facility drainages.

## 7.3 EQUIPMENT TRAFFIC

Cover soil placement using low-ground pressure equipment, such as wide-tracked dozers, is recommended and use of heavy wheeled equipment, that could cause linear surface depressions, is not recommended. Over-compaction (i.e., exceeding the density specification for cover materials) could reduce the water-holding characteristics of the cover or the ability of the cover to establish and support vegetation. Such over-compaction could be caused by repeated passage of heavy equipment over cover materials during or after placement (such as would result from repeated use of a haul route). Such haul road will not be used, and equipment loads on the soil cover during construction will be limited to the normal equipment traffic associated with placing, spreading and compacting the cover soil. Once the cover is completed in an area, vehicular traffic on the soil cover will be limited. Also, construction materials and equipment will not be temporarily stored on the cover during or after construction. Areas that become over-compacted because of equipment traffic will be loosened, such as by shallow disking or ripping.

## 7.4 PROCEDURE FOR CONFIRMING LINE AND GRADE

The AFC must be constructed with the minimal thicknesses of the Interim and Final Cover Layers to accomplish the goals of moisture retention and storage. Since the Interim Cover Layer is applied

immediately following waste placement, it is not practical to maintain survey control of the Interim Cover thickness using pre and post survey methods. Therefore, the site operator shall ensure that a minimum thickness of interim cover is installed. The certifying engineer, responsible for closure certification, might require proof of appropriate Interim Cover placement.

Prior to Final Cover placement, a detailed survey of the waste and Interim Cover grade should be completed. The vertical control criterion for survey accuracy should be at least 0.25 feet, and comparison of actual and design grade should done on a 50-feet grid.

Following installation of the Final Cover Layer, verification of the constructed dimensions (line and grade) will be completed. A survey of the Final Cover, using the same vertical and horizontal criteria as above, will be compared to the survey of the upper surface of the Interim Cover. The comparison will confirm that 90 percent of the points of measurement (i.e., on 50-ft grid) of total final cover thickness satisfy the minimum requirement of 2.0 feet and that there is no point of measurement where the total final cover thickness is more than 0.25 feet less than the design requirement of 2.0 feet.

No point on the Trench 13 final cover will exceed a maximum elevation of 2,860 ft NAVD88.

Changes to line and grade requirements will have the approval of the Project Engineer prior to implementation.

## 7.5 FINAL COVER SLOPE STABILITY EVALUATION

The "Trench 13 Design, Slope Stability" calculation series in **Appendix 2,** includes evaluation of the stability of the Trench 13 final cover. These stability calculations were made in the same manner as those described for Trench 13 excavations (see **Section 4.9**)

The following aspects of Trench 13 final cover configuration are considered in final cover stability calculations.

- Above-grade and waste slopes: 3.0H:1.0V on steep slopes, 20H:1V on top deck slopes
- Final cover thickness: 3.0 feet
- Final cover maximum elevation: 2860 ft NAVD88.

- Combined thicknesses of surface soil replacement and leveling berm ranging from 16 to 26 feet

The properties of final cover materials and disposed waste considered in these calculations, including material strength properties, are consistent with site-specific laboratory testing results, technical literature, and assumptions made for previous slope stability calculations for the USEN Facility and are presented in **Table 7-1**.

**Table 7-1 Soil Properties used for Cover Stability Modeling**

| Material | Unit Weight (PCF) | Cohesion (PSF) | Basis for Values |
|---|---|---|---|
| Final Cover soil | 110 | 170 | Laboratory testing determined cohesion value for 85% MDD |
| Disposed Waste (shallow) | 100 | 550 | Previous calculation |
| Disposed Waste (deep) | 115 | 750 | Assumption |

The following final cover failure possibilities were considered under static and pseudo-static loading (i.e., 0.42 g) conditions.

a. Shallow failure – failure plane within final cover material

b. Deep failure – failure plane within waste, penetrating leveling berm

The results of the slope stability calculations for the various slope and material configurations are presented in **Table 7-2**.

