Attachment 18
Landfill Engineering Report Cell 16, Subcells 16-1 and 16-2

Appendix D.5.1
Cell 16 Engineering Report (02-08-12)

Landfill Engineering Report
Cell 16 Subcells 16-1 & 16-2
Grand View Facility

Prepared for:

US Ecology Idaho

February 8, 2012

Revision 1

Prepared by:

AMERICAN GEO TECHNICS

Prepared for:

U.S. Ecology Idaho
P.O. Box 400
Grand View, Idaho 83624

Attention: Terry Geis, Facilities Manager

Landfill Engineering Report
Cell 16 Subcells 16-1 & 16-2
Grand View Facility

American Geotechnics
Project No. 07B-G1654

Revision 1

Prepared by:
American Geotechnics

PROFESSIONAL ENGINEER REGISTERED 2/10/12 11632 STATE OF IDAHO VAUGHN THURGOOD

Vaughn Thurgood, PE
Project Engineer

Rex W. Hansen, PE
Principal Engineer

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1.0 INTRODUCTION

American Geotechnics was retained by U.S. Ecology Idaho (USEI) to provide engineering design services for the proposed Cell 16 landfill unit located at USEI's Grand View facility.

Cell 16 will serve as a Resource Conservation and Recovery Act (RCRA) landfill unit in compliance with the requirements of Title 40 Code of Federal Regulations (CFR) §264, Subpart N. This report presents the engineering analysis and design basis for Cell 16. Specifically, this report addresses the following components:

- compliance with siting requirements;
- design and performance of the liner system;
- run-on prevention and run-off containment;
- operational procedures;
- design and performance of the cover system; and
- stability analysis.

1.1 Project Description

Cell 16 will be located along the west side of the existing Grand View facility in Section 19, Township 4 South, Range 2 East. The landfill unit is rectangular, measuring approximately 1,150 feet in the east to west direction, and 2,800 feet in the north to south direction. The landfill consists of two subcells, as shown on Drawings 16-11-01 and 16-11-02. In plan view, the total liner area consists of approximately 74 acres.

Future additional subcells are anticipated for Cell 16 to expand around the south side of Section 19. A natural grade break occurs along the boundary that separates the north leg of Cell 16 from the south leg. The engineering analysis presented within this report is focused solely upon the north leg of Cell 16. The relative location of the north and south leg of Cell 16 are illustrated in Figure 1 (Appendix A).

Construction of the Cell 16 north leg will occur in a phased approach, with construction of the initial phase expected in 2012. The total waste capacity of the north leg is approximately 10 million cubic yards. Based upon waste placement rates experienced over the past 5 years at the facility, the north leg of Cell 16 should provide sufficient air space for approximately 20 years.

2.0 LANDFILL SITING

USEI owns all of Section 19 (640 acres) and several fragments of other adjacent properties. The limits of Cell 16 are compliant with the landfill siting restraints presented in the 2006 *Siting Application for Section 19*. Specifically, the landfill expansion is sited in a location where:

- The seasonal high depth of groundwater is greater than 100 feet below the lowest point of the disposal cell;
- The depth to fractured rock is greater than 100 feet below the lowest point of the disposal cell;
- Surface bodies of water are 2,500 feet or farther from the disposal cell;
- The disposal cell is located outside of the 500-year flood plain;
- Active faults are located at least 200 feet from the disposal cell;
- Public and private wells are located at least 1,000 feet from the disposal cell;
- Occupied residential structures are 5,000 feet or farther from the disposal cell; and
- The disposal cell maintains at least 500 feet separation from adjacent property boundaries.

The extents of these siting constraints are illustrated relative to Cell 16, as applicable, in Figure 2 (Appendix A). A copy of the Section 19 Siting License issued by the Idaho Department of Environmental Quality is enclosed in Appendix B.

2.2 Site Conditions

The existing site topography generally slopes down towards the north with about 2 to 3 percent grade. Steeper slopes exist over short distances in the vicinity of natural gullies and ravines. Existing vegetation consists primarily of sparse grass and sagebrush. The surface materials consist of sand, gravel and silt. The subsurface conditions and site geology are discussed in the Geotechnical Report (Appendix H). The arid location receives on average less than 8 inches of precipitation per year.

3.0 REGULATIONS

3.1 RCRA

Cell 16 design was conducted and produced 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.

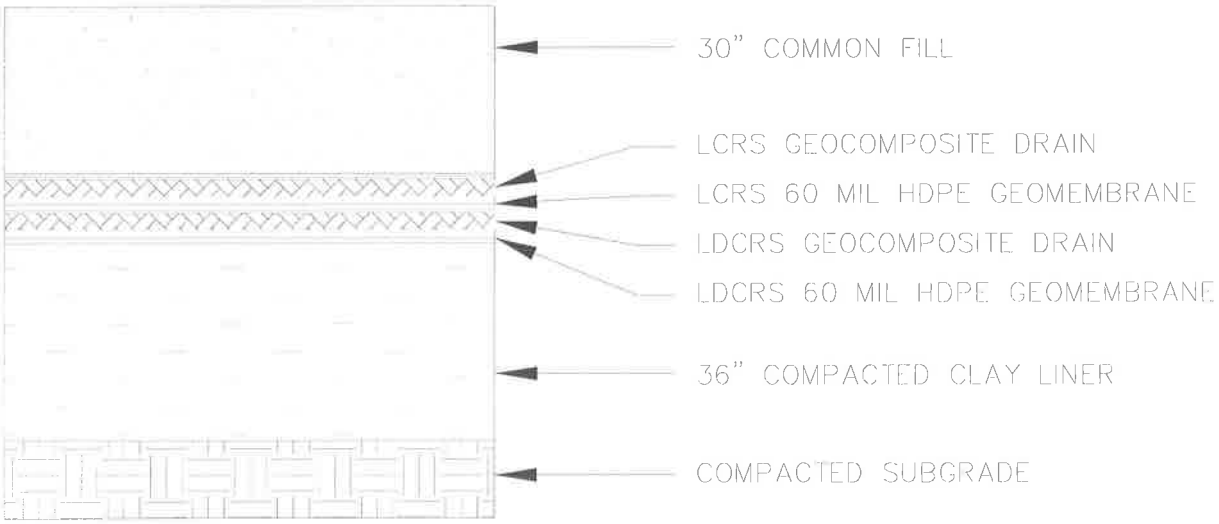
3.2 TSCA

The design was conducted 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. These requirements did not conflict with the previously stated RCRA regulations, which are generally more restrictive than TSCA requirements.

4.0 LCRS AND LDCRS SYSTEM DESIGN

4.1 Configuration

The floor and sidewalls of Cell 16 will be lined with a leachate collection and removal system (LCRS) and a leak detection collection and removal system (LDCRS). The LCRS includes geocomposite and geomembrane layers which provide primary containment and removal of leachate generated within the landfill. The LDCRS includes geocomposite and geomembrane layers which are underlain by a compacted clay liner, as required by RCRA design standards. The liner components are consistent with those used previously in the construction of Cell 15 (WGI, 2002). The configuration of individual liner components are shown in the figure below.



Typical Liner Configuration

The individual liner components are described in the following sections.

4.2 Liner System Loading

The typical profile of Cell 16 includes a maximum waste thickness of 140 feet and approximately 5 feet of cover soil across the crown of the cell. Observations made during the

construction of Cell 15 indicate that the average waste density for USEI's waste streams is 115 pcf. Design considerations for Cell 16 are based upon a slightly higher density of 125 pcf. The cover soil also has an approximate density of 125 pcf. Therefore, the liner system is designed to withstand a maximum load of:

$$Q_{max} = 145 \text{ ft} * 125 \text{ pcf} = 18{,}125 \text{ psf} \approx \underline{18{,}000 \text{ psf}}$$

4.3 Phased Construction

Cell 16 consists of two subcells with a width of 575 feet each, measured in the east-west direction. Each subcell has a maximum total length of 2,800 feet, measured in the north-south direction.

Cell 16 will be built in multiple construction phases termed as the initial phase, interim phase(s), and maximum phase, as shown on Drawing 16-11-04 (Appendix C). During each phase of construction, the subcells are constructed full width in the east-west direction. However, the length of the subcells in the north-south direction is variable. The initial phase begins at the north end of the cell (lowest point) and proceeds southward with a length of 900 feet or less.

The waste stockpile is setback 100 feet from the liner termination along the south end of the cell during each phase of construction, as illustrated in Drawings 16-11-04 and 16-11-05 (Appendix C). Storm water management practices and the basis for the set-back distance are presented in Section 5.5 of this report. Waste placement in previous phases must have a minimum depth of 20 feet before construction of the next phase may proceed. The length of each interim phase is limited to 800 feet or less. The owner may choose to construct the landfill in shorter phases, if desired. The quantity of interim phases is variable up to the maximum overall cell length of 2,800 feet. The rational for selecting the lengths of the initial and interim phases are discussed in Section 4.7 of this report.

4.4 Material Design and Selection

High density polyethylene (HDPE) is used as the liner membrane and geonet drain material. This material is the most chemically resistant material available for liner construction and is the same material used in previous landfill units at the Grand View facility. The thinnest possible liner thickness is desirable, as long as it is not less than 60 mils, based on EPA's minimum technology guidance (EPA, 1989).

Geocomposite drain materials and pipes are used to transport leachate to the sump. The performance of geocomposite materials were evaluated under the maximum possible load. Pipes are designed to prevent collapse from induced waste loads.

Geotextiles are selected to provide separation of the overlying waste and the upper geonet drainage layer. Geotextiles will also provide cushioning of aggregate particles that might otherwise puncture the liners. A nonwoven geotextile is the most suitable material for performing these two functions. It maximizes separation and provides adequate filtering for clay-size particles. Geotextiles are made of polypropylene or polyester plastics.

4.5 Secondary Containment

The lower liner provides composite protection against leakage by placing an HDPE membrane in intimate contact with a compacted clay liner (CCL).

Compacted Clay Liner (CCL)

The CCL will be constructed with high plasticity clay obtained from the nearby Ketterling source. The Ketterling clay materials have consistently yielded permeability values less than 1x10-7 cm/sec when placed in accordance with Specification 02228 (Appendix D). The engineering properties of the clay materials are described in the Geotechnical Report (Appendix H). Several investigations have been performed on the Ketterling source over the past 20 years to characterize the material properties and identify the extent of the clay deposit. A copy of the most recent investigation, performed in 2007, is enclosed in Appendix G.

Specification 02228 identifies construction practices required for successful placement of CCL. Once the CCL is constructed, it must be protected from desiccation cracking and drying prior to covering with the geomembrane liner, as described in the project specification. The CCL must also be protected against the damaging effects of frost penetration. Preventive measures to protect low permeability CCL material from frost penetration at the site were developed and analyzed in the 2002 Engineering Report for Cell 15. The same preventive measures are incorporated into Cell 16 as follows:

- At least 12 inches of cover must be in place over the CCL liner prior to October 29th; and
- At least 30 inches of cover must be in place over the CCL liner prior to January 1st.

Geomembrane

A 60-mil HDPE geomembrane will lie directly over the finished CCL surface to form a composite lower or secondary liner. The membrane surfaces are textured to increase the interface friction angles. Specification 02771 requires the geomembrane material to have a tensile yield stress of at least 132 lbs per inch of width at a strain of 12 percent. The anticipated maximum differential strain along the bottom of Cell 16 is less than 1 percent, as stated in the Geotechnical Report.

4.6 Primary Containment

Primary containment of leachate within the landfill is provided using a 60-mil HDPE geomembrane. The membrane is placed over the LDCRS. The primary membrane is in contact with geocomposite drains located above and below the liner.

4.7 Liner Performance Evaluation

Performance of the Cell 16 liner system was evaluated using the US EPA's HELP model (Schroeder, 1994). The liner models were simulated over a 25-year period using local rainfall data and the material properties presented in this report. Results of the HELP model analysis for the liner system are summarized in the following table.

Predicted Liner System Drainage Prior to Waste Placement		
	Peak Daily Values*	
Item	(in/day)	(ft^3/day)
Drainage from LCRS	0.649	2,356
Drainage from LDCRS	0.090	326
Leakage through secondary containment	0.000	0.00

*Per unit acre of landfill.

To demonstrate the attenuating effect waste placement has on leachate as it travels towards the liner system, another HELP model was performed to evaluate liner performance after placement of 20 feet of waste in the landfill, as summarized in the following table.

Predicted Liner System Drainage with 20 feet of Waste		
	Peak Daily Values*	
Item	(in/day)	(ft^3/day)
Drainage from LCRS	0.011	38
Drainage from LDCRS	0.002	8
Leakage through secondary containment	0.000	0.00

*Per unit acre of landfill.

Thus, the models predict the unit rate of drainage into the LCRS system is substantially reduced from approximately 2,000 to 35 cubic feet per day when at least 20 feet of waste is placed in the landfill. USEI has observed this attenuating effect on previous landfills at the site as waste placement progresses in each cell.

This information is used to predict the maximum leachate flow volumes during the phased construction of Cell 16. The assumed maximum length of the initial phase is 900 feet, for which the entire footprint is subject to the higher rate of leachate flow. The assumed maximum length of an interim phase is 800 feet. During any interim phase, the maximum length of cell exposed

to the higher rate of leachate flow is equal to the length of the interim phase plus the 100 foot waste setback area from the previous phase. The maximum inflow rate into the LCRS and LDCRS system for each subcell were computed as follows.

	Predicted Peak Leachate Flows[1] – Cell 16 Phased Construction			
	Subcell Feature	**Initial Phase[2]**	**Interim Phase[2]**	**Maximum Phase[2] (or Final Interim)**
Length	Total Cell Length (ft)	900	1,700	2,800
	Max Exposed Length (ft)	900	900	900
	Length with Waste Coverage (ft)	0	800	1,900
Area	Total Area (acres)[3]	11.9	22.4	37.0
	Max Exposed Area (acres)	11.9	11.9	11.9
	Waste Covered Area (acres)	0	10.6	25.1
Flow	Peak LCRS Flow Rate (ft^3/day)	28,040	28,440	**28,990**
	Peak LDCRS Flow Rate (ft^3/day)	3,880	3,960	**4,080**

1) All values are in units per subcell.
2) Based upon worst-case scenario with maximum length during each phase.
3) Width of each subcell is 575 feet.

By using the phased approach to construction, the increased demands on the LCRS and LDCRS systems are relatively small after construction of the initial phase.

4.8 Leachate Collection and Removal System (LCRS)

The LCRS is designed to collect leachate draining from the waste and convey it to a collection sump, while keeping the head on the liner less than 12 inches. Leachate enters the LCRS geocomposite from above and is transmitted laterally along the side slopes and bottom slope to the collection pipes, that then conveys the leachate to the sump. The design of the system considers the quantity of leachate needing conveyance. The impingent rate for the LCRS system was calculated using the US EPA's HELP model. The results of the HELP model indicate the maximum head on the liner system is less than 12 inches.

Geocomposite

The LCRS geocomposite consists of a geonet heat bonded to nonwoven geotextile fabrics. The geocomposite material is designed to provide the required transmissivity of leachate under the expected loading of the landfill. Nonwoven geotextile provides both filtering and separation characteristics compatible with fine-grained waste. The specified 8 oz/yd^2 non-woven geotextile fabric will provide the necessary filtering characteristics with an apparent opening size (AOS) of a No. 80 sieve.

Geocomposite material placed on 3H:1 side slopes must be double sided (have textile fabric bonded to both sides of the geonet) for improved friction characteristics. The floor of Cell 16 is sloped at approximately 3.5 percent towards the collection pipes. Geocomposite material placed on the floor of the cell may be single or double sided. Single-sided geocomposite materials are capable of providing higher transmissivity values than a double-sided geocomposite. Single sided geocomposite material must be installed with the textile fabric on the top side.

LDCRS geocomposite material placed along the sidewalls of the cell have a minimum laboratory hydraulic transmissivity of 3.0×10^{-4} m^2/s, and geocomposite materials placed across the floor have a minimum transmissivity of 1.0×10^{-3} m^2/s (measured at 18,000 psf normal stress). Other material properties of geocomposite layer are enumerated in Specification 02274 (Appendix D).

Piping System

An HDPE header pipe is placed longitudinally along the invert of each subcell to receive leachate flows from the geocomposite and accelerate conveyance to the sump. An 8-inch diameter pipe provides sufficient flow capacity. The capacity of the pipe was evaluated based upon a reduced gradient, to account for the calculated differential strain across the floor of the cell.

The required wall thickness of the pipe was calculated, based upon the long-term maximum overburden pressure of 18,000 psf. The header pipe will have a minimum standard diameter ratio (SDR) of 11.

Sump and Pump

The sump serves as a collection point for leachate before it is pumped from each landfill subcell. The size of the sump is selected to optimize pump operations and facilitate continuous pumping operation during leachate removal. The maximum leachate flow volume anticipated for each LCRS sump is 28,990 ft^3 per day. Each LCRS sump is equipped with two (2) leachate removal pumps, one rated at 110 gpm and the other at 58 gpm. The rated capacities are based upon a maximum hydraulic head of 100 feet within the riser pipes and leachate pipe. The LCRS pumps have a combined capacity of 32,300 ft^3 per day. The low flow pump will operate singly during most leachate removal events.

Each LCRS sump has dimensions of approximately 80 feet by 40 feet by 2 feet deep. The sump is recessed 2 feet below the liner system. The LCRS sump has a working capacity of approximately 12,500 gallons before leachate begins to back-up onto the liner system. The pumps are rated for 100 start-ups per day. The theoretical maximum number of start-ups per day during peak operation is less than 20. Pump operating procedures are outlined in Section 5.3 of this report.

4.9 Leak Detection, Collection and Removal System (LDCRS)

The LDCRS is designed to remove leachate that leaks through the primary liner and is contained by the secondary composite liner. The LDCRS has a calculated leak detection travel time of less than 24 hours and maintains less than 12 inches of head on the liner system. Leachate entering the LDCRS geocomposite is transmitted laterally along the side slopes and bottom slope to a collection piping system, which then conveys the leachate to the sump.

Geocomposite

The LDCRS geocomposite consists of a geonet heat bonded to nonwoven geotextile fabrics. Geocomposite material placed on the sidewalls of the cell must be double sided. Geocomposite material placed on the floor of the cell may be single or double sided. Single sided geocomposite material must be installed with the textile fabric on the top side.

LDCRS geocomposite material placed along the sidewalls of the cell have a minimum laboratory hydraulic transmissivity of 3×10^{-4} m^2/s, and geocomposite materials placed across the floor have a minimum transmissivity of 1×10^{-3} m^2/s (measured at 18,000 psf normal stress).

Sump and Pump

The maximum leachate flow volume anticipated for the LDCRS sump is 4,080 ft^3 per day. Each LDCRS sump is equipped with one leachate removal pump, rated at 35 gallons per minute. The daily leachate removal capacity of the LDCRS pump is 6,700 ft^3 per day.

Each LDCRS sump has a trapezoidal shape with approximate maximum dimensions of 20 feet by 20 feet in plan view and variable depth up to 2 feet, as shown on Drawing 16-11-06. The sump is recessed 3 feet below the LDCRS header pipe. The LDCRS sump has a working capacity of approximately 900 gallons before leachate begins to back-up onto the liner system. The pump is rated for 100 start-ups per day. The theoretical maximum number of start-ups per day during peak operation is less than 40.

4.10 Anchor Trench Design

The liner components are sufficiently stable through interface friction without relying on pullout resistance from an anchor trench. However, an anchor trench is included in the construction drawings for the liner systems. The anchor trench provides temporary control during liner installation, including resistance to inadvertent shifting of panels and resistance to wind uplift at the crest of the berm.

4.11 Wind Uplift

The frost protection layer consists of 30 inches of common fill which also protects the liner system against wind uplift. The common fill provides sufficient ballast to prevent uplift by any external force, including wind. Sandbags will be used as temporary ballast during liner installation.

5.0 LANDFILL OPERATING PROCEDURES

Operating procedure for Cell 16 are similar to previous procedures implemented for existing landfills at the site. The purposes of the operating procedures are to implement a minimum level of safeguard practices recommended by the designer. Additional safeguards may be implemented during operation by the owner, in consultation with the designer, as unique conditions and circumstances arise.

5.1 Waste Placement

Waste placement should begin along the the bottom of the landfill, proceeding upward in uniform horizontal lifts, with exception to access ramps. Access ramps, which ascend the side slopes of landfill, should be limited to a horizontal width of 30 feet, as shown in Figure 3 (Appendix A).

General constraints on waste lift thickness and requirements for daily cover are addressed in Attachment 19 of the current USEI site permit (EPA ID No. IDD073114654).

5.2 Landfill Access

During waste placement activities, heavy trucks and equipment may access into the landfill from the south or east sides, using designated routes. Haul ramps and access roads must maintain at least 36 inches of vertical clearance above the synthetic liner components. Locations where access roads cross over designated ditches (i.e. interior perimeter ditch) a temporary 18-inch diameter culvert should be installed and marked. Special attention should be given to the vertical profile of access roads as they cross over the crest of the liner system (all perimeter locations) to confirm the following:

- required vertical clearance is maintained with respect to the liner system; and

- grade separation between clean and contaminated zones are maintained (i.e. the longitudinal profile of the access road should crest near the same location as the liner system to control storm water).

5.3 Leachate Inspection and Removal

Leachate pumps must be operated in manner that maintains less than 12 inches of head on the bottom slope liner system. Specific parameters for pump operation within each sump are described below.

LCRS Sump Inspection

Each LCRS sump is equipped with two submersible pumps for leachate removal. The low flow pump (58 gpm) should be used during typical leachate removal events. The high flow pump (110 gpm) should be used in conjunction with the low flow pump, as needed, when the low flow pump is not sufficient to lower the sump head (during maximum leachate removal events).

Each LCRS sump is also equipped with a pressure transmitter level sensor. Pump operation should be initiated when inspections indicate at least 12 inches of head within the LDCRS sump. The pumps should be operated in a manner to maintain the liquid depth within the LCRS sump at a level less than 24 inches (depth of LCRS sump).

LDCRS Sump Inspection

Each LDCRS sump is equipped with a submersible pump (35 gpm) and a pressure transmitter level sensor. Pump operation should be initiated when inspections indicate at least 12 inches of head within the LDCRS sump. The pumps should be operated in a manner to maintain the liquid depth within the LDCRS sump at a level less than 24 inches (depth of LDCRS sump).

As a general procedure, pump operation should continue to a level of 6 inches or until suction is broken by low water level. Sump inspections for Cell 16 should occur daily during normal operating conditions.

5.4 Leachate Pipe Conveyance

Leachate pumped from the Cell 16 riser pipes is conveyed through a double wall leachate pipe to the on-site leachate treatment system. A flexible hose with quick-connect couplings is used to connect each pump to the leachate pipe, as shown on Drawing 16-11-07. A flow meter is installed for each LCRS and LDCRS sump. The double wall leachate pipe consists of a 6-inch diameter carrier pipe, sufficient to handle the maximum flow rates, and a 10-inch diameter containment pipe. Both pipes are HDPE, have smooth walls, and a standard diameter ratio of SDR 17. The leachate pipe is approximately 2,200 feet in length. The longitudinal profile of the leachate pipe is described, as follows:

- Highest elevation (2,580 ft) occurs at the inlets, near the sump riser pipes;
- Lowest elevation (2,530 ft) occurs near the north end of Cell 5; and
- Outlet elevation at the leachate treatment facility is 2,570 feet.

The pipe is buried at least 28 inches below finished grade for frost protection and at least 36 inches below roadways. The leachate pipe maintains positive drainage towards the lowest point with at least ½ percent grade. A manhole access is provided at the lowest point to allow for visual inspection of the secondary containment. The manhole also allows maintenance access to the carrier pipe with a drain valve, as needed.

5.5 Storm Water Controls

Temporary storm water controls are implemented during operation of the landfill to prevent run-on of clean storm water and to retain contaminated stormwater that lands within the landfill unit. Storm water control features have been sized to accommodate the 25-year, 24-hour storm event.

Run-on Controls

The natural topography at the site generally slopes towards the north. An interceptor ditch will be excavated near the south end of Cell 16 during all phases of construction, as shown on Drawing 16-11-04. The ditch will be oriented to drain towards the northwest, around the west side of the landfill. The ditch will intercept the majority of the potential run-on from the rangeland located up gradient of the landfill. The remaining portions of potential run-on that are not intercepted by the ditch will be retained by a temporary swale and dike, located along the southern edge of the landfill, as shown on Drawing 16-11-05.

Stormwater that does not infiltrate the storm water control features within 7 days should be removed in an appropriate manner.

Run-off Controls

A berm is located around the east, west, and south perimeter of the Cell 16 liner system, as shown on Drawing 16-11-08. Storm water that lands outside of the berm is diverted away from the landfill. Stormwater that falls inside of the berm is retained by the liner system. Waste placement is set-back at least 9 feet from the perimeter berm to form a perimeter ditch that is approximately 3 feet deep and 18 feet wide. As waste placements proceeds above the berm, surface water generated from the waste pile will flow towards the north end of the landfill. The toe of the waste pile, along the north end of the cell, is temporarily set-back 27 feet from the perimeter berm to provide adequate containment during cell operation.

Along the south perimeter of Cell 16, the waste pile is set-back 100 feet from the temporary dike, as shown in Drawing 16-11-05. The cell floor slopes away from the temporary dike at 2.5 percent grade.

5.6 Erosion Maintenance

Occasional maintenance may be required to remove significant sedimentary deposits that form within the stormwater control features of Cell 16. Maintenance activities should not be performed during soft or saturated field conditions.

6.0 COVER DESIGN

The Cell 16 final cover will consist of evapotranspiration (ET) soils. Design of the ET cap including, drawings, specifications, performance evaluation and stability analysis are addressed in a separate report prepared by Daniel B. Stephens & Associates. The typical section of the ET cover consists of approximately 5 feet of sandy silt materials.

7.0 ENGINEERING STABILITY ANALYSIS

7.1 Stability Design Considerations

Slope stability of the landfill was modeled at various stages of construction using Slope/W software by Geo-Slope International (2004). The analyses considered the engineering material properties presented in this report for the following stages of construction.

- Stability of the Liner System on 3H:1V sidewalls of landfill, with 30 inches of frost protection material;
- Stability of the Liner System with a temporary access ramp during waste placement, loaded with a surcharge of 20 kips per lineal foot (representative of equipment);
- Final waste placement at 3H:1V slopes prior to cover placement; and
- Long term stability with the Cover Materials.

Each model considered failure along arbitrary circular slip surfaces and specified interfaces within the liner system under static and seismic loading conditions. Inclusion of the synthetic liner tear strength would serve to increase the computed factors of safety. For the sake of convenience, tear strength of the synthetic liner components were omitted from the stability analysis.

Seismic loading was simulated using pseudo static analysis. The peak horizontal and vertical seismic coefficients for the site identified in the 2009 Geotechnical Report were:

K_h = 0.051 and
K_v = 0.051.

Minimum Factors of Safety

In-situ and laboratory test results were utilized to develop the subgrade material properties used in the analysis for this report. Quality control testing will be performed by multiple parties on the soils and liner materials during construction. In light of these considerations, the following minimum factors of safety will be appropriate for the project.

FS_{static} = 1.5
$FS_{seismic}$ = 1.1

7.2 Material Properties

The engineering properties for the native soils and the synthetic liner components are discussed in this section.

Soil Properties

The following material properties for Cell 16 were identified in the 2009 Geotechnical Report and are used in evaluating stability of the landfill modifications.

Soil Shear Strength Properties			
Material	Internal Friction Angle (°)	Cohesion Intercept (psf)	Undrained Shear Strength (psf)
Native Subgrade	34	--	--
Common Fill	32	--	--
Compacted Clay Liner (CCL)	31	--	3,000
Waste Materials	30	125	--

Specific stability analysis of the ET cover materials are addressed in a separate report prepared by Daniel B. Stephens & Associates.

Liner Interface Friction Angles

Several potential slip planes were considered on this project. The shear strength envelope of each potential interface failure was compared for the bottom liner system and the cover system. Peak shear strength envelopes are used in this analysis to evaluate construction loads and other short term scenarios. Post-peak shear strength envelopes were also identified and used to evaluate the long term stability of the liner system and the cover system.

Sideslope Liner System

Liner materials used in the sideslope liner system includes frost protection soils, double-sided geocomposite layers, textured geomembranes, and compacted clay. The short term stability of the sideslope liner system is governed by a bilinear shear strength envelope related to the geocomposite/geomembrane interface, defined as:

$C_1 = 98.5$ psf, $\phi_1 = 23.7$ degrees, $N_2 = 6{,}500$ psf, $\phi_2 = 20.2$ degrees

The long term stability of the sideslope liner system is governed by a bilinear shear strength envelope which is also related to the geocomposite/geomembrane interface, defined as:

$C_1 = 111.5$ psf, $\phi_1 = 12.5$ degrees, $N_2 = 2{,}000$ psf, $\phi_2 = 10.8$ degrees

Floor Liner System

Liner materials used in the floor liner system includes single-sided geocomposite layers, smooth geomembranes, and compacted clay. The short term and long term stability of the floor liner system are both governed by a linear shear strength envelope related to the geonet/geomembrane interface, defined as:

$C = 0$ psf, $\phi = 8$ degrees

7.3 Stability Analysis

Results of the stability analysis are included in Appendix F and summarized in the following table.

Slope Stability Analysis Summary		
Model Description	**Factor of Safety - Static Load - (Min Required = 1.5)**	**Factor of Safety - Seismic Loads- (Min Required = 1.1)**
Sideslope Floor Liner Systems Initial Construction	2.04	1.76
Sideslope Floor Liner Systems Access Ramp	1.67	1.39
Sideslope Floor Liner Systems Full Waste Placement	2.19	1.89

This analysis indicates the landfill will maintain adequate stability during the several different stages of construction.

7.4 Settlement

Settlement analysis for Cell 16 is contained in the 2009 Geotechnical Report. The maximum anticipated settlement near the center of the cell is 6.3 feet, resulting in a variable differential strain up to 0.38%, measured in the east-west axis, and differential strain up to 0.18%, measured along the north-south axis. The predicted differential strain is well within the tolerable limits of both the synthetic and clay liner components (Qian, 2002).

8.0 REFERENCES

The following works were referenced and researched in the development of opinions and conclusions stated in this report:

American Geotechnics, (2006). *Hazardous Waste Facility Siting License Application Cell 16 Grand View, Idaho*. Prepared for US Ecology. June 30.

Driscopipe, (1991). *Systems Design.* Prepared by Phillips Driscopipe, Inc., a subsidiary of Phillips 66 Company. Richardson, Texas.

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Koerner, R.M., (1999). *Designing with Geosynthetics, Fourth Edition.* Prentice Hall. Upper Saddle River, NJ.

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National Resources Conservation Service, (1986). Technical Release 55 (TR-55) – Urban Hydrology for Small Watersheds. US Department of Agriculture. Washington, D.C. June.

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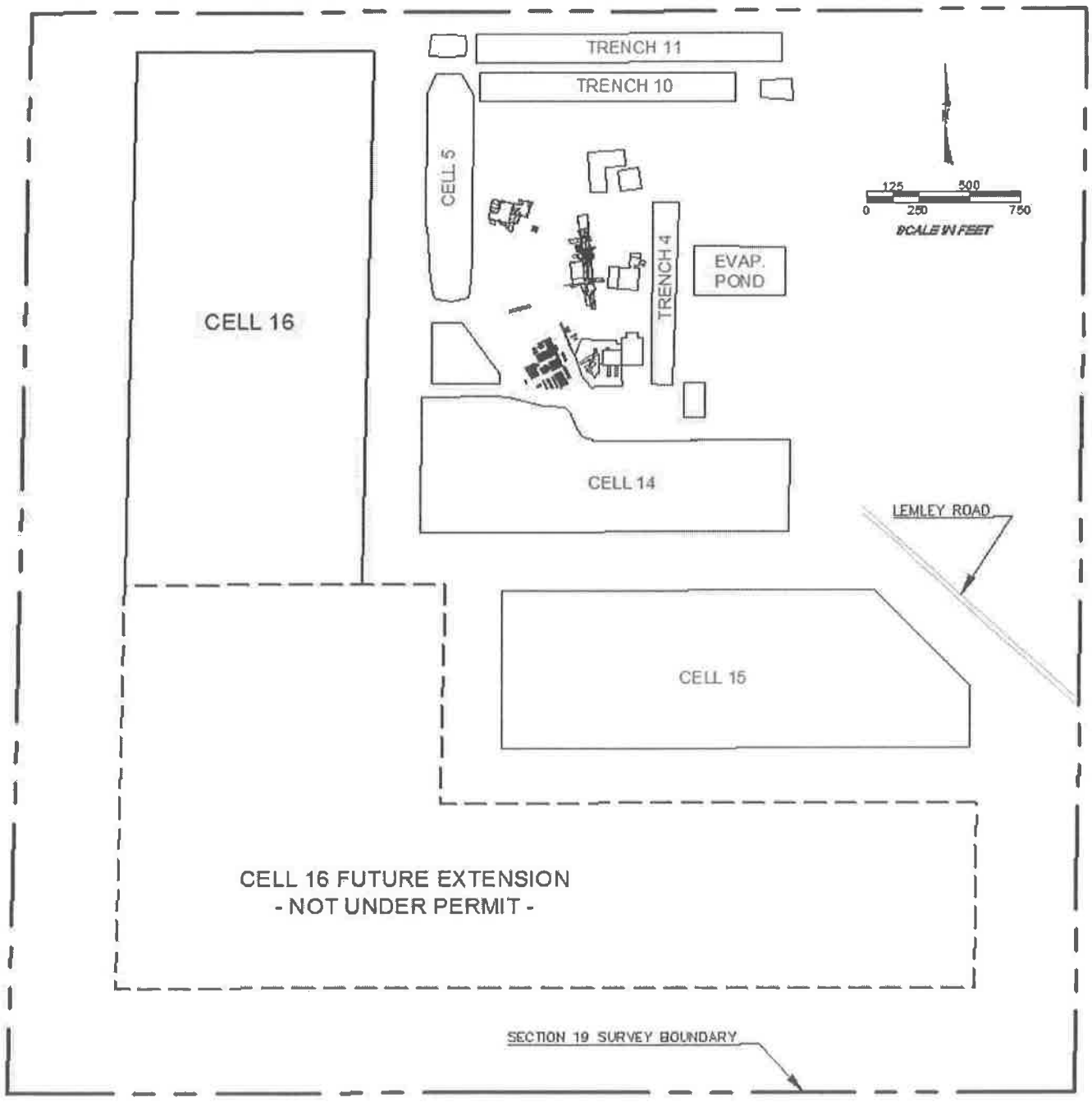
Appendix D.5.2
Cell 16 Engineering Report Appendix A - Figures (02-08-12)

APPENDIX A

FIGURES



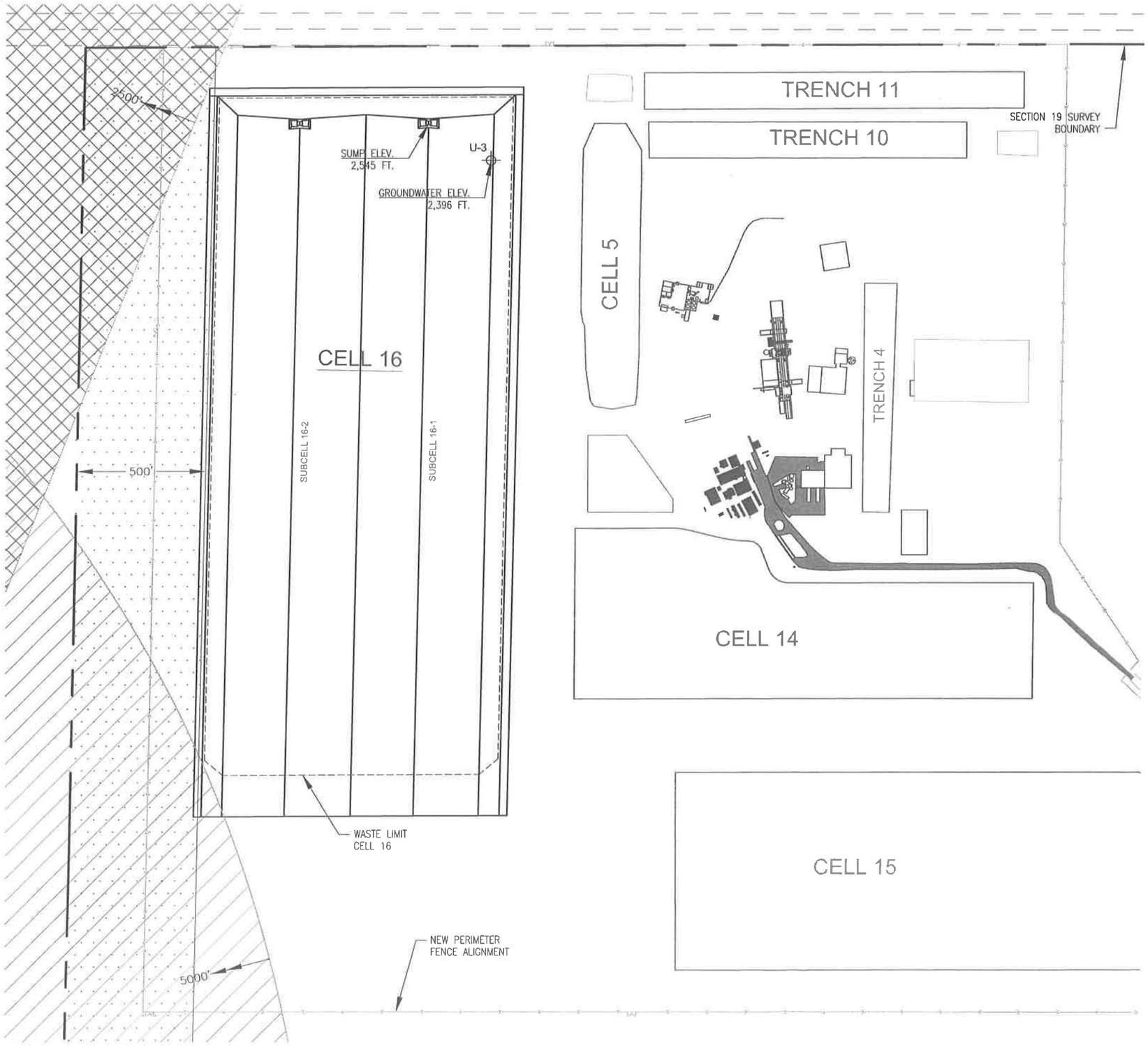
LOCATION MAP
US Ecology Facility
Grand View, Idaho

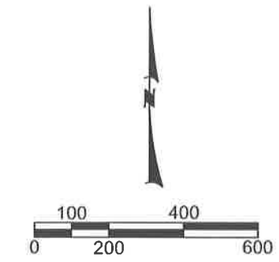
FIGURE 1

Project Number:
07B-G1654

April 2011

AMERICAN GEOTECHNICS





LEGEND

- 500' ADJACENT PROPERTY BUFFER
- USEI PROPERTY UNDER BLM NO WASTE AGREEMENT
- 2,500' WATERWAY BUFFER
- 5,000' RESIDENTIAL BUFFER

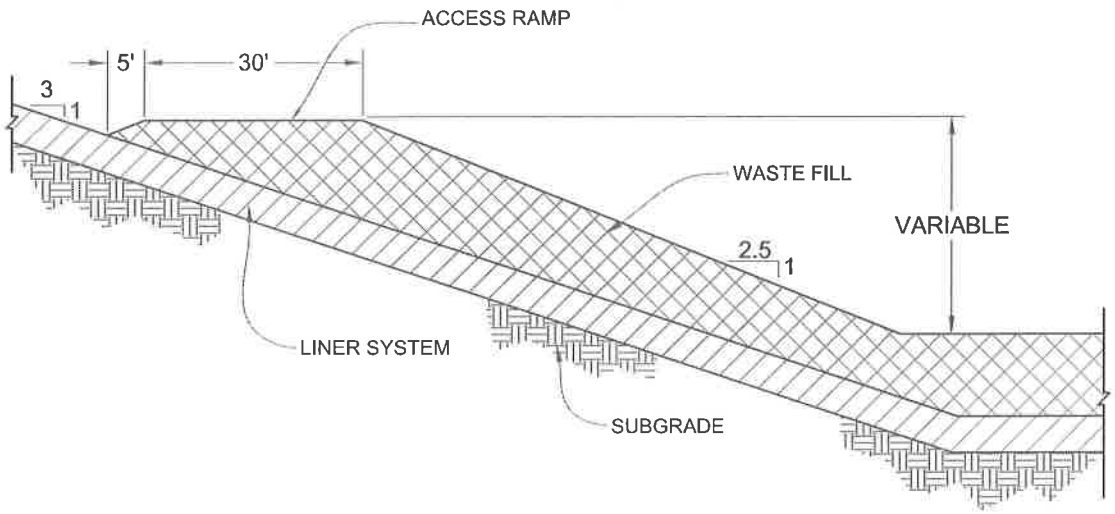
SITING REQUIREMENTS
Cell 16 - US Ecology
Grand View, Idaho

FIGURE 2

Project No.
07B-G1654

April 2011

AMERICAN GEO TECHNICS



NOT TO SCALE

ACCESS RAMP DETAIL
Cell 16 US Ecology
Grand View, Idaho

FIGURE 3

Project No.	Date:
07B-G1654	April 2011

AMERICAN GEOTECHNICS

Appendix D.5.3
Cell 16 Engineering Report Appendix B - Section 19
Siting License

APPENDIX B

SECTION 19 SITING LICENSE

Hazardous Waste Facility Siting License
U.S. Ecology Idaho, Inc.
Section 19, Township 4 South, Range 2 East (Boise Meridian)
Owyhee County, Idaho

This License is issued in accordance with the State Hazardous Waste Facility Siting Act, Idaho Code §§ 39-5801, *et seq.* This license is issued to:

U.S. Ecology Idaho, Inc. (USEI)
P.O. Box 400
10.5 Miles NW on Hwy 78, Lemley Road
Grand View, Idaho 83624

I. On June 30, 2006, USEI (the Licensee) submitted an application for this license. The application was deemed complete on July 25, 2006. Supplemental information was provided by USEI on August 23, 2006. The Application and Supplemental Information provided by USEI is attached to this License, incorporated herein, and made an enforceable part hereof.

II. The application and supplemental information were determined to meet minimum technical siting criteria on September 5, 2006.

III. USEI proposes siting disposal and ancillary facilities upon the remainder of the undeveloped land area of Section 19 as described in the Siting License Application and Supplemental Information. USEI currently operates an existing permitted hazardous waste treatment, storage, and disposal facility on a portion of Section 19. By this application, USEI is proposing phased construction of additional land disposal cells for continued operation once the existing cells reach capacity.

IV. This License is conditioned upon the Licensee's compliance with:

A. All applicable state, local, and federal laws, including the State Hazardous Waste Facility Siting Act (Idaho Code §§ 39-5801, *et seq.*), and the State Hazardous Waste Management Act (Idaho Code §§ 39-4401, *et seq.*).

B. The siting criteria in the Idaho Hazardous Waste Management Plan, as adopted by the Idaho Legislature in 1987.

C. The information and representations made in the Application and Supplemental Information including but not limited to the construction and operation conditions set forth by USEI in the Site License Application and Supplemental Information dated August 23, 2006.

V. In so issuing this License, the Director has determined the issuance of this License is consistent with the Idaho Hazardous Waste Management Plan.

VI. This License authorizes the Licensee to site hazardous waste treatment, storage, and disposal units necessary for continued operations at its existing location, pursuant to the terms and conditions set forth herein. This license does not constitute a hazardous waste facility permit pursuant to the Idaho Hazardous Waste Management Act (Idaho Code §§ 39-4401, *et seq.*).

VII. This license may be transferred only upon written request to the Director, demonstrating that the transferee is able to comply with the terms and conditions of this license and the State Hazardous Waste Facility Siting Act (Idaho Code §§ 39-5801, *et seq.*).

VIII. Any significant alteration of or addition to the licensed facility or its operations described in this License, the Application and/or the Supplemental Information submitted August 23, 2006 shall require modification or re-issuance of this License and this License shall not be modified except

in writing consistent with the provisions of the Idaho Hazardous Waste Facility Siting Act, Idaho Code §§ 39-5801, *et. seq.*

Dated this 6th day of December, 2006

Toni Hardesty
Director
Idaho Department of Environmental Quality

Appendix D.5.4
Cell 16 Engineering Report Appendix C - Drawing Set (revised 2-8-12)

APPENDIX C

DRAWING SET

SHEET #	DRAWING DESCRIPTION
16-11-00	DRAWING INDEX / COVER SHEET
16-11-01	CELL LINER LAYOUT / PLAN VIEW 1
16-11-02	CELL LINER LAYOUT / PLAN VIEW 2
16-11-03	CELL LINER / SECTIONS AND DETAILS
16-11-04	CONSTRUCTION PHASING AND WASTE PLACEMENT
16-11-05	INTERIM STORM WATER CONTROL DETAILS
16-11-06	SUMPS AND RISERS / SECTIONS AND DETAILS
16-11-07	LEACHATE PIPE / SECTIONS AND DETAILS
16-11-08	WASTE PLACEMENT / SECTIONS AND DETAILS

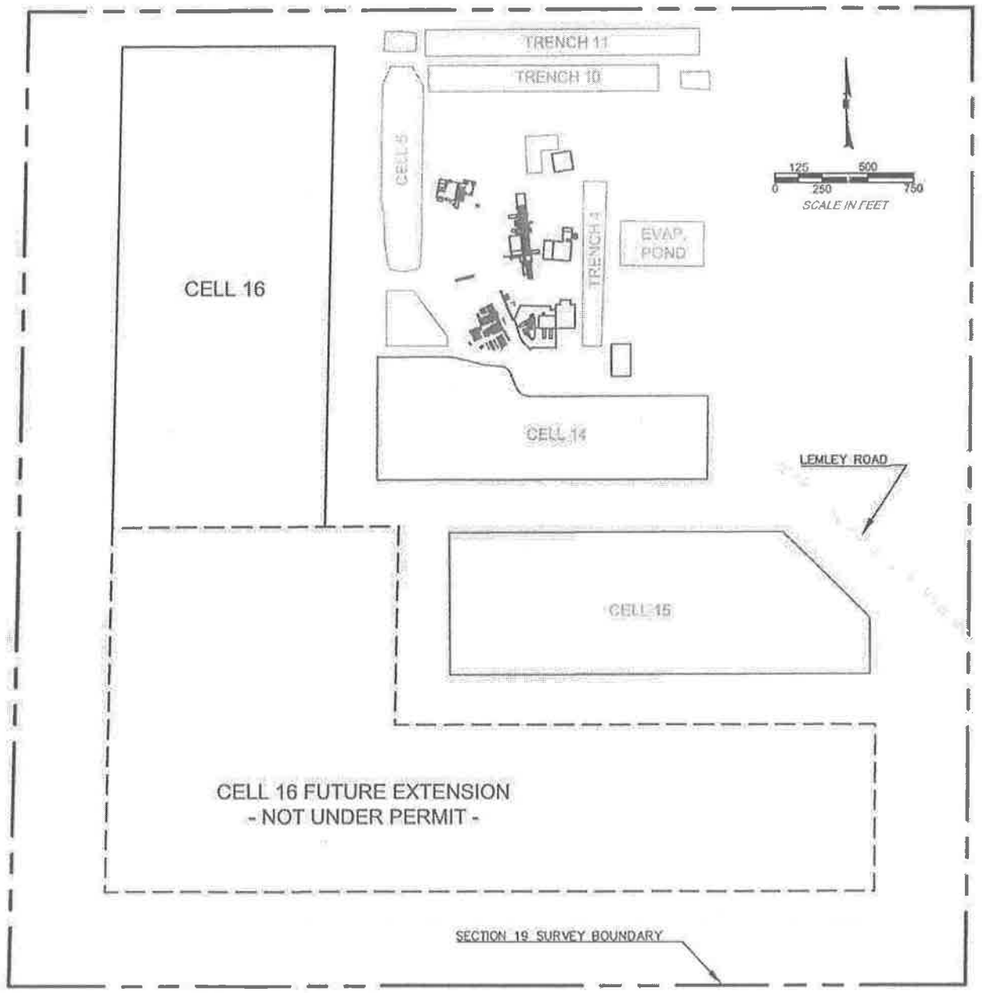
GENERAL NOTES

1. DIMENSION LABELS HAVE PRECEDENCE OVER SCALED DIMENSIONS.
2. ANY DISCREPANCIES SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER.
3. INTERNAL REFERENCES TO DRAWING NUMBERS WITHIN THIS SET HAVE BEEN ABBREVIATED FOR SIMPLICITY (E.G. DRAWING 16-11-06 IS REFERENCED AS DRAWING 06).
4. SURVEY OF EXISTING TOPOGRAPHY WITHIN CELL 16 FOOTPRINT PERFORMED BY ARROW SURVEY IN MARCH 2008.
5. CONTRACTOR SHALL COMPLY WITH THE CLEAN WATER ACT NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM (NPDES). THE CONTRACTOR MUST FILE A NOTICE OF INTENT (NOI) WITH THE EPA AND IMPLEMENT AN APPROVED STORM WATER POLLUTION PREVENTION (SWPP) PLAN FOR THE INTERIM CONSTRUCTION CONDITIONS. THE OWNER'S SURFACE WATER MANAGEMENT PLAN WILL ADDRESS LONG-TERM CONSIDERATIONS FOR SEDIMENTATION CONTROL.

CELL 16 SURVEY CONTROL POINTS				
BM ID.	EASTING (FT)	NORTHING (FT)	ELEVATION (FT)	NOTES
16-1	362,173.35	508,251.75	2,652.86	5/8" ROD
16-2	361,964.15	509,451.56	2,601.21	5/8" ROD
16-3	360,020.25	508,858.37	2,590.88	BRASS CAP
16-4	360,078.90	511,490.94	2,582.46	BRASS CAP
16-5	361,893.38	511,499.82	2,527.44	ALUM CAP

LEGEND

- GUT
- FILL
- 3.5% — GRADE & DIRECTION OF DRAINAGE
- SURVEY CONTROL POINT
- POWER POLE
- U-2 — WELL
- FENCE LINE
- LEACHATE PIPE
- PROPERTY BOUNDARY
- UNIMPROVED ROAD
- 2550 — EXISTING TOPOGRAPHY
- CULVERT
- CUT/FILL INTERFACE
- DRAINAGE CHANNEL



FACILITY SITE MAP

REV	DATE	BY	DESCRIPTION
0	2/9/12	VJT	ISSUED FOR CONSTRUCTION

PROFESSIONAL ENGINEER REGISTERED 2/10/12 11632 STATE OF IDAHO VAUGHN THURGOOD

US Ecology Idaho
an American Ecology company

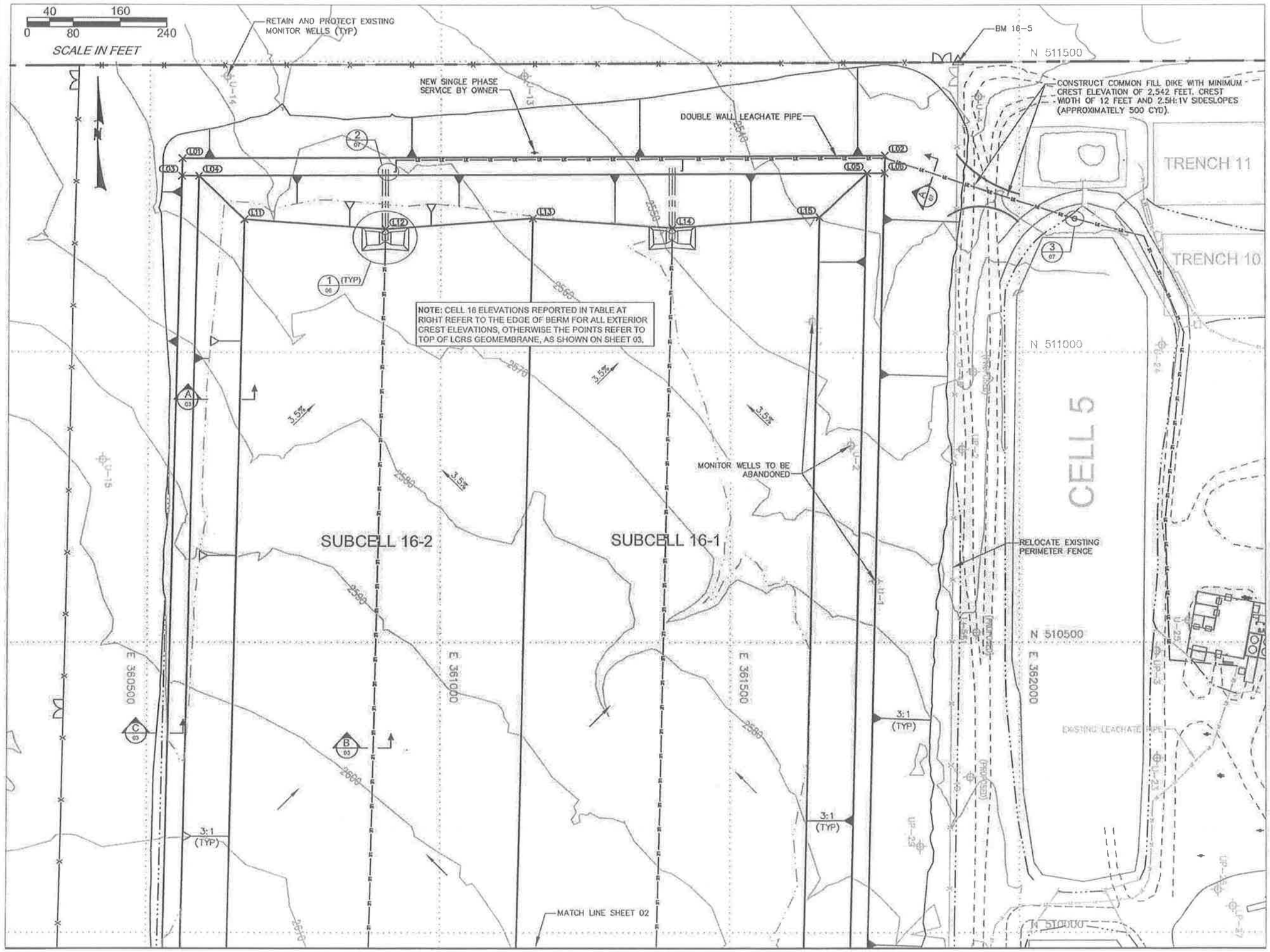
PREPARED BY
AMERICAN GEO TECHNICS
5260 Chinden Blvd · Boise, Idaho 83714
Phone (208) 658-8700 · Fax (208) 658-8703

DRAWN BY	CHECKED BY	PROJECT NUMBER
VJT	RWH	07B-G1654

PROJECT NAME
CELL 16 LANDFILL UNIT
GRANDVIEW, IDAHO

DRAWING INDEX
COVER SHEET

DRAWING NUMBER	REV
16-11-00	0



Cell 16 Point Table

POINT #	NORTHING	EASTING	ELEVATION
L01	511332.94	360555.82	2580.00
L02	511338.09	361765.81	2580.00
L03	511302.94	360555.20	2580.00
L04	511303.06	360585.20	2580.00
L05	511307.96	361735.19	2580.00
L06	511308.09	361765.19	2580.00
L07	508502.94	360496.90	2650.00
L08	508503.06	360526.90	2650.00
L09	508507.96	361676.89	2650.00
L10	508508.09	361706.89	2650.00
L11	511228.40	360664.14	2555.00
L12	511212.20	360904.83	2549.26
L13	511230.50	361158.49	2555.00
L14	511214.31	361399.17	2549.26
L15	511232.61	361652.83	2555.00
L16	508503.41	360607.40	2623.12
L17	508504.43	360848.45	2616.95
L18	508505.51	361101.75	2623.12
L19	508506.54	361342.79	2616.95
L20	508507.62	361596.10	2623.12

REV	DATE	BY	DESCRIPTION
0	2/8/12	VJT	ISSUED FOR CONSTRUCTION

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Vaughn Thurgood

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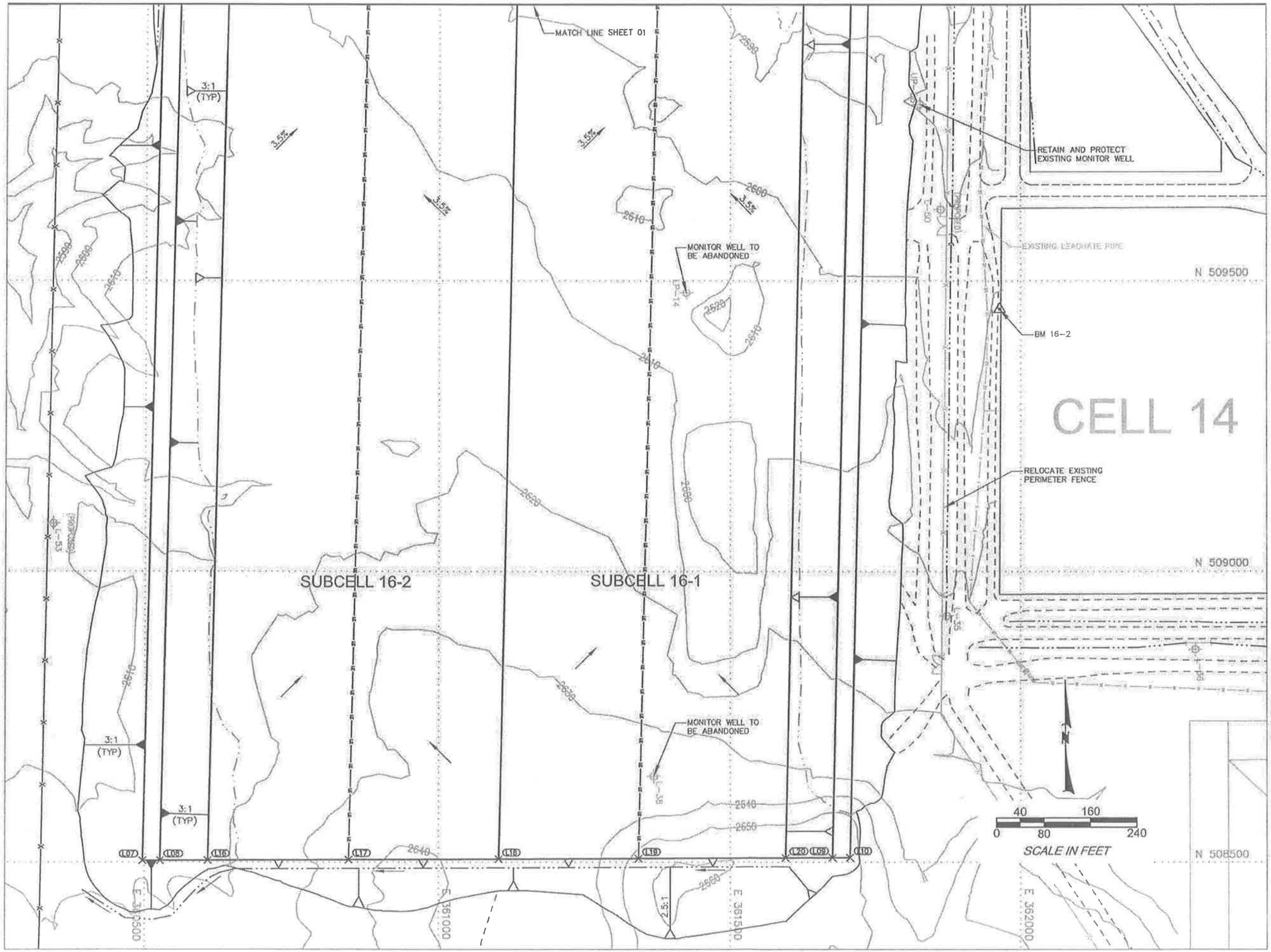
DRAWN BY	CHECKED BY	PROJECT NUMBER
VJT	RWH	07B-G1654

PROJECT NAME
CELL 16 LANDFILL UNIT
GRANDVIEW, IDAHO

CELL LINER LAYOUT
PLAN VIEW 1

DRAWING NUMBER	REV
16-11-01	0



NOTES:

1. SEE SHEET 01 FOR CONTROL POINT COORDINATE TABLE.

REV	DATE	BY	DESCRIPTION
0	2/8/12	VJT	ISSUED FOR CONSTRUCTION

PROFESSIONAL ENGINEER
REGISTERED
2/10/12
11632
STATE OF IDAHO
VAUGHN THURGOOD

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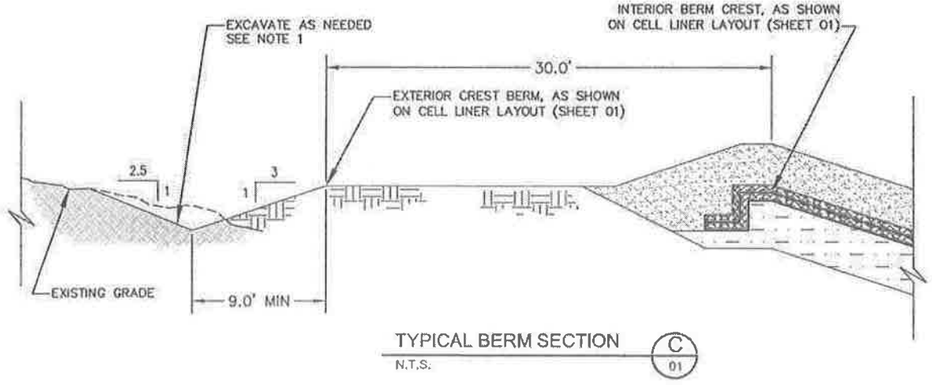
DRAWN BY	CHECKED BY	PROJECT NUMBER
VJT	RWH	07B-G1654

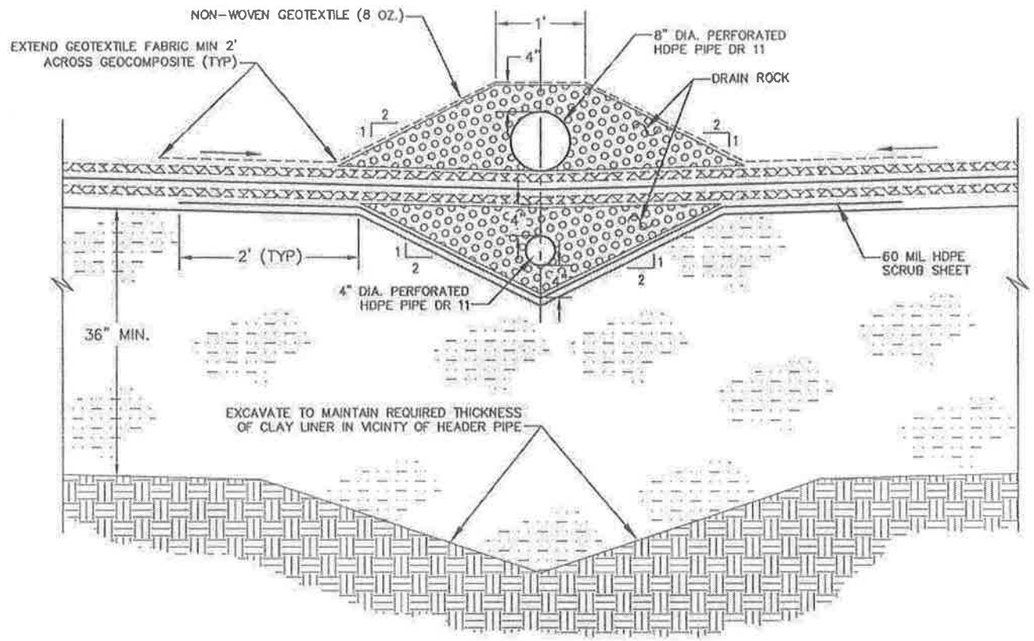
PROJECT NAME
CELL 16 LANDFILL UNIT
GRANDVIEW, IDAHO

CELL LINER LAYOUT
PLAN VIEW 2

DRAWING NUMBER 16-11-02 REV 0



TYPICAL BERM SECTION (C 01)
N.T.S.

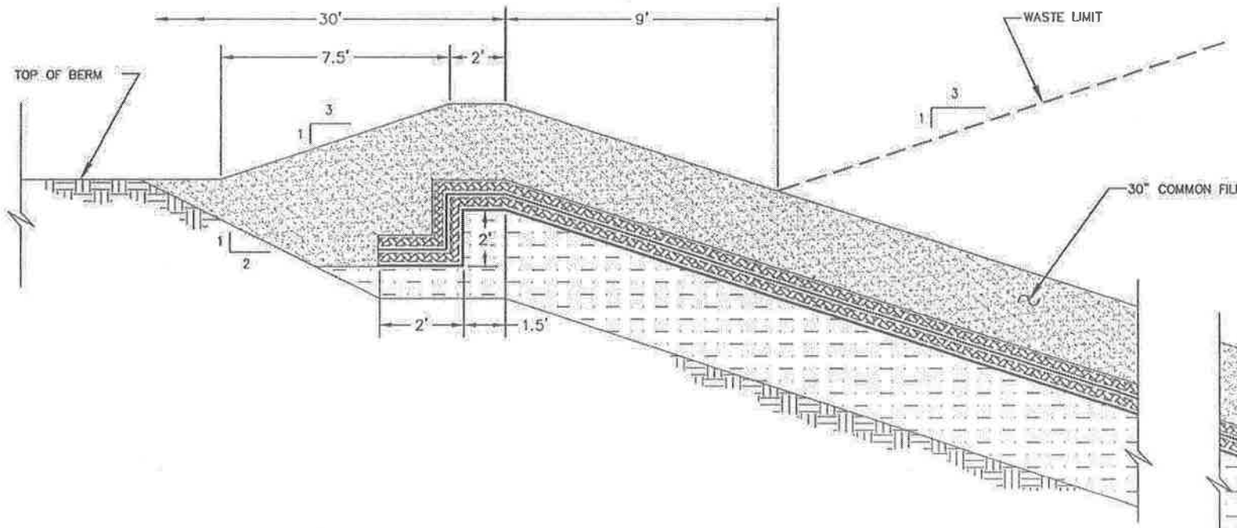


LCRS & LDCRS HEADER PIPES (B 01)
N.T.S.

NOTES:

1. EXCAVATE EXTERIOR SHOULDER OF BERM, AS NECESSARY, TO MAINTAIN AT LEAST 3 FEET OF VERITCAL BERM REVEAL (9 FEET OF HORIZONTAL SLOPE).
2. ALL GEOMBRANE PANELS INSTALLED ALONG SIDESLOPES MUST BE TEXTURED. GEOMEMBRANE PANELLS INSTALLED ACROSS THE FLOOR OF THE CELL MAY BE SMOOTH OR TEXTURED.

REV	DATE	BY	DESCRIPTION
0	2/8/12	VJT	ISSUED FOR CONSTRUCTION



TYPICAL LINER AND ANCHOR TRENCH SECTION (A 01)
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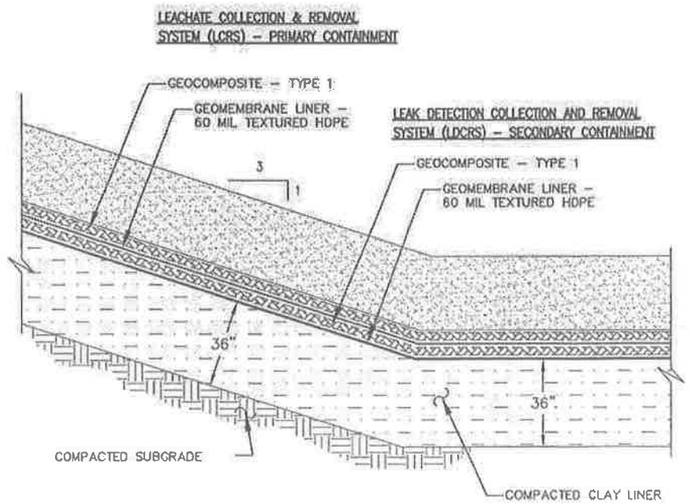

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STATE OF IDAHO
VAUGHN THURGOOD

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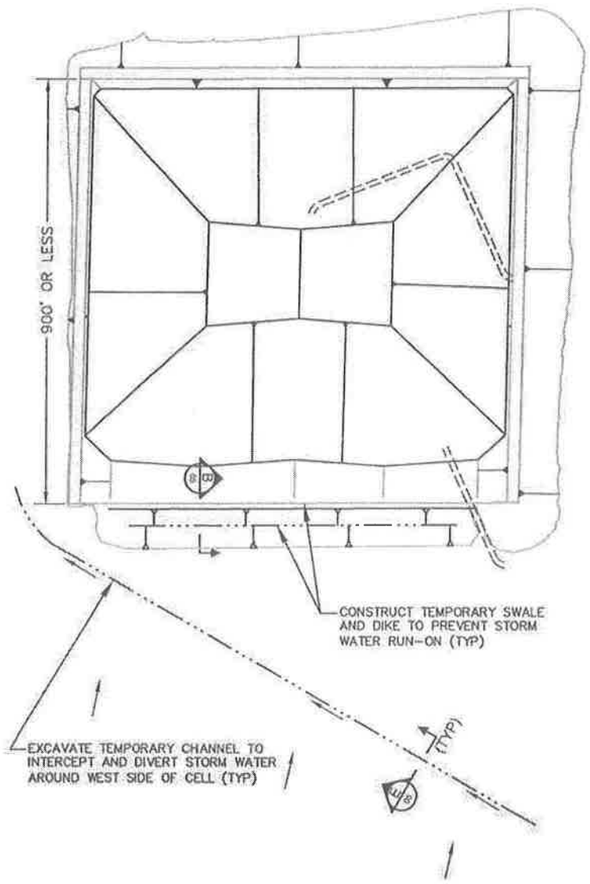
DRAWN BY	CHECKED BY	PROJECT NUMBER
VJT	RWH	07B-G1654

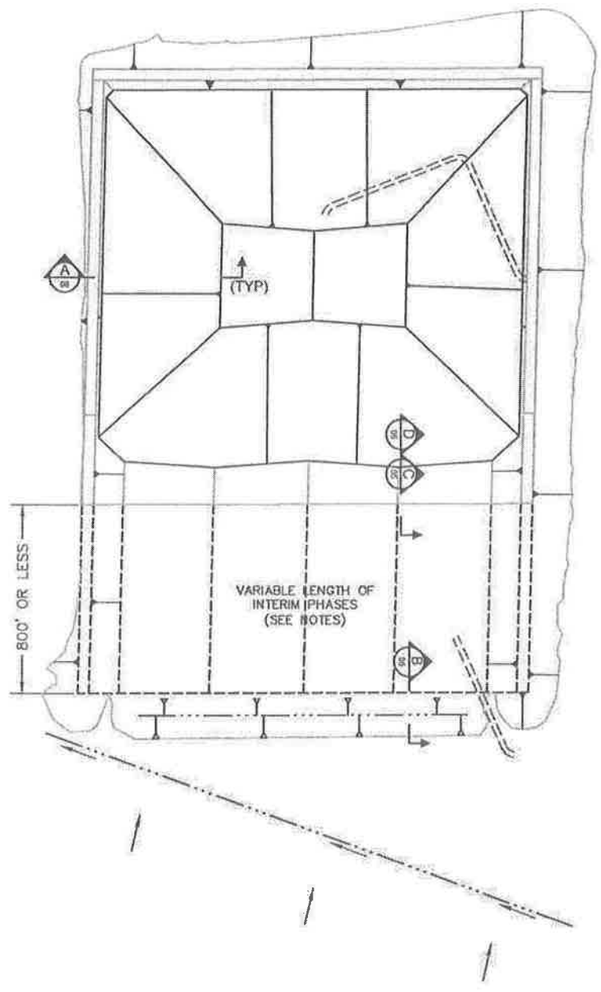
PROJECT NAME
CELL 16 LANDFILL UNIT
GRANDVIEW, IDAHO

CELL LINER
SECTIONS AND DETAILS

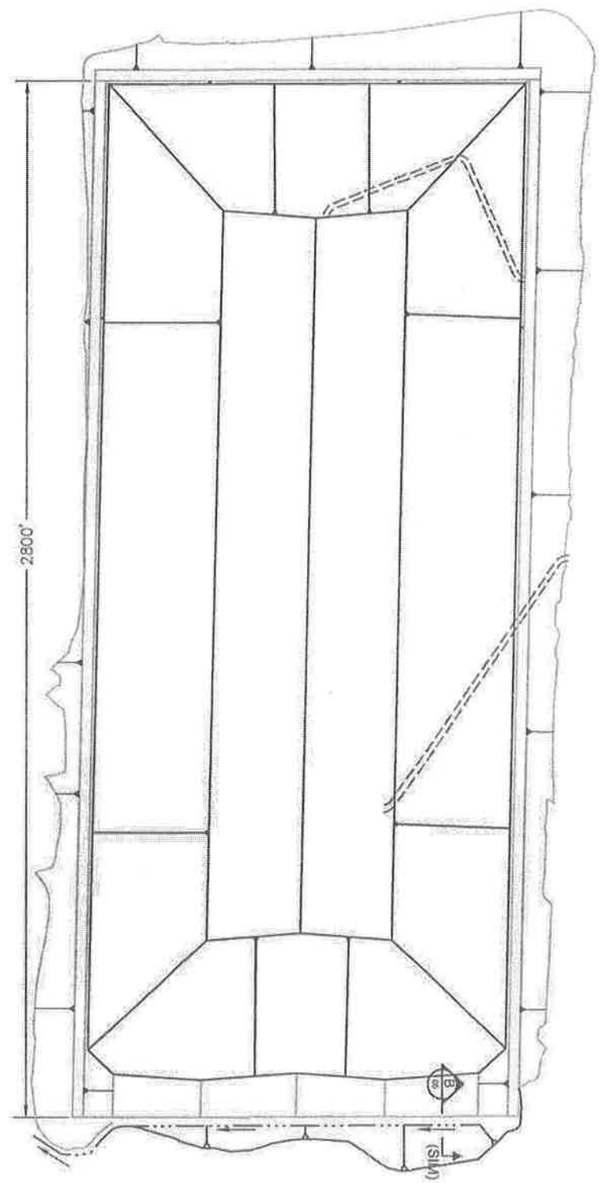
DRAWING NUMBER	REV
16-11-03	0



INITIAL OPERATIONAL PHASE 1
N.T.S.



INTERIM CONSTRUCTION PHASE 2
N.T.S.



MAXIMUM OPERATIONAL PHASE 3
N.T.S.

NOTES:

1. CELL LINER CONSTRUCTION TO BE PERFORMED IN PHASED INTERVALS.
2. THE LENGTH OF EACH PHASE, MEASURED IN THE NORTH / SOUTH DIRECTION, IS VARIABLE WITH A SET MAXIMUM VALUE.
3. THE LENGTH OF THE INITIAL PHASE IS LIMITED TO 900 FEET OR LESS. THE LENGTH OF SUBSEQUENT INTERIM PHASES ARE LIMITED TO 800 FEET OR LESS.
4. WASTE MATERIALS SHOULD BE PLACED IN CONTINUOUS HORIZONTAL LIFTS WITHIN EACH PHASE, PROCEEDING FROM BOTTOM TO TOP.
5. WASTE PLACEMENT IN PREVIOUS PHASES MUST HAVE A NOMINAL DEPTH OF 20 FEET, EXCLUDING THE REQUIRED WASTE SET-BACK ZONE, PRIOR TO CONSTRUCTION OF AN ADDITIONAL PHASE.
6. THE MAXIMUM OVERALL LENGTH OF THE CELL, IS LIMITED TO 2,800 FEET.

REV	DATE	BY	DESCRIPTION
0	2/8/12	WT	ISSUED FOR CONSTRUCTION

PROFESSIONAL ENGINEER REGISTERED 2/10/12 11632 STATE OF IDAHO VAUGHN THURGOOD

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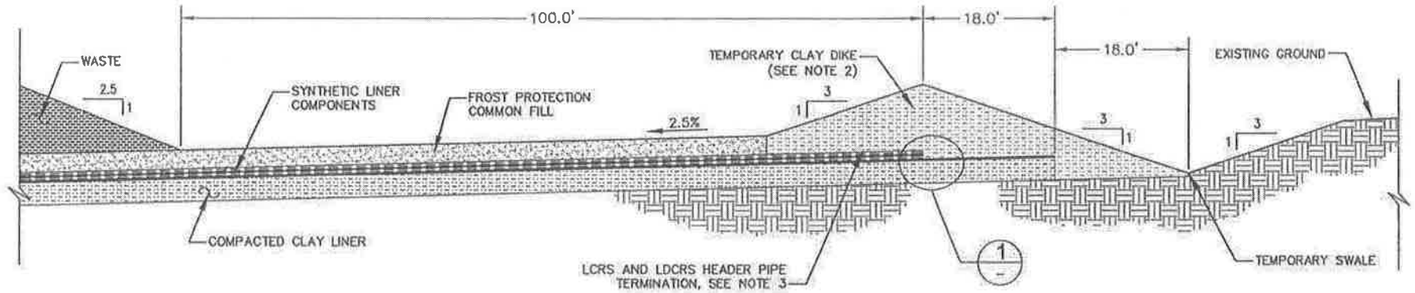
5260 Chinden Blvd • Boise, Idaho 83714
Phone (208) 658-8700 • Fax (208) 658-8703

DRAWN BY	CHECKED BY	PROJECT NUMBER
VJT	RWH	07B-G1654

PROJECT NAME
CELL 16 LANDFILL UNIT
GRANDVIEW, IDAHO

CONSTRUCTION PHASING AND WASTE PLACEMENT

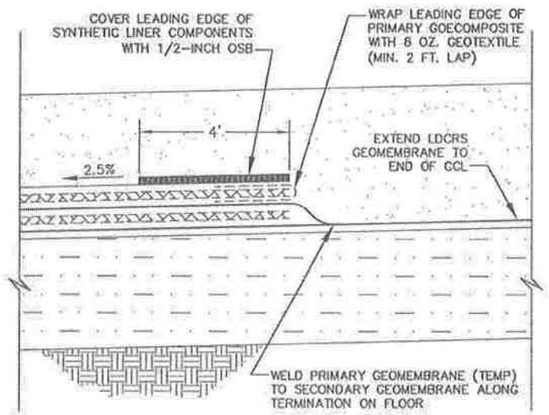
DRAWING NUMBER	REV
16-11-04	B



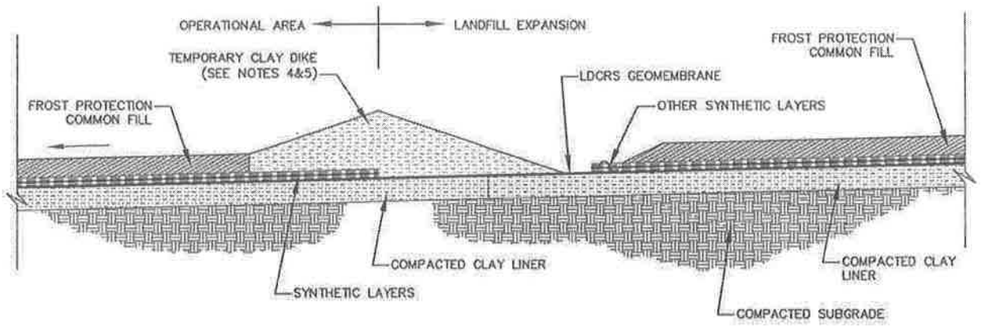
TYPICAL PHASE TERMINATION — B/04
N.T.S.

NOTES:

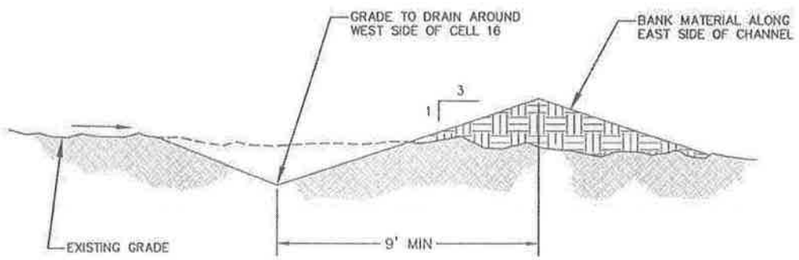
1. WASTE PILE IS SET BACK AT LEAST 100 FEET FROM THE TEMPORARY CLAY DIKE CREST ON THE SOUTH END OF THE CELL.
2. CREST OF TEMPORARY CLAY DIKE CONSTRUCTED TO AN ELEVATION AT LEAST 9 FEET ABOVE THE LCRS HEADER PIPE INVERT, MEASURED NEAR THE LINER TERMINATION.
3. EXTEND LCRS HEADER PIPE TO WITHIN 10± FEET OF THE SYNTHETIC LINER TERMINATION. EXTEND LDCRS HEADER PIPE TO WITHIN 5± FEET OF THE SYNTHETIC LINER TERMINATION. COVER PIPE ENDS WITH A TEMPORARY BLIND FLANGE.
4. DURING CONSTRUCTION THE CONTRACTOR IS RESPONSIBLE FOR PREVENTING STORM RELATED RUN-ON FROM ENTERING THE OPERATIONAL AREA OF THE LANDFILL. THE CONTRACTOR MUST BE EQUIPED TO REMOVE RUN-OFF GENERATED WITHIN THE CONSTRUCTION EXPANSION AREA.
5. REMOVAL OF THE TEMPORARY CLAY DIKE AND SUBSEQUENT TIE-IN WITH THE LDCRS & LCRS GEOCOMPOSITE LAYERS SHALL NOT OCCUR UNTIL SUFFICIENT FROST PROTECTION MATERIALS ARE IN PLACE, AS APPROVED BY THE ENGINEER.



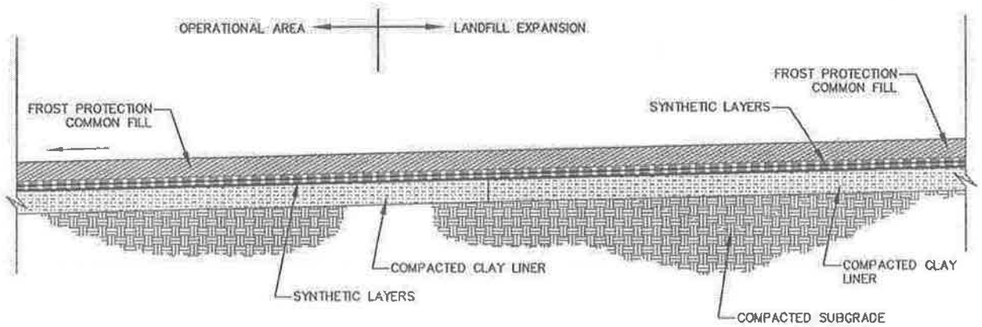
SYNTHETIC LINER TERMINATION — 1/--
N.T.S.



INTERIM LINER TIE-IN — C/04
N.T.S.



TEMPORARY CHANNEL — E/04
N.T.S.



COMPLETED LINER TIE-IN — D/04
N.T.S.