**Table 7-2 Cover Slope Stability Evaluation**

| Slope considered | Minimum SF Static | Minimum SF 0.42 g |
|---|---|---|
| a. Shallow failure | 4.74 | 1.93 |
| b. Deep failure | 2.50 | 1.02 |

This calculation series shows that the final cover configuration for the Trench 13 Design is acceptably stable under static loading and pseudo-static loading conditions. Slope failures involving cover and waste materials have factors of safety against failure that are greater than the design requirement (i.e., 1.5 or greater for static loading conditions, and 1.0 or greater for pseudo-static or seismic loading conditions considering a maximum horizontal acceleration of 0.42g).

## 7.6 UPLIFT PRESSURES FROM WIND LOADS

The design of the cover uses only natural soil components. Uplift will not be a concern during or after cover construction.

## 7.7 THERMAL EXPANSION AND CONTRACTION

The design of the cover uses only natural soil components. Thermal expansion and contraction will not be a concern during or after cover construction.

## 7.8 POST-CLOSURE COVER SETTLEMENT

Post-closure settlement of the landfill cover attributed to settlement within the soil cover, settlement (and degradation/consolidation) of the waste fill, and settlement of the foundation materials underlying the waste fill were addressed in the 1996 Design Report and supporting calculations. These calculations are not repeated herein.

## 7.9 PERFORMANCE MONITORING

USEN operates an alternative cover performance monitoring system on Trench 11 that has been in place since December 2013. The location of the Trench 11 performance monitoring system, on the north-facing slope of Trench 11 on a portion of the cell having a slope of 20H:1V, was chosen as representing the most likely location for cover infiltration. The north-facing slope reduces direct sunlight and results in increased moisture retention and infiltration. Furthermore, the 20H:1V slope results in low run-off and high moisture retention with increased infiltration. Other locations considered on Trench 11 included east, south, and west oriented slopes and locations on 3H:1V slopes: All options were deemed less conservative.

The Trench 13 design includes a 20H:1V slope; however it is south-facing slope and is likely to see less moisture retention. Trench 13 also includes 3H:1V slopes, but these slopes are expected to see greater runoff and less moisture retention, by comparison to the 20H:1V slopes.

As final cover soils are expected to be site-sourced materials that are a mix of silts, sands, and gravel, the materials are expected to be a homogenous mix and similar to those used for Trench 11.

Performance data to date from the Trench 11 monitoring system has shown minimal infiltration and no drainage from the monitoring system has been recorded, demonstrating that the alternative final cover has been effective in preventing infiltration into the waste layer.

Recognizing that variability of cover materials and orientations can exist, USEN will evaluate conditions of the Trench 13 cover for a suitable location for a second Facility performance monitoring station. The installation of the system will not occur until after closure of Phase A at Trench 13. The location and design of the second Facility alternate final cover performance monitoring system will be submitted for Agency approval prior to construction.

**Table 7-3 Final Cover Construction-Observation and Material Specifications**

| Inspection Task | Inspection/Test Method Reference | Sample/Test Quantity/Frequency | Observation/Sample Locations | |
|---|---|---|---|---|
| | | | Source/ Stockpile | Cover Area |
| **GENERAL REQUIREMENTS FOR FIELD INSPECTION OF FINAL COVER CONSTRUCTION** | | | | |
| General project observations | Visual observations, plus basic measurements and recordkeeping | Continuous observation, during final cover construction | Yes | Yes |
| Soil material observation | Observation of cover soil material | Continuous observation, during final cover construction | Yes | Yes |
| **SOIL TESTS TO BE DONE DURING FINAL COVER CONSTRUCTION** | | | | |
| Particle-size analysis | ASTM C 136 | 3 tests per material type, reconfirmed as needed | Yes | Yes |
| Moisture/density curve | ASTM D1557, Modified proctor moisture-density relation (or approved alternative method) | 3 tests per material type, reconfirmed as needed | Yes | Yes |
| In-place density and moisture content | ASTM D6938 (or approved alternative method) | As specified | NA | Yes |

| Inspection Task | Inspection/Test Method Reference | Sample/Test Quantity/Frequency | Sample Location | | Acceptance Criteria |
|---|---|---|---|---|---|
| | | | Source/ Stockpile | Cover Area | |
| **INTERIM COVER LAYER** | | | | | |
| Particle-size analysis | ASTM D422 | 3 tests per material type, reconfirm as needed, verify by visual observation. Materials >6.0 inch might be judged acceptable if '*de minimis*' and rarely, if ever, in grain-to-grain contact. | Yes | NA | 100% <6.0" |
| Lift thickness, for interim cover layer | Measurement after loose placement | Random measurements and observation | NA | Yes | Total loose thickness ≥12.0" |
| **FINAL COVER LAYER** | | | | | |
| Particle-size analysis | ASTM D422 | 3 tests per material type in stockpile, reconfirm as needed, verify maximum size criterion by visual observation at placement. Materials >6.0 inch might be judged acceptable if '*de minimis*' and rarely, if ever, in grain-to-grain contact. | Yes | Yes | 100% ≤ 6.0"<br>≤10% > 1.0"<br>≥5% passing #200 sieve |
| Moisture/density relation | ASTM D1557, Modified proctor moisture-density relation | 3 tests per material type, reconfirmed as needed | Yes | NA | NA |
| Lift thickness, final cover layer | Measurement before placement and after placement | One measurement for each 50 ft by 50 ft grid area | NA | Yes | Loose lift thickness > 24.0" |

| Inspection Task | Inspection/Test Method Reference | Sample/Test Quantity/Frequency | Sample Location | | Acceptance Criteria |
|---|---|---|---|---|---|
| | | | Source/ Stockpile | Cover Area | |
| In-place density and moisture content | ASTM D1557 (after compaction) | one test for every 10,000 square feet of cover placed | NA | Yes | 85% MDD (±3%)<br>OMC minus 2% or less |
| **FINAL COVER DRAINAGE ARMORING** | | | | | |
| Rock Particle Size | Supplier certification | 1 per source, reconfirm as needed, verify by visual observation | Yes | NA | **Without Grout**<br>$D_{50} \geq 2$ in. (lateral drainages and upper deck berms)<br>$D_{50} \geq 6$ in. (access road drainages)<br>$D_{50} \geq 12$ in. (sideslope flumes)<br>**With Grout**<br>$D_{50} \geq 4$ in. (sideslope flumes and access road drainages) |
| Rock Specific Gravity | ASTM C 127 | 1 per material type | Yes | NA | S.G. > 2.5 g/cm$^3$ |
| Rock Angularity | Visual inspection | Random measurements and observation | Yes | NA | Angular to Sub-rounded |
| Grout Compressive Strength | ASTM C39 | 1 per application | Yes | NA | Minimum 28-day compressive strength of ≥ 2,500 psi |
| Grout Thickness | Measurement after placement | Random measurements and observation | NA | Yes | Fill interstitial space |
| **FINAL COVER LINE AND GRADE** | | | | | |
| Final Cover Thickness | Survey (compare surfaces) | The vertical control criterion for survey accuracy should be at least 0.25 feet. Compare measurements for each 50 ft by 50 ft grid area | NA | Yes | 90 percent of points of measurement comparison ≥2.0 ft, no point of measurement comparison <1.75 ft |
| Maximum Elevation | Survey | The vertical control criterion for survey accuracy should be at least 0.25 feet. One measurement for each 50 ft by 50 ft grid area | NA | Yes | Maximum elevation of 2,860 ft NAVD88 |

MDD = Standard Proctor (ASTM D1557) maximum dry density.
OMC = Standard Proctor (ASTM D1557) optimum moisture content

# 8. RUN-ON/RUN-OFF CONTROL SYSTEMS AND FACILITY SURFACE-WATER MANAGEMENT

## 8.1 GENERAL

Surface-water management (SWM) systems for the USEN Facility are designed to accommodate precipitation from the 25-year, 24-hour storm event. This storm is estimated to yield 2.26 inches of precipitation as determined by the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Version 5 at the Amargosa Farms Garey Station (Station I.D. 26-0150). Features providing run-on protection and final cover erosion protection have been designed to provide protection from a 100-year, 24-hour precipitation event of 3.13 inches.