REV	DATE	BY	DESCRIPTION
0	2/8/12	VJT	ISSUED FOR CONSTRUCTION

PROFESSIONAL ENGINEER REGISTERED 2/10/12 11632 STATE OF IDAHO VAUGHN THURGOOD

US Ecology Idaho
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PREPARED BY
AMERICAN GEO TECHNICS
5260 Chinden Blvd · Boise, Idaho 83714
Phone (208) 658-8700 · Fax (208) 658-8703

DRAWN BY	CHECKED BY	PROJECT NUMBER
VJT	RWH	07B-G1654

PROJECT NAME
CELL 16 LANDFILL UNIT
GRANDVIEW, IDAHO

INTERIM STORM WATER CONTROL DETAILS

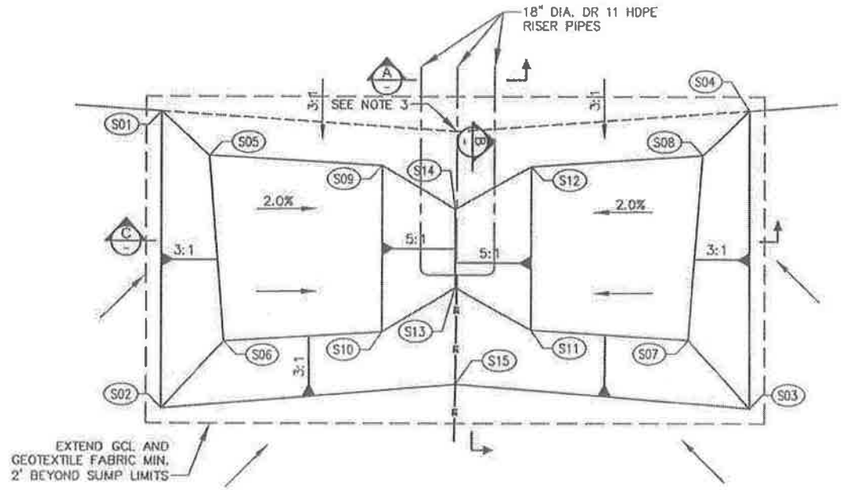
DRAWING NUMBER 16-11-05 | REV B

SUBCELL 16-2 SUMP COORDINATES			
POINT ID.	NORTHING (FT)	EASTING (FT)	ELEVATION* (FT)
S01	511,214.95	360,864.05	2,550.23
S02	511,174.95	360,864.05	2,551.21
S03	511,174.95	360,944.05	2,551.17
S04	511,215.03	360,944.05	2,550.15
S05	511,208.97	360,870.49	2,548.23
S06	511,183.99	360,872.44	2,548.19
S07	511,184.15	360,935.57	2,548.11
S08	511,209.00	360,937.59	2,548.15
S09	511,207.66	360,894.05	2,547.76
S10	511,185.25	360,894.05	2,547.76
S11	511,185.47	360,914.05	2,547.68
S12	511,207.49	360,914.05	2,547.68
S13	511,191.24	360,904.05	2,545.76
S14	511,201.70	360,904.05	2,545.76
S15	511,178.19	360,904.12	2,550.11

*ELEVATIONS REFER TO TOP OF LCRS GEOMEMBRANE

SUBCELL 16-1 SUMP COORDINATES			
POINT ID.	NORTHING (FT)	EASTING (FT)	ELEVATION* (FT)
S01	511,217.05	361,358.40	2,550.23
S02	511,177.05	361,358.40	2,551.21
S03	511,177.05	361,438.40	2,551.17
S04	511,217.14	361,438.40	2,550.15
S05	511,211.08	361,364.84	2,548.23
S06	511,186.09	361,366.79	2,548.19
S07	511,186.25	361,429.91	2,548.11
S08	511,211.11	361,431.94	2,548.15
S09	511,209.76	361,388.40	2,547.76
S10	511,187.36	361,388.40	2,547.76
S11	511,187.57	361,408.40	2,547.68
S12	511,209.60	361,408.40	2,547.68
S13	511,193.34	361,398.40	2,545.76
S14	511,203.81	361,398.40	2,545.76
S15	511,180.30	361,398.47	2,550.11

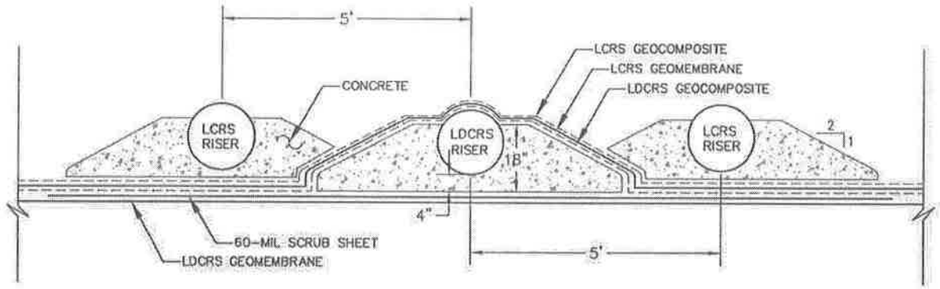
*ELEVATIONS REFER TO TOP OF LCRS GEOMEMBRANE



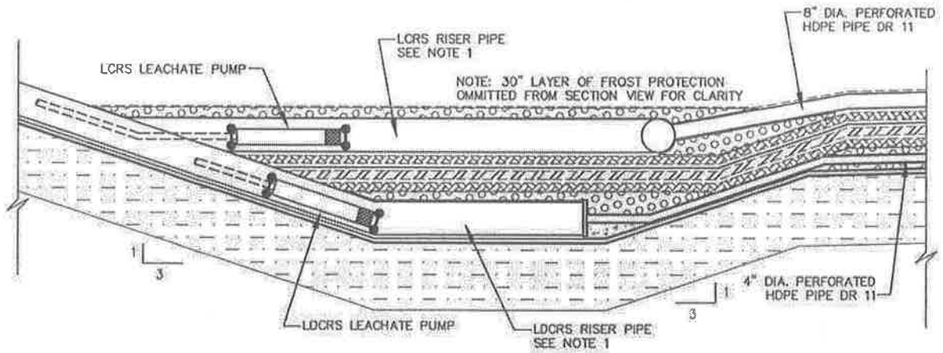
TYPICAL SUMP LAYOUT (1/01) N.T.S.

NOTES:

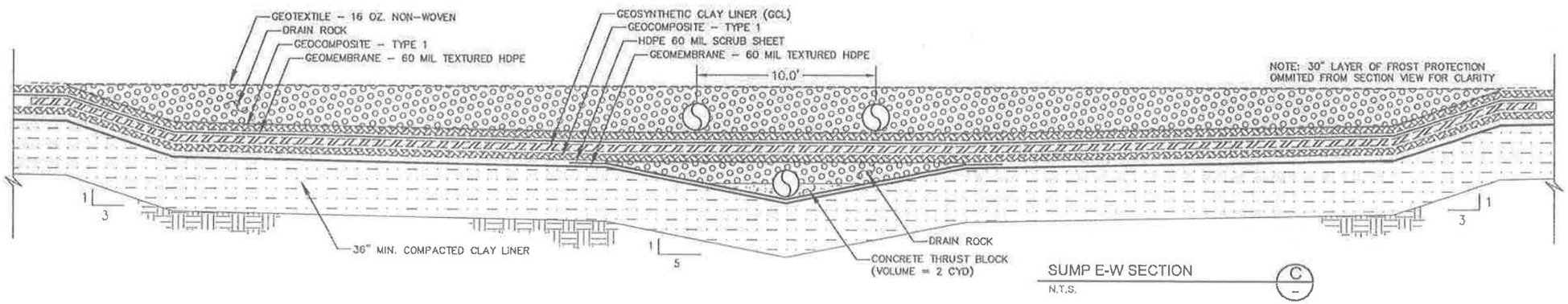
1. LOWER PORTIONS OF LCRS AND LDCRS RISER PIPES, LOCATED WITHIN THE SUMP, TO BE PERFORATED IN ACCORDANCE WITH PROJECT SPECIFICATIONS.
2. INSTALL ALL LEACHATE PUMPS DURING THE INITIAL PHASE OF CONSTRUCTION.
3. LEADER INDICATES LOCATION OF POINT L12 & L14 FROM SHEET 02 WHICH IS SHOWN FOR CLARITY ONLY. THESE POINTS IMPOSE IMAGINARY GRADE BREAKS AT THIS LOCATION.



RISER PIPE SECTION (A) N.T.S.



SUMP N-S SECTION (B) N.T.S.



SUMP E-W SECTION (C) N.T.S.

REV	DATE	BY	DESCRIPTION
0	2/8/12	VJT	ISSUED FOR CONSTRUCTION

PROFESSIONAL ENGINEER REGISTERED 2/10/12 11632 STATE OF IDAHO VAUGHN THURGOOD

Vaughn Thurgood

US Ecology Idaho
an American Ecology company

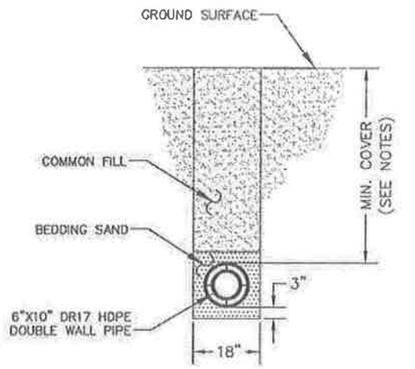
PREPARED BY
AMERICAN GEO TECHNICS
5260 Chinden Blvd · Boise, Idaho 83714
Phone (208) 658-8700 · Fax (208) 658-8703

DRAWN BY	CHECKED BY	PROJECT NUMBER
VJT	RWH	07B-G1654

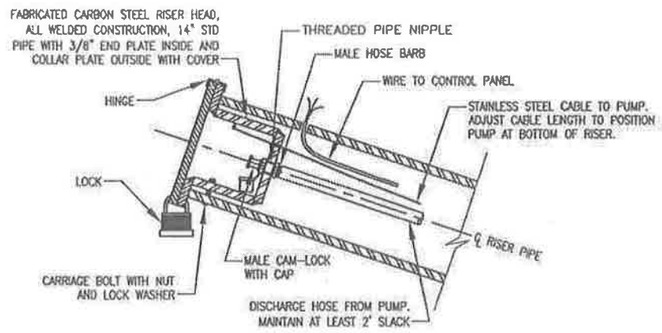
PROJECT NAME
CELL 16 LANDFILL UNIT
GRANDVIEW, IDAHO

SUMPS AND RISERS SECTIONS AND DETAILS

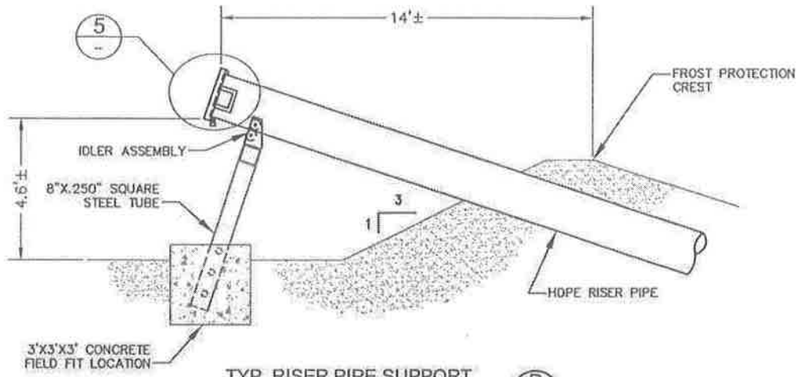
DRAWING NUMBER	REV
16-11-06	B



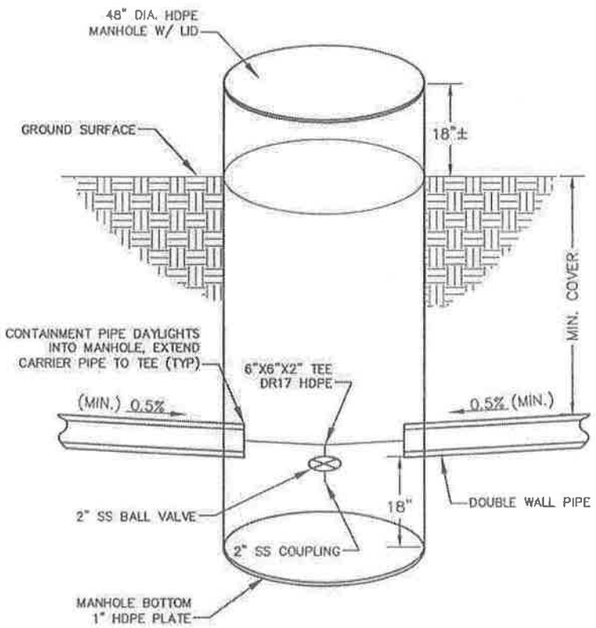
TYP. PIPE TRENCH SECTION (A) N.T.S.



TYPICAL RISER PIPE HOOK-UP (5) N.T.S.



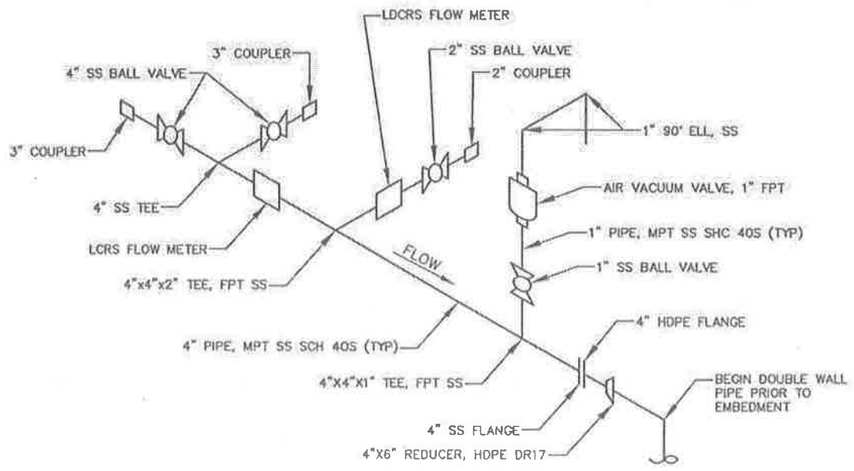
TYP. RISER PIPE SUPPORT (B) N.T.S.



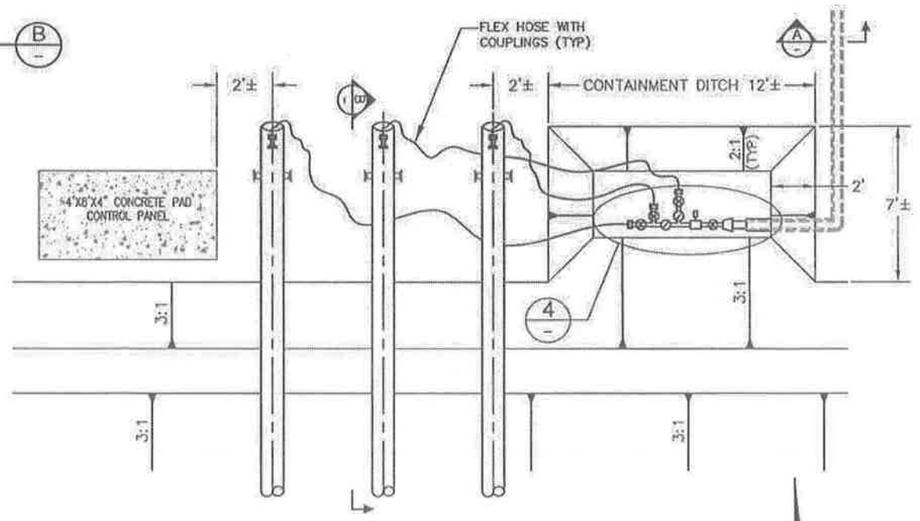
LEACHATE PIPE MANHOLE ACCESS (3) 01 N.T.S.

NOTES:

1. DOUBLE WALL LEACHATE PIPE TO MAINTAIN MINIMUM COVER OF 36 INCHES BENEATH ROADWAYS, 28 INCHES ELSEWHERE.
2. PROVIDE AS-BUILT SURVEY COORDINATES FOR BURIED LEACHATE PIPE AT ALL HINGE POINTS AND AT A MINIMUM SPACING OF 100 FEET ON CENTER.
3. DOUBLE WALL LEACHATE PIPE TO MAINTAIN POSIVITE DRAINAGE TOWARDS MANHOLE AT ALL TIMES.
4. MANHOLE PROVIDES SECONDARY CONTAINMENT. BASE AND SIDEWALL PENETRATIONS MUST BE SEALED.
5. ORIENT 4-INCH VALVE AND COUPLER INSIDE OF MANHOLE TO ALLOW FOR MAINTENANCE ACCESS AND PIPE DRAINAGE.
6. PROVIDE FLEX HOSE AND COUPLINGS FOR EACH RISER.
7. UPON INSTALLATION, THE 6-INCH CARRIER PIPE TO BE PRESSURE TESTED AT 80 PSI OVER A 24 HOUR PERIOD. THE 10-INCH CONTAINMENT PIPE TO BE PRESSURE TESTED AT 5 PSI OVER A 24 HOUR PERIOD.



LEACHATE PIPE HARDWARE (4) N.T.S.



TYPICAL RISER / LEACHATE PIPE CONNECTION (2) 01 N.T.S.

REV	DATE	BY	DESCRIPTION
0	2/10/12	VJT	ISSUED FOR CONSTRUCTION

PROFESSIONAL ENGINEER REGISTERED 2/10/12 11632 STATE OF IDAHO VAUGHN THURGOOD

US Ecology Idaho
an American Ecology company

PREPARED BY
AMERICAN GEO TECHNICS
5260 Chinden Blvd · Boise, Idaho 83714
Phone (208) 658-8700 · Fax (208) 658-8703

DRAWN BY	CHECKED BY	PROJECT NUMBER
VJT	RWH	07B-G1654

PROJECT NAME
CELL 16 LANDFILL UNIT
GRANDVIEW, IDAHO

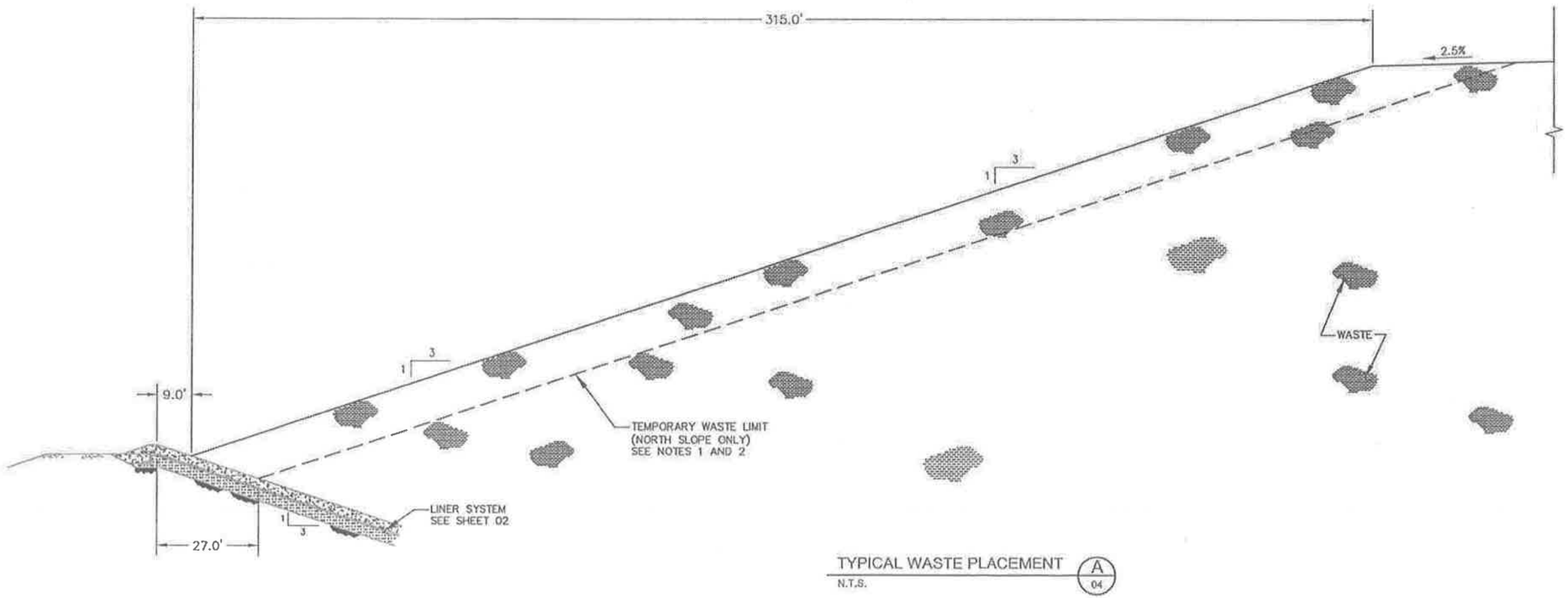
LEACHATE PIPE SECTIONS AND DETAILS

DRAWING NUMBER	REV
16-11-07	B

CELL 16 DESIGN CAPACITY (Reduced for 30" Clean Frost Protection)	
LENGTH (ft)	ESTIMATED WASTE CAPACITY (cyd)
INITIAL PHASE 900 ft (assumed)	2,022,200
INTERIM PHASES per additional 100 ft	433,700
MAXIMUM PHASE 2800 ft (total)	10,262,500

NOTES:

1. WASTE PLACEMENT ALONG THE NORTH PERIMETER OF CELL 16 SHALL BE TEMPORARILY SET-BACK AT LEAST 27 FEET FROM THE LINER CREST, TO PROVIDE CONTAINMENT OF POTENTIAL STORM WATER RUN-OFF.
2. FINAL WASTE PLACEMENT ALONG THE NORTH SLOPE SHOULD OCCUR NEAR COMPLETION OF THE MAXIMUM PHASE, PRIOR TO CLOSURE.
3. INSTALL 16" DIAMETER CORRUGATED CULVERTS AT EACH DRAIN CHANNEL CROSSING DURING CONSTRUCTION OF TEMPORARY ACCESS ROADS.



TYPICAL WASTE PLACEMENT (A/04)
N.T.S.

REV	DATE	BY	DESCRIPTION
0	2/8/12	VJT	ISSUED FOR CONSTRUCTION

PROFESSIONAL ENGINEER REGISTERED 2/10/12 11632 STATE OF IDAHO VAUGHN THURGOOD

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DRAWN BY	CHECKED BY	PROJECT NUMBER
VJT	RWH	07B-G1654

PROJECT NAME
CELL 16 LANDFILL UNIT
GRANDVIEW, IDAHO

WASTE PLACEMENT SECTIONS AND DETAILS

DRAWING NUMBER	REV
16-11-08	B

Appendix D.5.5
Cell 16 Engineering Report Appendix D - Specifications (revised 2-21-12)

APPENDIX D

SPECIFICATIONS

Cell 16 Specifications

Section No.	Title	Issued
01010	*Summary of Work*	2-8-12
01025	*Measurement and Payment*	7-15-11
01300	*Submittals*	7-15-11
02005	*Surveying Services*	7-15-11
02200	*Earthwork*	7-15-11
02228	*Low-Permeability Soil Layer*	7-15-11
02253	*Geosynthetic Clay Liner*	7-15-11
02272	*Geotextile*	7-15-11
02274	*Geocomposite*	7-15-11
02771	*HDPE Geomembrane*	2-21-12
15062	*Piping and Mechanical*	7-15-11
16050	*Electrical Work*	7-15-11

SECTION 01010

SUMMARY OF WORK

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1.2 DEFINITIONS 2
1.3 CONTRACTOR PREPARED PLANS 3
1.4 OPERATIONAL CRITERIA 3
1.5 QUALITY CONTROL PLAN (QC PLAN) 4
1.6 CONDITIONS OF WORK IN PLACE 4
1.7 OWNER WITNESS AND INSPECTIONS 5
1.8 SUBMITTALS 5
1.9 CONSTRUCTION DOCUMENTS 5

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2.1 (NOT USED) 5

PART 3 EXECUTION 5

3.1 (NOT USED) 5

SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.1 SCOPE

A. The Work includes Cell 16 Construction: Landfill construction work will include, but will not be limited to, the following activities:

1. Constructing temporary transportation facilities necessary to support the work.
2. Providing temporary stormwater, erosion and sediment control. Contractor shall file a Notice of Intent with the EPA for each phase of landfill construction and implement an approved Storm Water Pollution Prevention (SWPP) Plan to address the temporary construction conditions.
3. Developing and operating the Owner's off-site Ketterling Clay Borrow Pit unless otherwise directed by the Owner.
4. Excavating and stockpiling unsuitable foundation soils.
5. Excavating and preparation of the disposal cell foundation.
6. Constructing a 3-foot-thick, compacted clay liner (CCL).
7. Providing, furnishing, and installing aggregates, pipe, concrete drainage products, and manufactured (geosynthetic) materials.
8. Constructing a Leak Detection Collection and Removal System (LDCRS) and a Leachate Collection and Removal System (LCRS) along the base and side slopes of the disposal cell including installation of pipes and pipe penetrations.
9. Installing the LDCRS and LCRS sumps, riser pipes, and pump systems for leachate removal.
10. Constructing a leachate piping system from Cell 16 to the existing leachate treatment facility.
11. Installation of frost protection materials over the synthetic liner materials.
12. Construction of a permanent maintenance road around the perimeter of the disposal cell.
13. Providing emission and dust control.
14. Maintenance, including dust control, of existing haul road from the Owner's off-site Ketterling Clay Borrow Pit to the site.
15. Landfill construction is limited to the portion described in the Owner's Request for Proposal (RFP). Temporary features necessary to construct each phase of the landfill, such as haul roads, ramps and drainage control facilities are constructed as required.

B. Site Restoration will include:

1. Seeding of disturbed areas as defined by the Owner.
2. Borrow area restoration shall be graded to drain.

C. Storm Water Control (including leachate):

1. Submit a storm water management plan to the Owner for review and approval before starting any work. The plan will specify how storm water is collected and directed during excavation, construction, and during placement of freeze protection materials.
2. During excavation, containment areas (ponds), pipes, and pumps inside the cell must be sized to store and remove the 2-year, 24-hour storm water runoff from the area inside the top crest of the berm.
3. During excavation, construct ditches, furnish and install a system of pipes, gates, or corrugated metal pipe, as necessary to pump storm water from the disposal cell excavation to the temporary drainage as directed by the owner.

D. Miscellaneous:

1. Miscellaneous work will include, but will not be limited to, the following activities:
   a. Providing all submittals required by these specifications.
   b. Coordination with respect to Owner's inspections.
   c. Surveying, as defined in Section 02005.
   d. Providing Quality Control as defined in the Construction Quality Assurance Plan.
   e. Providing health and safety training for workers.
   f. Maintaining haul roads and access roads.
   g. Removing overbuilt materials and smoothing all surfaces after completion of construction.
   h. Excavating and construction of anchor trenches for anchorage of manufactured materials.
   i. Stockpiling and/or disposal of soils not suitable for construction purposes.

1.2 DEFINITIONS

A. Owner: As used in these Technical Specifications, the Owner is defined as US Ecology of Idaho.

B. Owner's Off-Site Borrow Source: A borrow source of Ketterling clay designated by the Owner as the source for low-permeability fill material. It is located a total of about 2.2 miles from the site.

C. Owner's Inspection: Unless otherwise indicated in these specifications, a key item of fabrication and/or manufacturing or field construction activity that will require inspection, including sampling and testing, as applicable, by the Owner and stoppage of the work until after the inspection and written approval or notice to proceed is given by the Owner. The Contractor shall give five days advance notice to the Owner prior to the day that such inspection activity will take place.

D. Site: A site location map of the Grand View facility, including the Cell 16 area is shown on Drawing No. 16-11-00.

E. Witness Point: Unless otherwise indicated in these specifications, a key item of fabrication and/or manufacturing or field construction activity that will require inspection by the Owner. Five days advance notice to the Owner is required prior to the day that such inspection activity will take place. A written notification by the Owner shall be required to waive a witness point.

1.3 CONTRACTOR PREPARED PLANS

A. The Contractor shall prepare plans describing sequencing, scheduling, procedures, and coordination limited to the Contractor's scope of the Work. All plans shall be subject to approval by the Owner.

B. Plans: Plans shall describe sequencing, scheduling, activities, tasks, procedures, and coordination common to the work. The required plans as described in Section 01010 are:

a. Storm Water Management Plan
b. QC Plan
c. Geosynthetics Installation Plan

1.4 OPERATIONAL CRITERIA

A. In addition to strict adherence to the specifications and Construction Drawings, all work shall be performed in accordance with the Contractor-prepared and Owner-approved Operations Plans.

B. Each material stockpile shall have slopes not steeper than 1.5H:1V and the height of each stockpile shall not exceed 15 feet unless otherwise approved by the Owner.

C. Each material stockpile shall be shaped to drain at the end of each day. The shaped stockpile shall be seeded and mulched in accordance with Section 02936.

D. Prior to extended shutdowns of a week or longer, or when heavy rains are anticipated or forecasted, grade and smooth all active working soil areas to seal the surfaces to prevent water ponding.

E. During shutdown periods, have sufficient staff on site for shutdown activities. During snow removal, shutdowns or non-working periods including overnights, weekends, holidays and periods of inclement weather, the Contractor shall:

1. Maintain a fire watch for all operating power equipment, including generators, pumps, and combustion engines.
2. Ensure erosion and surface water controls, traffic control devices, and barricades are in place and working properly.
3. Maintain dust control on all roads and soil areas within the Work Area and other areas where the Contractor has disturbed soil or stockpiles

F. Coordinate with the Owner for any necessary interruption of access to any facility or shutdown of water supply or electrical power as required.

G. Scheduling the performance of construction operations is the sole responsibility of the Contractor and shall ensure completion of progress established by the approved Contractor's Operations Plan. This includes a determination of the availability of all specified or accepted substitute products, and the scheduling of their deliveries in order to allow sufficient time for installation during orderly and timely progress of the Work.

H. In sequencing work, the Contractor shall not proceed with the next sequence of work until the Owner has completed all tests, inspections and approvals. Required test, inspection and approval items by the Owner and the holding time for each item are summarized in the Specification Sections to which they apply.

1.5 QUALITY CONTROL PLAN (QC Plan)

A. Develop and submit a Quality Control (QC) Plan to the Owner for review and approval, prior to beginning the Work. The QC shall address the major tasks and activities, general sequencing, coordination, and scheduling as discussed in the Construction Quality Assurance Plan.

1.6 CONDITIONS OF WORK IN PLACE

A. Owner will witness the soil removal by the Contractor and will perform confirmation testing to determine if it is suitable, or unsuitable for future use, and will provide direction for storage and disposal within the site.

B. The construction site is considered free of contaminated materials.

C. Removal of annual surface vegetation prior to mining activities at the Owner's clay borrow source should be expected.

1.7 OWNER WITNESS AND INSPECTIONS

A. Specific Owner witness and inspections are listed in the Sections to which they apply.

1.8 SUBMITTALS

A. The Contractor shall submit the following to the Owner for approval in accordance with Section 01300:
   1. Operations Plan.
   2. Contractor's QC program
   3. Contractor's Storm Water Management plan
   4. Material Safety Data Sheets (MSDS) for each material.
   5. As-built drawings reflecting final as-built field conditions.
   6. Other items as discussed in the Specifications.

1.9 CONSTRUCTION DOCUMENTS

A. Only controlled current copies of Construction Documents marked "Revision 0" (Rev. 0) and subsequent numeric revisions shall be utilized for construction by the Contractor.

PART 2 PRODUCTS

2.1 (Not Used)

PART 3 EXECUTION

3.1 (Not Used)

END OF SECTION 01010

SECTION 01025

MEASUREMENT AND PAYMENT

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1.5 FIELD MEASUREMENTS 2
1.6 REJECTED MATERIALS 2

PART 2 PAYMENT 3

2.2 DEFECT ASSESSMENT 3
2.3 NON-PAYMENT FOR REJECTED PRODUCTS 3

PART 3 PRODUCTS 4

PART 4 EXECUTION 4

SECTION 01025

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.1 SCOPE

A. This Specification Section covers the requirements for measurement of items.

B. The Contractor shall compute all quantities and obtain agreements from the Owner. Measurement methods in the individual specification sections complement the criteria of this section.

1.2 RELATED REQUIREMENTS

C. Section 01010 - Summary of Work.

D. Applicable Construction Drawings and Specifications.

E. Layout of Work and Surveys.

1.3 DEFINITIONS

F. Acre (AC) is a unit of land measure equal to 43,560 square feet.

G. Bank cubic yard (BCY) is a unit of volume utilized for measurement of in situ or undisturbed soil or aggregates.

H. Cubic yard (CY) is a unit of volume utilized for measurement such as cast-in-place concrete.

I. Each (EA) is a unit utilized for counting of discrete items.

J. Fill cubic yard (FCY) is a unit of volume utilized for measurement of mechanically-densified soil or aggregates.

K. Gallon (GAL) is a unit of volume utilized for measurement of liquids.

L. Linear foot (LF) is a unit of length utilized for measurement of linear elements, such as steel culvert pipe, chain-link fence, conduit, wire, cable and grounding.

M. Lump Sum (LS) is a unit of measure for the entire item, unit of work, structure or combination thereof.

N. Overexcavation is defined as (1) excavation carried out beyond the lines and grades indicated in the Construction Drawings or other Construction Documents, or (2) excavation not authorized by the Contractor.

O. Square foot (SF) is a unit of area utilized for measurement of areal elements, such as site grading or geosynthetics.

1.4 MEASUREMENT OF QUANTITIES

P. Measurement by Volume:

1. Measurement by volume shall be by the cubic dimension. Method of volume measurement shall be measured on actual volume, as specified or as directed by the Owner.

2. When material is to be measured on a volume basis and it is impractical to determine the volume by the specified method of measurement, the material shall be weighed using a certified scale approved by the Owner. Certification shall be current within the past 12 months and recalibrated as required per manufacturer's instructions. Such weights shall be converted to volume measurement. Factors for conversion from weight measurement to volume measurement will be determined by the Owner and shall be agreed to by the Contractor before such method of measurement will be accepted.

Q. Measurement by Area: Measurement by area shall be by the square dimension or acreage. Method of area measurement shall be measured on actual surface area or on area projection on a horizontal plan as specified.

R. Linear Measurement: Linear measurement shall be by the linear dimension. Generally, items, components, or work to be measured shall be measured at the centerline of the item in place.

S. Each Measurement: Each measurement shall be per the countable unit specified.

1.5 FIELD MEASUREMENTS

T. The Contractor shall compute all quantities of Work performed, or of the materials and equipment delivered to the site. All quantities will be agreed to or verified by the Owner.

1.6 REJECTED MATERIALS

U. Quantities of materials wasted or disposed of in a manner not called for under the Scope of Work; rejected loads of material; rejected material not unloaded from the transportation vehicle; material placed or removed outside the limits indicated on the Construction Drawings or established by the Owner; or material remaining on hand after completion of the Work, shall not be included in the final total quantities.

PART 2 PAYMENT

A. Payment Includes: Full compensation for all required labor, products, tools, equipment, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

B. Final payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities accepted by the owner's representative multiplied by the unit sum/price for Work which is incorporated in or made necessary by the Work.

2.2 DEFECT ASSESSMENT

A. Replace the Work, or portions of the Work, not conforming to specified requirements.

B. If, in the opinion of the owner's representative, it is not practical to remove and replace the Work, the owner's representative will direct one of the following remedies:

1. The defective Work may remain, but the unit sum/price will be adjusted to a new sum/price at the discretion of the Owner.
2. The defective Work will be partially repaired to the instructions of the owners representative, and the unit sum/price will be adjusted to a new sum/price at the discretion of the Owner.

C. The individual specification sections may modify these options or may identify a specific formula or percentage sum/price reduction.

D. The authority of the Owner, to assess the defect and identify payment adjustment, is final.

2.3 NON-PAYMENT FOR REJECTED PRODUCTS

A. Payment will not be made for any of the following:

1. Products wasted or disposed of in a manner that is unacceptable.
2. Products determined as unacceptable before or after placement.
3. Products not completely unloaded from the transporting vehicle.
4. Products placed beyond the lines and levels of the required Work.
5. Products remaining on hand after completion of the Work.
6. Loading, hauling and disposing of rejected products.

PART 3 PRODUCTS

NOT USED

PART 4 EXECUTION

NOT USED

END OF SECTION 01025

SECTION 01300

SUBMITTALS

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1.5 IDENTIFICATION OF SUBMITTALS 2
1.6 COORDINATION OF SUBMITTALS 3
1.7 SCHEDULES 3
1.8 SUBMITTAL REQUIREMENTS 4

PART 2 PRODUCTS **5**

NOT USED 5

PART 3 EXECUTION **5**

NOT USED 5

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.1 SCOPE

A. This specification section describes the requirement and procedures for submittals as identified and listed in the Technical Specifications. To ensure that the specified products are furnished and installed in accordance with technical requirements the Owner has established procedures for advanced submittal of design data and for its review and acceptance or rejection.

1.2 SUBMITTAL DRAWINGS

A. Scale Required: Unless otherwise specifically directed by the Owner, all submittal drawings shall be of such scale as to clearly show all pertinent features of the item and its method of connection to the work.

B. Certification of Submittal Drawings: When submittal drawings are required to be prepared either by or under the direct supervision of a registered professional engineer, these submittal drawings shall bear the seal of that registered professional engineer appropriate for the discipline intended.

C. Status of Submittal Drawings: Submittal drawing submittals processed by the Owner, or by the Owner's Representative or consultants, do not become Construction Documents. The purpose of the submittal drawing review is to establish a reporting procedure and is intended for Contractor convenience in organizing the Work and to permit the Owner to monitor Contractor progress and compliance with Construction Drawings and Specifications. If deviations, discrepancies, or conflicts between submittal drawings and the Construction Drawings and Specifications are discovered, the Construction Drawings and Specifications will govern.

1.3 AS-BUILT DRAWINGS

A. The Contractor shall maintain and submit as-built drawings for all Work performed. The as-built drawings shall be marked up with redlines. The submittal of as-built drawings, with surveyor's seal on them, shall be completed prior to final acceptance of the Work by the Owner. The Contractor shall maintain and submit as-built drawings of the work as completed for different areas, phases, and disciplines. The as-built drawings shall be prepared in accordance with the following requirements:

1. The Construction Drawings shall be utilized as the drawing base for the Contractor's as-built drawings.

2. The as-built drawings shall be to scale, of good quality, and legible.
3. The as-built drawings shall include all approved field modifications made during construction.
4. The as-built drawings shall include consolidated information provided by vendor data and drawings, Contractor and Owner sketches and drawings.
5. The as-built drawings shall reflect final as-built field conditions.

B. The Contractor shall mark up one set of controlled prints to show the as-built conditions as work progresses including the accurate location of all Contractor-installed underground utilities. These as-built marked prints shall be kept current and available on the jobsite at all times. All changes which are made in the work or additional information which might be uncovered in the course of construction, shall be accurately and neatly recorded as they occur by means of details and notes. As work progresses, the Contractor shall submit, as-built marked prints for each drawing superseded by revision on a monthly basis or as otherwise required by the Owner.

C. The as-built marked prints will be jointly reviewed for accuracy and completeness by the Owner's representative and a responsible representative of the Contractor on a monthly basis. The Contractor shall correct any inaccuracies and complete mark-up of any omissions noted in this review. Completed as-built drawings shall be subject to approval by the Owner.

D. As-built drawings shall conform to the requirements of Section 02005.

1.4 MANUFACTURER'S CERTIFICATES

A. Submit certificates to the Owner according to the requirements of each Specification Section.

1.5 IDENTIFICATION OF SUBMITTALS

A. The Contractor shall completely identify each submittal and resubmittal by showing at least the following information.
1. Name and address of submitter, plus name and telephone number of the individual who may be contacted for further information.
2. Name of Project as it appears on the Construction Documents.
3. Drawing number or Specifications Section number to which the submittal applies.
4. Submittal number, numerically serialized and sequential beginning with the number one.

1. Resubmittals shall be designated with numeric suffixes to the original submittal number. (e.g. Submittal No. 32R-1).

B. Each submittal shall be submitted using an approved form similar to the enclosed "Construction Submittal Transmittal and Disposition Form."

1.6 COORDINATION OF SUBMITTALS

A. General: Prior to submittal for Owner's review, the Contractor shall use all means necessary to fully coordinate all material, including the following requirements:

1. Determine and verify all field dimensions and conditions, materials, catalog numbers, availability with respect to Project Schedule, and similar data.
2. Coordinate as required with all trades.

B. Groupings of Submittals: Unless otherwise specifically permitted by the Owner, the Contractor shall make all submittals in groups containing all associated items: The Owner may reject partial submittals as not complying with the Construction Documents.

1.7 SCHEDULES

A. Initial Submittal:

2. The scheduling and progress reporting of construction is the responsibility of the Contractor.

3. The complete construction schedule shall be submitted for review and approval before start of work. The construction schedule shall consist of the following:
   a. Barchart Schedule: The selection and number of activities will be left to the discretion of the Contractor but subject to the Owner's approval. Unless otherwise approved by the Owner, the construction schedule shall consist of the following items and shall be represented on the same diagram. The activities shall be shown sequentially by major work area. Upon approval by the Owner, this schedule will be classified as the Baseline Schedule and will be the schedule against which all progress will be measured. The barchart schedule shall include the following:
      a) Identification number for each activity (activity code), coded in such a manner to reflect the major project work areas.
      b) Description of each activity.
      c) Baseline start and finish dates for each activity (early/late start and finish dates if CPM logic diagram required).
      d) Duration for each activity.
      e) Manpower assigned to each activity.
      f) Arrange in order of forecast start dates.
      g) Activities grouped by major work area.

a. Logic Diagram: The Contractor shall submit a critical path method (CPM) logic diagram, precedence or arrow. The CPM diagram shall be structured following the same criteria detailed in Items (1) - (4) of Paragraph A.2.a above.

B. Monthly Transmittals:

1. The construction schedule, as described above, shall show monthly status and shall be transmitted on or about the 15th of every month. This monthly transmittal shall consist of the following reports:

a. Barchart Diagram: Show progress, (actual or forecast start/finish dates) for each activity laid against the original Baseline Schedule. Include all items as described in Paragraph A.2.a. in addition to the following:

1) Arrange in order of actual/forecast start dates

2) Show new, approved field modification activities and their respective scheduled dates

3) Percent complete for each activity

4) Total float for each activity (only if CPM required)

b. Schedule Reports: List all activities in tabular format with the same information included on the updated Barchart Diagram and sorted as follows:

1) In the same order as the updated barchart diagram

2) In order of activity code

c. Narrative Report: Discuss accomplishments, goals/milestones met, current or anticipated problem areas, delaying factors and potential impacts. Also describe current or proposed corrective action or recovery plans that would be required to ensure meeting the completion date. Address individual activities as required.

1.8 SUBMITTAL REQUIREMENTS

A. Submittals such as catalog cuts, material certifications, shop drawings, Contractor drawings, operating/maintenance manuals, samples, special procedures, and/or other types of data as may be specified or listed in these documents shall be submitted to the Owner as specified herein.

B. The Contractor shall submit all data identified in these specifications, to the Owner with such promptness as to cause no delay in the Work or that of any other subcontractor. Unless otherwise specified, submittals for all material and equipment requiring approval shall be submitted, reviewed, and approved prior to receipt, inspection, installation, and/or incorporation of the item into the Work.

C. The Contractor shall furnish copies of such data requiring approval sufficiently in advance of the date that the material/equipment is required to meet the approved

schedule so that, if the item is disapproved, no delay will be occasioned to the schedule.

D. The Owner will review and generally return submittals within ten days of receipt, but in no case will this process take longer than 30 days.

E. Following a review, the Owner will indicate, by stamping or writing upon each submittal, the appropriate approval category:

1. Categories:

   a. Approved
   b. Approved as Noted, Work May Proceed
   c. Not Approved, Work May Not Proceed, Revise and Resubmit
   d. Receipt Acknowledged, Approval Not Required

F. The applicable blocks of the Construction Submittal Transmittal and Disposition Form will be completed by the Owner showing the disposition action for each item listed on the form. When submittals are returned marked with either "Revise and Resubmit," or "Rejected," the Contractor shall make such revisions and corrections as required and resubmit the submittal with the same submittal number followed by a sequential revision number.

G. One copy of the stamped Submittal will be returned to the Contractor. If further action is required, the Contractor shall perform such actions as directed. The required submittal and resubmittal sequence shall be repeated until no further action is required.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION 01300

CONSTRUCTION SUBMITTAL AND DISPOSITION			
US Ecology of Idaho Cell 16	From:_____	Date:_____	New Submittal:___ Resubmittal:___
		Submittal No.	
		Previous Submittal No. (if any)	

Disposition Legends:

(A) **APPROVED**

(B) Approved as noted work may proceed

(C) Not approved, work may not proceed

(D) Receipt Acknowledged Approval Not Required

(E)

Item No.		No. of Copies	Spec/Dwg. Reference	Submittal			Description	Disp. Status
				Mand. Apvl	QA ENG Apvl	Info		

Remarks:

Contractor's Signature:

Reviewers Comments:

Disposition By:

Additional Comment Sheets attached? Y_ N_

Review Distribution				Final Distribution:			

Figure 1 Construction Submittal Disposition Form

SECTION 02005

SURVEYING SERVICES

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SECTION 02005

SURVEYING SERVICES

PART 1 GENERAL

1.1 SCOPE

A. This Specification Section describes the requirements for surveying services.

1. A Land Surveyor licensed in the State of Idaho shall supervise or perform all necessary surveying for the successful execution of the work. Staking shall be in accordance with accepted surveying practices, provisions herein, and subject to Owner approval.
2. Control surveys and construction staking shall consist of, but are not limited to:
   a. Establishing temporary control points from the established bench marks as shown on the construction drawings.
   b. Verifying existing topographic features and existing above ground utility locations prior to work.
   c. Establishing a horizontal and vertical project control system based on the established monuments.
   d. Establishing preliminary and final surveys for quantity determinations.
   e. Setting alignments and/or baselines and grading stakes as required for the waste placement area, stockpiles, work areas, temporary access roads, ditches, channels, and all other work described in the Construction Drawings and Specifications.
   f. Conducting topographic surveys as required to periodically determine amount of work performed and prior to completion of work.
   g. Preparing and furnishing as-built drawings.
3. All surveying work shall be under the direct supervision of a person who has at least five years of experience in construction staking. Any work performed in referencing or re-establishment of land or United States survey monuments shall be performed by or under the direct supervision of an Idaho-registered land surveyor.
4. Redline drawings containing all items as constructed in the field shall be required. Redline drawings shall be kept up to date and as a minimum reflect all permanent features. Upon request, redline drawings shall be made available to the Owner for inspection.

1.2 RELATED SECTIONS

A. Section 01300 – Submittals

1.3 REFERENCES

A. Site Specific Health and Safety Plan

1.4 DEFINITIONS

A. The following are used to define responsibilities in these Specifications:
   1. Owner: US Ecology of Idaho or Designated Representative
   2. Contractor: The entity performing the work defined in these Specifications and Drawings.
   3. Engineer: The Engineer of record for the work covered by these Specifications and Drawings. A Registered Civil Engineer in the State of Idaho. The Engineer represents the Owner in technical decisions related to the work.

B. Work: All construction and pre- and post-construction activities related to the construction of Cell 16 as defined by the Specifications and Drawings.

1.5 SUBMITTALS

A. In accordance with the schedule given in this Section, submit the following to the Owner for approval in accordance with Section 01300:
   1. Topographic maps of pre-construction, post-construction and key interim features (i.e. prepared subgrade and clay liner)
   2. Calibration of equipment
   3. Idaho surveyor's license
   4. Deliverable data
      a. Reduced and checked field measurements
      b. All drawings and sketches
      c. Electronic data

1.6 SUBMITTAL SCHEDULE

A. The information, Construction Drawings, and data required shall be submitted in accordance with the following schedule:

Specification Reference	Requirements	Period
02005 (1.5.A.1)	Topographic Maps of Key Project Features	Within one week of survey completion
02005 (1.5.A.2)	Calibration of Equipment	15 days prior to work
02005 (1.5.A.3)	Idaho Surveyors License	15 days prior to work
02005 (1.1.A.4)	As-built Drawings	Upon completion of contract
02005 (1.3.A.4)	Deliverable Data	Prior to completion of work

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. Maintain accurate and complete notes of field surveys.
   1. Electronically collected field survey information shall be collected in Owner-approved total station data collector equipment. Backup equipment shall be available in the event of equipment malfunction. The format shall be consistently applied to all project survey work.

B. License: Survey work of record shall be conducted under the direction of a Land Surveyor registered in the State of Idaho.

C. Preserve Owner-furnished baseline controls, references, and location benchmarks. Provide all additional baseline stakes necessary for the successful execution of the work including, but not limited to:
   1. Additional lines, connections, ramps, and loops.
   2. Slope stakes.
   3. Fine-grade stakes.
   4. Construction benchmarks and reference stakes locating structures.

D. Perform construction layout surveys at least 2 full working days in advance of scheduled construction operations. At completion of a survey, notify the Owner and provide a copy of the field notes, Construction Drawings, and sketches so that the

Owner may perform checks or review the work. Allow at least 2 full working days for inspection before the scheduled start of associated construction operations.

E. Provide a copy of all surveying field notes and computations at least 2 working days prior to commencing applicable construction operations.

F. Upon completion of the work, provide all original surveying field notes, layouts, computations, and electronic files in standard bound survey notebooks, binders containing electronic file information and two copies each of electronic files compatible with the Owner's computer equipment and software.

3.2 SPECIFIC FIELD REQUIREMENTS

A. Establish temporary control points, as necessary, in accordance with Article 1.1.

B. Survey Monuments, Accuracy, and Documentation:
   1. The following information shall be recorded in survey notebooks for each control point established and for all other surveying:
      a. Designation of control point, as shown on the Construction Drawings.
      b. Elevation.
      c. Date of establishment.
      d. Description of the nature and location of the control point.
      e. A sketch of the control point location.
      f. Control points shall be referenced to a minimum of three permanent features that can be seen from the monument.
   2. The location of survey monuments for horizontal and vertical control work shall be established by traverse to conform with second-order Class II based on established monuments shown on the Construction Drawings. Location of other points shall conform to third-order Class II accuracy.
   3. The following information shall be recorded and documented for existing Owner-approved control points used or recovered for this work:
      a. General condition of monument.
      b. Exact letters and numbers stamped on the monument.
      c. A sketch of monument location.
      d. Date of use.
      e. Coordinates and elevation and the new calculated coordinates and elevations including error of closure and survey level of accuracy.

C. Temporary control points shall be placed so that they remain undisturbed throughout the construction period with at least two points being visible from any portion of the construction area.

D. Surveys:

1. Clearing Limit Staking: Clearing limits shall be staked according to the maximum clearing limits which shall be the surrounding fence as shown on the Construction Drawings. Clearing limits stakes shall be 4-foot lathe marked "clearing limits." Lathe shall be tied with brightly colored flagging. Flagging color shall be subject to approval by the Owner.
2. Alignment and Existing Ground Staking: Following clearing operations and before stripping operations begin, preliminary locations of alignments and/or baselines of project features shall be established. Cross-sections shall be taken to describe original ground features before stripping or excavation begins. The distance between grid points shall not exceed 50 feet, and all breaks shall be noted. In addition, cross sections shall be taken at all grade breaks along the baseline. A minimum of three points shall be recorded on each side of the baseline or alignment for each cross section. Additional points shall be taken at all grade breaks along the cross section.
3. Earthwork Staking: Staking for cut and fill limits shall establish the exterior limits of excavations and embankments. The maximum staking interval shall be 50 feet. Stakes shall be prominently noted with description of point, vertical distance to design elevation, and offset distance as applicable. A brightly flagged 4-foot lathe shall be provided with each stake.
4. Ditches and Channels: Ditches, channels and culverts shall be staked along an offset control line sufficiently removed from the centerline so that they remain undisturbed during construction. Both horizontal and vertical position shall be referenced from the offset line or lines with stakes clearly marked indicating the applicable horizontal and vertical reference distance.
5. Erosion Protection Features: Corners of riprap, erosion control materials, and other protected zones shall be staked and horizontally and vertically controlled to ensure that surfaces are uniformly installed to the design lines and grades. For shallow ditches and channels, the termination of protected zones shall be staked according to the Construction Drawings.
6. Final Surveys: The Contractor shall perform topographic surveys required to establish the actual quantities of work completed. The Owner may verify the surveys or supervise Contractor during performance of final surveys.
7. When required, construction cross sections shall be established in accordance with the following:
    a. Original contours on the Construction Drawings shall not be used to compute quantities.
    b. The Contractor shall record cross-section notes.

3.3 AS-BUILT DRAWINGS

A. Submit as-built horizontal and vertical control information including coordinates and elevations of all proposed facilities, including but not limited to, the following:

1. Disposal Cell excavation limits
2. Liners
3. Leachate collection system
4. Roads and grading
5. Fence

3.4 DELIVERABLE DATA

A. Before completion of the work, furnish one copy each of the following data:
   1. Reduced and checked field measurements.
   2. All Construction Drawings and sketches.
   3. All electronic data. All survey data submitted in electronic form shall have the following format:
      a. AutoCAD 3D .dwg files. All lines and point elevations (i.e., spot elevations, contour lines, etc.) on the file shall also be labeled with the appropriate elevation above MSL. All break lines shall be labeled.
      b. All contour elevations, break lines, and spot elevations shall be placed on separate layers.
   4. All records shall conform to the Owner's document control requirements. At the end of the construction, survey records shall be turned over to the Owner.

END OF SECTION

SECTION 02200

EARTHWORK

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SECTION 02200

EARTHWORK

PART 1 GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, materials, tools, equipment, surveying, testing, and supervision to excavate, haul, place, and compact subgrade, and common fill as indicated on the Drawings.

B. Furnish all labor, materials, tools, equipment, surveying, testing, and supervision to excavate, haul, place, and compact other earthen materials including pipe bedding, riprap bedding, riprap, and drain rock.

C. At the Owner's direction, furnish all labor, materials, tools, equipment, surveying, testing, and supervision to haul, place, and compact select waste material.

1.2 RELATED WORK

A. Section 01010 - Summary of Work

B. Section 01300 – Submittals

C. Section 02005 – Surveying Services

D. Section 02228 - Low-Permeability Soil Layer

E. Section 02253 - Geosynthetic Clay Liner

F. Section 02771 - Geomembrane

G. Section 02772 - Geotextiles

H. Contractor Quality Assurance Plan

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this Section to the extent referenced. The publications are referred to in the text by the basic designation only. Use the latest revision unless otherwise noted:

1. American Society for Testing and Materials (ASTM):

   C 535 Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

   D422 Standard Test Method for Particle Size Analysis of Soil

   D698 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort

   D2216 Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

   D2487 Standard Classification of Soils for Engineering Purposes

   D2922 Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods

   D3017 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods

2. Idaho Transportation Department Standard Specifications for Highway Construction, 2004.

1.4 SUBMITTALS

A. Quality Control Submittals:
   1. Borrow Source Testing:
      a. Classification analysis
      b. Grain size analysis
      c. Moisture content
      d. Moisture-density curve
   2. Subgrade Testing During Construction:
      a. In-place density
      b. Moisture-density relationship
   3. Common Fill Testing During Construction
      a. In-place density
      b. Moisture-density relationship
   4. Soil Cover Testing During Construction
      a. In-place density
      b. Moisture-density relationship

5. Certifications for imported materials
6. Contractor's Daily Report of Operations

B. Exceptions: Listing of all exceptions to the requirements specified herein.

1.5 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

A. Material shall be excavated and handled at the borrow site, transported, and placed and compacted at the job site in a manner that minimizes dust generation.

PART 2 PRODUCTS

2.1 TOPSOIL

A. Topsoil shall be stripped a nominal 3 inches where present and stockpiled as directed by the Owner.

2.2 CLEARING AND GRUBBING

A. Clearing and Grubbing shall be performed within the footprint of the proposed embankment construction.

B. Debris shall be stockpiled as directed by the Owner.

2.3 SUBGRADE

A. The subgrade is the upper 12 inches of native material upon which fill materials are placed.

2.4 SELECT WASTE

A. The Owner may direct the Contractor to place select waste as the uppermost one foot and final lift during waste placement in the cell to provide a foundation for geosynthetics of the cap system.

B. Select waste shall be non-treated soil waste that:
1. Contains no debris, sharp objects, or particles larger than 3 inches, if placed within 12 inches of geosynthetic liner materials.
2. Contains no debris, sharp objects, or particles larger than the loose lift thickness if placed a distance of at least 12 inches from geosynthetic liner materials.

2.5 COMMON FILL

A. Common fill shall be used for the construction of general site fill, above-grade containment berms, grade fill, protective layer material, and to meet design grades for the cap system, as shown on the Drawings.

B. Common fill shall be obtained from on-site soil stockpiles and required on-site excavations and processed as needed to remove objectionable quantities of debris, roots, or organic matter.

C. Common fill shall be free of lenses, pockets, or layers of material differing substantially in texture or gradation. Common fill shall not contain frozen material, or significant amounts of organic material.

D. Common fill shall have a maximum particle size of:
   1. 3-inch if placed within 12 inches of geosynthetic liner components.
   2. Loose lift thickness for all other locations.

2.6 PIPE BEDDING

A. Material shall be ½-inch minus gravel, crushed gravel, or crushed rock.

B. Material shall be clean, tough, of uniform quality and free from organic material.

2.7 DRAIN ROCK

A. Drain rock shall be dense, sound and resistant to abrasion with less than 35 percent wear, in conformance with ASTM C535 (grading 3). Shale, claystone, siltstone, and other rapidly degradable materials are not acceptable.

B. The rock shall be free of organic material, large rocks, and large clods of frozen material.

C. Material shall be comprised of rounded or sub-rounded rock.

D. Material shall meet the following requirements for gradation:

Standard U.S. Sieve	Percent Passing
1 ½ - inch	100
½ - inch	0 to 10
No. 200	0 to 2

2.8 WATER

A. The water used in the moisture conditioning or dust control will be supplied by the Owner from the existing pond approximately 1/2 mile south of the site along Lemly Road. The Contractor shall transport water from the Owner's supply point to the intended point of use.

B. The water shall be clean, relatively free of particulates, and free of synthetic organic contamination.

PART 3 EXECUTION

3.1 GENERAL

A. Earthwork shall be to the lines and grades shown on the Drawings.

B. Dust shall be minimized. If necessary, sprinkling with water is an acceptable method of dust control and suppression.

3.2 EXCAVATION

A. Excavated materials shall be stockpiled in location(s) approved by the Owner.

3.3 SUBGRADE PREPARATION

A. Prior to fill placement, the subgrade shall be proof-rolled. Soft or saturated areas shall be scarified, moisture-conditioned, and recompacted, or overexcavated and backfilled with properly compacted fill.

1. Occasional pockets of native fine grained sand exist at the site, as indicated in the Geotechnical Report. Native fine grain materials exposed at the subgrade elevation (prior to placement of the compacted clay liner), which lack adequate binder, may prove to be unstable under tire traffic and necessitate over-excavation. Over-excavation and subsequent replacement with preferred common fill materials will be paid for as separate line item in the bid schedule. Areas of over-excavation shall be approved and documented by the Engineer as the work progresses. The Contractor will not be compensated for over-excavation that occurs without prior approval of the Engineer.

B. No material shall be placed when either the fill or the subgrade is frozen.

C. If, in the Engineer's opinion, the surface of the prepared subgrade is too dry or too smooth to bond properly to the next lift, the uppermost 6 inches shall be scarified, moisture-conditioned as necessary, and recompacted.

3.4 FILL PROCESSING

A. The Contractor shall remove brush, roots, organic matter, and oversized particles from the fill material prior to placement.

B. The Contractor may need to screen oversize particles to achieve the required gradations for cover soil, bank run aggregate and other materials.

3.5 FILL PLACEMENT

A. Fill material shall be placed in continuous, uniform lifts with a lift thickness as follows:

1. A maximum compacted lift thickness of 12 inches for common fill and select subgrade materials.
2. The minimum compacted thickness of the initial lift of protective soil layer over the bottom and side slope liners shall be 12 inches, as required in Specification 02271. The maximum initial lift thickness of protective soil, placed over geosynthetic components, shall not exceed 3 feet.

B. The Contractor shall maintain the water content of the fill material within the range necessary to obtain the required compaction.

C. If, in the Engineer's opinion, the surface of the prepared foundation surface or the rolled surface of any layer of fill is too dry or too smooth to bond properly to the next lift, it shall be moistened and/or scarified. This shall be performed in an approved manner to a sufficient depth to provide a satisfactory bonding surface before the succeeding layer of material is placed.

D. If, in the Engineer's opinion, the surface of the prepared foundation surface or the rolled surface of any layer of fill is too wet for proper compaction, it shall be removed and/or scarified and allowed to dry prior to re-compaction. This shall be performed in an approved manner to a sufficient depth to provide a satisfactory bonding surface before the succeeding layer of material is placed.

E. Owner/Engineer-approved equipment shall be used to place and spread cover soil material on slopes with underlying geosynthetic materials. Placement of the soil shall begin at the bottom of the slope and progress up the slope, taking care not to stretch or damage the geosynthetics.

F. With the exception of the final lift of the cover soil, the final lift of placed and compacted fills shall be smooth-drum rolled. The final lift of the cover soil shall be scarified with a harrow to a depth of 4 inches just prior to seeding activities.

G. Drain rock shall be placed from a height of less than 12 inches to prevent damage to the underlying geosynthetics.

3.6 MATERIAL COMPACTION

A. Materials shall be compacted in accordance with the following requirements:

Fill Type	Requirement
Subgrade	Visual inspection of the surface to meet the satisfaction of the Engineer and 90% of Standard Proctor compaction density as defined by ASTM D698
Select Waste, Cover Soil or Common Fill Adjacent to Geosynthetics	Material shall be compacted by tracking a minimum of six passes with a D6 bulldozer or Engineer-approved equivalent
Select Waste or Common Fill as 12-inch thick Cap Subgrade	Material shall be compacted by tracking a minimum of six passes with a D6 bulldozer or Engineer-approved equivalent
All Other Common Fill	Minimum of 90% of Standard Proctor compaction density as defined by ASTM D698
Pipe Bedding	Minimum of 95% of Standard Proctor compaction density as defined by ASTM D698

B. Coverage by compaction equipment shall be uniform, especially at fill edges, in equipment turnaround areas and at the tops and bottoms of the slopes.

3.7 FINAL GRADES/TOLERANCE

A. The Contractor shall perform grading to the required lines and grades as shown on the Drawings. The contractor is responsible for grade staking.

B. Prepared grades for any geosynthetic components of the liner or cap shall have a relatively uniform smooth surface free of stones or other sharp objects that could damage the overlying materials. A tolerance of –0.25 to +0.25 feet from the elevations specified on the Drawings will be allowed.

C. The soil cover shall have a final grade tolerance of –0.00 to +0.25 feet.

3.8 PROTECTION

A. The Contractor shall protect all fill material from the effects of weather.

B. The Contractor shall maintain the surface and repair any damage to the earthwork until the Owner accepts the Work.

3.9 WATER MANAGEMENT

A. The Contractor shall protect the Work through temporary provision, placement, and maintenance of ample means and devices with which prompt removal and disposal of all ponded water that enters the Work area is possible.

B. Water pumped or drained from the Work area shall be disposed of in a manner satisfactory to the Owner and in accordance with State and Federal regulations, without undue interference with other work or damage to pavement or other surfaces or property.

PART 4 FIELD QUALITY CONTROL

4.1 DOCUMENTATION

A. The Contractor shall provide a daily report to the Owner regarding earthwork activities. This document shall include the following minimum information:
1. Type and quantity of material processed, placed and/or compacted
2. Location of material placement
3. Results of borrow source or in-place Quality Control testing

B. The Contractor shall provide the Owner with a copy of the chain-of-custody record for each sample sent to an independent laboratory.

4.2 TESTING

A. The Contractor shall conduct Quality Control testing in accordance with the following:
1. The following tests shall be performed on subgrade and common fill as applicable:

Property	Test Method	Frequency
Grain Size	ASTM D422	1 test per 5,000 cubic yards and any change in material
Moisture-Density Curve	ASTM D698	1 test per 10,000 cubic yards and any change in material
Density	ASTM D2922	1 test per 1000 cubic yards or per day if <1000 cubic yards placed - Fill 1 test per 20,000 square feet - Subgrade
Classification	ASTM D2487	1 test per 10,000 cubic yards and any change in material

2. The following tests shall be performed for the pipe bedding materials:

Property	Test Method	Requirement
Material Compliance, including Gradation	Supplier Certification	1 per source
Compacted Density	ASTM D2922	1 test per 500 cubic yards or per day if <500 cubic yards placed

3. The following tests shall be performed on drain rock:

Property	Test Method	Requirement
Gradation	Supplier Certification	1 per source
Los Angeles Abrasion	C535 or Supplier Certification	1 per source
Bulk Density	Supplier Certification	1 per source

4.3 QUALITY ASSURANCE SAMPLING AND TESTING

A. The Contractor shall assist the Owner with obtaining Quality Assurance samples for laboratory testing.

B. The Contractor shall allow the Owner access to perform sampling and inspect and test all earthwork lifts before subsequent layers are installed.

END OF SECTION 02200

SECTION 02228

LOW-PERMEABILITY SOIL LAYER

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SECTION 02228

LOW-PERMEABILITY SOIL LAYER

PART 1 GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, materials, tools, equipment, surveying, testing, and supervision to excavate, haul, process, place, compact and maintain the clay liner as detailed on the Drawings.

B. The material to be used for the construction of the primary clay liner shall be excavated from the source identified, transported to the site, processed according to the minimum processing requirements, placed in accordance with the Drawings, and compacted.

1.2 RELATED WORK

A. Section 01010 - Summary of Work

B. Section 01300 - Submittals

C. Section 02200 - Earthwork

D. Section 02771 - Geomembrane

E. U.S. Ecology Contractor Quality Assurance Plan

1.3 DEFINITIONS

A. Degree of Compaction: Degree of compaction shall be expressed as a percentage of the maximum laboratory dry density obtained by the procedure in ASTM D698 and ASTM D1557.

B. Borrow Source: The borrow source, unless otherwise indicated, is the Ketterling Clay Source. Any other borrow source shall require material testing prior to use, and material properties pertinent to the performance of the material as a compacted clay liner shall be at least equal to the previously tested and approved borrow source.

C. Subgrade: The subgrade is the upper 12 inches of material upon which the low-permeability soil is placed.

D. Pass: A one-way trip of a compactor roller over a surface.

1.4 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this Section to the extent referenced. The publications are referred in the text by the basic designation only. Use the latest revision unless otherwise noted:

1. American Society for Testing and Materials (ASTM):

D422-63	Standard Test Method for Particle-Size Analysis of Soils
D1140-00	Standard Test Method for Amount of Material in Soils Finer Than the No. 200 Sieve
D1557-00	Test Method for Laboratory Compaction Characteristics of Soil Using a Modified Effort
D2216	Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
D2487	Standard Classification of Soils for Engineering Purposes
D2488	Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
D2922	Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods
D3017	Moisture Content of Soil and Rock In-Place by Nuclear Methods
D4318	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
D5084	Standard Test Method for Measurement of Hydraulic Conductivity for Saturated Porous Materials Using a Flexible Wall Permeameter
D6391	Field Measurement of Hydraulic Conductivity Limits of Porous Materials Using Two Stages of Infiltration from a Borehole.

1.5 SUBMITTALS

A. Administrative Submittals: The following submittals are required a minimum of 14 days in advance of the start of the Work.

1. Schedule of the Contractor's operations.
2. A written plan that details the steps and processes that will be used by the Contractor in the performance of the Work. The Work includes both the construction of the test strip as well as the compacted clay liner. The plan shall include the following items:
   a. List of equipment anticipated to be used in the conduct of Work.
   b. Estimated schedule of clay excavation, processing, and placement.
   c. Maintenance procedures for the completed clay liner to prevent the adverse impact of the weather.

B. Quality Control Submittals:
1. Test results from the clay borrow source testing (performed by the Owner).
2. Report detailing the construction of the test strip, see Paragraph 3.5.
3. Test results from the compacted clay liner during construction.

C. Exceptions: Listing of all exceptions to the requirements specified herein.

1.6 EQUIPMENT

A. Pulvi-mixer: Pulvi-mixers should be similar to a Caterpillar Model SS-250. The rotor shall have tines specifically designed for cutting and mixing soil and shall be capable of processing soil to meet the project requirements.

B. Footed Compactor: Footed compactors should be similar to the Caterpillar Model 825C and shall have a minimum operating weight of 45,000 pounds, unless otherwise approved by the Engineer. The initial length of the compactor feet shall be 7.5 inches, in no case shall wear reduce the length to less than 6 inches.

C. Smooth-Drum Compactor: Smooth-drum compactors shall be self-propelled and capable of producing at least 3,000 pounds per linear foot of applied force, without vibration mode.

D. Water Truck: A water truck shall be used that is equipped with a horizontal spray bar. The truck must be able to spray water uniformly across the bar.

1.7 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

A. Material shall be excavated and handled at the borrow site in a manner that minimizes the production of dust.

B. The Owner will designate locations for a stockpile of the raw clay, processing area for the clay, and a location for the placement of tanks or other means for storing water.

C. The Contractor shall provide traffic control devices and personnel as needed to execute the construction.

PART 2 PRODUCTS

2.1 CLAY

A. The clay to be used in the construction of the compacted clay liner shall be obtained from the Owner's Ketterling Clay Source, unless otherwise directed by the Owner. Any other borrow source shall require material testing prior to use, and material properties pertinent to the performance of the material as a compacted clay liner shall be at least equal to the previously tested and approved borrow source.

B. The Ketterling Clay exhibits the following typical physical strength properties and characteristics:

Property	Value
Engineering Classification	CL, CH
PI	22 to 28
LL	46 to 54
Percent Passing No. 200 Sieve	98 to 100%
Maximum Density by D1557	100 to 106 pcf
Optimum Moisture Content by D1557	18 to 21%
In situ Dry Density	92 to 100 pcf
In situ Water Content	8 to 26%
Specific Gravity	2.76 to 2.78
Lab K_s	5×10^{-8} to 1×10^{-8} cm/s
Drained Strength: φ c	 26° 300 psf
Undrained Strength: φ c	 0° 3000 psf

2.2 WATER

A. Water used in moisture conditioning of the clay liner will be supplied by the Owner from the existing pond approximately 1/2 mile southeast of the Site on Lemley Road. The Contractor shall transport water from the Owner's supply point to the Contractor's storage facility.

PART 3 EXECUTION

3.1 GENERAL

A. The compacted clay liner shall be placed to the lines, grades, and thickness shown on the Drawings.

B. The Contractor shall excavate, haul to the site, process and moisture condition, place and compact the clay for the liner and maintain the clay liner in an approved manner until final completion and acceptance of the Work under this Contract.

3.2 DRAINAGE

A. At all times during construction, the Contractor shall temporarily provide, place, and maintain adequate means and devices with which to promptly remove and properly dispose of all water entering the cell. The cell excavation shall be kept dry until the structures, pipes, appurtenances to be built therein have been completed to an extent that they will not be damaged.

B. All water pumped or drained from the work area shall be disposed of in a manner satisfactory to the Owner and in accordance with State and Federal regulations, and without undue interference with other work or damage to pavements, other surfaces, or property.

3.3 MATERIAL PROCESSING

A. Moisture Content Adjustment: The excavated clay shall be either dried or moisturized to final uniform moisture content within the range allowed for placement and compaction.

1. Drying:
    a. If the water content needs to be reduced by less than three percentage points, the clay may be dried after it has been spread in a loose lift, just prior to compaction.
    b. If the water content needs to be reduced by more than three percentage points, the clay shall be dried in a separate processing area. The clay shall be spread in a layer 9 to 12 inches thick and disked, mixed, or air dried until the desired moisture content is reached. The Contractor shall perform periodic moisture content tests to determine when the clay has reached the appropriate moisture content.
2. Moisturization:
    a. If the water content needs to be increased by less than three percentage points, the clay may be moisturized after it has been spread in a loose

lift, just prior to compaction. The clay shall be allowed to uniformly hydrate prior to compaction.

b. If the water content needs to be increased by more than three percentage points, the clay shall be moisturized in a separate processing area. The clay shall be spread into a layer 9 to 12 inches thick, with water added uniformly over the layer. The clay shall be periodically mixed or disked to promote uniform moisturization. The Contractor shall perform periodic moisture content tests to determine when the clay has reached the appropriate moisture content. The clay shall be allowed to uniformly hydrate.

c. Water shall be added to a lift in a uniform manner as approved by the Owner. Application of water by means of a hose such that surface ponding or uneven distribution occurs is not allowed.

B. The clay shall be pulverized so that the maximum clod size is less than 2 inches. Hard, dry clods of any size are not permitted. Clods shall contain sufficient uniform moisture so that low-permeability soil can be compacted into a homogeneous mass without visible evidence of determined inter-clod pore spaces when excavated for inspection.

C. The maximum allowable particle size in the clay is 2 inches.

D. Stockpiling Processed Clay: After clay processing, stockpiles of clay shall be protected against changes in moisture content.

1. Small stockpiles shall be covered.
2. Large stockpiles shall either be sloped to promote drainage, with moisture added to offset drying at the surface.
3. Moisturized clay shall be stockpiled for at least 24 hours prior to placement to allow for distribution of water within the clay particles. Experience has shown that additional cure time, beyond 24 hours can facilitate ease of construction.

3.4 SUBGRADE PREPARATION

A. The subgrade shall be shaped to the lines, grades, and cross section as shown on the Drawings.

B. The subgrade shall be sloped to effectively drain. Ponding shall not be permitted. Sumps shall be installed as required. Soft or otherwise unsatisfactory material shall be removed and replaced with properly compacted satisfactory material. The subgrade shall be approved prior to the placement of low-permeability material.

C. The subgrade shall be sealed with a smooth-drum roller to minimize erosion and softening due to rain.

3.5 MATERIAL PLACEMENT AND COMPACTION

A. Construction Start-up:

1. Before construction of low-permeability soil layers, the Contractor may be required to demonstrate to the satisfaction of the Owner and IDEQ that the borrow, processing and compaction operations are capable of producing low-permeability soil in conformance with the project requirements using the Contractor's equipment and procedures.
2. To demonstrate construction methods and the probability of achieving the required permeability of the compacted clay liner, the Contractor shall construct a test strip in the location approved by the Owner.
   a. The test strip shall be constructed of five lifts, as outlined in Section 3.5.B, resulting in a minimum thickness of 3.0 feet.
   b. The dimensions of the test strip shall be a minimum of 30 feet wide and 120 feet long. The Contractor shall make adjustments to the test strip size to account for equipment run-out. The equipment shall be operating at full speed over the test strip.
   c. The test strip shall be constructed using the same equipment, materials, lift thicknesses, and methods that will be utilized during the construction of the compacted clay liner.
   d. The Contractor shall sample and test the test strip in accordance with the following table:

Property	Test Method	Frequency	Notes
Density	ASTM D2922	5 tests per lift	On compacted lift
Moisture Content	ASTM D3017	5 tests per lift	On compacted lift
Flex-wall Permeability [1,2]	ASTM D5084	5 tests	From Boutwell test location
Boutwell Permeability [1,2]	ASTM D6391	5 tests	Stage I of test procedure
Dry Density (In situ)	ASTM D5084	1 test per lift	On compacted lift
Moisture Content (In situ)	ASTM D2216	1 test per lift	From density test location
Percent Fines	ASTM D1140	1 test per lift	From density test location
Atterberg Limits	ASTM D4318	1 test per lift	From density test location
Grain Size	ASTM D422	1 test per lift	From density test location
Moisture-Density Relationship	ASTM D1557	1 test	

Note 1: All permeability values must be less than 1×10^{-7} cm/sec.
Note 2: Permeability testing for the test strip will be performed by the CQA Engineer.

   e. The CQA Engineer will administer the permeability testing on the test pad. Results of the permeability tests will be issued to the Contractor within 10 days of test pad construction.
   f. A correlation shall be established based upon the results of the lab and field permeability tests. The correlation will be used to determine the threshold limit for lab permeability on the constructed clay liner.

g. The Engineer will prepare a report that describes the construction and testing of the test strip. The report will include figures that illustrate the layout and cross section of the test strip. This report will incorporate all test results and will be a basis for comparing future test results on the compacted clay liner. The test pad shall be submitted to the owner and subsequently submitted to IDEQ for review. Acceptance of the Test Pad Report will require up to 30 days. Construction of the low permeability liner (CCL) may not proceed prior to acceptance of the Test Pad Report.

B. Lifts:

1. Low-permeability soil shall be placed in uniform lifts parallel to the ground surface, including slopes, unless otherwise approved.
2. Loose lift thickness shall not exceed 9 inches. Compacted lift thickness shall not exceed 6 inches. The exception is the first lift of the compacted clay liner over the subgrade may be 12 inches compacted thickness.
3. Lifts that have been sealed with a smooth-drum compactor shall be scarified approximately 1 inch and wetted as necessary before placement of subsequent lifts of low-permeability soil.

C. Moisture Conditioning:

1. Moisture adjustments of up to three percentage points can be made just prior to compaction at the final location.
2. Material that is too wet or too dry (more than three percentage points) shall be removed from the soil layer and replaced at the Contractor's expense.

D. Compaction:

1. The low-permeability soil shall be compacted to a water content and density that plots within the acceptable range shown in the figure in Paragraph 4.2.B.3.a.
2. A footed compactor shall be used to compact the low-permeability soil. Other compaction equipment may be used if demonstrated to provide adequate compaction through the test strip construction and testing in accordance with Paragraph 3.5.A.2.
3. The Contractor is encouraged to over-build the clay liner with a sacrificial lift of clay. The upper surface of the compacted clay liner should be left in a rough state, during the interim between construction and final trimming, to reduce the effects of interstitial wicking of moisture to the surface.

E. Joints:

1. Overlying lifts shall be placed so that the longitudinal joints between lifts are staggered by at least 2 feet.
2. Joints between old and new lifts, successive day's work, or joints that have become excessively dry shall be scarified, moisture conditioned, and reworked

as necessary to ensure continuous bonding. Adjoining low-permeability soils shall have nearly the same moisture content.

F. Final Grading/Tolerance:

1. The Contractor shall perform grading to the required lines and grades as specified on the Drawings. The Contractor is responsible for grade staking.
2. The final surface shall be constructed with a tolerance of –0.00 to +0.50 feet from the elevations specified on the Drawings. The minimum thickness of the compacted clay liner measured perpendicular to the slope shall be 36 inches with a tolerance of –0.00 to +0.50 feet.
3. The final surface shall not deviate more than 2 inches from a 10-foot-long straight edge placed anywhere on the finished surface.
4. The Contractor shall maintain the minimum slope in the base area of the cell, as shown on the Drawings.
5. Use of grade stakes, hubs, pins, and pin flags are prohibited on the clay liner. Survey control during construction of the clay liner should be accomplished with the aid of global satellite positioning (GPS) equipment. The surface of the compacted clay liner shall be free of all sharp objects that could puncture the succeeding geomembrane liner. Holes that are inadvertently made in the clay liner shall be filled with bentonite chips, moisturized and tamped with a rod.

3.6 PROTECTION

A. General:

1. The Contractor shall protect the clay liner from the effects of weather.
2. The finished, smooth surface and moisture content of the clay liner shall be maintained by the Contractor until the Geomembrane Liner Contractor inspects, approves, and deploys the geomembrane liner.

B. Desiccation:

1. The contractor shall protect the compacted clay liner from desiccation. The following methods are suggested means of protection from desiccation:
   a. Construct the clay liner to full thickness with an additional sacrificial layer in a consecutive manner. Placement of at least one lift per day will generally aid in the prevention of excessive loss of moisture. Failures in the clay liner have generally been associated with lifts of clay that are left exposed to the elements for an extended period of time.
   b. Add water to the compacted clay liner periodically. Water shall be added uniformly across the clay layer to prevent zones of excessively wet or dry clay.

c. Cover the clay with a temporary geomembrane or wet geotextile. This geosynthetic cover shall be weighted down to prevent air transfer between the clay and the geosynthetic cover. The temporary cover shall be removed prior to constructing the next layer.

2. If, in the Engineer's opinion, the compacted clay liner has been allowed to desiccate, the Contractor shall perform a moisture content test. If the moisture content of the liner has decreased by more than two percentage points, the following corrective action shall be taken as directed by the Owner:

   a. If the compacted clay liner has been desiccated to a depth less than or equal to the thickness of a single lift, the Contractor shall disk, moisten, allow to uniformly rehydrate, and recompact the lift. Alternately, the Contractor shall remove the desiccated soil and replace with properly moisture-conditioned and compacted clay, or protect the surface by overbuilding the liner thickness and cutting it back to final grade just prior to liner deployment. Any large, hard clods of clay shall be pulverized or removed from the area.

   b. If the clay layer has been desiccated to a depth greater than the thickness of a single lift, the contractor shall remove the clay from the construction area, process the clay, and replace the clay accordingly. The depth of removal shall be a minimum of 3 inches below the desiccation cracking as determined by the Engineer.

C. Freezing:

1. Frozen soil shall not be used in the construction of the compacted clay liner.
2. Liner placement must be concluded and at least 12-inches of protective soil or waste must be in place prior to October 29.
3. Prior to January 1, the remaining 18-inches of protective material, or other protective devices approved by the Engineer, must be in place.
4. If, in the opinion of the Engineer, frost damage has occurred, the following corrective action shall be taken as directed by the Owner.

   a. If superficial freezing occurs on the surface of a clay lift, the surface shall be scarified and recompacted.

   b. If an entire lift has been frozen, the entire lift shall be disked, pulverized, and recompacted.

   c. If the clay layer has been frozen to a depth greater than the thickness of a single lift, the Contractor shall remove the clay from the construction area, process the clay, and replace the clay accordingly. The depth of removal shall be a minimum of 3 inches below the frozen material as determined by the Engineer.

3.7 CORRECTIVE ACTION

A. If test results indicate that portions of the compacted clay liner do not conform with the physical and strength requirements, the liner shall be repaired to the limits defined by passing Quality Control results. To reduce the limits of the areas requiring repair, the Contractor may perform additional Quality Control sampling and testing to demonstrate conformance with the Specifications. Repairs shall be made from the point of failure extending in all directions to the nearest passing tests.

B. The water content of the clay may be adjusted in place, as described in Paragraph 3.5.C.

C. If the clay contains oversized material or clods, the particles shall be removed or the colds pulverized.

D. If the compacted clay liner does not meet the requirements of the figure in Paragraph 4.2.B.3, the clay shall be recompacted until Quality Control testing demonstrates compliance with the requirements. If the requirements cannot be met with additional compaction, the clay shall be removed and replaced with suitable clay material.

E. The Contractor shall repair all penetrations in the compacted clay liner from Quality Control and Quality Assurance testing. The penetrations shall be backfilled with bentonite, moisturized and compacted with a rod.

PART 4 FIELD QUALITY CONTROL

4.1 DOCUMENTATION

A. The Contractor shall provide a daily report to the Owner regarding the clay processing and placement. This document shall include the following minimum information:

1. Representative raw clay moisture content (%)
2. Quantity of raw clay processed (cubic yards or tons)
3. Quantity of reject material (cubic yards or tons)
4. Quantity of water added (gallons)
5. Representative processed clay moisture content (%)
6. Estimated quantity of material placed in cell (cubic yards or tons)

B. The Contractor shall provide the Owner with a copy of the chain of custody record for each sample.

4.2 SAMPLING AND TESTING

A. Borrow Source:

1. The Owner will perform borrow source sampling and engage a laboratory to perform testing to confirm the consistency of the source material in accordance with the table below:

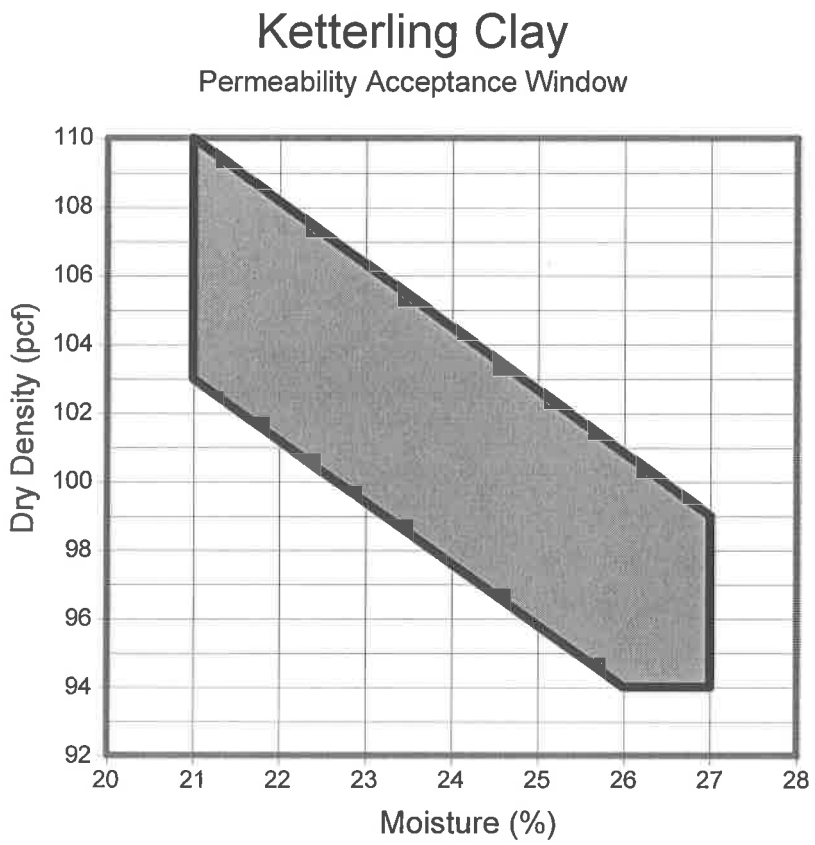
Property	Test Method	Frequency
Grain Size	ASTM D422	1 per 5,000 cy and each change in material
Percent Fines	ASTM D1140	1 per 5,000 cy and each change in material
Moisture Content	ASTM D2216	1 per 5,000 cy and each change in material
Atterberg Limits	ASTM D4318	1 per 5,000 cy and each change in material
Moisture-Density Relationship	ASTM D1557	1 per 5,000 cy and each change in material

B. Placed Liner:

1. The Contractor shall perform placed liner sampling and field testing in accordance with the table below:

Property	Test Method	Frequency	Notes
Density	ASTM D2922	5 tests per acre per lift	On compacted lift [2]
Moisture Content	ASTM D3017	5 tests per acre per lift	On compacted lift [2]
Percent Fines	ASTM D1140	1 test per acre per lift	From density test location
Atterberg Limits	ASTM D4318	1 test per acre per lift	From density test location
Permeability[1]	ASTM D5084	1 test per acre per lift	From density test location
Grain Size	ASTM D422	1 test per acre per lift	From density test location
Note 1: 95% of all tests shall not exceed the correlated threshold value for lab permeability, as discussed in sections 3.5.A.2.f and 4.2.B.4. No test value shall exceed the threshold value by greater than one-half order of magnitude. Note 2: Moisture and density tests shall be performed at least once per day during placement of CCL.			