## 8.2 CONTROL OF SURFACE WATER OUTSIDE THE DISPOSAL AREA

The overall site drainage control is evaluated in a site-wide Surface-Water Run-on and Run-off Control Demonstration included in **Appendix 6** and associated calculations in **Appendix 2.**

## 8.3 CONTROL OF SURFACE WATER IN THE DISPOSAL AREA

Surface water from precipitation which has fallen on placed waste or within the active/lined portion of the Trench will be managed following appropriate site protocols for contact water. Placed waste will be graded so that collected surface water is directed to interior holding locations from which it can be removed for proper management.

The calculations in **Appendix 2** evaluate the expected surface-water flow volumes from the 25-year, 24-hour design storm event when Phase 13A or 13E has just been constructed and waste filling operations commence. This configuration represents the greatest potential exposed surface area of waste (approximately 9.88 acres). The calculation includes the conservative assumption that sidewall surface water is not separated from water that has contacted waste. The 25-year, 24-hour design storm event over initial waste operations in Phase 13A or 13E would be expected to result in approximately 600,000 gallons of liquid. Based on past observations, this liquid primarily infiltrates and is either held until evaporated back to the atmosphere or the leachate infiltration to the LCRS system. Infiltrated liquids are management as described in **Section 6**.

If surface-water collects within the Trench, holding facilities will be provided by USEN. These facilities must be emptied or otherwise managed expeditiously after storms to maintain the design capacity of the system.

## 8.4 RUN-ON CONTROL

Run-on control at Trench 13 is required only during the period that disposal operations are occurring below grade. The requirement during that period will be to prevent rainfall outside of the Trench area from entering into the excavation and potentially being exposed to the waste disposal operations. This is accomplished by: (1) maintaining a minimum 2 percent slope away from the lined excavation; (2) installation of 1.0 foot of anchor trench backfill above grade; (3) installing berms of 2.0 foot or greater in areas where designed stormwater management channels are not incorporated (i.e. interim Phase termination western boundaries); and (4) keeping existing drainage paths away from Trench 13 in an open condition so that flow can occur.

Run-on control will not be necessary when the disposal operations extend above the existing grade.

## 8.5 COVER RUN-OFF CONTROL

The final cover promotes sheet run-off into designed drainage ways. Additional information on Trench 13 runoff control is provided in Section 7.2.3. The surface water management features located adjacent to Trench 13, and used to prevent run-on (i.e., drainage channels), also will be used to manage final cover run-off.

A detailed surface water run-on and run-off control demonstration is included as **Appendix 6.** In addition, an evaluation of the surface water management features and site wide conditions, contributing surface water run-off, is evaluated in calculations included in **Appendix 2.**

# 9. SURFACE EROSION

## 9.1 SURFACE EROSION

Soil erosion occurs as the removal of soil particles at the ground surface by water or wind. In this section, water erosion and wind erosion are considered using accepted erosion estimation methods and estimates of site-specific conditions. Initial water erosion of soil occurs as sheet and rill erosion that are defined as the removal of layers of soil from the land surface by the action of rainfall and runoff. This type of erosion occurs when rainfall exceeds infiltration. Wind erosion is the removal of soil particles by air, also a moving fluid. Wind erosion primarily affects arid and semi-arid regions because the surface in these areas frequently is poorly vegetated. The models used determine a soil erosion rate that quantifies removal of surface soil from a unit surface area per unit time.

### 9.1.1 Erosion by Water

#### 9.1.1.1 Evaluation Method

The U.S. Natural Resources Conservation Service (NRCS) Revised Universal Soil Loss Equation (RUSLE2)[8] was used to estimate soil erosion, by water, possible from the planned final cover design of Trench 13. RUSLE2 uses a region-specific database that contains a wide geographic range of values for soil properties, rainfall, slopes, and ground cover to estimate soil loss, sediment yield, and sediment characteristics from rill and inter-rill (sheet) erosion caused by rainfall and associated overland flow. The RUSLE2 equation is:

$$A = RKLSCP$$

Where

A = computed average annual soil loss

R = rainfall runoff erosivity factor

K = soil erodibility factor

LS = length-slope factor

C = cover management factor

P = supporting practices factor

[8] http://www.ars.usda.gov/Research/docs.htm?docid=6010

Factor LS, slope angle and length, is a site-specific input added by the user. The RUSLE2 computer model uses its internal, region-specific, database information to provide the model with appropriate values for the R, K, C, and P factors, as is noted below.

- Climate: RUSLE2 uses an internal database for site climatic data. For the USEN Facility, the location "USA\Nevada\Nye County/NV-Nye R3" was chosen.
- Soil: The soil survey for Nye County, Southwest Part was used to determine soil types prevalent at the USEN Facility and in the vicinity. The prevalent soil types include:
  - Weiser-Canoto association;
  - Yermo-Greyeagle-Arizo association;
  - Yermo, hot-Yermo-Arizo association; and
  - Commski-Yermo association.
- Crop Management: The crop management zone was set using the construction site template provided in RUSLE2 for CMZ Zone 31 and assumes no contouring. The construction site template assumes clearing-cutting by bulldozer, filling and leveling by bulldozer, heavy disking (simulating ripping), rolling smooth (representing slope back-dragging with a bulldozer blade), and 5) beginning weed growth.

For modeling Trench 13 final cover, two slopes were analyzed. Those were the 3H:1V, and 20H:1V slopes. In each case, the longest slope length for each slope type was assumed as a worst-case scenario. The calculation in **Appendix 2** identifies the longest slope lengths applicable to each cover slope segment that was considered in the RUSLE2 model.

#### 9.1.1.2 Soil Erosion Estimate

Native surface soil types were evaluated and compared to grain-size analyses for soil used as cover material on Trench 11 (approved AFC cover installation). Soil to be used to construct the Trench 13 cover will include a mixture of surface and subsurface soil derived from excavations for Trench 13 and other excavations at the USEN Facility. The native soil type most closely matching the Trench 11 installed material grain size analysis is the 2053 Yermo-Greyeagle-Arizo association.

The results of these analyses are shown on "RUSLE2 Erosion Calculation Record" sheets in **Appendix 2** and are summarized in **Table 9-1**

**Table 9-1 Water Erosion Summary**

| Slope (H:V) | Maximum Slope Length (feet) | Soil Loss (tons/acre/year) |
|---|---|---|
| 20:1 | 200 | 0.23 |
| 3:1 | 100 | 1.9 |

Both erosion rates calculated using RUSLE2 were less than the two tons per acre per year suggested by USEPA as a maximum erosion rate[9]. In addition, the calculated values are below the NRCS soil loss tolerance value of five tons per acre per year for the 2053 Yermo-Greyeagle-Arizo association.

Sheet flow shear stresses were evaluated on the 20H:1V upper deck and 3H:1V sideslopes of Trench 13 and found to be approximately 0.01 psf and 0.09 psf, respectively, when considering a 100-year, 24-hour precipitation event. Literature suggests that a soil surface texture with a $D_{50}$ of 0.25 inch can withstand shear stresses of 0.1 psf[10]. Surface soils on the Trench 11 side slopes have recently been observed to exhibit natural armoring that has resulted in an approximate $D_{50}$ particle size of 0.25 inch. Cover soils placed on the side slopes of Trench 13 will undergo a similar armoring process and are expected to converge on a $D_{50}$ of approximately 0.25 inches. The point of convergence is governed by the magnitude of tractive forces that are applied in the long-term, which are discussed in Calculation C.12.

The Trench 13 final cover upper deck flumes, sideslope lateral drainages, sideslope flumes, and access road drainages were evaluated using USDA's Technical Release 55 (TR-55) program and using Manning's equations for open channel flow. Based on the evaluation, the anticipated run-off depths are sufficient to provide over 1.0 foot of freeboard and the velocities are large enough to promote self-cleaning of the drainages. The following summarizes the analysis.

| | Flow Rate (cfs) | Depth (in) | Velocity (fps) |
|---|---|---|---|
| Upper Deck Flumes | 3.2 | 2.1 | 4.3 |
| Sideslope Lateral Drainages | 0.84 | 4.2 | 2.7 |

[9] USEPA. 1991. Design and Construction of RCRA/CERCLA Final Covers, EPA/625/4-91/025.