2. The Contractor shall establish a means of locating samples during construction of the compacted clay liner. Sampling locations within a lift shall be a minimum of 10 feet apart. Sample locations in successive lifts will be staggered to avoid taking samples at the same location.
3. The placed liner's density and moisture content shall fall within the range of values shown on the figure below:



4. The threshold value for laboratory permeability shall be 6.6x10-8 cm/sec. Modification to the correlated threshold value requires additional test strip construction and subsequent approval by IDEQ.

4.3 QUALITY ASSURANCE SAMPLING

A. The Contractor shall assist the Owner with obtaining Quality Assurance samples for laboratory testing.

B. The Contractor shall allow the Owner access to perform sampling and inspect and test the subgrade and compacted clay liner lifts before subsequent lifts are constructed.

END OF SECTION 02228

SECTION 02253

GEOSYNTHETIC CLAY LINER

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SECTION 02253

GEOSYNTHETIC CLAY LINER

PART 1 GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, materials, tools, equipment, surveying, testing, and supervision to furnish, install and protect the geosynthetic clay liner (GCL) as indicated on the Drawings. GCL shall be installed as part of the landfill cover system and as an additional barrier within each sump in the liner system.

1.2 RELATED WORK

A. Section 01010 - Summary of Work

B. Section 01300 - Submittals

C. Section 02200 - Earthwork

D. Section 02771 - Geomembrane

E. U.S. Ecology Contractor Quality Assurance Plan

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this Section to the extent referenced. The publications are referred to in the text by the basic designation only. Use the latest revision unless otherwise noted:

1. American Society for Testing and Materials (ASTM):

D 4632 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

D 4643 Determination of Water (Moisture) Content of Soil by the Microwave Oven Method

D 5261 Standard Test Method for Measuring Mass Per Unit Area of Geotextiles

D 5887 Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter

D 5888 Standard Guide for Storage and Handling of Geosynthetic Clay Liners

D 5889 Standard Practice for Quality Control of Geosynthetic Clay Liners

D 5890 Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners

D 5993 Standard Test Method for Measuring Mass Per Unit of Geosynthetic Clay Liners

D 6102 Standard Guide for Installation of Geosynthetic Clay Liners"

D 6243 Standard Test Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method

D 6496 Standard Test Method for Determining Average Bonding Peel Strength Between the Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners

D 6768 Standard Test Method for Tensile Strength of Geosynthetic Clay Liners

1.4 SUBMITTALS

A. Administrative Submittals: The following submittals are required a minimum of 14 days in advance of the start of the Work.
   1. Schedule of the Contractor's operations.
   2. A written plan that details the steps and processes that will be used by the Contractor in the performance of the Work. The plan shall include the following items:
      a. List of equipment anticipated to be used in the conduct of Work
      b. Transportation and off-loading
      c. Inspection of delivered materials
      d. Storage of delivered materials
      e. On-site handling and deployment
      f. Installation procedures
      g. General precautions to prevent damage
      h. Schedule

B. Shop Drawings:
   1. Details of seaming procedures, special construction details, anchoring detail, and temporary anchors.
   2. Manufacturer's data cut sheets for all proposed GCL materials for the project.

C. Samples: Representative samples of all GCL materials proposed for use on this project, together with their full designation, manufacturer name, and applicable installation instructions.

D. Certifications:
   1. Certification by the manufacturer that the properties of the GCL materials meet or exceed the physical strength requirements of Paragraph 2.1.B.2.
   2. Certification by the manufacturer that the raw material properties meet or exceed the requirements of Paragraph 2.1.A.
   3. Certification that the manufacturer performed continuous inspection of the GCL for the presence of broken needles and that the GCL has been found to be needle-free.

E. Quality Control Submittals:
   1. Certified test results provided by the manufacturer for all rolls of material. The following is the minimum information required:
      a. Material identification
      b. Roll number
      c. Batch number
      d. Parent material identification
      e. Manufacture date
      f. Test results
         1) Hydraulic conductivity
         2) Bentonite mass/unit area
         3) Peel strength
         4) Grab strength
         5) Hydrated internal shear strength
   2. Contractor's Daily Report of Operations.

F. Exceptions: Listing of all exceptions to the requirements specified herein.

1.5 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

A. Material shall be delivered to the site only after all required submittals have been approved by the Owner.

B. Material delivery, storage, and handling shall conform to the manufacturer's recommendations and shall be done in a manner that prevents damage to any part of the Work.

C. Rolls will be delivered to and stored on the site in protective packaging. The integrity of this packaging shall be maintained until the roll is to be installed.

D. Each roll of GCL shall bear a label that identifies the following:
   1. Manufacturer name
   2. Product identification
   3. Roll number
   4. Batch code/lot number
   5. Physical dimensions
   6. Weight
   7. Date of manufacture
   8. Location of manufacture

E. Unprotected outdoor storage of GCLs is not allowed. The Owner may provide an indoor storage location at the site. Storage at the site shall only be considered when proper positioning and protection can be maintained.
   1. Handling of rolls of GCL shall be done in a manner that prevents damage to the product or to its protective wrapping. ASTM D4873 shall be followed.
   2. The location of temporary site storage shall not be in areas where water can accumulate. The rolls shall be stored on high flat ground or elevated off the ground to avoid forming a dam that allows the ponding of water. If storage platforms are used, the rolls shall be continuously supported throughout their length.
   3. The rolls shall not be stacked in a manner that allows deformation of the roll or thinning of the product at the points of contact to occur.
   4. If outdoor storage of the rolls is to be longer than a few weeks, tarps shall be used to minimize moisture pickup. For storage periods longer than one season, a temporary enclosure shall be placed over the rolls, or they shall be moved to an enclosed facility.

PART 2 PRODUCTS

2.1 GEOSYNTHETIC CLAY LINER

A. Geosynthetic Clay Liner:

1. The GCL will consist of sodium bentonite encapsulated and secured by the manufacturer between two backing layers of non-woven polyester or polypropylene geotextile that are needle-punched together. The GCL shall be manufactured by mechanically bonding the geotextiles using a needlepunching process to enhance frictional and internal shear strength characteristics.
2. The GCL shall meet the physical properties in the table below.

Tested Property	Test Method	Testing Frequency	Minimum Average Roll Value (MARV)
Nonwoven Geotextile			
Top Mass per Unit Area	D 5261	1/200,000 ft^2	6.0 oz/yd^2
Bottom Mass per Unit Area	D 5261	1/200,000 ft^2	6.0 oz/yd^2
Bentonite Core			
Swell Index	D 5890	1/100,000 lbs	24 ml/2 g min
Moisture Content	D 4643	1/100,000 lbs	12 % max
Finished GCL			
Bentonite Mass per Unit Area [1]	D 5993	1/40,000 ft^2	0.89 lb/ft^2
Tensile Strength [2]	D 6768	1/40,000 ft^2	45 lb/in
Grab Strength [3] Elongation	D 4632	1/40,000 ft^2	150 lbs 100% Typical
Peel Strength [2]	D 6496 D 4632	1/40,000 ft^2	2.5 lb/in 15 lb
Hydraulic Conductivity [4] Index Flux	D 5887	1/200,000 ft^2	5×10^{-11} m/sec 1×10^{-8} m^3/m^2/sec max
Internal Shear Strength [5]	D6243	1/200,000 ft^2	650 psf @ 1,000 psf

[1] Equates to 1 lb/ft2 when indexed to 12% moisture content.
[2] 4 inch wide sample, average of 5 specimens.
[3] Weakest principal direction.
[4] 5 psi confining stress and 2 psi head.
[5] Hydrated for 24 hours under 250 psf confinement, shear rate of 0.01 in/min.

3. The geotextiles shall be continuously inspected for broken needles with an in-line metal detector. Broken needles shall be removed from the geotextile.
4. A minimum overlap guide-line and a construction match-line delineating the overlap zone shall be imprinted with non-toxic ink on both edges of the GCL panel to ensure the accuracy of the seam. These lines shall be used during CQA to ensure the minimum overlap is achieved. The minimum overlap guideline shall indicate where the edge of the panel must be placed in order to achieve a full six inches of bentonite overlap for each panel.
5. All GCL rolls shall be packaged in moisture resistant and UV protective plastic sleeves. The cardboard cores shall be sufficiently strong to resist collapse during transit and handling.

6. The manufacturer's Quality Control Plan shall be implemented and followed during the manufacture of the GCL.
7. Rolls of GCL shall be stored indoors until shipped to the site. Rolls of GCL shall be handled or stored in a manner that prevents damage to the protective cover and avoids deformation and thinning of the product at the points of contact with the storage frame or with one another.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:
1. The subgrade surface shall be dry. No water shall contact the GCL.
2. The GCL shall be protected from hydration during installation. No more GCL shall be deployed than can be covered and sealed by geomembrane in a day.
3. The Contractor is responsible for the cost associated with the removal and replacement of all deployed GCL that has been damaged by hydration.

B. Subgrade Preparation:
1. For GCL installation, subgrade is defined as the upper 12 inches of properly compacted select waste.
2. Select waste shall be compacted as specified in Paragraph 3.5 of Section 02200 – Earthwork.
3. Subgrade surface shall be free from all debris, roots, and angular or sharp rocks.
4. Prior to the deployment of the GCL, the subgrade will be prepared by filling all voids or cracks and smooth-drum rolling.
5. The subgrade shall be firm and unyielding by visual inspection when subjected to construction equipment traffic loading.

C. Shipping and Handling Equipment:

The party responsible for unloading the GCL shall contact the manufacturer prior to shipment to determine the correct unloading methods and equipment if different from the pre-approved and specified methods. Suitable handling equipment is described below:

Spreader Bar Assembly - A spreader bar assembly shall include both a core pipe or bar and a spreader bar beam. The core pipe shall be used to uniformly support the roll when inserted through the GCL core while the spreader bar beam will prevent chains or straps from chafing the roll edges.

Stinger - A stinger is a rigid pipe or rod with one end directly connected to a forklift or other handling equipment. If a stinger is used, it should be fully inserted to it's full length into the roll to prevent excessive bending of the roll when lifted.

Roller Cradles - Roller cradles consist of two large diameter rollers spaced approximately 3 inches apart, which both support the GCL roll and allow it to freely unroll. The use of roller cradles shall be permitted if the rollers support the entire width of the GCL roll.

Straps - Straps may be used to support the ends of spreader bars but are not recommended as the primary support mechanism. As straps may damage the GCL where wrapped around the roll and generally do not provide sufficient uniform support to prevent roll bending or deformation, great care must be exercised when this option is used.

D. Deployment:

1. The GCL shall be installed in a manner that minimizes the number of joints between panels that are subject to tensile stress. The panels shall be oriented so that the tensile stress in the panel is in the machine direction.
2. During placement, care must be taken not to entrap fugitive clay, stones, or sand that could damage the geotextile, cause clogging of drains or filters, or hamper subsequent seaming of materials either beneath or above the GCL or sealing of the GCL overlaps.
3. For deployment on side slopes, the GCL shall be anchored at the top and then unrolled to keep the material free of wrinkles and folds.
4. All edges of a panel shall be pulled tight to maximize contact and to smooth out wrinkles and creases.
5. Trimming of the GCL shall be done with great care so that fugitive clay particles do not come in contact with drainage materials such as geonets, geocomposites, or natural drainage materials.

6. The deployed GCL shall be visually inspected to verify that no potentially harmful objects, including stones, cutting blades, small tools and sandbags, are present.

E. Seaming:
1. Contacting surfaces of the seam area shall be clean and free from dirt, soil, mud, and/or any other materials that could reduce the effectiveness of the bentonite seam.
2. All seam areas shall be overlapped at least 6 inches along the sides and at least 12 inches along the ends. All overlaps shall be laid out so that the upgradient panel overlaps the downgradient panel as appropriate.
3. Seams shall be augmented with granular bentonite of the same quality as described in Paragraph 2.1.A. The bentonite shall be placed at a rate of one quarter (¼) pound per linear foot of seam spread 6 inches wide.
4. All seams shall be oriented perpendicular to the slope.
5. Seams at the base of the slope shall be a minimum of 15 feet from the toe of the slope.
6. In the event that a seam of joint that cannot be avoided occurs on a slope, the overlap shall be increased to a minimum of 3 feet so that the upgradient panel overlaps the downgradient panel.

F. Covering:
1. The Contractor shall not cover the GCL before observation and approval by the Owner.
2. The GCL shall be covered with its subsequent layer at the end of each day.
3. The overlying material shall not be deployed in a manner that mobilizes excess tensile stress in the GCL.

G. GCL Penetrations: Pipe penetrations through the GCL shall use an excess of hand-placed bentonite as indicated on the Drawings.

3.2 REPAIRS

A. Holes, tears, or rips in the covering geotextiles made during transportation, handling, placement, or anytime before backfilling shall be repaired by patching using a geotextile.

B. Tears or rips in the geotextile shall be repaired using a patch of the same type of geotextile as the damaged geotextile or other geotextile approved by the Owner.

C. On flat areas, the size of the patch shall extend at least 12 inches beyond any portion of the damaged geotextile. On slopes 3:1 (H:V) or steeper, the patch shall be a minimum of 3 feet larger in all directions than the area to be repaired.

D. All patches shall be adhesive or heat bonded to the product to avoid shifting during backfill operations. Seams for all patches shall be augmented with granular bentonite in accordance with Paragraph 3.1.D.3.

E. If bentonite particles are lost from within the GCL or if the clay has shifted, the patch shall consist of the full GCL product. It shall extend at least 12 inches beyond the extent of the damage at all locations.

F. Particular care shall be taken in using a GCL patch since fugitive clay can be lost and find its way into drainage materials or onto geomembranes in areas that will eventually be seamed together.

PART 4 FIELD QUALITY CONTROL

4.1 DOCUMENTATION

A. The Contractor shall provide a daily report to the Owner regarding the GCL installation. This document shall include the following minimum information:

1. Quantity of GCL deployed
2. Linear feet of seams constructed
3. Map indicating locations of field seams
4. Location and nature of repairs to the GCL

B. The Contractor shall provide the Owner with a copy of the chain-of-custody record for each sample sent to an independent laboratory.

4.2 TESTING

A. The manufacturer shall conduct Quality Control testing in accordance with the requirements of Paragraph 2.1.B.2. The Contractor shall provide the test results to the Owner prior to shipment of the GCL to the site.

4.3 QUALITY ASSURANCE SAMPLING AND TESTING

A. The Contractor shall assist the Owner with obtaining Quality Assurance samples for laboratory testing.

1. If requested by the Owner, the Contractor shall provide samples of the GCL for Quality Assurance sampling. The samples shall be 3 feet in length and the entire width of the GCL roll.

2. The results of Quality Assurance testing will be compared with the requirements in Paragraph 2.1.A.2 and with the Quality Control testing results provided by the manufacturer.

B. The Contractor shall allow the Owner access to perform sampling and inspect and test the GCL before subsequent layers are installed or constructed.

END OF SECTION 02253

SECTION 02272

GEOTEXTILES

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SECTION 02272

GEOTEXTILES

PART 1 GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, materials, tools, equipment, surveying, testing, and supervision to furnish and install the geotextiles as indicated on the Drawings.

1.2 RELATED WORK

A. Section 01010 - Summary of Work

B. Section 01300 - Submittals

C. Section 02200 - Earthwork

D. Section 02253 - Geosynthetic Clay Liner

E. Section 02771 - Geomembrane

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this Section to the extent referenced.

1. American Society for Testing and Materials (ASTM):

D 5261 Standard Test Method for Measuring Mass per Unit Area of Geotextiles

D 4632 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

D 4533 Standard Test Method for Index Trapezoidal Tearing Strength of Geotextiles

D 4632 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

D 4833 Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products

D 4491 Standard Test Method for Water Permeability of Geotextiles by Permittivity

D 4751 Standard Test Method for Determining Apparent Opening Size of a Geotextile

D 4354 Standard Practice for Sampling of Geosynthetics for Testing

D 4355 Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus

D 4759 Standard Practice for Determining the Specifications Conformance of Geosynthetics

D 4873 Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples

1.4 SUBMITTALS

A. The following administrative submittals are due 14 days prior to the Contractor beginning the Work:
   1. Contractor's schedule of installation of the geotextile fabric.
   2. Shop drawings that detail special construction details, anchoring details, and temporary anchors.
   3. Representative samples of all geosynthetics proposed for use on the project, together with their full designation, manufacturer name, and applicable installation instructions.
   4. Manufacturer's Certification that the geotextile fabric meets or exceeds the physical strength requirements found herein.

B. Quality Control Submittals:
   1. Daily report of Contractor's activities.
   2. The Contractor shall submit certified laboratory test results that the geotextiles meet the physical strength requirements found in Paragraphs 2.1 and 2.2 of this Section.

C. Exceptions: Listing of all exceptions to the requirements specified herein.

1.5 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

A. The Owner shall approve all submittals prior to the delivery of material at the site.

B. Material delivery, storage, and handling shall conform to the manufacturer's recommendations and shall be done in a manner that prevents damage to any part of the Work.

C. Handling of rolls shall be completed in a competent manner so that damage does not occur to the geotextile or to its protective wrapping. ASTM D4873 shall be referenced and followed.

D. Rolls shall be delivered to and stored on the site in ultraviolet light-resistant packaging. The integrity of this packaging shall be maintained until the roll is to be installed. Any protective wrapping that is accidentally damaged or stripped off the rolls shall be repaired immediately or covered if the geotextile will not be installed within 60 days.

E. Each roll of geotextile fabric shall bear a label that identifies the following:
1. Manufacturer
2. Product identification
3. Roll number
4. Batch code
5. Physical dimensions
6. Date of manufacture

F. Field storage shall be located in areas where water cannot accumulate. The rolls shall be elevated off the ground to avoid forming a dam that allows the ponding of water.

PART 2 PRODUCTS

2.1 SEPARATION GEOTEXTILE

A. Geotextile fabric shall be a needle-punched non-woven polypropylene fabric.

B. The delivered geotextile fabric shall meet the physical strength properties in the following table:

Tested Property	Test Method	Testing Frequency	8-Ounce Geotextile (MARV)	16-Ounce Geotextile (MARV)
Mass per Unit Area	D 5261	90,000 ft^2	8 oz/yd^2	16 oz/yd^2
Grab Tensile Elongation	D 4632	90,000 ft^2	220 lbs 50%	390 lbs 50%

Tested Property	Test Method	Testing Frequency	8-Ounce Geotextile (MARV)	16-Ounce Geotextile (MARV)
Puncture Strength	D 4833	90,000 ft^2	120 lbs	240 lbs
AOS, US Sieve [1]	D 4751	540,000 ft^2	80	100
Permittivity Flow Rate	D 4491	540,000 ft^2	1.5 sec^{-1} 0.30 cm/sec	0.7 sec^{-1} 0.27 cm/sec
UV Resistance (retained)	D 4355	Once per formulation	70%	70%
[1] AOS is a maximum average roll value.				

PART 3 EXECUTION

3.1 GENERAL

A. Geotextiles shall be handled in a manner that ensures they are not damaged in any way.

B. The contractor shall exercise care to ensure that the underlying layer is not damaged during installation.

C. In the presence of wind, the Contractor shall weight the materials with sandbags until the overlying material has been placed. Securing pins or other methods that may damage the HDPE geomembrane will not be permitted.

D. During backfill operations, the soil shall be placed so that the geotextile is not shifted or ripped from its intended position.

3.2 GEOCOMPOSITE APPLICATION

A. Because a geosynthetic such as a HDPE geomembrane will underlie the geocomposite during installation, the materials shall be deployed by hand.

B. The Contractor shall perform a visual inspection of the deployed materials to ensure that defects do not exist. Defective areas shall be replaced.

C. The overlying material shall not be placed in a manner that causes excess tensile stress in the geotextile to be mobilized. On side slopes, this requires soil backfill to proceed from the bottom of the slope upward.

3.3 LEACHATE DETECTION AND COLLECTION SYSTEM APPLICATION

A. The geotextile shall be placed on top of the drain rock as shown on the Drawings.

B. Adjacent geotextile panels shall be overlapped a minimum of 24 inches in the direction of flow with the upstream fabric on top of the downstream fabric.

C. Care shall be taken during installation of the drain rock and the leachate header and collector pipes to prevent damage to the fabric.

D. Do not wrap perforated or slotted pipe directly with geotextile.

3.4 PROTECTION

A. The Contractor shall protect the integrity of the geotextile materials until overlying materials are placed and until the Owner accepts the installed Work.

PART 4 FIELD QUALITY CONTROL

4.1 DOCUMENTATION

A. The Contractor shall provide a daily report to the Owner regarding installation activities. This document shall include the following minimum information:
   1. Type and quantity of material placed
   2. Location of material placement

B. The Contractor shall provide the Owner with a copy of the chain-of-custody record for each sample sent to an independent laboratory.

4.2 QUALITY ASSURANCE SAMPLING AND TESTING

A. The Contractor shall assist the Owner with obtaining Quality Assurance samples for laboratory testing.

B. The Contractor shall allow the Owner access to perform sampling and inspect and test all geotextiles before subsequent layers are installed on top of them.

END OF SECTION 02272

SECTION 02274

GEOCOMPOSITE

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SECTION 02274

GEOCOMPOSITE

PART 1 GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, materials, tools, equipment, surveying, testing, and supervision to install the geocomposite materials as indicated on the Drawings.

B. Type 1 geocomposite shall be placed as a part of the cell liner system, as shown on the Drawings.

1.2 RELATED WORK

A. Section 01010 - Summary of Work

B. Section 01300 - Submittals

C. Section 02200 - Earthwork

D. Section 02228 - Low-Permeability Soil Layer

E. Section 02253 - Geosynthetic Clay Liner

F. Section 02771 - Geomembrane

G. Section 02272 - Geotextiles

H. U.S. Ecology Contractor Quality Assurance Plan

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this Section to the extent referenced. The publications are referred to in the text by the basic designation only. Use the latest revision unless otherwise noted:

1. American Society for Testing and Materials (ASTM):

D 1505 Standard Test Method for Density of Plastics by the Density Gradient Technique

D 1603	Standard Test Method for Carbon Black in Olefin Plastics
D 4355	Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
D 4491	Standard Test Method for Water Permeability of Geotextiles by Permittivity
D 4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
D 4716	Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
D 4751	Standard Test Method for Determining Apparent Opening Size of a Geotextile
D 4873	Standard Guide for Identification, Storage
D 4833	Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
D 5261	Standard Test Method for Measuring the Mass Per Unit Area of Geotextiles
D7005	Determining the Bond Strength (Ply-Adhesion) of Geocomposites

B. Relevant publications from the Environmental Protection Agency (EPA):

1. Daniel, D.E. and R.M. Koerner, (1993), *Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities* EPA/600/R-93/182.

1.4 SUBMITTALS

A. The following administrative submittals are due 14 days prior to the Contractor beginning the Work:
   1. Contractor's schedule of installation of the geocomposite materials.

2. Shop drawings that detail seaming procedures, special construction details, anchoring details, and temporary anchors.
3. Written installation procedures for the geocomposite. These procedures should cover the basic procedures of off-loading, storage, deployment, joining, and precautions to prevent damage to the underlying materials and clogging of the geocomposite with soil or other fine materials.
4. Representative samples of all geocomposite materials proposed for use on the project, together with their full designation and manufacturer name.
5. Manufacturer's Certification that the geocomposite materials meet or exceed the physical strength requirements found herein.

B. Quality Control Submittals:
1. Daily report of Contractor's activities.
2. The Contractor shall submit copies of dated quality control certificates with laboratory test results showing that the geotextiles and drainage nets meet the material requirements found in Paragraphs 2.1 and 2.2 of this Section.

C. Exceptions: Listing of all exceptions to the requirements specified herein.

1.5 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

A. The Owner shall approve all submittals prior to the delivery of material to the site.

B. Material delivery, storage, and handling shall conform to the manufacturer's recommendations and shall be done in a manner that prevents damage to any part of the Work.

C. Handling of rolls shall be completed in a competent manner so that damage does not occur to the geocomposite or to its protective wrapping. ASTM D4873 shall be referenced and followed.

D. Rolls shall be delivered to and stored on the site in ultraviolet light-resistant packaging if recommended by the manufacturer. The integrity of this packaging shall be maintained until the roll is to be installed. Any protective wrapping that is accidentally damaged or stripped off the rolls shall be repaired immediately or covered if the geotextile will not be installed within 60 days.

E. Each roll of geotextile fabric shall bear a label that identifies the following:
1. Manufacturer
2. Product identification
3. Roll number
4. Batch code

5. Physical dimensions
6. Date of manufacture

F. Fielded storage shall be located in areas where water cannot accumulate. The rolls shall be elevated off the ground to avoid forming a dam that allows the ponding of water.

G. Different types of geocomposite material shall also be distinguished in the field by painting the ends of each material type with a common color, so that the materials can easily be identified by field personnel.

PART 2 PRODUCTS

2.1 TYPE 1 GEOCOMPOSITE

A. The liner geocomposite material shall consist of an HDPE core drainage net with 8-ounce geotextile fabric heat-bonded to at least one side of the net. All geocomposite material installed on sidewalls of the cell shall be double sided. All geocomposite material placed on the floor of the cell shall be installed with the textile fabric on the top side.

B. Geotextile fabric shall be a minimum 8-ounce needle-punched non-woven polypropylene fabric and shall meet the requirements of Section 02272.

C. The core drainage net shall be free from dirt, dust, and debris before the geotextile is bonded. The geotextile shall be joined to the core net in a manner that will not compromise the integrity of the geotextiles or reduce the geocomposite in-plane flow rate to below the required value.

Tested Property	Test Method	Testing Frequency	Minimum Average Roll Value (MARV)
Geocomposite			
Transmissivity [1]	D 4716	1/540,000 ft^2	$3.0x10^{-4}$ m^2/sec (sidewalls) $1.0x10^{-3}$ m^2/sec (floor)
Ply Adhesion	D 7005	1/50,000 ft^2	1.0 lbs/in
Geonet Core			
Density	D1505	1/50,000 ft^2	0.94 g/cm^3
Carbon Black Content	D1603	1/50,000 ft^2	2.0%
Geotextile (prior to lamination)			
Mass per Unit Area	D 5261	1/90,000 ft^2	8 oz/yd^2
Grab Tensile	D 4632	1/90,000 ft^2	220 lbs
Puncture Strength	D 4833	1/90,000 ft^2	120 lbs
AOS, US Sieve [2]	D 4751	1/540,000 ft^2	80
Permittivity	D 4491	1/540,000 ft^2	1.5 sec^{-1}
Flow Rate	D 4491	1/540,000 ft^2	110 gpm/ft^2
UV Resistance (retained)	D 4355	Once per formulation	70%

[1] Gradient of 0.1, normal load of 18,000 psf, between steel plates for 15 minutes.
[2] AOS is a maximum average roll value.

2.2 JUNCTION TIES

A. The geocomposite panels shall be joined together with locking ties that are typically referred to as cable ties.

B. The ties shall be manufactured of an ultraviolet stabilized nylon parent material that is of contrasting color to the geocomposite being joined (white ties with a black geocomposite).

PART 3 EXECUTION

3.1 GENERAL

A. The geocomposite materials shall be laid out and installed in accordance with the approved shop drawings and submittals.

B. The geocomposite shall be installed only after the underlying layer has been fully tested and accepted by the Owner.

3.2 INSTALLATION

A. The geocomposite shall be handled in a manner that ensures it is not damaged in any way.

B. The geocomposite shall be installed to minimize the number of joints between panels that are subject to tensile stress, and panels shall be oriented so that the tensile stress in the panel is in the machine direction.

C. On slopes, the geocomposite shall be secured at the top, then rolled down the slope in a manner that continually keeps the material in tension.

D. In the presence of wind, the Contractor shall weight the materials with sandbags until the final cover is installed.

E. The Contractor shall exercise care to ensure that the underlying layers are not damaged during installation.

F. The Contractor shall use care to ensure that stones, mud, and dirt are not entrapped in the geocomposite during placement and seaming.

G. Trimming of sheets shall be performed using an upward cutting hook blade.

H. The Contractor shall take the necessary precautions during deployment to protect the underlying layers.

I. The Contractor shall conduct a visual inspection of the deployed geocomposite to document that no potentially harmful objects are present, including stones, sharp objects, small tools, and sandbags.

J. During placement of backfill, the cover soil or select waste materials shall not shift the position of the geocomposite nor damage the geocomposite, the geotextile, or the drainage net core.

K. When using cover soil or select waste as backfill on side slopes, the work shall progress from the toe of the slope and upward.

3.3 JOINING

A. Adjacent edges of drainage net cores shall be overlapped a minimum of 4 inches and joined with ties at a spacing not exceeding 3 feet on center. Filter fabrics shall be overlapped a minimum of 6 inches.

B. The ends of drainage cores and filter fabrics (in the direction of flow) shall be overlapped for at least 12 inches. Drainage cores shall be joined with ties at spacing not exceeding 6 inches on center.

C. The top geotextiles covering the joined cores shall be overlapped and sewn using a hand-held sewing machine or thermally bonded with written approval of the Owner to provide a complete seal against backfill soil entering the drainage net core.

D. Horizontal seams on side slopes shall be minimized and staggered.

E. Holes or damage to the drainage net cores shall be repaired by removing the geotextile from the geocomposite for 12 inches around the damaged area. New drainage net core shall be placed over the exposed area and tied every 6 inches. The geotextile fabric shall then be repaired in accordance with Paragraph 3.4 of this Section.

F. Holes or tears of more than 50% of the width of the drainage net core on side slopes require that the entire length of the drainage core be removed and replaced.

G. Holes or tears in the geotextile covering the drainage net core shall be repaired in accordance with Paragraph 3.4 of this Section.

3.4 REPAIRS

A. Patching shall be used to repair holes or tears in the geotextile covering made during placement.
   1. The patch material used for repair of a hole or tear shall be the same as the damaged material.
   2. The patch shall extend at least 24 inches beyond any portion of the damaged geotextile.
   3. The patch shall be sewn or thermally bonded in place by hand or machine so that it does not shift out of position or move during backfilling or covering operations. Damage to geotextile from thermal bonding shall require the removal and replacement of the damaged patch. Thermal bonds shall be performed with a lyster, use of butane torches will not be allowed on the geocomposite material.
   4. The machine direction of the patch shall be aligned with the machine direction of the geotextile being repaired.
   5. The thread shall be of contrasting color to the geotextile and of chemical and ultraviolet resistance equal to or greater than that of the geotextile.

3.5 PROTECTION

A. The Contractor shall protect the integrity of the geocomposite materials until overlying materials are placed and until the Owner accepts the installed Work.

B. The geocomposite shall be protected from UV degradation and damage, as recommended by the manufacturer.

PART 4 FIELD QUALITY CONTROL

4.1 DOCUMENTATION

A. The Contractor shall provide a daily report to the Owner regarding installation activities. This document shall include the following minimum information:
   1. Type and quantity of material placed
   2. Location of material placement
   3. Location and sizes of patches
   4. Visual inspection notes in accordance with Paragraph 3.4.I of this Section

B. The Contractor shall provide the Owner with a copy of the chain-of-custody record for each sample sent to an independent laboratory.

4.2 QUALITY ASSURANCE SAMPLING AND TESTING

A. The Contractor shall assist the Owner with obtaining Quality Assurance samples for laboratory testing in accordance with the following frequency.

Property	Test Method	Required Frequency
Transmissivity	ASTM D4716	1 per 100,000 ft^2
Ply Adhesion	ASTM D7005	1 per 100,000 ft^2
*Performed in accordance parameters outlined in Section 2.1 of this Specification.		

END OF SECTION 02274

SECTION 02771

HIGH-DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE

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SECTION 02771

HIGH-DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE

PART 1 GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, materials, tools, equipment, surveying, testing, and supervision to install the geomembrane materials, as indicated on the Drawings.

1.2 RELATED WORK

A. Section 01010 - Summary of Work

B. Section 01300 - Submittals

C. Section 02228 - Low-Permeability Soil Layer

D. Section 02772 - Geotextiles

E. Contractor Quality Assurance Plan

1.3 DEFINITIONS

A. Geomembrane: HDPE liner and cover material.

B. Sheet: Each separate piece of HDPE geomembrane sheeting that is seamed to other sheets at the project site.

C. Panel: Unit area of a geomembrane that will be seamed in the field that is larger than 100 ft^2.

D. Film Tearing Bond: Failure under tension within one of the sheets by tearing instead of separation at a seam.

E. Patch: Unit area of a geomembrane that will be seamed in the field that is less than 100 ft^2.

1.4 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this Section to the extent referenced. The publications are referred to in the text by the basic designation only. Use the latest revision unless otherwise noted:

1. American Society for Testing and Materials (ASTM):

D 1004	Test Method for Initial Tear Resistance of Plastic Film and Sheeting
D 1238	Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
D 1505	Test Method for Density of Plastics by the Density-Gradient Technique
D 1603	Test Method for Carbon Black in Olefin Plastics
D 3895	Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
D 4833	Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
D 5199	Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
D 5397	Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
D 5596	Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
D 5994	Standard Test Method for Measuring Core Thickness of Textured Geomembranes
D 6392	Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
D 6693	Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes

The following publications shall be used as applicable:

2. U.S. Environmental Protection Agency (EPA):

EPA/530-SW-86-031	Technical Guidance Document: Construction Quality Assurance for Hazardous Waste Land Disposal Facilities. October, 1986
EPA/530-SW-91/051	Technical Guidance Document: Inspection Techniques for the Fabrication of Geomembrane Field Seams. May, 1991.
EPA/600/SR-93/182	Quality Assurance and Quality Control for Waste Containment Facilities

1.5 SUBMITTALS

A. Administrative Submittals:

1. Production dates for geomembrane.
2. Schedule of installation of the geomembrane.
3. A Liner Installation Plan that details the required procedures for proper installation of the HDPE geomembrane. Following is an outline of the minimum required elements of the plan:
   a. Transportation and off-loading
   b. Inspection of delivered materials
   c. Storage of delivered materials
   d. On-site handling and deployment
      1) Sub-grade acceptance
      2) Installation limits
   e. Seaming procedures
      1) Hot wedge welding
      2) Extrusion welding
   f. Quality control testing
      1) Test welds
      2) Non-destructive seam testing
         a) Double wedge seam air-pressure test
         b) Vacuum box test
      3) Destructive testing
   g. General precautions to prevent damage

B. Shop Drawings:

1. Manufacturer's specifications and literature for each geomembrane and all products furnished and used to complete the installation. Descriptions shall include name of manufacturer(s) and fabricator(s) and product trade name if any.
2. Product identification and supplier of the polymer resin for geomembrane production.
3. Geomembrane seaming plan drawing(s) including the proposed size, number, position and sequence of sheet placement. Layouts shall be fully dimensioned. Seaming plan shall include the location of field seams and the approximate total length of fusion and extrusion welds.
4. Details of joining procedures, field testing, special construction details, anchoring details, temporary anchors, cap strips, and replacement strips.

C. Qualifications: Submit documented evidence of the ability and capacity of manufacturer, installer, and geomembrane testing agency to perform this work.

1. Manufacturer and Fabricator: Certification that the manufacturer has manufactured HDPE geomembranes for at least 5 years and has manufactured a minimum of 10 million square feet of similar HDPE geomembranes. Fabricators shall have at least 5 years of continuous documented experience in the fabrication of HDPE components for liner system applications.
2. Installer: Certification of the following requirements shall be provided:
    a. Corporate Requirements: The Contractor shall have successfully installed 10 million square feet of the type of geomembrane product specified in applications similar to this project.
    b. Field Staff Requirements: The Contractor shall provide the following persons to the project and submit resumes as verification of past experience:
        1) Installation Supervisor: The Installation Supervisor shall be on site and be in responsible charge during all geomembrane installation (including sub-grade acceptance, HDPE sheet layout, panel placement, seaming, testing, and repairs) and all other activities performed by the Contractor. The Installation Supervisor shall have installed or supervised the installation of a minimum of 10 million square feet of HDPE geomembrane.
        2) Master Seamer: All seaming shall be performed under the direction of a Master Seamer. The Master Seamer may be the same person as the Installation Supervisor. The Master Seamer shall have seamed a minimum of 2 million square feet of HDPE geomembrane using the same type of seaming apparatus as that proposed for this project. Installation of the HDPE geomembranes shall be performed from beginning to completion under the

direction of the same Master Seamer (i.e. the Installation Supervisor may not be changed during construction).

3) Seamers: Seamers shall have documented experience seaming HDPE geomembrane using the same type of seaming apparatus as that proposed for use on this project.

D. Quality Control Submittals:

1. Quality Control Program Plan: Written description of the manufacturer's and installer's formal programs for quality control during manufacturing, fabricating, handling, installation, seaming, testing, and repairing geomembrane.
2. Factory test results and manufacturer's certification of compliance for geomembrane. Test results and certifications shall identify the lot number and roll number for each roll delivered to the project site.
3. Daily reports that include the following:
   a. Record of deployment by type, panel number, roll number, and size.
   b. Record of welding by machine, seamer, seam number, and length.
   c. Non-destructive testing by type, seam number, length, and repair location (if required).
   d. Repairs by location, type, re-testing, and technician.
   e. Destructive testing by sample number, seam number, date welded, seamer, date pulled, field pass/fail, and location.
   f. Trial welds by number, seamer, temperature, time and results.

E. Contract Closeout Submittals:

1. Record Drawings: Submit reproducible drawings of record showing changes from approved installation drawings. These shall include the identity and location of each repair, cap strip, penetration, boot, and sample taken from the installed geomembrane for testing.
2. Three copies of material and seam test results.
3. Record data.
4. Subgrade inspection certification form (follows this Specification Section).
5. Certificate of warranty for the HDPE geomembrane material, seams, and installation.

F. Exceptions: Listing of all exceptions to the requirements specified herein.

1.6 SEQUENCING AND SCHEDULE

A. The work in this Section requires careful coordination with the work in other Sections to prevent damage to the geomembrane and underlying materials.

B. The maximum exposed HDPE geomembrane that will be allowed at any one time, anywhere on site, is 12 acres per subcell.

C. If necessary, the HDPE geomembrane cover shall be protected from UV degradation.

D. The required submittal information, drawings, and data required shall be submitted in accordance with the following schedule:

Requirements	Period
Geomembrane production dates	Two weeks prior to manufacture
Schedule of installation	Two weeks prior to manufacture
Installer's qualification and installation plan	Four weeks prior to start of construction
Manufacturer's specifications	Two weeks prior to manufacture
Polymer resin identification	Two weeks prior to manufacture
Geomembrane seaming plan and details	Four weeks prior to start of construction
Material sample	Four weeks prior to start of construction
Manufacturer's qualifications	Two weeks prior to manufacture
Installer's qualifications	Four weeks prior to start of construction
Independent laboratory qualifications	Four weeks prior to start of construction
Quality control program plan	Four weeks prior to start of construction
Factory test results	Prior to start of construction
Laboratory test results	Within two working days
Daily field activity reports	Within two working days
As-builts and Record data	Four weeks after acceptance of work
Material and seam test results	Four weeks after acceptance of work
Record data	Four weeks after acceptance of work
Sub-grade inspection forms	Prior to installation of liner over subgrade
Certificate of warranty	Prior to acceptance of work

1.7 WITNESS POINTS

A. The Owner's Construction Quality Assurance (CQA) Manager or his designee will be present during the following inspections for verification of the work. The contractor shall give 24 hours notice to the Owner's CQA Manager prior to any of the Witness Point events.

B. Witness points are:

1. Verification of Contractor's inspection and acceptance of subgrade conditions.
2. Verification of Contractor's inspection of geomembrane installation.
3. Verification of Contractor's inspection of seams welding and on-site non-destructive field seam testing.

1.8 WARRANTY

A. Provide manufacturer's extended warranty in writing, with the Owner named as the beneficiary. The warranty shall provide for correction or, at the option of the Owner, removal and replacement of Work specified in this Section that is found defective during the periods listed below, commencing on the date of substantial completion.

1. Materials, factory seams, installation, and field seams shall be warranted by the Contractor to be free of defects and to be able to withstand normal weathering.
2. Warranty for materials and factory seams shall be for a minimum period of 5 years from the date of acceptance.
3. Warranty for workmanship or installation, including field seams, shall be for a minimum period of 2 years from the date of acceptance.

1.9 DELIVERY, STORAGE AND HANDLING OF MATERIALS

A. Materials shall be delivered to the site only after all required submittals have been approved by the Owner's Representative.

B. Material delivery, storage, and handling will be in accordance with the approved Liner Installation Plan.

C. Geomembrane materials shall be supplied in rolls, marked and tagged with the following information:

1. Manufacturer's name
2. Product identification
3. Lot number
4. Roll number
5. Product thickness
6. Roll dimensions
7. Date of manufacture

D. The geomembrane shall be shipped rolled and shall be stored on the ground in a location where it will not interfere with the on-going operations at the facility. Storage at the job site shall be in an area where standing water cannot accumulate. The ground surface shall be prepared so that no stones or other rough objects could damage the geomembrane are present. At a minimum, the ground shall be rolled with a smooth-drum roller.

E. The Contractor shall off-load all geomembrane once mobilized to the site. The work site is remote, and the Owner will not unload the delivered material.

F. Handling of materials on site shall be by suitable construction equipment, cables, and slings. Pushing, sliding, or dragging of rolls of geomembrane is not permitted.

G. Roll stack height shall be limited to prevent deformation or damage to the rolls and cores. The limit shall be in accordance with the manufacturer's recommendations.

H. Care in accordance with the manufacturer's recommendations shall be taken to keep the materials clean and free from damage prior to installation. If rolls are stored at the job site for more than 6 months, a sacrificial covering or temporary shelter shall be provided for protection against precipitation, ultraviolet light exposure, and accidental damage.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not install geomembrane or perform seaming unless installation procedures approved by the Owner are in place to address the following conditions, when:
   1. Liner temperature is less than 35 degrees F or more than 150 degrees F.
   2. Relative humidity is greater than 80 percent.
   3. Precipitation events, frost is on ground, or wind is excessive.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers shall meet the requirements specified in Paragraph 1.5 above.

2.2 HDPE GEOMEMBRANE

A. Composition: High-density polyethylene (HDPE) containing no plasticizers, fillers, extenders, or chemical additives, except for the following:
   1. Two to three percent by weight of carbon black to resin for ultraviolet resistance
   2. Antioxidants and heat stabilizers, not to exceed 1.5 percent by weight, may be added as required for manufacturing

B. Textured sheets shall be textured on both sides to the same roughness.

C. Sheet width shall be a minimum of 20 feet.

D. The raw material (resin) used in the production of the geomembrane shall meet the requirements in the table below. Testing shall be performed once per 8.17×10^4 kg (180,000 lbs), and at least one test shall be performed.

Property	Test Method	Required Value
Density	ASTM D1505	0.934 – 0.940 g/cm^3
Melt Flow Index	ASTM D1238, 190/2.16	≤1.0 g/10 min
OIT	ASTM D3895	100 min

E. The manufactured textured HDPE geomembrane material shall meet the following physical strength properties:

HDPE Textured Geomembrane Material Specifications			
Property	Test Method	Testing Frequency	60-mil Liner Minimum Requirements
Thickness, Minimum Average Lowest I Reading 8 out of 10 Lowest Individual Reading	D5994	per roll	 57 54 51
Density (min avg)	D1505	200,000 lb	0.94 g/cc
Tensile Properties (min avg) Strength at Break Strength at Yield Elongation at Break Elongation at Yield	D6693 Type IV	20,000 lb	 90 lbs/in. 126 lbs/in. 100% 12%
Tear Resistance (lbs)	D1004	45,000 lb	40
Puncture Resistance (lbs)	D4833	45,000 lb	90
Carbon Black Content (range)	D1603	20,000 lb	2.0%
Carbon Black Dispersion	D5596	45,000 lb	note (1)
Asperity Height Average 8 of 10 Lowest Individual	GRI GM 12	second roll	 10 mil 7 mil 5 mil
Notched Constant Tensile Load(2)	D5397	200,000 lb	300 hr
Oxidative Induction Time (OIT)	D3895	200,000 lb	100 min.

(1) Carbon black dispersion for 9 out of 10 different views shall be Category 1 or 2. No more than 1 view form Category 3.
(2) Conducted on representative samples of smooth membrane.

F. Smooth HDPE geomembrane material shall meet the following physical strength properties:

HDPE Smooth Geomembrane Material Specifications			
Property	Test Method	Testing Frequency	60-mil Liner Minimum Requirements
Thickness, Minimum Average Lowest Individual Reading (-10%)	D5199	per roll	 60 mil 54 mil
Density (min avg)	D1505	200,000 lb	0.94 g/cc
Tensile Properties (min avg) Strength at Break Strength at Yield Elongation at Break Elongation at Yield	D6693 Type IV	20,000 lb	 115 lbs/in. 132 lbs/in. 100% 12%
Tear Resistance (lbs)	D1004	45,000 lb	45
Puncture Resistance (lbs)	D4833	45,000 lb	130
Carbon Black Content (range)	D1603	20,000 lb	2.0%
Carbon Black Dispersion	D5596	45,000 lb	note [1]
Notched Constant Tensile Load	D5397	200,000 lb	300 hr
Oxidative Induction Time (OIT)	D3895	200,000 lb	100 min.

[1] Carbon black dispersion for 9 out of 10 different views shall be Category 1 or 2. No more than 1 view form Category 3.

G. The Contractor shall provide conformance test results at the frequency required in the previous table. Contractor shall also provide samples to the Owner for independent third party testing, upon request.

H. Geomembrane shall have a uniform surface with no visible defects and shall be free of holes, blisters, gels, undispersed ingredients, and any contamination or defect that may affect its serviceability. The membrane shall be free of pinholes, and the liner edges shall be straight and free of nicks and cuts.

I. The weld materials used in liner seaming shall have the same resin characteristics as the liner membrane.

2.3 HDPE FIELD SEAMS

A. The Contractor shall seam the geomembrane sheets together in the field to meet the following requirements:

B.

Property	Test Method	60-mil Liner Minimum Requirements
Bonded Seam Strength in Shear (lbs/in.) Fusion (lbs/in.) Extrusion (lbs/in.)	ASTM D6392	 120 120
Bonded Seam Strength in Peel (lbs/in.) Fusion (lbs/in.) Extrusion (lbs/in.)	ASTM D6392	 98 78

2.4 WELDING EQUIPMENT

A. The extrusion welding apparatus shall be equipped with gauges giving the temperature of the apparatus at the nozzle and the extrudate barrel.

B. The fusion welding apparatus shall be an automated vehicle-mounted device that produces a double seam with enclosed air space. It shall be equipped with gauges giving the applicable temperatures and machine speed.

C. Hot-air welding is not acceptable for permanent welds.

2.5 OTHER MATERIALS

A. Sandbags used for hold-downs shall be tied or fastened with material that will not damage the liner. Metal wire shall not be used. The material makeup of the sandbags shall be sufficiently strong to withstand the forces that will be placed upon them during their use and shall be constructed to preclude spillage of sand contained therein. Leakage of sand onto liner shall not be permitted.

PART 3 EXECUTION

3.1 INSPECTION

A. Geomembrane:

1. The Contractor shall be responsible for inspecting the rolls upon arrival at the site. Should any rolls show damage from transit, they shall be identified by the Contractor. Materials that cannot be repaired, in the Owner's judgment, shall be set aside for return to the manufacturer.

2. During unwrapping of the geomembrane for use and placement, the Contractor shall visually inspect each sheet surface. Each imperfection shall be marked for repair.

B. Subgrade Acceptance:

1. Immediately prior to the deployment of the geomembrane, the Contractor shall visually inspect the underlying subgrade. An Owner's Representative and a Representative of the Contractor who prepared the subgrade shall be present during the inspection.
2. The Contractor shall prepare a certification of "Subgrade Surface Acceptance" that documents the areas that the parties present have agreed meet the criteria for the installation of a geomembrane. A blank form is included at the end of the Section. The Contractor may use this form or an equivalent form approved by the Owner.

3.2 GENERAL

A. The fabrication and installation of each geomembrane shall be in accordance with the Drawings and the manufacturer's recommendations or as specified herein, whichever requirement is more stringent, and shall ensure the integrity and continuity of the completed installation. The liner shall be placed on prepared subgrade (soil, geocomposite or geotextile) as shown on the Drawings.

B. Where liner is placed in double or more thickness, seams shall be staggered.

C. With the exception of the equipment used for installation of geomembranes, as recommended by the manufacturer, driving construction equipment on any installed manufactured materials shall be prohibited until the surface has been covered with at least the minimum thickness of cover soil as defined in the following table.

Equipment Ground Pressure	Minimum Cover Thickness
<10 psi	12 in
10 – 20 psi	24 in
>20 psi	36 in

D. Smoking is prohibited during installation activities.

3.3 GEOMEMBRANE DEPLOYMENT

A. General:

1. The geomembrane shall be installed in accordance with the approved submittals. The panel layout can be adjusted in the field based on existing site

conditions, and any field adjustment shall be agreed upon by the Contractor and the Owner.

2. At the time of installation, the Contractor shall give each deployed panel an identification code consistent with the panel layout drawing.
3. The liner sheets shall be oriented in a manner that reduces stress on the seams. To this end, the liner shall be placed with seams oriented downslope where practicable. Horizontal seams shall be located at least 10 feet from the toe of the slope or areas of potential stress concentrations. A whole width of a panel shall be placed on each corner to minimize seaming at corners, in compliance with the approved panel layout drawings.
4. The panel layout shall minimize the number and length of field seams.
5. Panels shall be deployed so that the upgradient to flow overlaps the downgradient panel when practical.
6. Only panels that are to be seamed together in one day shall be deployed.

B. Deployment of the geomembrane panels shall be performed in a manner that complies with the following:

1. Any geosynthetic elements immediately underlying the geomembrane are clean and free of debris.
2. Adequate ballast is available to prevent uplift by wind. If the liner rolls during installation, the liner shall be replaced by the installer.
3. Direct contact with the geomembrane shall be minimized. Scrub sheets shall be used under mechanical equipment and placed in high pedestrian traffic areas.
4. Provisions for safe travel on lined slopes greater than 4:1 (H:V) shall be provided for workers and observers.
5. All tools and welding equipment shall be placed on a scrub sheet when not in use.
6. Cutting of patches shall be performed off the liner surface or on a scrub sheet.

C. The method of deployment of the geomembrane shall not cause scratches or crimps in the geomembrane and should not damage the subgrade. The method shall also follow the manufacturer's recommendation(s) to minimize wrinkles, especially differential wrinkles between adjacent panels.

D. Once deployed, each panel of geomembrane shall be inspected for indications of damage in the sheet continuity. Damaged areas shall be marked on the sheet, and the Owner shall be notified regarding which sections shall be repaired, rejected, or accepted.

E. Care shall be taken to ensure that the liner panels are positioned in a slackened condition so that they will conform to the subgrade irregularities, with no "bridging" of the liner over depressions or corners in the underlying subgrade, and so that the

liner will not become taut when exposed to the temperature range expected in the area or when the liner is covered.

F. Slack shall be "locked in" in the HDPE liners on the side slopes and base and in the anchor trenches by placing hold-down sandbags and backfilling the anchor trench. Hold-down sandbags shall be placed along the bottom edge of the side slopes so that the open distance between sandbags shall not exceed 2 feet. The proper amount of slack for the side slopes shall be positioned above the stationary sandbags and distributed uniformly up the slope. Lines of sandbags shall be positioned up the slope at sufficient spacing to maintain the uniform distribution of slack on the slope.

G. With consideration of the actual liner temperature at the time that the slack is to be locked in, the Contractor shall lock in adequate slack in each liner so that (1) no bridging or excess tension shall occur at temperatures lower than 40°F, and (2) no standing folds capable of folding over on themselves shall develop at temperatures higher than 90°F.

3.4 SEAMING OF GEOMEMBRANE

A. Field seams between panels shall be fusion-welded by the dual-hot-wedge welding method. Extrusion-welded seams shall be used at pipe penetrations (if any), at patches required after test samples are taken, and for minor repairs where it is not practical to use hot-wedge seams. Hot-wedge and extrusion welding techniques, including surface and edge preparation, shall be as described in EPA/530-SW-91/051.

B. Seam Preparation:

1. Field seaming shall follow sheet placement as closely as possible, but with adequate time allowed for the adjacent sheets to equilibrate with respect to temperature.
2. The panels of geomembrane shall be overlapped by a minimum of the following dimensions:
   a. 3 inches (73 mm) for extrusion welding
   b. 4 inches (100 mm) for fusion welding
3. Wipe contact surfaces of the sheets clean to remove dirt, dust, moisture, debris, and foreign materials.
4. For extrusion welds, grinding/buffing shall be conducted to remove oxidized material at the seam locations. This shall be done in accordance with EPA/530-SW-91-051 and the following requirements:
   a. The grinding shall not extend more than ¼ inch beyond the limit of the extrudate after seam completion.
   b. Grinding shall be performed preferentially in a perpendicular path across the seam.
   c. The depth of grinding shall be less than 10 percent of the sheet thickness.

d. Grinding shall be performed just prior to extrusion welding

e. All shavings produced from grinding shall be removed from the seaming area prior to welding.

5. The area of a seam shall be trimmed in advance of seaming following the following procedure:

a. All trimming of seams shall be advanced and maintained at least 50 feet ahead of seaming operations when possible.

b. Trimming shall be accomplished using a shielded blade or hook-knife.

c. Whenever possible, the cutting of the geomembrane will be from the underside of the sheet in an upward motion.

C. Seam Samples and Trial Seams:

1. Trial seams shall be made on scrap/fragment pieces of geomembrane to verify that the seaming conditions and equipment are adequate.

2. Trial seams shall be performed in accordance with the following schedule:

a. The beginning of each seaming period (start of day, midday, and any time after equipment shutdown) for each seaming apparatus and for each operator to be used.

b. A substantial change in weather conditions.

c. Upon request of the Owner.

3. Trial seams shall be performed under the same conditions under which the actual seaming will be conducted.

4. The sample size shall be 12 inches wide plus seam width and 30 inches long, with the seam centered lengthwise.

5. Six specimens, 1-inch wide each, shall be cut with a die by the seamer. Three specimens shall be tested in shear and three in peel using a field tensiometer. The test specimens shall fail in the film tearing bond.

6. Interpretation of Results:

a. If the destructive testing meets or exceeds the requirements in Paragraph 2.3, the welding machine and the seamer are approved for the work period.

b. If the specimen fails the destructive evaluation, the entire process will be repeated.

c. If the same welding machine and seamer fail the testing a second time, the welding machine and the seamer will not be accepted and cannot be used for seaming until the deficiencies are corrected and two consecutive successful trial seams are completed.

d. The test weld samples shall be marked with the date, time, seamer, air temperature, and welding machine number and delivered to the Owner.

D. HDPE Seaming:

1. Field seaming shall be conducted in dry conditions and in a manner that prevents dust, dirt, or other foreign material from being included in the seam.
2. All welding equipment shall be handled/operated in a manner that minimizes the potential for damage to the installed liner.
3. The extrusion welder shall be purged prior to beginning a seam until all potentially heat-degraded extrudate has been removed from the barrel.
4. Seams shall extend to the end of the panels in the anchor trench.
5. Seaming of geomembrane within the anchor trench shall be accomplished by temporarily supporting the adjacent sheets to be seamed on a wooden support platform so that horizontal seaming can be accomplished continuously to the end of the sheets.
6. All cross seams are to be patched with a 12-inch-diameter patch where they intersect.
7. Each field seam shall be identified by writing the following information on the geomembrane near the seam with waterproof paint:
   a. Date, starting time, and mark at starting point of weld
   b. Welder's name or identifying initials
   c. Completion time and mark at ending point of weld

3.5 GEOMEMBRANE PENETRATIONS

A. Pipe boots shall be fabricated to a size that tightly fits the outside diameter of the penetrating pipe. The boot shall be made of the same type of geomembrane as that of the liner through which the penetration is being made.

B. The skirt of the pipe boot that flares away from the pipe shall have at least 12 inches of geomembrane on all sides of the pipe. The skirt of the pipe boot shall be seamed to the base geomembrane by extrusion welding. If vacuum testing of the seam is impractical, a copper wire for spark testing shall be inserted prior to welding.

C. Stainless steel pipe clamps shall be used to attach pipe boots to the penetrating pipes and shall be of an adequate size to allow for a cushion of compressible material to be placed between the inside surface of the clamp and that of the geomembrane portion of the boot.

3.6 REPAIR OF HDPE GEOMEMBRANE

A. Repair Areas:

1. Repair areas will be identified and marked on the geomembrane by the Contractor and recorded on the daily report prepared by the Contractor.

2. Repairs shall be identified by an identification code/number and shall be located on the as-built drawing.

B. Extent of Repair Area:
   1. Point Repairs
      a. A hole, tear, blister, scratch, undispersed raw material, or geomembrane contamination defines a point repair. This type of repair shall also be made after the removal of a destructive test sample.
      b. The extent of the repair area is defined as the visible extent of damage or continuity of the liner plus a minimum of 6 inches in all directions.
   2. Seam Repairs
      a. Seam repairs are defined as necessary repairs identified by visual inspection, non-destructive, and/or destructive testing, occurring in the area of a seam between field panels. The extent of the repair is defined as the area between two passing destructive or non-destructive test locations.
      b. The following procedure will apply whenever a sample fails a Quality Control or Quality Assurance test. The Contractor has two options:
         1) The Contractor can reconstruct the seam between the failed location and any adjacent passed test location in both directions from the failed sample location.
         2) The Contractor can take additional samples from the failed seam at a 10-foot minimum distance in both directions from the failed test location. If these additional tests pass, then the seam shall be reconstructed between the two passing locations. If the test fails, then this process can be repeated.
      c. In all cases, acceptable reconstructed seams shall be bounded by two passed test locations.

C. Repair Procedure:
   1. Repair required areas with pieces of flat and unwrinkled geomembrane material free of defects and seams. The repair material shall be of the same type as the liner material.
   2. All patches, cap strips, and replacement strips shall have corners rounded to a 3-inch minimum radius.
   3. Each patch or cap strip shall be extrusion welded to the installed geomembrane around the entire perimeter of the patch or cap strip.

D. Each cap strip shall be centered over the weld or cut being repaired and extrusion welded to the existing geomembrane. In those instances where the weld area being capped contains patches, the geometry of the cap strip shall be varied as necessary to

ensure that the cap strip extrusion weld is not less than 8 inches from any existing weld.

E. Each replacement strip shall be fusion welded by the dual-hot-wedge method. The selected width of the replacement strip shall ensure that the fusion weld is not less than 8 inches from any existing weld.

3.7 GEOMEMBRANE ACCEPTANCE

A. The geomembrane system shall be accepted when:
   1. The installation is complete.
   2. All required Quality Control documentation has been received from the Contractor.
   3. All Quality Assurance testing is completed.

PART 4 FIELD QUALITY CONTROL

4.1 GENERAL

A. The Contractor shall visually inspect all site welds immediately following the work.

B. All field welds shall be non-destructively tested over their full length for continuity and water tightness using pressure tests for fusion welds and vacuum box tests for extrusion welds.

C. Non-destructive tests shall not be performed when air temperature drops below 33°F or if there is frozen precipitation or ice on the geomembrane surface.

D. The Contractor shall notify the Owner when testing is to commence, because all non-destructive testing will be witnessed by the Owner.

E. The Contractor shall assist the CQA Engineer with obtaining Quality Assurance samples for independent laboratory testing. Quality assurance samples shall be tested under direction of the CQA Engineer.

4.2 NON-DESTRUCTIVE TESTING

A. The Contractor shall non-destructively test all field seams over their full length using a vacuum test unit or air-pressure testing. Spark testing may only be used in localized areas of extrusion welds where vacuum box testing is impractical, as approved by the Engineer.

B. Non-destructive testing of the geomembrane within the anchor trench shall be performed while the seamed geomembrane is temporarily supported in the horizontal position.

C. Testing shall be carried out as the seaming work progresses, not at the completion of all field seaming.

D. The Contractor shall record the location, date, time, test number, tester's name and the outcome of the test.

1. Vacuum Box Testing:
   a. The equipment shall consist of the following:
      1) A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole valve assembly, and a gauge to indicate chamber vacuum.
      2) A vacuum tank and pump assembly equipped with a pressure controller and pipe connections.
      3) A rubber pressure/vacuum hose with fittings and connections.
      4) A bucket and wide brush or spray assembly.
      5) Soap.
   b. The following procedure shall be used:
      1) ASTM D4337 shall be followed.
      2) Energize the vacuum pump and reduce the tank pressure to about 5 psi.
      3) Wet a strip of geomembrane seam that is 3 inches larger than the vacuum box assembly with the soap solution.
      4) Place the box over the wetted area.
      5) Close the bleed valve and open the vacuum valve.
      6) Ensure that a leak-tight seal is created.
      7) For a period of 10 to 15 seconds, examine the seam through the viewing window for the presence of soap bubbles.
      8) If bubbles are not present, close the vacuum valve and open the bleed valve, then move the box over the adjoining area with a 3-inch minimum overlap and repeat the process.
      9) All areas where soap bubbles appear shall be marked and repaired.
      10) Vacuum-tested areas will be recorded on the daily report.
2. Air-Pressure Testing:
   a. The equipment shall consist of the following:
      1) An air pump equipped with pressure gauge capable of generating and sustaining a pressure of 30 psi.

2) A rubber hose with fittings and connections.
3) A sharp hollow needle or other approved pressure feed device.

b. The following procedure shall be used:
1) ASTM D4337 shall be followed.
2) Seal both ends of the seam to be tested.
3) Insert a needle or other approved pressure feed device that is connected to a pressure gauge into one end of the tunnel created by the fusion weld.
4) Energize the air pump to a pressure of 30 psi, close valve, and sustain pressure for 5 minutes.
5) At the end of 5 minutes, depressurize seam by placing a needle hole in the air space between the welds at the opposite end of the seam from the gauge. Observe the gauge.
6) If the seam maintains at least 27 psi during the 5-minute period and the pressure drops to 0 within 30 seconds of depressurization, seam is acceptable.
7) If the pressure drops below 27 psi during the test period, or does not drop to 0 during the 30-second depressurization period, repair needle holes and retest seam by same procedure or vacuum box test along the entire length of seam. If seam maintains a minimum of 27 psi, seam is acceptable.
8) If second air-pressure test fails, vacuum box test entire length of seam.
a) If no bubbles appear in vacuum box, bottom or second seam will be considered defective, and upper seam is acceptable.
b) If bubbles appear in vacuum box, repair each defective area by extrusion welding and test again by the vacuum box method.
9) Mark and repair needle holes.

4.3 DESTRUCTIVE TESTING

A. Testing shall be carried out as the seaming work progresses, not at the completion of all field seaming.

B. Random weld samples shall be cut from the installed welded geomembrane at a minimum frequency of one sample per 1,000 feet of weld per welding machine and a minimum of one test per machine per day.

C. Based upon visual observation and inspection, the Owner shall determine additional sample times and locations.

D. The Contractor shall indicate the location of all samples on the as-built drawing.

E. Holes in the geomembrane resulting from obtaining the seam samples shall be repaired in accordance with Paragraph 3.7 of this Section.

F. Sampling Procedures:
   1. The Contractor shall cut a 12-inch-wide by 36-inch-long sample with the seam centered lengthwise.
   2. Two 1-inch-wide specimens shall be cut from each end of the sample and discarded.
   3. The four specimens shall be field tested for peel and shear strength.
      a. To be acceptable, all four test specimens must pass.
      b. Any specimen that fails through the weld or by fusion at the weld sheet interface is considered a failure.
      c. Results of the testing must meet the requirements of Paragraph 2.3 of this Section.
   4. The remaining sample shall be cut and distributed as follows:
      a. One portion to the Contractor for testing at an independent laboratory (12 inches by 10 inches).
      b. One portion to the Owner for Quality Assurance testing (12 inches by 10 inches).
      c. One portion (12 inches by 10 inches) reserved for archive until certification approval is obtained from IDEQ.
   5. Results of the testing must meet the requirements of Paragraph 2.3 of this Section.
   6. Verbal results from all tests shall be provided to the Owner within 48 hours of the time that the independent laboratory receives the samples.

G. If there is a sample failure, rerun the field seam test using new sample coupons from the same sample. If that test passes, the Owner may assume that an error was made in the first test and accept the field seam. If the second test fails, the Contractor may:
   1. Cap the seam between any two previously passing seam test locations that include the failure location, or
   2. Cut additional samples on each side of the failure location (10-foot minimum each way) and repeat sample procedure for each side. If both sides pass, cap the field seam between the two passing locations. If either fails, repeat the process of taking samples for testing. Each field seam shall be bounded by two passing test locations prior to acceptance.

END OF SECTION 02771

US Ecology Idaho
Cell 16

GEOMEMBRANE INSTALLER'S CERTIFICATION OF SUBGRADE ACCEPTABILITY

Project Title: _____

Project Number: _____

Project Location: _____

Date: _____

Geomembrane Contractor: _____

Representative: _____

I, the undersigned, a duly authorized representative of _____ do hereby accept the subgrade surface, defined as the material supporting the geomembrane, and shall be responsible for its integrity and suitability, in accordance with the Specifications, from this date to acceptance of the geomembrane installation. I have personally inspected the condition of the constructed surfaces and the condition of the area meets or exceeds the minimum requirements for installation of the geomembrane.

Approximate Size of Area: _____

Description of Area: _____

_____

_____

_____

Signed:

_____	_____	_____
Geomembrane Contractor	Earthwork Contractor	CQA Representative

SECTION 15062

PIPING AND MECHANICAL

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SECTION 15062

PIPING AND MECHANICAL

PART 1 GENERAL

1.1 WORK INCLUDED

A. Procurement, installation, testing, inspection, calibration, and start-up of all pumps and components required for pressure pipelines. Pressure pipeline is single and double contained leachate pipe and hose from the Cell 16 risers to the leachate treatment facility, as shown on the drawings.

B. Procurement, installation, testing, inspection, calibration, and start-up of all components required for all non-pressure pipelines including the leachate collection (LCRS) piping and leak detection (LDCRS) piping as shown on the drawings.

C. Interconnecting piping required for the untreated leachate systems shall include, but is not limited to: pipe, fittings, flanges, shut-off valves, flow meter, vacuum breaker, vent and drain valves, instruments, gaskets, bolting, pipe supports/restraints, insulation, pipe labels and other piping components as required for installation of a complete, leak-free piping system.

1.2 RELATED WORK

A. Section 01010 - Summary of Work

B. Section 01300 - Submittals

C. Section 02220 - Earthwork

D. Section 02274 - Geocomposite

E. US Ecology Contractor Quality Assurance Plan

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this Section to the extent referenced. The publications are referred to in the text by the basic designation only. Use the latest revision unless otherwise noted:

1. American Society for Testing and Materials (ASTM):

D638	Standard Test Method for the Tensile Properties of Plastics
D790	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
D1238	Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
D1505	Standard Test Method for Density of Plastics by the Density-Gradient Technique
D1603	Standard Test Method for Carbon Black in Olefin Plastics
D1693	Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
D2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
D3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

1.4 SUBMITTALS

A. The following items are due 14 days prior to the Contractor beginning the Work:
   1. Shop drawings that include the following items:
      a. Fabrication of the required leachate collection and detection riser pipes, foundation, and elbows.
      b. Manufacturer's literature reflecting any standard accessories or fittings used for the project.
   2. A copy of the manufacturer's warranty for the products used.
   3. Manufacturer's certification that supplied materials meet or exceed the requirements found in Part 2 of this Section.

B. Exceptions: Listing of all exceptions to the requirements specified herein.

1.5 QUALITY ASSURANCE

A. Acceptable limits for cuts, gouges or scratches in HDPE components are as follows:
   1. O.D. Surface: Maximum depth of 10% of wall thickness.

2. I.D. Surface: Not allowed

B. Certification

1. Manufacturer shall certify that High Density Polyethylene (HDPE) components meet the following requirements:

a. PE3408 high density polyethylene meeting cell classification ASTM D3350 345444C or 345444E and conforming to the following physical properties:

Property	Test Method	Required Value
Cell Classification		
Density	ASTM D1505	0.95 g/cm^3 (min)
Melt Flow Index	ASTM D1238	0.1 – 1.0 g/10 minutes
Flexural Modulus	ASTM D790	133,000 psi
Tensile Strength	ASTM D638 or D2290	3200 psi
ESCR	ASTM D1693	>5000 hours
HDB	ASTM D2837	1600 psi
UV Stabilizer	ASTM D1603	2 – 3% Carbon Black
Elastic Modulus	ASTM D638	110,000 psi
Brittleness Temperature	ASTM D746	<-180 Degrees F
Vicat Softening Temperature	ASTM D1525	225 Degrees F
Thermal Expansion	ASTM D696	9x10^{-5} inch/inch/degrees F
Hardness	ASTM D2240	64 Shore D

2. Submit test result for each production lot of HDPE pipe and components for the following properties:

a. Melt Index
b. Density
c. % carbon
d. Dimensions
e. Quick Burst or Ring Tensile Strength

3. Manufacturer shall maintain and provide permanent Quality Control/Quality Assurance records and provide them upon request.

C. Piping systems shall conform to ASME B31.3 for all pressure services.

D. Installer: Certify that HDPE installer has received training in the manufacturer's recommended heat fusion procedures for each type of joint to be fused within the last 12 months.

1.6 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

A. Manufacturer shall package products for shipment in a manner suitable for safe transport by commercial carrier.

B. Ship, store, and handle pipe and fittings as specified by the manufacturer.

C. Inspect materials upon receipt of shipment and report shipping damage to the manufacturer within four (4) business days.

D. Handling of plastic pipe shall be done in a competent manner such that damage does not occur to the pipe. Only wide fabric choker slings capable of safely carrying the load shall be used to lift, move, or lower pipe and fittings. Inspect slings before use for unacceptable wear or damage. Verify that slings and are of sufficient capacity for the required load. Remove worn or defective equipment from job site.

E. Field-storage locations shall be free from excessive dirt, accumulated water, or debris.

F. Comply with manufacturer recommendations for outdoor storage of plastic pipe.

PART 2 PRODUCTS

2.1 LEACHATE PUMPS

A. General: For each sump in Cell 16, furnish and install the following centrifugal submersible EPG pumps:

- WSDPT Model 15-4, size 5, 3.0 HP, rated for 58 gpm at 100 ft head (LCRS)
- WSD Model 17-4, size 6, 5.0 HP, rated for 110 gpm at 100 ft head (LCRS)
- WSDPT Model 8-5, size 4, 1.5 HP, rated for 36 gpm at 100 ft head (LDCRS)

Each unit shall be suitable for side slope riser installation with a patented Wheeled Sump Drainer. Each unit shall come with a submersible electric motor for operation on 230 volts, 1 phase, 60 hertz service with 150 feet of power cable. Each unit shall be fitted with 150 feet of stainless steel lifting cable of sufficient strength to permit removal of the unit.

B. Design: Each SurePump with Sump Drainer shall be capable of pumping contaminated groundwater for spill recovery, leachate, purge, and sampling applications. A transmitter mount shall be welded to the Sump Drainer for liquid level control. The Sump Drainer shall permit the unit to "pump down" to within 8 inches of the sump bottom without any loss of performance or damage to the pump. The Sump Drainer shall be equipped with a vent valve to assist with the evacuation of air from the Sump Drainer.

C. Materials: Major components shall be made of 304 SS, seals and bearings are to be made of Teflon™. In addition, all fasteners shall be 304 SS.

D. Check Valve: Each unit shall include a built-in check valve, with housing and disc of 304 SS and check valve seat of Teflon.

E. Shaft: The shaft shall be of 304 stainless steel and rotate on Teflon bearings which are product lubricated.

F. Diffuser Chamber: The diffuser chambers for each impeller shall be of 304 stainless steel. Further, they shall be fitted with Teflon impeller seal rings.

G. Impellers: The impeller(s) shall be closed and consist of 304 stainless steel.

H. Options:
1. Each SurePump will come equipped with an EPG side wall disconnect system for ease of installation and service.
2. Each SurePump will be fitted with 150 feet of stainless steel lifting cable of sufficient strength to raise the pump unit.
3. WSDPT pumps shall be equipped with the EPG LevelMaster™ liquid level sensor system including a submersible level transmitter, chemically resistant lead wire, and programmable meter with digital readout.

I. Motor: The motor shall be a submersible, hermetically sealed Franklin motor in either Pollution Recovery or 316 Stainless Steel construction. The motor shall be designed for continuous duty, capable of sustaining up to 100 starts per day. The motor shall be connected to the pump via a motor adapter and coupling in 304 stainless steel. Single phase motors shall have thermal protection in the motor windings to protect the windings from overload. The unit will restart automatically after the motor cools down. Three phase motors shall have thermal protection located in the control panel which is to be manually reset.

J. Motor Lead Wire: The lead wire shall be no-splice with water proof "chemically resistant" insulation and be of the length specified above.

K. Warranty: The manufacturer warranties the units against defects in materials and workmanship for a period of twelve (12) months from date of installation, not to exceed 18 months from date of shipment.

2.2 PIPE AND FITTINGS

A. GENERAL

1. Fabrication, assembly, examination, inspection and testing of pressure pipe shall comply with ASME B31.3.
2. HDPE Pipe and fittings shall be supplied by the same Manufacturer. Pipe and fittings from different Manufacturers shall not be interchanged and connected.
3. Manufacture HDPE in accordance with ASTM F714 - Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter, or ASTM D3035 - Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter" and shall be so marked.

B. LEACHATE HEADER & RISER PIPES

1. Perforated HDPE pipe of diameter and wall thickness specified on Drawings.
2. Upper portions of LCRS and LDCRS riser pipes, located above the sump, are non-perforated.
3. Pipe perforations conforming to ASTM F810
4. Holes may be drilled in standard solid wall pipe as an alternative to purchasing perforated pipe as follows:
   a. Four rows of perforations at ninety degree spacing
   b. Perforations shall be 3/8-inch to ½-inch diameter
   c. Perforations in the same row shall be spaced 6 to 10 inches on center.

2.3 CELL 16 LEACHATE PIPE TO TREATMENT FACILITY

A. Hose: Interior wetted surface and exterior cover shall be abrasion and chemical resistant. Hoses may be factory assembled with crimp sleeves or field assembled with stainless steel clamps.

1. Tube: UHMWPE, synthetic rubber, or approved equivalent.
2. Reinforcement: synthetic fabric with double wire helix.
3. Cover: UHMWPE, synthetic rubber, or approved equivalent.
4. Pressure pipe end: Male adapter x Female NPT, Dixon 200-A-SS or equivalent.
5. Hose end: Female Cam and Groove type coupler x Hose Shank, Dixon RC200EZPF for UHMWPE Tubes or Dixon 200-C-SS for synthetic rubber hose, or approved equivalent.

B. Pipe:

1. 4-inch and smaller: Stainless Steel, ASTM A312 Grade TP304, ASME B36.19M

2. Pressure single wall: HDPE of diameter and wall thickness specified on Drawings.
3. Pressure double wall: HDPE pipe of diameters and wall thickness' specified on Drawings.
   a. Use spacer to center carrier pipe inside of containment pipe. Do not impede free drainage of liquid to the ends of pipe runs.
   b. Carrier and containment pipe may be manufactured as a single unit or fabricated in the field.

C. Flanges:
1. Stainless Steel: ASTM A182 Grade F304, ASME B16.5 Class 150 raised face, schedule 40S weld neck
2. HDPE:
   a. Flange Adapters: Made with sufficient through-bore length to be clamped in a butt fusion joining machine without the use of a stub-end holder. Sealing surface shall be machined with a series of mall v-shaped grooves to restrain the gasket against blow-out.
   b. Back-up Rings: Lap joint flanges pressure rated equal to or greater than the mating pipe shall be fitted onto the flange adapter. The lap joint flange bore shall be chamfered or radiused to provide clearance to the flange adapter radius.
3. Flange Bolting:
   a. Stud Bolts: ASTM A193 Grade B8 continuous thread
   b. Nuts: ASTM A194 Grade 8S Galling Resistant Nitronic 60 Heavy Hex.
4. Gaskets for ASME B16.5 Class 150 flanges:
   a. PTFE with Stainless Steel insert.
   b. Garlock Grylon #3510, 3530, 3540, or 3545
   c. 0.175" thick, Spiral Wound, 0.125" thick compression gauge, with AISI 304L winding and graphite filler, API Standard 601 Class 150, Flexitallic Style CG "Compression-Guage"
   d. Approved equivalent

D. Fittings:
1. HDPE fabricated or molded fittings shall use the same polyethylene resin as the mating pipe meeting the applicable requirements of ASTM D2513.
2. HDPE Fabricated Fittings:
   a. Rated for the same pressure as the mating piping.
   b. Machine ends to match mating pipe wall thickness.
   c. Mitered crosses are not allowed.

3. HDPE Molded Fittings: Butt fittings are preferred. Socket fittings may be substituted for 2" and small nominal diameter pipe if butt fittings are not available.
   a. Butt fitting: ASTM D3261 in addition to ASTM D2513.
   b. Socket fitting: ASTM D2683 in addition to ASTM D2513.
4. Stainless Steel Fittings: ASTM A182 Grade F304
   a. Tees, ells, reducers, couplings, etc.: ASME B16.11 Class 3000 threaded.
   b. Unions: MSS SP-83 Class 3000 threaded.

2.4 LEACHATE MEASURING STATION PIPE AND FITTINGS

A. Piping components and materials shall comply with ASME B31.3 requirements.

B. Piping, fittings and valves shall be rigid metallic and meet specifications shown in Piping Material Specification that follows this Section.

C. Piping tie-ins for continuation of piping shall consist of Class 150 flanges.

D. Flexible hose connections or restrained expansion joints shall be provided with equipment if required to limit nozzle loads from connected piping systems or as shown on the Drawings and meet specifications shown in Piping Material Specification that follows this Section.

E. Vents and drains shall be provided where necessary operation or maintenance and routed to an accessible location on the equipment for operation of the associated valve.

F. Air and Vacuum Valve:
   1. Body & Cover: ASTM A126 Grade B Cast Iron FPT ends.
   2. Float: ASTM A240 Stainless Steel
   3. Seat: Buna-N
   4. Vendor: APCO #142 or approved equivalent.

G. Block or Ball valve:
   1. Body: One piece stainless steel, full port, FPT, 1000 W.O.G., ASTM A351
   2. Blowout Proof Stem
   3. ¼ turn lever with locking device
   4. Approved Vendors:
      a. Sharpe
      b. Vogt

c. Apollo
d. Nibco
e. Approved equivalent

2.5 FLOWMETER

A. Provide a local indicating and totalizing flowmeter as shown on the drawings. Flowmeter indicating range must be valid from 20 to 200 gpm.

2.6 MANHOLE

A. Manhole: 48-inch diameter, SDR 17 minimum wall thickness, HDPE pipe.

B. Bottom Plate & Cover: 1½-inch thick HDPE plate designed by the Contractor and approved by the Owner, or Contractor supplied and Owner approved equivalent of standard manufacture.

2.7 IDLER ASSEMBLY

A. Rex Idler, CEMA-B, 35 degree, 11-20079-01 or approved equivalent..

PART 3 EXECUTION

3.1 GENERAL

A. Fabrication, assembly, examination, inspection and testing of pressure pipe shall comply with ASME B31.3.

B. Install pumps and equipment in accordance with manufacturers written instructions and the drawings.

C. Inspect equipment, pipe and fittings upon delivery. Reject pipe and fittings that do not comply with the Specifications.

D. Furnish labor required to handle the pipe and fittings during inspection, and to remove rejected pipe and fittings from the site.

E. Place pipe of the size and wall thickness shown on the drawings.

F. Place pipe as located on the Drawings in accordance with the manufacturer's recommendations.

G. Inline connections shall be butt fusion type. Branch connections shall be made with saddle fittings or tees. Saddle fittings shall be saddle fused to the main.

H. Begin pipe placement at the downstream end of a run and proceed upgrade.

I. Fit and match pipe to prevent shoulders or unevenness along the inside bottom half of the pipe, and so that the alignment and slope are correct.

J. Do not disturb installed pipe. Maintain pipe's grade and alignment during pipe jointing, pipe embedment, and backfilling operations.

K. Comply with the standard installation practices of ASTM D2321 and manufacturer's installation instructions and recommendations.

L. Install Wall Anchor and/or Water Stop fittings at Manholes to prevent movement of pipe at manhole wall and water leaking into or out of manhole at pipe penetration.

3.2 PIPE JOINING

A. Remove dirt or other foreign matter from piping prior to joining pipe sections or fittings. Trim ends of the pieces to provide a fresh surface for joining.

B. Align the ends to be joined to prevent a gap between the pipe ends.

C. Join pipe lengths and fittings in accordance with manufacturer's instruction and recommendations for butt fusion and saddle fusion.

D. Clean heater plate as required to ensure proper joints.

E. Temperature of the heating plate and heating time shall be in accordance with the manufacturer's recommendations and adjusted for actual field conditions.

F. Press pipe ends together to obtain a 1/8- to 3/16-inch bead around the entire perimeter of the pipe. Do not remove external or internal beads.

G. Comply with all manufacturer procedures and recommendations for joining and installation of pipe.

3.3 CONCRETE ANCHORS

A. Securely block and brace pipe, preventing movement, prior to the placement of the concrete anchor.

B. Concrete in the sump area shall set a minimum of 3 days prior to backfilling.

3.4 ACCEPTANCE

A. Prior to final acceptance of the Work by the Owner pipe shall:
   1. be true to both line and grade
   2. show no obstruction of flow
   3. be free from cracks and protruding joint materials
   4. contain no deposits of sand, dirt or other materials that will reduce the full cross-sectional area of the pipe.

PART 4 FIELD QUALITY CONTROL

4.1 CERTIFICATION

A. Confirm pressure pipe fabrication, assembly, examination, inspection and testing comply with ASME B31.3.

B. Provide a Quality Control certification of material properties for material delivered to the site. Provide corresponding manufacturer certified test results for HDPE pipe. The following is the minimum information required on the certification:
   1. Material Identification
   2. Segment Number (with identification of additional segments covered by each certified test result)
   3. Batch Number
   4. Parent Material Identification
   5. Manufacture Date
   6. Quality Control Testing Results

4.2 DOCUMENTATION

A. Submit a daily report of operations at the site. Include the following information:
   1. Quantity and type of pipe installed
   2. Location of pipe installed
   3. Details on pipe welding/joining
   4. Details of any repairs made to the pipe

END OF SECTION 15062

SECTION 16050

ELECTRICAL WORK

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APPENDIX I - ENGINEER'S CONTROL PANEL SPECIFICATION

SECTION 16050
ELECTRICAL WORK

PART 1 GENERAL

1.1 SCOPE

A. General: This Specification Section specifies the requirements for electric power, control, and instrumentation systems for the Cell 16 LCRS and LDCRS Systems, as shown on the Construction Drawings.

B. Scope:

1. The work to be performed and specified herein includes the following:
   a. Preparation of construction detail shop drawings in compliance with: the National Electrical Code (NEC), the National Electric Safety Code (NESC), other applicable codes and standards, the Construction Drawings, and the Specifications.
   b. Sizing of electrical power and control cables and raceways not sized by the Owner.
   c. Coordinate with Owner regarding tie-in with overhead power. The Owner will coordinate with the utility company and pay the necessary fee to extend overhead power distribution lines to the north end of Cell 16.
   d. Selection of suitable fittings, boxes, grounding connections and bonding hardware, and other miscellaneous items.
   e. Provision of a labeling system for equipment, devices, cables, individual conductors, and other installed items for easy identification and location during maintenance, troubleshooting and emergencies.
   f. Preparation of as–built Record Drawings.
   g. Procure, store if necessary, install, connect, interconnect, test, start–up and place in satisfactory and successful operation all equipment, materials, devices and necessary appurtenances, whether or not specifically mentioned herein or noted on the Construction Drawings, but which are necessary to make complete working systems.
   h. Coordinate with the Owner in all matters that relate to the existing power supply.
2. General items of work shall be as follows:
   a. Temporary Power Supply: Power may be supplied from the main line connecting to an existing 480V, 1-phase, 60 Hertz, pad mounted transformer located west of Cell 14 near the Subcell 6 Riser Pipe Area or from a portable generator with output voltage suitable for construction equipment.

b. LCRS and LDCRS Riser Pipe Area Power Supply: Power will be supplied from a pole mounted, 480V-240V, 1-phase transformer, to be located on the north perimeter berm of Cell 16, as shown on the drawings.

c. Contractor shall provide a 480V single-phase underground line in conduit from the overhead power pole to both of the Cell 16 sumps. Sump locations are shown on the Construction drawings.

d. For each sump, provide a slab-mounted transformer with a 15-kVA, 480V-240V, 1-phase, with a 240V fused-disconnect switch. Transformer shall be installed on the control panel concrete pad, adjacent to the riser pipes; provide supports, as needed.

e. Provide a 240-V, 1–phase fused-disconnect switch to protect buried conductors for supplying power to the LDCRS and LCRS Sump Monitoring Cabinet.

f. Provide EPG Companies Inc. LDCRS and LCRS Control Monitoring Cabinet, instrumentation, and controls including instruments, control devices, indicators, alarms, and all accessories as specified in Article 2.3 of this Specification.

Contact: Jim Bailey
EPG Companies Inc.
19900 County Road 81
Maple Grove, MN 55311
Tel.: (800) 443-7426
Fax: (763) 493-4812
E-mail: jbailey@epgco.com

g. Provide electrical power, control and instrument raceway and wiring system at the LDCRS and LCRS Sumps.

1.2 RELATED SECTION

A. Section 15063 – Piping

1.3 REFERENCES

NOT USED

1.4 JOBSITE CONDITIONS

A. Environmental Conditions:
1. Elevation Above Sea Level: 2600 feet

2. Ambient Temperature:
   Maximum: 100°F
   Minimum: –20°F
3. Wind Velocity – Maximum: 70 mph
4. Humidity:
   Mean Maximum: 79 percent
   Mean Minimum: 21 percent
5. Seismic Zone: 2B

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this Section to the extent referenced. The publications are referred to in the text by the basic designation only.

1. American National Standards Institute (ANSI):
   C2-1993 National Electric Safety Code (NESC)
   C80.1-1990 Rigid Steel Conduit - Zinc Coated
2. American Society for Testing and Materials (ASTM):
   B3-1995 Standard Specification for Soft or Annealed Copper Wire.
3. Inter-National Electrical Testing Association (NETA):
   ATS-1995 Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems
4. National Fire Protection Association (NFPA)
   National Electrical Code (NEC)
5. National Electrical Manufacturers' Association (NEMA):
   KS 1-1990 Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)
   ICS 2-1988 Industrial Control Devices, Controllers, and Assemblies
6. Occupational Safety and Health Administration (OSHA)
7. Underwriters' Laboratories, Inc. (UL)
8. Factory Mutual Engineering and Research Corp. (FM)

1.6 QUALITY ASSURANCE

A. The inspections and acceptance tests required by this Section shall be performed.

1.7 COORDINATION

A. Electrical work shall be performed in coordination with all other trades and the Owner in order to secure the best arrangement of the work.

1.8 SUBMITTALS

A. Provide in accordance with Section 01300.

B. Submit complete Contractor-prepared construction detail shop drawings and calculations for review as follows:

1. Shop Drawings: Contractor shall prepare shop drawings that show the arrangement of systems including plans, elevations and details, connection and support details, conduit and cable sizing, bills of material, elementary (schematic) control diagrams and connection wiring diagrams. Show overall dimensions and minimum clearance dimensions. Contractor-prepared shop drawings shall include as a minimum:
    a. Control Cabinet installation details, including, conduit stub-up plan, and anchoring details.
    b. Grounding details at the transformer slab and at the Monitoring Cabinet.

C. Submit Vendor drawings and data for the following equipment items:

1. Slab-mounted transformer.
2. LDCRS and LCRS Monitoring Cabinet. Contractor shall submit EPG Companies Inc. vendor drawings, which shall include as a minimum, the following:
    a. Plans, views, elevations and sections, of the internal and external arrangement of the cabinet.
    b. Assembly drawings with complete bill-of-material.
    c. Schematic and wiring diagrams showing all internal and external connections.
3. Instrumentation and Controls. Vendor drawings and data shall include:
    a. Manufacturer's drawings for all instrumentation devices.
    b. Manufacturer's instructions for all instrumentation and control devices.
    c. Operation and Maintenance Manuals for all instrumentation and control devices.
    d. Level recorder logic program documentation, fully annotated in both electronic file and hard copy form.

D. Submit complete catalog cuts for any electrical or control equipment items that do not have available shop drawings. Catalog cuts shall show all required ratings, specifications, standards compliance, finish, and enclosure type and rating.

E. Submit Certificate of Conformance stating that materials installed comply with this specification and the requirements of applicable codes and standards.

F. Submit legible copies of all inspections and acceptance test reports to the Owner within 10 days of completion of inspection and testing.

G. Submit copies of Instrument Commissioning Report to the Owner within 10 days of completion of inspection and testing.

H. Submit as-built Record Documents as described below.

1.9 SUBMITTAL SCHEDULE

Specification Reference	Requirements	Period
16050 (1.8.B)	Construction detail shop drawings and Calculations	15 days prior to ordering material or installation
16050 (1.8.C)	Vendor drawings and data	15 days prior to installation
16050 (1.8.D)	Catalog Cuts	15 days prior to ordering material or installation
16050 (1.8.E)	Certificate of conformance	Upon completion of all electrical work
16050 (1.8.F)	Inspection and test reports	No later than 5 days after completion of inspection or test
16050 (1.8.G)	Instrument Commissioning Report	No later than 5 days after completion of inspection or test
16050 (1.8.H)	As-built Record documents	Upon completion of all electrical work
16050 (1.10.A)	Folder with items listed	Upon completion of all electrical work
16050 (1.14.A)	Schedule of required outages	At least 5 days in advance of any shutdown.

1.10 RECORD DOCUMENTS

A. Accumulate the following data during the job's progress, and submit in a neat brochure or packet folder to the Owner:

1. All warranties, guarantees and manufacturer's directions for equipment and material furnished by the Contractor.
2. Copies of approved Contractor shop drawings and calculations.
3. Approved Vendor data and catalog cut sheets.
4. Repair parts lists for all major equipment items including name, address and telephone number of local representative.

1.11 WARRANTIES

A. Provide warranties.

B. Contractor shall coordinate manufacturer's warranty service for all materials supplied by the Contractor.

1.12 SPACE AND EQUIPMENT ARRANGEMENT

A. The Contractor shall be responsible for determining that the equipment proposed will fit the allotted space. Shop drawings shall show suitable arrangements that allow for operations, maintenance and NEC working space.

B. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. The Owner reserves the right to require minor changes in locations of equipment, prior to roughing in, without incurring additional costs or changes.

1.13 INTERRUPTION OF EXISTING ELECTRICAL AND OTHER NECESSARY SERVICES

A. Tie–ins or alterations to, or replacement of, existing circuits or equipment shall be scheduled to reduce out–of–service time to a minimum. A written schedule of dates and time and number of hours needed for all shutdowns shall be prepared and submitted to the Owner for approval, at least 5 days in advance of such work.

B. Do not interrupt or impede the Owner's operations and work in adjacent areas.

1.14 PROTECTION DURING CONSTRUCTION

A. Contractor shall provide protection for materials and equipment against loss or damage. All items shall be protected from the detrimental effects of weather. Prior to installation, items subject to corrosion under damp conditions, and items containing insulation, such as transformers, conductors, and devices shall be stored indoors.

1.15 HOLD AND WITNESS POINTS

A. Hold points are listed below. The Contractor shall not proceed with work until the Owner has conducted inspections and documented that the results are acceptable. In all cases, the Contractor shall notify the Owner 24 hours in advance that inspections and tests are required. The Contractor shall perform testing as required by Articles 3.07.

1. Owner approval of buried conduit before placing covering.
2. Owner approval of electrical service and grounding at the LDCRS and LCRS Monitoring Cabinet before the load center is energized.

PART 2 PRODUCTS

2.1 GENERAL

A. All equipment and materials furnished shall be new, unused, and shall conform to the applicable standards listed in this Section. Materials and equipment shall be UL and/or FM listed, unless the materials or equipment are of a type for which UL or FM does not provide a listing or labeling service.

B. Unless otherwise specified, the Contractor shall furnish all fittings, hangers, sleeves, conduits, anchors, mounting brackets, cable supports, wire terminals, lugs, connectors, identification tags, tape insulating compounds, nameplates and all other accessories, hardware, equipment and materials required to satisfactorily install and place into service the equipment and material specified.

C. Nameplates shall be provided for identifying new equipment including transformer, disconnect switch, LDCRS and LCRS Monitoring Cabinet, Instruments, and control devices. Nameplates shall be permanent, non-corroding, designed for 30-year life and attached to the equipment item using screws or pop-rivets.

D. All equipment furnished shall be suitable for continuous operation under the environmental and other conditions prevailing at the job site. All equipment, material, and supporting structures shall be designed for 30-year life and for the wind loading and seismic conditions stated in Article 1.02.

E. All electrical equipment specified and not specifically shown to be furnished and installed by the Owner shall be furnished and installed by the Contractor.

2.2 ELECTRICAL EQUIPMENT

A. Slab-mounted Distribution Transformer: The distribution transformer shall have kVA and voltage ratings as specified herein. It shall be dry-type, 150°C rise, 60 Hz, single-phase, with four 2.5% full-capacity taps (two above and two below normal), 95-kV BIL insulation, outdoor NEMA 4 type with grounding provision, and mounting support lugs.

B. Disconnect Switch: Disconnect switches shall be heavy duty, quick-make quick-break, horsepower rated, with full cover interlock and locking indicator handle, conforming to NEMA KS 1 for Type HD, with outdoor NEMA 4X enclosure. Disconnect shall have a ground bus.

C. Junction Breakout Boxes: Boxes shall be NEMA 4X weather tight enclosures with clearly labeled terminals for easy connection.

2.3 LDCRS AND LCRS MONITORING CABINET AND LIQUID LEVEL CONTROL INSTRUMENTATION

A. Provide EPG Companies Inc., UL listed L960 PT control panel to operate the two (2) primary pump motors (at 240V, 1-phase), one (1) secondary pump, and auxiliary control equipment in manual or automatic mode.

B. The monitoring cabinet enclosure shall be mounted and secure to withstand environmental conditions.

C. The controller shall be designed to operate primary pump #1 and primary pump #2 in a lead/lag alternating mode. The controller shall be designed to operate the secondary pump upon independent changes in liquid levels as sensed by individual pressure transmitters.

D. The enclosure shall be equipped with a window in the outer door, an inner door, a stainless steel drip shield, and a tamper resistant latch. The panel enclosure shall be NEMA type 4 finished with a polyester urethane paint.

E. For detailed information, refer to Appendix I of this Specification.

2.4 SYSTEM LOGIC AND FUNCTION

A. Each controller is designed to operate two pumps in lead/lag alternating mode and a third independent pump. In the lead/lag mode, the lead pump starts upon change in liquid level as sensed by a pressure transmitter. The pump will continue to run until the level decreases to the pump stop level set point. The lag pump will start if the liquid level continues to rise above the pump start level set point and will continue to run until the liquid level decreases to the pump stop level set point as sensed by the pressure transmitter. If the liquid level rises to the high level set point, a high level will be annunciated. If a motor trips while running due to an overload condition, the other pump will start automatically. The pressure transmitter level sensor shall have a range of 0 to 11 feet with a 4-20 mA output signal.

B. The third independent pump is designed to start upon the change in liquid level as sensed by a pressure transmitter. The pump will continue to run until the pump stop level set point is reached. If the liquid level rises to the high level set point, a high level will be annunciated. If the liquid rises to the high-high level fail-safe set point, the pump will shut off.

2.5 WIRE AND CABLE

A. Wire and cable installed in conduit and in wireways shall be stranded copper, rated 600-V, 90EC dry, 75EC wet, suitable for wet locations. Insulation shall be type XHHW or XHHW-2. Minimum wire size shall be No. 12 AWG for power circuits and No. 14 AWG for control circuits.

B. Instrument signal wiring shall be shielded twisted-pair cable. Individual twisted pair cable shall be 300-V, No. 16 AWG, 105EC, stranded copper, with PVC insulation, twisted in pairs with a tinned copper drain wire. The pairs shall be helically wrapped with an aluminum Mylar tape shield and covered with a black PVC jacket.

C. Bare copper grounding conductor shall be soft-drawn, stranded according to ASTM B3.

2.6 MISCELLANEOUS MATERIALS AND HARDWARE

A. Conduits:
   1. Rigid galvanized steel (RGS) conduit shall be standard weight, mild steel, hot-dip galvanized after threading, conforming to ANSI Specification C80.1. All fittings for RGS shall be threaded, hot dipped galvanized.
   2. Flexible metal conduit shall be liquid–tight type.

B. Grounding Materials:
   1. All hardware used for grounding, including nuts and bolts, washers, and lugs shall be silicon bronze-type specifically designed for grounding connections.
   2. Ground rods shall be copper–clad steel, 5/8-inch diameter and 10 feet long, minimum.
   3. Bolted-type connectors shall be used for exposed ground connections.
   4. Exothermic welding shall be used for all embedded or buried connections.

C. Splice and Junction Boxes:
   1. Splice and junction boxes shall be aluminum or stainless steel NEMA 4X rated. All boxes shall have mounting clips for attachment. Pre-drilled boxes are not acceptable.
   2. Contractor is to determine the sizes and number of boxes required based on code requirements.

D. Wiring Devices: 120-V ac receptacles shall be GFCI type, specification grade, rated 20 A, duplex, mounted in a weatherproof FS box.

E. Labeling System: The labeling system used to identify transformer as specified herein shall be permanent, durable, corrosion resistant, and of a size and color that will be easily readable from ground level. Labels shall be placed so that they are visible from the ground.

PART 3 EXECUTION

3.1 GENERAL

A. The work shall be done in an orderly and professional workmanlike manner and shall present a neat appearance when completed. All outdoor equipment shall be installed at accessible heights with NEC working space provided and above maximum snow level.

B. All equipment and materials installed shall be in accordance with the Construction Drawings, approved Contractor shop drawings, the Specifications, the manufacturer's

recommendations, and in compliance with the NEC and other applicable codes. The Contractor shall be responsible for, and shall correct by repair or replacement, damage to or failure of any part of any of the equipment or materials, that have been caused by faulty mechanical or electrical assembly. Necessary tests to demonstrate that the electrical and mechanical operation of the equipment is satisfactory and meets the requirements of this Specification shall be performed by the Contractor.

C. The routing of cables and conduit shall be preapproved by the Owner. The Contractor shall determine the final locations and routing by inspection of the site and discussion with and approval by the Owner before installing the equipment and materials.

D. The equipment shall be secured in position, level and plumb, using suitable mounting brackets and hardware.

E. The Contractor is responsible for ensuring that circuit breaker trip units, protective fuses, and overload devices are installed and set as required and made ready for service.

F. All mechanical connections shall be torqued to the manufacturer's specifications. All shipping blocking shall be removed. All equipment shall be thoroughly cleaned inside and outside of all dirt, grease, grit, cable and conductor strippings, metal filings, or other foreign matter. All equipment shall be touch–up painted as required.

3.2 WIRES AND CABLES

A. The more stringent of the cable manufacturer's recommendation or that dictated by Article 300 of the NEC for the minimum bending radius and maximum pulling tension shall be complied with. Where a lubricant is needed to limit pulling tension, a nonconducting lubricant that is not damaging to the insulation shall be used. Oil, grease, or soap, shall not be used for lubrication.

B. All feeder and branch circuit conductors shall be color coded as follows:

Phase	**1-PH, 120/240-Volt**
A	Black
B	Red
Neu	White
Gnd	Green

C. Terminate all aluminum and copper conductors in accordance with manufacturer instructions using termination hardware intended for the conductor material.

D. Contractor shall verify that all conductors in all instances are protected against overcurrent in accordance with the NEC.

3.3 CONDUITS

A. The following conduit systems shall be used in the locations indicated:
   1. Underground: Conduits shall be plastic or metal. Metallic conduits and fittings in direct contact with earth shall be coated with corrosion inhibiting coating or tape.
   2. Rigid galvanized steel, coated with corrosion inhibitor as required.
   3. Above Grade: Rigid galvanized steel.
   4. Connections to Vibrating Equipment or Instruments in the LCRS Sump: Liquid-tight flexible metal conduit.

B. Exposed conduits shall be securely fastened in place in accordance with the NEC Article 345, using corrosion–resistant materials.

C. All connections to outdoor enclosures shall be water–tight. Conduit ends shall be sealed as needed.

3.4 GROUNDING

A. Circuit and system grounding, equipment and enclosure grounding, methods of grounding, bonding, ground conductors and grounding connections shall be in compliance with Article 250 of the NEC.

B. Paint, scale, rust, corrosion, and other foreign matter shall be removed from the points of contact on metal surfaces of equipment and structures before ground connections are made.

C. All below grade connections and connections of ground wires to ground rods shall be exothermic type.

D. Precautions shall be taken to ensure that no damage is done to the grounding conductors or connections during backfilling or compacting operations. The work shall be arranged in such a manner that each part of the grounding system that is embedded shall be completed and inspected before backfilling is done.

E. A separate green ground conductor shall be run with every feeder and branch circuit that runs in conduit, sized as required by the NEC. The grounding conductor shall not be used as a system neutral or current–carrying conductor.

F. The Monitoring Cabinet, shall be grounded according to manufacturer's recommendations and additional ground rods shall be added if needed to ensure that the maximum resistance to ground at the Cabinet does not exceed 5 ohms.

G. A ground testing point shall be installed at the All grounding systems shall be tested as described below in Article 3.6, "Testing and Acceptance".

3.5 INSTRUMENTATION AND CONTROL

A. Level control instrumentation shall be installed as described as specified herein:
   1. Install monitoring devices, pumps, and pump controls per manufacturer recommendations.
   2. Do not install AC power or control circuits and analog signal cable in the same conduit.
   3. Handle shields on instrumentation cables as follows:
      a. Instrument cable shields shall be grounded at one end only, and that end shall be at the Monitoring Cabinet on the analog signal terminal block.
      b. Shields shall be electrically continuous from instrument to instrument, using terminal blocks at any intervening junction boxes. No splices will be permitted.
      c. If not connected to a terminal at or near the instrument, cut the shield and install heat shrink tubing to prevent moisture from entering the cable.

B. Calibration Procedures: Calibrate per manufacturer recommendations.

C. Commissioning Procedures:
   1. To commission an instrument or instrument loop, take all steps necessary to place the item or system in proper operational status, ready for start-up. Include at least the following steps:
      a. Check (and correct as necessary) the installation of each instrument for compliance with installation drawings and manufacturer's recommended installation practice.
      b. Perform a calibration or functional check on each item.
      c. Check for proper settings of alarm or setpoints on level switches.
   2. Document the steps in the commissioning process for each instrument in an Instrument Commissioning Report, including dates of performance and initials of the tester.
   3. Check electrical wiring to each instrument for compliance with the Manufacturer's directions and installation practices prior to energizing the instrument.
      a. Check for wiring continuity and insulation integrity.
      b. Check ground wiring, being particularly attentive to ground loops, and multiple grounds.
      c. Check instrument power connections for voltage level, type (AC or DC), and polarity.

4. Control loop checkout or commissioning, involving the activities needed to prove out a control loop and shall include the operation indicated below. Calibration may be performed during the loop checkout. Check all the following that apply:
   a. Check level switch action and setting.
   b. Check interlock action and alarm action.

3.6 TESTING AND ACCEPTANCE

A. The Contractor shall field test transformers, wire and cable, circuit breakers, load center panels, lighting systems, and grounding systems in accordance with the requirements of NETA standard ATS-1995 before putting them into operation.

B. A complete operable system shall be tested for performance in the presence of the Owner before final acceptance. Contractor shall notify the Owner 24 hours in advance of testing so that the Owner can witness testing at the Owner's discretion.

C. Testing Requirements:
   1. Compare equipment nameplate information with latest one-line diagram or shop drawings and report discrepancies.
   2. Perform those specific inspections and tests recommended by the manufacturer of the equipment.
   3. Perform those specific visual and mechanical inspections and electrical acceptance tests recommended by NETA in the presence of the Owner. Tests listed by NETA as optional will not be required. Acceptable test results shall be as noted in the NETA.
   4. Insulation resistance tests required by the NETA shall utilize appropriate guard circuits to protect personnel and equipment.
   5. Test grounding systems in accordance with the NETA and IEEE 81, using the fall-of-potential method to determine resistance to ground of completed systems. The resistance to ground shall not exceed 5 ohms.

APPENDIX I
ENGINEER'S SPECIFICATION; EPG SERIES L975P PUMPMASTER™ CONTROLLER I/O CONTROL PANEL

END OF SECTION 16050

APPENDIX I
ENGINEER'S CONTROL PANEL SPECIFICATION

ENGINEER'S SPECIFICATION

EPG Series L960PT PumpMaster™ Controller
Triplex I/O CONTROL PANEL

Furnish one EPG Companies Inc., UL listed 508A/698A, Series L960PT controller to alternate the operation of two pump motors plus a third independent pump motor and auxiliary equipment in manual or automatic mode. The control panel enclosure shall be NEMA type 4.

The enclosure shall be equipped with a window in the outer door, an inner door, a stainless steel drip shield, and a tamper resistant latch. The NEMA 4 (standard) enclosure is finished with polyester urethane paint.

The control system will operate from a _____ Volt, 60 Hertz, single phase power supply. Pump control components will be sized to operate pump motors of specified horsepower.

The control panel shall include the following as standard features:

- Main Disconnect Switch: The main disconnect switch shall be _____ Amp rated and will prevent opening of control panel while power is on, and includes _____ Volt, _____ Amp dual element fuses.
- "Hand-Off-Auto" Selector Switches: Allow manual or automatic operation. The selector switches shall be heavy duty, oil tight, NEW 4 rated switches mounted on the inner door. The hand position shall be momentary with a spring return.
- Motor Contactors: The motor contactors shall be sized to pump motor horsepower.
- Motor Start Winding Control with Start Capacitors and Start Winding Relays: Capacitors are used to start motors. Relays are used to remove start winding from circuit when motors reach operating speed.
- Control Transformer: Transformer with fused primary and secondary shall isolate control circuit from power circuit and provide easier and safer field wiring of accessories. It shall lower incoming voltage to 120 Volts.
- Run Lights: Indicate energization of motor circuit. They shall be heavy duty, oil tight, NEW 4 rated and shall have voltage surge suppressors built in to prolong lamp life. The lights shall be mounted on the inner door and will be green in color.
- Electronic Alternator: The electronic alternator shall include lead/lag pump operation to equalize wear on pump motors by alternating successive starts. The lag pump shall start after the lead pump starts if the liquid level continues to rise above the pump start level set point and both pumps will continue to run until the liquid level decreases to the pump stop level set point as sensed by the pressure transmitter.
- LevelMaster™ Level Controls: The LevelMaster level control meters shall be mounted on the inner door. One level meter shall be provided for each pump. The meters shall have digital readouts and the capability to monitor and maintain pumping operations as well as output high level alarms. They shall also provide high-high level alarm fail-safe features that shut off the pump motors. Level control shall be accurate to within 0.1 inch.
- Level Simulators: The level simulators shall be mounted on the inner door. One level simulator shall be provided for each pump. The level simulators are built-in test circuits designed to simulate 4-20 mA loads to assist in level setup and troubleshooting.
- Intrinsically Safe Barriers: The level sensor circuits shall be by protected by intrinsically safe barriers.
- Heater with Adjustable Thermostat: A heater with adjustable thermostat shall promote even distribution of heat and elimination of hot spots and condensation. Heater element shall be mounted in space between the sub-panel and the back of the enclosure and provide a minimum of 100 inches square of heating area.

- Lightning Arrestor: Shall be grounded, metal-to-metal, to water strata.
- Terminal Strip: Labeled and numbered terminal strip provides easy connection of external components.
- Corrosion Inhibitor Emitter: Inclusion of an industrial corrosion inhibitor emitter shall protect internal components of control panel from corrosion for up to one year and shall be replaceable.
- Options are available to meet specific needs.

SYSTEM LOGIC AND FUNCTION

The controller is designed to operate two pumps in lead/lag alternating mode and a third independent pump. In the lead/lag mode, the lead pump starts upon change in liquid level as sensed by a pressure transmitter. The pump will continue to run until the level decreases to the pump stop level set point. The lag pump will start if the liquid level continues to rise above the pump start level set point and will continue to run until the liquid level decreases to the pump stop level set point as sensed by the pressure transmitter. If the liquid level rises to the high level set point, a high level will be annunciated. If a motor trips while running due to an overload condition, the other pump will start automatically. The electric alternator provides equalized wear and usage of each pump by alternating successive starts. The pressure transmitter level sensor shall have a range of 0 to 11 feet with a 4-20 mA output signal.

The third independent pump is designed to start upon the change in liquid level as sensed by a pressure transmitter. The pump will continue to run until the pump stop level set point is reached. If the liquid level rises to the high level set point, a high level will be annunciated. If the liquid rises to the high-high level fail-safe set point, the pump will shut off. The pressure transmitter level sensor shall have a range of 0 to 11 feet with a 4-20 mA output signal.

Appendix D.5.6
Appendix D.5.6 - Cell 16 Engineering Report Appendix E - CQA Plan

APPENDIX E

CONSTRUCTION QUALITY ASSURANCE PLAN

Construction Quality Assurance Plan

Cell 16
Grand View, Idaho

Prepared for:

US Ecology Idaho

April 15, 2011

Prepared by:

AMERICAN GEO TECHNICS

Prepared for:

U.S. Ecology Idaho
P.O. Box 400
Grand View, Idaho 83624

Attention: Kevin Trader, Facilities Manager

Construction Quality Assurance Plan

Cell 16
Grand View, Idaho

American Geotechnics
Project No. 07B-G1654

Prepared by:
American Geotechnics

Vaughn Thurgood, PE
Geotechnical Engineer

Rex W. Hansen, PE
Principal Engineer

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1.0 INTRODUCTION

1.1 Purpose and Scope of Work

The purpose of this Construction Quality Assurance Plan (CQAP) is to provide the Quality Assurance (QA) requirements for Quality Control (QC) checks for construction, repair and closure of US Ecology Idaho's Cell 16 RCRA landfill unit in Grand View, Idaho.

The CQAP is prepared to provide the necessary documentation that is required under US Ecology's RCRA operation permit (EPA ID No. IDD073114654) to comply with Federal Register 40 CFR §264.19, to meet the minimum suggested standards set in EPA Document Number EPA600R-93182, *Quality Assurance and Quality Control for Waste Containment Facilities*, and to meet the minimum suggested standards set forth in EPA Document Number CERI 90-50, *Seminars – Design and Construction of RCRA/CERCLA Final Covers*.

This document addresses, by reference of the Technical Specifications, the observations, test methods, test frequencies, and documentation necessary to adhere to the construction-level specifications and design details in all phases of construction. Protocol for reporting test results that certify compliance with the Specifications, correcting construction deficiencies, and documentation of such corrections is also provided in the Specifications.

This CQAP document should be reviewed prior to initiation of construction or repair activities to determine consistency with the related Technical Specification Sections and current EPA technical guidance documents and regulatory requirements.

1.2 Execution

1.2.1 General

Landfill construction will consist of installation of a bottom liner, placement and compaction of waste materials, and construction of an engineered final cover system at closure. Cell 16 will be considered closed when the engineered final cover system is constructed and accepted.

This plan includes the submittals, approvals, inspections, observations, testing and documentation required during the pre-construction, construction and post-construction periods. These include:

- Pre-Construction:
  - Qualifications and authority of CQA Manager and Inspector(s)
  - Review and approval of materials submittals and shop drawings
  - Selection of an independent testing laboratory
  - Review of work plans, specifications and scheduling with Contractors
  - Verification of project survey stakeout
- Construction:
  - Daily field reports and photographs
  - Conformance testing and field testing
  - Verification of materials delivered to site
- Post-Construction:
  - Final evaluation
  - Tests to verify that installed materials will perform to specifications as an entire system
  - Certification of completed project
  - Final documentation report

1.2.2 Judgment Sampling

It is neither possible nor economically feasible to perform one hundred percent inspection of many materials and construction processes; thus, the quality of the material or process must be estimated from the results of inspection of a representative sample of the total material or constructed facility. Examples of this situation include estimations of the integrity of geomembrane field seams by destructive testing and assessments of the characteristics of the soil portion of a geomembrane-composite liner.

Judgment sampling refers to any sampling procedure in which decisions concerning sample size, sample selection scheme, and sample locations are based on considerations not derived from probability theory. The objective of such sampling may be to test typical samples that represent the whole, to test zones of suspect quality, or a combination of the two. For example, in sampling field-constructed geomembrane seams, samples could be taken at a minimum frequency per unit length of seam at locations assigned by the Construction Quality Assurance

(CQA) Inspector before seaming is started. Additional samples could then be taken from locations of suspect quality. The success of judgment sampling is dependent on the knowledge, capability, and experience of the Design Engineer, the CQA inspection personnel, the CQA Manager, and the Project Manager. Organizations that construct a large number of similar projects often employ judgment sampling using sample frequencies based on past construction experience. For example, more intensive sampling may be required in areas where design specifications may be more difficult to achieve, such as field seaming of geomembrane on steep slopes.

1.2.3 Recommended Field Staffing

The following recommendations are the proposed minimum staffing requirements to meet the CQA observation procedures. The terms "full-time" and "part-time" refer to the presence of the CQA personnel on the job site. The term "full-time' should not be construed to mean that all operations of the contractor will be individually observed, but that a CQA representative would be on the project site during working hours of a specific activity. Adequate staffing will be provided to document the performance of construction operations. The term "part-time" should not be interpreted to mean only an occasional CQA presence, but rather that an activity does not require the intense documentation and observations or a critical item. For example, part-time CQA presence would be adequate during mass excavations, while a full-time presence of CQA representatives are needed during the installation of the geomembranes. The number of required full-and part-time CQA representatives is dependent upon the degree of each activity being performed and the number of activities occurring concurrently.

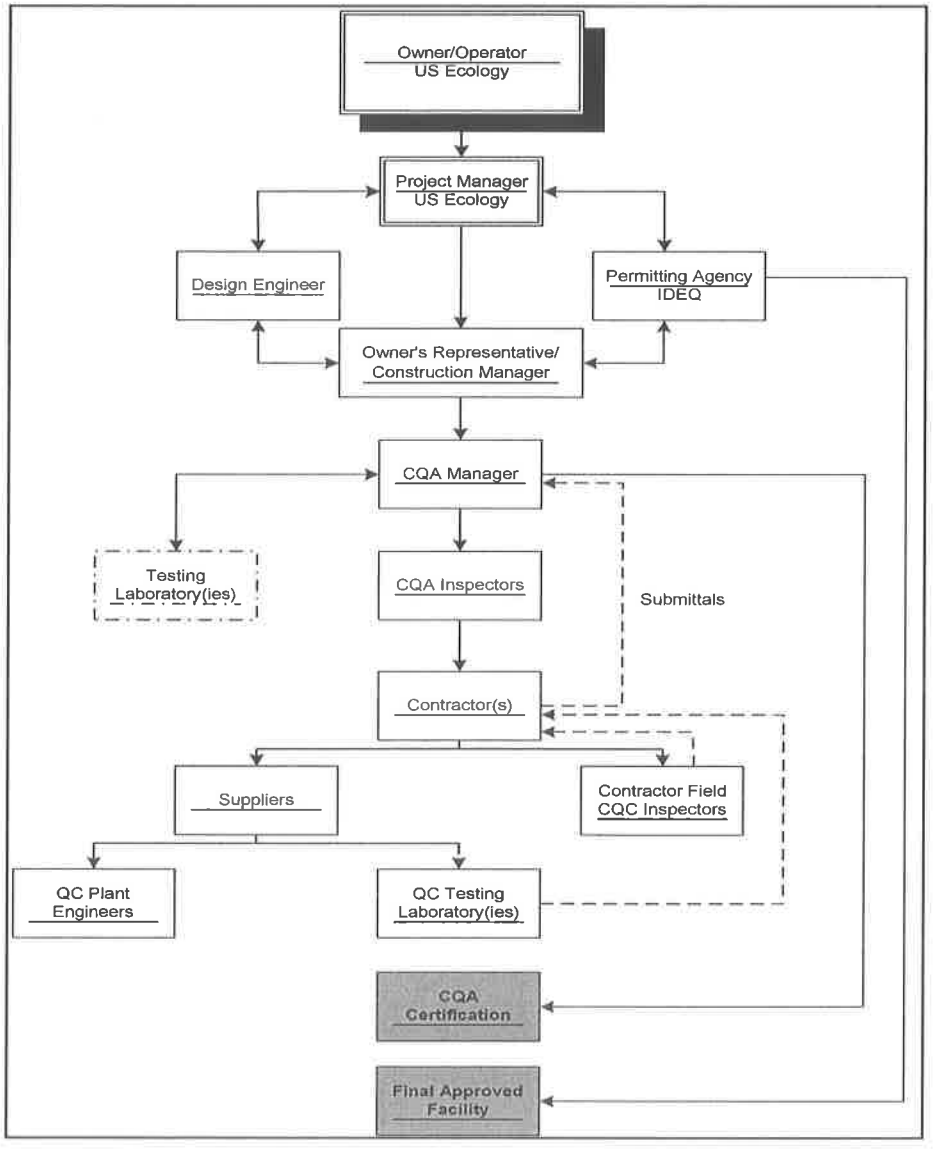
The table below identifies the minimum CQA staffing requirement by activity:

Construction Activity	CQA Staffing
Excavation	Part-time
Common Fill Placement	Part-time
Compacted Clay Liner Placement	Full-time
Select Waste Placement (Initial 12-inches)	Full-time
Geomembrane Installation	Full-time
Geosynthetic Clay Liner Installation	Full-time
Geotextile Placement	Full-time
Geocomposite Placement	Full-time
HDPE Pipe Placement	Full-time
Pumps and Controls	Part-time

2.0 PROJECT PERSONNEL

2.1 General

This section describes the various CQA project personnel and their responsibilities, authority, and required qualifications as related to the implementations of the CQAP. The Figure below presents the Project Organization and structure of CQA inspection activities to be implemented throughout construction, repair and closure of the RCRA landfill unit at Cell 16 in Grand View. Throughout this CQAP, any reference to the Owner or Operator shall mean US Ecology.



2.2 Execution

2.2.1 Authority and General Responsibility

Permitting Agency, Idaho Department of Environmental Quality (IDEQ)

It is the responsibility of the IDEQ to review US Ecology's Design of Cell 16, including this CQAP, for compliance with IDEQ regulations and to make a decision to issue or deny a permit based on this review. The IDEQ also has the responsibility to review all CQA documentation during or after construction of a cell, possibly including visits to manufacturing facilities and the construction site. The visits will allow IDEQ personnel to observe CQA practices and to confirm that the CQAP was followed and that the facility was constructed as specified in the Technical Specifications and Drawings.

Owner/Operator, US Ecology Idaho

US Ecology Idaho is responsible for the design, construction and operation of the waste disposal unit. This responsibility includes complying with IDEQ requirements, the submission of CQA documentation and verification to the IDEQ that the cell was constructed in accordance with the IDEQ-approved Technical Specifications and Drawings. US Ecology Idaho has the authority to select and dismiss organizations charged with design, construction and CQA. US Ecology Idaho will appoint a Project Manager and a Construction Manager for Cell 16 construction or closure, as described below.

- A US Ecology Idaho Project Manager will administer the CQAP described herein.
- The US Ecology Idaho Construction Manager will report directly the US Ecology Project Manager. The Construction Manager will direct the daily construction activities at the facility and will have daily direct contact with Contractor and Vendor personnel. The Construction Manager has the authority to halt any phase of construction because of quality related concerns with respect to either materials or their installation.
- US Ecology may appoint a representative who is responsible for coordinating schedules, meetings, and field activities. This responsibility includes communications to other members of the US Ecology Idaho organization, the IDEQ and other permitting agencies, material suppliers, Contractors, and the CQA Manager.

The Owner's Representative may be an employee of US Ecology Idaho or may be a qualified third party hired by the Owner/Operator.

Design Engineer

The Design Engineer's primary responsibility is to design a waste containment facility that fulfills the operational requirements of the Owner/Operator, complies with accepted design practices for waste containment facilities, and meets or exceeds the minimum requirements of the IDEQ. The Design Engineer may be an employee of US Ecology Idaho or a design consultant hired by US Ecology Idaho. If unexpected conditions are encountered during construction, the Design Engineer may be involved with changes to some aspect of the design during the construction phase of the project.

CQA Manager

The CQA Manager has the overall responsibility for CQA. The CQA Manager is responsible for reviewing the CQAP as well as the Technical Specifications and Drawings for the Work so that the CQAP can be implemented without contradictions or discrepancies. Other CQA Manager responsibilities include education and supervision of CQA Inspectors on special CQA requirements for the Work, scheduling, coordination, ensuring that testing laboratories are conforming to CQA requirements and procedures, ensuring that sample chain-of-custody procedures are followed, confirming that test data are accurately reported and that test data are maintained for later reporting, and preparation of periodic reports. The CQA Manager will verify that communication of all QA/QC issues are conveyed to and acted upon by the appropriate organizations. The CQA Manager will oversee the CQA Inspectors and may perform duties associated with a CQA Inspector. The most important duty of the CQA manager is overall responsibility for confirming that the facility was constructed in accord with the IDEQ-approved Technical Specifications and Drawings. The CQA Manager identified for different phases of the construction will be identified to the Contractor prior to the start of Work on that phase

Key responsibilities of the CQA Manager, which may be delegated to a CQA Inspector, include:

- Review material submittals required by the construction-level specifications and design details and evaluate materials proposed for use by the Contractor and make recommendations to US Ecology Idaho. Product literature, testing and certification

can be used to prove a proposed equivalent material meets or exceeds the performance of a specified material.

- Review panel layout shop drawings that show the proposed installation of synthetic lining materials. Verify that every effort is taken to minimize the need for field seams, especially in critical areas including slopes and sumps.
- Complete daily field reports that will document the chronological history of each lining system project.
- Confirm that testing equipment, personnel and procedures do not change during the project or that any such changes do not result in a deterioration of the monitoring process.
- Provide the US Ecology Idaho Project Manager with weekly reports on the field testing/monitoring results.
- Verify that the minimum contract requirements and Contractor's proposed and accepted quality control measures are being followed.
- Verify that the equipment used in testing meets the test requirements and that the tests are conducted by qualified personnel according to the standard procedures defined by the CQAP.
- Monitor all tests conducted by the Contractor's personnel as may be required by the Contract and/or the construction-level specifications and design details.
- Perform QA sampling and analyses as required by the CQAP and the Technical Specifications.
- Perform onsite monitoring of the construction or closure work-in-progress to assess compliance by the Contractor with the facility design criteria, Technical Specifications and Drawings
- Report to the Contractor results of all observations and tests as the Work progresses and interact with the Contractor to provide assistance in modifying the materials and work scope to comply with the specified design.
- Recommend acceptance or rejection of Work items.
- Verify that all deficient areas have been reworked and re-tested to meet the Technical Specifications.

- Recommend limiting and/or restricting equipment and personnel movement on installed liner materials in accordance with the required work activities.
- Maintain a field file of all field reports, meeting notes, weekly reports, submittals, shop drawings, etc.
- Prepare a final CQA Report. The purpose of the CQA Report is to provide a permanent record of the construction to the reviewing regulatory agencies that the liner, landfill, and cap systems were constructed in accordance with the Technical Specifications, Drawings, permit, and applicable regulations.

CQA Inspectors

CQA Inspectors will perform the daily QA activities associated with construction, repair, and closure of the RCRA landfill unit. These CQA Inspectors will report directly to the CQA Manager and are responsible for conducting the required inspection, field testing and documentation of delivered and installed materials to demonstrate that the construction components satisfy the material and performance requirements of the respective designs. The CQA Inspectors have the authority to conduct all observations, testing, and documentation as necessary to satisfy the requirements of this CQAP.

The CQA Inspectors will collect and tabulate all field inspection and test information and will perform audits of QC activities performed by Contractors. CQA Inspectors will report their findings and recommendations to the CQA Manager, who will forward this information to the US Ecology Idaho Project and Construction Managers.

Based on the QA information provided, the US Ecology Idaho Construction Manager may reject construction materials, methods and/or modify construction operations provided the modifications conform to the requirements of the Technical Specifications. The US Ecology Idaho Project Manager may conduct audits of all aspects of the CQAP for landfill construction and closures during the construction.

Contractor(s)

The Contractor has the overall responsibility for construction QC during construction. The Contractor also has the primary responsibility for ensuring that the facility is constructed in accordance with the Technical Specifications and Drawings using the necessary and industry-accepted construction procedures and techniques. All Contractors providing construction

services for the US Ecology Idaho Cell 16 landfill unit will comply with the Contractor's QA/QC program that has been reviewed and approved by the US Ecology Idaho Project Manager. The Contractor's QA/QC program must be in accordance with this CQAP.

Each Contractor may elect to employ QC Inspectors, who will test and document some or all phases of construction, including the testing of vendor-supplied materials and of completed construction to demonstrate adherence to the Technical Specifications.

These Contractor QC Inspectors will report to a senior QC Inspector or Engineer of the same firm, whose responsibilities include collection and tabulation of all field test data as well as audits of the QC Inspectors. The senior QC person will report his findings and recommendations to the Contractor, who will forward this information to the CQA Manager.

The construction Contractor has the authority to direct and manage his employees, subcontractors and their equipment, means and methods they use to accomplish the construction so as to satisfy the design requirements of the Work.

US Ecology Idaho will self-perform waste placement for protective soil layers and cover liner subgrade within Cell 16. In this case, they are both the Owner and the Contractor. As such, US Ecology Idaho will be responsible for both the QA and the QC for this task.

Vendors/Suppliers

Each identified Vendor (manufacturer or materials supplier) used during the construction, repair or closure of the US Ecology Idaho Cell 16 landfill unit will implement a QA/QC program. This program shall consist, at a minimum, of a QC Plant Engineer who supplies pertinent information to the CQA Manager through the material vendor or the Contractor. Vendor QA/QC programs shall be developed to ensure that all materials required for the Work are provided in accordance with the Technical Specifications and Drawings.

The responsibility of each vendor QC Plant Engineer will be to test physical and chemical properties of materials and products that will be delivered and used for the construction in accordance with the CQAP, the Technical Specifications, Drawings, and the vendor's QA/QC document. In addition, the QC Plant Engineer shall perform appropriate evaluation of the test data and report the results to the CQA Manager and the US Ecology Idaho Construction Manager.

Based on the results provided, the US Ecology Idaho Construction Manager may reject material and/or halt production and/or reject finished products.

Testing Laboratory

The testing laboratory is responsible for ensuring that tests are performed in accordance with applicable methods and standards, for following internal QC procedures, for maintaining sample chain-of-custody records, and for reporting data. The testing laboratory must be willing to allow the Owner, permitting agency, Design Engineer, Contractor or CQA Manager to observe the sample preparation and testing procedures and record keeping procedures, if they so desire. The Owner, permitting agency, Design Engineer, or CQA Manager may request that they be allowed to observe some or all tests on a particular job at any time, wither announced or unannounced. The testing laboratory personnel must be willing to accommodate such a request, but the observer should not interfere with the testing or slow the testing process.

2.2.2 Qualifications and Training

General

All CQA personnel will be properly trained and qualified to test and inspect double and composite-lined landfill construction.

Vendors and Contractors will submit qualifications of their proposed quality control personnel to the US Ecology Idaho Project Manager for review and approval. These qualifications will be kept on permanent file as a record of the construction process.

CQA Manager

The CQA Manager is the key individual in the inspection and certification program. This person will have sufficient education and technical administrative experience to perform his responsibilities. He will have demonstrated knowledge of the following:

- Specific construction practices relating to landfill construction/repair/closure
- Hazardous waste facilities construction
- Observation and testing procedures
- Documentation procedures

- All construction-level specifications, permit requirements, and regulations applicable to US Ecology Idaho's Cell 16 landfill construction, repair, and closure

The CQA Manager will have sufficient practical, technical and managerial experience to successfully oversee and implement CQA activities for landfill construction/closure and hazardous waste facilities. The CQA Manager must show at least 2 years total experience with the job responsibilities listed in section 2.2.1. Although the CQA Manager is usually an individual experienced in a variety of activities, particular specialists will invariably be involved in the project. The CQA Manager must be a qualified third party hired by the Owner/Operator. The CQA Manager may also serve as the CQA Certifying Engineer; however, the CQA Certifying Engineer shall be a registered Professional Engineer licensed in accordance with the regulations of the State of Idaho.

CQA Inspector

CQA Inspectors shall have adequate formal training in observation and testing procedures. This includes demonstrated knowledge of specific field practices relating to the following:

- Construction techniques used for double-and composite-lined facilities
- Codes and regulations concerning material and equipment installation
- Observation and testing procedures
- Equipment
- Documentation procedures
- Site health and safety

Like the CQA Manager, CQA Inspectors will be employees of independent firms. Accordingly, throughout this CQAP, reference to the CQA Manager includes all CQA Inspectors and laboratories working under the direction of the CQA Manager.

Contractor(s)

As a part of his bid package, the Contractor will provide a listing/discussion of relevant contract work similar to that described herein, including present commitments, as well as projects completed within the last 2 years. For each of these projects, the following information shall be included:

- Site name and location
- Site description including description of work
- Dates when work was performed
- Note if the firm was the prime contractor
- Total contract value
- Name and telephone number of a contact of reference for the project
- Project manager and onsite supervisor assigned to the project
- Subcontractors utilized (include laboratories) and a description of the work that they performed

Testing Laboratory

The testing laboratory shall have its own internal QC plan to ensure that laboratory procedures conform to the appropriate American Society for Testing and Materials (ASTM) standards or other applicable testing standards.

3.0 PROJECT MEETINGS

3.1 General

To successfully complete the Work, it will be necessary for the Contractors, CQA Manager, and the Owner to have formal, structured communications on a regular basis. This section of the CQAP provides a minimum basis for general project meetings.

3.2 Execution

The following meetings can be held during the progress of the Work as deemed necessary and as described below:

Pre-bid Meeting

A pre-bid meeting can be held to discuss the Technical Specifications and Drawings and the CQA requirements for the project. This meeting can provide the companies bidding on the project with a better understanding with the level of QA/QC required for the project. Furthermore, if the prospective bidders identify any problems with the Technical Specifications and Drawings, they can be rectified prior to receiving bids and awarding a Contract.

Pre-Construction Meeting

A pre-construction meeting will be held prior to the start of major construction items. As determined by the Owner, the Owner's Representative, the CQA Manager, the lead CQA Inspector, the Contractor and major subcontractors will attend the meeting to establish lines of communication, review construction plans, review the CQAP, and discuss other issues associated with construction. This meeting should take place at least one week prior to the start of major construction items.

The objectives of the pre-construction meeting are to:

- Introduce individuals involved in the project and the review the responsibilities of each organization
- Review lines of authority and communication for each organization
- Discuss the established protocol for observations and tests

- Discuss the protocol for shop drawing submittals and reviews
- Discuss the established protocol for handling construction deficiencies, rework and re-testing to meet project Specifications
- Review methods for documenting and distributing field monitoring data and other documents
- Review work area security and safety protocol
- Distribute and discuss the CQAP with the CQA Manager and identify the Contractor's expectations; identify the most critical components of the CQAP
- Discuss procedures for the protection of materials and for the prevention of damage from inclement weather or other events
- Discuss the schedule and sequencing of work
- Review and discuss procedures for manufacturer's quality control and construction QC procedures to be employed by manufacturers, installers and Contractors
- Make a list of action items requiring resolution and assign responsibility
- Conduct a site walk to verify that the design criteria, plans, and Specifications are understood and to review material and equipment storage locations
- Discuss procedures to be followed for Request for Information from the various parties involved with the Project
- Distribute copies of any special permit restrictions that are relevant to construction or CQA

A representative of the CQA Manager will take meeting minutes at the pre-construction meeting.

Progress Meetings

Progress meetings can be held by the Owner at the discretion of the CQA Manager, the Owner, and/or the Contractor at the work site at an agreed-upon date and time. The objectives of each progress meeting are to:

- Review the activities and accomplishments completed since the last meeting

- Review the work location activities and construction monitoring requirements for upcoming work
- Identify the Contractor's personnel and equipment assignments for the upcoming work
- Discuss any potential construction problems

A representative of the CQA Manager will take meeting minutes at each progress meeting.

Problem or Work Deficiency Meetings

Special meetings will be held when a problem or deficiency has occurred or may possibly occur. As determined by the Owner, attendance at these special meeting is mandatory for the Owner, Contractors, and CQA Manager. The purpose of the meeting is to define and resolve the problem or recurring work deficiency in the following manner:

- Define and discuss the problem or deficiency
- Review alternative solutions
- Implement a plan to resolve the problem or deficiency

The CQA Manager will document each special meeting.

4.0 FIELD ENGINEERING

4.1 General

Field engineering involved surveying and field engineering services for verification of the Contractor's work, including layout, minimum grades, and thickness of layers, as well as the determination of as-built conditions.

4.2 Execution

4.2.1 Surveys

The Contractor will retain a professional surveyor, registered in the State of Idaho, to perform topographic surveys of the facility prior to the start of any Work and at the completion of each of the following activities:

- Completion of the compacted subgrade
- Completion of the bottom liner installation
- Completion of the closure construction
- Completion of other activities as required by the CQAP for Contractor payment

Topographic maps prepared from these surveys will reflect a one foot contour interval for areas with slopes flatter than 3:1 (horizontal:vertical) and a two foot contour interval for slopes steeper than 3:1.

These surveys will be used to verify that the grades specified in the Technical Specifications are met and as the basis for earthwork and material quantity determination for Contractor payment.

5.0 SUBMITTAL REVIEW

5.1 General

Submittals required by the Technical Specifications shall be made to, and shall be reviewed by the CQA Manager.

5.2 Execution

The CQA Manager shall review and comment on all submittals as indicated in the CQAP. The CQA Manager will determine whether or not the submittals are in compliance with the Contract Documents and Technical Specifications. Finally, the CQA Manager will make a recommendation to the Owner to approve or reject the submittals.

6.0 QUALITY CONTROL DOCUMENTATION REVIEW

6.1 General

This section of the CQAP covers the responsibility of the CQA Manager to review the QC documentation provided by the Contractor to determine compliance with the intent of the design.

6.2 Execution

The CQA Manager will perform a thorough review of all QC documentation provided by the Contractor to confirm compliance with the Technical Specifications and Drawings. The CQA Manager will perform a review and comment on the QC documentation. The CQA Manager will then make a recommendation to the US Ecology Idaho Project Manager as to whether the QC documentation should be approved or rejected.

7.0 REFERENCES

7.1 General

This section of the CQAP covers the required documentation that will be provided by the CQA Manager to fully document the progress of construction. This includes the daily reporting of construction activities, the reporting of test results and the preparation of the final CQA report.

7.2 Execution

7.2.1 Daily Documentation

The CQA Manager will prepare complete daily field reports that will document the chronological history of the project. At a minimum, each daily report will record the following, as applicable:

- Date and project name
- Weather conditions
- Locations of work performed
- Equipment and personnel utilized
- Description of areas of work observed and/or tested and re-tested
- Summary of completed field testing
- List of the types and quantities of off-site materials received including any quality control data provided by the supplier
- Summary of decisions made regarding acceptance of specific portions of work, and/or remedial actions implemented in cases of sub-standard quality
- Unique identifying sheet numbers of inspection data sheets and/or problem reporting and corrective measures used to substantiate any CQA decisions described in the previous item
- Summaries of any meetings held and actions recommended or taken
- Unique identifying sheet number of geomembranes for cross-referencing and document control

- Calibrations or re-calibrations of test equipment, including actions taken as a result of calibration
- Names of any visitors to the construction site
- Record project dated photographs
- Signature of CQA Manager or Inspector(s)

7.2.2 Weekly Documentation

The CQA Manager will provide the US Ecology Idaho Project Manager a weekly report on the field testing and monitoring results including:

- Reviews and interpretations of observation records and test results
- Identification of work that the CQA Manager believes should be accepted, rejected or uncovered for observation, or that may require special testing, inspection or approval
- Reports that reject defective work including identification of deficiencies

7.2.3 Inspection and Testing Reports

All observations, results of field tests, and results of laboratory tests performed on or off-site will be recorded on a suitable data sheet. Recorded observations may take the form of notes, charts, sketches, photographs, or any combination of these. Where possible, a checklist may be useful to verify that pertinent factors are not overlooked. As a minimum, the inspection data sheets will include the following information:

- Description or title of the inspection activity
- Location of the inspection activity or location from which the sample was obtained
- Type of inspection activity and procedure used (reference to inspection data sheet or daily summary report by inspector)
- Where relevant, estimation of how long the problem has existed
- Any disagreement noted by the inspector between the inspector and Contractor about whether or not a problem exists or the cause of the problem
- Suggested corrective measures

- Documentation of correction if a corrective action was taken and completed prior to finalization of the problem and corrective measures report (reference to inspection data sheet, where applicable)
- Where applicable, suggested methods to prevent similar problems
- Signature of the CQA Field Inspector and review signature of CQA Manager

7.2.4 Final Report

The CQA Manager and CQA Inspectors will monitor the placement, protection, and testing of the various components of the lining or cover system installations associated with the landfill unit. Each CQA Inspector will maintain a field logbook in which key activities and observations will be recorded on a daily basis. In addition, a daily field report or log will be prepared at the completion of each day to serve as a formalized quality assurance record regarding the field construction activities, testing, and communications that occurred that day. The CQA Manager and CQA Inspectors will maintain separate logs that document the conversations with and test results provided by the Contractor. The CQA Manager will review and approve the QC logs provided by the Contractor and provide overall quality assurance of the Contractor's work.

The CQA Manager will prepare a final CQA Report for US Ecology Idaho that certifies that the components of the landfill liner and cap unit have been installed in accordance with this CQAP document and the Technical Specifications. At a minimum, the CQA Report will include the following items:

- General summary of work to include Contractors, construction activities, observations, problems and corrective actions, deviations from design, etc.
- Summary of daily field reports
- Manufacturer's laboratory test results and certification(s) of all materials used during the construction
- Laboratory and field testing results of the soil liner material and placement
- Independent laboratory testing results and certification(s) for HDPE resin, geomembrane, and welds
- Foundation (sub-base surface) acceptance form from the Contractor
- Project dated photographs

- As-built drawings
- Certification from CQA Manager that the document is complete and accurate

The final CQA report will serve as the permanent record of the completed construction or closure of the landfill. The document will serve to assure the regulatory agencies that the landfill unit was constructed or closed in accordance with the facility permit and the Technical Specifications and Drawings.

7.2.5 Document Control

Any portion of the CQA documents that are modified will be communicated to and agreed upon by all parties involved. An indexing procedure will be developed for convenient replacement of pages in the CQAP, should modifications become necessary, with revision status indicated on the appropriate pages.

A control scheme will be implemented to organize and index all CQA documents. The control scheme will be designed to allow easy access to all CQA documents and will enable a reviewer to identify and retrieve original inspection reports or data sheets for any completed work element.

During construction, the CQA Manager will be responsible for all CQA documents. This includes a copy of the design criteria, plans, specifications, CQAP, and originals of all data sheets and reports. Duplicate record will be kept at another location.

Once construction is complete, the document originals will be stored by the Owner in a manner that will allow for easy access while still protecting the documents from damage. An additional copy will be kept at the facility is this is a separate location from the Owner's main files. A final copy of all required CQA documents will be provided to the permitting agency. The Owner will maintain all documentation through the operating and post-closure monitoring periods of the facility.

8.0 SECTION 02220 EARTHWORK

8.1 General

The testing requirements and frequencies outlined below are prepared to demonstrate the placed and constructed material is in accordance with the Technical Specifications and Drawings.

8.2 Execution

8.2.1 Review of Submittal Information

The CQA Manager or his designee shall review, comment, and approve the Contractor's submittals as specified in the Technical Specifications, Section 02220, Paragraph 1.04.

8.2.2 Quality Control Documentation

The CQA Manager or his designee shall approve and complete the quality control documentation required by the Technical Specifications, Section 02220, Paragraph 4.01.

8.2.3 Borrow Source Testing

To confirm the consistency of the source material for earthwork activities, perform and document the testing program outlined in the Technical Specifications, Section 02228, Paragraph 4.2.

8.2.4 Common Fill Placement Testing

The following activities related to the placement of common fill are required:

- Monitor the construction of the compacted fill
- Perform and document testing on the placement of the common fill material in accordance with the Technical Specifications
- Record all test locations and corresponding elevation or lift number

8.2.5 Drain Rock Placement

The following activities related to the installation of the drain rock are required:

- Monitor and observe the installation of the drain rock
- Observe that the material is not placed from a height greater than 12 inches above the underlying geosynthetics
- For the installation of the drain rock associated with the leachate collection and detection system, verify that the minimum depth of rock is installed above the collector and header pipes
- For the installation of the drain rock associated with the flume structure, verify that the material is placed to the lines, grades, and thickness indicated on the Drawings

8.2.6 Riprap Placement

The following activities are related to the installation of the riprap at the drop flume structure:

- Monitor and observe the installation of the riprap
- Observe that the material is not placed from a height greater than 18 inches above the subgrade
- Observe that elongated pieces are not present; the least dimension of any one piece shall not be less than 1/3 the greatest dimension of the piece
- Observe that the riprap is placed to the lines, grades, and thickness indicated on the Drawings

8.2.8 CQA Monitoring and Observations

Verify and document that all of the fill materials have been constructed to the lines, grades, and thickness required by the Technical Specifications and Drawings.

9.0 SECTION 02228 LOW PERMEABILITY SOIL LAYER

9.1 General

The testing requirements and frequencies outlined below are prepared to demonstrate the placed and constructed material is in accordance with the Technical Specifications and Drawings.

9.2 Execution

9.2.1 Review of Submittal Information

The CQA Manager or his designee shall review, comment, and approve the Contractor's submittals as specified in the Technical Specifications, Section 02228, Paragraph 1.05.

9.2.2 Quality Control Documentation

The CQA Manager or his designee shall approve and complete the quality control documentation required by the Technical Specifications, Section 02228, Paragraph 4.01.

9.2.3 Borrow Source Testing

To confirm suitability of the borrow source material for the compacted clay liner, perform and document the testing program specified in the Technical Specifications, Section 02228, Paragraph 4.02.

9.2.4 Test Strip Construction

The CQA Manager or CQA Inspector shall perform the following observations and verifications during the construction of the test strip:

- Monitor the construction of the test strip
- Monitor and note the number of equipment passes required to generate passing density, moisture and permeability test results; this information will help target areas of suspect compaction during the construction of the compacted clay liner
- Verify and document that the test strip is constructed in accordance with the Technical Specifications, Section 02228, Paragraph 3.05

- Perform and document test strip sampling and testing in accordance with the Technical Specifications, Section 02228, Paragraph 3.05

All tests performed for the test strip must pass or the test strip will be redone using modified procedures as determined by the Engineer in consultation with the Contractor and a new test strip constructed and tested.

9.2.5 Compacted Clay Liner Testing

The CQA Manager or CQA Inspector shall perform the following observations and verifications during the construction of the compacted clay liner:

- Monitor the construction of the compacted clay liner
- Perform and document the sampling and testing program specified in the Technical Specifications, Section 02228, Paragraph 4.02
- Record all test locations and the elevation or lift associated with the test location

9.2.6 CQA Monitoring and Observation Requirements

The CQA Manager or CQA Inspector shall verify and document that the raw clay is processed, placed, compacted, protected, repaired, and constructed to the required lines, grades and thickness in accordance with the Technical Specifications, Section 02228, Part 3. In addition, the following area-specific observation and testing shall be performed:

- Borrow Source
  - Observe that the fill material is free from lenses, pockets, streaks, and/or layers of material differing substantially in texture and gradation
  - Observe that the fill material is free of organic material, large rocks, large clods, and frozen material
- Clay Processing:
  - Observe that the raw clay is processed for clod size reduction to meet the specified gradation, moisturized to the specified range, and allowed to cure prior to placement
- Fill Placement:

- Observe that the fill is constructed in uniform lifts; record the location and lifts of clay fill constructed on a daily basis
- Ensure uniformity of coverage by compaction equipment, especially at the edges of the clay fill, in equipment turnaround areas, and at the tops and bottoms of the slopes
- Ensure that layers of clay fill that are too wet are removed, allowed to dry or worked with appropriate equipment to reduce the moisture content
- Ensure that layers of clay fill that are too dry are brought to proper moisture content by applying supplemental water and mixing uniformly throughout the layer
- Verify and document that the compacted clay liner has been constructed to the lines, grades, and thickness required by the Technical Specifications and Drawings
- Inspect the clay surface for cracks, holes, soft or wet areas, defects or any other feature that may increase its field permeability
- Ensure that the final clay surface is smooth and free of objects that could penetrate the overlying geomembrane liner
- Observe that the clay liner is protected from desiccation until the geomembrane liner has been installed

9.2.7 Final Approval

Upon completion of the clay liner, the CQA Manager shall accept and approve the compacted clay liner prior to deployment or construction of the overlying layer.

10.0 SECTION 02253 GEOSYNTHETIC CLAY LINER

10.1 General

The observation requirements, testing requirements, and frequencies outlined below are prepared to demonstrate that the placed and constructed geosynthetic clay liner (GCL) is in accordance with the Technical Specifications and Drawings.

10.2 Execution

10.2.1 Review of Submittal Information

The CQA Manager or his designee shall review, comment, and approve the Contractor's submittals as specified in the Technical Specifications, Section 02253, Paragraph 1.04.

10.2.2 Quality Control Documentation

The CQA Manager or his designee shall approve and complete the quality control documentation required by the Technical Specifications, Section 02253, Paragraph 4.01.

10.2.4 Certification of Material Properties

The CQA Manager or his designee shall review the certifications of material properties supplied by the manufacturer for conformance with the Technical Specifications, Section 02253, Paragraphs 1.04 and 4.02.

10.2.4 CQA Monitoring and Observation Requirements

The following activities related to the deployment and installation of the GCL shall be performed:

- Verify and document that the deployment of the GCL panels is performed in accordance with the Technical Specifications, Section 02253, Paragraph 3.01
- Document the locations of the panels, seams, and repairs in the deployed GCL
- Verify and document that all pipe penetrations are constructed in accordance with the Technical Specifications, Section 02253, Paragraph 3.01.F

The CQA Manager or CQA Inspector shall make observations of the Contractor's work. The following list is a general guidance of critical areas of observation:

- Observe that equipment used does not damage the GCL by handling, trafficking, production of excessive heat, leakage of hydrocarbons, or other means
- The prepared subgrade is in acceptable condition immediately prior to the deployment of the GCL
- Observe that seam overlaps meet the minimum requirements of the Technical Specifications, Section 02253
- Observe that adequate temporary ballast has been used to prevent uplift by wind
- Observe that the GCL is protected from the elements (primarily rain) and that the material is in good condition prior to the placement of the flexible membrane liner
- Observe that the GCL has not been hydrated prior to the installation

10.2.5 Storage at the Site

Verify and document that storage of GCLs at the project site is performed in accordance with the Technical Specifications, Section 02253, Paragraph 1.05.

10.2.6 Repairs

Verify and document that all holes, tears, or rips in the covering geotextiles made during transportation, handling, placement, or anytime before backfilling are repaired in accordance with the Technical Specifications, Section 02253, Paragraph 3.02

11.0 SECTION 02271 HDPE GEOMEMBRANE

11.1 General

This section includes the requirements and frequencies of testing and observations that are required to demonstrate that the geomembrane liners are constructed in accordance with the Technical Specifications and Drawings.

11.2 Execution

11.2.1 Review of Submittal Information

The CQA Manager or his designee shall review, comment, and approve the Contractor's submittals as specified in the Technical Specifications, Section 02271, Paragraph 1.05.

11.2.2 Quality Control Certification of Material Properties

The CQA Manager or his designee shall review the certifications of material properties supplied by the manufacturer for conformance with the Technical Specifications, Section 02271, Paragraphs 1.05 and 4.01. In addition, the quality control documentation provided by the manufacturer shall be reviewed to assure conformance with the requirements of the Technical Specifications.

11.2.3 Delivery, Storage, and Handling of Materials

The CQA Manager or his designee shall perform the following activities to verify that the HDPE geomembrane are delivered, handled, and stored in accordance with the requirements of Section 02271:

- Verify and document that material delivered to the site is handled and stored according to the Owner-approved Liner Installation Plan
- Verify and document that all products delivered to the site have package labels that contain the required information in Section 02271, Paragraph 1.09.
- Verify and document that the rolls or pallets of geomembrane are unloaded and stored in accordance with specification Section 02271, Paragraph 1.09

11.2.4 Quality Assurance Conformance Sampling and Testing

The CQA Manager or his designee shall conduct the following activities to assure that the QA requirements of specification Section 02271 are fulfilled:

- Verify that QA sampling and documentation of the geomembrane material and welding rod are performed in accordance with the Technical Specifications, Section 02271, Paragraph 1.05
- Perform QA sampling and testing in accordance with the Specifications, Section 02271, Part 4

11.2.5 Subgrade Acceptance

The CQA Manager will verify and document that the subgrade surface is inspected and accepted in accordance with the specifications, Section 02271, Paragraph 3.01.

11.2.6 Panel Deployment

The CQA Manager or CQA Inspector shall verify and document that the deployment of the flexible geomembrane panels is in accordance with the Technical Specifications, Section 02271, Paragraph 3.03. A CQA Inspector shall check the panels for signs of potential damage. If damage to the liner is identified, the areas shall be marked for repair or replacement, as appropriate. All suspect damage to the deployed sheets shall be documented.

11.2.7 Defects and Repairs

The CQA Manager or his designee shall verify and documents that the flexible geomembrane panel repairs are performed in accordance with the Technical Specifications, Section 02271, Paragraph 3.06.

11.2.8 Seaming Quality Assurance

The CQA Manager or his designee shall verify that the seaming of the geomembrane panels, trial welds, and pipe penetrations are performed in accordance with the Technical Specifications, Section 02271, Paragraphs 3.04 and 3.05. The following is a general guidance of critical areas of observations:

- Observe to ensure that the geomembrane is free from dirt, dust and moisture

- Observe to ensure that the seaming equipment and materials are as specified
- Observe the weather conditions to ensure that they are acceptable for seaming
- Perform measurements of temperatures, pressures, and speed of seaming, when applicable, to ensure that they are as specified. Gauges and dials shall be checked and recorded.
- Observe to ensure that the geomembrane is not damaged by equipment or personnel during the seaming process
- Observe to ensure that the critical seams are made during the coolest part of the day so that the material will be in an unstressed condition
- Observe that all cutting of patch material is performed off the installed geomembrane. When this is not possible, an additional piece of waste HDPE geomembrane shall be used as a buffer.
- Observe to ensure that all patch corners are rounded to at least 3 inches in radius and that the patch overlaps at least 6 inches over the geomembrane
- Ensure that tools are placed on a piece of waste HDPE geomembrane to protect the previously installed sheets
- Document the location of seams, placement of panel sheets, repairs, and test locations

11.2.9 Non-Destructive Quality Control Testing

The CQA Manager or a CQA Inspector shall be present and witness all non-destructive quality control testing that is performed in the field during HDPE geomembrane installation. These tests include the following:

- Vacuum Testing: The CQA Manager or Inspector shall verify and documents that the Contractor's performance of the vacuum testing is in accordance with the Technical Specifications, Section 02271, Paragraph 4.02
- Air Pressure Testing: The CQA Manager or Inspector shall verify and document that the Contractor's performance of the air pressure testing is in accordance with the Technical Specifications, Section 02271, Paragraph 4.02

11.2.10 Destructive Seam Strength Testing

The CQA Manager or a CQA Inspector shall verify and document that the Contractor's performance of the destructive seam sampling and testing is in accordance with the Technical Specifications, Section 02271, Paragraph 4.03. The CQA Manager or Inspector shall determine destructive testing locations. These locations shall be clearly marked on the adjacent sheets and documented for the as-built records. In addition, QA testing that is carried out by the Owner shall be in accordance with Section 02271, Paragraph 4.03.

11.2.11 Quality Control Documentation

For QA purposes, the CQA Manager shall verify and document that the Contractor maintains and provides all QC documentation required by Section 02271, Paragraphs 1.05 and 4.01.

12.0 SECTION 02272 GEOTEXTILES

12.1 General

This section of the CQAP covers the required documentation that will be provided by the CQA Manager to fully document the progress of construction. This includes the daily reporting of construction activities, the reporting of test results and the preparation of the final CQA report.

12.2 Execution

12.2.1 Review of Submittal Information

The CQA Manager or his designee shall review, comment, and approve the Contractor's submittals as specified in the Technical Specifications, Section 02272, Paragraph 1.04.

12.2.2 Quality Control Certification of Material Properties

The CQA Manager or his designee shall review the certifications of material properties supplied by the manufacturer for conformance with the Technical Specifications, Section 02272, Paragraphs 1.04 and 4.02. In addition, the quality control documentation provided by the manufacturer shall be reviewed to assure conformance with the requirements of the Technical Specifications.

12.2.3 Quality Assurance Sampling and Testing

The CQA Manager or his designee shall verify that QA sampling, testing and documentation is performed in accordance with the Technical Specifications, Section 02272, Paragraph 4.02.

12.2.4 CQA Monitoring and Observation Requirements

The CQA requirements for the installation of the geotextile fabric that is a component of the geonet composite (geocomposite) is included in the Geocomposite Section of this Document, as these materials are bonded to the geonet and their installation will be concurrent.

The CQA Manager or CQA Inspector shall monitor the installation of the geotextile that is installed as a part of the leachate detection and collection system. The installed geotextile shall be inspected for damage, and repairs or replacement of these areas shall be ordered, as

appropriate. The Inspector shall verify that the proper width of material is wrapped under the drain rock during the installation, in accordance with the details on the Drawings.

13.0 SECTION 02274 GEOCOMPOSITE

13.1 General

This section includes the observation requirements as well as the testing requirements and frequencies to demonstrate that the geocomposite materials specified for the project meet the material and installation requirements of the Technical Specifications and Drawings.

13.2 Execution

13.2.1 Review of Submittal Information

The CQA Manager or his designee shall review, comment, and approve the Contractor's submittals as specified in the Technical Specifications, Section 02274, Paragraph 1.04.

13.2.2 Quality Control Certification of Material Properties

The CQA Manager or his designee shall review the certifications of material properties supplied by the manufacturer for conformance with the Technical Specifications, Section 02274, Paragraphs 1.04 and 4.01. In addition, the quality control documentation provided by the manufacturer shall be reviewed to assure conformance with the requirements of the Technical Specifications.

13.2.3 Quality Assurance Conformance Sampling and Testing

The CQA Manager or his designee shall verify that QA sampling, testing and documentation is performed in accordance with the Technical Specifications, Section 02274, Paragraph 4.02.

13.2.4 CQA Monitoring and Observation Requirements

The CQA Manager or Inspector shall carry out the following observations and inspections to verify that the geocomposite materials are deployed and installed according the to requirements of the Technical Specifications:

- Verify and document that the deployment of the geocomposite is in accordance with the Technical Specifications, Section 02274, Paragraphs 3.01 and 3.02.

- Observe that the equipment utilized for the Work does not damage the geocomposite by handling, trafficking, production of excessive heat, leakage of hydrocarbons, or any other means.
- Observe that the minimum seam overlap distance requirement is met.
- Observe that seaming is performed in accordance with the requirements outlined in Section 02274, Paragraph 3.03.
- Observe that adequate ballast has been placed to prevent uplift by wind.
- Observe the deployment of the geocomposite and check for signs of potential damage. If damage to the geocomposite is identified, the area shall be marked for repair or replacement, as appropriate. Document all suspect damage to the deployed fabric.

13.2.5 Handling and Storage at the Site

The CQA Manager or his designee shall verify and document that the rolls of geocomposite are handled and stored in accordance with the Technical Specifications, Section 02274, Paragraph 1.05.

13.2.6 Repairs

The CQA Manager or CQA Inspector shall verify and document that all holes or tears in the geocomposite during the placement or anytime before backfilling are repaired in accordance with the Technical Specifications, Section 02274, Paragraph 3.04.

14.0 SECTION 15062 PIPING

7.1 General

This section includes the observation requirements as well as the testing requirements and frequencies to demonstrate that the placed and constructed piping is in accordance with the Technical Specifications and Drawings.

7.1 Execution

14.2.1 Review of Submittal Information

The CQA Manager or his designee shall review, comment, and approve the Contractor's submittals as specified in the Technical Specifications, Section 15062, Paragraph 1.04.

14.2.2 Quality Control Certification of Material Properties

The CQA Manager or his designee shall review the certifications of material properties supplied by the manufacturer for conformance with the Technical Specifications, Section 15062, Paragraph 4.01. In addition, the quality control documentation provided by the manufacturer shall be reviewed to assure conformance with the requirements of the Technical Specifications.

14.2.3 Delivery, Storage, and Handling of Materials

The CQA Manager or his designee shall perform the following activities to verify that the various pipe materials are delivered, handled, and stored in accordance with the requirements of Section 15062, Paragraph 1.05.