[10] Texas Department of Transportation, Hydraulic Design Manual, August 2015.

| | | | |
|---|---|---|---|
| Sideslope Flumes | 5.0 | 2.0 | 6.8 |
| Access Road Drainages at 5% | 1.5 | 4.9 | 3.1 |
| Access Road Drainages at 10% | 1.5 | 4.3 | 4.0 |

Shear stresses were evaluated for channelized flow along upper deck flumes, sideslope lateral drainages, sideslope flumes, and along access road ditches. The analysis has concluded that:

- Rock with a $D_{50}$ of 2.0 inches are appropriate for use as a protective lining in upper deck flumes and berms, and in sideslope laterals;
- Rock with a $D_{50}$ of 6.0 inches are appropriate for access road drainages; and
- Rock with a $D_{50}$ of 12 inches are appropriate for use on sideslope flumes.

Cement grout applications can be used an alternative to large rock material to increase tractive force resistance. For sideslope flumes and access road drainages, rock armoring with a minimum $D_{50}$ of 4.0 inches and interstitial spaces filled with cement grout is an acceptable alternative to the materials specified above. Grout adds stability and size to the smaller rock matrix. Cracking of the grout and rock matrix will not significantly diminish the protective properties of the armoring and is expected.

### 9.1.2 Erosion by Wind

The U.S. Natural Resources Conservation Service (NRCS) Wind Erosion Prediction System (WEPS) model was used for this analysis. WEPS is intended to estimate erosion from agricultural fields that are managed for production of various crop types. The model allows for consideration of certain topographic features that modify wind direction and velocity, but cannot consider complex geometric shapes, such as a landfill cover. Also, the agricultural nature of the surface preparation and crop management inputs to the model might not accurately reflect the early history of a closed landfill. As a result, the accuracy of the wind erosion estimate must be considered uncertain. For later comparison to the model's soil loss estimate, it is important to note that natural soil loss from desert soil type present in the site area is five tons per acre per year.[11]

[11] Bechtel SAIC Company, LLC, September 2006. Soil-Related Input Parameters for the Biosphere Model.

9.1.2.1 Evaluation Method

WEPS is used to estimate expected soil loss (as soil weight per surface area unit) based on soil properties, wind and climate history for a local weather station, and site geography. The Wind Erosion Equation (WEQ) upon which WEPS is based is widely used for estimating soil loss by wind from agricultural fields. The functional form of WEQ is:

$$E = f\,(I, C, K, L, V)$$

Where, E is the average soil loss (tons/acre/year), I is the soil erodibility, K is the soil ridge roughness, C is the climatic factor, L is the field length along the prevailing wind erosion direction, and V is the vegetative factor.

WEPS is a process-based, daily time-step model that simulates weather, field conditions, and erosion to predict wind erosion. The WEPS model allows the use of uploaded region-specific database information to determine the WEQ soil loss factors. For the Trench 13 wind erosion estimates, the following four databases were uploaded:

1. Climate Data (Amargosa Valley 4S);
2. Soil Data (Nye SW, 2053 Yermo-Greyeagle-Arizo Association);
3. Wind Data (Mercury/Desert Rock); and
4. Crop Management Data (CMZ-31)

Climate: The first WEPS input is climate data based on the location input. For the USEN Facility, the climate factors for the monitoring station "Amargosa Valley 4S" were used.

Soil: The USDA's web soil survey was used to determine the prevalent surface soil types in the vicinity of the US Ecology Facility and the soil type most closely matching the grain size analysis for soils used as cover material on Trench 11. The representative soil type and the one used in the WEPS erosion estimate is the 2053 Yermo-Greyeagle-Arizo association. This soil type was considered to be sufficiently similar to the expected final cover materials for use in the soil loss estimate.

Wind: The weather station selected as representative for wind speed and direction was the Mercury/Desert Rock Station.

Crop Management: The crop management zone was set using the construction template provided in RUSLE2 for CMZ Zone 31. The RUSLE2 database file for CMZ Zone 31 was converted to a WEPS database file. The construction site template assumes non-vegetated disturbed soil that has been modified using certain combinations of construction or agricultural equipment.

#### 9.1.2.2 Soil Erosion Estimate

The WEPS model simulation used a basic area shape (e.g., rectangle, square, circle, or quarter circle), site-specific dimensions, and an orientation (relative to wind direction) as input for the model run. The US Ecology Trench 13 area was modeled as:

- North Slope (2,190 ft x 300 ft) with regional slope of 33%;
- Upper Deck (1,835 ft x 516 ft) with a regional slope of 5%;
- South Slope (2,190 x 225 ft) with a regional slope of 33%; and
- East and West Slopes (300 ft x 940 ft) with a regional slope of 33%.