14.2.4 CQA Monitoring and Observation Requirements

The CQA Manager or Inspector shall carry out the following observations and inspections to verify that the geocomposite materials are deployed and installed according to the requirements of the Technical Specifications:

- Verify and document that the installation of the piping is in accordance with the Technical Specifications, Section 15062, Part 3

- Observe the installation of the piping and its interaction with any geosynthetic components in contact; if damage to the geosynthetic components is identified, the area shall be marked for repair or replacement, as appropriate
- Document all suspect damage to the geosynthetic components

Appendix D.5.7
Cell 16 Engineering Report Appendix F - Stability Analysis

APPENDIX F

STABILITY ANALYSIS

Stability Analysis

Sideslope and Floor Liner Systems
Initial Construction

US ECOLOGY CELL 16

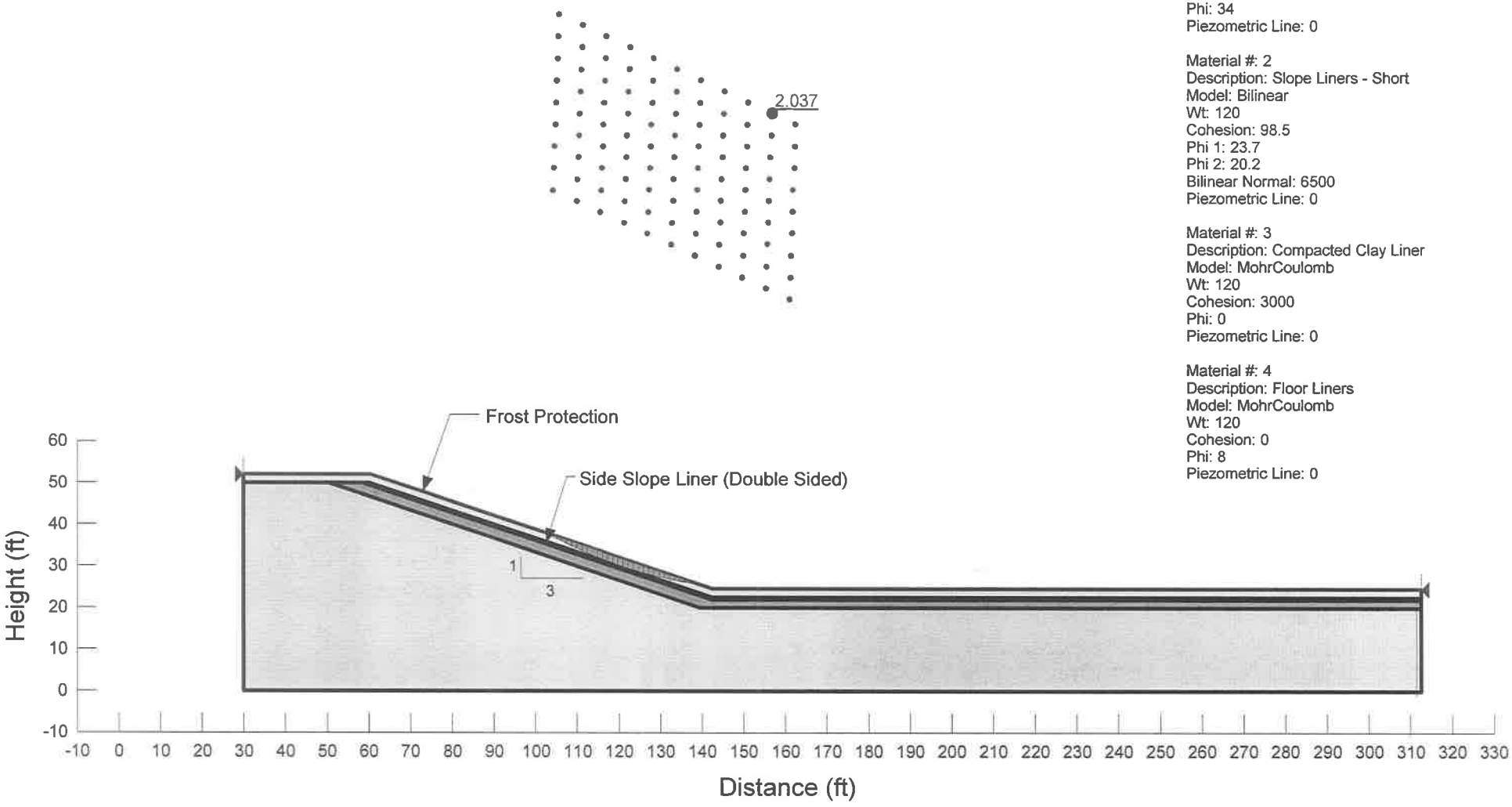
Embankment Section With Liner and Frost Protection
Analysis Method: Morgenstern-Price
Slip Surface Option: GridAndRadius
Seismic Coefficient: Horz: 0, Vert: 0

Material #: 1
Description: Cover Soil-Common Fill
Model: MohrCoulomb
Wt: 125
Cohesion: 0
Phi: 34
Piezometric Line: 0

Material #: 2
Description: Slope Liners - Short
Model: Bilinear
Wt: 120
Cohesion: 98.5
Phi 1: 23.7
Phi 2: 20.2
Bilinear Normal: 6500
Piezometric Line: 0

Material #: 3
Description: Compacted Clay Liner
Model: MohrCoulomb
Wt: 120
Cohesion: 3000
Phi: 0
Piezometric Line: 0

Material #: 4
Description: Floor Liners
Model: MohrCoulomb
Wt: 120
Cohesion: 0
Phi: 8
Piezometric Line: 0



US ECOLOGY CELL 16

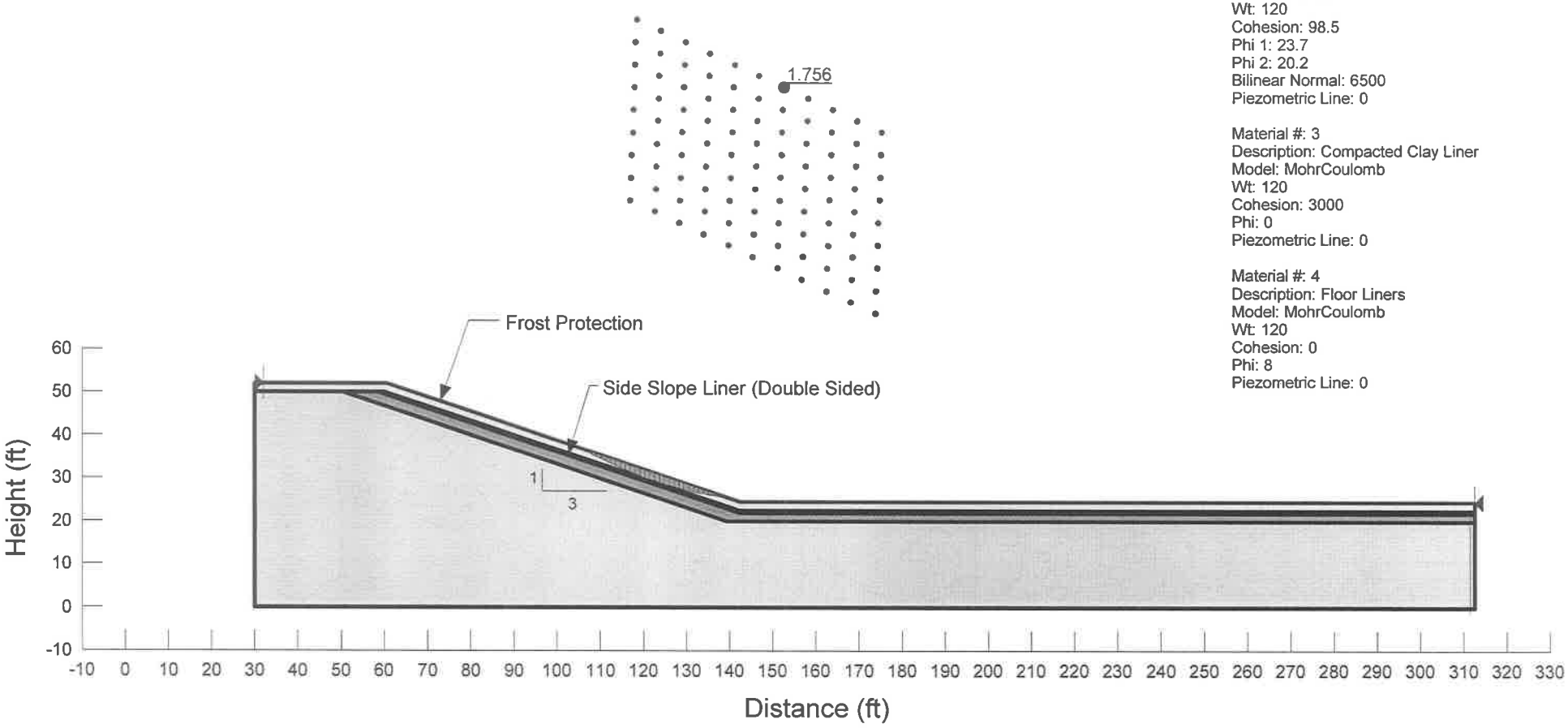
Embankment Section With Liner and Frost Protection
Analysis Method: Morgenstern-Price
Slip Surface Option: GridAndRadius
Seismic Coefficient: Horz: 5.1e-002, Vert: 5.1e-002

Material #: 1
Description: Cover Soil-Common Fill
Model: MohrCoulomb
Wt: 125
Cohesion: 0
Phi: 34
Piezometric Line: 0

Material #: 2
Description: Slope Liners - Short
Model: Bilinear
Wt: 120
Cohesion: 98.5
Phi 1: 23.7
Phi 2: 20.2
Bilinear Normal: 6500
Piezometric Line: 0

Material #: 3
Description: Compacted Clay Liner
Model: MohrCoulomb
Wt: 120
Cohesion: 3000
Phi: 0
Piezometric Line: 0

Material #: 4
Description: Floor Liners
Model: MohrCoulomb
Wt: 120
Cohesion: 0
Phi: 8
Piezometric Line: 0



Stability Analysis

Sideslope and Floor Liner Systems
Access Ramp

US ECOLOGY CELL 16

Embankment Section With Liner and Temporary Ramp
Analysis Method: Morgenstern-Price
Slip Surface Option: GridAndRadius
Seismic Coefficient: Horz: 0, Vert: 0

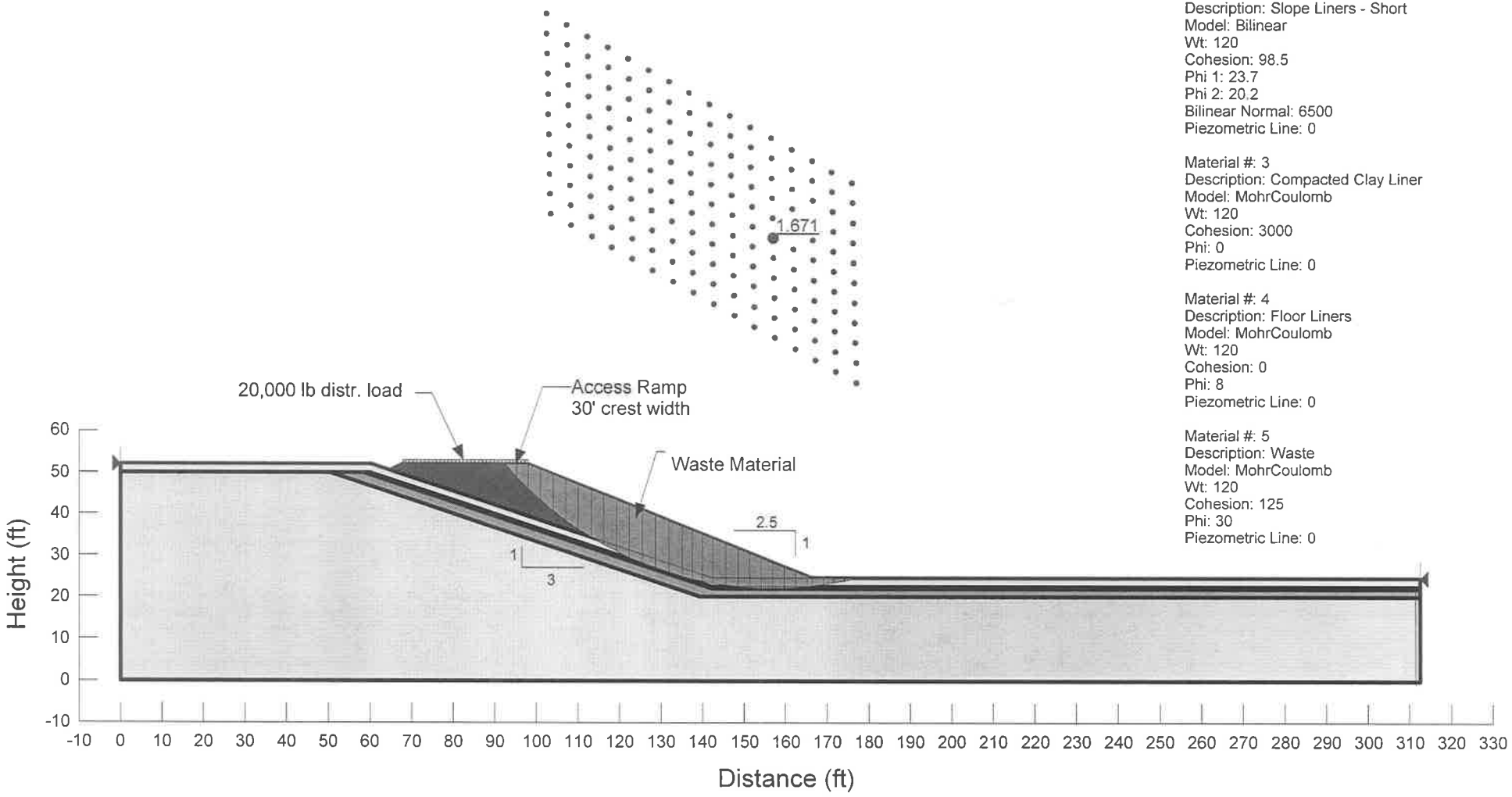
Material #: 1
Description: Cover Soil-Common Fill
Model: MohrCoulomb
Wt: 125
Cohesion: 0
Phi: 34
Piezometric Line: 0

Material #: 2
Description: Slope Liners - Short
Model: Bilinear
Wt: 120
Cohesion: 98.5
Phi 1: 23.7
Phi 2: 20.2
Bilinear Normal: 6500
Piezometric Line: 0

Material #: 3
Description: Compacted Clay Liner
Model: MohrCoulomb
Wt: 120
Cohesion: 3000
Phi: 0
Piezometric Line: 0

Material #: 4
Description: Floor Liners
Model: MohrCoulomb
Wt: 120
Cohesion: 0
Phi: 8
Piezometric Line: 0

Material #: 5
Description: Waste
Model: MohrCoulomb
Wt: 120
Cohesion: 125
Phi: 30
Piezometric Line: 0



US ECOLOGY CELL 16

Embankment Section With Liner and Temporary Ramp
Analysis Method: Morgenstern-Price
Slip Surface Option: FullySpecified
Seismic Coefficient: Horz: 5.1e-002, Vert: 5.1e-002

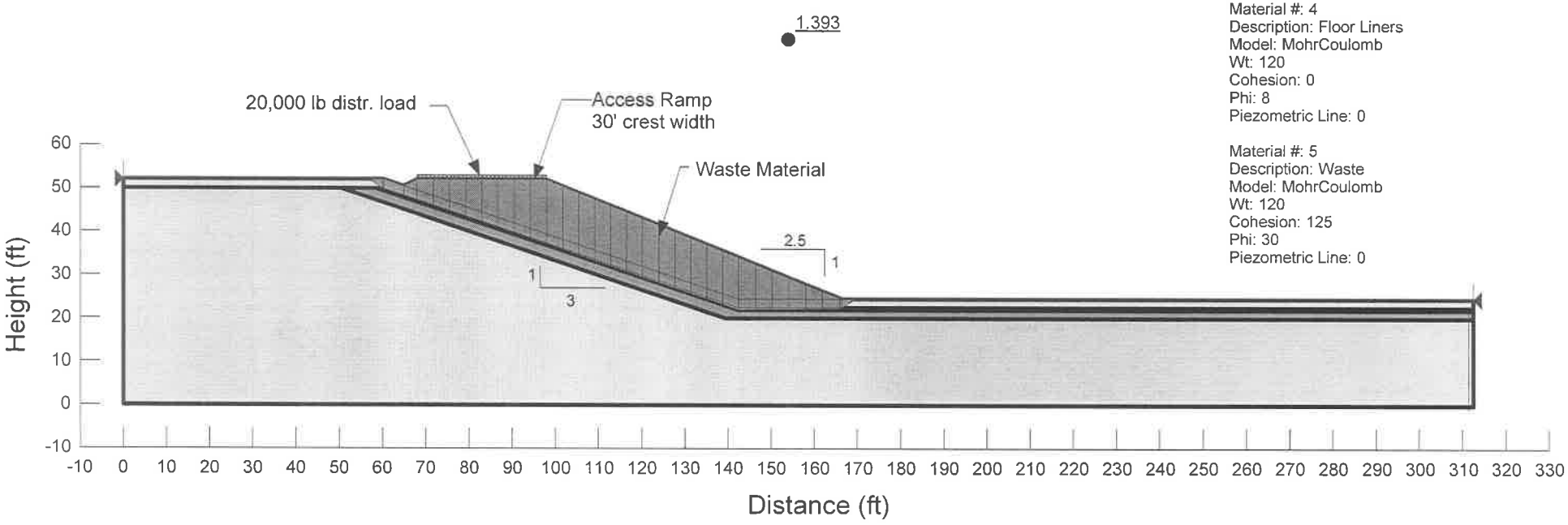
Material #: 1
Description: Cover Soil-Common Fill
Model: MohrCoulomb
Wt: 125
Cohesion: 0
Phi: 34
Piezometric Line: 0

Material #: 2
Description: Slope Liners - Short
Model: Bilinear
Wt: 120
Cohesion: 98.5
Phi 1: 23.7
Phi 2: 20.2
Bilinear Normal: 6500
Piezometric Line: 0

Material #: 3
Description: Compacted Clay Liner
Model: MohrCoulomb
Wt: 120
Cohesion: 3000
Phi: 0
Piezometric Line: 0

Material #: 4
Description: Floor Liners
Model: MohrCoulomb
Wt: 120
Cohesion: 0
Phi: 8
Piezometric Line: 0

Material #: 5
Description: Waste
Model: MohrCoulomb
Wt: 120
Cohesion: 125
Phi: 30
Piezometric Line: 0



Stability Analysis

Sideslope and Floor Liner Systems
Full Waste Placement

US Ecology Landfill Cell 16

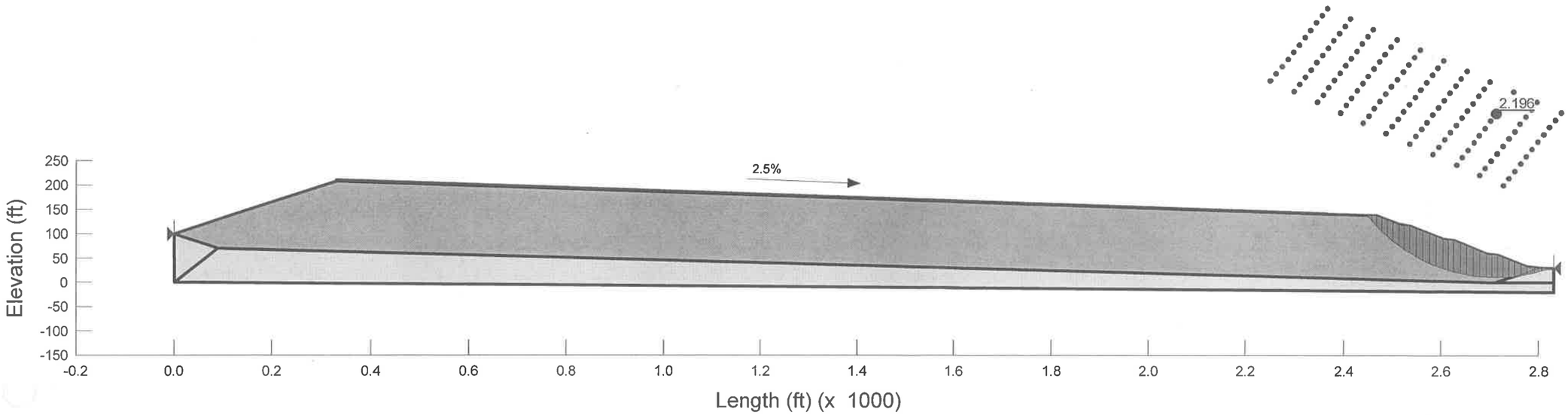
Final Construction - Cell Length
Method: Morgenstern-Price
Slip Surface Option: GridAndRadius
Seismic Coefficient: Horz: 0 Vert: 0

Material #: 1
Description: Common Fill / Cover Soil
Model: MohrCoulomb
Wt: 125
Cohesion: 0
Phi: 34

Material #: 2
Description: Waste
Model: MohrCoulomb
Wt: 120
Cohesion: 125
Phi: 30

Material #: 3
Description: Floor Liner
Model: MohrCoulomb
Wt: 120
Cohesion: 0
Phi: 8

Material #: 4
Description: Slope Liner - Long
Model: Bilinear
Wt: 120
Cohesion: 111.5
Phi 1: 12.5
Phi 2: 10.8
Bilinear Normal: 2000



US Ecology Landfill Cell 16

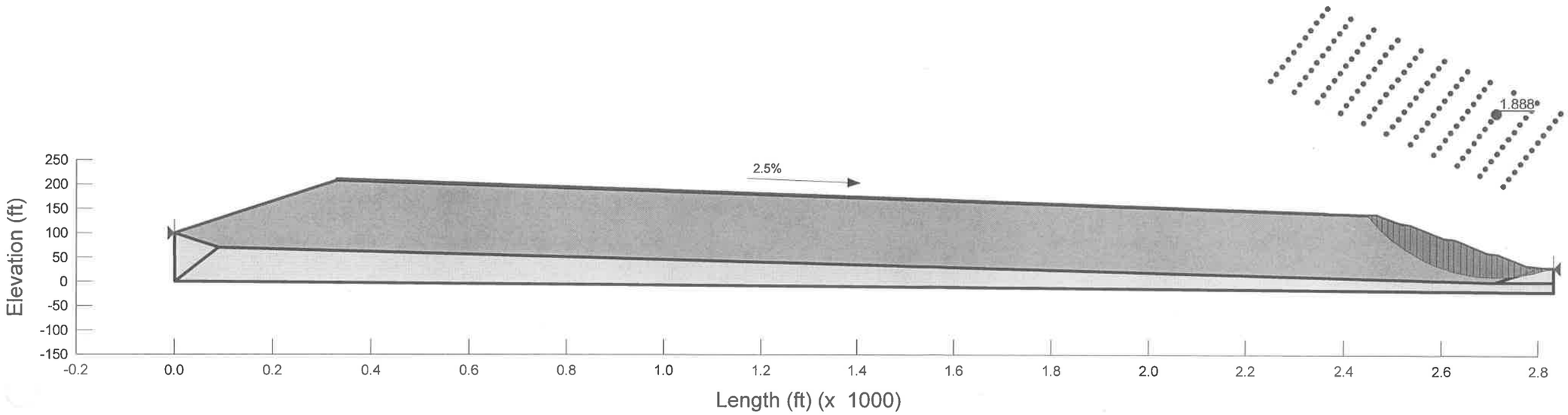
Final Construction - Cell Length
Method: Morgenstern-Price
Slip Surface Option: GridAndRadius
Seismic Coefficient: Horz: 5.1e-002 Vert: 5.1e-002

Material #: 1
Description: Common Fill / Cover Soil
Model: MohrCoulomb
Wt: 125
Cohesion: 0
Phi: 34

Material #: 2
Description: Waste
Model: MohrCoulomb
Wt: 120
Cohesion: 125
Phi: 30

Material #: 3
Description: Floor Liner
Model: MohrCoulomb
Wt: 120
Cohesion: 0
Phi: 8

Material #: 4
Description: Slope Liner - Long
Model: Bilinear
Wt: 120
Cohesion: 111.5
Phi 1: 12.5
Phi 2: 10.8
Bilinear Normal: 2000



Appendix D.5.8
Cell 16 Engineering Report Appendix G - Ketterling Clay Investigations

APPENDIX G

KETTERLING CLAY INVESTIGATIONS – JOHNSON PROPERTY

August 9, 2007
Project No. 06B-G1434.1

US Ecology Idaho
PO Box 400
Grand View, Idaho 83624

Attention: Kevin Trader, Facilities Manager

SUBJECT: Ketterling Clay Investigations
Johnson Property & Steiner Property

Dear Kevin:
This letter presents the results of our exploration drilling and laboratory tests performed near US Ecology's hazardous waste facility in Grand View. The purpose of this investigation was to determine the presence and extent of Ketterling materials at each location.

EXPLORATIONS

A total of eight test borings (B-101 thru B-108) were drilled in May of 2007, as follows:

- Three borings (B-101 thru B-103) were drilled at the existing Ketterling Source, located north of Highway 78;
- Four borings (B-104-B-107) were drilled at the Johnson Property, also located north of Highway 78 approximately ¼ mile east of the active Ketterling Source; and
- One boring (B-108) was drilled at the Steiner Property, located immediately east of the treatment facility off of Lemley Road.

Please reference the enclosed maps to see the approximate boring locations at each property.

LABORATORY TESTING

Extensive laboratory testing was performed on all of the clay materials encountered during the investigation. The laboratory tests performed on the clay materials included:

- Moisture content;
- Gradations and hydrometer analysis;
- Moisture / density relationships (proctors);
- Atterberg limits;

- Permeability; and
- Specific gravity.

A summary of the test results are presented on the enclosed tables.

EVALUATION

The index properties, and engineering properties measured on clay materials encountered at the Johnson Property reflect the same properties which have been observed at the Ketterling Source during the past 14 years of mining. The Ketterling clay has been observed to generally have the following characteristics:

- Liquid Limit = 46 to 54
- Plasticity Index = 22 to 28
- % Passing # 200 Sieve = 99 to 100
- % Passing 0.002 Sieve = 30 to 38
- Max. Density (modified) = 101 to 105 pcf
- Optimum Moisture (mod.) = 18 to 21
- Permeability = $5x10^{-8}$ to $1x10^{-8}$ cm/sec
- Specific Gravity = 2.76 to 2.78

As a side note, upon completing one of the permeability tests from the Johnson property (B-107 at 65 feet) we determined to measure the permeability of the clay when it was exposed to an effective stress of 90 psi (all other perm tests were performed at a standard effective stress of 3 psi). The permeability of the clay was observed to reduce from $2.0x10^{-8}$ cm/sec to $2.4x10^{-9}$ cm/sec with the increased effective stress. This is noteworthy because it provides an indication that the permeability of the compacted clay liners is reduced by a full order of magnitude after placement of approximately 120 feet of overburden and waste materials.

CONCLUSIONS

Johnson Property

Based upon a comparison of the test results we conclude that the clay materials deposited at the Johnson property are consistent with the Ketterling materials encountered at the current source, located ¼ mile to the east. The clay materials at the Johnson Property are suitable for use on future construction of compacted clay liner. A volume calculation for the Johnson Property clay was not performed in connection with this evaluation, but may be performed when survey data is obtained.

Steiner Property

Clay materials encountered at the Steiner property were not consistent with the Ketterling clay. These materials were variable with depth, ranging from moderately lean clay with a liquid limit of 42 near a depth of 10 feet to very fat clay with a liquid limit of 95 near a depth of 49 feet. Although it may be possible to construct a clay liner with these materials, the variability in material properties would present difficulty in establishing the necessary construction sequences (i.e. proper moisture content, minimum density, compactive effort needed, etc.). The workability of these materials and a new Boutwell correlation value would need to be determined through construction of a test pad if these materials were used for construction a clay liner. Given the relatively high liquid limit, these clay materials may be useful as a waste solidification reagent.

Please contact us if additional information or clarification is needed.

Respectfully submitted,

American Geotechnics

PROFESSIONAL ENGINEER REGISTERED 8-16-89 11632 STATE OF IDAHO VAUGHN THURGOOD

Vaughn Thurgood, PE
Geotechnical Engineer

Rex W. Hansen, PE
Geotechnical Engineer

Attachments:
- Summary of Test Results
- Boring Location Maps
- Boring Logs
- Laboratory Test Reports
  - Current Ketterling Source
  - Johnson Property
  - Steiner Property

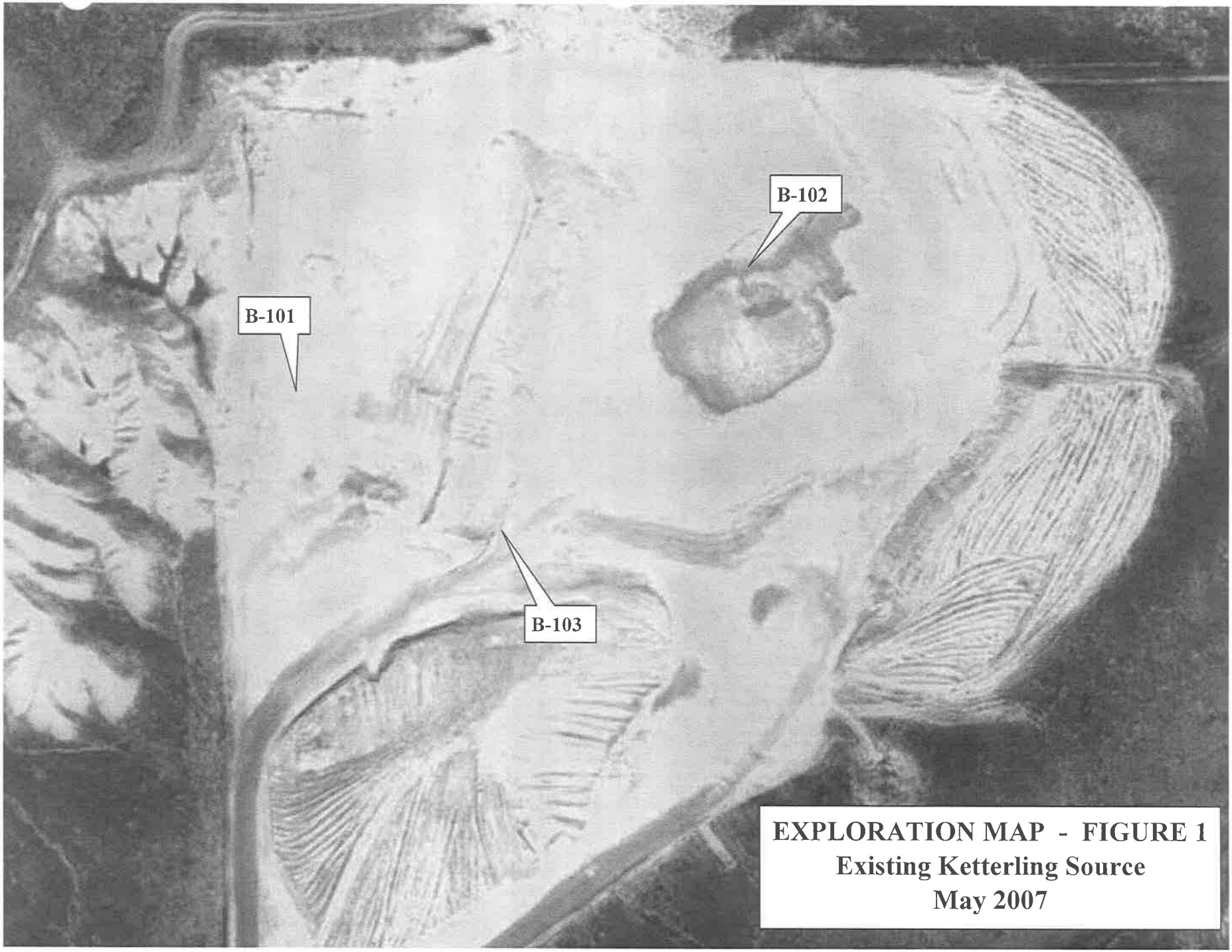
AMERICAN GEO TECHNICS

Location	SUMMARY OF CLAY INVESTIGATIONS									
	Depth (ft)	Natural Moisture (%)	LL	PI	% Pass #200	Clay Content < 0.002	Optimum Moist (D698)	Maximum Density (pcf)	Remolded Perm* (cm/s)	Comments
Ketterling Pit								--	--	
B-101	10	22	51	27	99.8	32	20.5%	103.1	--	
B-101	20	22	50	27	99.7	--	18.9%	103.5	--	
B-101	30	25	48	23	99.5	--	20.5%	102.2	--	
B-101	40	26	51	24	99.8	35	19.9%	101.6	--	
B-101	50	25	48	22	99.7	--	20.5%	101.2	--	
B-101	60	27	50	25	99.9	36	--	--	--	
S. Face	0	--	38	22	--	--	--	--	--	Loose fill located on far south cut slope
SE Face	0	--	52	25	--	--	--	--	--	Located in south end of dugway
B-102	5	24	54	29	99.8	34	19.4%	104.4	--	Specific gravity measured @ 2.77
B-102	18	24	51	26	99.8	--	--	--	--	
B-103	5	22	51	26	99.7	35	20.1%	104.8	--	
B-103	18	25	51	27	99.8	--	--	--	--	
Johnson Property										
B-104	10	12	52	26	99.6	--	--	--	--	Specific gravity measured @ 2.77
B-104	20	13	51	28	99.6	37	18.4%	104.8	5.6×10^{-8}	Remolded 97.1 pcf @ 25%
B-104	30	14	50	26	99.8	--	--	--	--	
B-106	8	12	50	26	97.6	--	--	--	--	
B-106	14	13	51	26	99.8	--	--	--	--	
B-107	19	26	49	27	99.2	--	--	--	--	
B-107	25	25	47	26	99.2	30	19.1%	105.5	5.4×10^{-8}	Remolded 92.6 pcf @ 29%

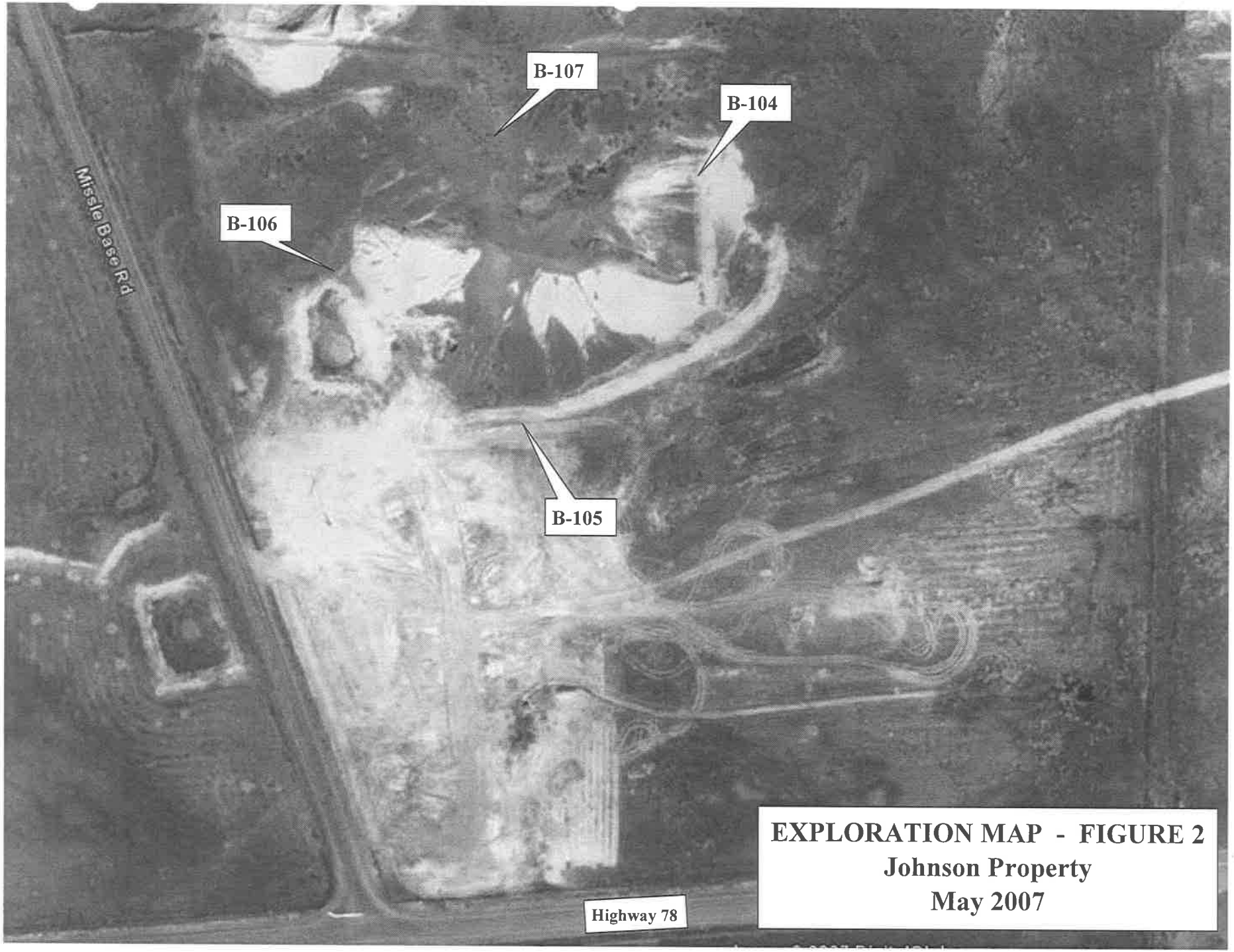
AMERICAN GEO TECHNICS

SUMMARY OF CLAY INVESTIGATIONS										
Location	Depth (ft)	Natural Moisture (%)	LL	PI	% Pass #200	Clay Content < 0.002	Optimum Moist (D698)	Maximum Density (pcf)	Remolded Perm* (cm/s)	Comments
Johnson Cont.								--	--	
B-107	35	28	50	25	99.7	--	--	--	--	
B-107	45	26	50	23	99.0	36	20.0%	106.8	$2.3x10^{-8}$	Remolded 96.4 pcf @ 26%
B-107	55	27	50	25	99.6	--	--	--	--	
B-107	65	25	50	25	99.8	32	19.6%	106.1	$2.0x10^{-8}$	Remolded 92.4 pcf @ 29%
									$2.4x10^{-9}$	Performed additional perm test on same specimen to evaluate the confining effect of approximately 110 feet of waste.
Steiner Property								--	--	
B-108	10	22.0	42	14	99.7	--	--	--	--	
B-108	20	21.6	55	27	99.5	29	20.8	102.9	$1.0x10^{-7}$	Remolded 95.6 pcf @ 26%
B-108	30	34.7	77	42	99.3	--	--	--	--	
B-108	40	25.3	86	49	99.1	51	32.6	80.2	$4.4x10^{-8}$	Remolded 74 pcf @ 39%
B-108	49	53.9	95	55	99.6	--	--	--	--	

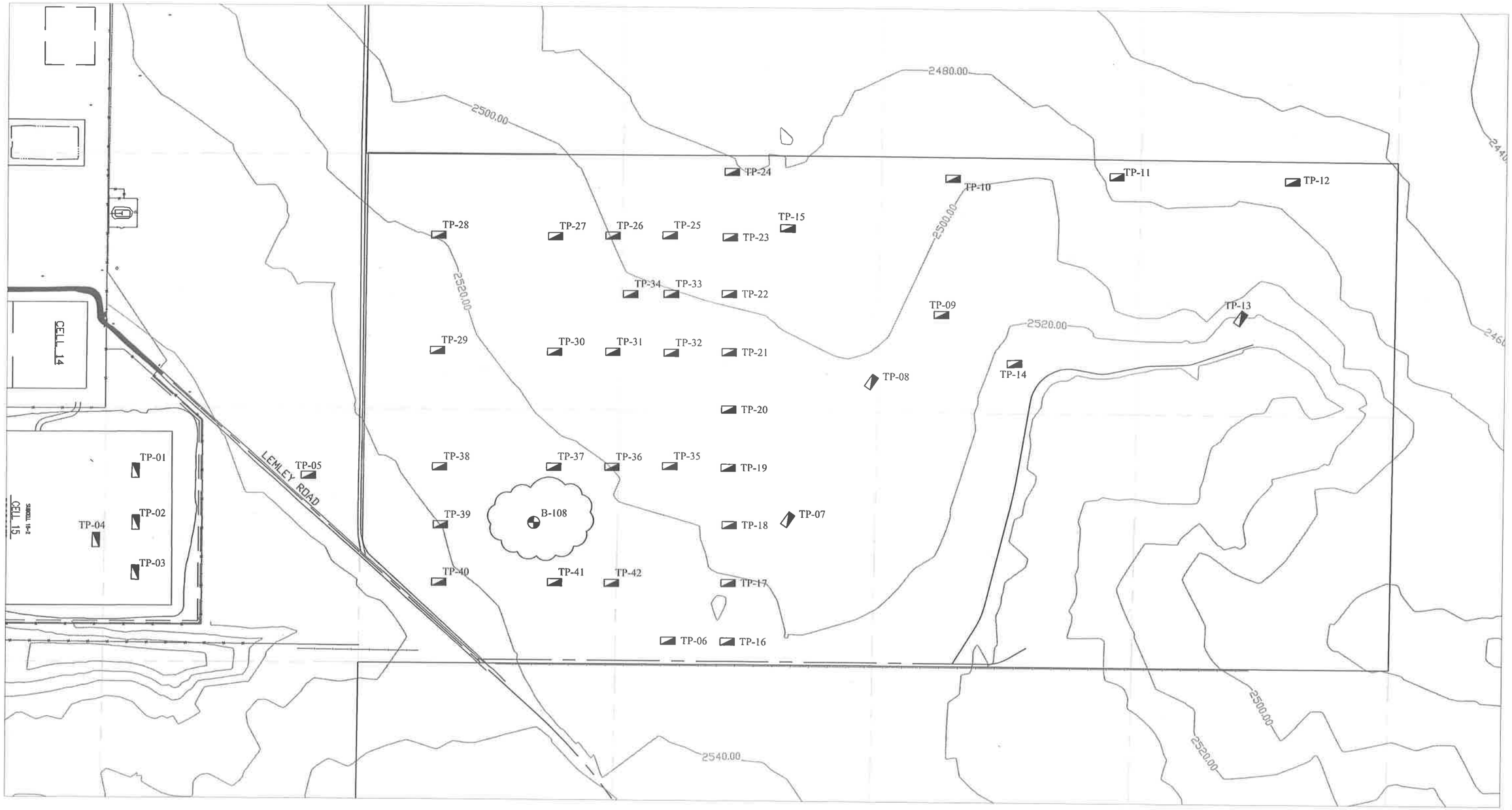
* Flex-wall permeability testing performed on remolded specimens.



EXPLORATION MAP - FIGURE 1
Existing Ketterling Source
May 2007



EXPLORATION MAP - FIGURE 2
Johnson Property
May 2007



EXPLORATION MAP
Steiner Property
Grand View, Idaho

FIGURE 3

Project No.	Date:
06B-G1434.1	May, 2007

AMERICAN GEO TECHNICS

PROJECT: Phase III Clay Investigations
LOCATION: Ketterling Source
ELEVATION:
DATE: May 21, 2007
LOGGED BY: Vaughn Thurgood
DRILLING METHOD: Hollow stem auger

WATER LEVEL: None encountered.

BORING LOG NO. B-101

AMERICAN GEO TECHNICS

DEPTH (ft.)	SAMPLE TYPE - No.	SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS (Stratification lines represent approx. boundaries between materials.)
0				Fat Clay (CH)-	Boring located on west bench, approximately 30 feet above existing floor of pit.
2					
4	CS-1				
6					
8					
10					
12	CS-2				
14					
16					
18					
20					
22	CS-3				
24					
26					
28					Transition form brown-yellow to brown-gray.
30					Occasional red sand particles.
32	CS-4				
34					
36					
38					Gray mottling, ribbons of bentonite?

PROJECT: Phase III Clay Investigations
LOCATION: Ketterling Source

BORING LOG NO. B-101

AMERICAN GEO TECHNICS

WATER LEVEL: None encountered.

DEPTH (ft.)	SAMPLE TYPE - No.	SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS
40					
42	CS-5				
44					
46					
48					
50					
52	CS-6				
54					
56					
58					
60	CS-7				
62					
64				Bottom of hole at 63 feet.	
66					
68					
70					
72					
74					
76					
78					
80					

PROJECT: Phase III Clay Investigations
LOCATION: Ketterling Source
ELEVATION:
DATE: May 22, 2007
LOGGED BY: Vaughn Thurgood
DRILLING METHOD: Hollow stem auger

WATER LEVEL: None encountered.

BORING LOG NO. B-102

AMERICAN GEO TECHNICS

DEPTH (ft.)	SAMPLE TYPE - No.	SAMPLE SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS (Stratification lines represent approx. boundaries between materials.)
0				Fat Clay (CH)-	Hole located in the floor of pit near east end where ponding had previously occured.
2					
4	CS-10				
6					
8					
10	CS-11				
12					
14					
16	CS-12				
18				Bottom of hole at 18 feet.	
20					
22					
24					
26					
28					
30					
32					
34					
36					
38					

PROJECT: Phase III Clay Investigations
LOCATION: Ketterling Source
ELEVATION:
DATE: May 22, 2007
LOGGED BY: Vaughn Thurgood
DRILLING METHOD: Hollow stem auger

WATER LEVEL: None encountered.

BORING LOG NO. B-103

AMERICAN GEO TECHNICS

DEPTH (ft.)	SAMPLE TYPE - No.	SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS (Stratification lines represent approx. boundaries between materials.)
0				Fat Clay (CH)-	Hole located in the access road cut, along the south side of the pit floor.
2					
4	CS-13				
6					
8					
10	CS-14				
12					
14					
16	CS-15				
18				Bottom of hole at 18 feet.	
20					
22					
24					
26					
28					
30					
32					
34					
36					
38					

PROJECT: Phase III Clay Investigations
LOCATION: Johnson Property
ELEVATION:
DATE: May 22, 2007
LOGGED BY: Vaughn Thurgood
DRILLING METHOD: Hollow Stem Auger

WATER LEVEL: None encountered

BORING LOG NO. B-104

AMERICAN GEO TECHNICS

DEPTH (ft.)	SAMPLE TYPE - No.	SAMPLE SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS (Stratification lines represent approx. boundaries between materials.)
0				Poorly Graded Gravel with Silt and Sand (GP-GM)-	Boring located on east bench of Clay Mound
2				Fat Clay (CH)-	
4					
6					
8					
10	CS-16				
12					Transitions from brown-yellow and mellow to brown-gray and hard.
14					
16					
18					
20	CS-17				
22					
24					
26					
28					
30	CS-18				
32					
34					
36				Bottom of hole at 35 feet.	
38					

PROJECT: Phase III Clay Investigations
LOCATION: Johnson Property
ELEVATION:
DATE: May 22, 2007
LOGGED BY: Vaughn Thurgood
DRILLING METHOD: Hollow Stem Auger

WATER LEVEL: None encountered

BORING LOG NO. B-105

AMERICAN GEO TECHNICS

DEPTH (ft.)	SAMPLE TYPE - No.	SAMPLE SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS (Stratification lines represent approx. boundaries between materials.)
0				Poorly Graded Gravel with Silt and Sand (GP-GM)-	Boring located about 30 feet out from the toe of the mound on south side.
4	OSS-19	14-12-10			
6				Silt (ML)-	
10	OSS-20	3-4-6			
14	OSS-21	5-4-5			
16				Bottom of hole at 15.5 feet.	

PROJECT: Phase III Clay Investigations
LOCATION: Johnson Property
ELEVATION:
DATE: May 22, 2007
LOGGED BY: Vaughn Thurgood
DRILLING METHOD: Hollow Stem Auger

WATER LEVEL: None encountered

BORING LOG NO. B-106

AMERICAN GEO TECHNICS

DEPTH (ft.)	SAMPLE TYPE - No.	SAMPLE SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS (Stratification lines represent approx. boundaries between materials.)
0				Silty Gravel with Sand (GM)-	Boring located at the toe of the mound on the west side.
2					
4					
6				Silt (ML)-	
				Fat Clay (CH)-	
8	OSS-22	30-71-75			
10					
12					
14	OSS-23	36-68-75			
				Bottom of hole at 14.5 feet.	
16					
18					
20					
22					
24					
26					
28					
30					
32					
34					
36					
38					

PROJECT: Phase III Clay Investigations
LOCATION: Johnson Property
ELEVATION:
DATE: May 22, 2007
LOGGED BY: Vaughn Thurgood
DRILLING METHOD: Hollow Stem Auger

WATER LEVEL: None encountered

BORING LOG NO. B-107

AMERICAN GEO TECHNICS

DEPTH (ft.)	SAMPLE TYPE - No.	SAMPLE SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS (Stratification lines represent approx. boundaries between materials.)
0				Poorly Graded Gravel with Silt and Sand (GP-GM)-	Boring located on top of the mound.
4	OSS-24	24-23-24		Silty Sand with Gravel (SM)-	
6				Poorly Graded Gravel with Silt and Sand (GP-GM)-	
14	OSS-25	35-56-75			
18				Fat Clay (CH)-	
20	OSS-26	5-9-13			Very moist, soft, brown-yellow.
24	CS-27				
30					
34	CS-28				
38					

PROJECT: Phase III Clay Investigations
LOCATION: Johnson Property

WATER LEVEL: None encountered

BORING LOG NO. B-107

AMERICAN GEO TECHNICS

DEPTH (ft.)	SAMPLE TYPE - No.	SAMPLE SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS
40					Slow transition to dryer material.
42					
44	CS-29				
46					
48					
50					Water added to auger overnight.
52					
54	CS-30				
56					
58					
60					
62					
64	CS-31				
66					
68					
70				Bottom of hole at 69 feet.	
72					
74					
76					
78					
80					

PROJECT: Phase III Clay Investigations
LOCATION: Steiner Property
ELEVATION:
DATE: May 23, 2007
LOGGED BY: Vaughn Thurgood
DRILLING METHOD: Hollow stem auger

WATER LEVEL: None encountered.

BORING LOG NO. B-108

AMERICAN GEO TECHNICS

DEPTH (ft.)	SAMPLE TYPE - No.	SAMPLE SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS (Stratification lines represent approx. boundaries between materials.)
0				Silt with Sand (ML)-	Boring located between TP-37 and TP-41, approx 800 feet north of the water supply pond.
2					
4	OSS-32	5-12-15			
6				Lean Clay (CL)- Milk chocolate brown.	
8					
10	CS-33				
12					
14				Fat Clay (CH)-	Transitions to light brown-gray, ketterling like material.
16					
18					
20	CS-34				
22					
24					
26					
28	CS-35				
30					
32					
34					
36					
38					

PROJECT: Phase III Clay Investigations
LOCATION: Steiner Property

WATER LEVEL: None encountered.

BORING LOG NO. B-108

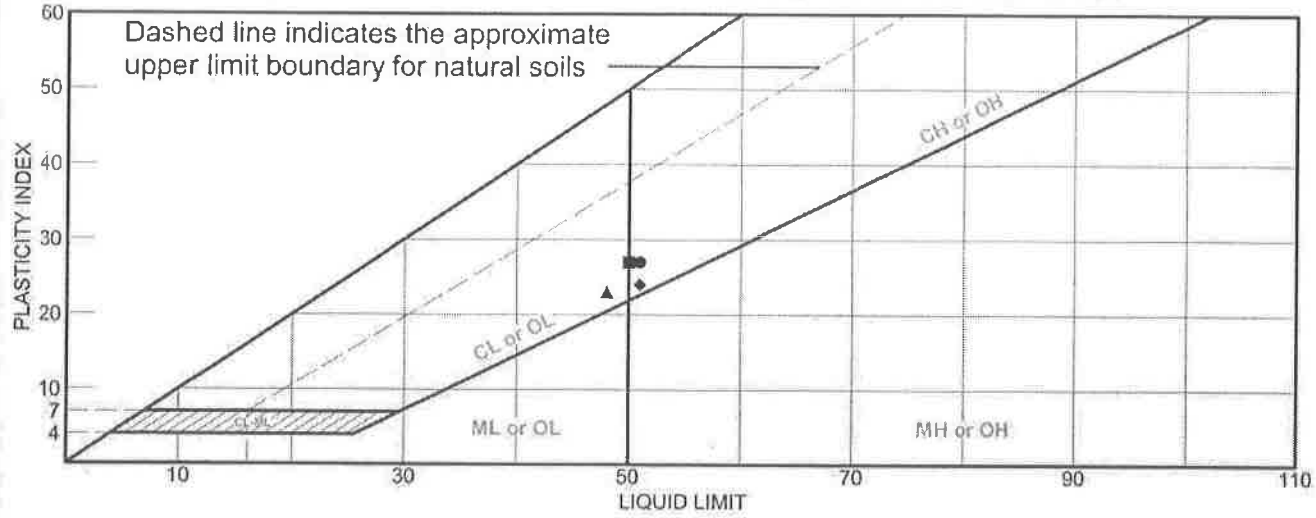
AMERICAN GEO TECHNICS

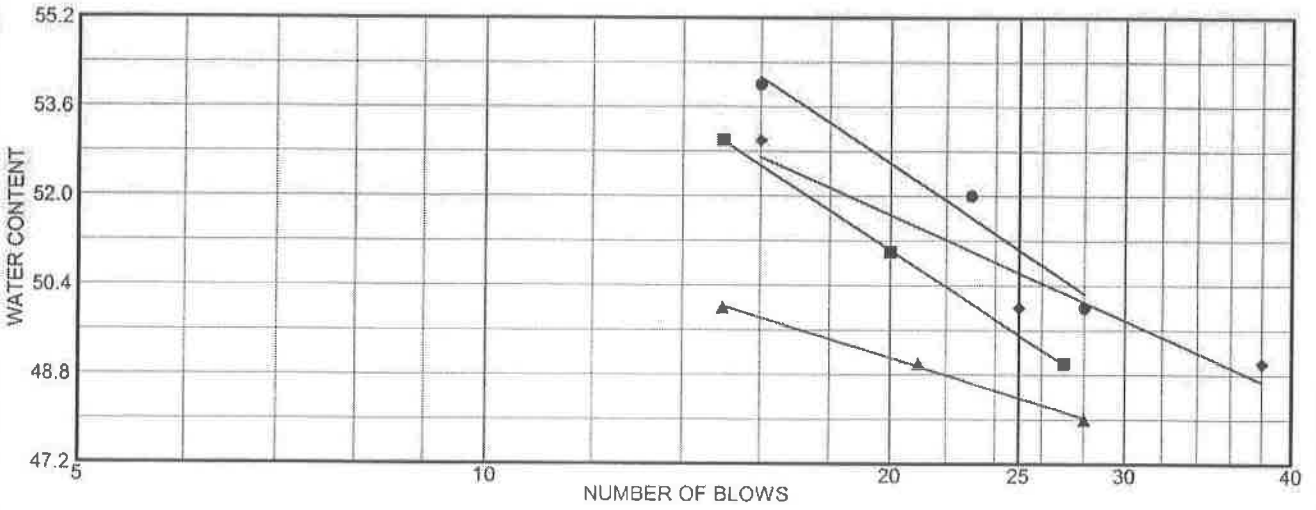
DEPTH (ft.)	SAMPLE TYPE - No.	SAMPLE SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS
40	CS-36				
42					
44					
46	CS-37				
48				Poorly Graded Sand (SP)-	
				Clayey Sand (SC)-	
50				Bottom of hole at 49 feet.	
52					
54					
56					
58					
60					
62					
64					
66					
68					
70					
72					
74					
76					
78					
80					

AMERICAN GEO TECHNICS

Current Ketterling Source

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Fat Clay (CH)	51	24	27	100	100	CH
■	Fat Clay (CH)	50	23	27	100	100	CH
▲	Lean Clay (CL)	48	25	23	100	100	CL
◆	Fat Clay (CH)	51	27	24	100	100	CH

Project No. 07B-G1540 **Client:** U.S. Ecology of Idaho

Project: Phase III CQA

Phase III CQA

● **Location:** B-101, BK-2; 10.0'

■ **Location:** B-101, BK-3; 20.0'

▲ **Location:** B-101, BK-4; 30.0'

◆ **Location:** B-101, BK-5; 40.0'

Remarks:

●

■

▲

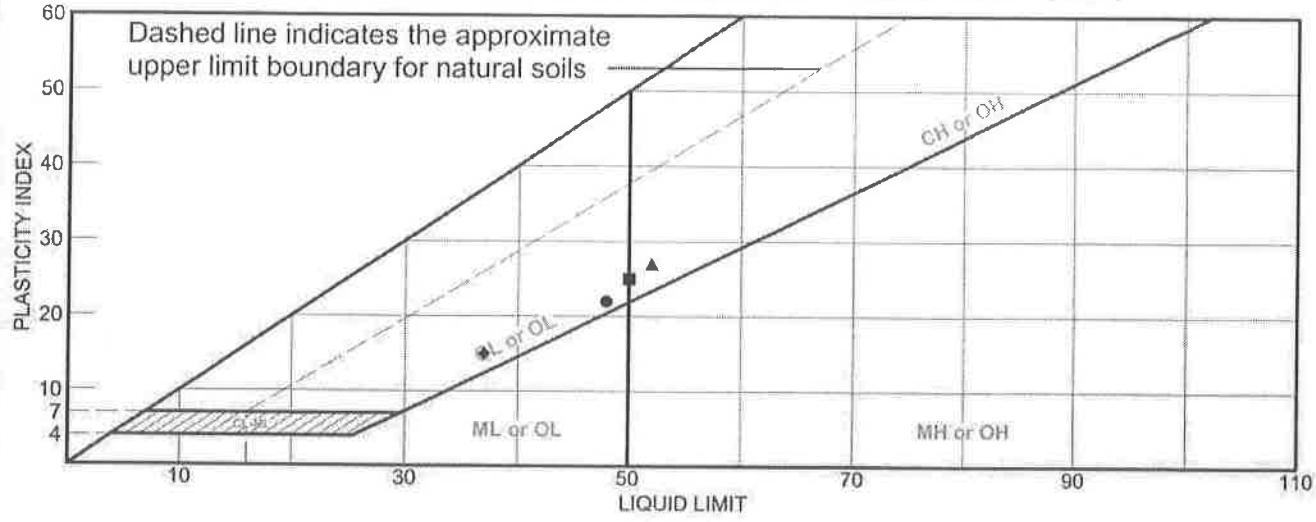
◆

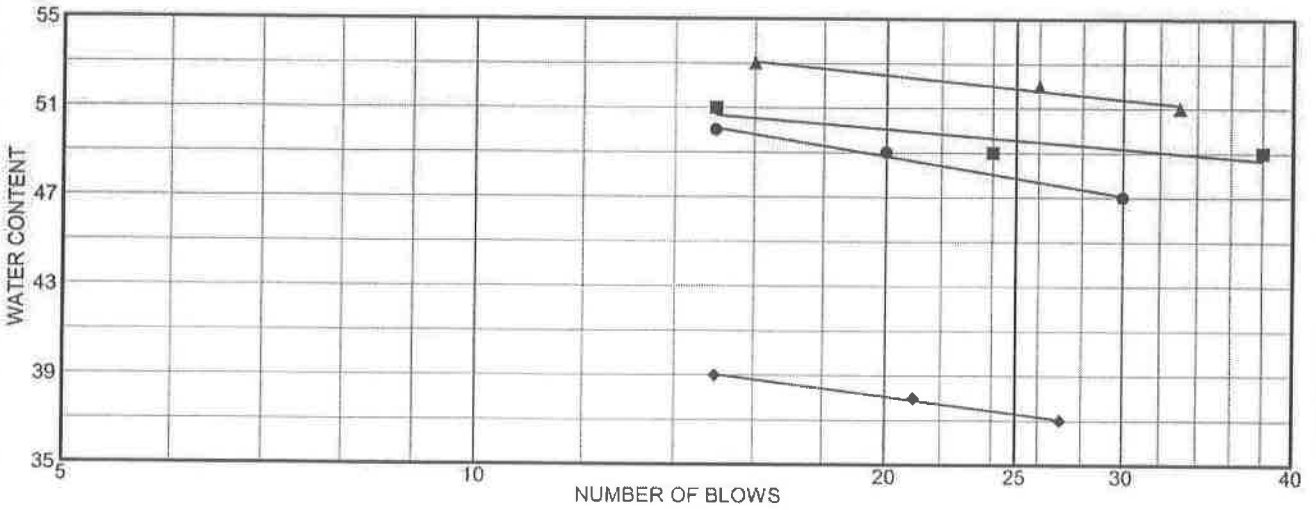
AMERICAN GEOTECHNICS

Boise, ID

Reviewed by:

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean Clay (CL)	48	26	22	100	100	CL
■	Fat Clay (CH)	50	25	25	100	100	CH
▲	Fat Clay (CH)	52	25	27			
◆	Lean Clay (CL)	37	22	15			CL

Project No. 07B-G1540 **Client:** U.S. Ecology of Idaho

Project: Phase III CQA

Phase III CQA

● **Location:** B-101, BK-6; 50.0'

■ **Location:** B-101, BG-7; 60.0'

▲ **Location:** B-101, SOUTH EAST FACE; 5/21/07

◆ **Location:** B-101, SOUTH FACE; 5/21/07

Remarks:

●

■

▲

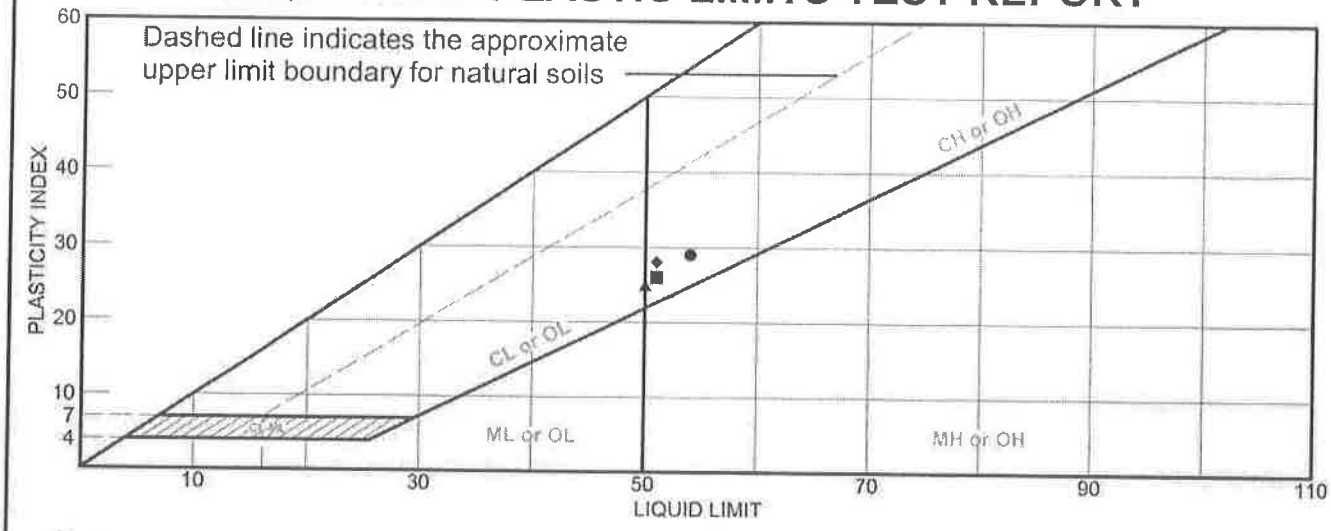
◆

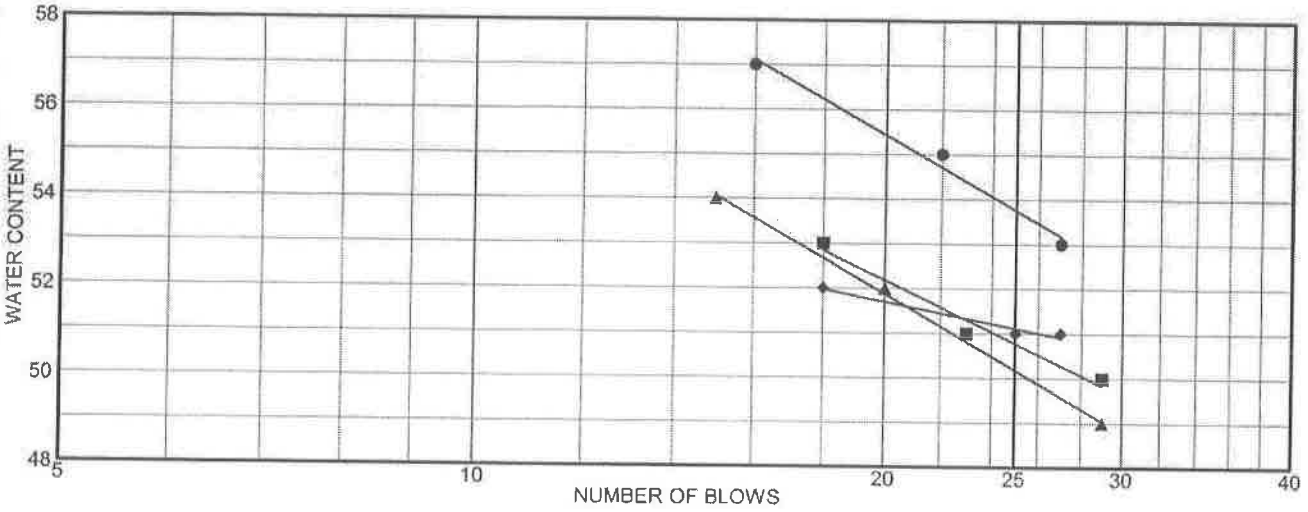
AMERICAN GEOTECHNICS

Boise, ID

Reviewed by:

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Fat Clay (CH)	54	25	29	100	100	CH
■	Fat Clay (CH)	51	25	26	100	100	CH
▲	Fat Clay (CH)	50	25	25	100	100	CH
◆	Fat Clay (CH)	51	23	28	100	100	CH

Project No. 07B-G1540 **Client:** U.S. Ecology of Idaho

Project: Phase III CQA

Phase III CQA

● **Location:** B-102, BK-10; 5.0'

■ **Location:** B-102, BG-12; 18.0'

▲ **Location:** B-103, BK-13; 5.0'

◆ **Location:** B-103, BG-15; 18.0'

Remarks:

●

■

▲

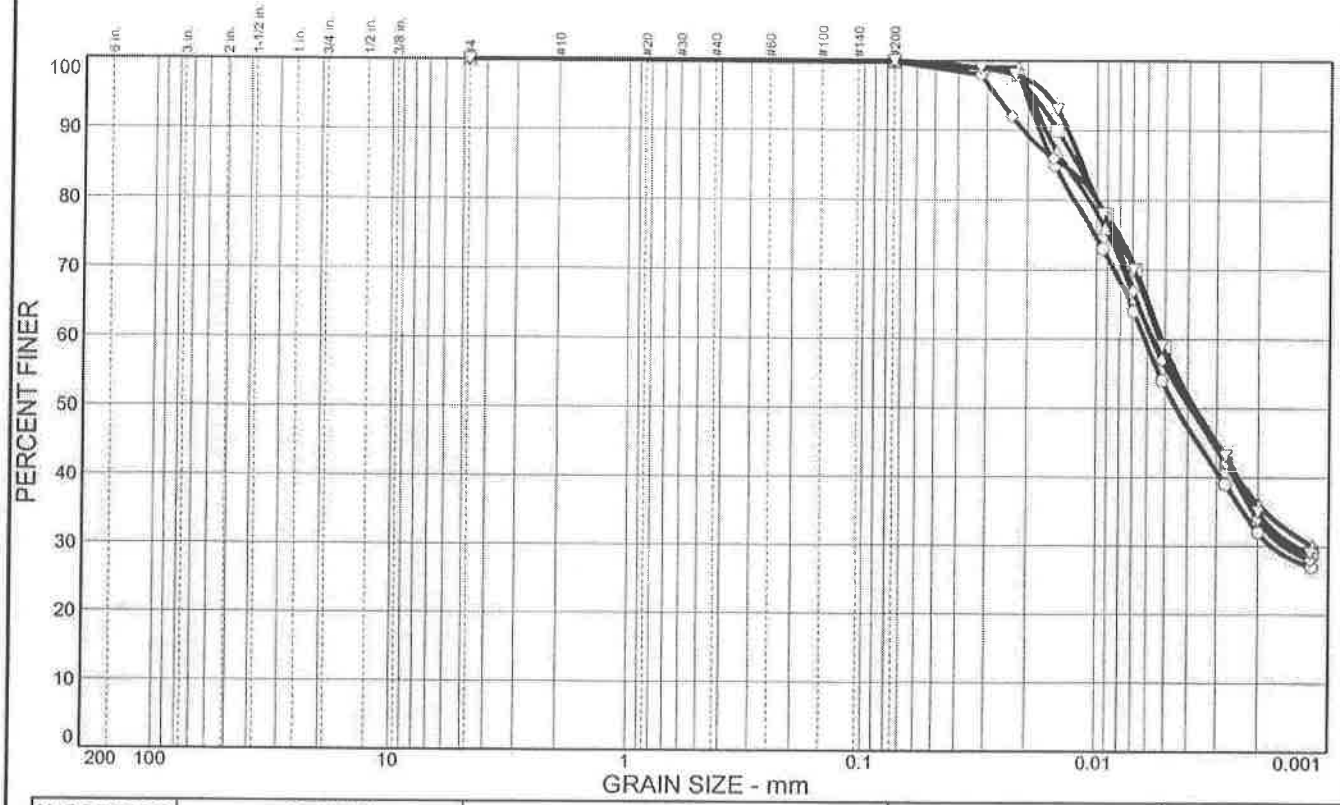
◆

AMERICAN GEOTECHNICS

Boise, ID

Reviewed by:

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	0.2	46.7	53.1
□	0.0	0.0	0.2	41.1	58.7
△	0.0	0.0	0.1	43.3	56.6
◇	0.0	0.0	0.2	43.7	56.1
▽	0.0	0.0	0.0	42.0	58.0

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	51	24	0.0153	0.0062	0.0045	0.0017				
□	51	27	0.0121	0.0052	0.0037	0.0014				
△	50	25	0.0138	0.0056	0.0039	0.0012				
◇	54	25	0.0140	0.0057	0.0039	0.0015				
▽	50	25	0.0116	0.0053	0.0037	0.0014				

	MATERIAL DESCRIPTION	USCS	AASHTO
○	Fat Clay (CH)	CH	
□	Fat Clay (CH)	CH	
△	Fat Clay (CH)	CH	
◇	Fat Clay (CH)	CH	
▽	Fat Clay (CH)	CH	

Project No. 07B-G1540 **Client:** U.S. Ecology of Idaho

Project: Phase III CQA

○ **Location:** B-101, BK-2; 10.0'

□ **Location:** B-101, BK-5; 40.0'

△ **Location:** B-101, BG-7; 60.0'

◇ **Location:** B-102, BK-10; 5.0'

▽ **Location:** B-103, BK-13; 5.0'

Remarks:

○

□

△

◇

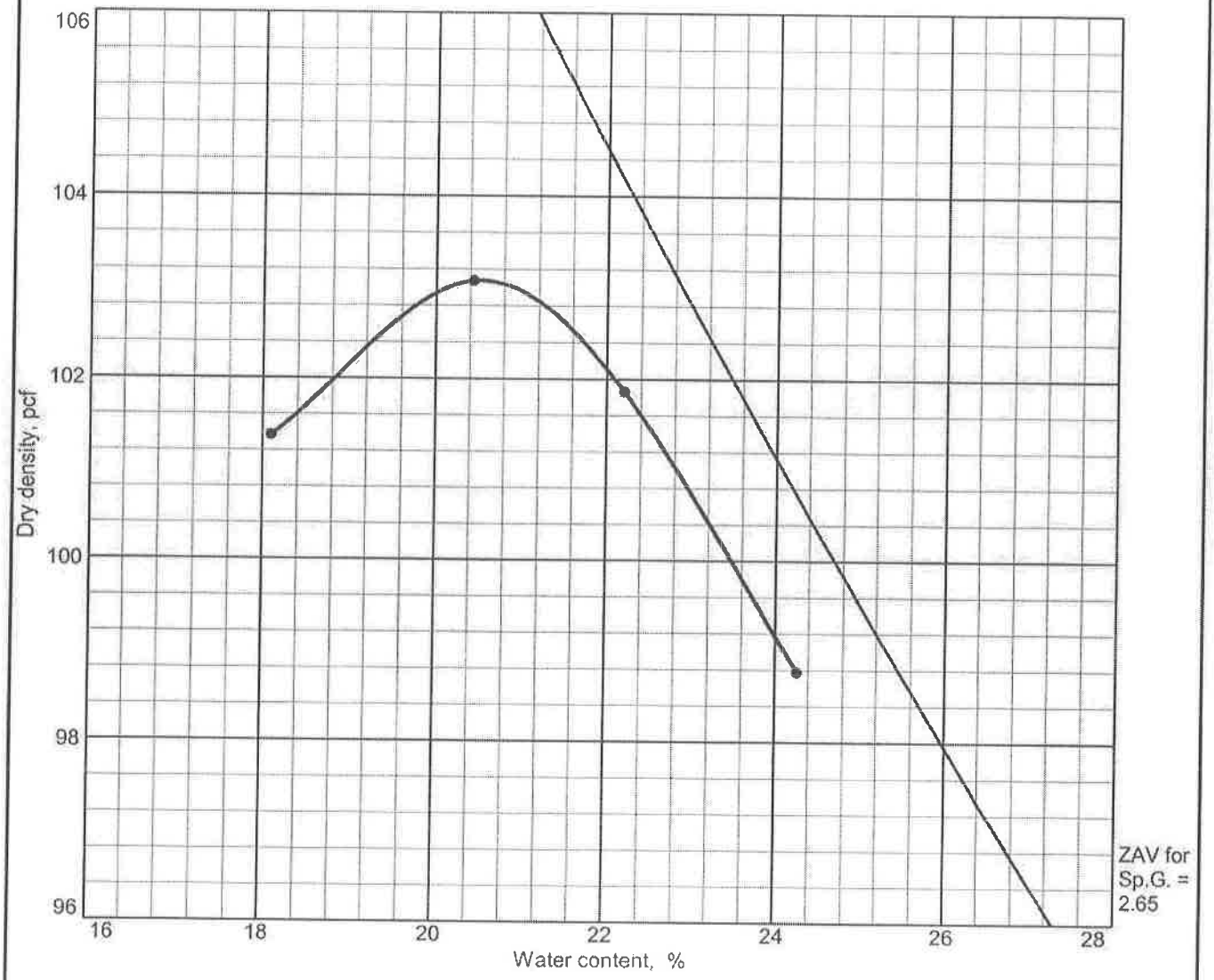
▽

AMERICAN GEOTECHNICS

Boise, ID

Reviewed by:

COMPACTION TEST REPORT



Test specification: ASTM D 1557-00 Method A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
10.0'	CH				51	27	0.0	100

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 103.1 pcf Optimum moisture = 20.5 %	Fat Clay (CH)

Project No. 07B-G1540 **Client:** U.S. Ecology of Idaho
Project: Phase III CQA

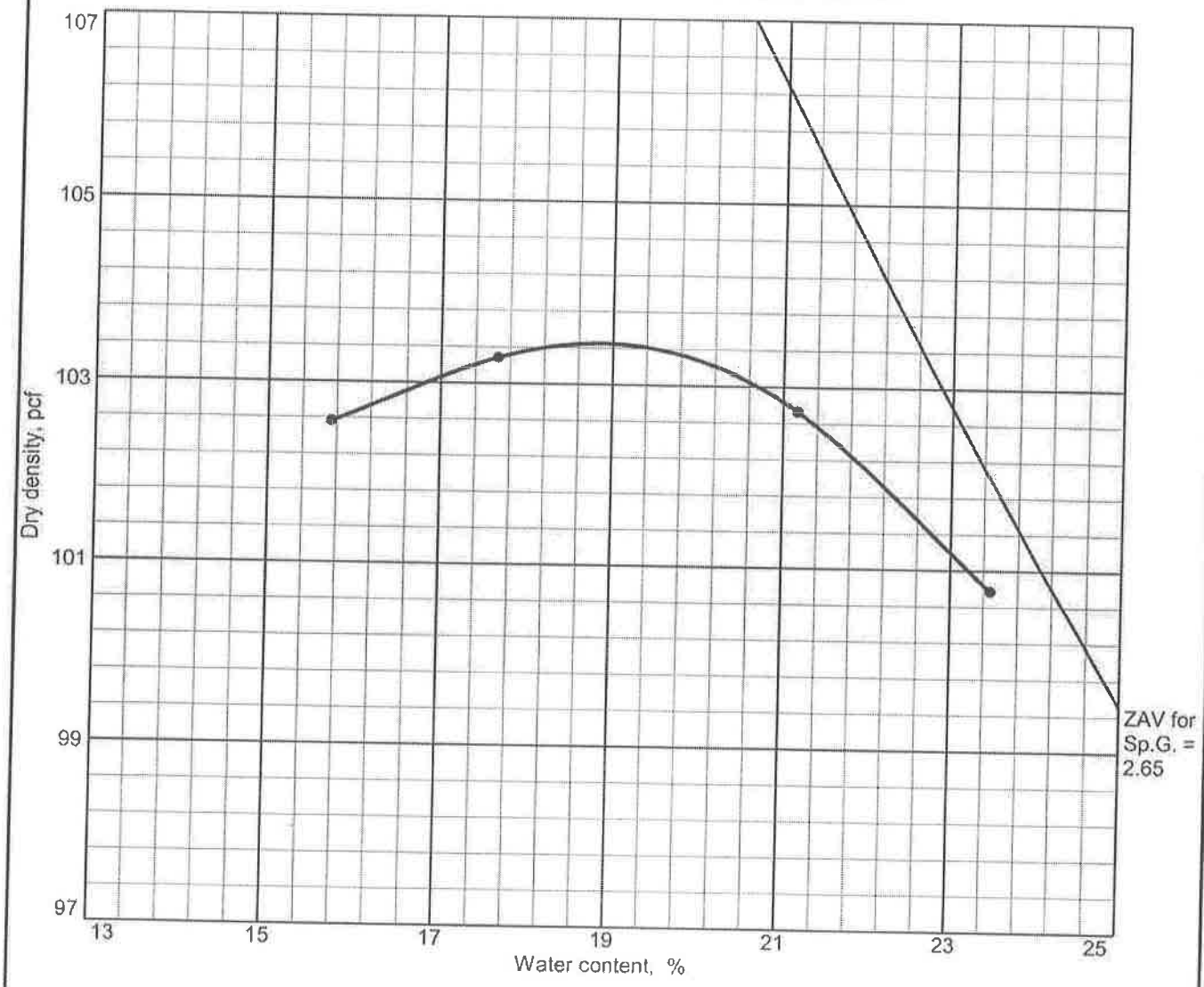
● **Location:** B-101, BK-2; 10.0'

AMERICAN GEOTECHNICS
Boise, ID

Remarks:

Reviewed by:

COMPACTION TEST REPORT

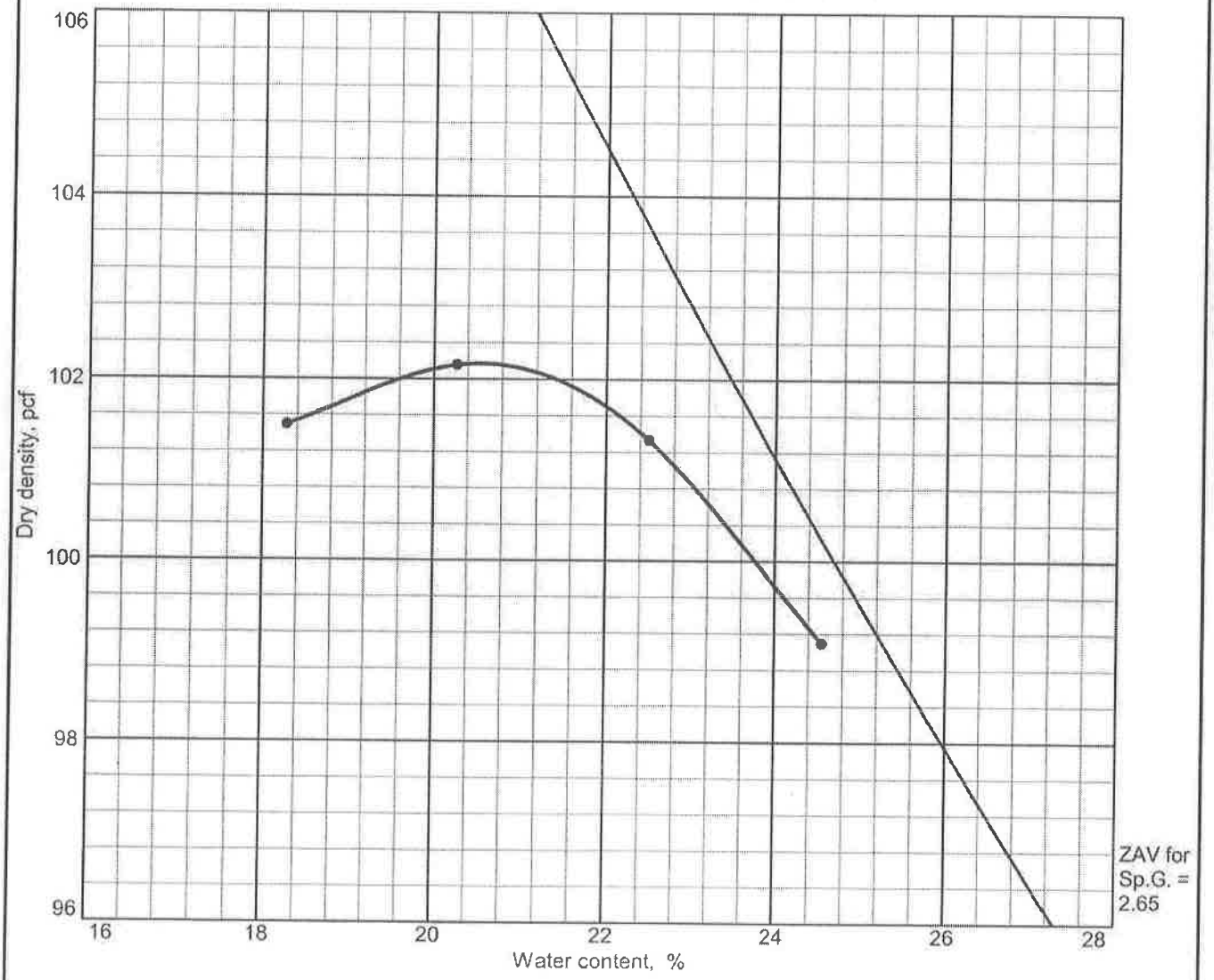


Test specification: ASTM D 1557-00 Method A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
20.0'	CH				50	27	0.0	100

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 103.5 pcf Optimum moisture = 18.9 %	Fat Clay (CH)
Project No. 07B-G1540 **Client:** U.S. Ecology of Idaho **Project:** Phase III CQA • **Location:** B-101, BK-3; 20.0'	**Remarks:**
AMERICAN GEOTECHNICS Boise, ID	Reviewed by:

COMPACTION TEST REPORT

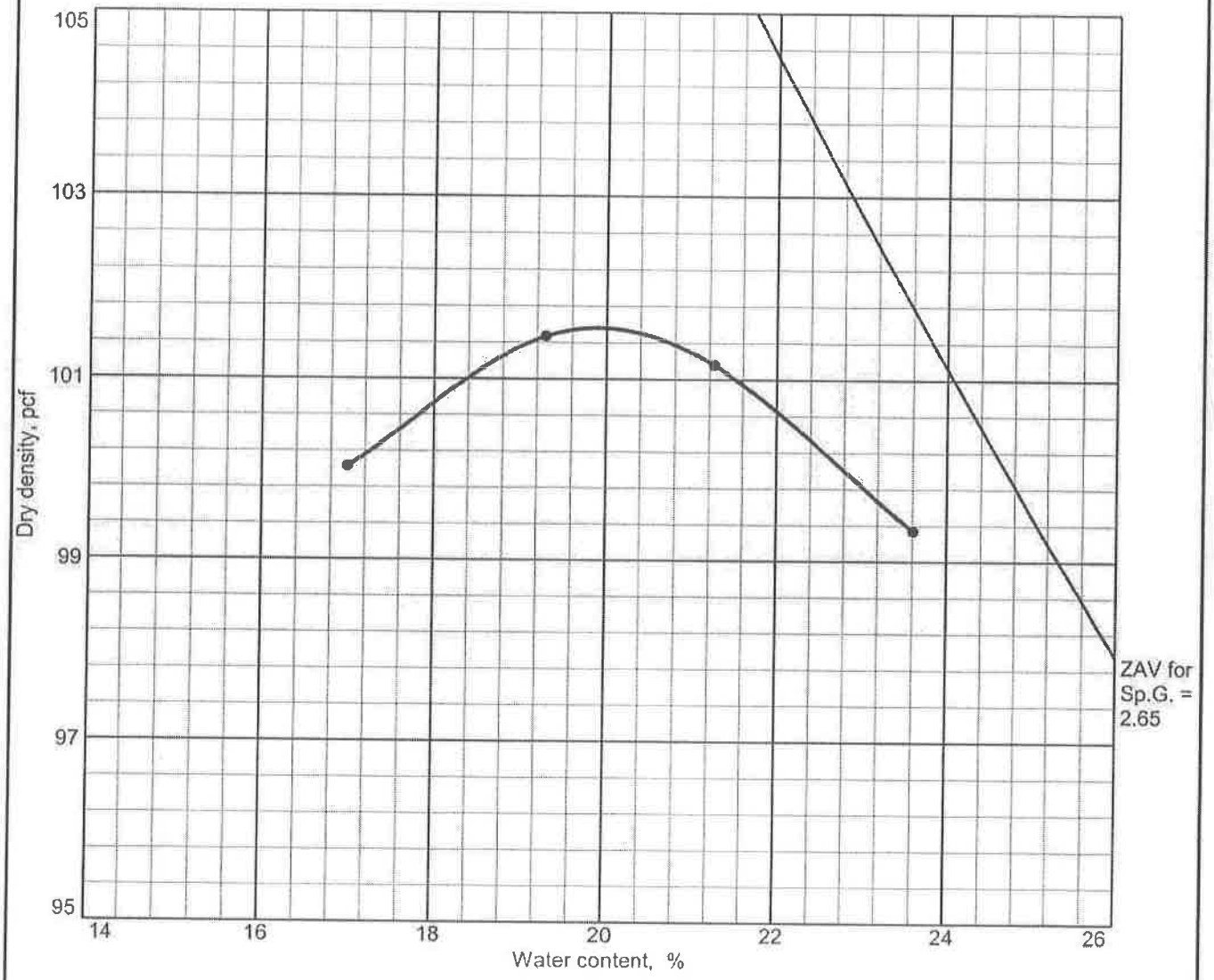


Test specification: ASTM D 1557-00 Method A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% >	% <
	USCS	AASHTO						No.200
30.0'	CL				48	23	0.0	100

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 102.2 pcf Optimum moisture = 20.5 %	Lean Clay (CL)
Project No. 07B-G1540 **Client:** U.S. Ecology of Idaho **Project:** Phase III CQA • **Location:** B-101, BK-4; 30.0'	**Remarks:**
AMERICAN GEOTECHNICS Boise, ID	Reviewed by:

COMPACTION TEST REPORT

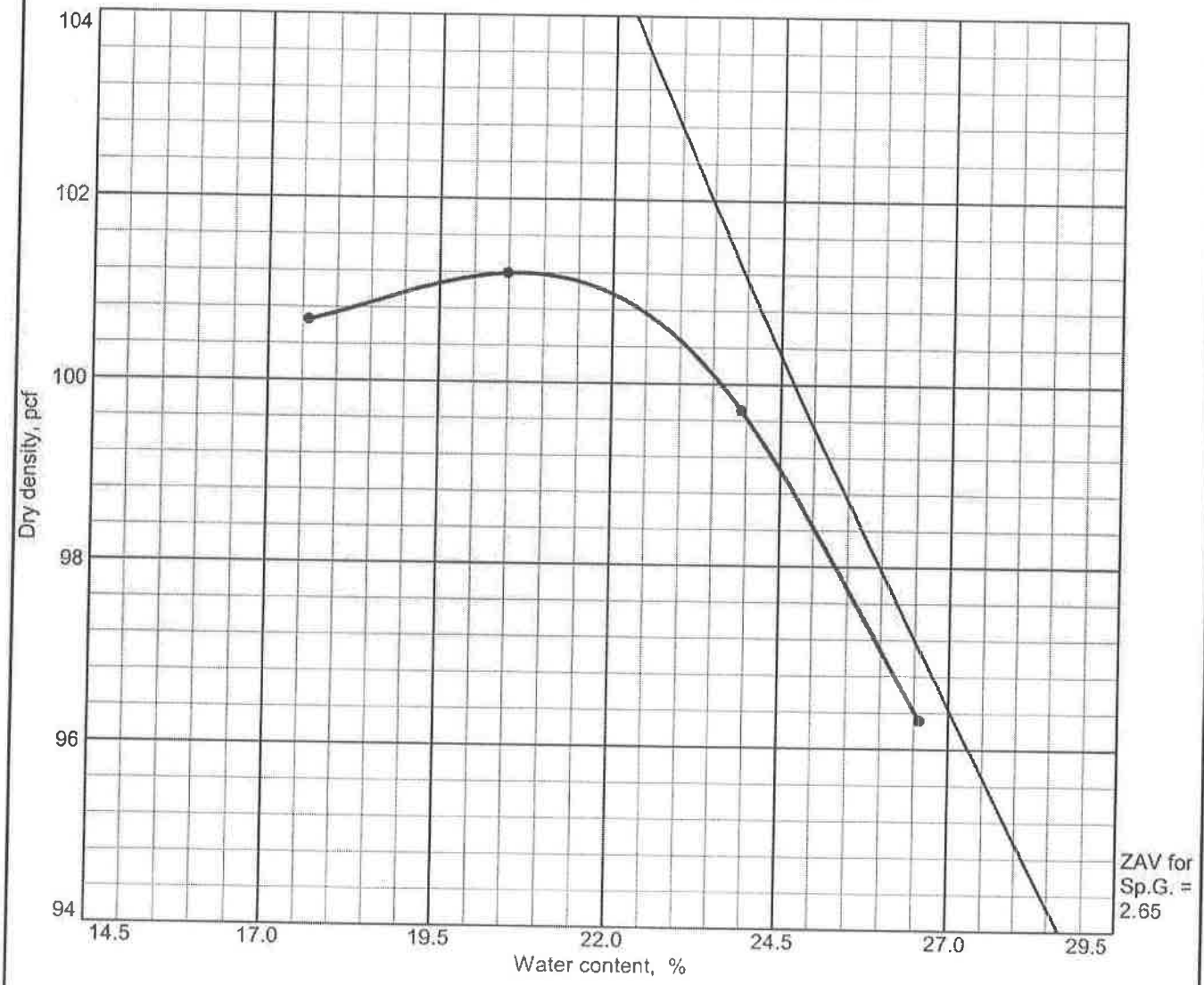


Test specification: ASTM D 1557-00 Method A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
40.0'	CH				51	24	0.0	100

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 101.6 pcf Optimum moisture = 19.9 %	Fat Clay (CH)
Project No. 07B-G1540 **Client:** U.S. Ecology of Idaho **Project:** Phase III CQA ● **Location:** B-101, BK-5; 40.0'	**Remarks:**
AMERICAN GEOTECHNICS Boise, ID	Reviewed by:

COMPACTION TEST REPORT

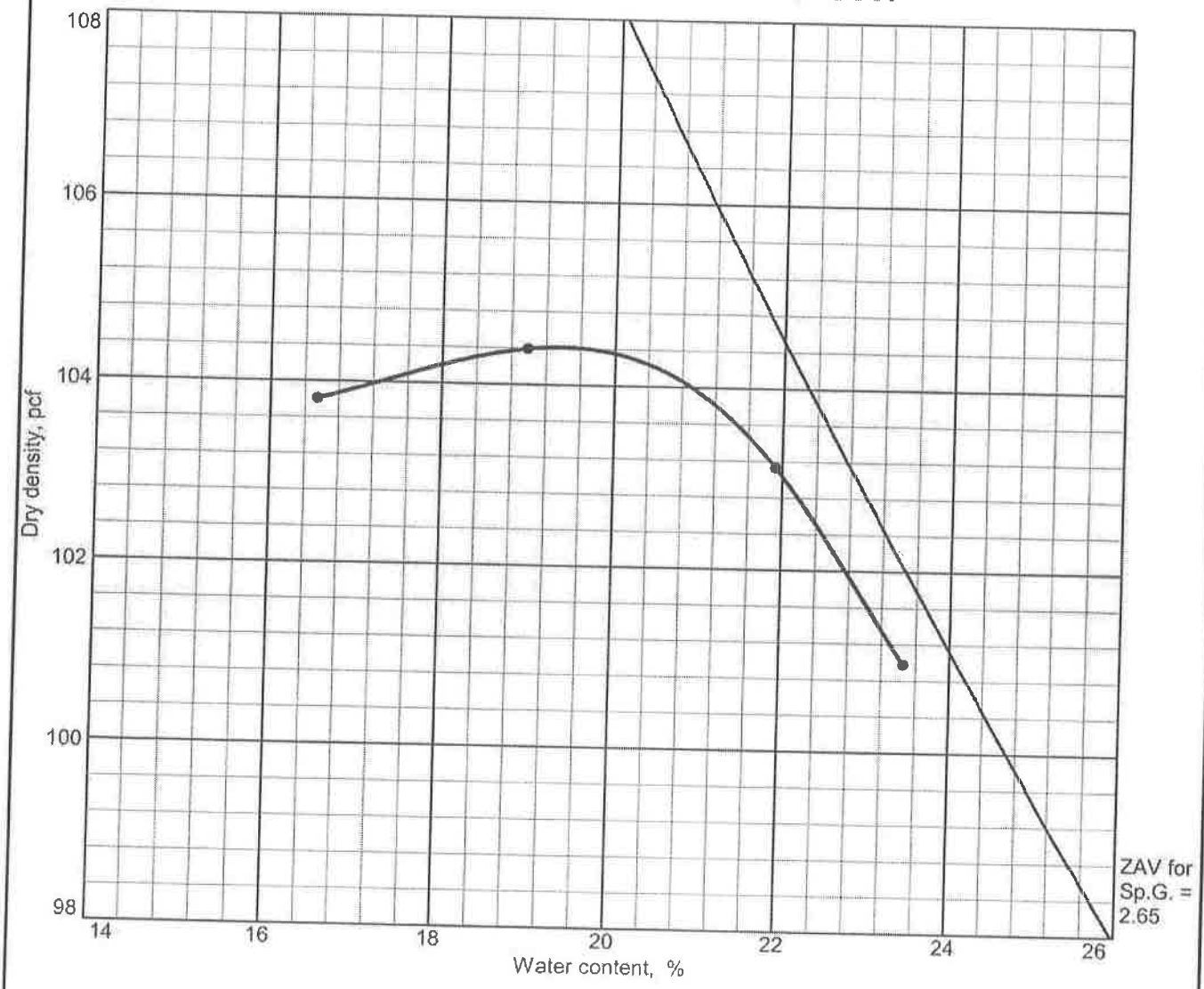


Test specification: ASTM D 1557-00 Method A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
50.0'	CL				48	22	0.0	100

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 101.2 pcf Optimum moisture = 20.7 %	Lean Clay (CL)
Project No. 07B-G1540 **Client:** U.S. Ecology of Idaho **Project:** Phase III CQA • **Location:** B-101, BK-6; 50.0'	**Remarks:**
AMERICAN GEOTECHNICS Boise, ID	Reviewed by:

COMPACTION TEST REPORT

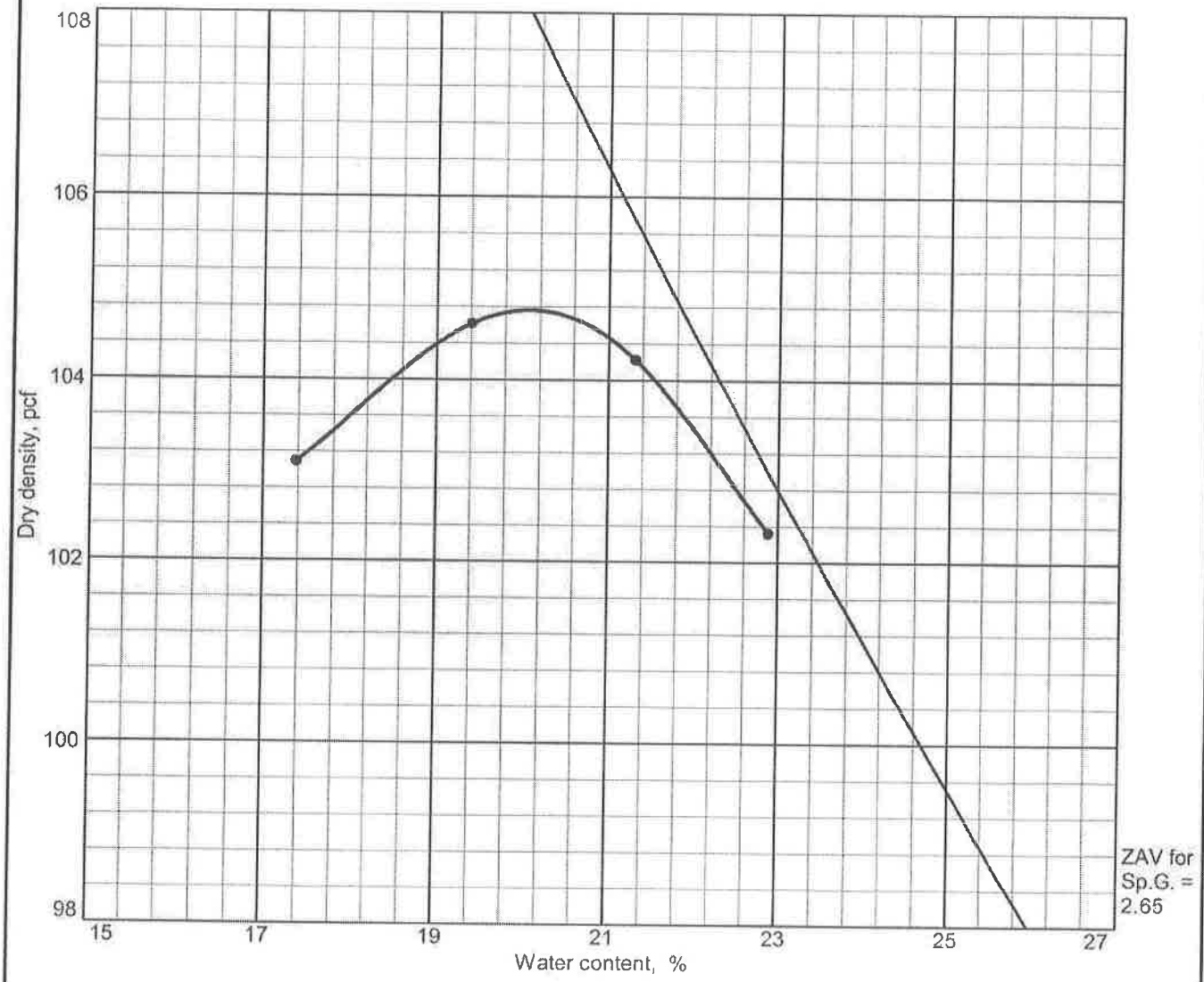


Test specification: ASTM D 1557-00 Method A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
5.0'	CH				54	29	0.0	100

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 104.4 pcf Optimum moisture = 19.4 %	Fat Clay (CH)
Project No. 07B-G1540 **Client:** U.S. Ecology of Idaho **Project:** Phase III CQA • **Location:** B-102, BK-10; 5.0'	**Remarks:**
AMERICAN GEOTECHNICS Boise, ID	Reviewed by:

COMPACTION TEST REPORT

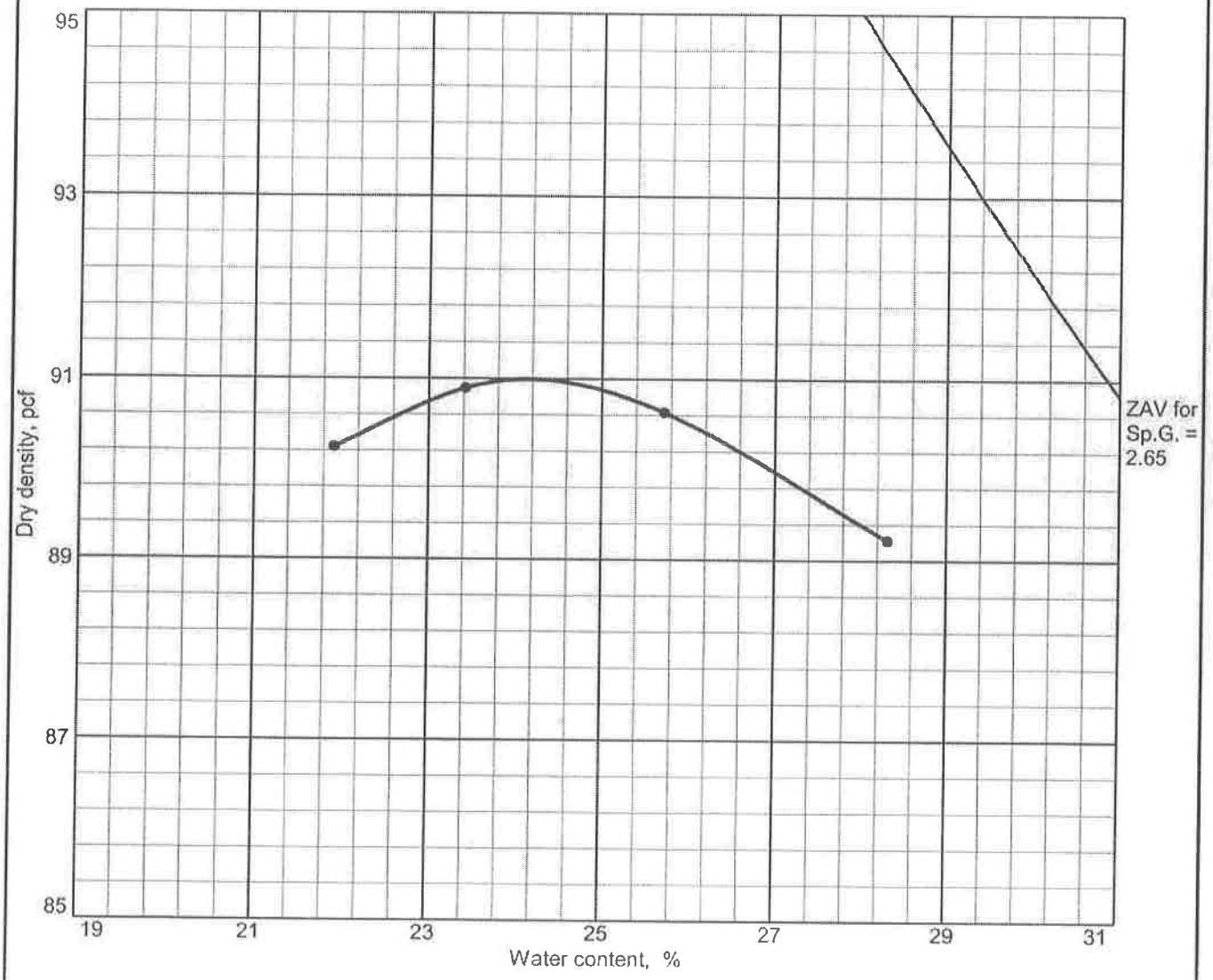


Test specification: ASTM D 1557-00 Method A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
5.0'	CH				50	25	0.0	100

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 104.8 pcf Optimum moisture = 20.1 %	Fat Clay (CH)
Project No. 07B-G1540 **Client:** U.S. Ecology of Idaho **Project:** Phase III CQA • **Location:** B-103, BK-13; 5.0'	**Remarks:**
AMERICAN GEOTECHNICS Boise, ID	Reviewed by:

COMPACTION TEST REPORT



Test specification: ASTM D 698-00a Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
10.0'	CH				51	27		100

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 91.0 pcf Optimum moisture = 24.2 %	Fat Clay (CH)

Project No. 07B-G1540 **Client:** U.S. Ecology of Idaho
Project: Phase III CQA

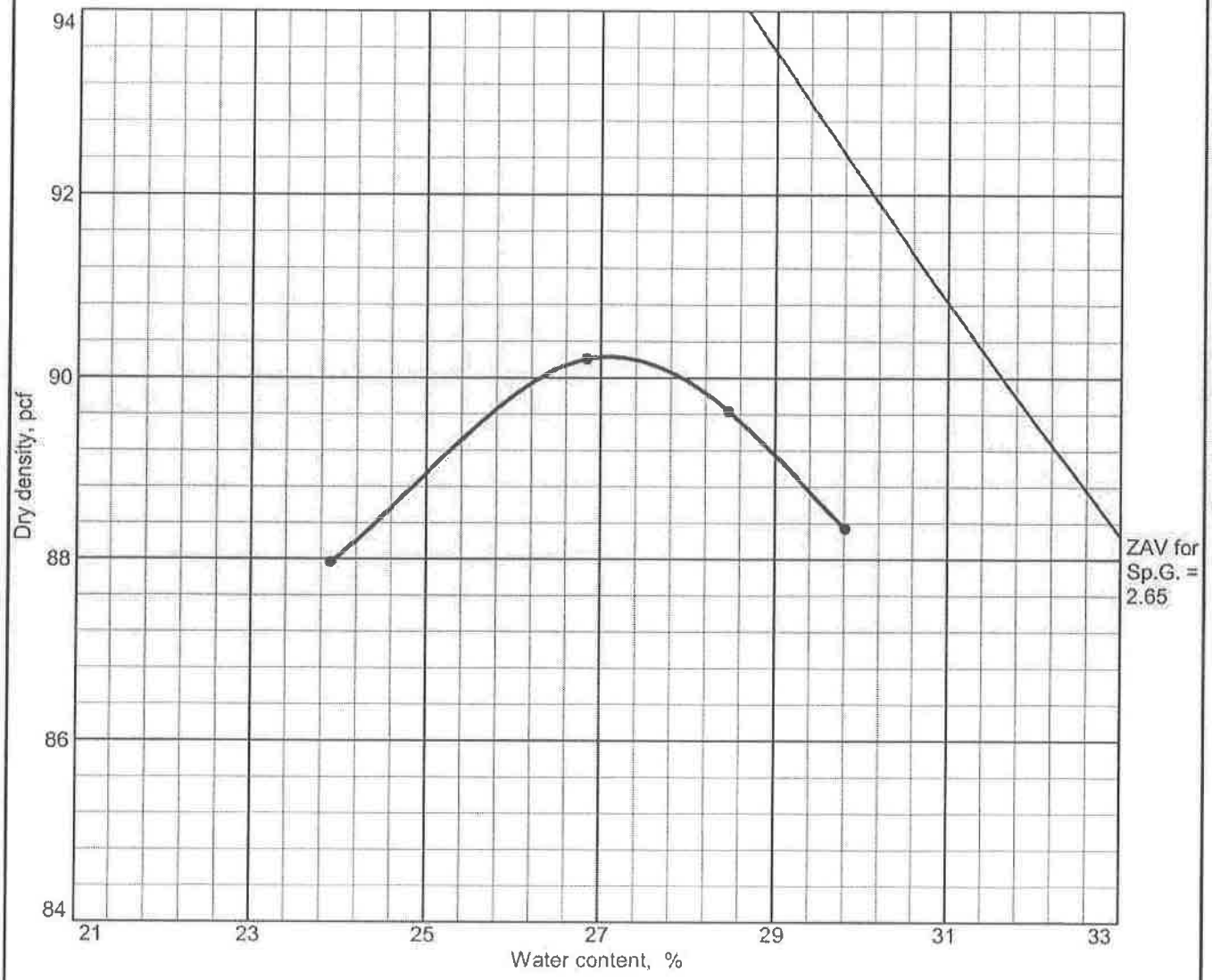
• **Location:** B-101, BK-2; 10.0'

AMERICAN GEOTECHNICS
Boise, ID

Remarks:

Reviewed by:

COMPACTION TEST REPORT

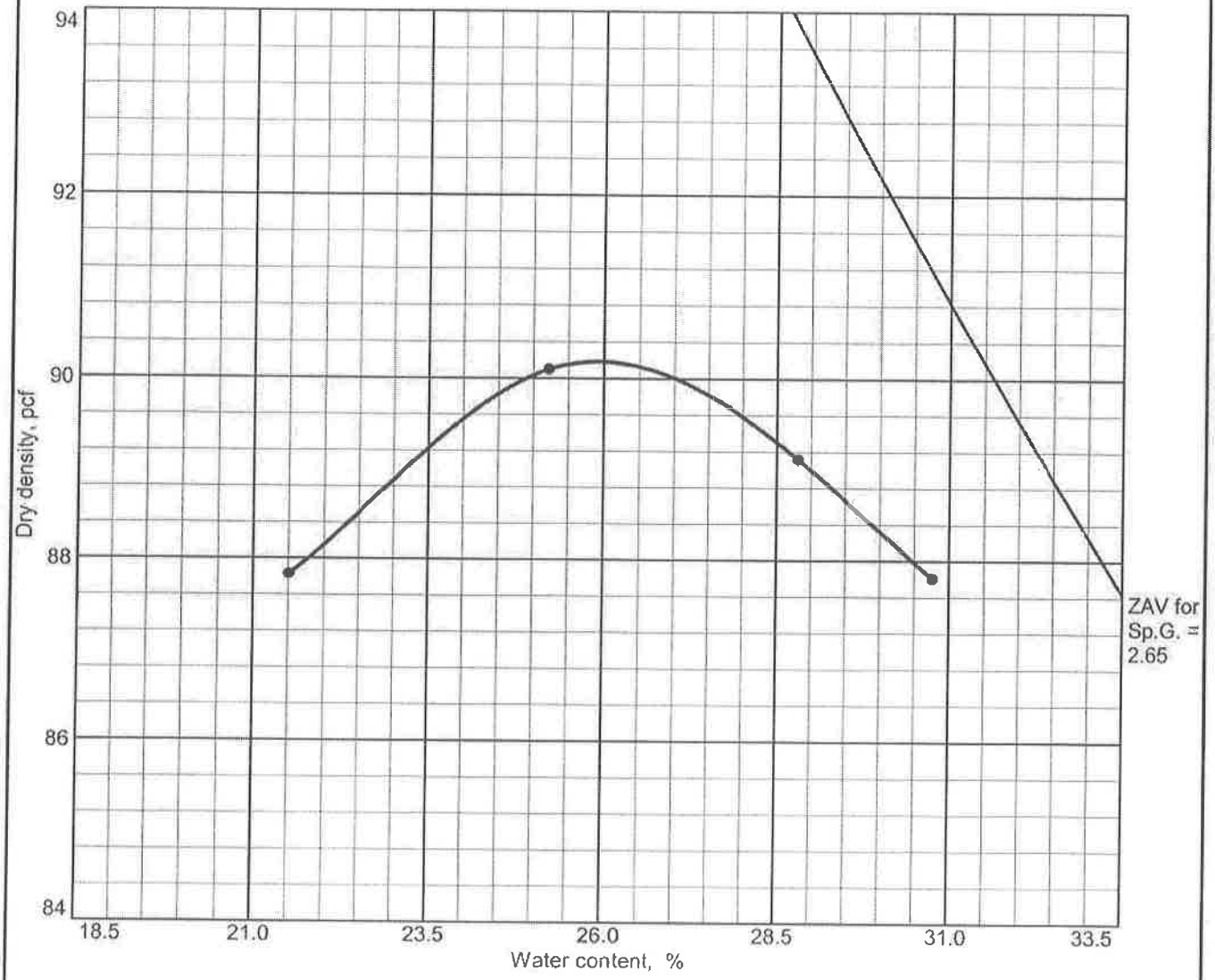


Test specification: ASTM D 698-00a Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
20.0'	CH				50	27		100

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 90.2 pcf Optimum moisture = 27.1 %	Fat Clay (CH)
Project No. 07B-G1540 **Client:** U.S. Ecology of Idaho **Project:** Phase III CQA ● **Location:** B-101, BK-3; 20.0'	**Remarks:**
AMERICAN GEOTECHNICS Boise, ID	**Reviewed by:**

COMPACTION TEST REPORT

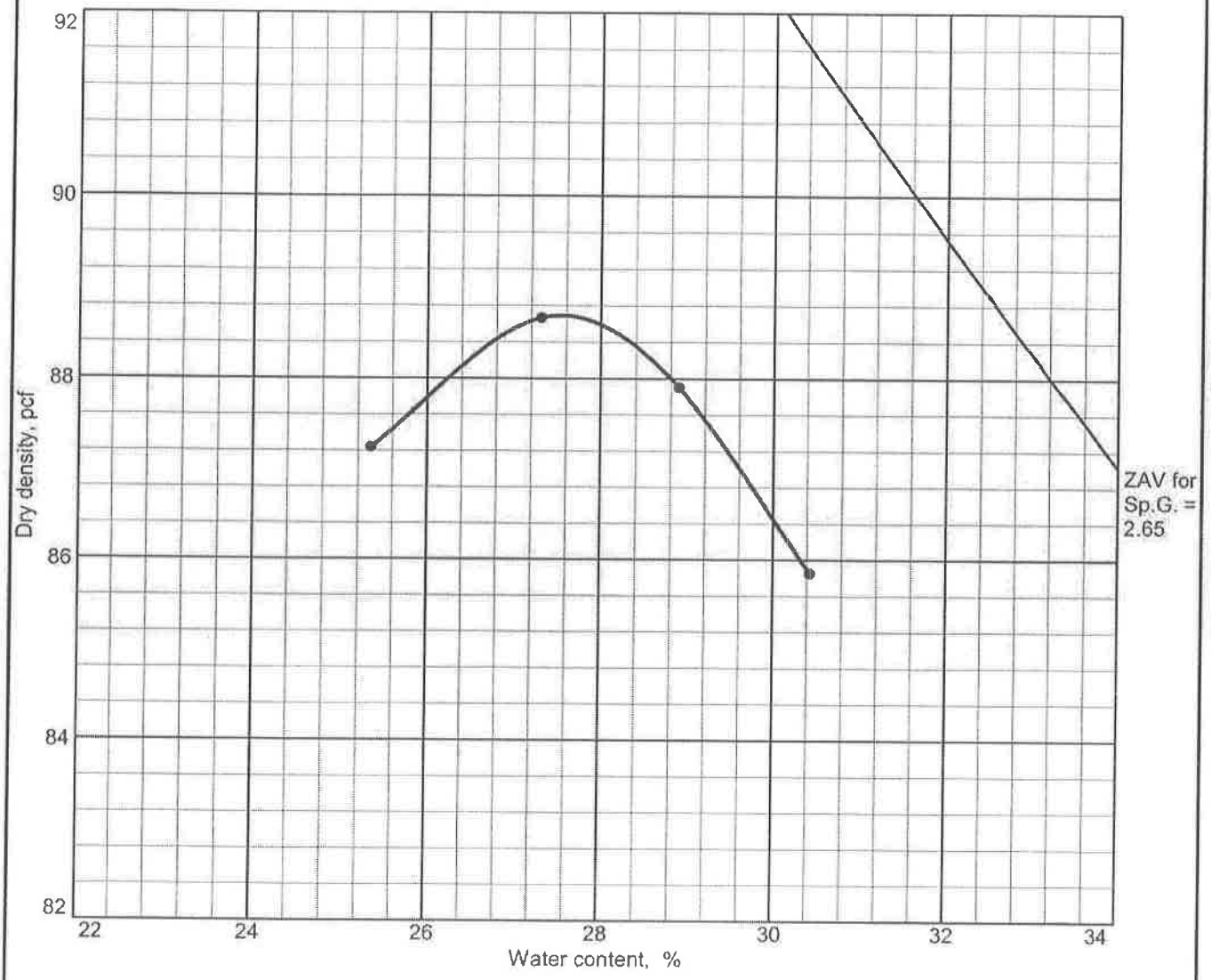


Test specification: ASTM D 698-00a Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
30.0'	CL				48	23		100

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 90.2 pcf Optimum moisture = 25.9 %	Lean Clay (CL)
Project No. 07B-G1540 **Client:** U.S. Ecology of Idaho **Project:** Phase III CQA ● **Location:** B-101, BK-4; 30.0'	**Remarks:**
AMERICAN GEOTECHNICS Boise, ID	**Reviewed by:**

COMPACTION TEST REPORT

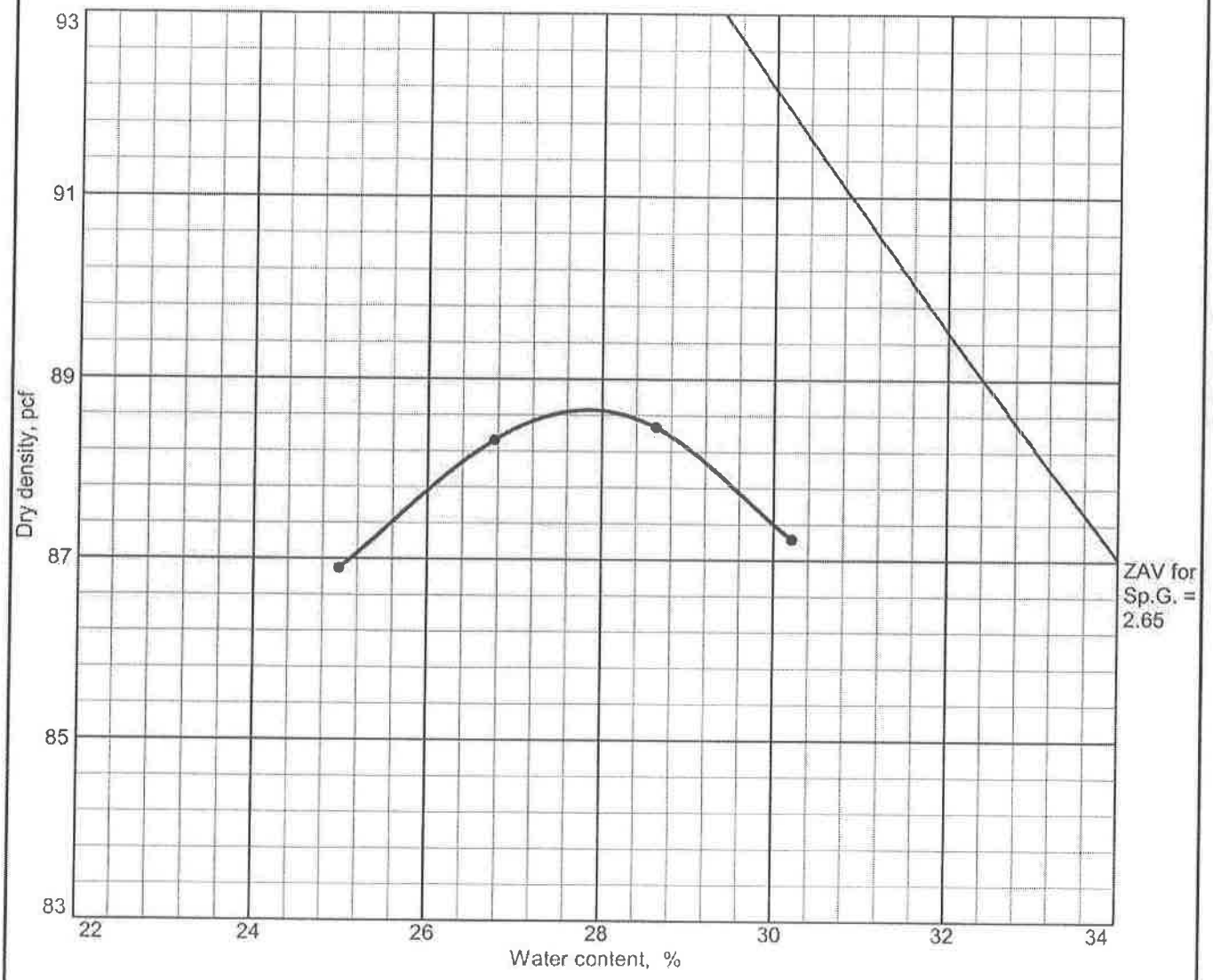


Test specification: ASTM D 698-00a Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
40.0'	CH				51	24		100

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 88.7 pcf Optimum moisture = 27.5 %	Fat Clay (CH)
Project No. 07B-G1540 **Client:** U.S. Ecology of Idaho **Project:** Phase III CQA ● **Location:** B-101, BK-5; 40.0'	**Remarks:**
AMERICAN GEOTECHNICS **Boise, ID**	**Reviewed by:**

COMPACTION TEST REPORT



Test specification: ASTM D 698-00a Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
50.0'	CL				48	22		100

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 88.7 pcf Optimum moisture = 27.8 %	Lean Clay (CL)

Project No. 07B-G1540 **Client:** U.S. Ecology of Idaho
Project: Phase III CQA

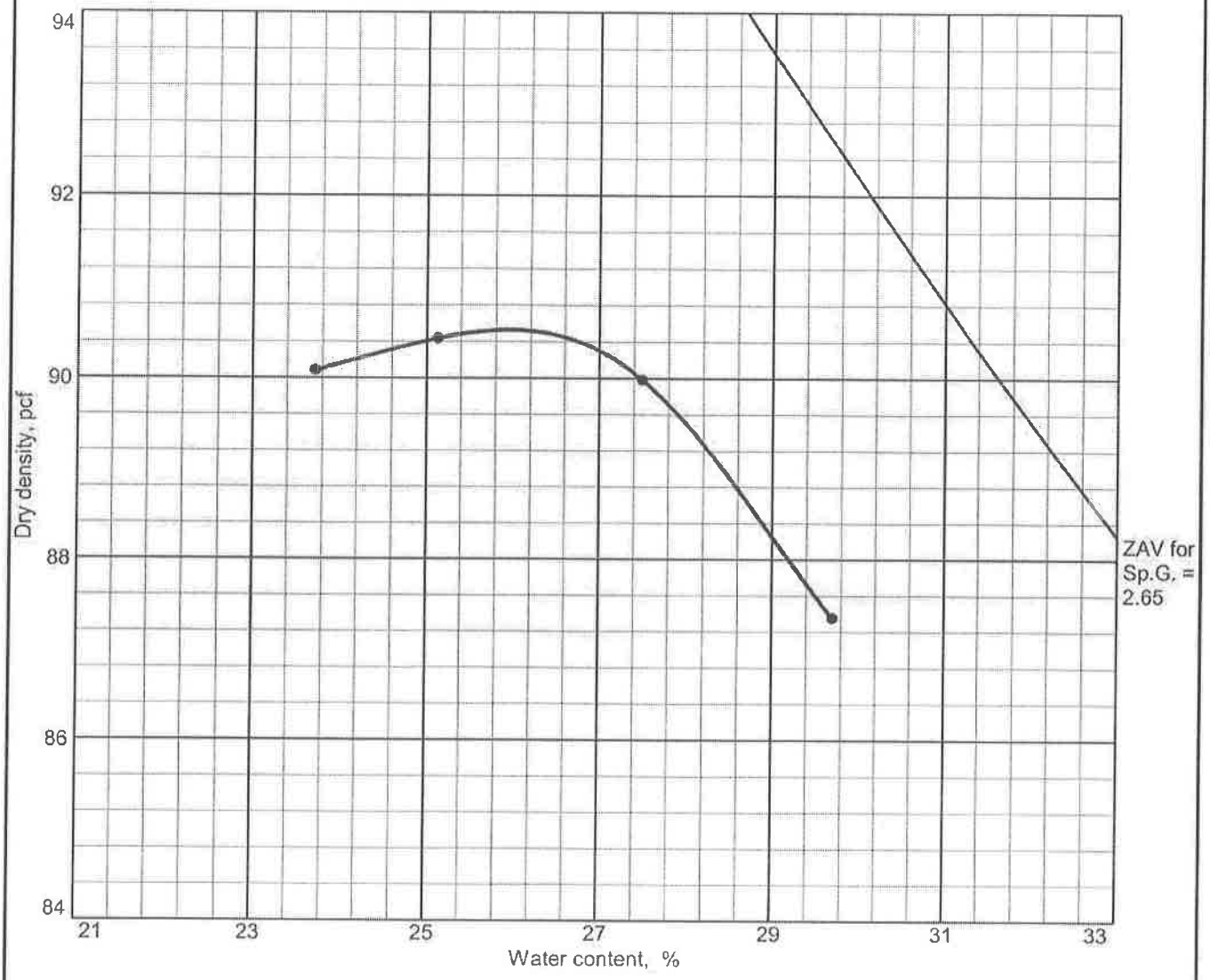
• **Location:** B-101, BK-6; 50.0'

Remarks:

AMERICAN GEOTECHNICS
Boise, ID

Reviewed by:

COMPACTION TEST REPORT

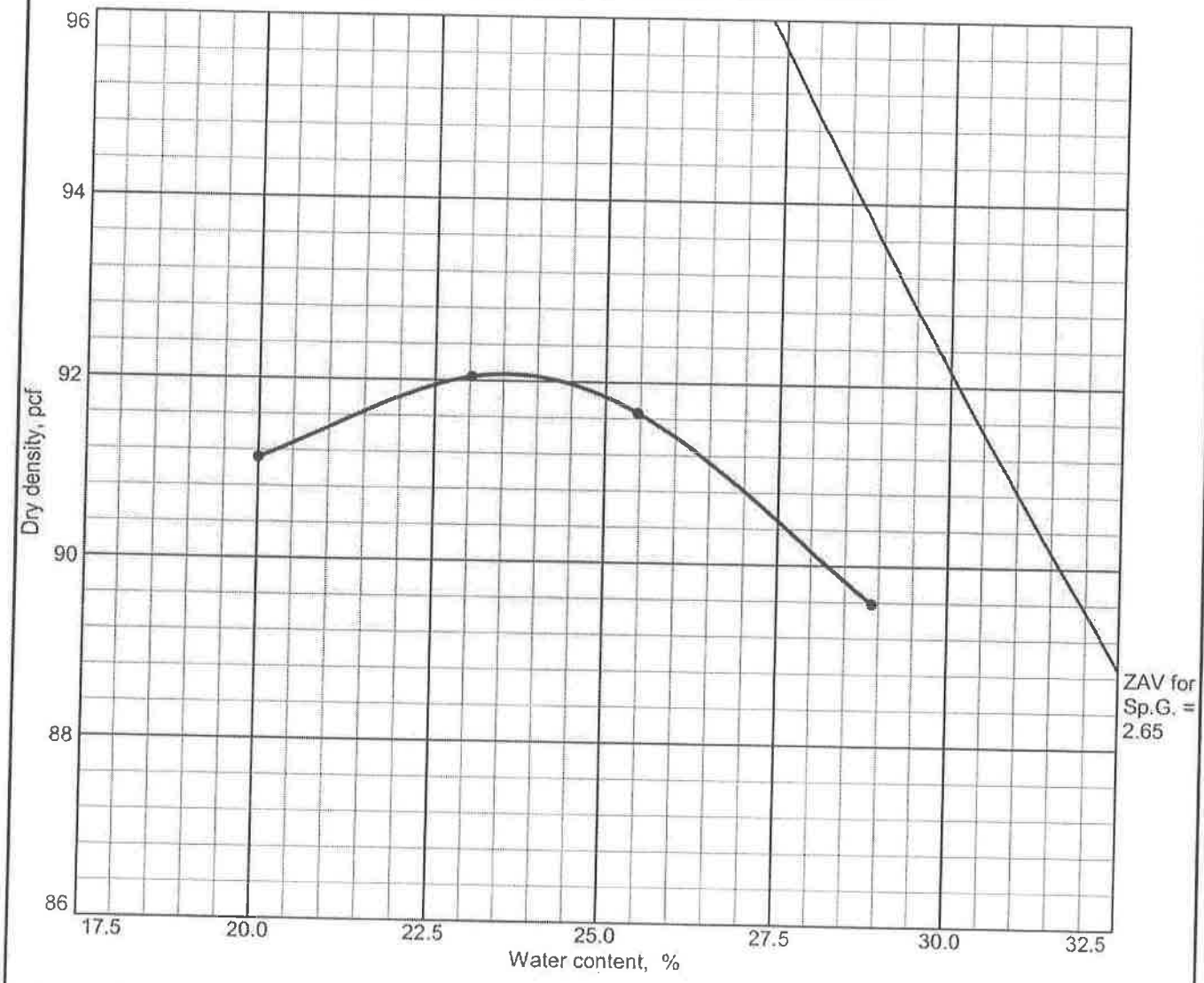


Test specification: ASTM D 698-00a Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
5.0'	CH				54	29		100

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 90.5 pcf Optimum moisture = 26.0 %	Fat Clay (CH)
Project No. 07B-G1540 **Client:** U.S. Ecology of Idaho **Project:** Phase III CQA ● **Location:** B-102, BK-10; 5.0'	**Remarks:**
AMERICAN GEOTECHNICS Boise, ID	Reviewed by:

COMPACTION TEST REPORT



Test specification: ASTM D 698-00a Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
5.0'	CH				50	25		100

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 92.1 pcf Optimum moisture = 23.6 %	Fat Clay (CH)
Project No. 07B-G1540 **Client:** U.S. Ecology of Idaho **Project:** Phase III CQA • **Location:** B-103, BK-13; 5.0'	**Remarks:**
AMERICAN GEOTECHNICS Boise, ID	**Reviewed by:**

AMERICAN GEO TECHNICS

Johnson Property

American Geotechnics
5260 Chinden Blvd.
Boise, Idaho 83714
Phone:(208) 658-8700
Fax: (208) 658-8703

Report to: U.S. Ecology of Idaho
Project: Phase III Clay Investigation
Report Date: 07/16/07
Project No.: 07B-G1434.1

Material Information

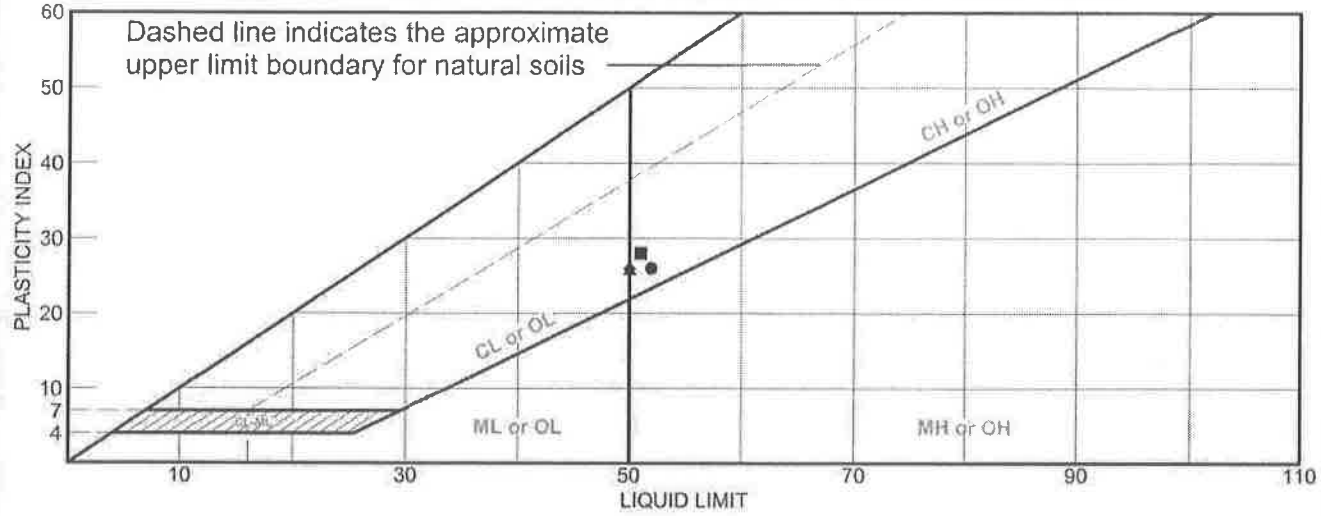
Date Sampled: 5/23/07
Sampled By: American Geotechnics
Date Received: 5/23/07
Date Tested: 6/18 thru 7/16/07

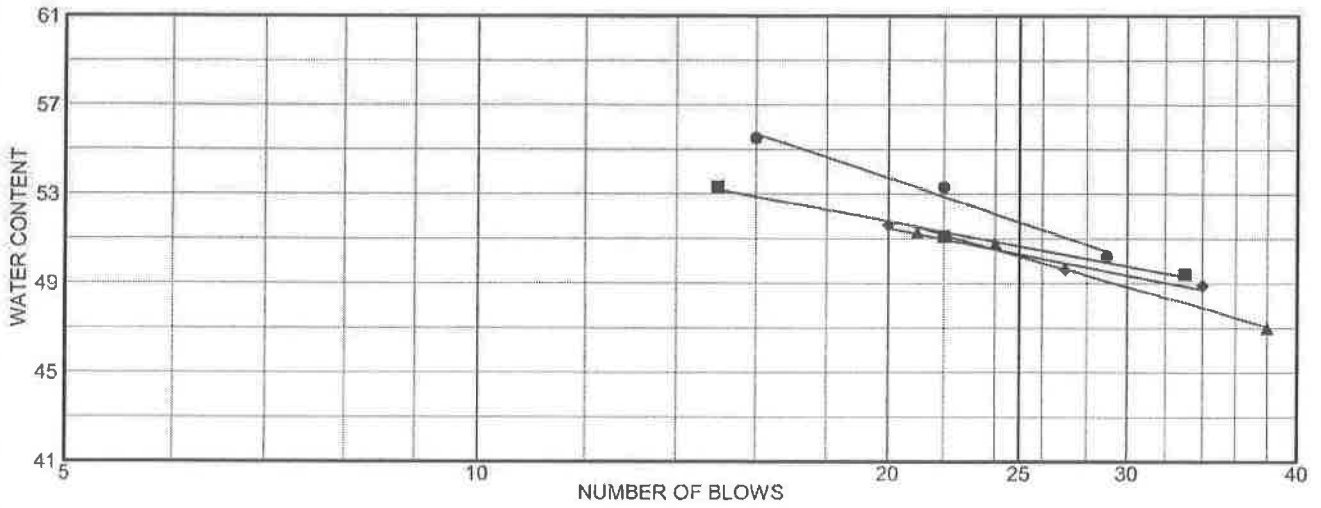
Test Results

Lab Number	Sample ID	Depth	% Natural Moisture	% Passing #200	Liquid Limit	Plastic Index	Soil Type
07-0438	B-104, BK-16	10.0'	12.3	99.6	52	26	CH
07-0439	B-104, BK-17	20.0'	13.2	99.6	51	28	CH
07-0440	B-104, BK-18	30.0'	13.9	99.8	50	26	CH
07-0441	B-106, 0SS-22	8.0'	12.1	97.6	50	26	CH
07-0442	B-106, 0SS-23	14.0'	12.7	99.8	51	27	CH
07-0443	B-107, 0SS-26	19.0'	25.9	99.2	49	26	CL
07-0444	B-107, BK-27	25.0'	25.5	99.2	47	23	CL
07-0445	B-107, BK-28	35.0'	27.9	99.7	50	25	CH
07-0446	B-107, BK-29	45.0'	26.4	99.0	50	23	CH
07-0447	B-107, BK-30	55.0'	27.0	99.6	50	25	CH
07-0448	B-107, BK-31	65.0'	25.0	99.8	50	25	CH

Reviewed By: _____

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Fat Clay (CH)	52	26	26	100	100	CH
■	Fat Clay (CH)	51	23	28	100	100	CH
▲	Fat Clay (CH)	50	24	26	100	100	CH
◆	Fat CLay (CH)	50	24	26	99	98	CH

Project No. 06B-1434.1 **Client:** U.S. Ecology of Idaho

Project: Phase III Clay Investigation Johnson

Phase III Clay Investigation Johnson

● **Location:** B-104, BK-16; 10.0'

■ **Location:** B-104, BK-17; 20.0'

▲ **Location:** B-104, BK-18; 30.0'

◆ **Location:** B-106, OSS-22; 8.0'

Remarks:

●

■

▲

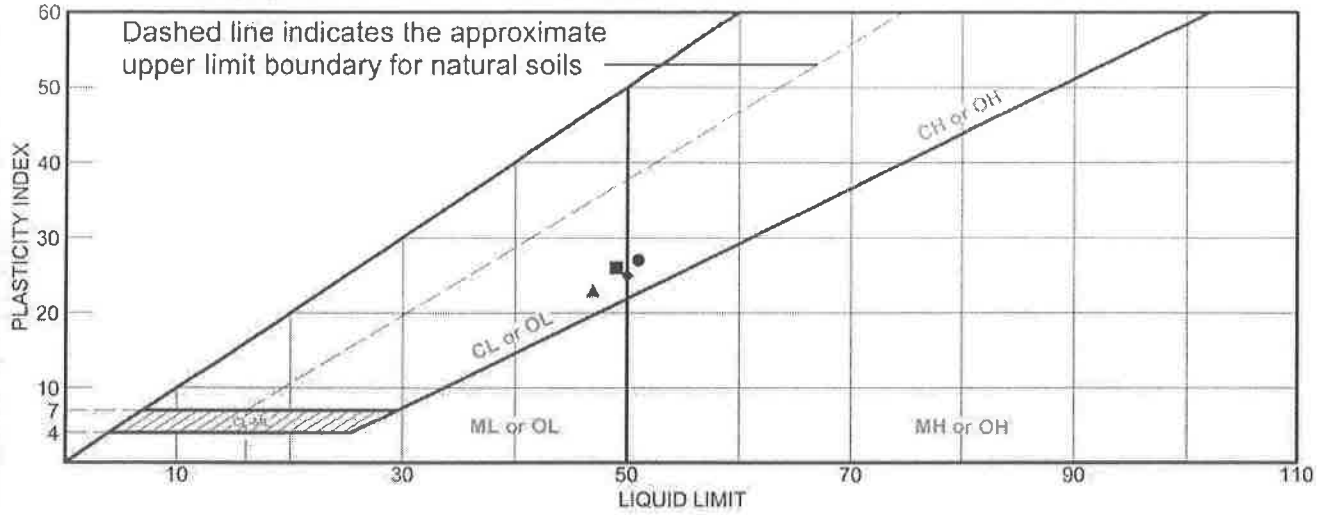
◆

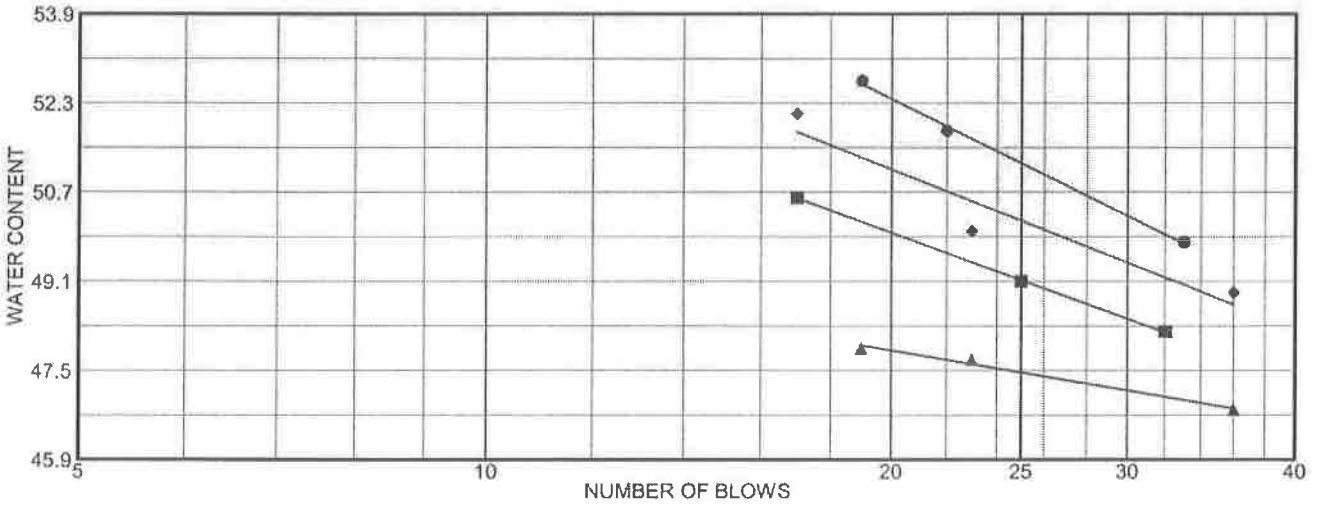
AMERICAN GEOTECHNICS

Boise, ID

Reviewed by:

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Fat Clay (CH)	51	24	27	100	100	CH
■	Lean Clay (CL)	49	23	26	100	99	CL
▲	Lean Clay (CL)	47	24	23	99	99	CL
◆	Fat Clay (CH)	50	25	25	100	100	CH

Project No. 06B-1434.1 **Client:** U.S. Ecology of Idaho

Project: Phase III Clay Investigation Johnson

Phase III Clay Investigation Johnson

● **Location:** B-106, OSS-23; 14.0'

■ **Location:** B-107, OSS-26; 19.0'

▲ **Location:** B-107, BK-27; 25.0'

◆ **Location:** B-107, BK-28; 35.0'

Remarks:

●

■

▲

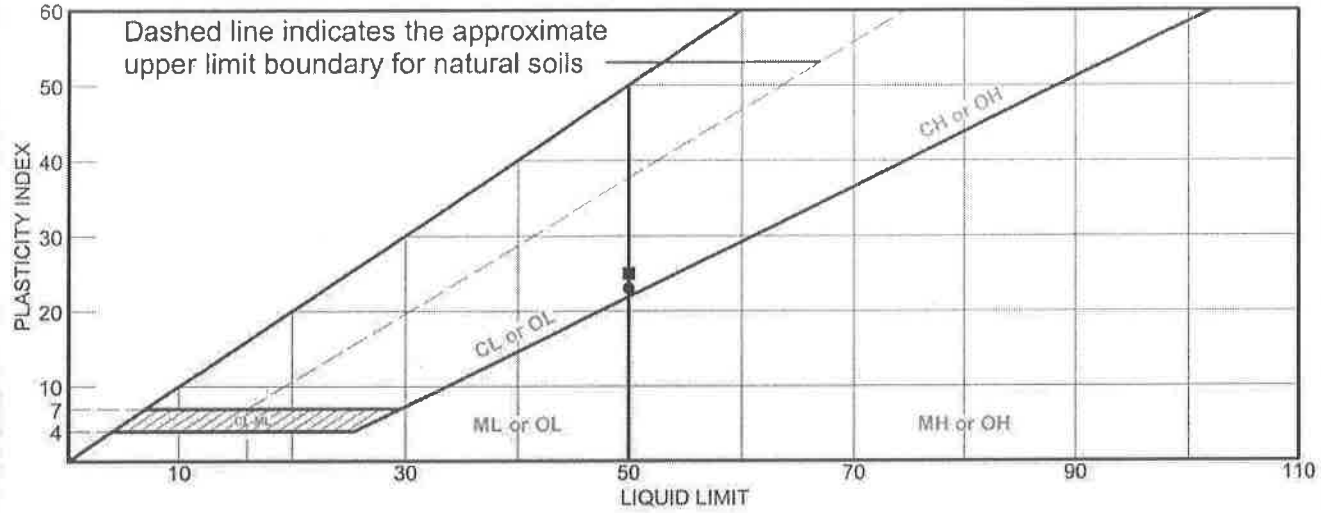
◆

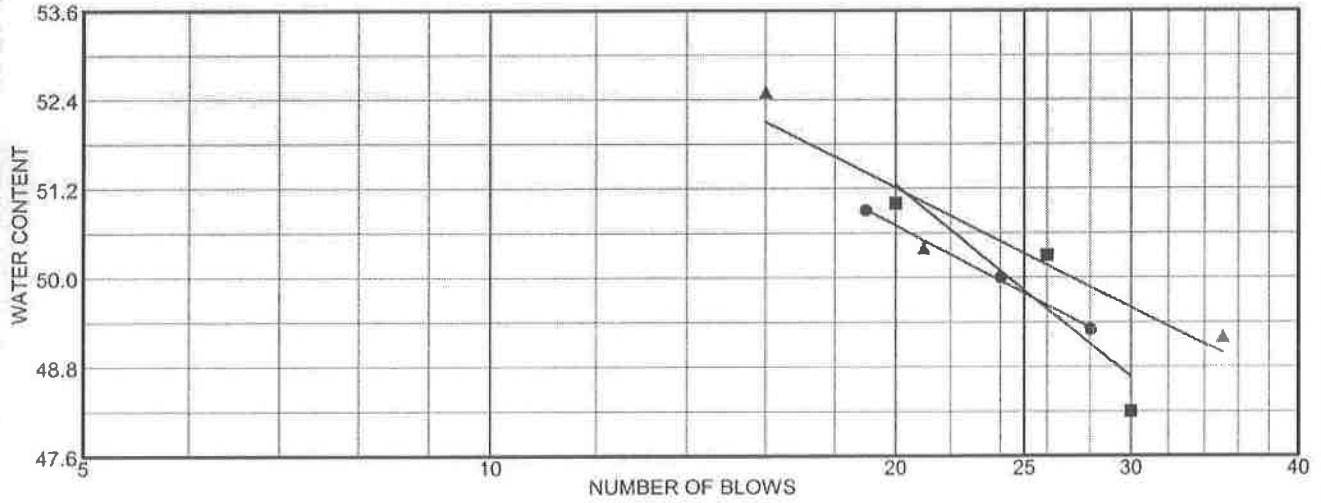
AMERICAN GEOTECHNICS

Boise, ID

Reviewed by:

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Fat Clay (CH)	50	27	23	100	99	
■	Fat Clay (CH)	50	25	25	100	100	CH
▲	Fat Clay (CH)	50	25	25	100	100	CH

Project No. 06B-1434.1 **Client:** U.S. Ecology of Idaho

Project: Phase III Clay Investigation Johnson

Phase III Clay Investigation Johnson

● **Location:** B-107, BK-29; 45.0'

■ **Location:** B-107, BK-30; 55.0'

▲ **Location:** B-107, BK-31; 65.0'

Remarks:

●

■

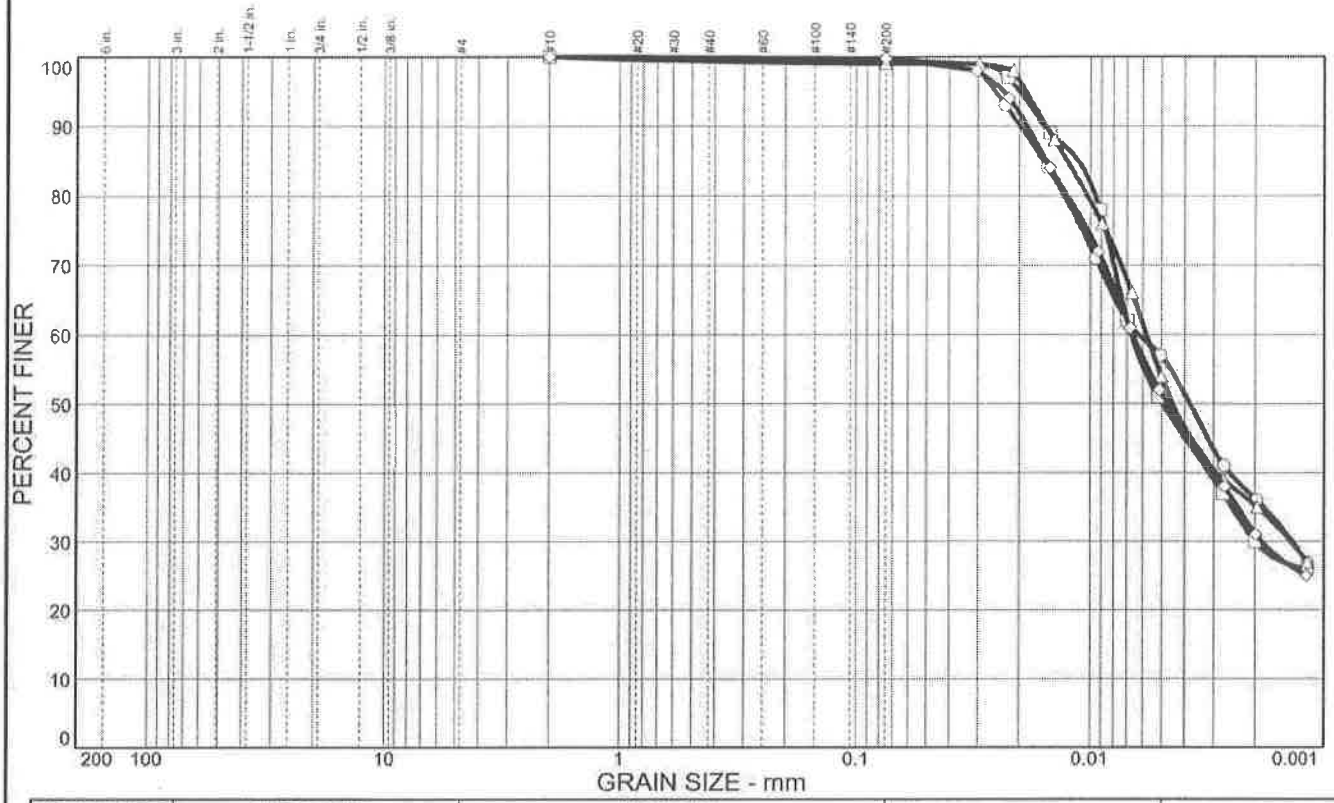
▲

AMERICAN GEOTECHNICS

Boise, ID

Reviewed by:

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	0.4	42.8	56.8
□	0.0	0.0	1.0	48.9	50.1
△	0.0	0.0	1.0	45.2	53.8
◇	0.0	0.0	0.2	48.4	51.4

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	51	23	0.0160	0.0063	0.0038	0.0014				
□	47	24	0.0113	0.0067	0.0050	0.0020				
△	50	27	0.0127	0.0058	0.0045	0.0014				
◇	50	25	0.0155	0.0066	0.0047	0.0019				

MATERIAL DESCRIPTION	USCS	AASHTO
○ Fat Clay (CH)	CH	
□ Lean Clay (CL)	CL	
△ Fat Clay (CH)		
◇ Fat Clay (CH)	CH	

Project No. 06B-1434.1 **Client:** U.S. Ecology of Idaho

Project: Phase III Clay Investigation Johnson

○ **Location:** B-104, BK-17; 20.0'

□ **Location:** B-107, BK-27; 25.0'

△ **Location:** B-107, BK-29; 45.0'

◇ **Location:** B-107, BK-31; 65.0'

Remarks:

○

□

△

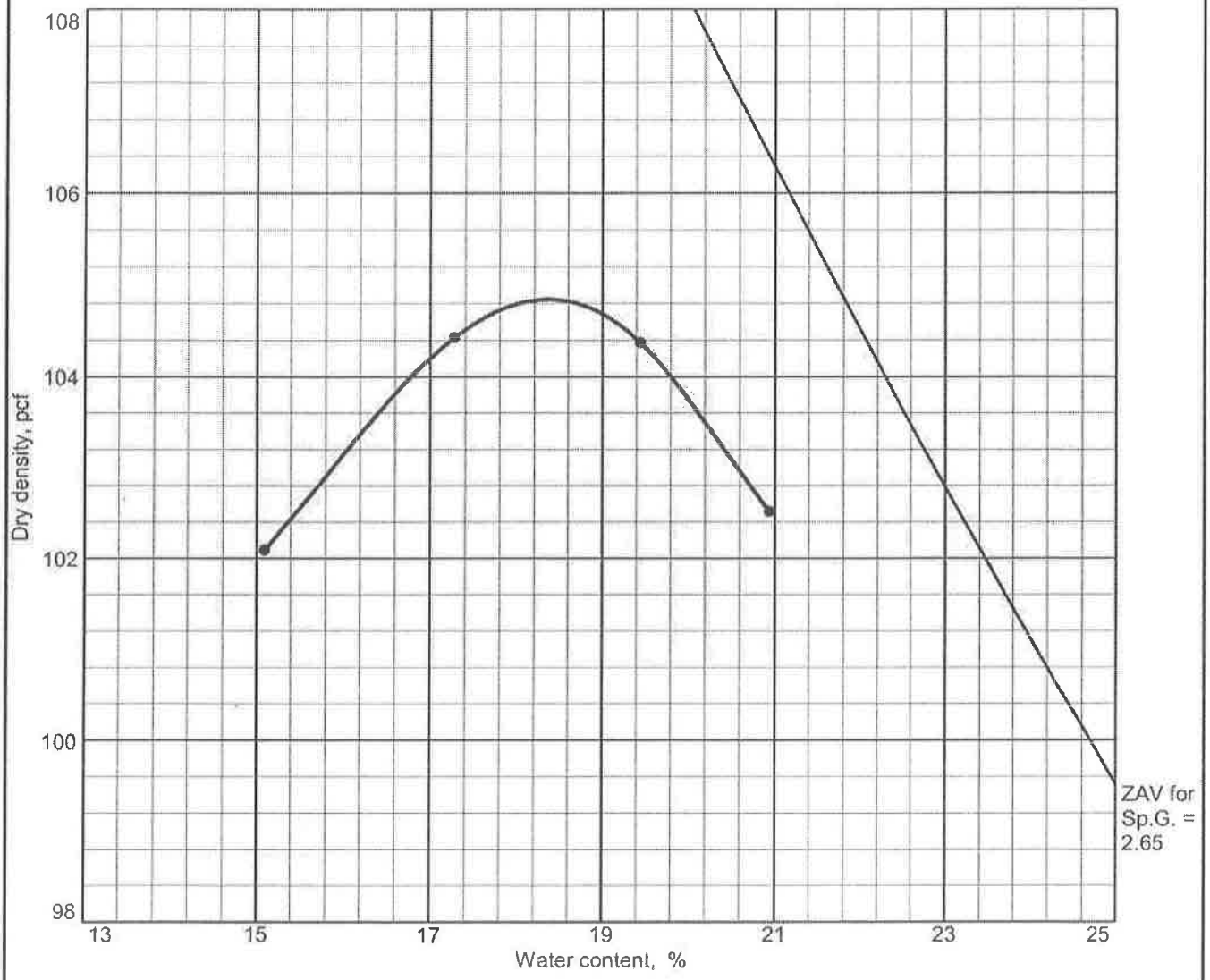
◇

AMERICAN GEOTECHNICS

Boise, ID

Reviewed by:

COMPACTION TEST REPORT

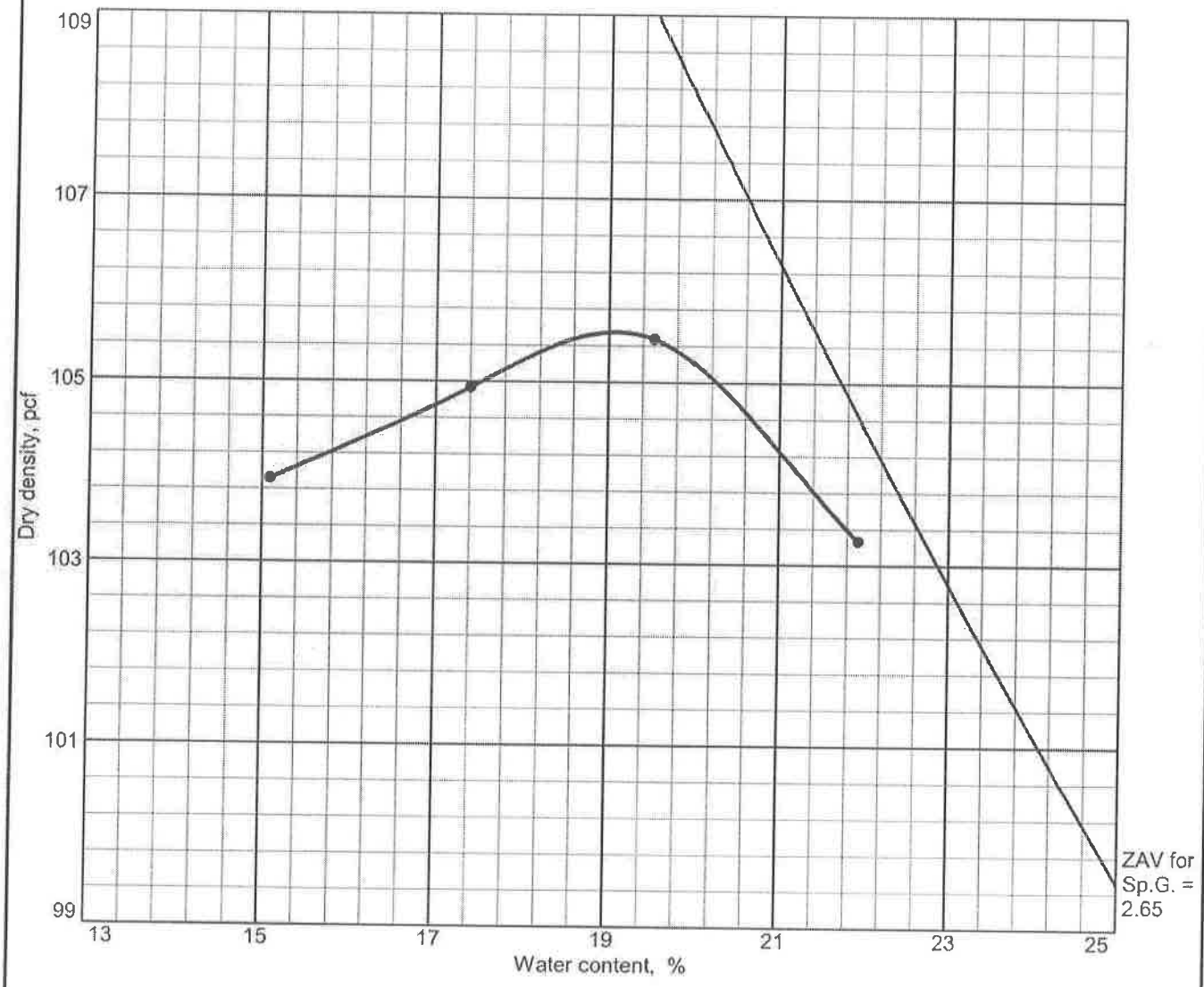


Test specification: ASTM D 1557-00 Method A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
20.0	CH				51	28	0.0	100

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 104.8 pcf Optimum moisture = 18.4 %	Fat Clay (CH)
Project No. 06B-1434.1 **Client:** U.S. Ecology of Idaho **Project:** Phase III Clay Investigation Johnson ● **Location:** B-104, BK-17; 20.0'	**Remarks:**
AMERICAN GEOTECHNICS Boise, ID	Reviewed by:

COMPACTION TEST REPORT

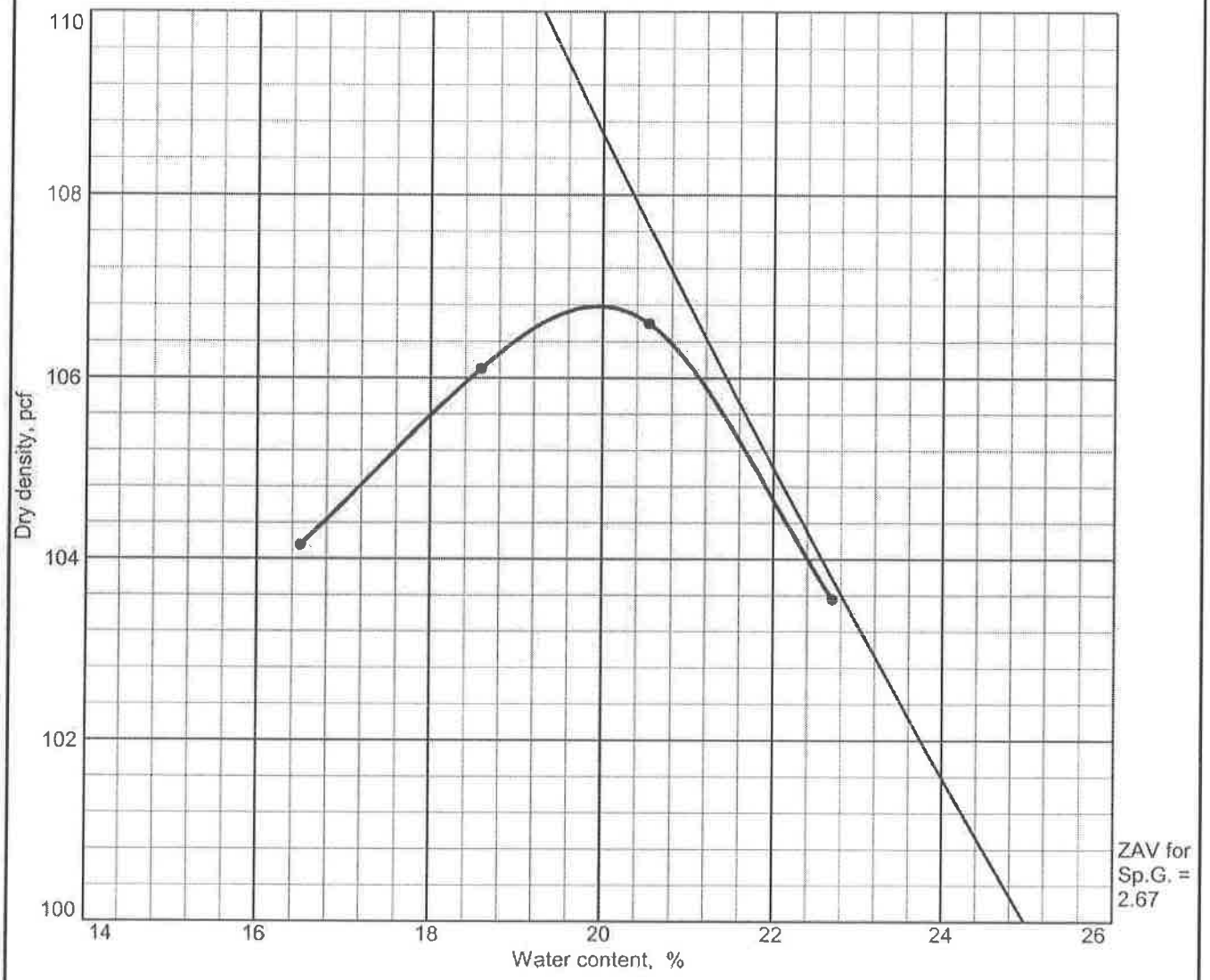


Test specification: ASTM D 1557-00 Method A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
25.0'					47	23		99

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 105.5 pcf Optimum moisture = 19.1 %	
Project No. 06B-1434.1 **Client:** U.S. Ecology of Idaho **Project:** Phase III Clay Investigation Johnson • **Location:** B-107, BK-27; 25.0'	**Remarks:**
AMERICAN GEOTECHNICS Boise, ID	Reviewed by:

COMPACTION TEST REPORT

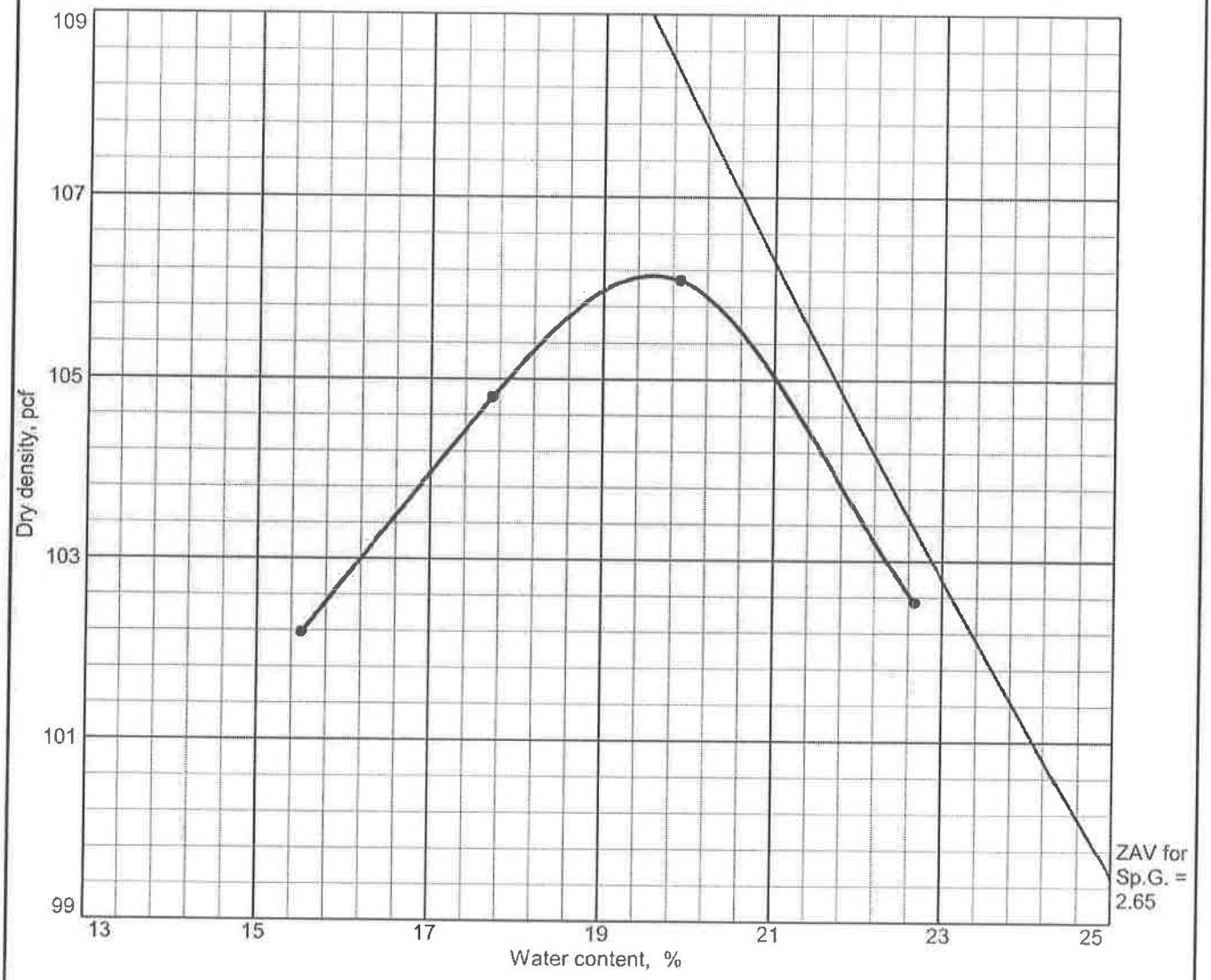


Test specification: ASTM D 1557-00 Method A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
45.0'					50	23		99

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 106.8 pcf Optimum moisture = 20.0 %	Fat Clay (CH)
Project No. 06B-1434.1 **Client:** U.S. Ecology of Idaho **Project:** Phase III Clay Investigation Johnson ● **Location:** B-107, BK-29; 45.0'	**Remarks:**
AMERICAN GEOTECHNICS **Boise, ID**	**Reviewed by:**

COMPACTION TEST REPORT



Test specification: ASTM D 1557-00 Method A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
65.0'	CH				50	25	0.0	100

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 106.1 pcf Optimum moisture = 19.6 %	Fat Clay (CH)
Project No. 06B-1434.1 **Client:** U.S. Ecology of Idaho **Project:** Phase III Clay Investigation Johnson ● **Location:** B-107, BK-31; 65.0'	**Remarks:**
AMERICAN GEOTECHNICS Boise, ID	Reviewed by:

AMERICAN GEOTECHNICS, INC.
Boise, Idaho

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Phase III Clay Investigation							
Date:	6/25/2007	Panel Number :	P-1					
Project No. :	06B-G1434.1	Permometer Data						
Boring No.:	B-104	a_p =	0.031416	cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Sample:	BK-17	a_s =	0.767120	cm^2		Pipet Rp	5.6	cm^3
Depth (ft):	20.00	M_1 =	0.030180	C = 0.0003191		Annulus Ra	1.4	cm^3
Other Location:		M_2 =	1.040953	T = 0.2510347				
Material Description :	Lean Clay (CL)							

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			399.16	g				
Tare or ring Wt. :			0.0	g	Tare No.:	0	Tare No.:	0
Wet Wt: of Sample :			399.16	g	Wet Wt.+tare:	322.90	Wet Wt.+tare:	413.41
Diameter :	2.78	in	7.07	cm^2	Dry Wt.+tare:	298.20	Dry Wt.+tare:	318.33
Length :	2.06	in	5.22	cm	Tare Wt:	199.90	Tare Wt:	0.00
Area:	6.08	in^2	39.22	cm^2	Dry Wt.:	98.3	Dry Wt.:	318.33
Volume :	12.50	in^3	204.90	cm^3	Water Wt.:	24.7	Water Wt.:	95.08
Unit Wt.(wet):	**121.56**	pcf	**1.95**	$g/cm^{\wedge 3}$	% moist.:	**25.1**	% moist.:	**29.9**
Unit Wt.(dry):	**97.15**	pcf	**1.56**	$g/cm^{\wedge 3}$				

Assumed Specific Gravity:	**2.65**	Max Dry Density(pcf) =	104.8	OMC =	18.4
		% of max =	92.7	+/- OMC =	6.73
Calculated % saturation:	112.60	Void ratio (e) =	**0.70**	Porosity (n)=	**0.41**

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 4.1 cm Hydraulic Gradient = 10.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
6/25/2007	540	5.2	0.383513	21.5	0.965	5.77E-08	1.64E-04	
6/25/2007	600	5.19	0.393513	21.5	0.965	5.34E-08	1.51E-04	
6/25/2007	420	5.28	0.303513	21.5	0.965	5.81E-08	1.65E-04	
6/25/2007	480	5.25	0.333513	21.5	0.965	5.61E-08	1.59E-04	

SUMMARY

	k_a =	5.63E-08 cm/sec		Acceptance criteria =	50 %
	ki		Vm		
	k1 =	5.77E-08 cm/sec	2.5 %	Vm =	$\frac{\lvert ka-ki \rvert}{ka} \times 100$
	k2 =	5.34E-08 cm/sec	5.2 %		
	k3 =	5.81E-08 cm/sec	3.2 %		
	k4 =	5.61E-08 cm/sec	0.4 %		

Cell line Blew out prior to running 2nd perm.

Hydraulic conductivity	k =	**5.63E-08**	cm/sec	**1.60E-04** ft/day
Void Ratio	e =	**0.70**		
Porosity	n =	**0.41**		
Bulk Density	γ =	**1.95**	g/cm^3	**121.6** pcf
Water Content	W =	**0.39**	cm^3/cm^3	(at 20 deg C)
Intrinsic Permeability	k_{int} =	**5.77E-13**	cm^2	(at 20 deg C)

Plate: B.3

AMERICAN GEOTECHNICS, INC.
Boise, Idaho

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Phase III Clay Investigation							
Date:	7/4/2007	Panel Number :	P-3					
Project No. :	06B-G1434.1			Permometer Data				
Boring No.:	B-107	a_p =	0.031416 cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3	
Sample:	BK-27	a_a =	0.767120 cm^2		Pipet Rp	5.6	cm^3	
Depth (ft):	25.00	M_1 =	0.030180	C = 0.0003221	Annulus Ra	1.4	cm^3	
Other Location:		M_2 =	1.040953	T = 0.2473076				

Material Description : Lean Clay (CL)

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			400.69	g	Tare No.:	0	Tare No.:	0
Tare or ring Wt. :			0.0	g	Wet Wt.+tare:	304.69	Wet Wt.+tare:	407.74
Wet Wt: of Sample :			400.69	g	Dry Wt.+tare:	274.98	Dry Wt.+tare:	311.25
Diameter :	2.79	in	7.09	cm^2	Tare Wt:	172.78	Tare Wt:	0.00
Length :	2.09	in	5.30	cm	Dry Wt.:	102.2	Dry Wt.:	311.25
Area:	6.11	in^2	39.44	cm^2	Water Wt.:	29.71	Water Wt.:	96.49
Volume :	12.77	in^3	209.18	cm^3	% moist.:	29.1	% moist.:	31.0
Unit Wt.(wet):	119.53	pcf	1.92	$g/cm^{\wedge 3}$				
Unit Wt.(dry):	92.61	pcf	1.48	$g/cm^{\wedge 3}$				

Assumed Specific Gravity:	2.65	Max Dry Density(pcf) =	105.5	OMC =	19.1
		% of max =	87.8	+/- OMC =	9.97
Calculated % saturation:	104.45	Void ratio (e) =	0.79	Porosity (n)=	0.44

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 4.2 cm Hydraulic Gradient = 10.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
7/4/2007	540	5.3	0.343547	19.5	1.013	5.37E-08	1.52E-04	
7/4/2007	600	5.28	0.363547	19.5	1.013	5.12E-08	1.45E-04	
7/4/2007	420	5.37	0.273547	19.5	1.013	5.44E-08	1.54E-04	
7/4/2007	480	5.32	0.323547	19.5	1.013	5.67E-08	1.61E-04	

SUMMARY

k_a =	5.40E-08	cm/sec		Acceptance criteria =	50 %
ki			Vm		
k1 =	5.37E-08	cm/sec	0.6	%	Vm = $\frac{\lvert k_a - k_i \rvert}{k_a} \times 100$
k2 =	5.12E-08	cm/sec	5.1	%	
k3 =	5.44E-08	cm/sec	0.8	%	
k4 =	5.67E-08	cm/sec	5.0	%	

Hydraulic conductivity	k =	5.40E-08	cm/sec	1.53E-04	ft/day
Void Ratio	e =	0.79			
Porosity	n =	0.44			
Bulk Density	γ =	1.92	g/cm^3	119.5	pcf
Water Content	W =	0.43	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	5.53E-13	cm^2	(at 20 deg C)	

Plate: B.3

AMERICAN GEOTECHNICS, INC.
Boise, Idaho

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Phase III Clay Investigation							
Date:	6/30/2007	Panel Number : P-2						
Project No. :	06B-G1434.1				Permometer Data			
Boring No.:	B-107	a_p =	0.031416 cm^2		Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Sample:	BK-29	a_a =	0.767120 cm^2			Pipet Rp	5.6	cm^3
Depth (ft):	45.00	M_1 =	0.030180	C = 0.0003227		Annulus Ra	1.4	cm^3
Other Location:		M_2 =	1.040953	T = 0.2486174				
Material Description :	Lean Clay (CL)							

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			403.24	g	Tare No.:	0	Tare No.:	0
Tare or ring Wt. :			0.0	g	Wet Wt.+tare:	332.81	Wet Wt.+tare:	414.30
Wet Wt: of Sample :			403.24	g	Dry Wt.+tare:	296.57	Dry Wt.+tare:	318.83
Diameter :	2.78	in	7.06	cm^2	Tare Wt:	159.10	Tare Wt:	0.00
Length :	2.08	in	5.28	cm	Dry Wt.:	137.47	Dry Wt.:	318.83
Area:	6.07	in^2	39.16	cm^2	Water Wt.:	36.24	Water Wt.:	95.47
Volume :	12.61	in^3	206.59	cm^3	% moist.:	26.4	% moist.:	29.9
Unit Wt.(wet):	121.80	pcf	1.95	g/cm^3				
Unit Wt.(dry):	96.39	pcf	1.54	g/cm^3				

Assumed Specific Gravity:	2.65	Max Dry Density(pcf) =	106.8	OMC =	20
		% of max =	90.2	+/- OMC =	6.36
Calculated % saturation:	110.76	Void ratio (e) =	0.72	Porosity (n)=	0.42

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 4.2 cm Hydraulic Gradient = 10.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
6/30/2007	540	5.47	0.152245	21.1	0.974	2.25E-08	6.37E-05	
6/30/2007	600	5.45	0.172245	21.1	0.974	2.29E-08	6.50E-05	
6/30/2007	660	5.42	0.202245	21.1	0.974	2.46E-08	6.97E-05	
6/30/2007	480	5.48	0.142245	21.1	0.974	2.36E-08	6.69E-05	

SUMMARY

k_a =	2.34E-08	cm/sec		Acceptance criteria =	50 %
ki			Vm		
k1 =	2.25E-08	cm/sec	4.0	%	Vm = $\frac{\lvert k_a - k_i \rvert}{k_a} \times 100$
k2 =	2.29E-08	cm/sec	1.9	%	
k3 =	2.46E-08	cm/sec	5.1	%	
k4 =	2.36E-08	cm/sec	0.8	%	

Hydraulic conductivity	k =	2.34E-08	cm/sec	6.63E-05	ft/day
Void Ratio	e =	0.72			
Porosity	n =	0.42			
Bulk Density	γ =	1.95	g/cm^3	121.8	pcf
Water Content	W =	0.41	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	2.40E-13	cm^2	(at 20 deg C)	

Plate: B.3

AMERICAN GEOTECHNICS, INC.
Boise, Idaho

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Phase III Clay Investigation
Date:	7/25/2007
Panel Number :	P-2
Project No. :	06B-G1434.1
Boring No.:	B-107 BK-31
Sample:	07-0448
Depth (ft):	65.00
Other Location:	
Material Description :	Fat Clay (CH)

Permometer Data

a_p = 0.031416 cm^2
a_a = 0.767120 cm^2
M_1 = 0.030180 C = 0.0003213
M_2 = 1.040953 T = 0.1237724

Set Mercury to Pipet Rp at beginning

Equilibrium	1.8	cm^3
Pipet Rp	9.9	cm^3
Annulus Ra	1.5	cm^3

SAMPLE DATA

Wet Wt. sample + ring or tare :		400.21	g
Tare or ring Wt. :		0.0	g
Wet Wt: of Sample :		400.21	g
Diameter :	2.79 in	7.09	cm^2
Length :	2.09 in	5.30	cm
Area:	6.12 in^2	39.50	cm^2
Volume :	12.77 in^3	209.28	cm^3
Unit Wt.(wet):	**119.33** pcf	**1.91**	$g/cm^{\wedge 3}$
Unit Wt.(dry):	**92.43** pcf	**1.48**	$g/cm^{\wedge 3}$

	Before Test		After Test
Tare No.:	0	Tare No.:	0
Wet Wt.+tare:	419.25	Wet Wt.+tare:	391.10
Dry Wt.+tare:	373.90	Dry Wt.+tare:	311.61
Tare Wt:	218.02	Tare Wt:	0.00
Dry Wt.:	155.88	Dry Wt.:	311.61
Water Wt.:	45.35	Water Wt.:	79.49
% moist.:	**29.1**	% moist.:	**25.5**

Assumed Specific Gravity: **2.70** Max Dry Density(pcf) = 0 OMC = 0
% of max = #DIV/0! +/- OMC = 29.09
Calculated % saturation: 83.63 Void ratio (e) = **0.82** Porosity (n)= **0.45**

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 8.4 cm Hydraulic Gradient = 20.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
7/25/2007	780	9.47	0.409347	22.4	0.945	2.02E-08	5.73E-05	
7/25/2007	840	9.44	0.439347	22.4	0.945	2.02E-08	5.73E-05	
7/25/2007	900	9.41	0.469347	22.4	0.945	2.02E-08	5.72E-05	
7/25/2007	960	9.38	0.499347	22.4	0.945	2.02E-08	5.72E-05	

SUMMARY

ka = 2.02E-08 cm/sec Acceptance criteria = 50 %

ki		Vm		
k1 =	2.02E-08 cm/sec	0.2	%	Vm = $\frac{\lvert ka-ki \rvert}{ka} \times 100$
k2 =	2.02E-08 cm/sec	0.0	%	
k3 =	2.02E-08 cm/sec	0.1	%	
k4 =	2.02E-08 cm/sec	0.1	%	

Hydraulic conductivity	k =	**2.02E-08** cm/sec	**5.72E-05**	ft/day
Void Ratio	e =	**0.82**		
Porosity	n =	**0.45**		
Bulk Density	γ =	**1.91** g/cm^3	**119.3**	pcf
Water Content	W =	**0.43** cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**2.07E-13** cm^2	(at 20 deg C)	

Plate: B.3

AMERICAN GEOTECHNICS, INC.
Boise, Idaho

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Phase III Clay Investigation							
Date:	8/1/2007	Panel Number : P-2						
Project No. :	06B-G1434.1				Permometer Data			
Boring No.:	B-107 BK-31	a_p =	0.031416 cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.8	cm^3	
Sample:	07-0448	a_a =	0.767120 cm^2		Pipet Rp	9.9	cm^3	
Depth (ft):	65.00	M_1 =	0.030180	C = 0.0003213	Annulus Ra	1.5	cm^3	
Other Location:	E. Stress 90psi	M_2 =	1.040953	T = 0.1237724				

Material Description : Fat Clay (CH)

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			400.21	g	Tare No.:	0	Tare No.:	0
Tare or ring Wt. :			0.0	g	Wet Wt.+tare:	419.25	Wet Wt.+tare:	391.10
Wet Wt: of Sample :			400.21	g	Dry Wt.+tare:	373.90	Dry Wt.+tare:	311.61
Diameter :	2.79	in	7.09	cm^2	Tare Wt:	218.02	Tare Wt:	0.00
Length :	2.09	in	5.30	cm	Dry Wt.:	155.88	Dry Wt.:	311.61
Area:	6.12	in^2	39.50	cm^2	Water Wt.:	45.35	Water Wt.:	79.49
Volume :	12.77	in^3	209.28	cm^3	% moist.:	29.1	% moist.:	25.5
Unit Wt.(wet):	119.33	pcf	1.91	g/cm^3				
Unit Wt.(dry):	92.43	pcf	1.48	g/cm^3				

Assumed Specific Gravity:	2.70	Max Dry Density(pcf) =	0	OMC =	0
		% of max =	#DIV/0!	+/- OMC =	29.09
Calculated % saturation:	83.63	Void ratio (e) =	0.82	Porosity (n)=	0.45

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 8.4 cm Hydraulic Gradient = 20.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
8/1/2007	23400	8.56	1.319347	21.7	0.960	2.35E-09	6.66E-06	
8/1/2007	18000	8.83	1.049347	21.7	0.960	2.39E-09	6.76E-06	
8/1/2007	19800	8.73	1.149347	21.7	0.960	2.39E-09	6.78E-06	
8/1/2007	21600	8.64	1.239347	21.7	0.960	2.38E-09	6.74E-06	

SUMMARY

k_a =	2.38E-09	cm/sec		Acceptance criteria =	95 %
ki			Vm		
k1 =	2.35E-09	cm/sec	1.1	%	Vm = $\frac{\lvert ka-ki \rvert}{ka} \times 100$
k2 =	2.39E-09	cm/sec	0.4	%	
k3 =	2.39E-09	cm/sec	0.6	%	
k4 =	2.38E-09	cm/sec	0.1	%	

* Effective stress = 90 psi

Hydraulic conductivity	k =	2.38E-09 cm/sec	6.74E-06	ft/day
Void Ratio	e =	0.82		
Porosity	n =	0.45		
Bulk Density	γ =	1.91 g/cm^3	119.3	pcf
Water Content	W =	0.43 cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	2.43E-14 cm^2	(at 20 deg C)	

Plate: B.3

American Geotechnics
5260 Chinden Blvd.
Boise, Idaho 83714
Phone:(208) 658-8700
Fax: (208) 658-8703

Report to: U.S. Ecology of Idaho

Report Date: 7/27/07
Project No.: 06B-G1434.1
Sample No.: 07-0445

Project: Phase III Clay Investigation

Material Information

Source: Johnson
Type: Fat Clay (CH)
Date Sampled: 5/23/07
Sampled By: American Geotechnics
Date Received: 5/23/07
Date Tested: 7/25 thru 7/27/07

Test Results

Specific Gravity of Soil
ASTM D-854
Method

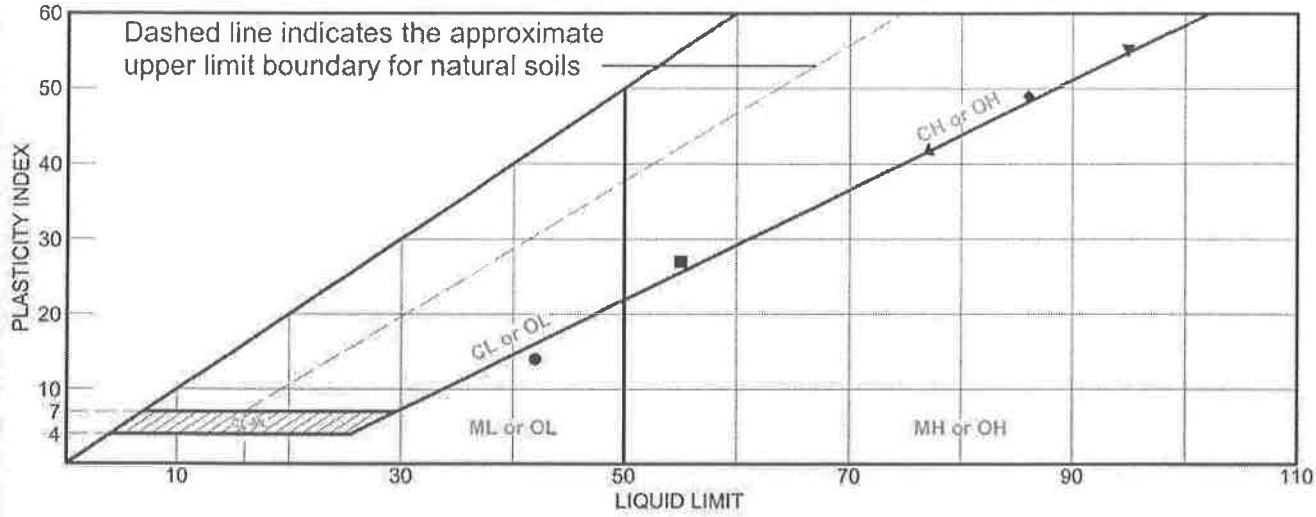
		Spec Limits
Apperent Spg:	2.769	N/A

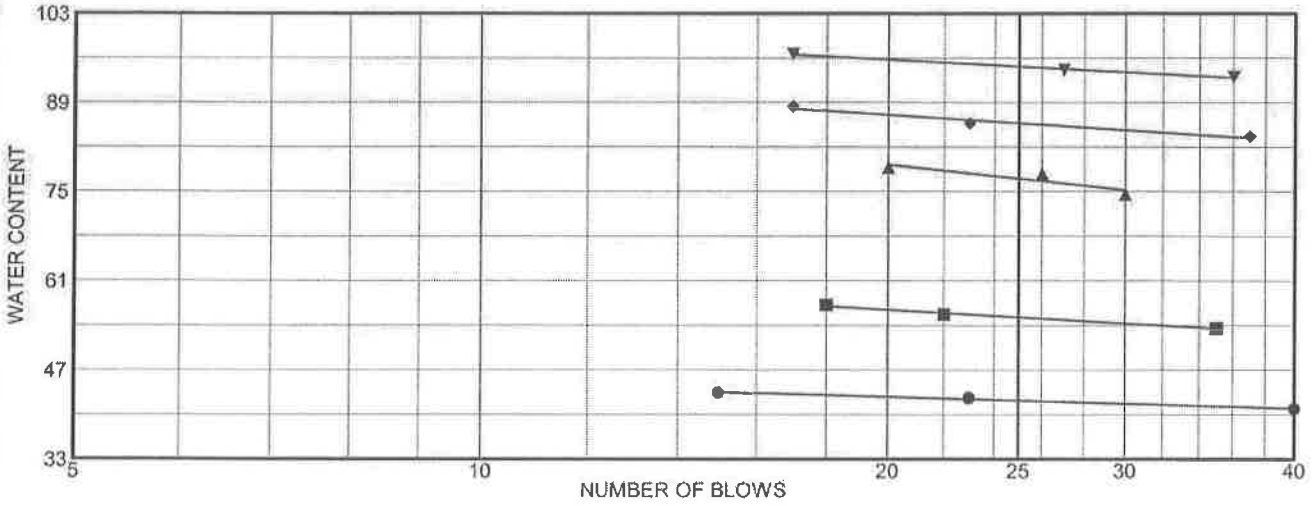
Reviewed By: _____

AMERICAN GEO TECHNICS

Steiner Property

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Silt (ML)	42	28	14	100	100	ML
■	Fat Clay (CH)	55	28	27	100	100	CH
▲	Fat Clay (CH)	77	35	42	100	99	CH
◆	Fat Clay (CH)	86	37	49	100	99	CH
▼	Fat Clay (CH)	95	40	55	100	100	CH

Project No. 06B-1434.1 **Client:** US Ecology of Idaho

Project: Phase III Clay Investigation

Phase III Clay Investigation

● **Location:** B-108, BK-33; 10.0'

■ **Location:** B-108, BK-34; 20.0'

▲ **Location:** B-108, BK-35; 30.0'

◆ **Location:** B-108, BK-36; 40.0'

▼ **Location:** B-108, BK-37; 49.0'

Remarks:

●

■

▲

◆

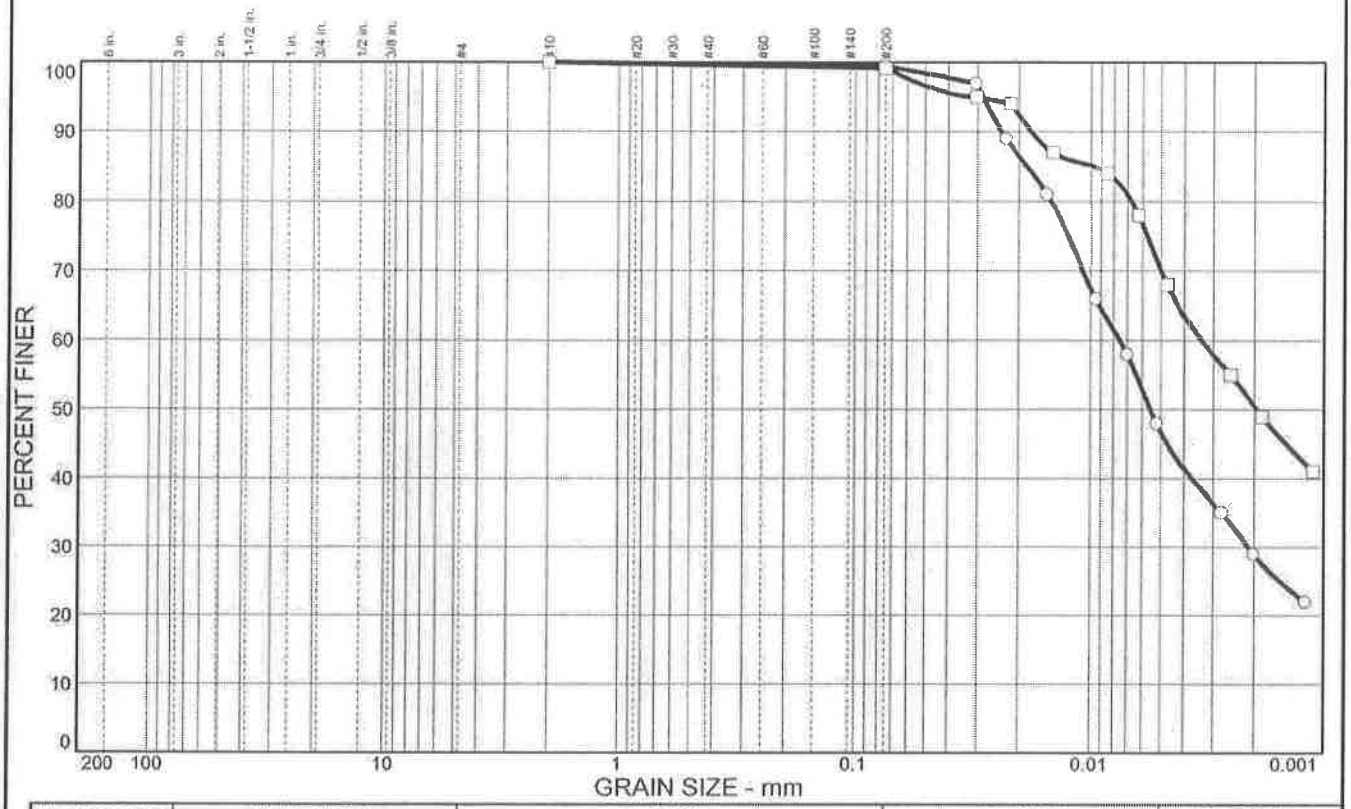
▼

AMERICAN GEOTECHNICS

Boise, ID

Reviewed by:

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	0.5	52.7	46.8
□	0.0	0.0	0.9	29.1	70.0

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	55	28	0.0185	0.0075	0.0055	0.0021				
□	86	37	0.0096	0.0034	0.0020					

MATERIAL DESCRIPTION	USCS	AASHTO
○ Fat Clay (CH)	CH	
□ Fat Clay (CH)	CH	

Project No. 06B-1434.1 **Client:** US Ecology of Idaho

Project: Phase III Clay Investigation

○ **Location:** B-108, BK-34; 20.0'

□ **Location:** B-108, BK-36; 40.0'

Remarks:

○

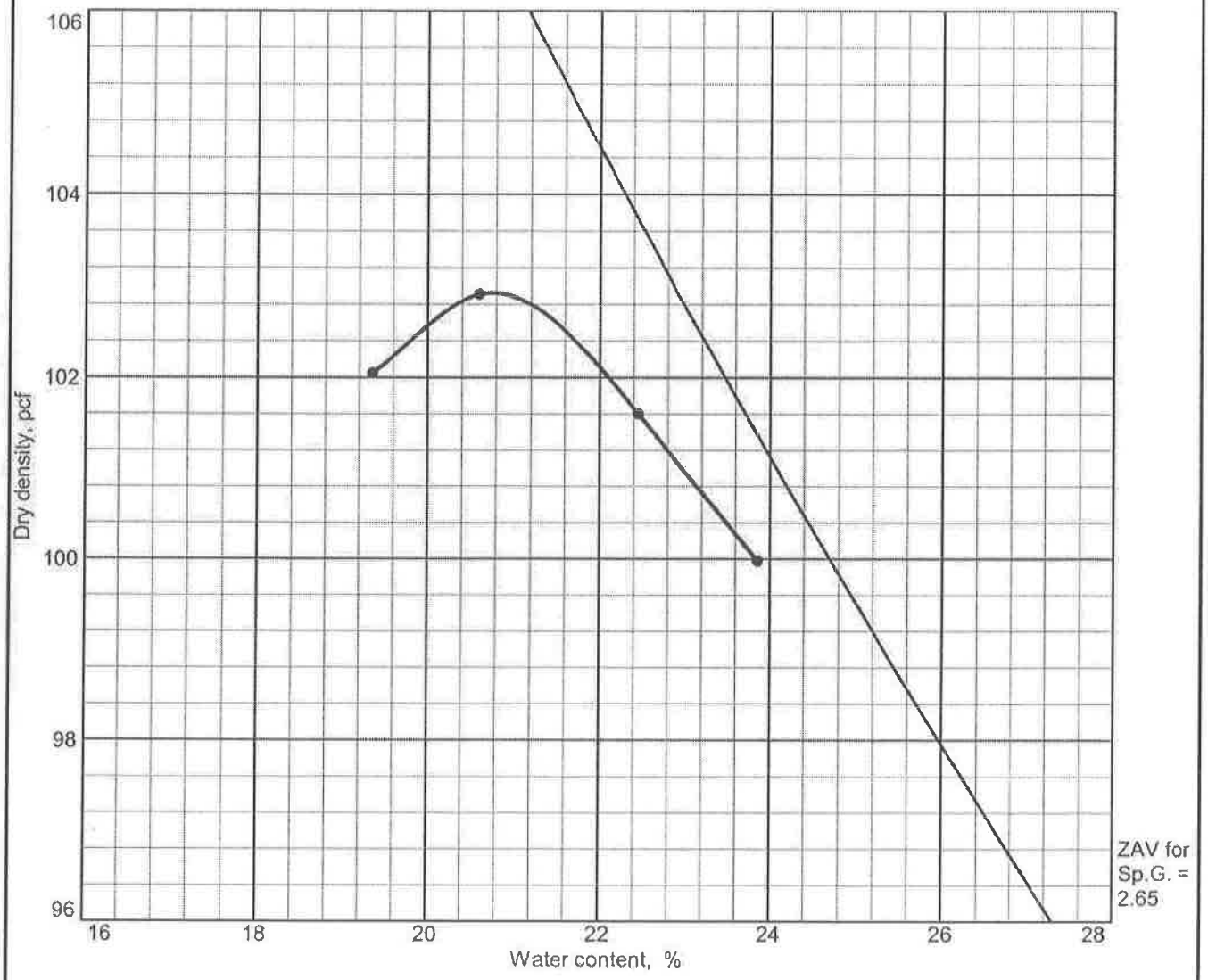
□

AMERICAN GEOTECHNICS

Boise, ID

Reviewed by:

COMPACTION TEST REPORT



Test specification: ASTM D 1557-00 Method A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
20.0'	CH				55	27	0.0	100

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 102.9 pcf Optimum moisture = 20.8 %	Fat Clay (CH)

Project No. 06B-1434.1 **Client:** US Ecology of Idaho
Project: Phase III Clay Investigation

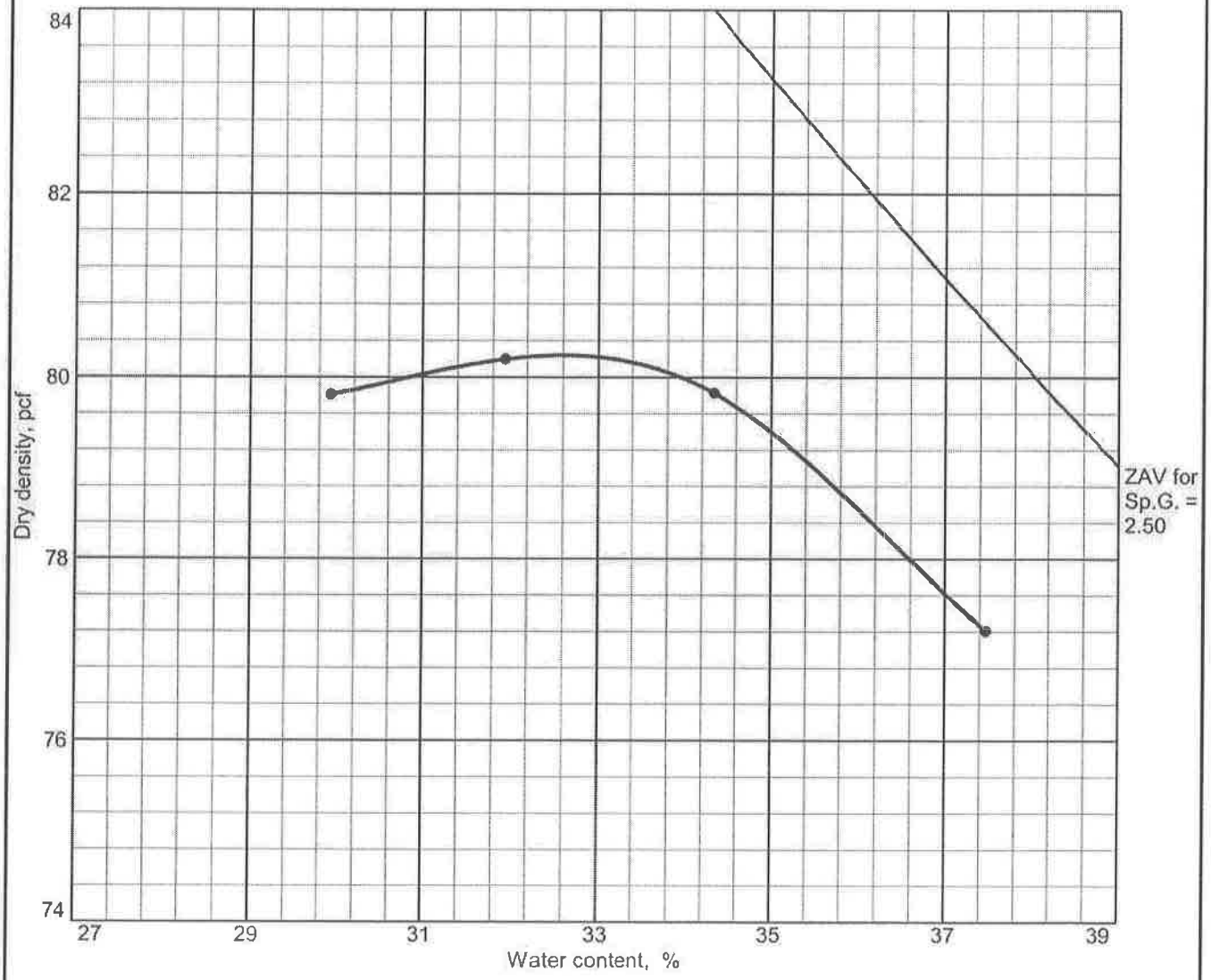
• **Location:** B-108, BK-34; 20.0'

AMERICAN GEOTECHNICS
Boise, ID

Remarks:

Reviewed by:

COMPACTION TEST REPORT



Test specification: ASTM D 1557-00 Method A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
40.0'	CH				86	49	0.0	99

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 80.2 pcf Optimum moisture = 32.6 %	Fat Clay (CH)

Project No. 06B-1434.1 **Client:** US Ecology of Idaho
Project: Phase III Clay Investigation

● **Location:** B-108, BK-36; 40.0'

Remarks:

AMERICAN GEOTECHNICS
Boise, ID

Reviewed by:

AMERICAN GEOTECHNICS, INC.
Boise, Idaho

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Phase III Clay Investigation							
Date:	7/12/2007	Panel Number :	P-1					
Project No. :	06B-G1434.1	Permometer Data						
Boring No.:	B-108	a_p =	0.031416 cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.8	cm^3	
Sample:	BK-34	a_a =	0.767120 cm^2		Pipet Rp	5.8	cm^3	
Depth (ft):	20.00	M_1 =	0.030180	C = 0.0003195	Annulus Ra	1.6	cm^3	
Other Location:		M_2 =	1.040953	T = 0.2486174				
Material Description :	Fat Clay (CH)							

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			401.54	g	Tare No.:	0	Tare No.:	0
Tare or ring Wt. :			0.0	g	Wet Wt.+tare:	320.55	Wet Wt.+tare:	416.78
Wet Wt: of Sample :			401.54	g	Dry Wt.+tare:	277.61	Dry Wt.+tare:	319.11
Diameter :	2.79	in	7.10	cm^2	Tare Wt:	109.47	Tare Wt:	0.00
Length :	2.08	in	5.28	cm	Dry Wt.:	168.14	Dry Wt.:	319.11
Area:	6.13	in^2	39.56	cm^2	Water Wt.:	42.94	Water Wt.:	97.67
Volume :	12.73	in^3	208.68	cm^3	% moist.:	25.5	% moist.:	30.6
Unit Wt.(wet):	120.07	pcf	1.92	$g/cm^{\wedge 3}$				
Unit Wt.(dry):	95.64	pcf	1.53	$g/cm^{\wedge 3}$				

Assumed Specific Gravity:	2.65	Max Dry Density(pcf) =	102.9	OMC =	20.8
		% of max =	92.9	+/- OMC =	4.74
Calculated % saturation:	111.15	Void ratio (e) =	0.73	Porosity (n)=	0.42

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 4.2 cm Hydraulic Gradient = 10.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
7/12/2007	780	4.89	0.932245	22.4	0.945	1.02E-07	2.89E-04	
7/12/2007	840	4.86	0.962245	22.4	0.945	9.82E-08	2.78E-04	
7/12/2007	660	4.99	0.832245	22.4	0.945	1.06E-07	3.00E-04	
7/12/2007	720	4.97	0.852245	22.4	0.945	9.98E-08	2.83E-04	

SUMMARY

k_a =	1.01E-07 cm/sec		Acceptance criteria =	50 %	
ki		Vm			
k1 =	1.02E-07 cm/sec	0.5	%	Vm =	$\frac{\lvert k_a - k_i \rvert}{k_a} \times 100$
k2 =	9.82E-08 cm/sec	3.2	%		
k3 =	1.06E-07 cm/sec	4.4	%		
k4 =	9.98E-08 cm/sec	1.7	%		

Hydraulic conductivity	k =	1.01E-07 cm/sec	2.88E-04	ft/day
Void Ratio	e =	0.73		
Porosity	n =	0.42		
Bulk Density	γ =	1.92 g/cm^3	120.1	pcf
Water Content	W =	0.39 cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	1.04E-12 cm^2	(at 20 deg C)	

Plate: B.3

AMERICAN GEOTECHNICS, INC.
Boise, Idaho

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Phase III Clay Investigation							
Date:	7/16/2007	Panel Number :	P-3					
Project No. :	06B-G1434.1			Permometer Data				
Boring No.:	B-108	a_p =	0.031416 cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.8	cm^3	
Sample:	BK-36	a_a =	0.767120 cm^2		Pipet Rp	5.7	cm^3	
Depth (ft):	40.00	M_1 =	0.030180	C = 0.0003118	Annulus Ra	1.6	cm^3	
Other Location:		M_2 =	1.040953	T = 0.2536239				
Material Description :	Fat Clay (CH)							

SAMPLE DATA

					Before Test		After Test	
Wet Wt. sample + ring or tare :			338.31	g	Tare No.:	0	Tare No.:	0
Tare or ring Wt. :			0.0	g	Wet Wt.+tare:	409.34	Wet Wt.+tare:	367.48
Wet Wt. of Sample :			338.31	g	Dry Wt.+tare:	339.78	Dry Wt.+tare:	244.82
Diameter :	2.80	in	7.11	cm	Tare Wt:	160.77	Tare Wt:	0.00
Length :	2.04	in	5.17	cm	Dry Wt.:	179.01	Dry Wt.:	244.82
Area:	6.16	in^2	39.73	cm^2	Water Wt.:	69.56	Water Wt.:	122.66
Volume :	12.54	in^3	205.44	cm^3	% moist.:	38.9	% moist.:	50.1
Unit Wt.(wet):	102.76	pcf	1.65	$g/cm^{\wedge 3}$				
Unit Wt.(dry):	74.00	pcf	1.19	$g/cm^{\wedge 3}$				

Assumed Specific Gravity:	2.70	Max Dry Density(pcf) =	80.2	OMC =	32.6
		% of max =	92.3	+/- OMC =	6.26
Calculated % saturation:	105.87	Void ratio (e) =	1.28	Porosity (n)=	0.56

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 4.1 cm Hydraulic Gradient = 10.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
7/16/2007	1020	5.2	0.542845	21.1	0.974	4.41E-08	1.25E-04	
7/16/2007	840	5.28	0.462845	21.1	0.974	4.52E-08	1.28E-04	
7/16/2007	900	5.26	0.482845	21.1	0.974	4.41E-08	1.25E-04	
7/16/2007	960	5.23	0.512845	21.1	0.974	4.41E-08	1.25E-04	

SUMMARY

k_a =	4.44E-08	cm/sec		Acceptance criteria =	50 %
ki			Vm		
k1 =	4.41E-08	cm/sec	0.6 %	Vm =	$\frac{\lvert ka-ki \rvert}{ka} \times 100$
k2 =	4.52E-08	cm/sec	1.8 %		
k3 =	4.41E-08	cm/sec	0.6 %		
k4 =	4.41E-08	cm/sec	0.6 %		

Hydraulic conductivity	k =	4.44E-08	cm/sec	1.26E-04	ft/day
Void Ratio	e =	1.28			
Porosity	n =	0.56			
Bulk Density	γ =	1.65	g/cm^3	102.8	pcf
Water Content	W =	0.46	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	4.55E-13	cm^2	(at 20 deg C)	

Appendix D.5.9
Cell 16 Engineering Report Appendix H - Geotechnical Engineering Report

APPENDIX H

GEOTECHNICAL ENGINEERING REPORT

Geotechnical Engineering Report

Cell 16 Landfill

Grand View, Idaho

Prepared for:

U.S. Ecology Idaho

March 18, 2009

Revision 0

Prepared by:

AMERICAN GEO TECHNICS

Prepared for:

U.S. Ecology Idaho
P.O. Box 400
Grand View, Idaho 83624

Attention: Kevin Trader, Facilities Manager

Geotechnical Engineering Report
Cell 16 Landfill
Grand View, Idaho

American Geotechnics
Project No. 07B-G1654

Revision 0

Prepared by:
American Geotechnics

PROFESSIONAL ENGINEER REGISTERED 3/18/09 11632 STATE OF IDAHO VAUGHN THURGOOD

Vaughn Thurgood, PE
Project Engineer

Justin S. Stoffel, EIT
Geotechnical Engineer

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1.0 INTRODUCTION

1.1 Purpose and Scope of Work

This report presents the results and recommendations of our geotechnical investigation performed for the Cell 16 Landfill at the U.S. Ecology Idaho (USEI) Grand View waste disposal facility. The site is located in Section 19, Township 4 South, Range 2 East, approximately nine miles northwest of Grand View, Idaho. A vicinity map of the site is included as Figure 1 in Appendix A.

In general, the purpose of this investigation was to evaluate the subsurface conditions of the proposed landfill area and determine the suitability for the proposed site construction pertinent to the geotechnical design considerations. The investigation included subsurface exploration, representative soil sampling, field and laboratory testing, engineering analyses, and preparation of this report. This report does not address groundwater hydrology at the site.

Settlement analysis for the landfill is presented in this report along with engineering properties for the native site materials. Slope stability and the related interface friction angles for synthetic liner materials are addressed separately in the Landfill Engineering Report for Cell 16.

1.2 Project Description

The design of Cell 16 consists of a rectangular landfill unit approximately 74 acres in size, which will be constructed in multiple phases. The proposed limits and relative location of Cell 16 are illustrated on Figure 2 (Appendix A). The landfill unit will be constructed with a perimeter berm along the north, west and east sides. The berm will have a typical height of approximately 30 feet. Construction of Cell 16 will require approximately 10 feet of excavation across the floor of the Cell. Waste placement will be variable across the cell up to a maximum depth of approximately 140 feet.

2.0 SITE INVESTIGATION

2.1 Borehole Explorations

The subsurface conditions at the site were explored in March 2008 by drilling 4 test borings (DH-05, 06, 07, and 08) and excavating 5 test pits (TP-9, 10, 11, 17, and 18) as shown on the *Exploration Map* (Figure 3, Appendix A). Logs of the subsurface conditions, as encountered in the borings and test pits, were recorded at the time of the field work by a geotechnical engineer. Photos showing site conditions are included in Appendix B. The boring and test pit logs are presented in Appendix C. USEI provided logs of monitor wells previously installed in this portion of the site (U-1, U-2, U-3, LP-14, L-38) which are also included in Appendix C.

Geotechnical drilling was accomplished with a BK-81 truck-mounted drill rig equipped with hollow-stem augers for soil sampling. Haz-Tech Drilling of Meridian, Idaho performed the drilling services. The boreholes were advanced to depths of up to 101.5 feet. Soil samples were obtained in general accordance with ASTM D 1586 using a standard split-spoon sampler and ASTM D 3550 using an oversized split-spoon sampler. Standard Penetration Test (SPT) driving resistances for each six inch interval of penetration, expressed as "SPT Count" are presented on the boring logs at the respective sampling depths. Samples recovered were described, and classified in the field using ASTM D 2488 (Unified Soil Classification System) as a guide. Representative portions of each sample were packaged and transported to our laboratory for testing.

Excavation of the test pits was accomplished with Caterpillar model 235 excavator. Soil samples recovered from the test pits were identified, described, and classified using ASTM D 2488 as a guide. Representative samples were packaged and transported to our laboratory for testing.

2.2 Laboratory Evaluation

Representative samples were tested in the laboratory to evaluate the pertinent physical and engineering properties of the soils. The following test methods and procedures were utilized:

- ASTM C 117 – Materials Finer No. 200 Sieve in Mineral Aggregates by Washing.
- ASTM C 136 – Sieve Analysis of Fine and Coarse Aggregates.

- ASTM D 2166 – Unconfined Compressive Strength of Cohesive Soils.
- ASTM D2216 – Water Content of Soils
- ASTM D 2435 – One Dimensional Consolidation Properties of Soils.
- ASTM D 2487 – Classification of Soils for Engineering Purposes.
- ASTM D 3080 – Direct Shear Test of Soils Under Consolidated Drained Conditions.
- ASTM D 4318 – Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

Results of the laboratory index tests are presented on the logs of exploration at their respective depth in Appendix C. The laboratory index test results and the strength and deformation test results are also contained in Appendix D.

3.0 SITE CONDITIONS

3.1 Geology

The site lies within the western potion of the Snake River Valley. The surface geology of the site is composed primarily of the Bruneau Formation, which is underlain by the Glenns Ferry Formation. Plutonic and volcanic rocks, which form the flanks of the valley, are buried deep beneath younger materials in the center of this structural depression.

The Bruneau Formation consists of unstratified lacustrian and fluvial deposits from the Quaternary period. These materials range from fine sediments to high energy river gravels and are generally encountered within the upper 100 to150 feet at the site.

The Glenns Ferry Formation consists primarily of lacustrian sediments deposited in Lake Idaho during the late Miocene to the early Pleistocene era. The upper groundwater level at the site is encountered within the Glenns Ferry Formation. This formation is generally encountered at depths below 100 to 150 feet at the site. The Ketterling clay source, located approximately two miles southeast of the site, is a part of the Glenns Ferry Formation. The engineering characteristics of the deep Glenns Ferry sediments at the site have been investigated previously on several occasions. Some of the more notable explorations were conducted by Shannon and Wilson in 1959 and by Conversion Systems in 1983.

Upon review of the available geological publications, no active faults were identified in the vicinity of the project site. No indications of faulting, landslides, or other recent earth movement were observed during our field reconnaissance.

3.2 Subsurface Profile

A subsurface profile was compiled along Section A-A' of Figure 3 and is presented as Figure 4 in Appendix A. The subsurface profile illustrates the logs of exploration relative to the bottom liner along the middle of Cell 16. The following table contains a generalized subsurface profile developed for the Cell 16 area to provide a basis for the discussion of prevailing soil conditions in this area.

Generalized Subsurface Profile for the Proposed Cell 16	
Stratum	**Generalized Description***
I	An alluvial deposit of gravel and sand, silt, and cobbles (GP, GM, SP-SM, SM). These materials range from moderately dense to very dense, yielding typical Standard Penetration Test (SPT) values of 60 to 100 blows per foot. The materials were observed to be relatively dry with weak cementation of particles. The stratum is approximately 40 feet thick (Bruneau River Formation).
II	An alluvial deposit of sand, silty sand and silt (SP, SM, ML) with occasional thin layers of reworked sediments (CL, CH). These materials range from moderately dense to very dense, yielding typical SPT values of 45 to 100 blows per foot. The materials were observed to be relatively dry with weak cementation of particles. The stratum is approximately 50 feet thick (Bruneau River Formation).

*See the logs of exploration (Appendix C) for detailed subsurface information.

3.3 Groundwater

Groundwater levels, as observed in the existing monitor wells at the site, are generally located at elevation 2385 feet to 2442 feet, or a depth of 150 to 200 feet below existing ground surface. Historic records of groundwater monitoring performed by USEI indicate that the groundwater elevations at the site are relatively constant.

3.4 Seismicity

Based upon the 2008 USGS Seismic Hazard Map, the site has a 10% probability of exceedance in a 250-year period for a peak ground acceleration of 0.103 g (See Appendix E). Title 40 Code of Federal Regulations §264.18 requires that all new hazardous waste facility must be located at least 200 feet from a fault which has experienced displacement during the Holocene period. The nearest known fault with Holocene displacement is located approximately 22 miles south of the site at Halfway Gulch.

Pseudostatic analysis should be used to evaluate the effects of seismic events in relation to slope stability. The ground acceleration value of 0.103 g represents the anticipated peak horizontal (K_h) and vertical (K_v) ground accelerations for the site. Analysis performed by Terzaghi (1950) indicated that the peak acceleration should be multiplied by a values ranging between 0.1 and 0.5 to account for the non-rigid response of earthen slopes and embankments. Additional analysis using the Marcuson (1981) and Hynes-Griffin and Franklin (1984) methods suggest that

pseudostatic analysis based on values of one-third to one half of the peak acceleration is appropriate for slope stability considerations. Given the presence of dense silt and sand at the site we have selected a value equal to one-half the peak ground acceleration, thus the slope stability analysis should include the following peak horizontal and vertical coefficients:

$K_h = 0.5 * 0.103 \approx 0.051$ and
$K_v = 0.5 * 0.103 \approx 0.051.$

4.0 STRUCURAL ANALYSIS

4.1 Material Properties

The engineering properties of the subgrade and clay liner materials are defined in this section. The following sections identify the material properties used for analysis in this report and the basis upon which they were selected.

4.1.1 Subgrade and Embankment Materials

The material properties for the subgrade materials at the site were determined from in-situ SPT testing and various laboratory tests identified in Section 2.2 of this report. The generalized subsurface profile is described in Section 3.2 of this report.

Stratum I

Stratum I consists of alluvial deposits of sand, gravel, and cobbles with silt. These materials were observed to be very dense and relatively dry. SPT testing of these materials generally resulted in N-values generally higher than 80 blows per foot. The following properties were used to model the materials for Stratum I.

Moist Unit Weight, γ_{moist}	= 130 pcf
Internal Friction, ϕ	= 36°
Cohesion, C	= 0 psf

Stratum II

Stratum II consists of alluvial silt and sand deposits with intermittent layers of clay. These materials were observed to be very dense and relatively dry with weak cementation of particles. SPT testing of these materials generally resulted in N-values ranging around 50 blows per foot. The following properties were used to model the materials for Stratum II.

Moist Unit Weight, γ_{moist}	= 125 pcf
Internal Friction, ϕ	= 34°
Cohesion, C	= 0 psf

Common Fill

Common fill will be placed for grading purposes within the foundation of the landfill and to construct the perimeter embankments around the landfill. Common fill will also be placed as

frost protection material over the liner system. Common fill will consist of the native materials encountered at the site. Common fill will be placed in controlled lifts and compacted to a density equal to 90 percent of standard proctor (ASTM D 698) or higher. Extensive laboratory testing was performed on the native soils during the 1959 and 1983 geotechnical explorations by Shannon & Wilson, and Conversion Systems, respectively. The following material properties are assumed for properly compacted common fill.

Moist Unit Weight, γ_{moist}	= 125 pcf
Internal Friction, ϕ	= 34°
Cohesion, C	= 0 psf

4.1.2 Clay Liner Materials

Clay liner materials will be obtained from the Ketterling source (Glenns Ferry formation) to construct a low permeability compacted clay liner (CCL). Project specifications require the CCL to be compacted to 95% of standard proctor (ASTM D698) or greater with a moisture content above optimum moisture. Laboratory testing performed, in connection with the 2002 Geotechnical Report, established the engineering properties of the clay liner material as follows.

Moist Unit Weight, γ_{moist}	= 120 pcf
Undrained Strength	
Internal Friction, ϕ	= 0°
Cohesion, C	= 3,000 psf
Drained Strength	
Internal Friction, ϕ	= 34°
Cohesion, C	= 0 psf

4.1.3 Landfill Waste Materials

The waste materials received at the Grand View facility are generally 'soil like' and relatively dense. A significant portion of the waste stream at the site includes kiln dust generated from steel mills. These waste materials become cemented through the stabilization process, resulting in estimated cohesion values between 3,000 to 5,000 psf. Other waste streams generally consist of construction debris and contaminated soils. Organic waste materials are notably absent from

the typical waste stream at the site. Waste stability analysis in the 2002 Engineering Report (WGI) was based upon an internal friction of 30 degrees, a cohesion value of 125 psf and a density of 135 pcf. Recent surveys performed on Cell 15 indicate the average waste density is approximately 115 pcf, however a density of 125 pcf was used for the geotechnical analyses of Cell 16. The following engineering properties were used to model the waste materials.

Moist Unit Weight, γ_{moist}	= 125 pcf
Internal Friction, ϕ	= 30°
Cohesion, C	= 125 psf

4.2 Settlement Analysis

Waste thickness within Cell 16 will be variable up to 140 feet in the deepest location. The thickness of the cover material is assumed to be 3 feet across the crown of the cell. The laboratory consolidation test results, high SPT blow counts, and low natural moisture contents indicate the soils at the site are over-consolidated.

Settlement calculations were based on two known methods to help determine total settlement across Cell 16. Saturated conditions exist below a depth of about 150 feet at the site. Soils above the water table will be subject primarily to elastic strain, whereas the saturated soils, including medium to high plasticity clays will be subject primarily to time-rate consolidation.

4.2.1 Elastic Strain Method

The Perloff method of computing settlement as a function elastic strain (ASCE, 1994) was used to evaluate the immediate settlement for the unsaturated soil strata of Cell 16, assumed to be the upper 150 feet. The foundation geometry and soil parameters used in this analysis accounted for the cell size and reflected our current understanding of the subsurface stratigraphy. The Perloff Method was used herein to estimate settlement near the center of the cell and along the perimeter of the cell. The differential settlement between the center of the cell and perimeter locations were computed and then divided by the horizontal distance to determine differential strain, as presented in the following table.

Settlement Analysis, Elastic Strain – Cell 16			
Cell Location	**Settlement at Location (ft)**	**Differential Settlement from Center (ft)**	**Differential Strain from Center (%)**
Center	3.8	--	--
Middle of Long Side	2.9	0.9	0.20
Middle of Short Side	2.4	1.4	0.11

The greatest differential settlement occurs along the middle of the long side of the cell.

4.2.2 Conventional Consolidation Method

The classical one-dimension consolidation method was used to find the foundation settlement near the center of Cell 16 for soils extending below the water table. This method utilizes the coefficient of compressibility, C_c . The oedometer test method for measuring C_c (ASTM D 2435) requires saturation of the soil sample during the test procedure. This method of analysis also assumes that the load is applied instantaneously rather than gradual placement over a period of multiple years. The consolidation settlement associated with the deep sediments was found near the center of Cell 16 and was estimated to be about 2.5 feet. Due to bridging, soil arching, and non-homogeneity of subsurface materials, two dimensional settlement analysis is generally conservative and tends to overestimate the actual settlement.

4.2.3 Total Settlement

The total estimated settlement for the critical locations within Cell 16 was found by summing the estimated settlement of both the elastic and consolidation models, mentioned previously. The total settlement is shown in the following table.

Total Combined Settlement–Cell 16					
Cell Location	Elastic Settlement Upper Stratum (ft)	Consolidation Settlement Lower Stratum (ft)	Total Settlement (ft)	Differential Settlement from Center (ft)	Differential Strain from Center (%)
Center	3.8	2.5	6.3	--	--
Middle of Long Side	2.9	1.7	4.6	1.7	0.38
Middle of Short Side	2.4	1.5	3.9	2.4	0.18

The maximum estimated settlement near the center of the cell is 6.3 feet, resulting in a maximum differential strain of 0.38%.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 General

Based on the results of our field and laboratory investigations, it is our opinion the site is suitable for the proposed landfill construction. The prevailing subsurface conditions at the USEI Grand View facility are dense and stiff. Notable settlement has not been observed in the preceding landfill units of Cells 5, 14, and 15. The liner systems should be designed to accommodate a potential differential strain up to ½ percent.

5.2 Project Specifications

Requirements for foundation preparation and placement of fill materials are outlined in the current earthwork specification (Section 02200) for Cell 16. American Geotechnics will perform a review the project specifications for Cell 16 and will issue revisions to these specifications, as appropriate, to conform to the findings of this investigation.

6.0 CLOSURE

6.1 Limitations

Recommendations contained in this report are based on our field explorations, laboratory tests, previous boring information and our understanding of the proposed construction. The study was performed using a mutually agreed upon scope of work. It is our opinion that this study was a cost-effective method to evaluate the subject site and evaluate some of the potential geotechnical concerns. More detailed, focused, and/or thorough investigations can be conducted. Further studies will tend to increase the level of assurance; however, such efforts will result in increased costs. If the Client wishes to reduce the uncertainties beyond the level associated with this study, American Geotechnics should be contacted for additional consultation.

The soils data used in the preparation of this report were obtained from the field explorations made for this investigation. It is possible that variations in soils exist between the points explored. The nature and extent of soil variations may not be evident until construction occurs. If any soil conditions are encountered at this site that differ from those described in this report, our firm should be immediately notified so that we may make any necessary revisions to our recommendations.

The recommendations made in this report are based on the assumption that an adequate program of testing, observation, and engineering consultation will be made during construction to verify compliance with the report findings and recommendations. This should include, but not necessarily be limited to, observations and testing described within this report, and engineering consultation as may be required during construction. These observation and testing items are critical with regards to the conclusions and recommendations provided in this report. If these items are not adequately performed during construction, then the Client agrees to assume American Geotechnics' responsibility for any potential claims that may arise during or after construction.

The report has been prepared for specific application to this project in accordance with the generally accepted standards of practice at the time the report was written. No warranty, express or implied, is made.

This report may be used only by the Client and for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on- and off-site), or other factors including advances in man's understanding of applied science may change over time and could materially affect our findings.

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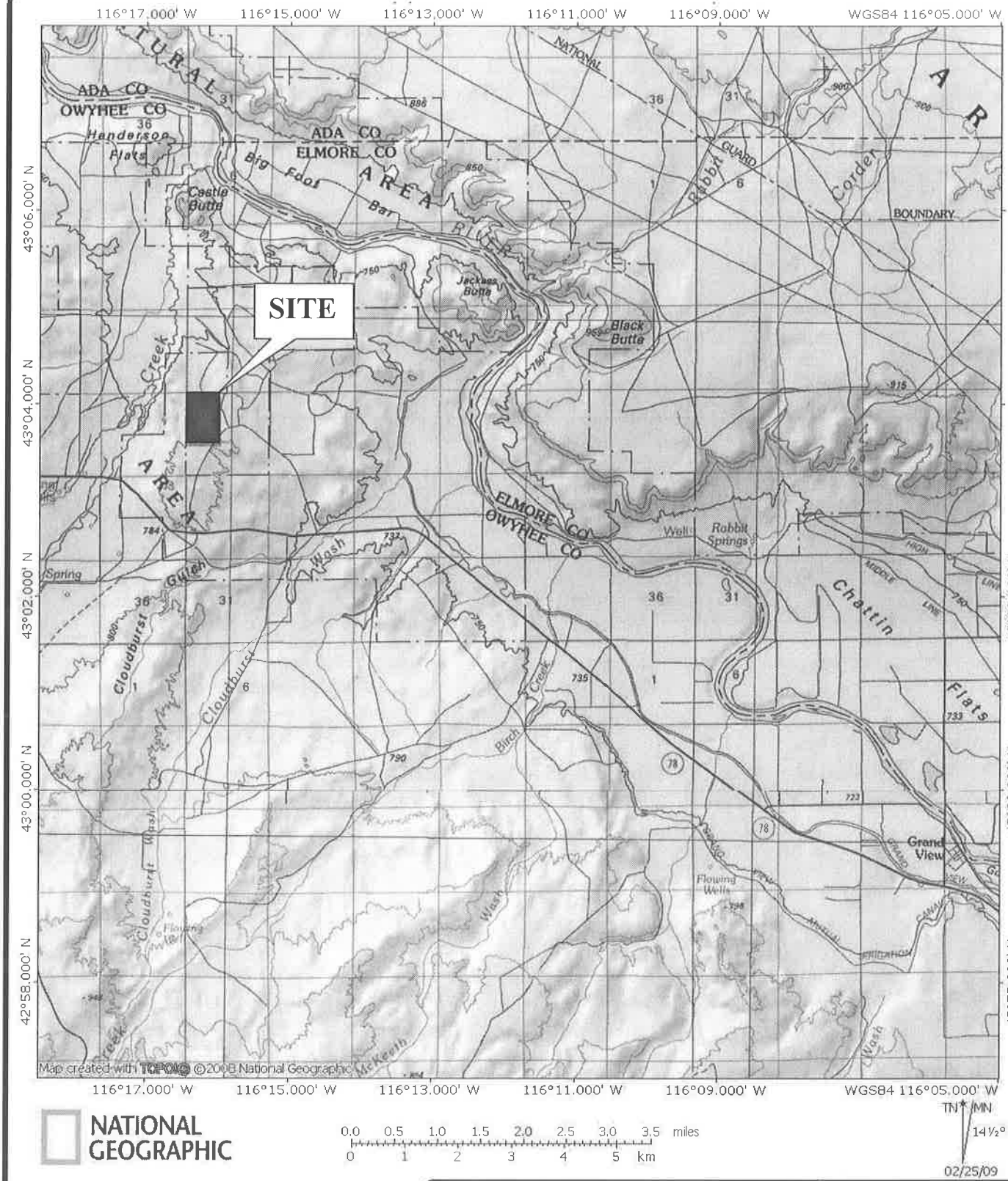
APPENDIX A

FIGURES



VICINITY MAP

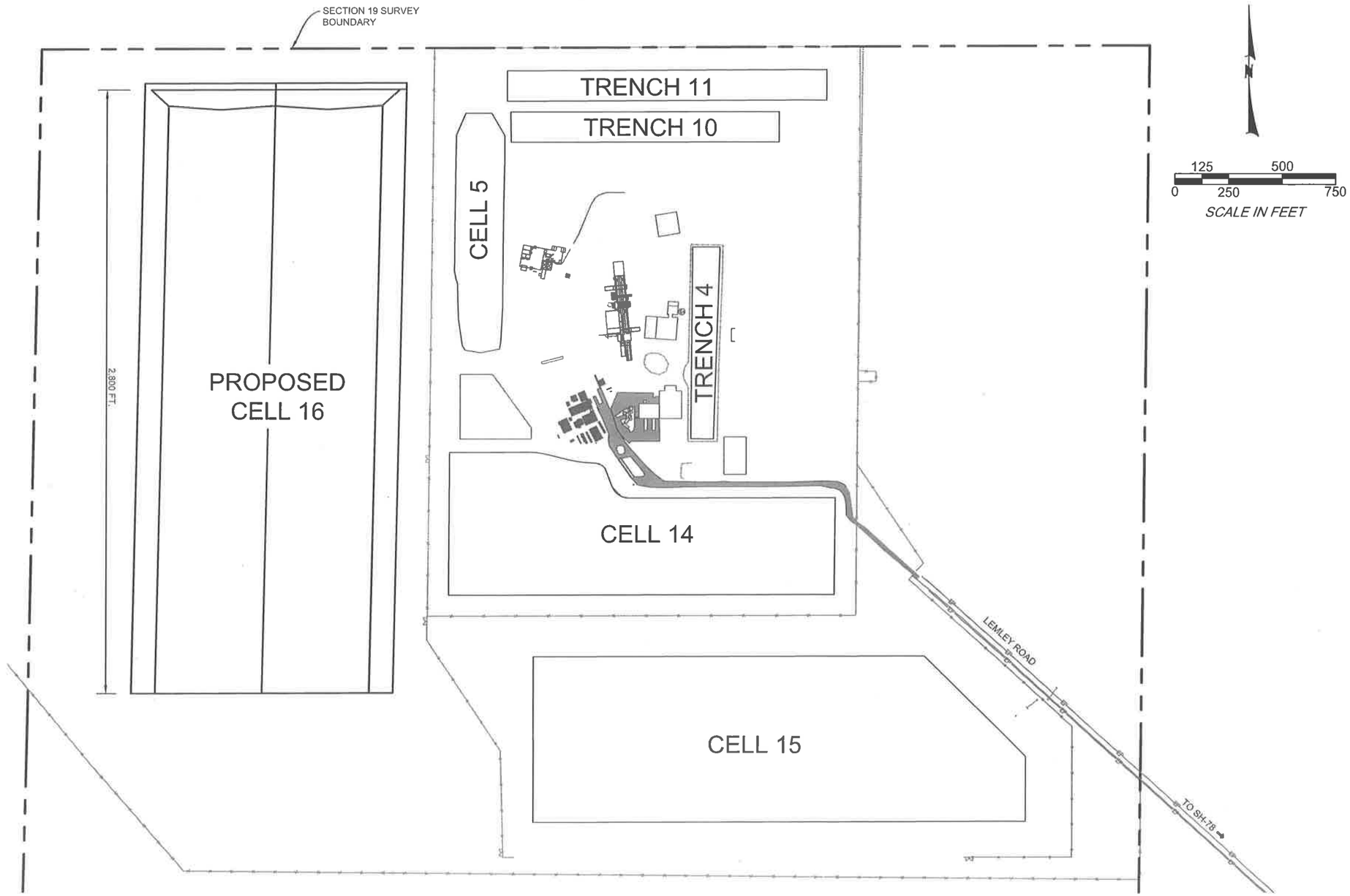
U.S. Ecology Idaho, Cell 16
Grand View, Idaho

Project No.
07B-G1654

March, 2009

Figure 1

AMERICAN GEOTECHNICS



Site Facility Map
U.S. Ecology Idaho, Cell 16 Landfill
Grand View, Idaho

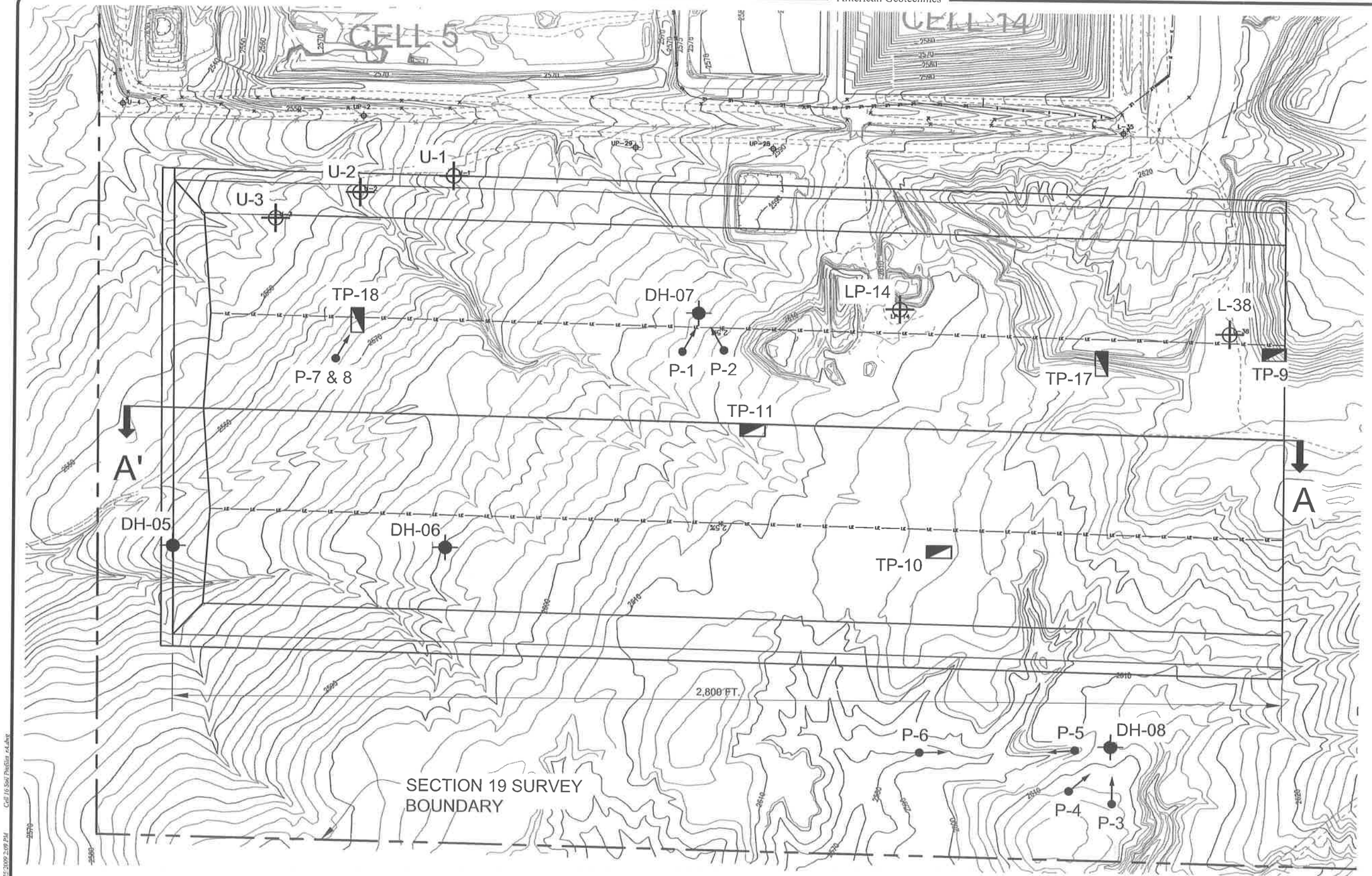
FIGURE 2

Project No.
07B-G1654

March, 2009

AMERICAN GEO TECHNICS

Justin Stoffel, American Geotechnics, Inc. 2/25/2009 2:09 PM Cell 16 Soil Profiles -4.dwg



62.5 250
0 125 375
SCALE IN FEET

LEGEND

TP-1 GEOTECHNICAL TEST PIT

B-1 GEOTECHNICAL BORING LOCATION

GROUNDWATER MONITOR WELL LOCATION

P-1 PHOTO LOCATION AND DIRECTION

Exploration Map
U.S. Ecology Idaho, Cell 16 Landfill
Grand View, Idaho

Project No. 07B-G1654

March, 2009

FIGURE 3

AMERICAN GEOTECHNICS

Justin Sniffin, American Geotechnics, Inc. 2/24/2009 2:09 PM Cell 16 Soil Profiles v4.dwg

A

A'

TP-9 EL. 2644
L-38 EL. 2634
NGE (3/6/08)
DH-08 EL. 2608
N = 4
N > 80
N > 80
N > 80
N > 80
N = 48
N = 54
N = 51
N = 46
N = 59
N = 61
N = 53
N = 69
N = 43
N = 49
N* = 52
N = 38
N* = 54
N = 40
N = 31
N* = 72
NGE (3/7/08)
TP-17 EL. 2614
NGE (3/7/08)
TP-10 EL. 2616
NGE (3/6/08)
LP-14 EL. 2608
APPROXIMATE EXISTING GRADE
APPROXIMATE TOP OF LINER ELEVATION ALONG CENTER OF CELL
TP-11 EL. 2604
NGE (3/6/08)
DH-07 EL. 2594
N = 19
N = 30
N = 64
N > 80
N > 80
N > 80
N > 80
N = 56
N = 50
N = 60
N = 71
N = 50
N* = 57
NGE (3/7/08)
DH-06 EL. 2591
N = 1
N = 40
N = 50
N > 80
N = 68
N > 80
N > 80
N > 80
N = 70
N = 57
N > 80
N* = 59
N > 80
N* > 80
N > 80
N > 80
NGE (3/3/08)
U-1 EL. 2568
TP-18 EL. 2564
NGE (3/7/08)
U-2 EL. 2554
U-3 EL. 2549
DH-05 EL. 2565
N = 47
N = 49
N = 69
N > 80
N = 71
N > 80
N > 80
N > 80
N = 77
N = 75
N > 80
N > 80
N = 72
N > 80
N > 80
N > 80
N > 80
N > 80
N* > 62
NGE (3/5/08)
GE at EL. 2442' (11/26/84)
GE at EL. 2418.4' (2/13/85)
GE at EL. 2384.9' (9/11/85)
GE at EL. 2389.5' (8/7/89)
GE at EL. 2391.9' (11/13/87)

2650
2625
2600
2575
2550
2525
2500
2475
2450

ELEVATION IN FEET

508500
509000
509500
510000
510500
511000
511500

NORTHING IN FEET

LEGEND

- Poorly Graded Gravel (GP)
- Poorly Graded Gravel with Silt (GP-GM)
- Silty Gravel (GM)
- Poorly Graded Sand (SP)
- Poorly Graded Sand with Gravel (SP)
- Poorly Graded Sand with Silt (SP-SM)
- Silty Sand (SM)
- Clayey Sand (SC)
- Silt (ML)
- Lean CLay (CL)
- Silty Clay (CL-ML)
- Silty Clay with Gravel (CL-ML)

GE Groundwater Encountered
NGE No Groundwater Encountered
N SPT Count (Blows Per Foot)
N* Corrected SPT Count (Blows Per Foot)

VERTICAL EXAGERATION = 10

Subsurface Profile-Section A-A'

U.S. Ecology Idaho, Cell 16 Landfill
Grandview, Idaho

Project No. 07B-G1654

March, 2009

FIGURE 4

AMERICAN GEOTECHNICS

Cell 16 Soil Profiles .dwg
3/25/2009 2:09 PM
Justin Stoffel, American Geotechnics, Inc.

APPENDIX B

SITE PHOTOS

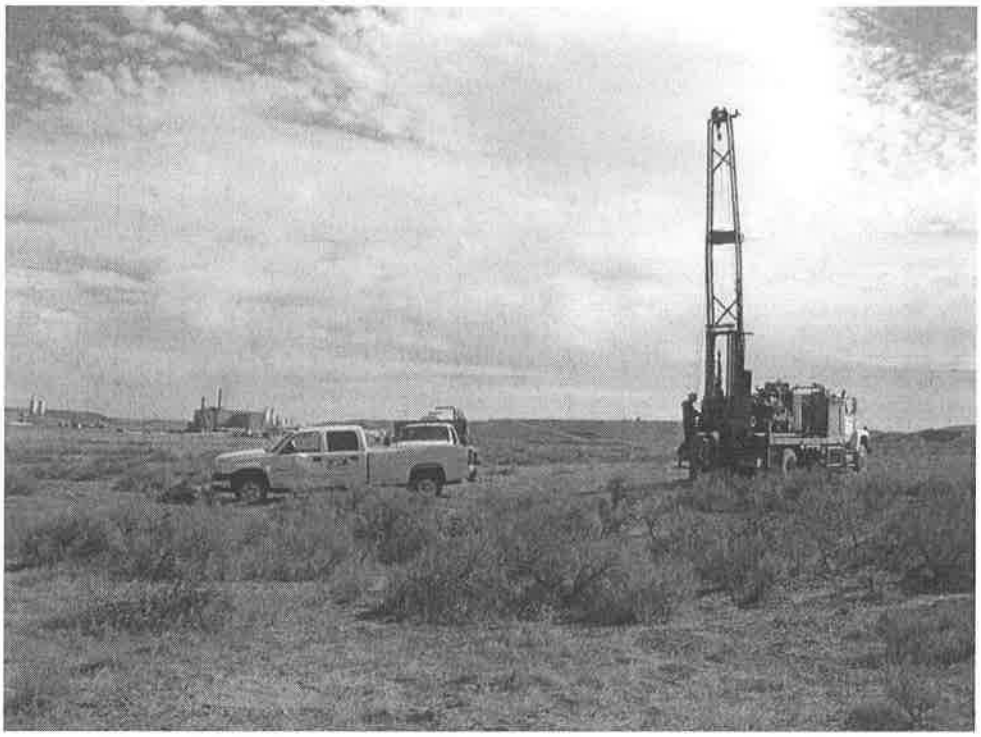


Photo – 1 View of drill rig setup on DH-07, looking east towards Cell 14.

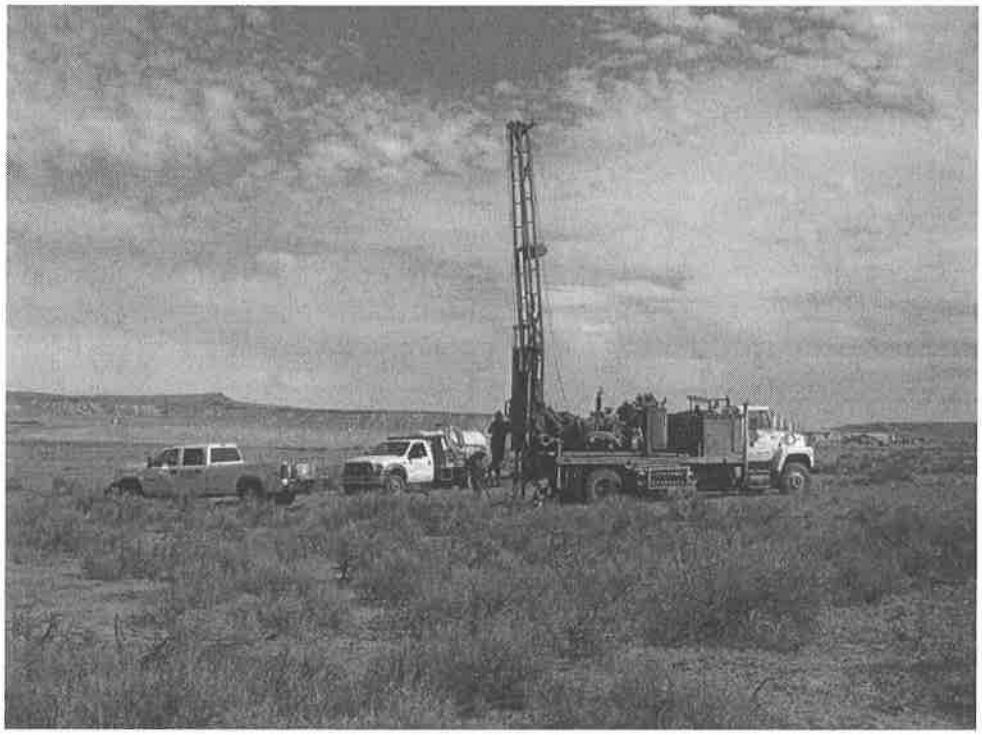


Photo – 2 View of drill rig setup on DH-07, looking northeast towards Cell 5.

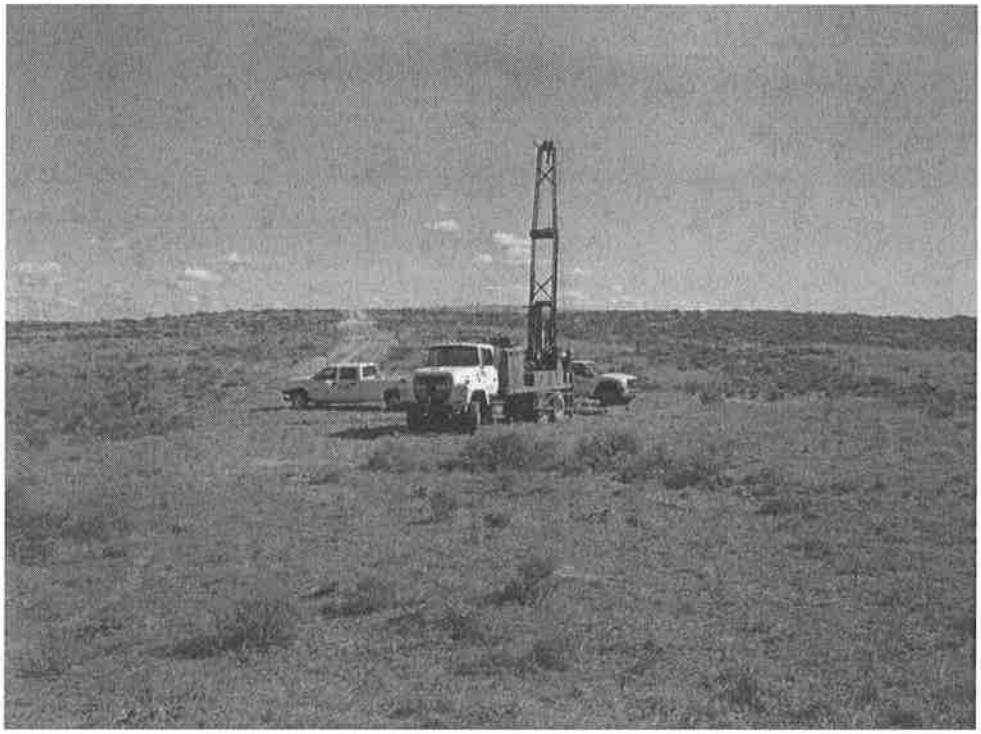


Photo – 3 View of drill rig setup on DH-08, looking east towards future Cell 16 footprint.

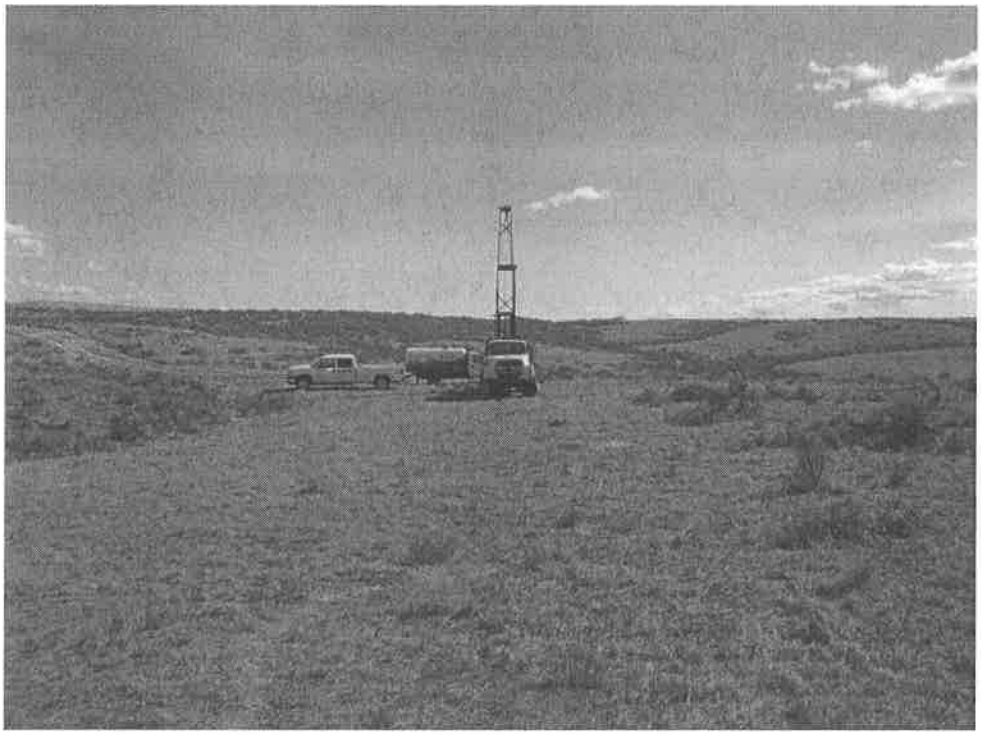


Photo – 4 View of drill rig setup on DH-08, looking south.

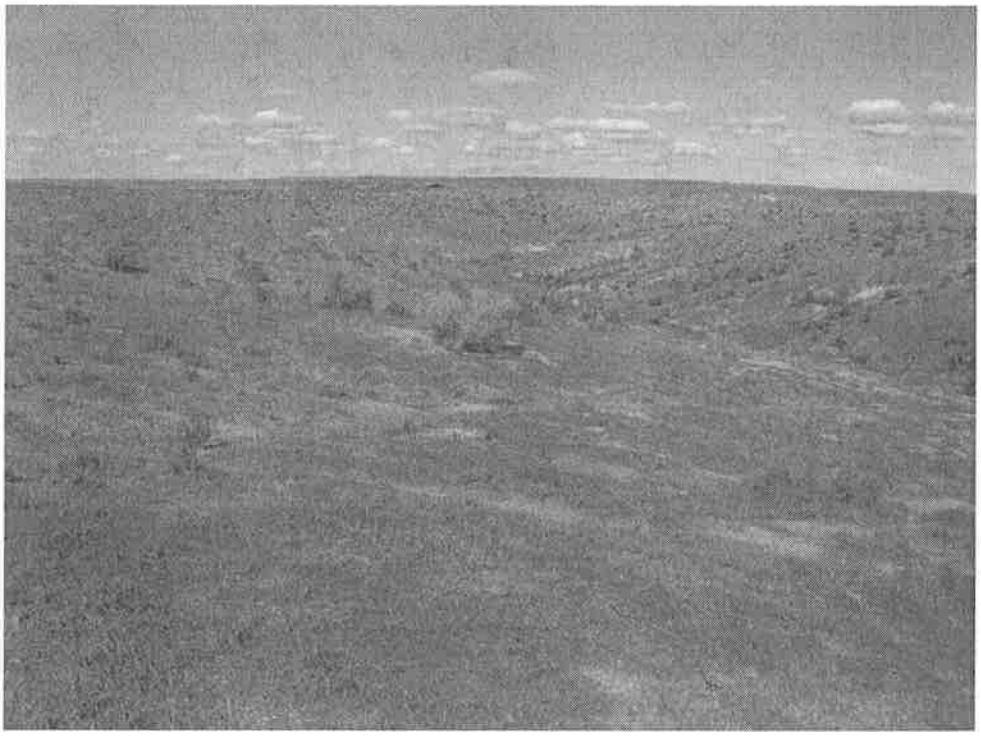


Photo – 5 View from DH-08, looking north along adjacent ravine.

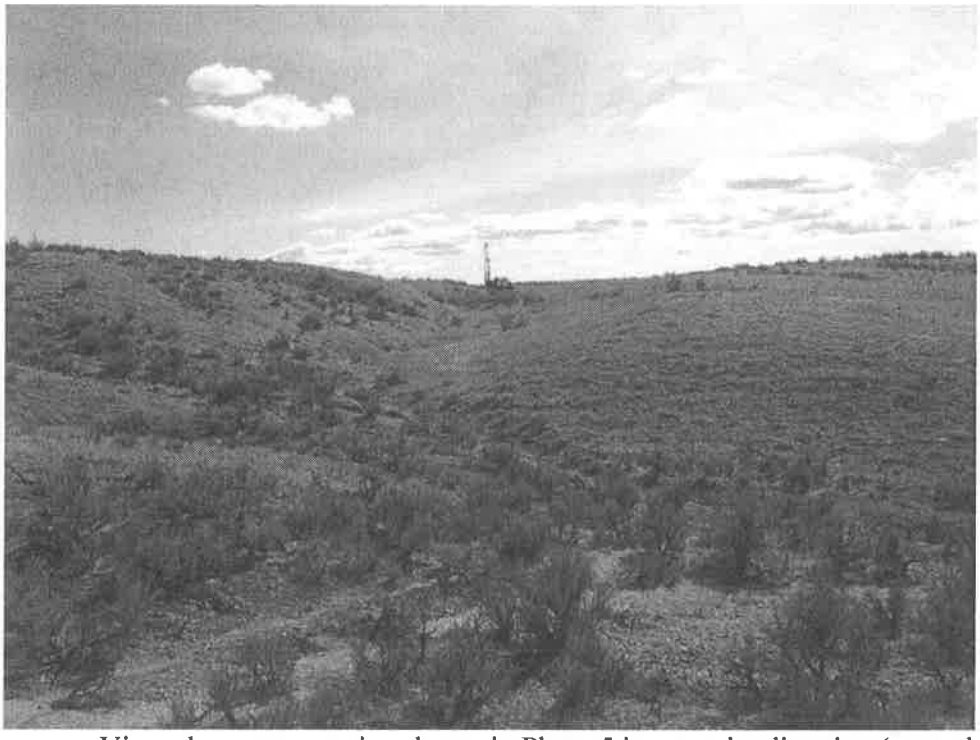


Photo – 6 View along same ravine shown in Photo 5 in opposite direction (towards DH-08).

Photo – 7 View of test pit excavation at TP-18, looking southeast towards treatment facilities.

Photo – 8 View of sand and gravel materials encountered in TP-18.

APPENDIX C

LOGS OF EXPLORATION

PROJECT: USEI Geotechnical Investigation
LOCATION: Grandview, Idaho
ELEVATION: 2,564.9

NORTHING: 511,304.9
EASTING: 360,810.3

DATE: March 5, 2008
LOGGED BY: Vaughn Thurgood
DRILLING METHOD: Hollow stem auger

WATER LEVEL: None encountered on 3/5/08

BORING LOG NO. DH-05

AMERICAN GEO TECHNICS

DEPTH (ft.)	SAMPLE TYPE - No.	SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS (Stratification lines represent approx. boundaries between materials.)
0	SS-34	1-4-13		Sandy Silt (ML)- About 70% non-plastic fines; about 30% fine sand; moist; light brown.	
2				Poorly Graded Gravel with Sand and Cobbles (GP)- About 60% fine to coarse, hard, subrounded gravel; about 35% fine to coarse, subangular sand; dry; light brown.	
4					
6	SS-35	5-13-27			
8					
10	SS-36	25-29-40			
12					Change of materials near 13 feet.
14					
16	SS-37	28-40-50/5"		Poorly Graded Sand (SP-SM)- About 80% fine to coarse, hard, subangular sand; about 10% fine, subrounded gravel; about 10% non-plastic fines; moist to dry; light brown-gray.	
18					
20	SS-38	18-30-41		Silty Sand (SM)- 75% fine to coarse, hard, subangular sand; 25% non-plastic fines; dry, ω=6%; light brown-gray.	
22					
24					
26	SS-39	21-40-46			
28					
30	SS-40	24-40-50/6"		Silty Sand (SM)- About 85% fine to coarse, hard, subangular sand; about 15%	

PROJECT: USEI Geotechnical Investigation
LOCATION: Grandview, Idaho

DATE: March 5, 2008
WATER LEVEL: None encountered on 3/5/08

BORING LOG NO. DH-05

AMERICAN GEO TECHNICS

DEPTH (ft.)	SAMPLE TYPE - No.	SAMPLE SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS
32				non-plastic fines; dry; light brown-gray.	
34					
36	SS-41	16-36-50/6"			Occasional thin layers of fat clay, less than 2" thick with PP=2.5 tsf.
38					
40	SS-42	27-49-50/5"			
42					
44					
46	SS-43	27-50/6"			
48					
50	SS-44	25-50/6"			
52					
54					
56	SS-45	29-48-43			Occasional thin layers of fat clay, less than 1" thick.
58					
60	SS-46	22-48-50/4"			
62					
64					

PROJECT: USEI Geotechnical Investigation
LOCATION: Grandview, Idaho

DATE: March 5, 2008
WATER LEVEL: None encountered on 3/5/08

BORING LOG NO. DH-05

AMERICAN GEO TECHNICS

DEPTH (ft.)	SAMPLE TYPE - No.	SAMPLE SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS
66	SS-47	22-50/6"			
68					
70	SS-48	26-50/5"			
72					
74					
76	SS-49	21-40-50/4"			
78					
80	SS-50	22-49-50/4"			
82					
84					
86	SS-51	14-40-50/4"		Sandy Silt (ML)- 62% non-plastic fines; 38% fine sand; stiff; moist, ω=21%; light brown.	Pocket penetrometer = 3.0, 3.2, 3.5 tsf. Occasional thin layers of sand.
88					
90	SS-52	7-14-50/5"			Pocket penetrometer = 3.1, 3.2, 3.5 tsf.
92				Silty Sand (SM)- About 65% fine sand; about 45% low to no plasticity fines; moist; light brown.	Occasional thin layers of sand.
94					
96	OSS-53	12-30-60		Lean Clay (CL)- 95% fines, LL=48, PI=23; 5% fine sand; stiff; moist, ω=29%; light brown.	Sampler broke off during recovery, augered beyond without pilot bit to retrieve sample.