**Table 9-2 Wind Erosion Summary**

| Model Run | Soil Loss (tons/acre/year) |
|---|---|
| North Slope at 3H:1V | 3.96 |
| Upper Deck at 20H:1V | 4.86 |
| South Slope at 3H:1V | 3.99 |
| East and West Slope at 3H:1V | 4.19 |
| Average | 4.25 |

The soil loss tolerance value assigned by NRCS as a standard for protecting soil as natural resource is five tons per acre per year for the 2053 Yermo-Greyeagle-Arizo association in this natural desert setting. This value is greater than the USEPA-recommended maximum erosion rate of two tons per acre per year for hazardous waste disposal sites, but is less than the five tons per acre per year that is common for desert soils.

Wind erosion is assumed to result in uniform soil removal over a broad area and not in a manner than tends to concentrate soil removal (such as rill erosion by water). Accordingly, consideration of the significance of surface soil removal (or thinning) is pertinent. The soil loss caused by wind erosion was analyzed for the potential of thinning the cover to the point of exposing waste. Using

the erosion rate estimated for the orientation of Trench 13 and assuming that cover soil is placed with a density of 100 lbs per cubic foot or approximately 1.35 tons per cubic yard, the following soil loss is estimated.

For one year: $4.25\frac{tons}{acre} * \frac{1}{1.35}\frac{yd^3}{tons} * \frac{1}{43{,}560}\frac{acre}{ft^2} * \frac{27}{1}\frac{ft^3}{yd^3} = 0.0020\,ft$ of soil loss per year
or 0.023 inches of soil loss per year
For 30 years: 0.70 inches of soil loss

## 9.2 EROSION CONCLUSIONS

Using regional input values believed to be a reasonable representation of site conditions, the calculated estimates of surface erosion on the Trench 13 final cover do not exceed maximum erosion rate recommendations, in the case of water erosion, or reasonable soil thinning rates, in the case of wind erosion. This conclusion is applicable to use of native soil types for the Trench 13 final cover without special attention to placement of a surficial layer specifically intended to reduce surface erosion. In fact, a soil gradation, similar to the Yermo-Greyeagle-Arizo association, is sufficiently coarse-grained to be considered an "erosion reduction" layer without special treatment (such as selective particle size separation using a grizzly or screen). Modeled conditions are initial placement conditions. Following several years of wind and water erosion, the surface will self-armor, as fines are removed and coarse materials remain, and become more erosion resistant than at initial placement.

It should be recognized that during heavy precipitation events, rill and moderate gully erosion is expected. Such areas will require maintenance; however, once repaired, the function of the final cover is restored and does not represent a failure of the cover system.

# 10. REFERENCES

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US Ecology, Inc. Beatty – Cell 12 Design. July 1996.

USEPA. Design and Construction of RCRA/CERCLA Final Covers, EPA/625/4-91/025. 1991.

# APPENDIX 1

# DESIGN DRAWINGS

| Drawing Number | Drawing Title |
|---|---|
| NV13-15-001 | Cover Sheet |
| NV13-15-002 | Site Plan |
| NV13-15-003 | Northern and Southern Horizontal Control Line |
| NV13-15-004 | Western and Eastern Horizontal Control Line |
| NV13-15-005 | Subgrade Excavation 1 of 2 |
| NV13-15-006 | Subgrade Excavation 2 of 2 |
| NV13-15-007 | Subgrade Profiles |
| NV13-15-008 | Liner Details |
| NV13-15-009 | LCRS/LDS Sump Details 1 of 2 |
| NV13-15-010 | LCRS/LDS Sump Details 2 of 2 |
| NV13-15-011 | Final Waste Grade – Plan View |
| NV13-15-012 | Final Cover – Plan View |
| NV13-15-013 | Final Cover Profiles |
| NV13-15-014 | Surface Water Management 1 of 3 |
| NV13-15-015 | Surface Water Management 2 of 3 |
| NV13-15-016 | Surface Water Management 3 of 3 |
| NV13-15-017 | Phase Construction |
| NV13-15-018 | Above-Grade Waste, Interim Protective Berm, and Cover Placement |
| NV13-15-019 | Final Cover Details |