PROJECT: USEI Geotechnical Investigation
LOCATION: Grandview, Idaho

DATE: March 5, 2008
WATER LEVEL: None encountered on 3/5/08

BORING LOG NO. DH-05

AMERICAN GEO TECHNICS

DEPTH (ft.)	SAMPLE TYPE - No.	SAMPLE SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS
98				Poorly Graded Sand (SP)- About 95% fine sand; about 5% fines; dry; light brown- gray. Bottom of hole at 97.5 feet.	No groundwater encountered on 3/5 08.
100					
102					
104					
106					
108					
110					
112					
114					
116					
118					
120					
122					
124					
126					
128					
130					

PROJECT: USEI Geotechnical Investigation
LOCATION: Grandview, Idaho
ELEVATION: 2,590.7

NORTHING: 510,464.7
EASTING: 360,874.2

BORING LOG NO. DH-06

AMERICAN GEO TECHNICS

DATE: March 3, 2008
LOGGED BY: Vaughn Thurgood
DRILLING METHOD: Hollow stem auger

WATER LEVEL: None encountered on 3/3/08

DEPTH (ft.)	SAMPLE TYPE - No.	SAMPLE SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS (Stratification lines represent approx. boundaries between materials.)
0	SS-18	1-0-1		Sandy Silt (ML)- About 70% non-plastic fines; about 30% fine sand; moist; light brown.	Evidence of ground disturbance from burrowing animals (ground squirels) observed near the ground surface.
2					
4					
6	OSS-19	9-16-24		Silty Sand (SM)- 55% fine sand; 45% non-plastic fines; dry, ω=9%; light brown.	Oversized sampler used. Occasional weak cementation of particles.
8					Trace of gravel encountered near 8 feet.
10	SS-20	9-18-32		Poorly Graded Sand with Silt (SP-SM)- About 90% fine to medium sand; about 10% non-plastic fines; dry; light brown-gray.	
12					Contact with gravel near 12.5 feet.
14					
16	SS-21	50/3"		Poorly Graded Gravel with Sand and Cobbles (GP)- About 60% fine to coarse, hard, subrounded gravel; about 35% fine to coarse, subangular sand; dry; light brown.	
18					
20	SS-22	29-34-34			
22					
24					
26	SS-23	50/6"			
28					
30	SS-24	50/3"			

PROJECT: USEI Geotechnical Investigation
LOCATION: Grandview, Idaho

DATE: March 3, 2008
WATER LEVEL: None encountered on 3/3/08

BORING LOG NO. DH-06

AMERICAN GEO TECHNICS

DEPTH (ft.)	SAMPLE TYPE - No.	SAMPLE SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS
32					
34					
	SS-25	50/3"			
36					
38					
40	SS-26	24-37-33		Poorly Graded Gravel with Sand (GP)- About 50% fine to coarse, hard, subrounded gravel; about 45% fine to coarse, subangular sand; dry; light brown.	Driller indicates occasional pockets of sand encountered.
42					
44					
46	SS-27	22-19-38		Clayey Sand (SC)- About 55% fine sand; about 45% low plasticity fines; stiff; moist; light brown.	
48					Change of materials near 48 feet.
50	SS-28	24-47-50/5"		Silty Sand (SM)- About 85% fine to medium sand; about 15% non-plastic fines; moist; light gray.	
52					
54					
56	OSS-29	16-39-46			Oversized sampler used.
58					
60	SS-30	28-43-48			
62					
64					

PROJECT: USEI Geotechnical Investigation
LOCATION: Grandview, Idaho

DATE: March 3, 2008
WATER LEVEL: None encountered on 3/3/08

BORING LOG NO. DH-06

AMERICAN GEO TECHNICS

DEPTH (ft.)	SAMPLE TYPE - No.	SAMPLE SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS
66	OSS-31	9-39-75/5"		Lean Clay (CL)- 65% fines, LL=34, PI=13; 35% fine sand; stiff; moist, ω=18%; light brown-yellow.	Oversized sampler used. Pocket penetrometer > 4 tsf.
68				Silty Sand (SM)- About 85% fine to medium sand; about 15% non-plastic fines; moist; light gray.	Driller notes intermittent layers of clay and sand.
70				Lean Clay (CL)-	
72	SS-32	20-42-50/6"		Silty Sand (SM)- About 85% fine to medium sand; about 15% non-plastic fines; moist; light gray.	
74					
76	OSS-33	21-58-67		Lean Clay (CH)- 99% fines, LL= 41, PI=19; 1% fine sand; stiff; moist, ω=23%; light brown.	Oversized sampler used. Sampler broke off during recovery, augered beyond without pilot bit to retrieve sample.
78				Bottom of hole at 78 feet.	No groundwater encountered on 3/3/ 08.
80					
82					
84					
86					
88					
90					
92					
94					
96					

PROJECT: USEI Geotechnical Investigation
LOCATION: Grandview, Idaho
ELEVATION: 2,593.9

NORTHING: 509,954.4
EASTING: 361,428.7

DATE: March 7, 2008
LOGGED BY: Vaughn Thurgood
DRILLING METHOD: Hollow stem auger

WATER LEVEL: None encountered on 3/7/08

BORING LOG NO. DH-07

AMERICAN GEO TECHNICS

DEPTH (ft.)	SAMPLE TYPE - No.	SAMPLE SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS (Stratification lines represent approx. boundaries between materials.)
0	SS-76	1-4-15		Sandy Silt (ML)- About 60% non-plastic fines; about 40% fine sand; moist; light brown.	
2				Poorly Graded Gravel with Sand and Cobbles (GP)- About 60% fine to coarse, hard, subrounded gravel; about 35% fine to coarse, subangular sand; dry; light brown.	
4					
6	SS-77	14-16-14		Poorly Graded Sand with Gravel (SP-SM)- About 75% fine to coarse sand; about 15% fine gravel; about 10% non-plastic fines; dry; light brown-yellow.	
8					Return to gravel near 8.5 feet.
10	SS-78	13-26-39		Poorly Graded Gravel with Sand and Cobbles (GP)- About 60% fine to coarse, hard, subrounded gravel; about 35% fine to coarse, subangular sand; dry; light brown.	
12					
14					
16	SS-79	22-46-50/4"			
18					
20	SS-80	49-50/4"			
22					
24					
26	SS-81	50/4"			Change of material near 26.5 feet.
28					
30	SS-82	17-40-50/5"		Silty Sand (SM)- About 80% fine sand; about 20% non-plastic fines; moist; light	

PROJECT: USEI Geotechnical Investigation
LOCATION: Grandview, Idaho

BORING LOG NO. DH-07

DATE: March 7, 2008
WATER LEVEL: None encountered on 3/7/08

AMERICAN GEO TECHNICS

DEPTH (ft.)	SAMPLE TYPE - No.	SAMPLE SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS
32				brown-yellow.	
34					
36	SS-83	20-26-27		Silty Sand (SM)- About 85% fine to medium sand; about 15% non-plastic fines; moist; light gray.	
38					
40	SS-84	14-22-28			
42					
44					
46	SS-85	21-30-30			
48					
50	SS-86	17-32-39		Silty Sand (SM)- About 70% fine sand; about 30% low plasticity fines; stiff; moist; light brown-yellow.	
52					
54					
56	SS-87	22-25-25		Lean Clay (CL)- About 95% fines; about 5% fine sand; hard; moist; light brown-yellow.	Pocket penetrometer = 3.0, 3.2, 4.0 tsf.
58				Silty Sand (SM)- About 85% fine to medium sand; about 15% non-plastic fines; moist; light brown.	
60	OSS-88	21-33-49			Oversized sampler used.
62				Bottom of hole at 61.5 feet.	No groundwater encountered on 3/7/ 08.
64					

PROJECT: USEI Geotechnical Investigation
LOCATION: Grandview, Idaho
ELEVATION: 2,608.3

NORTHING: 508,947.4
EASTING: 360,338.7

DATE: March 6-7, 2008
LOGGED BY: Vaughn Thurgood
DRILLING METHOD: Hollow stem auger

WATER LEVEL: None encountered on 3/7/08

BORING LOG NO. DH-08

AMERICAN GEO TECHNICS

DEPTH (ft.)	SAMPLE TYPE - No.	SAMPLE SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS (Stratification lines represent approx. boundaries between materials.)
0	SS-55	1-1-3		Sandy Silt (ML)- 64% non-plastic fines; 36% fine sand; soft; moist, ω=9%; brown.	
2					Contact with gravel at 2 feet.
4					
6	SS-56	27-48-50/6"		Poorly Graded Gravel with Silt, Sand and Cobbles (GP-GM)- About 60% fine to coarse, hard, subrounded gravel; about 30% fine to coarse sand; about 10% fines; moist; light brown.	
8					
10	SS-57	27-39-50/5"			
12					
14					
	SS-58	50/4"			
16					
18					
20	SS-59	50/4"			
22					Change of materials near 21.5 feet.
24					
26	SS-60	12-21-27		Silty Sand (SM)- About 85% fine to medium sand; about 15% non-plastic fines; moist; light brown-gray.	
28					
30	SS-61	13-22-32			

PROJECT: USEI Geotechnical Investigation
LOCATION: Grandview, Idaho

DATE: March 6-7, 2008
WATER LEVEL: None encountered on 3/7/08

BORING LOG NO. DH-08

AMERICAN GEO TECHNICS

DEPTH (ft.)	SAMPLE TYPE - No.	SAMPLE SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS
32					
34					
36	SS-62	14-22-29		Silty Sand (SM)- 82% fine to medium sand; 18% non-plastic fines; dry, ω=5%; light brown-gray.	
38					
40	SS-63	13-21-25			
42					
44					
46	SS-64	13-25-34			Occasional thin layer of clay, less than 1" thick.
48					
50	SS-65	15-26-35			
52					
54					
56	SS-66	16-24-29			Occasional thin layer of clay, less than 1" thick
58					
60	SS-67	16-31-38			Occasional thin layer of clay, less than 1" thick
62					
64					

PROJECT: USEI Geotechnical Investigation
LOCATION: Grandview, Idaho

DATE: March 6-7, 2008
WATER LEVEL: None encountered on 3/7/08

BORING LOG NO. DH-08

AMERICAN GEO TECHNICS

DEPTH (ft.)	SAMPLE TYPE - No.	SAMPLE SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS
66	SS-68	14-22-21			
68					Trace of gravel near 69 feet.
70	SS-69	13-19-30		Silty Sand (SM)- About 75% fine sand; about 25% low plasticity fines; stiff; moist; light brown-yellow.	
72					
74					
76	OSS-70	20-35-41		Lean Clay (CL)- 88% fines, LL=42, PI=20; 12% fine sand; stiff; moist, ω=24%; light brown-yellow.	Oversized sampler used.
78					
80	SS-71	6-10-28		Lean Clay (CL)- 89% fines, LL=38, PI=16; 11% fine sand; stiff; moist, ω=22%; light brown.	Pocket penetrometer = 3.0, 3.5 tsf.
82					
84					
86	OSS-72	17-34-44		Lean Clay (CL)- 97% fines, LL=47, PI=25; 3% fine sand; stiff; moist, ω=25%; light brown.	Oversized sampler used.
				Silty Sand (SM)-	
88				Lean Clay (CL)- About 90% medium plasticity fines; about 10 fine sand; moist; stiff; light brown.	
90				Silty Sand (SM)-	
	SS-73	18-22-18		Lean Clay (CL)-	Pocket penetrometer = 3.0, 3.2 tsf.
92				Silty Sand (SM)- About 85% fine to medium sand; about 15% non-plastic fines; moist; light brown.	
94					
				Sandy Lean Clay (CL)-	Pocket penetrometer = 3.0, 3.4 tsf.
96	SS-74	10-15-16		Silty Sand (SM)- About 85% fine to medium sand; about 15% non-plastic fines; moist; light brown.	

PROJECT: USEI Geotechnical Investigation
LOCATION: Grandview, Idaho

DATE: March 6-7, 2008
WATER LEVEL: None encountered on 3/7/08

BORING LOG NO. DH-08

AMERICAN GEO TECHNICS

DEPTH (ft.)	SAMPLE TYPE - No.	SAMPLE SPT COUNT (blows/6-in.)	SYMBOL	DESCRIPTION	REMARKS
98					
100	OSS-75	16-30-74		Lean Clay (CL)- 97% fines, LL=46, PI=24; 3% fine sand; stiff; moist, ω=24%; light brown.	Oversized sampler used.
102				Silty Sand (SM)- Bottom of hole at 101.5 feet	No groundwater encountered on 3/7/ 08.
104					
106					
108					
110					
112					
114					
116					
118					
120					
122					
124					
126					
128					
130					

PROJECT: USEI Cell 16
LOCATION: Grandview, Idaho
ELEVATION: 2,644 est.

NORTHING: 508,534 est.
EASTING: 361,318 est.

LOGGED BY: Vaughn Thurgood
EXCAVATION EQUIPMENT: CAT 235 Excavator
DATE OF EXCAVATION: March 6, 2008

WATER LEVEL: None encountered on 3/6/08

TEST PIT LOG: TP-9

AMERICAN GEO TECHNICS

DEPTH (feet)	SAMPLE TYPE - No.	SAMPLE SYMBOL	DESCRIPTION	NOTES (Stratification lines represent approximate boundaries between materials.)
0 – 6	BK		Poorly Graded Sand with Gravel (SP)- About 80% fine to medium sand; about 15% fine to coarse subrounded gravel to 3"; about 5% fines; trace of subrounded cobbles to 4"; moist; light brown-gray.	Test pit located on shoulder of stockpile materials excavated from Cell 14.
6			Bottom of hole at 6 feet.	

0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 5.5, 6, 6.5, 7, 7.5, 8, 8.5, 9, 9.5, 10, 10.5, 11, 11.5

PROJECT: USEI Cell 16
LOCATION: Grandview, Idaho
ELEVATION: 2,616 est.

NORTHING: 509,362 est.
EASTING: 360,811 est.

LOGGED BY: Vaughn Thurgood
EXCAVATION EQUIPMENT: CAT 235 Excavator
DATE OF EXCAVATION: March 6, 2008

WATER LEVEL: None encountered on 3/6/08

TEST PIT LOG: TP-10

AMERICAN GEO TECHNICS

DEPTH (feet)	SAMPLE TYPE - No.	SAMPLE SYMBOL	DESCRIPTION	NOTES (Stratification lines represent approximate boundaries between materials.)
0 – 1.5	BK		Sandy Silt (ML)- About 70% non-plastic fines; about 30% fine sand; moist; light brown.	
1.5 – 4	BK		Silty Sand with Gravel (SM)- About 40% fine to coarse sand; about 30% non-plastic fines; about 30% fine to coarse, subrounded gravel to 2"; dry; light brown.	
4 – 8			Poorly Graded Gravel with Sand and Cobbles (GP)- About 60% fine to coarse, subrounded gravel to 3"; about 35% fine to coarse, sand; about 5% fines; by volume about 10% hard, subrounded cobbles to 6"; dry; light brown.	
8			Bottom of hole at 8 feet.	

PROJECT: USEI Cell 16
LOCATION: Grandview, Idaho
ELEVATION: 2,604 est.

NORTHING: 509,848 est.
EASTING: 361,121 est.

LOGGED BY: Vaughn Thurgood
EXCAVATION EQUIPMENT: CAT 235 Excavator
DATE OF EXCAVATION: March 6, 2008

WATER LEVEL: None encountered on 3/6/08

TEST PIT LOG: TP-11

AMERICAN GEO TECHNICS

DEPTH (feet)	SAMPLE TYPE - No.	SAMPLE SYMBOL	DESCRIPTION	NOTES (Stratification lines represent approximate boundaries between materials.)
0 – 5	BK		Sandy Silt (ML)- About 60% non-plastic fines; about 30% fine sand; about 10% fine to coarse subrounded gravel to 3"; trace of cobbles to 4"; moist; light brown.	
5 – 7.5			Poorly Graded Gravel with Sand and Cobbles (GP)- About 65% fine to coarse, subrounded gravel to 3"; about 30% fine to coarse, sand; about 5% fines; by volume about 10% hard, subrounded cobbles to 5"; moist; light brown.	
7.5			Bottom of hole at 7.5 feet.	

0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 6 6.5 7 7.5 8 8.5 9 9.5 10 10.5 11 11.5

PROJECT: USEI Cell 16
LOCATION: Grandview, Idaho
ELEVATION: 2,614 est.

NORTHING: 509,154 est.
EASTING: 361,409 est.

TEST PIT LOG: TP-17

AMERICAN GEO TECHNICS

LOGGED BY: Vaughn Thurgood
EXCAVATION EQUIPMENT: CAT 235 Excavator
DATE OF EXCAVATION: March 7, 2008

WATER LEVEL: None encountered on 3/7/08

DEPTH (feet)	SAMPLE TYPE - No.	SAMPLE SYMBOL	DESCRIPTION	NOTES (Stratification lines represent approximate boundaries between materials.)
0 – 2			Sandy Silt (ML)- About 70% non-plastic fines; about 30% fine sand; moist; light brown.	
2 – 11.5			Poorly Graded Gravel with Sand and Cobbles (GP)- About 65% fine to coarse, subrounded gravel to 3"; about 30% fine to coarse, sand; about 5% fines; by volume about 10% hard, subrounded cobbles to 6"; moist; light brown.	Occasional sand layers, less than 12 inches thick.

PROJECT: USEI Cell 16
LOCATION: Grandview, Idaho

DATE OF EXCAVATION: March 7, 2008
WATER LEVEL: None encountered on 3/7/08

TEST PIT LOG: TP-17

AMERICAN GEO TECHNICS

DEPTH (feet)	SAMPLE TYPE - No.	SAMPLE SYMBOL	DESCRIPTION	NOTES
12 – 24			Bottom of hole at 18 feet.	

PROJECT: USEI Cell 16
LOCATION: Grandview, Idaho
ELEVATION: 2,564 est.

NORTHING: 510,838 est.
EASTING: 361,423 est.

LOGGED BY: Vaughn Thurgood
EXCAVATION EQUIPMENT: CAT 235 Excavator
DATE OF EXCAVATION: March 7, 2008

WATER LEVEL: None encountered on 3/7/08

TEST PIT LOG: TP-18

AMERICAN GEO TECHNICS

DEPTH (feet)	SAMPLE TYPE - No.	SAMPLE SYMBOL	DESCRIPTION	NOTES (Stratification lines represent approximate boundaries between materials.)
0 – 1			Sandy Silt (ML)- About 70% non-plastic fines; about 30% fine sand; moist; light brown.	
1 – 5.5			Poorly Graded Gravel with Sand and Cobbles (GP)- About 65% fine to coarse, subrounded gravel to 3"; about 30% fine to coarse, sand; about 5% fines; by volume about 5% hard, subrounded cobbles to 4"; moist; light brown.	
5.5 – 9			Poorly Graded Sand (SP)- About 95% fine to medium sand; about 5% fines; moist; ligh brown.	
9 – 11.5			Poorly Graded Gravel with Sand and Cobbles (GP)- About 65% fine to coarse, subrounded gravel to 3"; about 30% fine to coarse, sand; about 5% fines; by volume about 10% hard, subrounded cobbles to 6"; moist; light brown.	

PROJECT: USEI Cell 16
LOCATION: Grandview, Idaho

DATE OF EXCAVATION: March 7, 2008
WATER LEVEL: None encountered on 3/7/08

TEST PIT LOG: TP-18

AMERICAN GEO TECHNICS

DEPTH (feet)	SAMPLE TYPE - No.	SAMPLE SYMBOL	DESCRIPTION	NOTES
12 – 17				
17			Bottom of hole at 17 feet.	
17.5 – 24				

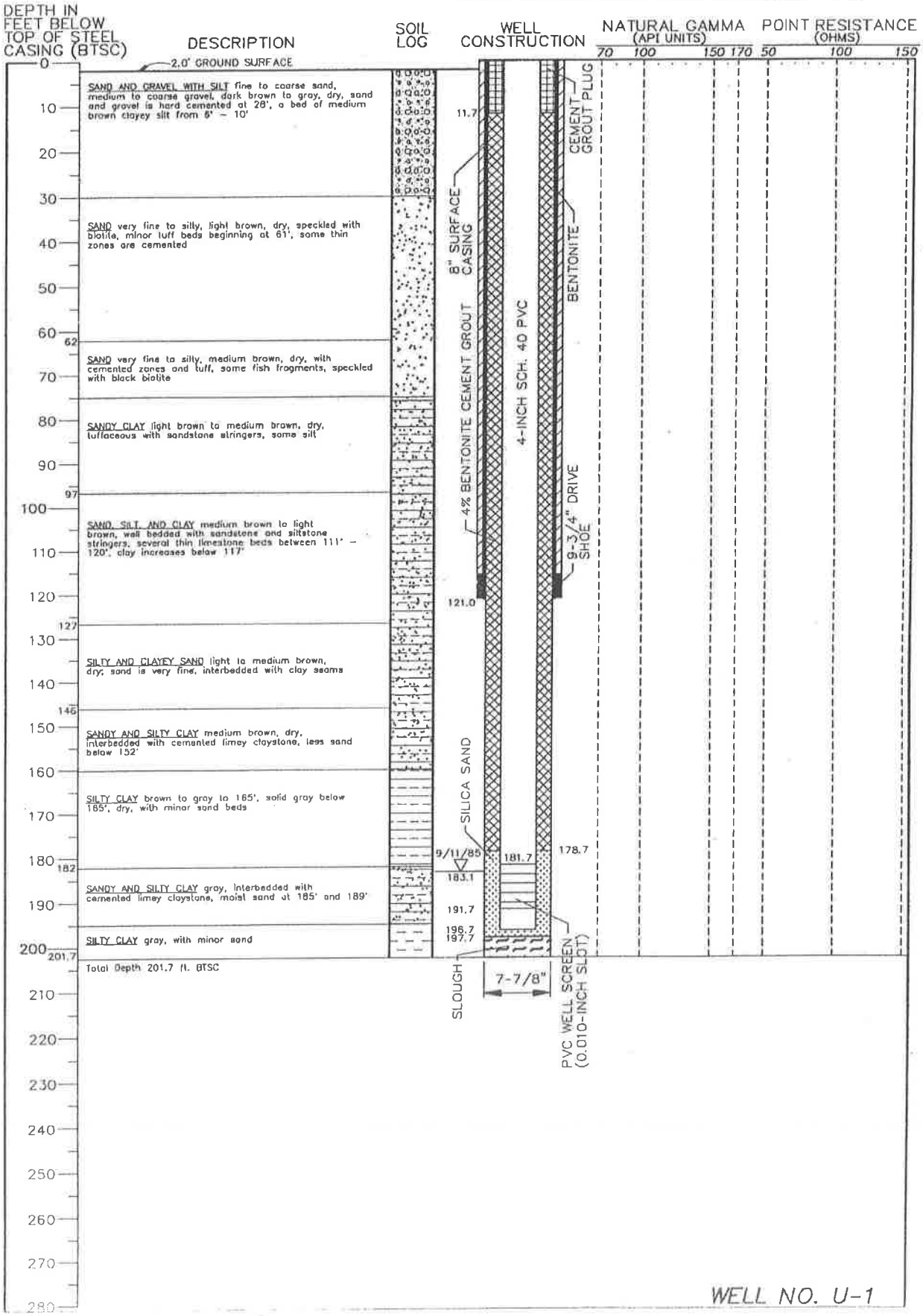
MONITORING WELL SOIL AND GEOPHYSICAL LOG

PROJECT NAME: ESII SITE B PROJECT NO.: 142505.A1

WELL NO: U-1 SEC.: 19 T.: 4S R.: 2E NORTH: 510,611 EAST: 361,754

TOP OF STEEL CASING ELEVATION: 2568.03 DATE(S) DRILLED: 8/15/85 TO 8/19/85

DATE DEVELOPMENT COMPLETED: -



WELL NO. U-1

29-Sep-1997 U-1.DWG

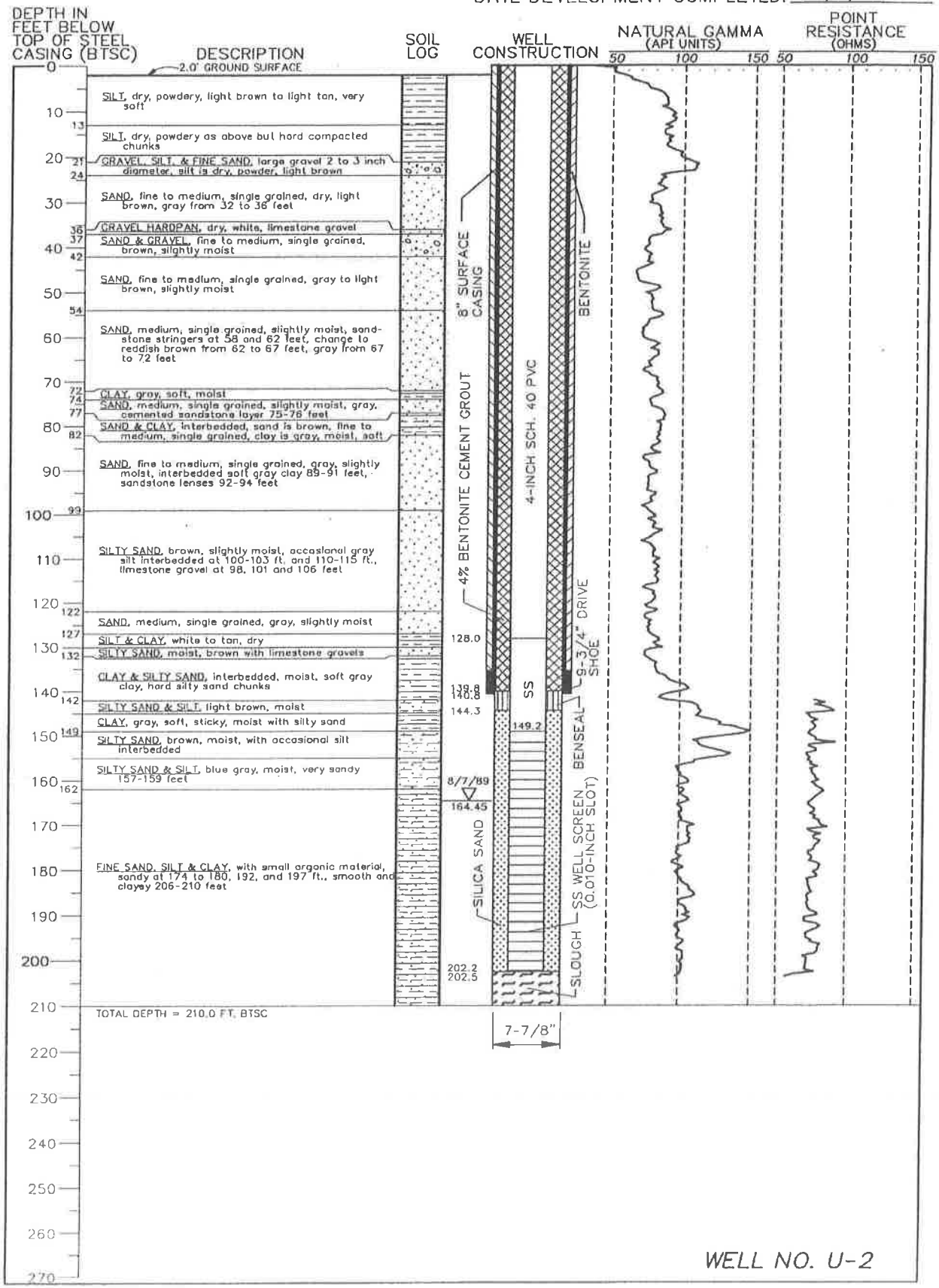
MONITORING WELL SOIL AND GEOPHYSICAL LOG

PROJECT NAME: ESII SITE B PROJECT NO.: 142505.A1

WELL NO: U-2 SEC.: 19 T.: 4S R.: 2E NORTH: 510,845.2 EAST: 361,711.5

TOP OF STEEL CASING ELEVATION: 2553.83 DATE(S) DRILLED: 7/28/89 TO 8/2/89

DATE DEVELOPMENT COMPLETED: 9/5/89



U-2.DWG

WELL NO. U-2

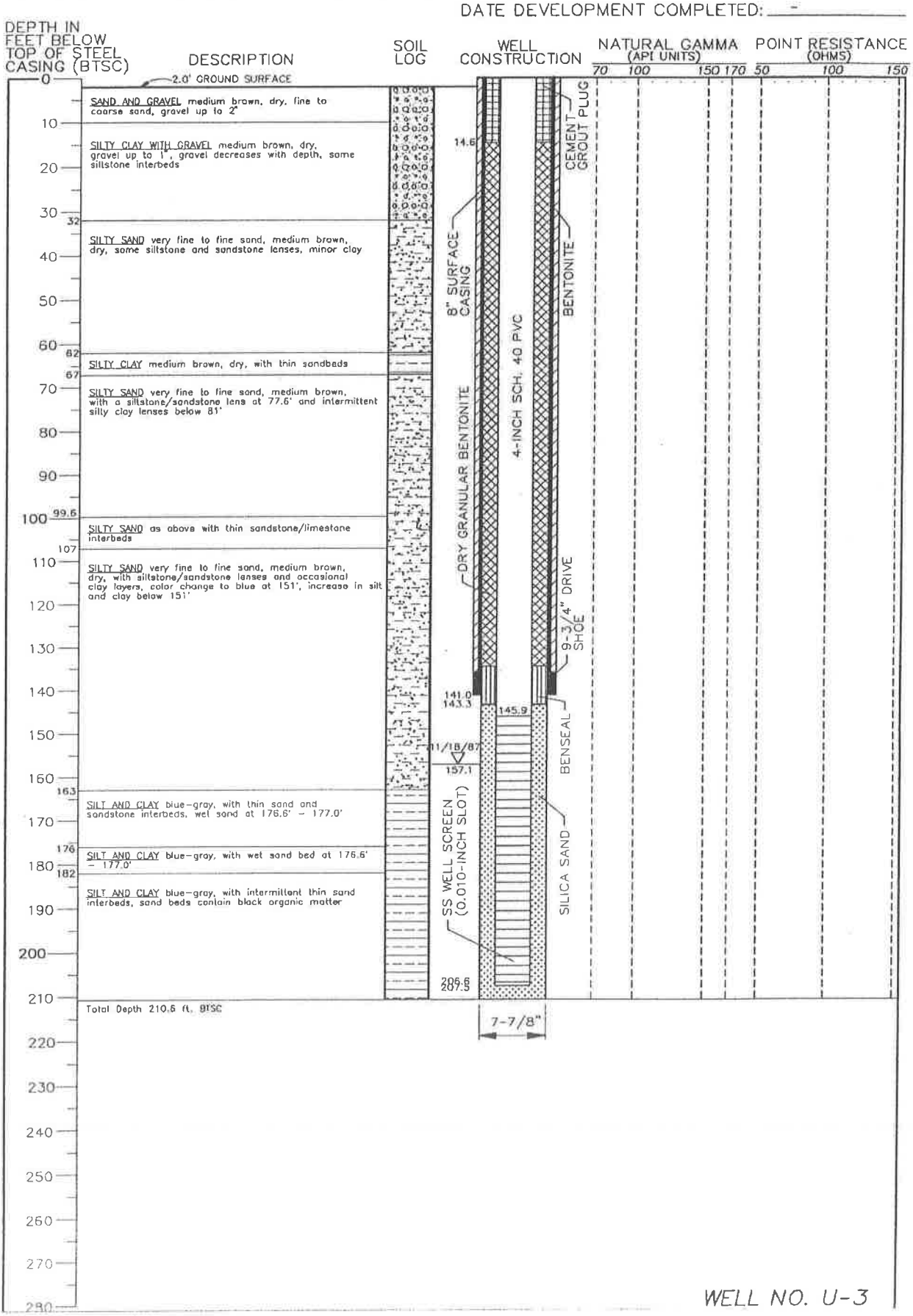
MONITORING WELL SOIL AND GEOPHYSICAL LOG

PROJECT NAME: ESII SITE B PROJECT NO.: 142505.A1

WELL NO: U-3 SEC.: 19 T.: 4S R.: 2E NORTH: 511,058 EAST: 361,645

TOP OF STEEL CASING ELEVATION: 2549.23 DATE(S) DRILLED: 11/16/87 TO 11/18/87

DATE DEVELOPMENT COMPLETED: -



24-Sep-1997 U-3.DWG

WELL NO. U-3

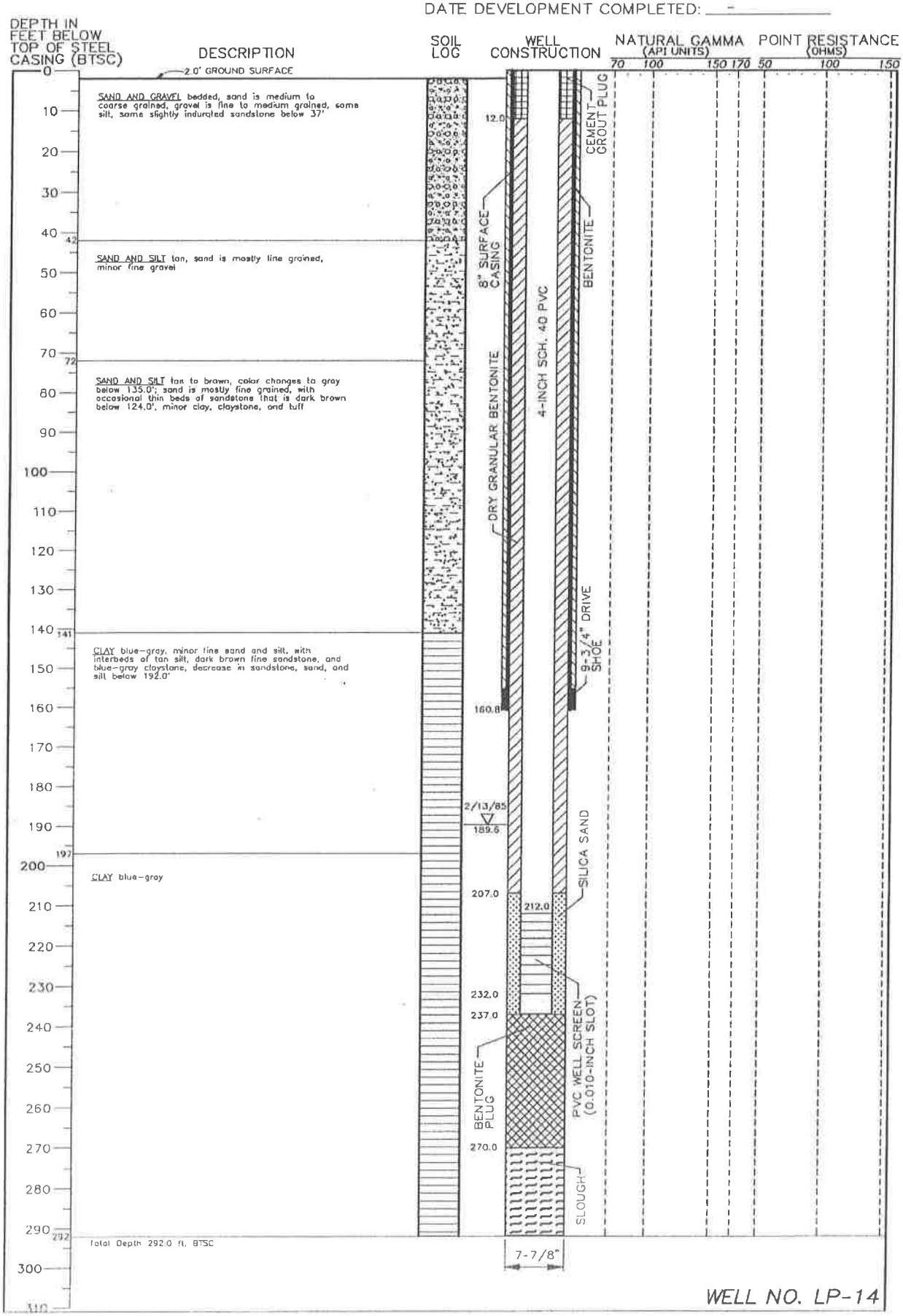
MONITORING WELL SOIL AND GEOPHYSICAL LOG

PROJECT NAME: ESII SITE B PROJECT NO.: 142505.A1

WELL NO: LP-14 SEC.: 19 T.: 4S R.: 2E NORTH: 509,484 EAST: 361,428

TOP OF STEEL CASING ELEVATION: 2608.07 DATE(S) DRILLED: 10/3/84 TO 10/5/84

DATE DEVELOPMENT COMPLETED: -



WELL NO. LP-14

08-Oct-1997 LP-14.DWG

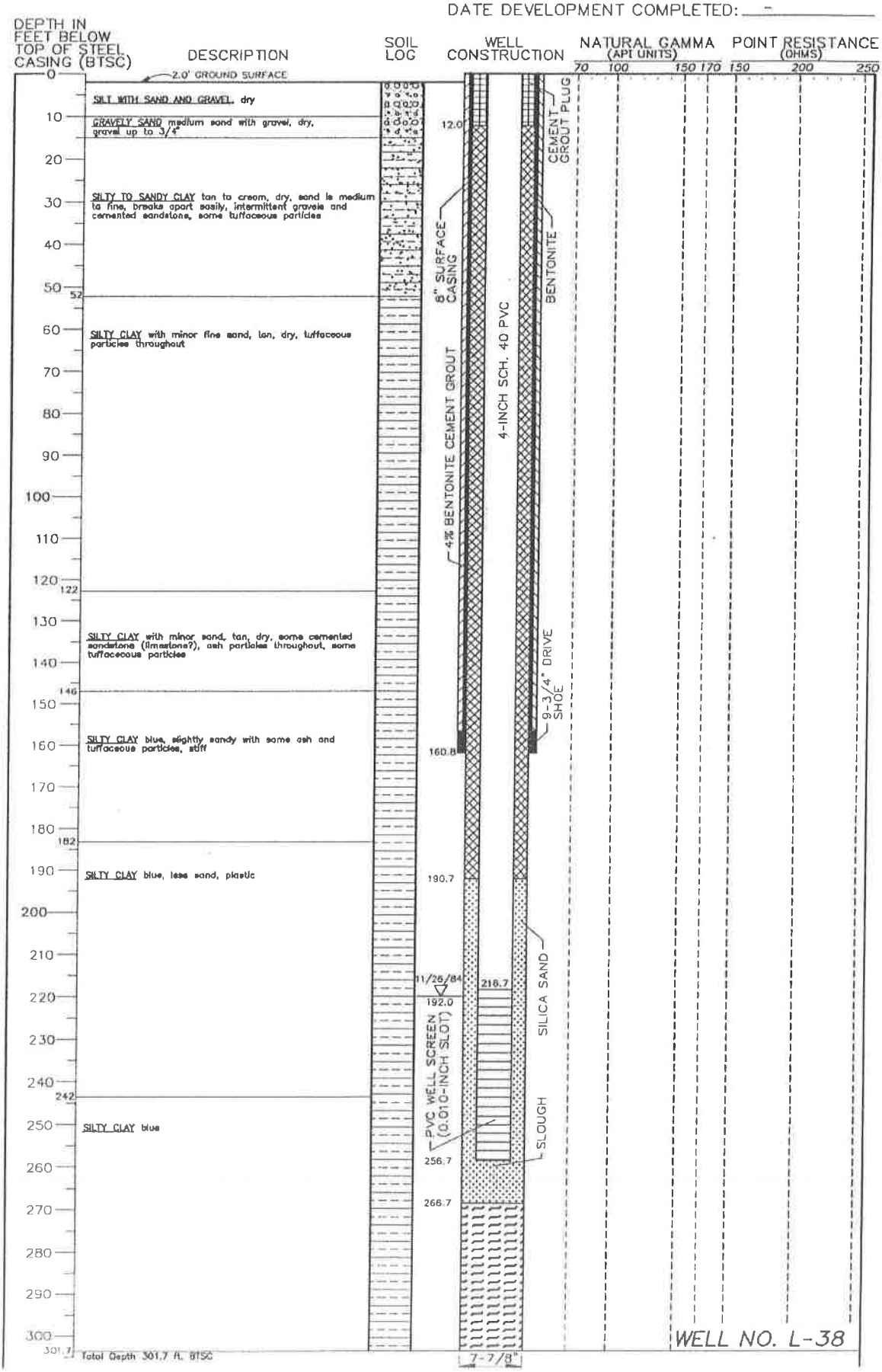
MONITORING WELL SOIL AND GEOPHYSICAL LOG

PROJECT NAME: ESII SITE B PROJECT NO.: 142505.A1

WELL NO: L-38 SEC.: 19 T.: 4S R.: 2E NORTH: 508,653 EAST: 361,373

TOP OF STEEL CASING ELEVATION: 2633.84 DATE(S) DRILLED: 10/01/84 TO 10/03/84

DATE DEVELOPMENT COMPLETED: -



APPENDIX D

LABORATORY TEST RESULTS

American Geotechnics
5260 Chinden Blvd.
Boise, Idaho 83714
Phone:(208) 658-8700
Fax: (208) 658-8703

Report to: US Ecology
Project: Cell 15 & Cell 16 Design
Report Date: 5/9/08
Project No.: 07B-G1653

Material Information

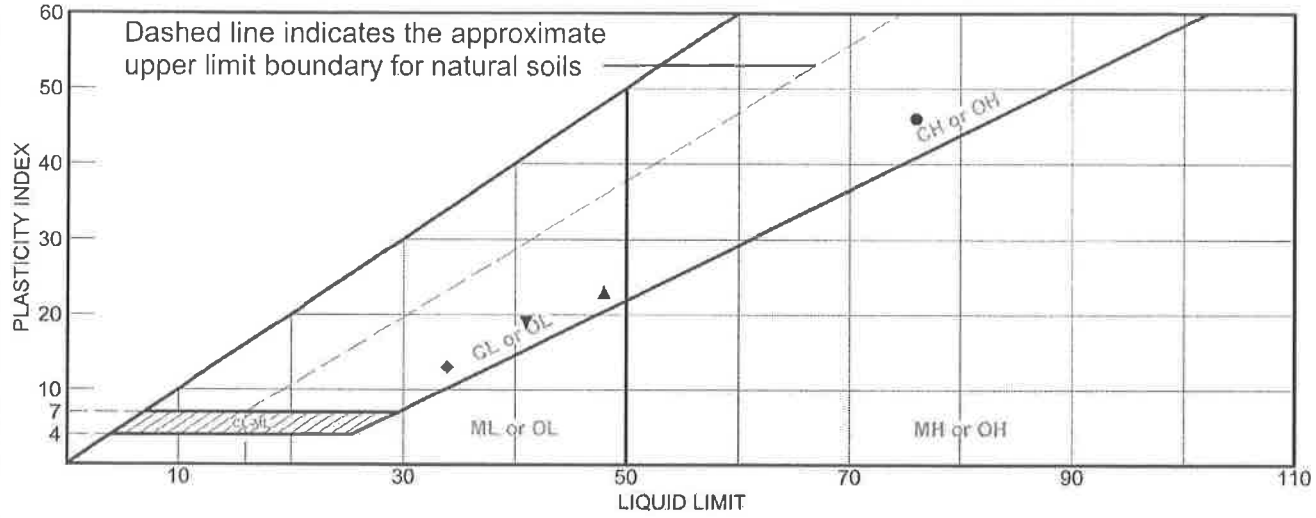
Date Sampled: 3/7/08
Sampled By: American Geotechnics
Date Received: 3/10/08
Date Tested: 3/11 thru 4/10/08

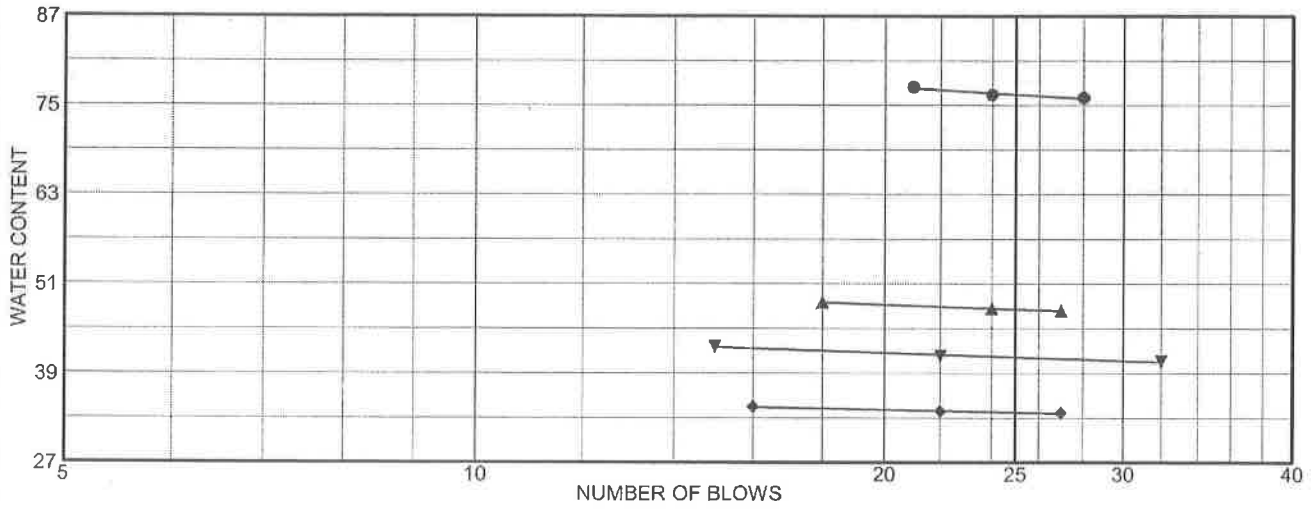
Test Results

Lab Number	Sample ID	Depth	% Natural Moisture	% Passing #200	Liquid Limit	Plastic Index	Soil Type
08-0219	DH-04, SS-4	15.0'	12.4	92.4	39	9	ML
08-0220	DH-04, SS-5	20.0'	12.6	99.1	41	12	ML
08-0221	DH-04, SS-7	30.0'	5.7	66.1	26	4	ML
08-0222	DH-04, SS-11	50.0'	27.6	99.6	84	56	CH
08-0223	DH-04, OSS-12	55.0'	29.3	94.0	90	78	CH
08-0224	DH-04, OSS-14	65.0'	31.2	96.9	76	46	CH
08-0225	DH-05, SS-38	20.0'	6.0	24.9	---	---	SM
08-0226	DH-05, SS-51	85.0'	21.2	62.0	NV	NP	ML
08-0227	DH-05, OSS-53	95.0'	28.7	94.7	48	23	CL
08-0228	DH-06, OSS-19	5.0'	9.3	44.8	---	---	SM
08-0229	DH-06, SS-22	20.0'	2.3	7.2	---	---	SW-SM
08-0230	DH-06, OSS-31	65.0'	17.6	64.7	34	13	CL
08-0231	DH-06, BK-33A	76.0'	23.2	98.9	41	19	CL
08-0232	DH-07, SS-78	10.0'	2.1	5.4	---	---	SP-SM
08-0233	DH-07, SS-87	55.0'	25.7	95.0	---	---	CL
08-0234	DH-08, SS-55	0.0'	9.4	63.8	---	---	ML
08-0235	DH-08, SS-56	5.0'	2.4	11.6	---	---	SP-SM
08-0236	DH-08, SS-62	35'	4.9	17.6	---	---	SM
08-0237	DH-08, OSS-70	75'	24.4	88.2	42	20	CL
08-0238	DH-08, SS-71	80'	22.4	89.2	38	16	CL
08-0239	DH-08, OSS-72	85'	25.1	97.1	47	25	CL
08-0240	DH-08, OSS-75	100'	24.3	97.3	46	24	CL

Reviewed By: _____

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Fat Clay (CH)	76	30	46	100	97	CH
■	Sandy Silt (ML)	NV	NP	NP	78	62	ML
▲	Lean Clay (CL)	48	25	23	100	95	CL
◆	Sandy Lean Clay (CL)	34	21	13	79	65	CL
▼	Lean CLay (CL)	41	22	19	100	99	CL

Project No. 07B-G1653 **Client:** US Ecology of Idaho

Project: Cell 15 & Cell 16 Design

Cell 15 & Cell 16 Design

● **Location:** DH-04 OSS-14; 65'

■ **Location:** DH-05 SS-51; 85'

▲ **Location:** DH-05 OSS-53; 95'

◆ **Location:** DH-06 OSS-31; 65'

▼ **Location:** DH-06 BK-33a; 76'

AMERICAN GEOTECHNICS

Boise, ID

Remarks:

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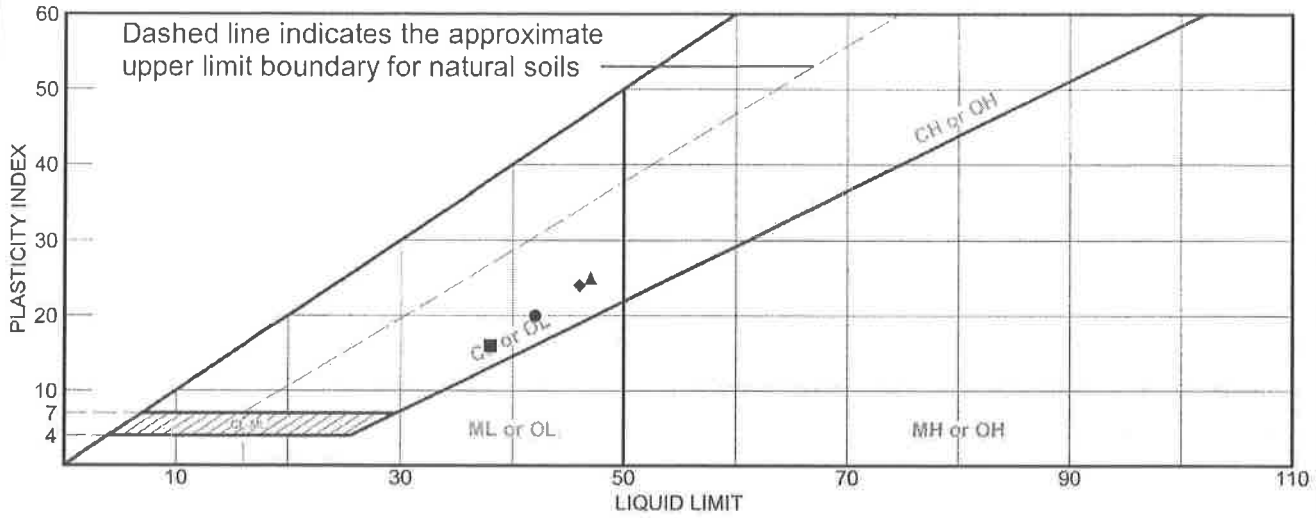
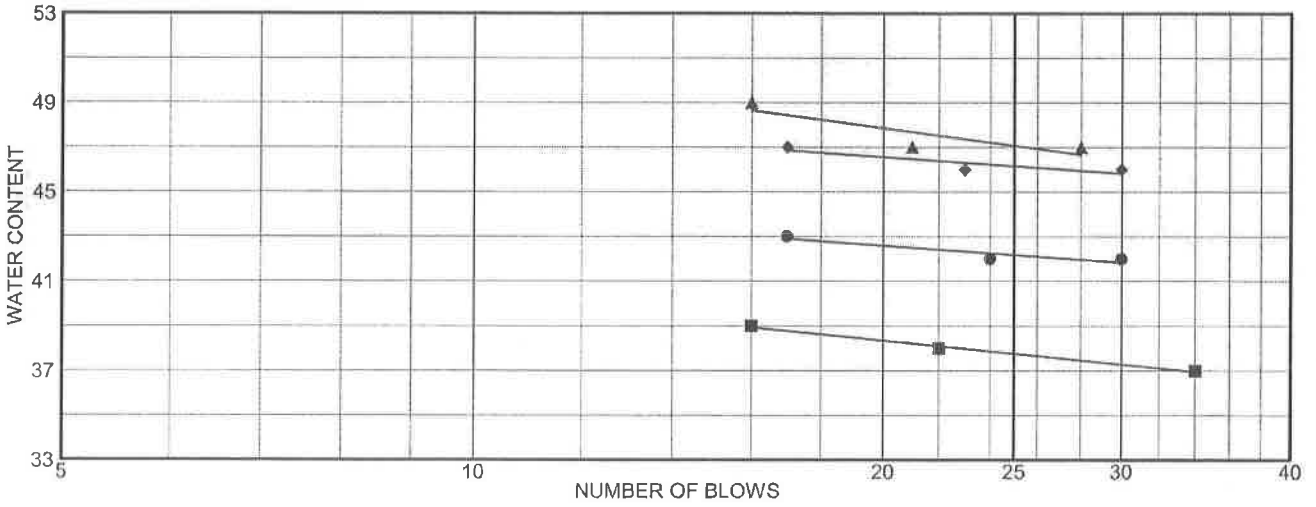
Reviewed by:

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean Clay (CL)	42	22	20	98	88	CL
■	Lean Clay (CL)	38	22	16	98	89	CL
▲	Lean Clay (CL)	47	22	25	100	97	CL
◆	Lean Clay (CL)	46	22	24	100	97	CL

Project No. 07B-G1653 **Client:** US Ecology of Idaho

Project: Cell 15 & Cell 16 Design

Cell 15 & Cell 16 Design

● **Location:** DH-08 OSS-70; 75'

■ **Location:** DH-08 SS-71; 80'

▲ **Location:** DH-08 OSS-72; 85'

◆ **Location:** DH-08 OSS-75; 1OO'

AMERICAN GEOTECHNICS

Boise, ID

Remarks:

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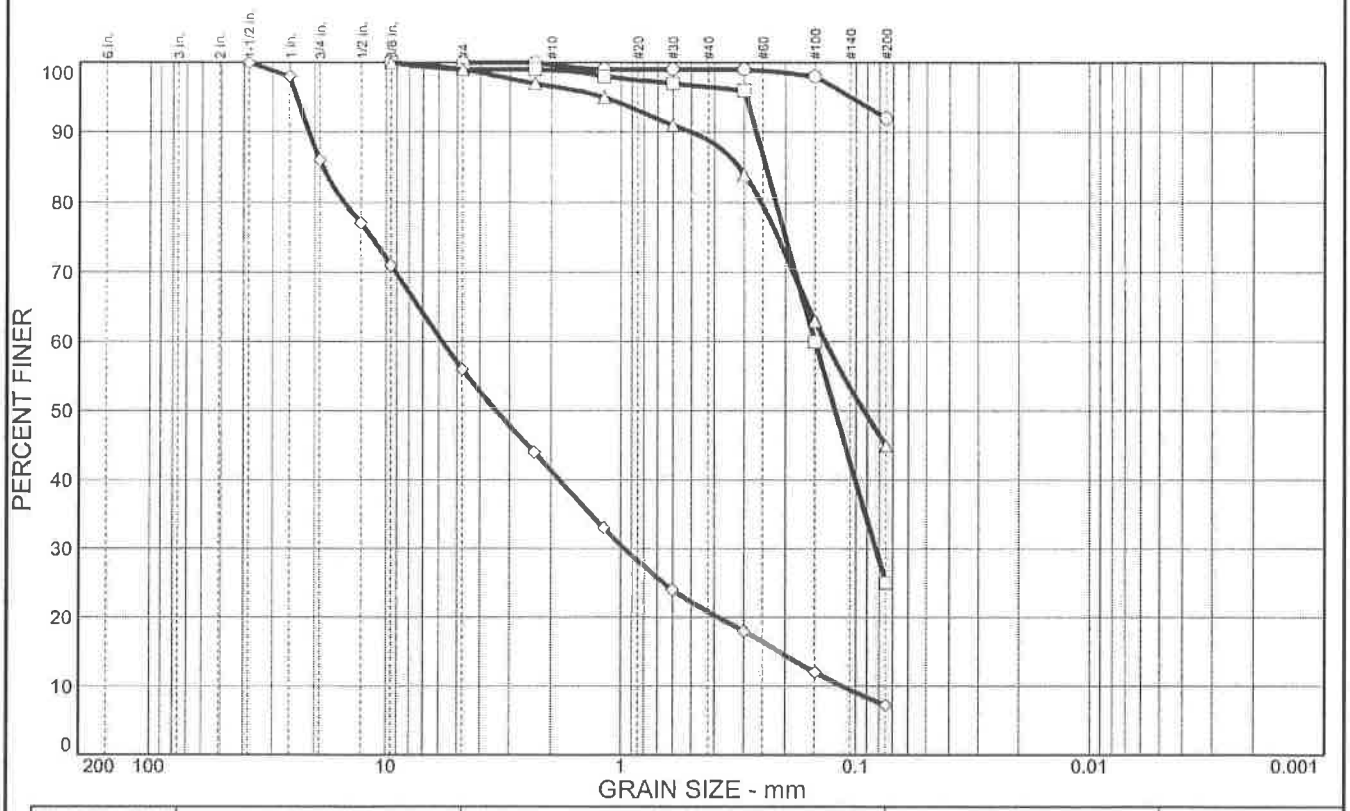
Reviewed by:

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0	0	8	92	
□	0	1	74	25	
△	0	1	54	45	
◇	0	44	49	7	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	39	30								
□			0.243	0.150	0.123	0.0830				
△			0.315	0.136	0.0926					
◇			18.5	5.78	3.41	0.963	0.213	0.115	1.40	50.38

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silt (ML)	ML	
□ Silty Sand (SM)	SM	
△ Silty Sand (SM)	SM	
◇ Well-Graded Sand with Silt and Gravel (SW-SM)	SW-SM	

Project No. 07B-G1653 **Client:** US Ecology of Idaho

Project: Cell 15 & Cell 16 Design

○ **Location:** DH-04 SS-4; 15'

□ **Location:** DH-05 SS-38; 20'

△ **Location:** DH-06 OSS-19; 5'

◇ **Location:** DH-06 SS-22; 20'

AMERICAN GEOTECHNICS

Boise, ID

Remarks:

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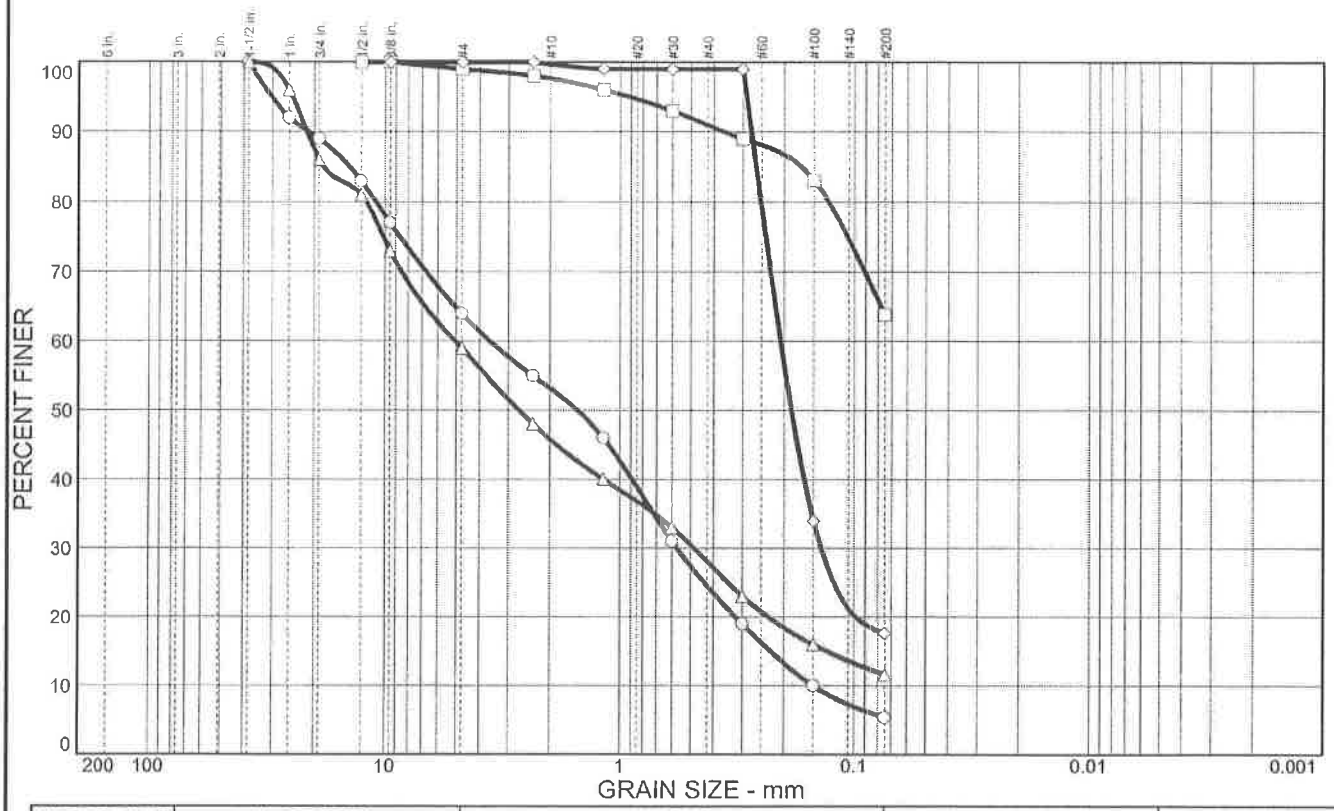
Reviewed by:

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0	36	59	5	
□	0	1	35	64	
△	0	41	47	12	
◇	0	0	82	18	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			14.2	3.59	1.52	0.572	0.228	0.150	0.61	23.96
□			0.171							
△			18.2	5.06	2.71	0.484	0.131			
◇			0.264	0.208	0.186	0.139				

MATERIAL DESCRIPTION	USCS	AASHTO
○ Poorly Graded Sand with Silt and Gravel (SP-SM)	SP-SM	
□ Sandy Silt (ML)	ML	
△ Poorly Graded Sand with Silt and Gravel (SP-SM)	SP-SM	
◇ Silty Sand (SM)	SM	

Project No. 07B-G1653 **Client:** US Ecology of Idaho

Project: Cell 15 & Cell 16 Design

○ **Location:** DH-07 SS-78; 10'

□ **Location:** DH-08 SS-55; 0'

△ **Location:** DH-08 SS-56; 5'

◇ **Location:** DH-08 SS-62; 35'

Remarks:

○

□

△

◇

AMERICAN GEOTECHNICS

Boise, ID

Reviewed by:

American Geotechnics
5260 Chinden Blvd.
Boise, Idaho 83714
Phone:(208) 658-8700
Fax: (208) 658-8703

Report to: US Ecology
Project: Cell 15 & Cell 16 Design
Report Date: 5/9/08
Project No.: 07B-G1653

Material Information

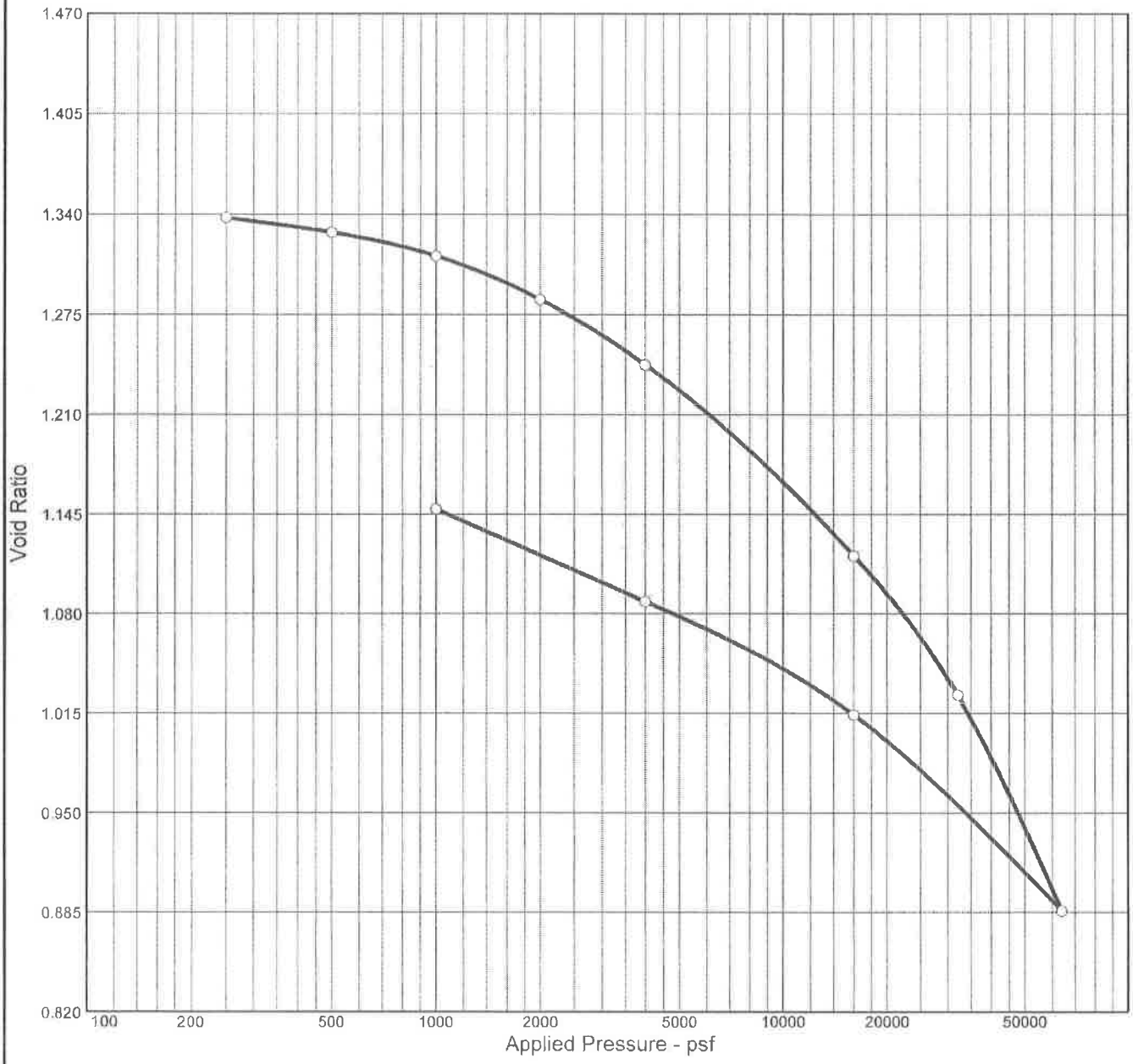
Date Sampled: 3/7/08
Sampled By: American Geotechnics
Date Received: 3/10/08
Date Tested: 3/17/2008

REMAC Test Results

Lab Number	Sample ID	Depth	AVG. Dia.	AVG. Ht.	Dial Reading (lbs)	Compressive Strength (tsf)	% Compress	Failure Type
08-0222	DH-04, SS-11	50.0'	6.083	2.783	214.0	9.9	7.0	Complex

Reviewed By: VST

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	P_c (psf)	C_c	Initial Void Ratio
Saturation	Moisture							
67.3 %	31.2 %	75.5	76	46	2.75	32593	0.48	1.275

MATERIAL DESCRIPTION	USCS	AASHTO
Fat Clay (CH)	CH	

Project No. 07B-G1653 **Client:** US Ecology of Idaho

Project: Cell 15 & Cell 16 Design

Location: DH-04 OSS-14; 65'

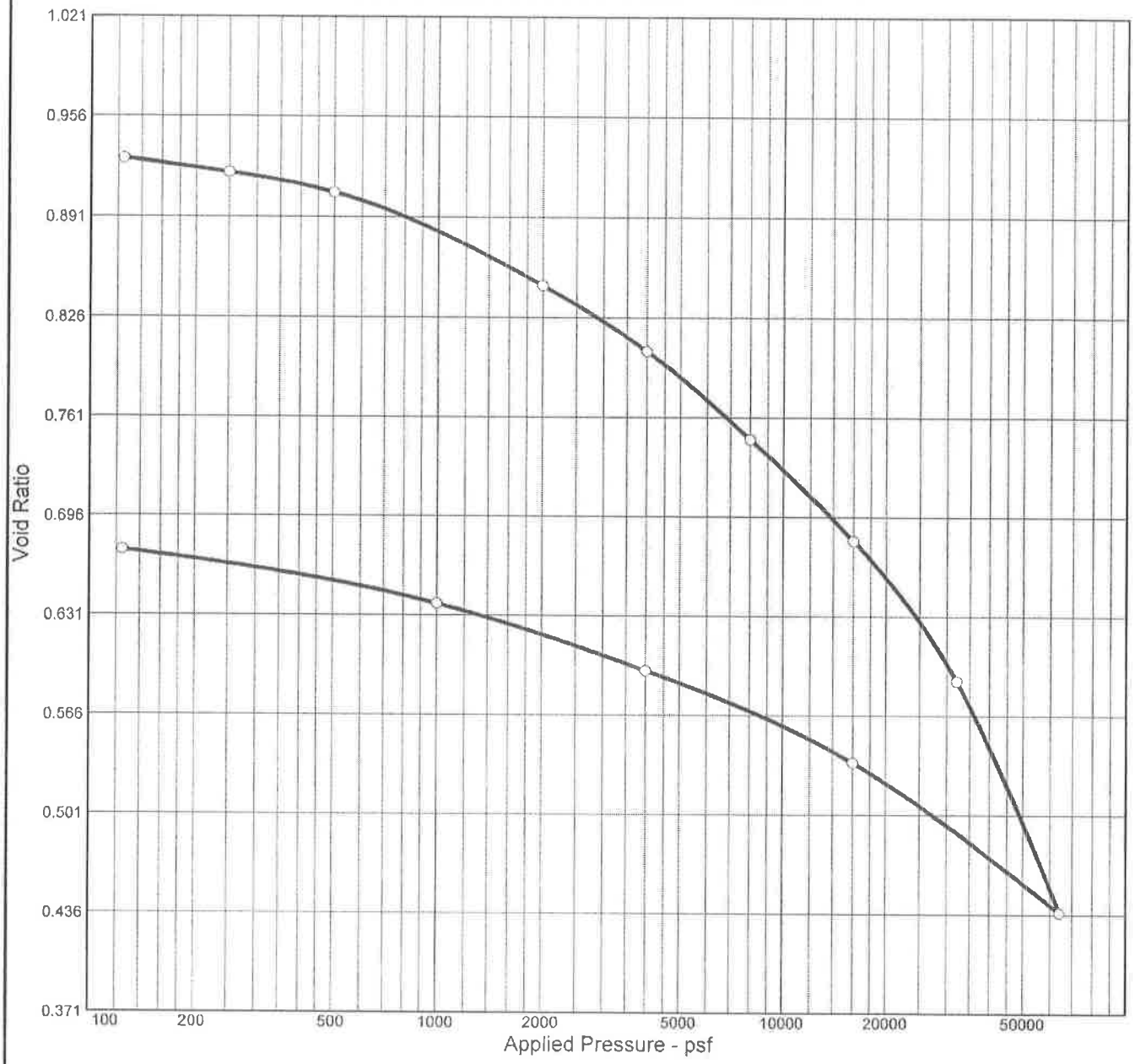
AMERICAN GEOTECHNICS

Boise, ID

Remarks:

Reviewed by: VJT

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	P_c (psf)	C_c	Initial Void Ratio
Saturation	Moisture							
84.8 %	28.7 %	88.9	48	23	2.75	33335	0.52	0.931

MATERIAL DESCRIPTION	USCS	AASHTO
Lean Clay (CL)	CL	

Project No. 07B-G1653 **Client:** US Ecology of Idaho

Project: Cell 15 & Cell 16 Design

Location: DH-05 OSS-53; 95'

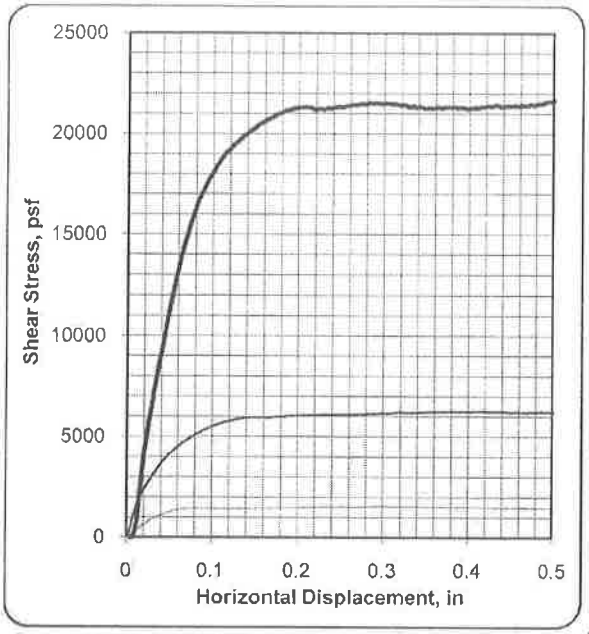
Remarks:

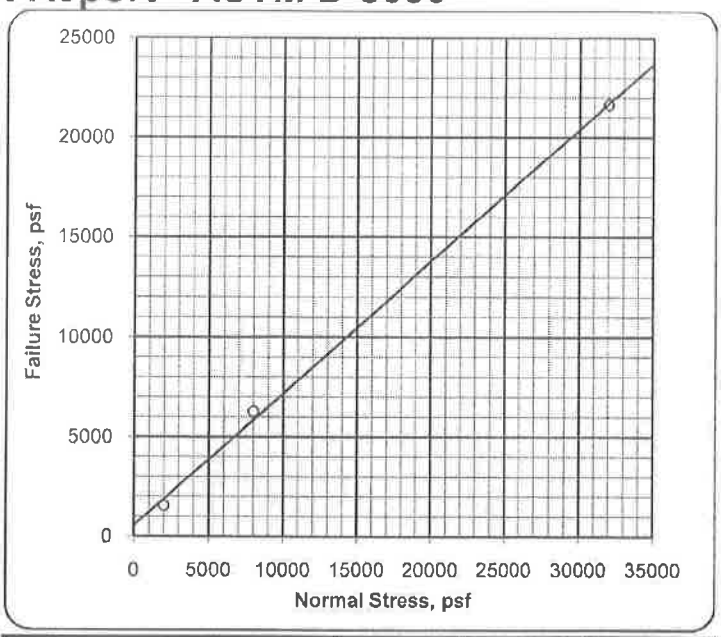
AMERICAN GEOTECHNICS

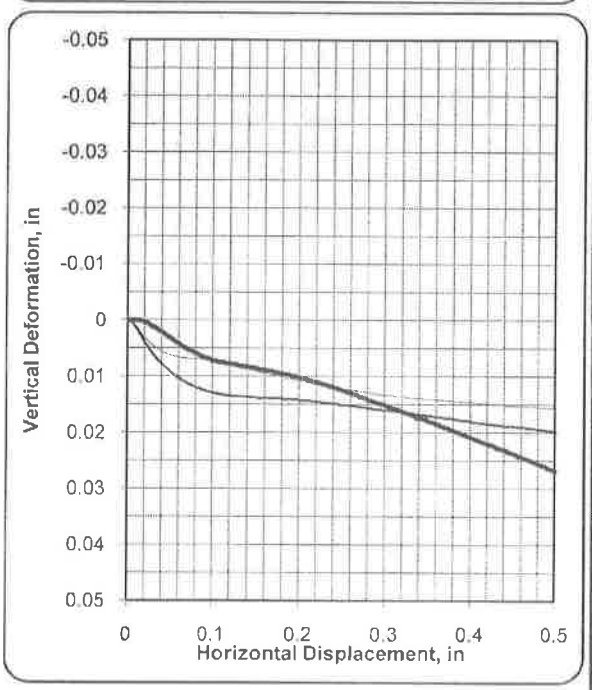
Boise, ID

Reviewed by: VJT

Direct Shear Test Report - ASTM D-3080







	Sample Number	1	2	3
Initial	Water Content, %	20.8	20.8	20.8
	Dry Density, pcf	82.0	78.9	84.2
	Saturation, %	54.2	50.3	57.2
	Void Ratio	1.02	1.10	0.96
	Diameter, in	2.420	2.420	2.420
	Height, in (before consol.)	0.999	0.999	0.999
At Test	Water Content, %	36.2	26.4	18.5
	Dry Density, pcf	89.2	89.9	99.4
	Void Ratio	0.85	0.84	0.66
	Diameter, in	2.420	2.420	2.420
	Height, in (prior to shear)	0.918	0.879	0.846
	Normal Stress, psf	2000	8000	32000
	Failure Stress, psf	1549	6277	21630
	Failure Displacement, in	0.29	0.42	0.50
	Time to Failure, min	58.9	83.6	100.3
	Ultimate Stress, psf	1451	6211	21630
	Ultimate Displacement, in	0.500	0.500	0.500
	Rate of Strain, in/min	0.005	0.005	0.005

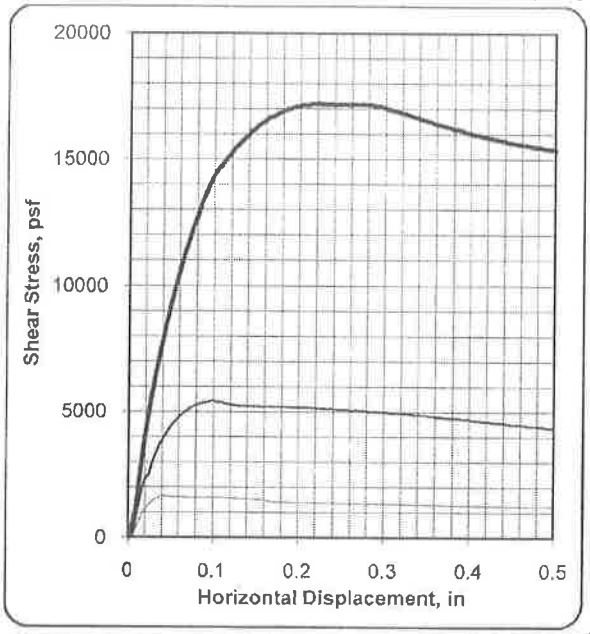
Sample Type	In-situ	C, psf	0
Description	Silty Sand (SM)	ϕ, deg	37.8
Specific Gravity (assumed)	2.65	tan ϕ	0.775

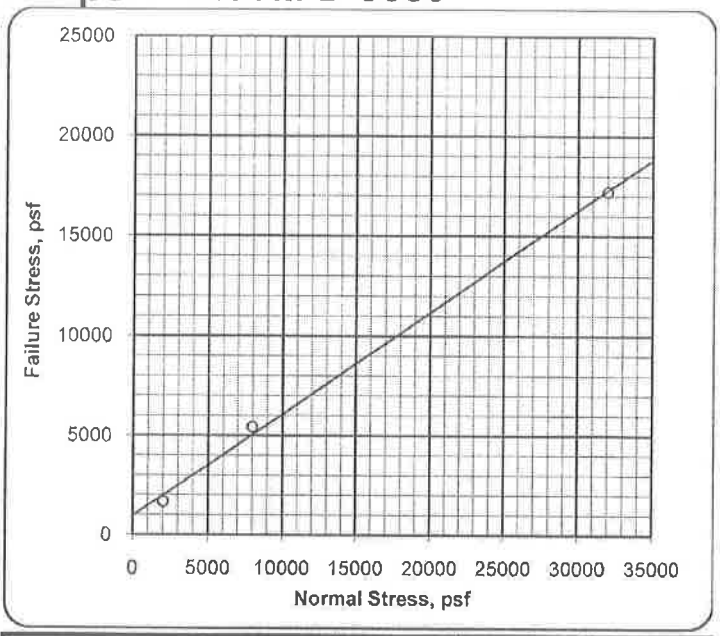
Client	US Ecology of Idaho
Project	Cell 15 & 16 Design
Project Number	07B-G1653
Sample Location	DH-06 OSS-19 @ 5'
Date	5/6/2008

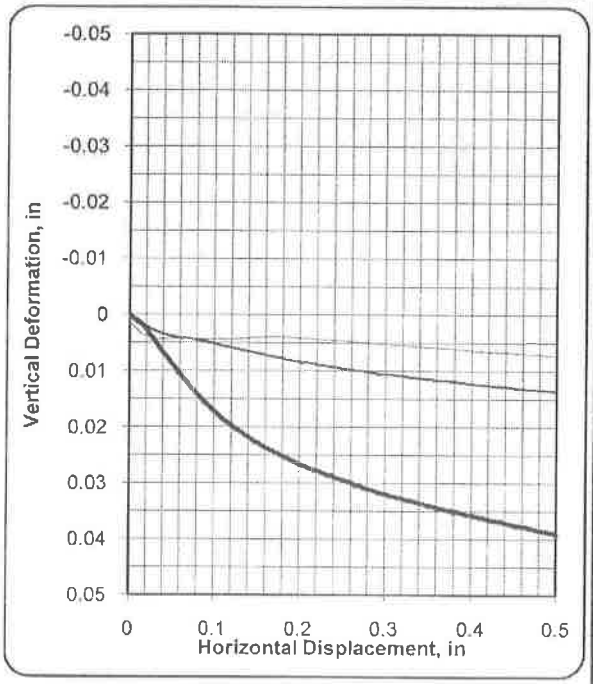
Tested by: TT Reviewed by: VT

AMERICAN GEOTECHNICS

Direct Shear Test Report - ASTM D-3080







	Sample Number	1	2	3
Initial	Water Content, %	24.3	24.3	24.3
	Dry Density, pcf	98.3	94.7	97.1
	Saturation, %	89.6	82.3	87.1
	Void Ratio	0.75	0.81	0.77
	Diameter, in	2.418	2.420	2.417
	Height, in (before consol.)	1.001	0.999	0.999
At Test	Water Content, %	30.5	29.5	23.1
	Dry Density, pcf	100.2	99.3	109.6
	Void Ratio	0.71	0.73	0.57
	Diameter, in	2.418	2.420	2.417
	Height, in (prior to shear)	0.982	0.953	0.885
	Normal Stress, psf	2000	8000	32000
	Failure Stress, psf	1665	5433	17213
	Failure Displacement, in	0.05	0.10	0.22
	Time to Failure, min	64.8	141.0	315.6
	Ultimate Stress, psf	1212	4351	15377
	Ultimate Displacement, in	0.500	0.500	0.500
	Rate of Strain, in/min	0.0007	0.0007	0.0007

Sample Type	In-situ	C, psf	980
Description	Lean Clay (CL)	ϕ, deg	27.0
Specific Gravity (assumed)	2.75	tan ϕ	0.509

Client	US Ecology of Idaho
Project	Cell 15 & 16 Design
Project Number	07B-G1653
Sample Location	DH-08 OSS-75 @ 100'
Date	5/6/2008

Tested by: TT Reviewed by: VT

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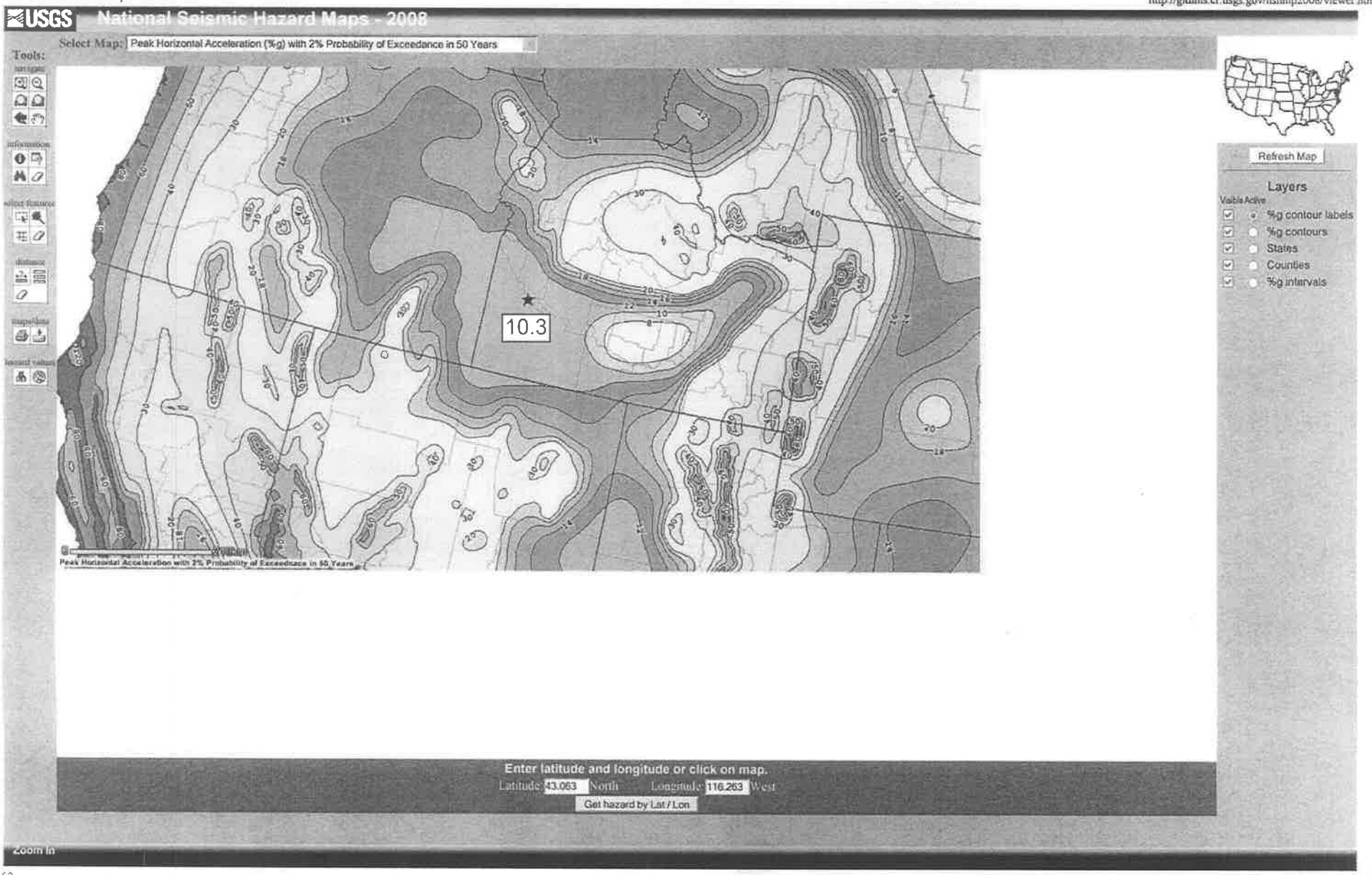
APPENDIX E

SEISMIC HAZARD


USGS
National Seismic Hazard Maps - 2008
Select Map:
Peak Horizontal Acceleration (%g) with 2% Probability of Exceedance in 50 Years
Tools:
navigate
information
select features
distance
maps/data
hazard values
10.3
Peak Horizontal Acceleration with 2% Probability of Exceedance in 50 Years
Refresh Map
Layers
Visible Active
%g contour labels
%g contours
States
Counties
%g intervals
Enter latitude and longitude or click on map.
Latitude 43.063 North
Longitude 116.263 West
Get hazard by Lat / Lon
Zoom In