# APPENDIX 2

# DESIGN CALCULATIONS

| Calculation No. | Calculation Name |
|---|---|
| C.01 | Surface Water Management |
| C.02 | Trench 13 Excavation and Final Cover Slope Stability |
| C.03 | LCRS Infiltration Rates |
| C.04 | LCRS Flow Capacity, Sump Restriction, and Pump Sizing |
| C.05 | Drainage Piping Strength Analysis |
| C.06 | LCRS and LDS Sump Capacities |
| C.07 | Bearing Capacity of Gravel used to Support LCRS Riser |
| C.08 | LDS Flow Capacity, ALR, and Extraction Rate |
| C.09 | Liner Stability on Trench 13 Side Slopes |
| C.10 | Anchor Trench Dimensions |
| C.11 | Trench 13 Foundation Settlement Estimate |
| C.12 | Final Cover Erosion by Water |
| C.13 | Final Cover Erosion by Wind using WEPS |

# APPENDIX 3

# CONSTRUCTION QUALITY ASSURANCE PLAN

## APPENDIX A: DESIGN DRAWINGS

## APPENDIX B: CONSTRUCTION MATERIALS SPECIFICATIONS

## APPENDIX C: CONSTRUCTION METHODS SPECIFICATIONS

# APPENDIX 4

# RESPONSE ACTION PLAN

# APPENDIX 5

# GEOTECHNICAL EVALUATIONS

*Geotechnical Investigation of Trench 12 at the US Ecology Hazardous Waste Management Facility, Beatty, Nevada* (Grant Environmental *1994*)

*Geotechnical Investigation in Support of Trench 13 Construction - September 2015*

*Geotechnical Investigation of Trench 12 at the US Ecology Hazardous Waste Management Facility, Beatty, Nevada* (Grant Environmental *1994*).

*Geotechnical Investigation in Support of Trench 13 Construction - September 2015*

# APPENDIX 6

# SURFACE-WATER RUN-ON AND RUN-OFF CONTROL DEMONSTRATION

# APPENDIX 7

# ENVIRONMENTAL MONITORING AND REPORTING PLAN

*Environmental Monitoring and Reporting Plan included as Section 13 of the Class 3 Permit Modification Request Addressing Landfill Trench 13*

# APPENDIX 8

# CLOSURE AND POST-CLOSURE CARE

*Scheduled, Unscheduled, and Post Closure Care Plans included as Sections 15, 16 and 17 of the Class 3 Permit Modification Request Addressing Landfill Trench 13*

# APPENDIX 9

# SUPPORT DOCUMENTS

| Document | Date | Author | Description |
|---|---|---|---|
| D.01 | 1995-12-07 | NDEP Letter | Conceptual Design of Cell 12 |
| D.02 | 1996-03 | TRC Report | Cell 12 Design Report |
| D.03 | 1996-03 | TRC Report | Cell 12 Design Report Volume II |
| D.04 | 1996-04-04 | TRC Letter | MTR Equivalence Supplement |
| D.05 | 1996-06-04 | NDEP Letter | Preliminary Review of MTR for Trench 12 |
| D.06 | 1996-07-09 | USE Letter | Cell 12 Design |
| D.07 | 1996-09-13 | NDEP Letter | Part B Renewal Application NOD Comments |
| D.08 | 1996-11-04 | NDEP Letter | Part B Renewal Application – Additional Comments |
| D.09 | 1996-12-17 | HMA Letter | Response to NOD Comments |
| D.10 | 1997-01-17 | HMA Letter | Draft Response to Verbal Comments |
| D.11 | 2002-02-14 | AAT Letter | Final Trench Design Documents |
| D.12 | 2002-03-20 | NDEP Letter | Cell 12 Design – Concurrence of MTR Equivalency |
| D.13 | 2007-10 | AAT Report | Supplement – Landfill Report for Trench 12 |
| D.14 | 2008-04 | AAT Report | Design Basis and Construction Specifications for Trench 11 and Trench 12 Final Covers |